imc STUDIO 5.2

Manual

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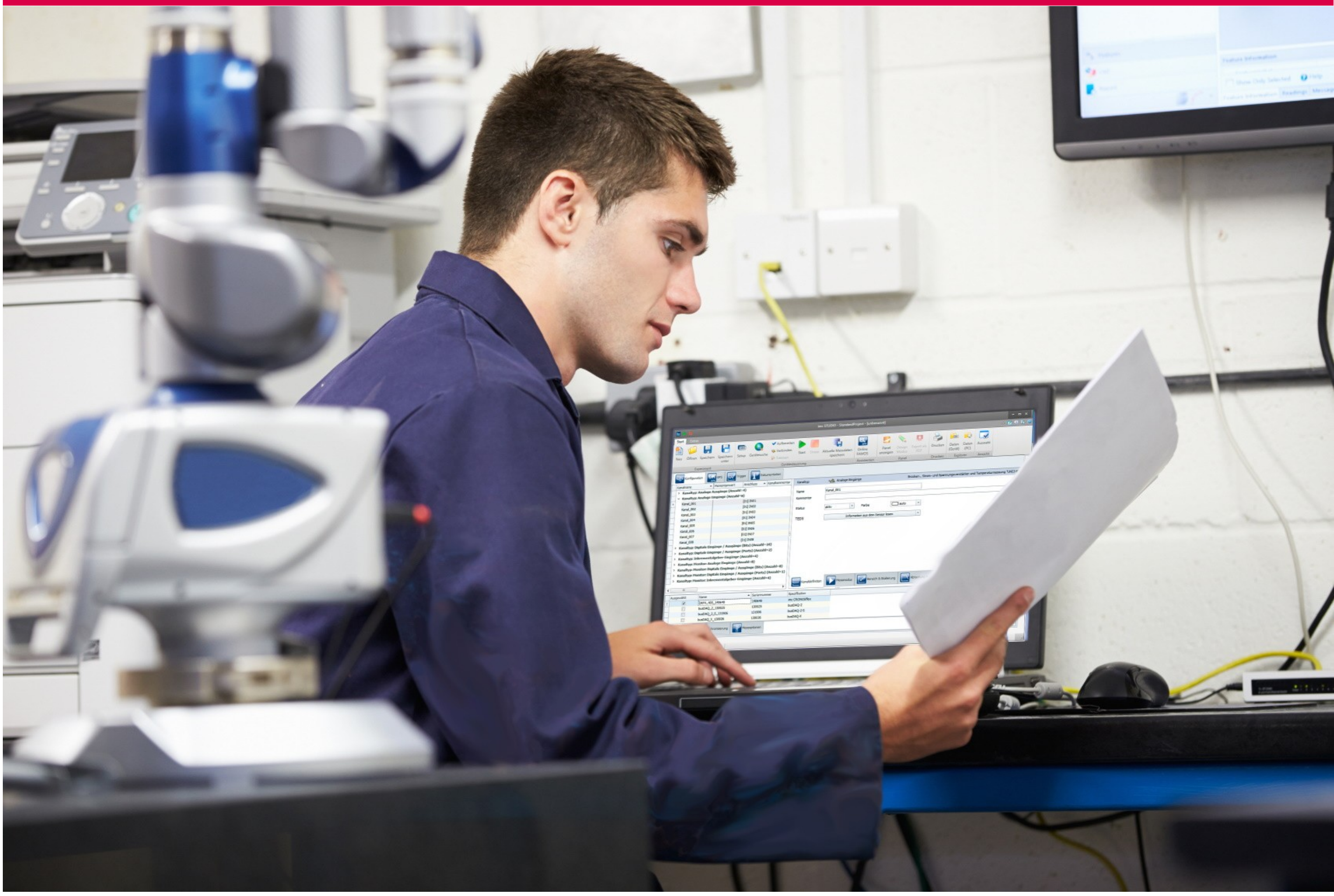

imc Test & Measurement GmbH • Voltastraße 5 • 13355 Berlin • Germany

Foreword

Thank you for deciding to purchase our product. We wish you total success in accomplishing your measurement assignments with the help of your hardware and software. If you have any open questions about our products, please contact our Hotline (hotline@imc-tm.de).

Disclaimer of liability

The contents of this documentation have been carefully checked for consistency with the hardware and software systems described. Nevertheless, it is impossible to completely rule out inconsistencies, so that we decline to offer any guarantee of total conformity.
We gratefully accept any suggestions for improvements, please contact our Hotline (hotline@imc-tm.de).

We reserve the right to make technical modifications of the systems.

Copyright

Open Source Software Licenses

Some components of imc products use software which is licensed under the GNU General Public License (GPL). Details are available in the About dialog.

A list of the open source software licenses for the imc measurement devices is located on the imc STUDIO/imc WAVE installation medium in the folder "*Products\imc DEVICES\OSS*" or "*Products\imc DEVICEcore\OSS*". If you wish to receive a copy of the GPL sources used, please contact our Hotline.

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1 Welcome to imc STUDIO

In this manual, you will find a detailed description of how to operate the imc STUDIO software.

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General Notes	Important notes before the start 9, Quality Management 9, imc Customer Support / Hotline 10, License agreement 12
Setting Up 15	Software setup operations System requirements 15, Installation 16, Start 31
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imc Online FAMOS and imc Inline FAMOS 835	Processing and analysis of measured data during a running measurement imc Online/Inline FAMOS Function Reference 887
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To look for WHAT?	Contents	
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Data Processing 1665	Data processing and streaming calculations on the PC during running measurement Inline FAMOS 1667 and Power Quality 1668 Bus Decoder 1683 and Powertrain Monitoring 1687	
Video 1711	Capturing and processing video data Video configuration 1712 and Displaying video channels 1716	
Programming Interface	Scripting 1730:	Interface for using Scripts in imc STUDIO (Tutorial 1846).
	Third Party Device Interface 1860:	Interface for using third party devices in imc STUDIO (Tutorial) 1897.
	API 1900:	Interface for developing custom application with access to imc STUDIO functions.

Customer Support / Hotline

If you have any open questions about our products, please contact our Hotline.

Questions or problems? Contact our Customer Support / Hotline 10.

Copyright

2 General Notes

2.1 Before you Start

Dear user.

1. The software you have obtained, as well as the associated manual are directed toward competent and instructed users. If you notice any discrepancies, we request that you contact our Hotline 10.
2. Updates during software development can cause portions of the manual to become outdated. If you notice any discrepancies, we request that you contact our Hotline.
3. Please contact our Hotline if you find descriptions in the manual which you believe could be misunderstood and thereby lead to personal injury.
4. Read the enclosed license agreement 12. By using the software, you agree to the terms and conditions of the license agreement.

2.2 Notes / Quality Management

Quality Management

imc Test & Measurement GmbH holds DIN-EN-ISO-9001 certification since May 1995. You can download the CE Certification, current certificates and information about the imc quality system on our website: www.imc-tm.com/quality-assurance/.

imc Warranty

Subject to the general terms and conditions of imc Test & Measurement GmbH.

Product Improvement and change requests

Please help us to improve our documentation:

- What terms or descriptions are incomprehensible?
- What additions and enhancements you suggest?
- Where have material mistakes slipped in?
- Which spelling or typing errors have you found?

Responses and other feedback should be directed to the Hotline 10 (phone / e-mail)
or by writing to: imc Test & Measurement GmbH, Voltastrasse 5 in 13355 Berlin, Germany

2.3 imc Customer Support / Hotline

If you have problems or questions, please contact our Customer Support/Hotline:

imc Test & Measurement GmbH

Hotline	(Germany):	**+49 30 467090-26**
E-Mail:	hotline@imc-tm.de	
Internet:	www.imc-tm.com	

International partners

For our international partners see www.imc-tm.com/distributors/.

Tip for ensuring quick processing of your questions:

If you contact us **you would help us**, if you know the **serial number of your devices** and the **version info of the software**. This documentation should also be on hand. Thank you!

- The device's serial number appears on the nameplate.
- The program version designation is available in the About-Dialog (click on the symbol in the menu bar).

2.4 Documentation - Help

All imc STUDIO products come with **help** (CHM or EXE format). In the menu bar, click on the symbol to open the help. The help may also contain parts shared imc software components. These parts may differ from the rest of the help in terms of style and structure. All help files are equipped with a full text search functionality and have an index.

Note — Notes on the descriptions and the screenshots

The screen shots appearing in this documentation were created with a variety of Windows versions and their appearance may thus differ from that of your installed program.

imc STUDIO works with user groups and access rights 126. The user group has wide-reaching influence on the visibility and/or operability of menus, icons, etc. Note that in all imc STUDIO documents the administrator roll is assumed to be filled. All descriptions are therefore related to the full utilization of the user interface.

The following descriptions and screenshots always pertain to the view with the full scope of functions (**Complete**). Many of these functions are also found in the minimized view at another location.

Documentation in EXE format (e-Book for Windows)

The e-Book is an independent "EXE"-file. Its pages are html-pages which are displayed via a browser. This means that an up-to-date default browser is needed.

Overview of the functions

	Function	Description
	Links	Via the title bar, you can open additional documents and access the tutorials by just a few clicks.
	Back to last/next chapter	Jumps to the last opened chapter, or respectively back.
	Top	Jumps to the first chapter in the table of contents.
	Prev	Jumps to the previous chapter in the table of contents.
	Next	Jumps to the next chapter in the table of contents.
	Print view	The current page is opened in the default browser. In this way, the page can be printed out via the browser.
	Feedback	If you have any questions on the description, you can write an e-mail to the imc Hotline. This function works with the default mail program to generate an e-mail with a pre-arranged subject and addressee. Additional info such as the chapter-ID and chapter name are also inserted. This enables us to process your question quickly.

2.5 imc Software License Agreement

imc Test & Measurement GmbH
Voltastrasse 5
13355 Berlin
Commercial register: Berlin-Charlottenburg HRB 28778
Managing director: Kai Gilbert, Ralf Winkelmann

imc Test & Measurement GmbH
Terms and Conditions
Governing the Use of imc Test & Measurement GmbH Software
As of: January 10, 2020

§ 1 Objects of the Agreement

(1) In addition to the "General Terms and Conditions Governing imc Test & Measurement GmbH Deliveries and Services to Customers", these terms and conditions apply to all contracts concluded with imc Test & Measurement GmbH (hereinafter referred to as "imc") which involve the transfer of rights of use to any software developed by imc (standard software, software created or adjusted specifically for the Customer, which is recorded on the machine-decodable data carriers such as data files, databases and database material, updates, upgrades, releases, etc., including corresponding documentation, information and materials, hereinafter referred to as "Software").

(2) The Software is provided to the Customer as an executable object program on machine-decodable data carriers specified in the "Objects of the Agreement". The Software's product documentation is also supplied to the Customer either in print or on a machine-decodable data carrier. Unless otherwise expressly agreed in writing, the Customer is not issued the source code of the Software.

§ 2 Rights of Use, Scope

With regard to any transfer of rights of use to Software created by imc, the following provisions apply:

(1) Basic provisions

a) The Customer is granted a non-exclusive and – subject to the terms and conditions governing the use of Software by third parties, resale and leasing – non-transferrable right of use to the Software for its own purposes. "Use" signifies running the programs and editing the data records.

b) Until each due fee is paid in full, the Customer is entitled to use the Software solely on a revocable basis. If the Customer is in default with regard to the payment of fees, imc is entitled to revoke the use of the respective services for the duration of the default. The Customer is granted the permanent right to use copyright protected services, in particular the Software, only upon full payment of the agreed fee.

c) The Customer agrees to undertake appropriate precautionary measures to prevent unauthorized access by third parties to the Software. The original data carriers and the data carries used to make copies as per the agreement, as well as the documentation, are to be stored in a secure location. Employees are to be notified that the production of copies beyond the scope of the agreement is not permitted.

d) If the right of use is revoked or expires due to another reason, the Customer is obligated to return to imc the Software, the copies made by the Customer and the documentation. Provided that a physical return of the Software and the copies is not possible due to technical reasons, the Customer is obligated to delete such and confirm deletion to imc in writing.

(2) Reproduction

a) The Customer is entitled to make copies of the Software only if copies are necessary to use the Software in accordance with the contract. The following are considered cases in which reproduction is necessary: installation of the Software from the original data carrier onto the hard disk drive of the hardware used, as well as loading the Software into the computer memory.

b) The Customer is entitled to create a backup copy if such is necessary to safeguard future use. Copies may only be made for other purposes after prior written consent has been issued by imc.

c) The Customer is not allowed to make any reproductions other than those expressly permitted under the provisions of this agreement.

(3) Use of the Software by Third Parties, Resale and Leasing

a) The Software may be used for the purposes stipulated in this contract, in particular for the Customer's business operations. Access to the Software may also be provided to parties which rely on using the Software as instructed by the Customer. In particular, the Customer is entitled to operate the Software or allow the Software to be operated on data processing devices, which are located on the premises of and are directly owned by a third party company (outsourcing). The prohibition against multiple use remains unaffected.

b) The Customer may permanently sell or give the Software to third parties provided that the Customer is granted permanent use of the Software. In the context of its period of use, the Customer may temporarily transfer the Software to third parties for a fee or free of charge. The prohibition against multiple use remains unaffected. The Customer is expressly notified that transfer to third parties is not permitted and use by third parties is technically not possible if an individual license must be acquired or an individual activation is required for third party usage, such as in the case of runtime licenses.

c) With regard to the valid use of Software by a third party, the Customer is obliged to ensure that the third party acknowledges the provisions of this agreement governing the rights of use as binding for such third party. The Customer may not transfer Software and documentation to third parties if there are grounds to suspect that the third party may infringe upon the provisions of this agreement governing the rights of use, in particular with regard to the unauthorized production of copies.

d) Subject to the provisions stipulated in § 4 Paragraphs 1 and 2 or a deviating express agreement in writing, the Customer may not use the Software while the Software is being used by a third party (prohibition against multiple use); in the event that the Software is transferred to the third party, the customer is obliged to surrender to imc all Software copies including, if applicable, all existing backup copies, or to destroy copies not surrendered.

(4) Decompilation

The reverse translation of the provided program code into other code forms (decompilation), disassembling and other forms of reverse engineering of the various production phases of the Software is not permitted. If interface information is required to achieve the interoperability of a separately created computer program, such may be requested from imc, or a third party to be named by imc, for a minor fee. Section 69 e of the German Copyright Act ("UrhG") remains unaffected by this provision.

(5) Changes by imc

If imc conducts adjustments, changes or enhances the Software on behalf and on account of the Customer, the Customer thus acquires the corresponding rights of use to the changes or enhancements of the Software to which he is entitled according to the stipulations of this agreement.

(6) Exceptional Usage Requests by the Customer

If the Customer requests to use the Software according to terms which deviate from the requirements stipulated in Paragraphs 2 through 5, this exceptional use of the Software must be agreed in writing by imc. In such an instance, the Customer agrees to provide imc with information about the desired scope of use, the pertinent field of application, etc. If imc subsequently grants a license covering the Customer's special intended use, the parties agree that a new license fee is owed by the Customer, which is independent of payments made by the Customer for the previously existing license.

§ 3 Copyright, Protection of the Software

(1) The intellectual property, in particular the copyright as well as all industrial property rights and trade secrets, are retained by imc and are not transferred to the Customer. The Customer's ownership of the machine-decodable data carries and data processing units remains unaffected.

(2) Copyright notices, serial numbers as well as designations and reservations of rights which serve as program identification or a protective right may not be removed or changed. The Customer is obliged to transfer the existing protective right notices to all copies. In particular, backup copies of the Software must be expressly designated as such.

§ 4 License Types, Multiple Use

(1) In the case of a Single-User License, the Software may be activated and run on only one data processing unit. "Activation" refers to the process of transferring the license to the data processing unit.

If the technical specifications for the Software permit a second activation, then the Customer may additionally activate the Software on a second data processing unit. However, the Software may only run on one data processing unit at any one time, not on both simultaneously.

(2) With a Network License, the Software may be run on as many data processing units as the amount of licenses obtained. In this case a central data processing unit acts as the license server for which the activation process is performed.

If the technical specifications for the Software permit a second activation, then the Customer may additionally activate and run the Software on as many data processing units as the amount of licenses obtained. However, these additional data processing units must be used by the same users who operate the Software via the license server.

(3) Subject to the provisions in Paragraphs 1 and 2 or a deviating express agreement in writing regarding network use, multiple use of the Software is not permitted.

(4) If the data processing unit is changed, the Customer is obliged to delete the Software from the hard disk drive of the previously used hardware.

§ 5 Trial Version

If the Software used is a free trial version, then the following additional limitations apply:

(1) The trial version only entitles the user to test the Software. In particular, commercially productive utilization is not permitted.

(2) The rights of use granted expire after the elapse of a period stated in the product description.

§ 6 License Key

(1) Upon delivery of the Software the Customer receives a License Key. Using this License Key, the Customer is able to activate the Software purchased. By means of this License Key the Customer can also view his license status and order updates and upgrades.

(2) The License Key is to be protected against access by third parties in order to prevent misuse. If, however, a third party gains unlawful access to the Key, the Customer is obliged to notify imc immediately via telephone, as well as in writing, so that the previous License Key may be suspended and a new one issued.

§ 7 Conclusion

(1) The law of the Federal Republic of Germany shall apply under exclusion of private international law. The provisions of the UN Convention on Contracts for the International Sale of Goods (CISG) do not apply.

(2) The place of performance for all obligations arising from this agreement is imc's registered seat. Insofar as the Customer is a merchant as defined by the German Commercial Code (HGB), a legal entity under public law, or a special asset under public law, the exclusive place of jurisdiction for all disputes directly or indirectly arising from the contractual relationship is agreed as imc's registered seat. The same applies to persons who have no general place of jurisdiction in Germany, as well as to persons who have moved their place of residence or usual whereabouts abroad since conclusion of the contract, or whose place of residence or usual whereabouts is unknown at the time the action is filed. In addition, imc is entitled to file suit at the statutory venue.

(3) Oral side-agreements are not valid. Deviating or supplementary conditions as well as modifications of this contract, including this written requirement clause, are only valid if agreed in writing and expressly marked as a modification or supplement.

(4) If certain provisions of this contract are inoperative or unfeasible, this does not prejudice other provisions of the contract. The contracting parties agree to contractually substitute an operable provision which approximates the commercial intention of the contract as closely as possible for any inoperable one.

3 Setting Up - Software

This chapter describes the **first steps** in operating imc STUDIO and the **installation of additional imc products**.

imc STUDIO is the common framework forming a **product package** through the combination of modular components (plug-ins).

Which components are available depends on the product installation (order).

Chapter overview

Synopsis	Chapter
Startup operations for imc STUDIO - **installation** and **product configuration** prior to first use	• System requirements 15 • Installation / Uninstall 16 • **Product Configuration / Licensing** 29
The first start, important settings	• **The first start** 31 • Device connection / Network / Firewall 33
List of components used and their versions	• Version Information 37

3.1 System requirements

Supported operating systems
Windows 10*
Windows 8.1

*released in conformance with the version of Windows 10 applicable at build date of imc software

Minimum requirements for the PC [1]	Recommended configuration for the PC [2]
Hyper-threading or Dual Core processor with 2 GHz clock speed	Quad Core processor with 2 GHz clock speed or higher
2 GB RAM (32 bit) / 4 GB RAM (64 bit)	3 GB RAM (32 bit) / 8 GB RAM (64 bit)
10 GB free hard disk space (NTFS format)	10 GB free hard disk space (NTFS format)
Display resolution 1280 x 768	Display resolution: 1280 x 1024 or more
	64 bit operating system

1 A system with minimum requirements is not adequate for connection with multiple devices and complex design tasks with the imc STUDIO Developer. Use such systems preferably only for data monitoring purposes.

2 The requirements for the PC’s configuration increase with the number of devices involved and the scope of the Data Processing-calculations to be performed.

Supported Measurement Devices

Which devices you can use in imc STUDIO is described in the documentation on the "*Setup*" > "*Device Overview* 165", as well as in the "*Technical Data Sheet*". For the purpose of connecting with imc STUDIO Monitor, the devices must additionally have at least **32 MB of internal (interface) device memory** available (which is assured for all current device models, except for a limited number of imc CRONOS-PL and imc CRONOS-SL devices dating back to before 2007).

3.2 Installation - Preparation

Software requires a license

This means that the program may only be started **upon obtaining a license** (see Product Configuration / Licensing 29).

Administrator rights required

For the purposes of installation and uninstallation, a user account with **administrator privileges for the PC is required**.

If you are logged on to the PC **without administrator rights**, **log yourself out** and log back on with an administration-level user account. If you don't possess the appropriate account type, you will need the support of your system administrator or IT department.

See also Notes on Windows User Account Control 19.

Restarting the computer in the process of installation

During the installation process, the installation program will prompt you to restart the PC.

Note	Restarting

After the restart, login to **the same user account** with which you had previously begun the installation.

Coexisting applications: imc STUDIO, imc STUDIO Monitor, imc WAVE, ...

Some imc programs are installed as an independent and specially adapted instance of imc STUDIO. They are based on imc STUDIO.

Unless otherwise stated, these programs are installed and used in parallel. As long as these instances are based on the same version of imc STUDIO (e.g. 5.2R1), they are all subordinated to the same program installation, which means they share resources.

For this reason, installation of the instances in this case must be performed in one single shared Setup procedure. Any attempt to perform installation in succession or subsequently will cause the already existing instances to be deleted.

This applies particularly to the joint and parallel installation of imc WAVE and imc STUDIO, which must be performed in a single step.

Do not install imc STUDIO and imc WAVE in succession, but always at the same time.

Update or parallel installation

The Setup utility checks whether any version of imc STUDIO is currently installed on the computer. If so, it can be uninstalled by means of the Setup. An associated confirmation prompt is posted in that case. All user data such as the database remain intact.

You can keep **both versions installed in parallel**, as long as the version numbers are different (e.g. 5.0 and 5.2). The new version can be installed in the same folder (default case: "C:\Program Files (x86)\imc" for 64-bit Win10). In this folder, a new subfolder with the new version number is created for imc STUDIO.

In both cases, you are able to **adopt** a variety of **settings** from the old versions. These include the project settings and views. By contrast, other settings such as the product configuration and the database path need to be set up from the beginning.

Adopting the settings with the help of the existing database (recommended)

If you wish to continue using the existing database, the possible settings will be adopted. For a parallel installation, two data bases are needed. Create a copy so that the old imc STUDIO version can continue to work with the existing database. A confirmation prompt about making a copy is posted.
See: Update with the help of the existing database 18.

Please also observe the **notes regarding the update and compatibility** on our website 10 under FAQ!

Adopting the settings without using the existing database

You can apply the settings, such as the views, without using the database. To do this, save and import the appropriate settings.
See: Update without using the existing database 18.

The subsequent procedure - an overview

Follow the installation program instructions (see: "Installation step by step 20").

- The installation process first checks whether the **required system software** is installed. If ones is missing, it will be installed automatically.
- After restarting the system, the selected products are installed.
- After the installation is concluded, it is possible to start imc LICENSE Manager directly to activate your license.
- Once the license has been activated, you can use the products.

Uninstalling

To uninstall the product, use the Windows Control Panel/Settings and select the respective entry:

- "*Control Panel*" > "*Programs*" (Uninstall a Program) (Windows 7)
- "*Settings*" > "*Apps & features*" (Windows 10)

Reference See also

- Unattended Installation - Silent Installation 41
- Installation - Installing projects 40
- Recommended Virus Scanner Settings 39
- Changing Languages and Installing Additional Languages 38

3.2.1 Update with the help of the existing database

If you continue to use the existing database, whatever settings are possible will be adopted. This includes Views, any Setup-columns created by the user, the user administration and all experiments.

If you wish to run multiple versions of imc STUDIO or maybe restore an older version at a later time, create a copy of the database.

Note	The database

It is impossible to use the imc STUDIO database by both versions in parallel.

- If the same path is selected in the new imc STUDIO version, the database is used automatically. When loading old experiments, a note is posted in the logbook that the **experiments belong to an older version. Once saved, they can no longer be loaded** with the old version.
- If the database structure has been altered, you will be notified of this. A **dialog for performing conversion** appears. There you can convert the database or have it copied beforehand. After the conversion, the entire **database can no longer be used with the old version**.

Note	Using new views

- Be aware that the new version provides new functions, such as new or enhanced Setup pages and new menu items.
- **Use of the new Views is recommended, in order for these new functions to be accessible! Please look under "What's new" whether there have been any changes in this regard.**
- User-made columns such as meta data columns are not automatically inserted into the pages. The configurations of these columns, however, is adopted from the old View. You can re-insert these columns at the desired position (by means of the Column Chooser).
- Multiple views are provided. Select a view and add whatever Setup pages are required or saved, and save the view under a new name.
- How to save Views is explained in the imc STUDIO documentation under "*imc STUDIO (general)*" > "*Views* 135".

3.2.2 Update without using the existing database

In imc STUDIO, various settings were saved with the respective **project** and apply to all the experiments it contains. Among other things, these include the view settings: user-defined views, column configurations (e.g. metacolumns).

Please first check which settings you will need.

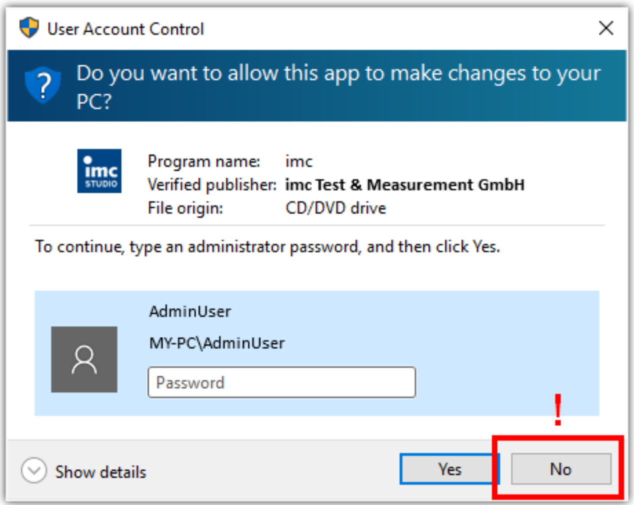
In order to **retain these settings** in the new version after having **performed the update** without using the existing database, export of the settings are necessary.

- If you wish to reuse **all of the project's settings**, export the project settings 98 (by means of the Projects-dialog: Menu ribbon: "*Project*" > "*Manage Project*").
- If you wish to reuse **only the viewing settings**, export the views 137.

3.2.3 Notes and Troubleshooting

Notes on Windows User Account Control

Do not change the user account

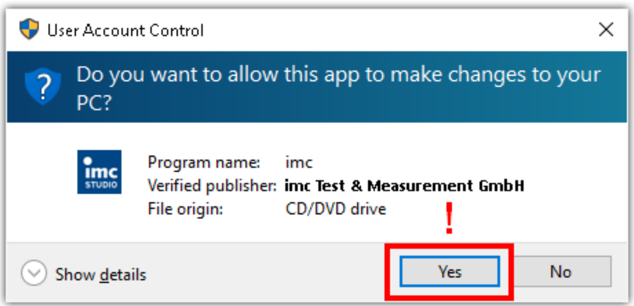


Example of a password request.
Select "No".

With Windows, installation can be started without administrator rights. In this case, the operating system requires selection of a user account and associated password, as shown in the example below.

> **Do NOT continue with the installation** in this way, otherwise it will be incorrect. **Select "No"**.

Confirm the prompt by the user account control



Select "Yes", to start the installation.

When you are logged in to a user account possessing administrator rights, you may receive a prompt by the Windows User Account Control (UAC) to allow changes. Select **"Yes"** as shown below.

Notes on the security software

Some virus scanners **prevent correct installation** of imc programs. We are currently aware of this affecting products from the companies McAffe and ESET. In principle, almost any virus scanner can have settings possibilities which prohibit necessary functions during installation.

For installation purposes, certain steps are necessary, such as:

- registration of programs for Autorun
- registration of programs as a service
- running of scripts from the TEMP-folder
- ...

The error profile may include various messages during installation. Or installed programs failing to launch.

In such cases, please contact your administrator to find out whether certain rules can be suspended for the duration of the installation. For any further questions, please contact our Hotline 10.

3.3 Installation Step by Step

Actual texts appearing in the user interface may differ from those shown in the screen shots, depending on the product configuration (path/version name).

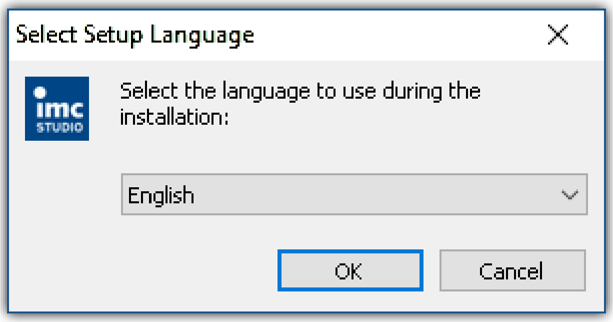
Installation from the product DVD

- Close all programs.
- Insert the product DVD.
- In usual cases, the Setup program will automatically start after a brief delay. Otherwise use the Windows Explorer and start the installation program from the DVD.

Installation after Download

- If you have obtained the product electronically (download, Email), simply start the installation program manually.

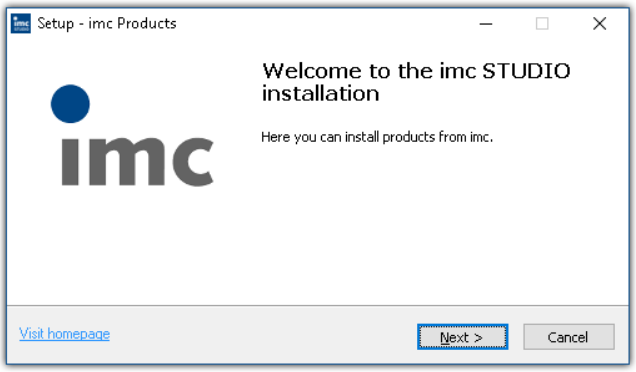
Installation language settings



Selecting the language during installation

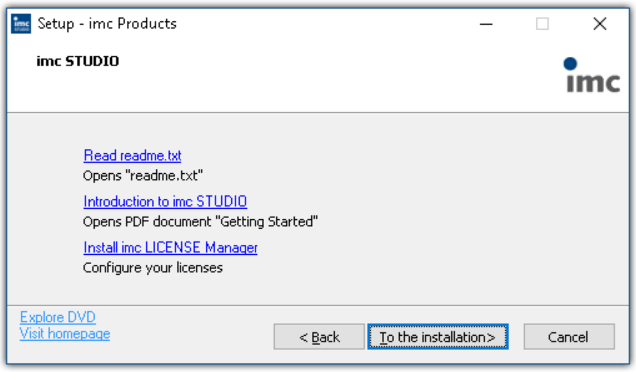
When you start the installation, you first see a dialog for selecting the installation language.

Performing installation



Installation setup welcome page

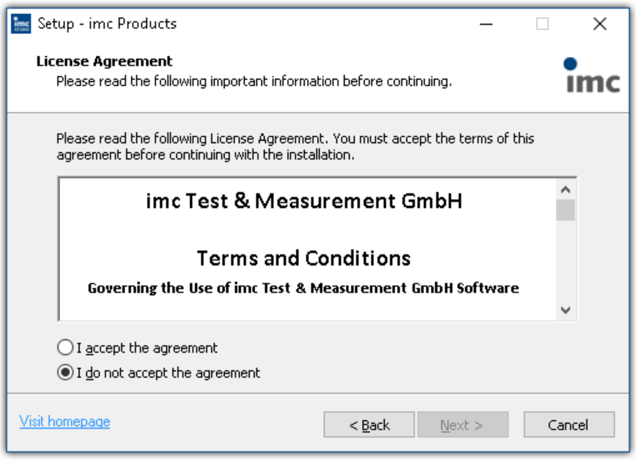
Once you have selected the language, the installation setup starts with a welcome page:



Before starting installation

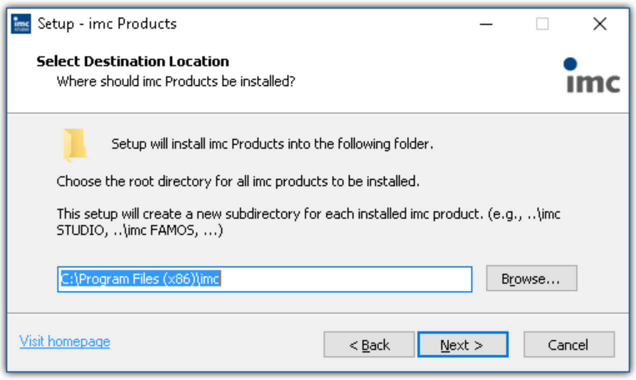
On the installation setup's next page, you are offered the following choices:

- open the "*Readme*"-file,
- open the "*Getting Started*"-document,
- separate installation of imc LICENSE Manager and
- display of the DVD contents.



License agreement

You must accept the license agreement to continue the installation.



Entering the installation path

In the next step, select the file path where the products should be installed. For each imc product, a separate subfolder is created in this path (e.g. imc STUDIO 5.2). Therefore it is recommended that the path should end with ".. \imc".

Select the products / Installation type

Now you can select which components should be installed. There are three types available:

- Demo 23
- Auto 23
- User-defined 24

"*User-defined*" gives you the ability to affect all installation settings.

However independent from the selected installation type the products that are always included are:

- imc LICENSE Manager for managing the licensing, and
- imc Shared Components, proving common components of the imc products, such as the curve window.

Details on the types and the respective subsequent installation steps are provided in the associated sections below.

Note Note on re-configuring imc STUDIO

Regardless of which variant of the installation is selected, when imc STUDIO is installed, all components/plug-ins are included. This way, after successful installation it is possible to adapt the configuration at any time by means of the product configuration 29 and to select the appropriate edition.

3.3.1 Demo and Auto

The installation types **Demo** and **Auto** are only slightly different. For both types the installation settings are already configured. If you need further settings please choose the user-defined installation type 24.

The imc STUDIO edition and the necessary components/plug-ins can be adapted at any time subsequent to successful installation by means of the product configuration 29.

Installation: Demo	Installation: Auto
Use the installation type "*Demo*" in order to test the full scope of imc STUDIO for 30 days. No other products which require a password will be installed.	Use the installation type "*Auto*" in order to install the standard imc STUDIO edition including all necessary components. Optionally, the password-protected sensor management system imc SENSORS is installed.

The installation type is installed along with imc Shared Components and imc LICENSE Manager:

Installation: Demo - Components	Installation: Auto - Components
imc STUDIO Developer (Demo) [1]	imc STUDIO Standard [2]
imc DEVICES [3]	imc DEVICES [3]
imc FAMOS Reader [4] + Enterprise (Demo)	imc FAMOS Reader [4]
imc Format Converter	imc Format Converter
	optionally imc SENSORS [5]

Installation: Demo - Description

1: The associated Demo license must be activated after concluding installation by means of imc LICENSE Manager, otherwise it is not possible to start imc STUDIO.

Once the demo trial period has elapsed, use the product configuration 29 to covert the edition to the license you have purchased.

Installation: Auto - Description

2: The edition imc STUDIO Standard requires the purchase for license.

The associated license must be activated after concluding installation by means of imc LICENSE Manager, otherwise it is not possible to start imc STUDIO.

3: As a package of device drivers and firmware used by imc STUDIO.

4: The imc FAMOS Reader is freeware which also needs to be registered using imc LICENSE Manager.

5: Optionally, imc SENSORS is installed, which is a tool for administering sensors. This product requires a password for installation. If you do not wish to install imc SENSORS, you can de-select it.

Installation start follows directly (see: "Starting the installation 28").

3.3.2 User-defined

This installation type enables the user to choose a detailed configuration. Based on your selection of components desired, different installation steps are displayed.

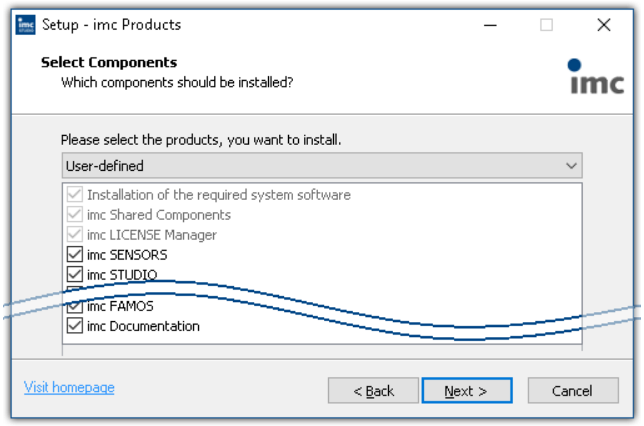
Note	Who should select User-defined installation

Use the installation type User-defined if you wish to **configure the individual products**.

With this type, it is possible to install **password-protected components**. Further, you can install and configure additional imc products such as **imc FAMOS**.

Note that some components can require a separate license.

Selecting components



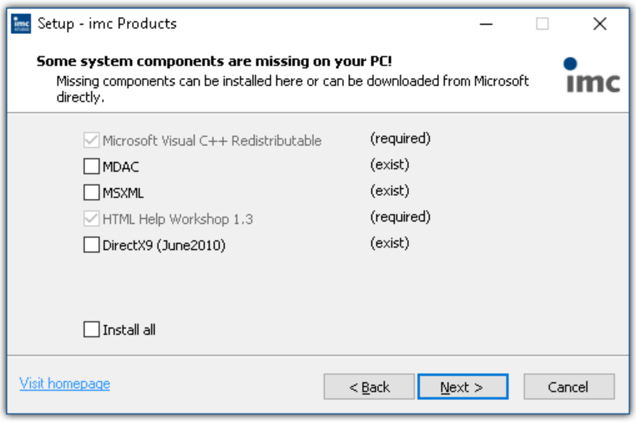
Selecting User-defined installation

Once you have selected the installation type "*User-defined*", it is possible to select/de-select the desired components in the box at the bottom.

imc LICENSE Manager and
imc Shared Components are included, as well as the **necessary system component**, otherwise the installed products will not function properly.

Selection	Description
Required system components	System components require using of imc products.
imc LICENSE Manager	imc LICENSE Manager enables the display and activation of all imc software products requiring a license.
imc Shared Components	Shared components of the imc products, such as the curve window.
imc SENSORS	imc SENSORS is a turnkey database program applicable across different measurement devices, for administering and editing freely definable sensor information.
imc STUDIO	imc STUDIO is modular software platform handling all aspects of modern measurement technology from simple data acquisition to sophisticated test configurations.
imc STUDIO Monitor	License-required component for imc STUDIO
imc WAVE	imc WAVE is a software package for NVH (Noise Vibration and Harshness) analysis. It is based on imc STUDIO and is installed as a separate instance of imc STUDIO. It can be equipped with multiple, separately licensed analyzers.
Firmware and driver package imc DEVICES	Package of device drivers and firmware required by imc STUDIO and imc WAVE for imc devices.
imc FAMOS	imc FAMOS is a program for analyzing, evaluating and documenting measurement results.
imc Format Converter	Converts imc measurement data to other formats such as EXCEL and ASCII.

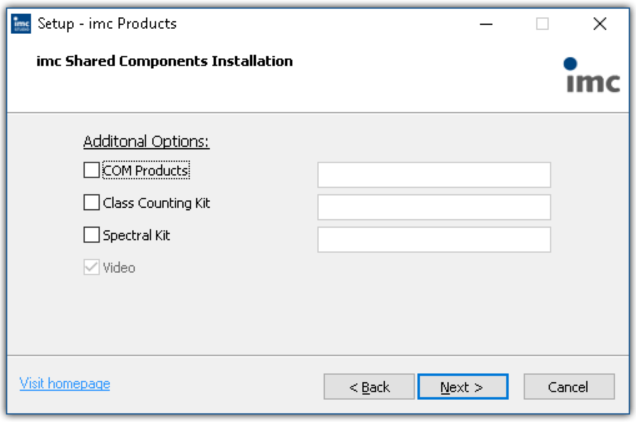
Required system components



Required system components (example)

In the next step, the system components which the products selected require are displayed, along with a note about which are already installed on your system. It is also possible to re-install any already installed components. Which components are missing/present depends on the system and it update status, so that the illustrations below are intended as an example only.

Configuring imc Shared Components

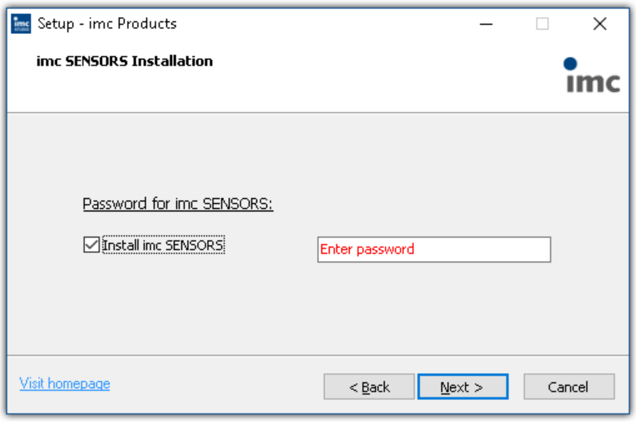


Configuring imc Shared Components

In this installation step, it is possible to install password-protected components of imc Shared Components.

Option/Component	Description
COM Products	The imc COM programming interface is a system integration tool
Class Counting Kit	Function library for imc COM products
Spectral Kit	Function library for imc COM products

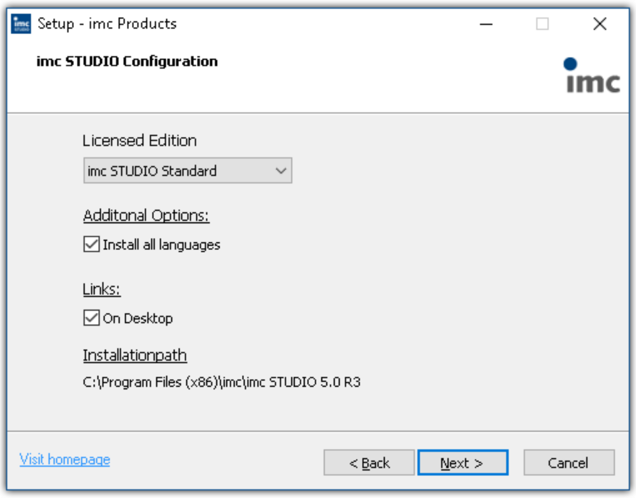
Password for imc SENSORS



Password prompt for imc SENSORS

If you have selected imc SENSORS, you are prompted to enter the password prior to installation. But if you do not wish to install imc SENSORS, de-select it here.

Configuring imc STUDIO

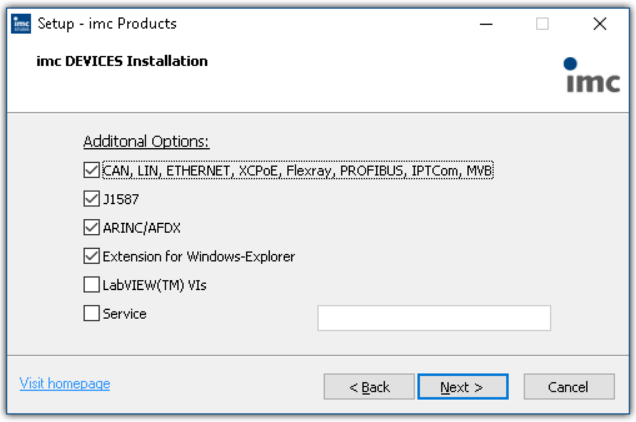


Configuring imc STUDIO

It is possible to make settings for your licensed product edition here. In consequence, later product configuration 29 can be omitted.

Option/Component	Description
Licensed edition	Information on the editions is provided in the **Technical datasheet** for imc STUDIO.
Install all languages	This option installs imc STUDIO in all available languages. If you do not need any extra languages, you can shorten the installation process. Please note that some functions require other languages. E.g. foreign-language parameter sets can only be imported if the corresponding language is installed. If the option is de-selected, then English and the operating system's language (if available) are installed automatically. If desired, all other supported languages can be installed later (see section "*Installing additional languages* 38").
Links	Program starting links can be created on the Desktop.

Configuring imc DEVICES

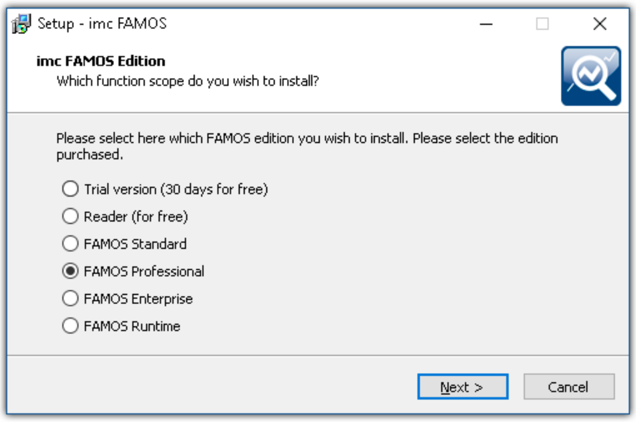


Configuration imc DEVICES

Here, you can install optional components of the imc DEVICES device driver package, which are used by imc STUDIO and imc WAVE.

Option/Component	Description
CAN, LIN, ETHERNET, XCPoE, Flexray, PROFIBUS, IPTCom, MVB	For measurement devices with one of these Fieldbus terminals
J1587	For measurement devices with a J1587-Bus terminal
ARINC/AFDX	For measurement devices with a ARINC- or AFDX-Bus terminal
Extension for Windows-Explorer	Access to the device hard drive via the MS Windows-Explorer
LabVIEW(TM) VIs	Library for accessing the imc devices via LabVIEW(TM)
Service	Service support. Install this component only if requested by Customer Support.

Configuring imc FAMOS



Configuration of the imc FAMOS installation

In this step, you configure the imc FAMOS installation. Select the editions you wish to install. Note that all editions except the *Reader*-edition require a license.

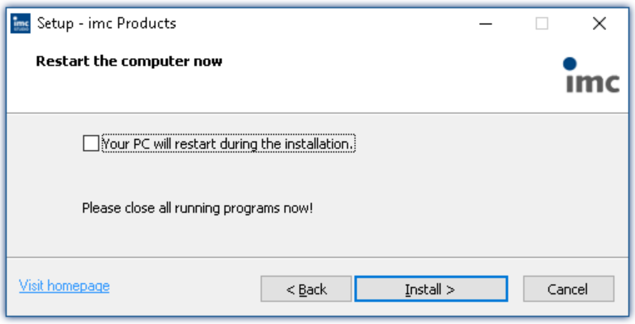
Follow the Assistant's instructions and select your preferred language for the help files and example files like projects, sequences and dialogs. Select any optional components which you wish to install along with imc FAMOS. Additionally, a folder for sample files is needed.

Reference	imc FAMOS editions

More detailed information on the imc FAMOS editions is provided in the imc FAMOS manual.

Once all products have been configured, the installation can start.

3.3.3 Starting the Installation



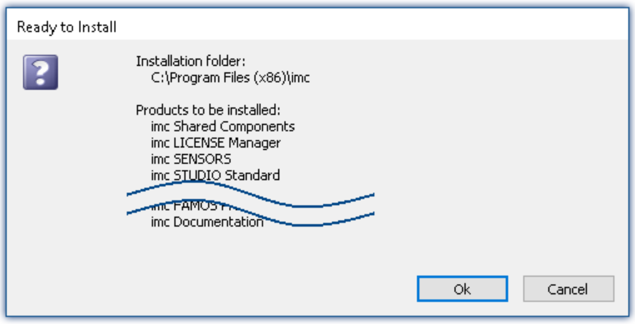
Concluding the installation setup and starting installation

Before the installation, a **system reboot** is performed. For this reason, first **close any running programs** before continuing!

Confirm the reboot by means of the checkbox and then continue (button: "Install"). Initially, the required system components are installed. Subsequently, the PC reboots automatically.

Warning Windows user account

After restarting, **be certain to log in with the same user account** with which you started the installation process. Using a different user account can cause failure of correct installation of the components.



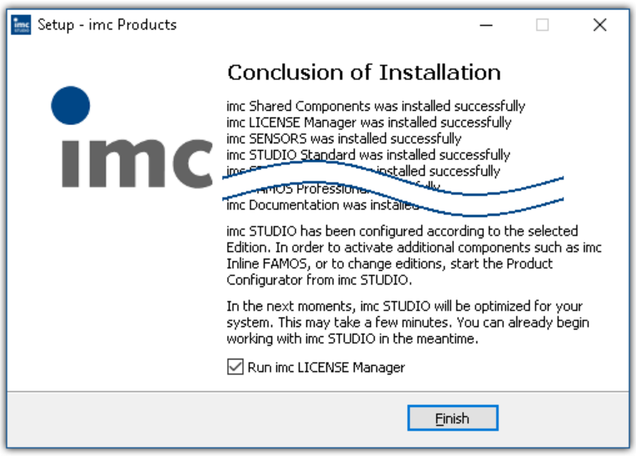
List of components to install, following restart (example)

After logging in, the actual installation of the products begins. You are presented with a list of which components are to be installed, which you can confirm by clicking on "Install". The figure below shows an example; the actual dialog may appear differently depending on your respective previous selections.

Next, installation of the individual imc products begins.

Note Disabling the system start

While installation is running, the operating system is disabled from starting again, meaning that no other programs can be started.



Concluding installation

When installation is finished, the following message is posted.

Next, you can start imc LICENSE Manager in order to activate your license. It is also possible to start the imc LICENSE Manager later via the Start menu.

3.4 Product Configuration / Licensing

imc STUDIO can be ordered and licensed/activated in various product configurations. Further details can be found in the order forms or on www.imc-tm.com. For a list of all possible editions and components (plug-ins), see the "*Technical datasheet*" or contact our Hotline 10.

Editions and components

The following editions are available for imc STUDIO, and each include a certain basic package of components (plug-ins)/functionalities.

Edition	Order code
imc STUDIO Runtime	imc STUDIO-RUN
imc STUDIO Standard	imc STUDIO-STD
imc STUDIO Professional	imc STUDIO-PRO
imc STUDIO Developer	imc STUDIO-DEV

With an appropriate "*Engine*" activated, any edition can run the configurations of higher editions.

Additional optional or individually licensable components (plug-ins) can also be integrated.

Each edition is able to apply configurations created with a higher edition, but not to modify them.

For the Edition **Standard**, **Professional** or **Developer**, the corresponding license is required. These can be activated in the imc LICENSE Manager. The Edition **Runtime** is a restricted version, free of charge. You can register this edition in the imc LICENSE Manager. There, select the option "**Trial versions and freeware**".

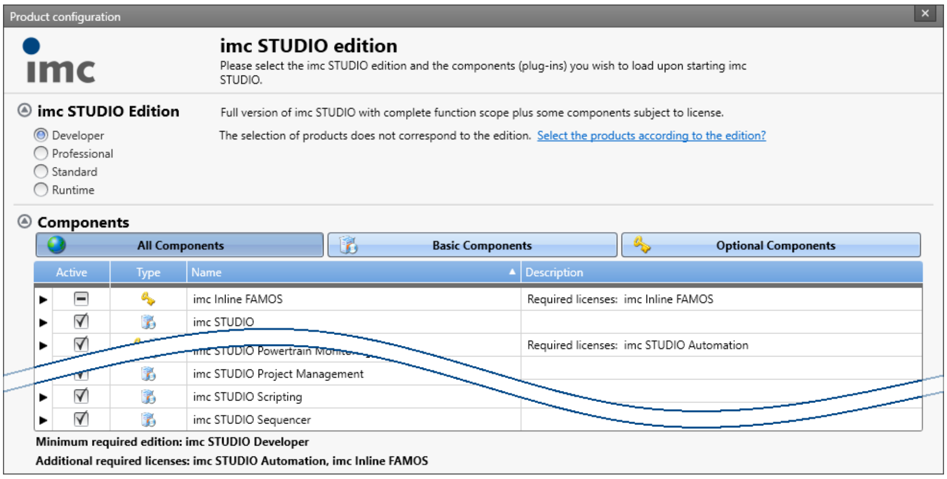
Licensing (imc LICENSE Manager)

The software licenses are managed with "*imc LICENSE Manager*". After concluding installation, you can start imc LICENSE Manager directly in order to configure your license (e.g. by means of the Windows Start menu: group "*imc*" > "*imc LICENSE Manager*"). If imc STUDIO is started without an appropriate license having been configured, the product configuration program opens, from where it is also possible to start imc LICENSE Manager.

Follow the instructions of the imc LICENSE Manager. imc LICENSE Manager offers a separate documentation. Start imc LICENSE Manager and click on "*Help*".

Changing the product configuration

You can change the product configuration in order to adapt it to the license purchased. For instance, if during installation you have selected a different edition or if you have purchased a product upgrade. To do this, start imc STUDIO and click in the menu bar (top right) on the symbol . The product configuration assistant now opens. You can change the configuration to correspond to the licenses you have purchased. Follow the instructions and close the assistant.



Assistant for altering the product configuration

After completing the configuration, you must close and restart imc STUDIO to apply the new settings.

Changing the edition

In the dialog's upper region, a number of editions are available for selection. The default selection is the edition currently being used. If you change the selection, you can decide whether the available components are to adapt to the selection. In most cases this is recommended, since this is the only way all of the edition's functions will be available after an update.

Optional components are not affected by the edition selection and remain in their previous state.

Please only change the edition if you have activated an appropriate edition in the imc LICENSE Manager.

Changing the components used

Additional components (plug-ins) for the edition selected are available to choose. Some of these plug-ins require a separate license.

In the bottom region of the dialog, the available components are shown. The set of components currently used is selected by default (except subsequently to an edition change).

Column		Description
Aktive		The component(s) is/are activated.
		The component(s) is/are deactivated
		Some of the components are activated. After clicking here, the components underneath are deactivated.
Type		The component requires an extra license in addition to the license for the edition.
	/	The component can be activated for the selected edition without any additional license.
Name		Product name of the component
Description		Short descriptive text about the component. More detailed descriptions of the individual components are provided in the Technical Spec Sheet.

Activate/deactivate the individual components in the column "Active". Below the list, the information on which additional licenses are required is presented.

Note imc STUDIO Automation

The component "Automation" has its own independent license and for this reason always appears in the list when selected. If you possess an imc STUDIO Developer license, you also have a Automation-license.

FAQ

Why are there sometimes two components for the same product? E.g. "Automation Editor" and "Automation Engine"

Answer: Many components are subdivided into their actual function, on one hand, and on the other their respective settings interface. This distinction exist for the following reason: each edition can run any function created with a higher-level edition, but not modify it.

In other words, using the component "Automation Engine", you can run Automation-Tasks in the Standard edition. However, the Editor ("Automation Editor") is only available in the Developer edition.

When should the "Engine" be deactivated

Answer: In most cases, it is not necessary to deactivate the engine if the component is not required. However, be aware that every component activated makes resource demands.

At a minimum, keeping unnecessary components active slows down the launch of the system.

Disadvantage: All functions belonging to the deactivated components no longer work. Example "Sequencer": Commands at Widgets, hotkeys/keyboard shortcuts, user-defined buttons, Metadata-Assistant, user-defined events.

3.5 Start

Start the software by means of the associated desktop icon or via the Start menu.

imc STUDIO

Further, as part of installation an icon is set up on your desktop and - depending on your choice during installation 20 - a symbol in the quick launch toolbar.

If no icon was set up (installation option), then open the **Windows Start menu**. There you find the group "**imc**" and in it a link to start the product.

If product configuration / licensing 29 is missing, the Product configuration starts automatic.

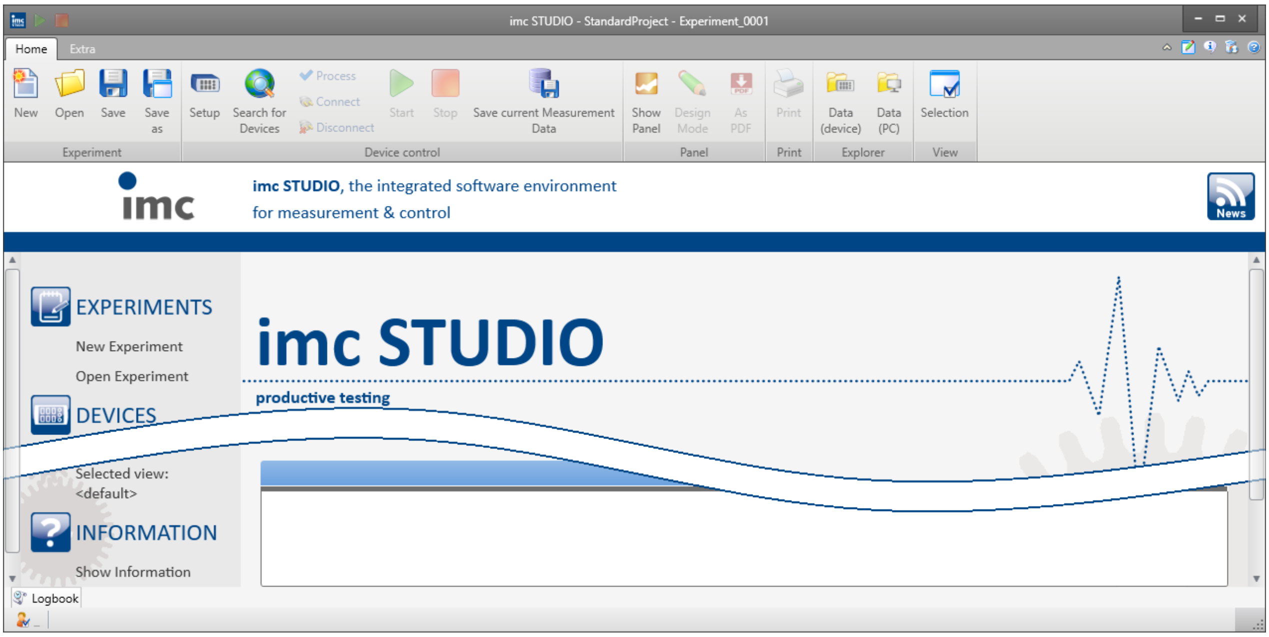
Splash screen

Next, a splash screen appears, indicating that software components are being loaded. Depending on the installation and the PC capacity, this could take some time.

Loading the software components after start

Homepage - Start page

By default the Homepage is shown when the software is started. The Homepage shows certain functions, depending on the particular product, as buttons. Click on the corresponding buttons, to select your desired functions. After the first installation, the "***Homepage***" may appear as shown in the example below:



Welcome Page (Example)

imc STUDIO starts with a simplified view

Along with installation of imc STUDIO, a number of **Views** are provided. Views in this sense are defined designs for the user interface's appearance.

imc STUDIO offers a wide variety of possibilities and functions, but the entire scope of these is not always needed for a single simple measurement.

Note imc STUDIO starts with a simplified view

In order to make it easier to get familiar with the software, the program starts with a simplified view with limited choices. All important functions for measurement and visualization of measured data are available. The menu ribbon is structured in such a way that proceeding from left to right accesses all of the Main windows 34.

Changing from the simplified view to View: Complete

You can switch to a different view at any time, in order to obtain access to all of the existing functions. To do this, go first to the menu item "*Extra*" and in the drop-down list of views, select: "**Complete**".

Note Notes on the descriptions and the screenshots

The following descriptions and screenshots always pertain to the view with the full scope of functions. Many of these functions are also found in the minimized view at another location.

3.5.1 Device Connection / Network / Firewall

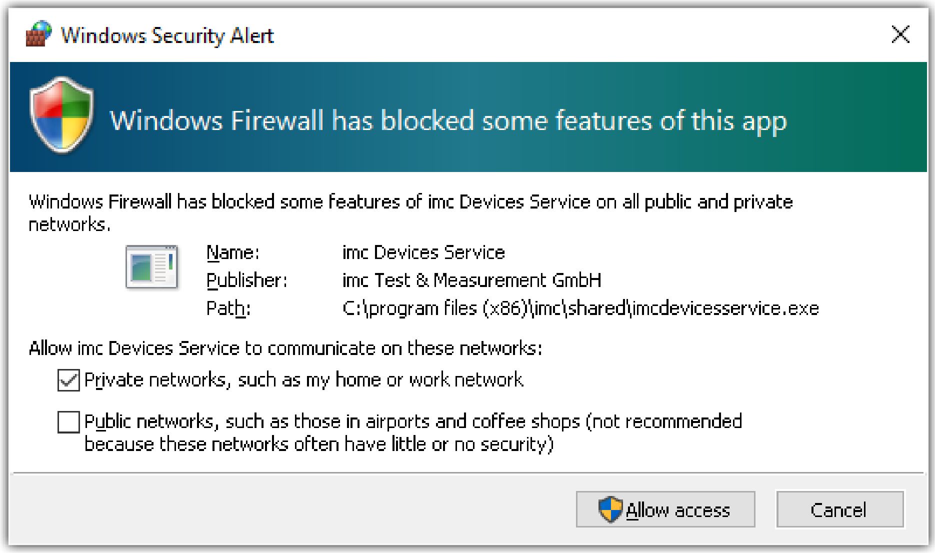
To use an imc measurement device, imc STUDIO must set up a **connection via a network** (mostly LAN). Details on the network settings are presented in the chapter "*Setting Up - Connect the device* 43".

Firewall

The firewall used might **prevent** establishment of a **connection** between the operating software and the measurement device. If the software is unfamiliar to the firewall, then a corresponding prompt usually appears upon **accessing the network**. This happens, for example, after starting the software and upon first accessing the device (e.g. in a device search). Some firewall programs can also block access to system and hardware-components.

In all cases, **correct operation** is only possible if the **connection is not blocked**. The following programs are usually affected:

Program	Default path
imc STUDIO: imc.Studio.exe	C:\Program Files (x86)\imc\imc STUDIO...
imc DEVICES: imcDevices.exe	C:\Program Files (x86)\imc\imc DEVICES...
imc DEVICES Service: imcDevicesService.exe	C:\Program Files (x86)\imc\Shared



Example of the firewall warning under Windows 10

Windows firewall: Here, there is a distinction between private and public networks. For operation on LAN, it is sufficient to **enable "*Private networks*"**. Enable this access type. You may wish to read the operating instructions for your firewall, and/or ask your administrator / IT-department.

3.5.2 Main Windows / Plug-ins

imc STUDIO provides the framework for ***plug-ins***. Plug-ins appear within imc STUDIO as ***main windows***. A plug-in can have one or more main windows.

The main windows appear in the Navigation Pane.

On the left you see an example of the Navigation Pane with the main windows **Homepage**, **Setup**, **Panel**, **Automation** and **Sequencer** (**Panel** is selected).

To jump to one of the main windows, click on the corresponding button in the Navigation Pane.

Navigation Pane 119: Select this link to go to further information on operation of the Navigation Pane.

Note — Notes on the use of the simplified view

- When you use the simplified view 32, the Navigation Pane is hidden. In this case, in order to go to the main windows Setup and Panel, use the menu ribbon.
- The other main windows can only be reached via the Navigation Pane.
- If you need it, you can show the Navigation Pane 121, or change the view 135.

Tool window

Most plug-ins have their own tool window (e.g. the Panel with the tool windows: Widgets and Data Browser). The tool windows are described in their respective sections.

Reference — See also

Tool window 120: Select this link to go to further information on operating the tool windows and for a description of the tool windows belonging to the imc STUDIO frame.

3.5.3 Important Settings

User and User groups

imc STUDIO has the ability to administer various **users** which are permitted to use the program in various ways. For details see the section "User administration 126".

Options

Before beginning to work with imc STUDIO, you can change essential settings, such as the **folder path where the experiments are saved**.

You can change the folder path in the options 110 (under "*Project Management*" > "*HDD settings*"):

Ribbon	View
Extra > Options ( )	all

Note Reading and writing access rights are required

Please note that this setting will apply for every user of imc STUDIO. Each user must possess reading and writing access rights for the specified folder path.

3.5.4 Command Line Parameters

Opening an Experiment file

An experiment file 92 (e.g. MyExperiment.imcstudio) can be opened directly in the Windows Explorer by double-clicking. This starts a new instance of imc STUDIO and opens the experiment file. The same procedure also applies for linkages to experiment files, for example files on the Desktop.

Experiments can be started with command line parameters. To do this, create a link to an experiment file and enter the desired parameter.

```
["imc STUDIO-Installation"] "Experiment-File" [/fullscreen] [/do[StartMeasurement]]
[/do[StartSequencer]]
```

`["imc STUDIO-Installation"]`	**Open Experiment with a specific imc STUDIO installation (optional)**

In order to open an experiment file with a particular installation of imc STUDIO, extend the link with the respective installation's name. For example:

```
"C:\ProgramData\imc\imc STUDIO\Applications\_1\imc STUDIO.exe"
"imcDB://DB\StandardProject\MyExperiment"
```

The experiment file `MyExperiment.imcstudio` is started in the imc STUDIO installation under `Applications\_1\`.

`"Experiment file"`	**Experiment to be loaded**

Mandatory entry. Opens the experiment entered with the imc STUDIO installation which is set up as the default program under MS Windows. Mostly this is the last imc STUDIO version installed, or imc STUDIO Monitor, if this component was installed along with it.

One possibility is to specify the path in absolute terms:

```
"C:
\Users\Public\Documents\DB\StandardProject\MyExperiment\config\MyExperiment.imcSt
udio"
```

Another way is to specify it in reference to the name of the database and of the project (the appropriate database folder must be selected):

```
"imcDB://DB\StandardProject\MyExperiment"
```

`/fullscreen`	**Fullscreen mode (optional)**

In order to start an experiment in fullscreen mode, the experiment file is opened with the parameter `/fullscreen`.

```
"imcDB://DB\StandardProject\MyExperiment" /fullscreen
```

After opening the experiment file, the Panel is started in fullscreen mode, if the experiment contains at least one Panel page.

`/do[StartMeasurement]`	**Starting the measurement (optional)**

In order to start the measurement automatically upon opening an experiment file, The experiment file is opened with the parameter `/do[StartMeasurement]`.

```
"imcDB://DB\StandardProject\MyExperiment" /do[StartMeasurement]
```

or

```
"imcDB://DB\StandardProject\MyExperiment" /fullscreen /do[StartMeasurement]
```

/do[StartSequencer]	**Starting the Sequencer (optional)**

In order to automatically start Sequencer upon opening an experiment file, the experiment file is opened with the parameter `/do[StartSequencer]`.

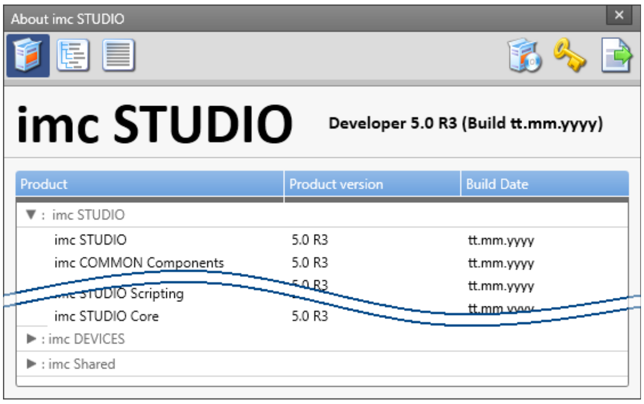
```
"imcDB://DB\StandardProject\MyExperiment" /do[StartSequencer]
```

or

```
"imcDB://DB\StandardProject\MyExperiment" /fullscreen /do[StartSequencer]
```

3.6 Info / Version Information

imc STUDIO consist of multiple components (plug-ins). In order to see which components are included in your package, click in the menu bar on the symbol . Then a pop-up window appears displaying the product names and details on the components:



Version information (example)

With the buttons on the left side, you can change the list's depth of detail and how it is sorted.

With the buttons on the right side, you can start the assistant for the product configuration 29, start the imc LICENSE Manager 29 or export the product selection.

While performing the export, you can save the contents as a file in XML format. For inquiries for Hotline, it may be necessary to send it as an Email (see also chapter "*Customer Support / Hotline* 10").

3.7 Information and Tips

3.7.1 Changing Languages and Installing Additional Languages

If in the installation type "User-defined 24" the option "***Install all languages***" was not selected, then upon conclusion of the installation, imc STUDIO is available in **English** plus, if provided, in **the operating system's language**. In all other cases all supported languages are already installed.

Note	Observe operation system settings

Please ensure that your operating system is set correctly to the display language. Some languages require modifications to be made accordingly. In particular, the "System locale" must be set correctly to correspond with the display language.

Otherwise, with some languages there can be problems with the characters. Languages affected include Japanese, Chinese, Russian, ...

Changing the language

By default, the imc software will start in the same language as the Windows version installed. If this language is not supported, then the English program version appears.

The language can be changed, irrespective of the Windows version. Use the program "***imc Language Selector***". The program is found in the Start menu under the group "imc".

Note	Constraints

Only the imc software's texts are converted. Components which depend on the operating system's language setting are not affected.

Please only use one of the following two languages:

- Default: the operating system's language
- English

Any other selection may cause malfunctioning if the operating system and the imc programs use different languages.

Installing additional languages

If desired, all other supported languages can be installed later (no data processing medium is required).

Note	Which languages are be installed subsequently

In subsequent installation of languages, **all languages supported** are installed. There is **no selection** possibilities.

Step by step

- Administrator rights are required.
- Open the **installation folder** of imc STUDIO (e.g. "*C:\Program Files (x86)\imc\imc STUDIO...*"), e.g. with Windows Explorer or by means of the command line.
- There, open the folder "***Languages***"
- Run the file "***InstallLanguages.bat***".
- Wait until the script stops and posts the message "*Failures: 0*". This indicates that the installation has completed successfully.

Note	Instruction notes

If installation was unsuccessful, the necessary user rights may be missing:

- If "*InstallLanguages.bat*" is called via the **command line**, run the **command line as Administrator** (context menu: "Run as Administrator")
- If "*InstallLanguages.bat*" is called via the **Windows Explorer**, run the **call as Administrator** (context menu: "Run as Administrator")

3.7.2 Recommended Virus Scanner Settings

The presence of many channels can **burden the PC** if a virus protection program scans the data captured. This may cause a **jiggling display** and high demands on the processor.

We strongly recommend **removing imc STUDIO from the virus scan**. Most virus protection programs are able to classify individual programs as low-risk. To do this, please refer to the instructions for your virus scanner.

Low-risk	Default path
Add the program **imc.Studio.exe** to the list of low-risk programs	C:\Program Files (x86)\imc\imc STUDIO...
Add the program **imcDevices.exe** to the list of low-risk programs	C:\Program Files (x86)\imc\imc DEVICES...
Add the **database** path along with all subfolders to the list of low-risk folders	C:\Users\Public\Documents\DB

Ensure that its data are not searched for viruses during reading or writing

3.7.3 Installation - Installing projects

You can prepare projects which are automatically included with the installation. E.g., after the installation, special views and experiments will already be available.

- Create a project-export-file (".imcStudioExport") for the purpose. Make sure that the project is exported and not only the experiments (selection). Upon exporting, you can define what the file is to contain. E.g., only the project settings, or also the experiments.
- Save the file(s) in the following path: DVD:\Products\imc STUDIO\Projects

Any existing projects having the same name will be overwritten.

Produce an installation medium and run the installation as usual or install from the hard drive.

After the first launch of imc STUDIO, projects are imported into the database.

FAQ

Question	Answer
What happens if the project exists already?	All project settings will be overwritten.
What happens if the project has contents which do not exist in the project to be imported?	All content besides project settings remains intact. E.g. experiments, measured data, metadata, ...
What happens if the project has contents which already exist in the project to be reported?	These will be overwritten. As well, any experiments, measured data, metadata, ... are overwritten.
What happens if there are any other projects present?	These projects remain intact.
What all is imported from the project?	All project settings and any experiments, measured data, metadata, ... the projects contain

3.7.4 Unattended Installation - Silent Installation

For unattended installation ("*Silent installation*"), certain parameter files (.ini) are required. Create these files by means of a command line call.

```
Setup.exe /CREATEINIFILES="<TargetPatch>"
```

To do this, proceed as follows:

- Copy the content of the data carrying medium (e.g. the DVD) to your hard drive: e.g. under "c:\DVD\"
- Start Windows' command prompt ("cmd", "command shell").
- Navigate to the appropriate file path and call the Setup with the following command line (in the example here, the folder is: "c:\DVD\"):

```
Setup.exe /CREATEINIFILES="c:\DVD\"
```

The frame setup is started and may be configured as desired. When the settings are finished being made, there is no restart, as there usually would be. Instead, at the specified target location, *.ini-files are created which have the following structure:

Main file

DVD/Configuration/Setup.ini

Product files

DVD/Products/$Productname$/Configuration/$Filename$.ini

z.B.

DVD/Products/imc STUDIO/Configuration/imc STUDIO.setup.ini

DVD/Products/imc FAMOS/Configuration/Setup_imcFamos.ini

The ini-files contain the settings which have been made.

Subsequently, the DVD folder can be copied to a data carrier and used for the unattended installation.

Calling the unattended installation

The installation process is called with command line parameters, where "`/SILENT`" causes the silent setup installation to start. The following is an example of a 64-bit system:

```
DVD/Setup.exe /Lang=en /DIR="C:\Program Files (x86)\imc" /SILENT
```

With the additional parameter "`/UNINSTALL=ALL`" the de-installation of all previous versions is inhibited.

If the switch is set to "NECESSARY" only the necessary version are de-installed. When setting the switch to "NONE", no version is removed.

In special cases a de-installation is needed, e.g. if you install the 5.2R2 to a 5.2R1. The 5.2R1 needs to be de-installed.

Note

Creating ini-files in a different folder

You can also create the ini-files in a different folder. In this case, merge the two folders afterward (not recommended because prone to errors).

Please always create new ini-files each time

With any new version, it may occur that new keys are entered in the ini-files. For this reason, create new ini-files for any new version.

4 Setting Up - Connect the device

There are multiple ways to **connect the imc measurement devices with the PC**. In most cases, the **connection via LAN** 43 (local area network, Ethernet) is implemented. See section *"Connecting to LAN in four steps* 44*"* for the **quickest way to connect** PC and measurement device.

But there are also other connection types:

- Modem 69 (TCP/IP with PPP)
- WLAN 62
- Radio modem 78 (GSM, mobile phone network)
- Null modem 76 (serial interface)

These are described in a separate chapter: Special options for connecting to the device 48.

The devices use the **TCP/IP protocol** exclusively. With this protocol, some settings and adaptations for your local network may be necessary. For this purpose, the support of your network administrator may be necessary.

Note

When **using multiple TCP/IP connections**, e.g. LAN, WLAN and modem, observe the remarks in the chapter "*Computers with multiple TCP/IP connections* 52".

4.1 Connection via LAN

To connect via LAN there are two options:

1. The measurement device is connected to an **existing network**, e.g. via network switch or hub.
2. The measurement device is connected directly to a network adapter on the PC (**point-to-point**).

In a LAN, the first case is typically implemented. For both variants, **different cables** may be required! Modern PCs and network switches are usually equipped with Auto-MDI(X) automatic crossover recognition, so that having multiple various cables is no longer necessary.

1. Connecting to an existing network:

- An uncrossed UTP cable, e.g. CB-UTP-3 is necessary
- Connect the measurement device's LAN jack to a switch. Only with a hub or switch is it possible to run multiple devices.

2. Direct connection to the PC (point-to-point):

- If you are using older PCs with AUTO-MDI(X) Crossover Detection, you need a special "crossed" UTP-cable (Category 5, RJ45 connector, e.g. CB-UTPX-3)
- Connect the measurement device's LAN connector directly with the PC's LAN jack

Recommended network configuration:

If possible, always use up-to-date network equipment in order to achieve the maximum transfer bandwidth. The current standard (2014) is: 100BASE-T (Fast Ethernet 100 MBit/s) or 1000BASE-T (GBit Ethernet). GBit Ethernet network equipment (switch) is backwards compatible, so that imc devices can be operated with 100MBit Fast Ethernet.

The cable length between the switch and a PC or a device should be less 100 m. Use a shielded cable. If the length of 100m is exceeded, then you have to insert another switch. If the system is being integrated into an existing network, you must ensure that the minimum data rate can be guaranteed. If this is not the case, you should use network bridging.

4.2 Connecting via LAN in four steps

The most common case is described below: the PC and the device are connected via cable or switch. The device's IP-address must be set in the PC's address range. Subsequently, the device can be connected with the PC. If a connection has ever been established previously, the software knows the device's hardware configuration. In that case, experiment configurations can be prepared without any connection to the device.

Step 1: Determining the PC's IP-address

Before starting the configuration of your measurement device, you should **determine your computer's IP-address** (the following screenshots and texts refer to MS Windows 10). There are multiple ways to do this, of which some may not be possible on your PC, depending on the administrator rights you have. In such cases, you should contact your responsible administrator/IT-service.

Before determining the IP-address, connect the measurement device with the PC and activate it.

The device's and the PC's IP-addresses and subnet masks must be compatible with each other.

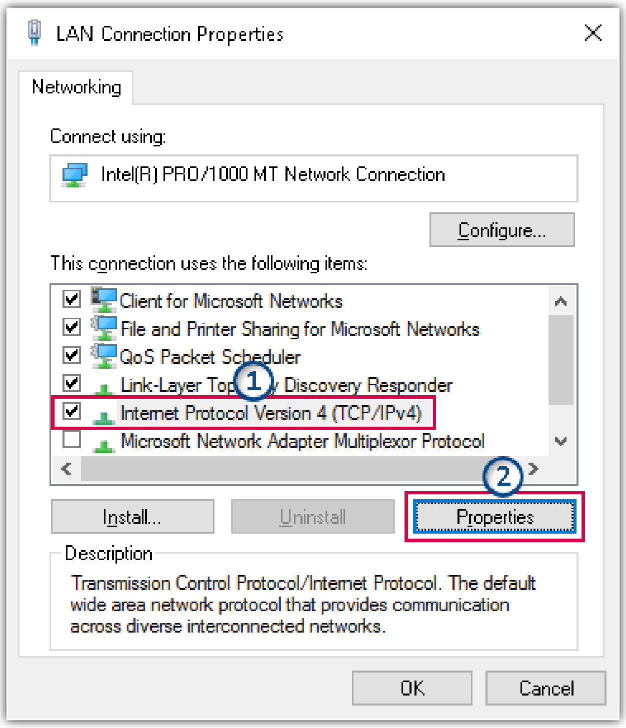
To open the configuration dialog, use one of the following:

- Open the Windows Control Panel and search for "**View network connections**"
- Select "View network connections"

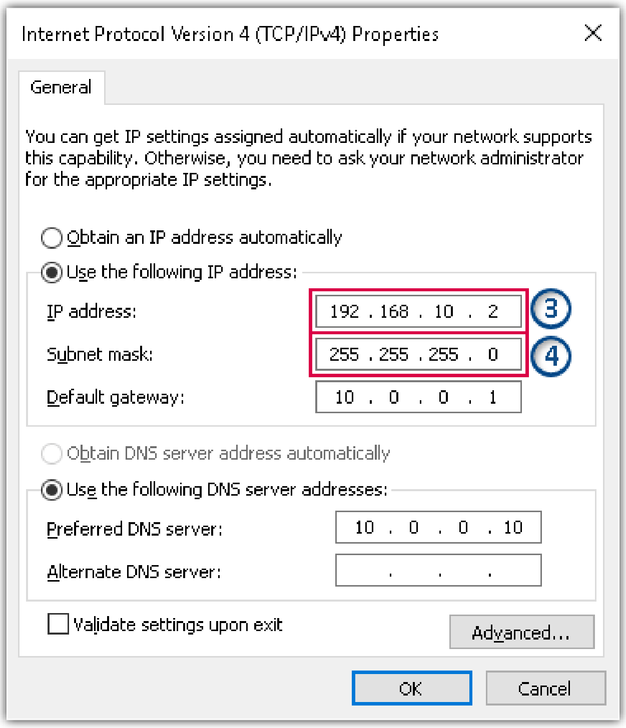
- Open Windows' input box by using the keyboard combination of Windows-key + R `[Win-R]`.
- Enter the following command in the edit box: `control netconnections`

The "**Network Connections**" window appears. Then right-click the mouse over the entry for your network connection and then select the item "**Properties**" in the context menu once again. Then the Connection Properties window appears.

Select Version 4 of the **Internet Protocol Version 4 (TCP/IP4)** and click on **Properties**. Now the current settings are visible. Please note the computer's **IP address** (3) and the **subnet mask** (4).



Select Internet Protocol (TCP/IP)



Settings for TCP/IP

Warning

Be careful in changing settings, since if the same network card is used, there may be difficulties later in the company network. Please discuss this with your responsible administrator/IT-service.

Note **Obtain IP-address automatically (DHCP)**

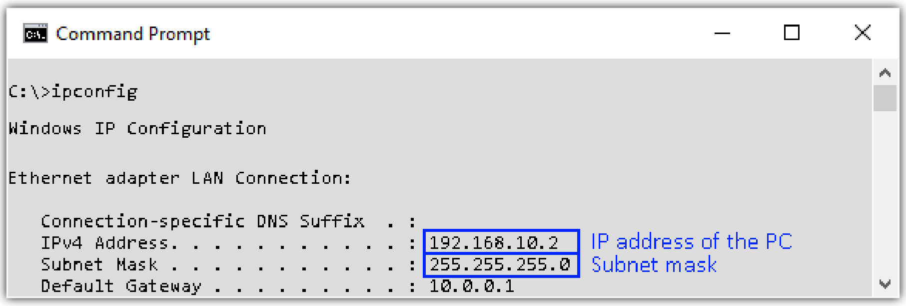
If "Obtain IP address automatically" (DHCP) is selected, no IP address is displayed. In this case, you have to determine the current IP-address using the Command Prompt/Command line.

Note, however, that automatically obtained IP-addresses might change the next time the operating system is started!

Determine the IP address using the Command line

Open Windows' input box by using the keyboard combination of Windows-key + R `[Win-R]`. Type `cmd` in the text box and confirm by pressing Return. In the command line window which then appears, type in `ipconfig`.

Now you can read the IP-address of the desired network connection:



Result of the command "ipconfig"

In the example shown, the fixed IP 192.168.10.2 with subnet mask 255.255.255.0 is selected. For measurement devices, any numbers would be suitable which begin with 192.168.10. and then do not contain 0, 2, or 255. The 0 and the 255 should not be used, if possible, due to their special significance. The 2 is the computer's number.

Step 2: Connecting the measurement device

When you **connect** the measurement device **directly to your PC**, you may need to use a **"crossed" network cable** in some circumstances. If the measurement device is connected to the network **via a network hub** or switch, or a patch box, use an **uncrossed network cable**. Modern PCs and network switches are able to switch electronically. Hence you can use both cable types.

Use an appropriate network cable.

Step 3: IP-configuration

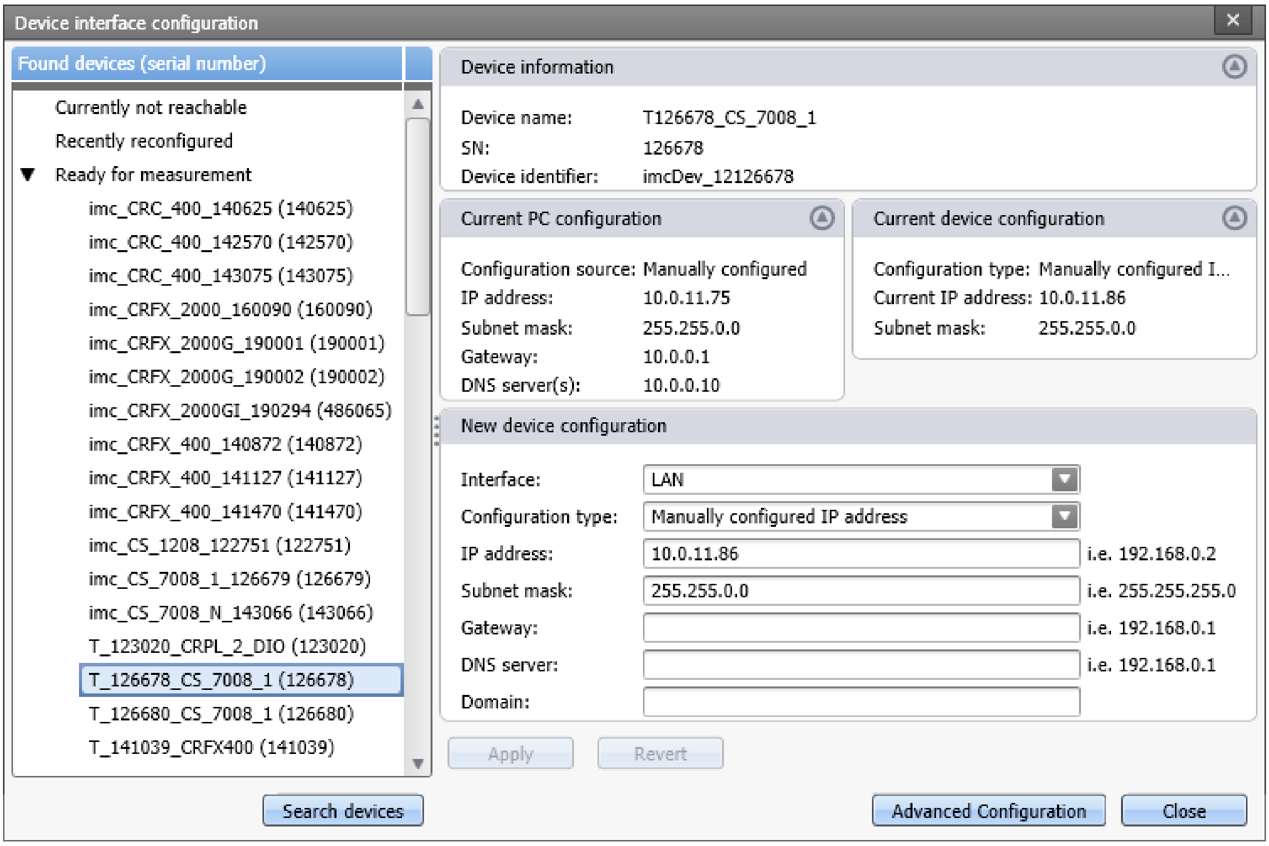
Start imc STUDIO. Open the dialog for configuring the device IP address by clicking on the button "*Device interfaces*" ( ).

Ribbon	View
Setup-Configuration > Device interfaces ( )	Complete

If this **button** is **not present** in the view you are in, it is also possible to open the dialog after a device search if it failed to find any new devices. Subsequently, a prompt appears asking whether to search for devices with an inappropriately configured network interface. Close this message box by clicking "*Yes*".

Once the dialog starts, the system automatically searches for all devices in the network. In the tree diagram, all available devices are indicated. If the device is found in the group "**Currently not reachable**", you need to configure the LAN settings. If the device is found in the group "**Ready for measurement**", you can retain the current settings or view them. Select the device.

If there is any IP-conflict, devices affected will not be listed.



Picture 1: Display of measurement devices found and of the IP-address

If the configuration type: *DHCP* is used, **the IP-address is obtained automatically** from the DHCP-server. If there is a direct connection between the device and the PC with a crossed cable, you should deactivate the DHCP. If it is **impossible to obtain any setting values** via DHCP, the **alternative values are used**. These could lead to errors in the connection (different networks, same IP-addresses, etc.).

Without DHCP, you must **set the IP-address manually**. Please note that the device's and PC's IP-address must fit together, in other words that in the network mask only the portion representing the device is different (see example).

Example for IP settings	PC	Device
IP-address	10. 0. 0. 34	10. 0. 0. 45
Network mask	255.255.255. 0	255.255.255. 0

In order to apply the changes, click on the button **Apply**. Wait for the device to restart and then close dialog.

Note — Connection via modem or WLAN

If the connection to the device is established via a modem or WLAN, start the program "*imc DEVICES Interface Configuration*" by clicking on the button: "*Advanced Configuration*" (see picture 1). An exact description is found in the software manual chapter: "*Setting Up - Connect the device*" > "*Special options for connecting to the device* 48".

Step 4: Integrating a device into an experiment

Now you are ready to add the device to the imc STUDIO experiment. If your device is unknown to the system, first perform the "*device search* 175".

Ribbon	View
Home > Search for devices ( )	all
Setup-Control > Search for devices ( )	Complete

Select the desired device: Once you click in the checkbox "*Selected*" for the desired device, it is ready to use in the experiment (see *Device Search - Known and Selected* 222).

Selected	Device name	SN	Device specification
☑	T_124835_C1_1_LEMO_ET	124835	imc C1-1 LEMO
☐	T_130039_busDAQ_X	130039	busDAQ-X
☐	T_130311_SPARTAN_U32_CAN	130311	imc SPARTAN

You can also select multiple devices for your experiment.

Now the device is "*known*". After the next program start it is available for selection. For further information, see the documentation on plug-in Setup 164.

4.3 Special options for connecting to the device

Additional ways to connect with the device are presented below. For other special cases, please see the section on LAN connection.

4.3.1 Devices and TCP/IP

It is absolutely necessary to carry out the instructions below in the sequence given. But first read through the whole section in order to get a preview of the needed measures.

General preparations

A imc device with TCP/IP supports a classic network interface (LAN).

For a device having a LAN-interface, the following parameters must be set appropriately:

- IP-address
- Subnet-mask
- DNS-server-address (optional)
- Domain (optional)
- Router-address (optional)

If your network is equipped with a DHCP-Server, these data can be accessed automatically by the device upon switch-on. Have your network administrator make the necessary configuration of the DHCP-server and the DNS-server. You can skip the rest of this section, in that case, and proceed with Configuration of the PC 50.

Note Notes for the Administrator

- We recommend using a fixed assignment of IP-addresses to the devices and to set an unlimited lease-time. A device's host name cannot be changed. It is comprised of a prefix and the device serial number, e.g. " imcDev__99030143".
  For a device with a PPP-interface, it makes sense to set the following parameters:
- local and remote IP-address,
- Baud rate and protocol of the serial interface to modem or cable,
- DNS-server address (optional),
- user name and password (optional),
- scripts for connecting and disconnecting (optional).

If there is no DHCP-server, the necessary device settings must be made as described further below. Have your administrator issue IP-addresses for your device units and make note of the address assignments. Have the administrator enter the device units in the DNS-server if there is one. In this case, also make note of the DNS-server's IP-address and the name of your network domain.

Find out the subnets in which the devices are to be operated and make note of the corresponding subnet-masks. You will also need the IP-addresses of any routers present which your devices units are to use.

Once you have gathered all the above information, you can proceed with the next section.

4.3.1.1 Configuration of the PC

To operate TCP/IP devices you need a PC on which the TCP/IP-protocol is installed and ready. We assume here that your PC is already set up appropriately. If this isn't the case, follow the instructions in your network card's documentation and in the WINDOWS help texts in order to install TCP/IP on your PC.

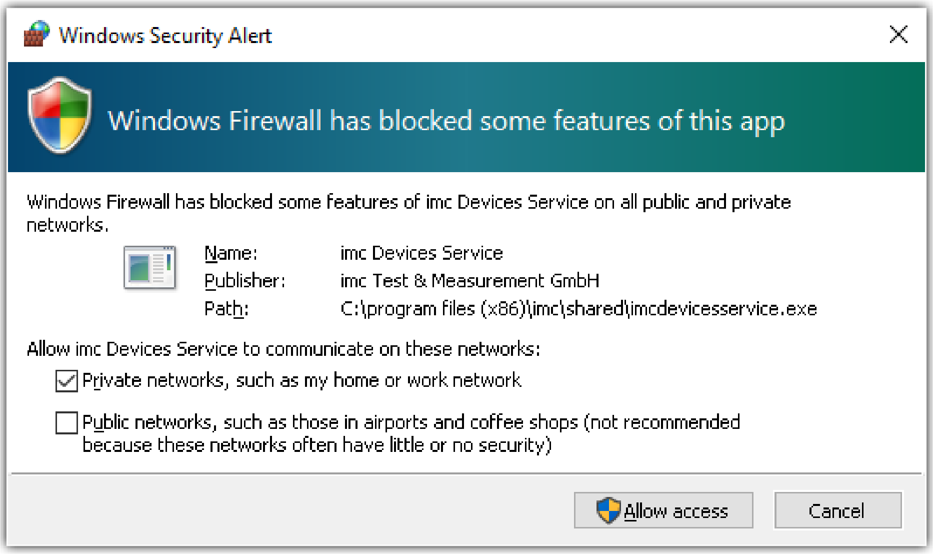
Avoid changing your PC's IP address if the PC is on an existing network! Simply adjust the configuration of the measurement devices! The chapter "*Device connection via Modem (TCP/IP with PPP)* 69", contains hints on preparing your PC for running PPP-devices.

Firewall and Ports

The firewall used might **prevent** establishment of a **connection** between the operating software and the measurement device. If the software is unfamiliar to the firewall, then a corresponding prompt usually appears upon **accessing the network**. This happens, for example, after starting the software and upon first accessing the device (e.g. in a device search). Some firewall programs can also block access to system and hardware-components.

In all cases, **correct operation** is only possible if the **connection is not blocked**. The following programs are usually affected:

Program	Default path
imc STUDIO: imc.Studio.exe	C:\Program Files (x86)\imc\imc STUDIO...
imc DEVICES: imcDevices.exe	C:\Program Files (x86)\imc\imc DEVICES...
imc DEVICES Service: imcDevicesService.exe	C:\Program Files (x86)\imc\Shared



Example of the firewall warning under Windows 10

Windows firewall: Here, there is a distinction between private and public networks. For operation on LAN, it is sufficient to **enable "*Private networks*"**. Enable this access type. You may wish to read the operating instructions for your firewall, and/or ask your administrator / IT-department.

Note

Alternatively, you can enable the ports. To do this, each port must be entered for UDP and TCP. The following ports are used:

- UDP 1200
- TCP 1200 through 1202

4.3.1.2 Use of TCP/IP devices in various network situations

In some cases it's necessary to be able to run the PC together with the measurement device both in a network (e.g. company network) and, for mobile applications, with a point-to-point connection. In order to enable convenient and reliable operation in both settings, the following manner of proceeding is recommended.

In larger networks, the IP-addresses for the network's PCs are usually assigned automatically ("*Network settings*" > "*Internet protocol (TCP/IP)*" > "*Properties*" > "*Obtain IP-address automatically*"). For that purpose, the network comes with a DHCP-Server (DHCP: **D**ynamic **H**ost **C**onfiguration **P**rotocol).

If the Windows operating system is started on the PC in such a network (a physical connection between PC and the network (EtherNet cable) exists!), then the PC is automatically assigned an appropriate IP-address and the value for the subnet mask is set. The measurement devices can obtain appropriate IP-addresses and subnet masks in the same way if the use of DHCP for the device is enabled. Thus, within a network with a DHCP-server, there aren't any address conflicts and no problems finding the devices in the network.

If the same PC is now started outside of the network environment (where there isn't any DHCP-server; e.g. on board a vehicle), then assignment of the IP-address proceeds according to the APIPA-protocol **(A**utomatic **P**rivate **IP** **A**ddressing). In such cases, an IP-address is assigned by the Windows operating system from a reserved IP-address range (169.254.0.1 ... 169.254.255.254). The subnet mask is set to the value 255.255.0.0. See also AutoIP 52.

In this case the measurement devices use the IP-address set in the device.

If an address from the range reserved for APIPA is selected in the device as the IP-address, and the subnet mask is set to the value 255.255.0.0 (the use of DHCP for the device remains enabled!), then it's also possible to set up a connection between the PC and the device within the company network without any problems.

Note

- The IP-address actually used for the PC and the value for the subnet mask can be determined by entering the following command line in the "(MSDOS-) input prompt": "`ipconfig /all`"
- If an IP-address for a device is to be set from the range reserved for the APIPA, it must first be checked which IP-address has been assigned for the PC, if no DHCP server is available. To do this, the PC is deactivated and disconnected form the network. After activation of the PC, the IP-address currently in use is determined as described above. Make a note of this IP-address!
- Ensure that each device is assigned its own IP-address. This also goes for assignment of IP-addresses from the range reserved for the APIPA! This prevents address conflicts even in networks without a DHCP-server.
- Fundamentally, the physical connection (EtherNet cable) between the device and the network should be set up before the device is activated, so that automatic assignment of the IP-address can work. If the automatic IP-address reference fails, the IP-address already set remains valid from this moment until the device is deactivated. However, this address isn't generally suitable for the IP-addresses used in the network and address conflicts can result, or locating the device in the network will fail!

4.3.1.2.1 Computers with multiple TCP/IP connections

If you have set up multiple TCP/IP interfaces in your PC system, be sure to enter different subnets for each one! Otherwise random conflicts will occur. Reasons for having multiple TCP/IP interfaces include:

- You separate your connection to the company network and your connection to the measurement device by means of two network boards.
- You occasionally connect your measurement device via modem (PPP)
- You have added a Bluetooth connection.

The settings for the addresses could look like this, for instance:

	Measurement device	Router-company	Network Board1	Network Board 2
IP-Address	192.168.1.3	192.168.0.1	192.168.1.26	192.168.0.13
Subnet-Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0

In this example, your PC would communicate via Network Board 1 with the device and via Board 2 with the company network.

4.3.1.2.2 DHCP and APIPA

The settings presented here apply to the imc device, not the PC:

Setting	Description
Use DHCP	(Dynamic Host Configuration Protocol) The device tries to get its settings from a DHCP server. If the server is not available, the fixed settings are used! This corresponds to the alternative configuration in Windows PC.
DHCP ClientID	The *DHCP ClientID* can be entered if the DHCP server requires a special DHCP ClientID for IP assignment. If there is no entry, the MAC-address 79 is used. Supposing measurement devices are to be assigned IP by the DHCP server from a particular range. In that case, 'MeasDev 1' etc. could be entered, for example.
DHCP Hostname	If your administrator makes the device accessible via a DHCP Hostname, enter it here. Otherwise, leave this box empty.
Auto-IP (DHCP + APIPA)	(*Automatic Private IP Addressing*) *Use DHCP is* automatically activated along with this option. If the DHCP server cannot be reached, the fixed configuration for the address is not used. Instead, the device uses a random number generator to get an address in the range from 169.254.1.0 to 169.254.254.255. Afterwards it tests whether the address generated is available. If it is already used for another device, the search is repeated until a free address is found.

Note

If the PC's network interface is configured to "Obtain IP address automatically" (e.g. DHCP), then there is a problem with point-to-point connections when the network connection is cut and then restored (e.g. restart of the device interface in the process of a firmware update).

In such a case, the restoration of the device connection is delayed until the PC's network interface is completely reactivated (with a permanently valid IP-address).

4.3.2 Start the network configuration - Interface configuration

By means of the dialogs "*Device Interfaces*" and "*Interface-Configuration*", it is possible to find out whether connection to the device can even be established at all. You are able to review the device's network system and to adapt the settings to the local network.

All entries are checked for plausibility, thus preventing incorrect entries. Even so, making the configuration requires system expertise and you may need support from your network administrator.

With imc STUDIO various options for interface configuration are supplied:

<table>
<tr><th>Programs</th><th>Description</th></tr>
<tr><td>Device Interfaces 53</td><td>Offers a simple guided interface for modifying the devices' LAN-configuration.
If the simple configuration is inadequate, it is possible to start the advanced Assistant via the dialog: Interface-Configuration 54.
The following connection types can/can't be configured via the dialog:
<table>
<tr><th>yes</th><th>no</th></tr>
<tr><td>Device connection via LAN</td><td>Device connection via Modem (TCP/IP with PPP)</td></tr>
<tr><td>Device connection via WLAN
IP-configuration only</td><td>Device connection via WLAN
advanced configurations, such as speed, encryption, ... but must be pre-configured via Interface-Configuration 54.</td></tr>
</table></td></tr>
<tr><td>Interface-Configuration 54</td><td>The program is used for the extended configuration of imc devices (prerequisite: production of the motherboard after August 2003. Older devices are not supported by imc STUDIO).</td></tr>
</table>

Start the configuration with "Device interfaces"

Start imc STUDIO. Open the dialog for configuring the device IP address by clicking on the button "*Device interfaces*" ().

Ribbon	View
Setup-Configuration > Device interfaces ()	Complete

If this button is not present in the view you are in, it is also possible to open the dialog after a device search if it failed to find any new devices. Subsequently, a prompt appears asking whether to search for devices with an inappropriately configured network interface. Close this message box by clicking "*Yes*".

Reference	Make settings

See further: "*Device connection via LAN* 56"

Start the configuration with "Interface-Configuration"

Start the program "*imc DEVICES Interface-Configuration*".

Start via:	Description
imc STUDIO	Open the dialog for configuring the device IP-address by means of the button "Device interfaces" (). (See "*Start the configuration with "Device interfaces"* 53") There, click on the button: "*Advanced Configuration*".
the Start menu	Start the program: imc DEVICES Interface Configuration, from the program group: "imc" .

At the left there is a tree labeled "*PC*" and below it one entry for each network adapter which uses TCP/IP. The name or IP-address of your PC is usually displayed here. The respective entry can consist of either a domain name or the associated adapter's IP-address. This includes the dial-up network's adapters.

Note — Inactive entries

If all the entries have been set as inactive or there is no entry, your PC is not configured correctly. Exit the program and check all network settings. Subsequently, repeat the configuration.

Reference — Make settings

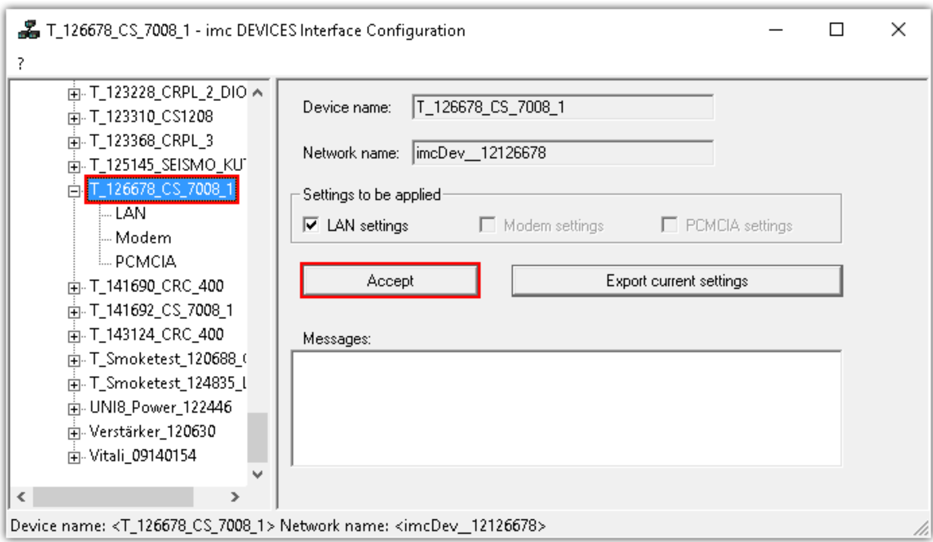
See further:

- Device connection via LAN 59
- Device connection via WLAN 62
- Device connection via Modem (TCP/IP with PPP) 69

Accept changes

The configuration is only written to the respective measurement device once you click on the button "*Accept*".

- After the configuration, select the device again in order to return to the overview.



- In the group "*Settings to be applied*", select the device adapters for which the changes are to be applied.
- In order to write the changes to the measurement device, click on the button: "*Accept*"

Once the configuration has been written to the device, a warm start is carried out so that the new settings take effect. This process requires some time.

Reject changes

To reject all changes, simply exit Interface-Configuration and respond to the prompt "Reject all changes?" with "Yes". If you select "No" for this prompt, the entries you made on the right side of the dialog remain intact. But they will only be applied once you click on the button *Accept*.

Export current settings

For documentation purposes, it is possible to export the interface settings currently applicable in the device to a CFG-file. Import is not available. The device folder is automatically the destination and the suggested file name is the device name with a suffix.

Note

After confirmation "Interface-Configuration" allows, that the subnet mask has a format, that is not common for that network class.
Example: Networks starting with 192 are so called class C networks. They always use the subnet of the format 255.255.255.X. In special situation it is necessary to change the format to 255.255.X.X.

4.3.3 Device connection via LAN

Preparation

Connect the devices to the LAN 43 and switch the devices on.

Note

No devices found

If the devices described below fail to find any devices, check whether your PC and the devices are properly connected to the network and activated.

If finding devices still does not succeed, set up a direct connection to the PC. You should also check whether the Firewall and port 50 setting is preventing a network connection to the device.

DHCP

DHCP (Dynamic Host Configuration Protocol) in conjunction with an appropriate server enables dynamic assignment of an IP address to the devices (see "*DHCP and APIPA* 52").

The devices ship set for DHCP. If an DHCP server is activated in your network, no further manual settings are needed. See your network administrator if you have any questions.

Warning Valid IP address

To set a valid and available IP address for the device in an existing network, be sure to contact your network administrator. If you set an IP address for the device which is already used by another device in the network, the result will be that one of the devices is no longer available in the network.

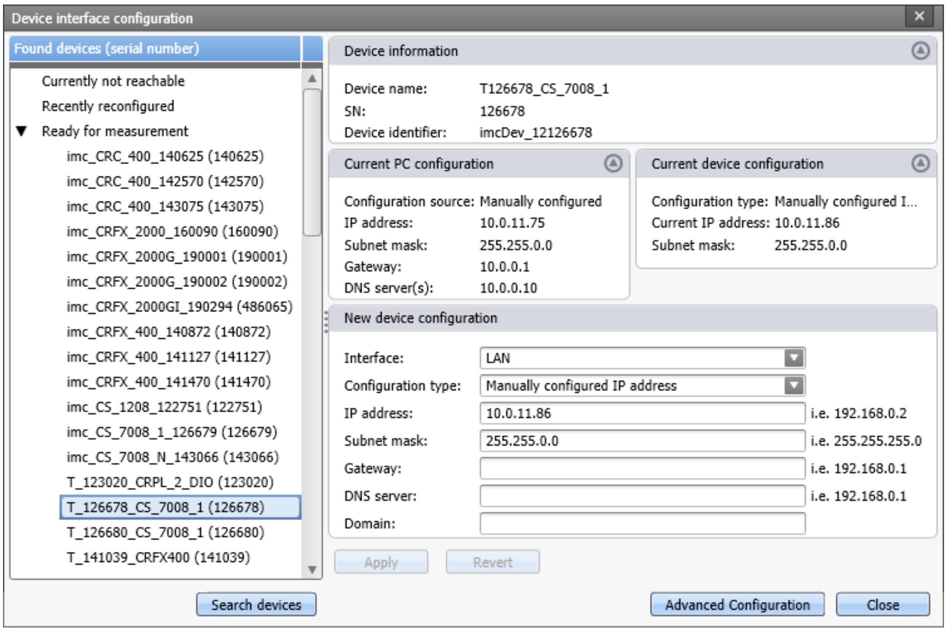
LAN-Configuration with Device Interfaces

Open the dialog for configuring the device IP address by clicking on the button "*Device interfaces*" ().
See "*Start the network configuration - Interface configuration* 53".

Ribbon	View
Setup-Configuration > Device interfaces ()	Complete

Once the dialog starts, the system automatically searches for all devices in the network. In the tree diagram, all available devices are indicated. If the device is found in the group "**Currently not reachable**", you need to configure the LAN settings. If the device is found in the group "**Ready for measurement**", you can retain the current settings or view them.

Select the device.



Display of measurement devices found and of the IP-address

The right-side portion is subdivided into four regions:

Region	Description
Device information	Lists information for identifying the device.
Current PC configuration	Lists the current configuration of the PC-adapter via which the device was found.
Current device configuration	Lists the current configuration of the device adapter.
New device configuration	Here, you can modify the device interface configuration.

Support by a configuration suggestion

This dialog offers support in configuring the interface. If the device's configuration is not appropriate for the PC, an appropriate configuration is found and suggested. Suggestions appear in "green" shade.

Note	Check the suggestion

Please check the suggestion exactly! Do not accept the suggestion without first verifying the IP-address: Is it a valid and available IP-address?

Subject to the PC-configuration, the next free IP-address is offered as the suggestion. Free IP-addresses might be occupied by devices which are currently switched off. In most cases, the suggested configuration can be used for a "point-to-point connection", since there are no other devices in the network in this case.

No suitable suggestion:

In some cases it may occur that no IP-address is suggested. For IT reasons, the software is not able to conduct a search across all IP-addresses and only a small number of IP-addresses are checked. If all addresses checked are occupied, no result is returned. If the device is selected once again, a new search is started among other addresses.

If no address is suggested, it is best not to conduct any more searches but rather to manually enter a suitable address.

Procedure

- Select the device
- Check the settings and make the appropriate changes
- To write the changes to the measurement device, click on the button: "*Apply*"

Once the configuration has been written to the device, a warm start is carried out so that the new settings take effect. This process requires some time.

Advanced configuration

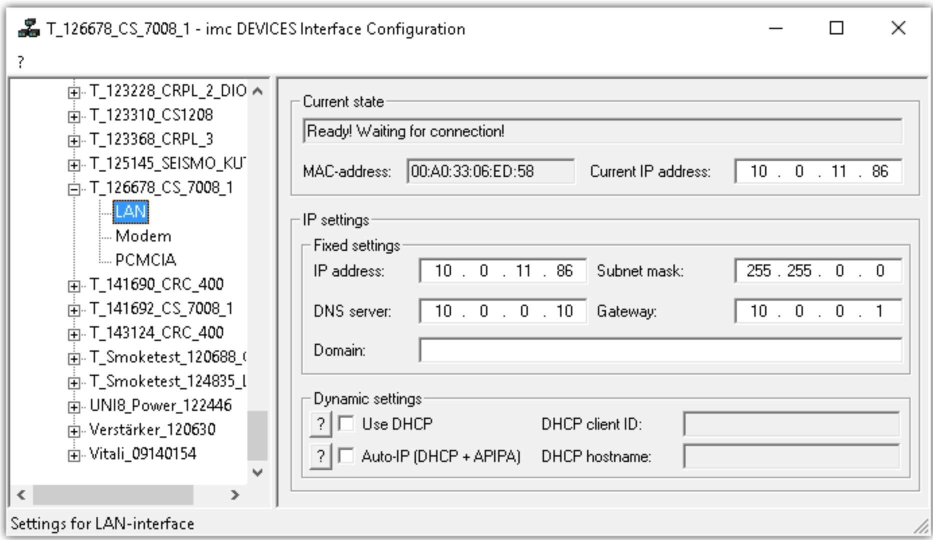
In some networks, configuration via the dialog is not adequate. For instance, it may be possible to activate the device connection via WLAN, but not to configure it. A device connection can not be established via modem (TCP/IP with PPP). In these cases, click on the button: "*Advanced Configuration*". The dialog: "*Interface-Configuration* 59" opens. Follow the instructions for configuring the device interface.

LAN-Configuration with Interface-Configuration

You can adjust the LAN configuration via the "*Interface-Configuration* 54" dialog.

Double-click on the network adapter's entry in order to start an automatic search. Depending on the network and the number of devices connected to it, this can take a while.Then the tree diagram will display all available devices under the adapter.

There, select the device desired and click on the sub-item "*LAN*". You can now see the measurement device's current configuration, as shown below:



TCP/IP configuration

Enter the IP settings in the right-side region.

Region	Description
Current state	Lists the device-adapter's current configuration.
IP settings	Here, you can modify the device interface configuration.

To write the changes to the measurement device, click on the button: "*Accept* 54"

Once the configuration has been written to the device, a warm start is carried out so that the new settings take effect. This process requires some time.

4.3.3.1 TCP/IP, PPP via a router

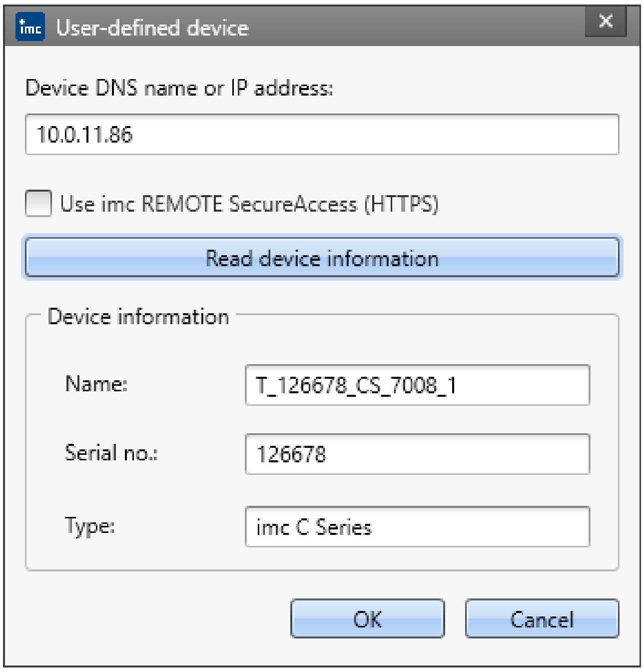
In a structured network (network with routers, Internet, ...), imc devices could not be integrated by means of a network search. With the knowledge of the IP-address or of the domain name (DNS name), it is now possible to integrate a device into the Device Table 296 and to establish a connection.

To do this, run a devices search by IP address or DNS name.

Ribbon	View
Setup-Control > Search for devices by IP/DNS ( )	Complete

Proceed as follows:

1. Open the dialog "Search for devices by IP/DNS".



2. Enter the IP-address or the DNS name.
3. Clicking on the button "*Read device information*" initiates an attempt to establish a connection. If it is successful, then the device's name, its serial number and its product type are displayed and the device can be integrated into the experiment.

Note

If you wish to define a device which is connected to the PC via the Dial-up network, you must first set up the Dial-up connection

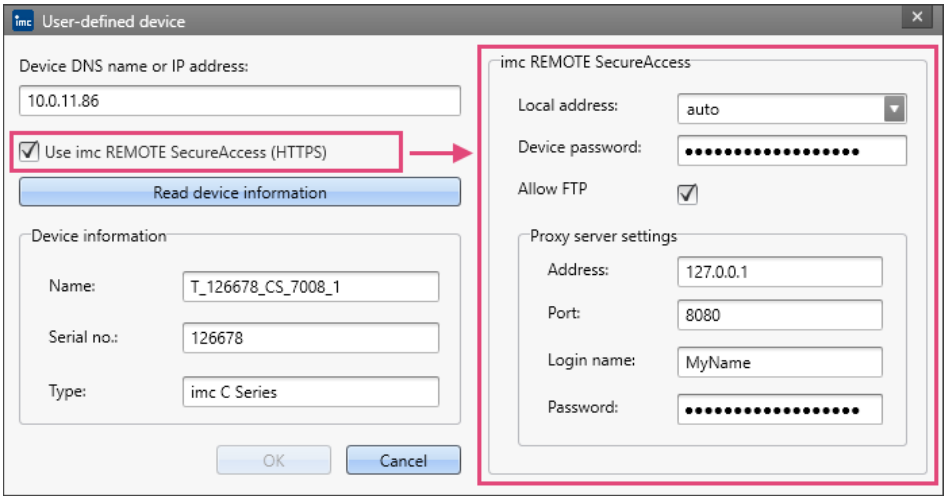
4.3.3.2 Using imc REMOTE SecureAccess

"imc REMOTE SecureAccess" allows direct and secure access to a device, even with activated Firewall.

Note

Only imc devices having serial numbers 14000 and higher are supported, for which the associated activation code has been provided. Note that with this type of connection, data transfer progresses very slowly.

Activation is performed in the dialog "*User-defined device*", as described in the chapter "TCP/IP, PPP via a router 60".



imc REMOTE SecureAccess

Parameter	Description
Local address	Retain the default setting unless you wish to enable other network subscribers access the device via your PC. In this case, enter here the local IP-address via which to provide the remote access.
Device password	If the connection to the device is password-protected 195 in the device properties, enter the password here.
Allow FTP	Allow/forbids FTP via the remote access.
Proxy server settings	
Address	If a proxy server is required in order to connect with the device, enter the server's name or IP-address.
Port	Specify the proxy server's port here.
Login name	If a login is required for access to the proxy server, enter the user name here.
Password	If a login is required for access to the proxy server, enter the password here.

Note Prerequisites

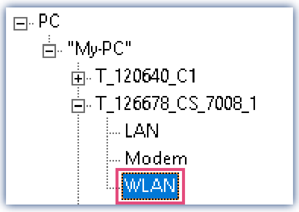
- The option "*imc REMOTE SecureAccess*" must be purchased and is [protected by an activation code](198).
- Only imc devices having serial numbers of 14000 or higher are supported.
- For transfer via a secure https-access, a certificate is necessary, which is provided along with the installation package. This certificate has an expiration date and must be renewed annually. After expiration, the system gives a notification that the certificate is no longer valid. Depending on what your IT-environment's security level settings is, it may or may not be possible to set up a connection to the imc device any longer. In this case, contact the [imc Hotline](10) and your IT-administrator.

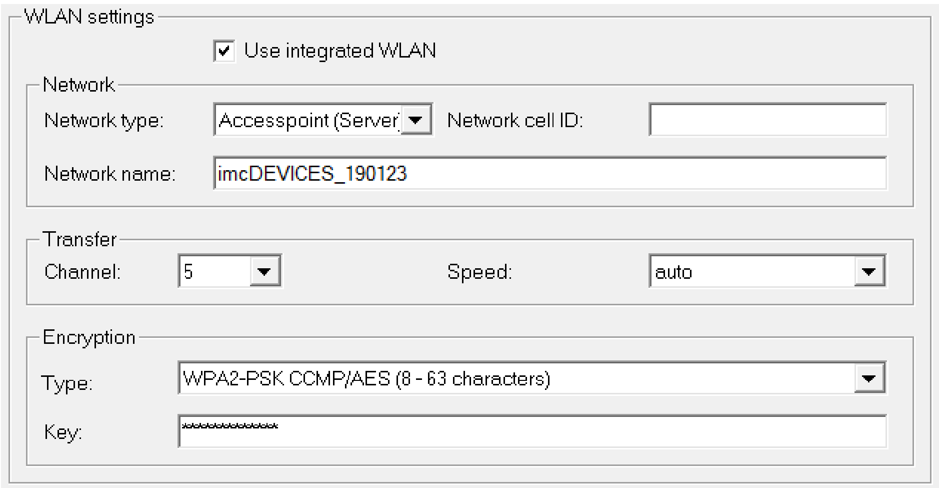
Close imc REMOTE SecureAccess

If you wish to connect the imc directly once again, meaning without the secure access, the device must be re-integrated into your system. This means removing the device from the Device List and adding it again without "imc REMOTE SecureAccess".

4.3.4 Device connection via WLAN

You can adjust the WLAN configuration via the "*[Interface-Configuration](54)*" dialog. There, select the device desired and click on the sub-item WLAN.





Parameter	Description
Network type	*Accesspoint (Server),* if this is offered; otherwise the setting is *Managed (Client)*. The setting *Ad-Hoc* is no longer supported under Windows10.
Network cell ID	This may be required in order to select an Accesspoint (4 hexadecimal characters); otherwise, leave this empty.

Parameter	Description
Network name	Name of the network to which you intend to connect the imc device: • For the network type *Accesspoint (Server)*, the imc-device automatically provides the WLAN name via which the PC connects with it. • For the network type *Managed(Client)*, you must enter here the WLAN-name via which the imc device is to be accessed.
Channel	Channel 1-13 for 2.4 GHz. If the WLAN-module supports 5GHz, there are >36 channels. Observe all national regulations. For instance, in the USA, channels 12 and 13 may not be used.
Speed	The meaning of *auto* depends on the integrated WLAN-card! *11 Mbit/s* ***max*** means that the system attempts to transfer data at 11 Mbit. If the connection is too bad, however, the transfer rate is reduced automatically. With the setting *11 Mbit/s* ***fixed***, the transfer rate is not adapted automatically.
Encryption	The key must be the same for all participants. The exact number of characters set in the combobox must be entered. The setting 104 Bit is called 128 Bit on the PC by many drivers. When changing the encryption type, enter the key again.

Note

- Do not enable "***Use DHCP***" in the "*Dynamic settings*" section if the device operates as an **Access point (Server)**. However, the device does not assign IP addresses! These must be assigned in the same IP address range in the PC-WLAN settings. Make sure that the Subnet-Mask on the PC corresponds to the device.
- If a maximum value has been set for the speed and the connection quality is bad, the speed is adjusted automatically. In consequence of frequent speed adjustments, there may be data overflows. In such a case, set a lower maximum speed.
- The device does not support data exchange between the WLAN connection and the LAN connection. Even if unauthorized access to the WLAN takes place, there is no danger of access to the device via the LAN.
- For devices as of group 4 and higher (SN>13xxxx), up to **54 Mbit/s** can be transmitted. The necessary prerequisite is that the system was commissioned since Summer, 2012
  Attention: For these devices, the WLAN function can no longer be set correctly using older versions of the software.
- For devices as of group 7 and higher (SN>19xxxx) up to **300 Mbit/s** can be transmitted. Therefore *Speed* at *Transfer* must be set to "*auto*". Furthermore the *Network type "Managed*" may be activated and please select as Encryption "*WPA2-PSK CCMP/AES (8-63 characters)*". If you select another encryption, then the speed will be reduced to 54 Mbit/s conforming to the 802.11n Standard.

4.3.4.1 WLAN connection setup possibilities

PC via integrated WLAN - Device via integrated WLAN

Directe connection via integrated WLAN

A working WLAN connection can simplify your work significantly. But a bad WLAN connection can drastically impede your work and in many cases can lead to data overflow. Therefore, you should only use this technology if a stabile connection can be assured. Along with direct integration of WLAN with the devices, there are other options for achieving efficient data transfer with WLAN.

PC via Access Point - Device via integrated WLAN

PC via Access Point - Device via integrated WLAN

The PC is connected with an Access Point. This connection is made either with a cable or a stabile WLAN connection. The Access Point can be chosen in such a way to ensure adequate power supply for a strong antenna.

PC via Access Point - Device via Access Point

PC and device via Access Points

This option is well suited for wireless transmission across especially long and problematic expanses.

At distances of over 30m, we recommend the use of Access Points at both ends. This means that strong, directed antennas can be used whose power supply can be ensured by the choice of appropriate Access Points.

The connection between the Access Point and the PC or the device is made by an cable or stabile WLAN hookup.

In this case, the interface from the PC and the measurement device is configured like a normal LAN connection 56. The cable is replaced by the wireless connection and administered by the Access Points. These must be configured in accordance with the instructions provided for them.

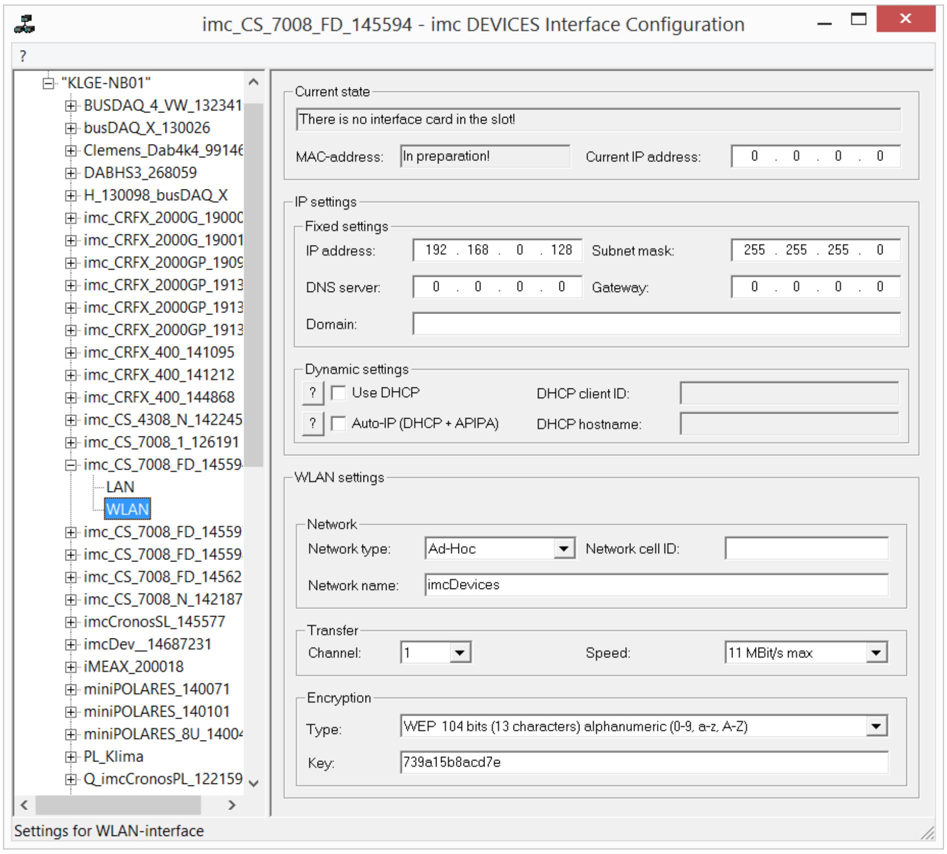
4.3.4.2 Ad-hoc - WLAN and Windows 8.1 / 10

The following solution only applies to imc devices with a WLAN module, which supports Ad-Hoc as network type.

Problem: Under Windows 8.1/10, there is no longer any Ad-hoc connection.

Solution: An "*access point*" is set up using the command prompt ("cmd"), via which the device can be reliably connected.

Configure the WLAN-settings in the device by means of "*Interface Configuration*":

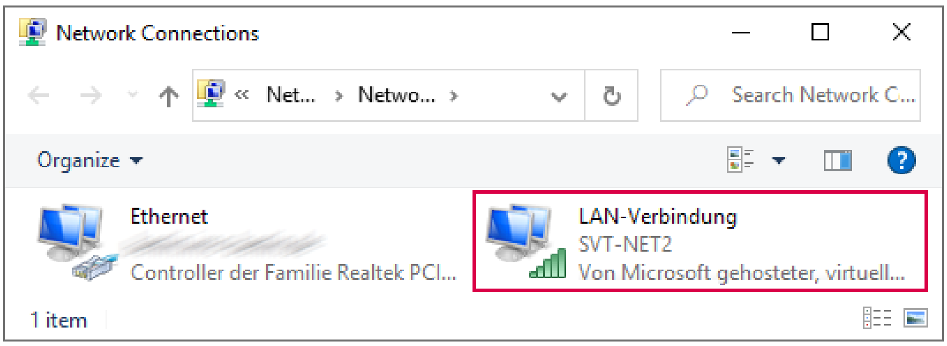


Create an additional LAN-connection:

Open the command line interface ("*cmd*") with admin-privileges. Set the network name and password. You can enter the following, for example:

```
netsh wlan set hostednetwork mode=allow ssid="SVT-NET2" key="0123456789"
netsh wlan start hostednetwork
```

Now an additional connection is available.



Now it should be possible to access the device. In the IP-settings, set an appropriate address for the device, here for example 192.168.0.111. The device can now be found in a device search and connected in the normal way.

Note

After restarting the computer, the connection is no longer available. The two lines can also be written in a batch file. These command lines must then be run with admin rights. The connection settings are then restored. See also the description below of the procedure as a Task.

Creating the batch file and running it via the Task Scheduler

Creating a batch file

Create a text file with these two lines

```
netsh wlan set hostednetwork mode=allow ssid="AP_name " key="Password"
netsh wlan start hostednetwork
```

e.g.

```
netsh wlan set hostednetwork mode=allow ssid="SVT-NET2" key="0123456789"
netsh wlan start hostednetwork
```

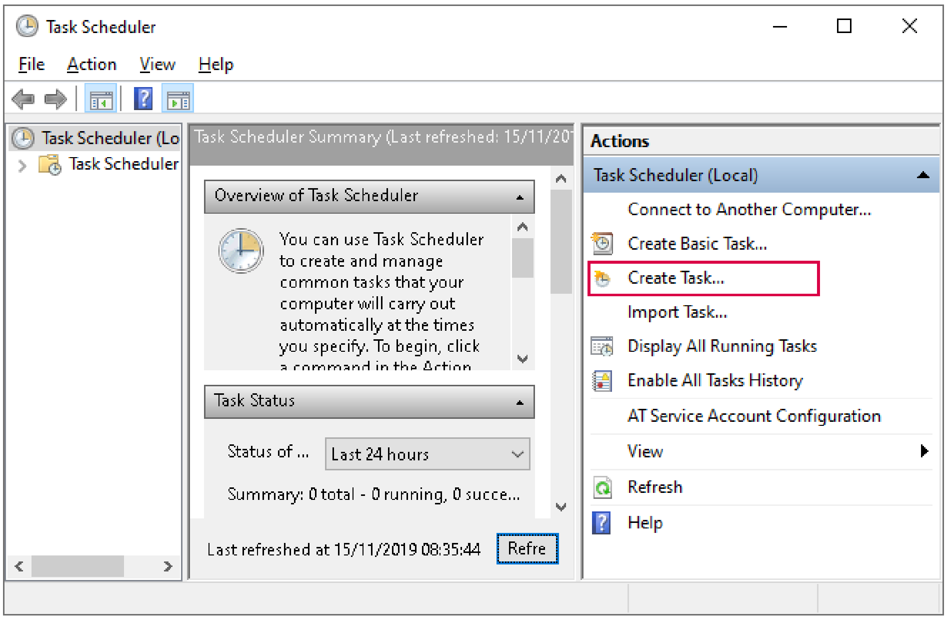
Name this file e.g. "*MyAP*" and give it the extension "*.bat*"

Calling the file via the Task Scheduler

Start the "*Task Scheduler*":

- Open Windows' input box by using the keyboard combination of Windows-key + R `[Win-R]`.
- Enter the following command in the edit box:
  `Taskschd.msc`

Click on "*Create Task*" in the dialog "*Task Scheduler*".



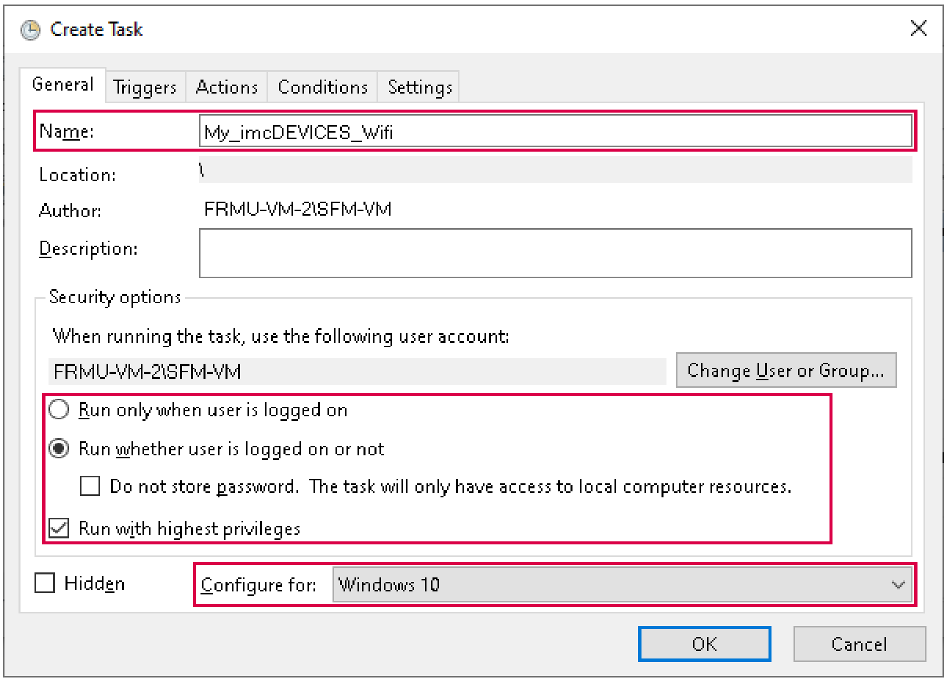
Configure the "*Task*" as follows:

Tab: General

Provide an appropriate name, e.g. "*My_imcDEVICES_Wifi*"

Make the following configuration:

- Checkbox: "*Run whether user is logged on or not*"
- Checkbox: "*Run with highest privileges*"
- "*Configure for*": Here, select your Windows-version: e.g. "*Windows 10*"

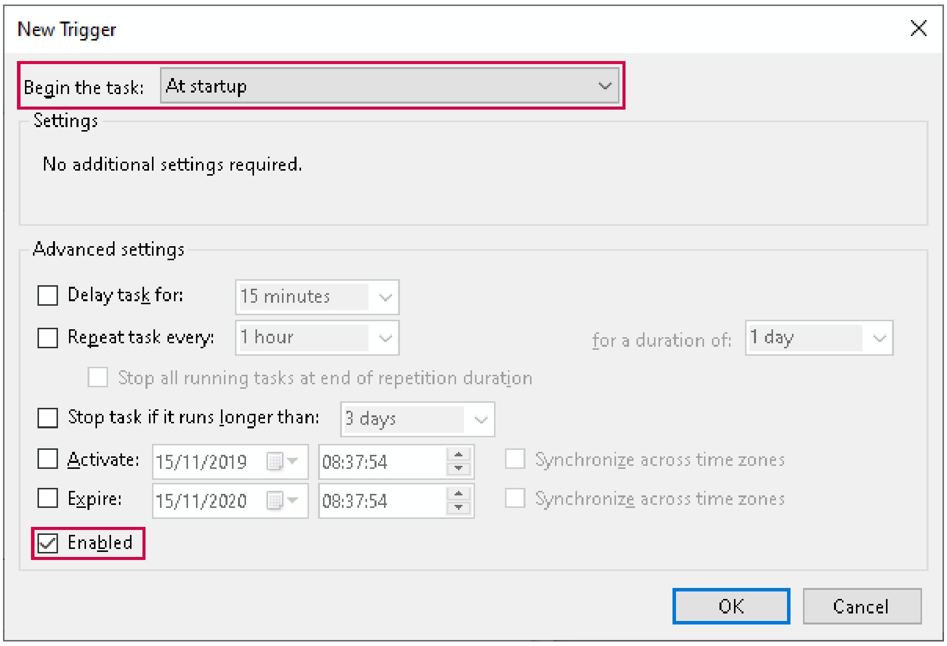


Tab: Trigger

Click on the "*New...*"-button.

Make the following configuration:

- "*Begin the task*": "*At startup*"
- Checkbox: "*Enabled*"

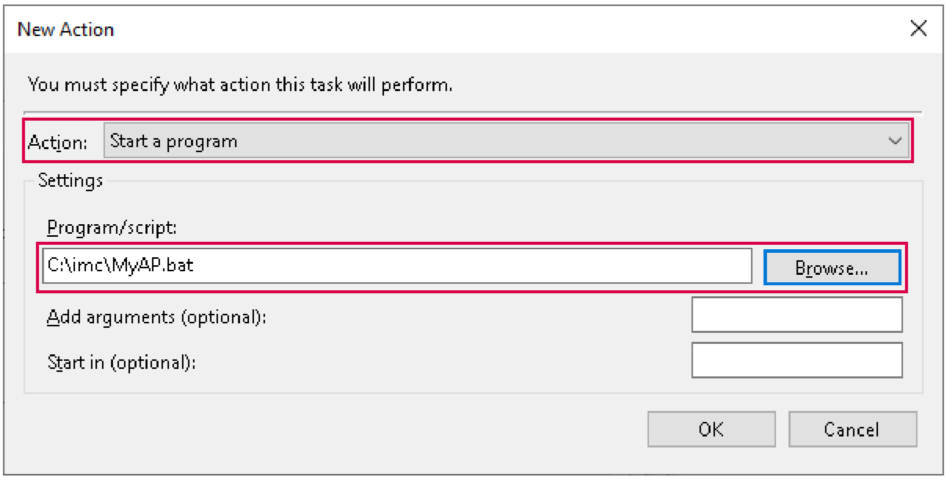


Tab: Actions

Click on the "*New...*"-button.

Make the following configuration:

- "*Action*": "*Start a program*"
- "*Program/Script*": Here, select the batch-file created



Tab: Conditions and Settings

Here, deactivate all options.

4.3.5 Device connection via Modem (TCP/IP with PPP)

What is a PPP connection?

The abbreviation PPP means Point–to–Point Protocol. As the name indicates, this protocol concerns single point to single point connection (i.e., one client and one server) as opposed to Ethernet, where any number of subscribers are connected together via the Ethernet-bus. The client is always the one to set up the connection and to register with the server. The server checks the client's authorization and transfers to the client all information necessary for participating in network communication. After this, both parties configure their network interface; a connection then exists between the two. The PPP-protocol manages this preliminary procedure; it does not handle the actual communication! Instead, the PPP-protocol can be viewed as building a sort of "tunnel" between the parties and packaging the actual network communication protocol, for instance TCP/IP.

In a TCP/IP-based network, the individual subscribers are distinguished by their personal IP address. Strictly speaking, the address is not assigned to the PC or device, but to the network interface. After all, if a PC has two Ethernet connections, it can have two IP-addresses.

IP addresses, then, can be assigned not only to Ethernet interfaces but to any network interface which is able to transfer data according to the IP protocol. In this sense, even the WINDOWS Dial-Up Network (with the PPP-option activated) represents an IP interface.

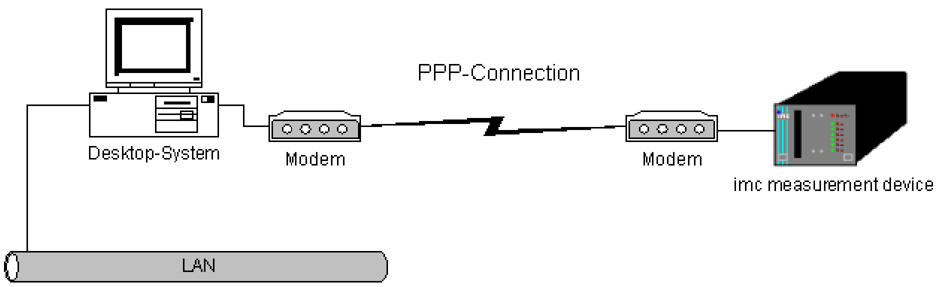
Physically, such point-to-point connections are serial connections. In the simplest case, the two PPP-subscribers are connected via a zero modem cable, but in most cases it is via modems.

Note

- In summary, PPP in conjunction with TCP/IP serves to connect ***one PC with one device*** via a serial modem line. The PPP-connection remains transparent for the network subscribers. The PPP connection is a property of the *Dial-up Network*.
- The following chapter only describes the connection to ***one*** device via modem. Accessing ***multiple*** devices via a router with a SIM card requires setting up a VPN tunnel. That does not require any imc-specific information. Ask your provider or contact an IT service provider who offers this service.

4.3.5.1 Connection via PPP

For connection via PPP, the device needs a serial interface in addition to the Ethernet connection. This serial interface can be connected to a modem. The measurement device is in this case the PPP server, the control-PC the PPP client. That means that the PC calls the device to establish a connection. TCP/IP is used as the network data transfer protocol.



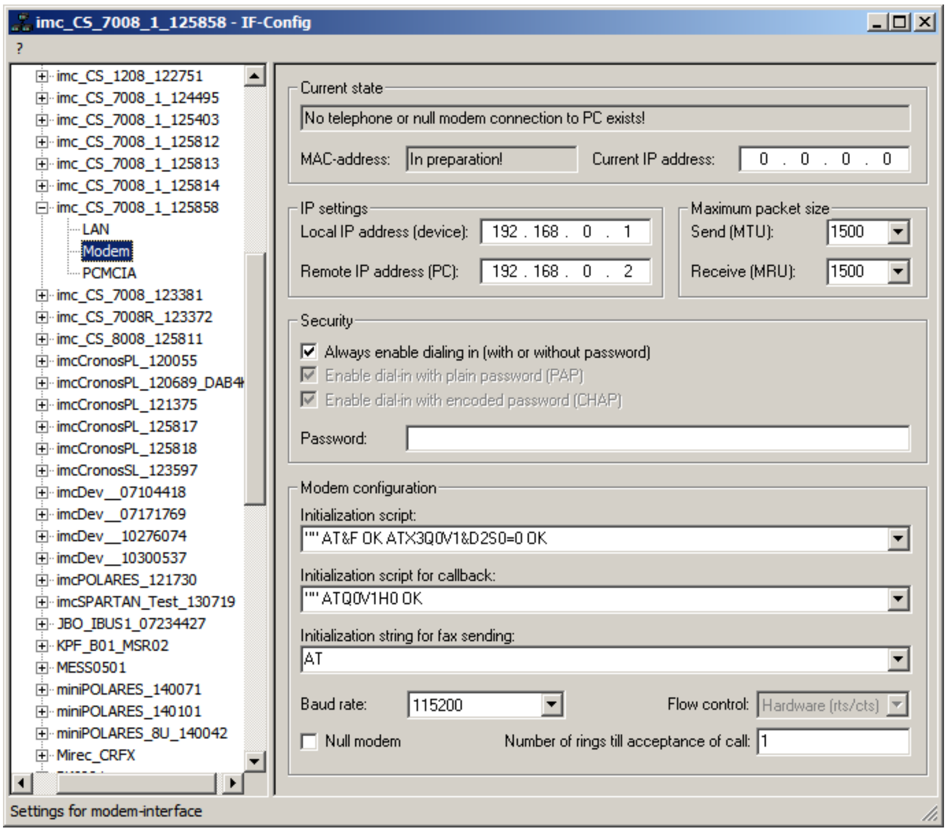
4.3.5.2 Configuring devices as a PPP-Server

The measurement devices can be configured as a PPP-server. For configuring devices, the auxiliary program "*Interface-Configuration*" is provided.

Configuring devices with Interface-Configuration

For the PPP configuration, the device must be connected with the PC via Ethernet. Start the program "*Interface-Configuration*". In the tree diagram, select your device on the left side. Expand the entry for your device and click on the sub-entry *Modem* there.

All of the PPP-settings necessary for operating the device as a PPP-server can be made on the control panel which covers the right side of the screen. For more related info, refer to the section "*Modem settings for TCP/IP devices* 71" of this chapter!



To write the settings to the imc measurement device, simply click on the device's entry on the left side and on the right side on the button *Accept*. First check whether the settings appearing in the box above the button are to be applied, and activate or deactivate them according to your wishes.

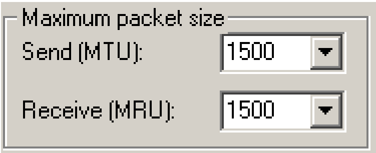
Once the configuration has been written to the unit, the device performs a restart and makes the new settings operative. This process lasts about 1-2min. When the message *Settings have been applied* appears in the *Messages* box the configuration of the device is complete, and you can continue with the next device.

4.3.5.3 Modem settings for TCP/IP devices (PPP)

IP address: Since Windows isn't able to assign an IP-address to the device, an IP-address must be entered in the box *Local IP-address (device).* The second box*, Remote IP-address (PC)* can be left on 0.0.0.0. In this case, an IP-address must be assigned to the caller (PC) by means of the Dial-Up network settings. This IP-address must be located in the same subnet as the address assigned to the device. See also the notes at "Computers with multiple TCP/IP connections 52".

DNS Server: Not needed if there is a direct connection between the PC and unit.

Configuration with Interface-Configuration



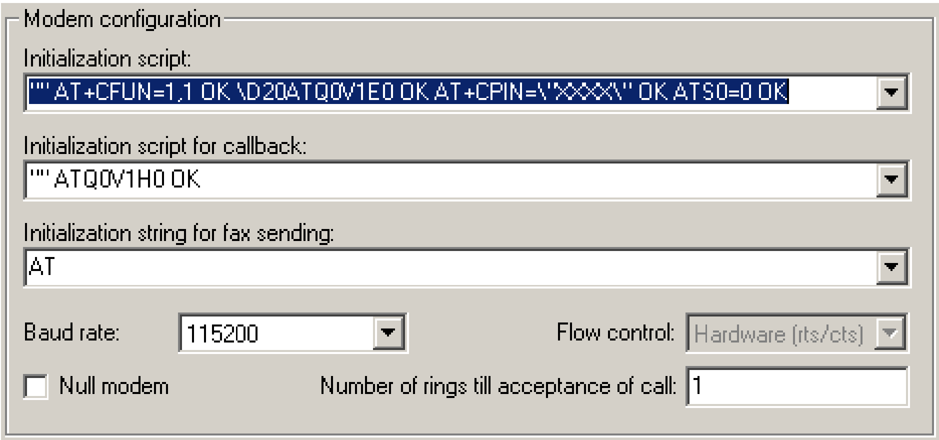
Maximum package size: This option enables the maximum package size to be reduced, in order to improve the data throughput in the face of bad conditions. The default value of *1500* should only be reduced in the case of very bad telephone connections with many CRC errors. CRC errors can be indicated either in the status of the dialup connection or in the system monitor, depending on the Windows version.

In the box ***Security***, it's possible to set a password for setting up the modem connection. By clicking on a checkbox, the corresponding option is activated, which determines in what way the password is to be received. The system later inquires the password before a modem connection can be set up.

- *Always enable dialing in* means that the password protection is deactivated! Anyone who knows the telephone number can dial in, whether they can enter the password or not.
- *Plain password* means that PAP is accepted. In this protocol, the password is transferred in plain text. Therefore, there is a possibility that it could be intercepted. Using such an intercepted password, an intruder could dial into the device.
- *Encoded password* means that CHAP is accepted. In this protocol, no information is transferred from which the password could be derived. Even if an intruder is able to discover an authorized user's response to a password prompt, it's still not possible to abuse the password. Each password prompt demands a totally different response which only can be derived if the original password is known.
- It is possible to enable both PAP and CHAP.
- The password may have up to 32 characters.

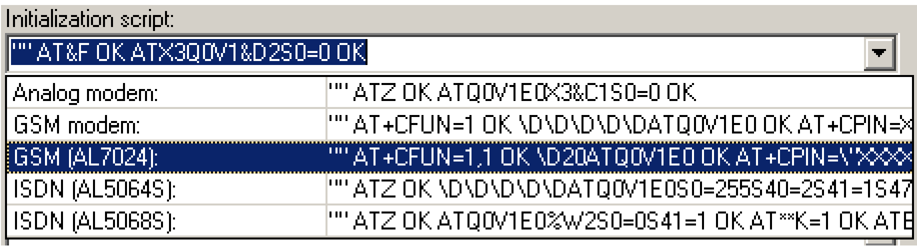
Modem configuration: Here, the *Baud rate* of the PPP interface as well as the *Scripts* are set, which govern the connection setup or disconnection process.

The PPP interface is set up via a serial connection, whose maximum possible Baud rate is 115200 Bd. The flow control of the serial interface is achieved exclusively by means of the hardware protocol. These settings must be the same for both subscribers.

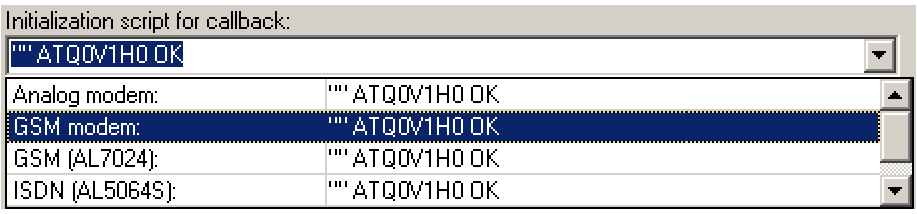


The two initialization scripts consist of a sequence of "Command-response pairs", in which, however, the first step is to await the modem's response. Since a command would normally need to be sent as the first step, the empty quotation marks indicate that there is no command to expect. Then the script proceeds with the next pair; beginning with a command such as "ATZ". And then comes the matching response, such as "OK", etc.

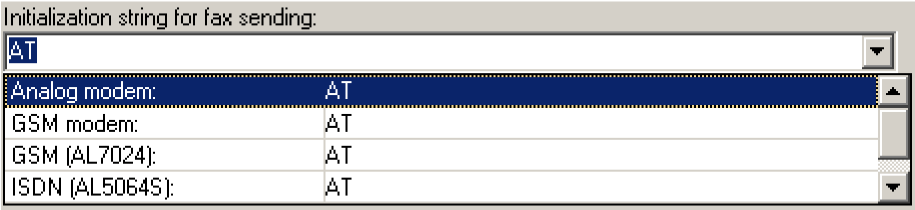
- The *initialization script* can have at most 128 characters. Its purpose is to carry out the basic initialization of the modem. If the modem requires special initialization, the appropriate commands should be entered at this point. The combobox already contains examples of the most common ones, which should be enough for most normal cases. For a GSM-modem, only a PIN must be entered.



- The *Initialization script for callback* should not be changed. Up to 64 characters can be entered. The callback function makes it possible to first call the device and then be called back by it.



- The *Initialization string for fax sensing* is a single AT-string of up to 64 characters in length. Therefore this is not a script like the one in other controls! Here you can enter special AT-commands which are needed to set the modem into fax-mode. Most of the time, there should be no reason to change anything here!



- *Number of rings till acceptance of call:* If set to a number, so a user can get the phone, the line can be used for the device and for talking.

If you use a zero modem connection, it is enough to set the check mark for the *Zero modem* control. Otherwise, you select the modem type. To do this, right-click on the little arrow at the end of the line of text, in order to expand the selection (with GSM, replace XXXX with the pin).

COM-Port*:* The PPP-interface is realized via a serial connection. For this purpose, the last dialog page, *COM-Port*, is provided:

The settings to be made are *Baud rate* and *Protocol*. The maximum Baud rate which can be set is 115200 Bd. However, for devices manufactured prior to August, 2003 (no LEDs at the Ethernet interface) it's 57600 Bd. The serial interface then functions by means of a hardware- or software protocol; devices dating from August, 2003 only by means of hardware protocol. These settings must be the same for the modem and the device.

The default values are:

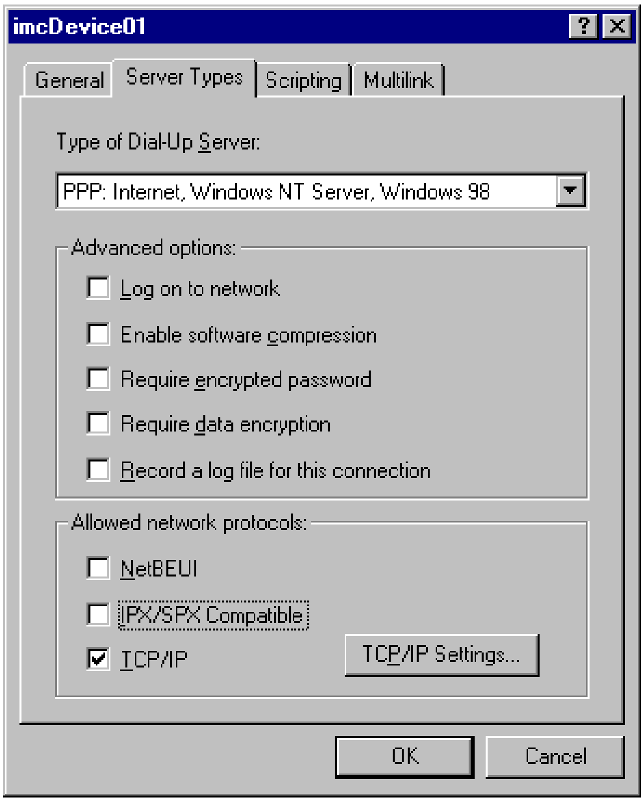
Baud rate	*max 115200 Bd./57600 Bd*
Protocol	*Hardware*

To use a hardware flow control, a cable is needed which is connected to these lines. This isn't always the case with zero modem cables.

4.3.5.4 Configuring a PC as a PPP-client

In order to use the Windows PC as a PPP-client, the following conditions must be met:

- A modem is connected to the PC,
- It is installed under Windows,
- The Dial-Up network under Windows was installed.

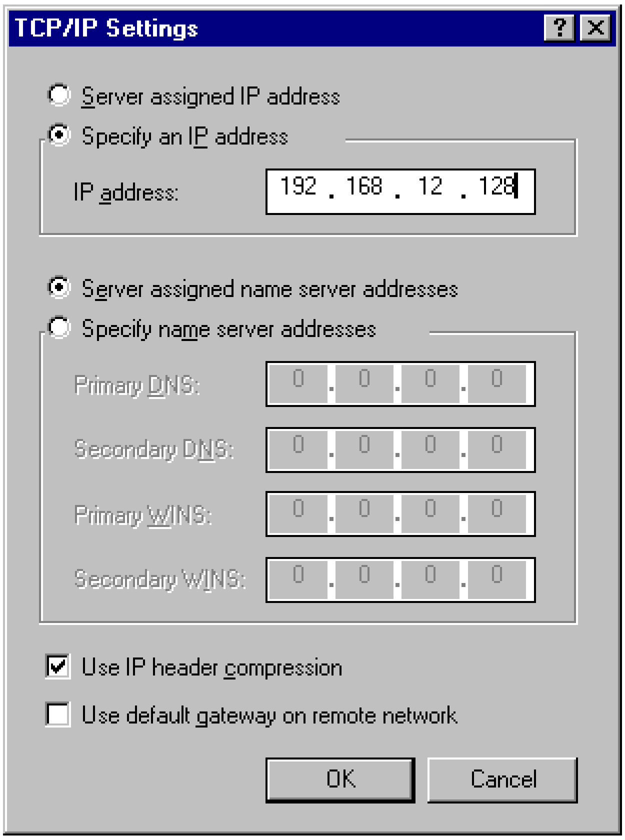


In order to be able to set up a direct connection (without a modem) between the device and the PC by way of a null modem cable, this "null modem" must also be installed. The installation to select is called, for example in WindowsXP, "Communication cable between two computers". Not all Windows operating systems are designed for such an installation as a default. With a router running under a different operating system, such as Linux, it's possible to set up a connection via a null-modem cable.

Refer to the modem manufacturer's documentation and that of Microsoft Windows for information about installing the modem and the Dial-up network. The following will restrict itself to a few explanations and points on the general procedure which is recommended.

Create a new connection. Enter the telephone number of the device's modem. Then the Dial-up Network's properties can be edited. The following illustrations show the recommended default configuration, which should always work. Only the IP-address must be entered according to the user's own needs. The dialogs shown come from Windows98. In other versions of Windows, the dialogs look different, but are used in an analogous way.

Some additional notes on configuration:



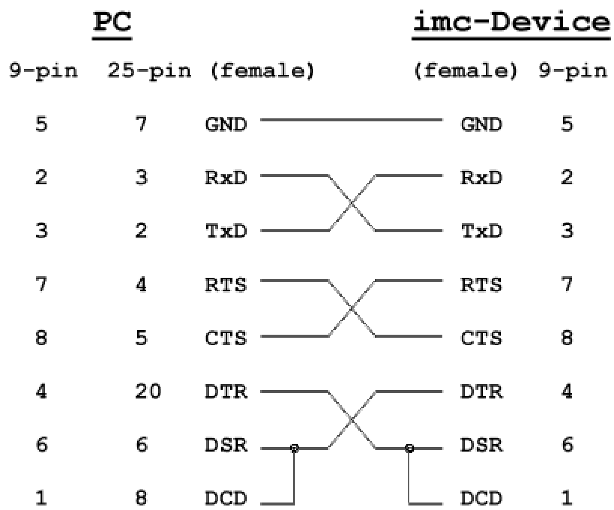
- **Protocol**: Select only TCP/IP! Deselect all other protocols.
- **IP-address**: The instructions above configure the device as a PPP server in such a way that the PPP interface on the PC has a fixed address. For this reason, an unambiguous address which identifies the Dial-up Network as a TCP/IP network interface on the local PC must be specified. If the computer has an Ethernet adapter, this IP-address may not belong to the same Subnet.
- **Name-Server**: Not needed if there is a direct modem connection between the PC and the unit.
- **Standard-Gateway**: Must be deactivated, since the device is neither an Internetprovider nor router. Otherwise there is a danger that the network will not work on the PC involved!
- **Compression**
- **LCP Expansion**: Not supported by the measurement devices.

4.3.5.5 Making a null modem cable

If you wish to operate your device via a null modem connection, you need the right kind of cable. Below, the required pin configuration is described. There is a distinction between cases where the unit’s counterpart supports Hardware-Handshaking (RTS, CTS) and where it doesn't.

Null modem with Hardware-Handshaking

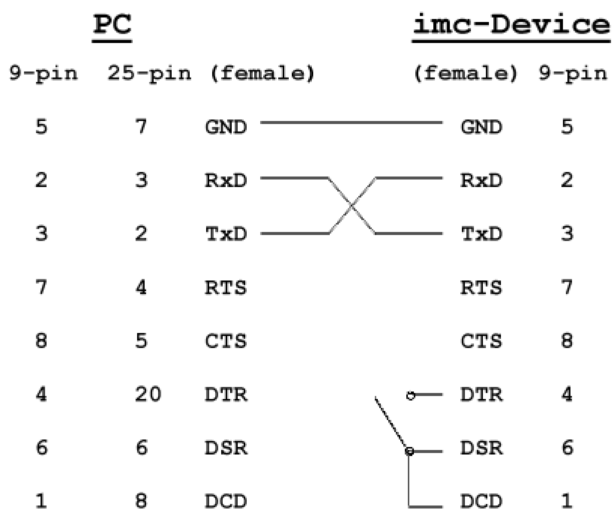
For a null modem cable with Hardware-Handshaking, your cable must be configured like this:



The PC's control line ***D**ata **T**erminal **R**eady* (DTR) instructs the device to wait for a PPP-connection. If this line isn't controlled properly by your PC, you can use the unit’s DTR-signal as a substitute.

Null modem without Hardware-Handshaking

For a null modem connection without hardware handshaking, a three-wire connection is adequate.



In order for the device to be able to enter a PPP-connection, the signals Data Set Ready (DSR) and Data Carrier Detect (DCD) must be connected at the device with the line Data Terminal Ready (DTR). This can happen either right inside the terminal plug or via a switch.

4.3.5.6 Establishing/Disconnecting a PPP Connection

Establishing a PPP connection

As already explained in the introductory passages, a PPP connection actually remains transparent for its subscribers. That means that the imc STUDIO operating software makes no reference to the PPP connection; as far as it is concerned, the connection is of the usual TCP/IP type. In consequence, the PPP connection must first be set up by Windows before the imc STUDIO operating software is started.

To establish the PPP connection, select the icon with the link to the device in the Dial-Up Network which was set up according to the instructions in the last section 71.

After the connection has been successfully established, a TCP/IP connection is ready for the imc STUDIO operating software. Now the operating software can be started, and a network search can be carried out in the manner usual under TCP/IP. After the network search the unit should appear in the list of hardware and can be selected.

Note

In order to use your device via the PPP connection, first set up the connection via the Dial-Up Network, then start the software.

Disconnecting a PPP-connection

First disconnect from the device on the software level (Ribbon: *Home > Disconnect*). Only after this is done, close the modem connection by selecting *Disconnect* in the Dial-Up network. The device then returns to a standby state.

4.3.5.7 Commissioning a radio modem with TCP/IP (PPP)

Falcom A1, A2D-1, A2D-2

Prerequisites:

1. Modem set to 9600Baud (factory setting).
2. HyperTerminal connection settings: 9600, 8bits, no parity, 1 stop bit, no protocol.
3. HyperTerminal connection settings: 115200, 8bits, no parity, 1 stop bit, no protocol.

Preparing the modem:

1. Connect modem to PC via serial cable.
2. Start HyperTerminal connection at 9600Baud.
3. Input: "at" then ENTER. Modem must respond with "OK".
4. Change transfer speed to 115200Baud by entering "at+ipr=115200", then ENTER. Modem must respond with "OK".
5. Start HyperTerminal connection at 115200Baud.
6. Input: "at&f", then ENTER, "at&s0", ENTER, "at+ipr=115200", ENTER, "at&w", ENTER. Modem must respond each time with "OK".

Preparing the device:

The program "Interface-Configuration" is used to make the following changes in the device:

1. The IP-address is set to match the PC's Dial-up entry.
2. For the initialization script, the combobox entry for the GSM-modem is selected.
3. In the command "AT+CPIN=XXXX", XXXX is replaced by the SIM-card’s PIN. If the SIM-card doesn’t require a PIN, "AT+CPIN=XXXX O AT OK" is deleted.
4. The Baud rate is set to 115200.

WaveCom Fastrack

Prerequisites:

1. Modem set to 115200Baud (factory setting).
2. HyperTerminal connection settings: 115200, 8bits, no parity, 1 stop bit, no protocol.

Preparing the modem:

1. Connect modem to PC via serial cable.
2. Start HyperTerminal connection at 115200Baud.
3. Input: "at" then ENTER. Modem must respond with "OK".
4. Input: "at&f", then ENTER, "at&s0", ENTER, "at+ipr=115200", ENTER, "at&w", ENTER. Modem must respond each time with "OK".

Preparing the device:

The program "Interface-Configuration" is used to make the following changes in the device:

1. The IP-address is set to match the PC's Dial-up entry.
2. For the initialization script, the combobox entry for the GSM-modem is selected.
3. In the command "AT+CPIN=XXXX", XXXX is replaced by the SIM-card’s PIN. If the SIM-card doesn’t require a PIN, "AT+CPIN=XXXX O AT OK" is deleted.
4. The Baud rate is set to 115200.

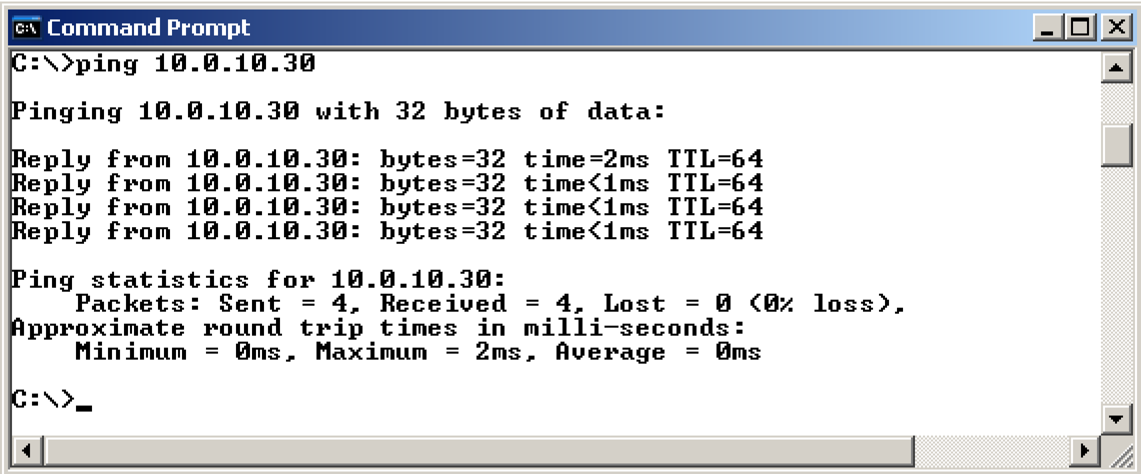
4.3.5.8 Determining the MAC-address of the measurement device

In order to find your imc measurement device’s MAC-address, start the "input prompt" (Keyboard combination [<Win> + R]. Type cmd and confirm by pressing Return).

There, begin by accessing the device with a ping and the IP-address. The IP-address can be found with the help of the program Interface-Configuration 54.

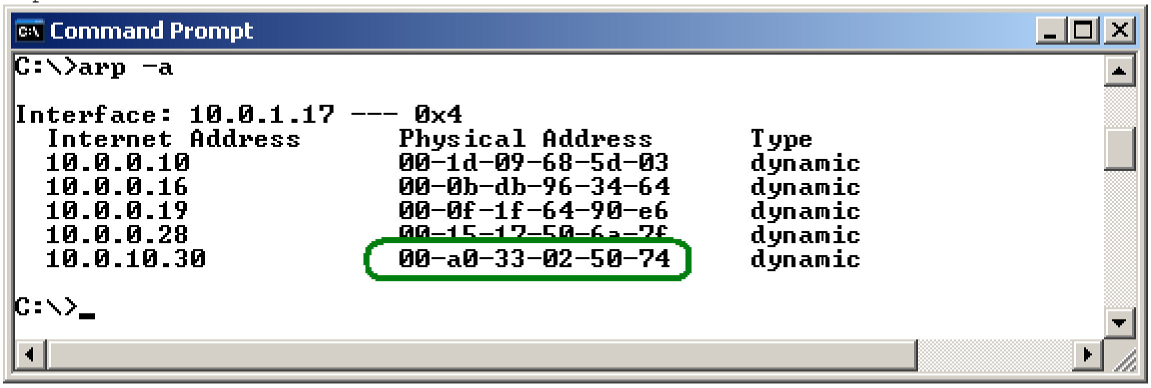
Example for the ping command:

```
ping 10.0.9.30
```



Next, enter the following command:

```
arp -a
```



In the second column ("Physical Address") you will find the MAC-address.

4.3.5.9 Instructions for setting up a PPP-device

1. **PC Control panel > call network**
2. **install TCP/IP Dial-Up adapter**
3. **set IP-address properties if no DNS-server is available**
    a. IP 192.168.12.1 (e.g. imc)
    b. Sub 255.255.255.0
4. **otherwise, configure DNS (normally, this has already been done)**
    a. Host name: name; domain: imc.imc-berlin.de
    b. search order: add 192.168.11.1 to list
    c. Domain imc.imc-berlin.de
5. **Creating a Dial-Up network**
    a. General
        i. phone number
        ii. select modem
            1. General
                a. configuration of COM connection
                b. maximum speed 115200
            2. Settings: Standard
            3. Options: Standard
    b. Server types (win98SE)
        i. Type: PPP
        ii. Options TCP/IP everything else off
            1. TCP/IP settings
                a. permanently set 192.168.12.12
        iii. Script: Standard
        iv. Multilink: Standard

6. **Call Interface-Configuration (from the imc program group)**
   a. Search
   b. Choose device and call PPP settings
   c. IP-Address
      i. Set local address e.g. 192.168.12.13
      ii. Remote IP doesn’t matter
      iii. Username & password if necessary
      iv. Script
         1. Default > don’t change anything
         2. GSM
            Send ATZ\r
            Pause 1
            Send AT+CPIN=XXXX\r
            Pause 20
            Send ATS0=1 \r
            Pause 1
            Signal lcp open
7. **Hardware: Default: 38400; Hardware**
8. **Write to device**
9. **Physically construct modem line**
10. **Set up Dial-Up connection**
11. **If the connection is established, start imc-software**
    a. Choose device > edit
    b. Choose network settings
    c. Click TCP/IP
    d. Activate host address (in this example: 192.168.12.12)

4.4 The Network

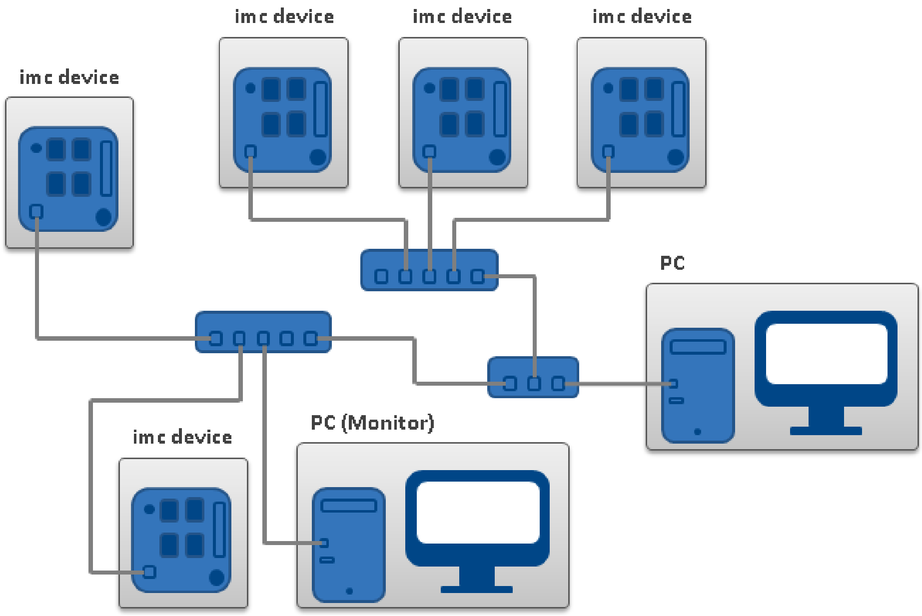
Optimize the network

You should observe the following notes for networks with high data rate, to reduce the risk of a data overflow.

1. The network between switches/hubs and PC should be 1GBit/s
2. The actual data rate is decreasing with the number of channels. Avoid unnecessary channels.
3. The RAM buffer should be as big as possible, not *Auto*. See also RAM buffer time 718.
4. Save only channels you need to the internal disk.
5. Avoid curve window setting that need a lot of performance. Choose scroll mode. Avoid the rezoom function after a long measurement duration. Don't set the sample points to symbols. Try to find a curve window configuration, that shows no bucking.
6. Observe the recommended virus scanner settings 39! It would check every sample written to the hard drive. That takes most of the performance of a PC and the hard drive.
7. Check the processor and network load with the PC task manager

Example of a Complex Network

Theoretically, every type of network can possibly function. Until now, we have only considered networks consisting of a PC and n imc Devices units. However, it is possible for example, to have 3 PC's, two printers and n imc-Devices units connected in a network:



Monitoring

The PC on which imc STUDIO is installed is declared as the Master-PC, which configures the measurement device. Various other clients can access the measuring device via the network (e.g. via imc STUDIO Monitor or imc LINK, or, it is set up accordingly, using a browser via imc REMOTE WebServer).

The well-known network restrictions are also valid here. In particular, it is impossible for more than one person to write to the same file. Furthermore, it is impossible for one person to open a file while another writes to it. In general, all network restrictions that apply to files also apply to the individual Devices units.

In consequence, the software con prevent multiple users from configuring the same device.

Using a second network

To avoid disturbing data transfer between devices units and PC's, a second network using a second network card per PC can be set up. This second network can be used for transferring data between the PC's.

4.5 Firmware Version

The device software (imc STUDIO) always ships with a matching firmware version. The software only works with devices having the right firmware. Upon the connection/preparation, the versions are compared. If they don't match, the firmware update 84 is carried out.

If multiple firmware versions are installed on the PC, then a defined version must be selected for each device. The selection strategy is set in the Options: "*Setup*" > "*Device options*" > "*Selection of the imc DEVICES version*".

Ribbon	View
Extra > Options ( )	all

Option	Description
Selection of the imc DEVICES version	If multiple imc DEVICES versions are installed on the PC, a specific version must be selected for the operation of each device. This option controls the selection strategy. If only one imc DEVICES version is installed, this setting has no effect. • **Manual:** With "**Manual**", the system always asks which firmware version to use when device are selected or an experiment is loaded. • **Automatic:** "**Automatic**" avoids firmware updates. The version currently running on the device is used preferentially. • **Always use latest:** With this selection, the most current firmware version compatible with this imc STUDIO version is always used.

Note — **Use of older firmware**

Please note that a new firmware version not only contains new functions, but also reflects resolved issues. These changes only take effect if the device is also using the new firmware.

FAQ

Question: Which firmware versions support my imc STUDIO version?

Answer: There is a clear assignment regarding the compatibility with the firmware/firmware group:

imc STUDIO version	assigned firmware group
3.0	2.7
4.0	2.8R3
5.0R1	2.8R5
5.0R3	2.8R7
5.0R5+	2.9
5.2	2.10, 2.11, 2.13
...	...

For version 4.0 to 5.0, the applicable rule is: the assigned group and all older **groups up to 2.8R3** are compatible with the imc STUDIO-version used.

Example: the following firmware groups are compatible with imc STUDIO 5.0R1: 2.8R3 and 2.8R5.

As of version 5.2, the applicable rule is: the assigned group and all older **groups up to 2.10** are compatible with the imc STUDIO-version used.

Question: Can devices in the same experiment use different firmware versions?

Answer: Yes. If multiple devices are used, each one may use a different firmware version. Prerequisite: The imc STUDIO-version used supports the firmware versions.

Question: Can I install a new firmware version without changing the imc STUDIO version?

Answer: Yes. Prerequisite: The imc STUDIO version used supports the firmware version.

Question: Is there a way to determine what firmware the device is using?

Answer: Yes.

- On the Setup page: "*Devices* 295", a column can be added: Device firmware
- In the Device properties 194.

4.5.1 Firmware Update

Every software version comes with matching firmware for the hardware. The software only works with devices having the right firmware.

Once the program connects up with the unit, the device's firmware is checked. If the software version doesn't match the device's firmware version, you are asked if you want to perform a firmware-update.

Depending on the device type, the following components are loaded automatically: Interface-firmware (Ethernet, modem, ...), booting program, amplifier firmware, firmware for the signal processors.

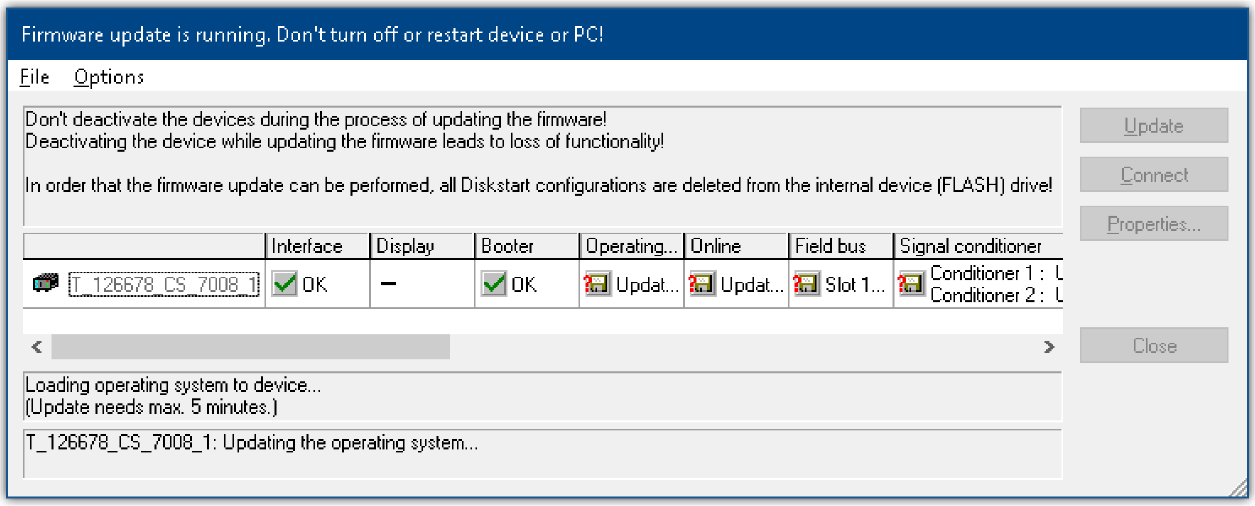
Note

The firmware update is only required if the software was obtained as an update. If you obtained your measurement with the software, no firmware update is necessary.

Warning

Do not under any circumstances deactivate the device during the firmware update.
If any error messages appear during the firmware update, do not switch the device off, but contact the imc Hotline. The firmware update may be continued with guidance from the Hotline.

The dialog for the firmware-update looks like this:



Start of the firmware update (example of a single device)
The state of the components of the firmware is diaplayed in the list.

Component	Description
Interface	Interface-Firmware (Ethernet)
Booter	Start-up program for the device upon switching-on
Operating system	Device operating system
Online	Online-functions and hard drive controller
Display	Operating system of the connected displays 775
Field bus	Field bus
Signal conditioners	Amplifiers

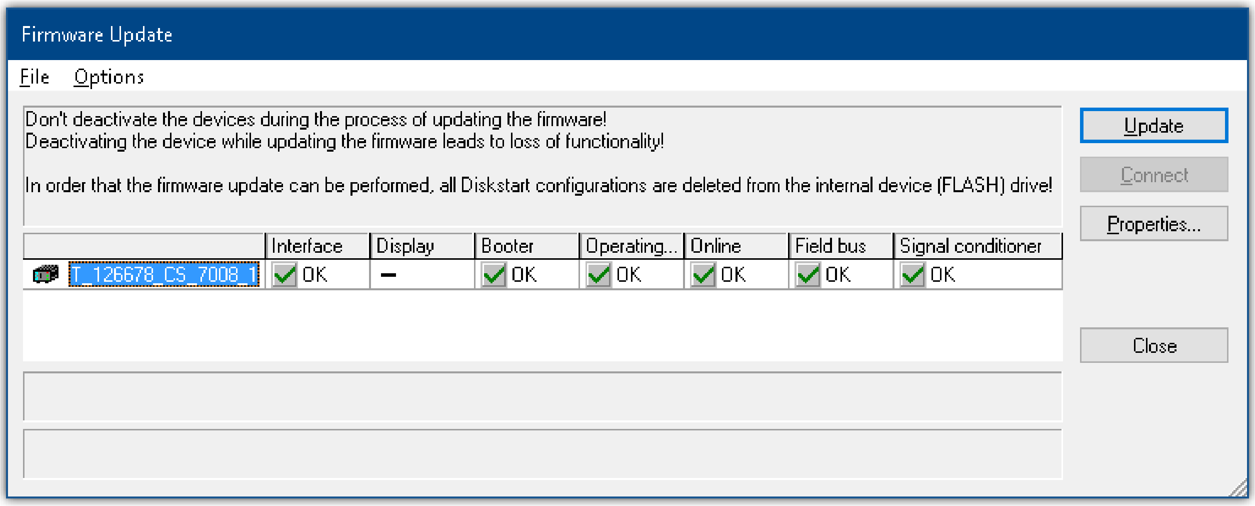
The following symbols for the individual firmware components appear in the list:

Symbols	
	not current
✓	firmware conforms to current standards
!	error occurred during update procedure
—	this option is not available on the device

If no status indicators are displayed, no connection could be made to the corresponding device.

The duration of the update depends on the amount of amplifiers (can last up to several minutes). You will be informed on the progress.

You are notified when the firmware setup concludes successfully, as shown below:



Conclusion of the firmware update (example of a single device)

- Choose "*Close*". The device can now be used with the product software.

Warning — Do not interrupt the firmware update!

Be absolutely certain to observe the following:

1. Under no circumstances should the device or its power supply be deactivated during the firmware update!
2. The network connection may not be interrupted. Use a cable connection, not WLAN!

- For a variety of reasons, the firmware update sometimes does not conclude properly, for example due to interruption of the power supply. For instance, the "handshake signal" at the end of the procedure may be missing. In this case, no measurement channels would be displayed initially. However, restarting the device and its software and performing the firmware update again usually restores everything to normal.
  It may be necessary to call the menu function "Update all components" in the FW-Update dialog's Options menu. This scenario only results in permanent damage in the most rare cases, and it is very worthwhile to repeat the procedure before sending a device in for repair.
- Behaviour under error condition, Windows cuts off the network connection without the user's knowledge; but this can be prevented using the PC's Control Panel.
  Background: During the firmware updates there is no data transfer for a few minutes and thus no network activity; Windows detects inactivity of the connection and the following mechanisms are set in motion:
  a. Windows' energy saving mode switches the LAN adapter off, consequently interrupting the network connection!
  b. Windows switches to the next LAN adapter if there is one (some PCs have multiple adapters in order to, for instance, access SAP or Novell in parallel, which are often running on separate networks.)
  c. Other scenarios are feasible, e.g. if switches are activated, which can also respond to missing data traffic.

If an error message is posted during the firmware update, leave the device on and contact the imc Hotline. It may be possible to continue the firmware-update under the guidance of the Hotline using a service program.

Note

Firmware logbook

The "*File*" menu offers a function for working with the firmware log file. Every action taken during a firmware update plus any errors which may occur are recorded in a log file. This log file can be displayed with menu "*File*" > "*Show log file*".

Update all components

The "*Options*" menu offers the option to "*Update all components*". This makes it possible to earmark all the components of the selected device for an update. The function is only to be used in compliance with instructions from the imc-Hotline.

Calling an update manually

The following function is possible **only in conjunction with the "imc STUDIO Developer" edition**. You need to possess **"imc Developer" user privileges** (with user administration activated)

You can call the Firmware-Update dialog manually.

Ribbon	View
Setup-Configuration > Updating Firmware	Complete

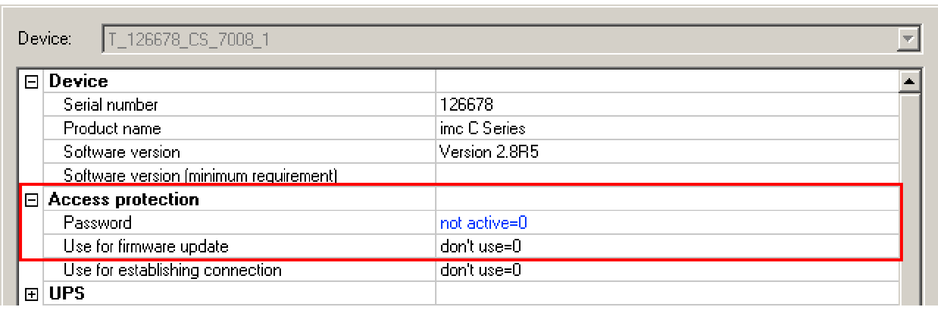
The function is only to be used in compliance with instructions from the imc-Hotline.

Firmware update - Password locking

It is possible to prevent an unintentional firmware update. For this purpose, the "*Access protection*" > "*Password*" and "*Use for firmware update*" control is provided in the "*Device properties dialog*" 194".

Ribbon	View
Setup-Configuration > Device Properties	Complete

No default password is supplied in the manufacturing. When a firmware update is started, the system checks whether firmware updating is enabled in the device configuration; otherwise the firmware update is canceled with an error message.



Blocking / Unblocking of the firmware update

Blocking and unblocking

The firmware update is blocked with a freely defined password. To unblock, you must enter the password which was used to install the blockage. It is only removed if the password is identical with the password saved in the device.

Note A general password is available

Resetting of the password can also be accomplished by a **General password**. This general password is derived from the device's serial number and can be provided by imc if necessary.

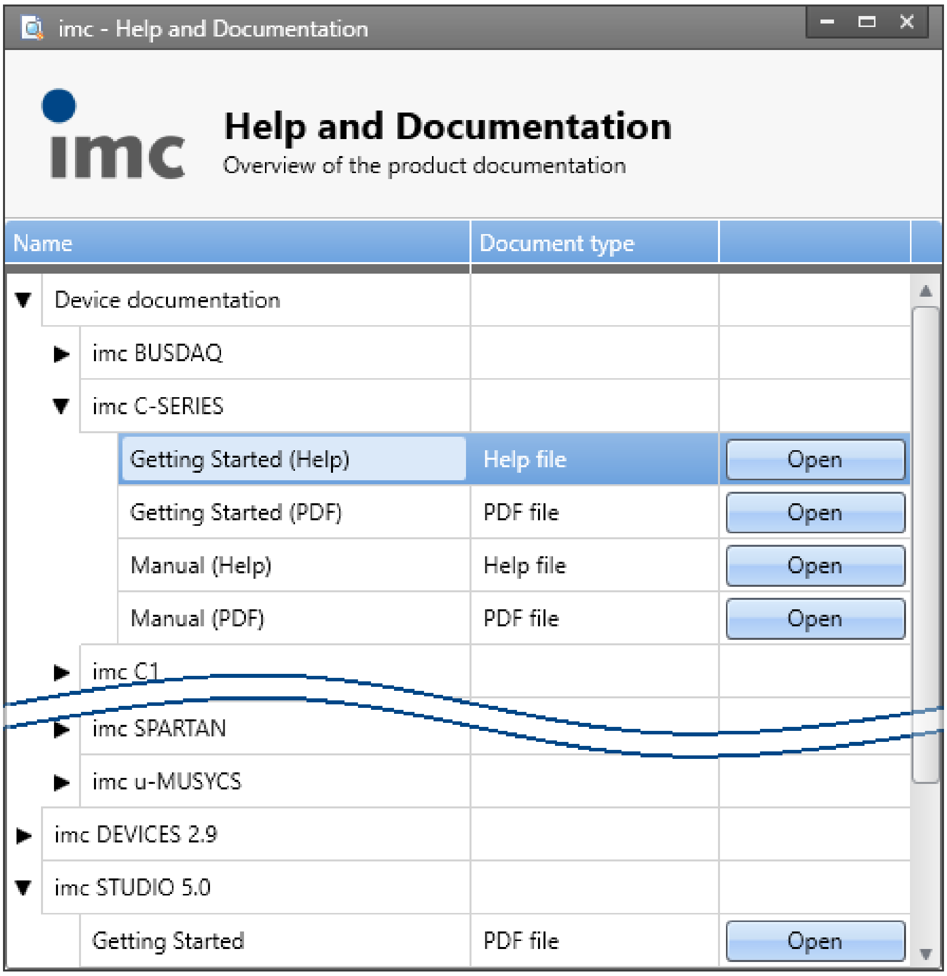
5 Documentation of devices - Document Viewer

This manual is mainly about the device software. Separate documentation is available for each device model. Read this as well in order to obtain optimum utility from your device.

How to find the device manuals?

To do this, use the program "imc Document Viewer" which helps to locate the documents. A few clicks of the mouse will open the desired document. This program is available

- via the Ribbon: "*Help*" > "*Additional Documents*",
- via the Startmenu under the group "*imc*" or
- on the data carrier ("*imc Document Viewer.cmd*")



The "Document Viewer" lists here the imc C-SERIES documents "First Steps" and "Manual" in both PDF and CHM formats.

Note Uninstalling the documentation

The documentation for older, already uninstalled software versions is not deleted automatically. Thus it may happen that multiple manual versions are listed. It is advisable to delete the old versions.

To delete documents manually, start the process of uninstalling the program: "imc Documents". A prompt appears to ask which documents to uninstall.

As long as not all of them are selected, only the selected documents are uninstalled. The program "imc Document Viewer" is only included for uninstallation once the last documentation is uninstalled.

Thus, you will be able to uninstall old document versions without any difficulties.

6 imc STUDIO (general)

imc STUDIO is the **common framework** forming a product package through the combination of modular components (plug-ins).

Which plug-ins are available depends on the product installation (order).

Chapter overview

Synopsis	Chapter
Data storage: How are **data stored** and loaded	• Experiments, Projects and the Database 92 • Ribbon "Project": Open / Save experiments 102 • What is saved where? 142
Navigation through the entire **software**	• Navigation Pane 119
Feedback from imc STUDIO - information, warnings and error reports	• Logbook 122
Limited operability due to disabled user privileges	• User administration and Access rights 126
The software user's interface is flexible. Saving and restoring of views	• Saving / Loading views 135
Support of process automation by means of replaceable text modules	• Placeholders 145

6.1 Experiments, Projects and the Database

This chapter describes the interdependencies among the "*Datenbase*", "*projects*", "*experiment templates*" and "*experiments*".

Experiment

The experiment includes a record of all settings needed for generating the measurement data as well as viewing and evaluating them. The actual measured data are saved with the "experiment" to which they belong.

You can create a variety of experiments to accomplish a corresponding variety of measurement tasks. imc STUDIO always works with exactly one experiment and all changes are saved to it.

Among others, the following settings are saved:

- the experiment file (filename extension: "*.imcStudio"),
- measurement files and metadata,
- various backup files and administration files

Among other things, the experiment file contains all the settings configured in the main windows and in the Setup-Assistants.

Each experiment has a unique name which is set when it is saved 97.

Measurement data

By default, the measured data are saved in the Experiment folder. They belong to the experiment. You specify the data structure in the Device-settings under "*Storage* 298" (Setup page: "*Devices*" > "*Storage*").

Project

A project is primarily a collection of various experiments. The factory settings of imc STUDIO are configured in such a way that only one project is present and that you are aware of it to the minimum extent possible.

All of your experiments are saved in this project ("*StandardProject*").

Some options and configurations are not saved along with the experiment. For instance, they might be saved along with the project and apply to all experiments belonging to the project. In some cases, you can define what has to be saved where. E.g. when generating variables, you can change the validity scope and, for instance, save it not just for that experiment but for all experiments in the project.

Whatever is saved at the Project level (and thus not with the specific experiment) is correspondingly denoted at the locations affected.

A project can include:

- one or more experiments
- one or more experiment templates 100
- project settings (e.g. views, user administration and project-events)

After the first start of imc STUDIO, a standard project is set up in which your experiments are saved.

Project view - working with multiple projects

When you activate "*Project view*", there is a [project-based tree diagram in the Open- and Save-dialogs](96). Here, you can create additional projects and load experiments from other projects.

Note Creating a project resets variables

When you create a new project, the status of the experiment currently open is saved temporarily and reloaded later after the new project has been set up. In consequence, the values of the variables are reset to the condition they would have if the experiment were re-loaded.

In the process, the event "*Experiment_Loaded*" is not triggered. If you need this to happen for your experiment, please re-load it manually.

If you save your experiment with the new project ("*Save As*"), something similar happens. Here, too, the variables are reset, but additionally the event "*Experiment_Loaded*" is triggered.

You can activate the "*Project view*" in the options (under "*Project Management*" > "*General options*"):

Ribbon	View
Extra > Options ( )	All

Option	Description
Project view activated 113	To create more projects, you must activate the **Project view**. This option is deactivated by default. (Information on Projects 92). There is an extended view available of some dialogs 95. Multiple projects can be created and used. • Only activate the **Project view** if you wish to use and manage multiple experiments in separate projects. • If this function is deactivated, some dialogs are displayed in **simplified form** (e.g. "*Save experiment*" and "*Open experiment*" are **missing Project selection**, for instance).

Datenbank

The database is the data repository for imc STUDIO. Here, the projects and their associated experiments are saved. The database does not have its own settings and configurations.

The folder path for the **database can be freely selected** (in the Options under: "*Project Management*" > "*HDD Settings*").

Ribbon	View
Extra > Options ( )	All

Option	Description
Database folder 114	Here you set where the "**Database**" is to be saved. (Information on Data management 141) The database is not user-dependent. Note that every user who is set up in the system has writing and reading rights for this path.

Database conversion

If the database structure has been changed, you are subsequently notified. One way this can happen is as a result of updating to a new version.

Databases are not downward compatible.

A **conversion-dialog** appears. You can convert the database or have it copied beforehand. After the conversion, the entire **database can no longer be used with the older version**.

In the upper region, the reason why the database does not fit with the current version is noted. E.g., the database may be too new or too old. In the list below, all databases found in the folder selected are listed. The "Status"-bar contains information on the database.

The following approaches are available:

Approach	Description
Select an existing database	Select the appropriate database and click on the button "*Apply*". If it is necessary to **convert the database**, an additional dialog appears. Here, the user is prompted to decide whether to **use the database under a new name**. If you choose: • **no:** the existing database is converted. It can no longer be used with the older version. • **yes** (*recommended*)**:** the database is copied. Enter a name for the new database. Now you have two databases. You will have a backup copy and can continue to use the old database with the old version.
Create a new database	Click on "*Create new*". Enter an appropriate name for the database. It will be created in the folder selected (parallel to any already existing databases).
Change the database's folder	Click on the button "..." next to where the folder is indicated. Select an appropriate folder. Here, select a folder where the database folder is to be created later. Not the database itself. E.g. the default folder: "*C:\Users\Public\Documents*". The database will be created in this folder, e.g. "DB".

Experiment Template

See: Experiment Templates 100

Note — Creating one's own files on an experiment - in the folder "Meta"

You can **create your own files on the experiment**, such as metadata, imc FAMOS-sequences, info-files, ...

To do this, use the **folder: "Meta"**. First create this folder manually in the experiment path. If you save or export the experiment under a different name, all files from the folder "Meta" come along with it.

Reference

See also:

- Structure of and files in the database: "*Data Management* 141"
- What is saved where? 142

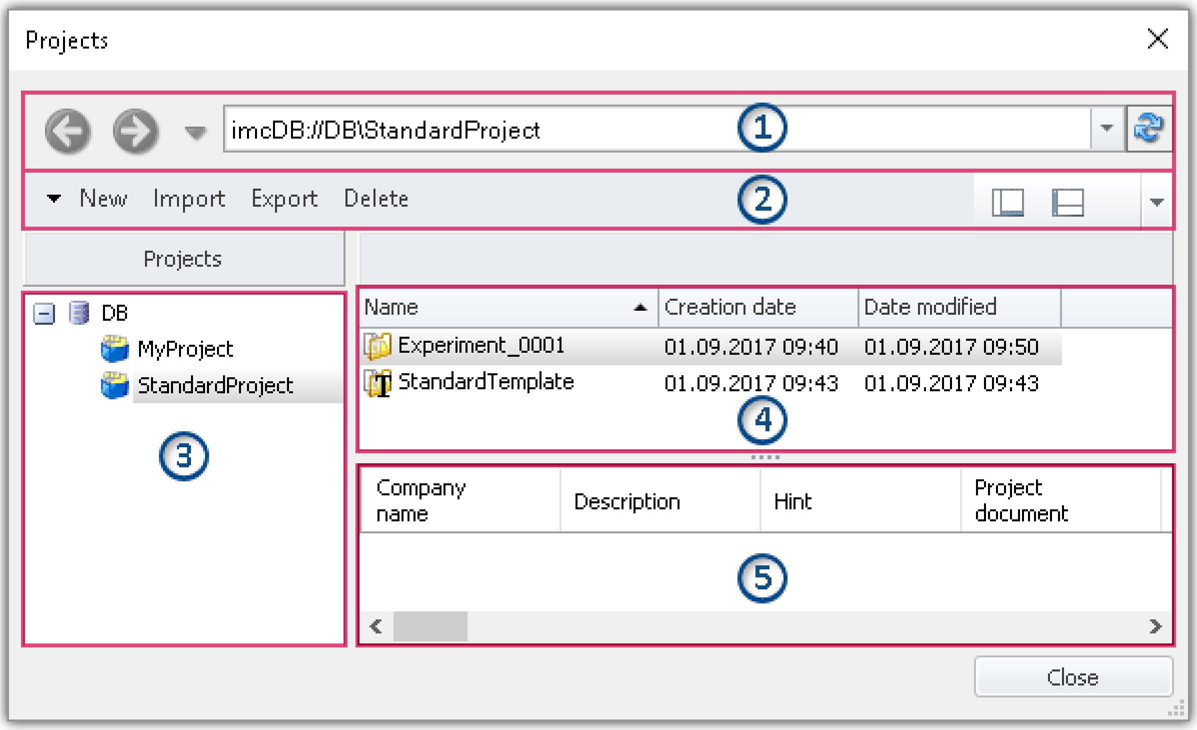
6.1.1 Dialogs: Project and Experiment

The Project Management dialogs are described below:

- with "**Project view**" and
- with "**Experiment templates**".

By default, these options 113 are deactivated, in consequence of which not all functions are available. Options-dependent functions are mentioned explicitly below.

The dialogs following the functions "**Manage Project**", "**New Experiment**", "**Save As**" and "**Open**" are structured similarly. The dialog is described below on the basis of "*Project Management*" as an example. Not all dialogs feature the complete scope of functionality.



Example: Manage project

The dialog is subdivided into five regions (from top to bottom):

1. Address bar
2. Menu bar
3. List of all projects
4. List of all experiments and experiment templates in the selected project
5. Linked metadata information belonging to the selected experiment

By default, the regions 1,2 and 4 are displayed; the others can be activated if desired.

Region 1: Address bar

The address bar displays only the names of the database and the project selected. The bar has no additional functions.

Region 2: Menu bar

Function	Description
New	**Create new project:** Creates a new project in the selected database (a database must be selected). **Create new experiment template:** Creates a new experiment template 100 (a project must be selected).
Import 99	Imports elements (projects, experiments and or experiment templates) from a file in the selected entry. The file can contain multiple elements. You can select either all or individual elements for import. Additionally, the target name can be changed. Be sure to first select the target correctly. You can only import a project if the database is selected. You can only import experiments and experiment templates if a project is selected. You can only import projects if the Project view is activated.
Export 98	Exports the selected entries to a file. Whole projects and individual/multiple experiments and experiment templates can be exported to a file. Manually created folders are not included with the export. The exception is a folder in the experiment path named: "**Meta** 94".
Delete	Deletes the selected entries. Complete projects and individual experiments/experiment templates can be deleted. If you select delete an experiment with saved measurement data, a prompt appears for confirmation that you wish to delete the data.
 / 	Show/Hide Region 3 (list of all projects)
 / 	Show/Hide Region 5 (metadata information)

Regions 3 and 4: List of all projects/experiments and experiment templates

In these two regions, the projects/the experiment and experiment templates are listed. When you select a project, all elements of the project selected are displayed in the region at right.

Region 3 is only displayed if the project view is activated and the region is shown (via the menu button: ).

Region 4 only shows the experiment templates if these are activated.

Region 5: Linked metadata information

The metadata saved with the selected experiment are displayed in this region. When an experiment is saved, the metadata can be saved automatically along with it. In the Options 112 "*Metadata*" > "*Experiment - Metadata*" > "*Setup page*", you can select which source to use for the metadata.

Only shown if the region is shown (via the menu button:).

Reference | Specialties

Dialog: New experiment

See: Creating an experiment 97

Dialog: Manage Project

See: Experiment Templates 101

6.1.2 Creating/Saving an Experiment

Each experiment has an identifying name which is specified when it is created/saved. Each name may be used only once per project.

When you create an experiment (ribbon menu item: "*Home*" or "*Project*" > "*New*"), or when you save an experiment under a new name, you are asked for a name. In this case, enter a unique name.

If the "Project view 113" is activated, you can additionally select the **target project**.

New Experiment

When you create a **new experiment**, it is generated from an experiment template (see "Experiment template 100").

- If experiment templates are displayed 100, select an experiment template.
- If they are not displayed, the **preferred experiment template** 101 is used automatically (at default: "***StandardTemplate***").

All changes since the last save are discarded if a new experiment is created.

Save experiment as

When you save an experiment under a new name, a new experiment having the current settings is created.

- Measurement data from the existing experiment are not transferred along to the new experiment (exception: if the experiment was previously never saved; in that case a prompt appears to ask whether to include these measured data).
- Files from the folder "Meta" 94 are copied and are available in the new experiment.

6.1.3 Exporting and importing experiments and projects

Using the project- and experiment-dialogs, you can export/import complete projects along with associated experiments and measurement data. On the other side of scale, you can also export/import only the project settings, or individual experiments.

Exporting

The elements selected are exported to a file.

Menu ribbon	View
Start > Open ()	All
Start > Save as... ()	All
Project > Manage Project ()	Complete
Project > Open ()	Complete
Project > Save as... ()	Complete

Procedure: Select the elements you wish to export, e.g. two experiments. Click on "*Export*".

A dialog appears in which you can select what to package in the "*imcStudioExport*-file". Confirm your selection and select an appropriate destination.

Selection	Description
Project-settings	(Only when exporting projects) All projects selected are exported
Experiment-settings	Project-export: All experiments saved with the project are exported Experiment-export: All experiments selected are exported
Data	Among other items, the experiment's measurement data are included with the export (caution: the file can become very large)

Note Metadata

Manually created folders are not included with the export. The exception is a folder in the experiment path named: "Meta 94".

Importing

You can import previously exported projects or experiments by means of the Project-/Experiment-dialog.

Menu ribbon	View
Start > Open ( )	All
Project > Manage Project ( )	Complete
Project > Open ( )	Complete

Procedure: First select the location to which to import the content. Next, click on the "*Import*"-button and select the file desired.

The "*imcStudioExport*-file" may contain multiple elements. You can select either all or only individual elements for import. Additionally, the target name can be edited.

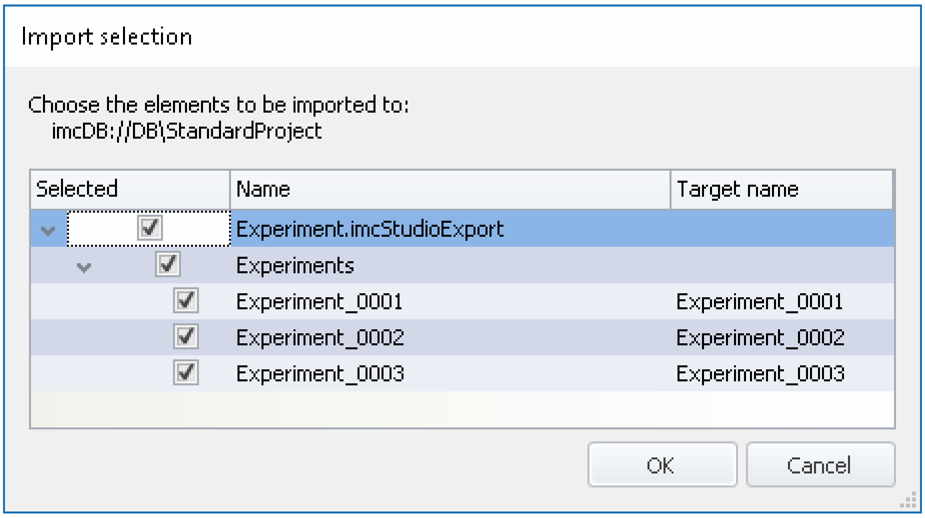
In the first dialog, select the main elements to import (which projects or which experiments). When exporting projects, the individual projects are shown; when importing experiments, the various experiments are shown. In the column "*Target name*" you can edit the name.

Be sure that you previously select the target correctly.

You can import a project if the database is selected.

Experiments, if a project is selected.

Notes: You can only import projects if the Project-view is activated.



Confirm your selection.

Subsequently, another dialog appears (as for the Export procedure), where you can set which additional elements to import from the file.

Selection	Description
Project-settings	(Only when importing projects) All projects selected are imported
Experiment-settings	Project-import: All experiments saved with the project are imported
	Experiment-import: All experiments are imported from the file
Data	Among other items, the experiment's measurement data are included with the import

Be sure that the correct target had been selected previously. You can only import a project if the database is selected. You can only import experiments and experiment templates if a project is selected.

You can only import projects if the Project View is activated.

Note — What happens when importing existing elements

You can import project-settings and experiment-settings without deleting the underlying elements. E.g., you can swap out the project. The underlying experiments remain intact.

Thus, the project can be modified at a developing PC and then imported to the test station.

Only elements having the same name are overwritten.

6.1.4 Experiment Templates

When you create a new experiment, it is generated from an experiment template.

The new experiment contains all properties of the selected template. In templates, all settings which are saved will be saved also in an experiment.

After the first installation or after creating a new project, the project contains an "empty" experiment template.

Making experiment templates visible

To be able to use experiment templates, you must first make **experiment templates visible**. This option is deactivated by default.

- Select from the menu "*Extra*" > "*Options* 110"
- In the Options dialog select "*Project Management*" > "*General options*"

Note

- Only activate this function if you wish to create multiple similar experiments.
- If this function is deactivated, some dialogs are displayed in simplified form (e.g. "**New experiment**" without experiment template selection, among other things).

Creating experiment templates

Ensure that experiment templates are visible.

You can generate experiment templates from a variety of sources:

Source	Description
From present settings	The configuration currently set is used for the template.
From existing experiment	Select an experiment from which to generate the template.
From default settings	An empty template is created.

- Select the project (if the projects are not displayed, click on the white background, in order to avoid selecting an experiment)
- Click on the button: "*Manage Projects*"

Menu ribbon	View
Project > Manage Project ( )	Complete

- In the dialog, click on the menu item: "*New*" > "*Add experiment template*"

- Select a source

The experiment template is created from the source and and is available when creating an experiment 97.

Preferred experiment template

You can **mark** an experiment template **as preferred** (template context menu > "*Set as preferred experiment template*").

If the experiment templates are no longer displayed, the new preferred experiment template is automatically used when a new experiment is created.

6.2 Ribbon

6.2.1 Project Menu

The "**Project**" menu is available in every plug-in.

Some of the dialogs offer an extended view 113. By default, the dialogs are displayed without "**project view**" and "**experiment templates**".

Project

Menu item	Description
Manage Projects 95	Managing projects and experiment templates
Save Project	Saves the current project

Experiment

Menu item	Description
New 97	Creates a new experiment
Open	Opens an existing experiment
Save	Saves the current experiment
Save as 97	Saves the current experiment under a new name. Additionally, the experiment is reset. The variables are assigned the respective initial value (e.g. device variables = "0", or user-defined variables are assigned the respective initial value specified). The event "*Experiment_Loaded*" is triggered.

Im-/Export

Menu item	Description
Import / Export 103	In this dialog you can import and export various components.

Measurement Data

Menu item	Description
Save current Measurement Data Save current Measurement Data as	In addition to the optional automatic data saving, you can also perform targeted saving of the data currently in the PC (Current measurement) either during or subsequent to the measurement. See also Setup - Advanced Device Functions: "*Storage Options and Directory Structure*" > "*Controlling Data Storage*" > "*Targeted Data Saving, or Saving Subsequent to Measurement* 733"

Note — Without imc STUDIO Project Management

In the product configuration, the component "**imc STUDIO Project Management**" can be deactivated. This is always the case in imc STUDIO Monitor, for example.

If "**imc STUDIO Project Management**" is deactivated, a number of limitations apply.

Among others, there is no longer any database. The dialogs for saving and opening experiments match the standardized "Save As"- or "Open"-dialogs. Experiments can be saved at any desired location. The saved measurement data are stored in the designated experiment folder.

The functions of the Project Management are listed in the Technical Spec Sheet.

The description of the Project- and Experiment-dialogs n the following pages pertain to imc STUDIO with activated Project Management.

Changes in the menu without imc STUDIO Project Management:

Project - without Project Management

Menu item	Description
Save Project	Saves the current project. In this case, all "Project"-settings are saved as "Application"-settings and apply for all experiments.

Experiment - without Project Management

Menu item	Description
New experiment	Creates a new experiment. The storage location is first determined by means of "*Save experiment/Save experiment as*". The device currently selected remains selected. However, the device’s configuration will be reset.
Open experiment	Opens an existing experiment. The experiment can be be saved anywhere in the file system.
Save experiment	Saves the current experiment at the storage location previously set using "*Save experiment as*"; if no storage location had been determined yet, "*Save experiment as*" is run automatically.
Save experiment as	Saves the current experiment under an arbitrary name at any location in the file system

6.2.1.1 Import / Export

In this dialog you can import and export various components.

Select the ribbon menu item *Project > Import / Export*.

Option	Description
Parameter set	Enables loading and exporting of values (data pool) and settings (device configuration). Select the desired settings/values. Details are provided in the documentation on the command: "*Import parameters* 1589" and "*Export parameters* 1584".

Option	Description
Views, metadata columns, (sensors,) ... 137	Exports views, metacolumns, ... and sensors set up in imc STUDIO to a file. Or conversely, import views and metadata columns, ... from a file. You can adapt the imc STUDIO user interface, for instance by altering the Setup pages or the tool window. These settings can be saved by means of exporting. in this way, views can be transferred to other projects/applications/PCs.
imc DEVICES experiment 290	Imports the devices configurations of an old imc DEVICES experiment or an imc DEVICES device configuration for a device.
Supplemental files	Supplemental files can be import and exported: • Characteristic curves and filter data for imc Online FAMOS / imc Inline FAMOS (*.dat) • imc Online FAMOS source code (*.ofa) • Synthesizer directory structures (*.dat) • Messaging configurations (e-mail, SMS, UDP, ...) (*.msg) Export: Shows the dialog to manage supplemental files 185, in which you can export in the experiment existing supplemental files. See the description: "*Setup*" > "*Ribbon*" > "*Configuration*" > "*Supplemental Files* 185".
Synthesizer-/controller configuration	Imports synthesizer-/controller configuration.
imc DEVICES adjustment values	Imports adjustment values created with imc DEVICES.
Device descriptions ('<Device name>')	Import: Imports device descriptions (umi files) as new devices in the Setup, a devices had been selected following a device search. Afterward, the device is available for configuration. Export: Exports the device description (umi file) for the device '<Device name>' into a selectable folder.
MFB configuration	Imports ARINC (*.idb), AFDX (*.xml) or CAN (*.cba) configurations.
Panel pages of an imc STUDIO experiment	Imports just the Panel pages of an imc STUDIO experiment without any device configuration data or measured data. Be aware that all pages present will be deleted.
Transfer experiment to other devices 288	Opens an experiment and offers a choice of which devices to use for the experiment.
Setup table description	Imports an exported Setup table description.
Setup column descriptions	Imports an exported Setup column description to an existing table description.
Import sensors	Imports sensors created in imc STUDIO from a view settings file 137.

6.2.2 Edit Menu

The effects of some functions depend on the current main window.

Clipboard

Menu item	Description
Cut	Removes the selection (the selected elements / the highlighted text) to the Clipboard.
Copy	Copies the selection (the selected elements / the highlighted text) to the Clipboard.
Paste	Inserts the Clipboard contents at the position highlighted.

Edit

Menu item	Description
Undo	Reverses the effect of the last change to the current window.
Redo	Restores the previously reversed change to the current window.
Delete	Deletes the selection (e.g. the source text, the Panel-page, the Widgets selected or the selected Automation-element).
Select all	**Panel:** Selects all of the page's Widgets.
Aktualisieren	**Setup:** Metadata columns are updated. This affects file which, for instance, are accessed via a link (such as PDF-files). These are re-loaded if they have changed in the background.

Search

Menu item	Description
Find	Find specific text in the current window. **Automation:** Searches through the source text of all elements and lists all results found in the Search-dialog. It is possible to browse through the individual elements by clicking the mouse (see "*Source Code - Find and Replace* 1488").
Find and Replace	Find and replace specific text in the current window. **Automation:** Searches through the source text of all elements and lists all results found in the Search-dialog. All results located can be replaced here (see "*Source Code - Find and Replace* 1488").

Print

Menu item	Description
Print	**Panel:** Opens the dialog for printing the Panel pages. **Setup:** Creates a printable version of a report of the current configuration. Appearing in the list are multiple device- and channel-configurations, as well as the imc Online FAMOS-source text (see "*Report of the Setup-configuration* 293"). **Automation:** Creates a printable version of a report of the current configuration. There are three available varieties, extending from a broadly outlined structure to the contents with the source text of all elements (see "*Report of Automation-configuration* 1491").
Print Preview	**Panel:** Opens a print preview. Here you can see the possible appearance of printing results. This can be helpful when Widgets such as the curve window are used, which have their own color settings for the printout. **Setup:** Creates a report. See "*Print*". **Automation:** Creates a report. See "*Print*".

6.2.3 View Menu

Views

Menu item	Description
Save View 135	Saves current view Overwrites the used view in the project settings.
Save View as 135	Saves current view in the project settings under a new name freely specified by the user, e.g. "Test Drive 1".
View selection 135	Loads view from the project settings.
Delete View 136	Deletes a saved view from the project settings.
Restore 136	Restores views from the factory settings.

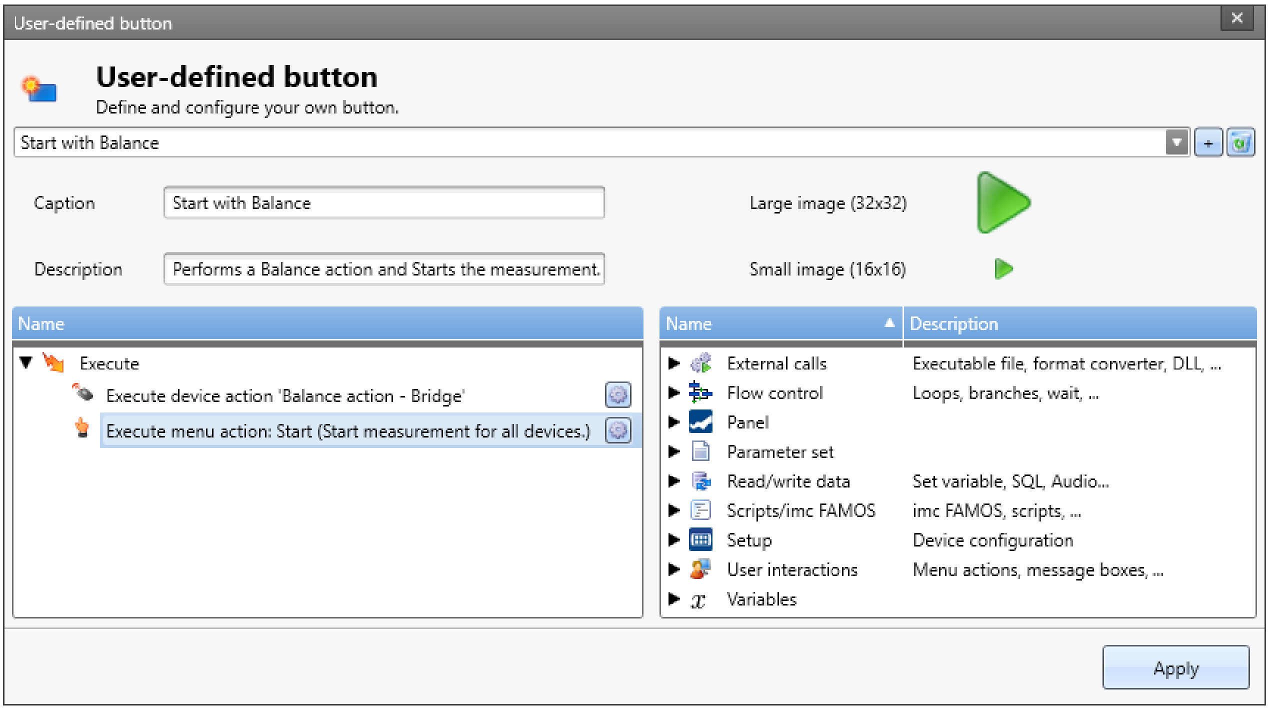
Layout

Menu item	Description
Reset Window Arrangement	This function sets the currently open main window's GUI back to its last saved condition. This affects the window arrangements: • the position and size of the imc STUDIO window • the position and size of the tool window
Customize Ribbon Menu 139	By means of this function the menu ribbon can be customized.
User-defined buttons 108	Creates user-defined buttons which cause commands to be carried out.
Choose Tool Windows	Opens the dialog: "Tool windows chooser 121" in order to show/hide the tool windows.

6.2.3.1 User-defined buttons

You can create your own personal buttons for the menu ribbon. Certain commands are associated with each button, which are run when the respective button is pressed.

The pop-down list contains all user-defined buttons available. The "Caption" of the respective button is used for identifying the button in this list. The list can be used to open existing buttons and to reconfigure/delete them.



Example of a user-defined button:
this one performs a channel balance and then starts measurement

Adding a new button

Click on the "+"-symbol to create a new button.

Configure the display in the button's menu ribbon:

- Caption: the displayed caption in the menu ribbon
- Description: die Information in the button's tool-tip
- Image: the icon in the menu ribbon for the large and the small variants

Command configuration

Below, there are two areas:

- At left, the commands to be run
- At right, the available commands

Use the Drag&Drop technique to add commands to the list at left and configure the commands accordingly.

Deleting a command

If you wish to delete a command from the list, select it and click on the <Del>-key.

Adding a button to the menu ribbon

Click on the button "Apply". In consequence, the dialog for modifying the menu ribbon appears, but its scope is limited to the user-defined buttons. Add the button at the desired location in the menu ribbon. Information on this topic is presented in the chapter: "*Customize ribbon* 139".

Note	Saving the button's configuration

The **configuration of the buttons** is saved 142 with the respective **project**. Thus, the button is available in all of the project's experiments.

The configuration **is only saved** whenever the **project is saved**.

The display in the button's menu ribbon is saved with the view.

6.2.4 Extra Menu

The content of the menu "**Extra**" depends on what plug-ins are included.

Options

Menu item	Description
Options 110	General options
Metadata Assistant 246	Using the Metadata Assistant, you can save metadata from the Setup along with a saved measurement or also save them directly to the channel file.

User Administration

Menu item	Description
Login 131	Logs in a user
Logout 131	Logs a user out
Administration 127	Sets up a user and assigns them to user groups
User access rights 134	Assigns rights to user groups
Startup behavior 130	For setting imc STUDIO's startup behavior

Sequencer

Menu item	Description
Start (Sequencer)	Starts the Sequencer. For more info see the description of the plug-in Sequencer 1524
Stop (Sequencer)	Stops the Sequencer. For more info see the description of the plug-in Sequencer 1524

6.2.4.1 Options

In this dialog you can make fundamental settings for the individual components.

Where are the options saved?

The individual options each have different storage locations. Some are saved with the project, others belong to the entire application (the imc STUDIO installation). A diskette-symbol indicates the storage location:

Scope	Description
Application option	Options which apply for the imc STUDIO installation. The apply for all projects and experiments belonging to the selected database.
Project option	Options applying to all experiments belonging to the current project.

Resetting options

By means of the selection list (at the bottom left), it is possible to reset either all options or individual pages.

Selection	Description
Reset	Resets the **currently opened page** to its **last state**. I.e., back to the settings which applied at the time the dialog was opened.
Reset All	Resets the options for **all pages** to their **last state**. I.e., back to the settings which applied at the time the dialog was opened.
Default	Resets the **currently opened page** to the **factory settings**. I.e., back to the settings which applied upon installation of the system.
Default All	Resets the options for **all pages** to **factory settings**. I.e., back to the settings which applied upon installation of the system.

Commands

E-mail options

Default values for the Mail-command. As long as no other settings are made in the corresponding command, these default values are used.

Please obtain the necessary settings values from your E-Mail provider.

Options - Mail options	Description
Mail server (SMTP)	Outgoing mail server of the E-Mail provider used.
Password	Password for authentication.
Port	SMTP server port used.
Postfix	This postfix will be appended to every email.
Sender name	The name of the sender of the email (your name).
Sender address	Sender address (your email address).
User	User name for logging in.

Data Browser

General options

Options	Description
Automatic loading on demand	Measurements are loaded automatically if your variables are linked to a Widget on a Panel page.
Grouping by categories	The variables are grouped in the Data Browser according to their respective categories (e.g. "Analog inputs", "User-defined variables"). This can be deactivated in order to sort the variables by their names. You can create your own groups by naming the variables according to the following syntax: "Group.Name". For instance, if there are two channels: MeasPoint1.Temperature and MeasPoint1.Voltage, these variables are automatically grouped in the group: "MeasPoint1".
Display filter list	Enables filters to be defined which filter according to the channel name and to metadata. The filters defined are listed in the Filter List in the Data Browser and are available for selection there.
Save the assignment of the measurement number	If a measurement number is assigned to a measurement, the assignment is saved with the experiment.

General options

Default dialog options

Here it is possible to specify default answers for dialog queries. If a value other than "Show dialog" is selected, the dialog is not shown and instead the selected answer is used.

Logbook

Logbook

Options - Logbook	Description
Delete Logbook-files [days]	After the specified number of days elapse, the logbook files are deleted automatically. The deletion verification test is performed upon starting the program and at 0:00 (12 AM).
Default settings for the filters in the logbook tool window	Category of messages for which the filter presets are to be made.
Open logbook in response to a report of category:	For this category, the logbook is opened and attached.

Metadata

General Options

Options - Experiment - Metadata	Description
Export upon saving	Activates/deactivates automated export of the selected Setup page to the experiment. The export is performed whenever the experiment is saved. For example, in the project management dialogs (e.g. Open Experiment), the parameters saved for the experiment can be displayed (see: "*Dialogs: Project and Experiment in Region 5* 97").
Setup page	Here you define what Setup page to export when saving the experiment.

Panel

General Options

Options - Options	Description
Multi-lingual text input	Enables textual input for computers with other language settings. For example, in this way, Panel pages can be pre-configured for different language settings. If the language set is configured for the respective text, it is displayed. Otherwise, the default language: "English" is displayed.

Navigation

Options - Options	Description
Always link new Widgets to Navigation bar	If this option is activated, newly positioned Widgets are automatically linked with the Navigation bar.
Navigation through all Panel pages	Activates the mode in which the Navigation bar navigates through all Panel pages, including invisible pages.
Post-processing mode as default	Automatically activates the Post-processing mode.
Widgets navigation mode	One can choose which value the Widgets will show. The following possibilities are available: • **Automatic:** While the measurement is running or while working on the current measurement, the Widgets show the **current value**. They show the value at the **slider's position**, whenever one is working on saved measurement data. • **Always show navigation value:** The Widgets always show the value at the **slider's position**. • **Always show current value:** The Widgets always show the **current value**.

Options - View	Description
Datacut tools	Shows the datacut tools. These tools make it possible to setup a datacut, mark an interval and process it.
Post-processing tool	Shows the post-processing tool for activating Postprocessing Mode, which enables you to insert tags in the Report channel at navigation time.
Time controls	Shows advanced time controls on the Navigation Bar. The visible range of the linked curve windows is displayed and can be set for each of the two sides separately.

Panel Widgets

Options - Widget Configuration	Description
Refresh rate of newly created Widgets	Specifies the refresh rate of Widgets which are newly created. If a Widget is created on a Panel page, it is assigned the refresh rate set here.

Project Management

General Options

Options - General	Description
Load measurements	If this option is activated, saved measurements in the Data Browser are displayed.
Project view activated	To create more projects, you must activate the **Project view**. This option is deactivated by default. (Information on Projects 92). There is an extended view available of some dialogs 95. Multiple projects can be created and used. • Only activate the **Project view** if you wish to use and manage multiple experiments in separate projects. • If this function is deactivated, some dialogs are displayed in **simplified form** (e.g. "*Save experiment*" and "*Open experiment*" are **missing Project selection**, for instance).
Traceability of measurements	When Traceability is activated, all experiment settings belonging to the respective measurement are saved separately. Thus, for every measurement, it is possible to retrieve the configuration via the Data Browser. Note: Changes made to the setting only take effect on future measurements.
Show experiment template	In order to be able to use experiment templates, you must previously make the **experiment templates visible**. This option is deactivated by default. (Information on Experiment templates 92) An extended view of certain dialogs 95 is available. Experiment templates can be created and used. • Only activate this function if you wish to create multiple similar experiments. • If this function is deactivated, some dialogs are displayed in **simplified form** (e.g. "*New experiment*" and "*Edit project*" appear **without experiment template selection**).

HDD Settings

Options - General	Description
Database folder	Here you set where the "**Database**" is to be saved. (Information on Data management 141) The database is not user-dependent. Note that every user who is set up in the system has writing and reading rights for this path.

Measurement storage area

Options - Measurement storage area	Description
Use a user-defined measurement storage path	By default, this is the Experiment-path. This denotes the folder in which all measurements are saved (according to the measurement folder structure specified). See also "Setup - Advanced Device Functions": "*Storage Options and Directory Structure*" > "*Controlling Data Storage*" > "*User-defined Measurement Storage Area* 736".
Use a user-defined measurement folder structure	This refers to the structure below the measurement storage folder. For instance, folders are set up here according to the settings for Path naming (e.g. Continuous numbers). See also "Setup - Advanced Device Functions": "*Storage Options and Directory Structure*" > "*Controlling Data Storage*" > "*User-defined Measurement Storage Area* 736".

Scripting

Script options

Reference

See "*Scripting*" > "*Script options* 1844".

Sequencer

General options

Optionen - General	Description
Reduce logbook entries	Reduces the number of logbook entries produced by the Sequencer. The following messages will be suppressed and not be reported to the logbook window or the logbook file: • Starting/Stopping command • Messages regarding loops (for/while) • Messages regarding if and switch

Setup

General

Options - Common	Description
Data storage state after download	The state of the data storage after initialization (download or reconfiguration) of the devices has been performed. • **Like before initialization:** The state does not change in consequence of initialization. • **Data storage suspend:** After initialization, the state is set to: "Data storage suspend". Data storage must be resumed as soon as the incoming measured data need to be saved. • **Data will be saved:** After initialization, the state is always set to: "Data storage running". This option does not replace activation of storage for each channel. Instead, this option regulates the condition of "**Suspend and Resume data storage** 174". Please observe the notes on "Initialization". Once the button has been pressed, initialization is only performed if any change has been made. See "**Download and reconfigure** 171".
Parameter set export - Expanded mode	If set, you can control which columns 1587 will be exported upon parameterset export.

Device options

Options - General	Description
Selection of the firmware version	If multiple imc DEVICES versions are installed on the PC, a specific version must be selected for the operation of each device. This option controls the selection strategy. If only one imc DEVICES version is installed, this setting has no effect. • **Manual:** With "**Manual**", the system always asks which firmware version to use when device are selected or an experiment is loaded. • **Automatic:** "**Automatic**" avoids firmware updates. The version currently running on the device is used preferentially. • **Always use latest:** With this selection, the most current firmware version compatible with this imc STUDIO version is always used.
Show warning for critical parameter changes	Show a warning when a critical parameter value changes, e.g. when changing the supply provided to all of a module's channels. Disabling this option can be particularly useful when using automated procedures such as Sequencer or Scripting, since the warning otherwise pauses the procedure until it has been confirmed.
Time limit for calling device control software [s]	Timeout in seconds for a call to the device control software. If this time elapses, the device control software automatically restarts. This can cause a parts of the configuration to be lost. If the devices are operated over a very slow connection, this value can be increased to ensure correct functioning. The minimum and the default value is 60 seconds.

Options - First selected device	Description
Append device names to the channel names	If this option is activated, when a device is selected, the device name is always appended to the channel name, even when the first device is selected. If the option is deactivated, the device name is only appended as of the second device. This setting only takes effect the next time a device is selected, unless any device was selected previously.

Options - Virtual device clock	Description
Virtual device clock: The virtual clock synchronizes during running measurement with the Master-device’s clock. This is necessary when functions are being used on the PC which require an exact time track (e.g. Video). In networks under high load, good synchronization (between the PC's virtual device clock and the device) is not always possible. When the demands on the network are too high, imc STUDIO posts a corresponding error message when an attempt is made to start measurement. It may be helpful to increase the setting for the Minimum accuracy. See also "Setup pages - Configuring Device": "*Synchronization*" > "*Clock types*" > "*VRTC - Virtual clock on the PC*" 315 ".	
Minimum accuracy [ms]	The option defines the maximum time in milliseconds that the PC's virtual clock may deviate from the device clock. This concerns mainly non imc devices, e.g. video. In case of video a value of 10 ms provides synchronisation of measurement data to video images at 100 frames per second. Too low a value prevents measurement start.

Sensors

Options - Sensor Characteristic Wizard	Description
Adjusting variable editable	Makes the option "Adjusting variable" editable in the Assistant.
Adjusting variable visible	If this option is activated, the option "Adjusting variable" is displayed in the Assistant. The values of the characteristic curve can be imported in reference to the adjusting variable.
Delay editable	Makes the option "Delay" editable in the Assistant.
Delay visible	If this option is activated, the option "Delay" is displayed in the Assistant.
Measurement variable editable	Makes the option "Measurement variable" editable in the Assistant.
Measurement variable visible	If this option is activated, the option "Measurement variable" is displayed in the Assistant. The values for the characteristic curve can be imported in reference to the measurement variable.

Variables

Datapool

Settings for memory use by the imc STUDIO Datapool.

Options - FIFOs	Description
Automatic RAM size	If true, the RAM required for the FIFOs is automatically calculated by imc STUDIO.
Maximum RAM size (MB)	Must be a value between 500-4000. Only evaluated if the automatic calculation of the RAM size is deactivated.

Options - Curve window	Description
Automatic RAM size	If true, the RAM required for the curve window is automatically calculated by imc STUDIO.
Maximum RAM size (MB)	Must be a value between 0-200. Only evaluated if the automatic RAM calculation is deactivated.

Options - Speicher Optionen (PC)	Description
Split up pretrigger data into intervals	If the pretrigger's measured data are located in time across interval boundaries, it is possible to treat the measured data as follows: • **deactivated:** The pretrigger's data all are placed in the first interval (the interval in which the trigger fires) (*default setting*). • **activated:** The pretrigger's data are cut correctly. In this way, interval folders can be created subsequently. See also: "*Setup pages - Configuring Device*" > "*Trigger and Events*" > ... > "*Pretrigger* 410"

Save current Measurement Data

In addition to the optional automatic data saving, you can also perform targeted saving of the data currently in the PC (Current measurement) either during or subsequent to the measurement.

Reference

See also Setup - Advanced Device Functions: "*Storage Options and Directory Structure*" > "*Controlling Data Storage*" > "*Targeted Data Saving, or Saving Subsequent to Measurement* 733".

Save current Measurement Data - Variable export

Define beforehand which file type the command "*Export variable* 1618" is to use for saving the variables. This is only a preset which is set for the command when the variable is selected. You can still modify the file type in the command later. The system will not adopt any file type in the command configuration which the variable does not support.

User-defined variables

These settings are used automatically upon import, conversion, or when setting user-defined variables.

Options - Automatic prefix on variable name according to scope	Description
Scopes (Experiment, Persistent, Project, Sequencer, Temporary)	If true, all variables of the scope will receive a prefix to their name upon creation or conversion.

6.2.5 Help Menu

Internet

Menu item	Description
imc Website	Opens the imc website's Home page. Here, the user is provided with a quick way to contact imc , for example.

Activation

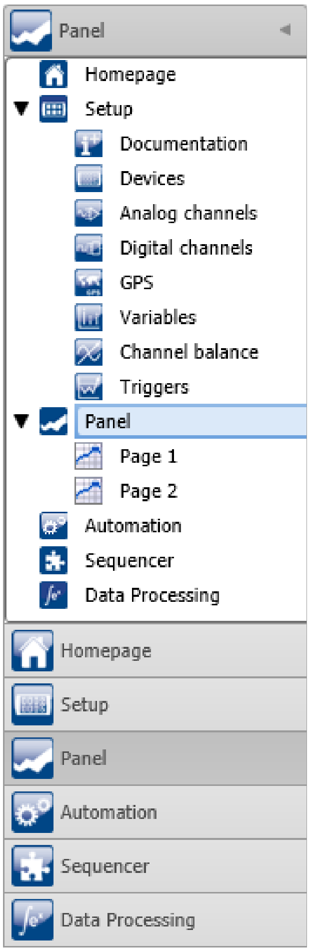
Menu item	Description
Product Configuration	Opens the Product configurator. This allows you to modify the product configuration in order to adapt it to the license you purchased. See "Changing the product configuration 29"
imc LICENSE Manage r	Opens the imc LICENSE Manager. The software licenses are manged by means of the imc LICENSE Manager. If appropriate, customize the licenses here.

Help

Menu item	Description
Help	Opens the "Help" for imc STUDIO.
Additional Documents	Opens the "imc Document Viewer 89". Here you will find documents on the imc devices and other products.
About	Here, all the important "version information 37" on your installation of imc STUDIO is presented.

6.3 Navigation Pane and Quick Access Toolbar

Navigations pane



Maximized Navigation Pane (example)

In the **Navigation pane**, the main windows of the installed plug-ins are displayed as a tree diagram. To open/change the main window, click on its corresponding entry.

The Navigation pane can be opened or closed, maximized and minimized.

- To **maximize/minimize** the Navigation pane, click in its top bar on the arrow symbol.
- To **open/close** the Navigation pane, click on the upper region of it below the arrow.

If the Navigation pane is maximized or opened, the main windows are additionally displayed as a tree diagram (see example shown).

Via the tree diagram, it is possible to jump to different main windows or directly to the pages containing the main windows. Using the arrow symbols (▶ ▼) which are in front of the main windows, the tree diagram branch can be expanded/collapsed.

You can hide the Navigation pane.

If you hide the Navigation pane, please note that your ability to navigate between the main windows. For this case, you should add the command: "*Browse workspace*" at suitable locations, for instance in the ribbon menu ("User-defined buttons 108").

To show or hide the Navigation pane use the dialog: "**Tool windows chooser** 121".

Quick access toolbar

The "Quick access toolbar" can be supplemented with various menu items. Which actions are available for this purpose doesn't depend on what tab is currently displayed in the menu ribbon.

Using the context menu, you can either add or remove menu actions.

- Adding: context menu of the menu item in the menu ribbon (note: the menu ribbon may not be minimized)
- Removing: context menu of the menu item in the toolbar

You may place the toolbar either above or below the menu ribbon.

Note	Saving the configuration

The **configuration of the "Quick access toolbar"** is saved 142 with the respective **view**.

The configuration **is only saved** whenever the **project is saved**.

6.4 Tool Windows

Tool windows contain special elements for operating/viewing a main window. (For information on operating the tool window: "Operation 120")

Five tool windows
- The imc STUDIO frame's log book
- Four additional windows from the main window imc STUDIO Panel

One tool window belongs to the imc STUDIO frame and is always available:

- Logbook 122

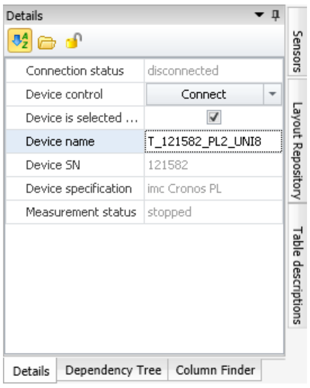
The *Logbook* is always displayed and can be minimized. The other main windows' tool windows (e.g. for the Panel) are displayed as soon as the respective main window is opened.

Note Not all tool windows are visible

By default, all necessary tool windows are displayed. All others can be displayed 120, if you need them.

6.4.1 Operation

Tool windows contain special elements for operating and editing a main window.



Tool window (example)

Each main window has its own tool window, which is described in the documentation of the respective component. Tool windows can be moved and deleted.

By default, the tool windows are pinned to the main window (e.g. at the bottom or right margin).

The picture shows an opened tool window ("***Details***"). It is pinned and contains two additional tabs. If you click on one of these tabs, the corresponding tool window opens ("***Dependency Tree***" and "***Column Finder***").

Three other collapsed tool windows are seen at the right margin ("***Sensors***", "***Layout Repository***" and "***Table descriptions***").

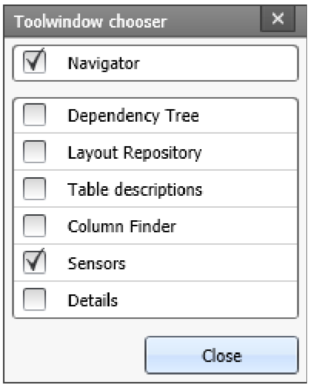
A tool window is opened when the mouse is swiped over it.

As long as a tool window is selected, or if the mouse is located over the tool window, the tool window remains open. Otherwise, it collapses to the side.

Showing/hiding the tool window

You can either show or hide tool windows. To do this, open the dialog: "**Tool window chooser**"

- use the ribbon "*View*" > "*Tool windows*", or
- the button ( ) in one of the present tool windows.



Dialog: Tool windows chooser

The dialog: Tool window chooser opens.

Set a checkmark in front of the tool windows which you wish to have displayed.

Pinning the tool window

Tool windows can be pinned. Pinned tool windows remain open even when no longer selected.

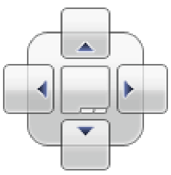
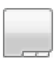
In order to pin a tool window, click on the thumbtack-button ( ).

Freely positioning the tool window

In order to freely position the pinned tool window, move the tool window's title bar using drag and drop to the desired position.

Docking the tool window

In order to dock the tool window, use the drag and drop technique by grabbing the tool window's by its title bar and moving it to the desired position. A Dock-symbol will appear at the locations which are possible.

	In the center of the targeted window (main window or tool window), a cross appears. To dock the tool window, release the mouse button with the mouse over the desired position.
	Dock at the top/bottom margin
	Dock at the left/right margin
	Insert as a tab in a different window (see example)

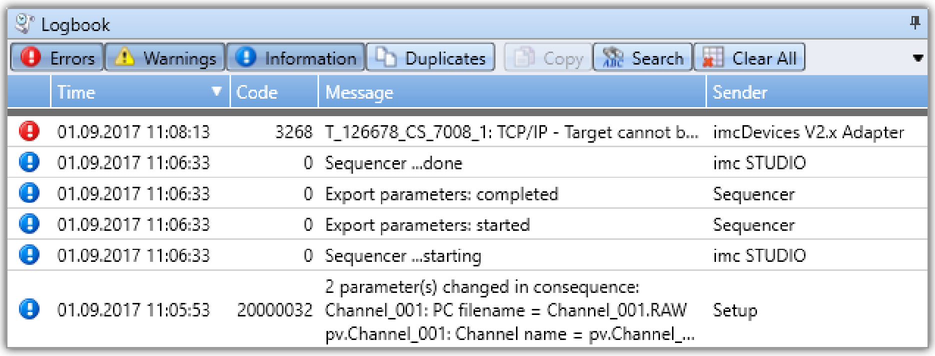
6.4.2 Logbook

In the tool window "**Logbook**", messages of the categories: "*Fatal*" (), "*Error*" (), "*Warning*" () and "*Information*" () are entered. The logbook entries indicate what problems and errors exist and provide hints on where to find them and how to remedy them. Some actions performed are documented.

E.g., a note is entered in the logbook for every command performed:

- performed successfully ("*Information*") or
- otherwise "*Error*" or "*Warning*"

By default, the Logbook is opened when an entry any of the categories "*Fatal*", "*Error*" or "*Warning*" occurs. By default "*Information*" category notes are entered into the logbook without any further effect.



Example of logbook entries

Each logbook entry consists of:

Parameter	Description
Symbol for the category	*Fatal* (), *Error* (), *Warning* () and *Information* ()
Time	Time the logbook entry occurred
Code	Logbook entry's error code
Message	Exact description of the logbook entry
Sender	The origin of the logbook entry

After a new imc STUDIO start, the logbook is empty. The logbook itself only displays messages which occurred since the last start. Older messages can be opened with the "*Logbook-Viewer*".

Note — The logbook is saved

For purposes of tracing history, the logbook is saved daily:

Default path for Windows 10: **C:\ProgramData\imc\imc STUDIO\Applications_1\log** (example)

Buttons	Description
Filtering the Logbook	You can filter according to category.  **Logbook filter** To do this, click on the Filter-button in the logbook's title bar: "*Errors*", "*Warnings*" or "*Information*" Usually, all categories are selected. Filtering also takes effect on new messages Note that the filter has an effect when a new message appears. For this reason, this message may not be displayed. Default setting for the filters You can pre-configure the filter settings using the option 111 ("*Default settings for the filters in the logbook tool window*"). Thus for example, you can have certain information entries hidden by default. Such entries can later be displayed again if needed without affecting the default setting. This option is applicable to a specific project.
Searching in the logbook	It is possible to search the logbook for entries and text passages.  To do this, click on the *Search*-button in the logbook's title bar. An input appears. Enter the desired search keyword here. All messages are displayed which contain the text entered. Search also takes effect on new messages Note that the **search works like a filter** and has an effect when a new message appears. For this reason, this message may not be displayed.
Hiding duplicates	It is possible to hide duplicates. In certain cases, the system attempts to perform the same action multiple times in succession. In consequence, multiple duplicate reports are displayed in the logbook.  In order to keep the logbook clear and concise, it is possible to group the duplicates. To do this, click on the "*Duplicates*"-button in the logbook's title bar. The first and the last messages are always displayed, thus indicating the points in time for the first and last occurrences. In front of the displayed text for the grouped message, a number appears in parentheses. This number indicates how many times the message occurred.
Copying a selected message	It is possible to copy the selected message to the Clipboard.  To do this, click on the "*Copy*"-button in the logbook's title bar. The copy contains all information which is visible in the logbook.

Buttons	**Description**
Deleting messages	It is possible to delete displayed messages.  To do this, click on the "*Clear All*"-button in the logbook's title bar. "*Clear All*" clears the display Be aware that this only purge the display, but the logbook on the hard drive remains unaffected. As well, it is still possible to view the deleted messages in the "Logbook-Viewer".
Activating/deactivating automatic scrolling	When a new message is entered in the logbook, the display in the "Autoscroll" mode automatically jumps to the new entry. If you wish to investigate older messages, you can deactivate this mode.  This happens automatically when a message is selected, or click on the "*Autoscroll*"-button. Re-activate the mode by: • pressing <Esc> • left-clicking the mouse over the selected entry while holding down the <Ctrl> key • clicking on the "*Autoscroll*"-button in the menu New messages are not automatically displayed visibly Be aware that when the "Autoscroll" mode is deactivated, you will not be automatically notified when new messages appear.
Sending Email	You can send the logbook via Email (e.g. to the imc Hotline).  When you click on the "*Send e-mail* "-button, your Email-program starts. The logbook is zipped and attached to the Email. The imc Hotline is automatically added as a recipient.
Starting the Logbook-Viewer and opening old logbooks	By means of the "Logbook-Viewer", you can look at current, deleted and saved logbook entries.  When you click on the button, the "Logbook-Viewer" opens. In addition to the familiar logbook-functions, it is possible to load saved logbooks.
Options for the Logbook	From within the logbook, you can open the Options for the Logbook 111. 

Useful options

Options - Logbook	Description
Delete Logbook-files [days]	After the specified number of days elapse, the logbook files are deleted automatically. The deletion verification test is performed upon starting the program and at 0:00 (12 AM).
Default settings for the filters in the logbook tool window	Category of messages for which the filter presets are to be made.
Open logbook in response to a report of category:	For this category, the logbook is opened and attached.

6.5 User Administration and Access rights

In some cases, it is mandatory for each user to be able to identify themselves. This ensures that only authorized users can work with imc STUDIO.

Note

- The user administration is available as of the product edition **imc STUDIO PRO**.
- By default, the User Administration is deactivated. In that state, each user has the rights belonging to the group "*imc Administrators*".

In imc STUDIO, a variety of actions are associated with particular user groups. Each user registered is assigned to a particular user group.

Affiliation with one of these user groups determines which imc STUDIO functions are available. For instance, a test engineer could configure experiments and hand them over to technicians to run. If the access rights are configured accordingly, then these users could perform the measurements and check and save the results. However, they would not be able to change the experiments.

The user group has extensive influence on the visibility and/or operability of menus, icons, etc..

Users' privileges are determined according to their respective group association. There are no special rights for an individual user.

The groups are ordered hierarchically (lower > higher):

User is in the group "**imc Standard Users**"
User is in the group "**imc Advanced Users**"
User is in the group "**imc Administrators**"
User is in the group "**imc Developers**" (only in the product edition: **imc STUDIO DEV**)

Note The user administration is saved with the project

- The User Administration settings are saved with the respective project.
- Changes take immediate effect, but are only saved when the project is saved.

Chapter overview

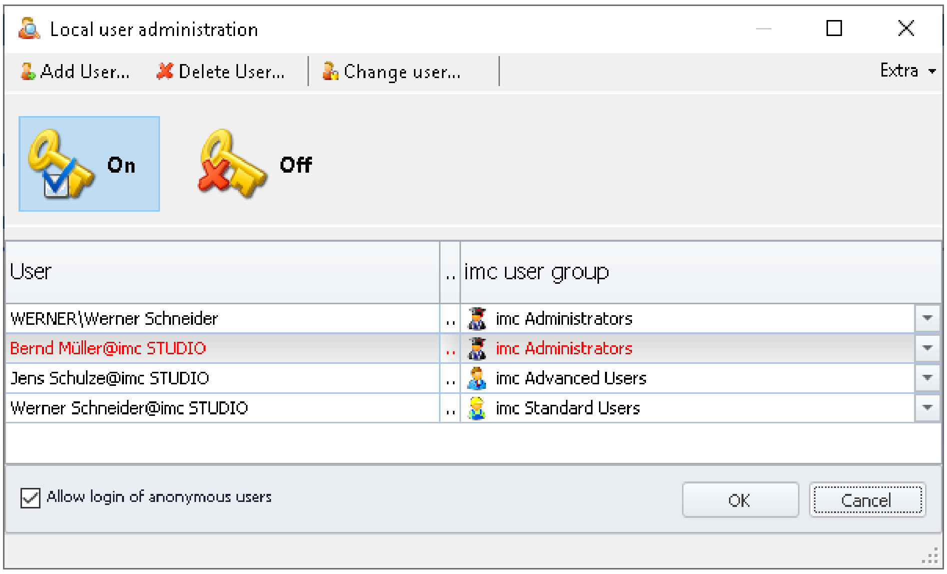
Synopsis	Chapter
The association of users to user groups is set in the "User Administration". Activating / deactivating the User Administration.	User Administration 127
Upon installation, default access rights are assigned. As a "*imc Administrators*", you can make very detailed configurations.	Setting access rights 134
When the program starts, it determines to which user group the user logged into the PC belongs.	Startup behavior 130
You can switch users after the program start.	Logging on, logging off, and switching users 131

6.5.1 User Administration

In this dialog you can activate/deactivate the user administration. You can set up users and assign them to the user groups. Thus, each user obtains rights corresponding to their respective group.

Open the dialog by selecting the ribbon menu item "*Administration*".

Ribbon	View
Extra > Administration ( )	Complete



User Administration
Assignment to imc user groups

Note — Login is required in order to start the User Administration

- The User Administration settings can only be changed if a user having the associated rights is logged in.
- For this reason, a separate login process is necessary for starting the User Administration.

Activating / deactivating the User Administration

When the User Administration is (being) deactivated, every user has the rights associated with the group "*imc Administrators*".

- To activate the User Administration, click on the Activation-button ( )
- To deactivate the User Administration, click on the Deactivation-button ( )

User types

There are a variety of user-types:

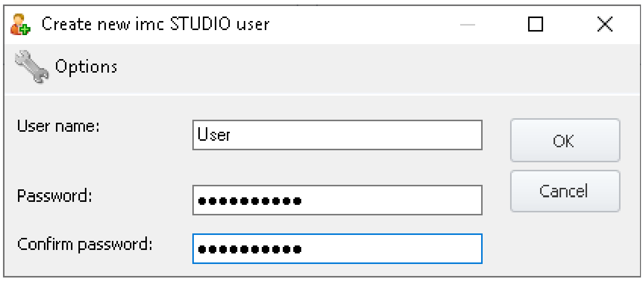
imc STUDIO internal users	Users who can be assigned independently of the particular PC or domain. The user can be protected with a password.
Local computer accounts or groups	Windows or Domain account or group. The group memberships set under Windows or in the domain are not used. The user is protected by the password used for login to Windows 131.
Active Directory domain accounts or groups	

Adding users

Adding a user of the type imc STUDIO internal user:

- click on the button "*Add user*"
- select the user type "*Create an imc STUDIO internal user*".

The following dialog appears:



Dialog for adding a user of the type "imc STUDIO internal user"

- Enter a user name
- Enter a password and confirm it.
- When the entry is correct, click on "*OK*". The user is added.

The new user's identity is structured as follows: *UserName@imc STUDIO*.

Note — Minimum length of user name and password

The minimum length of the user name and of the password can be determined using the options in the title bar.

Adding a user of the type Local computer or Active Directory domain accounts or groups:

- Click on the button "*Add user*"
- Select a user type "*Add a Local Computer account or group*" or "*Add a domain account or group from Active Directory*"
- The Windows dialog for finding an account or group appears; follow its instructions
- Once a correct entry has been made, the user is added.

The new user's identity is structured as follows: *UserName@Complete Computer Name*.

Deleting / removing a user

To delete a user from the list:

- select the user
- click on the button *Delete User*
- confirm the prompt by clicking on *Yes* if you have selected the correct user for deletion

Assigning a user to an user group / Changing the user group

The groups are ordered hierarchically (lower > higher):

	User is in the group "**imc Standard Users**"
	User is in the group "**imc Advanced Users**"
	User is in the group "**imc Administrators**"
	User is in the group "**imc Developers**" (only in the product edition: **imc STUDIO DEV**)

To assign a user to an user group

- open the drop-down list of the column "*imc User Group*" and
- select the desired group

Note

The system must always contain at least one user belonging to the group "*imc Administrators*" or higher.

Anonymous users

Users who are not entered in the User Administration are referred to as "*Anonymous Users*".

If Anonymous Users are permitted, any user can log in with an arbitrary name. This user receives the rights belonging to the user group "*imc Standard Users*".

If, for instance, the PC-user is not set up as a user, at the time that person starts imc STUDIO, they are logged in as an Anonymous (with Startup behaviour 130: "*Windows Session*").

Prohibiting logging in as an Anonymous User

To prohibit Anonymous Users from logging in,

- delete the checkmark next to "*Allow login of anonymous users*".

Export/Import

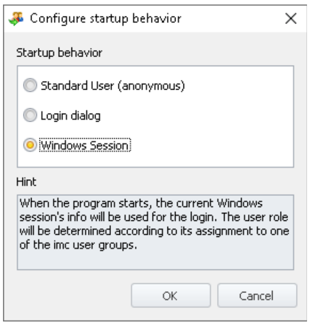
In order to be able to use the up-to-date user administration also in different projects or on other computers, you can export it and then import it at the intended destination.

- click on the button "*Extras*"
- select the desired action: Export or Import

6.5.2 Startup Behavior

In this dialog, the startup behavior is set. Open the dialog by selecting the ribbon menu item "*Startup Behavior*".

Ribbon	View
Extra > Startup Behavior ( )	Complete



Startup behavior

Startup Behavior	Description
Standard User (anonymous)	imc STUDIO always starts with the access rights of the group "*imc Standard Users*"
Login Dialog	When starting the program, the Login 131 dialog is displayed.
Windows Session	The program uses the access rights of the user logged into the PC, in accordance with the affiliation with one of the user groups. That is the default setting after installation. For the assignment between the users and the user groups, see the section User administration 127. If the User Administration is activated, any PC-users not belonging to any user group 127 are assigned the rights of the group "*imc Standard Users*".

6.5.3 Logging On, Logging Off and Switching Users

The user name serves to identify and authenticate a user. This ensures that only authorized users work with imc STUDIO.

With startup behaviour "*Login Dialog* 130" when imc STUDIO starts the Log On window appears. As well, after imc STUDIO has started, you can switch users

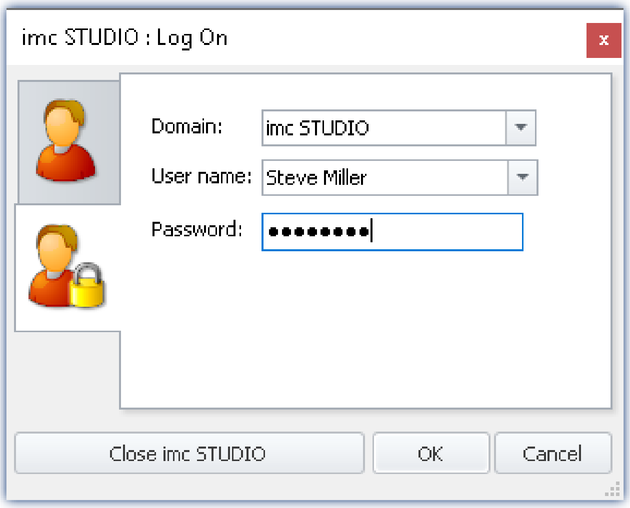
Ribbon	View
Extra > Login/Logout (/)	Complete
Home > Login/Logout (/)	Complete

If the **User Administration is deactivated**, logging on is always anonymous. Every user receives the rights belonging to the group "*imc Administrators*" for the duration of the session.

If the **User Administration is activated** the user can select:

• Log on an anonymous user	Only possible of Anonymous Users are permitted (see "User Administration 127"). In this case, anonymous users have the rights belonging to the group "*imc Standard Users*".
• Log on as registered user	

Logging on a registered user



Login Dialog
Logging on a registered user

Authentication of the registered user upon logging on references:

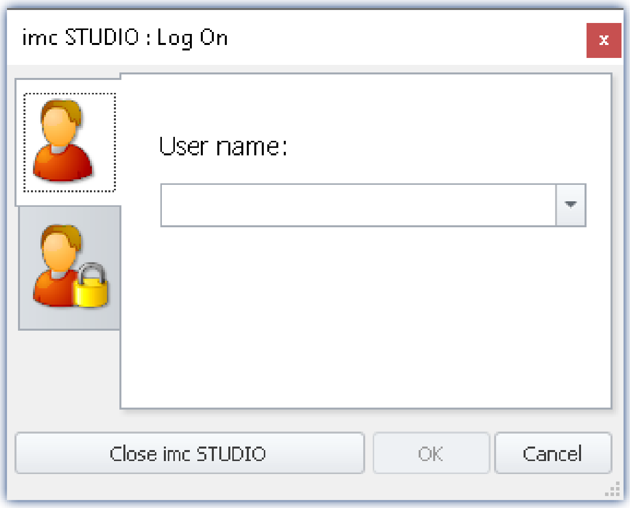
• the domain,	Select the domain: "*imc STUDIO*", "*Computer-name*" or "*Domain-name*"
• the User name and	Select a registered user (all users belonging to the selected domain are listed)
• the associated password.	If required, enter the correct password

Note — Windows-Password

- For logged-on users of the PC, imc STUDIO uses the associated Windows password.
- The password entered is never saved by imc STUDIO. The password is transmitted to Windows as hash-code. Windows verifies its validity and returns the result to imc STUDIO.

Logging on an anonymous user

Authentication of the anonymous user references the user name. However, any arbitrary name can be used.



Login Dialog
Logging on an anonymous user

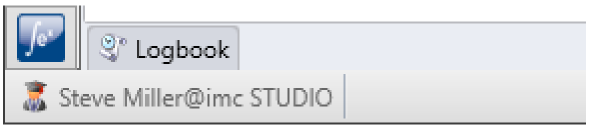
Logging a user off

When the user currently logged on logs off, the Login dialog appears.

The user is logged off. Cancel is not possible.

Status bar

The Status bar at the lower left indicates which user is currently logged on. To the left of the name is the symbol representing the respective user group.

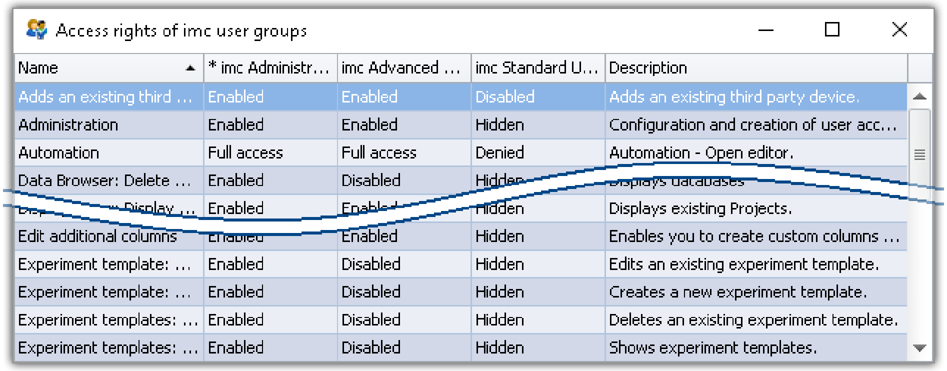


6.5.4 Setting Access Rights

In the dialog "***Access rights of imc user group***" the rights belonging to the user groups are listed and can be edited according to your wishes.

Open the dialog by selecting the ribbon menu item "*Setting Access Rights*".

Ribbon	View
Extra > Setting Access Rights ( )	Complete


Access rights of imc user groups

Name	* imc Administr…	imc Advanced …	imc Standard U…	Description
Adds an existing third …	Enabled	Enabled	Disabled	Adds an existing third party device.
Administration	Enabled	Enabled	Hidden	Configuration and creation of user acc…
Automation	Full access	Full access	Denied	Automation - Open editor.
Data Browser: Delete …	Enabled	Disabled	Hidden	Displays databases
… Display …	Enabled	Enabled	Hidden	Displays existing Projects.
Edit additional columns	Enabled	Enabled	Hidden	Enables you to create custom columns …
Experiment template: …	Enabled	Disabled	Hidden	Edits an existing experiment template.
Experiment template: …	Enabled	Disabled	Hidden	Creates a new experiment template.
Experiment templates: …	Enabled	Disabled	Hidden	Deletes an existing experiment template.
Experiment templates: …	Enabled	Disabled	Hidden	Shows experiment templates.

Dialog for setting access rights

Any user in a higher group can restrict the rights of a user in a lower group, or assign him higher rights up to his own level. However, one cannot change one's own rights or those of a member of a higher group.

The following rights levels exist:

Rights level	Description
Hidden	not visible (not accessible for operation)
Disabled	visible, but blocked (not accessible for operation)
Enabled	visible and accessible
Denied	
Write protected	visible and accessible for operation by not editable
Full access	no restrictions

For some entries, the rights may differ from the list above.

6.6 Views

The program's GUI is adaptable, so that for example the windows and columns can be positioned and displayed according to the user's desires. **The layout of the GUI is** saved in so-called "*Views*". It is possible to create separate views for various requirements.

The following settings are saved along with a view:

Region	Description
Window arrangement	The imc STUDIO window's and the tool window's **position and size**
Menus	Layout of the **menu ribbon** and the **Quick access toolbar** 119
Layout	• The last main window opened • The tool window's layout (e.g. what metadata columns are displayed in the Data Browser) • The arrangement and configuration of the Setup pages (e.g. arrangement of columns, such as metadata columns)

Note

Please note that only the positions of individual elements is saved. The existence and configuration, for instance, of the Setup-columns (tables- and column descriptions) is saved along with the respective project.

When you save a view, the whole project is also saved. This includes the current configuration of the columns.

Saving views

In order to save the current view, select the menu item "*Save View (as)*":

Menu item	View
View > Save View / Save View as (/)	Complete
Extra > Save View / Save View as (/)	Standard, Compact

All settings belonging to the current view are saved. These include the items named above.

Note The views are saved with the project

The views are saved with their respective project. When a view is saved, it is necessary for the project to be saved. The system will notify the user accordingly.

Along with the project, additional settings are saved along with it, which affect the views:

- Setup table descriptions and column descriptions (these include, for example, additional columns, such as metadata-columns, parameter set columns, ...) (tool window: Table Descriptions)
- saved Setup complete layouts (tool window: Layout Repository)

Loading views

In order to load a saved view, select the menu item "*View*" in the drop-down list of the respective view. Here, all views available to the project are displayed.

After the selection the view is loaded.

The record of an experiment includes the view in which the experiment was saved. When the experiment is loaded, the view also loads automatically.

Deleting views

To delete a saved view, select the menu item "*Delete View*".

Menu item	View
View > Delete View ()	Complete
Extra > Delete View ()	Standard, Compact

In the dialog which then opens, select the view to delete from the drop-down list. Confirm your selection by clicking on "*Save project*".

Restoring views

Views are not write-protected. They can be restored to their original state. The factory settings come with a copy of all views created as part of the program installation.

To restore a view from the factory settings, select the menu item "*Restore*".

Menu item	View
View > Restore ()	Complete
Extra > Restore ()	Standard, Compact

In the dialog which then opens, select the desired views. They are imported from the factory settings. Conform your selection by clicking on "*OK*".

Reference See also

- Import of sensors 104
- Export/import of views 137
- Export/import of Setup table descriptions 281
- Export/import of Setup column descriptions 281

6.6.1 Exporting/importing views

When you export the view settings, a variety of project settings are stored in the export file.

Settings	Description
Saved views 135	• table descriptions and column descriptions (these include, for example, additional columns, such as "metadata columns", "parameter set columns", ...) (tool window: "*Table Descriptions*") • saved complete layouts (tool window: "*Layout Repository*")
Sensors	• user-defined characteristic curves/sensors (tool window: "*Sensors*")

Export of views, metadata columns, sensors, ...

By means of the menu item "*Import/Export*", you can export the view settings:

Menu item	View
Project > Import / Export ()	Complete
Extra > Import / Export ()	Standard, Compact

- Choose option "*Export*" and then the list item "***Export views, meta data columns, sensors, ...***"
- Choose an appropriate file name and path for the view settings file

Note Save the view beforehand

Save the view beforehand if you have made any changes (see "*Views* 135").

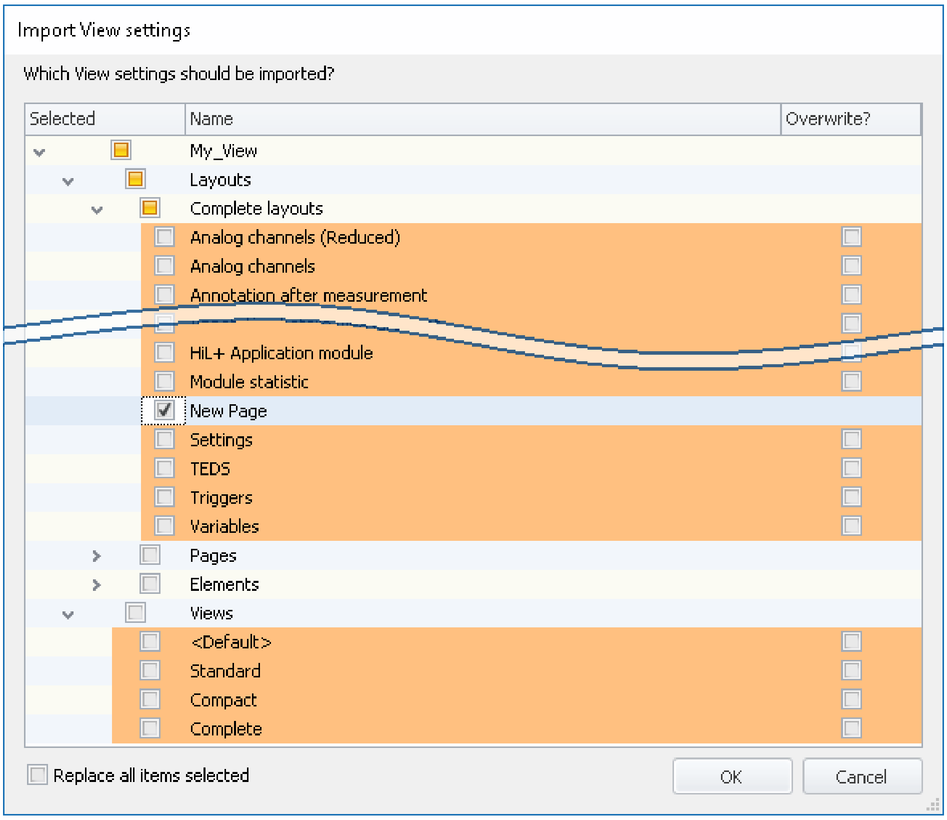
Import of views, metadata columns, ...

Using the menu item "*Import/Export*", you can **import the view settings to the current project**:

Menu item	View
Project > Import / Export ()	Complete
Extra > Import / Export ()	Standard, Compact

- Choose option "*Import*" and then the list item "***Import views, meta data columns, ...***"
- In the file selection dialog, selected the saved view settings file

Thereafter you will see a dialog allowing you to import either all or individual view settings.



Entries having **colored shading already exist** in the current project. In this example, the complete layout "*New Page*" is not yet present there.

Checkbox	Description
Selected (left)	Check this box if you wish to **import the element**
Overwrite? (right)	Check this box if the element in the project is to be **overwritten without any confirmation prompt**. If the box is not check-marked, a prompt appears to inquire the name for the element to be imported. (Unless "*Replace all items selected*" is check-marked.)
Replace all items selected	Corresponds to "*Overwrite?*" for all entries: Check this box if you want to **replace all elements without any confirmation prompt**.

You can select the following elements:

Element	Description
Layouts	All these elements belong to the Setup pages. Saved pages and saved designs, which can be displayed on the pages. For more information on the complete layouts, see the chapter: "*Table Description and Complete Layout* 282"
Views	Her you find the imc STUDIO-views. The views 135 apply for all components of imc STUDIO.

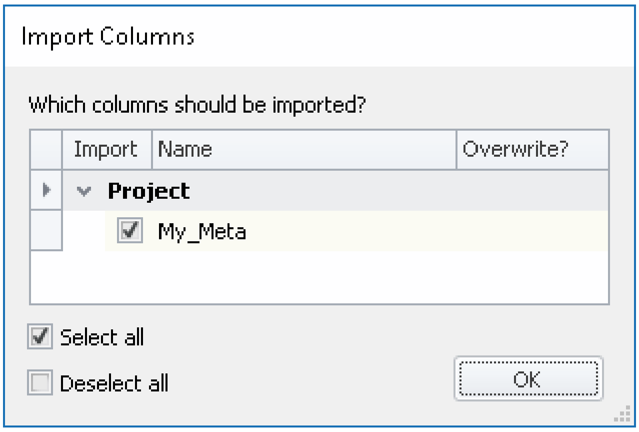
Note — **New functions can be overwritten**

Be aware that when making replacements, new functions may be lost if you import old views/columns.

Importing defined additional columns

An additional prompt appears if

- discrepancies between existing **Setup columns** were detected or
- the file contains **additional columns**.



Select which columns to import and/or any to replace.

If the **column already exists**, a checkbox appears under "*Overwrite?*". If the box is not check-marked, the **column is automatically renamed**. You can edit the name afterward. For more information, see the chapter: "*Creating and configuring additional columns* 258".

Reference — **See also**

- Import of sensors 104
- Export/import of Setup table descriptions 281
- Export/import of Setup column descriptions 281

6.6.2 Customize Ribbon

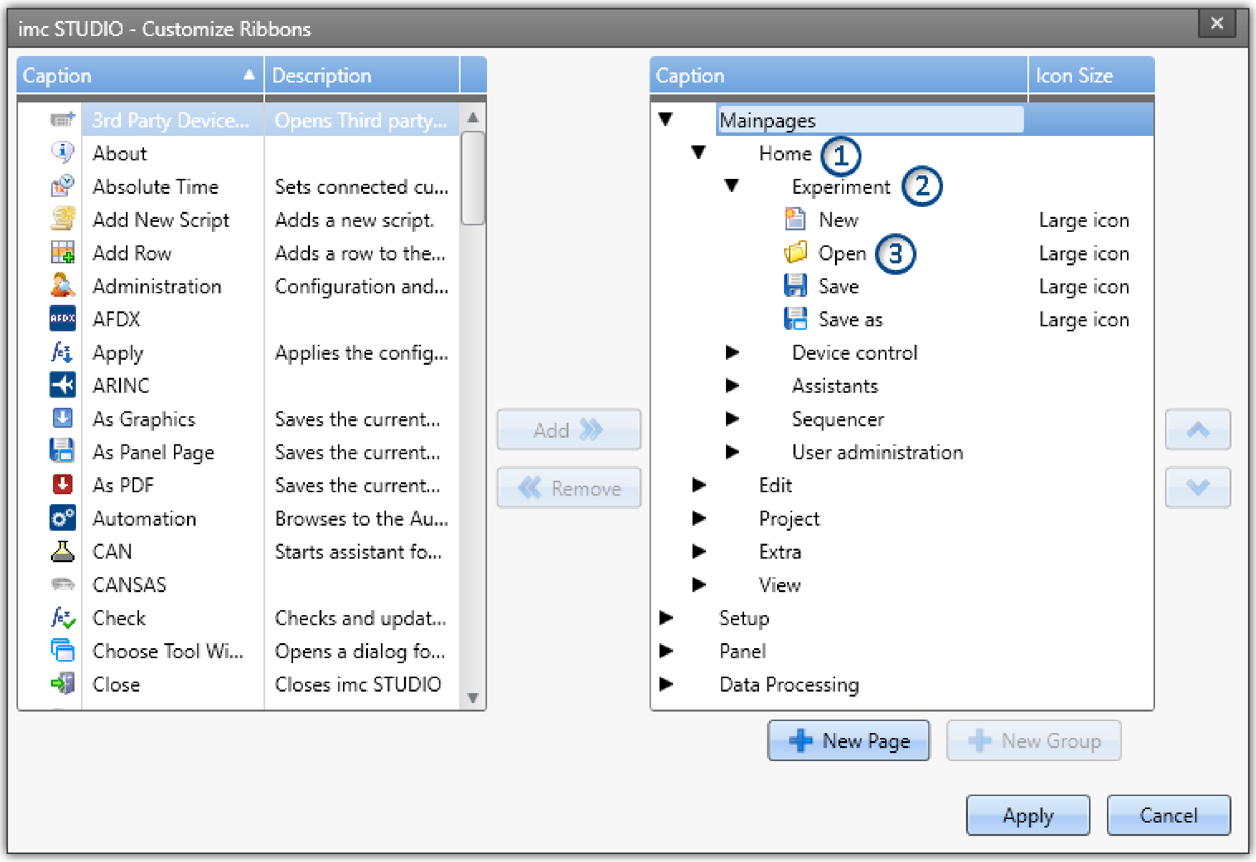
In order to provide quick access to the most important functions, you can customize the menu ribbon. The menu ribbon usually consists of multiple filecards (pages, panes) and multiple groups. The groups contain the menu actions. You can move or delete existing menu actions, or add new ones. Additionally, you are able to create your own custom groups and pages.

Each view has its own menu ribbon configuration. You can modify these configuration and save them along with the associated views.

In order to modify the menu ribbon, open the dialog: "*Customize Ribbon*".

Ribbon	View
View > Customize Ribbon ( )	Complete

If this button is not present in your view, the dialog can also be opened by clicking on the corresponding symbol ( ) in the menu bar (top right).



In the left-side pane, you find all available menu actions. In the right-side pane, the menu actions belonging to the currently selected view are shown. The lists may also include actions which may not be visible in the user interface; e.g., actions only permitted for certain user roles/privileges, or actions which are only activated in conjunction with special product configurations.

Using the buttons: , you can add new **pages** (1) or **groups** (2). To do this, first select the desired location in the right pane. Using the button: , add the **action** (3) selected in the left pane at below the current position.

Delete the currently selected action, page or group from the list using the button.

The buttons and are used to change the action's position within the group. The **icon-size** in the menu ribbon can be modified in the column at the far right of the right pane, behind the respective action.

Reference Personalized menu items

You have the ability to create your own personal menu items. See:

- a command sequence ("*User-defined buttons* 108")
- a Setup page as a dialog (property: "*Show in Dialog as menu action*" - "*Properties of pages/complete layouts* 283" - Only in imc STUDIO Developer)

6.7 Information and Tips

6.7.1 Data Management

imc STUDIO uses a "*Database*" for saving projects. The database's path can be freely specified (see "*Experiments, Projects and the Database* 93").

All "**Projects**", "**Experiment templates**", "**Experiments**" and **measured data** are saved to the database.

The following files are created for a sample project:
(Project: "*MyProject*", Experiment template: "*MyTemplate*", Experiment: "*MyExp*")

<table>
<tr><td><pre>MyProject</pre></td><td>Project Name</td></tr>
<tr><td><pre>+---config</pre></td><td></td></tr>
<tr><td><pre>| | logo.png
| | MyProject.imcAppSettings
| | project.pcf
| |</pre></td><td>Project properties</td></tr>
<tr><td><pre>| \---templates
| | MyTemplate.imcStudioTemplate
| | StandardTemplate.imcStudioTemplate
| |</pre></td><td>Experiment templates</td></tr>
<tr><td><pre>| \---~MyProject
| \---2012-11-19.bak
| MyProjekt~001.imcAppSettings
|</pre></td><td>Project backup files</td></tr>
<tr><td><pre>\---MyExp</pre></td><td>Experiment Name</td></tr>
<tr><td><pre>   +---00000001
    | 129977989468984375.ms.lnk
    | Chanel_01.raw
    | meta.de.csv.lnk
    |
    +---00000002
    | 129977989628330078.ms.lnk
    | Kanal_01.raw
    | meta.de.csv.lnk
    |</pre></td><td>Saved measurements (the data structure is set in the device settings under Storage 298) *.raw: measured data *.ms.lnk: link to the appropriate experiment setting *.csv.lnk: link to the saved metadata</td></tr>
<tr><td><pre>   +---config</pre></td><td></td></tr>
<tr><td><pre> | | MyExp.imcStudio
    | |</pre></td><td>Experiment-file (*.imcStudio) and internal files</td></tr>
<tr><td><pre> | +---.ms
    | | 129977989468984375.ms
    | | 129977989628330078.ms
    | |</pre></td><td>Saved experiment (configuration) containing the saved measurements</td></tr>
<tr><td><pre> | \---~MyExp
    | \---2012-11-19.bak
    | MyExp~001.imcStudio
    | MyExp~002.imcStudio
    |</pre></td><td>Experiment's backup files</td></tr>
<tr><td><pre>   \---Meta</pre></td><td></td></tr>
<tr><td><pre>   \---.mm
            +---0
            | | meta.de.csv
            | |
            | \---meta.de.data
            | \---DevSetup
            \---1
                | meta.de.csv
                |
                \---meta.de.data
                    \---DevSetup</pre></td><td>Saved metadata belonging to the saved measurements</td></tr>
</table>

Note

Please note that not all files are listed here. For the internal administration of the database, several internal files are necessary.

6.7.2 What is saved where?

Every setting, option and parameter is saved. Some are saved with the loaded experiment, some with the project and others with the program. Below is a list of the important areas and where they are saved.

Legend:

Appl:	Application	**Seq:**	Sequencer	**Tab.d:**	Table description
Proj:	Project	**Exp:**	Experiment	**File:**	File system

Name	Description	Appl	Proj	Seq	Exp	View	Tab.d	File
Supplemental files	Files such as characteristic curves for device/ imc Inline FAMOS				Exp			
Selected device					Exp			
Known devices		Appl						
Connected sensors					Exp			
Default values	Setup pre-set values	Appl						
Metadata Assistant	Configuration of the assistant				Exp			
Repository (Automation)								File
Repository (Panel)								File
Sequencer	Sequence table in the Sequencer				Exp			
Sequencer-Events (Experiment)	Events which apply to the loaded experiment				Exp			
Sequencer-Events (Sequencer)	Events which apply to the loaded experiment			Seq				
Sequencer-Events (Project)	Events which apply to all of the project's experiments		Proj					
User Administration	Defined users		Proj					
Access rights	Privileges of user roles		Proj					

Name	Description	Appl	Proj	Seq	Exp	View	Tab.d	File
Menu ribbon (customizing)	Which button appears where					View		
User defined buttons (collection)	What buttons exist and their significance		Proj					
User defined buttons (customizing)	Which button appears where		Proj					
Quick access toolbar	Which button appears where					View		
Show tabs (Panel-Fullscreen)	Visibility of the checkbox "Show tabs" in the Panel-Fullscreen		Proj					
Options (experiment)					Exp			
Options (project)			Proj					
Options (application)		Appl						
Views	window arrangements, menus, layouts, ...		Proj					
Table descriptions	Aggregation of the normal and additional columns		Proj					
Normal columns	What columns exist and their significance						Tab.d	
Additional columns	What columns exist and their significance						Tab.d	
Column arrangement	What columns are displayed where					View		
Complete layouts	Completely designed pages		Proj					

6.7.3 Backup Copies – Data security mechanism for experiments

Each time the imc STUDIO experiment is saved, a backup copy of the previous "save-state" is also recorded. The following data storage depth arrangements are implemented:

- Per each calendar day, a maximum of the last 10 versions is saved.
- A maximum of 5 calendar days are saved.
- From the 3rd and previous calendar days, only the respective last version is saved.

Storage location - Backup-folder

The backup copies are located in a backup-folder within the Experiment-folder. There you will find a folder whose name has a prefixed tilde-character: "*~<ExperimentName>*". E.g. "*~Experiment_001*".

Note	The Backup-folder is hidden

This Backup-folder is hidden. However, it is possible to enter its path into the address bar of the Windows Explorer in order to open the folder. Or, you can have the hidden folders displayed.

The Backup-folder contains one associated sub-folder for each work day: e.g. 2018-05-17.bak, 2018-05-16.bak, ...

These each contain the most recent saved states of the experiment. Below is an example with three and four saved versions.

MyExperiment\config\~MyExperiment\2018-05-16.bak\
    MyExperiment~001.imcStudio
    MyExperiment~002.imcStudio
    MyExperiment~003.imcStudio
MyExperiment\config\~MyExperiment\2018-05-17.bak\
    MyExperiment~001.imcStudio
    MyExperiment~002.imcStudio
    MyExperiment~003.imcStudio
    MyExperiment~004.imcStudio

Restoring a backup version

To restore a saved version, import the .imcStudio-file via the Project-dialog 96. First copy the file, for instance, to the Desktop, and rename it in a convenient way, e.g. MyExperiment~004.imcStudio -> MyExperiment.imcStudio.

Note	Overwriting during import deletes the backups

Be aware that upon importing, the original experiment is overwritten if you give it exactly the same name. All additional backups are also deleted in consequence.

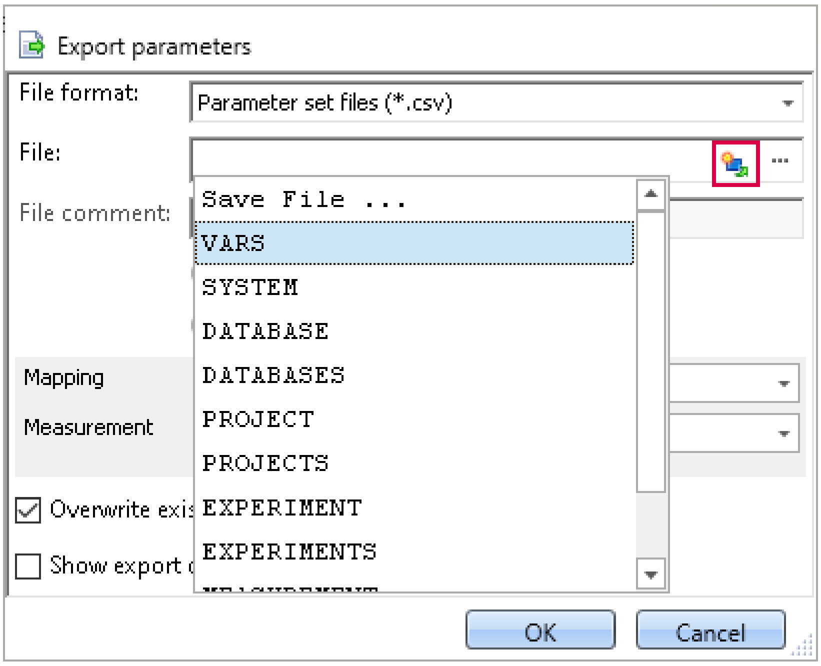
6.8 Placeholders

In imc STUDIO , you can use placeholders at various positions, which are **automatically recognized and resolved**.

With the help of placeholders, you can, for example, record a parameter set in the current experiment folder without knowing the path, or also display the variable's value in a text.

Placeholders can be used both in some commands as well as with Widgets 1098. A list of all known placeholders is presented in the section "*list of placeholders* 146".

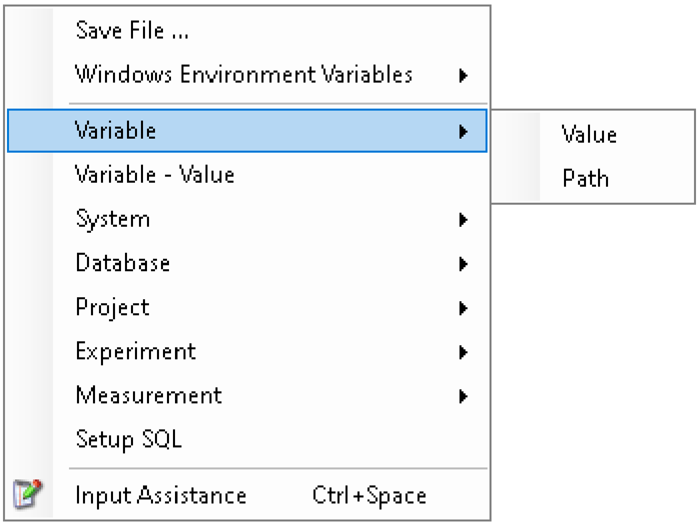
Placeholders are offered where the placeholder symbol ( ) is displayed. Not all placeholders can be used at all positions. To obtain a list of available placeholders, click the left mouse button over the placeholder symbol ( )



List of available placeholders for the comand "Export parameters"

Along with clicking the mouse over the placeholder symbol, there are other possibilities in the input box for having the list of available placeholders displayed:

- by means of the key combination CTRL + Space
- by means of the context menu (right mouse button)
- in the context menu by means of the item "*Input Assistance*"



Input box context menu

There is also the possibility of entering the desired placeholder entirely manually; however, it is not possible to see whether the placeholder is supported at this location.

In the next sections, the following information is available:

- Listing and description 146 of known placeholders
- Formatting 159 of the placeholders
- Environment variables of the OS 163 supported by imc STUDIO

6.8.1 List of placeholders

The following placeholders are described in this section:

- CONTROL 147
- DATABASE/DATABASES 148
- EXPERIMENT/EXPERIMENTS 149
- MEASUREMENT 152
- PAGE 153
- PANEL 153
- PROJECT/PROJECTS 153
- SELCONTROL 155
- SETUP 156
- SYSTEM 157
- VAR/VARS 158

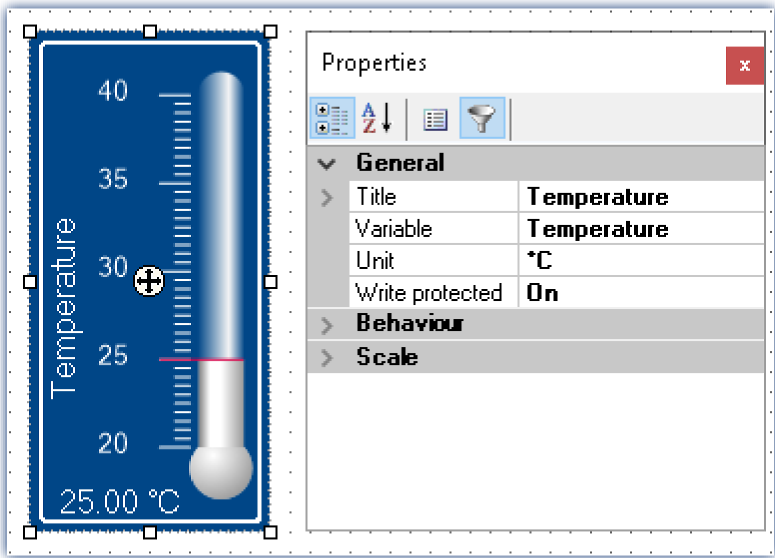
6.8.1.1 CONTROL

These placeholders are only available for Widgets.

Name	Context menu	Description
UNIT	Control - Unit	Unit of the current Widget, corresponding to the box Unit in the Properties-dialog. If there is no Unit, or if it is empty, the unit of the linked variable is adopted.
TITLE	Control - Title	Title of the current Widget, corresponding to the box *Title* in the *Properties*-dialog
VALUE	Control - Value	Current value of the variable, which is linked with the current Widget.

Example

The following example illustrates what the three placeholders mean.



Properties of a Widget

In this example, the placeholders listed above have the following values:

- <CONTROL.UNIT> = °C
- <CONTROL.TITLE> = Temperature
- <CONTROL.VALUE> = 25

6.8.1.2 DATABASE/DATABASES

This placeholder is available everywhere where filepaths are needed, e.g. for export and import commands.

Name	Context menu	Description
NAME	Database - Name	Name of the database (= name of the database folder)
PATH	Database - Path	Path to the DB folder

Here, the entries are used which are entered in the *Global Options*.

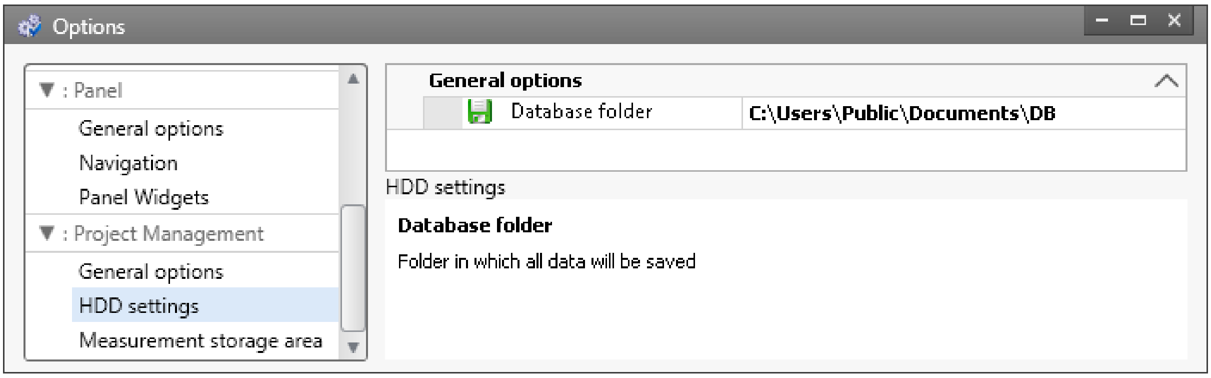
Note

The placeholder *DATABASE* always pertains to the current project database. If you wish to use the placeholder with another database, the placeholder *DATABASES* must be used, e.g.: <DATABASES["Another_Database"].PATH>

The workings of the two placeholders is illustrated by the following to examples.

Example 1

The first example pertains to the unchanged imc STUDIO default settings, here under Windows 10:

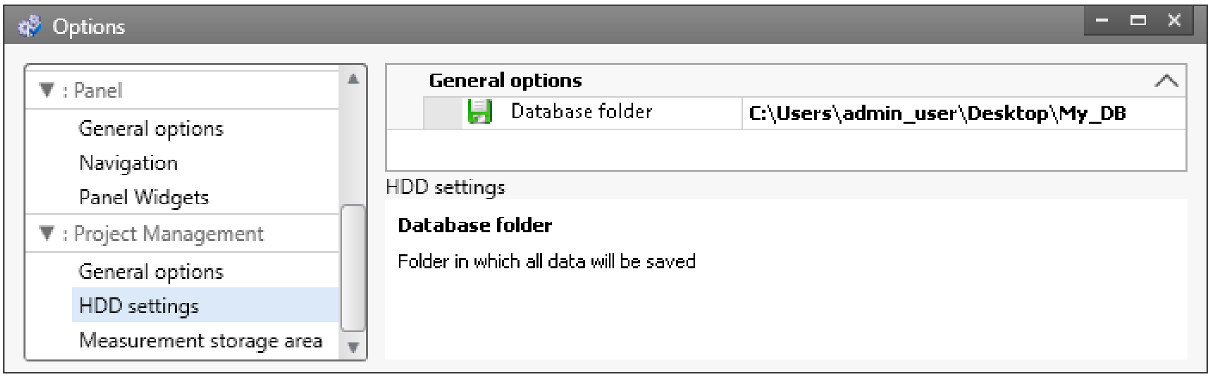


Default database path under Windows 10

- <DATABASE.NAME> = DB
- <DATABASE.PATH> = C:\Users\Public\Documents\DB

Example 2

The second example shows the resolved placeholders when the database path is changed:



Changed database path

- <DATABASE.NAME> = My_DB
- <DATABASE.PATH> = C:\Users\admin_user\Desktop\My_DB

To obtain the same values by using the placeholder DATABASES, the call must be structured as follows:

- <DATABASES["My_DB"].NAME> = My_DB
- <DATABASES["My_DB"].PATH> = C:\Users\admin_user\Desktop\My_DB

6.8.1.3 EXPERIMENT/EXPERIMENTS

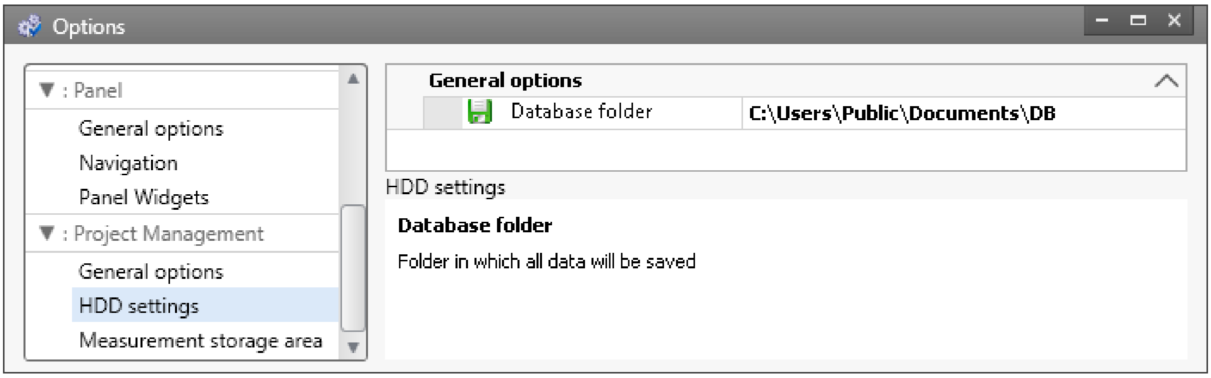
Name	Context menu	Description
CFG	Experiment - Configuration path	Path to the configuration folder ("*config*" folder) of the experiment
NAME	Experiment - Name	Name of experiment
PATH	Experiment - Path	Path to the experiment's saving folder
SETTINGS	Experiment - Configuration file	Experiment file including path (*.imcStudio)

Note

The placeholder *EXPERIMENT* always pertains to the current experiment. If you wish to use the placeholder with another experiment, the placeholder *EXPERIMENTS* must be used, e.g.: <EXPERIMENTS["Another_Experiment"].PATH>

Example

The example is based on unchanged imc STUDIO default settings, here under Windows 10:



Default database path under Windows 10

The project's name is *StandardProject,* the experiment is called *My_Experiment*.

With these settings, the placeholders listed above have the following values:

Input	Result
<EXPERIMENT.CFG>	C:\Users\Public\Documents\DB\StandardProject\My_Experiment\config
<EXPERIMENT.NAME>	My_Experiment
<EXPERIMENT.PATH>	C:\Users\Public\Documents\DB\StandardProject\My_Experiment
<EXPERIMENT.SETTINGS>	C:\Users\Public\Documents\DB\StandardProject\My_Experiment\config\My_Experiment.imcStudio

To obtain the same values by using the placeholder "*EXPERIMENTS*", the call must be structured as follows:

Input	Result
<EXPERIMENTS["My_Experiment"].CFG>	
	C:\Users\Public\Documents\DB\StandardProject\My_Experiment\config
<EXPERIMENTS["My_Experiment"].NAME>	
	My_Experiment
<EXPERIMENTS["My_Experiment"].PATH>	
	C:\Users\Public\Documents\DB\StandardProject\My_Experiment
<EXPERIMENTS["My_Experiment"].SETTINGS>	
	C:\Users\Public\Documents\DB\StandardProject\My_Experiment\config\My_Experiment.imcStudio

Note Deviating System Behavior

Deviating system behavior in absence of the component: imc STUDIO Project Management:

If the component imc STUDIO Project Management is deactivated, no database is used to manage the experiments jointly. For this reason, the placeholder returns different results.

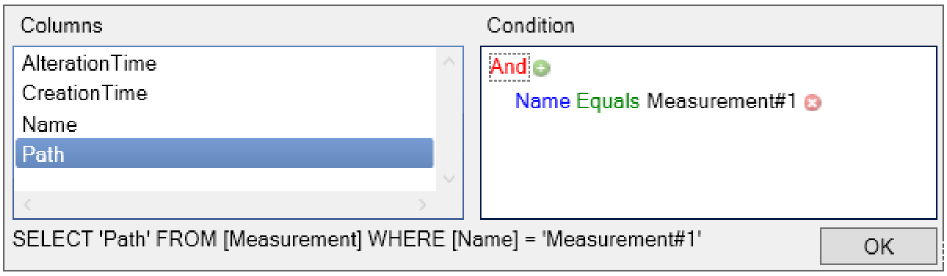
Name	Context menu	Description
CFG	-	*Not supported.*
NAME	-	*Not supported.*
PATH	Experiment - Path	Path to the storage directory of the configuration file ".imcStudio"/".imcExp"
SETTINGS	-	*Not supported.*

6.8.1.4 MEASUREMENT

With this placeholder, you can access properties and metadata belonging to a saved measurement, such as the directory path, or metadata saved along with the measurement.

Name	Context menu	Description
SQL	Measurement SQL	Access to data of a saved measurement

The placeholder reads properties and metadata belonging to the saved measurements. For this purpose, commands in the database language SQL are used. When the placeholder is entered, an assistant opens automatically, which handles the entering of the SQL command.



MEASUREMENT.SQL-Assistant

In the assistant, there is a choice among various **columns**, which can be associated with a **condition**:

Parameter	Description
Columns	Here, all available properties and metadata are displayed. Select the desired property; multi-selection is possible using the CTRL-key. In the default case, where there is no additional export of data, you can select among the following properties: • the last time the measurement was modified (AlterationTime), • the time the measurement was created (CreationTime), • the measurement's directory path (Path) and • the measurement's name (Name). This always returns the fixed name. If any metadata with the measurement were saved, they are listed here.
Condition	Here you specify which measurement's selected properties and metadata you wish to see. For example, in order to always see the metadata belonging to measurement #1, proceed as follows: • Click on the , which causes the condition to appear • Next, click on "AlterationTime" and select "Name". • Subsequently, select "Measurement#1" from the selection list behind "equals". If the condition is left empty, the properties/metadata of all measurements are displayed in succession (separated by ',').

Note — Columns and Condition

In the **Columns**, select the **properties/metadata**, which you wish **to display**. In the **Condition**, specify **which measurement's properties/metadata** you wish to use.

Example

The selection made in the image above returns the directory path of the measurement which is currently designated as #1 (in the Data Browser).

6.8.1.5 PAGE

This placeholder is only available for the Panel.

Name	Context menu	Description
NUMBER	Page - Number	Number of the current Panel page
VARS	Page - Variables	All variables which are linked with at least one Widget on the current page

Example

In the Panel, the following pages are generated:

- Start
- Meas
- Report

Existing pages in the Panel

For instance, if the placeholder is used on the page *Start*, then <PAGE.NUMBER> = 1, on the page *Report*, <PAGE.NUMBER> = 3.

If, for instance, a curve window is linked with *Channel_001* on the page *Start* and a standard meter is linked with the user-defined variable *Test*, then <PAGE.VARS> = Channel_001,Test.

6.8.1.6 PANEL

This placeholder is only available for the Panel.

Name	Context menu	Description
PAGECOUNT	Amount of Panel pages	Total number of pages in the Panel

Example

In the Panel, the following pages are generated:

- Start
- Meas
- Report

In which case, <PANEL.PAGECOUNT> = 3.

6.8.1.7 PROJECT/PROJECTS

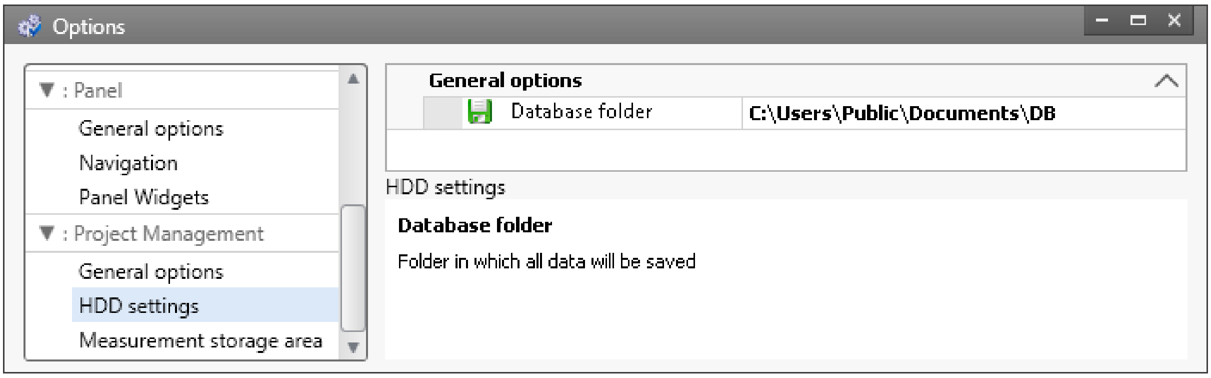
Name	Context menu	Description
CFG	Project - Configuration path	Path to the project's configuration folder (*config* folder)
NAME	Project - Name	Name of the project
PATH	Project - Path	Path to the project's saving folder
SETTINGS	Project - Configuration file	Settings for the project (*.imcAppSettings file)

Note

The placeholder *PROJECT* always pertains to the current project. If you wish to use the placeholder with another experiment, the placeholder *PROJECTS* must be used, e.g.:
<PROJECTS["Another_Project"].PATH>

Example

This example is based on unchanged imc STUDIO, default settings, here under Windows 10:



Default database path under Windows 10

The project's name is *StandardProject.*

With these settings, the placeholders listed above have the following values:

Input	Result
<PROJECT.CFG>	C:\Users\Public\Documents\DB\StandardProject\config
<PROJECT.NAME>	StandardProject
<PROJECT.PATH>	C:\Users\Public\Documents\DB\StandardProject
<PROJECT.SETTINGS>	C:\Users\Public\Documents\DB\StandardProject\config\StandardProject.imcAppSettings

To obtain the same values using the placeholder *PROJECTS*, the call must be structured as follows:

Input	Result
<PROJECTS["StandardProject"].CFG>	C:\Users\Public\Documents\DB\StandardProject\config
<PROJECTS["StandardProject"].NAME>	StandardProject
<PROJECTS["StandardProject"].PATH>	C:\Users\Public\Documents\DB\StandardProject
<PROJECTS["StandardProject"].SETTINGS>	C:\Users\Public\Documents\DB\StandardProject\config\StandardProject.imcAppSettings

6.8.1.8 SELCONTROL

This placeholder is only available for the Panel.

Name	Context menu	Description
VARS	Variables of the selected control	List of all variables linked with the selected Widget

Example

A curve window is linked with the following channels:

- Channel_001
- Channel_002
- Channel_003

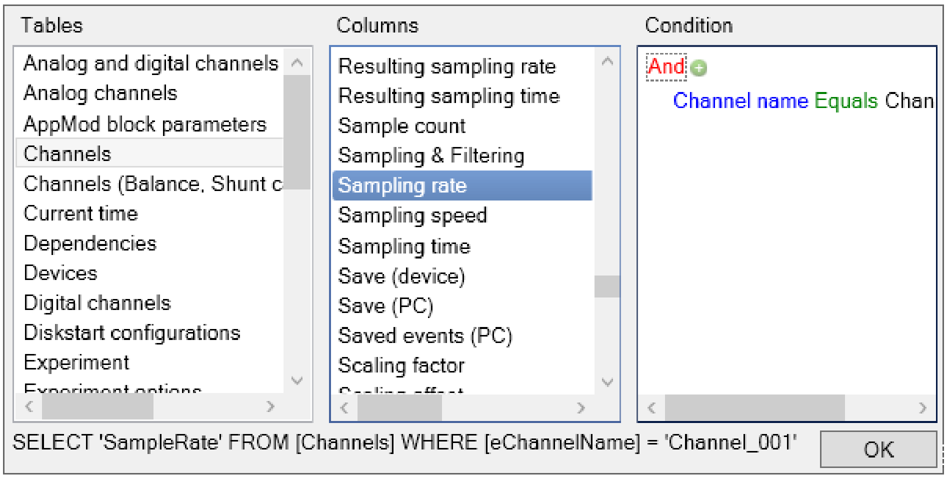
In which case, <SELCONTROL.VARS> = Channel_001,Channel_002,Channel_003.

6.8.1.9 SETUP

By means of this placeholder, you can access data from the Setup.

Name	Context menu	Description
SQL	Setup SQL	Access to current data from the Setup

The placeholder reads current parameter values from the Setup. Therefor, commands expressed in the SQL database language are used. When entering the placeholder, a wizard is automatically opened, which handles making the entries for the SQL command:



SETUP.SQL wizard

The wizard displays the following columns:

Parameter	Description
Tables	Here all table descriptions are listed, select the one desired. In order for the "*SETUP*"-placeholder to be able to get the current values from the Setup, it must query the table description. For more details on table descriptions and Setup pages, please observe the reference below.
Columns	Once your table description has been selected, all associated columns (parameters) which are available appear here. Select the parameter desired; it is also possible to select multiple parameters by using the CTRL-key.
Condition	Specify any condition here, for example a particular channel name, if desired. If the condition is left empty, all values belonging to the selected column, e.g. the sampling rates of all channels, are displayed.

Example

The selection which was made in the picture above returns the sampling rate of the channel "Channel_001" as a text string, e.g. "100 Hz". If the condition which had been entered is deleted, the full amount of sampling rates would be returned as an enumeration, e.g. "100 Hz, 1 kHz, 100 Hz,100 Hz, 1 kHz, , ,100 Hz, ...". Elements which do not possess any sampling rate, return an empty element (", ,").

Reference

Information on the relationship between table descriptions, complete layouts and Setup pages is provided in the chapter Table description and complete layout 282.

Since metadata such as entries on the pages *Documentation, Annotation before measurement* and *Annotation after measurement* belong to the Setup, these can also be displayed in the Panel or used in commands by this means.

Note

The placeholder reads by the SQL command **always the current value** from the Setup, i.e. the value is updated as soon as any change is made in the Setup.

6.8.1.10 SYSTEM

This placeholder enables the current date and the system's time to be used.

Name	Context menu	Description
DATE	System - Date - Standard	The operating system's current date. Format M/d/yyyy for English (USA) operating systems
	System - Date - Path suitable	The operating system's current date, format yyyy-MM-dd
TIME	System - Time - Standard	The operating system's current time, format hh:mm for English (USA) operating systems
	System - Time - Path suitable	The operating system's current time, format hh-mm-ss

Explanations of the formatting of the date 160 and the time 161 are provided in the section Formatting 159.

Example

Supposing the time June 14th, 2011, 2:30 p.m. is set in the (English(USA)) operating system. Then the two placeholders return in their default formatting:

- <SYSTEM.DATE> = 6/14/2011
- <SYSTEM.TIME> = 2:30 PM

The remaining formatting options are described in the section Formatting 159.

6.8.1.11 VAR/VARS

Name	Context menu	Description
COMMENT	Variable - Comment	Comment on the variable, e.g. the channel comment
FILE	Variable - File	File, in which the variable is saved
NAME	Variable - Name	Name of the variable
PATH	Variable - Path	Path in which the VARS.FILE is saved
PROPS	Variable - Properties	Several variable properties, e.g. category or metadata, which have been written into channel data.
UNIT	see YUNIT	see YUNIT
VALUE	Variable - Value	Current value of the variable, of a channel or a bit
XUNIT	Variable - X-unit	X - unit of the variable, e.g. s for seconds
YUNIT	Variable - Y-unit	Y - unit of the variable
YUNIT2	Variable - Y-unit2	Y-unit of the 2nd component (only relevant with complex data sets)
ZUNIT	Variable - Z-Unit	Z - unit of the variable

Note

The placeholder *VAR* always refers to the variable which is linked with the Widget. If you wish to access a different variable via the placeholder, the placeholder *VARS* is to be used, e.g.: <VARS["myVariable"].PATH>.

Example

A vibration in "*µ eps*" is measured over time (seconds). In imc Online FAMOS, an FFT of the input signal is performed.

The resulting virtual channel is saved together with the measurement channel on the PC.

Data storage settings:

- Path: C:\Users\Public\Documents\DB\StandardProject\My_Experiment
- Path naming: Continuously numbers
- Storage interval: End of measurement

The virtual channel's name in this example is "*myFFT*" and the comment is called "*Result of FFT*".

Thus, the placeholders listed above are resolved after the first measurement as follows:

Input	Result
<VARS ["myFFT"].COMMENT>	Result of FFT
<VARS["myFFT"].FILE>	myFFT.RAW
<VARS["myFFT"].NAME>	myFFT
<VARS["myFFT"].PATH>	C:\Users\Public\Documents\DB\StandardProject\My_Experiment\00000001
<VARS["myFFT"].UNIT>	µ eps
<VARS["myFFT"].XUNIT>	s
<VARS["myFFT"].YUNIT>	µ eps
<VARS["myFFT"].ZUNIT>	Hz

<VARS["myFFT"].VALUE> is resolved, however in this example (FFT-calculation), it does not return a sensible value. Notes on formatting the placeholder VALUE are found under "*Formatting - VALUE* 161".

6.8.2 Formatting

With some placeholders, you have the possibility of specifying the formatting desired. The various formatting options are described as examples.

Usually, manual entry of the formatting string is necessary. The placeholder "*VALUE*" offers you support in making entries.

A formatting is possible with the following placeholders:

- PAGE.NUMBER/PANEL.PAGECOUNT 160
- SYSTEM.DATE 160
- SYSTEM.TIME 161
- VALUE 161

6.8.2.1 PAGE.NUMBER/PANEL.PAGECOUNT

The placeholders PAGE.NUMBER and PANEL.PAGECOUNT are integers where the amount of digits can be set.

If, for instance, <PANEL.PAGECOUNT> has the value 3, then this value may be outputted as follows:

- <PANEL.PAGECOUNT("00")> = 03
- <PANEL.PAGECOUNT("000")> = 003

These formatting strings can be used for <PAGE.NUMBER> in the same way.

6.8.2.2 SYSTEM.DATE

In the formatting string for the date, the following components can be used:

- d or dd = current date
- M or MM = current month
- yy or yyyy = current year
- Separator e.g. '.', ',', '-', '_'

Note

To use the placeholder when specifying the path as a string, use the separator "-". This character is allowed as a special character in all languages in pathnames.

Example

With the example of the date July 14th, 2019 (operating system English (USA)), the use of the formatting string is illustrated.

- <SYSTEM.DATE> = 7/14/2019
- <SYSTEM.DATE("yyyy-MM-dd")> = 2019-07-14
- <SYSTEM.DATE("yy-M-d")> = 19-7-14
- <SYSTEM.DATE("dd_MM_yy")> = 14_07_18

6.8.2.3 SYSTEM.TIME

In the formatting string for the time, the following components can be used:

- h or hh = current hour; 12h
- H or HH = current hour; 24h
- m or mm = current minute
- s or ss = current seconds
- Separator e.g. '.', ',', '-', '_'

Note

To use the placeholder when specifying the path as a string, use the separator "-". This character is allowed as a special character in all languages in pathnames.

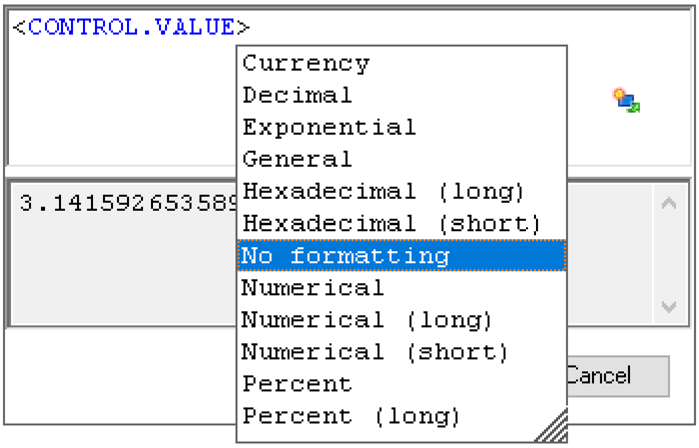
Example

With the example of the time 1:05:03 p.m. (operating system English (USA)), the use of the formatting string is illustrated.

- <SYSTEM.TIME> = 1:05
- <SYSTEM.TIME("hh-mm-ss")> = 01-05-03
- <SYSTEM.TIME("h-m-s")> = 1-5-3
- <SYSTEM.TIME("HH_mm_ss")> = 13_05_03

6.8.2.4 VALUE

Formatting for VALUE can either be entered by means of the input assistance (see figure below) or manually.



Input assistant for the formatting

The various formatting possibilities are explained in the following table on the basis of the variable pi=3.1415926535. The amount of digits before and after the decimal specified here can be replaced with any desired integer amount.

Description	Input assistant	Manual	Output
No formatting	No formatting	<VARS.["pi"].VALUE>	3.14159

Description	Input assistant	Manual	Output
Fixed point, 2 decimal digits	Numeric	<VARS.["pi"].VALUE("f2")> <VARS.["pi"].VALUE("0.00")>	3.14
Fixed point, 1 decimal digit	Numeric Short	<VARS.["pi"].VALUE("0.0")>	3.1
Fixed point, 6 decimal digits	Numeric Long	<VARS.["pi"].VALUE("0.000000")>	3.141593
Floating point, exponential notation, 2 decimal digits	Exponential	<VARS.["pi"].VALUE("e2")>	3.14e+000
Fixed point, 2 decimal digits, always output sign		<VARS.["pi"].VALUE("+#.##; -#.##")>	+3.14
Fixed point, 2 integer digits, 1 decimal digit, always output sign, no output of significant zeroes		<VARS.["pi"].VALUE("+00.0;-00.0")>	+3.14
Space before positive values, "-" before negative values		<VARS.["pi"].VALUE(" 0.00;-0.00")>	3.14
General	General	<VARS.["pi"].VALUE("g")>	3.1415926535
Fixed point, 4 decimal digits	Decimal	<VARS.["pi"].VALUE("0.0000")>	3.142
Hexadecimal	Hexadecimal Short	<VARS.["pi"].VALUE("x4")>	0003
	Hexadecimal Long	<VARS.["pi"].VALUE("x8")>	0003
Currency	Currency	<VARS.["pi"].VALUE("c2")>	3.14
Percent	Percent	<VARS.["pi"].VALUE("0.0%")>	314%
	Percent Long	<VARS.["pi"].VALUE("0.00%")>	314.16%

Instead of the decimal point comma can also be used. Then, the comma is displayed in the output, e,g,:

- <VARS.["pi"].VALUE("0,00")> = 3,14

With integer values, formatting is also possible. For instance, if a variable *amount* has the instantaneous value 4, then this value can be outputted also as 04, 004, etc.:

- <VARS.["amount"].VALUE("00")> = 04
- <VARS.["amount"].VALUE("000")> = 004

6.8.3 Environment variables of the OS

In imc STUDIO it is also possible to access the operating system's environment variables.

Tips on use:

- Set the variable to be resolved in angle brackets with percent symbols,
  as follows: <%USERNAME%>
- Observe capitalization. The variable must be spelled exactly as it is spelled by the operating system, e.g. *ProgramData*, *HOMEDRIVE* or *windir*.

Note Notes for 64-bit systems

- With **64-bit systems**, note that the variables **ProgramFiles** and **CommonProgramFiles** (under Microsoft Windows) refer to the respective 32-bit folders. This is because imc STUDIO is a 32-bit program and the variable values returned by the operating system refer to the running program (imc STUDIO). In this case, the operating system returns values to 32-bit paths.
- If you need the 64-bit paths, use the variables **ProgramW6432** and **CommonProgramW6432**.

7 Setup - Device (general)

imc STUDIO Setup is the **imc STUDIO** plug-in for uniform configuration and control of imc measurement devices.

Chapter overview

Synopsis	Chapter
Which devices are supported?	• Device Overview 165
Getting familiar with concepts concerning system operation	• Operation 212
What steps are necessary for performing a measurement? What actions are available?	• Performing a measurement: Procedure 222 • Ribbon 166
Applying characteristic curves and pre-made configurations to a channel	• Sensors 204
Saving supplemental information on the measured data	• Parameter set 226 • Metadata Assistant 246
Designing custom columns and user interfaces	• Setup-Layout 253 • Creating and configuring additional columns 258

Reference — Configuring the device and measurement

With the Setup pages , you can configure one or more measurement quickly and easily.

The extensive data saving, triggering and real-time functions are organized clearly for every device. The measurement parameters can be set individually for each channel. The measured data can be saved separately for each channel. Measurement channels can be monitored continually and only start recording upon the occurrence of specified events.

See: "*Setup pages - Configuring Device* 294"

Note

If the documentation mentions a device, the comments apply similarly to other devices as well. All screenshots were created using the "*Complete*" view.

7.1 Device Overview

imc STUDIO connects with the imc measurement devices e.g. via the local area network (LAN). For setup of the connection, the devices must be pre-configured (see "*Setting Up - Connect the device* 43").

Some of the capabilities discussed in this manual only pertain to certain device models. The associated device groups are indicated at the respective locations in the manual. The groups are shown in the following table which can be used with imc STUDIO.

— not available ● standard ○ optional

CRXT imc CRONOS-XT CRFX imc CRONOS*flex* CRC imc CRONOS*compact* CRPL imc CRONOS-PL

Device	imc CRPL imc CRSL	imc C1 imc C-SERIE	imc SPARTAN	imc BUSDAQ	imc BUSDAQ*flex*	imc SPARTAN-R imc SPARTAN-N imc CRSL-N	imc CRC-400 imc CRFX-400	imc C1-N imc C-SERIE-N	imc C1-FD imc C-SERIE-FD	imc CRFX-2000	imc CRC-2000G	imc CRC-400GP	imc CRFX-2000G	imc CRFX-2000GP	imc CRXT
Group	**2**[1]	**3**	**4**			**5**				**6**	**7**				
Sn[2]	12	12	13			14				16	19				
TCP/IP Interface [MBit/s]	100	100	100	100	100	100	100	100	100	100	1000	1000	1000	1000	1000
Rate[3] [kHz]	400	400	400	400	400	400	400	400	400	2000 / 400[4]	2000 / 400[4]	2000 / 400[4]	2000	2000	2000
Monitor connection	(●)[5]	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connections[6]	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
Data Storage															
CF	—	—	●	●	●	●	●	●	●	—	—	—	—	—	—
PCMCIA	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Express Card	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—
CFast	—	—	—	—	—	—	—	—	—	—	●	●	●	●	●
USB	—	—	—	—	—	—	—	—	—	●	●	●	●	●	—
Storage on network drive	—	—	●	●	●	●	●	●	●	●	●	●	●	●	●
Synchronization															
DCF	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
IRIG-B	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●
GPS	○	○	●	●	(●)[7]	●	●	●	●	●	●	●	●	●	●
NTP	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●
PTP	—	—	—	—	—	—	—	—	—	—	—	●	—	●	●
Phase offset correction	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●

1 to identify on date of manufacture (as of summer, 2003)
2 Extend serial number range by four digits
3 Max. aggregate sampling rate (see data sheet)
4 2000 via EtherCAT else 400
5 Monitor connection as of 2007
6 Number of imc STUDIO Monitor-connections or imc REMOTE (as of 14xxxx) connections
7 not available for imc BUSDAQ*flex*-2-S

7.2 Ribbon

The ribbon of "imc STUDIO Setup".

7.2.1 Control

Table filter

Menu item	Description
Hide Passive Channels	The function helps to display only the channels that are relevant. Passive channels are hidden. The status of this setting is saved with the experiment. This means it remains activated until the button is clicked again.
Show Start Trigger	Shows/hides the configuration of the Start trigger (Trigger_48). In most case, the configuration does not need to be modified. You can view the configuration on the Setup page: "Trigger".

Device Control

Menu item	Description
Process configuration 167	The current configuration is inspected for errors and made available to all plug-ins. For this purpose, no connection to the device is required. There are cases where certain settings are possible to make during operation while not being actually supported by the respective device type. In such a case, a corresponding error message will be posted (see documentation on imc STUDIO, chapter "Logbook 122").
Connect 167	imc STUDIO connects itself with all selected measurement devices (normally via LAN).
Download 171	Changed settings are analyzed and completely imported by the device.
Reconfigure 171	All settings are analyzed and completely imported by the device.
Start measurement 172	The measurement is started for all devices.
Stop measurement 172	The measurement is stopped for all devices.
Suspend data storage 174	If data transfer to storage is activated, it is suspended for all devices.
Resume data storage 174	If data transfer to storage is activated, it is resumed for all devices.
Disconnect 167	imc STUDIO disconnects from all selected measurement devices.
Search for devices 175	The device search causes the system to search the network for any suitable devices. Ultimately, the devices found are listed.
Search for devices by IP/DNS 175	Search for devices by a user-defined IP address or DNS name.
3rd Party Device Management 175	Opens the "3rd Party Device Management" to add Third Party Devices to the device list.

7.2.1.1 Process configuration

The current configuration is inspected for errors and made available to all plug-ins. Connection to the devices is not required for this purpose.

Note

There are cases where certain settings are possible to make during operation while not being actually supported by the respective device type. In such a case, a corresponding error message will be posted.

Ribbon	View
Home > Process ( )	all
Setup-Control > Process ( )	Complete

7.2.1.2 Connect and Disconnect

imc STUDIO connects itself with/disconnects itself from all selected measurement devices (normally via LAN).

Ribbon	View
Home > Connect ( )	all
Setup-Control > Connect ( )	Complete
Home > Disconnect ( )	all
Setup-Control > Disconnect ( )	Complete

Note

If the measurement device's software version is different than that of the product installation on the PC, the Firmware Update 83 follows next.

Change of the imc measurement device

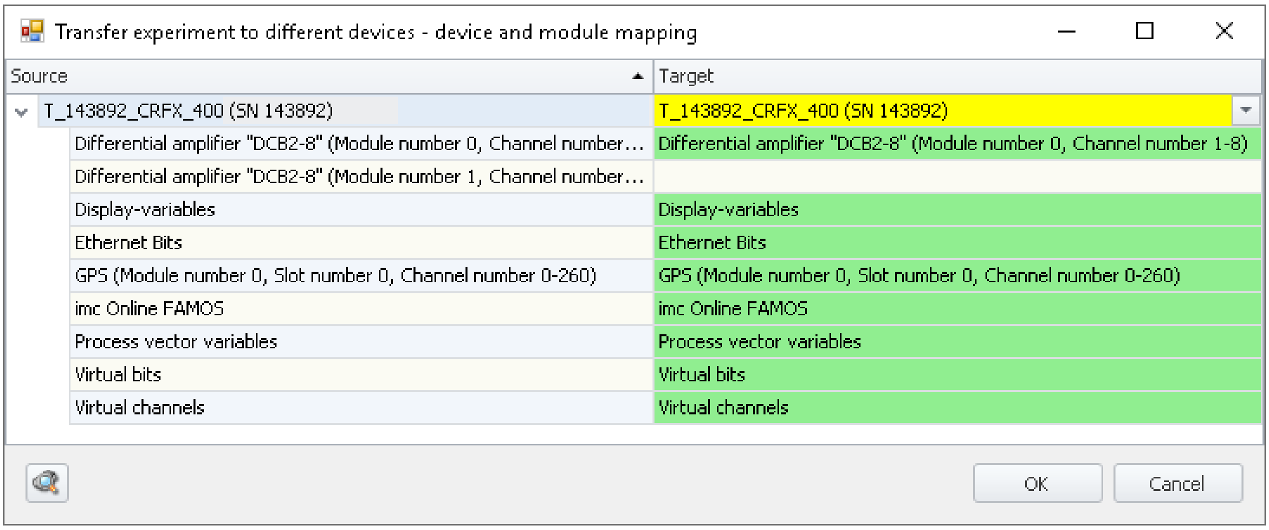
When connection takes place, the system checks whether the previously registered device and the actually connected device match. There can be discrepancies when modular systems are connected. If a difference is detected, the current device setup needs to be determined. Subsequently, the changes are reflected in imc STUDIO.

Warning

Please note that for this reason it may not be possible to apply the existing experiment settings. For instance, if the device previously had a bridge amplifier and it was replaced with a temperature amplifier

When changes are detected, a prompt appears which asks you how to treat the current configuration. You can **discard** the configuration or **transfer** it to the "current, changed" device. In this case, transfer the configuration to the device.

A module assigning dialog appears. If just a module was added, you do not need to make any changes here. But if you have replaced a module or if internal hardware has been replaced as part of some servicing work, please verify the assignment.



Transferring in the case of a changed device configuration

At left you see the older device and at right the new one.

Below the respective device, you see a list of all of a device's "Modules" and components. What this list contains depends on the device's hardware configuration. Use the drop-down-list at right to select the appropriate modules.

The colors:

Green: All of the module's settings can be transferred.

Yellow: Not all of the module's settings can be transferred. For example, the amplifier type may be different.

Please ensure that the target module is able to use the configuration required by the source module. E.g. a universal amplifier can use some of a temperature amplifier's settings.

Red: This assignment should not be selected.

What settings are applied:

In principle, all settings are applied, except for the calibration values (taring, bridge balancing, two-point scaling, ...). Settings which can not be applied are ignored and listed in the log book following the transfer.

Connected while the device is running a measurement

If an attempt is made to establish a connection with a device which is already running a measurement, you can either connect with the running measurement 169 or **stop the measurement** and connect with the device later.

Warning

When imc STUDIO establishes a connection with a running measurement, the current settings are discarded and the running experiment's settings are loaded.

7.2.1.2.1 Disconnect/Connect - with a measurement running

Disconnecting from the device during a running measurement - Disconnection file

If imc STUDIO is disconnected from the device during a running measurement (without stopping measurement), then a **disconnection file is saved on the PC**. This is loaded each time connection with the measurement is restored. The disconnection file reflects the **current state of the experiment** at the moment in time the **measurement starts**.

After "*Disconnect*" has been selected, the device resumes the measurement.

Note — No connection restoration without an experiment

If the **experiment is deleted** form the PC with the disconnection file, then re-connection with the running measurement is **no longer possible**.

Re-connecting with the measuring device

Disconnection and re-connection are performed on the same computer. In the meanwhile, imc STUDIO can be exited (or the computer can be shut down).

Upon re-connecting with a device currently running a measurement, the system **checks** whether the associated **experiment and the disconnection file are on the PC**. Only then is it possible to restore the connection. This means: If you start a measurement with computer A, then disconnect it from the device and later connect the device to computer B, this will not work.

If re-connection is possible, the **original experiment is re-loaded from the disconnection file**. Most of the time, a prompt to save data appears, since the currently loaded experiment will be discarded (even if nothing changes, the experiment is loaded).

Warning — Measured data are lost under "Current measurement"

Since the experiment is loaded from the disconnection file, the measured data are emptied from "Current measurement". They are thus no longer available. By contrast, the saved measured data remain available.

Note — Re-connection not via the Setup-table

Reconnection with the running measurement is only possible by means of the menu item "*Connect*". Not, by contrast, by means of the column "*Device control* 297".

Measured data and their storage during the disconnection phase

As long as imc STUDIO is not connected to the device, it is not possible to view the current measurement data.

After re-connection, data storage in the most recent files is resumed. A new "event" is generated (event-based data sets). The RAM-buffer contents are not imported. The data measured between disconnection and restored connection are missing and are not saved. Remedy: Save the measured data additionally to the device.

Exception: imc STUDIO is not closed between disconnection and re-connection, and additionally, no data gap is detected: In this case, the RAM-buffer's content is imported and saving is resumed without interruption.

Note

If a measurement is performed in disconnected mode and you establish a connection to the device only **after completion** of the measurement, then the **measurement data are not in the Data Browser**.

Connecting to a device running a measurement, which was started by a Diskstart/Autostart procedure

When a Diskstart configuration is generated, an additional **disconnection file is saved on the PC**. Connection to the measuring device proceeds in the manner described above for re-connecting.

If the selected data storage location is the device's "*removable drive*", then in addition to the Diskstart-configuration, the imc STUDIO-experiment (*.imcStudio) is saved to the device's removable drive. In this case, **it is possible to connect** with a device running a measurement, even **without an experiment and disconnection file**.

Editing an experiment created by connecting with a device

When connection to a device running a measurement is successful, the corresponding settings of all imc STUDIO components are loaded. These can be edited and used for re-configuring the device.

Warning Saving overwrites the experiment

Save the configuration, and thus overwrite the original experiment.

If you re-connect with the measurement at a later time, you automatically re-load the disconnection file. In consequence, you restore the old state.

7.2.1.2.2 Outage of the network connection

When the network connection between the PC and the device is lost, it often causes data to be lost also. Here, too, re-connection with the running measurement is performed. But this is to be distinguished from "*Disconnection and re-connection*".

Reference RAM Buffer Duration - Outage of the network connection

For more information on how to avoid loss of measured data and how to restore the connection, see the chapter: "*Setup - Advanced Device Functions*" > "*Storage Options and Directory Structure*" > "*RAM Buffer Duration - Outage of the network connection* 718".

7.2.1.3 Download and Reconfigure

Before first starting the measurement, the configuration must be loaded in the device. The device is initialized automatically if the configuration in the device is not up-to-date. If the device contains the current configuration, no initialization is performed.

In order to prepare the device, use one of the two possibilities below:

Action	Description
Reconfigure	All settings are analyzed and completely imported by the device.
Download	Changed settings are analyzed and completely imported by the device. If no changes are detected, the device's configuration is already up-to-date. The actual preparation process is not carried out in that case. If you wish to have it carried out anyway, you must run "*Reconfiguration*".

Ribbon	View
Home > Download ( )	Complete
Setup-Control > Download ( )	Complete
Setup-Control > Reconfigure ( )	Complete

Note

- Under some circumstances the action "*Process configuration* 167" is automatic executed first, if this had not been done already.
- For preparation and reconfiguration, the PC must previously have set op a connection to the device (see "Connect and Disconnect 167").

FAQ

Question: Why don't I have the buttons "Download" and "Reconfigure"?

Answer: These two buttons are only present in the "*Complete*" view. In most cases, the device does not need to be manually initialized. It is sufficient for the device to be automatically initialized upon starting the measurement.

If you need the function anyway, you can either change the view, or add the button to your user interface (see "Customize Ribbon 139").

Question: What happens when multiple "writers" each try to set their own value during the initialization (Download)? For instance, if a value is set for the DAC via a Widget, and also in imc Online FAMOS in the control command: "OnInitAll".

Answer: (as of firmware 2.8R7) To prevent signal jumps on a DAC-output channel, then during initialization, the system checks whether a DAC output channel is initialized in the "OnInitAll" in the imc Online FAMOS-code. If so, this value is used and any previously set value from the data pool (e.g. via a Widget) is ignored.

Question: The following error message is being posted: "The device has been shut down inaccurate in the past. Please check the uninterruptible power supply of your device!" What should I do?

Answer: When you shut down the device, it needs a few seconds to power down. During this time, the device is being powered by the internal UPS. If the UPS is defective, the device can not power down correctly and shuts down immediately.

Please check whether the device goes off immediately upon tripping the main switch, or only after one second or longer.

If the device goes off immediately, then presumably the UPS is not working correctly. Please get in touch with the imc Hotline 10.

7.2.1.4 Start and stop measurement

The measurement is started/stopped for all devices.

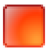
Note

- It may be necessary to carry out the "preparation 171", unless this has already taken place.
- For starting and stopping the measurement, the PC needs to have established a connection with the device (see "Connect and Disconnect 167")

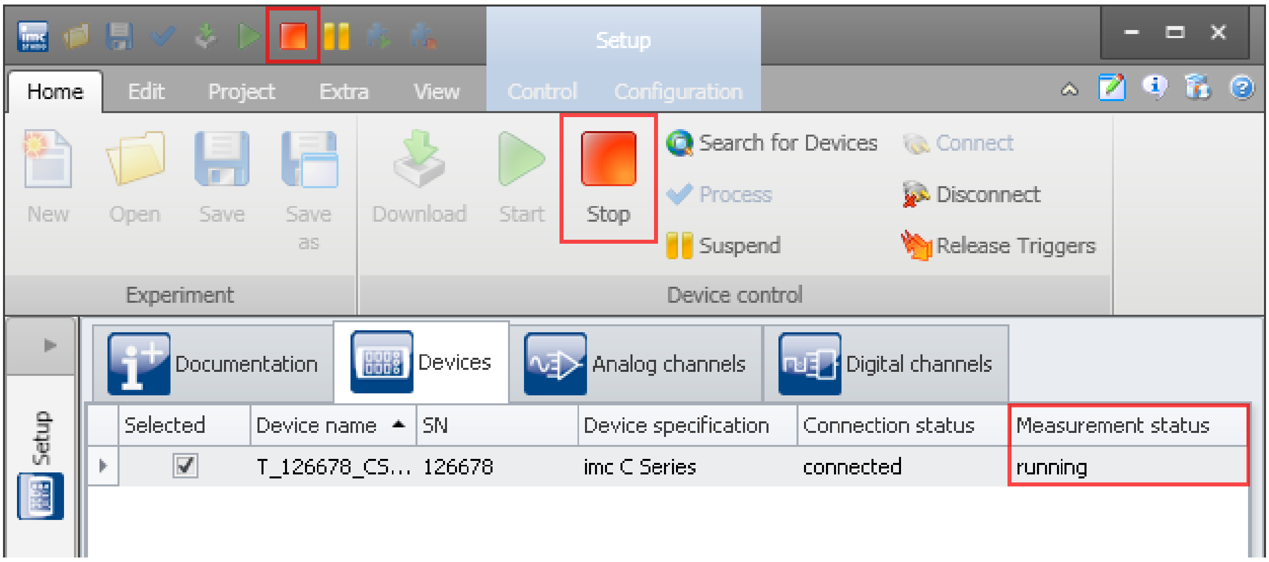
Ribbon	View
Home > Start ( )	all
Setup-Control > Start ( )	Complete
Home > Stop ( )	all
Setup-Control > Stop ( )	Complete

Measurement status (running, stopped)

The measurement's status is denoted e.g. by the stop-symbol (if imc STUDIO is connected with the device):

Icon	Description
	**Measurement running** (solid red)
	**Measurement stopped** (color depends on the Windows setting)

You can also see the status in the column "***Measurement status***" on the "**Devices**" page:



Column "Measurement status"

Note — 6 flashes during measurement

During a running measurement, LED 6 flashes at a 1-second rhythm. This provides a simple visual indication of whether the measurement is running.

LED 6 does not flash,

- if it is used in the imc Online FAMOS source code,
- if flashing is deactivated in the imc Online FAMOS Options,
- if imc Online FAMOS is disabled.

7.2.1.5 Suspend and Resume data storage

If the saving of measured data is activated 381, then you are able to govern the data storage **during the running measurement**. You can **interrupt (suspend) data storage** and **resume it again** at a later time.

Ribbon	View
Home > Suspend data storage ( )	all
Setup-Control > Suspend data storage ( )	Complete
Home > Resume data storage ( )	all
Setup-Control > Resume data storage ( )	Complete

Effect

If you **suspend data storage**, the **files are closed** and appear in the Data Browser (as if the measurement had been concluded). Any **more data** which arrive or are calculated subsequently **are not saved**.

When you **resume data storage**, then **new files are created** in a **new measurement folder** (as if the measurement had just been started). Any data arriving before "resumption of data saving" are not saved.

This function is designed for **interrupting data saving for longer periods of time**. Please do **not use it to make "cuts" of data records** (concluding one measurement folder and immediately beginning a new one).

Note

- Data storage **con only be controlled** if it was previously **activated**.
- This **suspension/resumption** of data storage **is not synchronized** across the devices! Thus, the respective **data excerpt boundary points** of different devices/channels **may differ by a few measurement points**.

Scope

These actions **apply to all devices and to the PC**. No separation is possible. Any additional components which return data to be saved (such as 3rd-party devices) are also affected.

Note Video-files are not affected

The **saving of Video files** is **not affected** by this function. Video files are always recorded.

Reference Data storage state after download

Using the option "Data storage state after download", you can control the function’s state. E.g. it is possible to make data storage generally active following "Download".

See the option: "*Setup*" > "*General*" > "*Data storage state after download* 115".

7.2.1.6 Search for devices

The device search causes the system to search the network for any suitable devices. How long this will take depends on how many devices are connected and on the network type. Ultimately, the devices found are listed and the view automatically switches to the "**Devices**" page of the plug-in **Setup**.

Ribbon	View
Home > Search for devices ( )	all
Setup-Control > Search for devices ( )	Complete

E.g., after the first launch of imc STUDIO, the device table 296 is empty. Before you can create an experiment, you must enter one or more devices into the table. To do this, perform a device search. The device table 296 lists all devices found. The image below shows a typical situation:

	Selected	Device name	SN	Device specification
	☐	T_124835_C1_1_LEMO_ET	124835	imc C1-1 LEMO
	☐	T_130039_busDAQ_X	130039	busDAQ-X
	☐	T_130311_SPARTAN_U32_CAN	130311	imc SPARTAN

Results of device search (example)

Reference

- How to correctly set **your device's network configuration** and what to make note of is presented in the chapter:
  "*Setting Up - Connect the device* 43"
- For more information on **selecting the device for the experiment**, see the chapter: "*Device Search - Known and Selected* 222"

7.2.1.7 Search for devices by IP/DNS (TCP/IP, PPP via a router)

In a structured network (network with routers, Internet, ...), imc devices could not be integrated by means of a network search. With the knowledge of the IP-address or of the domain name (DNS name), it is now possible to integrate a device into the Device Table 296 and to establish a connection.

Ribbon	View
Setup-Control > Search for devices by IP/DNS ( )	Complete

Reference

More information is presented in the chapter: "*Setting Up - Connect the device* 43" > "*TCP/IP, PPP via a router* 60"

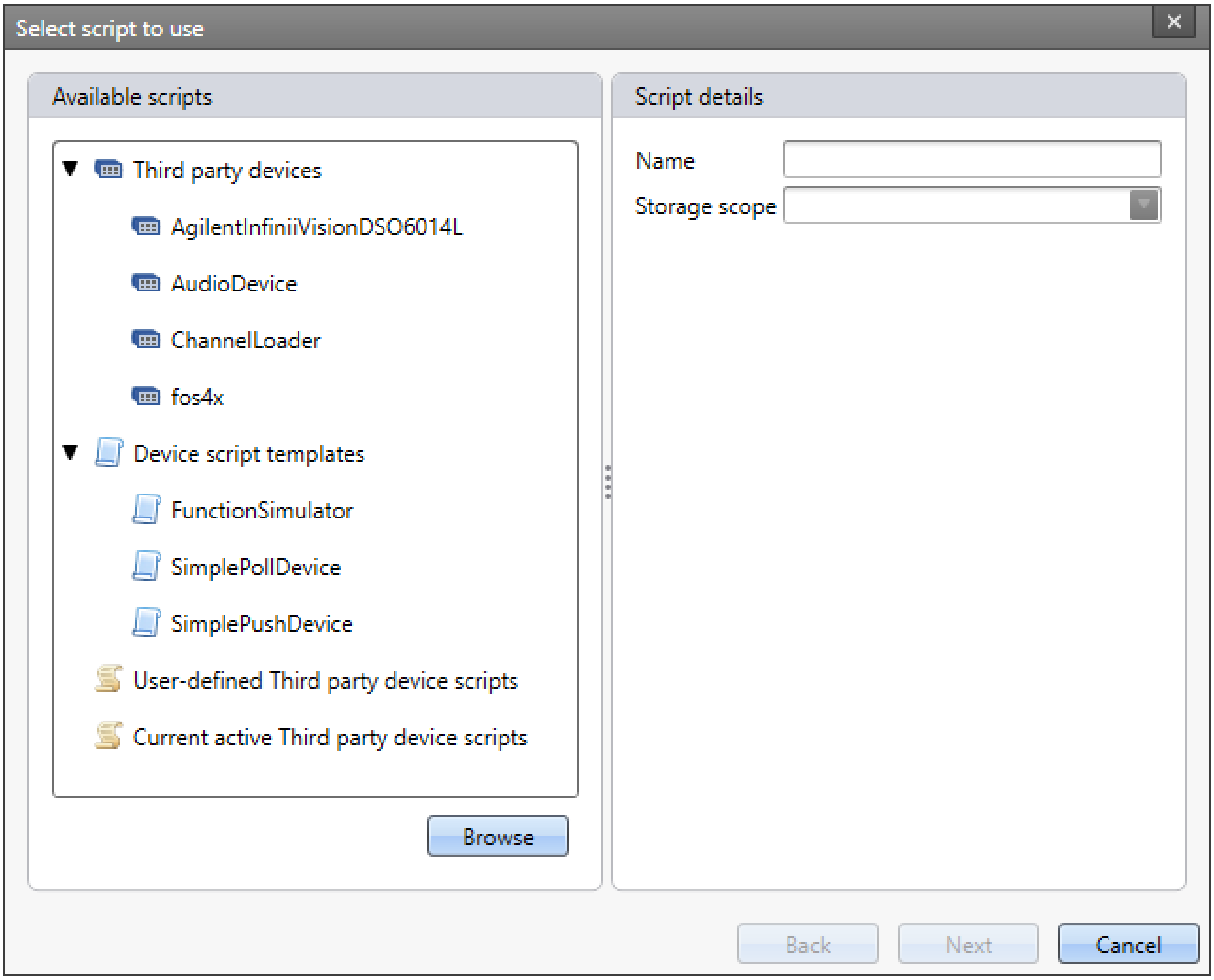
7.2.1.8 3rd Party Device Management

Using the **3rd-Party Device Management**, it is possible to select executable 3rd-party device script templates, e.g. the Function-Simulator, the SimplePollDevice or the SimplePushDevice. Likewise, there are already pre-made 3rd-party devices. Along with the AudioDevice and the ChannelLoader, the Agilent Scope and the fos4x are also available. The last of the two device require an extra license.

Note

- The 3rd-Party Device Management is available in the editions *Developer*, *Professional* and *Standard*.
- For the use of 3rd-party devices, an activated **imc STUDIO 3PDI-Inclusive** or **imc STUDIO 3PDI-Exclusive** license is required.
- The **AudioDevice** and the **ChannelLoader** can be used without any **3PDI license**.
- For the **AgilentInfinniVisionDSO6014L** an **imc STUDIO 3PDI-Digital Scope** license is required.
- For the fos4x device an **imc STUDIO 3PDI-fos4x** license is required**.**

Ribbon	View
Setup-Control > 3rd Party Device Management ( )	Complete



3rd Party Device Management Dialog

When selecting a script-template, there is an option for subsequently opening the Script-Editor.

User-defined scripts can be added by clicking on *Browse*.

In *Current active Third party device scripts* all Third Party Device Scripts are listed and can be deleted by selecting and clicking on *Next*.

Reference

For more information, see Scripting - Third Party Device 1860.

AudioDevice

In order to use connected Audio-devices, select the device-script *AudioDevice* and click on *Next*. Subsequently, all Audio-devices appear in the device list. When one of the Audio-devices is selected, the computer's Audio-input channels appear on the page *Analog Channels*. In this way, when a measurement starts, the computer's Audio-inputs can be graphed and recorded.

For more information on this subject, see the chapter AudioDevice 1873.

ChannelLoader

The *ChannelLoader* serves to play back data already recorded. To do this, select the *ChannelLoader* and click on *Next*. Subsequently, the device *ChannelLoader* appears in the device list. When *ChannelLoader* is selected, a file selection dialog with multi-selection appears. Here, multiple already-recorded data or imc FAMOS-data sets can be selected. On the page *Analog Channels*, the corresponding channels appear. When a measurement starts, then the selected data are played back cyclically at their respective sampling rates.

For more information on this subject, see the chapter ChannelLoader 1875.

Device script templates

The devices from the script-templates simulate a sine-signal, or in the case of the *FunctionSimulator*, a number of different signals (trapezoid, sawtooth, rectangle, ...).

7.2.2 Configuration

Note

In some dialogs (e.g. imc Online FAMOS), it is possible to make device-dependent settings. In that case, it is necessary to make a selection in the dialog of the device to which the settings pertain.

Assistants and Synthesizer

Menu item	Description
imc Online FAMOS	This starts the imc Online FAMOS dialog. For a detailed description, see the chapter: "*imc Online FAMOS and imc Inline FAMOS* 835".
imc Display Editor	This starts the imc Display Editor dialog. For a detailed description, see the chapter: "*Setup - Advanced Device Functions*" > "*imc Display Editor* 757".
imc CANSAS 183	This starts the imc CANSAS dialog.
Assistants	Here, a variety of setup assistants are offered. For a detailed description, see the chapter: "*Setup - Advanced Device Functions*" > "*Fieldbusses* 476".
Synthesizer Configuration and Synthesizer Control Panel	Operation of the Synthesizer is described in a separate document.

Device configuration

Menu item	Description
Export Configuration 228	This function provides a variety of exporting options. For most of the selection options, only the parameters (the content of the rows and columns) of the table on the currently open Setup page are exported.
Import Configuration 229	This function enables the import of parameters. You can also select from which file to import which variable's values and/or settings.
Statistic	Displays the dialog which shows various statistics on Setup parameters.
Default Values 187	These are preset values for the configurations of the devices and channel. These values are applied upon selection of devices and when creating new device variables/channels or Data Processing variables.
Device interfaces 53	Displays the dialog for configuring the devices' (network-) interfaces.
Diskstart 179	Displays the dialog for creating Diskstart and Autostart experiments.
Device Properties 194	Displays the dialog showing the device's properties.
Module Properties 199	Displays the dialog showing the properties of the device's amplifiers/modules.
Supplemental Files 185	Shows the dialog to manage supplemental files. Here you can export, import and view existing additional files.

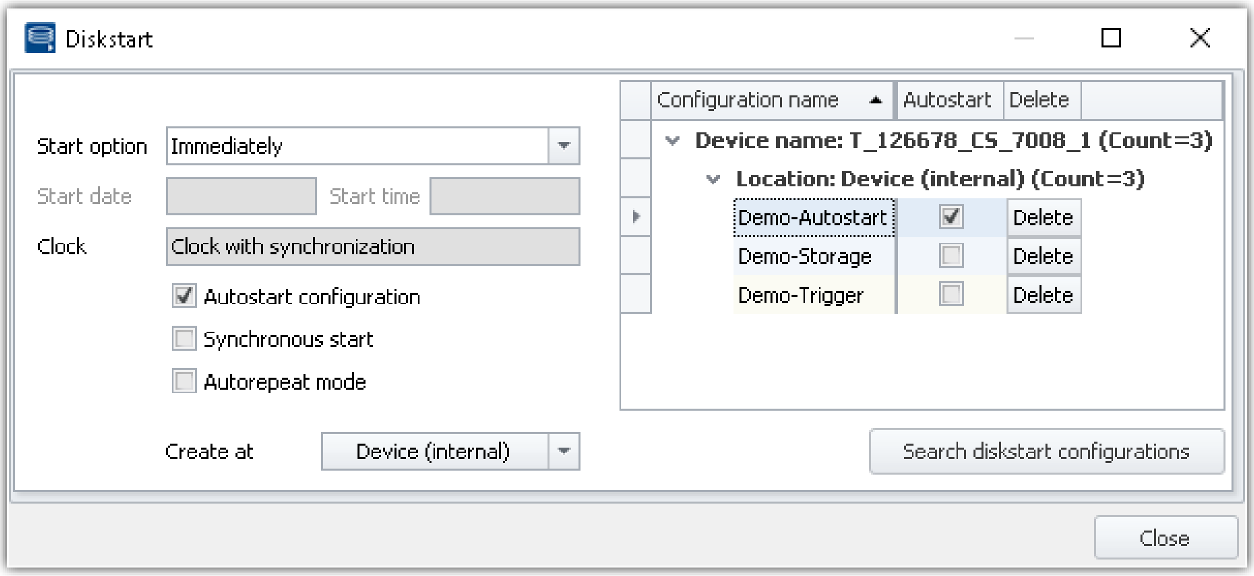
Edit

Menu item	Description
Create Process vector variable	This function creates a user-defined pv-variable 355 for a device. The variable can be used in imc Online FAMOS, as if it were declared there in the `OnInitAll`. A variety of data types are available. In the imc devices, the following data type can not be subjected to calculations: "*Float*"
Remove Rows	Deletes the selected pv-variable.

7.2.2.1 Diskstart

The measurement device is able to start a measurement without being connected to any PC. In most cases, this only makes sense of the data acquired are saved to the optional device hard disk. It is possible to save multiple, parallel Diskstart configurations in the device drive, but only one having the setting: "*Autostart configuration*".

Ribbon	View
Extra > Diskstart ( )	Standard, Compact
Setup-Configuration > Diskstart ( )	Complete



Diskstart without Autostart

Once the device has been activated, the Diskstart configuration can be selected by means of a connected Display unit. **For this, the optional Display unit is absolutely necessary.**

Diskstart with Autostart

If a Diskstart configuration having the property: "*Autostart configuration*" exists, then the associated measurement starts automatically as soon as the device is activated. This is done **without selection by means of a Display unit**. All other Diskstart configurations located on the device HD are thus no longer available for selection.

Exactly one Diskstart configuration having the property: "*Autostart configuration*" can be saved.

Start option

Start options are available both for the normal start (in response to the Start button), as well as for the Diskstart. The functionality is described in the chapter "Timed start 344" (the limitations and conditions are delineated).

Clock

The start condition "**Synchronous start**" ensures that the device only starts measurement once the device clock has been synchronized according to the synchronization settings 301.

Observe the "*maximum time to wait*", which is set in the device properties 197.

Autorepeat mode

When a Diskstart is performed, then after the end of a measurement, the measurement devices are able to start it again right away. This mode is called "*Autorepeat mode*".

Note — Note on Timed start with Autorepeat

In "*Autorepeat mode*", the duration between the measurements is not defined. For this reason, the Timed start only works for the first measurement. All subsequent measurements then start immediately.

Note — Autorepeat under imc STUDIO

In imc STUDIO, "*Autorepeat mode*" is replaced with a variety of other components, e.g. the Sequencer. The program can additionally be configured with an equivalent triggering setup.

For this reason, the "*Autorepeat mode*" only remains available for Diskstart.

Autonomous starting of a measurement makes imc STUDIO unable to connect with the running measurement without problems.

When imc STUDIO connects with the running measurement, the Autorepeat mode is deactivated. This means that the measurement is still concluded properly, but will not be re-started again afterwards.

Balance at device startup

Activate the property "*Balance at device startup*" (Setup page: "*Channel balance*" or "*Analog channels*") for the desired channels. If you wish, you can also display the parameter of the same name as an additional column by using the "*Column chooser* 254".

Parameter Category: Channel	Description *long name*	 *short name*	 *column ID*
Balance at device startup	*Balance at device startup*	*Balance at startup*	*eBalanceAtDeviceStart*
	This parameter has two purposes: • Before a Diskstart/Autostart measurement starts, it is possible to perform **balancing** for selected channels. • The channels selected can be balanced using the **imc Online FAMOS function** `RunAutoBance()` 1001. This balancing operation starts automatically before every Diskstart-measurement. The type of balancing performed is set on the following page: Setup page: "*Channel balance*" > "*Balance* 387". Available options: Taring or bridge balancing (depending on the hardware).		

Note

The system performs a version check (to determine the firmware version). A Diskstart configuration is generated for precisely the current firmware version. if the device's firmware version is changed (e.g. by means of an update), then it is no longer possible to load the existing Diskstart configuration, or the configuration is canceled with the error message "Error: -132". Once the Diskstart configuration has been generated again, it can be opened again with the current Devices-software version.

7.2.2.1.1 Creating a Diskstart configuration

You can save an experiment as a Diskstart configuration

- directly in the device (on the device's hard drive ("*Device (internal)*" or "*Removable drive*")
- or initially on the PC ("*PC harddisk*"), if, for example, the measurement device is not available and the data are copied to the removable data carrier later.

Note

- If the storage location is: "*Removable drive*", then in general the complete imc STUDIO experiment is saved to the data carrier. The storage location: "*Device (internal)*" is not sufficiently large.
- If the Diskstart configuration is saved to the "***Device removable drive***", any PC having the correct imc STUDIO version can **connect** with the running measurement **without having the experiment stored** (see: "*Disconnect/Connect - with a measurement running* 170").
- When the option "*Synchronous start*" is activated, the device waits until it has been synchronized to the synchronization source specified. If the synchronization source is no longer present, the response depends on the device properties: the option "*Max. time to wait for synchronization*" > "0" starts the device immediately even without synchronization when the time elapses. For a value of "0", the waiting period is Unlimited; for "-1" it starts immediately and does not synchronize.

Precondition for both options:

- The desired device must be registered with the program.

Preconditions for the storage locations: "*Device (intern)*" and "*Removable drive*":

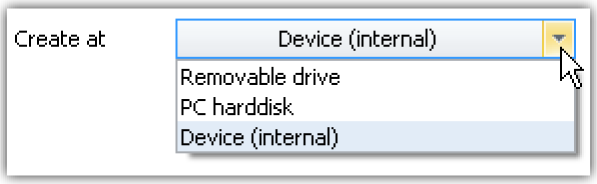
- A connection must be established between the device and PC.
- The device must have sufficient memory.

Creating a Diskstart configuration

Proceed as follows to create a new Diskstart configuration:

- Ensure that there is a connection between the device and the PC (if the selected storage location is ("*Device (internal)*" or "*Removable drive*").
- Select the menu ribbon item "*Setup-Configuration*" > "*Diskstart*" ().
- Make the appropriate settings for the options *"Start option" and "Start date/-time"* 345.
- Activate the option: "*Autostart configuration* 179" if desired.

- Open the list box "*Create at*" and select the appropriate entry.



- Click on the button "*Create at*"

Note

- When the Diskstart configuration is created, an "ume-file" or "ums-file" (if with "*Autostart*") is generated on the basis of the current experiment settings. Saving the current experiment configuration is not necessary for this purpose. But there may be different experiments on the device hard drive from the PC.
- If "*PC harddisk*" is selected as the storage location, then an "ume"/"ums"-file is created on an arbitrarily selectable path. A corresponding experiment file ("**.imcSudio*") is also created.

Storage location: PC hard drive

If your measurement device is currently not available, you can set up a Diskstart by selecting the "*PC harddisk*" was the storage location.

Two files are created in the selected storage location:

- **Diskstart configuration file** for the device: "*.ume.zip" (without "*Autostart*") or "*.ums.zip" (with "*Autostart*")
- a corresponding **imc STUDIO experiment file**: "*.imcStudio"

You have thus created a configuration file which can be used for Diskstart.

The Diskstart configuration file can now be copied to a removable disk.

- Insert an appropriate removable drive into your PC.
- Create a **subfolder having the experiment's name** and copy both files to the subfolder created.

Example Example without Autostart

Experiment name: "Experiment_001"

Device name: "dev001"

Drive name for the removable data storage medium: "D"

```
D:\Experiment_001\Dev001.ume.zip
D:\Experiment_001\Experiment_001.imcStudio
```

Note Changing a Diskstart to a Diskstart with Autostart

It is possible to generate a Diskstart configuration with Autostart from an existing configuration without Autostart, without needing to create a new file.

To do this, change the file extension:

*.ume.zip (without "*Autostart*") --> *.ums.zip (with "*Autostart*")

7.2.2.1.2 Deleting a Diskstart

To delete a Diskstart configuration, proceed as follows:

- Ensure that a connection has been established between the device and the PC.
- Select the menu ribbon item "*Setup-Configuration*" > "*Diskstart*" ( ).
- If the desired configuration name does not appear, click on the button "*Search diskstart configuration*". All existing Diskstart-configurations will then appear in the table.
- Click on the button "*Delete*" next to the configuration to be deleted in the table.

7.2.2.1.3 Selecting and starting the Diskstart configuration

The Diskstart configuration is created and and saved to the device.

After activating the device, the removable drive and any hard drive are automatically searched for Diskstart configurations. If one or more Diskstart configurations are found, then a selection list plus some brief instructions are offered on the device display.

Selection of the Diskstart configuration is only accomplished by means of the device's display; no PC or connection to a PC is required.

Following selection of the Diskstart configuration and confirmation of the selection, the device can be configured and started at the push of a button.

7.2.2.1.4 Connecting with a running Diskstart measurement

Information on establishing a connection between a PC and a device running a Diskstart measurement are presented in the chapter: "Disconnect/Connect - with a measurement running 170".

7.2.2.2 imc CANSAS

This starts the imc CANSAS dialog.

Prerequisites

To see this entry it is necessary that

- the imc CANSAS configuration software is at least from version 1.4Rev 5 and
- the measurement device is equipped with a CAN interface of type CAN2.

Reference	Manual

- The Help for the imc CANSAS configuration software can be opened by function key [F1] from the imc CANSAS assistant.
- As a manual in PDF format it can be copied from the setup-CD for imc CANSAS.

Integrating the imc CANSAS software with imc STUDIO

Certain functions and menu items aren't available for calling from imc STUDIO. For example, the imc CANSAS configuration is not administered as an MDB-database, since it is saved along with the experiment under imc STUDIO. XML-export/import is possible.

Access to the imc CANSAS hardware is provided via the measurement devices' CAN-Bus hardware. This communicates via Ethernet, so that all interfaces incl. imc-USB as well as the Interface-Dialog are blocked.

Note — Do not make changes to the channel settings in imc STUDIO

Please **do not make any changes to the properties** of imc CANSAS-channels by means of the imc STUDIO-software's configuration pages. This includes not making such changes as: name, comment, sampling interval, unit and X-axis.

Instead make these settings in the imc CANSAS-software. If you do make any change in imc STUDIO, an error message will appear upon preparation.

Error correction: Please undo the changes (e.g. by means of the menu ribbon item "*Edit*" > "*Undo*"). Or, open imc CANSAS and then close it one time. All settings will be re-imported and the configuration will be corrected automatically.

When using imc STUDIO to configure the imc CANSAS modules, the modules are integrated by the device in a similar manner as amplifiers. This requires unique identifiers, since the process of preparing the measurement includes checking and setting the imc CANSAS module configurations. This substantially simplifies the operation of imc CANSAS modules, since the steps of exporting and importing CAN-Bus configurations are avoided.

Constraint

An Experiment involving imc CANSAS modules which were integrated into the system using the CAN-Assistant of imc STUDIO expects exactly the same imc CANSAS modules to be present when a measurement is prepared. Thus, if a previously integrated imc CANSAS module was removed from the measurement setup, then an error message is posted upon the next startup, since the missing module can no longer be addressed. It is only possible to start the measurement once the module has been removed from the setup using the CAN-Assistant. Even replacing a module with another which is identically configured will cause an error, since imc STUDIO will initially not recognize the replacement module. Measurement can only proceed once the new module has been exchanged and configured in the imc CANSAS interface. This means that replacement is not possible during a running measurement, even though the CAN-Bus technology supports it.

Remedy

This response can be avoided in either of two ways:

1. Direct configuration of the imc CANSAS modules using the PC-interface

If imc CANSAS modules are likely to be exchanged or removed in the course of a measurement project, it is worthwhile continuing to work with the imc CANSAS software and a CAN/PC interface. In that case, the configuration can be imported to imc STUDIO as a CBA file. Later, if any imc CANSAS module is replaced by another which is configured in the same way, the measurement procedure will not be adversely affected. If any imc CANSAS module is removed, the measurement will start without any error message being posted, but no data will be accumulated for that module’s channels. This case can be monitored using either dedicated error checking for individual channels, or the Heartbeat function.

2. Setting parameters and creating CBA files

When exchanging, removing or adding a imc CANSAS module, the following steps are necessary:

a) Once all imc CANSAS modules have been configured in the imc CANSAS Assistant, open the CAN-Assistant and export the CAN-Bus configurations for each node as a CBA file.

b) Save the Experiment for later changes under a new name.

c) Open the imc CANSAS Assistant from within the imc STUDIO program and remove all imc CANSAS modules. The CAN-channels will then be removed in the CAN-Bus Assistant.

d) Open the CAN-Assistant again and import the previously created CBA file for the appropriate node.

e) Save the Experiment under a new name. The imc CANSAS channels will then be measured like before, as described in step 1. However, the checking of imc STUDIO is omitted.

f) This procedure doesn’t create a database available in imc CANSAS. In order to reconfigure the imc CANSAS modules, the Experiment previously saved in step b) must be opened. Once adaptation of a imc CANSAS module has been carried out, its node in the CAN-Assistant must be saved again as a CBA file as described in step d). Then, open the Experiment saved under step e) and import the altered node into the CAN-Assistant.

7.2.2.3 Supplemental Files

Supplemental files are **files saved in the device**. For instance, it is possible to **access** a characteristic curve supplemental file **with imc Online FAMOS**.

Additionally, you can also import a supplemental file **for a imc Inline FAMOS-task**. An imc Inline FAMOS-task is treated exactly the same as a device. Anything stated below about devices also applies to any imc Inline FAMOS-task.

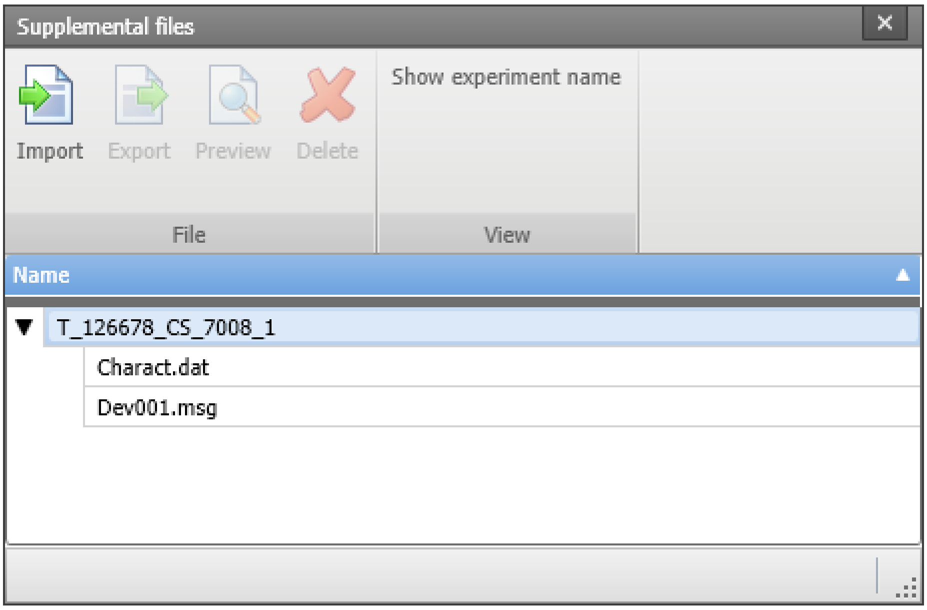
The following supplemental file type are available:

- Characteristic curves and filter data for imc Online FAMOS / imc Inline FAMOS (*.dat)
- imc Online FAMOS source code (*.ofa)
- Synthesizer directory structures (*.dat)
- Messaging configurations (e-mail, SMS, UDP, ...) (*.msg)

Ribbon	View
Setup-Configuration > Supplemental Files	Complete

The Supplemental files dialog

In this dialog, all existing supplemental files are listed according to their associated selected device. In the example below, there is a device having a characteristic curve file (Charact.dat) and a messaging configuration file (Dev001.msg).



Dialog: Supplemental Files (example)

By means of this dialog, supplemental files can be:

- deleted,
- displayed (Preview),
- exported,
- and new files can be imported (also possible by means of the menu ribbon item "*Project*" > "*Import / Export* 104")

Import

- After clicking on "*import*", **select the file desired** from the file selection dialog.
- If you use **multiple devices** in the experiment, then after selection of the file, a device selection dialog appears. Here, you can **select to which devices to import** the file.

Imported supplemental files are saved in the Experiment-file. When the **measurement is downloaded**, the supplemental files are **copied to the device memory** (except imc Inline FAMOS-supplemental files). In this way, it is possible for imc Online FAMOS, for example, to access the file without needing to be connected with the PC.

Renaming

Click the mouse on the name of a file to be imported. A cursor appears, and you can rename the file.

Preview

Using the function "*Preview*", an **external program** is started, which opens the file selected.

Changes which were made by means of the external program **can not be applied** automatically in the existing supplemental file. If you wish to save the changes made, save the file as a copy in a different folder, and then import this new file.

7.2.2.4 Default Values

Default values are pre-set values for the configurations (parameters) of the devices and channels (e.g. saving to the device). It is possible to specify either individual parameters or whole groups of parameters.

The default values are applied when the device is selected and when creating new device variables/channels as well as Data Processing-variables (e.g. for virtual channels and Field-bus channels).

When does it make sense to alter the default values?

When the default settings of the devices and channels are not appropriate for most of your applications.

Ribbon	View
Setup-Configuration > Default Values ( )	Complete

In this dialog, all available default values are listed.

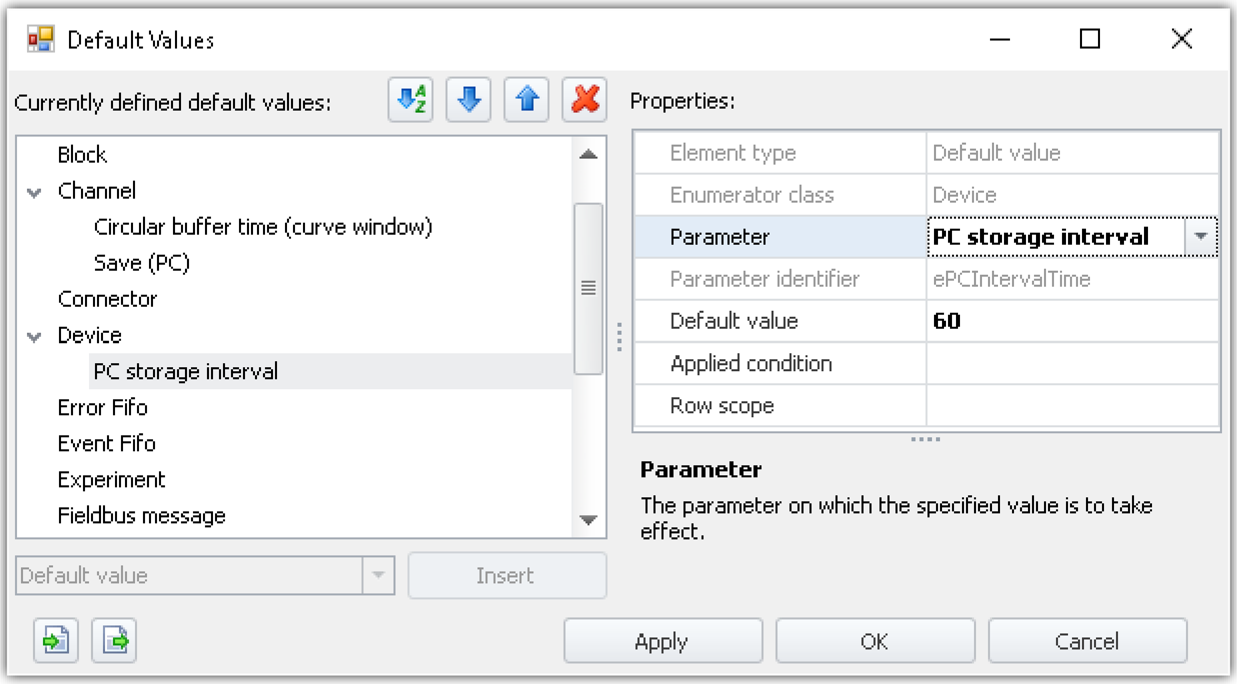
Example:

- For all channels, the channel saving on the PC should be activated. It is possible to later deactivate data saving for each channel separately, but after having been set up, each channel should start off being saved.
- The circular buffer for the curve window should always be set to "*Undefined*" after selection of the device.
- The interval storage should always be activated after selection of the device.

Note

Ensure that these settings are set initially (e.g. upon device selection). Subsequently, every parameter can be modified.

With the default settings, it is possible to set parameters in dependence on other parameters.



Example of default values: "PC storage interval" is set to "60 s"

Creating default values or groups of default values

In order to create "Default values" or "groups of default values", open the dialog: "Default values" (Ribbon "*Setup-Configuration*" > "*Default Values*").

- In the left-side portion of the dialog, select an appropriate Enumerator-class (application area of the parameters). A list of the classes and the areas they contain is presented in the chapter "Enumerator-class 245".
- In the drop-down selection list (lower left), select "Default value" or "Default value group".
- Click on "*Insert*" and the element is created at the location selected.
- In the "*Properties*" windows, you can set the target parameter, the default value to be set, and any other settings such as the applied condition, etc.

Properties

Property	Description
Element type	Makes the distinction between a default value and a group of default values. (write-protected)
Enumerator class	Specifies in which Enumerator-class the element belongs. (write-protected)
Parameter	The parameter to which the default value is to be applied. Select the parameter here.
Parameter identifier	The parameter's unique designation. (write-protected)
Default value	The value to which the specified parameter is to be set. E.g., when selecting a device or when creating virtual channels.
Applied condition	Here, you can define various logical conditions which allow default values to be set in certain cases. See also "*Order and dependencies of the default values* 189".
Row scope	Determines to which rows the default value is to be applied. Specifies row numbers, separated by commas, or ranges by using the minus sign. The first row has the index: "1". Example: 1-4: The first four parameters found are set. Thus for instance, an amplifier's first four channels can be modified, and the last four by specifying "5-8". The following is also possible: 1,6-8. The order does not necessarily match the table sorting arrangement displayed. For instance, after the analog channel "*[01] IN01*", the associated monitor channel appears. For this reason, use a well-defined "*Applied condition*" in order to set clear boundaries. For example, among others the channel type should be included.
Group name	The group mane displayed. The name can be entered to be particular to selected languages. The respective name is then displayed in accordance with the particular language setting. If the (non-English) name is empty, then the English name is always used.

Order and dependencies of the default values - Sorting and deleting

To **sort** entries, use the "up/down" arrow-symbols (/) or move them by means of Drag&Drop.

To **delete** entries, use the "X" symbol ( ).

Sequential order

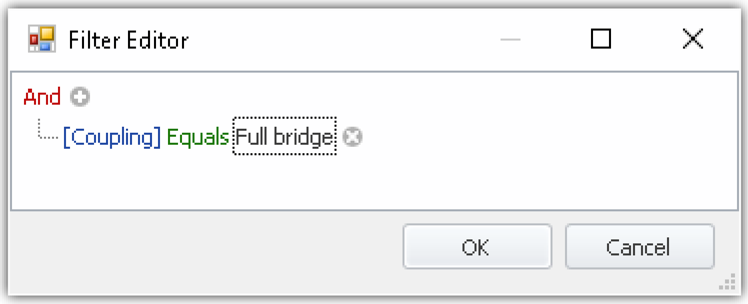
The order of the entries affects the results. The default values are set from top to bottom in succession. Since the values can be set to depend on other parameters, this is important to take into account.

Example:

The balance action is to be set to "Bridge" for all channels having the coupling "Half bridge". However, beforehand all full bridges must be set as half bridges.

Setting up dependencies

The dependency is defined by means of the property "**Applied condition**" using the Filter Editor. Here, you can enter various logical conditions. In the example mentioned above, that would be the following logical condition:



In order for the dependencies to be language independent, they are resolved in the list into the internal parameters. In this case: ([eCoupling] = 5).

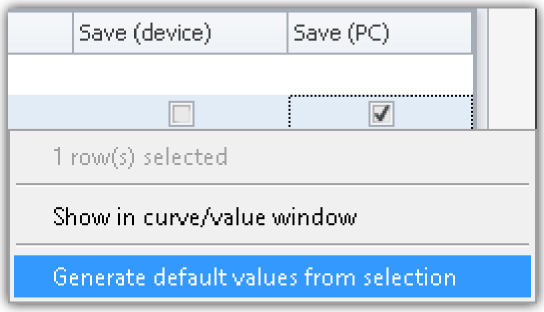
Dependencies can be defined either for each default value separately or for a whole group of default values. In this case, add a "Default value group" and add the respective parameters to the group. Define the application condition for the group. The individual default values do not require any application conditions of their own, but may also have separate conditions.

Generating default values from the current settings (tip)

It is often tedious and not so easy to set the default values correctly. Sometimes it is more reliable if the internal specifications are used to set the measurement range, for example.

In order to get familiar with the default values or to set up many parameters quickly, it is best to generate the default values from existing settings. By means of the channel table, you can define the selection as a default value.

To do this, open the context menu and select: "*Generate default values from selection*".



Context menu of a cell
Generate default values from selection

A dialog for setting the Default value group provides help in finding an appropriate condition. Select the condition for which the default value is to apply. The condition is entered in the generated group as the applicability condition.

Example:

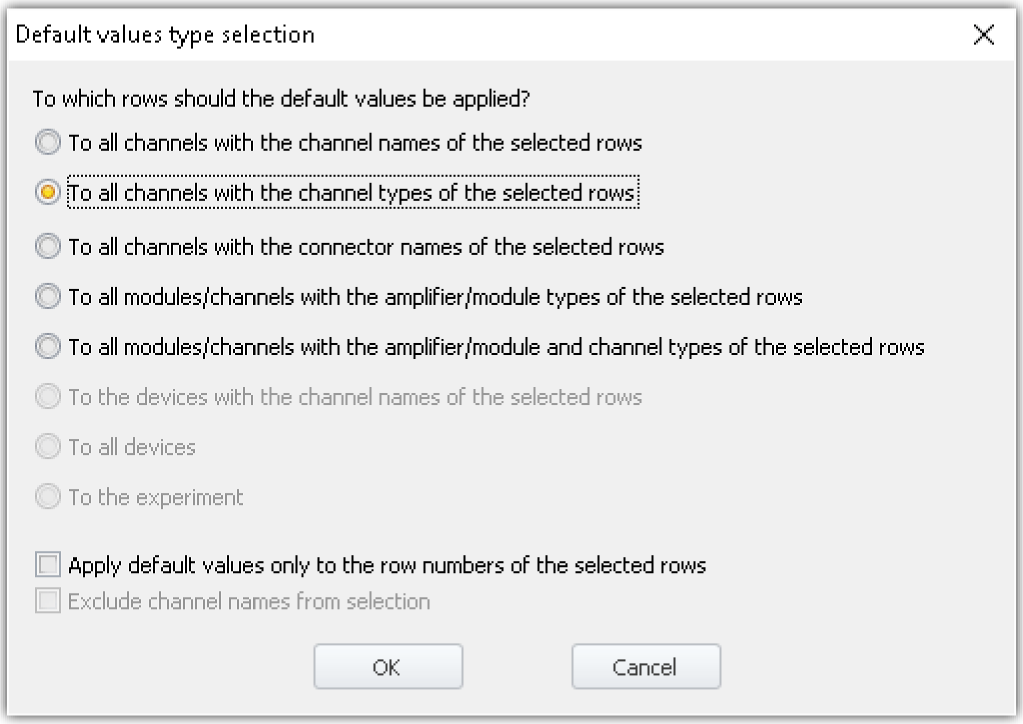
Make the following parameter settings for an analog channel:

Parameter	Value	Dialog (View: *Standard*)	Dialog (View: *Complete*)
Coupling	Half bridge	Measurement mode	Measurement mode
Input range	±10 "mV/V"	Measurement mode	Range & Scaling
Sampling rate	10 kHz	Sampling & Filtering	Sampling & Preprocessing
Save data (PC)	activate	Data transfer	Data transfer

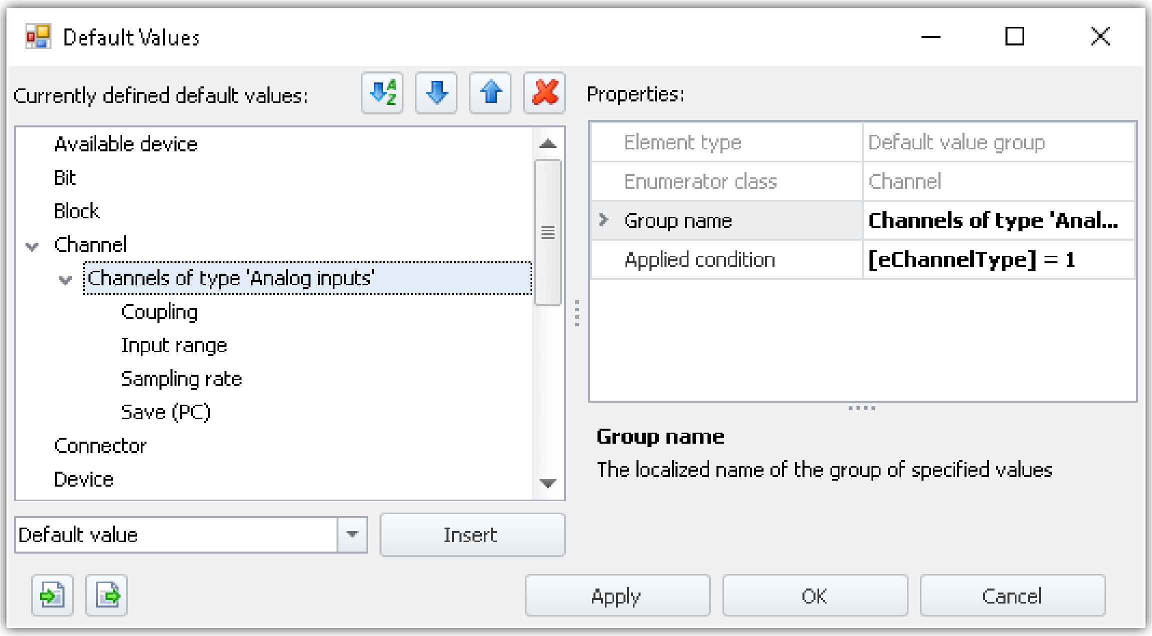
These settings are also found in the channel table in various columns. If you generate default values from a combined column 260 (one with multiple parameters), all of the column's parameter are set as the default value. In this case, either you have the desired parameter displayed 254 as a normal column and create the default value only from it, or you can later delete any default values not required.

Below, the second way is described:

- Select the (combined) columns: "Measurement mode", "Range & Scaling", "Sampling & Filtering" and "Save (PC)"
- Open the context menu and select: "*Generate default values from selection*"
- In the subsequent dialog for selecting the condition, select, for instance "*To all channels with the channel types of the selected rows*". Thus, a group is generated with the applicability condition: "*Channels of type 'Analog inputs'*"



- Open the dialog "Default values" and delete from the group generated all parameters which are not to be set.



Example: Setting default values for multiple parameters.
But only for the channels of type 'Analog inputs'

- Upon the next device selection, the analog channels are modified accordingly.

Note — This example serves illustration purposes and is incomplete!

In any case, ensure whether every analog channel you use can really be used as a bridge amplifier. In that case, use the additional condition that only such channels are modified which can be set as a full bridge.

The pre-defined conditions

Conditions	Examples
To all channels with the channel names of the selected rows	"Channel name" equals "Channel_001"
To all channels with the channel types of the selected rows	"Channel type" equals "Analog inputs"
To all channels with the connector names of the selected rows	"Connector" equals "[01] IN01"
To all modules/channels with the amplifier/module types of the selected rows	"Module type" equals "Bridge, current and voltage amplifier and temperature measurement unit "UNI2-8""
To all modules/channels with the amplifier/module and channel types of the selected rows	"Module type" equals "Bridge, current and voltage amplifier and temperature measurement unit "UNI2-8"" AND "Channel type" equals "Analog inputs"
To the devices with the device names of the selected rows	"Device name" equals "imc_CS_7008_1"
To all devices	empty (thus, all devices are affected)
To the experiment	

Additional options	Description
Apply default values only to the row numbers of the selected rows	In the default values, the property: "Row scope" is set accordingly. E.g., the value "2" is entered if the second analog channel was selected.
Exclude channel names from selection	The channel name is not set as the default value even if it is selected.

Note — Saving the default values

The **configuration of the default values** is saved with the respective **installation** ("**application**"). Thus, the default values are available in all experiments which were generated with that installation of imc STUDIO.

These settings are only saved if the "**project**" is also saved.

Transferring default values to other PCs or installations (import/export)

In order to transfer the default values, use the Import/Export icons(/).

Warning All existing entries will be deleted

If any default value already exist at the time of import, they will be deleted. After the import, only the imported default values are available.

7.2.2.5 Device Properties

That dialog shows the configuration of the device. Most properties depend on the hardware. For example changing the type of the display is only useful, if the device is not equipped with an internal display.

Ribbon	View
Setup-Configuration > Device Properties	Complete

A message is warning for wrong settings when opening the dialog. Please contact the imc Hotline 10 before changing the settings.

Note

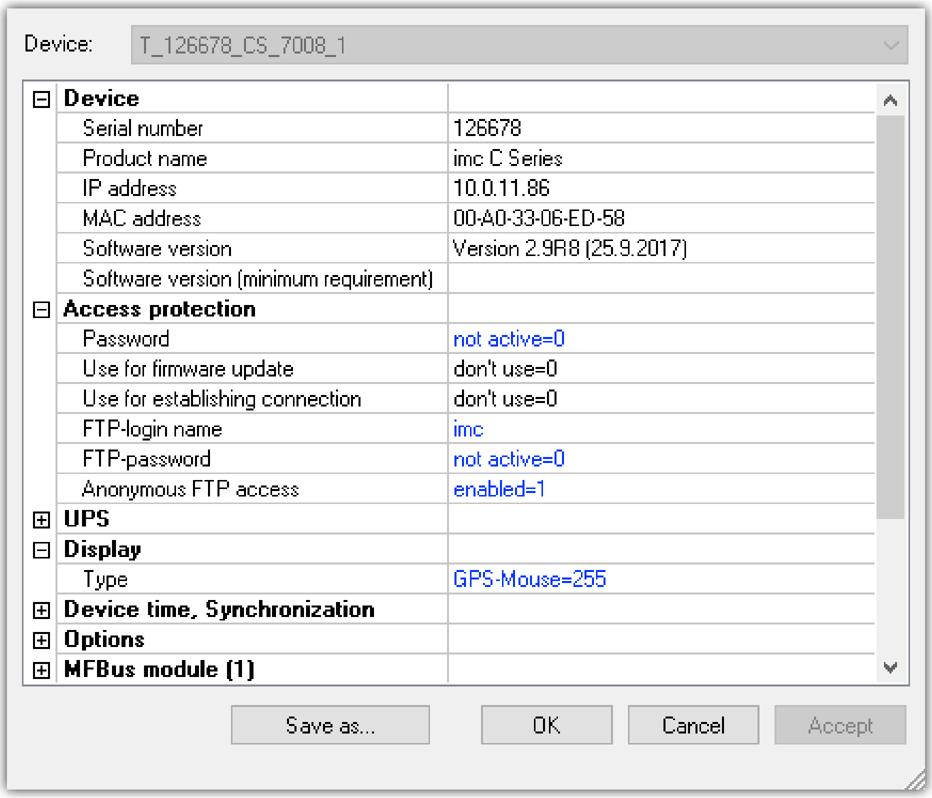
Restart

All changes of the settings need a restart of the system!

Log file

Whenever changed device properties are adopted, a text file is generated. All information on the device properties currently set is saved as soon as the button "*Apply*" in the Properties dialog is clicked.

- Storage location: Firmware folder of the device software, e.g. "*C:\Program Files (x86)\imc\imc_DEVICES_2.13R3\Firmware*".
- Name of the file: "*PropertiesLog_<Devicename>_yyyy-MM-dd_HH-mm-ss.txt*"



Device properties

Property: Device	Description
Serial number	Serial number of the device. Can't be changed.

Property: Device	Description
Product name	Device types: imc C-SERIES, imc CRONOS*compact* etc.
Software version	Version of the firmware.
Software version (minimum requirements)	The minimum required software version to run the device as configured. This prevents downgrading to a version which would not support parts of the device.
GPS receiver	Here, any available information on the GPS receiver, for example the identifier and the version, is displayed.

Property: Access protection	Description
Password	For protection against firmware update or connection setup. To delete the password, enter the valid password again.
Use for firmware update	Enable and Disable of firmware update 87.
Use for imc REMOTE WebServer	Enabling/disabling of operation via the device's Web-Interface.
Use for establishing connection	Enabling/disabling of the connection to the device (FTP, LAN, imc REMOTE SecureAccess 61). When the device is newly integrated in consequence of a device search, it is necessary to enter the password twice. The first time is for establishing the connection in order to "know" the device, and the second time is for the purpose of entering the device in the list.
Certificate	The certificate needed for setup of a connection via imc REMOTE SecureAccess. Here, select the certificate "imcCert.cpt", which is in the installation path under "*Firmware\Idif*\", e.g. "*C:\Program Files (x86)\imc\imc_DEVICES_2.13R3\Firmware\Idif*". The certificate is always valid for one year and must be replaced upon expiration. The certificate is obtained from imc Hotline 10.
Expiration date	Expiration of the above mentioned certificate.
FTP-login name	Login name for FTP access
FTP-password	Password for FTP access
Anonymous FTP access	**enabled=1:** No prompt for "*FTP-login name*" and "*FTP-password*" **disabled=0:** The "*FTP-login name*" and "*FTP-password*" are used

Property: UPS	Description
Acquisition time after power fail [s]	Maximal measurement time after loss of supply voltage. The factory set time can be changed by the user. This entry has to be aligned with the hardware, thus may not be changed without consultation with imc. In case **the power of the accumulator is not sufficient**, data of devices will still be saved.

Property: Display	Description
Type	Type of display; alphanumerical, graphical and its resolution. The alphanumerical display is not supported for all devices. Devices having an internal display can only control one type. Technically an internal display is a "normal" display with a mounted cable. So even for these devices the display type can be changed. That connector could be used for a **GPS-mouse**, too. To change it, select the entry "*GPS-Mouse=255*". That option is not available for all devices. In case of doubt contact the imc Hotline 10. After switching to GPS, all GPS signals can be received be the process vector variables.

Property: Device time and synchronization	Description
Time zone	*none*: Devices behave as in versions prior to imc DEVICES 2.7R3. The device seems to apply the time source's time zone. With download by the PC: the device runs in the PC's time zone With synchronization: the device seems to run in the synchronization source's time zone If a time zone is set, then when the device clock is set the time source is converted to the device's local time. For this purpose, the time source's time zone must be known. When setting the device clock, the PC tells its own time zone to the device. With all sources which send NMEA strings to the device's RS232 interface, it is assumed that the time is expressed in UTC. All time information at the Sync socket (DCF/IRIG B) is expected to conform to the time zone set for the device!
Daylight Saving Time	• **activated=1:** the device automatically switches to/from daylight saving time. • **deactivated=0:** the device uses standard time all year round!

NTP	• **Server (1), (2):** IP-address or name of server
	• **max time discrepancy [ms]:** States the permitted time discrepancy from the NTP-Server in ms, up to which the device is still considered synchronized. When this discrepancy is surpassed, the message – "*Not synchronized*" or "*Synchronization in progress..*".. is displayed.
	For the sake of the measurement precision and comparability of measured data, we recommend increasing the value of this entry if the discrepancy is big. Otherwise it will be necessary to dispense with synchronization completely.
	• **Interval[s] (min;max):** Specifies the minimum and maximum time for the synchronization intervals, to which the following applies:
	  ◦ Short intervals provide higher accuracy, but make more demands on the network.
	  ◦ Long intervals may produce lower accuracy, but make less demands on the network.
	
	Accuracy:
	• If the external conditions (mainly temperature, network resource requirements) only fluctuate slightly, then the accuracy may be high even with long intervals. Shorter synchronization intervals should be selected if, for instance, frequent temperature fluctuations are to be expected.
	• NTP-Standard: min = 16 s, max = 1024 s. This value is also used if nothing was entered. This is adequate for constant temperatures, e.g. for installation of the devices in a cabinet.

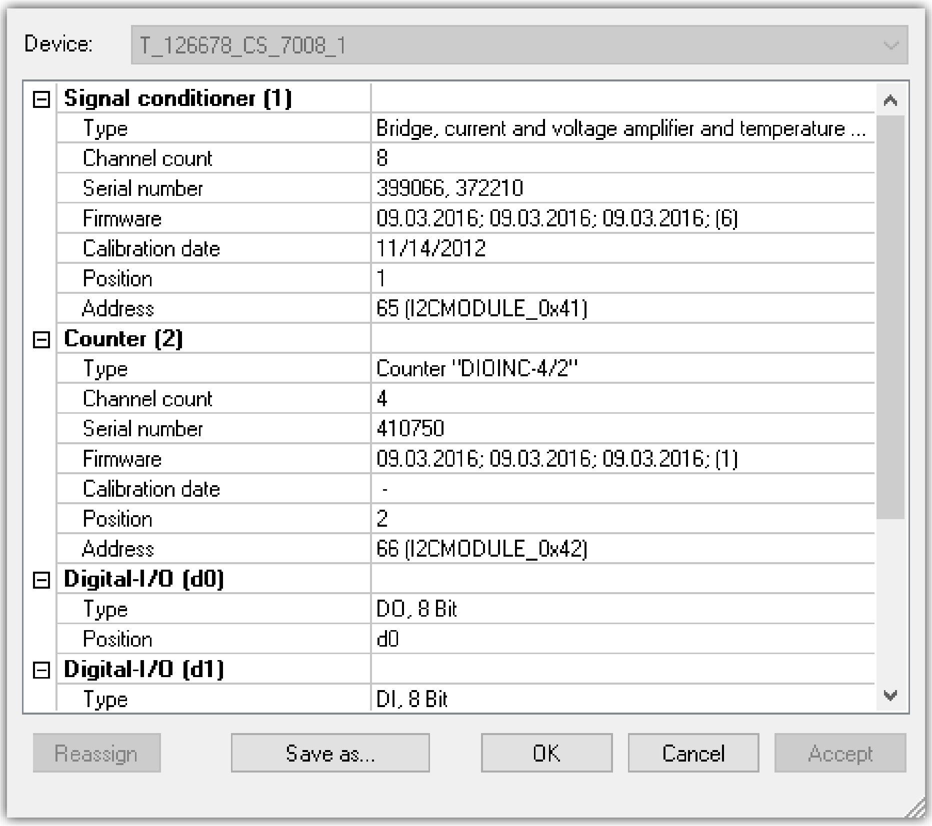
Property: Device time and synchronization	Description
	Example: NTP setting: min=8 s, max=64 s Conditions: • Devices were exposed to daytime-based temperature fluctuations, in other words, they were not installed in a cabinet. • Use of a company's internal NTP-server Result: Among 3 devices, there are signal timing discrepancies of 0.01 .. 0.2 ms. This value is far below the uncertainty level stipulated in the standard IEC 61000-4-30 and enables very good comparison of measurement signals.
Max. time to wait for synchronisation [s]	• **0**: unlimited wait (default) • **-1**: don't wait • **xxx**: wait xxx seconds **Note:** • Select a waiting time which is certain to work for synchronizing with an operational synchronization input signal. Otherwise, after the waiting time the measurement will begin out of synch. However, this can only be subsequently recognized in the measured data if you record the Sync state along with the data by means of the imc Online FAMOS function `IsSyncronized`. • For a GPS Master with DCF-77 Slaves, a waiting time of 300s is recommended.
Synchronization signal input	Specifies a default clock to be used upon activation. If the value for synchronization signal is n.s.=0, the settings remain intact after activating the device. • 0 none: not defined. • 1 no synchronization signal: Synchronization signal input not evaluated • 2 SYNC synchronization signal: only DCF or IRIB-B is evaluated • 3 GPS synchronization signal: only GPS receiver evaluated • 4 SYNC or GPS synchronization signal: depending on which signal is applied first upon deactivation, either DCF, IRIB-B or GPS is utilized • 5 NTP synchron signal: Network Protocol used • 6 EtherCAT synchronization signal • 7 PTP: Precise These setting are applied in the experiment when connected with the device and there are no other settings regarding Synchronization 301 had been specified for the experiment.
Synchronization signal output	Specifies whether the device time is outputted as a DCF/IRIG-B signal.

Property: Options	Description
Some software options come at an extra charge. These options are enabled by means of so-called **enabling codes**. The enabling code is a multi-digit number and is determined for each device on the basis of its serial number. Options can be enabled at factory and be available when the device is delivered (see the decal on the device frame new the serial number plaque). The options can be enabled after delivery. Enabled options are noted in the device’s configuration (Flash-EEPROM) and thus are permanent and cannot be lost.	
imc Online FAMOS	Enable Online processing with imc Online FAMOS 835 base packet.
imc Online FAMOS Professional	This option comprises multiple subparts ("Optimization of the online programs by use of the on-chip memory”, "Online Synchronous task”, "Process vector”). The availability of these function option subparts, however, depends on the particular hardware configuration and is determined upon connecting with the device (see the chapter on "imc Online FAMOS 835").
Online classification	Enables functions of Online Class-counting Kit (see the chapter on imc Online FAMOS 835).
Online-Order tracking	Enables functions of Order Tracking Kit (see the chapter on "imc Online FAMOS 835").
CAN-Database Import	Enables Vector-database access, DBC-format; order option */VEC-DATB (license per device)
imc STUDIO Monitor	Shows, if the devices is prepared for imc STUDIO Monitor. That entry can not be changed.
ECU-protocols	Activates the functions for CAN-bus subscribers which support the ECU protocol (see the chapter on "imc Online FAMOS 835" and the "imc Online/Inline FAMOS Function Reference 887").
Measurement time (T3) until suspend (s)	Only available to devices having a sleep-mode. Describes the minimum duration for which the suspend signal must be applied.
imc REMOTE	Activation of imc REMOTE LinkSecure, imc REMOTE SecureAccess or imc REMOTE WebServer. This requires an activation code which must be purchased along with the device. It is also possible to perform the activation subsequently. • **imc REMOTE LinkSecure:** Option for imc LINK providing secure access via an https connection • **imc REMOTE SecureAccess:** Enables imc REMOTE SecureAccess 61 for direct and secure access to a device, even with activated Firewall. • **imc REMOTE WebServer:** Enables imc REMOTE WebServer 814 which provides platform-independent remote access to imc measurement systems.

7.2.2.6 Module Properties

The dialog lists all amplifiers equipped with the device.

Ribbon	View
Setup-Configuration > Module Properties	Complete



Modul configuration

Along with the "*type designation*", "*serial number*", "*firmware*" and "*calibration date*", you will find the "*address*" (with bus designation) and the resulting "*position*" of the amplifier.

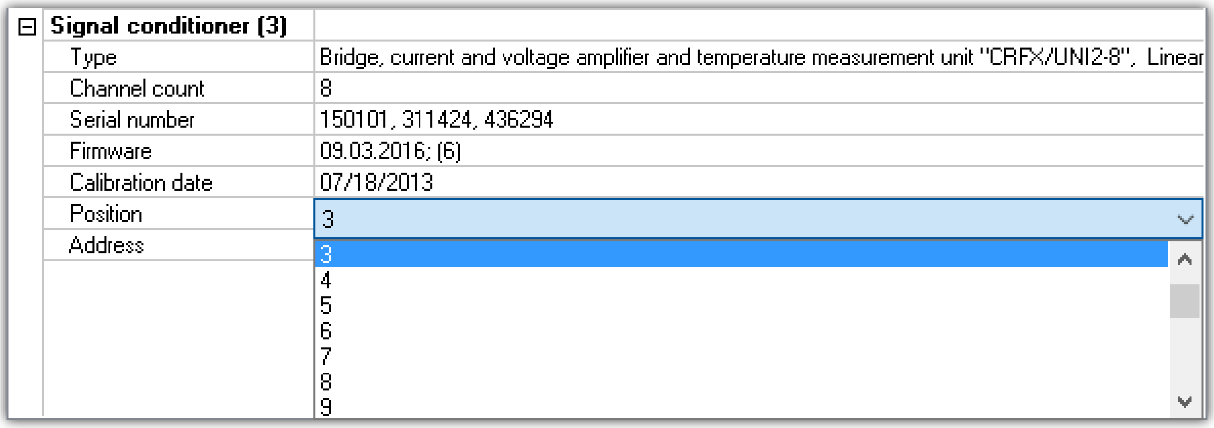
By using "*Save as...*" a file is created which lists the connected amplifiers

There are two groups of amplifiers:

- **Permanently installed amplifiers** use an address switch on the amplifier, which is set upon delivery of the system. With some devices, this can be changed by trained users (see "Device manual").
  A permanently installed amplifier is distinguished by the address designation: **I2CMODULE**.
- **Modules** (e.g. imc CRONOSflex or CRONOS-XT modules 353) are integrated with a master (e.g. CRFX/CRXT Base unit or with an EtherCAT Master (ECAT-DA) for imc CRONOS*compact*). The obtain their module address automatically. The numbering of the module occurs upon first connection and remains intact. Along with assignment of the module number (Position), a "ScanID" (identifier for the module) is also allocated. A 7-segment display represents the module address.
  A CRFX/CRXT module is distinguished by the address designation: **xbus**.

Assigning the module number

- **Reassign**: The button "*Reassign*" overwrites the existing numbering of the modules with an uninterrupted re-numbering.
- **Assign manually**: Enter the position manually. Click the number and choose a position from the list.



Assign manually

Warning

Note that changing the module configuration is equivalent to re-ordering the amplifiers. If a change in the order of module entries is made, any experiments present can no longer be used.

Removing CRFX/CRXT modules

If an module is removed, the device description retains the module numbering. A gap results in the numbering. Since the device description is saved along with the experiment, the old experiment can easily be reused in any later application of the same module.

Exchange of CRFX/CRXT modules

The device description identifies an module by its serial number. After exchanging an module with another of the same model, the new module is recognized as such by its serial number and receives a new address. In this case, correct the address (*Assign manually*), **before** resuming the use of existing experiments.

Note — **Notes on assigning the module number**

- If an CRFX/CRXT module is alternately used with different imc devices, it saves the module address for each measurement device separately. The number of module addresses is limited to 63.
  If the number of possible module addresses is exceeded, the oldest entry is deleted.
  A module can thus have different module addresses in different device configurations. The use of the same module in different devices is thus possible without needing reassignment of the module address each time.
- If the ScanID matches the module address saved on the module is used.
- If there is a conflict in the ScanID (multiple modules having the same module address), then *Reassign* of the module addresses is performed.
- For all other modules (non-matching of the ScanID), the module addresses are reassigned.
- When assigning module addresses, the last address used is applied. The newly assigned addresses follow (are appended to the end of) the last address assigned.
- When the module addresses are reassigned, a new ScanID is made and all modules are assigned a new address.

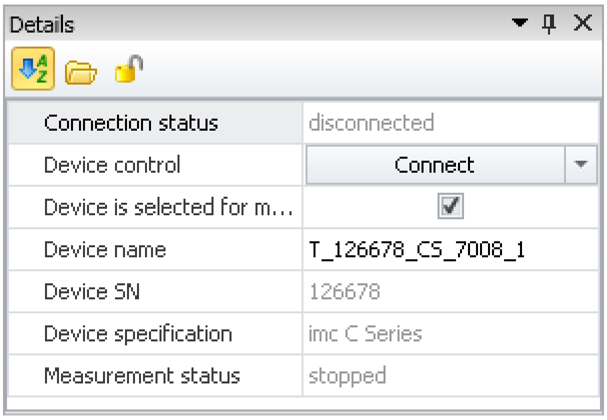
Note — **Notes on changing the device configuration**

- After the device software connects with a device, it is at this time not possible to take any changes of the device configuration (removal and/or addition of modules) into account (e.g. event notification with subsequent adaptation of the settings dialogs).
- If the device configuration is changed, changes are only taken into account after separating from and reconnecting the device with the device software
- During a running measurement, it is not possible to respond to changes of the device configuration (no "hot plug")!

7.3 Tool Windows

7.3.1 Details

The content of the "*Details*" window depends on which page is selected. As in the "tabular display 212", you can also directly edit 220.parameters in this tool window.



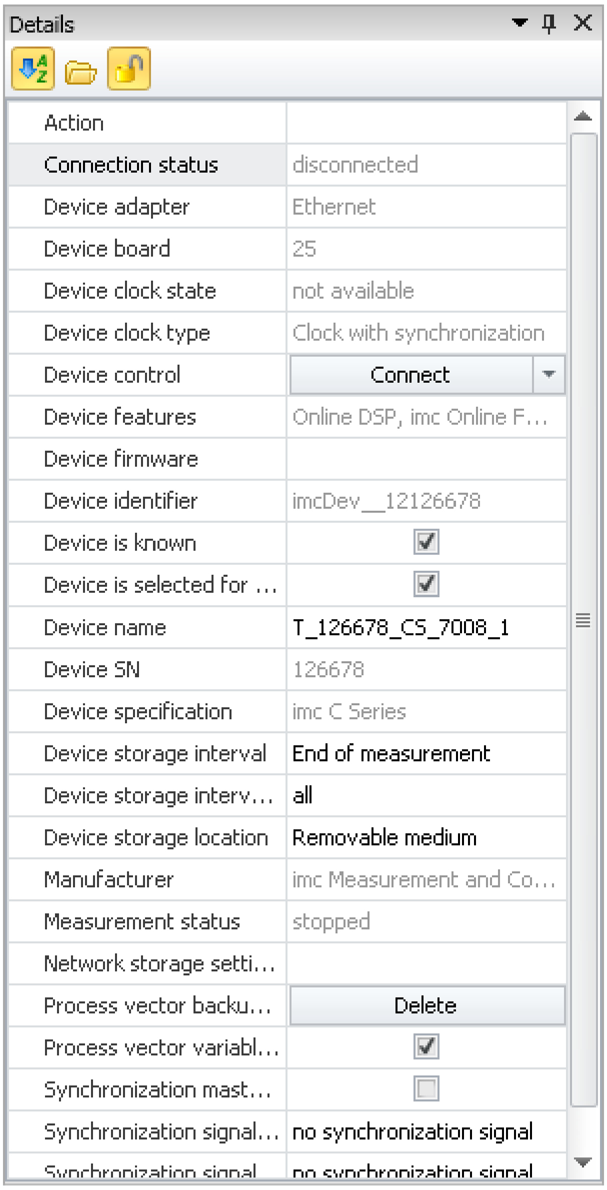
Tool window "Details" in the plug-in "imc STUDIO Setup" (example)

Hidden parameters

By default, the Details window sows a selected set of parameters which can also be seen in the tabular display and the dialogs. By clicking on the **padlock symbol** ( ), all other parameters are also displayed which belong to the selections in the tabular display ("hidden parameters").

Example

When you click on the padlock symbol, you see the much more extensive list of all device parameters. The image below shows only an excerpt:



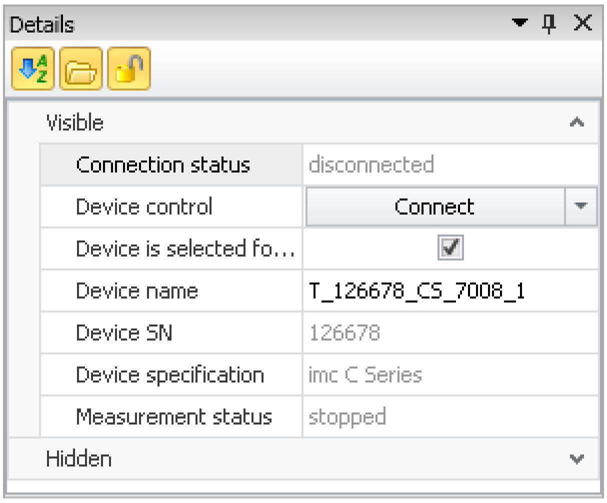
"Details" tool window for a selected device with display of the hidden parameters

In this display, you can also set parameters which are not available either in the tabular display or in the dialogs.

Grouping / sorting parameters

The parameters in the "*Details*" window can also be displayed in groups. To do this, click on the grouping symbol ( ). The parameters are then divided into the following groups:

- Visible
- Hidden



"Details" tool window in grouped display

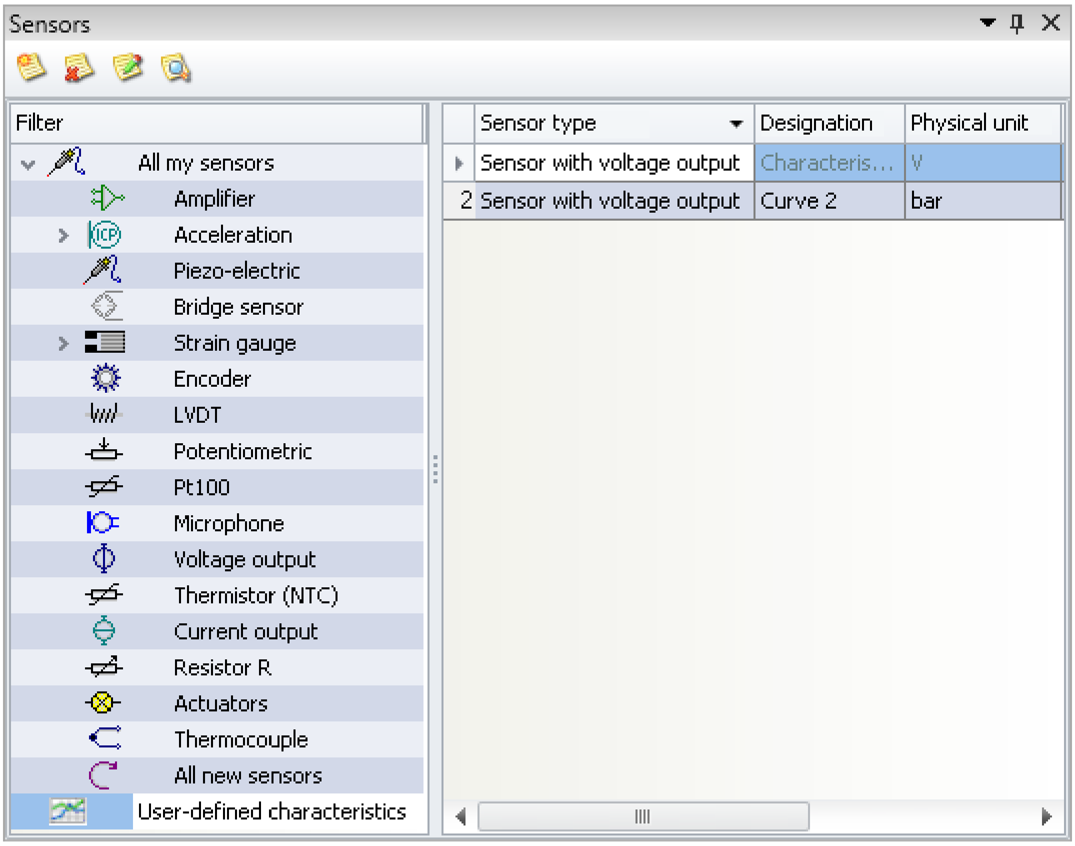
The groups can be opened or closed individually (symbols:).

To sort the parameters alphabetically, click on the sorting symbol ( ). Click again to change the sorting order.

7.3.2 Sensors

The tool window "*Sensors*" presents all information on existing sensors and characteristic curves (both referred to below as "Sensors" in most cases).

Here is where you find information on the sensors used. Additionally, you can create and edit "**user-defined characteristic curve**". If **imc SENSORS** is installed, the sensors from this database are shown and are available for use.



"Sensors" tool window in the plug-in "imc STUDIO Setup " (example)

Structure

The window is split in two parts. At the left, there is a structured list of all sensor groups. At the right you see the sensors belonging to the selected group and their respective properties.

Groups	Description
All my sensors	The list of sensors from imc SENSORS. An exact description of the sensors is presented in the separate manual on imc SENSORS.
User-defined characteristics	The list of user-defined characteristic curves. These characteristic curves can be created and edited here.
Connected sensors	The list of sensors in the experiment. This list provides a quick overview. Additionally, you can also use the sensors for other channels. **Adding associated imc STUDIO characteristic curves to the group heading "User-defined characteristic curves".** User-defined characteristic curves (imc STUDIO characteristic curves) displayed here can be copied to the group heading "User-defined characteristic curves" by means of Drag&Drop. Thus, these characteristic curves are known to all experiments and available for use by them.

Definition of terms

Term	Description
Sensor	There are a variety of sensor types. They differ not only in shape, size, in the physical principles on which they are based, as well as in terms of their conversion between variables, but also in terms of properties, spec sheets and in how they are connected with measurement devices. Here, information on the sensors are edited. This applies in particular to the specs in the spec sheets and the calibration values.
User-defined characteristic curve	A sensor which is set up in imc STUDIO. This one is a sensor characteristic curve having multiple points. Its functional scope is limited in comparison with the sensors from imc SENSORS. Not all amplifiers support this type of characteristic curve. A list of amplifiers/devices 210 is presented at the end of this chapter.
Filter 210	A filter is a grouping of multiple sensors. E.g. Thermocouple, Strain gauge, Piezo-electric, ... You can create additional filters in imc SENSORS and import them into the tool window.
imc SENSORS 210	imc SENSORS is a tool for managing and editing information on sensors.

Writing sensor information to the channel

In order to write a sensor's information and configuration to a channel, use Drag&Drop to move the sensor to the channel desired. The configurations stored in the sensor are applied in the channel configuration.

Note

- The amplifier and imc STUDIO must both support the sensor. The sensor information is only applied if the channel also supports the properties entered.
- A list of amplifiers/devices 210 which support sensors having characteristic curves is presented at the end of this chapter.
- A list of modules supported is presented in the chapter: "*List of supported sensors (TEDS/imc SENSORS)* 418".

The sensor connected is now also located under: "*Connected sensors*".

Deleting sensor information from a channel

In order to delete the sensor information from a channel, the Setup page: "TEDS 415" is needed.

How to add a page is described in the chapter: "*Setup pages - Configuring Device*" > "*Additional Pages* 419".

- Open the Setup page: "*TEDS*".
- Select the channel desired (multi-selection is possible)
- From the list, select: "*Reset channel's sensor information*"
- Click on the button

The sensor information is deleted.

Note — The configuration remains intact

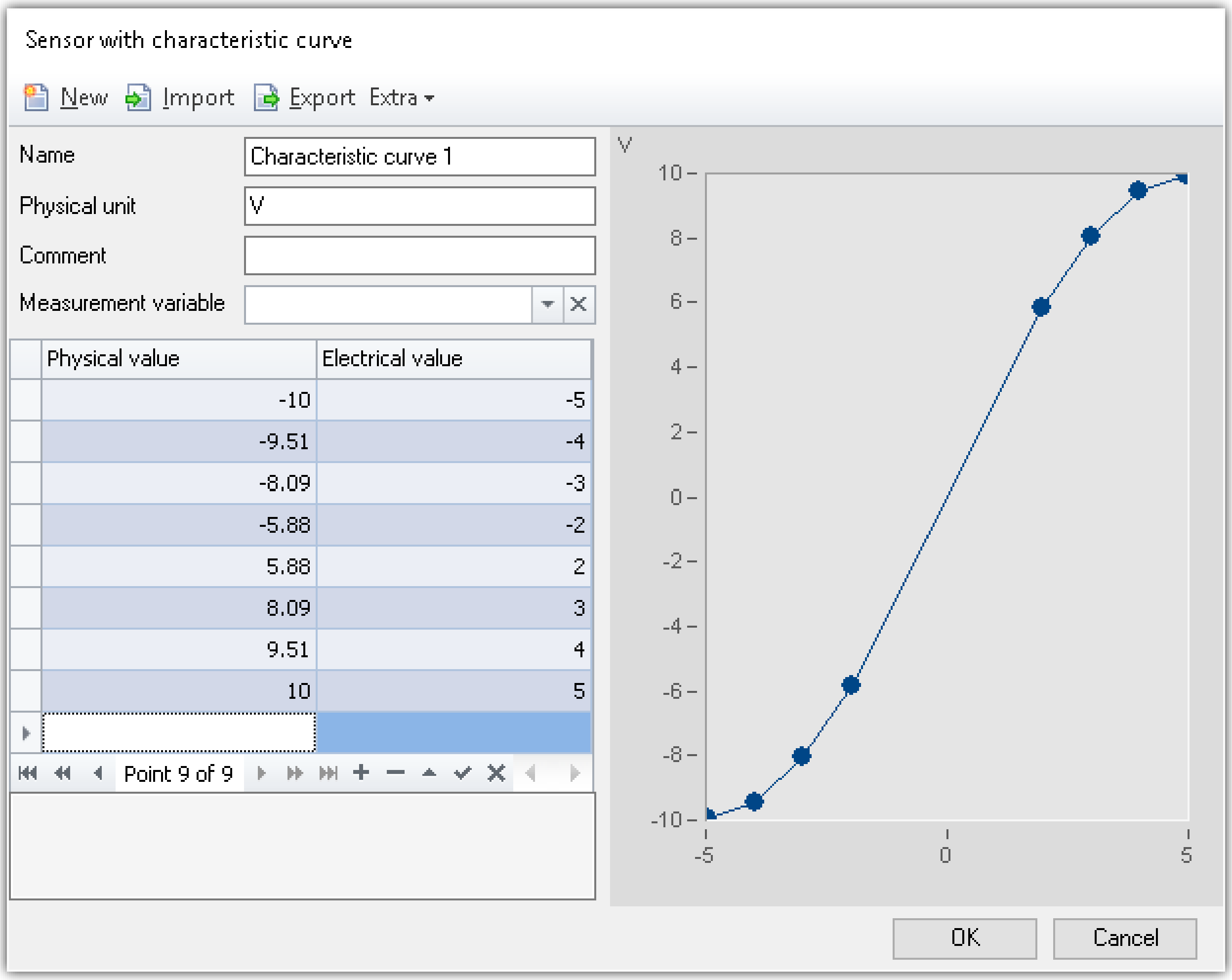
The channel configuration is not reset to its condition before importing. The current configuration remains intact as long as the sensor did not set any parameters which were not possible without sensor information. In that case, the default value is restored.

Toolbar and context menu

Menu item	Description
Create a new characteristic curve 208	Opens the dialog for creating/editing user-defined characteristic curves.
Delete characteristic curve	Deletes the user-defined characteristic curve selected.
Edit characteristic curve	The selected user-defined characteristic curve can be modified. The dialog for creating/editing user-defined characteristic curves is opened.
Open imc SENSORS	The program imc SENSORS is opened in a separate program window.
Find	Here you can search through the list of sensors either according to the "Filter"-name or the "Sensor"-parameters.
Add to imc SENSORS 211	Adds an existing sensor to the imc SENSORS database.
Layout	
Standard layout	Restores the original layout. E.g., imported filters are deleted and moved or deleted filters are set to back as they were earlier.
Import Filter 210	Here, a filter created in imc SENSORS can be imported in order to enable a user-defined grouping.
Delete Filter	Deletes the filter selected. Note: Only the filter is deleted, not the sensors indicated. Normally, only the selected filter is deleted. However, if the selected filter contains subordinate filters, then the user is prompted to specify whether to also delete these subordinate filters. Subordinate filters are all filters, located below the selected filter and are indented at least 1 position further right than the selected filter.
<< (level higher)	In the tree diagram, the filter is indented one position to the left. This raises it up one level in the hierarchy.
>> (indentation)	The filter is indented one position to the right. In this way it can be made to be a subordinate filter to the one above it, for example.
Filter list hidden	The filter list is hidden and appears as a bar in the lower portion of the tool window. There, the currently selected filter name is displayed. By clicking the mouse over this region, the list is opened in a separate window and the filter can be switched. Clicking the mouse again over the tool window hides the list again.

Creating a new sensor

To create a new sensor, open the context menu and select "*Characteristic curve*" > "*New*" or click on the corresponding button ( ). The dialog for creating/editing a user-defined characteristic curve opens.



Example of a user-defined characteristic curve

Menu item	Description
New	Opens an Assistant capable of setting up a simple sensor. You can also enter the points in the table.
Import	This lets you import previously generated sensors. These must be saved in the format *.dat* and can be generated using the imc software imc FAMOS, for example.
Export	You can export sensors once generated, in order to save them separately, or for use in a different operation.
Extra	Here you can access the options for the characteristic curve dialog. For instance, measurement and adjusting variables, which enable additional functions for creating characteristic curves, can be activated.

Points for the characteristic curve

A characteristic curve always consists of at least two points. In the table, you can enter the values for the characteristic curve, which will be displayed accordingly in the curve window.

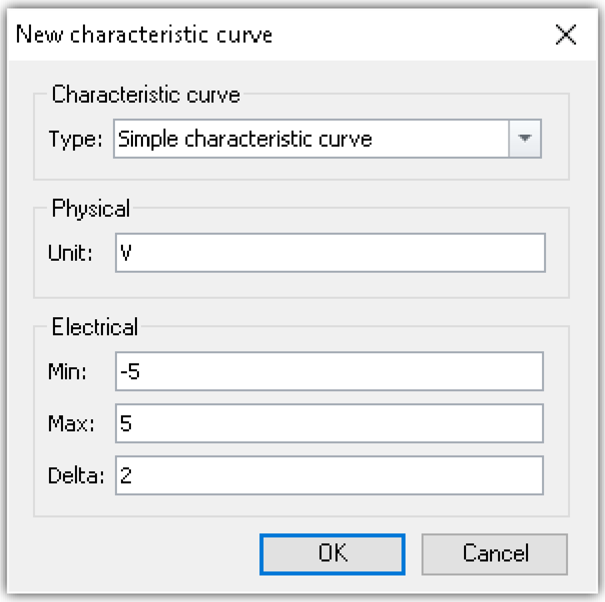
Values for the characteristic curve:

- Electrical value: the reading measured by the sensor
- Physical value: the value to be indicated in response to the corresponding electrical reading.

You can enter or import values ( ), or generate a line using the Assistant ( ), and later modify these as desired.

Quickly generating multiple points for subsequent editing

To quickly generate multiple points at fixed intervals, click on "*New*" ( ). A window appears, which provides a template for generating a characteristic curve.



In this example, a straight line is generated between -5 and +5 with a point-to-point interval of 2. In this way, you are able to generate many points quickly, which can later be easily modified.

Importing the values via the measurement variable

The electrical values can be read from the sensor directly. Select the sensor's associated pv-variable as the measurement variable. Now the electrical values can no longer be entered manually, but are measured directly. The measured value is automatically entered.

To read out a value, select the associated cell and click on the button at the cell's right edge:

	Physical value	Electrical value
	3	-494.11
	2	-353.11
▸	1	-295.123
*		

Acquiring a new electrical value via the measurement variable

FAQ

Question: Which amplifiers support sensors with characteristic curves?

Support of sensor characteristic curves is enabled for following devices:

Amplifier	Device				
	CRPL/SL	CRC	CRFX	CRXT	CANSAS
ICPU-8	●	---	---	---	---
DCB-8	●	---	---	---	---
LV2-8	●	---	---	---	---
UNI-8	●	---	---	---	●
ISO2-8	●	●	●	● as of 2.13R1	---
ISOF-8	---	---	●	● as of 2.13R1	---
UNI-4	●	●	●	● as of 2.13R1	---
SC2-32	●	●	---	---	---
ICPU2-8	Ø	●	●	● as of 2.13R1	---
UNI2-8	Ø	●	●	● as of 2.13R1	---
DCB2-8	Ø	●	●	● as of 2.13R1	---
B-8	Ø	●	●	● as of 2.13R1	---
LV3-8	Ø	●	●	● as of 2.13R1	---

Device	Firmware
Cx-41xx-N	●
Cx-41xx-FD	●
SPAR-N	●

●: Feature supported   imc STUDIO 5.2R10   included firmware 2.13R1

Ø: Feature currently not supported

---: Amplifier not available for this device series

User-defined grouping - importing filters

A filter is a grouping of multiple sensors. E.g. Thermocouple, Strain gauge, Piezo-electric, ...

You can create additional filters in imc SENSORS. These are not automatically displayed in imc STUDIO. Import the filter via the context menu in the Filters list "*Layout*" > "*Import Filter*".

Reference   Filter configuration

An exact description of the filter configuration is presented in the separate manual on imc SENSORS.

7.3.2.1 Sensor Database - imc SENSORS

imc STUDIO supports export of sensor spec-sheet data from a sensor database and the application of the data in configuring channels.

For this purpose, the program imc SENSORS must be installed. The sensor database imc SENSORS administers such information for sensors. In this program, it's possible to set up, edit and administer entries for sensors.

Open imc SENSORS

If imc SENSORS is installed, the sensor database can be started via the *Sensors* tool window. To do this, open the context menu and select "*Open imc SENSORS*" or click on the corresponding button ( ).

Importing sensor data from the sensor database

In order to transfer sensor information to a channel, it is not necessary for imc SENSORS to be opened. The *Sensors* tool window lists all sensors in the database. How to transfer the sensor information to the channel is presented in the description of the tool window "Sensors 206".

Adopting sensor information in the sensor database

To transfer sensor information from a sensor TEDS to the sensor database, open the context menu of the "*Sensors*" tool window and select "*Add to imc SENSORS*". The channels settings remain unaffected.

7.3.3 Layout Repository

Complete layouts: Her you will find a list of all available Setup pages. In order to display a page, use Drag&Drop to move it to the tab-bar (or use the context menu - see "*Additional Pages* 419").

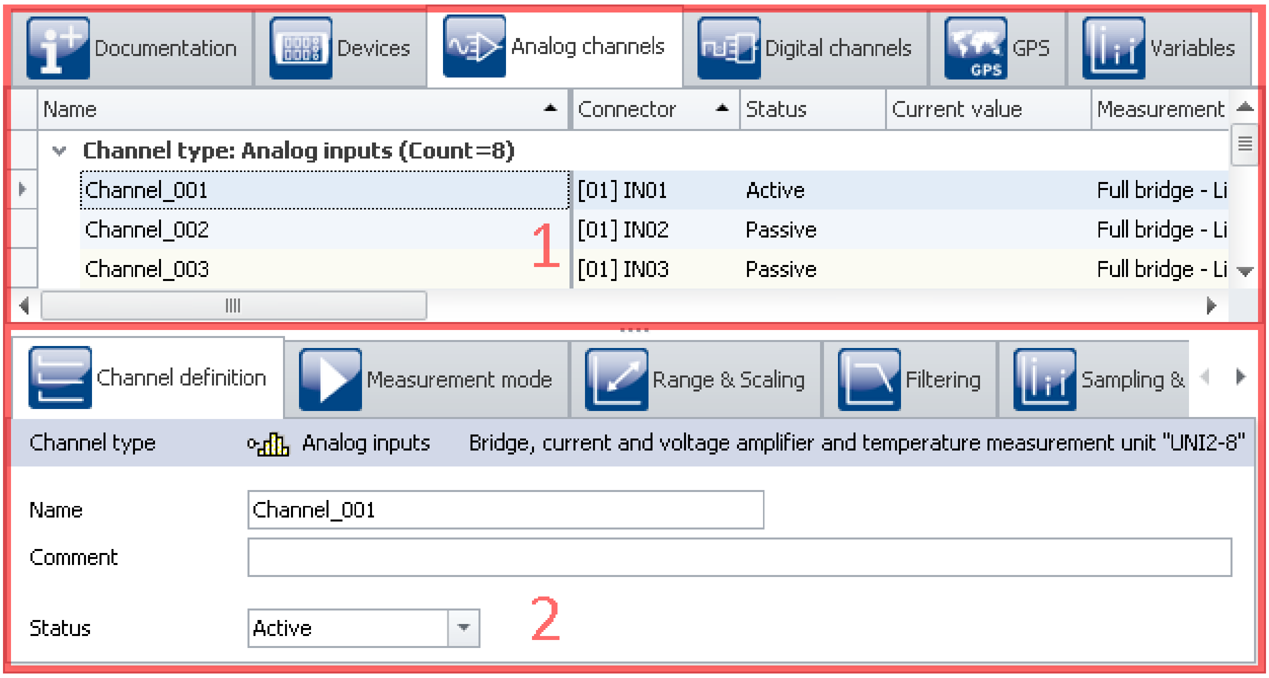
For the editions imc STUDIO Developer:

Complete layouts: Using the context menu, you can modify the settings of the saved pages (see "*Properties of Pages/Complete Layouts* 283").

Pages and Elements: Here you will find elements for modifying and designing your own personal pages (see "*Designing Pages* 284").

7.4 Operation

The Setup main window is subdivided into several predefined pages. Some pages are divided in two windows stacked vertically, as shown in the example below:



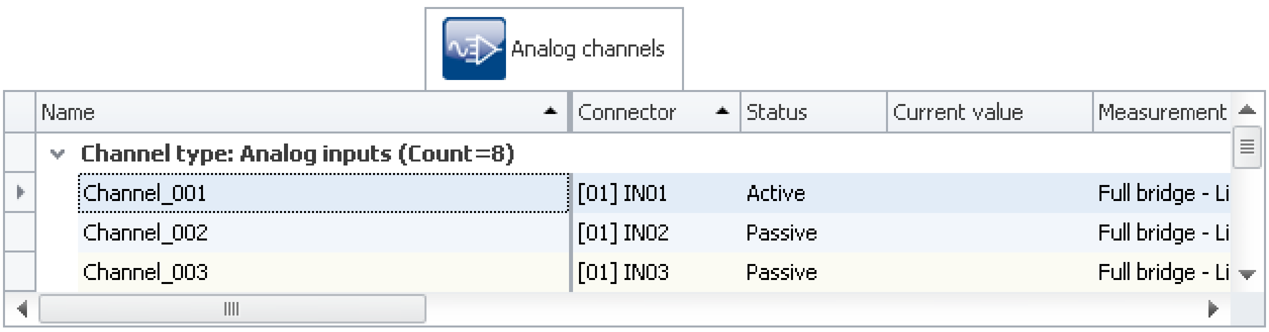
Tabular display and dialog (example)

Region	Description
1: Tabular display 212	The top window shows a tabular (rows/columns/cells). In the table, e.g. all known devices or channels/variables are listed. It offers a quick overview of parameters and can be filled with many columns.
2: Dialogs 219	The lower window shows special dialogs 219 for the most important parameters.
Assistenten 221	The Assistants are an aid in configuring particular device components such as Field-busses or imc Online FAMOS.

Editing: You can modify the parameters by means of in-place editing 215 in the table, as well as in the dialog 220. To edit the height of the window, use the mouse to drag the dashed separator line.

7.4.1 Tabular Display

In the tabular display, many parameters of the selected page are displayed in a segmented table.



Example of tabular "Analog channels"

You can edit 215 both individual parameters and sets of multiple parameters (see Selection 213) directly in the table cells. The availability and selection of settings depends on the page opened and on the selection in the table.

Other parameters: In principle, all parameters can be configured using the tabular. For this purpose, you can use the Column Chooser 216 to include the desired parameters in the table. Also, you can configure complex columns using the function Additional columns 258.

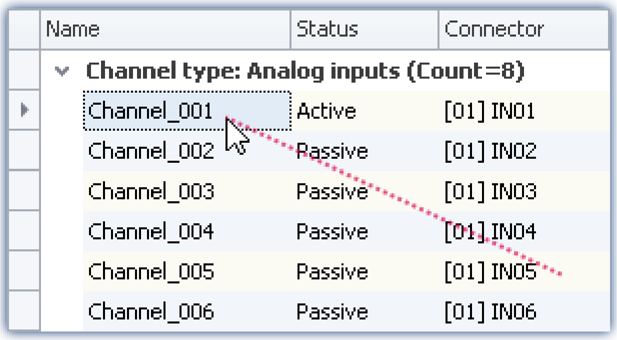
7.4.1.1 Selection

In the tabular display, you can edit both individual parameters as well as sets of multiple parameters **directly in table cell**.

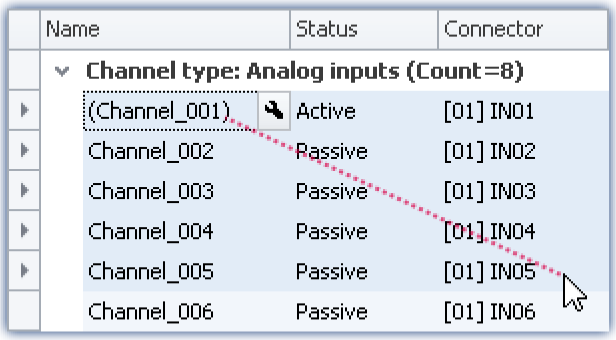
To do this, first select the row(s) which contain the parameters.

Selection with the mouse

To select contiguous cells, you only need to drag open a rectangle over the desired region with the mouse.



While holding down its button, drag the mouse over the region



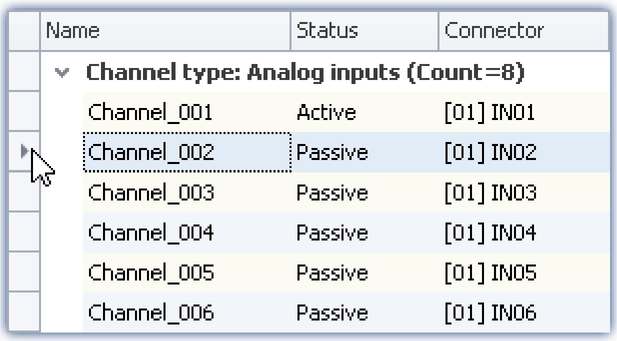
Release the mouse button at the position desired

Selection with mouse and keyboard

To do this, use the left margin column, as shown in the first image.

Selecting individual rows

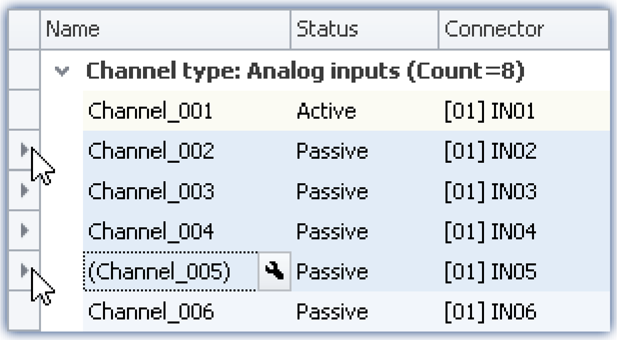
Click on the left edge of the desired entry:



Single line selected
(simply click on the edge of the table)

Selecting multiple, consecutive rows

Click on the first row which you wish to select. Then hold down the ***<Shift>*** key while clicking on the last row you wish to include in the selection. This selects all the rows from the first through the last.

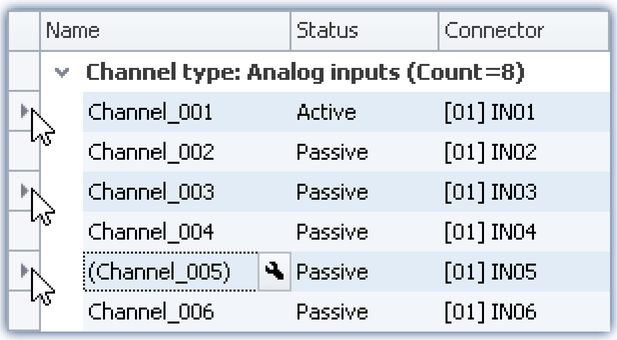


Selecting multiple consecutive lines
(hold down <Shift>-key)

You can also perform this procedure repeatedly (in multiple steps). To access more entries, you can use the scroll bar to move through the table. This means that you can also select lines in the table which are so far apart that they are not visible at the same time.

Selecting multiple rows separately

Click on the first row you wish to select. Then hold the ***<Ctrl>*** - key down and click on the next row which you wish to add to the selection. Each row you click on while holding down the ***<Ctrl>*** - key will be added to the selection.



Selecting multiple lines separately
(hold down <Ctrl>-key)

You can repeat this procedure (in multiple steps). To access more entries, you can use the scroll bar to move through the table. This means that you can also select rows in the table which are so far apart that they are not visible at the same time.

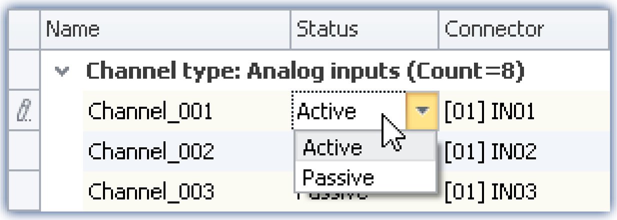
Cancel selection

To cancel a multiple selection, click on the left side of a single entry in the table

7.4.1.2 In-place editing

All parameters for which there is a column in the table can be edited in place (directly in the table). Note that there are dialogs 219 for selected parameters.

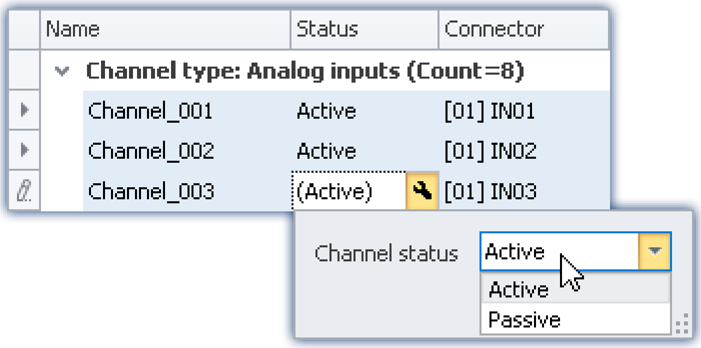
Editing single parameters



Editing single parameters: click on the row

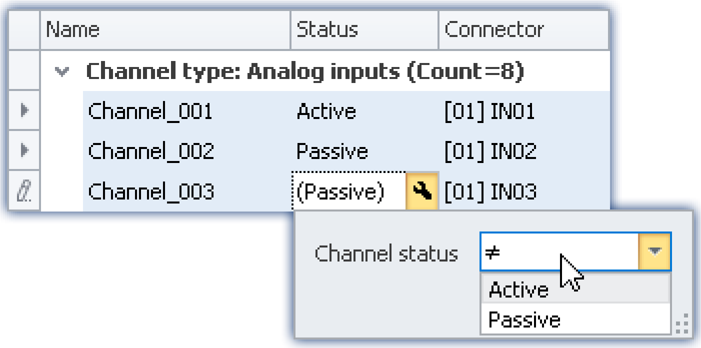
In order to edit individual parameters, click directly in the associated cell of the table. It is not necessary to select the line beforehand. After clicking, a control appears with which you can edit the parameters. The control's type depends on the particular parameter concerned. In the image above, you see a drop-down list for selecting the desired channel status (Active/Passive).

Editing multiple parameters



Control for multiple selection (example)

Select the desired row as explained in the previous chapter (Selection 213). Next, click on one of the rows where you wish to edit parameters. A control appears in which the corresponding parameter can be edited. If all of the parameter values are the same, the value is indicated; otherwise, an inequality - symbol (≠) is displayed:



Different parameters in a multiple selection procedure (example)

7.4.1.3 Configuring columns

By default, the various pages of **Setup** show a certain selection of columns (parameters). You can also configure the selection and order of the columns according to your own wishes (see "*Showing and moving columns* 254"). The column configuration is saved/opened with the view configured (see the manual imc STUDIO (general) > chapter Views 135).

Note Saving / restoring a configuration

In order to save a column layout, use the functions belonging to the View menu (see the manual imc STUDIO (general) > chapter "*Views* 135").

7.4.1.4 Sorting and grouping

Note Saving the sorting and grouping arrangements

The **sorting/grouping arrangements** are **saved with the views**. The views are **saved along with the project**. This means that any views are available for all of the project's experiments.

- See: "*What is saved where?* 142"
- See: "*Views* 135"

Sorting

Clicking the mouse over a column header causes the table to be sorted according to that column's content. The direction of the arrow at the right margin of the box indicates the sorting direction:

Reversing the direction: Each click of the mouse toggles the sorting direction to the respective opposite direction.

Undoing the sorting: Open the column header's context menu and select "*Clear Sorting*".

Sorting according to multiple columns: Activate the sorting according to an additional column by clicking the mouse while holding down the <SHIFT>-key.

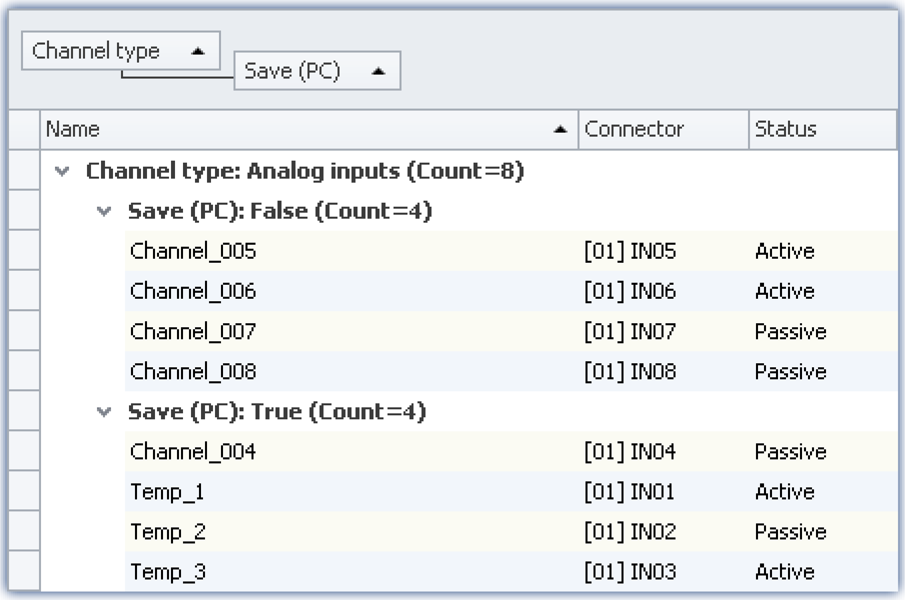
Name ▲	Connector	Status ▲
Channel type: Analog inputs (Count=8)		
Temp_1	[01] IN01	Active
Temp_3	[01] IN03	Active
Channel_004	[01] IN04	Passive
Channel_005	[01] IN05	Passive
Channel_006	[01] IN06	Passive
Channel_007	[01] IN07	Passive
Channel_008	[01] IN08	Passive
Temp_2	[01] IN02	Passive

The table is sorted according to the parameter "Status" and next by "Name".
Active channels are thus always at the top.
All active and passive channels are sorted alphabetically among themselves.

Grouping

By default, most tables are grouped according to one of the parameters. For instance, the channel tables are grouped according to the parameter: "*Channel type*". You can, if desired, cancel the grouping or modify it.

To do this, open the context menu in the upper left corner of the table and select the item "*Group By Box*". The box is then displayed above the table. Here, you can add table columns using Drag&Drop.



Name	Connector	Status
Channel type: Analog inputs (Count=8)		
Save (PC): False (Count=4)		
Channel_005	[01] IN05	Active
Channel_006	[01] IN06	Active
Channel_007	[01] IN07	Passive
Channel_008	[01] IN08	Passive
Save (PC): True (Count=4)		
Channel_004	[01] IN04	Passive
Temp_1	[01] IN01	Active
Temp_2	[01] IN02	Passive
Temp_3	[01] IN03	Active

Example of grouping according to the channel type and next by the saving status.

Disadvantage: Any columns according to which groups were formed can no longer be displayed in the table. If this is required however, then create an additional column of the type : "*Combined column* 258". This workaround lets you show the parameter after all. (Creating/editing of the columns is only possible with at minimum the imc STUDIO PRO 29 product versions.)

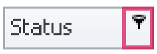
7.4.1.5 Filtering columns

Note Saving the filter settings

The **filter setting** is **saved with the views**. The views are **saved along with the project**. This means that any views are available for all of the project's experiments.

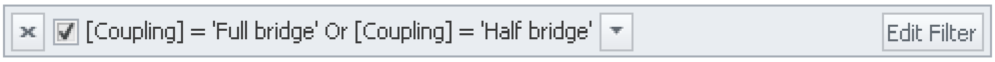
- See: "*What is saved where?* 142"
- See: "*Views* 135"

To select a filter you use the header of the column to which the filter is to be applied. When you move the mouse over the column header, the filter-symbol appears at right.



Clicking the mouse over the filter-symbol causes a selection menu to appear. Here you can select a value from among the current settings, which is to be the only one still displayed. Or, you can define your own filter ("*Custom*").

Once you have defined a filter, a filter bar appears on the bottom.



Filter-bar

Here, the filter currently set is shown. In this example, all columns which use either "*Full bridge*" or "*Half bridge*" coupling are used.

Removing filters: You can remove a filter by clicking on the "X", or by using the filter-symbol in the table header: select "*All*".

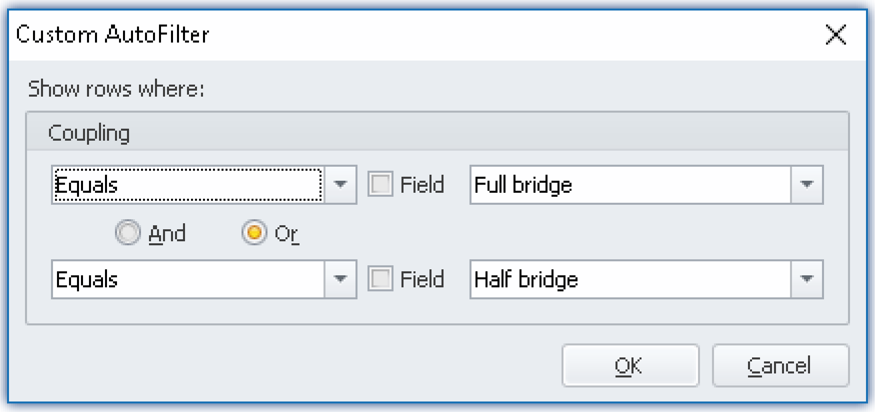
Activating/deactivating: Using the checkbox in the bar, you can activate/deactivate the filter without removing it.

Changing filters: Clicking the mouse over the Drop-Down symbol causes a list to appear, which offers the most recently used filters for selection. Here, you can select a different filter.

User-defined (custom) filters

If you can't find the appropriate value by means of the filter-symbol, or if you require different conditions, you can implement "*Custom*" entries.

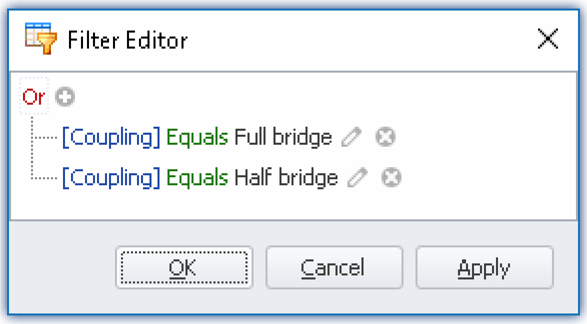
The following dialog appears. In this dialog, configure the filter as desired and then click on "OK". Note that the filter only works with exact values/texts.



Custom filter

Editing filters

In order to define complex filters, click in the Filter-bar on "*Edit filter*". The following dialog window then opens:



General Filter-dialog

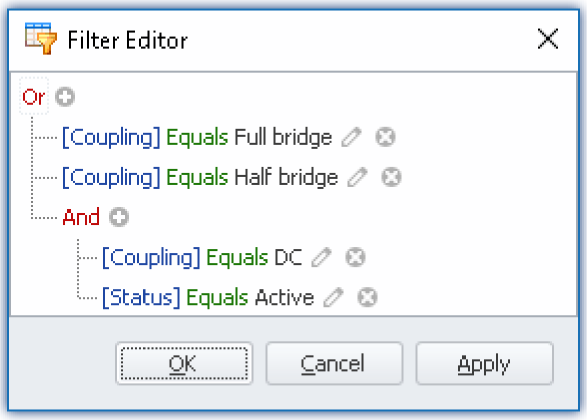
Using this dialog window, you are able to formulate complex combinations of filter conditions.

Changing the group's operator: When you click on the operator which is already set for the group, a list of operators then appears, from which you can select the appropriate one: "And", "Or", ...

Adding a condition: By clicking on , you can add any desired number of filter conditions to the operator group. In doing so, be sure to follow the pattern of placing the parameter (e.g. coupling) at the first position in the condition statement, then the condition itself in the second position (e.g. "equals" or "Does not equal", ...), and finally at the third position the "value".

Deleting: Clicking on lets you delete filter conditions.

Adding a group with an additional operator: Click on the operator set for the group. In the list which then appears, select "*Add group*". The new group can have a different operator type and can in turn contain any kind of conditions/groups.

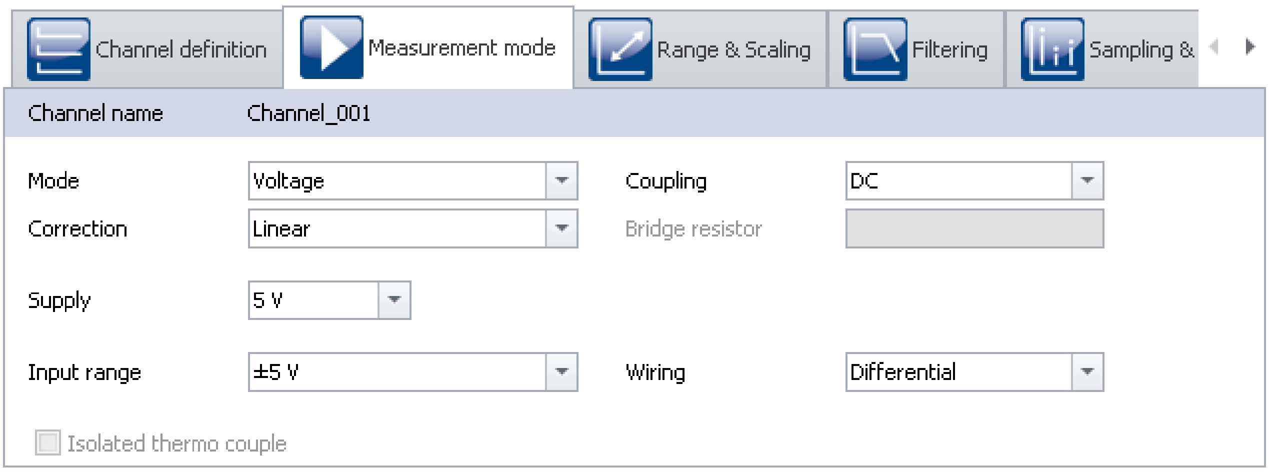


Filter setting with two groups
Coupling = "Full bridge" OR coupling = "Half bridge" OR
(coupling = "DC" AND Status = "Active")

Dependency on other parameters: Instead of entering a value according to which to filter, you can also select another parameter. This means you are able to add dependency relationships to other settings. To do this, click on the pencil-symbol or on the box-symbol next to the value to change.

7.4.2 Dialogs

In this section, the most important parameters of special dialogs are offered.



Example of "Measurement mode" dialog

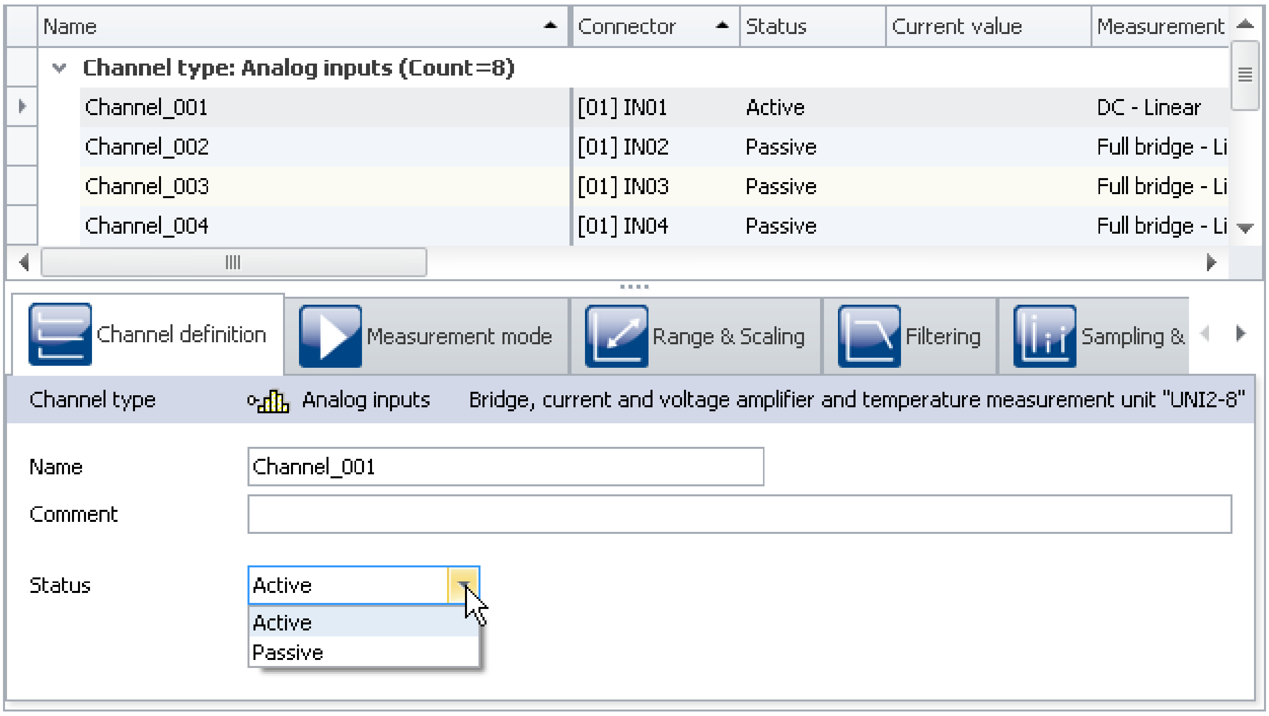
Selected parameters are presented here, distributed over multiple dialogs. The dialogs are designed in a clearly structured manner. As with the tabular display, you can also directly edit 220 parameters in the dialogs.

Availability and selection of the dialogs and the settings depends on what page is open and on the selection in the table.

7.4.2.1 Direct editing

You can directly edit (change) all parameters displayed in the dialogs.

Editing individual parameters



Editing individual parameters (example)

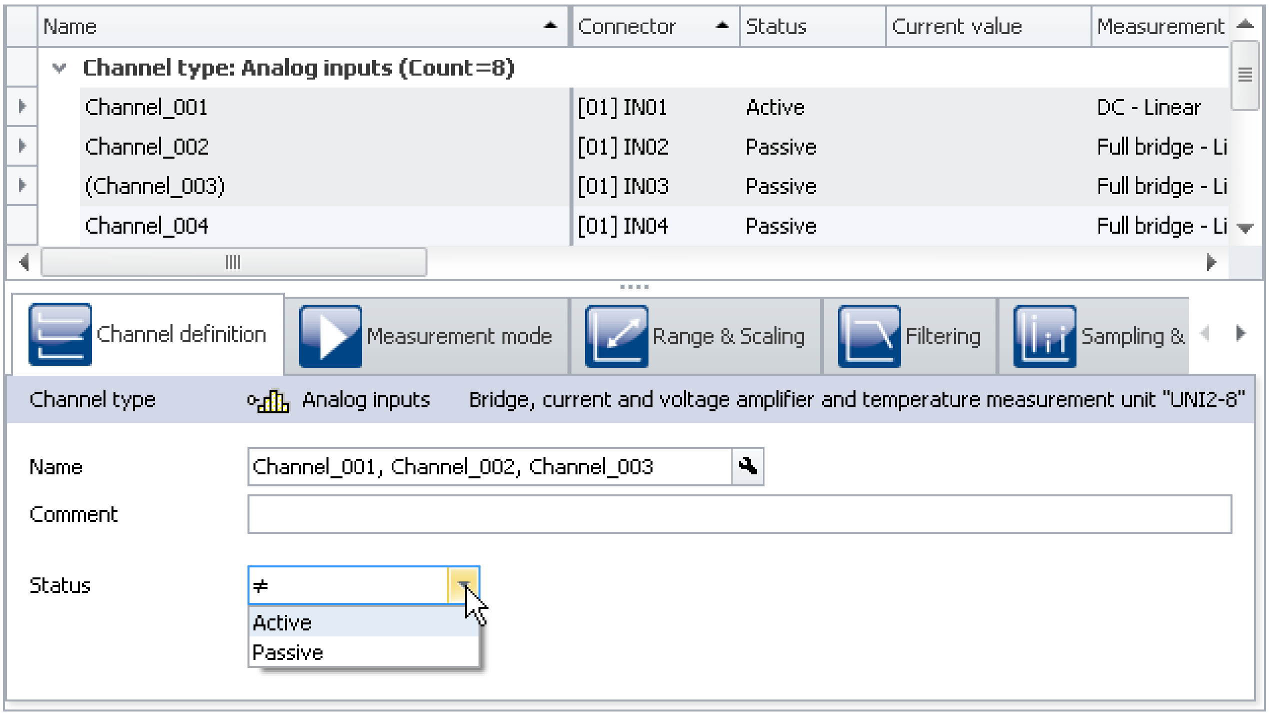
To edit a parameter, first select the corresponding table cell in the tabular display (see Selection 213). The dialogs associated with the selection are indicated. Open the dialog in which the parameter to be changed is found.

Click on the control with which the parameter can be edited (changed). The control's type depends on the parameter. In the image above, you see a drop-down selection list for setting the channel status (active/passive).

Editing multiple parameters

When a parameter in in a dialog is edited, then this change causes changes to all rows in the tabular display selected. If all parameters have the same value, this is displayed, otherwise an "unequal" symbol is shown (≠).

In the image shown below as an example, you see three selected channels and the dialog *channel definition*. If you select the **status** *active* in the drop-down dialog, the status for all three channels is set to *active*. The results are shown immediately in the channel table.



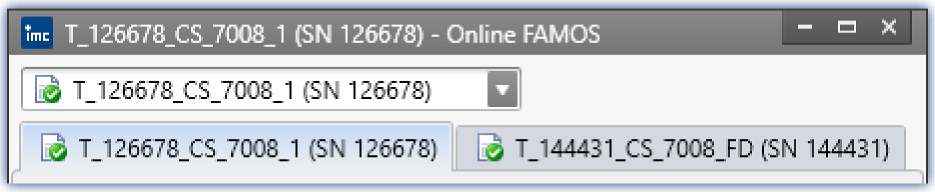
Non-matching parameters in a multiple selection (example)

7.4.3 Assistants

The Assistants are an aid in configuring particular device components such as Field-busses or imc Online FAMOS. The methods of operating and configuring the respective Assistants are presented in the associated chapters.

All Assistants are shown in a dialog frame by means of which you can select the device affected. If only one device is involved in the experiment, there is nothing for you to do; that device is automatically selected. But if there are multiple devices in the list, then use the drop-down list in the upper region of the dialog to select the device you wish to configure.

For each device selected in this way, a separate tab will appear.



The symbols appearing in front of the tabs provide an indication of any name conflicts (red X-symbol). A green check-mark indicates that there is no name conflict.

7.5 Performing a measurement: Procedure

This chapter describes how the measurement procedure (the experiment) is controlled. Many functions can be accessed via the Ribbon **Home** and all via the Ribbon **Setup** 166.

Action	Description
Connect signal leads	
Searching for and selecting devices 222	Before you can create an experiment, you must adopt one or more devices into the device table. To do this, run a device search and selection.
Firmware Update 83	The software only works with devices having the right firmware. Upon the connection/preparation, the versions are compared. If they don't match, the firmware update is carried out.
Configure devices 294	Each measurement setup can require a variety measurement device settings. Configure your device and each measurement channel according to their respective requirements. For this purpose, various software Assistants (wizards) are provided.
Process configuration 167	Current configuration is inspected for errors and made available to all the plug-ins. No connection with the device is required for this.
Connect 167	The program connects itself with all measurement devices selected (generally via LAN).
Balance	For amplifier channels: balance the channels. When a system having amplifier channels is switched on, or the gain, gain function or filter function is changed, the offset needs to be balanced.
Download 171	The current configuration is exported to the device.
Start measurement 172	The measurement is started for all devices.
Stop measurement 172	The measurement is stopped for all devices.

7.5.1 Device Search - Known and Selected

Term	Description
Search for devices	In a device search, the system searches the network for all suitable devices. The device table 296 lists all devices found.
Device is known	**Device is known** means that the device is already available for selection as soon as the software starts. The device's setup is familiar to the software and an experiment can created without needing to connect with the device.
Selected	**Selected** means that a device is to be used for the current experiment.

Making a device known

To make a device known, you must previously have launched a device search for it.

Select the Ribbon **Home** (or **Setup-Control**) **> Search for devices** (). The system then searches for devices in the network (see Device Search 175).

Finally, the devices found are listed. Te following image shows a typical display:

	Selected	Device name	SN	Device specification
	☐	T_124835_C1_1_LEMO_ET	124835	imc C1-1 LEMO
	☐	T_130039_busDAQ_X	130039	busDAQ-X
	☐	T_130311_SPARTAN_U32_CAN	130311	imc SPARTAN

Device search results (example)

Note

The devices listed now are not yet known!

To make a device which has been found "known", you can do either of two things:

- *select* the device (this means that the device is immediately selected for the experiment)
- select the disabled parameter *Device known* (e.g. in the tool window **Details** 201).

Once the device has been made *known*, its setup is determined.

Note Note on determining the device configuration

For the purpose of successfully determining how the device is configured, a temporary connection to the device is established.

If this is not possible, the device is not made known to the system. A corresponding entry appears in the log book. Possible reasons include:

- incorrect firmware version
- the device is in Measurement mode (which means that the device is currently performing a measurement)
- the device has established an active connection to a different computer

Now that the device is *known*, it is available for selection, without the need for a search, the next time the program starts.

Note Special case

Registering the device with the system by loading experiments

When an experiment is loaded in which an unknown (unregistered) device is used, the device is automatically adopted as a registered (known) device.

FAQ

Question: The device in an experiment has a different device configuration than my registered device. Will the registered device be replaced with it?

Answer: The registered device is only replaced when you establish a connection with the device. If an experiment with a registered device is loaded, but its configuration is different (e.g. CRFX with different modules), the registered device is initially not overwritten. The Device Table temporarily indicates a "new" device. When you restart imc STUDIO, the original device appears once again in the table.
Only once you establish a connection with the device will the device list be updated. The previous state is discarded.

Device selection

To be selected for an experiment, a device must be *selected*.

	Selected	Device name	SN	Device specification
▸	☑	T_124835_C1_1_LEMO_ET	124835	imc C1-1 LEMO
	☐	T_130039_busDAQ_X	130039	busDAQ-X
	☐	T_130311_SPARTAN_U32_CAN	130311	imc SPARTAN

By clicking on the desired devices *Selected* box, the device becomes ready for the experiment. You can also select multiple devices for your experiment.

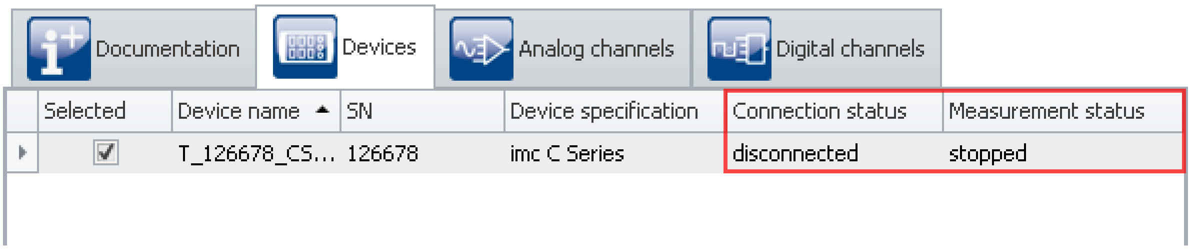
Note

You are not yet connected with the device!

If your device was not previously known, it is made *known* the first time the it is selected.

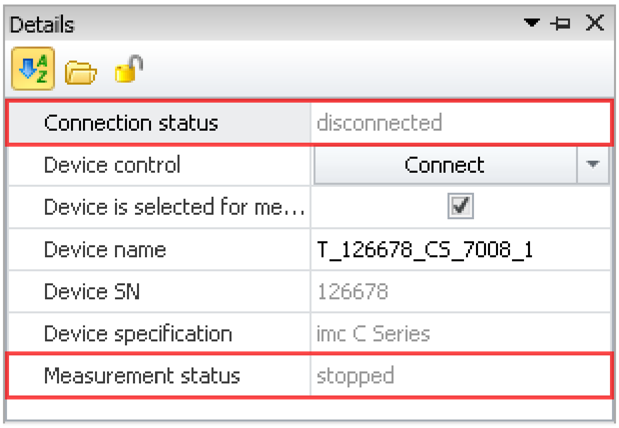
Status display

After selecting the device, the **status** of the ***Connection*** and of the ***Measurement*** is indicated in corresponding columns:



Status indication in the columns "Connection status" and "Measurement status"

The same information is also available in the ***Details*** toolbox ("Measurement status", "Connection status"):



Status display in the "Details" window

7.6 Information and Tips

7.6.1 Parameter set

What is a parameter set?

A parameter set is a group of parameters which can be used for various purposes. For instance, parameters may be **settings for the device and channel configuration**. They can also be **metadata** and **variables values**.

Example

Example: Channel configuration

Channel name	Save (PC)	Sampling time	Duration	...
Channel_001	True	1 ms	40 s	...
Channel_002	True	100 ms	10 s	...

Example: Metadata

Company name	Test object number	Test part number	Test station photo	Hint
My company	X1	X1_123	.\Picture1.png	speed test 1

Example: Variable values

Name	Category	Value	Typ	...
DisplayVar_01	DisplayVar	1	System.Single	...
DisplayVar_02	DisplayVar	10	System.Single	...
DisplayVar_03	DisplayVar	777	System.Single	...

The parameters can be exported to a file. This file is in most cases read- and writable using a text editor or EXCEL (various data types are available: see *Export formats*). In this way, the parameters can be edited and imported back at a later time. When editing , please observe the notes under: *Editing the parameter set* 232.

What can a parameter set be used for?

Parameterizing the device- and channel configuration by means of the file's contents

There are various ways to import the file and to configure the measurement device by this means. You can save multiple parameter sets and import a particular one before the start of each measurement, depending on the requirements.

Thus, the configuration of the measurement device and of the channels can always be correctly adapted without needing to edit it manually each time.

Initializing variable values by means of the file contents

Just as you can parameterize the device configuration, you can also initialize variable values. The files contain values for the variables, which you can import at the desired time.

Saving the configuration in a file as documentation on the experiment

For purposes of documentation on the measured data or the experiment, you can save the parameter sets of device/channel configurations, or current variable values. These are available for view without the need to start imc STUDIO or even for it to be installed. An additional documentation possibility is a report 293. Separate reports can be created with various configurations.

Metadata on the experiment or the measurement

You can save metadata on the experiment or measurement. Experiment metadata are displayed in the project dialogs for the selected experiment, and measurement metadata in the Data Browser for the measurement. You can perform filtering and sorting by them.

Note	Trigger-settings and imc HiL-/Application module assignments

Trigger-settings and imc HiL-/Application module assignments can not be exported as parameter sets in a useful way.

What contents may a parameter set have?

Content	**Description**
Texts and numbers	E.g. device and channel configuration (device name, channel name, terminal, coupling, sampling rate, ...), metadata (notes, E-mail address, date), texts and numeric variable values
Paths	E.g. metadata: information on the project documentation, pictures. When a parameter set is created which contains pictures or document, these are saved in an extra folder. The folder name corresponds to the filename with the extension: ".data". The path information provides a relational reference to the file. Upon export, the paths are resolved and the file can thus be imported.

File formats

A variety of file formats is available. Each format has certain advantages and should be selected according to the application.

Format	Description
Parameter set files (*.csv)	Tab-separated Text-file. Easily readable in EXCEL.
Horizontal Parameter set files (*.csv)	Tab-separated Text-file. Easily readable in EXCEL.
Parameter set files (*.txt)	Particularly suitable for metadata having only one line of text (e.g. for the Setup-page *Documentation*). Easily readable with any text editing program
XML Files (*.xml)	Contains extended information on the import, so that the target table, the language and the data pool are always correctly recognized.

Export parameter set via

Command: Export parameters

The command: "**Export parameters**" allows automated export of the parameters at desired times and according to previously adjusted settings.

There are pre-made export-configurations available such as "Export all channels" (the values of the active channels' variables) or "Export all channels and settings" (the values of the active channels' variables, and channel settings of all analog channels). Or you can manually select which variable values and settings to export.

Ribbon: Project > Import/Export > Export > Export parameter set

Corresponds to the command: "Export parameters", with the limitations that there are no pre-made configurations and that export is performed when you close the dialog.

Ribbon: Setup-configuration > Export Configuration

This function provides a variety of exporting options. For most of the selection options, only the parameters (the content of the rows and columns) of the table on the currently open Setup page are exported. The table is associated with a so-called table description 282. In the table description is where you set which parameters (e.g. Channel name, Channel status, ...) are present. Not all parameters which would be possible are displayed in the table. For this reason, there are a variety of export options, so that it is possible to export either the visible, or the selected, or even the invisible parameters.

Selection	Description
All columns of tables on current page	All parameters defined in the table description are exported.
Visible columns on current page	All parameters are exported which are visible on the page. These included all columns in the table, but also all parameters in the dialogs and on additional tabs (e.g. the three tabs on the page: "*Channel balance*")
Selected columns on current page	All parameters which are selected for all channels/variables are exported.
Selected columns and rows on current page	All parameters which are selected for only the selected channels/variables are exported.
Balance settings	The balance settings are exported, regardless of the Setup page selected. The record of the experiment includes the respective balance values saved for the various settings. For this reason, the balance values for each measurement range, for example, are exported to the same file. For a detailed explanation, see "*Exporting balance values (taring, scaling, bridge, ...)* 1588". Upon importing, the appropriate balancing settings are imported in accordance with the measurement range set.
Choose columns manually	A dialog for selecting the desired columns appears. In this dialog, select all parameters which you wish to export. All parameters selected are exported.

Note — Export of adjustment values

When parameters which are relevant for adjustment are imported, inconsistent states can occur if not all parameters for the adjustment are appropriate. E.g. if only the compensation values are imported. When these values are exported the system ensures that all adjustment information is available when one of these relevant columns is exported.

All of the available selections also export the "*Balance scaling information*" as soon as a relevant adjustment column is included. Exception: "*Choose columns manually*"; here only items which are actually selected are exported.

The possibility to edit the export file manually still remains, but in consequence, the adjustment information may become inconsistent.

Import parameter set via

Command: Import parameters

The command: "**Import parameters**" allows automated import of the parameters at desired times and according to previously adjusted settings. You can also select from which file to import which variable's values and/or settings.

Ribbon: Project > Import/Export > Import > Import parameter set

Corresponds to the command: "Import parameters", with the limitation that import is performed when you close the dialog.

Ribbon: Setup-configuration > Import Configuration

Corresponds to the command: "Import parameter set", with the limitation that import is performed when you close the dialog. Everything is imported, regardless of the Setup page opened.

Parameter set import-column

With the "*Parameter set import-column*", you can quickly load a variety of settings. When entries in the Setup-table are selected, the associated saved parameter set (*.csv) is loaded. See also Creating and configuring additional columns 258 > Parameter set import-column 274.

Note — Importing variables

For importing variables' values, instead of the command: "*Import parameter*", the command "*Import variables*" should be used. This command is specially designed for variable values.

Using the command: "*Import parameter*" can cause unintended alteration of the device control.

Note — How the correct target is found

Parameter sets are saved in the form of tables. When importing previously saved parameter sets, the following rules apply in normal cases:

- **Target table:** As the target table (table description), the table in which the most columns are found is used. Note that the columns are found on the basis of their display names. It doesn't matter whether the short or long display name is used for a column.
- **Language:** The file name will contain a language-indicator abbreviation in most cases. By means of this, a parameter set can also be imported from a different language (see "*Note: Language abbreviation* 230").
- **Device-/channel configuration or datapool (variable values):** The datapool is recognized as the target as soon as at least the columns "Name" and "value" are present in the parameter set table.
- **Target row**: The target rows of the parameters to be imported are found on the basis of the names of the corresponding elements. (See Mapping for import and export 231)
- If only one row exists in a target table (e.g. experiment description), then one row is always imported from the parameter set table.

If XML is selected as the file format, then additional parameters are included in the export, so that the target table, the language and the datapool are always recognized correctly.

Note — Language abbreviation

The csv-files are designed to be language-independent. No in-house designations are used, which makes them easily readable. A language-indicating abbreviation is automatically appended to the file name. Thus, upon import it is possible to recognize for which language the file was generated. Additionally, a parameter set can also be imported from a different language (as long as the source language is installed).

Language recognition: If the abbreviation is not present, the language with the most matching titles is used as the source language.

Special case: There is no language abbreviation, but there are multiple parallel, valid files.

If when importing a file is specified only with the ending ".csv" and without any language-indicator abbreviation, then the system automatically searches for valid files having an abbreviation (Filename.Language.csv). If there is any corresponding file, it will be imported.

If multiple such files exist (varying languages), the file in the current language is used preferentially. If it is not available, the first one found is imported. The command generates an entry in the logbook on which file was imported.

Mapping for import and export

Mapping: Import

Here you can select the parameters according to which to import. At least one parameter must be used for assignment purposes to ensure that the parameters are assigned to the correct channel.

Selection	Description
Import mapping by name	For all parameters (all table descriptions), the settings are imported. The assignment is made on the according to the **name**. This means: All parameters belonging to a source-row (from the parameter set) are imported to a row in the target, if the parameter **Name** is identical in both the source and the target. **Special case:** If the parameter set contains the columns: **Name** and **Channel name** with different names: In this case, the column **Name** is still used for the assignment, but the column **Channel name** for setting the new name! Then it is possible to adapt the name by means of the name assignment. But this means that the parameter set can no longer be used since the previous name then no longer exists. By this method it would be possible, for example, to initialize the channel names. Then assign the new names of the parameters using a second parameter set.
Import of channels according to connector and device serial number	For all channels/variables (parameters of the table description: **Channels**), the settings are imported. The assignment is made according to the **connector designation** and **the device serial number**. **Note:** When using multiple devices, this selection is preferable to "*Import of channels according to connector*", since each connector designation is unique within a device. Disadvantage: it is not possible to assign parameters to other devices this way. If necessary, edit the parameters beforehand, in order to adapt the serial number to the target device.
Import of channels according to connector	For all channels/variables (parameters of the table description: **Channels**), the settings are imported. The assignment is made according to the **connector designation**. **Note:** When using multiple devices, the connector designation is not always unique; the same one could appear in every device. Use this setting only when using only one device.
...	Select a user-defined mapping. See "*Mapping - Modifications of the default behavior* 236".

Assignment: Export

Here you can select what is to be exported.

Selection	Description
Export all channels	All variables having the channel type: "**analog inputs**" are exported.
Export all channels and settings	All content of the table description: "**analog channels**" is exported and all variables having the channel type: "**analog inputs**" are exported.
...	Select a user-defined mapping. See "*Mapping - Modifications of the default behavior* 236".

Editing the parameter set

<table>
<tr><th>Program</th><th>Description</th></tr>
<tr><td>Editing by means of a text editor (Notepad, Notepad++, ...):</td><td>Here there are no known limitations.</td></tr>
<tr><td>Editing a csv-file with EXCEL</td><td>Load the file into EXCEL by double-clicking or by means of EXCEL's menu. If EXCEL's text conversion wizard appears, select "tab stop" as the separator.

When you save the file after having made changes in EXCEL, this message appears; "The file may contain features which are not compatible with Unicode text. Do you want to keep the workbook in this format?"

• Confirm with "Yes"

When you close EXCEL, another message appears:
"Do you wish to save changes?"

• Select "Don't save"

The following formats are not appropriate since the automatically save with the separator character ";":

• CSV (separator character) (*.csv)
• CSV (Macintosh) (*csv)
• CSV (MS-DOS) (*.csv)

Known problems:

Unless different settings have been made and no accompanying unit has been specified, EXCEL automatically interprets numbers with the decimal separator: Decimal period as a date and concerts the accordingly. In this case, set the formatting of the cell to "Text". Or use the Decimal comma as the separator character with making entries.</td></tr>
<tr><td>Editing a csv-file by means of OpenOffice or LibreOffice</td><td>Load the file by double-clicking or via the program's menu. If the Text Import Assistant appears, select as the separator character/separator option: "Tabulator".

If you save the file after having made changes, a message appears asking for the data saving format.

• Click on "Keep current format"

Known problems:

• The character ' is used as an internal character in the editing process and it is deleted if it is at the beginning of a cell. This character otherwise has significance, for instance, as the unit for "feet" or "minutes of angle".
• Unless different settings have been made and no accompanying unit has been specified, numbers with the decimal separator: Decimal period are automatically interpreted as a date and converted accordingly. In this case, set the formatting of the cell to "Text". Or use the Decimal comma as the separator character with making entries.</td></tr>
</table>

7.6.1.1 Parameter set in the application

Loading the factor, offset, unit and channel name from a CSV

This example illustrates how to import various settings in a targeted manner. The example can be modified for the parameters required.

Begin by creating a csv-template from an export of all parameters.

Next, go to the Setup page: "*Analog channels* " and run the export procedure:

Ribbon	View
Setup-Configuration > Export Configuration ( )	Complete

Select "*All columns of tables on current page*" for the export. All parameters defined in the table description are exported. Conclude the export and thus create a file of the file type "*Parameter set file (*.csv)*".

Editing in EXCEL

Open the csv file with EXCEL

- Delete all columns except for the following: "*Name*", "*Channel name*", "*Unit*", "*Scaling offset*" and "*Scaling factor*"
- Also delete all lines except the analog channels desired.
- Be aware of EXCEL's automatic formatting (see "*Editing the parameter set* 232"): Set the "*Formatting*" of the columns: Scaling offset und Scaling factor to "*Text*"
- Next, change the values. Her is an example:

Name	Channel name	Unit	Scaling offset	Scaling factor
Channel_001	Messpunkt_1_Spannung	V	5	1
Channel_002	Messpunkt_2_Geophon	m/s	0	0,05076
Channel_003	Messpunkt_3_Geophon	m/s	0 m/s	0,05076 m/s/V

Notes on the values in the example:

- The column "*Name*" is used for assignment when importing.
- The column "*Channel name*" is used for the new name.
- The column "*Scaling offset*" depends on the unit and the column "*Scaling factor*" is additionally dependent on the measurement mode. In this example, import of Channel_003 would fail if the measurement mode was set to Bridge. In this case, the unit for the factor would need to be set to "*m/s/"mV/V"*" for example.
  As you see with Channel_002, you can also omit the unit.

Save the csv file. Here, too, observe the notes on EXCEL (see "*Editing the parameter set* 232"):

Upon saving, this message will appear:
"*The file may contain features which are not compatible with Unicode text. Do you want to keep the workbook in this format?*"

- Confirm with "*Yes*"

When you close EXCEL, another message appears:
"*Do you wish to save changes?*"

- Select "*Don't save*"

Import in imc STUDIO

Perform an import:

Ribbon	View
Setup-Configuration > Import Configuration ( )	Complete

For the mapping, use "*Import mapping by name*"

Restricted import of parameters, e.g. without channel name

Requirement: A parameter set contains many parameters, and they are all always included with an import. However, this is not always desirable.

Possible solution: One could edit the parameter set file by deleting all undesired parameters.

This is the easiest approach if it only needs to be done once. However, if the exporting process routinely generates a new file, it can save time to **modify the import mechanism** instead.

Below is an example illustrating the import of balancing values.

Example	When importing balancing values, not all of the parameters need to be imported

The scope of the balancing process comprises certain parameters such as the measurement range and measurement mode. But other parameters such as the channel name, comments, data saving settings, ..., are not to be included in the import.

In one particular application, the balancing values are routinely exported. This means that they can be used in all experiments for the same device. When required, it should be possible to import the file without needing to edit it each time. For this purpose, the "mapping 1589"-mechanism is to be modified one single time.

Mapping:

In the mapping instruction, you can select the parameters according to which to perform the import. You can additionally define other restrictions.

Specifically: The **balancing-parameters** associated with the **connection terminal designation "[01] IN01"** (appearing on a line in the parameter set) are mapped to the **device having the corresponding serial number** in the **line displaying the connection terminal designation "[01] IN01"**. Now this is performed for each parameter. Exception: Channel Name; this parameter is skipped.

Information on the mapping:

Each assignment defined will be saved in an xml-file.

Pre-made mapping files for the parameter set commands are located following installation (depending on the installation and possibly the version) under the this path: (hot key <win> +r)

shell:common appdata\imc\imc STUDIO\Applications_1\Extensions\Parameterset

The assignment files used are located in the respective import or export folder. **Please do not change the original files!** If you save your own files there, they will be available for import/export.

A detailed description is provided in the chapter: "*Mapping - Modifications of the default behavior*236".

Additional configurations for import, examples and ideas are also presented in that chapter. For instance, you can limit import to certain channel types, or exclude other parameters (such as the data storage configuration) from the import.

Proceed as follows:

The best approach is to copy one of the existing files and open it in a text editor (e.g. Notepad++).

The name of the new file must have this extension: ".mapping.xml"; e.g. Balancing_ConnectorAssignment.mapping.xml

Copy the following text to the file (be aware that any extra line break, caused by copying long lines, will need to be deleted):

```
<import>
    <languageblock language="de">
        <caption>
            Abgleichdaten nach Anschluss und Geräteseriennummer importieren
        </caption>
        <description>
            Für alle Kanäle werden die Abgleich Einstellungen importiert. Ignoriert
werden Parameter, wie der Kanalname. Dabei wird die Zuordnung anhand der
Anschlussbezeichnung und der Geräteseriennummer vorgenommen.
        </description>

        <mapping>
            <source>
                SELECT *
            </source>
            <target>
                SELECT *\Name,Kanalname WHERE Anschluss = source.Anschluss AND
Geräteseriennummer = source.Geräteseriennummer
            </target>
        </mapping>
    </languageblock>
</import>
<import>
    <languageblock language="en">
        <caption>
            Import balance settings in accordance with the connection and device
serial number
        </caption>
        <description>
            The balance settings are imported for all channels. The assignments are
made according to the connector designation and the device serial number. Parameters
such as the channel name are ignored.
        </description>

        <mapping>
            <source>
                SELECT *
            </source>
            <target>
                SELECT SELECT *\Name,Channel name WHERE Connector = source.Connector
AND Device SN = source.Device SN
            </target>
        </mapping>
    </languageblock>
</import>
```

Subsequently, there is a new item among the available mapping selections for import of the parameter set: "*Import balance settings in accordance with the connection and device serial number*".

In the following line of code, after the string "*\" you specify which parameter are not imported.

```
<target>
    SELECT *\Name,Channel name WHERE ...
</target>
```

For more examples of syntax, see the chapter "*Mapping - Modifications of the default behavior* 236".

Please also observe the notes about languages 238.

7.6.1.2 Mapping - Modifications of the default behavior

Note Advanced notes

This chapter provides advanced information on the import- and export mechanism. In most cases this chapter can be skipped.

Warning

The following description is of a modification of the default import and export behavior. For most applications, the existing mapping files are adequate.

Please don't change the existing mapping files, but rather make new assignments, at most.

The **mapping** determines how import and export are governed, for instance, according to what pattern data are imported. In this chapter, you will find some mapping examples. According to this pattern, you can define your own mapping files to design the import and export to corresponds to your requirements.

Each assignment defined will be saved in an xml-file.

Pre-made mapping files for the parameter set commands are located following installation (depending on the installation and possibly the version) under the this path: (hot key <win> +r)

shell:common appdata\imc\imc STUDIO\Applications_1\Extensions\Parameterset

The assignment files used are located in the respective import or export folder. **Please do not change the original files!** If you save your own files there, they will be available for import/export.

Scenarios for import

If only certain rows of a table are to be imported, or the parameters are to be imported according to criteria other than the name.

Scenarios for export

For instance, if all channels are to be exported, they must be selected and their names known. However, as soon as the configuration is changed and new channels are added, the export list must be modified. With the help of the export mapping rules, it is possible to export all channels no matter how many and what names are used, or conversely to to export only variables belonging to one type.

Defining a mapping rule

This mapping rule is saved in an XML file with the extension ".mapping.xml". **Be aware that the file must be UTF-8 encoded.** In every case, the language for which the mapping rule is used must also be specified.

In such a file it is possible to specify any desired mapping rules, and a name and a description for the mapping rule.

Example Introductory example of import, with explanations

```
<import>
    <languageblock language="en">
        <caption>
            Here, a designation can be specified
        </caption>
        <description>
            Here, an explanation of this mapping rule can be supplied.
        </description>

        <mapping>
            <source>
                Here is where you define which rows from which table of the parameter
set are to be imported.
            </source>
            <target>
                Here is where you define on which rows and columns the source row data
are to be mapped.
            </target>
        </mapping>
    </languageblock>
</import>
```

Languages in the mapping rule

In order for assignment to be possible, the language of the file to import and of the software in the mapping file must be available. English should be used as the fallback language in case some parameters in the currently used software language are not available.

For each language, create a separate **languageblock**-block.

Example **languageblock**-block

```
<import>
    <languageblock language="de">
        <caption>
            ...
        </caption>
        ...
    </languageblock>
    <languageblock language="en">
        ...
    </languageblock>
    <languageblock language="fr">
        ...
    </languageblock>
    <languageblock language="ja">
        ...
    </languageblock>
    <languageblock language="zh-CN">
        ...
    </languageblock>
    <languageblock language="zh-TW">
        ...
    </languageblock>
    ...
</import>
```

Syntax-examples for the import:

Syntax <source>	Description
`SELECT * FROM Channels`	All rows are used for import from the source file which can be assigned to the table description **Channels**. Device parameters and parameters of other table descriptions are not imported.
`SELECT *`	All rows are used for the import from the source file.
`SELECT * FROM Channels WHERE Name = 'My_TemplateChannel_Bridge'`	From the source file, all rows are used for the import 1. which were able to be assigned to the table description **Channels**, 2. and have **My_TemplateChannel_Bridge** for the parameter: **Name**.

Syntax <target>	Description
`SELECT * WHERE Name = source.Name`	All parameters of a source row are imported to a row in the target, if the parameter **Name** is identical in the source and in the target.
`SELECT * WHERE Connector = source.Connector`	All parameters of a source row are imported to a row in the target, if the parameter **Connector** is identical in the source and in the target.
`SELECT * WHERE Connector = source.Connector AND Device SN = source.Device SN`	All parameters of a source row are imported to a row in the target, 1. if the parameter **Connector** is identical in the source and in the target and 2. if the parameter **Device SN** is identical in the source and in the target.
`SELECT *\Name,Channel name WHERE Coupling = 'Full bridge'`	All parameters of a source row are imported to a row in the target if the parameter **Coupling** is **Full bridge** in the target. The parameters **Name** and **Channel name** are ignored and not set in the target.

Example Import 1: Channels - Import mapping by name

All rows are used for import from the source file which can be assigned to the table description **Channels**.

Each row in the parameter set is mapped to a row in the target table having the same **Name** as the source row.

```
<import>
    <languageblock language="en">
        <caption>
            Channels - Import mapping by name
        </caption>
        <description>
            The channels of the channel table are ordered by their names
        </description>

        <mapping>
            <source>
                SELECT * FROM Channels
            </source>
            <target>
                SELECT * WHERE Name = source.Name
            </target>
        </mapping>
    </languageblock>
</import>
```

Example Import 2: Import mapping by name

Similar to Example 1.

From the source file, all rows are used for the import, not only for the table description: **Channels**.

Each row in the parameter set is mapped to a row in the target table having the same **Name** as the target row.

```
<import>
    <languageblock language="en">
        <caption>
            Import mapping by name
        </caption>
        <description>
            All parameters are assigned according to their name.
        </description>

        <mapping>
            <source>
                SELECT *
            </source>
            <target>
                SELECT * WHERE Name = source.Name
            </target>
        </mapping>
    </languageblock>
</import>
```

Example **Import 3: Import of channels according to connector**

File: ConnectorAssignment_one_Device.mapping.xml

From the source file, all rows are used for the import.

The settings for all channels are imported. The assignment is performed on the basis of the connector designation. Each row in the parameter set is mapped to a row in the target table having the same **connector designation** as the source row.

```
<import>
    <languageblock language="en">
        <caption>
            Import of channels according to connector
        </caption>
        <description>
            The settings for each of a device's channels are imported. The assignments
are made according to the connector designation.
        </description>

        <mapping>
            <source>
                SELECT *
            </source>
            <target>
                SELECT * WHERE Connector = source.Connector
            </target>
        </mapping>
    </languageblock>
</import>
```

Example **Import 4: Import of channels according to connector and device serial number**

File: ConnectorAssignment.mapping.xml

All rows from the source file are used for the import.

The settings for all channels are imported. The assignment is performed on the basis of the connector designation and the device serial number.Each row in the parameter set is mapped to a row in the target table having the same **connector designation** and **serial number** as the source row.

```
<import>
    <languageblock language="en">
        <caption>
            Import of channels according to connector and device serial number
        </caption>
        <description>
            The settings for each of a device's channels are imported. The assignments
are made according to the connector designation and the device serial number.
        </description>

        <mapping>
            <source>
                SELECT *
            </source>
            <target>
                SELECT * WHERE Connector = source.Connector AND Device SN =
source.Device SN
            </target>
        </mapping>
    </languageblock>
</import>
```

Example Import 5

This mapping rule consists of two parts. First, the row of the parameter set which was imported for the channel table and which has the name "My_TemplateChannel_Bridge" is loaded. Next, this row is mapped to all rows in the target table for which "Full bridge" was set as the coupling.

In the second step, the row of the parameter set which was imported for the channel table and which has the name "My_TemplateChannel_DC" is loaded. Next, this row is mapped to all rows in the target table for which "DC" was set as the coupling.

In both cases, the name and the channel name are not set in the target.

```
<import>
    <languageblock language="en">
        <caption>
            Initializing analog channels
        </caption>
        <description>
            Creating a base configuration for all analog channels.
        </description>

        <mapping>
            <source>
                SELECT * FROM Channels WHERE Name = 'My_TemplateChannel_Bridge'
            </source>
            <target>
                SELECT *\Name,Channel name WHERE Coupling = 'Full bridge'
            </target>
        </mapping>

        <mapping>
            <source>
                SELECT * FROM Channels WHERE Name = 'My_TemplateChannel_DC'
            </source>
            <target>
                SELECT *\Name,Channel name WHERE Coupling = 'DC'
            </target>
        </mapping>
    </languageblock>
</import>
```

Example **Sample files for example Import 5**

Example: csv-file

Name	Channel status	Measurement mode	**Coupling**	Input range
My_TemplateChannel_Bridge	Active	Voltage	**Full bridge**	±100 "mV/V"
My_TemplateChannel_DC	Active	Voltage	**DC**	±5 V
My_Channel_without_effect	Active	Voltage	Quarter bridge	±10 "mV/V"

Example: Channel-configuration prior to import

Name	Channel status	Measurement mode	**Coupling**	Input range
Channel_001	Passive	Voltage	**DC**	±1 V
Channel_002	Passive	Voltage	**DC**	±1 V
Channel_003	Passive	Voltage	**DC**	±1 V
Channel_004	Passive	Voltage	Quarter bridge	±1000 "mV/V"
Channel_005	Passive	Voltage	Quarter bridge	±1000 "mV/V"
Channel_006	Passive	Voltage	**Full bridge**	±1000 "mV/V"
Channel_007	Passive	Voltage	**Full bridge**	±1000 "mV/V"
Channel_008	Passive	Voltage	**Full bridge**	±1000 "mV/V"

Example: Channel-configuration after import

Name	Channel status	Measurement mode	**Coupling**	Input range
Channel_001	Active	Voltage	**DC**	±5 V
Channel_002	Active	Voltage	**DC**	±5 V
Channel_003	Active	Voltage	**DC**	±5 V
Channel_004	*Passive*	*Voltage*	*Quarter bridge*	*±1000 "mV/V"*
Channel_005	*Passive*	*Voltage*	*Quarter bridge*	*±1000 "mV/V"*
Channel_006	Active	Voltage	**Full bridge**	±100 "mV/V"
Channel_007	Active	Voltage	**Full bridge**	±100 "mV/V"
Channel_008	Active	Voltage	**Full bridge**	±100 "mV/V"

The names are ignored. The channels: "*Channel_004*" and "*Channel_005*" remain as they are, since the coupling "*Quarter bridge*" is not in the assignment rule for the target.

The source row "*My_Channel_without_effect*" is also not in the assignment rule and is not used as a source.

Syntax-examples for the export:

Syntax <source>	Description
`SELECT * WHERE Caption = 'analog inputs'`	All contents of the table description and/or all variables of the channel type: "**analog inputs**" are exported. In this case, there is no table description of the name "**analog inputs**". However, there are variables of the channel type "**analog inputs**"
`SELECT * WHERE Caption = 'analog inputs' OR Caption = 'analog channels'`	All contents of the table description and/or all variables of the channel type: "**analog inputs**" or "**analog channels**" are exported. In this case, there is a table description of the name "**analog channels**". And there are also variables of the channel type "**analog inputs**"
`SELECT * WHERE Caption = 'analog channels'`	All contents of the table description and/or all variables of the channel type: "**analog channels**" are exported. In this case, there is a table description of the name "**analog channels**". However, there is no variable of the channel type "**analog channels**".

Syntax <target>	Description
`SELECT *`	obligatory specification

Example **Export 1: Export all channels**

All variables of the channel type: "**Analog inputs**" are exported.

```
<import>
    <languageblock language="en">
        <caption>
            Export all channels
        </caption>
        <description>
            Export data from all active channels.
        </description>

        <mapping>
            <source>
                SELECT * WHERE Caption = 'analog inputs'
            </source>
            <target>
                SELECT *
            </target>
        </mapping>
    </languageblock>
</import>
```

Example Export 2: Export all channels and settings

All contents of the table description: "**analog channels**" are exported and all variables of the channel type: "**analog inputs**" are exported.

The only distinction made is between the names: "analog inputs" vs. "analog channels". The names must be unique if they are used for the export.

```
<import>
    <languageblock language="en">
        <caption>
            Export all channels and settings
        </caption>
        <description>
            Export data and settings from all active channels.
        </description>

        <mapping>
            <source>
                SELECT * WHERE Caption = 'analog channels' OR Caption = 'analog
inputs'
            </source>
            <target>
                SELECT *
            </target>
        </mapping>
    </languageblock>
</import>
```

7.6.2 Enumeration Classes

In an Enumeration class, the associations to "Object-groups" (e.g. analog channels, Display-variables, devices, ...) are defined.

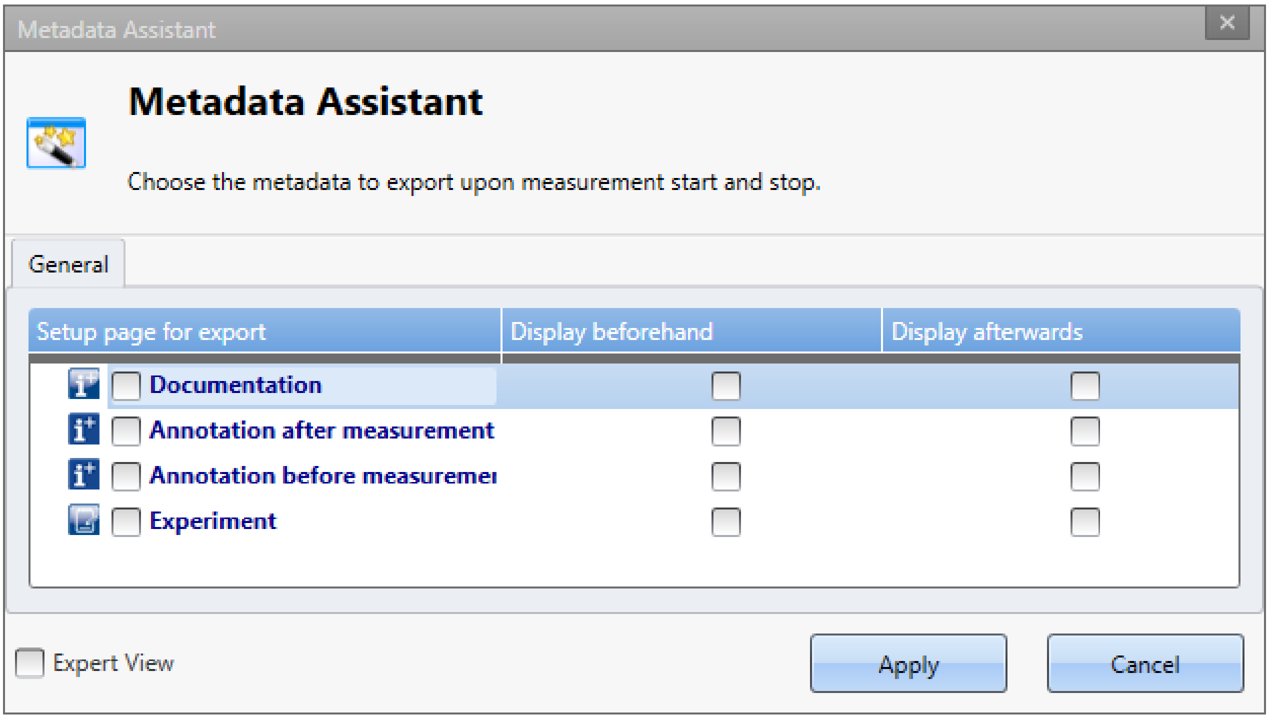
It is important to make an appropriate selection for the Default Values 187 for example, in order to have the correct targets for the defaults.

Enumerator class	Internal designation	Description
Experiment	eExperiment	Experiment metadata
Device	eDevice	Device settings
Module	eModule	Amplifier parameters
Bit	eSubChannel	DI-/DO-bits (incl. Mon-DI-Bits), virtual bits, Ethernet bits, Field-bus bits (MFBDIO), PV-variables (of DI-ports, analog-, incremental counter- or Field-bus channels)
Channel	eChannel	Analog channels, DIO-ports, other PV-variables, virtual channels, Display-variables, ...
Trigger	eTrigger	Trigger settings (trigger name, trigger linkage, event number, trigger, trigger count)
Parameter	eParameter	AppMod block parameter (only the parameter value can be set)

7.6.3 Metadata Assistant

Using the Metadata Assistant, you can save metadata from the Setup along with a saved measurement or also save them directly to the channel file.

Ribbon	View
Extra > Metadata Assistant ( )	all



Metadata Assistant in the Standard view

In order to have the **data on the measurement saved**, select the desired Setup page in the column "*Setup page for export*". Additionally, you can have the pages **displayed before the start** of or after the end of the measurement. To do this, check the box for the desired Setup page in the column "*Display beforehand*" / "*Display afterwards*".

FAQ

Question: How and where are the metadata saved?

Answer: The metadata **are saved as a *.csv-file**. For this purpose, a folder "*Meta*" is created in the experiment folder parallel to the measurements. In the respective **measurement folder, a link** to the associated csv-file is created.

When **exporting an experiment** with the measured data included, the metadata are also included.

Question: Can metadata also be saved on the device?

Answer: Metadata saved **along with the measurement** are only saved on the PC. Metadata which are saved **in the channel file** are also saved int he files which are stored on the device.

Note — Saving the configuration

The **configuration of assistant** is saved with the respective **experiment**.

- See also: "*What is saved where?* 142"

Note — Measurement storage area

If you are using the user-defined measurement storage area in combination with metadata, please read the notes in chapter Measurement storage area 736.

Use of the metadata in the Setup

If you wish to display metadata in the Panel, which were saved along with the measurement, you can get them using the placeholder <MEASUREMENT.SQL 152 >.

Example — Querying "Comment (Start)", which was saved with the measurement

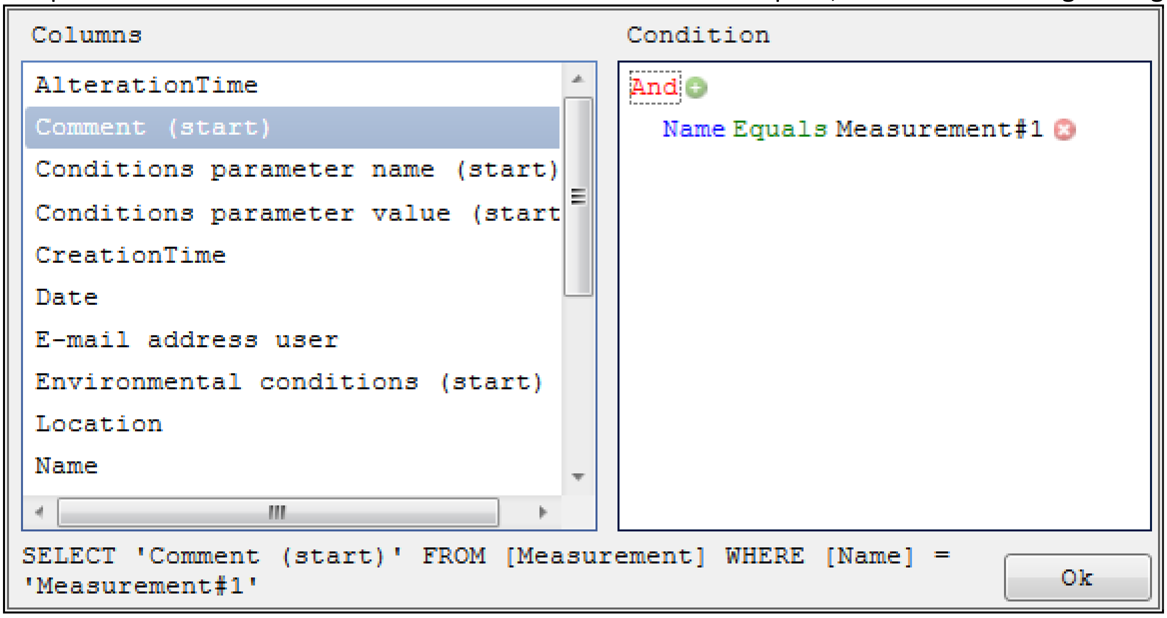
Activate one input channel of your measurement device and save it on the PC. Next, open the Metadata Assistant and for "***Annotation before measurement***", set the page to be exported and displayed before starting the measurement.

Next, run a measurement. Upon its start, the page is displayed as a dialog. Enter a text in the box "***Comment (Start)***" and exit the dialog using "*Close*". Let the measurement run a few seconds and then stop it.

Go to the Data Browser and select the saved measurement, so that it receives the **measurement number #1**.

You can now query the saved comment as follows:

- In the **Widget**: Create a text box of the group *Automotive, Industrial or Designer.* Open the text box's properties. Open the property ***Text*** and press CTRL+ Space to open the placeholder selection. Select the placeholder <MEASUREMENT.*>. In the Assistant which then opens, make the following settings:



Querying the "Comment (Start)" of the measurement having the symbolic measurement number#1

- In the **Data Browser**: Open the context menu in the Data Browser and select "***Add metadata-columns***". From the list, select "***Comment (Start)***". The column is now displayed in the Data Browser. Its respective content is in the line for the measurement.

Available Setup pages

By default, the Setup pages "***Documentation***", "***Experiment***", "***Annotation before measurement***" and "***Annotation after measurement***" are available in the Metadata Assistant.

FAQ

Question: Can I make additional Setup pages available?

Answer: Yes (imc STUDIO Developer only).

Whether or not Setup pages can be displayed in the Assistant is controlled via a property of the respective Setup page.

Open the Setup. In the tool window "**Layout Repository**", select the desired Setup page and open the properties (via the context menu or the key F4). Here you will find the property "***Metadata template***". Check the box and close the Properties window in order to make the Setup page available in the Metadata Assistant.

If the tool window "**Layout Repository**" is not visible, you can have it shown by selecting the menu item "*View*" > "*Tool windows*" or "*Extras*" > "*Tool windows*".

Question: Can I modify the available Setup pages?

Answer: Yes (in imc STUDIO Professional and higher).

To do this, open the desired page in the Setup. If this page (e.g. *Annotation before measurement*) is not present , you can add it to the other pages using Drag&Drop from the tool window "**Layout Repository**". If the tool window "**Layout Repository**" is not visible, you can have it shown by selecting the menu item "*View*" > "*Tool windows*" or "*Extras*" > "*Tool windows*".

Next, modify the page as desired. For information on this topic, see the section "*Setup-Layout* 253".

When you are finished modifying the page, open the context menu over the title of the Setup page and select "***Save as complete layout***". To overwrite the existing page, confirm the suggested name. **Be aware that this change will affect the entire project**. For imc STUDIO Developer only: If you wish to use the page under a new name, enter the new name. In this case, after saving you still need to set the property "***Metadata template***" (see previous FAQ). Subsequently, save the view.

Now when you open the Metadata Assistant, the changed page is available. **For technical reasons, the page must always be modified first before it is selected in the Assistant.** Otherwise its old edition is used.

7.6.3.1 Expert View

To use the Expert View, check the selection box next to "*Expert View*" in the Assistant's lower region. Now along with the tab "*General*" there will be three additional tabs for configuring your metadata.

Column selection

Here you can configure which **individual metadata about the measurement** to save.

The tab "*General*" offers the ability to save all information belonging to a Setup page along with the measurement. On the page "*Column selection*", you can refine this selection: All information (columns) regarding the Setup pages is listed, which can be **individually selected/deselected** as needed. If you require only some of the information, it is recommendable to first deselect the complete page and subsequently to select only the individual, desired items of information.

Storage is accomplished int the same way previously described for the tab , with the difference, that only the selected items of information are saved and available.

Meta-data in Channels

On this table page there are a variety of data available for selection, which you are able to save directly **in the channel**. In consequence, **no separate csv-file** is created. The information is saved with all the channels and thus also in the files on the hard drive.

All existing Setup parameters can be saved as supplemental information the channel files, even custom-created metadata columns.

This applies to data storage on the PC as well as in the device. In the case of a diskstart, such data are saved in the channel which were available at the time the diskstart was generated.

If you wish to export the saved data from the channel file, you can do that as follows:

- **Widgets:** Using the placeholder `<VARS["myChannel"].PROPS["myMetadata"]>`, the metadata which were saved in the channel file can be queried.
- **imc FAMOS:** Use the command "*Run imc FAMOS sequence* 1607". Use the command `UserPropText?` (for texts) or `UserPropValue?` (for numbers).
- **Data Browser**: The saved metadata can be added in the Data Browser as a column. To do this, open the context menu in the Data Browser and select "*Add metadata column*". In the list, select the **internal name** of the desired metadata. The column will be displayed along with the metadata in the respective channel's row. The columns of the Data Browser belong to the **View**. To retain the setting for the next start of imc STUDIO, save the view before exiting.

Ribbon	View
View > Save View ( )	Complete
Extras > Save View ( )	Standard, Compact

Note

Changes made during measurement

Metadata for the channel are specified **when the file is created**. Any changes made to the metadata during measurement are not adopted. This applies even when data storage resumes in a new file (e.g. in the case of "*Interval saving*").´

Internal name

Metadata saved **along with the measurement** (tab: "*General*" and "*Column selection*") are saved in a separate file. To access these metadata (Widget or Data Browser), the **name from the user interface** (e.g. "*Comment (Start)*") has to be used.

To query metadata which are **saved in the channel file**, you need the metadata's **internal name**. On this topic, read the next FAQ box: "*How do I find out the internal name?*"

FAQ

Question: How do I find out the metadata's internal name?

Answer: Open a saved channel containing metadata in the free-floating curve window (double-click on the channel in the Data Browser).

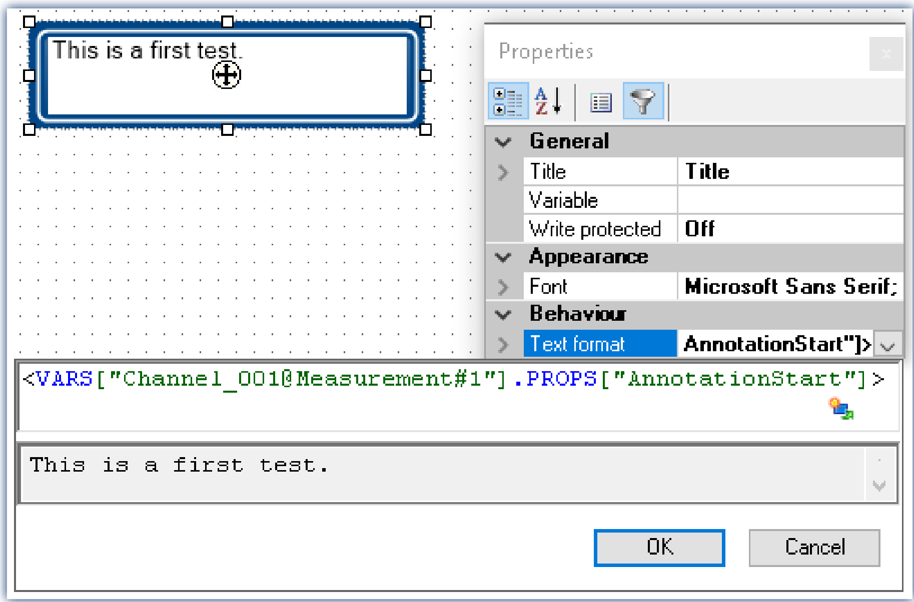
Next, select the menu item "*Configuration*" > "*More Channels*". Jump to to the tab "*Channel info*".

Here you will find under the heading "*User-defined properties*" the available saved metadata with their respective internal names.

Example — Querying a channel's "Comment (Start)"

If you have set ***Comment (Start)*** to be saved to the channel file (selected the entry ***Comment (Start)*** under ***Meta-data in Channels*** on the tab ***Other***) an already at least one measurement was performed with this configuration, you can query the saved comment in the following way:

- In the **Widget**: Create a text box of group *Automotive, Industrial* or *Designer.* Open the text box's properties. In the property ***Text***, enter the following (making all entries by means of the input assistance may not be possible; in that case, complete the text manually.):



Querying the "Comment (Start)" of the measurement having the symbolic measurement number#1

- Via **imc FAMOS**: Transfer the channel using the command "*[Run imc FAMOS sequence](1607)*". Enter as the imc FAMOS command `commentStart = UserPropText?(Channel_001, "AnnotationStart")`. The variable *commentStart* can be returned back to imc STUDIO, for example, in order to continue using it there. In order to always use the channel belonging to the measurement #1, in the transfer dialog make the setting "*To imc FAMOS Source=Measurement#1*".
- In the **Data Browser**: Open the context menu in the Data Browser and select "*Add metadata columns*". Select from the list "*AnnotationStart*". The column will now be shown in the Data Browser. The associated content appears in the row belonging to the channel.

Configuration of the events

This tab is only visible it the current user possesses the access right "*Metadata Assistant: Configuration of the events*". In the default case (so when no changes to the assess rights have been made), this function is only available for users belonging to the group "*imc Developers*".

Here you can link additional [commands](1545) to the starting/stopping of the devices.

7.6.4 Setup-Layout

This section describes the Setup-interface's designing options.

Chapter overview

Synopsis	Chapter
Showing and arranging existing columns	Showing and moving columns 254
Personally defined columns	Creating and configuring additional columns 258
Preventing dialogs from closing until after an entry has been made	Using Mandatory Boxes 277
Transferring columns to other PCs or to other projects	Export/import of column/table descriptions 281
Modifying and configuring pages	Table Description and Complete Layout 282 Properties of the Pages/Complete Layouts 283 Designing pages 284

7.6.4.1 Showing and moving columns

By default, the various Setup pages show a certain selection of columns (parameters). You can also **configure the selection and order** of the columns according to your own wishes. The column configuration is saved/opened with the view configured.

Note — Saving the column selection

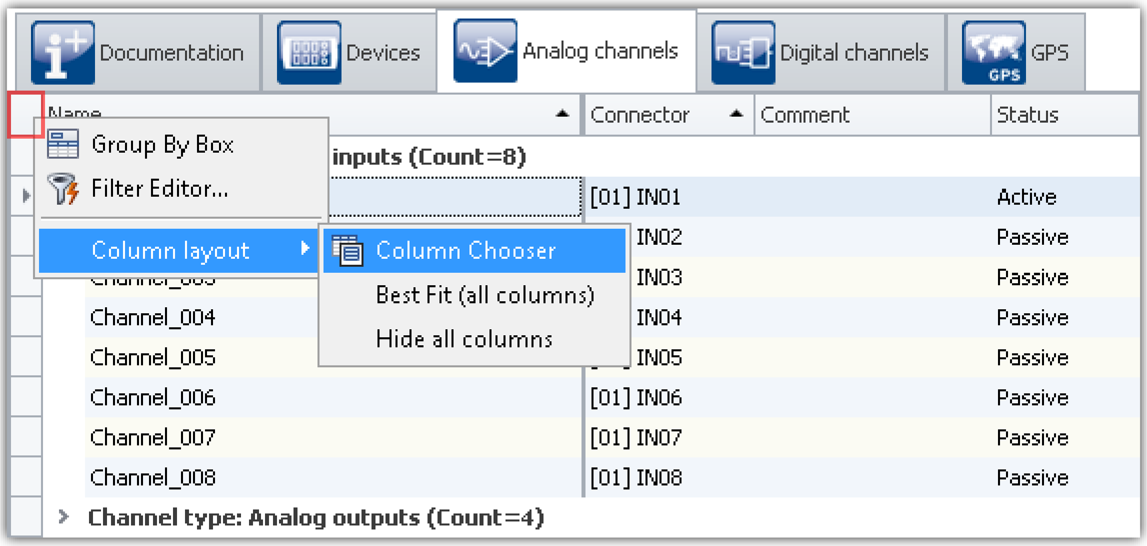
The **position and size of the column** is **saved with the views**. The views are **saved along with the project**. This means that any views are available for all of the project's experiments.

- See: "*What is saved where?* 142"
- See: "*Views* 135"

The pages are constructed in a variety of styles. The various design elements have different methods for configuration.

Display in a "Table": e.g. the pages "Devices", "Analog channels", ...

Opening "Column Chooser"

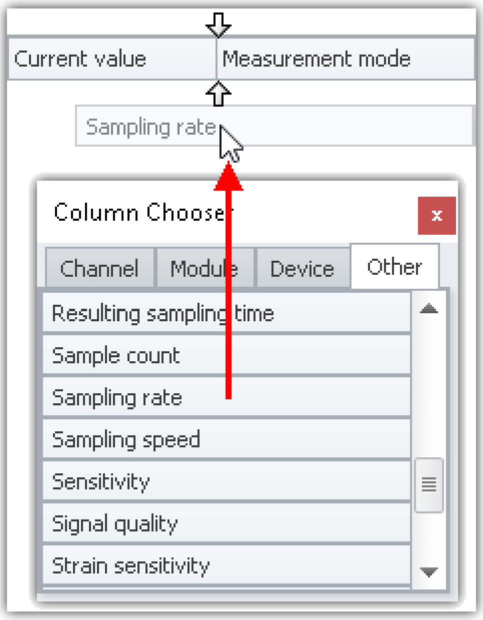


Opening the table's context menu

In order to insert columns, open the "*Column Chooser*" dialog. To do this, open the context menu in the upper left corner of the table. Select "*Column Chooser*".

Inserting columns

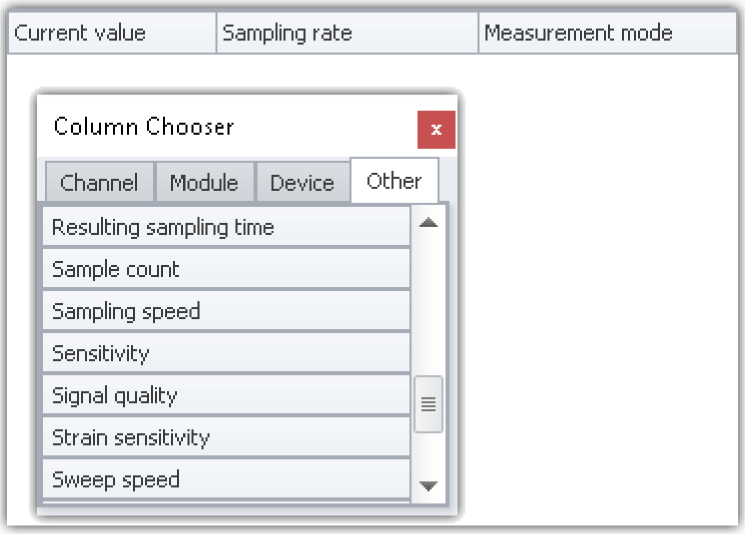
The dialog "*Column Chooser*" contains a list of al columns which can be inserted. In order to insert a column, **drag it from the list** to the column's header, as shown in the image below.



Dragging a column

The position of the arrows (before the column has been placed) **indicates** whether the column is to be inserted. In this example, the column "Sampling rate" is inserted to the right next to "Current value".

Once you have placed the column, it is inserted at the position chosen.



The column positioned

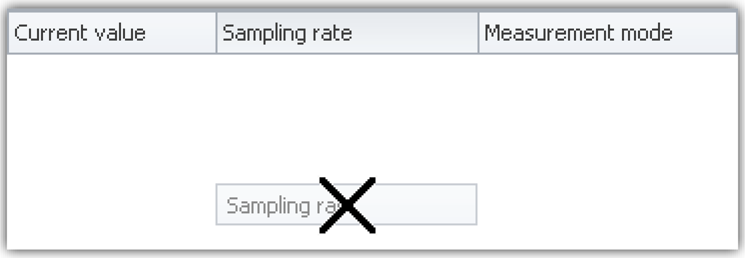
Moving columns (changing position)

To change a column's position, **use Drag&Drop to move it** to the title bar at the desired position.

Deleting columns

In order to delete a column, use one of the two following possibilities:

- Open the "*Column Chooser*" dialog and drag the column to the dialog window
- Drag the column to an empty area next to the table as shown below:



Deleting a column by Drag&Drop

The "*Column Chooser*" dialog does not need to be open.

Display in a "Detail-Table": e.g. the pages "Documentation", "Experiment", ...

Opening "Column Chooser"

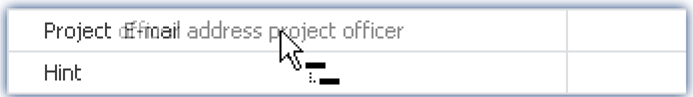
In order to insert columns, open the dialog "*Column Chooser*". To do this, open the **context menu of an existing column title** or of any empty area. Select the item "*Column Chooser*".

Inserting a column

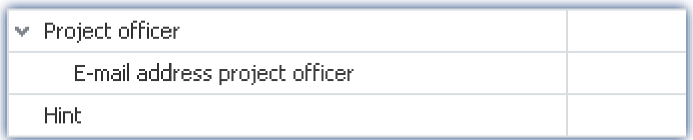
The dialog "*Column Chooser*" contains a list of all columns which can be inserted. In order to insert a column, **drag it from the list** into the existing table.

The **mouse cursor** indicates where the column will be inserted.

As a branch of an existing group



Insertion as a branch in an existing column



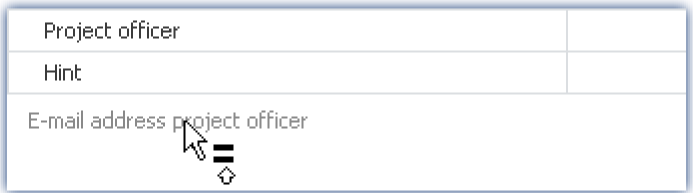
The next higher level column becomes a grouping element

Between existing columns

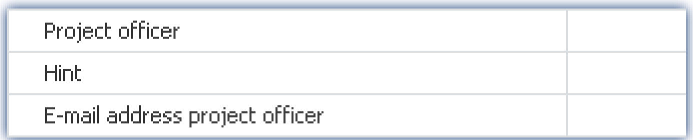
Isertion between two existing columns
Be aware that the cursor needs to be rather far to the left

The column is inserted in between

After the last column



Insertion after the last existing column



The column is inserted at the end

Moving columns (changing position)

First open the dialog "*Column Chooser*". In order to change the position of a column, **move the title** by means of Drag&Drop to the **desired position** (in the same manner as inserting the column).

Deleting columns

First open the dialog "*Column Chooser*". To delete a column, **move the title** by means of Drag&Drop to the **dialog**.

Note — Saving / restoring a configuration

In order to save a column layout, use the functions belonging to the View menu (see the manual imc STUDIO (general) > chapter "*Views*"). 135

7.6.4.2 Creating and configuring additional columns

Note	Prerequisite: imc STUDIO Professional

Creating/editing columns is only supported as of the product versions imc STUDIO PRO 29.

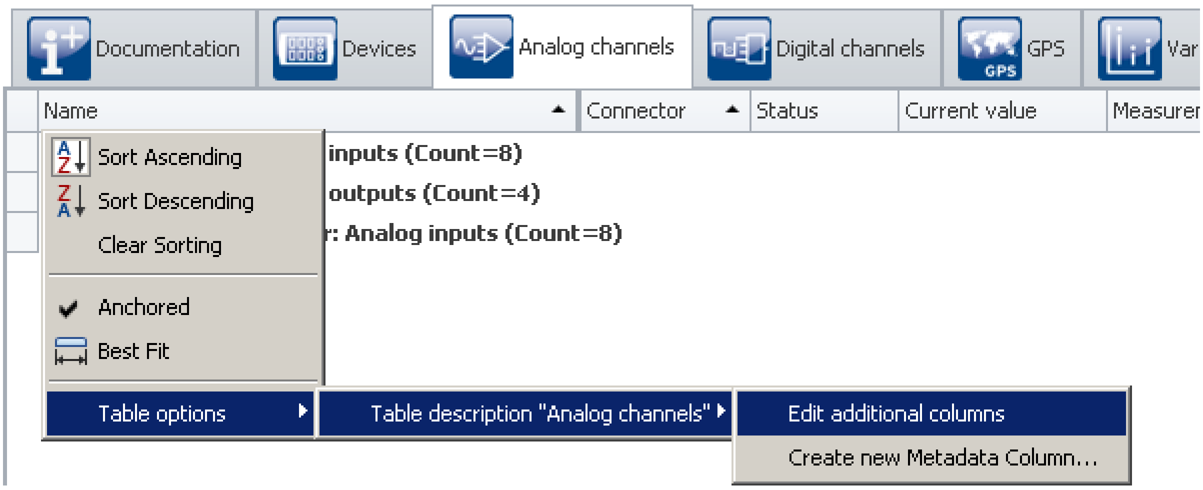
"*Additional columns*" contains controls for **improving and adapting** the **operation and documentation** of your measurement results in a wide variety of ways.

Type	Description
Combined column 260	Allows combination, operation and display of multiple parameters in a single column.
Metadata column 267	Allows display of any desired information and documents (also from third-party) applications.
Parameter set column 269	Fixed parameter sets (combinations of settings) can be saved in a column and set with a single click of a button.
Parameter set import column 274	Pre-defined, comprehensive parameter set files (*.csv) can be loaded by means of the drop-down list.

Additional columns are defined in two steps. **First select the type** of extra column and set certain basic properties such as the title and designation. Then for the "*Combined column*" and the "*Parameter set column*", select **the corresponding columns** and for the "*Metadata column*" select **the data type** or data source (file).

Creating the columns with the Collection editor

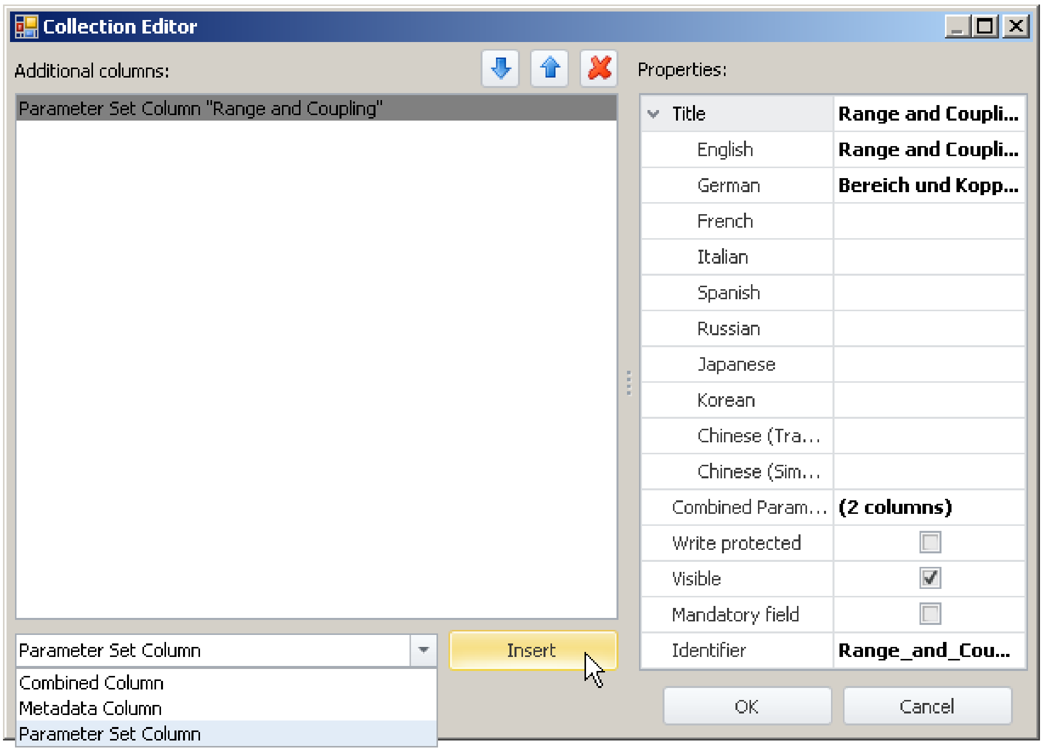
To create additional columns, open the **context menu of the column headers** and select "*Table options*" > "*Table description "<Name>"* " > "*Edit additional columns*".



"Edit additional columns" in the context menu of the column headers
Here also: Context menu of the table header

This function is available on every Setup page (Documentation (here without table), Devices, Channels, ...).

The **Collection Editor** opens:



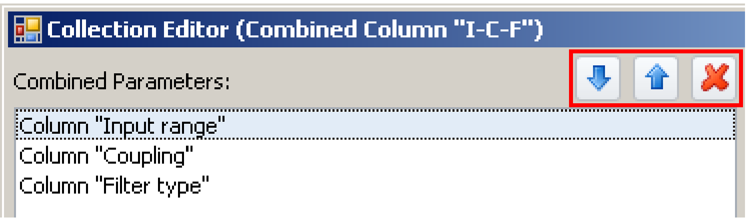
Collection Editor (example)

- In the drop-down list (at bottom left), **select the type of the additional column**.
- Click on "*Insert*" and **the column is adopted into the list**.
- In the "*Properties*" window, set the column's **appearance / functionality**.

For a detailed example, see the chapter "*Combined column* 260" or "*Parameter set column* 269".

Sorting/deleting columns and parameters in the Collection Editor

To **sort entries**, use the "Up/Down"-arrow icons (/). To delete entries, use the "X" icon ( ).



Collection Editor (example shows sorting)
List of parameters of a combined column

For a detailed example, see the chapter Combined column 260".

Common properties

Some properties are shared by all Additional columns:

Properties	Description
Title	The column title as it appears in the table. The title can be set separately for selected languages. Depending on the language setting, the corresponding title is displayed. If the title is empty, the English version is used. Special characters and spaces may be used. A comma in a column name should be avoided.
Write-protected	The column content cannot be edited in the column.
Visible	If you select this option, the column is defined but not visible. This makes sense for instance when you pre-define different columns and later display / select them individually.
Identifier	This identifier is used within the program to uniquely distinguish the column. By default, the title is used for it. If this identifier is already assigned, a distinguishing suffix is automatically appended ("_1", "_2", ...). **Special characters (except "_") and spaces may not be used.**

Note Saving the columns

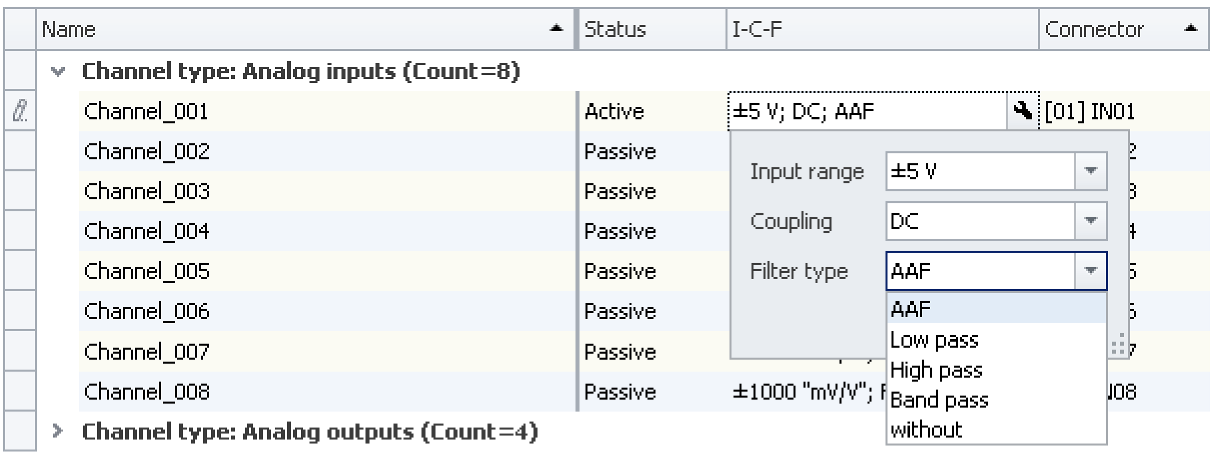
The **Additional column's configuration is saved** in the respective **table description**. The table descriptions are **saved along with the project**. This means that any additional columns defined are available for all of the project's experiments.

- See: "*What is saved where?* 142"
- See: "*Views* 135"

7.6.4.2.1 Combined Column

The **Combined column** joins multiple parameters in one column.

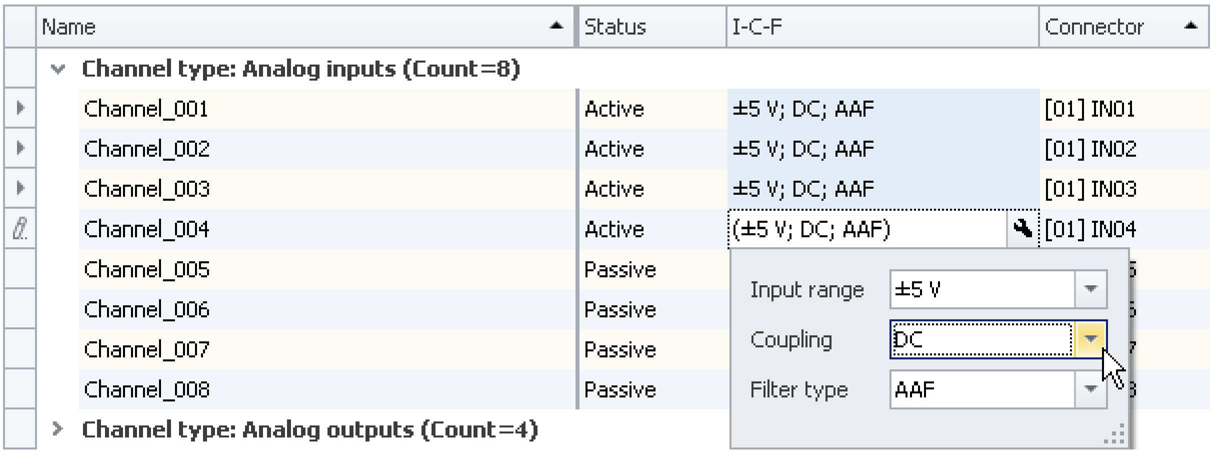
This can make sense, for instance when a measurement is often performed and a certain set of parameters must be set before every measurement. You can then set the parameters in this column and no longer need to open a series of various columns/index cards.



Combined column
Example of column: I-C-F

Configuring

In order to configure the parameters, click on them in the table cell (it is also possible to select multiple cells at once; see the chapter *Tabular Display > Selection* 213). The controls for the parameters are displayed and at the edge you see the wrench icon ( ):



Combined column with multiple selected cells
Example of column: I-C-F

If you change the coupling in the image above from "**DC**" to "**Half bridge**", for instance, the change applies to all selected cells. If the cells all had different couplings before opening the combined column, then the inequality symbol (≠) is shown in the box for the coupling.

To close the combined column, click again on the wrench icon ( )

Properties

For shared properties, see: Additional Columns 260.

Type	Description
Combined Parameters	List of the parameters which are to be set by means of the column.
Value display	Display format in the cell. The values belonging to the combined columns are always listed in sequence in a row. By means of the following options, the format can be modified. • **Default**: Displays only the value of the combined columns e.g. Channel_001; Active • **SimpleFormat**: Selected parameters can be shown/hidden. Separators or additional texts can be freely defined. • **DependentFormat**: Selected parameters can be shown/hidden according to the status of one parameter. Separators or additional texts can be freely defined. • **ShortCaption**: Displays the short form of the parameter name before each value e.g. Name: Channel_001; Status: Active • **LongCaption**: Displays the long form of the parameter name before each value e.g. Channel name: Channel_001; Channel status: Active

Type	Description
Hide disabled columns from caption	In the cell, the space for deactivated columns is omitted. For instance, in a column with the parameters: Filter type + Filter cut-off frequency 1 + Filter cut-off frequency 2 and parameter values: Low pass, 20 kHz with Hide *on*: Low pass; 20 kHz with Hide *off*: Low pass; 20 kHz; or for the parameter value: AAF with Hide *on*: AAF with Hide *off*: AAF; ;
Display format	By means of the display format, you can set which parameters are visible in the cell. Example with four parameters: 0: Filter type 1: Filter characteristic 2: Filter cut-off frequency 1 3: Filter cut-off frequency 2 Display format: {0} - {2} - {3} Result: e.g. Band pass - 10 Hz - 1 kHz You can also use other texts and separators: Display format: Filter: {0} > {2} > {3} Result: e.g. Filter: Band pass > 10 Hz > 1 kHz Only usable with the value display type: **SimpleFormat**.

<table>
<tr><th>Type</th><th>Description</th></tr>
<tr><td>Display format parameter

and

Variable display format</td><td>A variable display format is defined in accordance with a parameter's value.

Example: Column: Sampling & Filtering. Here, the measurement duration is only displayed if it is not set to Undefined.

The column has seven parameters.
0: Sampling rate
1: Duration
2: Filter characteristic
3: Filter type
4: ...

Display format parameter: Duration

<table>
<tr><th>Variable display format</th><th>Properties</th></tr>
<tr><td>0: "{0} - {3}"</td><td>ParameterValue: 0
PrintoutFormat: {0} - {3}</td></tr>
<tr><td>: "{0} - {3} - {1}"</td><td>ParameterValue:
PrintoutFormat: {0} - {3} - {1}</td></tr>
</table>

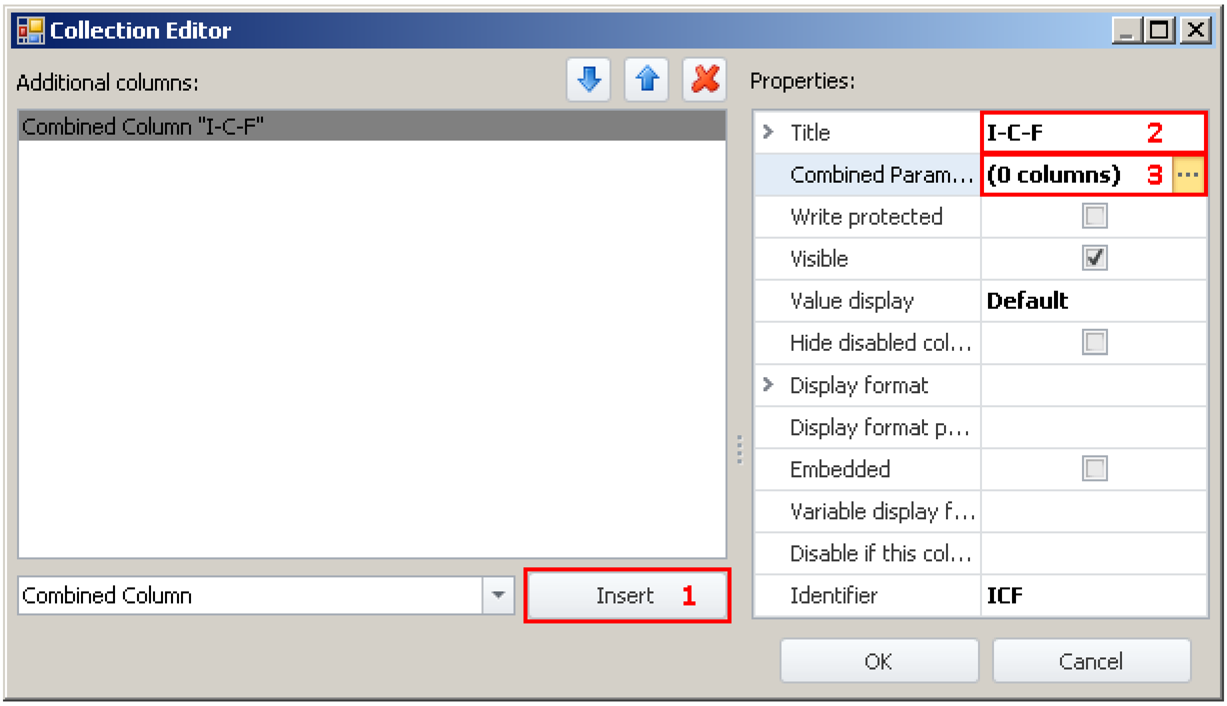
Parameter = 0 (Duration = Undefined)
Show the 0th and 3rd value with separator "-": e.g. 100 Hz - Low pass
Parameter = 10 s (Duration = 10 s)
Show the 0th and 3rd value with separator "-": e.g. 100 Hz - Low pass - 10 s
In this way, other display formats can also be defined.

Only usable with the value display: DependentFormat.</td></tr>
<tr><td>Embedded</td><td>The parameters can be edited directly in the cell, instead of in the separate window. An example is presented on the page: Triggers, the combined column: Properties.

For this function, it is necessary to alter the row height in order to make all parameters visible (only available as of imc STUDIO Developer).</td></tr>
<tr><td>Disable if this column is empty</td><td>If the selected column is empty (e.g. an empty metadata-column), it is not possible to view or edit the parameters belonging to the combined column. In order to delete the view, click on the <Backspace> key.</td></tr>
</table>

Example of a Combined column

Start the Collection editor as explained in the previous chapter Additional columns 258.



Creating a combined column (example)

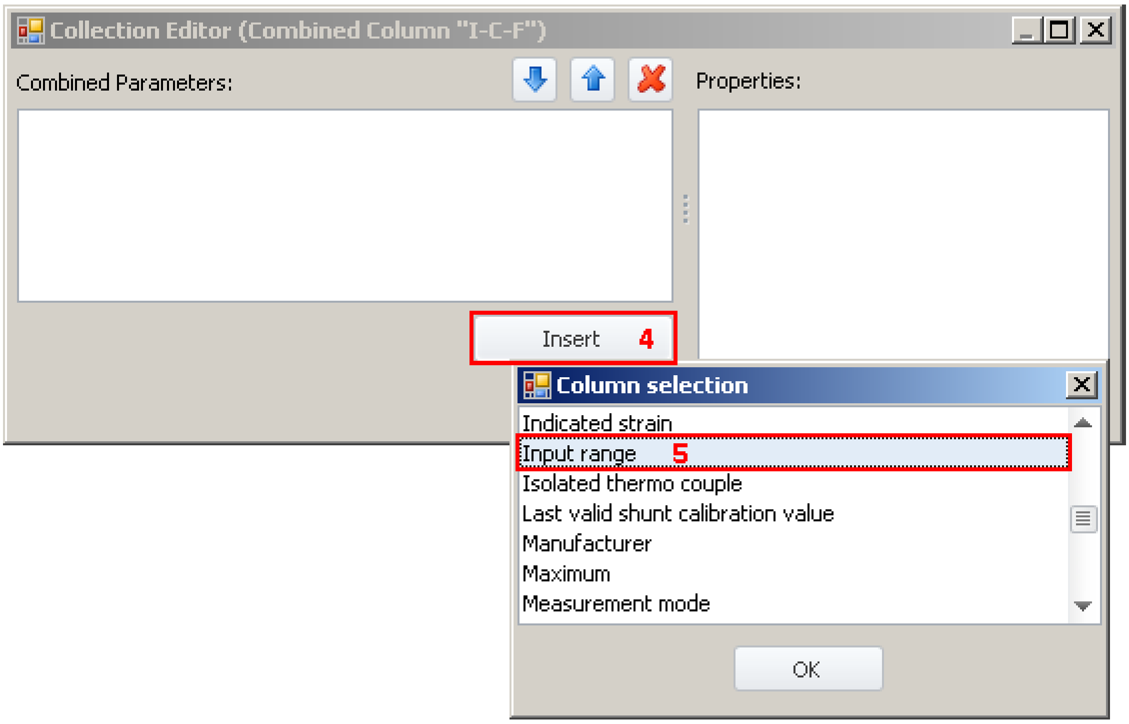
1) In the drop-down list, select the entry ***Combined Column*** and click on ***Insert***. This creates a nameless (title) combined column.

2) Enter the desired title in the input box ***Title***, e.g. "I-C-F" and hit the **<Enter>**-key (see image above). This entry is automatically used as a unique ***Identifier***. Note that special characters (except "_") and spaces can not be used as identifiers. Remove all "-" in this example.

Adding parameters (columns)

3) Click in the row ***Combined Parameters*** in the Properties window and click on the button with the three dots ( ).

This opens **an additional window belonging to the Collection editor**. Here you set which columns/parameters are to be combined.



Collection editor, second window, adding column "Input range"

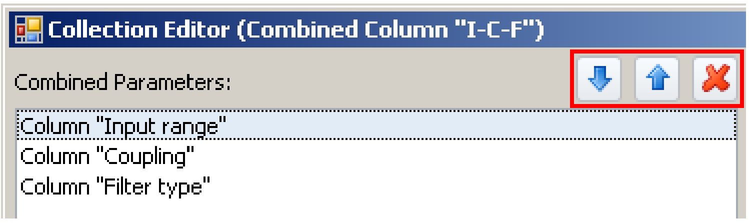
4) Click on ***Insert***: An additional window with a list of all available parameters opens.

5) Select from the list the desired parameter(s) (for this example: **Input range**, **Coupling** and **Filter type**).

Sort

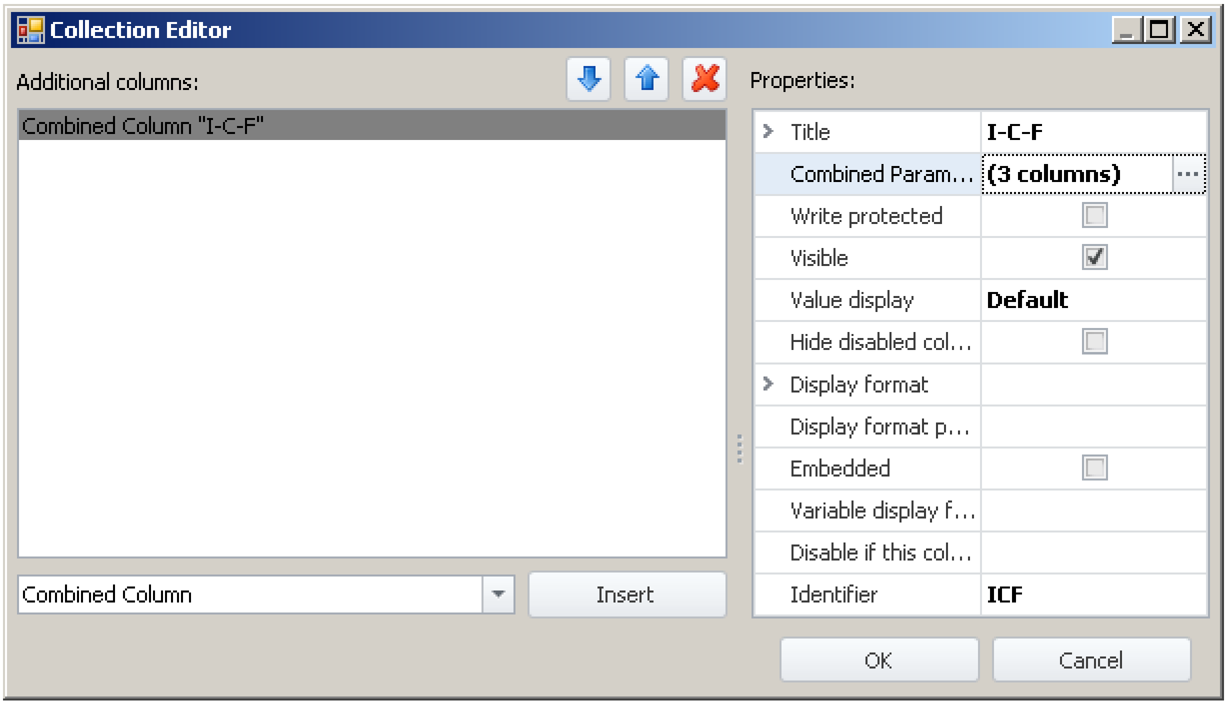
To sort entries, use the "Up/Down"-arrow icons (/).

Sort the order of "Input range", "Coupling", "Filter type", as shown below:



List of the combined parameters (after sorting)

Close the second window by clicking ***OK***. You ten see the first window with the configured column "**I-C-F**" and the note indicating that "(3 columns)" have been combined:



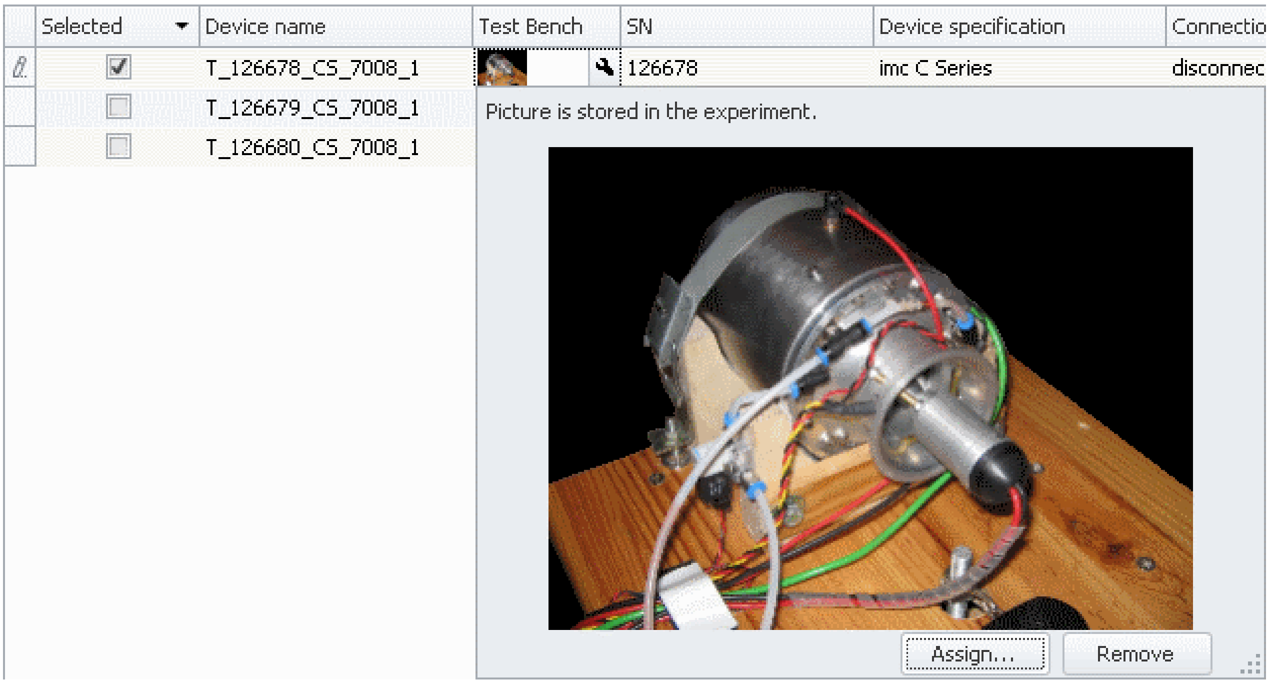
Collection editor, first window, combined column "I-C-F" (3 columns)

Close the window by clicking ***OK***. You now have a new column in the channel list, which shows the three parameters together and with the help of which you can configure them together.

7.6.4.2.2 Metadata Column

In a **Metadata column**, you can display any desired information or documents. They can be pictures (e.g. a picture of how to place the test object into the test rig), or a display of the date and time, or descriptive texts, or anything similar.

The metadata can be entered/edited at any time, for instance, even after a measurement. The natural use of metadata is for test/inspection documentation. The metadata content is saved along with the experiment, except for the types "Picture" and "Document". For these types, you can choose whether the file contents are saved with the experiment or only as a link.



Example of a metadata column

Metadata types

The following types are available:

Type	Description
Single-line text	Shows a single-line text in the column. To enter the text, click on the column.
Multiline text	Shows a multi-line text in the column. To read or edit the complete text, click on the cell.
Picture	Shows a picture (graphic) from a file. In the cell, the picture is minimized as a *Preview* or the associated icon is displayed as a *Placeholder*. In order to see the picture in full scale, click on the cell (see picture above)
Document	Shows a document of any desired type. In the cell, the associated icon is displayed as a *Placeholder*. Some document types, such as PDF and some graphics, can be viewed directly when you click in the cell. In order to open the document with the associated default program, click on the button: *Open*.
Text from list	Shows a selected text from a list of texts. To select a different text from the list, click on the cell. You create the list when making the column definitions (Property: "Text list").

Type	Description
Date	Shows a control having Date format. To enter the date, click on the cell. Click on the wrench icon ( ) to select a date.
Time	Shows a control having Time format (Hour:Minute:Second). To enter the time, click on the cell.
Logical value	Shows a logical value in the form of a checkbox (/). This lets you symbolize any binary state "true/false" ("on/off", "Error/OK"). To change the state, click on the checkbox.
Directory	Shows a link to a directory. Click on the wrench icon ( ) in order to start the folder selection dialog.

Properties

For shared properties, see: Additional Columns 260.

Type	Description
Text list	List of the texts available for selection. To edit the list, click on the button with the three dots ( ). Only usable for the type: Text from list.
Show placeholder	If *on*: instead of the preview, the icon corresponding to the file type is displayed. If *off*: a preview of the content is displayed • Type **Picture**: minimizes the picture • Type **Multiline text**: the first row Only usable for the types: **Picture**, **Multiline text** and **Document** (here, always *on*).
Storage type	Determines how the external file is integrated/linked. • **In the experiment**: The file is incorporated into the experiment. The column thus has no link to the original file. If the original file is altered, the change is ignored. This ensures, however, that the original file is always visible in the experiment. • **Link**: Only the link to the file is saved in the column. Please ensure that the file is retained. • **Link + in experiment**: The file is incorporated in the Experiment-file and the link exists in addition. As long as the file exists, it can be opened via the link. As soon as the file is no longer present, the incorporated file is used. If the file is saved **in the experiment**, the Experiment-file is correspondingly larger. If possible, the **link** should be used for large files. Only usable for the types: **Picture** and **Document**.
Default value	Value which is displayed before any value has been entered. Only usable for the types: **Single-line text**.

Type	Description
Entry format	Input format for a numerical input. • 0: Mandatory • #: Optional • Decimal separator: decimal period "." (please don't use decimal comma ",") When the entry format is empty, any arbitrary text can be entered. If the entry format is used, the only possible entry is al number conforming to the specified format. Only usable for the type: **Single-line text**. Example: 000.0## 001.2 123.4 123456.789 Example: 0.00 1.23 123.45 0.12
Mandatory box	Mandatory if the Setup page is embedded in a dialog. The dialog can only be closed once the entry has been made. In the following dialogs, mandatory box are evaluated: • Command: "Show Panel page as dialog" • Command: "Display Setup dialog" • The "Metadata Assistant's" dialog An example is presented in the chapter: Using Mandatory Boxes 277.
Show most recently use values	When active, a list of the most recently entered values can be opened in the column. Each entry in the list can be selected and used. Only usable for the type: **Single-line text**.
Most recently use values	For viewing and editing the list of most recently used values.

7.6.4.2.3 Parameter Set Column

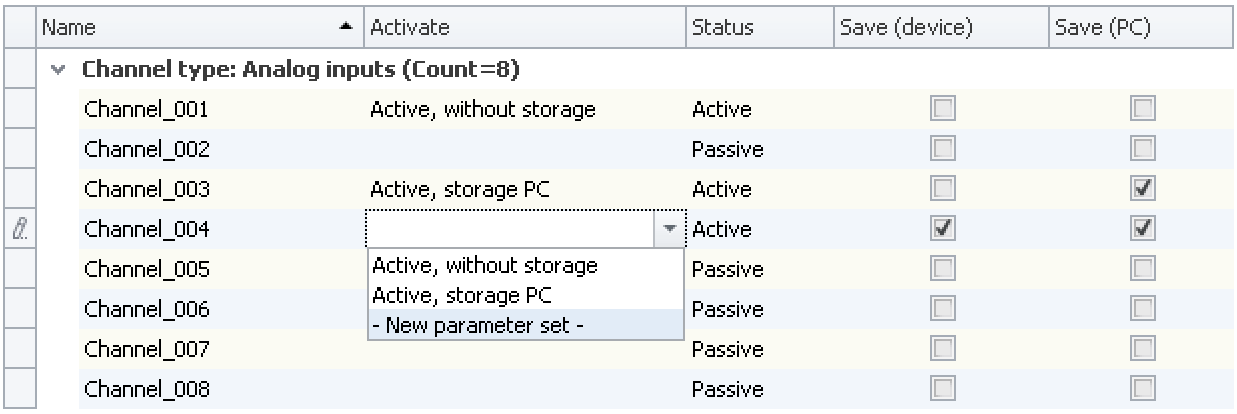
The ***Parameter set column*** offers the ability to join multiple settings with permanently set values to a ***parameter set***. Then, if the parameter sets are pre-defined, the end user must only select the parameter set corresponding to the desired measurement. This saves the user the need to know the entire measurement hardware and its complete settings options.

Creating a column

- Create a parameter set column (Title, Identifier).
- Set which columns (parameters) are joined together in the parameter set.
- This concludes the definition of the parameter set column.

Creating/saving parameters

- Next, make the appropriate individual parameter settings.
- Then click in the Parameter set column and select "- New parameter set -".



Example: Parameter set column with the parameters: Channel status, Save (device) and Save (PC).

- Assign a name for the parameter set.

In the parameter, all column settings are saved which are associated with the parameter set column.

In the example above, if a new parameter set belonging to the selected column is created, the following settings are saved:

- Channel status: Active
- Save (device): true
- Save (PC): true

For this column, an appropriate name can be assigned: e.g. *Active, storage PC and device*.

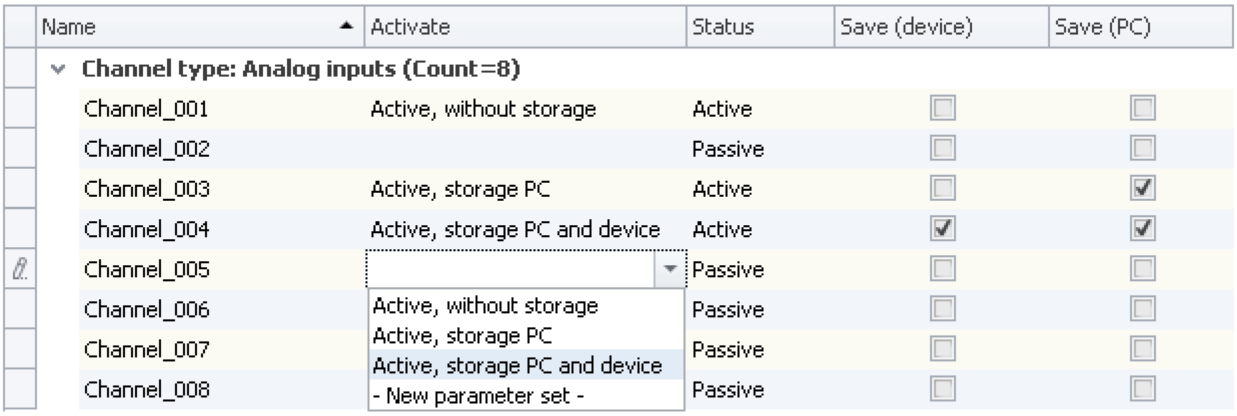
Note — Saving the parameter

The **configuration of the parameters** is saved 142 in the respective **supplemental column**. The column itself is saved with the project. Thus, the parameters defined are available in all the project's experiments.

The parameters **are only saved** when the **project is saved**.

Selecting a parameter set

When you select a parameter set from the list, all columns adopt the settings saved which are associated with the Parameter set column.



In the example, if the parameter set *Active, storage PC and device* is selected for Channel_005, the following settings are adopted:

- Channel status: Active
- Save (device): true
- Save (PC): true

These settings are adopted because they were previously so defined (see: **Creating/saving parameters**)

As long as no further columns are linked with the Parameter set column, all other parameters remain unchanged.

Renaming/deleting a parameter set

To rename or delete a parameter set, open the selection list in a cell and then open the context menu of the particular item.

Next, select *Rename parameter set* or *Delete parameter set*.

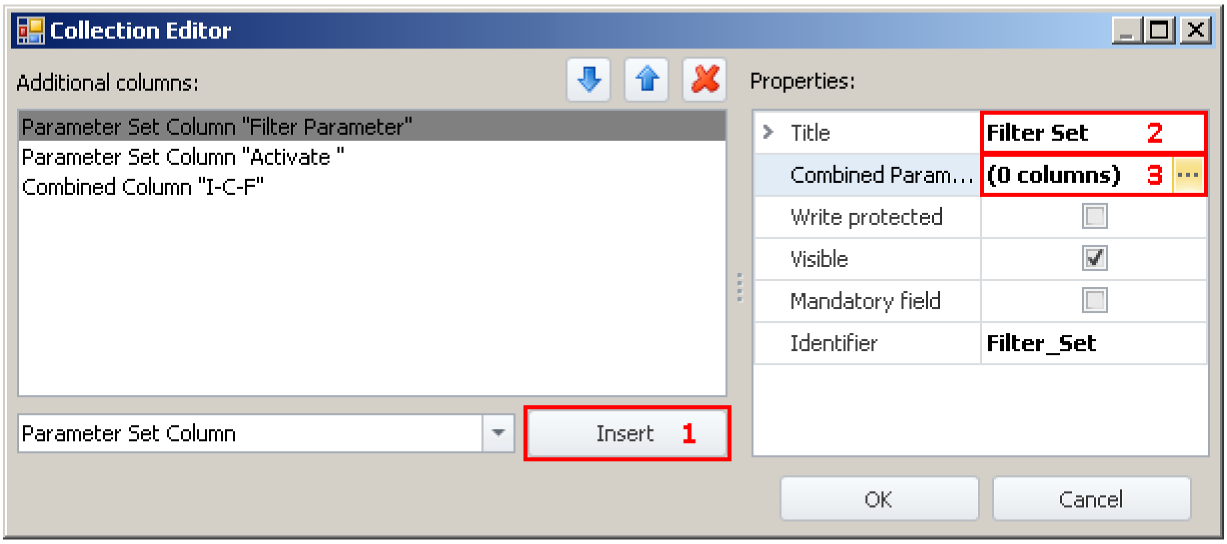
Properties

For shared properties, see: Additional columns 260.

Type	Description
Combined Parameters	List of the parameters which can be set via the column.
Mandatory box	Mandatory when the Setup page is embedded on a Panel page as a dialog. It is only possible to close the dialog once the entry has been made. An example is presented in the description of the command: Show Panel page as a dialog 1579.

Example of a Parameter set column

Start the Collection editor as explained in the chapter Additional columns 258.



Creating a parameter set column (example)

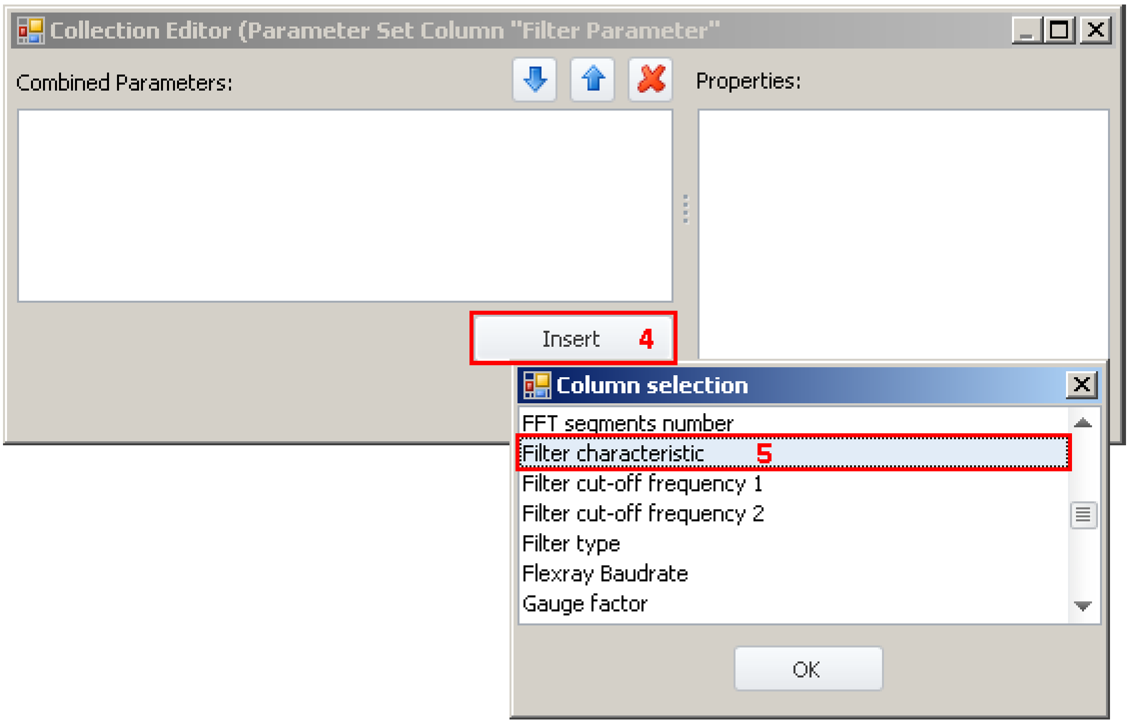
1) In the drop-down list, select the entry ***Parameter Set*** and click on ***Insert***. This creates a nameless (title) parameter set column.

2) Enter the desired title in the input box ***Title***, e.g. "Filter Parameter" and hit the **<Enter>**-key (see image above). This entry is automatically used as a unique ***Identifier***. Note that special characters (except "_") and spaces should not be used in identifiers. Delete all " " in this example. Instead you can use: "_".

Adding parameters (columns)

3) Click in the row ***Combined Parameters*** in the Properties window and then on the button with the three dots( ).

This opens **a further window belonging to the Collection editor**. Here you set which columns/parameters are to be combined.



Collection editor, second window, adding column "Filter characteristic"

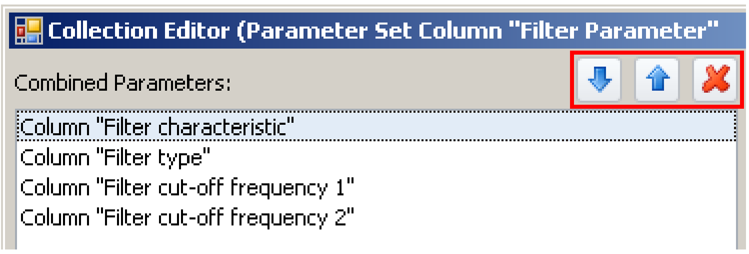
4) Click on ***Insert***: An additional window with a list of all available parameters opens.

5) From the list, select the desired parameter(s) (in this example: **Filter characteristic**, **Filter cut-off frequency 1**, **Filter cut-off frequency 2** and **Filter type**).

Sort

To sort entries, use the "Up/Down"-arrow icons (/).

Sort the order of "Filter characteristic", "Filter cut-off frequency 1", "Filter cut-off frequency 2", "Filter type", as shown below:



List of the combined parameters (after sorting)

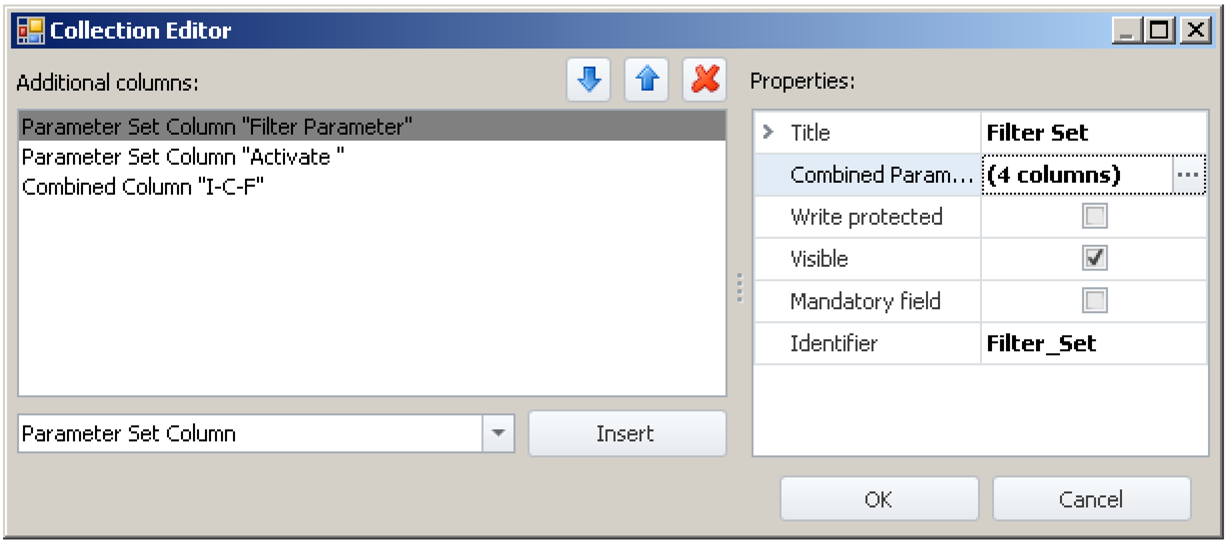
Note Why the sorting is important

The sorting determines the order in which the parameters are set.

For instance, the column: *Filter cut-off frequency 2* can only be assigned a value if the column is "active". In other words, if the column is required for the filter type used, as is the case with Bandpass, for example.

In consequence, it is necessary to set the parameter values in the order which their respective dependencies requires. The filter type must be set before the cut-off frequency.

Close the second window by clicking ***OK***. You ten see the first window with the configured column "**Filter Parameter**" and the note indicating that "(4 columns)" have been combined:



Collection editor, first window, parameter set column "Filter Parameter" (4 columns)

Close the window by clicking ***OK***. You now have a new column in the channel list, by means of which you can save and load the parameters of the four columns.

7.6.4.2.4 Parameter Set Import Column

By using the "*Parameter Set Import Column*", it is possible to quickly load a variety of settings. Selecting particular entries automatically selects the associated saved parameter set (*.csv).

Operation technique, and distinction from the Parameter Set Column:

The Parameter Set Column 269 is bound to its associated columns. By contrast, the **Parameter Set Import Column** operates like the command: Parameter set import 1589. A parameter set is imported and all settings belonging to it are made.

Parameters which are not in the file retain their values.

Example of a Parameter Set Import Column

At a certain test station, two engine types are routinely tested. For each type, there are 3 test procedures, having varying designations (metadata) and channel settings.

For each of these six "measurement states", one parameter set (*.csv) is generated. The following is a sample file:

Company name	Test object number	Test part number	Test station photo	Hint
My company	X1	X1_123	.\Picture1.png	speed test 1
Channel name	Save (PC)	Sampling time	Duration	
Channel_001	True	1 ms	40 s	

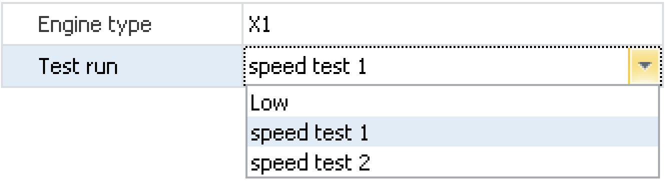
These files are saved in folders as follows:

```
Engine types
+---X1
|   |   speed test 1.csv
|   |
|   +---speed test 1.data
|   |   \---DevSetup
|   |           Picture1.png
|   |
|   |   speed test 2.csv
|   |
|   +---speed test 2.data
|   |   \---DevSetup
|   |           Picture2.png
|   |
|   |   low.csv
|   |
|   \---low.data
|       \---DevSetup
|               Picture3.png
|
+---X2
    |   speed test 3.csv
    |
    |   speed test 5.csv
    |
    |   low 3.csv
    |
    \---low 3.data
        \---DevSetup
                Picture4.png
```

The Engine Types X1 and X2 are folders in which the csv-files are located. Along with the csv-file, there can be a folder of the same name with the extension "*.data" containing additional files. These files can be used as linked metadata (e.g. pictures).

On the Setup-page, two columns are set up to conform to this folder structure.

- First column: First folder level: In this example, the engine type can be selected here (folder name: "X1" or "X2")
- Last column: File level: In this example, the test procedure can be selected here (name of the existing csv-files)



If an entry is selected in the first column, the content of the second column adapts according to what csv-files are present.

If an entry in the second column is selected, the csv-file is imported.

Properties

For shared properties, see: Additional Columns 260.

Type	Description
ImportRoot	Path to the first folder level
Column captions	Optional list: Designations of the column titles • No specification: columns have the default name: Parameter Set Level 1,2,3,... • Specification provided: Columns are assigned the pre-defined name. See example: *Engine type* and *Test run* To edit the list, click on the button with the three dots (...).

Note

- Multiple subfolders are also possible. For each additional subfolder, a separate column is created. However, a csv-file is imported only to the lowest level.
- Parameter Set Import uses for **Mapping: Import mapping by name**. When channel parameters are imported, the names of the channels must match the names in the csv-file.
- Parameter Set Import performs importation across Table Descriptions. This means that the csv-file can contain parameters for a variety of different Setup pages. In this example, there are parameters for the pages:
  - Documentation (table description: Experiment)
  - Analog channels (table description: Analog Channels, Digital Channels and Channels, ...)
- The column type is only present on the Setup pages: *Documentation* or *Experiment*.

7.6.4.3 Using Mandatory Boxes

When Setup pages are called in dialogs, it is possible to prevent the dialogs from being closed. In this case, it is only possible to close them once the important "mandatory entries" have been made.

Only metadata columns can be defined as so-called "Mandatory boxes".

It is not possible to use this function to verify any other entries (for instance, any entries made via Widgets or entries of device/channel-parameters). The verification of the validity of entries is based on what type and what format you had previously selected for the metadata column. So, for the type "*Folder*", for example, there is a check of whether the character \ is included, unless a user-defined format was used.

A mandatory box exclusively affects the behavior of the following functions:

- the command "Show Panel page as dialog"
- the command "Display Setup dialog"
- the dialogs of the "Metadata-Assistant"

It has no effect on the normal Setup pages.

To illustrate this function and its use, the following examples are presented.

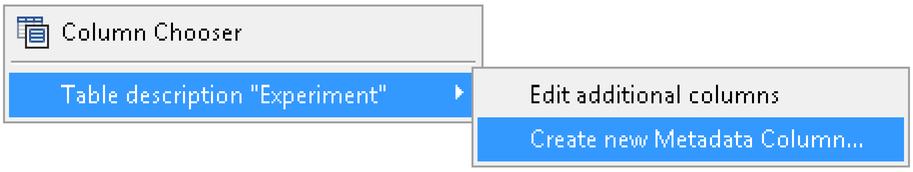
Example: Creating a Panel page as a dialog with a mandatory box

In this example, a new metadata column "*User*" is added to the already existing Setup page "*Documentation*" and declared as a mandatory box. Next, a Panel page is created on which the Setup page "*Documentation*" is displayed. This Panel page is called as a dialog, in such a way that the dialog can only be closed by clicking "OK" if there is an entry in the mandatory box.

Note: The page "*Documentation*" displays the columns of the table description named "*Experiment*".

Open the page "*Documentation*" in the **Setup**

Open the context menu over the white area and select "*Table description "Experiment"*" > "Create new Metadata Column...".



Context menu of the "Documentation" page (Table description: "Experiment")

A dialog opens, which is named "*Collection editor*". Click on the button "Insert". A column with no title initially opens.

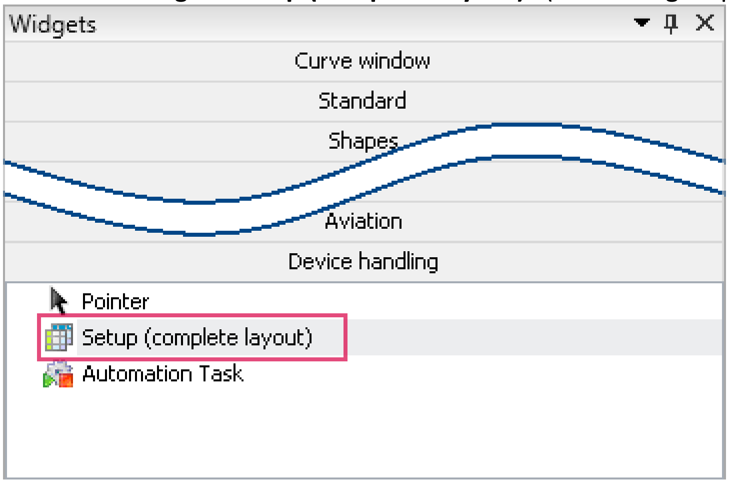
Enter the following **properties**:

- Title: User
- Type: Single-line text (unchanged)
- Mandatory box:

All other settings remain intact. Close the dialog with "OK". The new column is now present on the page "*Documentation*".

Next, go to **Panel**.

Insert the Widget "**Setup (complete layout)**" (from the group "*Device handling*") into the Panel page.



Device handling - Widget "Setup (complete layout)"

Open the Widget's properties and select the **Layout**: "*Documentation*".

Note

If the new column is not visible, perform the following steps:

To display it, open the context menu in the Widget and select the menu item "Column Chooser". There, select the "User" (Tab: "Rows") column and use Drag&Drop to move it to the Widget.

Jump to **Sequencer** and there, add the command "*Show Panel page as dialog*".

Configure the command:

- Panel page to be displayed: Select the previously configured page
- Display dialog buttons: Yes
- OK-button: Active: if all entries are valid

All other settings remain intact. Close the configuration by clicking "OK"

Next, **start** the **Sequencer**. The dialog opens and only closes again when "*User*" is assigned a **valid value** (here: text).

Example: Defining the existing column "Test engineer" as a mandatory box

On the Setup page "Documentation", you find the metadata column "*Test engineer*". We will define it as a mandatory box.

Note: The page "*Documentation*" displays the columns of the table description named "*Experiment*".

Note

It is not possible to edit existing columns with the Standard version of imc STUDIO!

In order to access existing metadata columns, open the properties of the table description "*Experiment*":

- Jump to the Setup
- If necessary, start by turning on the visibility of the tool window "*Table Descriptions*" (ribbon: "*View*" > "*Choose Tool Windows*"). The tool window is not available in the Standard version of imc STUDIO.
- Open the context menu of the table description "*Experiment*" and select "*Properties*".

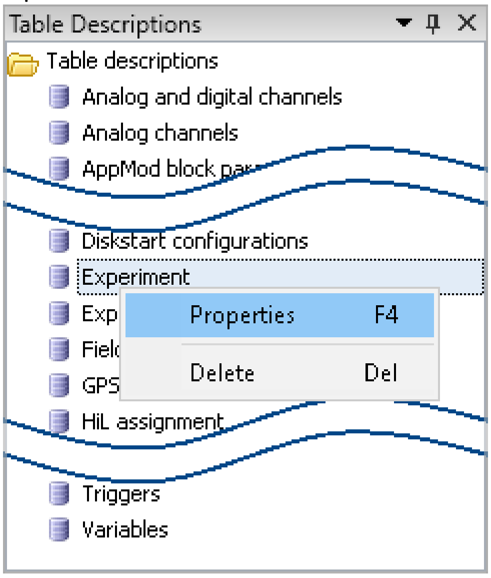
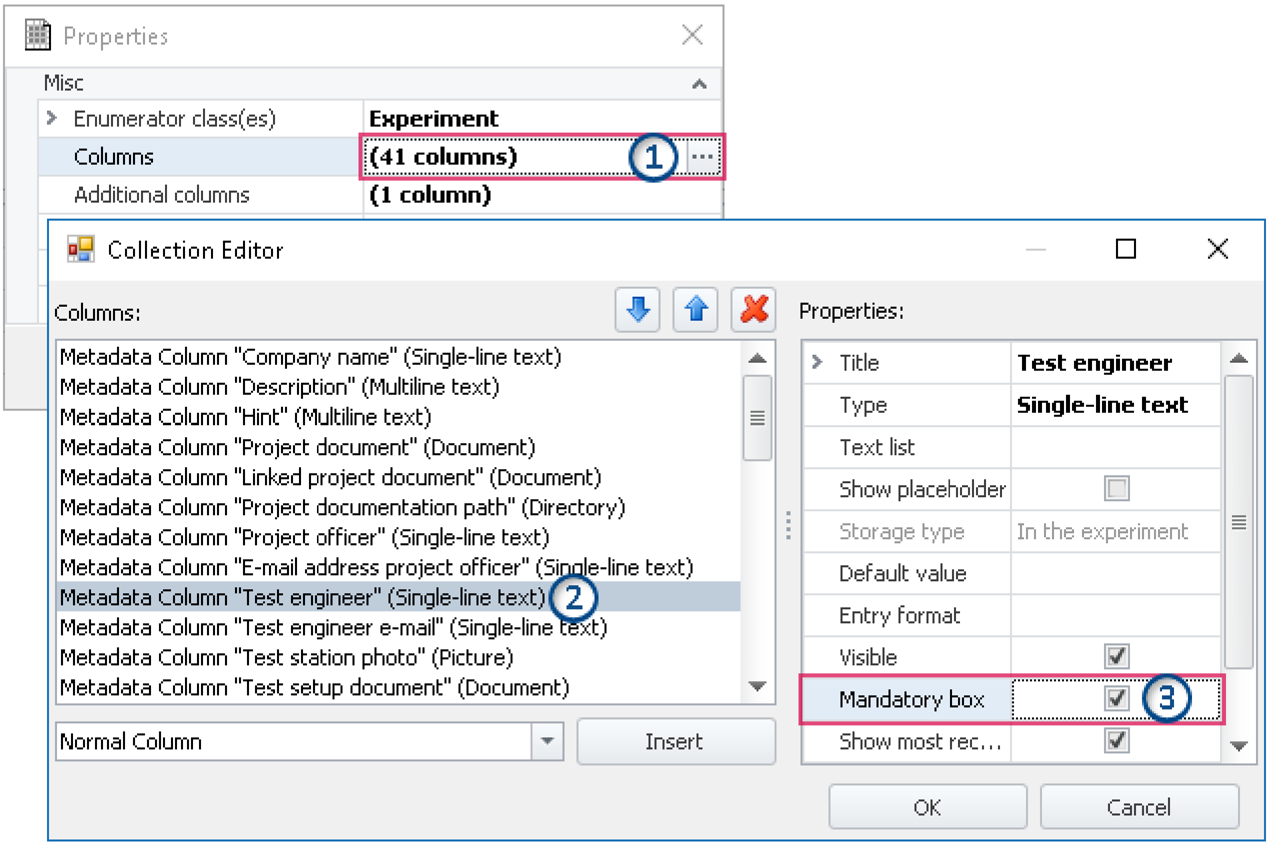


Table Descriptions tool window

Open the list of existing columns:

- In the Properties dialog, left-click the mouse over the column named "*Columns*" (1).
- Open the list by clicking on the button (...). A dialog named "*Collection Editor*" appears, which contains the properties of the individual metadata columns.



Properties and list editor for the table Experiment

Define the column "*Test engineer*" as a mandatory box:

- In the listing editor, select the column "*Test engineer*" (2)
- Put a check mark in the box for "*Mandatory box*" (3)
- Close the dialog with "OK".

Next, display the page "*Documentation*" in a dialog. The dialog only closes again when "*Test engineer*" is assigned a **valid value** (here: text).

7.6.4.4 Export/import of column/table descriptions

You are able to export/import complete table descriptions and individual column descriptions in a targeted way. For instance, you could transfer defined additional columns from one table description to another one. Or, you can exchange table descriptions without needing to import the entire view.

Exporting column/table descriptions

Using the menu item "*Import/Export*", you can **save the column and table description**:

Menu ribbon	View
Project > Import/Export ( )	Complete
Extra > Import/Export ( )	Standard, Compact

- Select the option "*Export*", and in the list, select the entry "*Export of Setup table description*" or "*Export of Setup column descriptions*"
- From the list offered, select the desired elements (a table description or one or more column descriptions belonging to a table description)
- Select an appropriate file name and path for the export file

Note	Save the view beforehand

Save the view beforehand if you have made any changes (see "*Views* 135").

Import of column/table descriptions

Using the menu item "*Import/Export*", you can **import the column - and table descriptions**:

Menu ribbon	View
Project > Import/Export ( )	Complete
Extra > Import/Export ( )	Standard, Compact

Importing a Setup table description

- Select the option "*Import*" and from the list, the entry "*Import of Setup table description*"
- In the file selection dialog, select the saved file

The table description is imported along with all columns it contains. If any table description having the same "*ID*" exists, a prompt appears. Here, you can either replace the existing description, or rename the "*ID*" of the new table description.

Please not that the "*ID*" is only the internal ID. The displayed name (e.g. in the tool window: "*Table description*") is not changed. If you have renamed the "*ID*", it is now possible that two table descriptions having the same displayed name, but different IDs, exist. This situation is not recommended.

Note	New functions can be overwritten

Please be aware that when making replacements, new functions may be lost if you import old views/columns.

Importing Setup column descriptions

- Select the option "*Import*" and from the list, the entry "*Import of Setup column descriptions*"
- In the file selection dialog, select the saved file
- From the list offered, select the target table description

All columns are imported to the selected table description. Table descriptions are not offered if they have columns with the same "*IDs*".

Reference See also

Exporting/importing Views 137

7.6.4.5 Configuring and designing the pages

7.6.4.5.1 Table Description and Complete Layout

Terms	Description
Table description	Collection of normal and additional columns
Column description	Configuration of a column in the table description
Complete Layout	Finished designed Setup pages. The page is filled with elements which are linked with table descriptions or columns belonging to table descriptions.
View	Arrangements of windows, menus, layouts, column arrangements, ...

The "*Table description*" **contains a variety of columns**. Based on these columns, the individual Setup pages are created. To do this, **the desired columns** belonging to one or more table descriptions are **selected and ordered**. The **new page** created can be **saved** as a "*Complete layout*" (as of imc STUDIO Professional) and thus made available e.g. for the metadata export.

In the "*Complete Layout*", only the information regarding the "visual" appearance is saved:

- which columns are displayed, and
- how and where they are displayed.

The columns' **values** are linked to the "*Table description*". This ensures that the values in all Setup pages are updated simultaneously.

Example

The column "*Channel name*" is used both on the page "*Analog channels*" and on the page "*Channel balance*". Now, if you change the channel name on one of these pages, it is automatically updated on the other page, since it affects the same column which simply appears on two different pages.

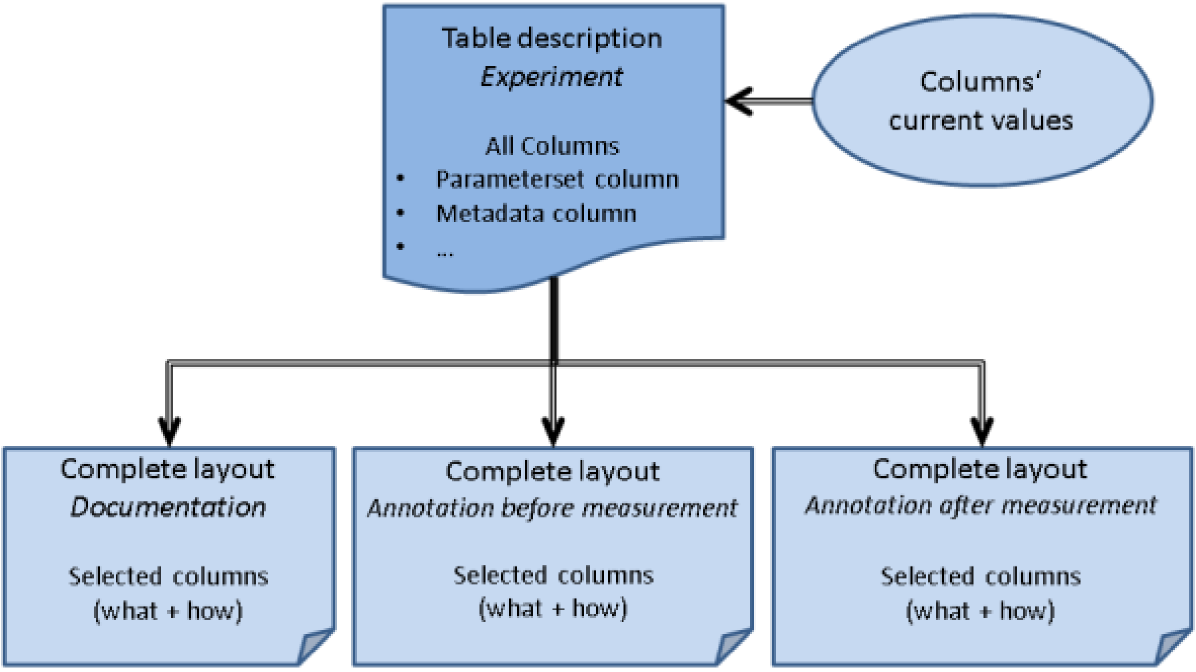


Table description and complete layout

7.6.4.5.2 Properties of the Pages/Complete Layouts

Note	Prerequisite: imc STUDIO Developer

This function is only available in the product versions imc STUDIO DEV 29.

By means of the tool window: "*Layout Repository* 211", you can modify the pages' settings. To do this, open a page's context menu (Complete layouts) and select "*Properties*".

Property	Description
Filename	Write protected - internal name of the page
Name	Display name in in the tab bar
Image	Displayed icon in front of the name (to delete a selected image, press the keyboard combination: <CTRL> + <Del>)
Metadata template	Activates the page for the "*Metadata Assistant* 249"
Statistics page	Activates the page for the output in the "Statistics"-dialog
Index of Statistics page	Position in the Statistics dialog - 0: first page; 1: second page; ...
Show in Dialog as menu action	Activates the page for the call from the menu ribbon. A new menu item is created, which calls the page as a dialog.

7.6.4.5.3 Designing pages

Note	Prerequisite: imc STUDIO Developer

The Design mode is only available for use from the product versions imc STUDIO DEV 29.

More fundamental **changes to existing pages**, or the **creation of new pages** are possible by means of the Setup-"*Design Mode*".

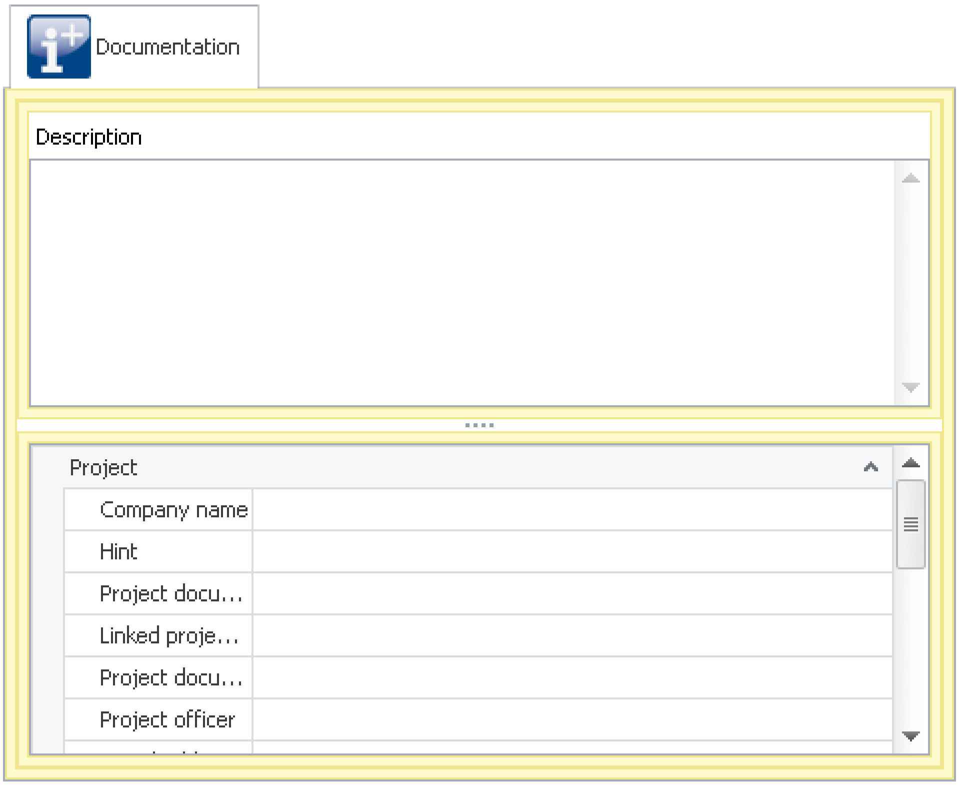
As a condition for being able to use "*Design Mode*", detailed knowledge of the interdependencies of table descriptions and the elements on the page is needed. Modification of the existing pages is only recommended for applications in which the existing pages are not sufficient.

Terms	Description
Design Mode	When "*Design Mode*" is active, the page elements can be modified.
Page	(in the tool window: "*Layout Repository*") Empty pages without content. At minimum, pages always have a frame. But they can also have multiple frame, which can be separated by a slider, for example.
Frame	Free area into which design elements can be inserted.
Elements	(in the tool window: "*Layout Repository*") Elements which can be filled with columns (columns from table descriptions). An element can contain additional elements, which, for instance, can be linked with other table descriptions, like the higher-level element.
Designer	External tool for enhancing existing elements.

Design Mode

To start the "*Design Mode*" of the Setup-component, select "*Design Mode*" in the context menu of an existing page.

The current page contains yellow "*frames*" for each of the usable spaces.



Example: the Documentation page
On the outer borders, the page's yellow frame is seen.
This contains two additional yellow frames. These are filled with elements.
The elements are linked with a table description.

In order to fill "*Frames*" with columns, an "*element*" must be inserted. You can also insert elements from the tool window "*Layout Repository*".

Example

Create a new page via the context menu of the tab bar: "*Create New Page*".

Open the new page by clicking on the mouse. An empty page with a frame becomes visible.

Insert an element from the tool window "*Layout Repository*", e.g.

- **Table:** this corresponds to the design of the pages "Devices", "Analog channels", ...
- **Detail-Table:** this corresponds to the design of the pages "Documentation", "Experiment", ...

The view only changes if the element already possesses additional design elements. The page remains empty after insertion of the detail-table, for example.

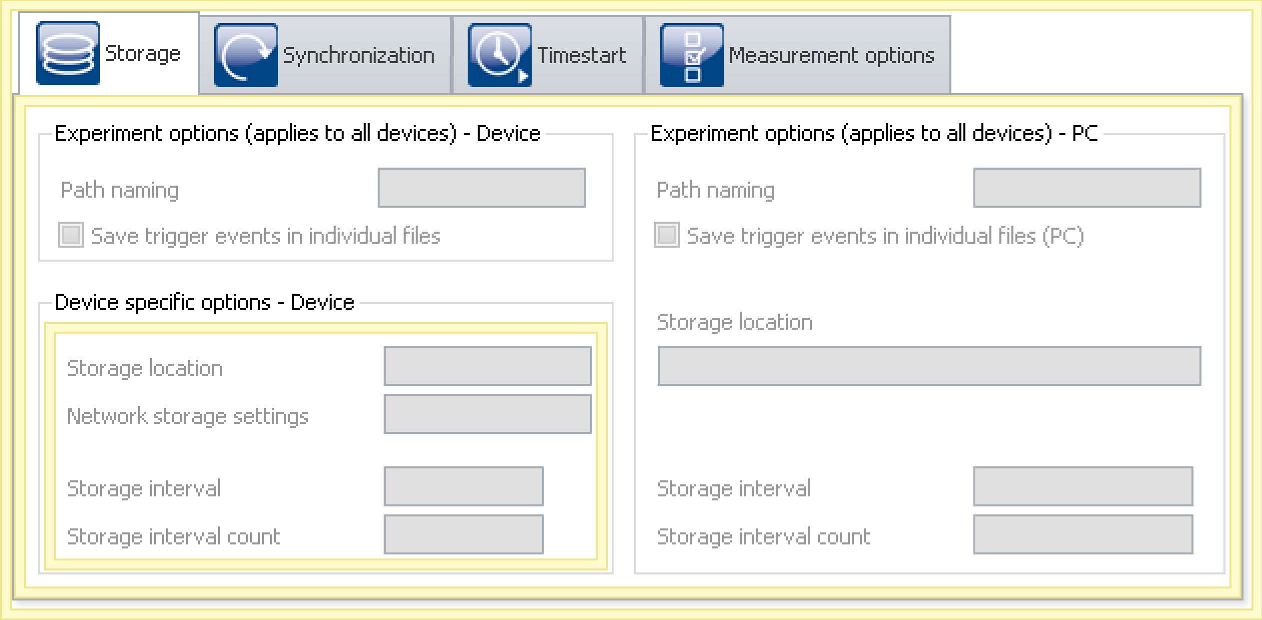
Next, you can link the element with a table description. Drag the appropriate table description from the tool window of the same name to the element. If you have selected a table-element, all of the columns are displayed.

Company name	
Hint	
Project document	
Linked project document	
Project documentation path	
Project officer	
E-mail address project officer	
Test engineer	
Test engineer e-mail	
Test station photo	
Test setup document	

Example of a new page with the element "Detail-Table" and the table description: "Experiment"
Conforms to the lower portion of the page: "Documentation"

Nested elements

In order to assign nested elements to table descriptions, start at the lowest level.



In this example, when one assigns a table description to the middle frame, then the same table description is also assigned to the small frame ("*Device specific options*"). Only then can you assign a different table description to the small frame.

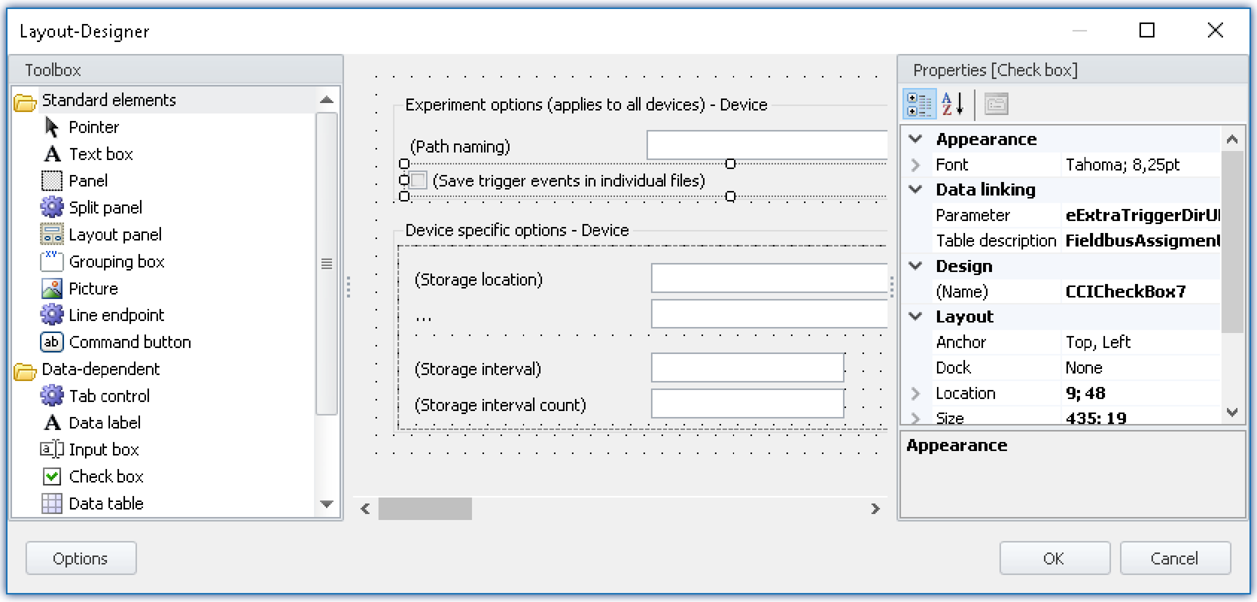
Designer

Warning Use of the "*Designer*"

Use of the "*Designer*" is expressly not recommended and is performed at the user's own risk. Any functions lost can only be restored by replacing the entire pages (from the "*Layout Repository*" or by resetting the view to the factory settings).

Open the Designer via a frame's context menu. Select "*Edit in Designer*". The contents of the selected frame are displayed in the "Layout-Designer".

In the Designer, you can add more elements and assign exact parameters to these.



FAQ

Why are some columns missing from the Parameter-list?

Answer: The list "*Parameter*" only shows "*Normal columns*". An example of these are parameters which come straight from the device.

All other columns are unfamiliar to the "*Designer*" and are thus no presented in the list, e.g.

- Calculated columns (such as the "Sampling rate")
- Combined columns (such as "ScalingPoint1" ("Point 1" of two-point scaling)
- Metadata columns, parameter set columns, mirrored columns, ...

Solution: You can enter the column's name in the input box, despite that it is not available as a selection in the list. Enter the exact column designation.

The linkage with the table description is made by means of the input box of the same name, or by means of Drag&Drop to the finished page.

7.6.5 Transferring an experiment to other devices

You can transfer a complete experiment to other devices. In the process, all **possible settings** are transferred along to the other devices. The transfer can be targeted for specific device modules; for this purpose, there is a software Assistant providing aid in making the desired assignment.

There are multiple ways to open the Assistant:

1. Transferring a complete experiment

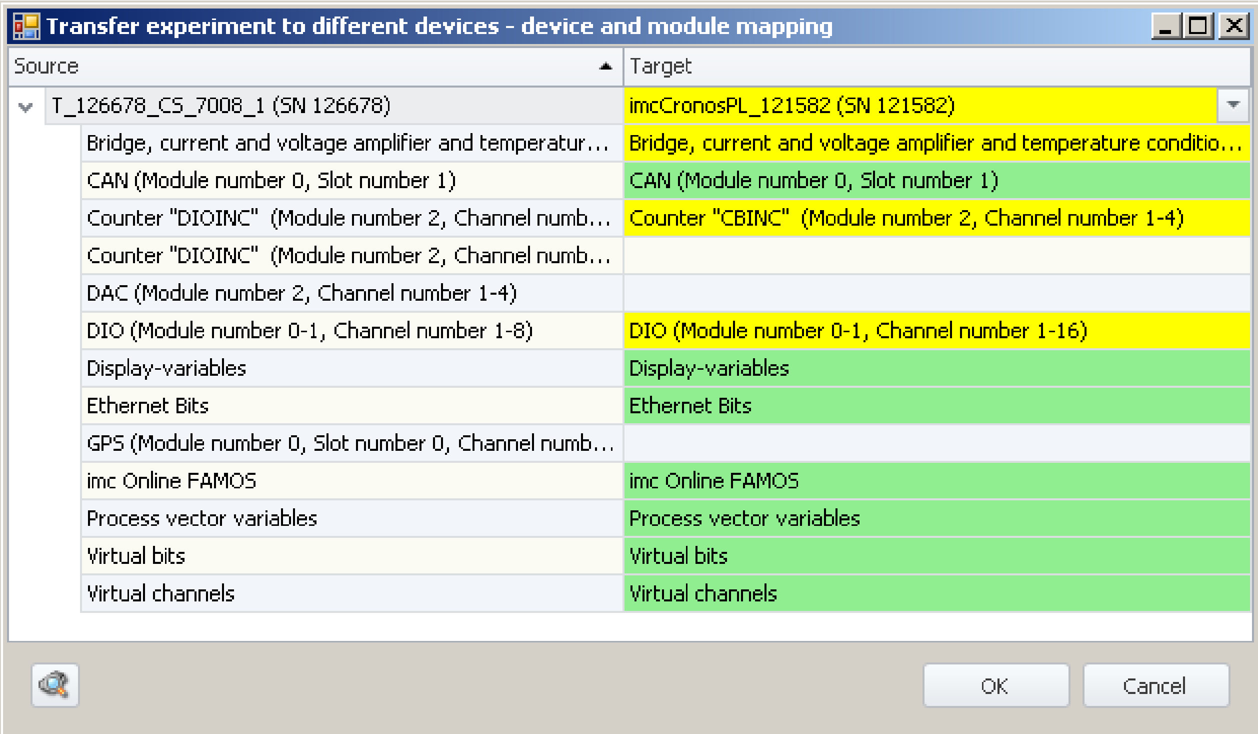
- Open the ***Project*** menu ribbon, select the command ***Import / Export***
  - Select the option ***Import*** and next the list entry ***Transfer experiment to other devices***
  - Select the desired experiment
- The Assistant opens

2. Switching devices in an open experiment

- Open an experiment
- Go to the **Setup page: Devices**
  - Select the device to be transferred (column: Selected)
  - A dialog appears: Transfer the setting by means of the button: ***Transfer***
  - In the next step, you can search for the device if it is not already part of the experiment. Otherwise, skip this step
- The Assistant opens

3. Unable to set up connection to the device

- If it is not possible to set up the connection to the device, it is possible to use a different device. The corresponding dialog for this purpose appears.
- This substitution in case of failed connection can also be automated by means of the command: Transfer device settings 1598. Automation is only recommended for devices of the same model and configuration.



Transferring to different device
Example: Different device types

At left, there is a list of all devices belonging to the experiment (or only one device if it was de-selected). At right is a list of target devices; this side is initially empty and must be configured.

Below each device's entry is a list of all of its respective "modules" and components. What this list contains depends on the device's hardware configuration.

To set the target device desired, select a device from the drop-down list which is in the right-hand column on the row displaying the source device. As soon as a device is selected, the device is analyzed. The Assistant generates a suggested allocation (see example above).

When the devices are of the same model and hardware configuration, it is possible to use the default setting. If the experiment is to be transferred to a different kind of device, verify the suggested settings.

The colors:

Green: All of the module's settings can be transferred.

Yellow: Not all of the module's settings can be transferred. For example, the amplifier type may be different.

Please ensure that the target module is able to use the configuration required by the source module. E.g. a universal amplifier can use some of a temperature amplifier's settings.

Red: This assignment should not be selected.

What settings are applied:

In principle, all settings are applied, except for the **calibration values** (taring, bridge balancing, two-point scaling, ...). Settings which can not be applied are ignored and listed in the **log book** following the transfer.

As well, the **channel names** are adopted.

If multiple devices are used in an experiment, the channels are automatically assigned names with the device name as a prefix. If some of these channels were not renamed, the name remains intact after the transfer. The device name within the channel name then no longer reflects the name of the new device.

Automated analysis

When a target device is selected, the analysis starts. The result is the suggested assignment. This can be initiated for all devices automatically, as soon as the dialog is opened. To do this, click on this button:

When the button is clicked, all devices registered with the system are analyzed. Once this step has been concluded, it is possible to select a device.

Advantage: In the drop-down-list, it is immediately visible which devices are suitable for the transfer.

Disadvantage: **All known** devices are analyzed, requiring a corresponding amount of time, according to how many there are.

Reference	Replacing modules

A similar dialog is displayed when one of a device's modules is replaced. See "*Change of the imc measurement device* 167".

7.6.6 Import of an imc DEVICES Experiment

You can transfer a complete imc DEVICES experiment to imc STUDIO. In the process, all possible settings are transferred.

- Open the ***Project*** menu ribbon, select the command ***Import / Export***
- Select the option ***Import*** and next the list entry ***Import of an imc DEVICES Experiment***
- Select the desired experiment

FAQ

Question: In imc STUDIO,there are no default values for device variables like in imc DEVICES. What is the best way to handle this?

Answer: When an imc DEVICES experiment with default values is imported, a corresponding notification dialog appears. The default values are temporarily applied as the current values for the variables.

The current values are not saved along with the experiment!

- Way 1:
  Use the commands: "Export Variable" + "Import Variable"
  Export the variables which are important for the procedure. You can have the export-file imported to the corresponding location automatically.
  Use the command: "Export Variable" to effect the export.
  For the import, a button on a Panel page, for example, or the Sequencer with the command sequence: "Import Variable " + "Execute menu action: Start (Start Measurement)"
- Way 2:
  Use the command: "Set Variables". Here, the values can unfortunately not be adopted automatically. Configure the command manually.
  To set the variable, use a button on a Panel page, for example, or the Sequencer with the command sequence: "Set Variables" + "Execute menu action: Start (Start Measurement)".

Question: How do I get the free-floating curve windows from imc DEVICES into the imc STUDIO Panel pages?

Answer: In imc DEVICES experiments, free-floating curve windows 1368 are used to view the measured data. In order that the curve window configurations not be lost when importing to imc STUDIO, the curve windows are also displayed in imc STUDIO. You can save the configuration of these curve windows and load them again into curve windows on the Panel pages. Thus, the configurations are also available in imc STUDIO.

Question: How do I make settings for "Autorepeat mode" in imc STUDIO?

Answer: In imc STUDIO, there are no "Autorepeat mode" in the sense in which they were used in imc DEVICES. Instead, please use the Sequencer to repeatedly restart the measurement, or modify the triggermachine in such a way that the measurement is not concluded, but instead a trigger repeatedly starts up again.

Question: Where do I find the action: "Balance active channels"

Answer: To adjust all active channels, use the command: "Execute device action" with the following configuration:

Enumerator class: Channel

Action column: Balance action

Action: Currently selected (thus, the imc DEVICES function is configured)

Filter type: All rows (passive channels are ignored!)

Note Known problems

The circular buffer contents are not imported correctly (imc DEVICES Version 2.7x - (build prior to 3. FEB. 2011).

The circular buffer memory set is not imported correctly from experiments which were created with the imc DEVICES version 2.7x (build date prior to 2/3/2011).

For all channels, the circular buffer memory for data storage is set to 1 min.

Solution: Open these experiments with the imc DEVICES version, which is installed with this imc STUDIO version, and save the experiment again.

After import, the device configuration is missing (imc DEVICES Version 2.6x and older).

imc DEVICES experiments belonging to Version 2.6x and older do not yet contain the device description file (*.umi). However, the import mechanism requires this file.

Solution 1: Before importing, copy the appropriate umi-file into the Experiment-folder.

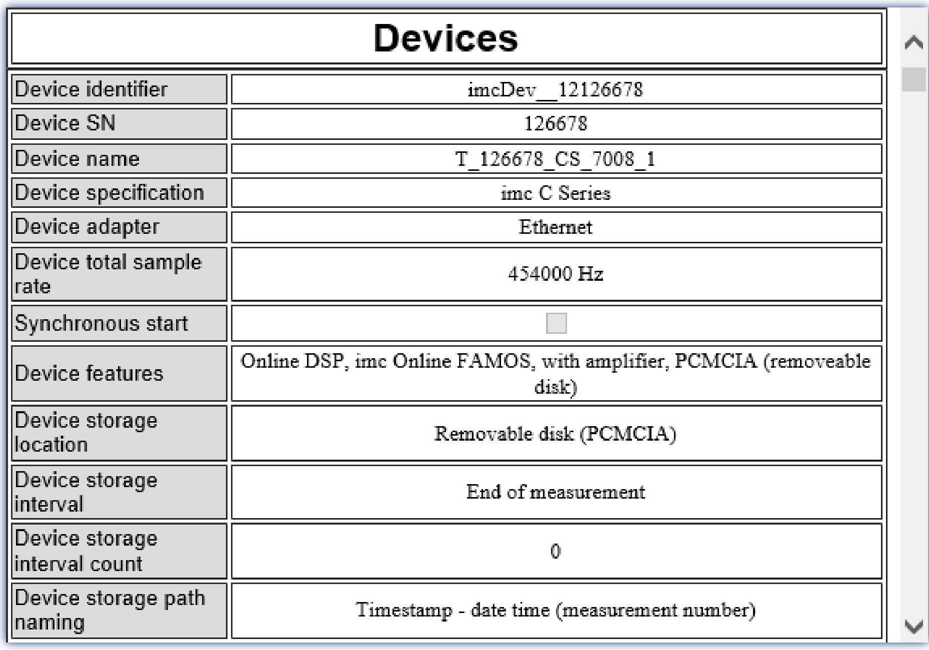
Solution 2: Open these experiments with the imc DEVICES version which is installed with this imc STUDIO version and save the experiment again **under a new name**. Import the newly created experiment.

7.6.7 Report of the Setup-configuration

You can **create a report** of the **current Setup-configuration**. The report is opened in the Browser and can be **saved or printed** there. Start the report via the menu ribbon if Setup is open.

Menu item	View
Edit > Print ( )	Complete
Edit > Print Preview ( )	Complete
Home > Print ( )	Compact, Standard

A list of many device and channel configurations, as well as of the imc Online FAMOS-source text is shown.



Devices

Device identifier	imcDev__12126678
Device SN	126678
Device name	T_126678_CS_7008_1
Device specification	imc C Series
Device adapter	Ethernet
Device total sample rate	454000 Hz
Synchronous start	
Device features	Online DSP, imc Online FAMOS, with amplifier, PCMCIA (removeable disk)
Device storage location	Removable disk (PCMCIA)
Device storage interval	End of measurement
Device storage interval count	0
Device storage path naming	Timestamp - date time (measurement number)

Example of a report
The first columns of the device configuration. The channel configuration appears further

Report creation via the Windows Explorer

You can generate a report without needing to start imc STUDIO. In the Explorer, navigate to the experiment folder and open the context menu of the "*.imcStudio*" file.

E.g. "*C:\Users\Public\Documents\DB\StandardProject\Experiment_0001\config\Experiment_0001.imcStudio*"

Under "*imc STUDIO Report*", select the entry: "*Setup Report for imc devices*".

8 Setup pages - Configuring Device

Each measurement setup can have a variety of requirements in terms of measurement device settings. Configure the device and each measurement channel according to its requirements. For this purpose, various software Assistants (wizards) are provided.

The following chapters describe the individual parameters of all pages (Setup pages) for configuring the measurement device.

Page	Description
Documentation 295	On this page, you can supply the experiment with **descriptions** and **metadata**.
Devices 295	Here, select the device for the measurement. Configure the data storage 298, synchronization 301 and the timed start 344, among other settings.
Analog channels 348	Here, configure the channel-specific parameters. Among others, those for the **analog inputs** and **virtual channels**.
Digital channels 348	Here, configure the channel-specific parameters. Among others, those for the **digital inputs/outputs** and **incremental counters**.
GPS 348	Here, configure the channel-specific parameters relating to the **GPS-channels**.
Variables 348	Here, configure the channel-specific parameters relating to the **Display-variables** and **process vector variables**.
Channel balance 387	On this page, you can have various **adjustment** and **calibration types** performed.
Triggers 394	Here, configure the **Trigger-Machine** in order to perform targeted starting and stopping of channels.
TEDS 415	Here, import **TEDS** information in order to obtain precise configuration of the channels.
HiL + Application module 420	Page for the configuration of **imc HiL** and **imc Application Module**.

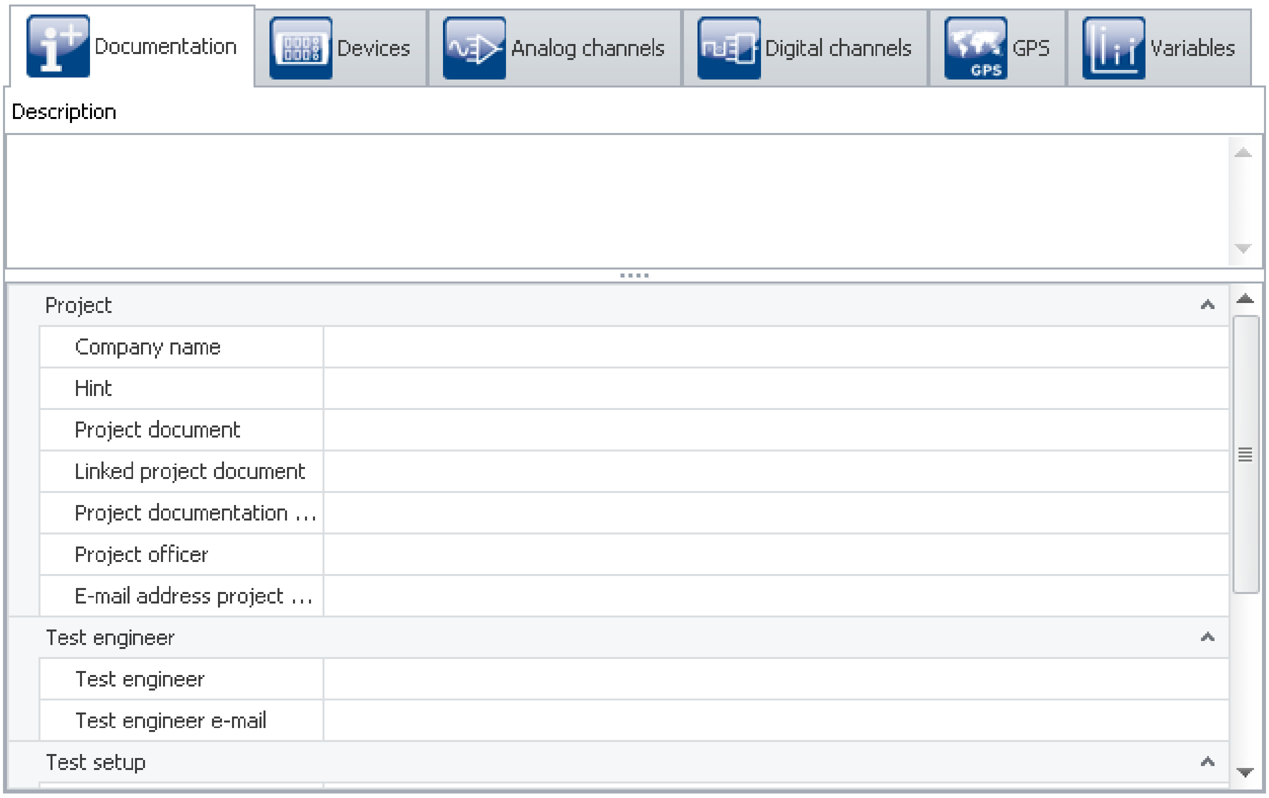
The menu ribbon offers various Assistants and additional dialogs 177 for configuration purposes.

Reference	Advanced Device Functions

For some settings, there are advanced descriptions in the manual: **Setup - Advanced Device Functions** 474. At the respective locations, you will find special references to the extra descriptions.

8.1 Documentation (Experiment Description)

On the page "*Documentation*", you can supply the experiment with descriptions and metadata.



The page is subdivided into two areas: the **Table** below and a **Description**.

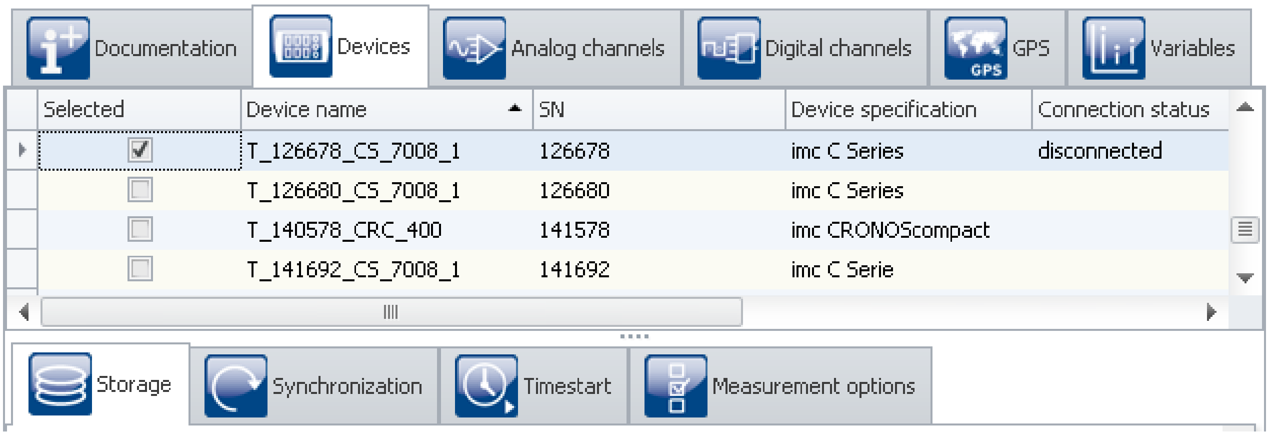
In the table, you can enter information pertinent to the experiment.

The table can be filled with multiple columns (see Configuring columns 256). By opening the **Column Chooser**, you can additionally move columns, group them together, or delete them.

In the box **Description**, you can provide your experiment with up to multiple lines of explicit description.

8.2 Configuring Devices

On the page **Devices**, you can set all device-specific parameters.



"Devices" page in the plug-in "imc STUDIO Setup"

The page is subdivided into two areas: the "*Device table*" and the "*Dialogs*".

In the Devices table, all known devices are listed. It offers quick access to many settings. In the lower area, you can select various dialogs. These offer clearly-presented access to the properties.

The availability and selection of the settings depends on the device type, which determines what settings options the parameters can have.

The following dialogs may be present:

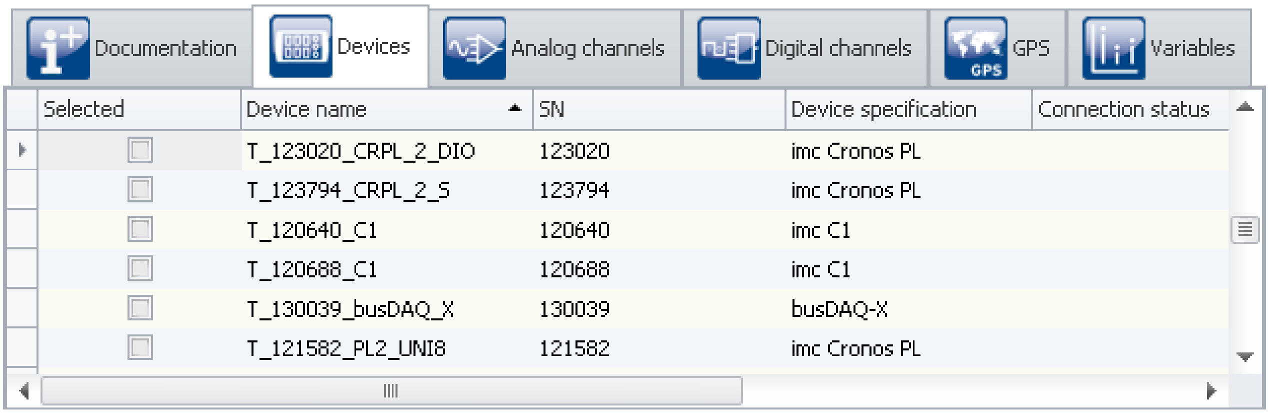
Page	Description
Storage 298	Settings for saving measured data in the device and on the PC.
Synchronization 301	Settings for synchronization to a clock or between multiple measurement devices
Timed start 344	This enables you to start the measurement at a defined point in time.
Measurement options 347	Various additional settings.
Video 348	Settings for a Video device. This page is only visible if an appropriate camera is selected.

Reference See also additional info on:

- Operation and configuration of the tabular display 212 and the dialogs 219
- Showing and moving columns 254
- Creating and configuring additional columns 258

8.2.1 Device Table

In this area, the **known** 222 **devices** are displayed in a structured table, as seen in the example image below.



Device-Table (example)

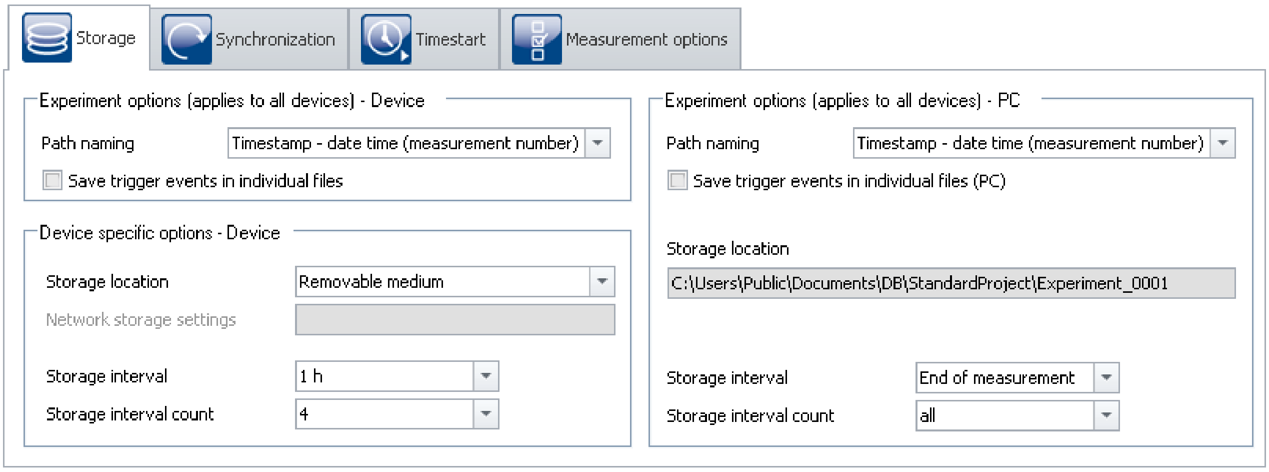
To be able to **use a device** for the current experiment, you must first find and select 222 it. To **adapt the devices' settings**, select one or more devices. After that, you either edit the table cells 215 directly or select the respective dialog 219 for the desired parameters.

Parameter	Description *long name* / *short name* / *column ID*
Selected	*Device is selected for measurement* / *Selected* / *Dev_SelForMeasurement* Clicking on the "*Selected*" box which corresponds to the desired device makes that device available for the experiment. You can also select multiple devices for your experiment. See "*Device Search - Known and Selected* 222"
Device name	*Device name* / *Name* / *eDeviceNickname* The displayed name of the device. You can modify the name if desired. The device's name must be unique; i.e. no two devices may have the same name. Maximum number of characters: 24. In order to be able to modify the name, first establish a "*Connection*" with the device. After having made the change, perform the "*Download*", so that the change is saved in the device. The device's name is also saved with the experiment. As soon as you load an experiment with a different device name and prepare it, the changed name is overwritten.
SN	*Device SN* / *SN* / *eDeviceSN* Unique identification number for the imc devices.
Device specification	*Device specification* / *Specification* / *eDeviceProduct* imc device type. Reference this name, for example, to obtain the associated device documentation.
Connection status	*Connection status* / *Connection* / *eConnectionStatus* Indicates the current connection status: "*connected*" or "*disconnected*".
Measurement status	*Measurement status* / *Measurement* / *eMeasurementStatus* Indicates the current status of the measurement: "*stopped*", "*running*" or "*reconfigured*".
Device control	*Device control* / *Device control* / *eDeviceControlAction* You can select an action via the selection list. By clicking the mouse over the button, you can cause the device to run the action. In contrast to menu items, this action only applies to the device selected. Thus you can stop a device during measurement, modify it in some way, and restart it, without affecting the other devices. The only other effect is that from that point in time, measured data are saved in a new folder. Disconnection and re-connection with the running measurement are not possible using this button. For that purpose, use the menu item "*Connect* 169".

8.2.2 Storage

Reference

This chapter contains a brief introduction to saving channel signal data. More detailed descriptions of all functions are presented in the chapter: *Setup - Advanced Device Functions > Storage Options and Directory Structure* 709.



"Storage" dialog

This dialog set s the options for saving the measured data to the device and to the PC. You can decide how to name folders and where to place them. You can also set at what intervals to save the measured data.

Parameter	Description
Path naming	Using this parameter, you set the folder structure for the measured data (see: Designation of the Measurement Data Folders 729). • Timestamp - date time (measurement number) The path name is formed from the start time • Continuously numbers
Save trigger events in individual files	Every triggered event is saved to the same file. If multiple events are saved (see: "*data transfer* 381" dialog) it becomes an event-based data set, otherwise, the previous one is deleted. If you select the property **Save trigger events in individual files**, a new file is created for each event.
Storage interval / Storage interval count	With these two parameters, you can limit the amount of data and number of files. In this way, it is possible to prevent complete exhaustion of available memory even during long-term measurements. **Storage interval:** After this much time elapses, a new file is created for the duration of the next saving interval. **Storage interval count:** Save the last x intervals sets the desired number of intervals. Once this number is reached, the oldest interval is deleted. Multiplying the count and the interval determines which measurement duration is available after the measurement has been run. **Example:** Storage interval = 5 min, Storage interval count = 12. The measurement duration is set to 24 h. This ensures that after one day (24 h) **at least** the last 60 min of the measurement are available in intervals of **a maximum of** 5 min.

Note

Save trigger events in individual files

- It is necessary to be very careful when using this option. Inconvenient selection of trigger conditions may cause the hard drive to quickly be filled with trigger folders.
- The time which the system needs to access data increases along with the number of folders.

Storage interval count

- Once the measurement is done, you will normally obtain one save interval more of data than was set.
- When interval storage is active, all **folders are deleted except for the specified number** of intervals!
- See the other notes in the chapter: *Setup - Advanced Device Functions* > *Storage Options and Directory Structure* 709 > *Intervall-Speicherung* 721.

8.2.2.1 Storage with the device

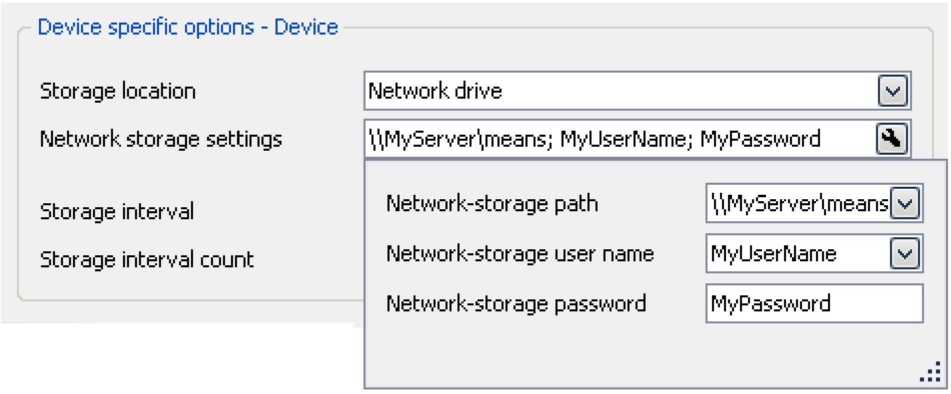
With the storage with the device, you can also specify a network drive as the target. I.e. the device can independently save the measured data to the network without that the program is running on the PC. However, the device must support network data storage, otherwise the option is not available. (Devices as of group 4 165)

In this dialog you only can make settings for the directories and their paths. The settings refer to the device. The storage settings pertaining to each channel are described in the chapter *Configure channels > Data transfer* 381.

Using these options, you can optimize the data storage according to various criteria (performance, data security).

Network storage settings

Only works for devices of group 4 and higher 165.



"Storage" dialog
Network storage settings

The network storage path must be stated in UNC notation (\\server\share\). Ensure that write access to the network storage path (clearance, "share") is possible with the specified user name and password.

The measurement instrument creates a subfolder on the network drive for the data, which is composed of the device's name and the experiment's name.

Example

You have entered a network path as shown in the image above

\\MyServer\means

The device is named:

imcCronosPL_123368

If you save the experiment under the name:

Test1

and start the measurement, you find the measured data on the path:

\\MyServer\means\imcCronosPL_123368\Test1.

Note — Network names

DNS or only IP address possible

8.2.3 Synchronization

This chapter describes the different options for synchronizing imc measurement devices.

This amounts to a **unified time base for different devices** whose measured data are compared. Synchronized devices can return **measured data which are exactly matched to each other in time**.

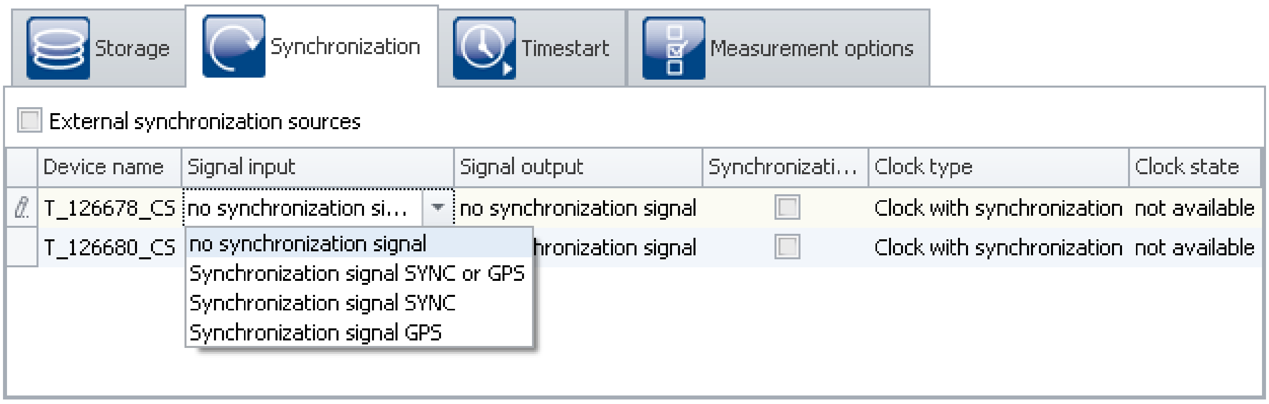
Reference Differences at runtime

Differences in the processing speeds between amplifiers, fieldbusses, etc., may also cause synchronization discrepancies. This topic is not covered here. Wherever it can, the system compensates for each of these devices' processing speed differentials.

Please find differences of the processing speed between measurement amplifiers in the corresponding device manual, chapter: "..." > "*Synchronicity*" > "*Delay*".

Setting synchronization

All **synchronization settings** are to be made in the dialog: "*Synchronization*" (on the Setup page "*Devices*").



In this dialog, you are able to **synchronize multiple devices with each other** or set a device according to an **external clock**. Synchronized devices can return **measured data which are exactly matched to each other in time**.

In order for the devices to be synchronized with each other, they must be **connected with the synchronization signal generator**. This can be either an external master or an imc device. Some models (e.g. DCF/IRIG-B) are connected with each other via the **SYNC terminal**. Others are synchronized via the **network** (e.g. NTP/PTP) or via **GPS**.

Parameter	Description
External synchronization sources	The devices are synchronized with an external synchronization source (e.g. DCF77, IRIG-B, ...). They have **no "*signal output*" of their own** and thus can not be the "*synchronization master*" in consequence. The checkmark's only effect is that no other "*Masters*" can be activated.
Synchronization master	If **no external synchronization source** is used and **only one device** is to be used **as the synchronization signal source**, put a checkmark here. This setting assistance is only relevant for IRIG-B and DCF77 and must not be activated for NTP and PTP synchronisation. The checkmark's only effect is that no other "*Masters*" can be activated.
Output	Here, select the synchronization signal according to which the other devices are synchronized. There are different output signals depending on the particular device. • E.g. DCF or IRIG-B. Devices which are synchronized with this device must be set for "*Signal input*" to either "*Synchronization signal SYNC*" or "*Synchronization signal SYNC or GPS* 323". • PTP serves to synchronize clocks within distributed computer systems. It forms a self-organizing hierarchical structure. In accordance with the specified settings, an imc device only becomes the PTP-master if there is no "better" PTP-master available. See the chapter: "*External timer: PTP* 326". • PTP-Master only 327: If the network includes no PTP-server true to absolute time, you can synchronize one imc device to a hardware synchronization signal (e.g. GPS). When you define that device as the PTP-master, it will no longer be synchronized by any other PTP-subscriber.
Input	Here, select the incoming synchronization signal, which depends on the synchronization signal source. For DFC and IRIG-B, please select "*SYNC*".

Note Simultaneously starting all devices

Channels of synchronized devices have correct absolute time. **However, the devices still start serially.**
To prevent this, select

- "*synchronous start* 346" under "*Timed start* 344"
- an appropriate "*Start options* 345". E.g. "*Automatic timed start*".

Guidepost

Summary	Chapter
What is synchronization needed for? What advantages does it have?	What's the purpose of synchronization - and how does it work? 303
Brief explanation of terms. For instance: synchronization, timed start, time zone, Synchronized Measurement Start (synchronized, but not simultaneous starting), Synchronous Start (simultaneous starting of all devices)	Definitions 305
Functioning and exact description of the various clock types. Internal device clocks, external time emitter, and the PC-clock.	Clock types 306
Various applications of synchronization. How are which clocks used? How do the devices need to be interconnected? What settings are to be made for imc STUDIO? Is there anything to pay attention to?	Synchronization varieties 319
What issues are involved when the synchronization signal is interrupted? What time discrepancies will occur? How to re-synchronize the signal?	Phase offset correction 330
What special issues are there in conjunction with time zones?	Working with time zones 330
If all devices are connected with an external Master: What happens if, for instance, the signal is lost? ...	What happens when? 335

8.2.3.1 What's the purpose of synchronization - and how does it work?

If you are only using one device, you may wonder what synchronization is good for. After all, your data already are associated with a correct time. For most users, it's sufficient to be able to compare measured signals with each other as long as they all were captured within the same device.

Synchronization is necessary if:

- **multiple devices** are measuring the same object simultaneously
- the **absolute time** is relevant

If **data** are captured **by different devices**, it should be possible to **track their chronological relationships** just as well as those of data originating in one device. Absolute time usually doesn't play any major role in this context.

Absolute time becomes important when **signals originating very far apart** are captured by separate devices. When such data are associated with an absolute time-stamp, they can be analyzed in conjunction with each other.

The synchronization process

After "Preparation", the devices apply whatever synchronization settings have been made.

Only **after the first preparation procedure**, the devices **synchronize** to the respective sources. The **device clock is adjusted** (phase), the **frequency is put under steady control** (frequency synchronized). When adopting the time, the **time zone** set in the device **is taken into account** (e.g. conversion of the GPS-time (UTC) to the time zone set).

Each synchronization type has special distinctions. With some, for instance, the PC clock time is adopted by the devices, with others not (for example, when an external Master is used). More information is presented in the chapter: "*VRTC - Virtual clock on the PC* 315".

When **starting a measurement**, its **start time** is either **determined** automatically (simple start, automatic timed start), or is specified explicitly (timed start). As soon as the start time has been determined, the device clock may not be set again (on this topic, see also the note further below, "*Time deviations*"). This also determines whether the measurement time is expressed in standard or daylight saving time.

Synchronization signal interruption (only for devices of group 5 165 and higher):
When the synchronization signal is available again after an interruption, the system determines how far the device's time deviates from the reference time. This phase error is corrected by adjusting the device clock rate until the device is once again absolutely synchronized to the reference time (on this topic, see: "*Phase error correction* 330").

Note	Time deviations

If you click on "Start Measurement" ( ) before the synchronization has been completed, it is no longer possible to correct any deviation by the device clock from the reference clock.

If **no time deviations** may exist, **then wait to start the measurement** until all devices are indicated as "*Synchronized*". Or force a "*Synchronous start* 346" (simultaneous starting of all devices) if you are using more than one device.

How does the deviation happen?

The starting time is set as soon as you click on "*Start measurement*" ( ) . This applies to every style of start, such as "*immediately*" or starting at a "*defined time*".

If the start time has been specified, the device clock will no longer be set (by a time adjustment to adopt the absolute time). In spite of this, the device will report that it is (frequency-) synchronized! (Clock status and imc Online FAMOS "`IsSynchronized`")

Thus, the frequency (clock rate) is synchronized, but there is an offset from the reference time.

Upon the next preparation procedure, the system tries again to adopt the absolute time given by the external reference clock. Toward this end, the synchronization is temporarily abandoned and then re-established. Starting of the next measurement should only begin after the re-synchronization has been performed. Otherwise, this process will be repeated upon each preparation procedure!

Determining the deviation from the reference clock in conjunction with NTP- and PTP-synchronization

The device clock's remaining deviation from the reference clock is represented by the variable "*pv.State.ResidualSyncTimeDeviation*". This value is determined when "*Start Measurement*" is pressed. At that moment the current deviation is determined.

- "0.0" : "Initial value", "no deviation" or "Unable to determine value" (see below).
- ">0" : Deviation in seconds

No statement for any other synchronization types

With the other synchronization types (such as GPS, DCF, ...), the value cannot be determined and is always set to "0.0"!

Note — Cases where the device clock is not adjusted

When the PC prepares a measurement, it also sets the device's time.
The device time is **not** set by the PC if:

- a valid synchronization signal is already applied (in particular when the device is synchronized), or
- the device's synchronization output (*SYNC*) is already running (otherwise, all devices must restart the synchronization), or
- "NTP" or "PTP" is selected as the synchronization signal

8.2.3.2 Definitions

Synchronization:

Devices are synchronized if their time bases are rigidly linked. This is achieved in either of two ways:

- *Use of an external time signal:* If the time signal of an exact time standard (absolute time encoder: e.g. DCF, GPS, NTP, ...) is available, it can be used to synchronize the devices. The time bases of the devices are then not only synchronized to each other but also to the time standard used.
- *Use of a device's own time base:* The time signal of one of the devices (master) is used to synchronize other devices (slaves). The time bases of the devices are only synchronized with each other, but not with absolute time.

Mixed-operation is possible, such that one device is synchronized with an external source and all other devices synchronize to the (Master) device.

Timed start:

The start is triggered by a particular clock at a pre-defined point in time. Each device has its own clock. If multiple devices are to start simultaneously, the precision of the start time depends on the precision of the synchronization.

Synchronized measurement start (synchronized, but not simultaneous):

This operating mode only works with multiple devices, and each device's own clock triggers the start. For this purpose, all clocks must be synchronized. The master clock is one of the following:

- an externally synchronizable clock
- a device's clock module, which has been declared as the Master, or
- each device uses its own time source,
- ...

Synchronous start (Simultaneous start of all devices):

When Synchronization is activated, simultaneous start 346 of all devices is possible. For this purpose, certain conditions must be met. Among others, an appropriate "*Start options* 345" must be selected. E.g. "Automatic timed start".

With the option "immediately", the devices measure synchronously, and are started quickly, but serially. The measured data are then only synchronized with each other in the absolute time display.

Additionally, the option: "*Synchronous start* 346" must be activated.

Time zone and switch to/from daylight saving time:

The device software is able to take the switch to/from daylight saving time or between time zones into account. The setting is made in the device configuration 196 (Ribbon "*Setup-Configuration*" > "*Device properties*", section "*Device time, synchronization*"): "*Time zone*" and "*Daylight saving time*".

Therms	Description
STD	**ST**andar**D** time
DST	**D**aylight **S**aving **T**ime
DST-state	DST or STD
DST-switch	switch from DST to STD or vice versa
UTC	Coordinated Universal Time (Greenwich meridian); no DST-switching!
localtime	the time prevalent in the respective time zone with regard to the current DST-state
RTC	RealTimeClock; internal device clock
SyncRTC 307	Synchronizable RealTimeClock of imc devices
VRTC 315	Virtual clock on the PC

8.2.3.3 Clock types

Internal clocks

Clock type	imc measurement device
SyncRTC 307	For all device types: Synchronizable RealTimeClock of imc devices
VRTC 315	Virtual clock on the PC

External clocks

Clock type	imc measurement device
DCF77 307	For all device types
IRIG-B 307	For devices of the group 5 and higher 165
GPS 308	All device types
NTP 308	For devices of the group 5 and higher 165
PTP 309	For devices of the group 7 and higher 165 with the suffix "-GP", as well as CRXT

8.2.3.3.1 Internal Clocks: Device Clock - SyncRTC

SyncRTC: **Sync**hronizable **R**eal **T**ime **C**lock.

The SyncRTC is the device's internal clock.

It is used to determine the start time of the first measurement after initialization, for example. Once this start time has been determined, the SyncRTC's absolute time plays no further role until the next measurement's initialization. Any time readings are derived by adding the sampling times to the start time, and the sampling times are derived from the SyncRTC's frequency.

If for instance the clock jumps (time change for daylight savings, etc.) this does not affect the measurement.

There are a variety of ways to synchronize the SyncRTC with external time sources. By doing this, it is ensured to both use the correct absolute time and the correct frequency.

Most devices* come with an external "SYNC" terminal and a GPS-input for synchronization with other clocks. The SYNC terminal can be configured as your choice of either an input or output. You can select either DCF77 or IRIG-B 002 (if supported by the device) as the signal format.

As the input signals, you can use other imc device signals or external time sources (e.g. DCF- or GPS-clocks from Meinberg, Hopf, etc.).

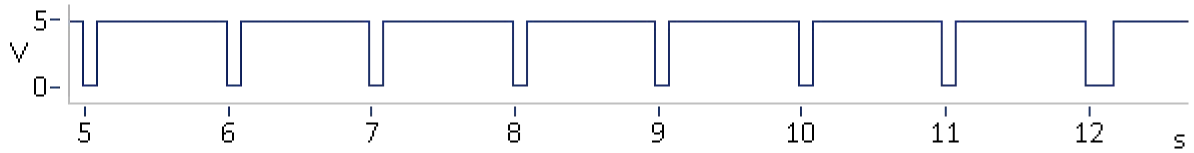
Depending on the device type, additional synchronization mechanisms are also available. See: Clock types: External clocks 306.

*Note: Certain terminals are not included with some device and housing types!

8.2.3.3.2 External Clocks: DCF77, IRIG-B, GPS, NTP

DCF77

The DCF77 signal is applied via the SYNC socket. The measurement device processes a LOW[1] 309 active 5V TTL signal (1Hz pulse). As well, inverted signals are recognized and evaluated by the hardware.



DCF77 TTL signal with inverted logic (Low active)

Duration of synchronization: The complete time is encoded within one minute and begins at the start of the next minute. For this reason the minimum duration for the synchronization process is at least one minute!

IRIG-B

For devices of the group 5 and higher 165.

The IRIG-B signal is applied via the SYNC socket. The measurement device processes a LOW[1] 309 active 5V TTL signal and supports IRIG-B002, B000, B001, B003. As well, inverted signals are recognized and evaluated by the hardware.

For all models, the pulse rate is 100 pulses per second, DC Level Shift (DCLS), width coded, no carrier. The last digit indicates the correct information:

B000	BCD, CF, SBS	BCD - Binary Coded Decimal, Code of the time (HH,MM,SS,DDD)
B001	BCD, CF	SBS - Straight Binary Second of day, daily second (0....86400)
B002	BCD	CF - Control Functions, depending on application
B003	BCD, SBS	

The models IRIG-B000, -B001, -B002 and -B003 listed here can be connected for the input signal. However, the measurement device only applies the BCD information!

Duration of synchronization: With a typical synchronization time of approx. 20 s, the IRIG-B is the fastest model available.

Note

- For the synchronization signal input, only "Synchronization signal SYNC" may be set.
- The time information is expected to correspond to the device's local time! This is important if a time zone was set for the device!
- **During signal output** only the **BCD information** will be applied, this means no CF and no SBS information will be applied.

GPS

The GPS (**G**lobal **P**ositioning **S**ystem) receiver is connected at the 9-pin DSUB terminal "GPS". The supply is provided by the measurement device. In this way, the GPS receiver finds its positions as soon as the device is activated.

The GPS signal, received all around the world, returns, among other things, Greenwich Mean Time (GMT)

Duration of synchronization process: The minimum duration for synchronization depends on the reception and on the last location of use. Upon first use, the receiver needs a few minutes until multiple satellites and its own position have been located. Upon the next start, the last position data are used, and the satellites are found found more quickly.

With a direct line of sight to the sky, the receiver is typically ready to transmit time and position data to the device after one minute.

NTP (Network Time Protocol)

For devices of the group 5 and higher 165**.**

The Network Time Protocol (NTP) is a standard for synchronizing clocks in computer systems and uses the transport protocol UDP. It was specially developed to enable reliable distribution of time information via networks having variable package runtimes.

Precision: NTPv4 can synchronize a local system's time via the public Internet at a precision of approx. 10 milliseconds. In local networks under ideal conditions, precision levels of 200 microseconds and even better are possible.

Duration of synchronization process: Synchronization to an NTP server is a lengthy process. At intervals, the device exchanges a data package with the server. With the default settings and a large time divergence it can take up to 3h to achieve a precision level in the range of 20ms, or up to 12h until the deviation is <5ms.

In order for synchronization to begin immediately upon system activation, NTP can be set up as the measurement device's default synchronization input (see device properties 194).

There you can also reduce the interval time in order to achieve better precision and faster synchronization. "Min-Interval" counteracts large divergence; as the values improve, the time interval increases up to "Max-Interval".

After the first synchronization procedure, the device should remain activated for at least one hour. Only then will the frequency deviation determined be saved in the device. When the device is restarted, the frequency deviation is known and the synchronization process proceeds correspondingly faster.

The measurement device supports up to two **NTP** servers. For setting **NTP**, the following parameters have to be set in the device properties 194:

- selection of the ***time zone***
- observance of the ***daylight saving's time*** transitions
- IP of the ***NTP server (1),*** IP of the ***NTP server (2)***

Note

- If the phasing between two voltages in different devices is to be compared, only the Master is to be synchronized to NTP. This synchronizes additional devices via SYNC (DCF77/IRIG-B), see NTP time via LAN in Master/Slave setup 324.
- The quality of the synchronization can be monitored with the help of the PV variable "pv.SyncTimeDeviation". It returns the estimated deviation of the NTP-server' clock time in seconds. The momentary value is not relevant! only after observing its course over longer periods is it possible to get an impression of the synchronization quality!
- How constant the synchronization is depends strongly on temperature fluctuations in the device! Every °C can temporarily cause a sizable deviation. High precision is only achieved under constant temperature conditions (e.g. in switching cabinets).

1: Due to the greater steepness of edges, LOW active signals achieve better precision than HIGH active signals.

8.2.3.3.3 External Clocks: PTP

The Precision Time Protocol (PTP) serves synchronize clocks within distributed computer systems. Compared with NTP, its achievable precision is significantly higher.

Characteristics	Description
Prerequisites and limitations	For devices of the group 7 and higher with the suffix "**-GP**", as well as **CRXT**. PTP-capable network equipment (switches) and optionally a PTP time server are required. The synchronization is confined to the local network. No possibility for synchronization via the Internet is provided.
Structure	PTP creates a self-organizing hierarchical structure, in which each device listens for information from the current time server throughout the network. If it does not identify any server, or if its own information is superior to that of the current server, it sends its own information to the network. The current server as well as all clients recognize that there is a new and better server and use the new server from then on. The previous current server stops sending its information. In principle, any PTP-capable imc device can also serve as a time server. By means of the configuration option "Slave only", it is possible to prevent a device from making itself available as the time server.
Precision	Under good conditions, PTP achieves a precision to the extent of well less than 1µs.

Characteristics	Description
Duration of synchronization process	The synchronization takes about 20-30 seconds after preparing (Download) the measurement. Depending on the set PTP parameter, the synchronization can last longer. The sync process takes longer if the measurement was started before the device could sync it's time with the time server. The offset in time will then be balanced over a longer period of time by adjusting the device's internal clock (SyncRTC).
Time zone	For the use of PTP it is necessary for the time zone to be set in appropriately for one's own needs, or else there may be an unintended time offset between the imc device and other devices or the PC.

Note

The parameters "*First step threshold*" and "*Step threshold*" can be used to influence the behavior before and after the start of the measurement (see the description of the parameters).

Application in imc STUDIO

On the Setup page "*Devices*" in the dialog "*Synchronization*", **the signal input is configured**. For PTP-capable devices, the "*Synchronization signal PTP*" is available there, among others.

When the **signal input "*Synchronization signal PTP*"** is selected, an additional tab with the name "PTP" appears. Here, you can configure PTP for the devices. This tab only appears when the associated device is selected.

Presets

Using various parameters it is possible to modify the protocol to meet your requirements. imc STUDIO offers a number of presets for these parameters. Additionally, you are able to edit every parameter.

Preset	Description
IEEE 1588 2008	Standard defined by IEEE (default setting)
fos4X	Configuration for allowing synchronization with the fos4X devices, which can be used in imc STUDIO as Third Party devices.
User-defined	Enables configuration of all PTP-parameters. If "user-defined" is selected, all parameters are displayed.

Note

The values set are discarded as soon as another preset is selected.

Note

- The PTP parameters are saved along with the experiment.
- For the parameter "Signal output", there is no option like "Synchronization signal PTP".
- If the parameter "External synchronization source" is activated int he dialog "Synchronization", then for all PTP-devices "Slave only" is activated.

Comparison: NTP vs. PTP

	NTP	PTP
Precision	10 ms via internet 200 µs in the local network	below 1 µs (down to 100 ns achievable)
Settling	up to 3 h, for a 20 ms precision level 308	approx. 20-30 s
Structure	internet time server supported specify time server	for local networks only self-organizing: the best server wins
Hardware	standard hardware	special devices: group 7 and higher with the suffix "-GP", as well as CRXT. PTP compatible Network switch required

PTP - Parameter

Among parameters there is a distinction between "Device-specific" and "Experiment options (for all devices)". "Device-specific" always applies to the device currently selected in the Devices table.

If you selected the preset "User-defined", you are able to modify all PTP parameters according to your requirements. The parameters are displayed as soon as "User-defined"is selected.

The following parameters can either be modified or are specified by the preset (the description of the parameters is provided further below):

Device-specific options				
Parameter	**Min**	**Max**	**IEEE 1588 2008 (Default)**	**fos4X**
Slave only	0	1	0	0
Priority 1	0	255	128	127
Priority 2	0	255	128	127
User description				
Delay asymmetry	-1000000	1000000	0	0
UDP TTL	1	255	1	1

Experiment options (for all devices)				
Parameter	**Min**	**Max**	**IEEE 1588 2008 (Default)**	**fos4X**
Domain number	0	255	0	0
Announce interval	-3	5	1	1
Sync interval	-6	5	0	-2
Delay request interval	-6	5	0	0
Announce receipt timeout	2	10	3	3

Experiment options (for all devices)				
Parameter	**Min**	**Max**	**IEEE 1588 2008 (Default)**	**fos4X**
Delay mechanism	Auto, E2E, hybridE2E, P2P		E2E	E2E
Network transport	UDPv4, UDPv6, L2/IEEE 802.3		UDPv4	UDPv6
TAI-UTC offset	-32768	32767	36	36
UDPv6 scope	0x02	0x0E	0x0E	0x02
Transport specific	0x00	0x0F	0x00	0x00
Step threshold	0.0	DOUBLE_MAX	0.0	0.0
First step threshold	0.0	DOUBLE_MAX	0.00002	0.00002
PTP destination MAC address			01:1B:19:00:00:00	
P2P destination MAC address			01:80:C2:00:00:0E	

Description

Device-specific options	
Parameter	**Description**
Slave only	Prevents the device from providing its clock time to other subscribers. This parameter can be set for all Preset-variants.
Priority 1	Sets the priority according to which the devices choose a server. The subscriber with the lowest value becomes the server. Priority 1 is the strongest among criteria!
Priority 2	Sets the priority according to which the devices choose a server. The subscriber with the lowest value becomes the server. Priority 2 is a weak criterion! Priority 1 and the server quality characteristics specified by the device manufacturer outweigh the parameter Priority 2, which is only evaluated if all other values are identical.
User description	Identification of the device for PTP-Management programs.
Delay asymmetry	With this value, a deterministic time offset resulting from asymmetric packet run times in the network can be compensated. For this purpose, exact information or measurements are necessary. If you use appropriate PTP-switches, it should not be necessary to adjust this parameter.
UDP TTL	Lifespan of the PTP-packets in the network. If a PTP-network is to be operated beyond the confines of one router, this value must be increased accordingly. This value is only taken into account if UDPv4 was set as the network transport.

The following parameters match for all devices involved. This applies not only to the devices from imc but to all switches, PTP-servers and other devices!

Experiment options (for all devices)	
Parameter	**Description**
Domain number	Using the domain number it is possible to create multiple independent PTP-domains. Devices having differing domain numbers do not influence each other.

Experiment options (for all devices)	
Parameter	**Description**
Announce interval	This interval determines at what intervals the current time server sends its quality information to the network. The value is stated as a power of 2. The value range of -3 to 5 covers interval times of 1/8s to 32s.
Sync interval	This interval determines at what intervals the current time server sends its time information to the network. This value is stated as a power of 2. The value range of -6 to 5 covers interval times of 1/64s to 32s. When the value is less than -3, imc devices can no longer send data at the speed required. These settings are only offered for reasons of compatibility and should be avoided. Note that large values lead to long intervals and thus slow down the synchronization and decrease its precision!
Delay request interval	This interval specifies at what intervals the PTP-slaves determine the packet run times in the network. The value is stated as a power of 2. The value range of -6 to 5 covers interval times of 1/64s to 32s. When the value is less than -3, imc devices can no longer send data at the speed required. These settings are only offered for reasons of compatibility and should be avoided. Note that large values lead to long intervals and thus slow down the synchronization and decrease its precision!
Announce receipt timeout	Specifies how many "Announce Intervals" a device waits until it assumes that the current PTP-master no longer exists and takes appropriate measures. Example: Announce interval = 1, Announce receipt timeout = 3 -> The time is: 2^1s * 3 = 6s.
Delay mechanism	For measurement of the packet run times, multiple procedures are available. Select the procedure here which you wish to use. **E2E:** With the End-To-End procedure, the packet run time along the entire route between the PTP-Slave and the PTP-Master. This procedure is the one most commonly supported and theoretically also works with switches which are not PTP-capable. For this reason it is the default. However, it is strongly to be recommended NOT using switches unless they explicitly support PTP, otherwise unpredictable behavior can result which can impair the synchronization by any unforeseeable amount. The procedure can be used without any problems in conjunction with appropriate switches. **P2P:** The Peer-To-Peer procedure can exclusively be used with P2P-capable infrastructure. Here, the packet run times are determined between two directly connected nodes (device and switch or switch and switch). On the way between the master and slave, one correction value from each switch traversed is incremented in the packet by the run-time determined and the dwell time in the switch. The receiver can calculate and incorporate the total run-time. This procedure has advantages when there are multiple switches between the master and the slaves. **Auto:** With this setting, "E2E" is used initially. As soon as a "P2P"-packet is recognized, the setting switches to "P2P".

Experiment options (for all devices)	
Parameter	**Description**
	hybridE2E: This is an improved form of "E2E" and reduces the network load since it uses Unicast packets instead of multicast packets. However, it is not supported by all commercially available devices.
Network transport	Depending on the infrastructure used, select UDPv4, UDPv6 or L2/IEEE802.3.
TAI-UTC offset	By default PTP uses atomic time (Temps Atomique International, TAI) as the time base. In the Announce packets, along with the server's quality characteristics, the offset between atomic time and UTC is also transmitted. In order that the device can distribute the correct offset, the current value must be entered here.
UDPv6 scope	Sets the lifespan of the PTP-packets if UDPv6 is set as the "Network transport".
Transport specific	Only needed if you use both imc devices and other devices in a shared PTP-network and the other devices here use a value which is not 0x00. Make the same setting here.
Step threshold	Sets the threshold value as of which a time deviation can no longer be compensated for by adjusting the device clock. This value is only taken into account once the time may no longer jump in the device clocks, which means after the start time of the first measurement after the initialization is set. If the value is 0, any deviation however large is compensated, which can take very long when deviations are large. If the value is not equal to 0 but smaller than the deviation from the PTP-Master, the frequency of the clock rate signals in the device, and thus also of all signal samples, is synchronized to the frequency of the PTP-Master. By contrast, the time deviation is NOT compensated for, but instead kept constant. In this way, it is possible to avoid the signal sampling either accelerating or slowing down over the time during which the deviation is compensated. This can be helpful for measurements in which the exactness of the sampling frequency is more important than the exactness of the absolute time.
First step threshold	This value works in the same way as "Step threshold", but is only used between the initialization of a measurement and when the start time of the the first measurement is determined after the initialization. Note: With the default settings, every time deviation after a measurement is initialized is eliminated within a few seconds. For very small deviations, this is accomplished by brief temporary modification of the clock frequency; for larger deviations, the device clock is directly adjusted. However, if a measurement is started before this procedure was completed, then regardless of how large the deviation is, it is compensated by modifying the clock frequencies in the device.
PTP destination MAC address	Only change this value if you use a different MAC-address in your infrastructure.
P2P destination MAC address	Only change this value if you use a different MAC-address in your infrastructure.

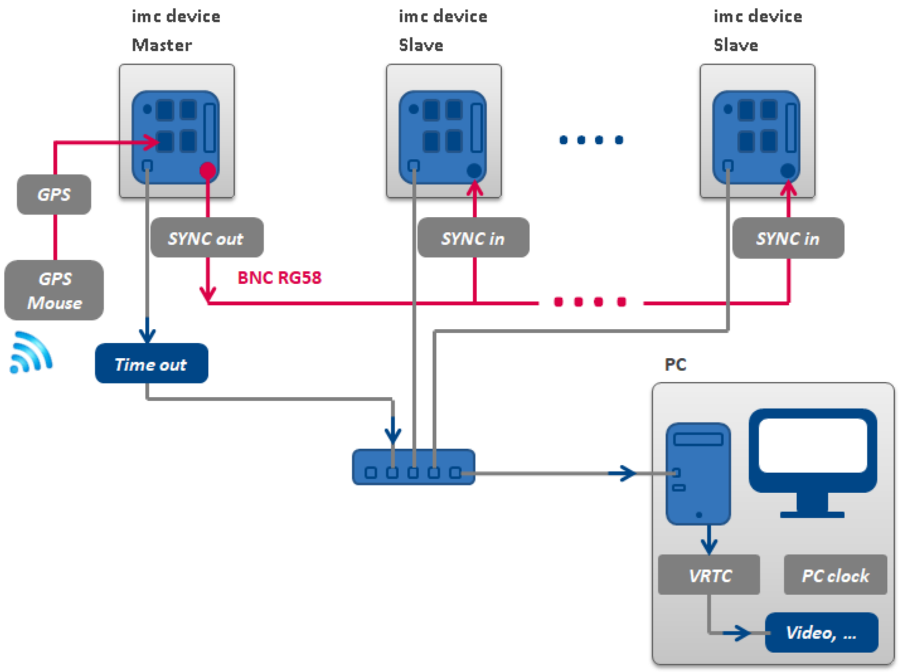
8.2.3.3.4 VRTC - Virtual clock on the PC

For the purposes of precise time output on the PC and synchronization of device results with PC results, a **virtual clock** (VRTC) is used.

The subscribers on the PC always use the virtual clock's time. Such a subscriber can be, for example, the clock on a Panel page or a Video-signal.

Outline: How does the virtual device clock work?

During the running measurement, the virtual clock synchronizes itself to the Master imc device's clock. This is needed if functions are used on the PC side which require an exact time track (e.g. Video, report channels and third-party devices such as Fos4X, ProfiNet, CAEMAX).



Example of synchronizing the VRTC via the Master device

On heavily burdened networks, good synchronization (of the PC's virtual device clock with the device) is not always possible. When the network load is too high, imc STUDIO posts a corresponding error message when an attempt is made to start the measurement.

It may help to increase the minimum accuracy.

Minimum accuracy:

The option defines the maximum time in milliseconds that the PC's virtual clock may deviate from the device clock. This concerns mainly non-imc devices, e.g. video. In case of video a value of 10 ms provides synchronization of measurement data to video images at 100 frames per second. Too low a value prevents measurement start.

The "*Minimum accuracy*" is located among the options under: "*Extra*" ribbon > "*Options*" in the region: "*Setup*" > "*Device options*" > "*Virtual device clock* 116".

FAQ

Question: Which clock time is used when preparing the devices?

Answer: This depends on what synchronization is set for the devices:

- Without an external synchronization master, the device clocks are **set to the VRTC's time** upon preparing (all device clocks, or in a synchronization, those of the master devices).
- If you have an external synchronization master, then when performing preparation, synchronize the device clocks with the synchronization master. The virtual clock is set **according to the master device's clock**.

Subsequently, the VRTC aligns itself to the device clock.

To find more tips and notes on variations, see the section "*Details on workings of VRTC*". In particular for synchronizing NTP- and PTP, or on the topic of the behavior during measurement.

Question: Is there a distinction between the PC clock and the VRTC on the PC?

Answer: Yes. The VRTC runs on the PC and under some circumstances it can assume the PC's clock time (see previous question). However, it has its own high-resolution counter which enables it to provide significantly more precise time readings than the PC time. The largest deviation occurs in the case of external synchronization. In that case, the VRTC adopts the device clock time upon preparation.

Resolution and deviation before and after start of measurement

During the measurement, the VRTC aligns itself to the device clock. The clock rate of the devices has a resolution of 1 ms or better.

The deviations differ among the devices **up until the moment of measurement start**:

- With **devices of Group 5** 165 **and higher**, at the moment the measurement starts the VRTC **typically has a 1 ms deviation**.
- With **devices of Group 4** 165 **and higher**, at the moment the measurement starts the VRTC **typically has a 15 ms deviation**. (Matching the behavior of imc STUDIO 5.0 for all device groups.)

Over the course of multiple seconds after starting measurement, the deviation improves. This should be noted about all VRTC subscribers, e.g. Video, report channels and third-party devices such as Fos4X, ProfiNet, CAEMAX.

Whenever possible, define a device of Group 5 165 or higher as the synchronization master. Especially when you are using multiple different devices within a measurement setup.

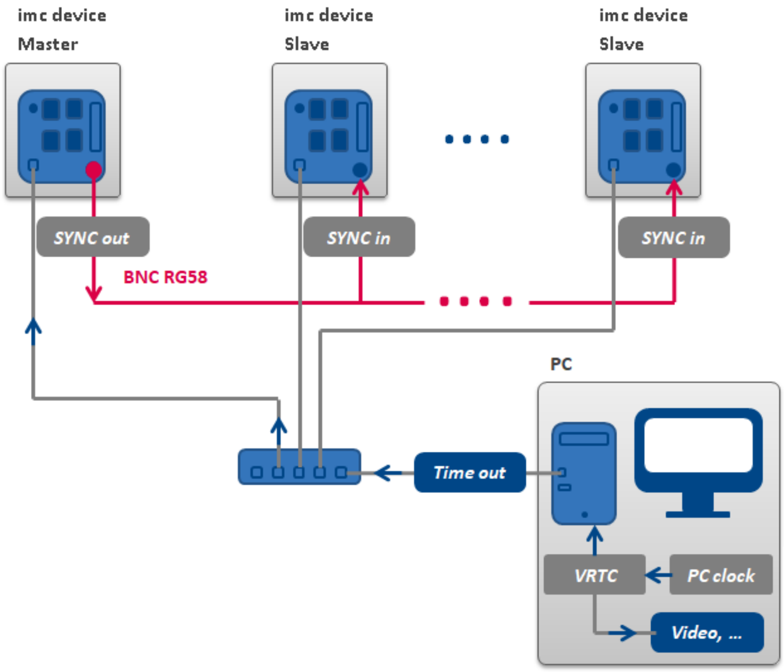
Details on workings of VRTC

When imc STUDIO starts, the VRTC adopts the PC's clock time.

If no measurement is running (or no other components require the VRTC) the system behaves as follows: The time between the PC and VRTC is calibrated every 10 s. Since there are no subscribers, the time adjustment simply jumps abruptly (in either positive or negative direction).

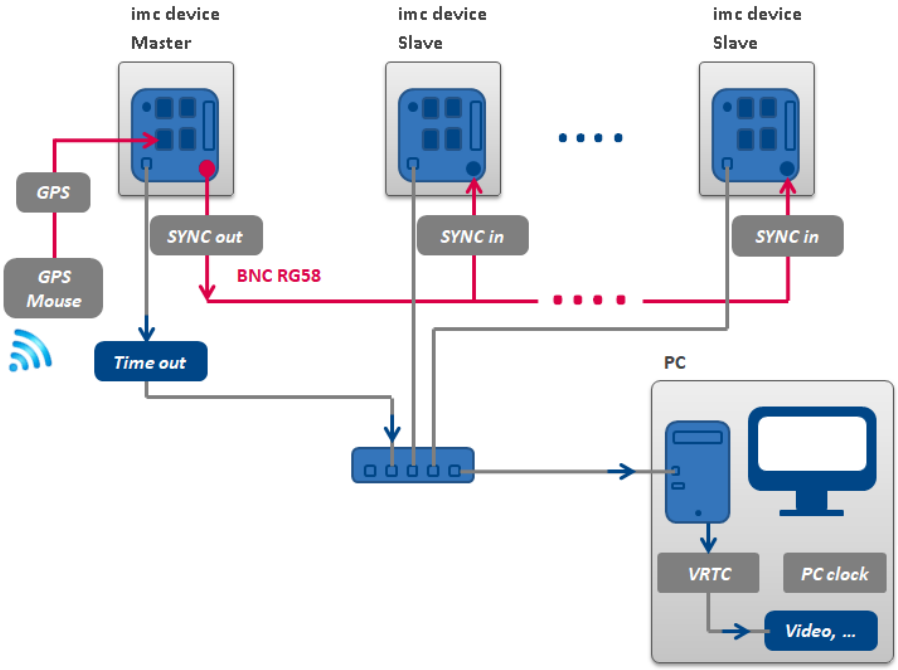
Behavior when preparing (all devices) - Setting the device clock:

- When there is no external synchronization master, then upon preparation, the device clocks are synched to the VRTC clock one single time (all devices' clocks, or in case of synchronization, those of the Master devices).



One-time-only synchronization during preparation, without any external Master

- If you have an external synchronization master, then when performing preparation, the device clocks synchronize with the synchronization master. The virtual clock is set **according to the master device's clock** a single time (see below the exception regarding NTP- and PTP-synchronization).



One-time-only synchronization during preparation, with an external Master

Behavior during measurement:

- The imc devices synchronize in accordance with their synchronization settings. These operate independently of the VRTC.
- Behavior of the VRTC
  - **No synchronization** of the devices mutually or **synchronization via DCF, IRIG B**:
    The VRTC aligns itself to the Master device's clock (if there is no Master device, then the first one in the list).
    The time alignment always increases monotonically. No abrupt skips are made.
  - **NTP**, **PTP**:
    There is no calibration of the VRTC to the device clock! Please synchronize the PC to the same source.
    The VRTC aligns itself to the PC's time.

Note	The precision level depends on the operating system

The precision of the PC's internal clock rate plays a large role here. Newer operating systems have higher precision. With Win 7, one can assume a precision level of up to 1 µs. With Win 10, up to 100 ns.

Note	Recommended methods

- Whenever possible, use defined Master devices.
- Whenever possible, define a device of Group 5 165 or higher as the Master. Especially when you are using multiple different devices within a measurement setup.
- When using NTP oder PTP, always synchronize the PC also with the source.

8.2.3.4 Synchronization varieties

In the following examples, two types of synchronization are presented.

Variety	Description
Master/Slave setup	All devices are synchronized mutually via "SYNC". The clock rate is provided by a Master device (which can be synchronized to an external clock, for example). All devices are connected via the SYNC jack. No terminal resistor is needed.
Separate synchronization of all devices	Individual synchronization of each device. If connection between devices via a SYNC line is not possible, then each device can be synchronized separately to an external clock.

Note

Voltage level differentials

If the synchronized devices are at different voltage levels, they should be compensated by means of a lead having the appropriate cross-section. If the SYNC terminal appears with yellow ring below it, it means the terminal is already isolated and shielded from voltage differentials (applicable to devices delivered as of Summer, 2012). Alternatively, it is possible to isolate the different voltage levels from each other using a adapter ISOSYNC 342.

- See also technical specs in the corresponding device manual, chapter "*Synchronization and time base*"

Outage of the synchronization source

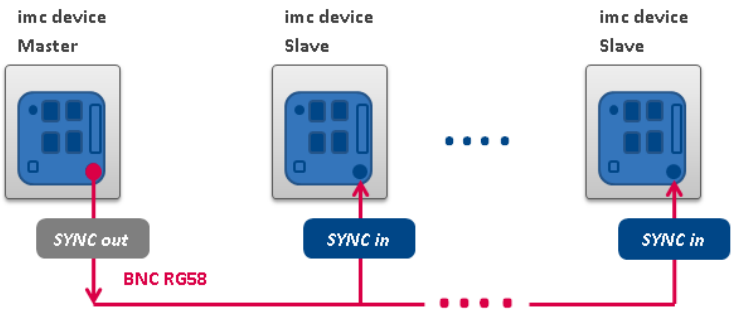
- If there is an **outage of the Master**, all devices continue to work according to their own internal clocks and drift apart in accordance with the precision stated in the technical data of the device.
- If there is an **outage of the external clock** (e.g. GPS or NTP/PTP), the Master continues according to its internal clock. However, the devices remain synchronized to each other.

8.2.3.4.1 DCF77 oder IRIG-B - No External Timer

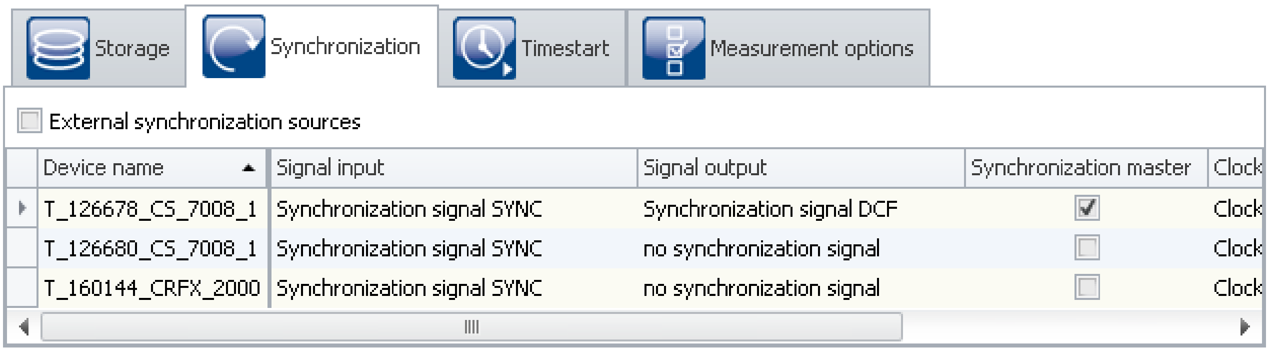
Master/Slave setup

Illustrated by example of: DCF77

The devices are synchronized with each other, but not synchronized to absolute time as provided by an external clock.



Example for synchronization with master and slave devices



Device name	Signal input	Signal output	Synchronization master	Clock
T_126678_CS_7008_1	Synchronization signal SYNC	Synchronization signal DCF	☑	Clock
T_126680_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐	Clock
T_160144_CRFX_2000	Synchronization signal SYNC	no synchronization signal	☐	Clock

Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

Note SYNC for DCF and IRIG-B

With DCF77 and IRIG-B, select "*SYNC*" as the signal input. The hardware automatically recognizes which type is involved.

Note

- The Master also synchronizes itself to its own signal, so that it also reports that it is synchronized. For this reason, its synchronization input is set to "*Synchronization signal SYNC*".
- A slave clock receiving an external clock signal is never set by PC.
- The master clock is set to PC time during preparation (see "*VRTC - Virtual clock on the PC* 315").

  This also happens, for instance, after activating the devices [1].

  The positive result of this is that when working with the devices, it is necessary to wait for the synchronization only once.
- In case the master device is equipped with a GPS receiver that should be ignored, the *Signal input* must be set to "*Synchronization signal SYNC*". Otherwise, the device might synchronize to the GPS-signal.

1: This doesn't apply if the the default synchronization setting is defined in the device properties. In that case, the time is only adjusted if the signal output is subsequently set to "No synchronization signal" on the Synchronizations-page. After the adjustment, run the initialization once and then set the desired synchronization.

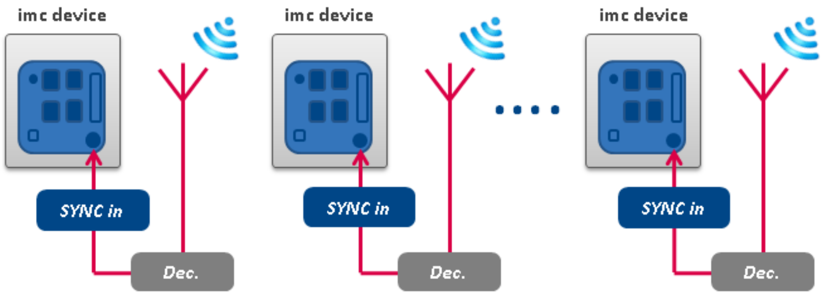
8.2.3.4.2 DCF77 oder IRIG-B - External Timer

Separate synchronization of all devices

Illustrated by example of: DCF77

Each device is synchronized to absolute DCF77 time and thus all devices are mutually synchronized.

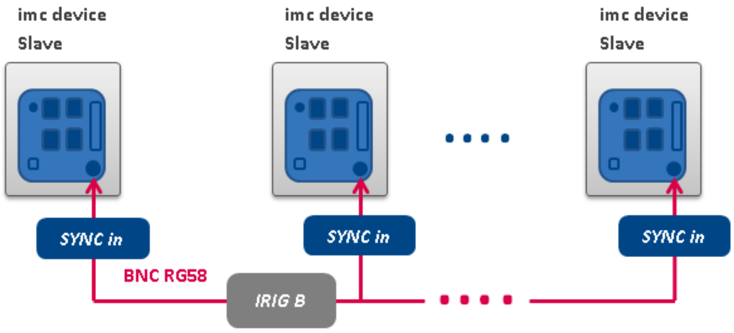
The antenna signal must be converted to by a decoder to TTL level.



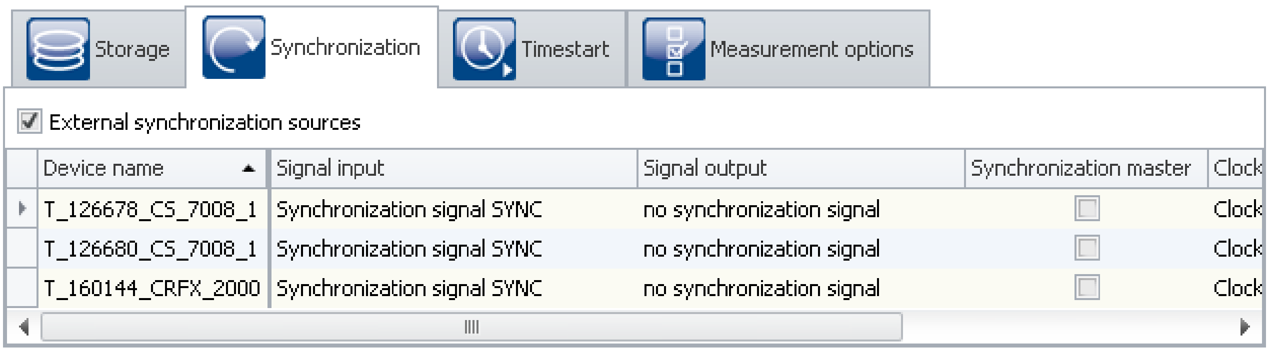
Example of individual synchronization with DCF77

Illustrated by example of: IRIG-B

Each device is synchronized to absolute IRIG-B time and thus all devices are mutually synchronized.



Example of individual synchronization with IRIG-B



Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

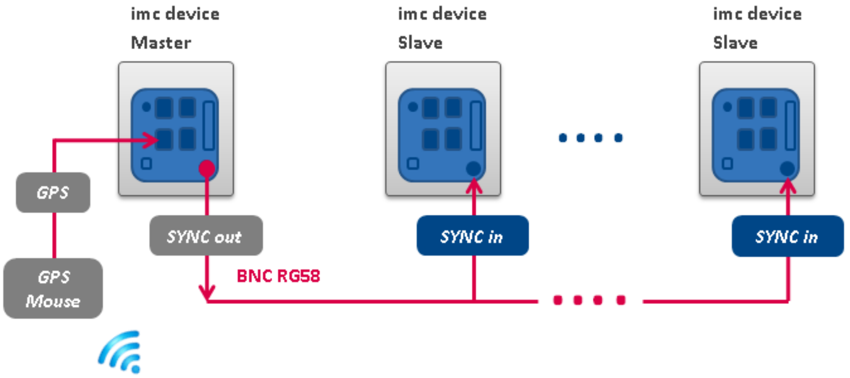
Note SYNC for DCF and IRIG-B

With DCF77 and IRIG-B, select "*SYNC*" as the signal input. The hardware automatically recognizes which type is involved.

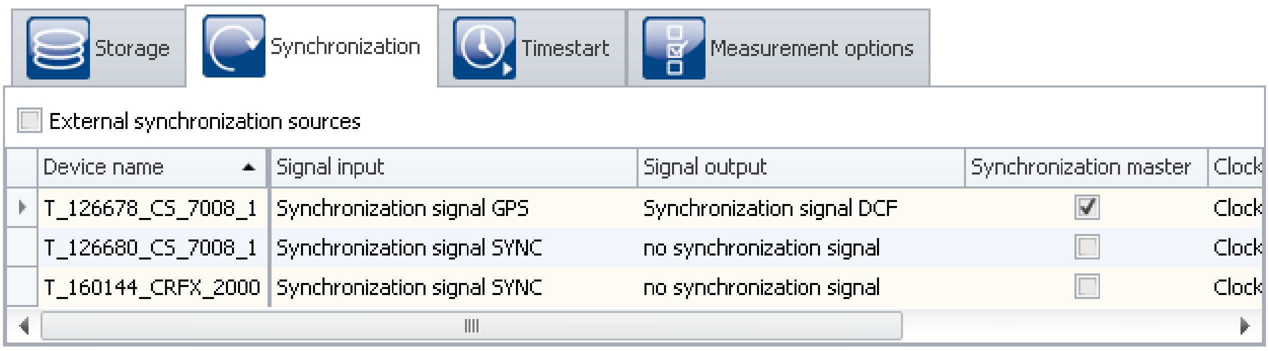
8.2.3.4.3 GPS receiver as timer

Master/Slave setup

The devices are synchronized with each other and synchronized to absolute GPS time.



Master device synchronized by GPS and slave devices by SYNC



Device name	Signal input	Signal output	Synchronization master	Clock
T_126678_CS_7008_1	Synchronization signal GPS	Synchronization signal DCF	☑	Clock
T_126680_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐	Clock
T_160144_CRFX_2000	Synchronization signal SYNC	no synchronization signal	☐	Clock

Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

Different response for GPS-synchronization + DCF/IRIG-B-output

- **Behavior of group 2 to 4** 165 **devices:** If DCF-output is activated for a device and simultaneously GPS is set as the synchronization input, the DCF-output only as long as the device is synchronized to the GPS-source. If the GPS-source fails, the DCF-output is temporarily deactivated!
- **Behavior of group 5 and higher** 165 **devices:** DCF/IRIG-B-output begins upon the first synchronization with GPS. If there is an outage of the GPS-signal, the DCF/IRIG-B-signal continues to be outputted anyway. All devices connected remain synchronized to the Master. Once the GPS-signal resumes, the resulting phase offset to the Master is corrected, see Phase offset correction 330. In the process, all connected DCF/IRIG-B Slaves are automatically adjusted to have the same phase.

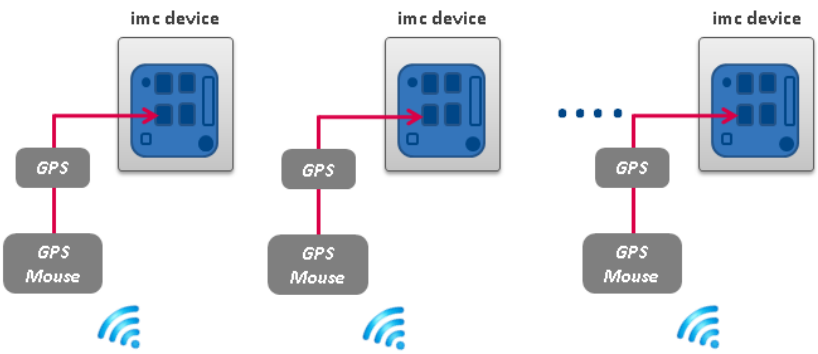
Different response for GPS- and DCF/IRIG-B synchronization + DCF/IRIG-B-output

- **Behavior of group 2 to 4** 165 **devices:** DCF-output begins immediately. If a GPS-signal is applied, the system synchronizes to it. If the GPS-signal has a temporary outage or if it is no longer available after preparation of the measurement, the device synchronizes to its own DCF-output. The GPS-signal is then no longer taken into account for the running measurement!
- **Behavior of group 5 and higher** 165 **devices:** DCF/IRIG-B-output begins immediately. Any GPS-signal applied always supersedes the device's own DCF/IRIG-B-signal as the synchronization source! If no GPS-signal is applied, the device synchronizes to its own DCF/IRIG-B-output.
  As soon as a GPS-signal is available, the device synchronizes to the GPS. The DCF/IRIG-B-output is briefly interrupted, so that all DCF/IRIG-B-Slaves adopt the GPS time. Following the first synchronization with GPS, the DCF/IRIG-B-output remains intact even if the GPS-signal fails!
  If the GPS-signal fails again, the synchronizes to its own DCF/IRIG-B-signal. If the external GPS-signal returns, the device synchronizes to the device by correcting the resulting phase offset 330. This automatically also adjusts all connected DCF/IRIG-B-Slaves to the phase.

Device name	Signal input	Signal output	Synchronization master
T_126678_CS_7008_1	Synchronization signal SYNC or GPS	Synchronization signal DCF	☑
T_126680_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐
T_160144_CRFX_2000	Synchronization signal SYNC	no synchronization signal	☐

Separate synchronization of all devices

Each device is synchronized to absolute GPS time and thus all devices are mutually synchronized.



Example of individual synchronization with GPS

Storage | Synchronization | Timestart | Measurement options

☑ External synchronization sources

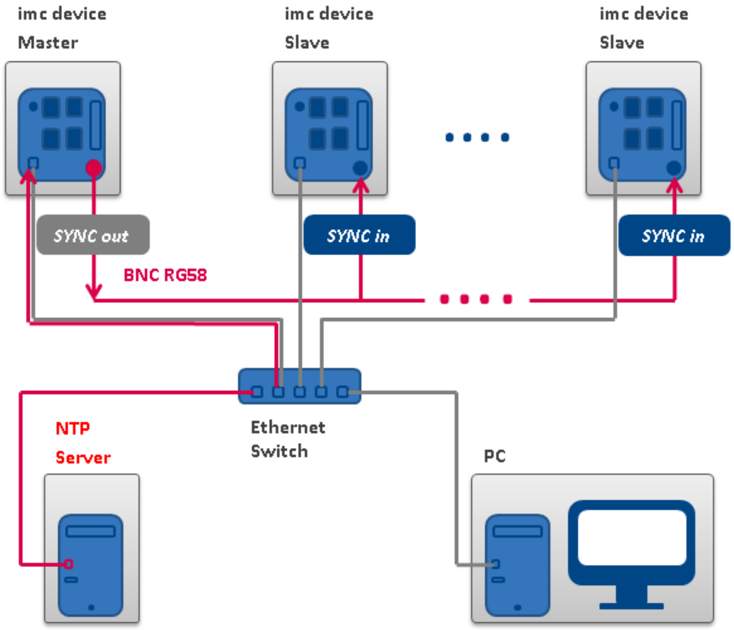
Device name	Signal input	Signal output	Synchronization master	Clock
T_126678_CS_7008_1	Synchronization signal GPS	no synchronization signal	☐	Clock
T_126680_CS_7008_1	Synchronization signal GPS	no synchronization signal	☐	Clock
T_160144_CRFX_2000	Synchronization signal GPS	no synchronization signal	☐	Clock

Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

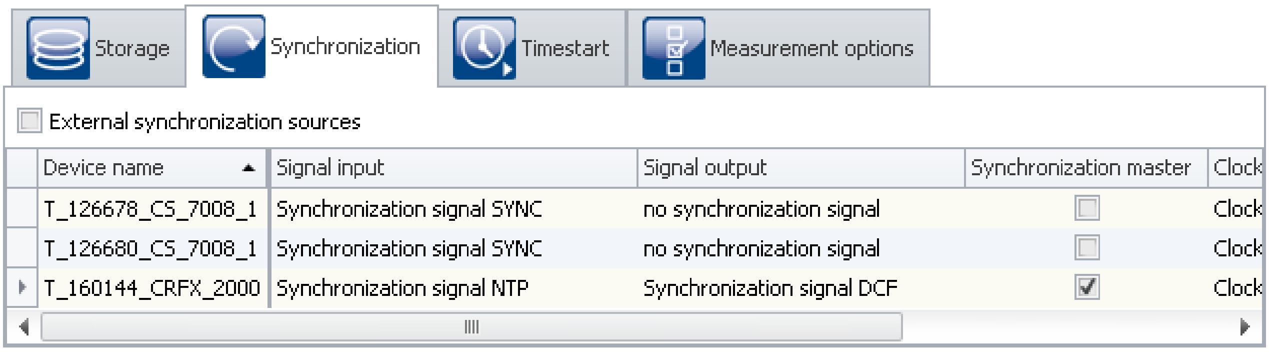
8.2.3.4.4 NTP

Master/Slave setup

The devices are synchronized with each other and synchronized to absolute NTP time.



Master device synchronized by NTP and slave devices

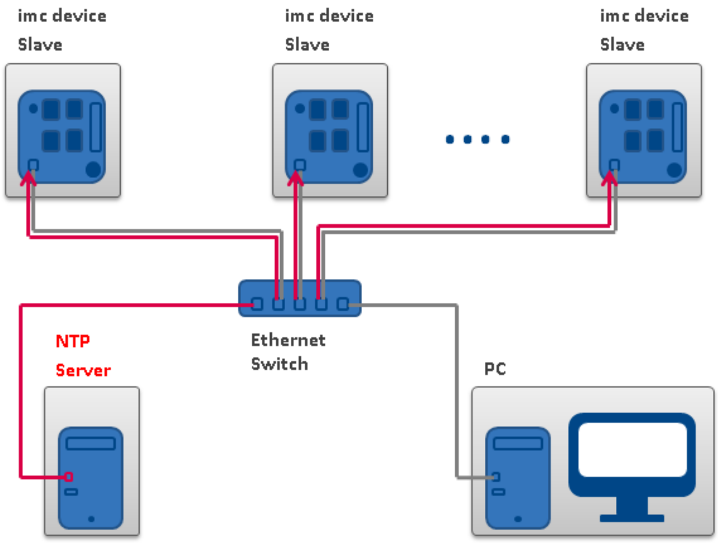


Device name	Signal input	Signal output	Synchronization master	Clock
T_126678_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐	Clock
T_126680_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐	Clock
T_160144_CRFX_2000	Synchronization signal NTP	Synchronization signal DCF	☑	Clock

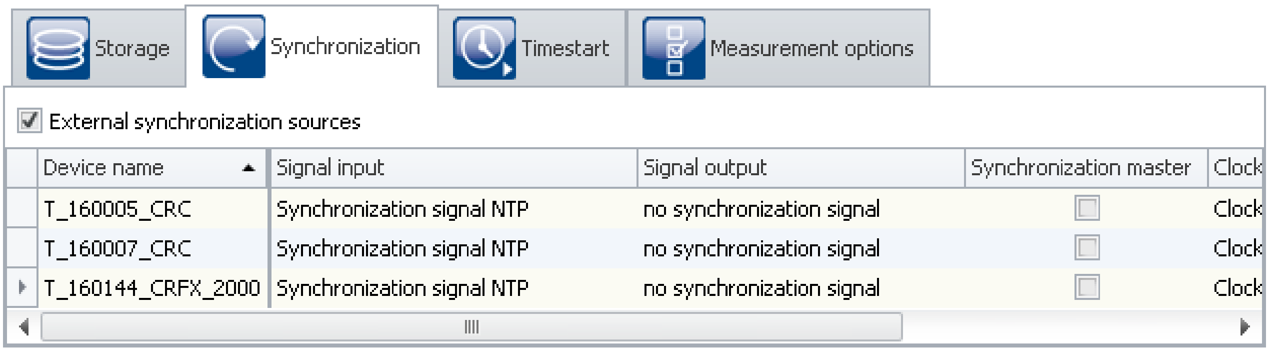
Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

Separate synchronization of all devices

Each device is synchronized to absolute NTP time. All devices are thus mutually synchronized, although to a limited extent (see External clock: NTP 308).



Example of individual synchronization with NTP

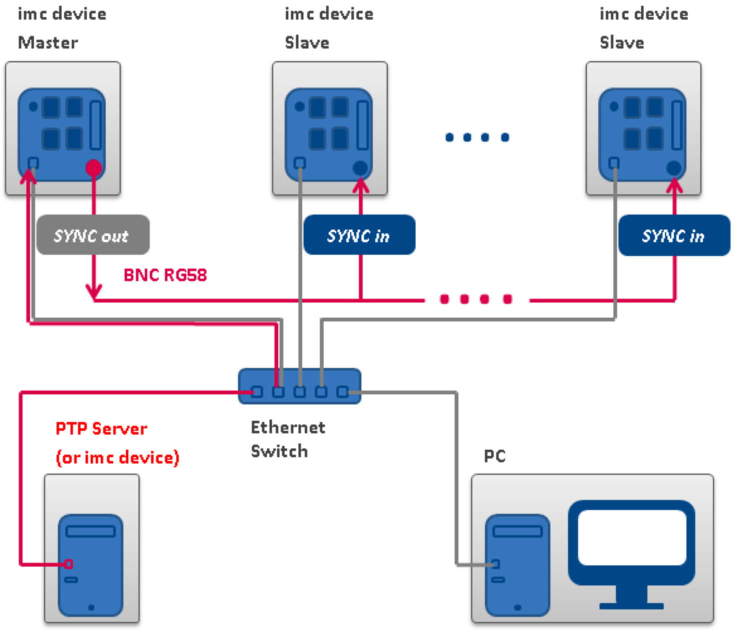


Settings in the plug-in Setup on the page "Devices" in the dialog "Synchronization"

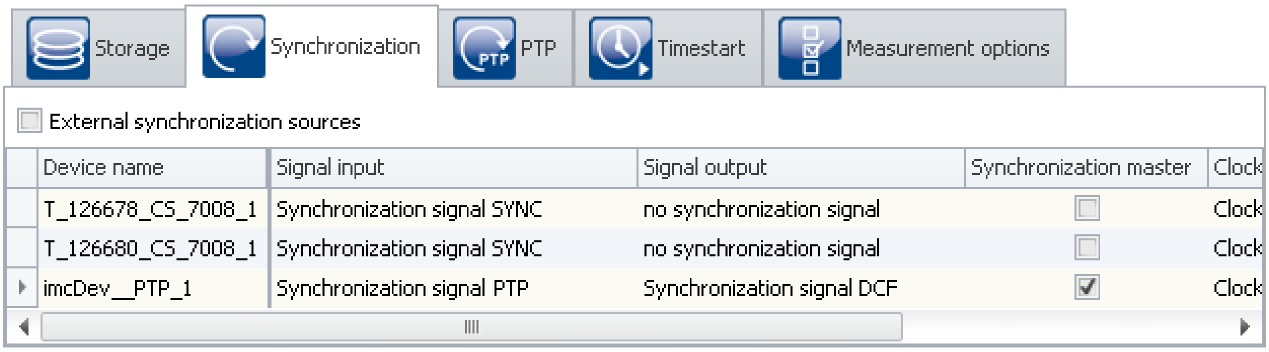
8.2.3.4.5 PTP

Master/Slave setup

The devices are synchronized with each other and synchronized to absolute PTP time.



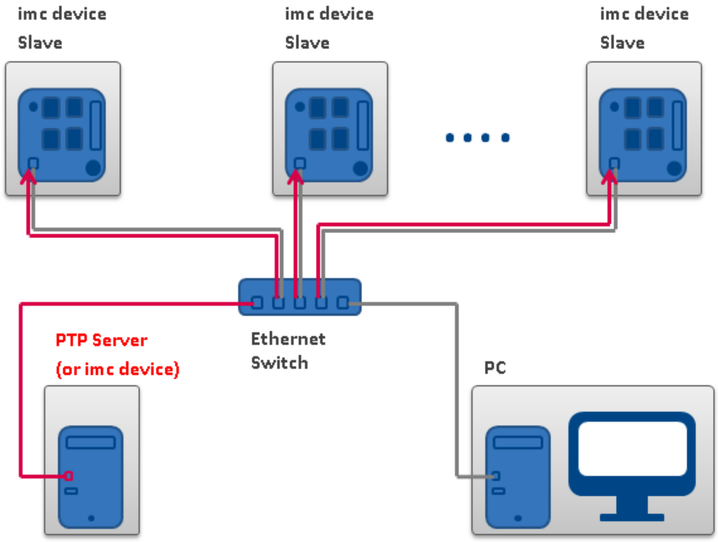
Master device synchronized by PTP and slave devices



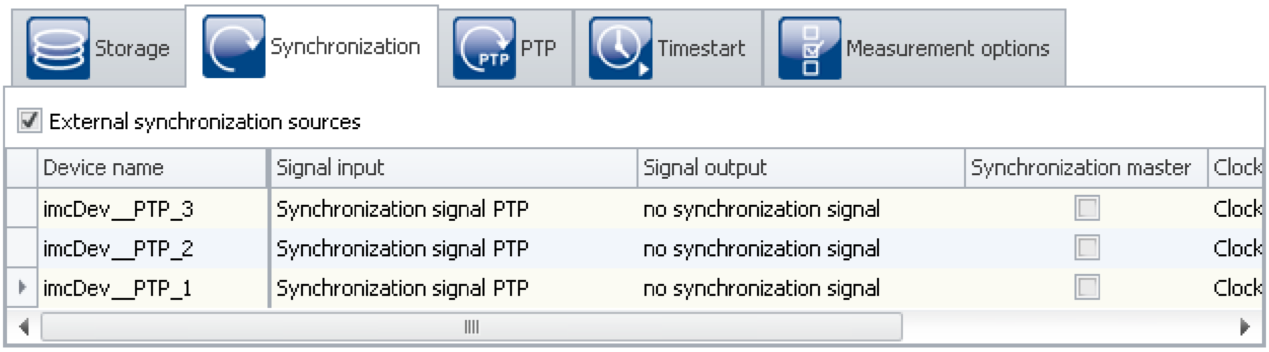
Settings in the Setup on the page "Devices" in the dialog "Synchronization"

Separate synchronization of all devices

Each device is synchronized to absolute PTP time. All devices are thus mutually synchronized, although to a limited extent (see External clock: PTP 309).



Example of individual synchronization with PTP



Device name	Signal input	Signal output	Synchronization master	Clock
imcDev__PTP_3	Synchronization signal PTP	no synchronization signal	☐	Clock
imcDev__PTP_2	Synchronization signal PTP	no synchronization signal	☐	Clock
imcDev__PTP_1	Synchronization signal PTP	no synchronization signal	☐	Clock

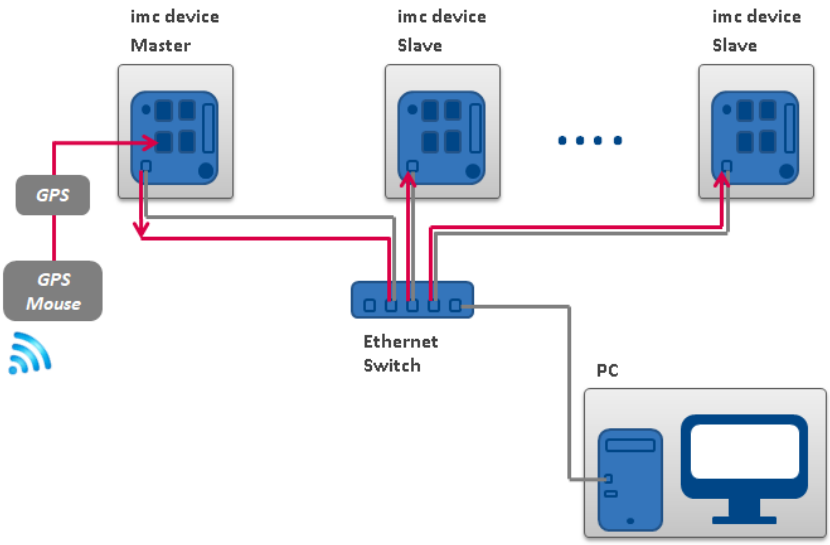
Settings in the Setup on the page "Devices" in the dialog "Synchronization"

8.2.3.4.6 PTP-Master only

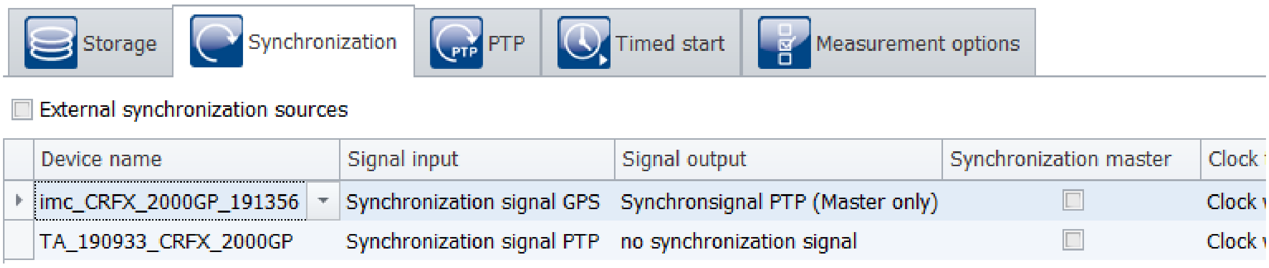
Due to the presets, an imc device only becomes the PTP-Master if no "better" PTP-master is available. See chapter: "*External clocks: PTP* 309".

Any unsynchronized imc device does not have **precise absolute time**. These devices should not become the master in a PTP-network. The PTP-parameters are selected accordingly. Any **imc device is identifies as a "bad" clock**. **Other subscribers which are true to absolute time** should accordingly be identified as a "good" PTP-master.

If the network includes **no PTP-server true to absolute time**, you can **synchronize** one **imc device** to a hardware synchronization signal (e.g. GPS). When you define that **device as the PTP-master**, it will no longer be synchronized by any other PTP-subscriber.



A PTP-master clock synchronizs itself to the GPS-clock. All other PTP-subscribers in the network can be synchronized to this master.



Settings in the Setup on the page "Devices" in the dialog "Synchronization"

Set the **signal input of the Master device** appropriately, e.g. GPS, SYNC, ...

Set the **signal output to "*Synchronization signal PTP (Master-Only)*"**. All other imc devices in the experiment **having "*Synchronization signal PTP*" as the signal input** are **automatically set to "*Slave-only*"**.

The synchronization procedure

The master **initially does not return time information** via PTP. Only after the "Master" **synchronizes to the external signal** does it return time information via the PTP-work.

- If the **only PTP-subscribers are imc devices**, they synchronize themselves with the Master specified.
- If there are **additional PTP-subscribers**, then the imc slave-devices may already be synchronized to the other subscribers. The **devices report that they are synchronized**, although they are **not synchronized with the imc-Master device**.

As soon as the **master device returns the time information**, the other **devices synchronize themselves to it**. How this is done depends on the parameters. The **devices select the subscriber of best quality** (see "*External clock: PTP*" 309"). As soon as any device is defined as the "*PTP (Master-Only)*", it is assigned **a slightly higher quality** than the other imc devices. Thus, other imc devices, which are not involved with the experiment but which are subscribers in the network, can also synchronize themselves to the master.

Note	Network structure and further notes

- Please always be aware of your PTP-network's setup in order to avoid any unintended effects. If another subscriber has higher quality, then the slave-devices may have an "absolute" time which is different than the master-device's.
- A "*Synchronization master*" must not be selected in this variant.
- Please observe the notes in the chapter Precision 343 and Constraints of the Synchronization 344, especially regarding *phase* and *RAM buffer duration*.

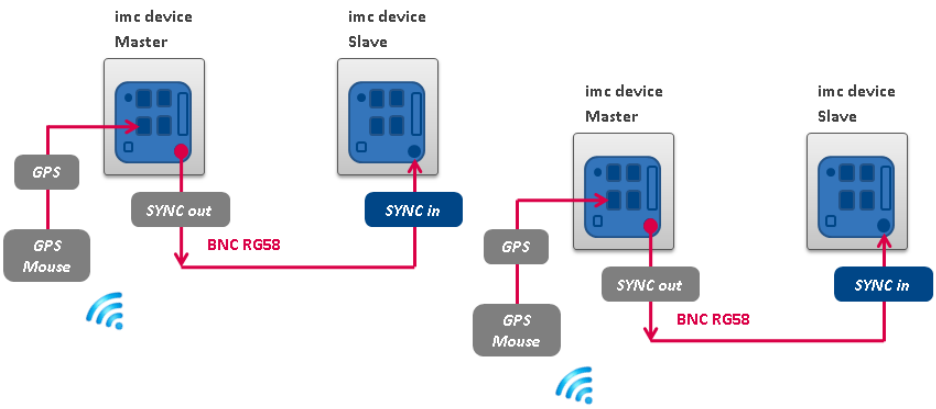
PTP-Master only, and DCF or IRIG-B output

As an additional way to output the time information as the PTP-master, the device can also be defined as the DCF- or IRIG-B-Master.

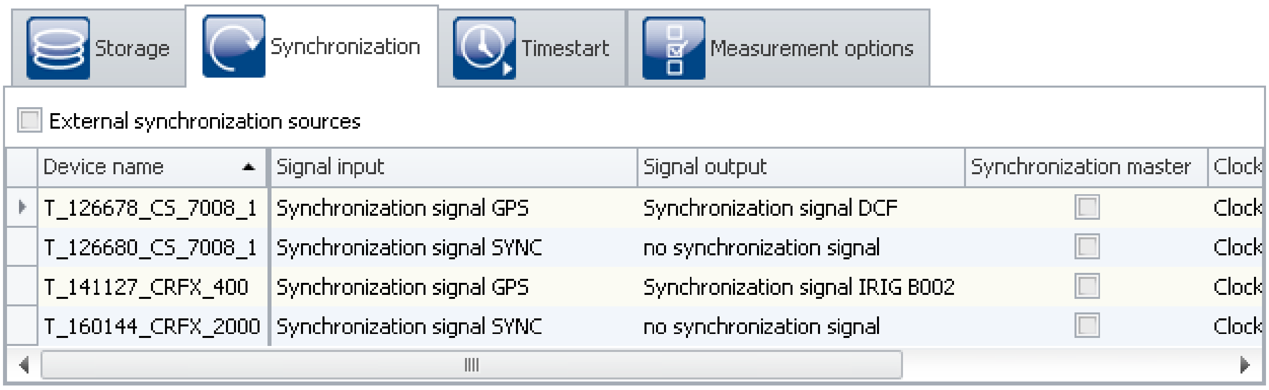
Set the **signal output to "*Synchronization signal PTP (Master-Only) and DCF/IRIG B002*"**.

8.2.3.4.7 Synchronized start with multi-master-devices

If it is not possible to connect multiple devices by a SYNC line, it is possible to divide the devices into multiple Master/Slave groups:



Example for two Master/Slave combinations



Device name	Signal input	Signal output	Synchronization master	Clock
T_126678_CS_7008_1	Synchronization signal GPS	Synchronization signal DCF	☐	Clock
T_126680_CS_7008_1	Synchronization signal SYNC	no synchronization signal	☐	Clock
T_141127_CRFX_400	Synchronization signal GPS	Synchronization signal IRIG B002	☐	Clock
T_160144_CRFX_2000	Synchronization signal SYNC	no synchronization signal	☐	Clock

Settings in the Setup on the page "Devices" in the dialog "Synchronization"

Note

Since in multi-Master/Slave operation there are multiple masters outputting the SYNC signal, the SYNC outputs of the various masters may not be connected with each other.

8.2.3.5 Phase offset correction

For devices of the groups 2-4 165:

With devices of groups 2-4, following an interruption of the synchronization signal only the frequency error is corrected (i.e. the frequency of the SyncRTC and of the signal sampling is synchronized with the time source). Any phase error is not corrected. The offset remains intact until the next initialization.

For devices of the group 5 and higher 165:

If the measurement device had been synchronized to a (time) source and if it receives this same source again after an interruption, the phase offset which emerged in the meantime is corrected. Signals captured by different devices are then synchronized just as well after resumption of reception as before the interruption.

If an implausible phase offset is calculated upon re-synchronization, the system assumes that the time source is different than before. In this case, no phase correction is performed during the running measurement, instead only the frequency error is corrected (i.e. the frequency of the SyncRTC and of the signal sampling is synchronized with the time source). A completely new synchronization procedure is performed when the measurement is re-initialized. The same applies in the case of a transition from DCF to GPS etc. .

8.2.3.6 Working with time zones

The abbreviations pertinent to the topic of time zones are presented in the section Definitions 306.

The time zone information includes the shift from the local standard time STD to UTC, as well as the difference between STD and DST and the respective time offsets.

Only when complete time zone information for two zones is supplied can the times be converted to local time.

One special case is a "double" hour in which the time is set back. Here, it is not enough to know in which time zone the time is stated. It is also necessary to know whether the time is time is stated in STD or DST.

If a planned DST-switch is not performed, the time may be correctly indicated due to explicit specification of the DST-state!

Example

- Time zone for Germany, 05.07. 14:00 STD
- This moment is actually during daylight saving time and should be stated as 15:00 DST
- However, the conversion to UTC in both cases correctly returns 13:00 UTC

What are time zones good for?

A device assumes the UTC time if it is synchronized with a GPS-receiver. In this case, stating a time zone can provide the remedy. The device then uses the time zone set, irrespective of whether the clock was set by GPS or by a PC.

Users of NTP 308/PTP 309 must also specify a time zone because the device would otherwise assume the UTC time.

Note

- If no time zone is used, the devices apply the respective clock's time zone.
  - Use of GPS: device time = UTC
  - PC sets the device time: device time is local PC time.
  - No DST-switching
- All statements regarding the topic of time zones are only effective if a time zone has been set for the device.

The DST switch is activated in the Device properties 196 (Ribbon *Setup-Configuration > Device properties*, section *Device time, Synchronization*): *Time zone* and *Switching from/to daylight saving time*.

The setting "*deactivated*" means that the device uses standard time (STD) all year, summer and winter! Even if the PC resets the device clock during daylight saving time, then, for instance 14:00 (DST in the PC) becomes 13:00 in the device (STD). The advantage of this is that there are no time skips in the data which would be reflected in the measured data!

Note

Even a DCF-or IRIG B002-source would only return STD in that case. Otherwise, the time is interpreted incorrectly - there is an error of one hour!

For the setting ***activated***, the PC's or synchronization source's time is interpreted and adopted according to the time zone expected.

In order for a time source's time to be adopted as the device's local time, the time source's time zone as well as its DST-state must be known.

The time supplied to the device via the RS232-interface in the form of NMEA-strings (GPS, IRIG B12X to GPS converter), is interpreted as UTC time.

With the NTP-protocol, the time zone of the clock source is also UTC. With PTP: Atomic time (TAI) + TAI-UTC-offset or also UTC. For this reason, the time statement is complete in such cases.

The time at the SYNC input terminal (DCF/IRIG B002) is expected to match the device's current time zone. The DST-state for these time signals can not always be determined correctly.

Example

- A device is to use DCF-synchronization and is set to the Central European time zone with DST-switching.
- The DCF-source returns the time 03.01.2010 04:58:13 hours
- The device interprets the time as STD, since according to the time zone setting this time is in STD.
- The DCF-source returns the time 14.07.2010 14:34:00 hours
- The device interprets the time as DST, since according to the time zone settings, this time is in DST.

If the source is not in the correct DST-state, there is a resulting error of one hour. For this reason, the device only adopts the source's DST-state upon the first synchronization procedure after activation or upon preparation of the measurement.

The "forbidden hour" resulting from the clock skipping forward is always converted to the corresponding next hour. A time during the "duplicate hour" prior to the clock skipping backward is always interpreted as DST!

After an interruption of the synchronization signal, upon re-synchronization the system determines whether the deviation between the time reference and the device time is approx. 1h (the difference between STD and DST). In that case, the system assumes that the DST-state of the time reference no longer matches the device's DST-state.

This can be the case when the device does not perform the DST-switch because a measurement is already in process or if the device did perform the DST-switch but not the DCF-source.

A device of groups 5 and higher 165 maintains its DST-state, but correctly adopts the source's time.

A device of groups 2 to 4 165 always adopts the DCF-signal's DST-state upon DCF-synchronization, but upon repeated synchronization it recognizes if the source has not performed the DST-switch. Thus, the time is interpreted correctly as long as the DST-state was correct upon the first synchronization.

Note

With the setting *Switching from/to daylight saving time* activated, the switch between standard and daylight saving time happens automatically at the appropriate time. However, the following limitations apply:

- Once a measurement's start time has been determined (Start button pressed), the device clock can no longer be adjusted. The DST-state, as well, must remain intact. For this reason, the DST-switch is only performed upon the preparation of the next measurement.
- With devices of groups 3 and 4 165, the SyncRTC is adjusted directly by the DCF-synchronization. Thus it is not possible to change the DST-state as long as there is DCF-synchronization. If the DCF-signal is not valid at the time of the switch, or if it fails afterwards, the swich is performed. Upon re-synchronization to DCF, the device again adopts the DCF-signal's DST-state. If the DCF-signal fails again, there is no new switch of the DST-state!
- A measurement always uses the device's current DST-state which applied at when the measurement's start time was determined, and retains it no matter whether the SyncRTC was adjusted. Only upon the next preparation of a measurement is it possible to change the DST-state.
- Diskstart, Autostart, Suspend/Resume (imc BUSDAQ) and automatic timed start always lead to preparation of a measurement and can cause the DST-state to change.

8.2.3.6.1 Possible scenarios

Example 1

- A device of groups 2 to 4 165 is to use DCF-synchronization and is set to a time zone with DST-switching.
- At the time of the switch from STD to DST, DCF-signal is interrupted.
- The device switches to DST.
- A measurement is started. The measurement uses DST.
- The DCF-signal is applied again and the device is re-synchronized.
- If the DCF-signal continues to return STD time, the SyncRTC adopts the time as STD. However, the running measurement retains DST.
- If the DCF-signal returns DST because the DCF-source also has made the DST-switch, the SyncRTC adopts the time as DST.

Example 2

- A device of groups 2 to 4 165 is to use DCF-synchronization and is set to a time zone with DST-switching.
- At the time of switching from STD to DST, a measurement is already running (in STD).
- The connected DCF-source performs the DST-switch.
- The SyncRTC adopts the DST from the DCF-signal. However, the running measurement retains STD.

Example 3

- A device of groups 2 to 4 165 is to use DCF-synchronization and is set to a time zone with DST-switching.
- The connected DCF-source DOES NOT perform DST-switching.
- The device retains its DST-state.

Example 4

- A device of groups 5 and higher 165 is to use DCF-synchronization and is set to a time zone with DST-switching.
- The device switches to DST at the appropriate moment, no matter whether the DCF-source switches or not.
- The DCF-signal is interrupted
- The DCF-signal is applied again and the device re-synchronizes.
- The device adopts the correct time in any case and the SyncRTC continues to run in DST time no matter whether the DCF-source is still running in STD or in DST.

Example 5

- A device of groups 5 and higher 165 is to use DCF-synchronization and is set to a time zone with DST-switching.
- At the time of the switch from STD to DST, a measurement is already running (in STD).
- The connected DCF-source performs the DST-switch.
- The SyncRTC and the running measurement retain STD.

8.2.3.6.2 Summary

If the external source returns incorrect time, for instance because

- a DST-switch was omitted, or
- if the DST-switch happens even though it is not activated for the device, or
- if the time zone does not match that of the device, or if UTC is not supplied,

then the device's time information is faulty!

Once the start time of the first measurement has been determined after the preparation, the SyncRTC may no longer be adjusted. For this reason, after setting the start time there may not be any DST-switch. For instance, a measurement whose start time is expressed in Standard Time is carried out according to Standard Time. As well, any subsequent measurements retain the same DST-state until the next preparation procedure.

For the interface's system time, the DST-switch will still be performed. The times recorded by the file system in the folders and files will have corresponding skips!

For a Diskstart, Autostart, Suspend/Resume (imc BUSDAQ) and automatic timed start, a preparation is performed! In these cases, the DST-state can change again! If the SyncRTC was unable to adopt a synchronization source's time because a measurement was running, then if needed the synchronization is interrupted during preparation and a new synchronization process is initiated! This always happens whenever necessary for exact adoption of the time.

Devices of groups 2 to 4 165:

Synchronization source: **External DCF-source (not the device's own DCF-output)**

- *Expected time zone:* Local time according to the device's settings
- The SyncRTC is set directly by the hardware and cannot be influenced. Following synchronization, the SyncRTC always has the source's exact time.
- The system assumes that the external synchronization source returns the correct local time at all times! Upon first synchronization, the DCF-source's DST-state must be correct, otherwise there is an error of one hour!!!
- As long as the first measurement's start time has not yet been determined, the system monitors whether the next DST-boundary has been passed. As long as the DCF-signal is received there is no automatic DST-switch of the SyncRTC. If the DCF-signal fails, the DST-switch is performed. Upon re-synchronization following a DCF-signal outage, the system tries to determine whether the DCF-source also experienced the DST-switch. The DST-state of the DCF-time is adopted correctly.

Synchronization source: **Device's own DCF-output (DCF-Master and DCF-Slave)**

- *Expected time zone:* Local time according to the device's settings
- As long as the first measurement's start time has not yet been determined, the system monitors whether the next DST-boundary has been passed. Then the DCF-output is deactivated (so that it is possible to write to the SyncRTC), then the SyncRTC adjusted by the DST-difference and the DCF-output re-activated. If other devices synchronize to the outputted DCF-signal, they are assigned the new time.

Synchronization source: **GPS / IRIG-B 12X converter**

- *Expected time zone:* UTC
- The system assumes that the source returns UTC time. The time is converted to the device's time zone. Before determining the first start time, a DST-switch is performed. For this purpose, the DCF-output is temporarily deactivated, if needed. If other devices are to be synchronized to the outputted DCF-signal, they are assigned the new time.

Devices of groups 5 and higher 165:

***Synchronization source:* External DCF-source (not the device's own DCF-output) / IRIG-B 002**

- *Expected time zone:* Local time according to the device's settings
- The system assumes that the external synchronization source returns the correct local time at all times! Upon first synchronization, the SYNC-source's DST-state must be correct, otherwise there is an error of one hour!!!
- Prior to determining the first start time, a DST-switch is taken into account, independent of the SYNC-signal applied.
- Upon re-synchronization following an outage of the SYNC-signal, the system attempts to determine whether the source has performed the DST-transition. The time is adopted correctly. The device retains its DST-state.

***Synchronization source:* Device's own DCF-output (DCF-Master and DCF-Slave)**

- *Expected time zone:* Local time according to the device's settings
- Prior to determining the first start time, a DST-switch is taken into account. For this purpose, the DCF-output is temporarily deactivated. If other devices synchronize to the outputted DCF-signal, they are assigned the new time.

***Synchronization source:* GPS / IRIG-B 12X converter / NTP / PTP (with UTC time base)**

- *Expected time zone:* UTC
- The system assumes that the source returns UTC time. The time is converted to the device's time zone. Before determining the first start time, a DST-switch is performed. For this purpose, the SYNC-output is temporarily deactivated, if needed. If other devices are to be synchronized to the outputted SYNC-signal, they are assigned the new time.

***Synchronization source:* PTP (with atomic clock time base)**

- *Expected time zone:* Atomic time (Temps Atomique International TAI)
- The source is assumed to provide Atomic Time, as well as the offset between Atomic Time and UTC of which it is aware. From this info, UTC can be calculated, making conversion to the device's time zone possible.
- If the device itself becomes the PTP-Master, it uses either the TAI-UTC-offset passed to it by the PC, or the offset which had last been communicated to it by another Master.

8.2.3.7 Application notes

8.2.3.7.1 Display of data in the curve window

If synchronized data are to be displayed correctly in a curve window, the following setting must be made for the X-axis in the curve window: *Date/time absolute*. Otherwise the trigger times of the different signals are aligned. When different triggers are used, which is always the case when multiple devices are involved, the reference to absolute time is lost.

8.2.3.7.2 What happens when?

If possible, use the ability to run multiple devices jointly in an experiment and to connect them via the SYNC connection. Set one device as the Master which synchronized all other devices' clocks. The Master can also be synchronized externally, but this is only necessary for the absolute time. If the only issue is the mutual synchronization of the various devices' data, the Master's internal clock is perfectly adequate as the time base.

The following examples thus only pertain to external synchronization without connection of a SYNC-line between devices.

Adequate reception by the DCF77/IRIG-B or GPS receiver is not always available. How does the device behave then?

- It does not matter whether DCF77/IRIG-B or GPS is used for the time base.
- Temporary loss of synchronization can cause the device clocks to drift off by up to 1 ppm. If loss of synchronization continues, the precision may drop as low as 50 ppm in consequence of strong temperature change. Once the synchronization signal is again recognized as valid, the device clocks are synchronized again. As soon as the synchronization signal is recognized as valid, the system's behavior depends on the device type 165:
  - With devices belonging to Groups 2-4, only the frequency error 330 is corrected.
  - Devices of groups 5 and higher attempt to compensate for the phase error 330.
- Deviation directly after loss of synchronization (1 ppm):

  $t_{delta} = t_{unsync} * 1 * 10^{-6}$; with t_{delta} = deviation in seconds

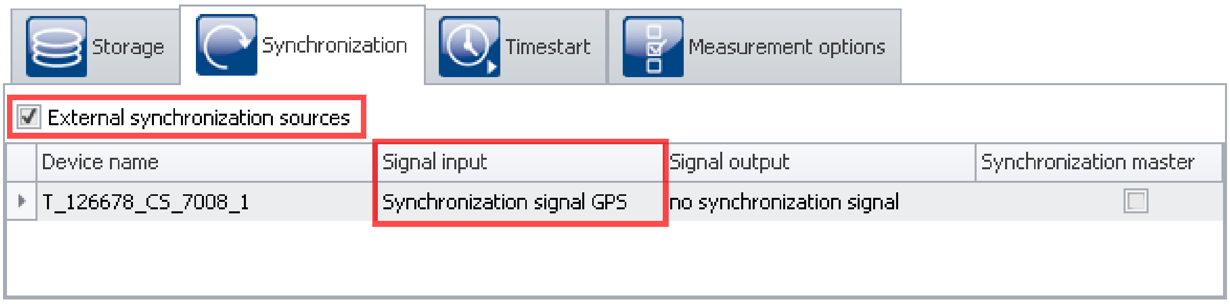
  t_{unsync} = Time without synchronization in seconds

  $1 * 10^{-6}$ = precision of the device time
- Deviation following long-term loss of synchronization (max. 50 ppm):

  $t_{delta} = t_{unsync} * 50 * 10^{-6}$

8.2.3.7.2.1 Measurement with one device

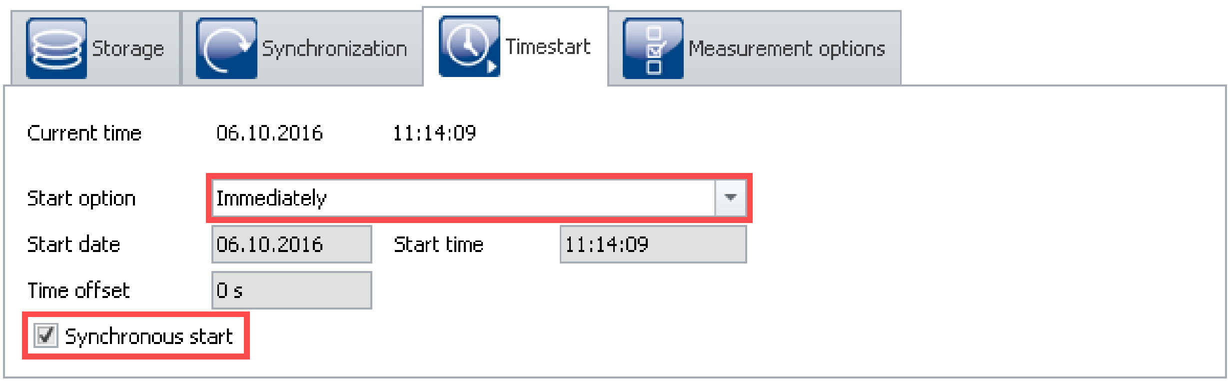
External synchronization via DCF77, IRIG-B, GPS receiver, NTP or PTP.



Settings in the Setup on the page "Devices" in the dialog "Synchronization"

Timed start option: "Immediately"

Synchronous start: activated



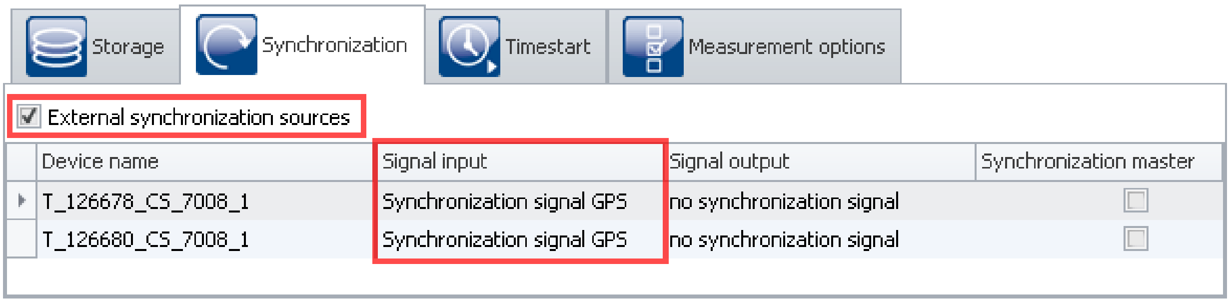
Settings in the Setup on the page "Devices" in the dialog "Timed start"

Scenario	Response	Data storage folder name
Synchronization signal always present.	Device starts and adopts time of the external clock (DCF77, IRIG-B, GPS, NTP or PTP) 306	Time stamp of the devices
Synchronization is always present. The device starts with self-activation upon activation.	Device waits until synchronization and then starts with time of the external clock.	Time stamp of the devices
Synchronization initially present. After measurement start, the clock signal is lost.	Device starts and adopts the time of the external clock. After loss of synchronization, the internal device clock takes over and drifts away*.	Time stamp of the devices
Synchronization is only present after the measurement has been prepared.	Measurement can only start once the device is synchronized.	Time stamp of the device
	Otherwise the start will not be carried out. Instead, an error message appears to notify of lacking synchronization.	or no measurement is set up
Autostart: Synchronization not present upon activation	Device waits for valid synchronization signal. Measurement starts upon synchronization see the manual: Plug-in: Setup - Diskstart 179.	Time stamp of the devices
Synchronization initially present. After measurement start the clock signal is temporarily lost (e.g. 30s) and is later permanently stable.	Device starts and adopts the time of the external clock. After loss of synchronization, the internal device clock takes over and drifts away*. As soon as the synchronization signal is recognized as valid again, the subsequent system behavior depends on the device type 165: With devices belonging to Groups 2-4, only the frequency error 330 is corrected. Devices of groups 5 and higher attempt to compensate for the phase error 330.	Time stamp of the devices

* Temporary loss of synchronization can cause the device clocks to drift off by up to 1 ppm. If loss of synchronization continues, the precision may drop as low as 50 ppm in consequence of strong temperature change.

8.2.3.7.2.2 Measurement with multiple devices

Devices are **externally** synchronized **separately**. There is **no** connection via the SYNC terminals.

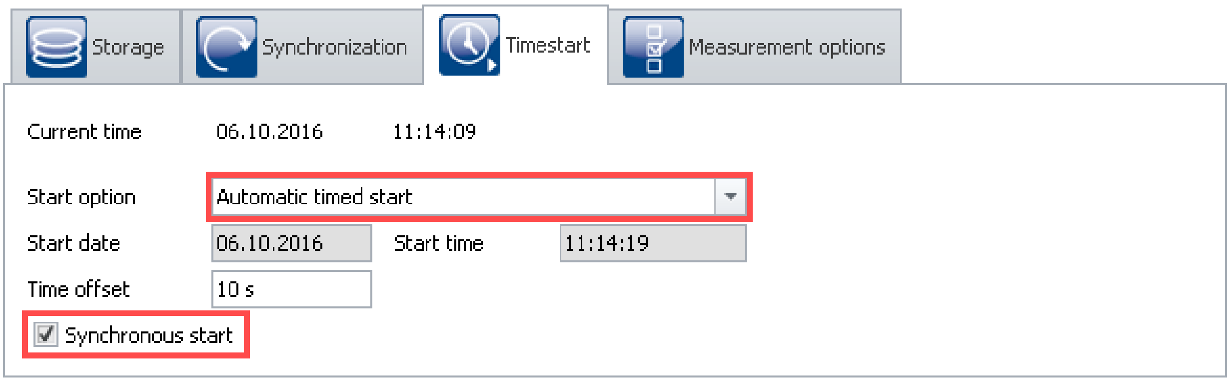


Settings in the Setup on the page "Devices" in the dialog "Timed start"

Synchronous start: activated

1) Timed start option: "Immediately": each unit behaves the same as for "Measurement with one device 336" mutually independently.

2) Timed start option: "Immediately" is not selected



Settings in the Setup on the page "Devices" in the dialog "Timed start"

Scenario	Behavior	Data storage folder names
Synchronization signal always present. Device is synchronized	Devices start and adopt the time of the external clock (DCF77, IRIG-B, GPS, NTP or PTP) 306	Time stamp of the devices
Synchronization always present. Devices start with self-activation upon activation.	Devices each wait independently and then start with time of the external clock.	Time stamp of the devices
Synchronization initially present. After measurement started, the clock signal is lost.	Device starts and adopts the time of the external clock. After loss of synchronization, the internal device clock takes over and drifts away*.	Time stamp of the devices
Synchronization is only present after the measurement has been prepared.	Start does not take place. Instead, an error message appears announcing missing synchronization.	No measurement set up
Autostart: Synchronization signal not present upon activation	Devices wait for a valid synchronization signal. Following synchronization, the devices each start independently. This means they don't start simultaneously, but each as soon as possible (corresponding to the Timed start option: "Immediately").	Time stamp of the devices
Synchronization initially present. After measurement start the clock signal is temporarily lost (e.g. 30s) and is later permanently stable.	Device starts and adopts the time of the external clock. After loss of synchronization, the internal device clock takes over and drifts away*. As soon as the synchronization signal is recognized as valid again, the system behavior depends on the device type 165: With devices belonging to Groups 2-4, only the frequency error 330 is corrected. Devices of groups 5 and higher attempt to compensate for the phase error 330.	Time stamp of the devices

* Temporary loss of synchronization can cause the device clocks to drift off by up to 1 ppm. If loss of synchronization continues, the precision may drop as low as 50 ppm in consequence of strong temperature change.

8.2.3.7.3 Synchronization control

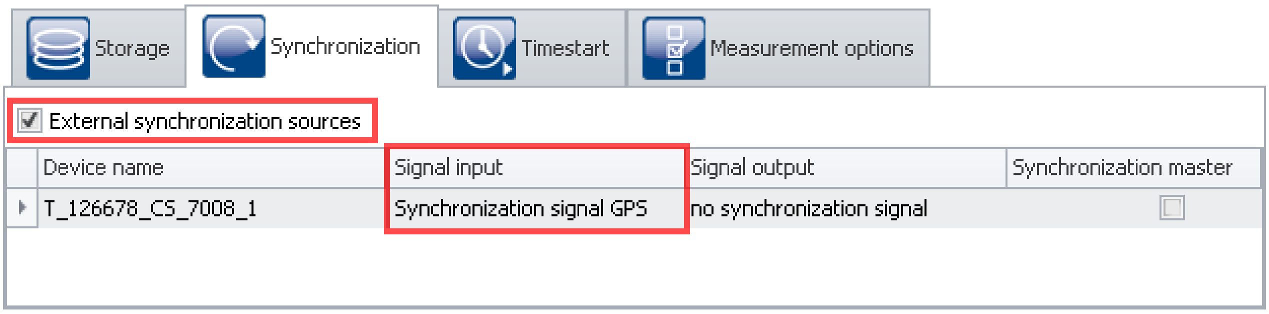
Normally, it's not necessary to stop recording of short measurements if the synchronization is lost. Use the formula presented in the section "What happens when?" 335 to calculate whether the resulting deviation is acceptable for your measurement.

The following functions and constraints must be taken into account for automated synchronization control:

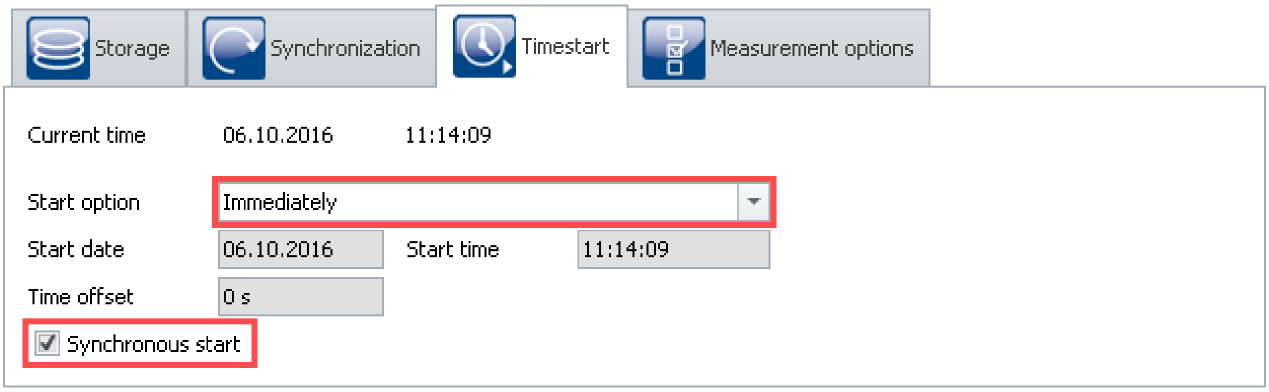
- If a device starts with a synchronized self-activated experiment, the measurement only starts once the synchronization has been established.
- **For devices of the groups 2-4 165:** After synchronization has been temporarily lost, the measurement must be re-prepared so that the external pulse clock can be received again.
- The synchronization status is requested using the imc Online FAMOS function `isSynchronized`.

8.2.3.7.3.1 Measurement controlled by PC

1. Synchronization settings



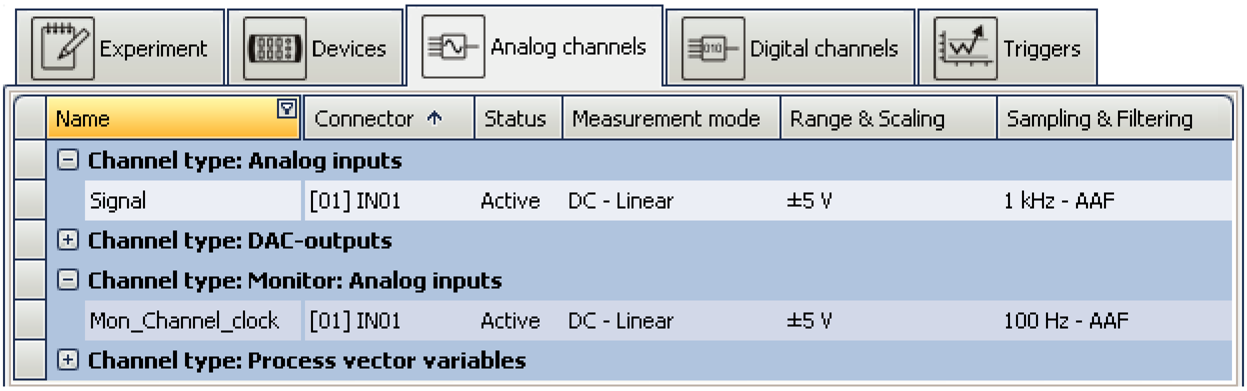
Settings in the Setup on the page "Devices" in the dialog "Synchronization"



Settings in the Setup on the page "Devices" in the dialog "Timed start"

2. Configuration

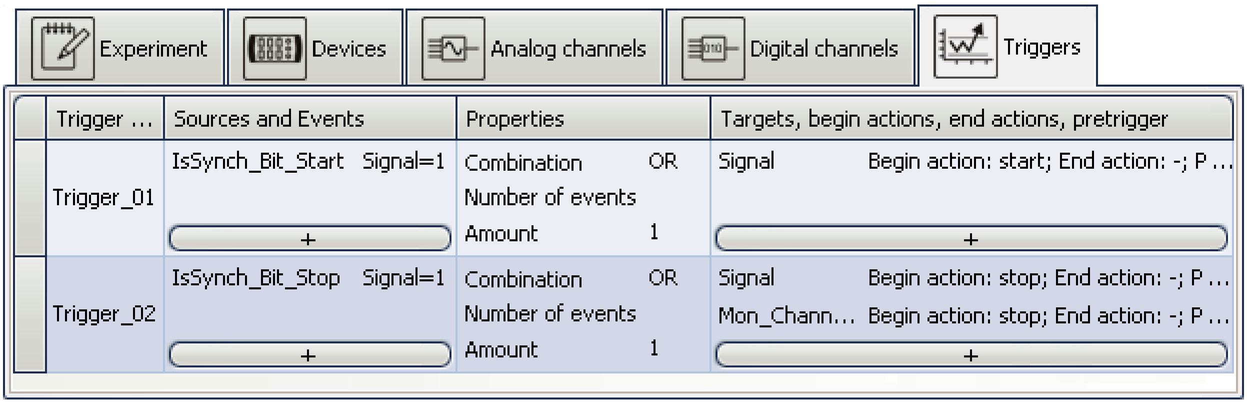
Activate along with the measurement signal to be captured a monitor channel with a sampling interval of *10ms* as the clock rate. Rename two virtual bits: *IsSync_Bit_Start* and *IsSync_Bit_Stop*.



Settings in the plug-in Setup on the page "Analog channels"

3. Trigger machine

The two virtual bits display an event at *Signal=1*. The signal to be measured is started by Bit *IsSync_Bit_Start*. The clock pulse channel is started immediately when the measurement begins. Both channels are closed once the virtual bit *IsSync_Bit_Stop* is set.



Trigger machine
Settings in the plug-in Setup on the page "Triggers"

4. imc Online FAMOS

imc Online FAMOS initially evaluates the synchronization signal. The state is displayed by *LED_01* and activates a digital output channel.

A binary channel is generated which is *1* whenever the synchronization signal is not valid. When the channel is integrated into the system, the last value indicates the sum of the unsynchronized times. When a specified time is exceeded, the stop bit is set.

```
; Create control channel for synchronization with 1Hz sampling rate
; Monitor channel:10ms sampling time
IsSync_Bit_Start= IsSyncronized( mean(Mon_Channel_clock, 100, 100) )

LED_01=IsSync_Bit_Start          ; Indicator with LED

; Create binary channel with 1Hz if not synchronized
_notSynchron= mean(Mon_Channel_clock, 100, 100)*0+1 - IsSync_Bit_Start

BEEP_01= _notSynchron    ; beeper if not synchronized
time_notSynchron= Integral(_notSynchron) ; summarize seconds

; Stop measurement, if syncsignal is not valid for more than 50s
IsSync_Bit_Stop= greater(time_notSynchron, 50)
DOut01_Bit01 = IsSync_Bit_Stop   ; Output to digital channel
```

8.2.3.7.3.2 Measurement controlled automatically (unmanned)

If the measurement is taking place on a system to which you have no access, a mechanism must be employed to re-start the device.

1. Preparation

- Set up the experiment as in the example Measurement controlled by PC 340.
- Save this experiment in the device as an autostart experiment.

2. Activating / deactivating the device via the REMOTE terminal or PowerFail.

Devices having a Remote terminal can be activated / deactivated by means of it. This is the case with all imc CRONOS-PL/SL, imc BUSDAQ, and imc SPARTAN devices and some imc C-SERIES devices. Devices without a Remote terminal are activated / deactivated simply by switching the power supply on / off. In both cases, the running measurement is closed properly before the device goes off.

Example: imc CRONOS-PL

- Activate: Connecting SWITCH and ON switches the device on
- Deactivation: Connecting SWITCH and OFF causes deactivation after 10s´

Example: imc CS-7008

- Put the main switch Position I
- Activate: Switch on the supply voltage
- Deactivate: Switch off the supply voltage; off after 10s

Temporarily switching off the supply ends the measurement if the duration exceeds Acquisition time (T1) after power fail 194. Upon resumption of the power supply, the device is activated, since the main switch is still in the ON-position. The autostart experiment is then automatically loaded and started once synchronization has been established.

3. Control by means of evaluating the digital output

In imc Online FAMOS, a digital output channel has already been prepared.

```
DOut01_Bit01 = IsSync_Bit_Stop   ; Output to digital channel
```

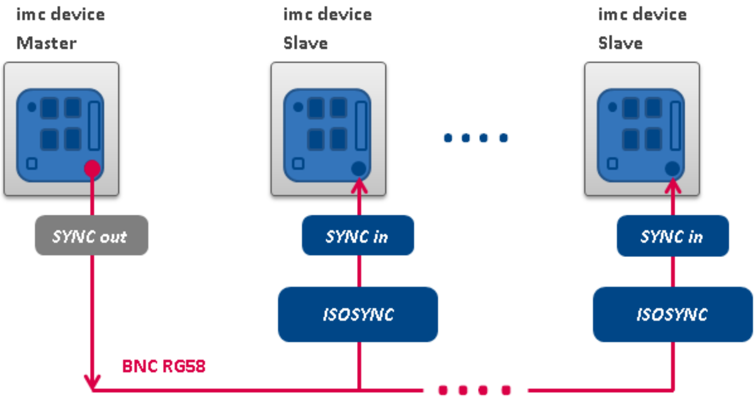
This output must be used by an external control mechanism in order to connect to the Remote terminal or to temporarily switch off the supply voltage.

8.2.3.7.4 ISOSYNC isolated Synchronization

When using multiple devices connected via the Sync terminal for synchronization purposes, ensure that all devices are the same voltage level. Any potential differences among devices may have to be evened out using an additional line having adequate cross section. If the SYNC terminal appears with yellow ring below it, it means the terminal is already isolated and shielded from voltage differentials (applicable to devices delivered as of Summer, 2012).

Alternatively it is possible to isolate the devices by using the module ***ISOSYNC:***

- For the purpose of isolating the synchronization signal, an ISOSYNC module is connected to the pertaining imc devices-SYNC-slaves. The ISOSYNC module has to be connected with SYNC terminal directly (a cable extension is not allowed)!
- The master device has **no** ISOSYNC module. That way it is determined what device is the master. The software must be configured according the hardware set-up. For a master device with internal isolation (yellow ring), the isolation is switched off automatically.
- The **DCF mode** must be set as signal output.



8.2.3.7.5 imc CRONOS (PC) with other devices

Synchronizing a stand-alone imc CRONOS unit (with built-in PC) with other imc devices is not possible!

8.2.3.7.6 Precision

- The maximum time difference between data from different devices is 1 sampling interval, max 3ms (as long as nothing else is set, such as for instance with NTP).
- In a synchronized start, the devices are started simultaneously. However, the moment when the first sample value arrives can differ. This is due to the system architecture and depends on various factors (e.g. averaging, sampling rate etc.). However, this doesn't affect the data's time stamp. This effect is visible in the curve window when data from different devices are displayed stacked on top of each other. In absolute time display, the samples are displayed in their correct time coordinates, but the signals of the different channels don't all begin at the same time.

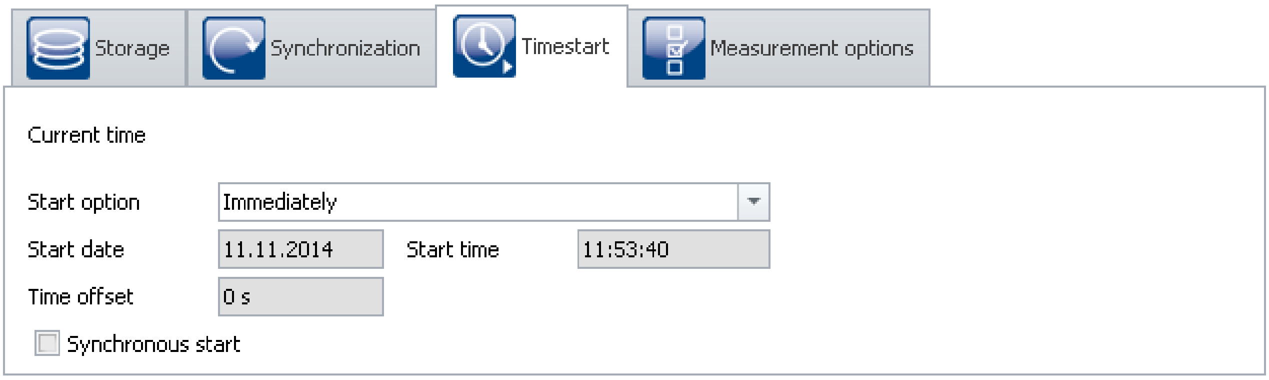
8.2.3.7.7 Constraints of the Synchronization

1. **Number of devices:** Max. 20 devices via the SYNC-terminal
2. **Cable lengths:** The maximum length of a synch line (SYNC) is 200m.
3. **Voltage level differences:** Ensure that all devices are at the same voltage level. Any potential differences among devices may have to be evened out using an additional line having adequate cross section. Alternatively, the devices can be synchronized with the module ***ISOSYNC*** while remaining electrically isolated. If the SYNC terminal appears with yellow ring below it, it means the terminal is already isolated and shielded from voltage differentials (applicable to devices delivered as of Summer, 2012).
4. **Start delay:** The time needed to arm the system is a multiple of the slowest sampling rate in the system. The minimum delay is approx. 3s. If channels are being used with very slow sampling rates, this means that the arming procedure will take a proportionally longer time. This applies not only to the first "start" of a measurement, but to each time the measurement is started or triggered. In particular, be careful to account for the start delay when choosing a starting time for an autostart measurement.
5. **Phase:** Please note that the phase of a signal depends on the filter settings. To compare two channels in time, they have to be set by the same filter settings. See also filter settings and synchronization in the hardware manual.
   Furthermore a long RAM-buffer time and different triggers could result in a time shift. Read also the notes in section RAM buffer duration and synchrony 720.

8.2.4 Timed start

In normal cases, the measurement starts when the Start button is pressed. If necessary, the device is prepared beforehand, which delays the measurement's beginning.

In this dialog, you can also **set other "start options"**.



"Start options" are available both for the normal start (in response to the Start button), as well as for the Diskstart 179 (the limitations and conditions are delineated).

Parameter	Description
Start option 345	Select the point in time when a measurement is to be started once the Start-button has been pressed.
Start date / Start time	Calculated possible starting time. Depends on the start option selected.
Time offset 345	Time by which to delay the start in order to ensure that all devices can start simultaneously. Only possible with "*Automatic timed start*". (Not available for the Diskstart!)
Synchronous start	This option ensures that the start only happens once the devices have been synchronized 301. It does not ensure that the devices start simultaneously 346.

8.2.4.1 Start option

Immediately

The measurement starts as soon as possible after the Start button is pushed. Upon the first start after the preparation process, data acquisition starts exactly at the start of the next full second.

The maximum start delay at the start is 1s. The time needed for downloading 171 is not considered here. If it is necessary, this time must be added to the total. This can be preempted by clicking on the Prepare button.

Note

The start option "*immediately*" is not possible with a **synchronous start** 346 **(simultaneous start of all devices)**.
With synchronization activated, simultaneous starting of the devices is **possible with "*Automatic timed start*"**, for example. With the option "*immediately*", the devices measure synchronously, and are started quickly, but serially.

At defined time

Not available for the Diskstart!

The measurement starts at the time set. "*At defined time*" is a setting only **appropriate to a one-time start**. For each additional start, the clock time must be re-adjusted.

Note

- Each start with the setting "*at defined time*" requires a preparation procedure for the device.
- If you start a measurement **at defined time**, for instance at 5:00 P.M., or at the next turn of the hour, there may be a delay before reading the first measurement value. This delay, caused by special exigencies of the system, depends on the sampling interval selected, and can be up to several seconds in the worst case.

Automatic timed start

Not available for the Diskstart!

An automatic timed start **ensures that all devices** participating in an experiment **start synchronously**. Here, the absolute time of the measurement's start isn't important.

To ensure that all devices are ready, a **time offset** is added to the current time. Devices connected to an RS232 interface or to a modem can have offsets of more than 30s, otherwise, at least 4 s.

Note imc Online FAMOS - OnInitAll

Every time measurement is started with "*Automatic timed start*", the control command `OnInitAll` is run in imc Online FAMOS. Even if the device itself did not need to be prepared.

8.2.4.2 Synchronous start

The option "Synchronous Start" ensures that the start only happens once the devices have been synchronized. It does not ensure that the devices start simultaneously.

Simultaneous start of all devices is possible. For this purpose, certain conditions must be met.

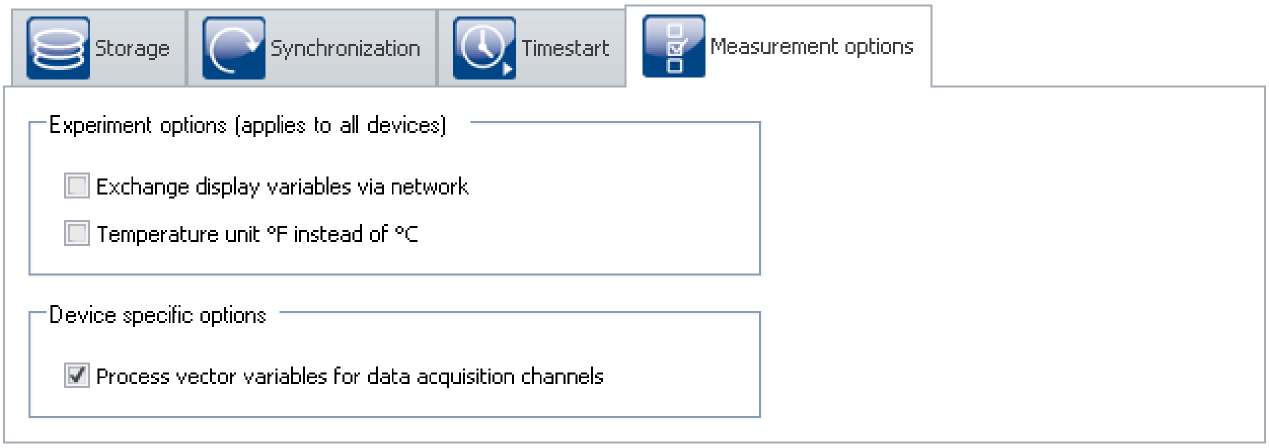
- The option: "**Synchronous start**" must be activated.
- Appropriate "**Start options** 345" must be selected. E.g. "Automatic timed start".
- For all devices, a **clock signal for the signal input** 301 must be selected.

Starting is possible even without this conditions being met, but in that case, all the devices will start serially. Channels of synchronized devices then have the correct absolute time, but the triggering time is a bit different for each device. With a curve window having the X-axis denoted in seconds, the time 0s begins with the release of the trigger. Only in the display mode with the X-axis expressed in absolute time are the channels belonging to different devices all displayed in the correct times.

Reference

Regarding synchronization, observe the notes in the manual:
"*Setup pages - Configuring Device*" > "*Configuring Devices*" > "*Synchronization* 301" > "*What happens when?* 335"

8.2.5 Measurement options



Exchange display variables via network

It is possible to exchange the display variable values via the network whenever they change. By this means, data from channels of different devices can be subjected jointly to calculation operations.

Note

- The system checks every 10 ms for changes to the display variables. For this reason, rapid changes (on channels with high sampling rates) are not taken into account.
- Checking and sending of the display variables burdens the measurement device's and the Ethernet's resources. Therefore, only only activate this function if you want to do operations on two devices' data jointly.

Temperature unit °F instead of °C

With this option, you set the default unit for all temperature channels.

Note

Make sure that temperature measurements performed via Field busses are set separately. All temperature channels are stated in the unit set here. If, for instance, temperatures in °C are captured via CAN-Bus, but °F is set here, the °C-temperatures from the CAN channels are stated in the unit °F without conversion.

Process vector variables for data acquisition channels

For data acquisition channels, process vector variables 351 are created. This option is activated by default.

Note

Even when the process vector variables are not used, they demand a portion of the device's available power. For this reason, less than the entire aggregate sampling rate of your device is actually usable.

For each device, you can deactivated process vector variables for the data acquisition channels. Remove the checkmark from the selected 213 device. This makes the entire aggregate sampling rate available. Additional process vector variables (e.g. GPS data) are not affected.

8.2.6 Video

This dialog is only shown when video devices are connected.

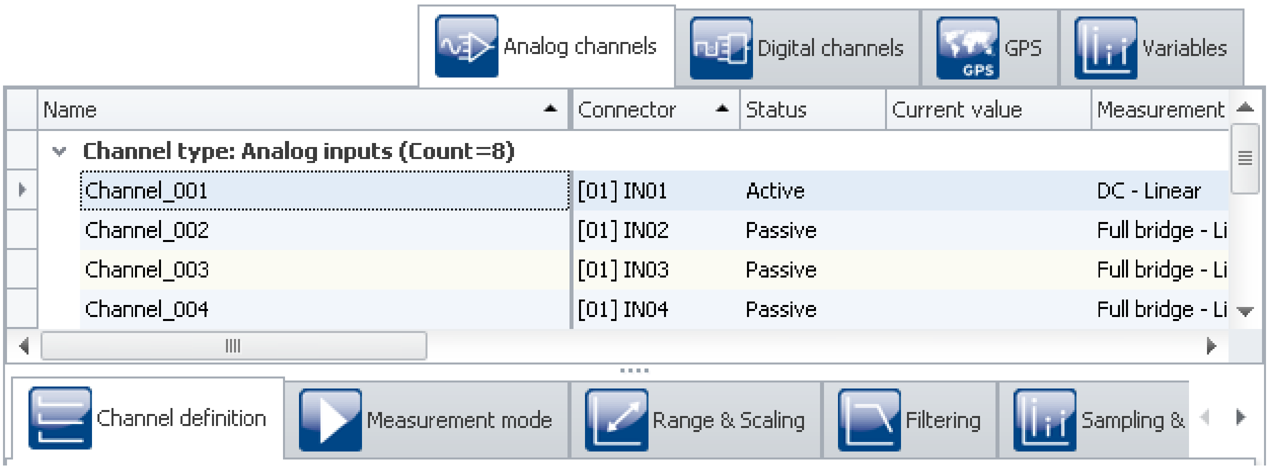
In this dialog, you can adjust the video settings. What settings are available depends on the device.

Reference

For a detailed description, see the manual: Video 1711.

8.3 Configuring Channels and Variables

On the pages **Analog channels**, **Digital channels**, **Variables** and **GPS** you can set all channel-specific parameters.



The four pages are subdivided into two areas: the *Channel table* and the *dialogs*.

In the channel table, all channels are displayed which are present in the selected measurement devices 222. It offers quick access to many settings. In the lower region, you can select various dialogs. These offer clearly-presented access to the properties.

The availability and selection of the dialogs and of the settings depends on the channel type, i.e. on the amplifier hardware installed in the device. Also depending on the channel type, there are different applicable settings options for the parameters.

The following dialogs may be present:

Page	Description
Channel definition 362	**Name** and **Status** of the channel.
Measurement mode 367	Fundamental configuration settings such as **measurement mode**, **measurement range**, **coupling**, **power supply**, ...
Range & Scaling 369	Configuration settings such as **measurement range**, **unit**, **scaling**: Factor/Offset-scaling and 2-point scaling, e.g. for entries from the spec sheet.

Page	Description
Strain gauges 371	Configuration of the **strain gauge parameters**. Only for devices having strain gauge channels.
Encoder 373	Configuration of the **incremental counter (encoder)**. Only for devices having an incremental encoder.
Video 376	Configuration of the **Video-channels**. Only for video devices.
Filtering 376	Configuration of the **input filters**: AAF, low-pass, high-pass, bandpass.
Sampling & Preprocessing 377	Configuration of the **sampling** and the **measurement duration**, of the **data type** and the **pre-processing**, such as mean value, RMS-value, or maximum/minimum.
Data transfer 381	Configuration of the channel-specific **data saving** on the PC or the device. **Circular buffer data storage** and **event count in the curve window** and the data storage.
Histogram / Rainflow 383	**Refresh rate** and **data saving rate** for histograms and other matrices.
Curve properties 383	Pre-defined settings for how the channel is to be displayed. Defined **channel-color** for the curve window. Specified **range for the display elements** (Widgets).

Note — Additional parameters

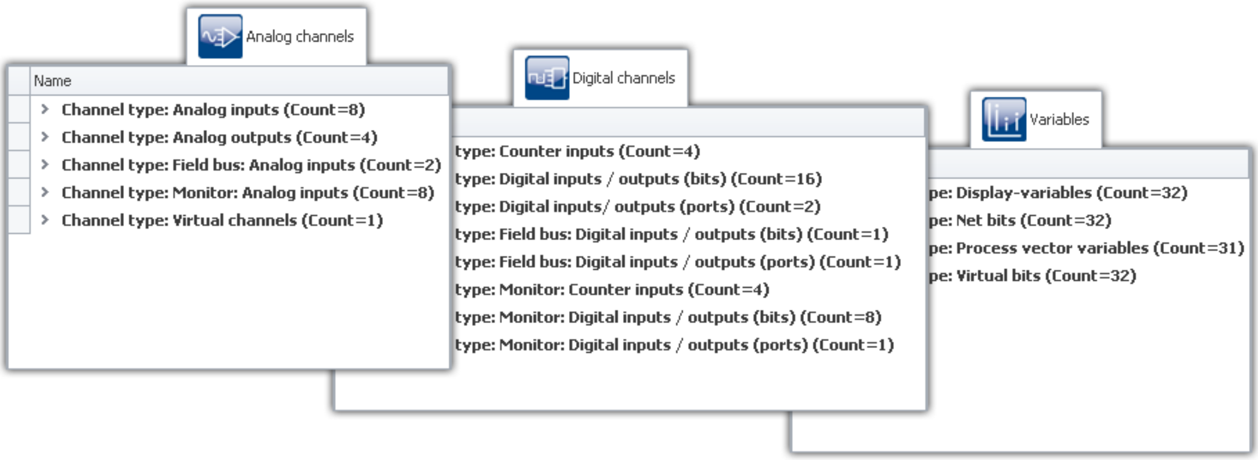
Not all parameters can be found in the dialogs. For special applications, additional settings are also required. In the chapter "*Additional Parameters* 385", you will find description s of the most important additional parameters.

Reference — See also additional info on:

- Operation and configuration of the tabular display 212 and the dialogs 219
- Showing and moving columns 254
- Creating and configuring additional columns 258

8.3.1 Channel table

In this area, the ***channels*** belonging to the selected devices are displayed in a structured table, as shown below:



Channel table

In the channel table, all the channels of all devices appear in the list, along with their configurations. The list is arranged in groups, each of which is represented by a branch (or: node) in the list. The group branches can be expanded or collapsed, thus determining whether or not the entries for the channels in the branch are displayed.

To select channels, first open a branch (›). Then select one or more channels. Subsequently, you can either edit table cells 215 directly, or open the dialog 219 for the desired parameter.

All the settings controls in the dialogs take effect on the channels which are selected in the table.

The channels are grouped as follows:

Analog channels	Description
Analog outputs	Analog outputs
Analog inputs	Analog data acquisition channels
Field bus: Analog inputs	CAN-interface required (CAN, LIN, J1587 etc.)
Virtual channels	Channels created with imc Online FAMOS
Monitor: <xyz> 352	Digital copies of the input channels which have the same name. With monitor channels it is possible to show slowly-sampled signals recorded before the trigger event.

Digital channels	Description
Digital inputs / outputs (bits and ports)	Depending on your device hardware configuration.
Incremental encoder inputs	ENC4 or INK4 required
Field bus: Digital inputs / outputs (bits and ports)	CAN-interface required (CAN, LIN, J1587 etc.)
Monitor: <xyz> 352	Digital copies of the input channels which have the same name. With monitor channels it is possible to show slowly-sampled signals recorded before the trigger event.

GPS	Description
GPS-Channels 360 (internal "Field bus: Analog inputs")	GPS-data as time-domain channels.

Variables	Description
Display-variables	The optionally available hand-held display unit interacts with the device via display variables. In effect, Display variables are virtual bits - they can be used for controlling the display of measurement data or for directly influencing a measurement process. These variables can also be used as temporary storage for a number in imc Online FAMOS or for the purpose of display/operation on a imc STUDIO Panel page.
Net bits 354	Up to 32 net bits are available for Ethernet devices. Events can be assigned to net bits and used as triggers in an Ethernet.
Process vector variables 355	The "*Process Vector*" is a collection of single-value variables (process vector variables or pv-variables). For all measurement channels of the device, these single-value variables are already pre-defined. In parallel to the already existing device-pv-variables, you can create your own pv-variables.
Virtual bits	The virtual bits behave like a 32-bit register, they can be polled and/ or set. This makes it possible to keep a record of states occurring during measurement and, for example, to use the info in the trigger machine.

Maximum channel count per device

Maximum channel count per device		
Active channels	512	active channels of the current configuration: Total sum of analog, digital, fieldbus and virtual channels as well as possible monitor channels
Active analog channels	198 (1)	activated analog channels of the current configuration (sum of primary channels and possibly monitor channels) (1): 128 with imc CRONOS*flex* (CRFX) and imc CRONOS-XT (CRXT), incl. output channels of type DAC-8 and DIO-Ports of type DI / DO, incl. 18 channels per CRFX/WFT-2 input
Fieldbus channels	1000	Number of defined channels (active and passive); Currently activated channels are limited by the total number of activated channels (512).
Process vector variables	800	The process vector is a collection of single-value variables, each containing the latest current measured values. A process vector variable is automatically created for each channel.

		without monitor channels			with monitor channels			
Channel type	**determined by**	**limit (aktive+passive)**	**activated**	**total activated**	**limit (aktive+passive)**		**activated**	**total activated**
Analog channels	system-expansion	240	198	512	Channel	240	198	512
					Monitor	240		
Incremental counter	system-expansion	16	16		Channel	16	16	
					Monitor	16	16	
DIO/DAC-Ports	system-expansion	16	16		Port	16	16	
					Monitor	16	16	
Fieldbus-channels	flexible	1000	512		Channel	1000	512	
					Monitor			
Virtual channels (OFA)	flexible	-	512		-	-	512	

DI-ports (respectively channels) have monitor-ports, DO/DAC-ports in contrary do not have monitor-ports
Example: one DO-16 module correspond to one DIO-port; one DI8-DO8-ENC4-DAC4 correspond to three ports

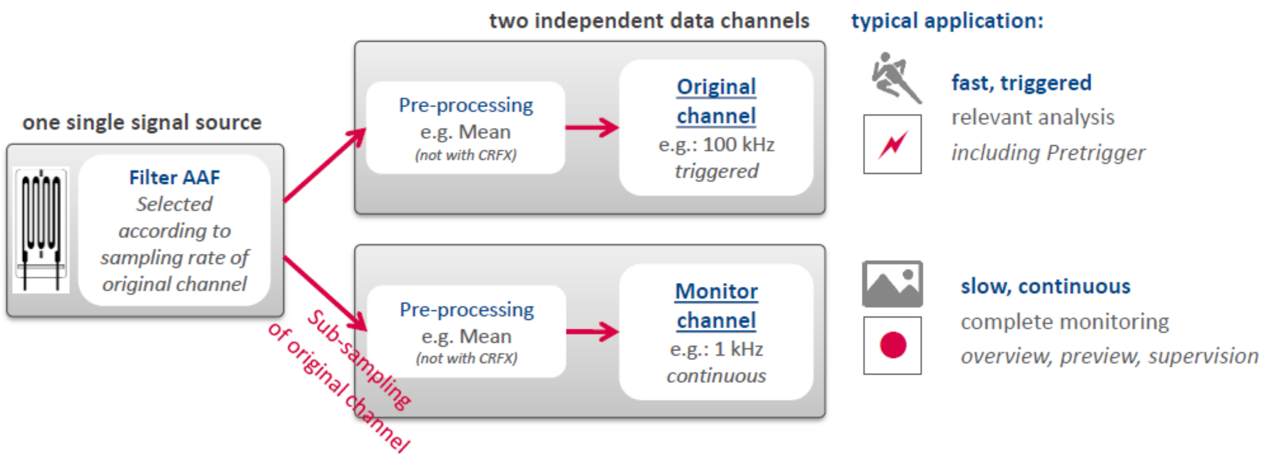
8.3.1.1 Monitor channels

Digital copies of the input signals of the same name for slow, continuous monitoring. The settings for triggering, storage and sampling rate are independent of the original channel. With monitor channels it is possible to show slowly-sampled signals recorded before the trigger event.

The **maximum sampling rate** is that of the input channel. The monitor channel does not have an independent low-pass filter. **Aliasing effects are therefore possible** with less sampling rate.

If a channel has "*preprocessing* 378", the monitor channel receives the data before allocation.

Monitor channels are available for the channel types analog, digital and incremental. Most fieldbus interfaces also offer an option for creating monitor channels.



Concept for monitor channels

8.3.1.2 imc CRONOSflex and CRONOS-XT Modules

The device software lists the imc CRONOS*flex* (CRFX) and imc CRONOS-XT (CRXT) module's amplifier channels automatically in the channel table.

Information on the maximum sampling rate per channel and on the maximum aggregate sampling rate per system, as well as on other possible limitations are described in the technical specs in the manual for the respective device.

At present, there is no **Preprocessing** (e.g. Arith. Mean) possible for CRFX/CRXT amplifier channels. Channels, recorded with the modules, can be processed with imc Online FAMOS functions only (Mean(), Min(), Max(), RMS())

Connection recognition

The numbering of the module happens automatically upon first connection and remains intact. This number is displayed at the module with a 7-segment display. It appears in the channel table in the column **Connector** as slot recognition in parentheses in front of the amplifier's channel number (e.g. **[01]** IN07, **[01]** IN08, **[02]** IN01).

An overview of the modules connected is provided in the dialog "*Module properties* 199". A CRFX/CRXT module is distinguished by the address designation (*xbus...*).

Reference

Observe the notes on **Removing and exchanging modules** and on **Re-assignment of module numbers** in the description of the dialog: **Module properties** 199.

Note Digital CRFX modules DIO, Pulse Counter and DAC

- 32-channel DI- or DO-modules are designed as "double-modules" which behave logically as two modules and which show corresponding IDs on two 7-Segment displays.
- The maximum count of modules per device is limited. For more information on this subject, see the device's technical specs and the chapter "*Channel table* 352".
- The 7-Segment display on the front of the modules shows the assigned address in HEX-format with a prefixed "d" for "digital module". Digital Flex modules which are installed within a base unit do not have a 7-Segment display and are assigned the address "d0" at factory.
- See also the description in the user’s manual imc CRONOS System Family, in the chapter "*DI, DO, DAC, HRENC and SYNTH*".

8.3.1.3 Net bits

imc STUDIO can derive trigger conditions from its own analog and digital channels as well as from AND/OR combinations of these. When working with multiple devices, it's often necessary to announce a trigger event to all devices.

When working with multiple channels, it is often necessary to announce a trigger event to all the devices. It is often difficult to lay digital lines in a widely dispersed network. One solution is to use an Ethernet-connection, if available. This is accomplished using the so-called Net Bits. One way to think of them is as 32 hard-wired digital lines running parallel to the Ethernet, which connect all imc STUDIO mutually. Thus the device has an Ethernet-DIO port, in addition to the physical DIO and the virtual DIO. These digital inputs and outputs can be used for triggering just like the unit's physical DIO-bits.

In this context, note the following:

- Net bits are only available with Ethernet devices.
- Net bits only take effect within the scope of one protocol.
- The net bits of TCP/IP devices only take effect within their Subnet.
- Another analogy to the physical DIO also applies: just as in the Ethernet, there is a delay between the setting of a bit and the recognition by another device of the new state.

Note

When a measurement is prepared (Downloaded), all bits, including the Ethernet bits, are reset. This also affects devices on the network which are currently performing measurements. Any Ethernet bits which had been set in the process of the running measurements will be reset when any device in the network is prepared

8.3.1.4 Process Vector Variables

The "*Process Vector*" is a collection of **single-value variables** (process vector variables or pv-variables). **For all measurement channels** of the device, these single-value variables are already **pre-defined**.

Note — Values are available immediately

Updating of the device pv-variables occurs immediately after preparing (Download) the measurement device. Thus, the pv-variables always display the current value, even if the measurement is not yet running, or has already concluded, or the channel-trigger has not yet released.

imc Online FAMOS works independently of the trigger mechanism and can thus access the measured values currently being captured by means of the variables. These can then be used, in conjunction with the "*Synchronous Tasks*", for monitoring and control purposes.

User-defined pv-variable

In parallel to the already existing device-pv-variables, you can create your own pv-variables. This is conditional on the following requirements:

Component | Rights	read	create	write
imc Online FAMOS	yes	no	no
imc Online FAMOS Professional	yes	yes	yes
imc Inline FAMOS	yes	no	yes (if they were created using imc Online FAMOS Professional)

Creating a user-defined pv-variable

You can create user-defined pv-variables from a variety of locations (prerequisite: "*imc Online FAMOS Professional* 846"):

- imc Online FAMOS 871 with Control Commands
- Automation 1432
- Setup page: "Variables" via the menu ribbon: "*Setup-configuration*" > "*Create Process vector variable* 178"

Special properties of the pv-variables

<table>
<tr><th>Properties</th><th>Description</th></tr>
<tr><td>Trigger independence</td><td>Updating of the device pv-variables occurs immediately after preparing (Download) the measurement device. Thus, the pv-variables always display the current value, even if the measurement is not yet running, or has already concluded, or the channel-trigger has not yet released.</td></tr>
<tr><td>Disallow read-/write-access</td><td>By means of the variable's "Status" (Setup page "Variables"), you are able to set whether other additional components are able to see the variable.
<table>
<tr><th>Status</th><th>Description</th></tr>
<tr><td>Active</td><td>The variable exists in the device and is transferred to the PC.

The following rules apply to user-defined pv-variables:

No write-permission on the PC: The value can only be written via imc Online FAMOS. Other components such as the Panel can only read the value but not write it.
If the initialization in imc Online FAMOS is removed, the variable remains in the list. The measurement can only be started if the variable is initialized in at least one location (e.g. imc Online FAMOS or Automation).
Otherwise this error message appears: Error number: 6408
"There is at least one process vector variable that is not being used. Make sure that it has write permission (Setup) or is being used (e.g. imc Online FAMOS, Automation, ...)"</td></tr>
<tr><td>Passive</td><td>The variable exists in the device, but is not transferred to the PC. It is only possible to access the value via imc Online FAMOS.

For user-defined pv-variables, the following applies:

If the initialization in imc Online FAMOS is removed, the variable is deleted from the list.</td></tr>
<tr><td>read/write</td><td>Like "active", but with write-permission on the PC; e.g. the value of the variable can be changed by means of the Panel.</td></tr>
<tr><td>write</td><td>not recommended - The status has no significance and usually behaves like "read/write"</td></tr>
</table></td></tr>
<tr><td>Direct read-access via some field busses</td><td>Appropriate variants of the CAN-Bus and LIN-Bus are able to read the current values of the pv-variables and to output these on the bus.

More detailed information including the prerequisites are presented in the descriptions for the respective field busses.</td></tr>
</table>

Special variants of the pv-variables

Variants	Description
User-defined pv-variable	pv-variables personally defined by the user, e.g. by means of imc Online FAMOS.
pv-variables of the data acquisition channels	pv-variables of the data acquisition channels (e.g. analog channels, CAN, ...) always show the currently captured measurement value starting from the action "*Prepare*" (Download).
Display GPS Information 360	GPS signal are made available as pv-variable and Fieldbus channels (with GPS interface)
State of the external power "*pv.State.ExternalPower*"	The pv-variable takes the following value: 0 = state unknown/not yet found (initialization value) 1 = external current supply present ("power ok") 2 = external current supply not present/deactivated ("power fail")
n of system time "*pv.State.SyncTimeDeviviation*"	Only in conjunction with NTP- and PTP-synchronization Current time deviation of devices from the NTP-or PTP-Server in seconds. The return value is exactly 0 if the server is ether not activated or cannot be reached; otherwise it is in the range of a few milliseconds.

Deactivation of process vector variables for data acquisition channels

By default, process vector variables are activated for the data acquisition channels (e.g. the analog channels).

Even if they are not used, the make great demands on the device system resources. Therefore, your device's entire aggregate sampling rate is only available if the process vector variables are deactivated. Otherwise you receive messages indicating that the aggregate sampling rate has been exceeded, although this is not true mathematically.

How to deactivate the **Process vector variables for data acquisition channels** is described in the manual for the plug-in: Setup - Measurement options 347.

Support of process vector variables of the type IEEE-Float

Process vector variables of the type IEEE-Float (e.g. process vector variables for CAN-channels of the type Float) can also be used in imc Online FAMOS. Corresponding CAN-channels then appear in the Channel table, as well as the associated process vector variables.

Names for device-pv-variables

If multiple devices are used in an experiment, a pv-variable's name is automatically extended with the device name (complete name). The name supplement also is applied to the pre-defined pv-variables.

Example

Device name "imcDev__05123456"

pv.Channel_001_imcDev__05123456" for pv-variable of a data capture channel "Channel_001"

"pv.GPS.longitude_imcDev__05123456" pre-defined pv-variable for the GPS position:

The variable type of pv-variables can be controlled by imc Online FAMOS

pv-variables can be generated at various points. In most cases, the type (Int, Float) can only be set in imc Online FAMOS when it is created. Using imc Online FAMOS,you can modify the type of pv-variables (e.g. belonging to the CAN-Assistant), which are not themselves created in imc Online FAMOS.

- int: a pure numerical value (disregarding factor and offset); with 32-bit precision
- float: a scaled numerical value (factor and offset taken into account); with 24-bit precision

Example

```
OnInitAll
    Int pv.CAN_001
    ; pure numerical value, 32-bit resolution
    ; Factor and offset disregarded
    ; If required, add the factor and offset to
    ; the imc Online FAMOS source code.

    Float pv.CAN_002
    ; Scaled numerical value, Float-resolution
    ; Factor and offset already taken into
End
```

8.3.1.4.1 Saving/Restoring pv-Variables

When a measurement is concluded or the device is deactivated, the current values of process vector variables can be saved in a way so that they are restored as the initial values upon restarting the measurement.

The current values are saved to a file in the device. This storage file is in non-volatile memory and remains intact even when the device is off.

Note

- There is only one storage file in the device; separate files are not created for the various experiments!
- The decision whether a process vector variable is restored with the same name depends on the restoration strategy used.
- A fully functional UPS is required.

Declaration

To save and restore process vector variables in the device, the desired pv-variables are provided with an attribute.

In an imc Online FAMOS program, this attribute is set using the keyword `restore` with a pv-variable is declared:

```
restore pv.Counter = 1
```

Save/Restore times

The current pv-variable values are saved at the following times:

- before (re-)configuration (configuration by user PC, Diskstart/Autostart); more precisely: after data capture is stopped
- when the device is deactivated (event POWER SHUTDOWN)

The pv-variable values are restored at the following times:

- after (re-)configuration (configuration by user PC, Diskstart/Autostart); more precisely: after opening and starting the online task and before starting the measurement

Restoration strategies

The attribute has a parameter for specifying the restoration strategy.

A variety of restoration strategies can be specified:

- Matching name, data type, scaling and comment
  By specifying a string (as the comment), it is possible to distinguish the same pv-variable name in different tasks (e.g. different experiments).
  Note: This restoration strategy is used by the operator software "imc DEVICES" (imc Online FAMOS).
- Matching name, data type, Idx, system address, and scaling (exact matching)
  Note: If the original experiment is changed, this usually results in a change of the Idx or system address, so that the values of the process vector variables are not restored!
- Matching name and comment
  By specifying a string (as the comment), it is possible to distinguish the same pv-variable name in different tasks (e.g. different experiments).
  Note: This restoration strategy is used by the imc STUDIO plug-in Automation.

Deleting the process vector backup file

To delete the saving file, proceed as follows:

- Open the plug-in **Setup**
- Open the page **Devices**

By means of the parameter **Process vector backup file**, you can delete the file. Add the parameter as a column in the table or use the **Details** tool window (hidden parameters must be made visible).

- Select the devices desired in the Device Table
- Click on the button *Delete* for the parameter **Process vector backup file**

What happens when you change experiments?

- The process vector variable remains intact in the device if an imc Online FAMOS variable of the same name and of the same type (Integer or Float) exists.
- If an experiment is run which does not include the variable, the variable is deleted from the process vector saving file and is thus no longer present.
- If the variable is used in the context of the imc STUDIO Automation, it remains intact as long as the Automation Task of the same name is present.

8.3.1.4.2 Update Rate of pv-Variables

The current measurement values for the Process Vector are updated at the respective **channel's clock rate**, but not higher than 10kHz. The filter that has been set for the channel is also used, exactly as for the channel's triggered acquisition.

Data from **imc CRONOS*flex* modules** are transmitted at a **maximum transfer rate** of 5 kHz (200 µs). Data recorded at higher sampling rates are transferred in blocks. This means that process vector variables (PVV) of imc CRONOS*flex* modules are **updated at a maximum rate of 5 kHz**. The process vector variables are thus subject to the following constraints:

Process vector variables from channels with sampling rates < 5 kHz can only be transferred at multiples of 200 µs:

Channel sampling rate	Update rate of the PVV
5 kHz	5 kHz
2 kHz	**1 kHz**
1 kHz	1 kHz

8.3.1.4.3 pv-Variables as Monitor Channels

In the plug-in Panel, it is possible to link Widgets with the process vector variables. Since these are already updated following the preparation (Download), in other words before release of a trigger, this technique is a simple alternative to monitor channels.

8.3.1.5 GPS

At the nine-pin GPS socket it is possible to connect a GPS-receiver. This makes it possible to achieve absolute **synchronization to GPS time**. If the GPS-mouse has reception, the measurement system synchronizes itself automatically. **Synchronization with a NMEA source** is possible. The precondition for this is that the clock must return the GPRMC-string along with the one-second-interval clock signal.

All **GPS information** can be **evaluated** and subjected to **subsequent processing** by OFA/IFA.

GPS signals are **available as**: process vector variables and fieldbus channels.

GPS information	Description
pv.GPS.course	Course in °
pv.GPS.course_variation	Magnetic declination in °
pv.GPS.hdop	Dilution of precision for horizontal
pv.GPS.height	Height over sea level (over geoid) in meter
pv.GPS.height_geoidal	Height geoid minus height ellipsoid (WGS84) in meter
pv.GPS.latitude pv.GPS.longitude	Latitude and longitude in degree (Scaled with 1E-7)
pv.GPS.pdop	Dilution of precision for position
pv.GPS.quality	GPS quality indicator 0 Invalid position or position not available 1 GPS standard mode, fix valid 2 differential GPS, fix valid ...

GPS information	Description
pv.GPS.satellites	Number of used satellites.
pv.GPS.speed	Speed in km/h
pv.GPS.time.sec	The number of seconds since 01.01.1970 00:00 hours UTC. For this reason, it is no longer possible to assign the value to a Float-format channel without loss of data. This count of seconds can be transformed to absolute time under Windows and Linux.To do this, use the function below. `MySeconds = CreateVChannelInt( Channel_001, pv.GPS.time.sec)`
pv.GPS.vdop	Dilution of precision for vertical see e.g. www.iota-es.de/federspiel/gps_artikel.html (German)

Note

Scaling of the latitude and longitude

pv.GPS.latitude and pv.GPS.longitude are **INT32 values**, **scaled with 1E-7**. They must be **treated as Integer channels**, otherwise the **precision is diminished**.

By means of imc Online FAMOS, you are able to generate virtual channels from them. However, due to the reversal of the scaling, precision is lost:

```
latitude = Channel_001*0+pv.GPS.latitude *1E-7
```

Recommendation: Use the corresponding field-bus channel: "*GPS.latitude*" or "*GPS.longitude*". Here, no scaling is required, so that the precision is preserved.

Sampling rate

Due to system limitations, GPS channels for determining the fastest sampling rate in the system are not taken into account. For an working configuration, at least **one other channel** (fieldbus, digital or analog) must be sampled at either the **same** sampling rate as the GPS-channel, or a **faster** one.

Internal variables; do not use

- pv.GPS.counter
- pv.GPS.test
- pv.GPS.time.rel
- pv.GPS.time.usec

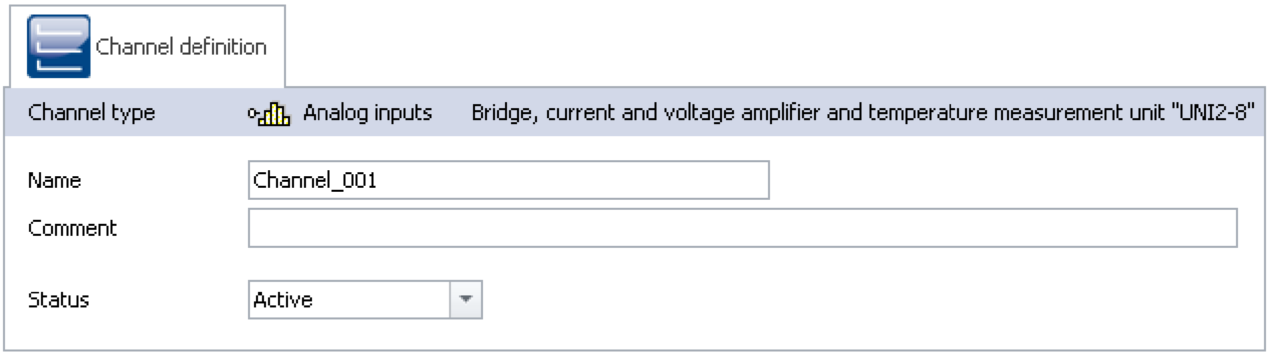
RS232 port settings

For imc devices to be able to use a GPS receiver, the following conditions must be met:

- **Baud rate**: Possible values are 4800, 9600, 19200, 38400, 57600 or 115200
- 8 bit, 1 stop bit, no flow control
- The following **NMEA strings** must be sent: ***GPRMC, GPGGA, GPGSA***. The order of the strings must be adhered to.
  Additional strings should be deactivated. If this is not possible, all other strings must be **before** the GPGSA string!
- The receiver must deliver a **1 Hz clock**.
- The rising edge of the clock must mark the second specified in the next GPRMC string.

- All three strings should be sent as soon as possible after the 1 Hz clock, so that there is sufficient time for processing between the last string and the next 1 Hz clock.

8.3.2 Channel definition



Parameter	**Description**		
	long name	*short name*	*column ID*
Name	*Channel name*	*Name*	*eChannelName*
	The channel's Name must be unique, i.e. no two names may have the same name. Maximum number of characters: 65. Three more characters may be added for the sake of any pv-variables. See "*Channel Name* 362".		
Comment	*Channel comment*	*Comment*	*eChannelComment*
	The Comment contains a **text for explanation concerning the channel**. The comment is saved along with the channel's settings in the experiment, and can be displayed in the Panel, for example.		
Status	*Channel status*	*Status*	*eStatus*
	The Status determines whether the particular **channel is activated for the measurement/the experiment**. • Active: Activates the channel • Passive: The channel is not recorded. However, the settings are kept.		

8.3.2.1 Channel Name

Note Using special characters in the name

If a channel name begins with a number or contains special characters such as "\?+!" or a space, in OFA/IFA the channel name must be set into curly braces.

Example:

Channel name = "123 My channel 100% display"

in OFA/IFA = "{123 My channel 100% display}"

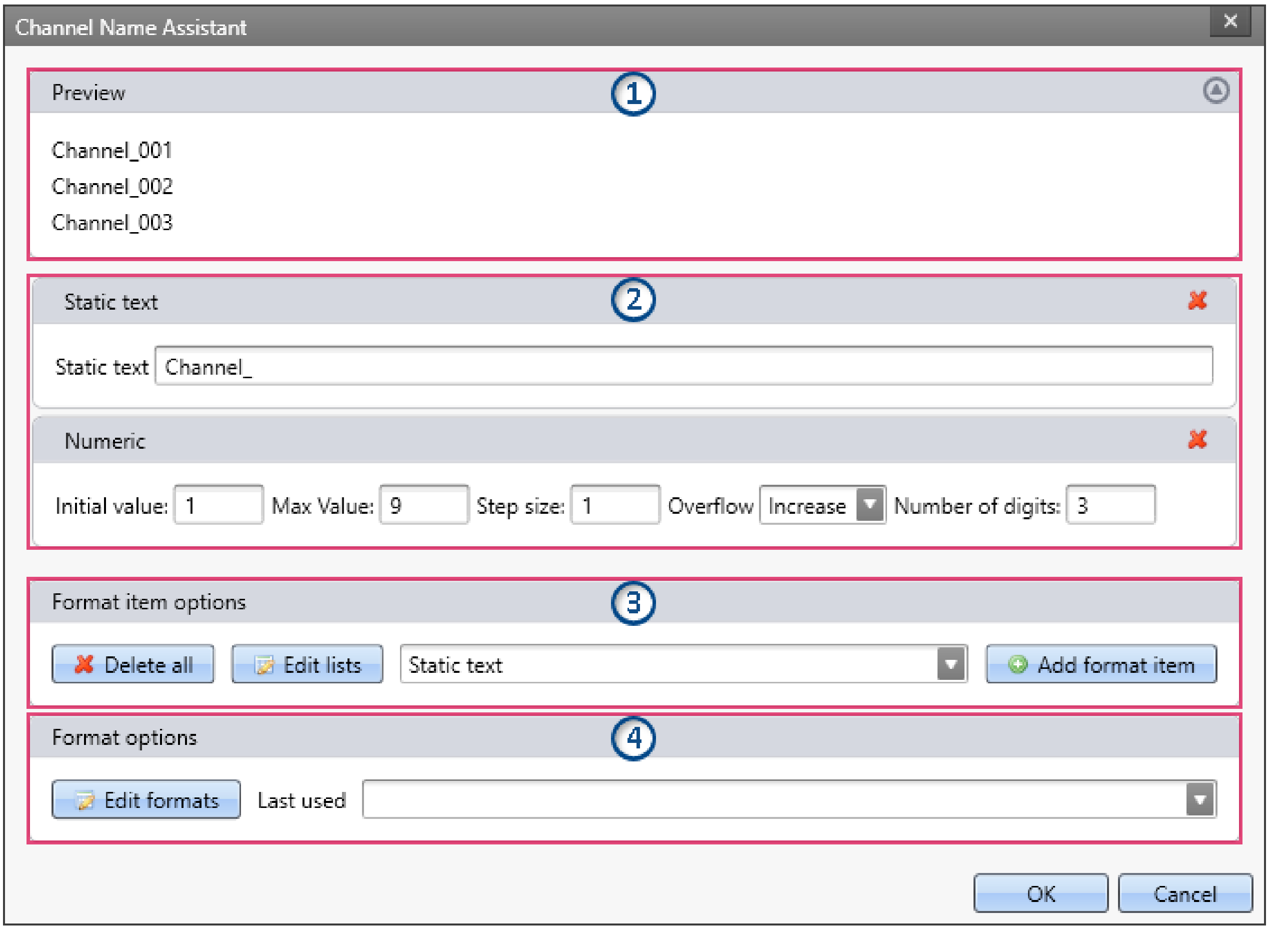
Joining variables to form a group

Display in the Data Browser

To join multiple variables together in a group, you can use the character '.' in the variable's name.
E.g. "*MeasPoint1.Temperature*", "*MeasPoint1.Voltage*" results in this display in the Data Browser.

Renaming multiple channels jointly (Channel Name Assistant)

By means of the "*Channel Name Assistant*", you can rename multiple channels simultaneously. For this purpose, there are a variety of naming formats available, such as numbering and text-lists.



Example with the Assistant's standard settings
As a result, the first channel is assigned the name "Channel_001", the second "Channel_002", ...

Area		Description
1	Preview	Here you find the first three results with the format items which are set.
2	Format items set	Here, all format items are defined. Configure them here also. From the top downward, the items are applied to the names. You can use Drag&Drop to modify the order. In the example above, the static text: "*Channel_*" is applied first. Next comes the (three digit) number: "*Channel_001*". Using the red "x" icon, you can delete an item.

Area	Description
3 New format items	**Create** here any **new format items**. Select from the list an appropriate item and add it. It will appear on the bottom. Additionally you can **edit lists** and add to them. Lists are used in the item of the same name in order to use user-defined texts for the name. Use "*Delete all*" to **delete the current configuration**. All items are deleted.
4 Saved formats	Here you can access the **most recent configurations used**. By means of "*Edit formats*", you can assign names to these configurations or delete them.

Configuring format items

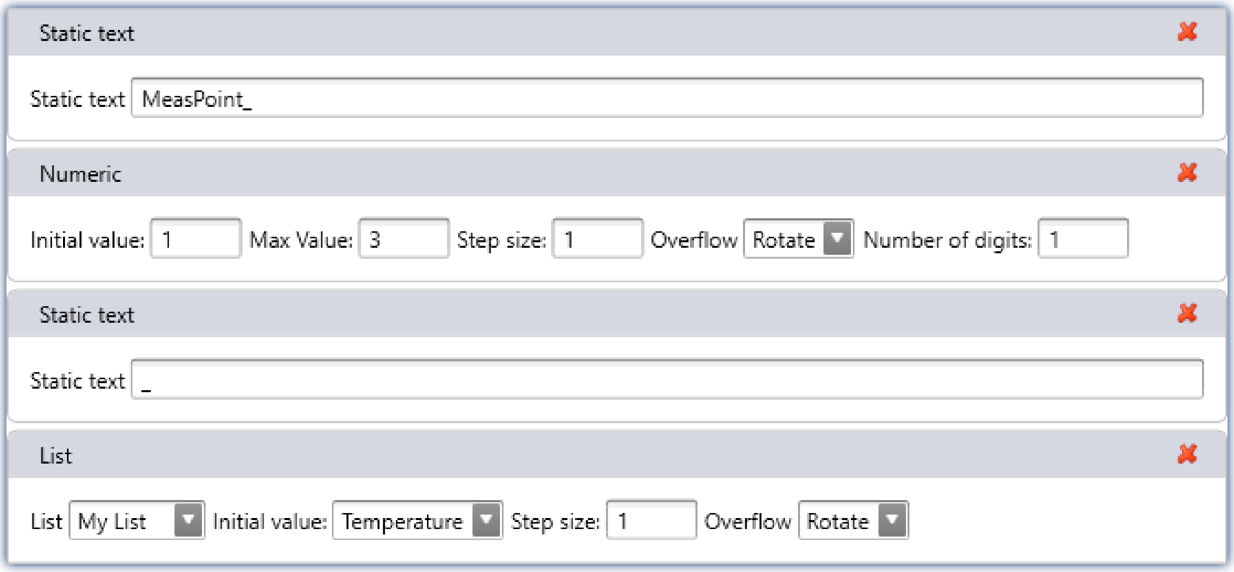
Format item	Description
Static text	The text defined is adopted as it is entered. It can also be used for special characters as separators for other items, e.g. "_".
Numeric	A consecutive number. • **Initial value:** Starting value • **Max value:** Has a function only in conjunction with rotation. See "*Overflow-Rotation*" • **Step size:** By what increments the number is to be increased. E.g. "1": 1,2,3,4,... | "2": 1,3,5,7,... • **Overflow-Rotation:** The numbers extend from the Initial value to the maximum value. After that, the number starts over at the Initial value. • **Overflow-Increase:** Applies the usual counting method. If one decimal place reaches the digit "9", the next higher decimal place is used: "10" • **Number of digits:** Minimum number of decimal places used for the number. E.g. "2": 01, 02, 03, ..., 99, 100, 101.
Alphabetical	The consecutive alphabet. • **Initial value:** Starting letter • **Max value:** Has a function only in conjunction with rotation. See "*Overflow-Rotation*" • **Step size:** By what increments the letter is to be increased. E.g. "1": A,B,C,D,... | "2": A,C,E,G,... • **Overflow-Rotation:** The letters extend from the Initial value to the maximum value. After that, the letter starts over at the Initial value. • **Overflow-Increase:** If one position reaches the letter "Z", the next position is used: "AA"

Format item	Description
List	Uses a defined list for the names. • **List:** Here, select a list to use. If applicable, create a list first ("*Edit lists*"). • **Initial value:** First list entry used. • **Step size:** The interval at which to progress through the list. E.g. "2": first entry, third entry, ... • **Overflow-Rotate:** The list entries extend from the Initial value to the last entry. Subsequently, progress continues with the first entry (not the Initial value!). • **Overflow-Increase:** Once the last entry has been used, the next position is used: "Entry1Entry1", "Entry1Entry2", ...
Column value	Uses a channel parameter as the name. Possible choices: Device name, Channel name, Channel comment, Connector, Module number, Device SN. **Example:** Information regarding the sensor connected is to be used in the name. When the sensor is read, the associated info is recorded in "*Channel comment*". This info can now be additionally used in the channel name.

Example — Combination of items

The name is to be composed of a measurement point number. Each measurement point has three connectors: "Temperature", "Voltage" and "Current".

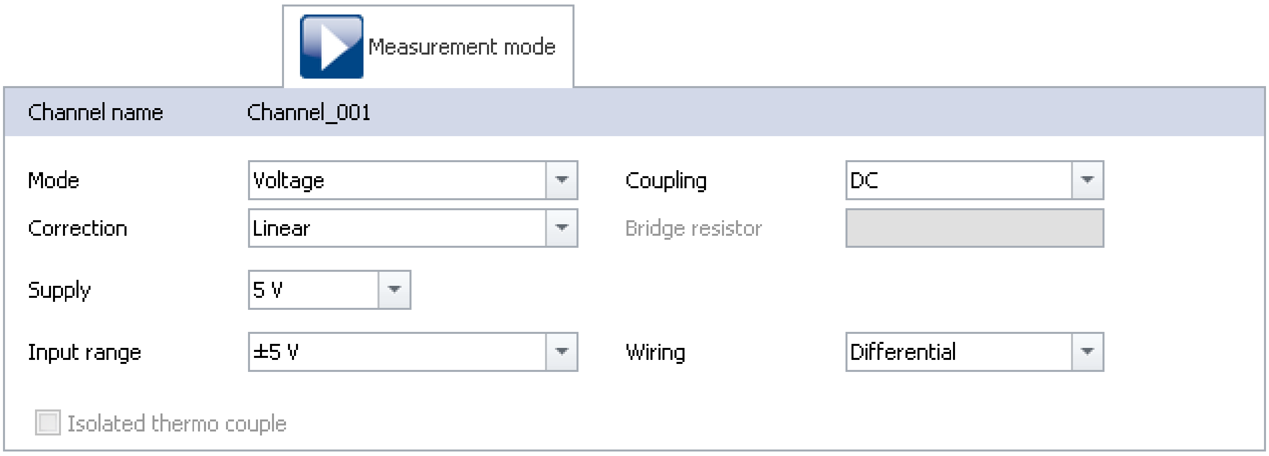
Previously, a list ("My List") had been defined, containing the three connector designations.



This configuration generates the following names of variables:

MeasPoint_1_Temperature
MeasPoint_1_Voltage
MeasPoint_1_Current
MeasPoint_2_Temperature
MeasPoint_2_Voltage
MeasPoint_2_Current
MeasPoint_3_Temperature
MeasPoint_3_Voltage
MeasPoint_3_Current

8.3.3 Measurement mode



Measurement mode

Reference

The settings available depend on the amplifier type. They are described in the pertinent device manual in conjunction with the interconnections.

Parameter	**Description**		
	long name	*short name*	*column ID*
Mode	*Measurement mode*	*Mode*	*eChannelMode*
	Basic settings for the measurement types: *Voltage*, *Current* or *Strain gauge* (Strain gauge: for further settings, a new dialog appears: Strain Gauge 371).		
Coupling	*Coupling*		*eCoupling*
	Depending on the amplifier and on the mode set, DC- or bridge measurement settings are possible. If the Strain Gauge mode is selected, a variety of possible applications is listed, which lead to different input ranges 369.		
Coupling is DC	*Coupling is DC*	*DC*	*eCouplingIsDC*
	For some amplifiers, it is necessary to switch the coupling for the whole amplifier board to DC-coupling. In this case, this must be set independently of the **Coupling**.		
Bridge resistor	*Bridge resistor*	*Resistor*	*eBridgeResistor*
	The bridge resistor must be stated for all bridge types, although it is actually only absolutely necessary for the quarter bridge. For full bridges, the bridge resistor is used along with the **calibration resistor** to calculate the **indicated strain** (see: Cable compensation without sense configuration 394) Also, with the bridge resistor, it is possible to determine the cable resistance even if no Sense line is connected.		

<table>
<tr><th>Parameter</th><th>Description
long name | short name | column ID</th></tr>
<tr><td>Correction</td><td>

long name	*short name*	*column ID*
Correction		*eCorrection*

Use of a correction curve (e.g. temperature measurement; depending on the amplifier). Requires the amplifier to operate in DC-voltage mode.

- *Linear*: No linearization of measured values
- *PT100*: Linearization according to a PT-100 thermistor characteristic curve
- *Type R, S, B, J, T, E, K, L, N, C* [1]:
Linearization according to a thermocouple characteristic curve
- *Sensor characteristic curve*: This is displayed when a sensor 204 is used

[1] For amplifiers produced after November 2012.

The condition for **temperature measurement** is that the amplifier is working on mode: voltage (DC).
</td></tr>
<tr><td>Supply</td><td>

long name	*short name*	*column ID*
Supply		*eSupply*

The power supply voltage can be used either for the bridge supply or the sensor supply. Each amplifier has its own power settings globally applicable to all its channels. By changing the settings for one channel, the settings of all channels belonging to the same amplifier are changed accordingly.

Some amplifiers provide the ability to switch the power supply on or off. See parameter: Bridge supply (On/Off) 386
</td></tr>
<tr><td>Input range</td><td>

long name	*short name*	*column ID*
Input range		*eRange*

Lists the input ranges available.

If you use scaling for the channel or if you have carried out an adjustment, the resulting physical input range with its unit is displayed here. For temperature measurements the input ranges depend on the thermocouple type or RTD.
</td></tr>
<tr><td>Wiring</td><td>

long name	*short name*	*column ID*
Channel wiring	*Wiring*	*eWiring*

The input circuit configuration

- single ended:
The channel signal is measured relative to ground. All channels using this setting share a common ground.
- differential:
The channel is measured differentially.
</td></tr>
<tr><td>Isolated thermo couple</td><td>

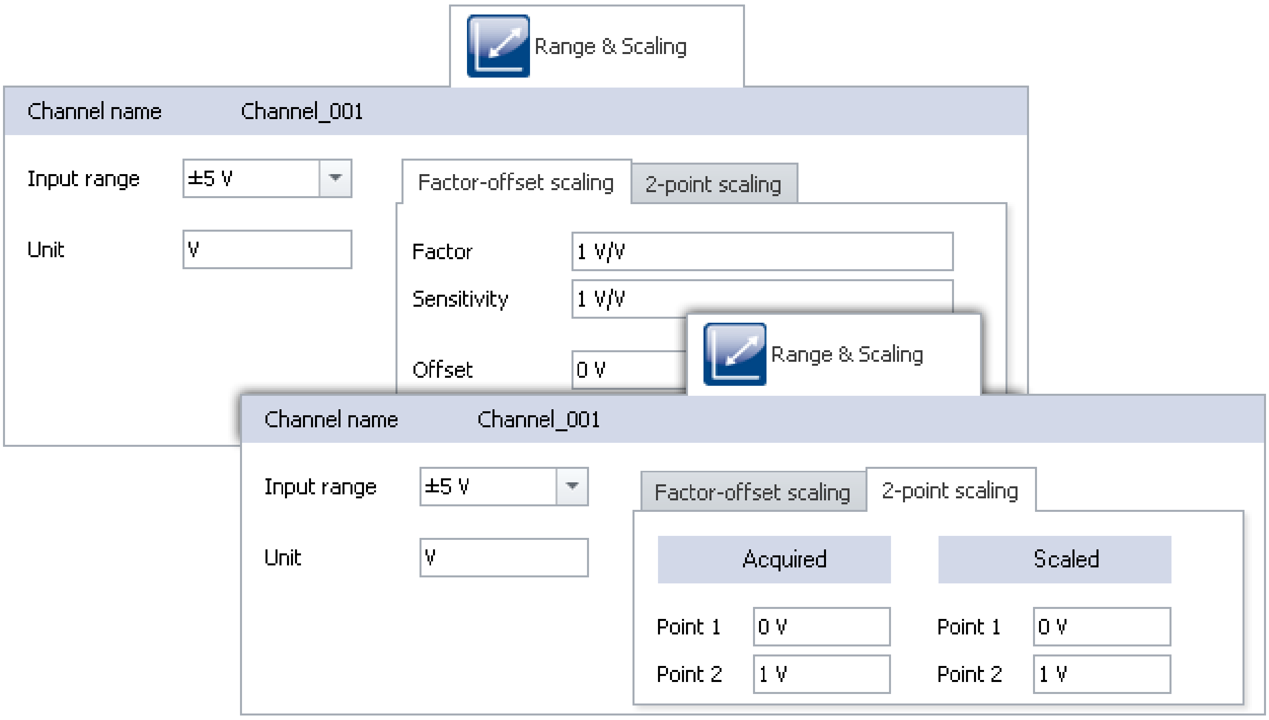
long name	*short name*	*column ID*
Isolated thermo couple		*eIsolatedThermoCouple*

Default is isolated thermocouple. When using none isolated thermocouples, that option has to be deactivated, to avoid ground loops.
</td></tr>
<tr><td>Polarization</td><td>

long name	*short name*	*column ID*
Polarization		*ePolarization*

Activates the power supply for certain microphone types. Please observe the notes on the respective amplifiers.
</td></tr>
</table>

8.3.4 Range & Scaling



Factor-offset scaling

Parameter	Description *long name* / *short name* / *column ID*
Input range	*Input range* / — / *eRange* Lists the input ranges available. If you use scaling for the channel or if you have carried out an adjustment, the resulting physical input range with its unit is displayed here. For temperature measurements the input ranges depend on the thermocouple type or RTD.
Unit	*Unit* / — / *eUserUnit* Unit of measurement values. Select SI units without milli, micro etc., which the curve window with do automatically.
Factor	*Scaling factor* / *Factor* / *eUserScalingFactor* Here, you can enter a scaling factor, in order to perform a conversion of the measured value to a physical quantity. The system will adjust the input range accordingly. Factor = 1/Sensitivity
Sensitivity	*Sensitivity* / — / *UserScalingFactor_Reciproce* Here you can enter a value for the sensitivity for the purpose of converting a measured value to physical quantities. The system will adjust the input range accordingly. Sensitivity = 1/Factor

Parameter	**Description** *long name* *short name* *column ID*
Offset	*Scaling offset* | *Offset* | *eUserOffset* If your signal is distorted by a DC component which cannot be compensated by the amplifier, the possibility exists to mathematically cancel this offset. In that case, the measurement signal is shifted by the amount of the offset entered. **Example:** If the signal hovers around a level of +2.5 V, an offset of -2.5 V shifts the signal towards the X-axis. Since the physical input range hasn't changed, the displayed range is also shifted by the offset amount. For the example of 2.5 V, a input range of previously ±10 V becomes a displayed input range of -12.5 V to +7.5 V.

To scale the measured values as a physical quantity, you can perform **factor-offset scaling** or **2-point scaling**. The input range is adapted accordingly.

Option	**Description**
Factor-offset scaling	Here you can enter a factor or the sensitivity (=1/factor) and an offset. Physical quantity = measured value * factor + offset
2-point scaling	Here you can assign physical pond to two measured values.

Example — Example of Factor-Offset-scaling

A bridge amplifier is operated in the 100 mV/V input range. A displacement sensor is connected which unbalances the bridge by 1.6 mV/V for one millimeter of displacement. Toward this end, enter 1.6e-3 for **Factor** and for the unit m, and the input range changes to ±0.16 m. Also, if you enter for **Offset** a value of 5e-3, the input range changes accordingly to -155 mm ...165 mm.

Example — Example for 2-point scaling

A pressure sensor returns a current of 4-20 mA to correspond to inputs of 0-10 bar. The current signal is captured via a connector with a 50 Ω shunt resistor. The resulting voltage is thus:

0 V to 10 bar corresponds to 4 mA * 50 Ω to 20 mA * 50 Ω = **0.2 V to 1 V**

- For **Acquired**, enter the resulting voltage values,
- and for **Scaled**, the corresponding pressure values.

Point 1:	0.2 V	corresponding to	0 bar
Point 2:	1 V	corresponding to	10 bar

Note

Higher precision can be achieved by performing two-point scaling on the amplifier (see: Two-point scaling 393). By means of this procedure, all uncertainty tolerances are taken into account in the scaling.

However, it is possible that the values scaled by the amplifier are additionally combined with the scaling described here.

Note — **Notes on hardware: balancing with setted offset**

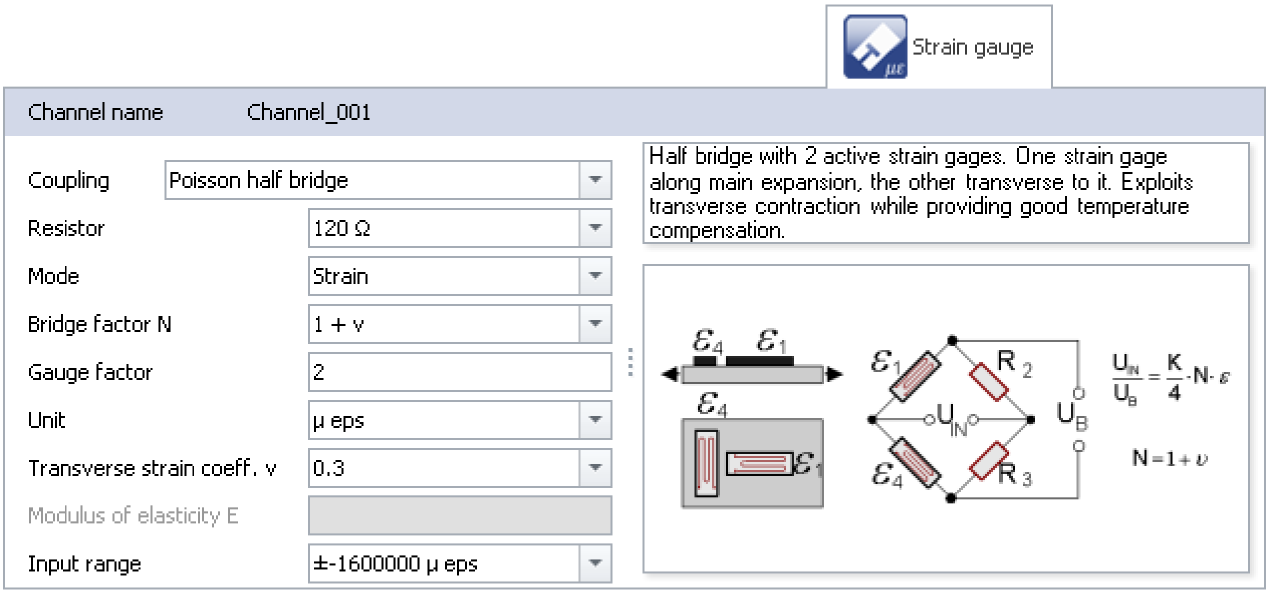
Zeroing with adjusted offset leads to different results with CRFX/CRXT modules and amplifiers installed in imc CRONOS*compact*, imc C-SERIES or imc SPARTAN:

- CRFX/CRXT: Zeroing 387 adjusts the channel in the physical unit, e.g. 0 bar. This applies to all modules for the acquisition of analog voltages with 16 or 24 bits, except UNI-4.
- imc CRONOS*compact*, imc C-SERIES, imc SPARTAN, CRFX/UNI-4: The electrical value is balanced, i.e. the entered offset is retained. After the adjustment, the physical value is displayed with a negative offset. This ensures that an offset entered subsequently is not overwritten. If you wish for the balancing to determine the offset, **only enter the factor**, and then subsequently balance the offset by means of the Balancing function 387. Adaptation to the behavior of CRFX/CRXT is in preparation.

8.3.5 Strain Gauge

Only enabled for channels in the mode: **Strain gauge**.

To configure the strain gauge, you must set the **Mode** to *Strain gauge* in the dialog **Measurement mode**. A new dialog **Strain gauge** appears, as long as the channel is selected in the channel table.



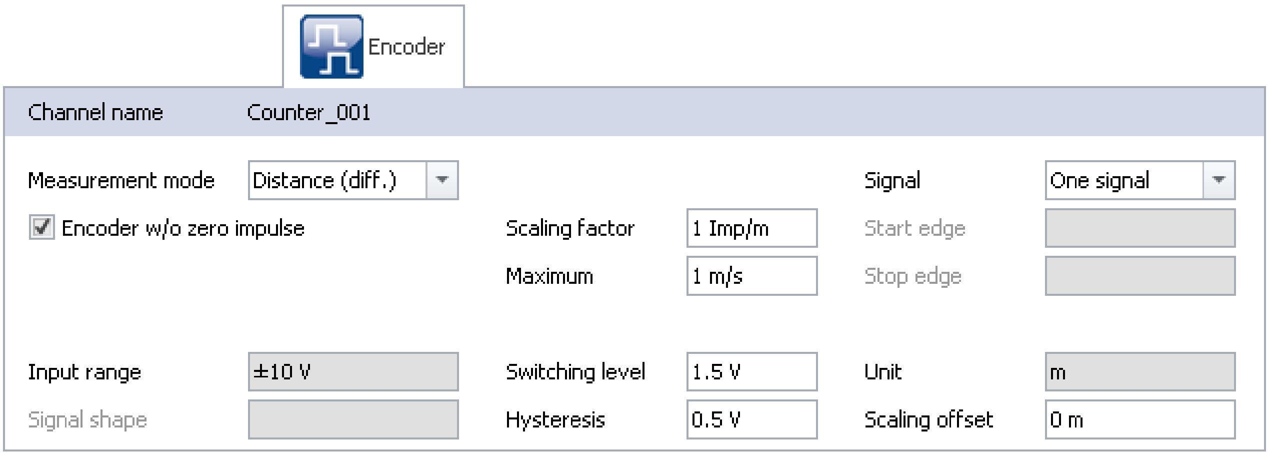
Parameter	Description		
	long name	*short name*	*column ID*
Coupling	*Coupling*		*eCoupling*
	Lists various usage possibilities. Corresponding descriptions and sketches of the strain gauge are displayed. The strain gauge is pre-set to conform to the coupling-selection. It is also still possible to make appropriate settings.		

Parameter	Description *long name* / *short name* / *column ID*
Resistor (Bridge resistor)	*Bridge resistor* / *Resistor* / *eBridgeResistor* The bridge resistor must be stated for all bridge types, although it is actually only absolutely necessary for the quarter bridge. For full bridges, the bridge resistor is used along with the **calibration resistor** to calculate the **indicated strain** (see: Cable compensation without sense configuration 394) Also, with the bridge resistor, it is possible to determine the cable resistance even if no Sense line is connected.
Mode	*Bridge mode* / *Mode* / *eBridgeMode* *Strain* or *Stress*
Bridge factor N	*Bridge factor N* / / *eBridgeN* The available selection depends on the coupling.
Gauge factor K	*Gauge factor* / / *eBridgeFactor* Depends on the part's material
Unit	*Bridge unit* / *Unit* / *eBridgeUnit* Unit of measurement values. For the mode **Strain**, the following units are available: *µ eps* and *µm/m*; (1 µm/m = 1 µ eps) For the mode **Stress**, the following units are available: *MPa* and *GPa* and *N/mm²* and *PSI* (pound-force per square inch) (1 MPa = 1 N/mm²; 1000 MPa = 1GPa; 1 MPa = 145,04 PSI)
Transverse strain coeff. v	*Transverse strain coeff. v* / / *eBridgeEps* Depends on the part's material
Modulus of elasticity E	*Modulus of elasticity E* / / *eBridgeEModule* Depends on the part's material
Input range	*Input range* / / *eRange* Lists the input ranges available. If you use scaling for the channel or if you have carried out an adjustment, the resulting physical input range with its unit is displayed here. For temperature measurements the input ranges depend on the thermocouple type or RTD.

8.3.6 Encoder

Only visible for devices with incremental counter inputs.

Certain properties are dependent on the hardware and are described in the respective device's manual. There, you will also find background information on the module's technical workings.



Parameter	Description		
	long name	*short name*	*column ID*
Measurement mode	*Measurement mode*	*Mode*	*eChannelMode*
	Measurement types. See Measurement mode - Overview 375		
Encoder without zero impulse	*Encoder w/o zero impulse*		*eNullImpuls*
	The **zero impulse** starts the incremental counter inputs' logic unit. Measured values are only recorded once an event has occurred at the **index channel**. If measurement without a zero pulse is selected, measurement begins directly after preparation of the measurement is complete.		
Signal	*Counter signal*	*Signal*	*eSignal*
	One signal counters or Two signal counters • One signal counters capture a sequence of impulses without a specified direction. The value is always positive, as for example a frequency or (typically) an RPM-value. • Two signal counters return two impulse sequences, mutually offset by 90°. in this way, the encoder can distinguish in which direction the sensor is moving. This type s especially suited to measurements of velocity, distance and angle.		
Scaling factor	*Counter scaling factor*	*Scaling factor*	*eUserScalingFactorENC*
	How many pulses represent one physical unit depends on the measurement mode set.		
Maximum	*Maximum*		*eMaximum*
	Maximum value or input range end value The measured value should lie within the upper third of the range. The resolution results from the maximum divided by 2^{16}, or 2^{15} for two-signal counters.		

Parameter	Description		
	long name	*short name*	*column ID*
Start edge	*Counter start edge*	*Start edge*	*eStartEdge*
	Start edge on time and pulse measurement. Depends on the measurement mode 375.		
Stop edge	*Counter stop edge*	*Stop edge*	*eStopEdge*
	Stop edge on time and pulse measurement. Depends on the measurement mode 375.		
Input range	*Counter input range*	*Input range*	*eInputRange*
	This setting is available only for certain incremental counters. For information on this subject, refer to the material on the respective incremental counters in the device manual.		
Signal shape	*Counter signal shape*	*Signal shape*	*eSignalform*
	This setting is available only for certain incremental counters. For information on this subject, refer to the material on the respective incremental counters in the device manual.		
Switching level	*Counter switching level*	*Switching level*	*eLevel*
	Here you set the lower voltage limit interpreted as the HIGH level.		
Hysteresis	*Counter hysteresis*	*Hysteresis*	*eHysteresis*
	The hysteresis ensures that duplicate impulses are not counted in the case of noisy signals. These two settings are used to derive the signal levels as follows: HIGH = Signal > Switching level LOW = Signal < (Switching level - Hysteresis)		
Unit	*Unit*		*eUserUnit*
	Measurement value unit. Depends on the measurement mode set.		
Scaling offset	*Scaling offset*		*eUserOffset*
	Here you can enter an offset.		

Note

Low-pass filter

Set the low-pass filter accordingly (see "*Filtering* 376"). The Low-pass ensures that peaks in the signal do not lead to duplicate counts.

Make sure that the frequency of the useful signal is not below the low-pass frequency set. Otherwise, your useful signal will be filtered smooth.

Sampling times/rates

For all active incremental encoders (and associated active Monitor channels) of one module (e.g. CRFX) or a device (e.g. C-SERIES), only one sampling interval/-rate may be set.

8.3.6.1 Measurement mode - Overview

Reference

More information about the measurement modes are described in the chapter: *Information and Tips* > Incremental Encoders 422 or in the respective device manual.

As a rule, what type of measurement is performed is determined by your setting for the **Measurement mode**:

Event counting

Measurement mode	Description
Events	Number of events within a sampling interval
Distance (differential)	Path traveled within one sampling interval. For this purpose, the number of pulses per meter must be entered. The absolute distance is not directly measurable but must be calculated in imc Online FAMOS.
Angle (differential)	Angle traveled within one sampling interval. For this purpose, the number of pulses per revolution must be entered. The absolute angle can be calculated in imc Online FAMOS or determined by the mode Angle (abs).
Angle (absolute)	Absolute angle. The differential angle measurement is converted to the absolute angle. By taking the zero impulse (the counter with no zero impulse should not be selected) into account, the absolute angle position is determined and indicated. Otherwise, the angle value is assumed to be 0° when the measurement begins.

Time measurement

<table>
<tr><th>Measurement mode</th><th>Description</th></tr>
<tr><td>Time</td><td>The time between two signal edges is determined. For this purpose, the settings options for the Start and Stop of the measurement appear. There are several possibilities:
<table>
<tr><td>positive edge</td><td>></td><td>negative edge:</td><td>↑ > ↓</td></tr>
<tr><td>negative edge</td><td>></td><td>positive edge:</td><td>↓ > ↑</td></tr>
<tr><td>positive edge</td><td>></td><td>positive edge:</td><td>↑ > ↑</td></tr>
<tr><td>The combination negative edge</td><td>></td><td>negative edge:</td><td>↓ > ↓ is not allowed</td></tr>
</table></td></tr>
<tr><td>Pulse time</td><td>The point in time of a signal edge within the sampling interval is returned. Certain imc Online FAMOS functions used this information, e.g. when determining a pulse signal's plot of angular speed: OtrEncoderPulsesToRpm.

The mode Pulse time depends on the sampling interval. The entry only appears for some amplifiers if the appropriate sampling interval is set (≤ 1ms or ≤ 100µs; see device manual).</td></tr>
</table>

Combined measurement

Measurement mode	Description
Frequency	The time of two consecutive pulses is converted to frequency. If the frequency was previously multiplied or divided, this can be reflected in the scaling value. The frequency is always unsigned, for which reason there is no two-signal encoder for it.
Speed	The sequence of pulses is converted to m/s. Toward this end, the amount of pulses per meter must be entered.
RPM	The sequence of pulses is converted to revolutions per minute. Toward this end, the amount of pulses per revolution must be entered.

8.3.7 Video

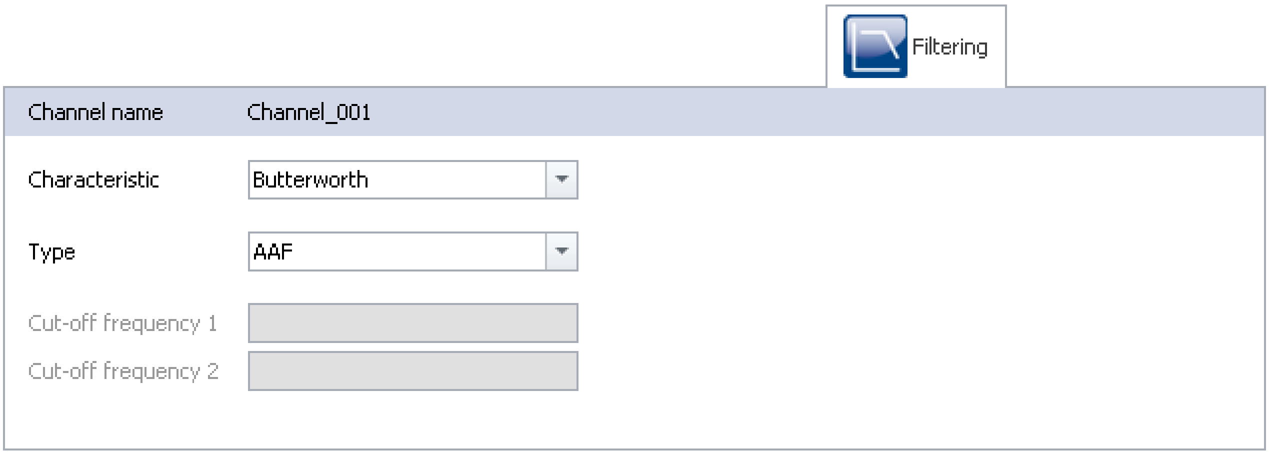
Only enabled when video devices are connected.

Reference

For a detailed description, see the manual: Video 1711.

8.3.8 Filtering

The amplifiers are able to filter the signal before it's subject to further processing in the system. The 6th-order filter with Butterworth or Bessel characteristics performs high-, low- and band-pass filtering.



Filter settings (example: Bandpass)

Here you can select the **filter characteristics** and the **filter type** for the selected channel. The cutoff frequency 2 can only be set for bandpass filters.

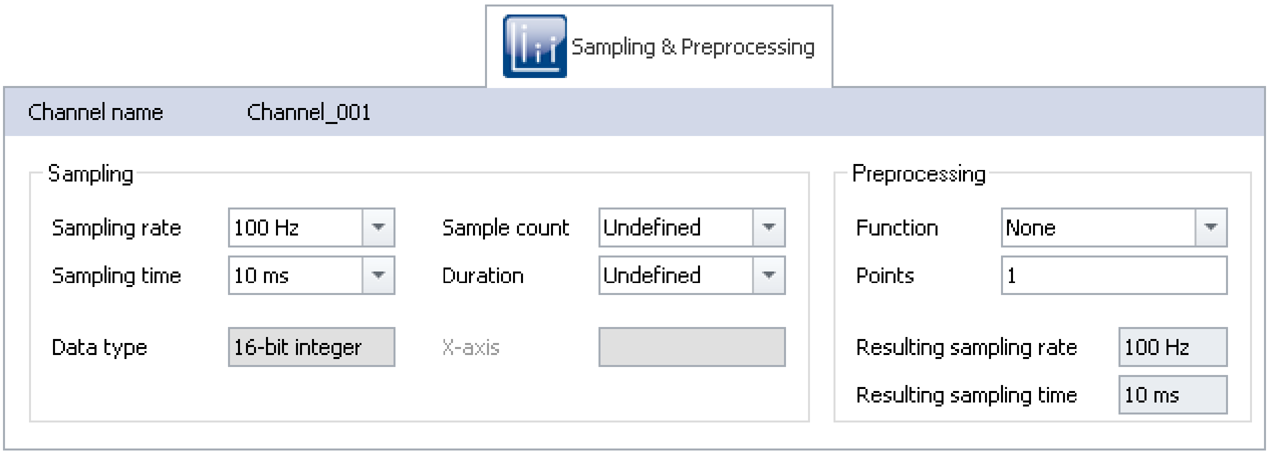
Along with filter types to select by their cutoff frequencies, there is also an **anti-aliasing filter (AAF).** This is a low-pass filter whose cutoff frequency is set to comply with the requirements of the Sampling Theorem. Thus, frequency components above ½ of the sampling frequency are suppressed. This refers exclusively to the input channel, not to its **monitor channel** 352. **Aliasing effects** are possible with a monitor channel by resampling.

The default setting is AAF, where a cauer filter is calculated internally. The displayed characteristic (in the picture Butterworth) is only used at a given cut-off frequency.

Reference

For a more detailed description of filtering techniques see the **device manual**.

8.3.9 Sampling & Preprocessing



Sampling & Preprocessing

The availability and selection of settings depends on the channel type.

Parameter	Description *long name*	 *short name*	 *column ID*
Sampling rate	*Sampling rate*		*SampleRate*
	Setting for the sampling rate. Sampling rate = 1/Sampling time **Active channels** can use a maximum of two different sampling times/rates per device. For all active **incremental encoders** (and associated active Monitor channels) of one module (e.g. CRFX) or a device (e.g. C-SERIES), only one sampling interval/-rate may be set. See also: Notes on the "Sampling rate" and the "Sum sampling rate" 380		
Sampling time	*Sampling time*		*eSampleTime*
	Setting for the sampling time. Sampling time = 1/Sampling rate **Active channels** can use a maximum of two different sampling times/rates per device. For all active **incremental encoders** (and associated active Monitor channels) of one module (e.g. CRFX) or a device (e.g. C-SERIES), only one sampling interval/-rate may be set.		
Sample count	*Sample count*		*SampleCount*
	The amount of measured values per measurement. Select *undefined* (or enter "0") for unlimited measurement duration. When the Sample count is entered, the resulting measurement duration is corrected accordingly. The measurement duration is given by: Sample count * Sampling time.		

<table>
<tr><th>Parameter</th><th>Description
long name | short name | column ID</th></tr>
<tr><td>Duration</td><td>Duration | | eDuration

The duration of the measurement. Select undefined (or enter "0") for unlimited measurement duration.

When the measurement duration is entered, the resulting sample count is corrected accordingly. The sample count is given by Duration/Sampling time.</td></tr>
<tr><td>Function</td><td>Processing function | Function | eProcessing

Simple processing of the measured values. In contrast to the corresponding functions in imc Online FAMOS, it is not possible here to set processing of moving segments of data.

Different functions depending on the channel type:
• Arithmetic Mean
• Minimum
• Maximum
• RMS
• Min-Max (by turns, the minimum and the maximum are returned)
• Reduction

Reduction: Data reduction for digital inputs:

Only once the signal applied changes is a new measured value recorded. The respective time of data capture is recorded as a time stamp along with the measured data, for the purpose of subsequent data processing.

Therefore the port has to be set to Measurement mode: Sampling.

Only whole ports can be captured with data reduction. Individual bits always are dependent on their port. As soon as an individual bit changes its state, the port is sampled and given a time stamp.</td></tr>
<tr><td>Points</td><td>Processing points | Points | eProcessingPoints

The number of data points (measured values) on which the function is to be carried out (not accounting for reduction). The number of points is also the reduction factor. This means that the resulting and stored sampling rate results from the set sampling rate/points. Monitor channels 350 receive the data without preprocessing. Thus, the maximum sampling rate of a monitor channel is the set sampling rate.</td></tr>
<tr><td>Resulting sampling rate</td><td>Resulting sampling rate | | PreprocessedSampleRate

Resulting count of values from the sampling rate/time set and the amount of points.

Resulting Sampling rate = Sampling rate/Points</td></tr>
<tr><td>Resulting sampling time</td><td>Resulting sampling time | | PreprocessedSampleTime

Resulting count of values from the sampling rate/time set and the amount of points.

Resulting Sampling time = Sampling time*Points</td></tr>
</table>

<table>
<tr><th>Parameter</th><th colspan="3">Description
long name | short name | column ID</th></tr>
<tr><td>Measurement mode</td><td colspan="3">

Measurement mode	*Mode*	*eChannelMode*

Basic setting for the measurement type **Digital Inputs**:

- **Bit Input:** the port indicates the current state
- **Sampling:** the port continually captures data. These digital channels can be displayed the same way as analog channels.

Changes apply to the port and the corresponding bits.</td></tr>
<tr><td>Data type</td><td colspan="3">

Channel data type	*Data type*	*eDataType*

Resolution of measurement results:

- **16-bit integer**
- **Float (24-bit mode)** (*32-bit float (24-Bit mantissa)*)

The availability of this option depends on the device.

Samples with 24-bit resolution generate twice as much data volume. For 24-bit resolution, please be aware of the increased memory requirement 741 and please observe the technical specifications stated in the user's manual for the respective device. In 16-bit mode, for devices belonging to Group 7 165 and higher, the maximum aggregate sampling rate achievable via EtherCAT is 2000 kHz.</td></tr>
</table>

Settings for field bus channels

The data of these channels are captured via a special Field-bus interface. The necessary definitions are made by use of the Field-bus Assistant. Field-bus channels are also included in the trigger machine.

Channel type	Description
Field bus: Analog inputs	The Field-bus channels carry data acquired by sensors which are connected to a field-bus such as a CAN-Bus.
Field bus: Digital inputs / outputs	The Field-bus channels carry digital data acquired by sensors which are connected to a field-bus.

If Field-bus channels are selected in the Channel table (assuming the device is configured correspondingly), there are additional parameters to set:

Parameter	Description *long name* / *short name* / *column ID*
X-axis	*X-axis* / / *eXFormatVariable* • *Sampling rate*: The setting Sampling time is related to the settings **Duration** or **Sample count** and **Sampling rate/time** as previously discussed. • *Time stamp*: Data acquisition is handled by external, asynchronous sampling within the field-bus. The corresponding time coordinate for the data point is passed as a time stamp along with the data for subsequent processing. In this case, the parameters **Sample count** and **Sampling rate/time** are irrelevant.
Duration	*Duration* / / *eDuration* If the parameter X-axis is set to *Time stamp*, the duration of the measurement depends only on the setting in **Duration**.
Assignment	*Assignment* / / *eAllocation* The data can additionally be assigned to a Display variable (only for analog Field-bus inputs).

Notes on the "Sampling rate" and the "Sum sampling rate"

Among the measurement device's physical measurement channels, up to two different sampling times can be in use. The smallest possible sampling time is 10 µs, corresponding to a channel sampling rate of 100 kHz (sampling frequency). The aggregate sampling rate of the system is the sum of the sampling rates of all active channels.

The aggregate sampling rate can take a maximum value of 400 kHz with devices of group 2 to 5 165.

The aggregate sampling rate can take a maximum value of 2 MHz via EtherCAT else 400 kHz with devices of group 7 165. This maximum aggregate sampling rate (2 MHz via EtherCAT) can only be achieved when not using the processvector variables, without any trigger, and only in 16-bit mode! A CRFX / DAC-8 module contributes 5 kHz and 16 bits per channel, regardless whether it is used in the experiment.

The sampling rates of the **virtual channels** computed by **imc FAMOS** do not contribute to the sum sampling rate. Along with the (maximum of) two "primary" sampling rates, the system can contain additional "sampling rates" resulting from the effects of certain data-reducing imc Online FAMOS functions (ReductionFactor RF).

Note

There is one constraint when selecting **two different sampling rates**: **Two sampling rates** having the ratio **2:5** and lower than 1 ms are not permitted (e.g. 200 µs and 500 µs). Any attempt to set sampling rates which do not comply with this rule will cause an error message to be posted:

"The two active sampling intervals may not be in a ratio of 2:5.   Error number: 365“

Note — Note for imc CRONOS*flex*

For CRONOS*flex* modules, the following limitations apply due to the CRFX systembus's 5 kHz bus rate:

- A CRFX-channel sampling at a slower rate than 5 kHz produces the same data load on the CRFX systembus as a 5 kHz channel. Thus for instance, 20 channels sampled at 100 Hz produce a load of 100 kHz on the CRFX systembus instead of 2 kHz.
- With 2 kHz channels, the resulting data load per channel is 10 kHz due to the 2:5 ratio.
- imc CRONOS*flex* DIO- and DAC modules support a maximum sampling rate of 5 kHz, even though 100 kHz can be set in the software.

Note — Note for GPS channels

Due to system limitations, **GPS channels** for determining the fastest sampling rate in the system are not taken into account. For an working configuration, at least one other channel (fieldbus, digital or analog) must be sampled at the same or faster sampling rate.

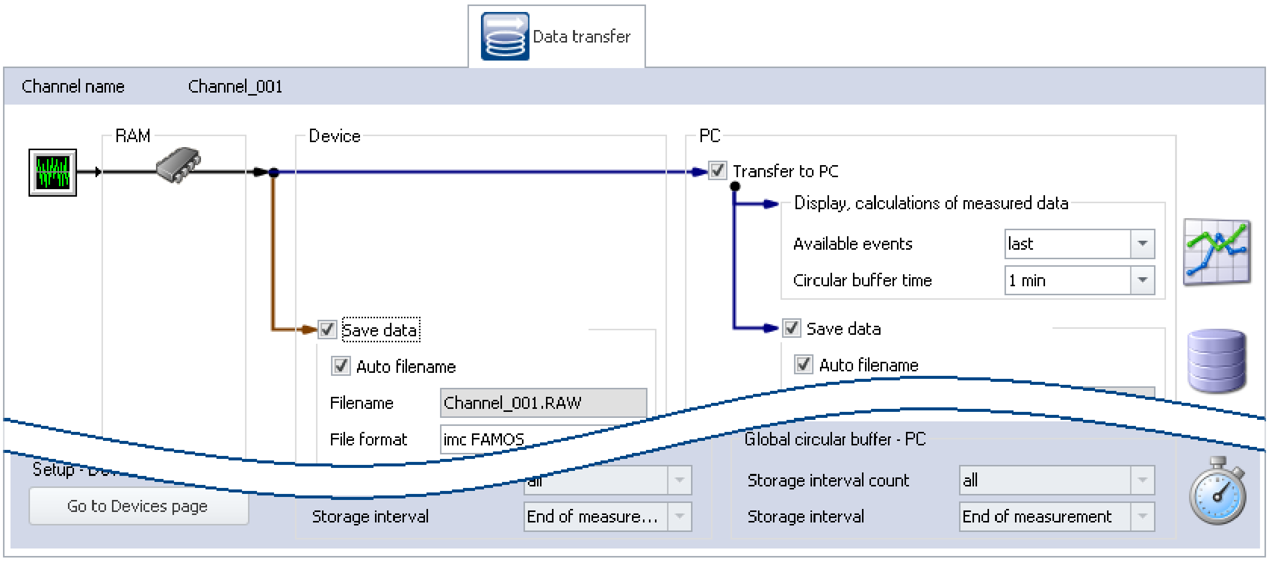
Reference

Please consider the specifications in chapter "Technical Specs" of the device manual and the description of the channels configuration.

8.3.10 Data transfer

Reference

This chapter contains a brief introduction to saving channel signal data. More detailed descriptions of all functions are presented in the manual:
Setup - Advanced Device Functions > Storage Options and Directory Structure 709.



Transfer to PC

For transfer of the measured data to the PC, there are two regions of the dialog:

Region	Description
Display, calculations of measured data	Temporary storage of measured data. E.g. for display of a Panel page and for subsequent processing.
Save data	Saving of measured data in the experiment folder. The data structure is set in the device settings under Storage 298.

Each of the regions is set separately.

Note

Per interval or measurement, one file is created per channel, which contains the respective measurement files

Available / Saved events

With this setting, you determine whether all triggered events are to be saved or only the last one.

If all events are saved, the result is an event-based data set. For storage of the measured data on the PC, each event can be saved to a separate file. (see Device settings/Storage 298)

Circular buffer time

Here you set how long the maximum time segment is. Enter a time in seconds. You can also make a formatted entry. To do this, append one of the following suffixes to the numerical value: s: seconds; min: minutes; h: hours; d: days.

Deactivate circular buffer: If you enter "*0*", circular buffer operation is deactivated and all data are saved.

Warning

If you set the storage duration to unlimited (0), the curve windows use unlimited amounts of RAM

This settings is absolutely not suitable for long-term measurements

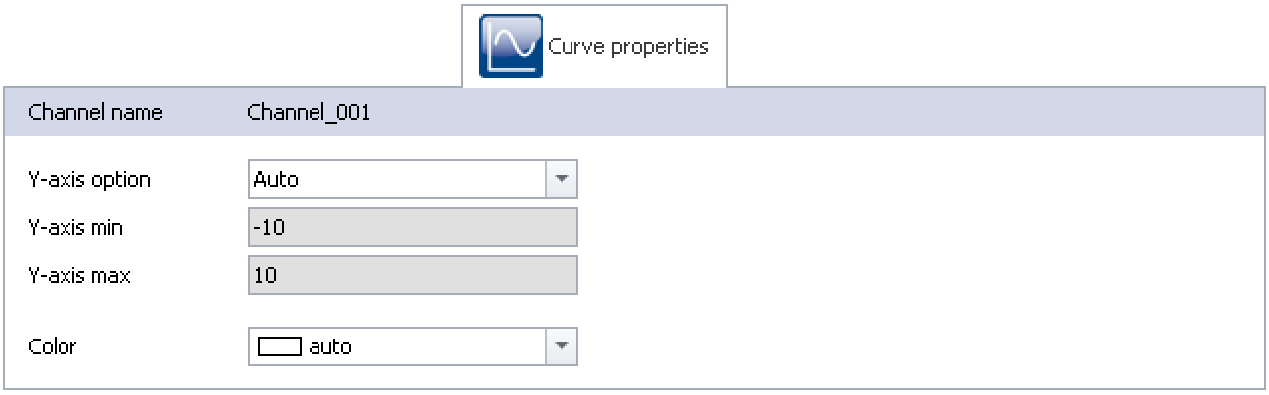
8.3.11 Histogram / Rainflow

Only visible for certain virtual channels generated in imc Online FAMOS using appropriate functions.

Here you can set defaults. These will affect the display and storage of the data of the respective virtual channel: e.g. Histogram or Rainflow.

Parameter	Description		
	long name	*short name*	*column ID*
Histogram display update interval	*Histogram display update interval*		*eHistogramUpdateInterval*
	Time interval for updating data which are derived from counting functions		
Histogram storage interval	*Histogram storage interval*		*eHistogramSaveInterval*
	Time interval for saving data which are derived from counting functions		

8.3.12 Curve properties



Parameter	Description *long name*	 *short name*	 *column ID*
Y-axis option	*Curve y-axis option*	*Y-axis option*	*eCurveYAxisOption*
	Pre-defined setting for the **range of display elements** (Widgets). The setting is applied to the (display) range if: • "auto" is set in the curve window or • the "Range" for the other Widgets is set as "From the variable". The following possibilities are available: • **Input range:** Max and Min values match the measurement range set for the channel • **User-defined (min, max):** Max and Min values can be set in the parameters further below • **Auto:** Not transfer of range information		
Y-axis min	*Y-axis min*	*Curve y-axis min*	*eCurveYAxisMin*
	If "Y-Axis option" is set to "User-defined": The transmitted Minimum-value for the display range.		
Y-axis max	*Y-axis max*	*Curve y-axis max*	*eCurveYAxisMax*
	If "Y-Axis option" is set to "User-defined": The transmitted Maximum-value for the display range.		
Color	*Color*	*Curve color*	*eCurveColor*
	Pre-defined setting for the **channel-color** in the curve window.		

8.3.13 Additional Parameters

Additional parameters are available, which are either already displayed in the channel table, or which you can add manually using the "*Column chooser* 254".

Category: Channel

<table>
<tr><th>Parameter</th><th colspan="3">Description
long name | short name | column ID</th></tr>
<tr><td>Balance at device startup</td><td colspan="3">Balance at device startup | Balance at startup | eBalanceAtDeviceStart

This parameter has two purposes:
Before a Diskstart/Autostart measurement starts, it is possible to perform balancing for selected channels.
The channels selected can be balanced using the imc Online FAMOS function <code>RunAutoBance()</code> 1001.
This balancing operation starts automatically before every Diskstart-measurement. The type of balancing performed is set on the following page: Setup page: "Channel balance" > "Balance 387". Available options: Taring or bridge balancing (depending on the hardware).</td></tr>
<tr><td>Connector</td><td colspan="3">Connector | | ePlugInName

The number returns a fixed identification of the variable. E.g. "[03] IN04". It is composed of:
[i]: the module’s address (mainly only for physical inputs and outputs)
xyz: abbreviation for the channel type (IN = analog channel, MIN: monitor: analog channel, ...)
j: consecutive numbering within the respective module or entire channel type, if no address available
Examples:
[03] IN04: analog input, fourth input at the address "03"
V005: Virtual channel with the number 5
[00] DO01Bit05: Digital outputs (bit) fifth bit at Port: "01", at address: "00"
[02] MCIN02: Monitor: incremental counter-inputs, second input at the address "02"
PV007: Process vector-variable with the number 7</td></tr>
<tr><td>Enumerated channel number</td><td colspan="3">See "Channel number"</td></tr>
</table>

Additional parameters are available, which are either already displayed in the channel table, or which you can add manually using the "*Column chooser* 254".

Parameter	Description		
	long name	*short name*	*column ID*
Channel number	*Enumerated channel number*	*Channel number*	*eEnumeratedChannelNumber*
	Corresponds to the column "Connector", with the exception of the module address. The module address is not included in the display and so the count is performed across all modules, rather than each module separately. The column: "Connector" does not correspond to the consecutive numbering on the front panel for some devices (e.g. imc SPARTAN and imc CRC). Example: Above: "Connector"; below: "Enumerated channel number"		

[01] IN01	[01] IN02	[01] IN03	...	[01] IN07	[01] IN08	**[02] IN01**	[02] IN02	[02] IN03	...	[02] IN07	[02] IN08	**[03] IN01**	[03] IN02
IN001	IN002	IN003	...	IN007	IN008	**IN009**	IN010	IN011	....	IN015	IN016	**IN017**	IN018

Category: Module

Parameter	Description		
	long name	*short name*	*column ID*
Bridge supply	*Bridge supply (On/Off)*	*Bridge supply*	*eBridgeSupplyOnOffAction*
	Some amplifiers provide the ability to switch the power supply on or off. The power supply voltage can be used either for the bridge supply or the sensor supply.		

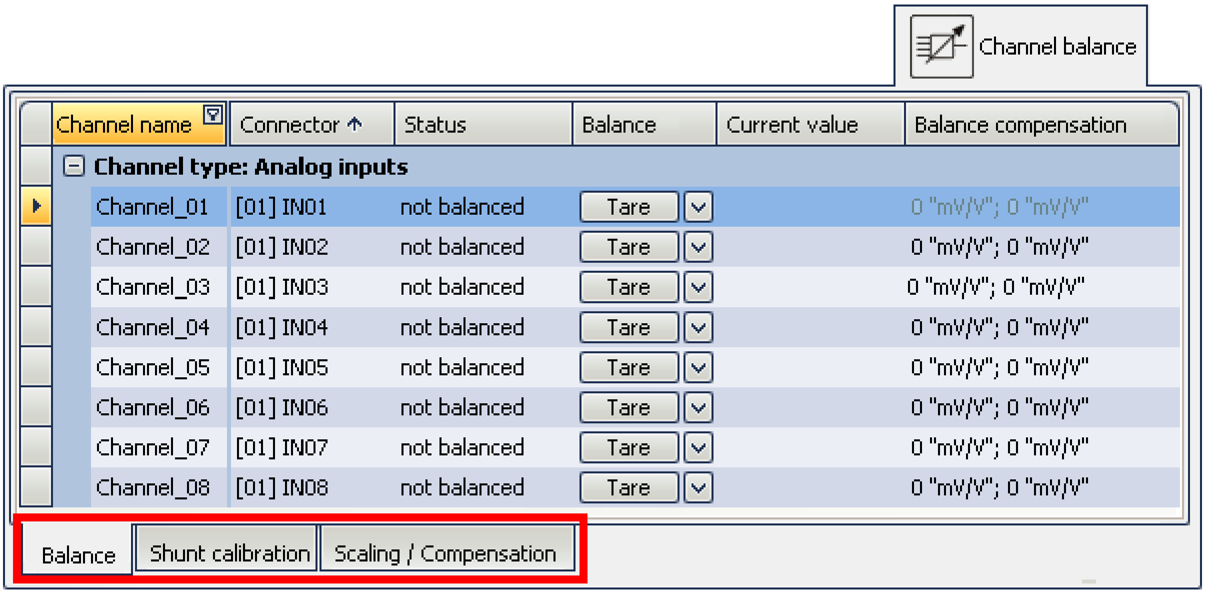
Category: Other

Parameter	Description		
	long name	*short name*	*column ID*
Current value	*Current value*		*CurrentValueDisplay*
	Displays the current measurement value (value of the associated process vector variable). The value is available after initialization (Download) of the measurement. Additionally, color-coding indicates in which region of the measurement range the value is located. If no value is displayed, either there are no process vector variables available or the measurement have not yet been initialized. If the value is displayed in gray, channel settings have been changed since the initialization.		

8.4 Channel balance

On the page **Channel balance**, you can have various adjustment and calibration types performed, and obtain information on the configuration.

To get to the desired page, there is a row of tabs at the lower left.

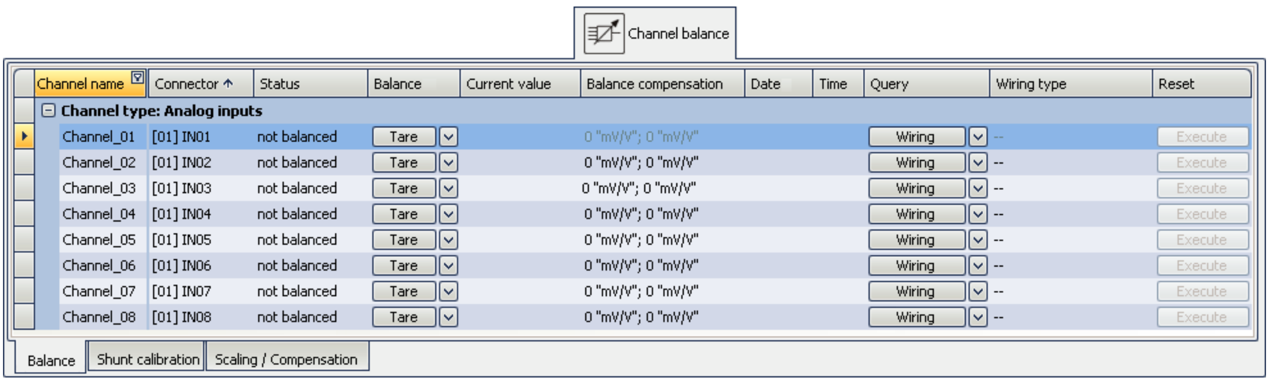


Balance 387	• Tare • Bridge • Query wiring • Reset charge
Shunt calibration 391	• Shunt calibration
Scaling / Cable compensation without Sense configuration 392	• Two-point scaling • Cable compensation

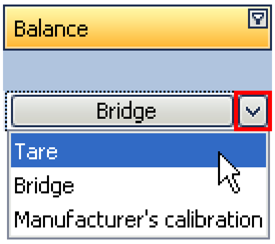
8.4.1 Balance - Tare and Bridge

Balance

This page enables, among other things, **taring** and **bridge balancing** of amplifier channels to be performed.



To perform an adjustment, first select the channel and in the column *Balance* using the button a right, the desired action.



Adjustment only starts once you click on the button after making your selection.

Balance	Description
Bridge	Performs physical bridge balancing for all selected bridge channels. Balancing can eliminate any offset distorting the measurement signal. The offset can be a multiple of the input range. With bridge balancing, the input range selected is retained. With multiple channels, the bridge balancing is performed in parallel amplifier-by-amplifier, but sequentially within an amplifier.
Tare	With taring, the distorting offset is canceled mathematically from the signals of the measured channels, which leads to a shift of the input ranges. The measurement chain including sensors is taken into account. Observe the notes on hardware 388.
Manufacturer's calibration	Manufacturer's calibration resets all selected channels to the original imc-factory calibration setting

Note Notes on hardware: balancing with setted offset

Zeroing with adjusted offset leads to different results with CRFX/CRXT modules and amplifiers installed in imc CRONOS*compact*, imc C-SERIES or imc SPARTAN:

- CRFX/CRXT: Zeroing 387 adjusts the channel in the physical unit, e.g. 0 bar. This applies to all modules for the acquisition of analog voltages with 16 or 24 bits, except UNI-4.
- imc CRONOS*compact*, imc C-SERIES, imc SPARTAN, CRFX/UNI-4: The electrical value is balanced, i.e. the entered offset is retained. After the adjustment, the physical value is displayed with a negative offset. This ensures that an offset entered subsequently is not overwritten. If you wish for the balancing to determine the offset, **only enter the factor**, and then subsequently balance the offset by means of the Balancing function 387. Adaptation to the behavior of CRFX/CRXT is in preparation.

Response of the balancing to changing the measurement range and measurement mode

The balancing process depends on the measurement range and measurement mode (Voltage – Current – Strain Gauge). This means that the balancing only applies for the currently valid setting. Whenever the measurement range or mode is changed, a new balancing process is necessary. The balance values are saved internally and are re-activated once the system returns to the associated setting.

For instance, if the measurement range is changed, the balance value applicable for the current range setting is saved internally, but cleared from the settings for the sake of the new measurement range. If there is already a balance value pertaining to the new measurement range, that value is loaded upon performing the preparation procedure

Example

Automatic restoration of the balance value upon changing the measurement range

Measurement range: ±5V
Value applied: 1V
Balancing performed -> shifted measurement range is -6 .. 4V

Measurement range changed to ±2.5V -> This clears the balance value
Value applied: 2V
Balancing performed -> shifted measurement range is -4.5 .. 0.5V

Measurement range changed to ±5V -> This clears the balance value
Download -> shifted measurement range is "-6 .. 4V", which matches the case of the first balance value.

Note

The results are saved with the experiment. Previous results are only deleted once a new adjustment or manufacturer's calibration has been performed.

FAQ

Question: Can I perform balancing also during a running measurement?

Answer: Yes. From firmware 83 version 2.8R7 onward, it is possible to perform taring or bridge balancing which a measurement is running. Stopping the measurement is not necessary.

Question: When is the balance OK?

Answer: Balance OK means that the balancing or taring has been performed successfully. With taring, the input range has been adapted accordingly and the procedure is complete. Successful balance is achieved once the remaining offset lies within the guaranteed tolerances.

Correspondingly, there are various error message which can be returned.

- The connected bridge is unstable, i.e. the unbalance initially found is replaced by another, not eliminated.
- The connected bridge's initial unbalance is too high. How much of an initial unbalance can be compensated depends on the amplifier type (UNI-8, BR-4, etc.) and input range and is stated in the corresponding spec sheets.

Balancing is performed independently by the amplifier card, which receives the command to perform the balance on the signals which are connected to it. A balancing value is calculated on the basis of the measured value (DAC-settings with BR4 or DCB4; or 24Bit ADC value with Uni8 and similar systems). Subsequently, a new measurement is made using this value, which either confirms the previously calculated value or, with DAC-controlled balancing, causes an additional iteration of the process.

Question: Are the balancing values saved with an experiment transferred when it is opened on a different device 288?

Answer: When opening an experiment which is transferred to a different device, the balancing values saved with the experiment are also retained. Be aware that the balancing values are subject to some imprecision because they result from the balancing of the bridge and the tolerance of the bridge completion in the amplifier. This means that in the case of half or quarter bridges, an additional balancing is required to achieve high precision.

Question: Can balance values be exported as a parameter set and then imported again later?

Answer: If the exported channel's amplifier type and all relevant amplifier settings (bridge mode, measurement range, 16- or 24-bit resolution...) match those of the imported channel, then export and import are categorically possible. With **taring**, the balance value corrects the measured vale and is thus not critical. With **bridge balancing**, there is an additional issue to consider since the balance values result both from the bridge balance adjustment process and from the tolerance of the bridge completion in the amplifier. For more on this topic, you can read the chapter Parameter set import 1593.

Automatic balancing upon Diskstart/Autostart or using imc Online FAMOS

Activate the property "*Balance at device startup*" (Setup page: "*Channel balance*" or "*Analog channels*") for the desired channels. If you wish, you can also display the parameter of the same name as an additional column by using the "*Column chooser* 254".

Parameter Category: Channel	Description *long name*	 *short name*	 *column ID*
Balance at device startup	*Balance at device startup*	*Balance at startup*	*eBalanceAtDeviceStart*

This parameter has two purposes:

- Before a Diskstart/Autostart measurement starts, it is possible to perform **balancing** for selected channels.
- The channels selected can be balanced using the **imc Online FAMOS function** `RunAutoBance()` 1001.

This balancing operation starts automatically before every Diskstart-measurement. The type of balancing performed is set on the following page: Setup page: "*Channel balance*" > "*Balance* 387". Available options: Taring or bridge balancing (depending on the hardware).

Query wiring

With this function, measurements of the Sense lines are taken and the circuit configuration is derived from the resulting data. In such cases, the hardware is unable to distinguish whether a circuit without Sense lines is involved or whether a bridge was accidentally not connected or connected incorrectly. Thus, this function is not intended for detecting the circuit but for verifying whether the desired circuit was correctly recognized by the hardware.

Note

With the quarter bridge, the hardware is unable to distinguish between 5- and 6-wire measurement

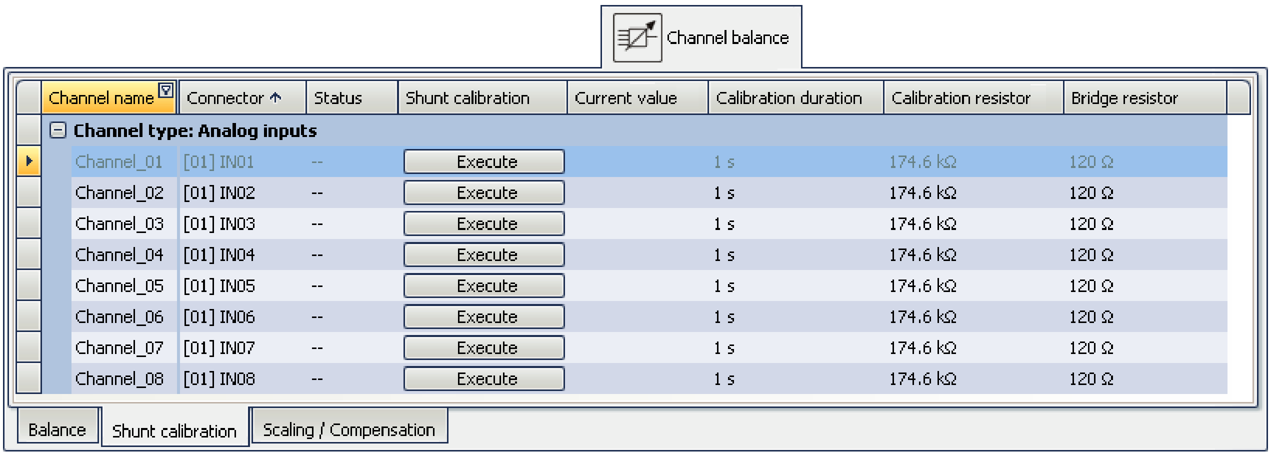
Resetting the charge

For charge amplifiers (coupling = "Charge/DC"), as well as for audio amplifiers with peak evaluation (filter type = "Peak"), it is periodically necessary to carry out a reset.

In the column Reset, the button *Execute* becomes active if this function is supported by the selected amplifier channel. This button manually resets the channel.

8.4.2 Shunt calibration

This page enables **shunt calibration** of amplifier channels.



When a shunt calibration is carried out, the bridge is unbalanced for a specified time by means of a shunt, a resistor connected in parallel. The shunts available depend on the amplifier type involved.

A shunt calibration can be carried out at any time during a running measurement.

The duration to be set is the minimum duration. It is much longer and depends on the system's load.

Note

The shunt calibration is to be considered as only a **function test**. Since the shunt is located within the device, the results are falsified by the resistance of the leads used. Precisely this fact is exploited, conversely, in cable compensation without a Sense line. The deviation measured is used to calculate the cable resistance.

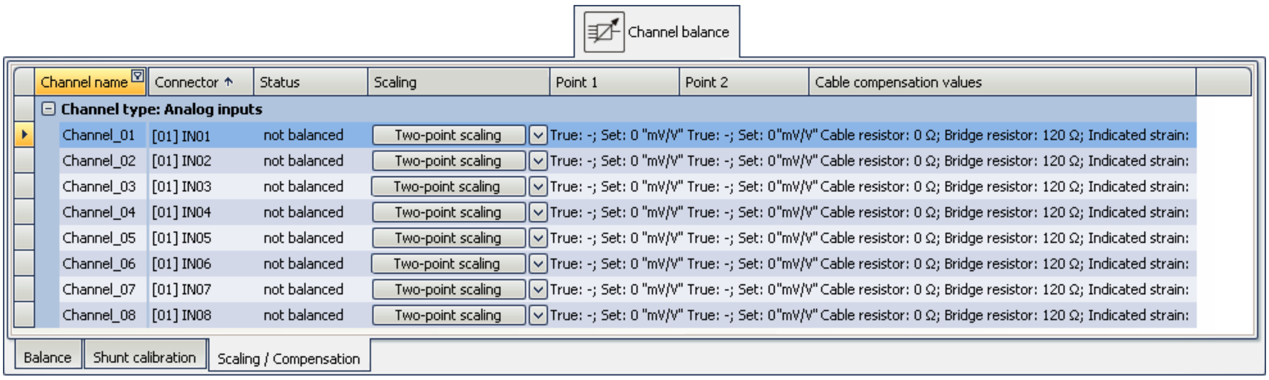
8.4.3 Run Balance or shunt calibration

Besides operation by means of the device software, it is also possible to balance or shunt calibration as follows:

- By means of a button on the "imc Display" which is linked to the Adjustment/Shunt calibration 770.
- Following a device's Diskstart/Autostart 180 (only balance)
- By means of the imc Online FAMOS function `DisplaySetButton` 923, which carries out an balance/shunt calibration if the button is linked with this function 770.
- By means of the commando: "Execute device action 1595"

8.4.4 Scaling / Cable compensation without Sense configuration

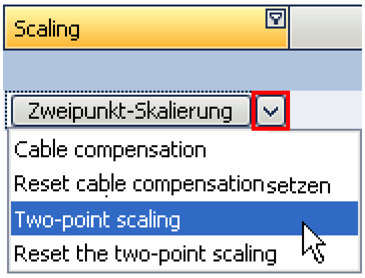
This page enables **Two-point scaling** 393 and **cable compensation without Sense line** 394 to be performed.



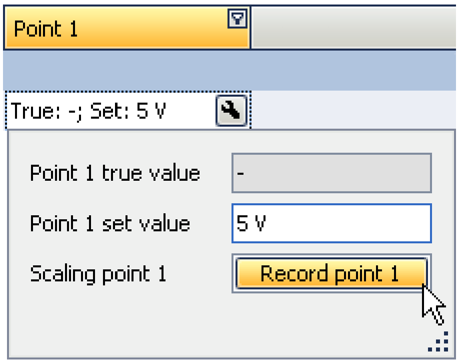
Two-point scaling

Two-point scaling allows linearization of the input range between two defined points.

To perform two-point scaling, first select the channel and in the column *scaling*, using the button at right, select *Two-point scaling*.

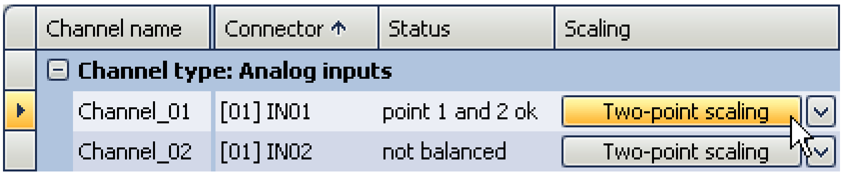


In the columns *Point 1/2*, set the respective target values. Record Point 1 and Point 2 in succession.



The status of the procedure is indicated in the column *Status*.

Once Points 1 and 2 have been successfully specified, the actual scaling must be performed. To do this, click on the button in the column *scaling*.



Note

- If bridge balancing or bridge taring is carried out after two-point calibration, any offset present is canceled, but the slope between the two points remains intact.
- The points must be separated by at least 1% of the input range. If it is necessary for technical reasons to perform the adjustment over a small input range, there is a problem since upon return to larger input range the prevalent two-point scaling will be rejected. In this case, it will be necessary to resort to the two-point scaling on the dialog Range & Scaling 369's page *Channels (Analog or Digital)*. A description is provided in the FAQ 1945.
- The two-point scaling described here is performed by the amplifier module by measuring the signals applied. These signals are passed on to the base system. The base system itself is also able to perform an additional Two-point scaling by manual input 369 by means of manual input. If both procedures are used, they are connected in series, meaning that the scaled valued from the amplifier become the input values of the base system's subsequent two-point scaling.

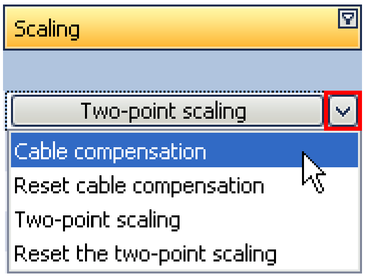
Resetting two-point scaling

To reset a two-point scale, in the column *scaling* use the button at right, *Reset the two-point scaling*. The results in the column *Point 1/2* are then no longer displayed. The two-point scaling is only deleted upon clicking on the button.

Cable compensation without sense configuration

If the bridge resistor is know, it's possible to determine the cable resistance, even or in fact especially if the Sense line isn't connected. Toward this end, a shunt calibration is performed. The deviation from the expected unbalance is used to determine the cable resistance.

In order to perform cable compensation, in the column *Scaling* use the button at right to select *Cable compensation*.



Set the bridge resistance if still needed.

To start the compensation, click on the button in the column *Scaling*.

After performing the cable compensation, the lie resistance values found will be displayed in the column *Cable compensation values*.

Note

- A bridge circuit with a SENSE-line is always preferable to cable compensation without a SENSE-line, in terms of the precision of the measurement results!
- For the cable compensation, the general rule of thumb in measurement engineering applies: select an input range so that the maximum expected input value reaches the top third of the input range. Otherwise, the cable compensation will not work reliably.

Resetting the cable compensation

To reset cable compensation, in the column Scaling select the button at right, Reset Cable Compensation. Only once the button has been pressed is the cable compensation deleted.

8.5 Trigger and Events

A complex trigger machine is implemented in the measurement device. This chapter describes the detailed handling of the trigger options of imc measurement devices.

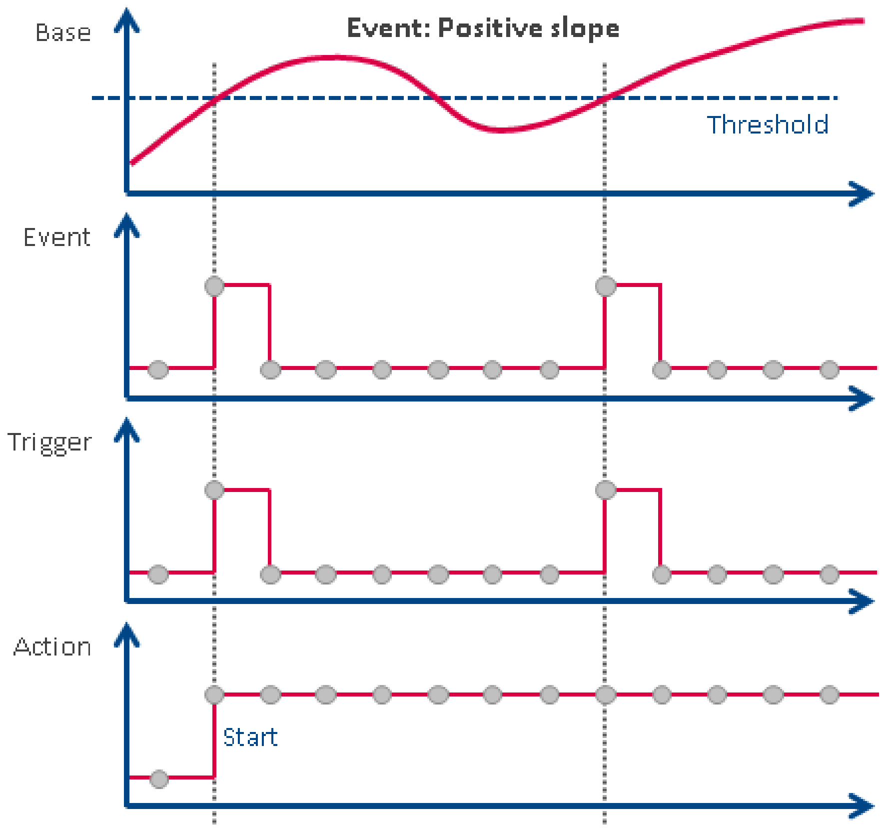
Many kinds of measurements are intended to start only once certain events occur. This applies, for instance, to measurements for which it is known in advance when measurement is to take place.

An example would be measurements of a bridge's vibration when heavy trucks drive over it. In such a case the vibration amplitude is greater than in response to a passing car, so the start of the measurement can be triggered by a specific vibration amplitude caused by a heavy truck.

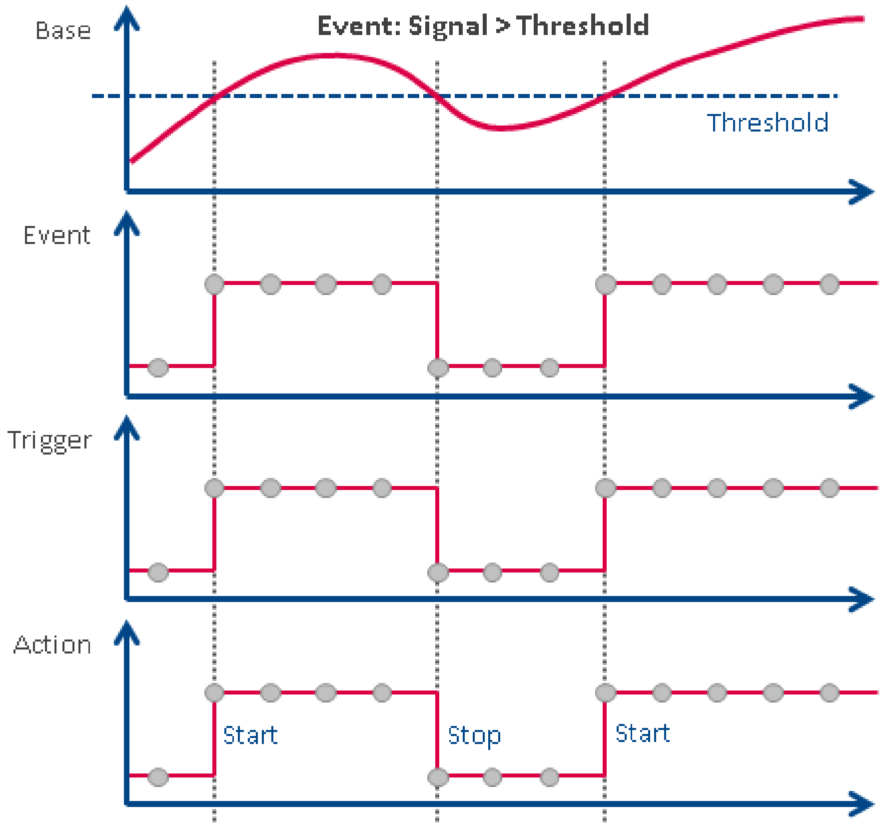
It is possible to continually monitor measurement channels and only to capture data in response to certain events. For this purpose triggers are used which start and stop channels based on the occurrence of certain events.

As soon as a certain event occurs in a signal (e.g. a particular level is exceeded > positive edge), the associated event channel's value becomes 1. This state remains in force for an increment of time. The trigger linked to the event is simultaneously triggered and the associated action is carried out.

Observe the two examples below:



An event releases a trigger and initiates an action
Example: Positive slope



An event releases a trigger and initiates an action
Example: Signal > Threshold

8.5.1 Overview

To begin, the "untriggered" measurement are explained. Afterwards, a description of the imc devices' Trigger-Machine 397 is presented:

- Starting and stopping by trigger. What to make note of (see: Sources and events 399)
- Special aspects of repeat measurements (see: Multiple triggering (Multi-Shot operation) 407)
- Triggering with virtual channels (see: Virtual Channels from imc Online FAMOS 412)
- Use of triggers in imc Online FAMOS (see: Online-Trigger 412)
- Slow background measurement with rapid triggering in the foreground (see: Example: Background Measurements 413)
- Event-driven setting of digital outputs (see: Example: Setting event-driven digital outputs 414)
- Measurement Procedure 411

Untriggered Measurements

Untriggered measurement is started using the Start-button ( ). No settings need to be made in order to do this. Recording of the data begins immediately. When measurement concludes is determined by the channel having the longest measurement duration. If this measurement is undefined, close the measurement by means of the Stop-button ( ).

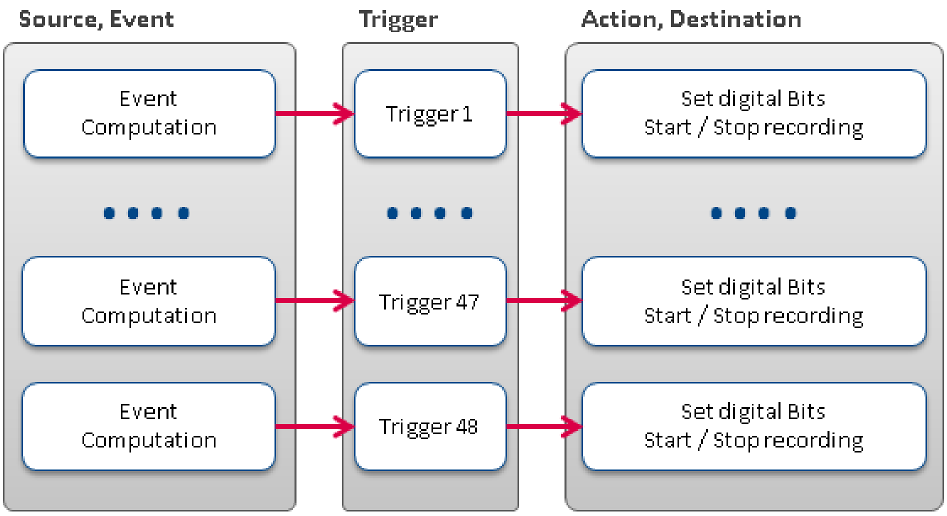
Note

Direct starting of the measurement can be accomplished internally by means of a *1-Trigger*. Even if you have not defined any trigger, the **"Trigger_48"** is already activated in the Trigger dialog as the *1-Trigger*. For more on this topic, see the description under "*Trigger Machine* 397".

8.5.2 Trigger Machine

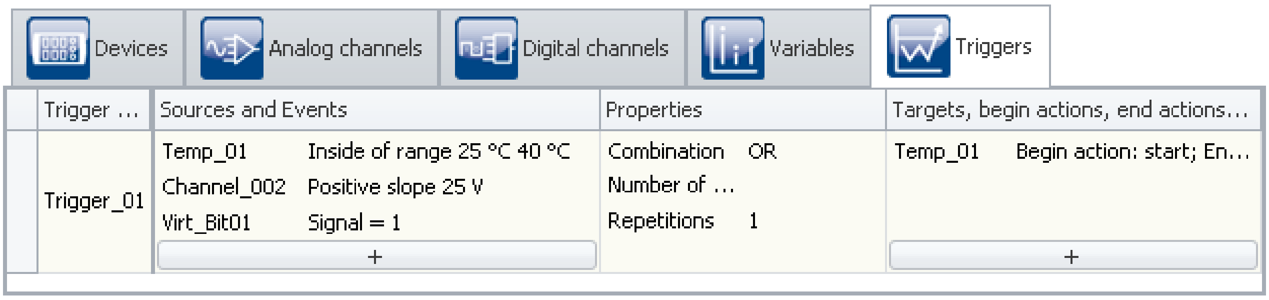
The measurement device implements a complex trigger machine which is capable of accomplishing difficult assignments. It has the following particular features:

- With the trigger machine, up to 48 triggers can each be released independently
- In CRFX/CRXT modules up to 8 trigger events per conditioner can be calculated.
- Individual channels can be started and stopped in response to events
- Digital inputs can govern triggers
- Events can set digital outputs
- Virtual bits can be used for internal linkages
- Events can be combined with AND or OR operations
- The trigger machine works in real-time



Structure of the trigger machine

The relevant settings are made on the Triggers page of the dialog.



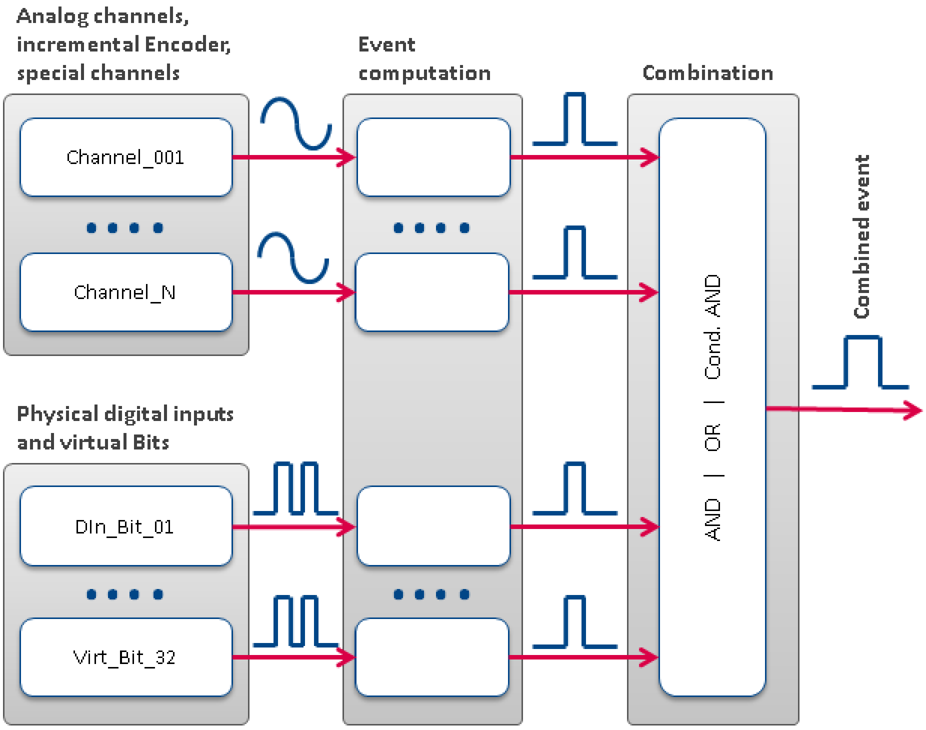
The Trigger dialog page

8.5.2.1 Definitions

Term	Definitions
Event 399	An Event is a defined course or state of a measured signal. It is a binary unit of information, so it can only be either "*true*" or "*false*". Analog or digital variables can generate events.
Action 404	An Action can be the start or stop of data capture, or setting of a digital output.
Trigger	The Trigger is a defined combination of events in response to which an action is performed.
Dwell time 403	A Dwell time is a technique for artificially prolonging events.
Pretigger 409	A Pretigger serves to record the signal course leading up to an event.

8.5.2.2 Sources and events

On the basis of each input channel (analog, incremental counter, Field-bus) and each digital input (bit), it is possible to calculate an event. Multiple events can be joined to form a combined event. Calculation of the combined event is illustrated in the following outline:

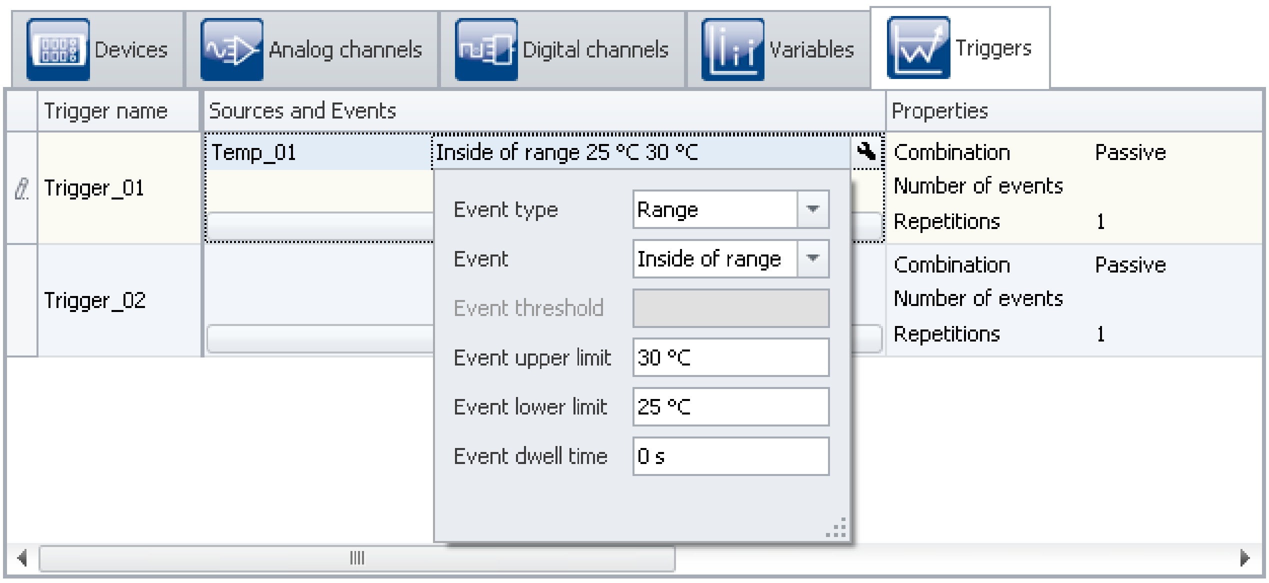


Event computation

Calculation of events from analog variables

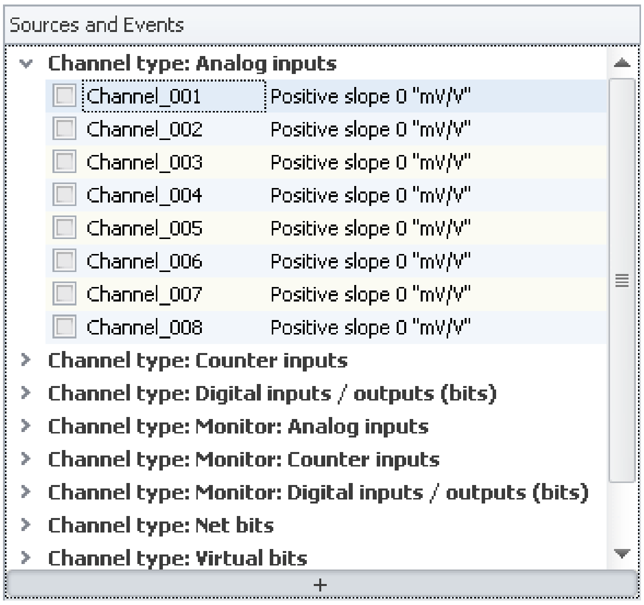
After pre-processing (correction by characteristic curve, scaling, averaging or formation of the RMS), the analog signal's physical value is entered into the event computation, which determines whether an event has occurred, according to the event type set.

The definition is made on the Setup page: "*Triggers*":



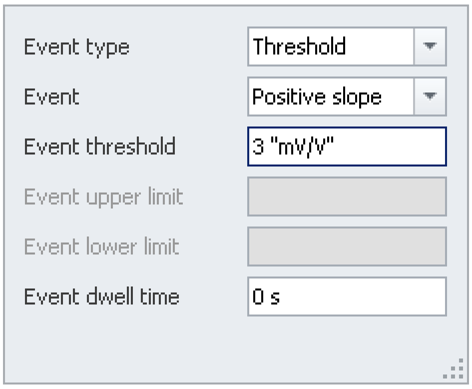
Example: The event occurs when the signal is within the boundaries 25 and 30 °C

Here, the channels (sources) and conditions (events) for releasing the triggers are set. Clicking the button + takes you to a selection dialog for the sources.



Selecting a channel

At left are shown the available channels and at right the events set. To select a channel, click in the checkbox in front of the channel name. To configure the events, click on the event's entry, which opens a menu for setting the event.



Setting an event

The available choices for "**Event type** 401" are "*Threshold*" and "*Range*". The specific event is selected next.

8.5.2.3 Event types

Event type: Threshold

The simplest and most common case is the event type "**threshold value**". In the box "Dwell time 403", you specify how long the event remains in effect once the condition is no longer met.

You can select the following events and their thresholds:

Event	Description
Positive slope	If the monitored channel's signal crosses the threshold from below, the event has occurred. This can theoretically happen very briefly, but in practical terms, it lasts for the space of one sampling interval. Note that in spite of the brevity of the event, a trigger may be released! This means it is even possible to set a digital output this way! In this case, the use of a "Dwell time 403" is frequently helpful.
Negative slope	The event has occurred if the monitored channel's signal crosses the threshold from above. Like "*Positive slope*", only in the reverse direction.
Signal>Level	As soon as the monitored channel's signal level is higher than the threshold, the event has occurred. This can be for a brief moment or a longer period, depending on the course of the signal.
Signal<Level	As soon as the monitored channel's signal level is higher than the threshold, the event has occurred. Like "*Signal > Threshold*", only in the reverse direction.

Event type: Range

The user sets an amplitude range in which the event is defined as operative. The range is determined by a lower and an upper boundary. In the box "Dwell time 403", you specify how long the event remains in effect once the condition is no longer met.

The following events and boundaries are available for selection:

Event	Description
Entering range	If the monitored channel enters the range, whether from above or below, the event is defined to have occurred. This can theoretically happen for only a brief instant, but as a practical matter, lasts for at least one sampling interval duration. Note that in spite of the brevity of the event, a trigger may be released! This means it is even possible to set a digital output this way! In this case, the use of a "Dwell time 403" is frequently helpful.
Exiting range	If the monitored channel's signal exits the range, whether upwards or downwards, the event is triggered. Like with "*Entering range*", only in the reverse direction.
Inside of range	As long as the monitored channel's signal level is within the range, the event is in effect. This can be for a brief moment or a longer period, depending on the course of the signal.
Outside of range	As long as the monitored channel's signal level is outside of the range, the event is in effect. Like "*Inside of range*", only in the reverse direction.

Events from digital signals and virtual bits

Digital signals come either from the device's digital inputs or the virtual bits. The 32 virtual bits (which amount to a 32-bit register), can also be read like digital inputs. For bits, there is no event type. In the box "Dwell time 403", you specify how long the event remains in effect once the condition is no longer met.

The following events are available for selection:

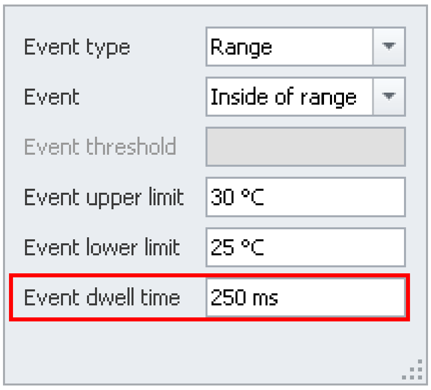
Event	Description
Signal = 1	If the monitored bit's value is *1*, the event is defined to have occurred. This can happen for either a brief instant or for a very long period, depending on the course of the measured signal.
Signal = 0	If the monitored bit's value is *0*, the event is defined to have occurred. The opposite of "*Signal=0*".
Signal change: 1 -> 0	If the monitored bit's value changes from *1* to *0*, the event is defined to have occurred. This can theoretically happen for only a brief instant, but as a practical matter, lasts for at least one sampling interval duration. Note that in spite of the brevity of the event, a trigger may be released! This means it is even possible to set a digital output this way! In this case, the use of a "Dwell time 403" is frequently helpful.
Signal change: 0 -> 1	If the monitored bit's value changes from *0* to *1*, the event is defined to have occurred. The opposite of "*Signal change 1 -> 0*".

Note

For technical reasons, calculation of the trigger occurs only after 2 sampling intervals of the slowest channel. For instance, if the slowest channel is sampled at a rate of 1Hz, it means that any change of bit values is taken into account only after 2 seconds.

8.5.2.4 Dwell time: Artificially prolonging events

With events which remain in effect only for brief periods (signal edges, level-crossing), it is often necessary to prolong the event artificially by defining a "*Dwell time*" > 0.



Einstellung der Haltezeit

maximum dwell time	
@ sampling rate	**dwell time in hours**
100 kHz	5
50 kHz	10
20 kHz	25
10 kHz	50
5 kHz	100
2 kHz	200
1 kHz and lower	500

Every event is prolonged by the duration of the Dwell time. By this means, even a very brief event can be retained for a defined duration.

Example

Example 1

A digital output is activated for an appreciable amount of time, even though the signal transition is very brief. A connected LED stays shining for a certain period instead of flashing for an instant.

Example 2

A measurement could be programmed to start not immediately upon detection of a signal edge, but rather following a pre-defined delay. This can be achieved, for instance, by making the signal edge first set a bit after a Dwell time and then set it back. The virtual bit's later transition from "*1*" to "*0*" is another event which is used for triggering the measurement's start.

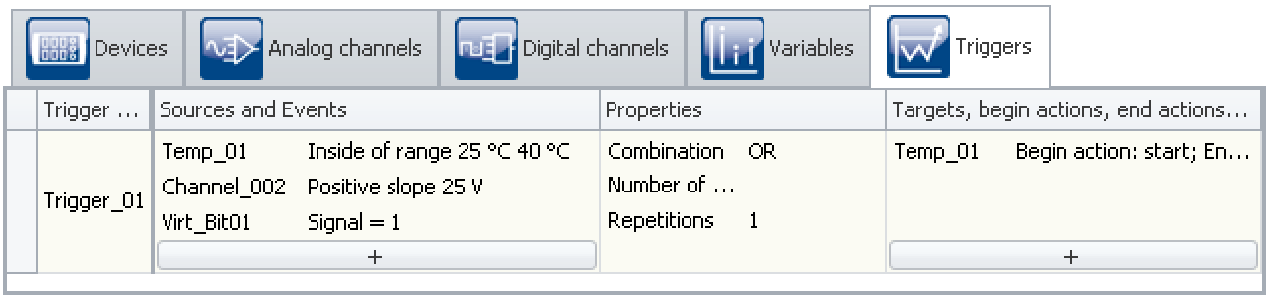
8.5.2.5 Combinations of events

It is possible to join multiple triggers in a logical expression. Five operators are available for the purpose:

Combinations	Description
AND	If all events are "*true*" at the same time, the combined event is "*true*" and the specified actions are carried out. For this reason it may not be sensible to combine two signal edge events with AND, since it is unlikely that two signals would have edges at the same time, unless the events were artificially prolonged by means of appropriate "dwell time 403".
OR	As soon as one of the events is "*true*", the combined event is "*true*" and the associated actions are carried out.
Conditional AND	If a certain number of events ("Repetitions 407") are "*true*" at the same time, the combined event is "*true*" and the associated actions are carried out.
1-Trigger	At the start of the measurement, the actions are performed. For this reason, no triggering event can be assigned. *Trigger_48* is by default a *1-Trigger*, meaning it automatically starts all channels on which measurement is not subject to other triggers.
Passive	A passive (deactivated) trigger is no longer in use and automatically deletes all associated actions so that the channels can be entered for other purposes.

Setting the logical operation to combine events is done on the Setup page: "*Triggers*" in the column "*Properties*".

To change the combination, open the selection list in the column "*Properties*" and select the desired combination.



Combining events

8.5.2.6 Actions and targets

A variety of actions, triggered in a variety of ways, can be set as the target.

A trigger with the action: "**Start data recording**" can be triggered in a variety of ways:

- The combined event is "*true*"
- By means of the user interface of imc STUDIO
- By means of imc Online FAMOS

There is only one way to release a trigger with the action: "**Set bit**" and "**Stop recording of data**":

- The combined event is "*true*"/"*false*"

Action: Starting data recording

Recording of the data **can only start of the trigger is "*armed*"** and the maximum count of trigger repetitions has not yet been reached.

A trigger is armed upon starting the measurement. This means it is ready to be released.

During data recording, the trigger is in the state "*released*".

If subsequently the recording of data on all of the trigger's target channels is concluded, for instance in consequence of the measurement duration set, the trigger is re-armed. If the maximum number of trigger repetitions has not yet been reached, the trigger can be released again.

Action: Setting bits

Each transition of the state of the combined event can set a bit to "1" or "0"; the combined event can include digital outputs and virtual bits. Virtual bits are in essence a 32-bit register which can be read from and written to at random. they have no physical terminal and only serve the purpose of exchanging information as well as halting states.

Note — Independence of count and measurement

- "*Set bits*" is **independent of the setting for "*Repetition*"**. It can be actuated any number of times.
- "*Set bits*" is **independent of whether a trigger is armed**. It is actuated independently of the measurement (after Preparation).

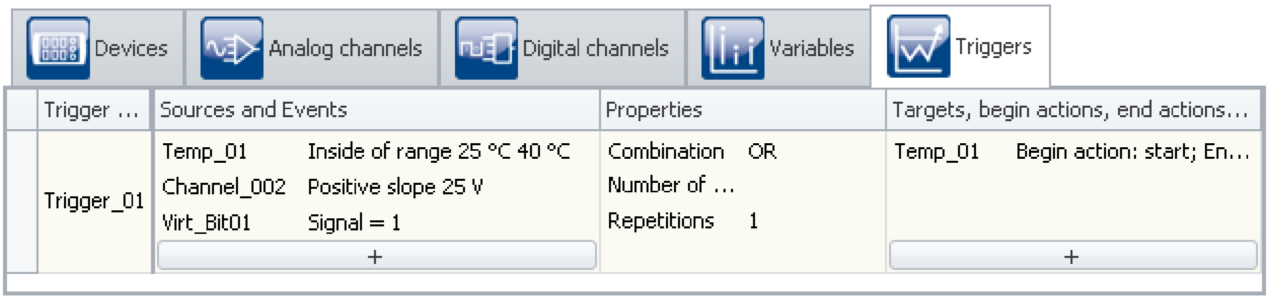
Note — Changing the value retroactively

Setting of a bit is performed one single time until the trigger is fired again. While the trigger is active, the bit’s value can be changed without the trigger always resetting it, for example, by means of the PC or imc Online FAMOS. This also applies to the virtual bits and the digital output bits.

Defining actions and targets

Making settings for the targets and actions is done on the Setup page: "*Triggers*" in the column "*Targets, begin actions, end actions, pretrigger*".

Here, the targets are specified. For instance a channel which is to measured or stopped upon release of the associated trigger.

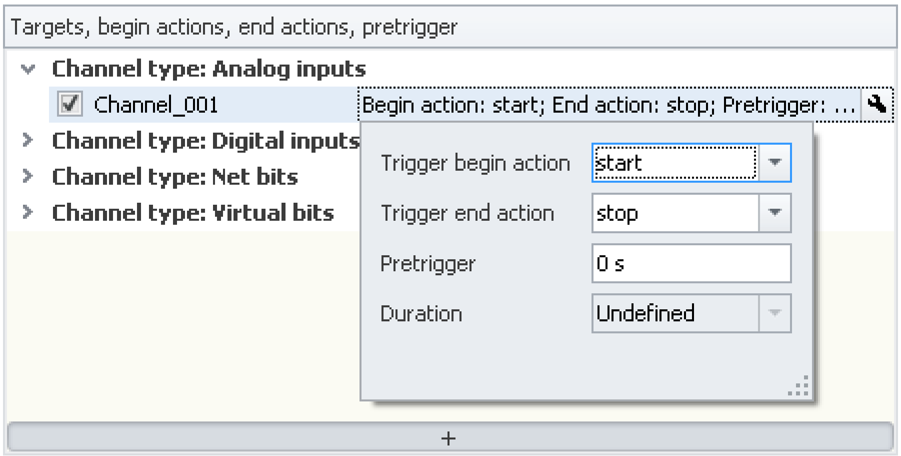


Defining targets and actions

The button [+] calls a dialog for selecting targets.

To select a target, click on the selection box.

To define the actions, click the left mouse button over the region at right.



Setting actions

Here, you can define the actions to be performed.

Parameter	Description
Trigger-start action	Action performed when the combined event becomes "*true*"
Trigger-end action	Action performed when the combined event becomes "*false*"
Pretrigger	A pretrigger determines the duration of data recording before the triggering time. See "Pretrigger 409"

Possible targets for data acquisition channels

Targets	Description
Begin action: start End action: -	If the trigger is "*armed*" and the combined event is "*true*", data recording is started.
Begin action: stop End action: -	If the combined event is "*true*", data recording is stopped.
Begin action: start End action: stop	Like "*Begin action: start*". Additionally, data recording stops is the combined event is "*false*". Thus the channel's signal is recorded as long as the combined event is "*true*".

A channel can be started and/or stopped by exactly one trigger. The two actions can be either in response to two different triggers or to the same one.

Possible targets for digital bits

Targets	Description
Begin action: Begin = 1 End action: -	If the combined event is "*true*", the bit is set to "*1*"
Begin action: - End action: End = 1	If the combined event is "*false*", the bit is set to "*0*"
Begin action: Begin = 0 End action: -	If the combined event is "*true*", the bit is set to "*0*"

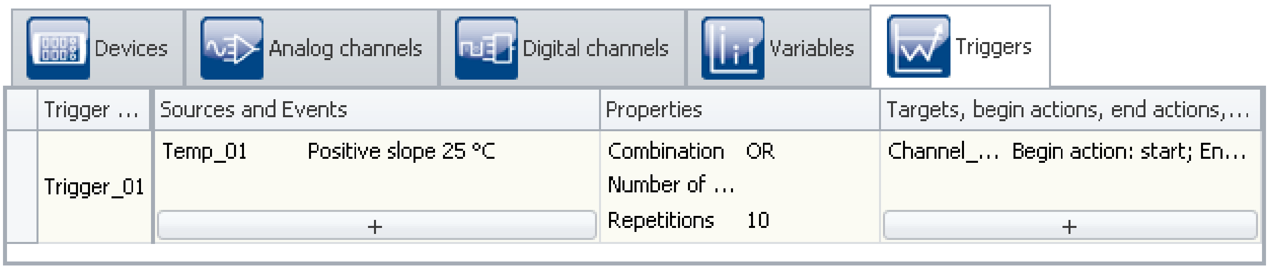
Targets	Description
Begin action: - End action: End = 0	If the combined event is "*false*", the bit is set to "*1*"
Begin action: Begin = 1 End action: End = 0	Like "*Begin action: Begin = 1*". Additionally, the bit is set to "*0*" if the combined event is "*false*". Thus, the bit is set to "*1*" as long as the combined event is "*true*".
Begin action: Begin = 0 End action: End = 1	Like "*Begin action: Begin = 0*". Additionally, the bit is set to "*1*" if the combined event is "*false*". Thus, the bit is set to *0* as long as the combined event is "*true*".

A bit can be set to 1/0 by exactly one trigger. The two actions can be either in response to two different triggers or to the same one.

8.5.2.7 Multiple triggering (Multi-shot operation)

Within a measurement, it is possible for individual triggers to release multiple times.

Setting the "Repetitions" on the Setup page: "*Trigger*" in the column "*Properties*".



Setting the amount

Using the property: "***Repetitions***", you can specify the number of trigger releases. Normally, this repetitions is set to "*unlimited*". You can specify any repetitions desired.

In consequence, the trigger is rearmed after each episode of data recording until the specified number of trigger releases has been reached.

If you do not already know exactly how often you wish the trigger to release, set the number of trigger releases to "*unlimited*".

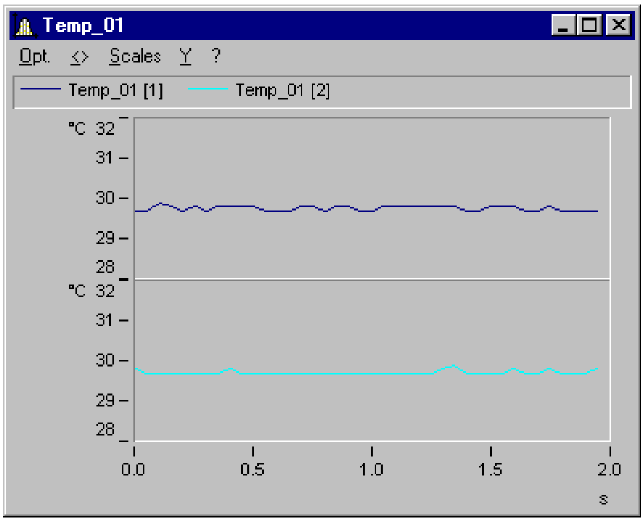
Note

- If you have set an unlimited number of trigger releases, the measurement never comes to an end by itself. Only after clicking on the Stop-button will the measurement conclude.
- The "*Repetitions*" can be set to **up to 32767 triggers**. Any larger number is automatically altered to "unlimited".
- "*Set bits*" is **independent of the setting for "*Repetition*"**. It can be actuated any number of times.
- Please note the remarks for pretriggers 409.

All data belonging to a measurement are written to a common folder when the data are saved; this also applies to channels with multiple trigger releases. These channels can be saved in a file having multiple "*Events*", or in individual files (see the documentation for the device configuration > "Storage 298").

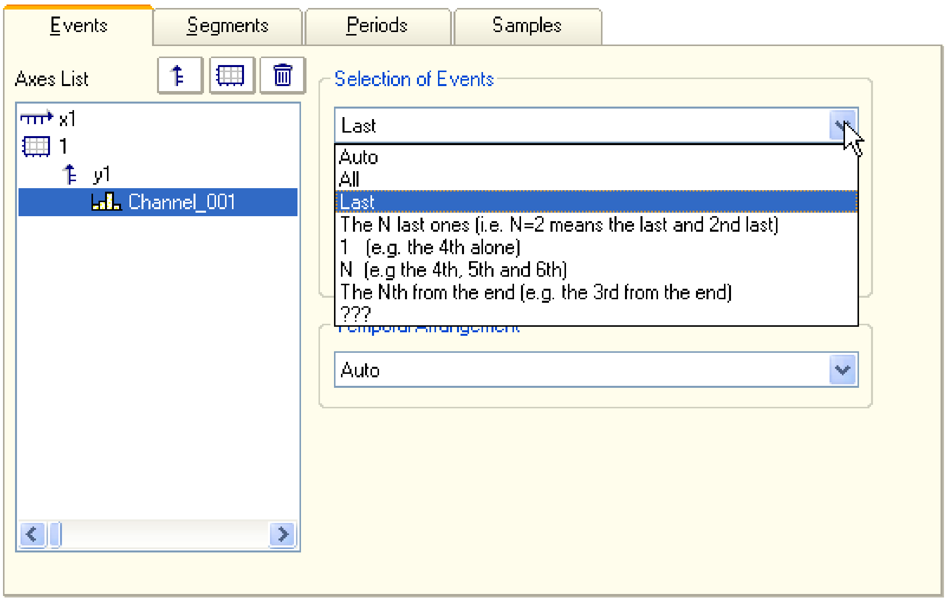
Among other things, multiple triggering enables easy, visual comparison of data from different trigger releases.

In the curve windows, you can compare the individual events:



Curve window with multiple events of the same channel

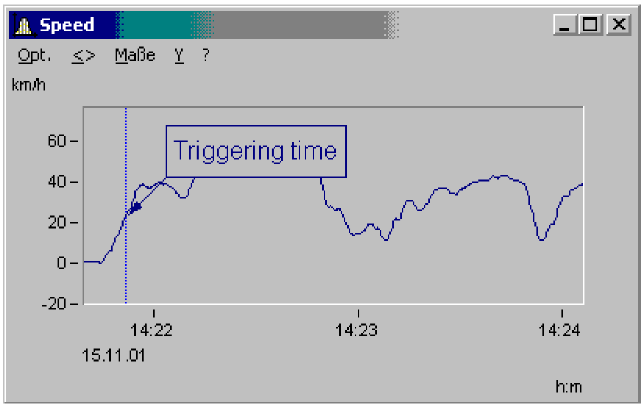
Toward this end, the curve window must be configured appropriately. Select the menu item "*Configuration*" > "*Events, segments, periods...*". On the page *Events*, you can select how many events you wish to have displayed.



8.5.2.8 Pretrigger

For every channel' signal recorded in response to a trigger, it is possible to also record the course of the signal leading up to the trigger event. A pretrigger determines the duration of recording before the trigger moment. The trigger moment's relative time is defined as 0. Pretrigger values have times < 0.

Setting the pretrigger is performed on the Setup page: "*Triggers*" in the column "*Target, begin actions, end actions, pretrigger*".



Note

- The pretrigger is defined for channels which are assigned to a defined trigger. Channels without such a trigger assignment, in other words, which are started directly when the measurement is started, are assigned to the symbolic special trigger "Trigger_48". **If one deleted a trigger assignment for a channel**, which is the same as assigning the channel to "Trigger_48", **the pretrigger is deleted automatically**.
- To be able to view a signal's plot including the pretrigger region, the first measurement (after prepare)needs to have been started before the trigger event by at least as much as the pretrigger time. For the second measurement filling the pretrigger will be started after stopping the first measurement.
  This is important to keep in mind, particularly with repeated trigger processes, since in such cases, the pretrigger only fills up after the preceding trigger event is complete. The pretrigger time counts toward the measurement duration set. **If the pretrigger is not completely filled, the overall measurement duration is that much shorter.**

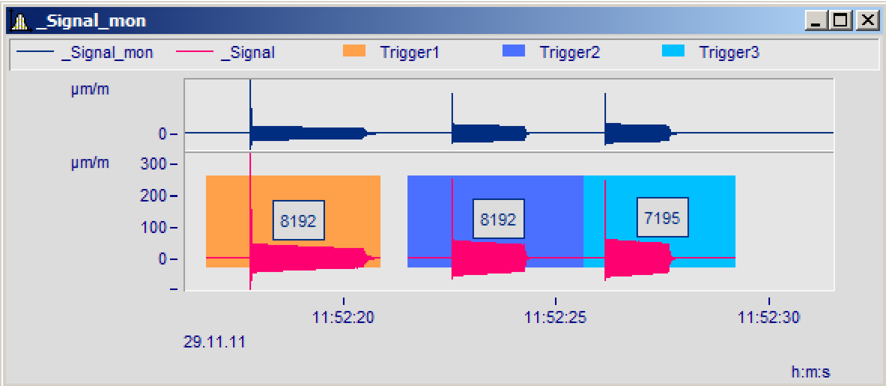
Example

Setting for the measurement duration: 10 s, Pretrigger time: 2 s

Measurement duration after trigger = (10-2)s = 8 s

If the trigger releases after 1s: Period of data capture = 1s +8s = 9s

- *Example: FFT with 8192 samples of which 1024 samples are for the pretrigger:*
  At 500 Hz sampling rate -> Measurement duration = 4.1 s, pretrigger time: 512 ms

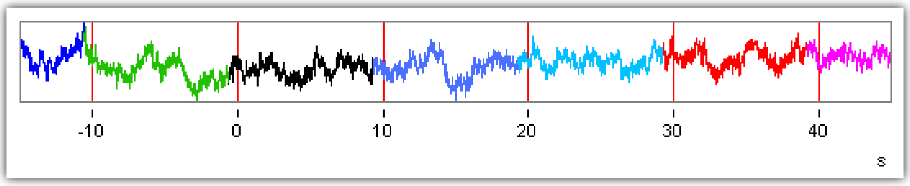


For the third event, the time was not sufficient for filling the pretrigger completely, and only 7195 samples were captured. Since the FFT needs 8192 for the calculation, it will not be possible to calculate the spectrum for this event.

Pretriggers in conjunction with intervals

If the pretrigger's measured data are located in time across interval boundaries, it is possible to treat the measured data as follows:

- The pretrigger's data can be saved together with the first interval (interval of the trigger firing) (*default setting*).
- The pretrigger's data can be cut correctly. In this way, interval folders can be created subsequently.



Example

Each color denotes one interval-folder. At "0", the trigger fired. The two colors preceding "0" are the pretrigger data. They can be saved either together with the interval of the trigger-start (black), or in their own separate interval folders.

The associated setting is made in the Options: "*Options* 110" > Area: "*Variables*" > "*Datapool*" > "*Split up pretrigger data into intervals* 117".

Note — Notes on the pretrigger preceding the measurement start

This function does not apply to measured data which were recorded in the pretrigger before the measurement's start. The pretrigger is already filled up for the second measurement, for example, before the measurement had been started. These measured data are always in the first interval-folder.

Reference	See also
Saving Interval 721	

8.5.3 The measurement process

With imc STUDIO, a measurement begins when the Start-button is pressed (or when the device is activated, if it is in Autostart mode). Next, all triggers are armed. Untriggered channels which are assigned to the 1-Trigger, "Trigger 48", immediately start recording data. imc STUDIO concludes measurement by itself once all component measurements specified have been performed. The measurement is over once no trigger has any outstanding repetitions to perform and all partial measurements are finished.

By clicking on the Stop-button, you can conclude a measurement before the appointed time.

All measured data recorded and saved to the hard drive are located in a common folder. This is where all data are found which belong to the same measurement. For a new measurement, a new folder is created.

Note

- Start delay: The measurement system requires at least two samples to start. This means that the slowest channel in the system determines the start delay. Example: A temperature channel with 10 s sampling time leads to a delay of 20 seconds.
- If the "*arithmetic mean*" function of the amplifier channel is also used, the start delay increases by the "*averaging points*" as a factor, see "*FAQ: Start delay* 1940".

8.5.4 Information and Tips

8.5.4.1 Trigger Machine and imc Online FAMOS

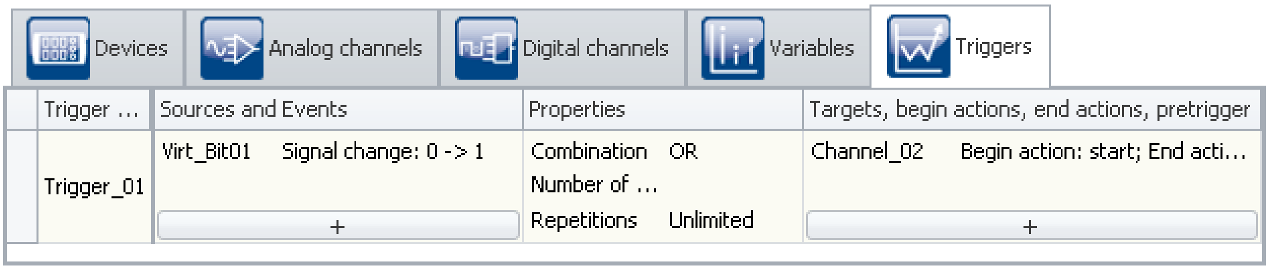
Virtual channels from imc Online FAMOS

Virtual channels generated by imc Online FAMOS can not be used directly as events for the trigger machine. Instead a virtual channel can be checked for events using imc Online FAMOS functions. The result switches one of the virtual bits which in turn can be evaluated by the trigger machine.

Operations

```
RMS_01= rms(Channel_01, 1000, 1000); RMS of voltage channel_01
Virt_Bit01= Greater( RMS_01, 230)  ; Virtual Bit= 1, if RMS_01 > 230V
```

imc Online FAMOS: Exceeding the RMS value of 230V sets Virtual Bit 01



Triggering of Channel_02 when the RMS values is exceeded, accomplished indirectly using Virt_Bit01

Note

It is possible to set a virtual bit both in the trigger machine and in imc Online FAMOS. To avoid this conflict, any bits set in imc Online FAMOS should never appear on the target side of the trigger machine.

Online-Trigger

imc Online FAMOS with Control Commands 844 enables targeted actions in response to particular states of the trigger: `OnTriggerStart`, `OnTriggerMeasure`, `OnTriggerEnd`.

Note

This only applies to triggers having a Start action: start.

The following applies to a trigger's control commands:

- When the trigger releases, the content of the control command `OnTriggerStart` is performed once.
- As long as the trigger is released, the content of the control command `OnTriggerMeasure` is performed continuously.
- When the triggering is finished, the content of the control command `OnTriggerEnd` is performed once.

If channels having different measurement durations are assigned to the same trigger, the triggering is completed at the end of the longest measurement.

- It is generally to be recommended that all of a trigger's physical channels are set with the same measurement duration.

8.5.4.2 Display before trigger events

Triggered channels are not displayed in a curve window before the trigger has been released. The data runs through the device as soon as the measurement has been started, but they can't be seen. If the sensor is disconnected or defective, it is not obvious why the trigger does not release.

For that reason we have the monitor channels. Those channels are sampled from the active channels. They can't be sampled faster than their original channels. But it is possible to define different or no trigger conditions to those monitor channels. So these channels can be seen before the original channels have been triggered.

Field-bus channels

There are no monitor channels for most field-bus channels. But they can be created with a trick. Use the Assistant to create within a channel’s message an additional channel having a different name and the exact same settings. This channel can then be captured without triggering.

8.5.4.3 Trigger-variables in the Data Browser

The Data Browser contains not only a trigger's results channels but also **variables** for every **trigger** configured. These can represent, for example, **information on the trigger's status**. The trigger variables convey a variety of kinds of information, which can each be displayed separately and can easily be moved to the Panel by means of Drag&Drop.

Trigger		Description
Trigger Name e.g. Trigger_48	Event number	With multi-triggering: count of previous trigger releases
	State	Current state of the trigger: armed, released, stopped
	Trigger time	Time when the state last changed

Note	The Start-action must include a channel

The variables **only return values** if a channel is set for the trigger's **Start-action**.

8.5.5 Examples

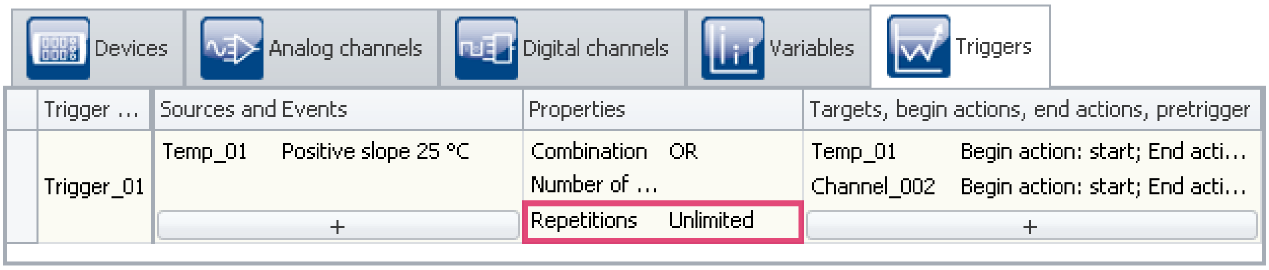
8.5.5.1 Background Measurements

Two measurement tasks are to be performed in parallel by the same device. For instance, if you wished to record each activation and each braking procedure of some equipment, at high resolution. Between the recording of such measurements, there are often long pauses. Conversely, there are some signals which must continually be measured without any pause or gap in the data, e.g. temperatures and an engines RPMs.

This situation is referred to as a triggered measurement in the foreground at a high sampling rate and an untriggered background measurement at a low sampling rate.

Set the foreground measurement channel's trigger settings on the Setup page "*Trigger*" accordingly.

Also set "***Repetitions***" to "*Unlimited*".



Trigger settings for the measurement in the foreground

On the Setup page: "*Analog/Digital channels*", set the measurement duration of the background measurement channels to "*Undefined*". In this case, you must end measurement manually using the Stop-button.

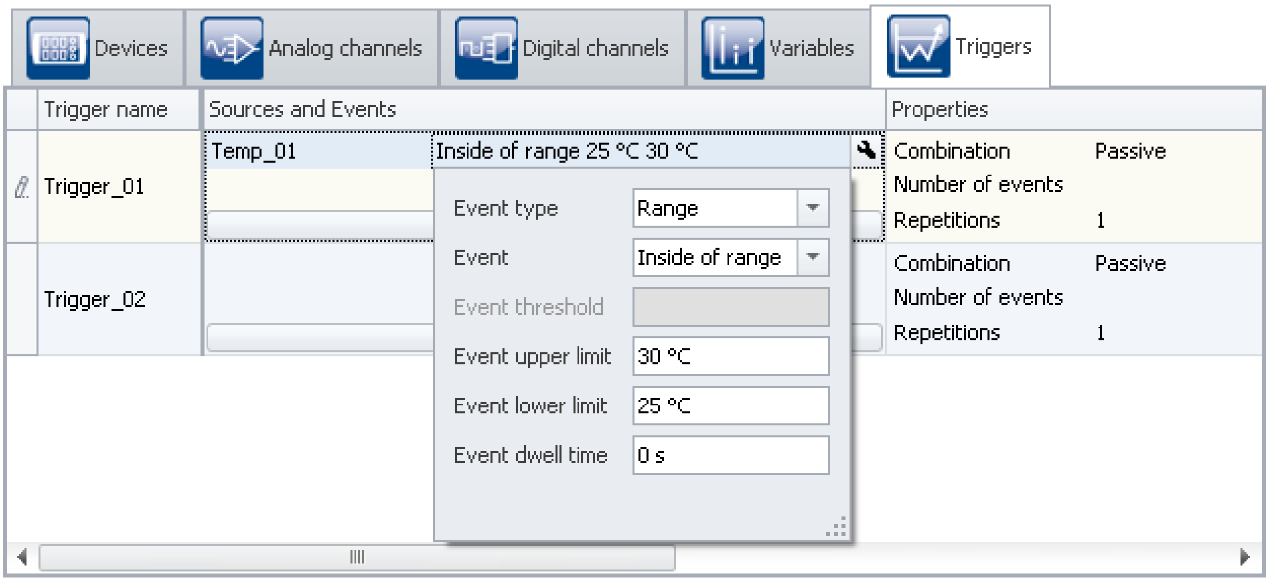
With these settings, it is possible for the trigger to release an infinite amount of times in succession during a measurement. After each concluded measurement, the trigger rearms automatically.

The measurement itself last until the background measurement is stopped by the Stop-button.

8.5.5.2 Event-Controlled Digital Outputs

A digital output is to be set to 1 for the duration that a signal is within a specified tolerance band.

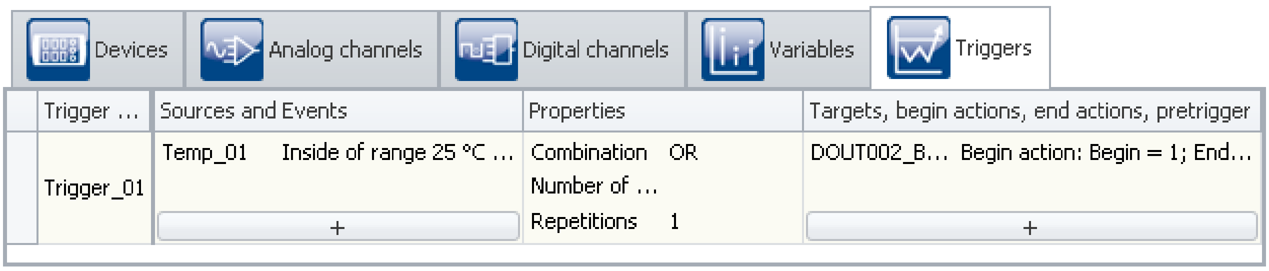
Set the channel's trigger event on the Setup page: "*Triggers*" accordingly:



Settings for the event

The event is defined to occur while the signal is within the specified range of 25 °C to 30 °C.

Next, the trigger is set.



Trigger settings for a bit output

Select as the "***source***" the channel from which the event is derived (here: "*Temp_01*").

Select as the "***target***" the desired digital output which you wish to set (here: "*DOUT002_Bit01*"). Set as the "***Begin action***": "*Begin=1*" and as the "***End action***": "*End=0*".

If the signal of the channel "*Temp_01*" is within the boundaries set while the measurement is running, the digital output bit's value is "*high*".

8.6 TEDS - Sensors

On the Setup page **TEDS**, you can use sensor information from TEDS to configure channels, and you can write such information to the TEDS.

Note

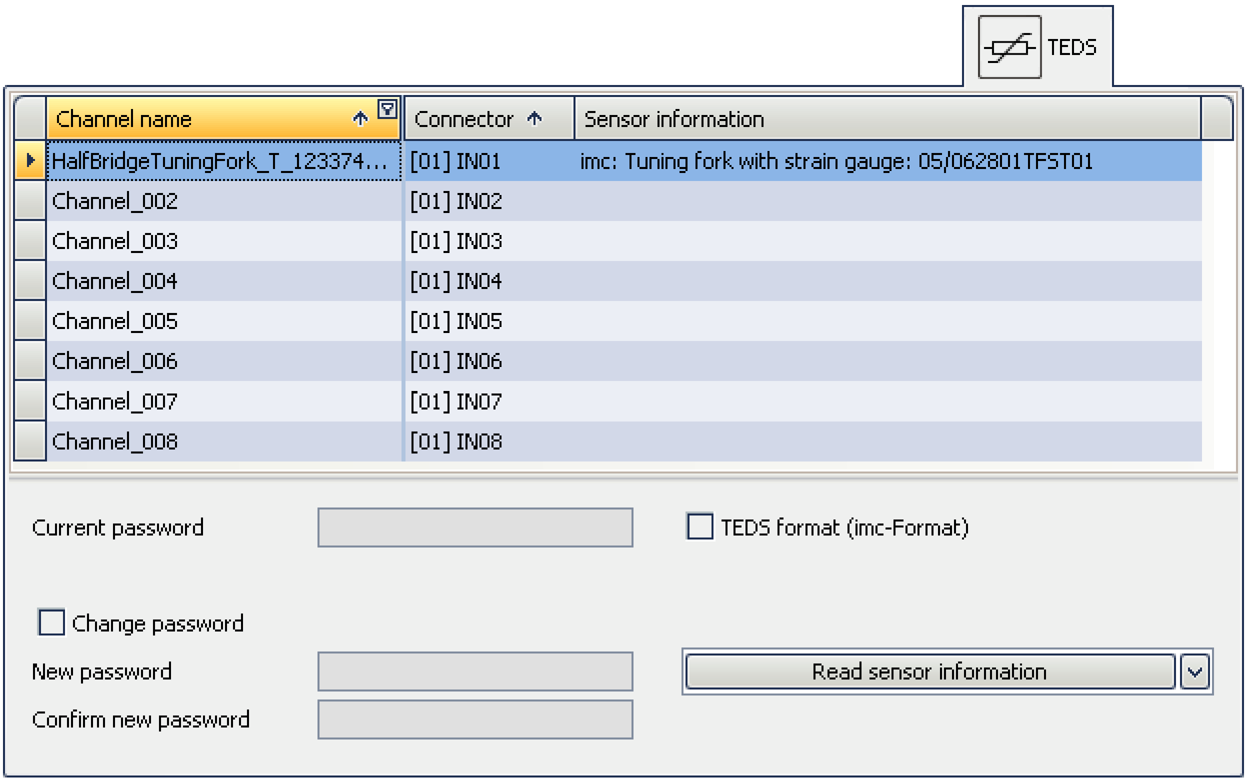
The page is not available

By default, this page is not displayed. To display it, please follow the instructions in the chapter: "*Additional Pages* 419".

Note on the views: Compact and Standard

Some functions (e.g. reading and discarding) are also available on the Setup page "*Analog channels*". In the dialog: "*Channel definition*".

The following descriptions always have the page "*TEDS*" as the point of departure.



This page is subdivided into two areas: the *Channel table* and a single Dialog. (For information on the operation and configuration of these: Tabular Display 212 and Dialogs 219)

What are TEDS

The device software supports readout of sensor spec-sheet data from a sensor TEDS and the application of this information in configuring channels.

The sensor TEDS are serial ROMs. They are connected to an amplifier channel via a digital signal line (*1-wire-PROM*). Each sensor TEDS has a unique ROM-ID (*Sensor-ID*, *silicon serial number*). A sensor TEDS can also contain additional information on a sensor. Electrically erasable and re-writable sensor TEDS are referred to as *Sensor-EEPROMs*.

Note

Some amplifiers support *TC-TEDS* (see the respective device manual for more information).

- Therefore the amplifier has to be equipped with a TC-TEDS-adapter. Instead of the standard DSUB-plugs, SMMI-thermocouples for type-K can be connected.
- By using suitable SMMI-thermocouple plugs (TC-TEDS) sensor information for thermocouples can be imported.

imc SENSORS and the Sensors tool window

There are two ways to configure the sensor information:

- by means of the product imc SENSORS 210
- using the imc STUDIO tool window Sensors (with limitations)

For more on this topic, see: The *Sensors* 204 tool window.

Reference

For a detailed description of the database itself, see the user's manual for **imc SENSORS**.

Below, the import of already recorded sensor data to imc STUDIO is described.

8.6.1 Read Sensor Information and Reset information

Read sensor information

Prerequisites:

- imc STUDIO must be connected with the device
- The amplifier and imc STUDIO must support the TEDS connected

Open the Setup page: "*TEDS*".

Read sensor information

- Select the channel desired, to which the TEDS is connected (multi-selection is possible if a TEDS is connected to each channel).
- From the list, select: "*Read sensor information*"
- Click on the button

The sensor information is read out and used to configure the channel. All changes resulting from import and application of sensor info are indicated in the "*Sensors*" 204 tool window.

Note

Sampling rate

If a **sampling rate** is defined in the TEDS, **it is ignored**. Since more than two different sampling rates per device are not possible, this would in most cases lead to an interruption of the reading process.

Saving imported sensor information

The sensor information once imported and linked to a channel are **saved with the experiment**. If the experiment is later transferred (e.g. copied to another PC), this sensor information isn't lost!

Reset channel's sensor information

- Open the Setup page: "*TEDS*".
- Select the channel desired (multi-selection is possible)
- From the list, select: "*Reset channel's sensor information*"
- Click on the button

The sensor information is deleted.

Note The configuration remains intact

The channel configuration is not reset to its condition before importing. The current configuration remains intact as long as the sensor did not set any parameters which were not possible without sensor information. In that case, the default value is restored.

8.6.2 Linking sensors with channels

Under "*Connected sensors*" in the tool window "*Sensors*" 204 presents a detailed list of the selected sensor's technical specs. However, these sensor data cannot be edited here!

Additionally, the available sensor information can be used to configure all the channels.

> **Note**
>
> In order to be able to edit the sensor spec-sheet data, the program imc SENSORS must be installed. The sensor database imc SENSORS administers such information for sensors. In this program, it's possible to set up, edit and administer entries for sensors; see "Sensor-Database 210"

8.6.3 List of sensor supported (TEDS/imc SENSORS)

Implemented sensor information (TEDS or imc SENSORS)	
Accelerometer	Based on the ICP principle: current-fed; voltage measured with AC coupling
Bridge	Common bridge, bridge sensor, e.g. for force, no strain gauge
LVDT	LVDT sensors, differential coils. Supplied with AC voltage.
Microphone	Microphone with built-in amplifier
PT100	Pt100 and related, e.g. Pt1000
StrainGauge	Strain-gauge bridge
Thermocouple	Thermocouple
Voltage	General voltage sensor
Amplifier	Conditioner, amplifier with voltage output
Potentiometric	Potentiometric sensor, operated in half-bridge configuration, for example

NOT supported sensor information (TEDS or imc SENSORS)	
Encoder	Incremental encoders
DigitalIn	Digital input of the measurement device, e.g. for querying a switch
ActorDigital	Digital output of the measuring device, e.g. relay for switching / control
Current	Sensors with amperage output, e.g. 0..20mA or 4..20mA
Resistance	Resistor, usually current-fed and whose voltage drop is measured to derive the resistance, which is often proportional to another physical quantity.
Thermistor	Thermistor, resistance thermometer with non-linear characteristic curve
PiezoElectric	Piezo-electric (acceleration/force/sound), requiring a charge amplifier
ActorVoltage	Analog voltage output
ActorCurrent	Analog current output
ActorPulse	Pulse output, e.g. PWM (pulse width modulator)

8.6.4 Writing sensor information to the sensor

The sensor information linked to a channel can be written to the sensor TEDS connected to the channel.

Note

It is only possible to write to a sensor from within the page *TEDS*! This underlines the fact that only sensor information can be written, in other words, such info which is displayed in the database imc SENSORS. However, no changes to the channel properties made in imc STUDIO are written to a sensor TEDS. This also goes for sensor information which can be edited by imc STUDIO. The only data which can be written to the sensor, then, are whatever is displayed in the *Sensors* tool window, not anything that is subsequently changed using imc STUDIO!

Example: The input range was set to ±5V using the sensor database or Sensor-TEDS. Later, the input range was changed to ±2V. This setting is not adopted in the Sensors tool window. The previously imported value ±5V remains intact in the sensor TEDS.

- Select the desired channel, whose channel settings are to be written to the TEDS (multi-selection is possible if a TEDS is connected to each channel)
- Select from the list: *Write sensor information*
- Click on the button

If the *sensor TEDS* is password protected, the password must be entered.

Here, it is also possible to edit the password.

Note Password protection

- In 1-Wire technology, sensor-Eproms do not have any password protection of the hardware or write-protection.
- Using the imc proprietary format (*TEDS format (imc-Format)*), all imc applications observe a software password protection: This means that only upon entry of the correct password, writing information to the TEDS can proceed. The password is a 32-bit integer.

8.7 Additional Pages

By default, only a selection of the available Setup pages is displayed. It is possible to have additional pre-configured pages shown, or to create your own*.

Among others, the following pages are available:

- TEDS 415
- HiL + Application module 420
- ...

* The availability of this function depends on your particular product license. See the technical spec sheet

Displaying a page

To add a page to the user interface,

- open the context menu over a page-tab or over the empty space to the right of one.
- Click on the corresponding page entry in the list under *Insert complete layout*.

In consequence, the page is inserted to the right of the selected locations.

Note Saving views

Changes to the view, such as: "Insert Setup page", must be saved with the view in order to be visible the next time the program is started.

See the manual "*imc STUDIO (general)*" > "*Views* 135".

8.7.1 HiL + Application module

Note The page is not available

By default, this page is not displayed. To display it, please follow the instructions in the chapter: "*Additional Pages* 419".

imc HiL

The imc HiL hardware is a supplemental component for the imc CRONOS measurement systems. imc HiL unites the functionalities of simulation, data capture, and open- and closed-loop control in a single compact system. The hardware basis for this component is a processor embedded in the measurement device, which is exclusively reserved for running MATLAB Simulink® models (Simulink Real-Time applications).

On the software side, the MATLAB Simulink® library is supplemented with imc connection blocks which represent an interface to the imc devices. By means of this expansion, it is possible to create Simulink applications in the customary way and to transfer them to imc devices. The interface for this purpose is the imc device software (imc STUDIO), in conjunction with the imc HiL Assistant, which is connected with all other imc components.

Highlights

- imc HiL **integrates** existing **MATLAB Simulink® models** (Simulink Real-Time)
- **Real-time simulation** of application situations with direct feedback to the object under test
- Provides a dedicated processor integrated into the measurement system:
  - CPU: Intel Atom
  - Clock: 1.1 GHz
  - Memory: 512 MB
- Expanded MATLAB Simulink ® library representing an interface to the imc devices
- imc STUDIO provides all settings and configurations for data acquisition and subsequent processing of signals within imc CRONOS measurement systems
- Support of tunable parameters
- No separate MATLAB license for the target system required

Prerequisites

You can download the current data sheet (PDF) from our website. This data sheet specify the prerequisites to the Developer (User)-PC of the MATLAB / Simulink models. You will also find the required licenses and the supported MATLAB versions and more details.

Reference	Manual

The imc HiL device manual describe the use and initiation of this interface.

imc Application Module

The imc Application Module serves to **integrate measurement channels from "third party" devices or systems** into an imc CRONOS*compact* respectively imc CRONOS*flex* system via standard hardware interfaces.

Examples of possible channel sources include:

- Specialized complex sensors
- "third party" devices
- Bus systems (e.g. field busses)

The standard interfaces supported include, in particular:

- Ethernet
- serial interfaces (RS-232, RS-485, RS-422)

The systems to be integrated are typically user-customized or dedicated devices by third-party manufacturers. The integration is achieved by means of a standard hardware module (APPMOD), which comes with a dedicated processor for which a custom application is programmed. This program is either created by imc on commission or can also be created and implemented by qualified partners or trained users provided with specialized development tools.

This user-specific hardware and software expansion is supported by the device software (imc STUDIO). A special version of the device software is not necessary.

Characteristics:

- encapsulated, custom hardware + software solution, embedded in a standard system
- Standard system with complete software support
- Flexible support by unaltered standard operating software
- Standard hardware component
- Stand-alone, autonomous system environment

Reference	Manual

The imc Application Module describe the use and initiation of the module, such as the RS-232, RS-485, RS-422.

8.8 Information and Tips

8.8.1 Incremental Encoders

The four incremental encoder channels are for measuring **time** or **frequency**-based signals. In contrast to the analog channels as well as to the digital inputs, the channels are not sampled at a selected, fixed rate, but instead time intervals between slopes (transitions) or number of pulses of the digital signal are measured.

The **counters** used (set individually for each of the 4 channels) achieve time resolutions of up to 31 ns (32 MHz); which is far beyond the abilities of **sampling procedures** (under comparable conditions). The *sampling rate* which the user must set is actually the rate at which the system evaluates the results of the digital counter or the values of the quantities derived from the counters.

8.8.1.1 Signals and Conditioning

8.8.1.1.1 Mode

The various modes comprise the following measurement types:

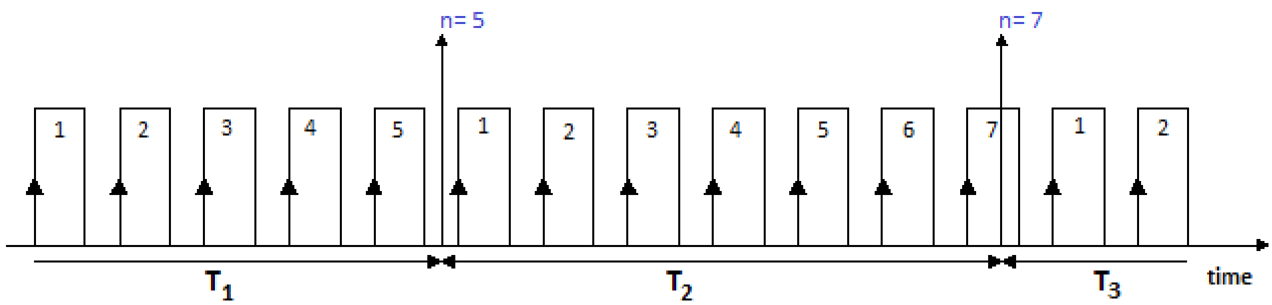
Event-counting	Time	Combined measurements
• events • distance(differential) • angle (differential) • angle (sum) • angle (abs 0-360°) • distance (sum)	• time • pulse time	• frequency • speed • RPM

Event-Counting

The following variables are derived from **Event counting**:

- events 427
- distance(differential) 427
- angle (differential) 427
- distance (abs.) 427
- angle (abs.) 427

The amount of events occurring within one sampling interval is counted. The event counter counts the sensor pulses within the sampling interval. **An event is a positive edge in the measurement signal which exceeds a user-determined threshold value**.

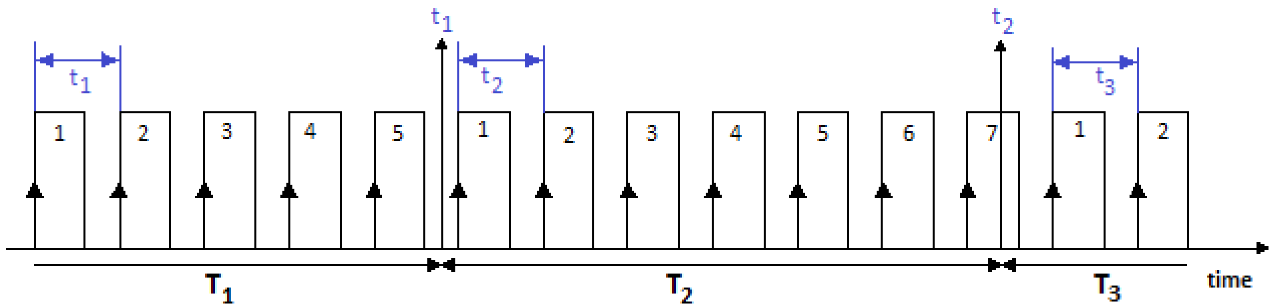


Time Measurements

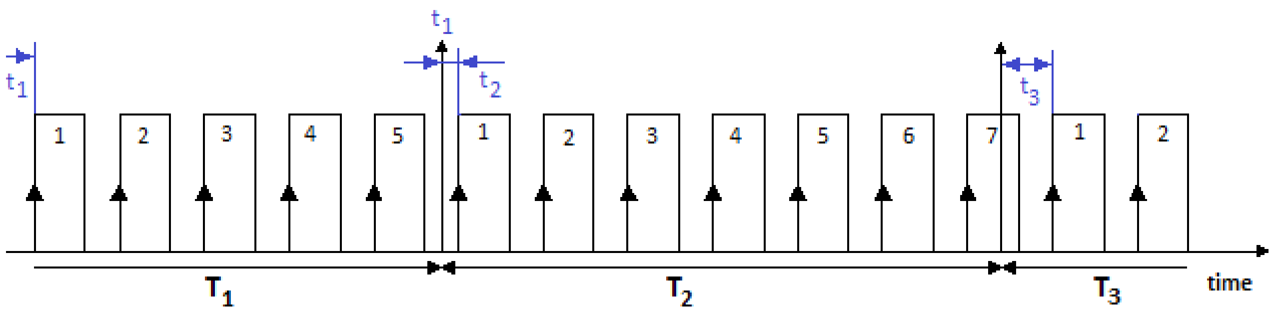
Exclusive measurement of **time** is performed as:

- time 428 (of two successive signal edges)
- pulse time 429 (time from the beginning of one sampling interval until the next signal edge)

Any other pulses occurring within the sampling interval are not evaluated for these measurement types.



time

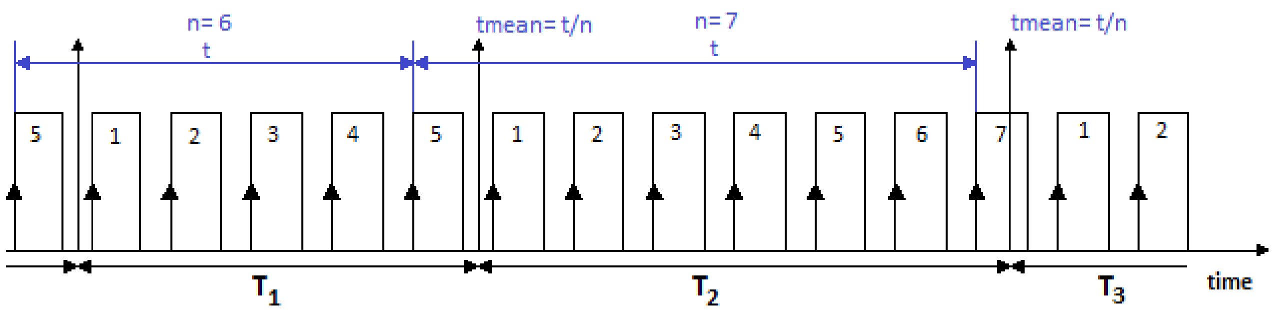


pulse time

Combination Mode

Determining a frequency and the derivative quantities RPM and velocity is based on the **combination of event counting and time measurement**. In other words, during a sampling interval, the number of events occurring as well as the time interval between the first and last event are measured:

- frequency 430
- speed 430
- RPM



The frequency is determined as the number of events counted divided by the time between the first and the last "complete" event in the interval. An event is complete when a positive edge is succeeded by a subsequent positive edge.

The frequencies must lie within the bandwidth of the module used. If the maximum frequency is exceeded during a measurement, the system returns the input range end value instead of the true measured values.

The derivative quantities displacement and angle measurement have the following settings:

- Choice of one-signal and two-signal encoder 426
- Start of measurement with or without "Zero impulse" 426
- Number of pulses (per unit)

The input ranges and resolutions for the RPM or velocity also depend on the number of encoder pulses set. If the number of pulses is known, the RPM and velocity values can easily be computed using the above table according to:

Parameter	Description
RPM	Input range = ([Frequency input range in Hz] * 60 / [Encoder pulses per revolution]) in RPM Resolution = ([Frequency resolution in Hz] * 60 / [Encoder pulses per revolution]) in RPM

Behavior in response to missing signal pulses

If a sequence of signal pulses is slowing down and then one sampling interval elapses without any pulse, no calculation can be performed for that sampling interval. In that case, the system assumes that the rotation speed is simply decreasing and an attenuating signal course is extrapolated. This "estimated" measurement value is then closer to the true value than the value determined from the preceding sampling interval. This technique has demonstrated its validity in practice.

Note

In extreme cases, the sensor does not return any more pulses, e.g. in case of a sudden outage. Then the algorithm generates an attenuation curve, meaning values > 0, even if the measurement object is actually no longer moving.

8.8.1.1.2 Measurement procedures

Differential measurement procedures

The quantities derived from *event-counting*, **Events, Distance** and **Angle** denoted by the annotation **(diff.)** are "differential" measurements. The quantity measured is the respective change of displacement or angle within the last sampling interval. (positive or, for dual track encoders, negative also) or the newly occurred events (always positive).

If, for instance, the total displacement is desired, it must be calculated by **integration** of the differential measurements using Online FAMOS functions.

Cumulative measurements

The quantities derived from *event-counting*, **Distance** and **Angle** appearing with the annotation **(abs.)** are "**cumulative**" measurements. In cumulative measurements, the return value is the **sum** of all displacement or angle changes, or of all event which occurred.

8.8.1.1.3 Scaling

A **maximum** value must be entered under ***Input range*** (max. frequency etc, depend on mode). This **Maximum** determines the scaling factor of the computational processing and amounts to the range which is represented by the available numerical format of 16bits. Depending on the measurement mode (quantity to be measured), it is to be declared as an input range's unit or in terms of a corresponding max. pulse rate.

In the interest of maximizing the **measurement resolution** it is recommended to set this value accordingly.

The ***Scaling*** is a sensor specification which states the relation between the pulse rate of the sensor and it's corresponding physical units (sensitivity). This is also the place to enter a conversion factor for the sensor along with any physical quantity desired, for instance, to translate the revolutions of a flow gauge to a corresponding volume.

The table below summarizes the various ***measurement types' units***; the **bold**/*cursive* letters denote the (fixed) primary quantity, followed by its (editable) default physical unit:

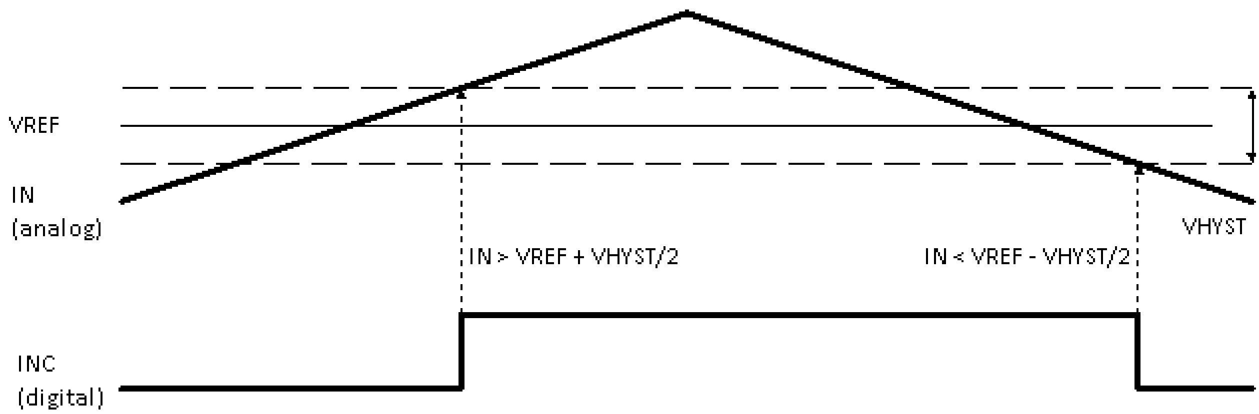
Measurement quantity	(Sensor-) scaling	Range	Maximum
Linear motion	**pulse**/*m*	m	m/s
Angle	**pulse**/*U*	U	U/min
Velocity	**pulse**/*m*	m/s	m/s
RPM	**pulse**/*U*	U/min	U/min
Event	**pulse**/*pulse*	1 pulse	Hz
Frequency	**Hz**/*Hz*	Hz	Hz
Time	**s**/*s*	s	s
Pulse time	**Hz**/*code*	Hz	Hz

8.8.1.1.4 Comparator conditioning

The incremental encoders' special properties make **special demands for signal quality**: the very high resolution offered by the detector or counter means that even very short impulses can be captured and evaluated, which sampling-based measurement methods (such as for the digital inputs of the DI16 module) would not (or almost never) be able to detect. Therefore, the digital signals must have clear edges in order not to produce disturbed readings. Spurious impulses or contact bouncing can lead to artifacts such as enormous peaks in RPM-signals etc..

Simple sensors working on the principles of induction or photoelectric relays often emit unconditioned analog signals which must be evaluated according to a threshold condition. Aside from that, problems can occur even with conditioned encoder signals (e.g. TTL-levels) due to long cables, bad reference voltages, ground loops or interference. imc incremental encoder channels are able to counteract these problems thanks to a special 3-stage conditioning unit.

First comes a high-impedance **differential amplifier** (± 10 V range, 100 kΩ) which enables reliable acquisition from a sensor even over a long cable as well as effective suppression of common mode interference and ground loops. Next, a (configurable) **smoothing filter** offers additional interference suppression adapted to the measurement situation. Lastly, a **comparator** with adjustable threshold and hysteresis serves as a digital detector. The (adjustable) **hysteresis** also serves to suppress interference.



If the analog signal exceeds the threshold **VREF + VHYST/2**, T

The *digital signal* changes from **0 to 1** when the *analog signal* exceeds the **VREF + VHYST/2** threshold.

The *digital signal* changes from **1 to 0** when the *analog signal* falls below the **VREF - VHYST/2** threshold.

The size of the hysteresis represents the width of a range-band inside of which the signal can fluctuate (due to signal noise and interference) without an impulse being recorded.

Ranges:

- VREF (Threshold) = -10 V .. +10V
- VHYST (Hysteresis) = +100 mV...+4V
- Low pass filter: None, 20 kHz, 2 kHz, 200 Hz

8.8.1.1.5 Single-signal/ Two-signal

The **single signal counter** returns a simple pulse sequence. This means that the pulse count and the time between pulses can be determined, but not the rotation direction of the incremental counter.

A **two signal encoder** returns two pulse sequences with a 90° offset. Along with the pulse frequency, the rotation direction can also be indicated as positive or negative. A measurement with two-signal counters is selected in the combobox "Measurement mode" together with the desired operation type.

8.8.1.1.6 Zero pulse (index)

The **zero pulse** starts the encoder channels' counter mechanism. This means the measured values are only recorded, if an event occurs at the **index-channel**. If measurement without a zero pulse is selected, the measurement starts directly upon preparing the measurement.

Note

- **The system only takes the zero pulse into account following preparing the measurement. Restarting the measurement does not cause a reset.**
- If the zero pulse fails to appear, the INC4 does not start measurement at all. In that case, the channels only return zero.

8.8.1.2 Mode (events-counting)

Events

The event counter counts the sensor pulses which occur during a single time interval (differential event counting). The interval corresponds to the sampling time set by the user. The maximum event frequency is about 500 kHz.

An event is a positive edge in the measurement signal which exceeds the user-set threshold value.

The derivative quantities displacement and angle measurement have the following settings:

- Choice of one-signal and two-signal encoder 426
- Start of measurement with or without "Zero impulse" 426
- Number of pulses (per unit)

Distance

Distance (differential)

Path traveled within one sampling interval. For this purpose, the number of pulses per meter must be entered.

Distance (absolute)

Absolute distance. The differential distance measurement is converted to the absolute distance. By taking the zero impulse (the counter with no zero impulse should not be selected) into account, the absolute distance position is determined and indicated. Otherwise, the distance value is assumed to be 0° when the measurement begins.

Angle

Angle (differential)

Angle traveled within one sampling interval. For this purpose, the number of pulses per revolution must be entered. The absolute angle can be calculated in imc Online FAMOS or determined by the mode Angle(abs).

Angle (absolute)

The differential angle measurement is converted to the **absolute** angle. By taking the zero impulse (the counter with no zero impulse should not be selected) into account, the absolute angle position is determined and indicated. Otherwise, the angle value is assumed to be 0° when the measurement begins.

Angle (sum)

The differential angle measurement is converted to the **cumulative** angle. In the process, any zero pulse is evaluated only one time. For this reason, angles which are > 360° are possible.

Note

When using incremental encoder modules that work internally with a 16-bit counter, encoders with high pulse rates can lead to overflows. The count is always carried out with sign: 2^{16}= 65536, i. e. ±32767. With two-signal encoders the pulse number is quadrupled internally and leads to a maximum number of pulses per revolution of 8192. For encoders with more pulses per revolution, the hardware must have a 32 bit counter, e. g. imc CANSAS*fit*-ENC6, otherwise an event count must be carried out instead and converted with imc Online FAMOS.

8.8.1.3 Mode (Time measurement)

Time measurement

The time measurement mode allows the definition of **edge conditions** between which the time interval is to be measured.

The following combinations are possible:

positive edge	>	negative edge:	(↑ > ↓)
negative edge	>	positive edge:	(↓ > ↑)
positive edge	>	positive edge:	(↑ > ↑)
The combination negative edge	>	negative edge:	(↓ > ↓) is not allowed

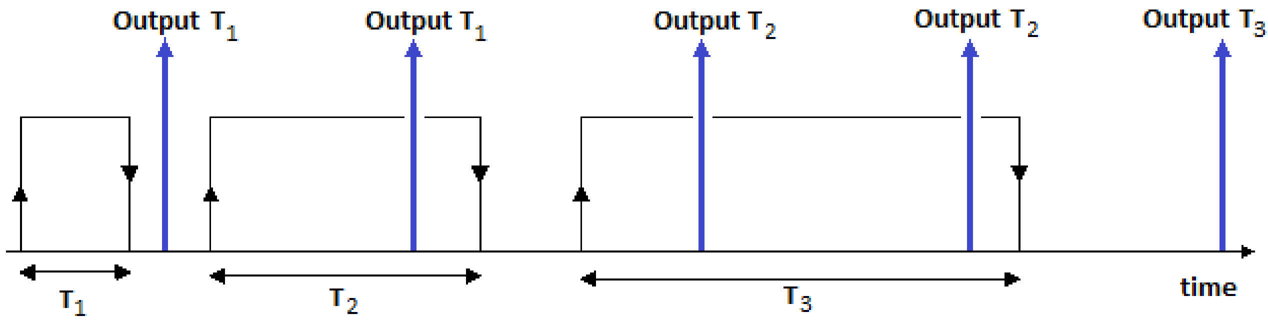
To ensure a high time resolution for the measurement results, suitable scaling must be set for the measurement. An **input range (INC4)** or **Max. time (s) (ENC-6)** specifies the maximum time interval which can be measured between the selected starting and stopping edge. **The time between the signal edges may not be greater than the selected input range.** If the maximum time interval is exceeded during measurement, the system returns the input value range end instead of the true measured value.

Input range	Time resolution	Input range	Time resolution
1 ms	31,25 ns	250 ms	8 µs
2 ms	62,50 ns	500 ms	16 µs
4 ms	125 ns	1 s	32 µs
8 ms	250 ns	2 s	64 µs
16 ms	500 ns	4 s	128 µs
30 ms	1 µs	8 s	256 µs
60 ms	2 µs	16 s	512 µs
120 ms	4 µs	30 s	1024 ms

Time resolution of INC4

The time resolution corresponds to the value of an LSB (Least Significant Bit).

During sampling intervals when no time measurement was possible (because either a starting or stopping edge was missing), the last valid return value continues to be returned until a time measurement is completed. If there is no valid return value, zero is returned. If more than one time measurement is completed during a single sampling interval (due to multiple starting and stopping edges), the last time measured is returned.



Above is illustrated a measured signal from which time readings are taken. Each reading starts at a positive edge in the signal and is stopped at a negative edge. The "up" arrows indicate the times at which the system returns a result. The returned values in this case are T1 –twice; T2 –twice; and T3.

Pulse Time

The point in time at which the edge is located within the sampling interval is determined. This information is needed by some functions in imc Online FAMOS, e.g. for determining the course of the RPMs from a pulse signal: OtrEncoderPulsesToRpm.

The measurement variable ***Pulse Time*** refers to phase-based data which is only relevant to special applications (particularly order-tracking analysis). It is required for subsequent online calculations. It represents the time between the last detected (asynchronous) pulse and the (synchronous) sampling time at which the counter readings were sampled and evaluated. The unit associated with this variable is called *Code*.

Note

The mode *Pulse Time* depends on the sampling rate. For all ENC-4 types, the entry is visible only if the sampling rate is equal or smaller 1ms. For HRENC-4 the sampling rate must be equal or less 100µs.

PWM

Pulse width modulation (PWM) is a type of modulation in which a technical variable (e.g. electrical current) switches between two values. In the process, the **duty cycle ratio is modulated at constant frequency**. PWM is also known as pulse duration modulation (PDM).

A good illustration of this modulation type would be a switch used to continually switch a heater on and off. The higher the ratio of the on-time to the off-time, the higher the average heating power is.

Measurement of PWM can not be performed directly with the device software. However, if the frequency is known, it is possible to perform it indirectly by time measurement with the following settings:

The **ratio** is the *Duration of HIGH (signal) level* over the *Period duration*.

The *Duration of HIGH (signal) level* is obtained by means of a **time measurement** from *positive to negative (signal) edge*.

The *Period duration* is the **inverse of the frequency**, which must be known.

PWM= $t_{pulse}/t_{Period\ duration}$ * 100% or t_{pulse} * f * 100%

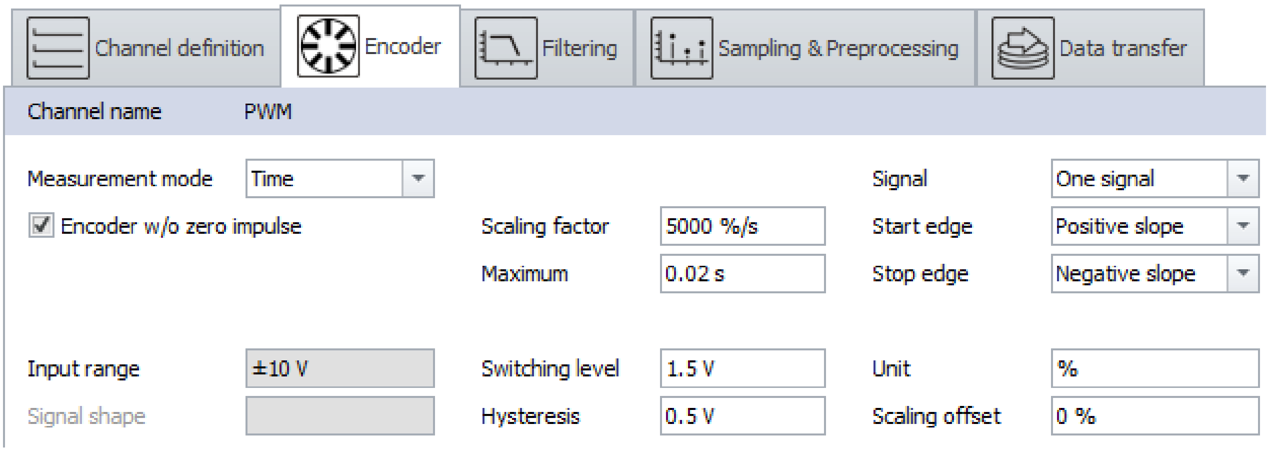
Example:

f= 50Hz, Pulse duration = 10ms

Scaling: t_{pulse} * f * 100%/ s = 5000%/s

at 10ms: 0.01s*5000%/s= 50%

This can be entered directly via the scaling:



Settings for PWM measurement in time mode

8.8.1.4 Mode (combined measurement)

Frequency

Frequency is determined by means of a combination measurement 423. If the frequency was previously multiplied or divided, this can be reflected in the scaling value. The frequency is always unsigned, for which reason there is no two-signal encoder for it.

Speed

The sequence of pulses is converted to m/s by means of a combination measurement 423. Toward this end, the number of pulses per meter must be entered.

RPM

The sequence of pulses is converted to revolutions per minute by means of a combination measurement 423. Toward this end, the number of pulses per revolution must be entered.

8.8.2 WFT module

Motor vehicle developers use 6-component wheel force transducers (WFTs – Wheel Force Transducer) to measure and record the various stresses on the vehicle's wheels during actual test drives – 3 forces (Fx, Fy, Fz) and 3 torques (Mx, My, Mz). These measurement results serve as the basis of simulation computations, or can serve as the input parameters for test bench runs.

The WFT-system is operated via a user interface belonging to the imc CRONOS family of devices. This makes a comprehensive software solution possible in conjunction with imc CRONOS and imc STUDIO.

This document provides a description of the parameters for configuring the WFT-module.

Reference	WFT-documentaion

A separate documentation describes setup and operation of the measurement wheel.

Notes

Importing parameters from the sensor

Upon first connecting with the sensor, all relevant settings are imported from the sensor. For instance, the measurement ranges are set appropriately so that they will no longer need modifying. If any change is detected at the sensor (for instance, a different serial number), then the parameters are re-imported upon the next established connection, and the existing configuration is overwritten.

Joint channel settings

The same sampling rate and filter settings apply for all channels belonging to the same connector.

8.8.2.1 WFT-parameters

In addition to the standard configuration choices, the WFT-module has special parameters and combination constraints. The module has two connectors. Internally, various output signals are computed from the signals, which are available as analog channels.

Names of analog channels are structured as follows: ChannelType_Position(l: left or r: right)_Address. Example: Fx_l_00, Revs_l_00, Status_l_00

When you select the WFT-channels from the channel list on the Setup-page "*Analog Channels*", an additional dialog appears: "*WFT*", in which you can make settings.

The following parameters are important for measurement with the WFT-module.

Dialog: WFT - Sensor information (read only)

Parameter - WFT Sensor information	Description *long name*	*short name*	*column ID*
Sensor type	Sensor type	*Type*	*eSensorMaterial*
	Returns information on the sensor's material: aluminum, titanium or steel		
Sensor serial number	*Sensor serial number*	*Sensor number*	*eSensorSN*
	Serial number of the WFT		
Sensor firmware	*Sensor firmware*	*Firmware*	*eSensorFirmware*
	Version of the WFT firmware		
Sensor info	*Sensor information*	*Sensor info*	*eSensorInfo*

Dialog: Measurement mode

Parameter - Measurement mode	Description *long name*	*short name*	*column ID*
Mode	*Measurement mode*	*Mode*	*eChannelMode*
	Basic setting denoting the kind of measurement		
Coupling	*Coupling*		*eCoupling*
	Depending on the channel selected, various usage options are listed.		

Mode	Description
mobile (rotating)	mobile deployment with rotating zero balancing
mobile (stationary)	mobile deployment with stationary zero balancing
stationary	stationary deployment; fixed angle of WFT

Coupling	Description
TTI	Transducer Telemetric Interface - Default value which can not be changed except for the angle-channel.
Spirit level	Only possible for the angle-channel, in order to determine the "*angle error*" by means of the internal bubble ("spirit") level. After the preparation procedure, the LED flashes at a constant rate. In the balancing process, the angle error is determined 434. Next, set the coupling back to "TTI" and run zero adjustment for the other channels (using the angle error found).

Parameter - Measurement mode	Description *long name*	*short name*	*column ID*
Wiring	*Channel wiring*	*Wiring*	*eWiring*
	The input circuiting: "*Telemetry*". Not possible to change.		
Input range	*Input range*		*eRange*
	The measurement ranges are imported from the sensor.		

Input range	Description
Fx, Fz, Fy, Mx, Mz, My	Should not be changed
Aux.	Quantization: 32mV/V / 32768

Input range	Unit	Range	Default
Fx/Fz	kN		
Fy	kN		
Mx/Mz	Nm		
My	Nm		
Aux	mV/V	[0.5; 32]	32 mV/V

Dialog: WFT - Transformation

Parameter - WFT Transformation	Description *long name*	*short name*	*column ID*
Axial displacement	*Axial displacement*		*eAxialDisplacement*
	Used for transforming the coordinate system to "*TTI*"		

Unit	Range	Default
mm	[-999.00; 999.00]	0 mm

Parameter - WFT Transformation	*long name*	*short name*	*column ID*
Radial displacement	*Radial displacement*		*eWheelRadius*
	Used for transforming the coordinate system to "*TTI*"		

Unit	Range	Default
mm	[0.00; 999.00]	0 mm

Dialog: WFT - Balance

Parameter - WFT Balance	Description *long name* *short name* *column ID*
Balance interval	*Balance interval* | | *eBalanceInterval* In revolutions (for rotating balance) or seconds (for stationary balancing)

Balancing	Unit	Range	Default
rotating balancing	rotations	[2; 1000] rotations	4 rotations
stationary balancing	s	[0.2; 100.0] s	4 s

Dialog: Miscellaneous

Parameter Miscellaneous	Description *long name* *short name* *column ID*
Angle error	Tab: Channel balance Quantization: 180° / 32768; balanced by spirit level or manual entry

Unit	Range	Default
°	[-120; 120°]	0°

Parameter Miscellaneous	Description
Filter characteristic	Tab: Analog channels > Dialog: Filter *Filter characteristics* | *Characteristic* | *eFilterCharacteristic* Here, you select the filter characteristic for the channel selected: Low-pass (8th order): Butterworth or Bessel
Filter cut-off frequency 1	Tab: Analog Channels > Dialog: Filter *Filter cut-off frequency 1* | *Cut-off frequency 1* | *eFilterCutoff1*

Unit	Range	Default
Hz	Depending on the characteristics	20 Hz

Parameter Miscellaneous	Description
Unit system (WFT)	Tab: Devices > Dialog: Measurement options *Unit system (WFT)* | *Unit system* | *eUnitSystem* Here you can choose the system of units: "*SI*" or "*US*". You must additionally change the parameter "*Temperature unit °F instead of °C*" to change the temperature unit.

Channels with associated parameters

Channels transmitted by the sensor (one each for the left and right wheels)

<table>
<tr><th>Channels</th><th>associated parameter</th></tr>
<tr><td>Status; Status-Flags 437
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Status_*</td><td></td></tr></table>
</td><td>---</td></tr>
<tr><td>Fx
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Fx_*</td><td>kN</td></tr></table>
</td><td>Input range Fx/Fz</td></tr>
<tr><td>Mx
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Mx_*</td><td>Nm</td></tr></table>
</td><td>Input range Mx/Mz</td></tr>
<tr><td>Fy
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Fy_*</td><td>kN</td></tr></table>
</td><td>Input range Fy
Offset
<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
</td></tr>
<tr><td>My
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>My_*</td><td>Nm</td></tr></table>
</td><td>Input range My
Offset
<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
</td></tr>
<tr><td>Fx
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Fz_*</td><td>kN</td></tr></table>
</td><td>Input range Fx/Fz</td></tr>
<tr><td>Mx
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Mz_*</td><td>Nm</td></tr></table>
</td><td>Input range Mx/Mz</td></tr>
<tr><td>Revolutions
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Revs*</td><td></td></tr></table>
</td><td>Input range
<table><tr><th>Range</th><th>Info</th></tr><tr><td>[-32768; 32737]</td><td>number of revolutions by the WFT</td></tr></table>
</td></tr>
</table>

Channels	associated parameter
RPM	Input range
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>RPM*</td><td>RPM</td></tr></table>	<table><tr><th>Range</th><th>Info</th></tr><tr><td>[-3061.224; 3061.131]</td><td>current rotation speed of the WFT; derived from internal calculations of the TTI</td></tr></table>
Temperature	Input range
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Temp_*</td><td>°C</td></tr></table>	<table><tr><th>Range</th><th>Info</th></tr><tr><td>[-128.0000; 127.9961]</td><td>temperature of the WFT</td></tr></table>
Auxiliary - extra input	Input range Aux Offset
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Aux_*</td><td>mV/V</td></tr></table>	<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
Fx (rotating coordinate system)	Input range Fx/Fz Offset
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>rot_fx_*</td><td>kN</td></tr></table>	<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
Mx (rotating coordinate system)	Input range Mx/Mz Offset
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>rot_mx_*</td><td>Nm</td></tr></table>	<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
Fz (rotating coordinate system)	Input range Fx/Fz Offset
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>rot_fz_*</td><td>kN</td></tr></table>	<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>
Mz (rotating coordinate system)	Input range Mx/Mz Offset
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>rot_mz_*</td><td>Nm</td></tr></table>	<table><tr><th>Info</th><th>Action</th></tr><tr><td>determined by "TTI" upon balancing</td><td>Offset-balance</td></tr></table>

<table>
<tr><th>Channels</th><th>associated parameter</th></tr>
<tr><td>Angle
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Angle_*</td><td>°</td></tr></table>
</td><td>Input range
<table><tr><th>Range</th><th>Default</th><th>Action</th></tr><tr><td>[-180.0000°; 179.9945°]</td><td>0</td><td>spirit ("bubble") level</td></tr></table>
</td></tr>
<tr><td></td><td>Angle error</td></tr>
<tr><td>Angle, Sine
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Sin_*</td><td></td></tr></table>
</td><td>Input range
<table><tr><th>Range</th><th>Default</th></tr><tr><td>[-1.000000; 0.999969]</td><td>0</td></tr></table>
</td></tr>
<tr><td>Angle, Cosine
<table><tr><th>Channel name</th><th>Unit</th></tr><tr><td>Cos_*</td><td></td></tr></table>
</td><td>Input range
<table><tr><th>Range</th><th>Default</th></tr><tr><td>[-1.000000; 0.999969]</td><td>0.999969</td></tr></table>
</td></tr>
</table>

Status-Flags

Bit	State-Code	Description (bit active/passive)
2^0	1	WFT detected / not detected
2^1	2	Measured values plausible, angle index passed at least one time/Measured values not plausible
2^2	4	Offset-balancing running / not running
2^3	8	Shunt active/passive
2^4	16	Remote active/passive
2^5	32	Bubble level mode active/passive
2^{15}	32768	Error / no error

8.9 Tutorial

This chapter presents some examples involving the plug-in **Setup**. The examples use **Widgets** 1098 from the plug-in **Panel** 1058, which may not be included in your installation (depending on the product configuration).

- Simple measurement - First Steps 439
- Subsequent saving of measured data 444
- Pre-defined saving of measured data 447
- Simple Triggering 450
- Simple Triggering - Enhanced 457
- Artificial sine 459
- Triggered measurement 463
- Thermocouple measurement 470

8.9.1 Simple measurement - First Steps

Assignment:

Set up an experiment. A measurement on an analog channel is to be started and the measurement results are to be displayed on a Panel page. The signal applied in this example is a ±2 V sawtooth voltage with a 1 Hz base frequency. If you use a different signal, the channel used must be set accordingly.

Learning goals:

- Creating an experiment
- Simple device operation

Elements used:

- Search for devices
- Device selection
- Connect
- Channel settings
- Save current Measurement Data

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel

Procedure:

Install **imc STUDIO**. More information on the installation is provided in the chapter: Setting Up - Software 15.

Connect a signal generator with *Channel_001* on your device. Refer to the device manual to see how to connect a signal with your device (terminals, etc.).

Start **imc STUDIO** as described in the chapter Start 31.

8.9.1.1 Setup - Settings

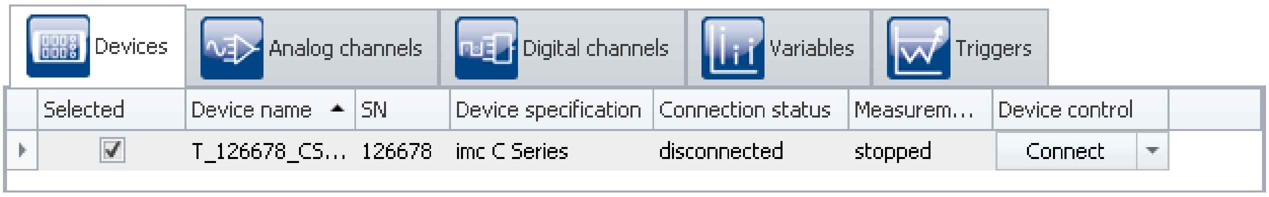
To begin, the measurement device is selected and configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Here you will find any devices which are known to the system due to having been used before. Following the first installation of imc STUDIO, the list is empty.

Select your device:

- If the device desired does not appear in the list, then perform a **device search** 222 ( ) (Ribbon *Home* (or *Setup-Control*) > *Search for Devices*). Subsequently, the list will display all devices found.
- Click on the Checkbox-symbol ( ) in order to **select** the device.



Selecting a device

The device is now known and selected, and is available each time **imc STUDIO** is started.

Configuring a channel

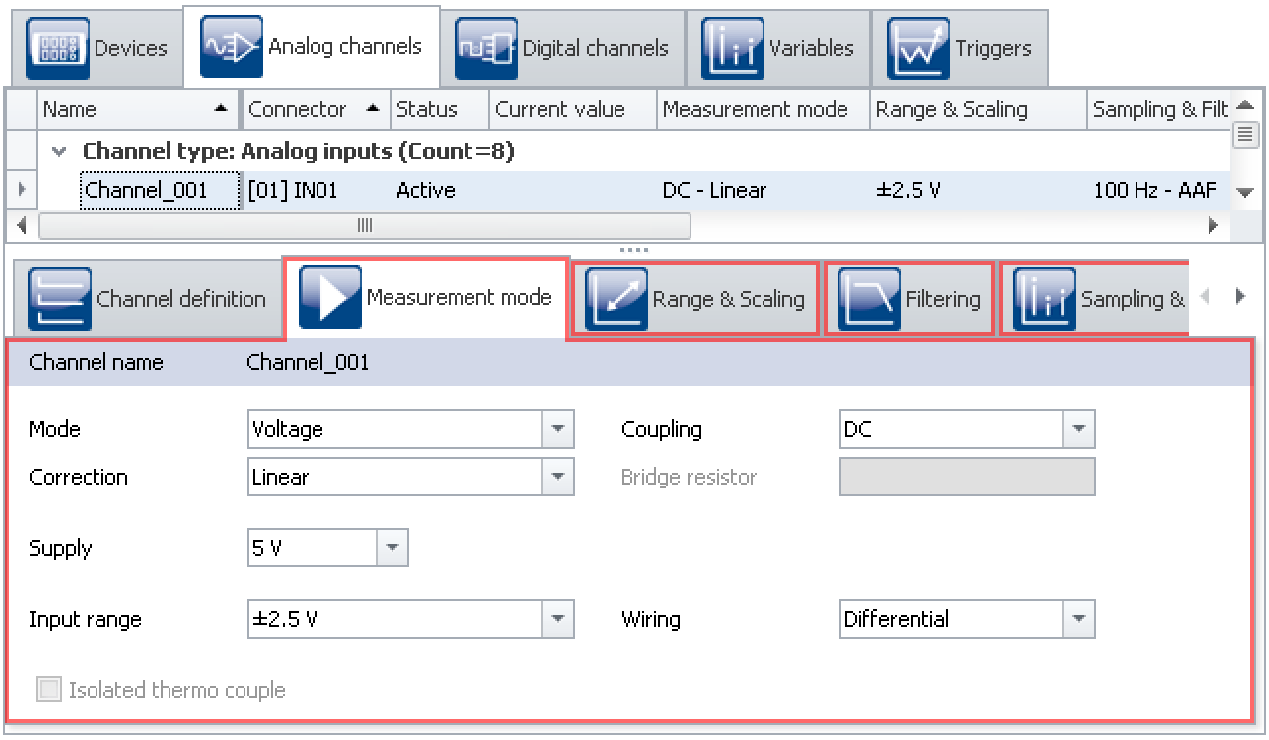
Now the channel used is configured:

- Go to the tab: **Analog channels** .

Under **Channel type: Analog inputs**, select *Channel_001*. By default, this is set to *active*. In order to make settings, click in the respective box and change the entry.

Set *Channel_001* in accordance with the input signal from your generator. In this example:

Parameter	Value	Dialog (View: *Standard*)	Dialog (View: *Complete*)
Mode	Voltage	Measurement mode	Measurement mode
Coupling	DC	Measurement mode	Measurement mode
Input range	±2.5 V	Measurement mode	Range & Scaling
Type	AAF	Sampling & Filtering	Filtering
Sampling rate	100 Hz	Sampling & Filtering	Sampling & Preprocessing
Duration	10 s	Sampling & Filtering	Sampling & Preprocessing



Picture 2: Configuring measurement channel by the dialogs

- To apply the changes, click on the button Process configuration 222 (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

By this means, the device settings are available to other plug-ins.

8.9.1.2 Panel - Settings / Start measurement

To display measured values, create a Panel page.

- Open the plug-in **Panel**.

How the plug-in Panel is structured is presented in the manual: Panel 1058.

Editing can only be performed in **Design mode** (e.g. add new **Widgets**, change **properties** etc.).

- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Note — Notes on Data Browser

The Panel has various **tool windows**. In **Data Browser** you can see the device's channels as shown in the image below. Following changes to the **Setup**, this list must be updated using the command **Process configuration** 222.

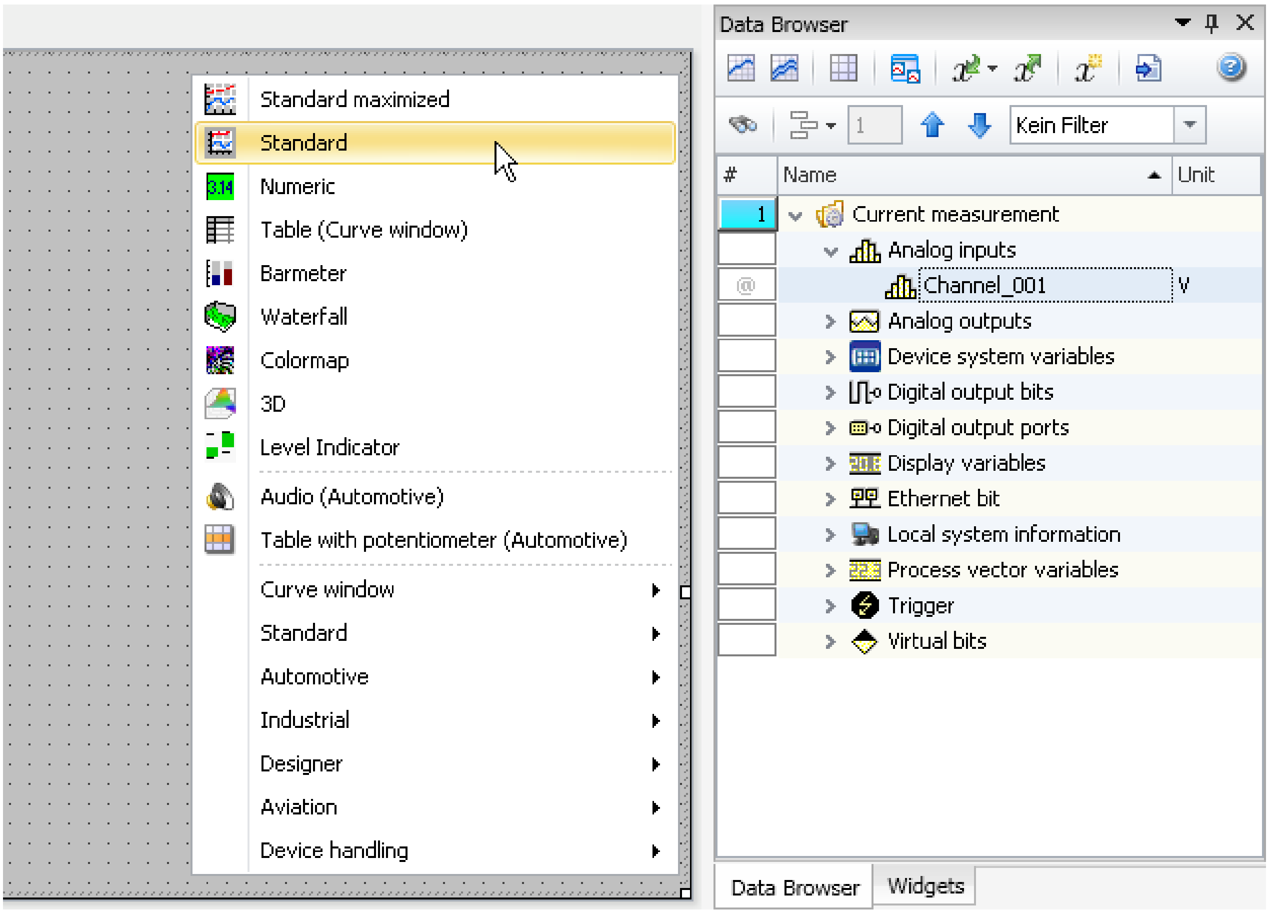
- Open the tool window **Data Browser** and select the analog input: *Channel_001*.
- Drag it onto the page using the Drag&Drop technique.

A menu appears offering **Widgets** appropriate for the analog channel's data type.

- Select one of these Widgets. In the example, a **standard curve window** is selected.

Reference — Curve window documentation

This Widget is the familiar curve window, which is also used in other imc software packages. For more information on this topic, see curve window documentation 1126.



Picture 3: Dragging an analog channel to the Panel page

There are a variety of Widgets available. The image in the example (Picture 3) may differ from your configuration.

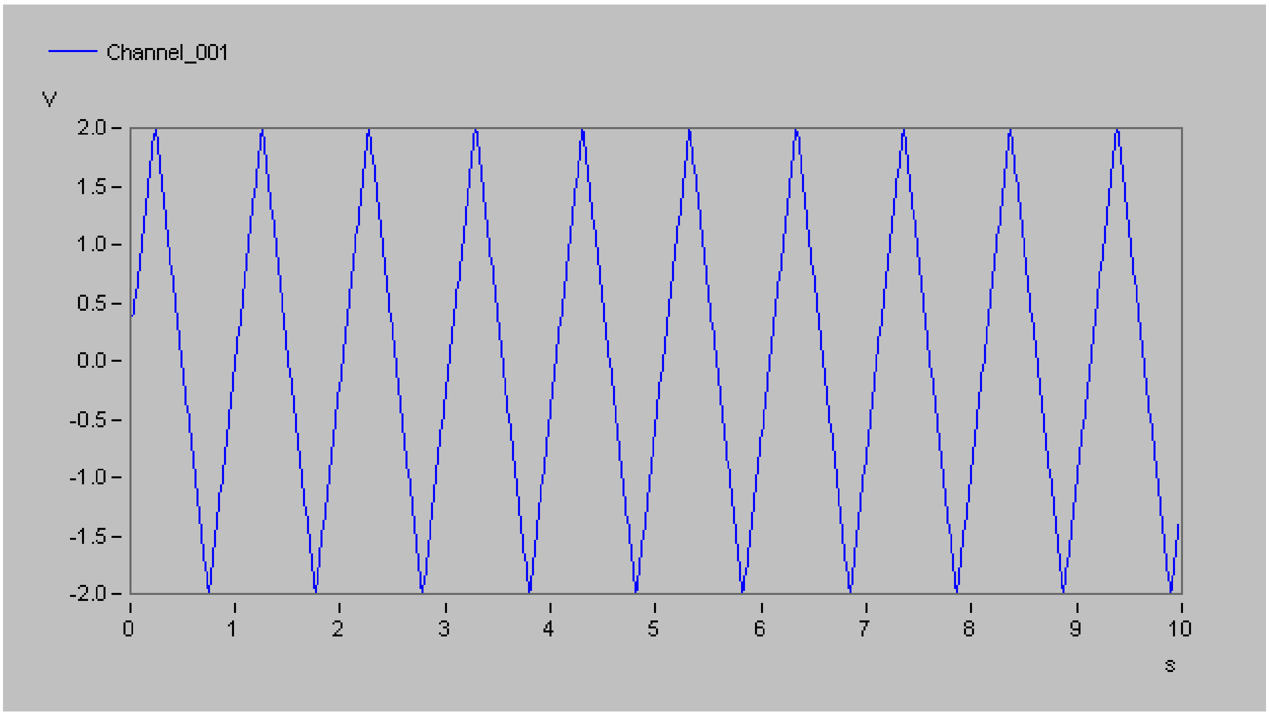
Following selection, the selected Widget appears on the Panel page and is linked with the analog input: *Channel_001* (more information on linkage of variables is provided in the documentation under *Panel > Variable Linkage* 1390).

As long as the Widget is selected, a cross appears in the center (⊕). This can be used to move the Widget or open a context menu there (by right-clicking).

- Deactivate the Design mode () (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Starting measurement

- To transfer the current settings to the device, click on the button **Download** 222 () (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).
- Start the measurement 222 () (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).



Picture 4: Curve window

After ten seconds, the measurement ends automatically. You can also start measurement multiple times and stop it prematurely using the associated button () (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).

Using the curve window, you can analyze the data in a wide variety of ways.

Save experiment

With this, you have concluded your first experiment. Save the experiment:

- Click on the button: **Save as** () (Ribbon *Home* (or *Project*) > *Save as*).
- Save the experiment under the name "*First Steps*".

Saving the measured data

In this example, the data were not saved permanently. They are not available on the hard drive, but it is possible to save them afterward (see Subsequent saving of measured data 444). Additionally, you can activate permanent storage of the data for each channel individually before the measurement (see Pre-defined saving of measured data 444).

Note	Permanent data storage

- When data storage is activated for each channel, the measured data are saved automatically. A corresponding folder is created for each completed measurement in the Data Browser.
- Activation of data storage ensures that no measured data are lost. Subsequently, it is always possible to delete the measured data once they are no longer required.

8.9.2 Subsequent saving of measured data

Assignment:

Perform a measurement and save the measured data subsequently on the hard drive.

Learning goals:

- Use of subsequent data saving

Elements used:

- Save current Measurement Data

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel

Procedure:

Load the experiment *First Steps* from the tutorial Simple measurement - First Steps 439 or stop the current measurement ( ) if it is still running.

To load the experiment:

- click on the button: **Open** ( ) (Ribbon *Start* (or *Project*) > *Open*)
- select the experiment *First Steps* and confirm by clicking in the dialog on "Open"

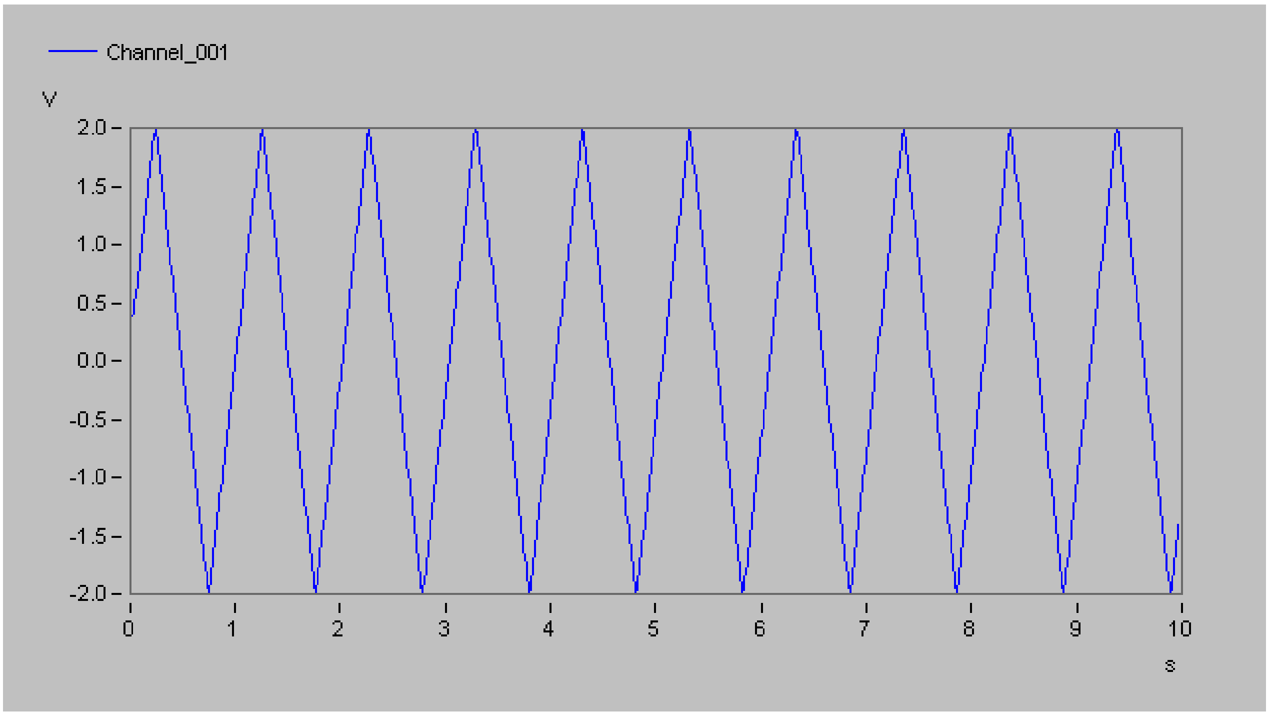
8.9.2.1 Panel - Starting measurement

Open the Panel page and perform a measurement.

Starting measurement

- To transfer the current settings to the device, click on the button **Download** 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).

- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).



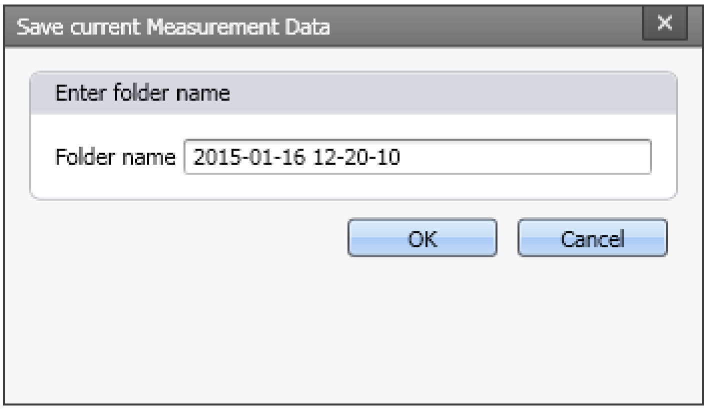
Picture 5: Curve window

After ten seconds, the measurement ends automatically.

8.9.2.2 Subsequent saving of measured data

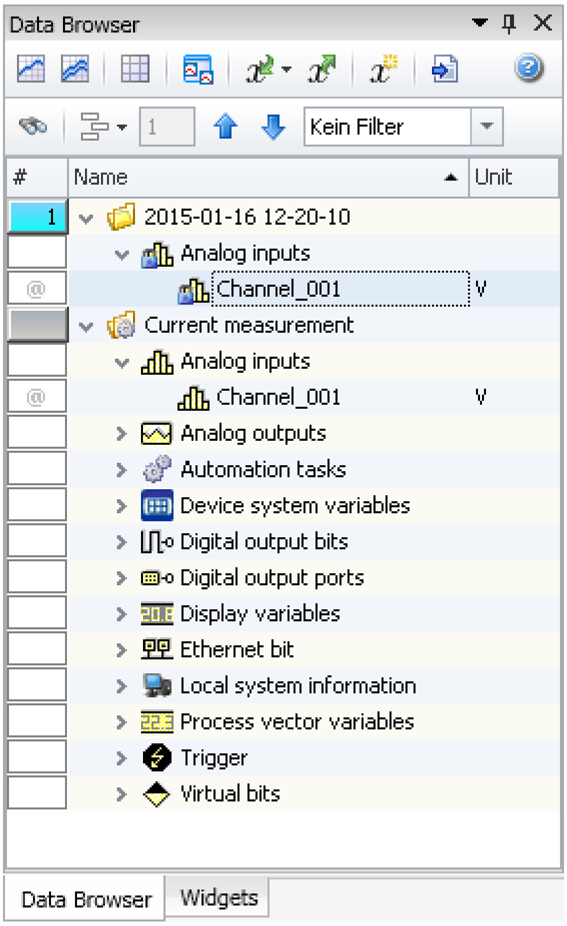
In this example, the data were not saved permanently. No data are on the hard drive, but these can be saved retroactively.

- Click on the button: **Save current Measurement Data** ( ) (Ribbon *Project* (or for a simplified view: *Home*) > *Save current Measurement Data*).
- If the action has not been configured otherwise, a dialog appears which prompts you to enter a folder name. The suggested default value is the current time stamp. Close the dialog by selecting "OK".



Picture 6: Dialog: Save current Measurement Data

Subsequently, all channels (including analog channels, virtual channels, ...) belonging to the experiment are saved to the hard drive. In the Data Browser, a folder corresponding to the folder name appears, which contains the saved measurement data. You can load and view it using the Panel.



Picture 7: Saved measurement data (example)

The measured data saved by means of *Save current Measurement Data* are always stored in the experiment folder. If you wish to save them to a freely selectable folder, use the button: **Save current Measurement Data as** (*Project* ribbon*)*. Be aware that measured data saved in this way are not recorded in the Data Browser and can thus not appear there.

Note Constraints

- **No single values can be saved in this way.** These include, for instance, Display-variables.
- Be aware that with this function, only such variables are saved, which are found in the Data Browser under **Current measurement**. For these variables, a **circular buffer memory** is usually activated, so that not all results since the measurement start are available.
  For device-variables, therefore, the Data Transfer Settings 381 are applicable. The storage type: *Display, calculation of measured data* is used.

Reference

More information on the function: **Save current Measurement Data** is presented in the document: *Setup - Advanced Device Functions > Storage Options and Directory Structure >* *Targeted Data Saving, or Saving Subsequent to Measurement* 733.

8.9.3 Pre-defined saving of measured data

Assignment:

Configure the measurement device in such a way that the measured data are already saved while the measurement runs. Subsequently, run a measurement.

Learning goals:

- Saving measured data during measurement

Elements used:

- Channel settings: Data transfer

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel

Procedure:

Load the experiment *First Steps* or stop the current measurement ( ) if it is still running.

Save the experiment under a new name: "*First Steps with data saving*"

- To do this, click on the button: **Save as** ( ) (Ribbon *Home (or Project) > Save as*).

8.9.3.1 Setup - Settings

Activate storage of the measured data for the active measurement channel.

- Open the plug-in **Setup**.
- Go to the tab: **Analog channels** .

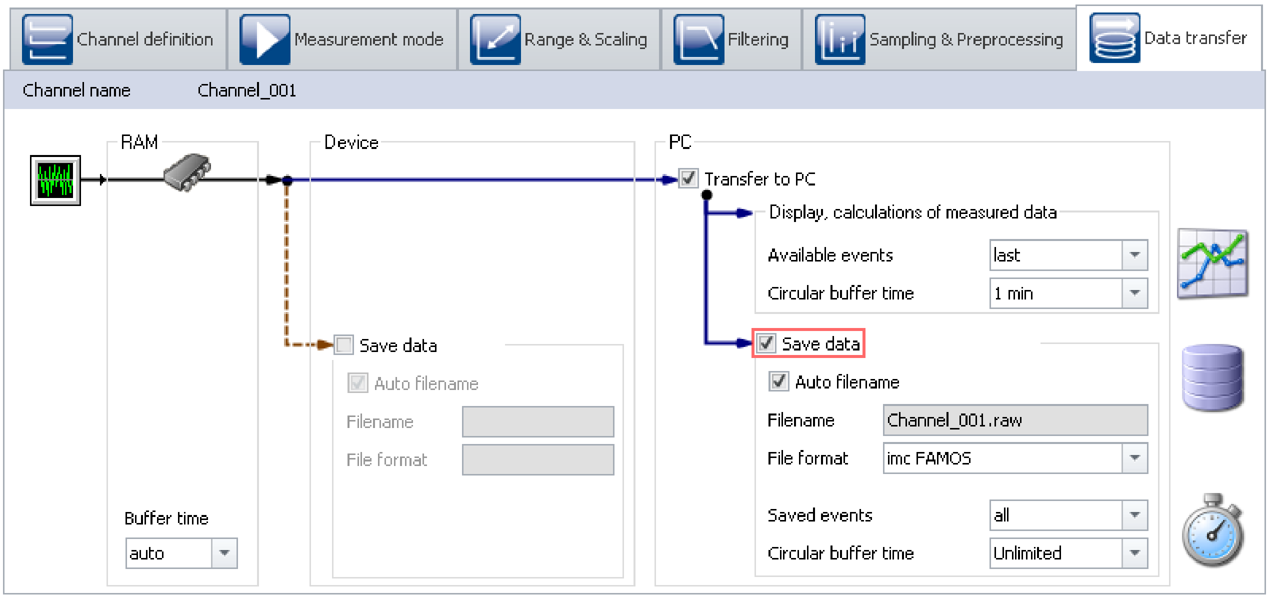
Under **Channel type: Analog inputs**, select *Channel_001*.

Activate storage of the measured data on the PC for the analog input: *Channel_001*.

Parameter	Value	Dialog (View: *Standard*)	Dialog (View: *Complete*)
Save data (PC)	Checkbox activated (true)	Data transfer	Data transfer

Note

The option ***Save data*** appears on the *Data Transfer* page in two places. Once where it activates storage of the measured data on the **device**, and once for storage on the **PC**. Ensure that you activate the type of data storage desired.



Picture 8: Activating the storage of measured data using the dialogs

- To apply the changes, click on the button **Process configuration** 222 (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

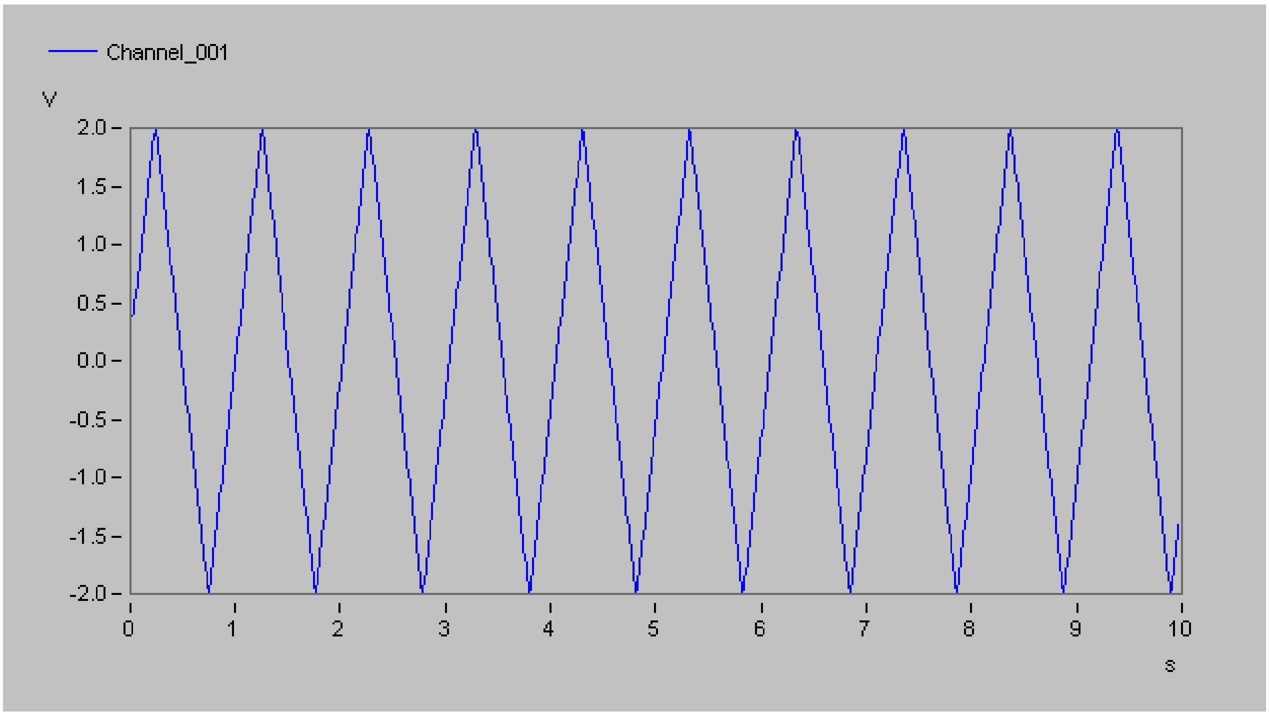
By this means, the device settings are available to other plug-ins.

8.9.3.2 Panel - Starting measurement

Open the Panel page and perform a measurement.

Starting measurement

- To transfer the current settings to the device, click on the button **Download** 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).
- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).

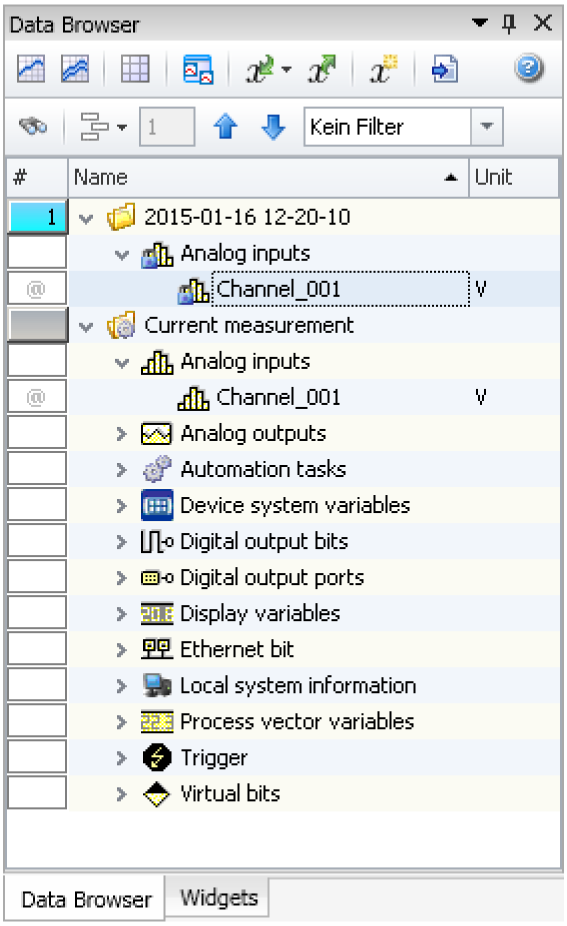


Picture 9: Curve window

After ten seconds, the measurement ends automatically.

At the end of measurement, the measurements are each saved in a separate subfolder in the **Experiment folder**. The folder is named according to the respective measurement's start-time stamp.

The saved measurement appears in the **Data Browser**:



Picture 10: Saved measurement data (example)

Note — Permanent data storage

- When data storage is activated for each channel, the measured data are saved automatically. A corresponding folder is created for each completed measurement in the Data Browser.
- Activation of data storage ensures that no measured data are lost. Subsequently, it is always possible to delete the measured data once they are no longer required.

Reference

More information on **activating the data storage** is presented in the chapter: *Data transfer* 381.

8.9.4 Simple Triggering

Assignment:

Display a measurement on an analog channel. Use a switch on the **Panel** page in order to interactively start and stop measurement on this channel.

Learning goals:

- Creating an experiment
- Simple device operation
- Use of a trigger

Elements used:

- Connection to the device
- Channel settings
- Trigger

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel

Procedure:

Begin by starting **imc STUDIO**.

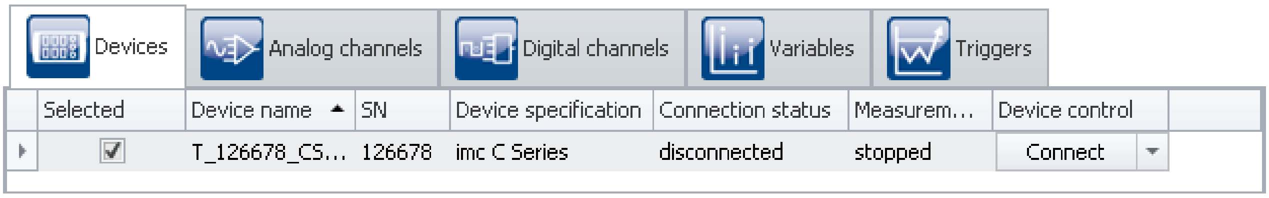
8.9.4.1 Setup - Settings

First, the measurement device is configured and an appropriate name is assigned to the variables.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device:

- If the device desired does not appear in the list, then perform a **device search** 222 ( ) (Ribbon *Home* (or *Setup-Control*) > *Search for Devices*). Subsequently, the list will display all devices found.
- Click on the Checkbox-symbol ( ) in order to **select** the device.



Selecting a device

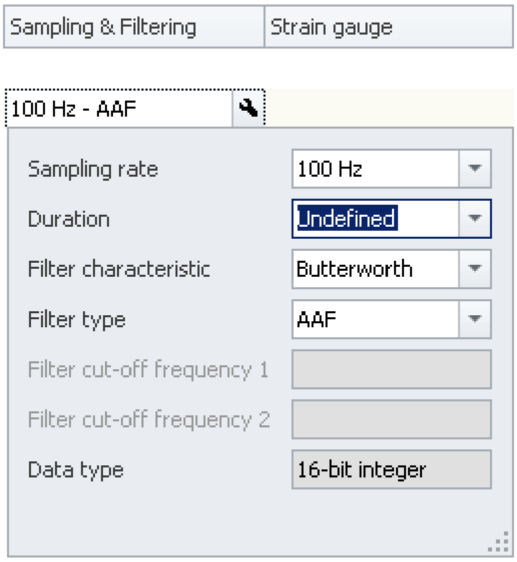
The device is now known and selected, and is available each time **imc STUDIO** is started.

Configuring the channels

- Go to the tab: **Analog channels** .

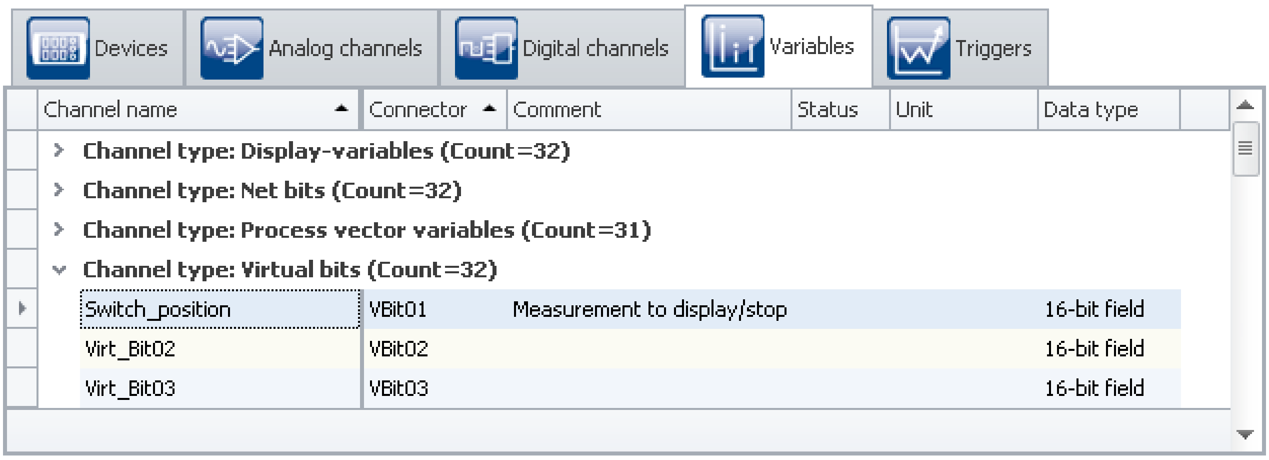
Under **Channel type: Analog inputs**, select *Channel_001*. By default, this is set to *active*.

- In order to set a measurement of unlimited duration, in the column **Sampling & Filtering**, on the row **Duration** set the value *Undefined* by means of the pop-down symbol ().



Picture 11: Unlimited measurement duration

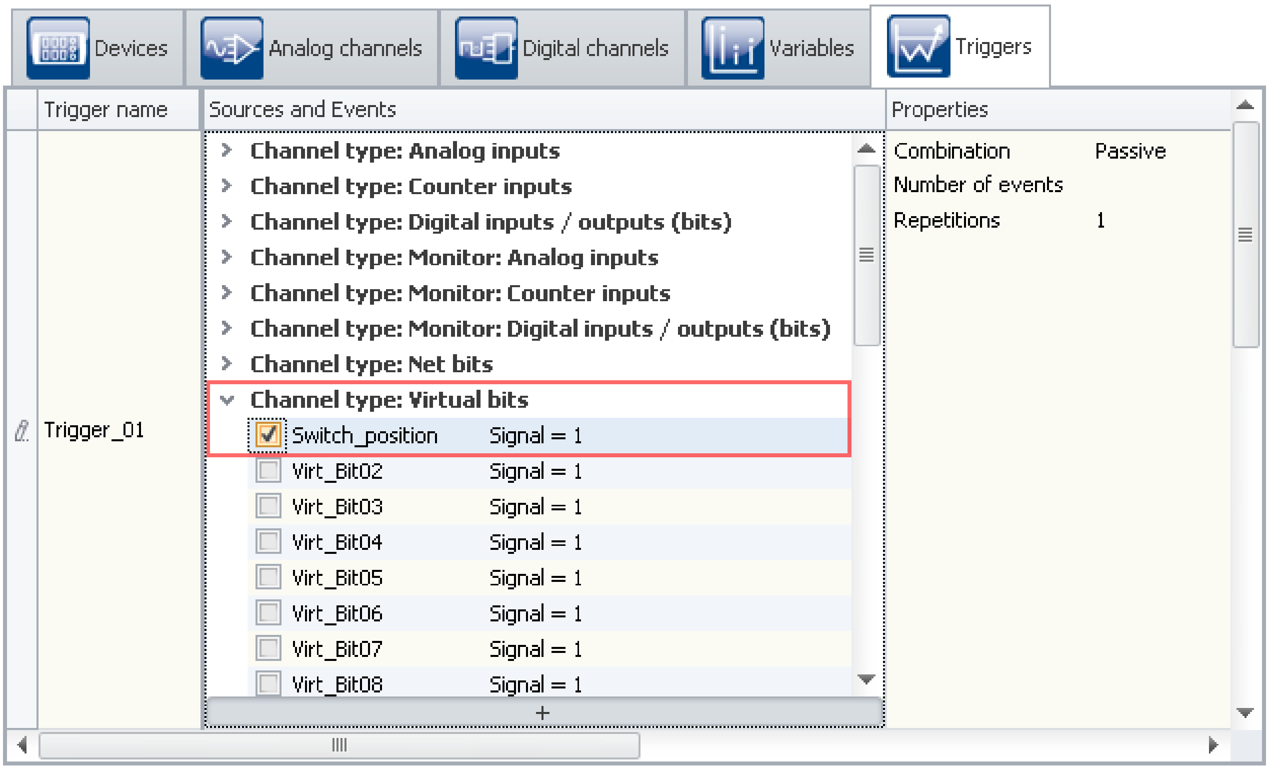
- Go to the tab: **Variables** .
- Under **Channel type: Virtual bits**, click on *Virt_Bit01* and rename it to *Switch_position*. If desired, you can enter a comment (*Measurement to display/stop*), as shown in the Picture 12:



Picture 12: Channel type "Virtual bits"

Defining triggers

- Go to the tab: **Triggers** .
- To define the **virtual bit** *Switch_position* as a source, click in the column **Sources and Events** on the plus-sign symbol (+).
- Select *Switch_position* (see Picture: 13)

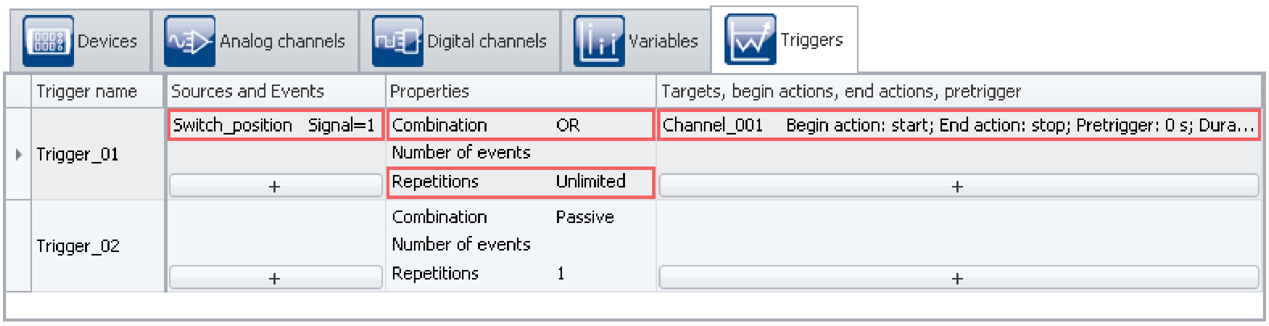


Picture 13: Trigger source

- In order to be able to release the trigger multiple times, in the column **Properties** set the **Repetitions** at *Unlimited*
- As the **target**, specify *Channel_001*

The measurement is to start when *Switch_position = 1* and stop when *Switch_position = 0*. To accomplish this, set the **Begin action** and **End action** as shown in Picture 14.

Parameter	Value
Trigger begin action	start
Trigger end action	stop



Picture 14: Settings for the trigger

- To transfer the current settings to the device, click on the button Download 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).

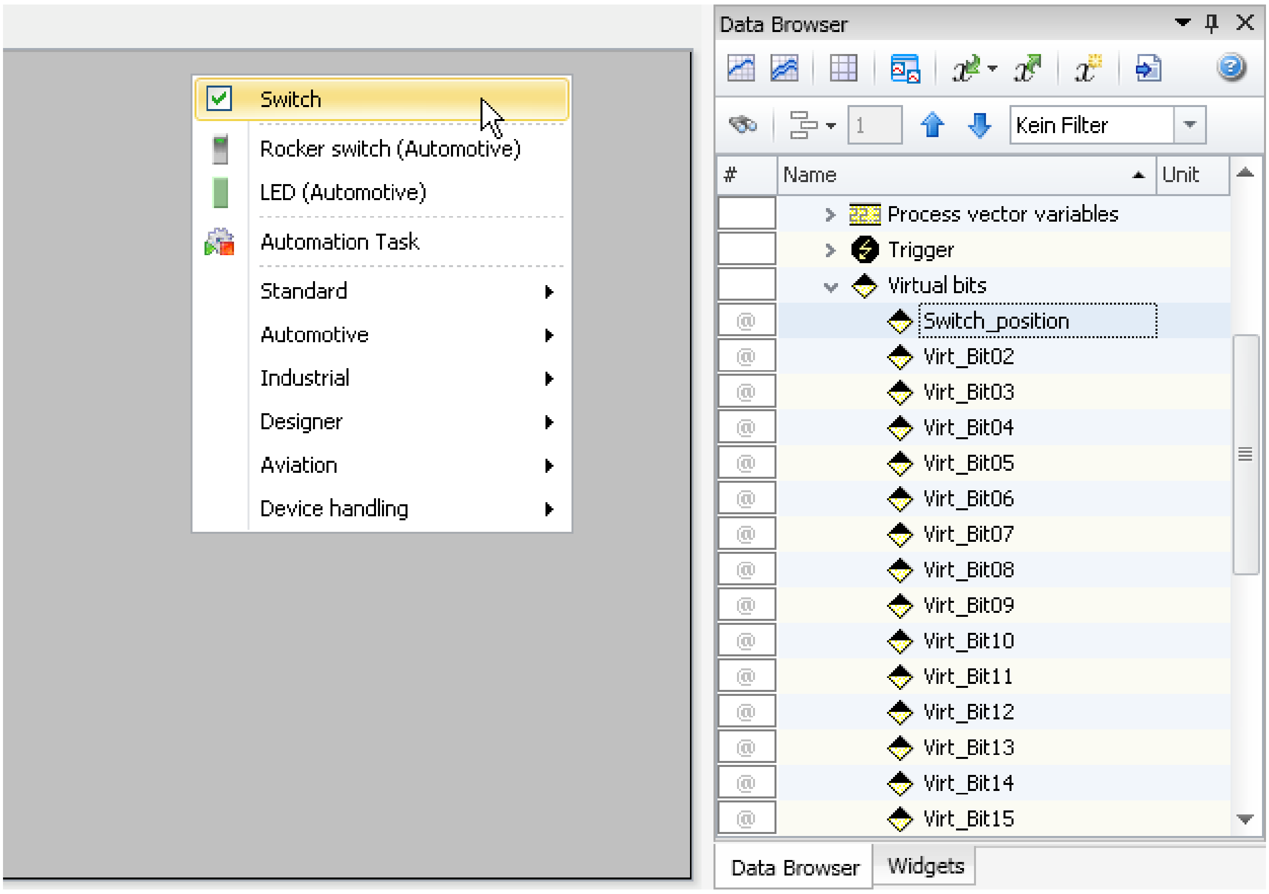
8.9.4.2 Panel - Settings / Start measurement

Now you can create the Panel page.

- Open the plug-in **Panel**.
- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

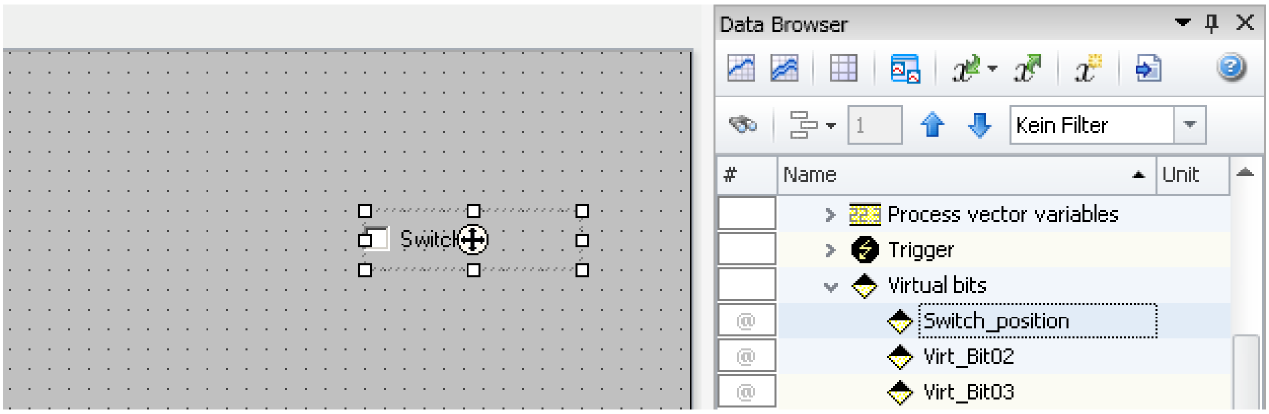
Switch

- From the **Data Browser**, you can now drag the *Switch_position* (found under **Channel type: Virtual bits**) to the Panel page.
- After releasing the mouse button (Drag&Drop technique), a context menu appears. From this context menu, select **Switch**.



Picture 15: Dragging a virtual bit to the Panel page

A wide variety of Widgets are now available. Please note that the image below is only an example and may not correspond to the Widgets available to you.

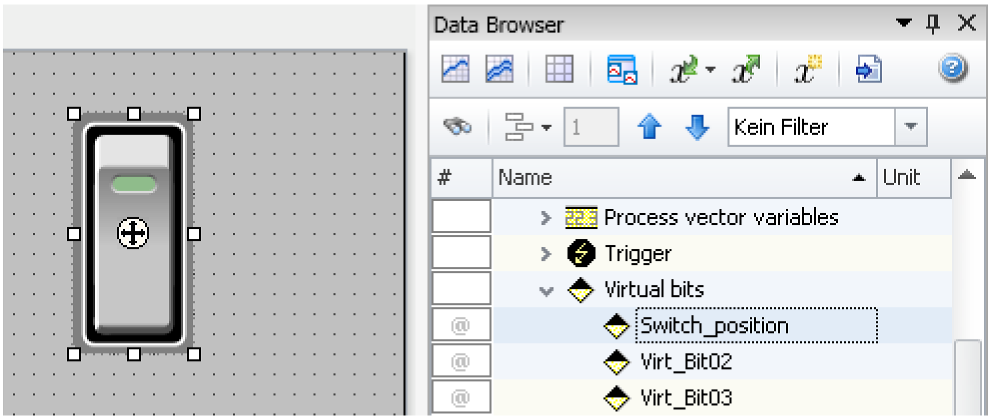


Now the switch on the Panel-page is linked with the virtual bit in the device named *Switch_position*. Using the switch, you can interactively switch the virtual bit on and off.

By means of the Widget-property: "Text", you can label the switch; e.g. "*Trigger start*". To do this, open the context menu over the "crosshairs" (⊕) within the selected Widget and select the entry: "*Properties*".

Note Additional Widgets

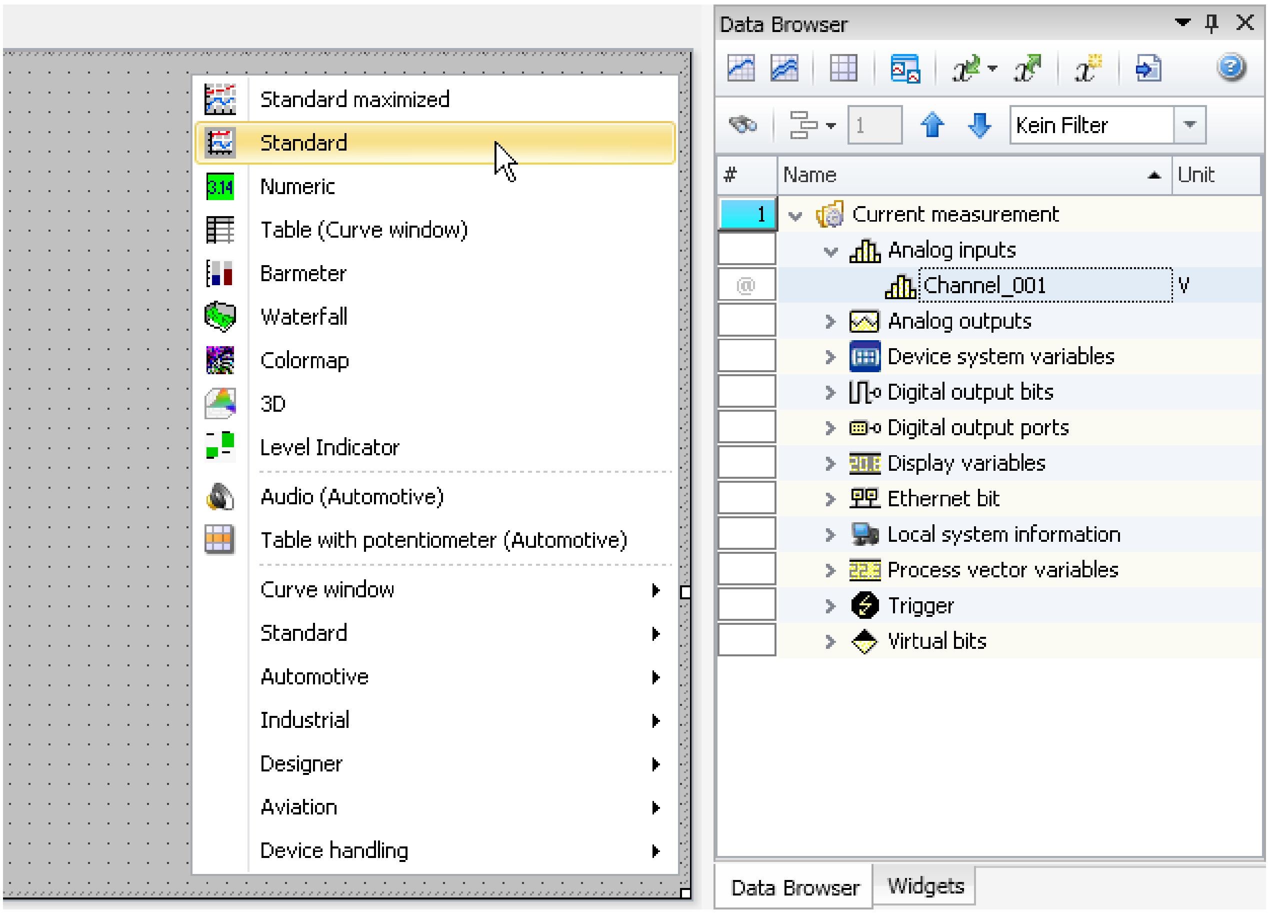
Depending on the product configuration, additional Widgets are available. Instead of a simple switch, you could select a rocker switch, for example, under the heading "Automotive":



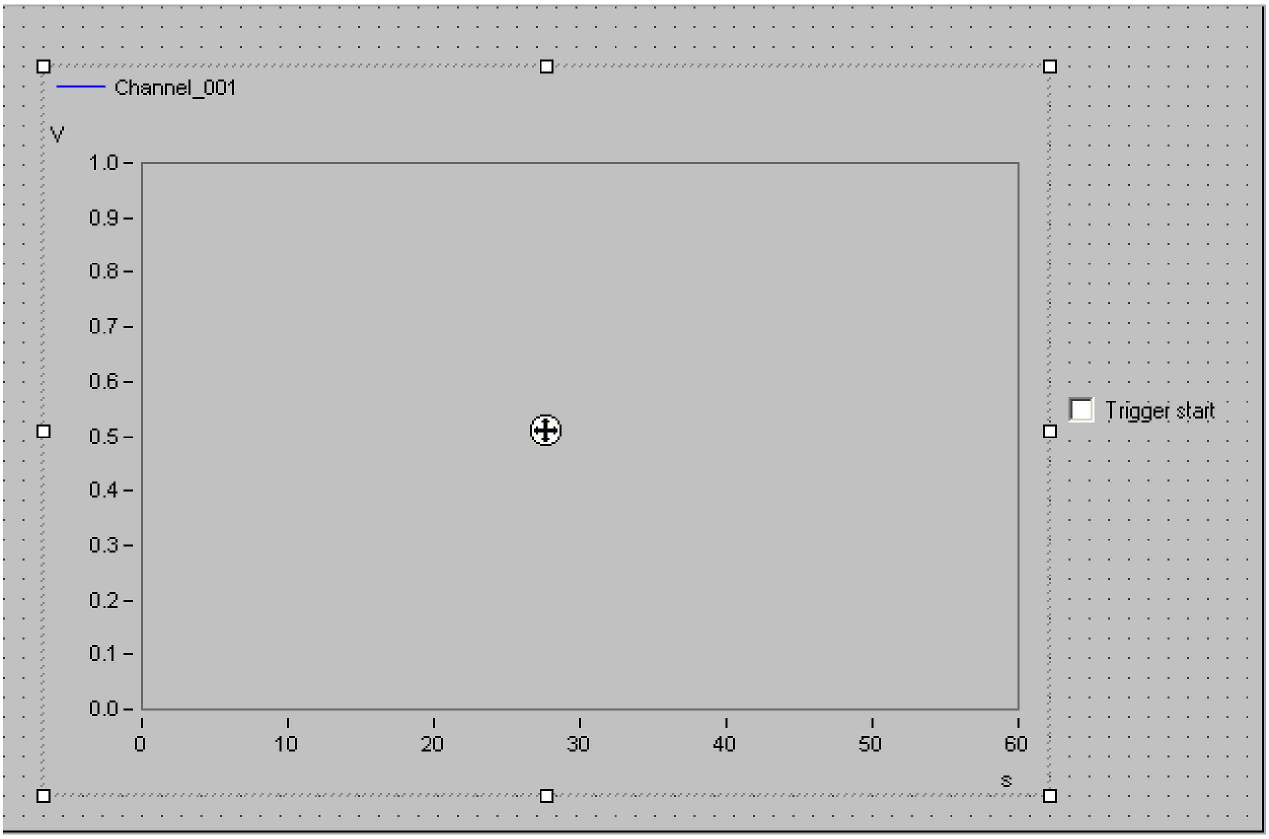
Curve window

After positioning the switch on the Panel page, next create the curve window:

- Drag the analog channel *Channel_001* from the **Data Browser** to the Panel page.
- Upon releasing the mouse button, you see a context menu where you will select the entry ***Standard***. This creates a standard curve window.



Picture 16: Dragging an analog channel to the Panel page



Picture 17: Example: Completed Panel page with two Widgets

As long as the Widget is selected, a cross appears in the center (⊕). This can be used to move the Widget or open a context menu there (by right-clicking).

- Deactivate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Starting measurement, clicking buttons, stopping

- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).

Channel_001 is triggered by the virtual bit *Switch_position*. This means that when you click on the switch, data capture on *Channel_001* starts/stops.

- Click on the switch multiple times.

Save experiment

With this, you have concluded the experiment. Save the experiment:

- Stop the measurement ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).
- Click on the button: **Save as** ( ) (Ribbon *Home* (or *Project*) > *Save as*).
- Save the experiment under the name "*Simple Triggering*".

Reference

For an additional display of text on the Panel page to indicate the status of the measurement, please read about the enhancement: Simple Triggering - Enhanced 457.

8.9.5 Simple Triggering - Enhanced

Assignment:

A text box on the **Panel** page displays the measurement's state (corresponding with *Switch position* 451). The states are (*running*, *stopped*).

Learning goals:

- Observation of the measurement's status on the Panel page

Elements used:

- Zones

Additionally used plug-ins:

- imc STUDIO Panel

Prerequisite:

- This is an enhancement of the experiment: *Simple Triggering* 450, which must already exist.
- The same conditions apply as for the experiment: *Simple Triggering* 450

Procedure:

Begin by starting **imc STUDIO**.

- Load the experiment ***Simple Triggering*** or stop the current measurement ( ) if it is still running.
- Save the experiment under a new name: "*Simple Triggering - Enhanced*"
  - To do this, click on the button: **Save as** ( ) (Ribbon *Home (or Project) > Save as*).

8.9.5.1 Panel - Settings / Start measurement

- Open the plug-in **Panel**.
- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).
- Drag the Widget: "**Listbox**" to the Panel page:
  - Tool Window: *Widgets* - Group: *Standard > Listbox*.

The "Listbox" is configured in the **Widget-properties**. To do this, open the context menu over the "crosshairs" ( ) within the selected Widget and select the item: "*Properties*".

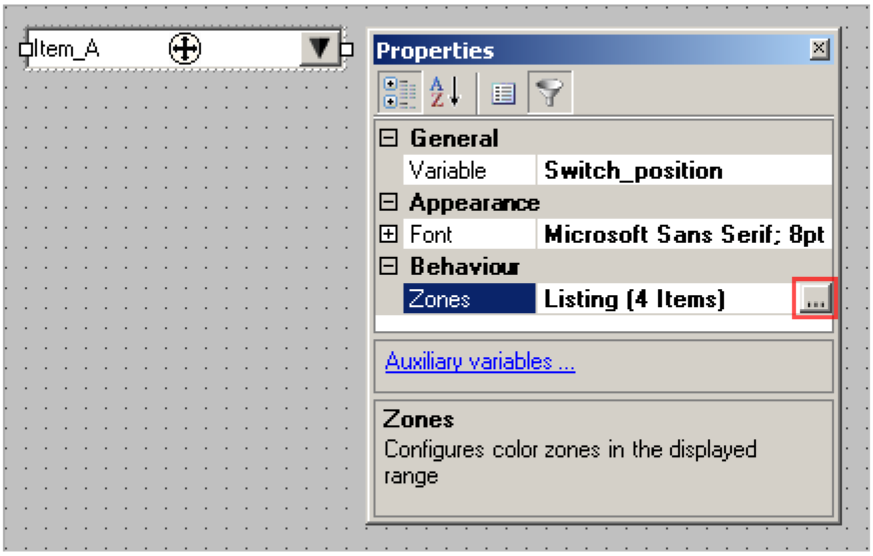
- Under the property: "**Variable**", select the virtual bit "*Switch position* 451".

You have now established a link between the switch and the listbox. When you click on the switch, the listbox indicates the applicable status.

Setting up and adapting states (zones)

The states displayed are to be adapted. For this purpose, some of the Widgets have the property: "**Zones**".

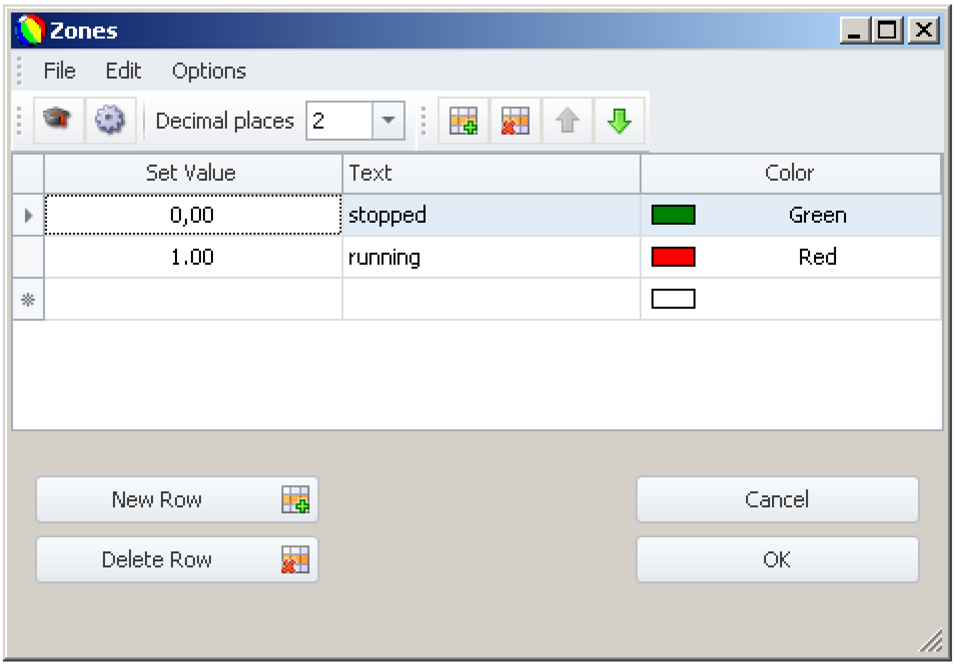
- Click on the symbol ... as shown in Picture 18:



Picture 18: States (zones) defined for the selection box

In the dialog window, it is now possible to define the zones. The measurement has two possible states: "*stopped*" and "*running*".

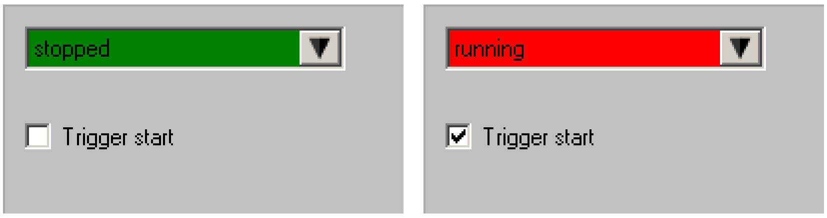
- Only two zones are required; begin by deleting all but two zones
- Enter the zones as shown in Picture 19 (the color is not relevant for the example):



Picture 19: Zones

- Deactivate the Design mode () (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).
- Start the measurement 222 () (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).
- then click on the switch on the Panel page

The listbox changes (*running*, *stopped*) in response to the switch position:



With this, the goal of this enhancement has been met.

Saving

With that, you have completed this example and can save it. Since the experiment has already been saved under a new name, it is sufficient to save the changes.

- Stop the measurement () (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).
- Click on the button: **Save** () (Ribbon *Home* (or *Project*) > *Save*).

8.9.6 Artificial sine

Assignment:

Generate an artificial sinewave imc Online FAMOS and display it on the Panel page. The frequency and amplitude are to be adjustable by Widgets.

Learning goals:

- Use of imc Online FAMOS
- Exercising control via the Panel

Element used:

- Connection with a device
- Channel settings
- imc Online FAMOS

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel

Procedure:

Begin by start **imc STUDIO**.

8.9.6.1 Setup - Settings

First, the measurement device is configured and the variables used are assigned an appropriate name.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device

Configuring the channels

- Go to the tab: **Analog channels** .

Under **Channel type: Analog inputs**, select *Channel_001*. Make the following settings for the channel's parameter configuration:

Parameter	Value
Name	Clock
Status	Active
Mode	Voltage
Coupling	DC
Input range	± 5 V
Sampling rate	1 kHz
Duration	Undefined

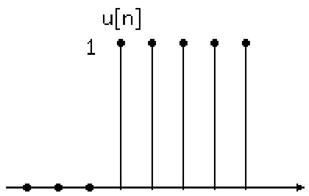
- Go to the tab: **Variables** .
- Under the **Channel type: Display-variables**, rename the following variables:
  - *DisplayVar_01 > Amplitude*
  - *DisplayVar_02 > Frequency*

imc Online FAMOS

- Open imc Online FAMOS () (Ribbon *Home* (or *Setup-Configuration*) > *Online FAMOS*)
- Enter the following source code in the imc Online FAMOS Editor:

```
t = integral(Clock * 0 + 1)
Oscillation = Amplitude * Sin(6.283185 * Frequency * t)
```

Note | Erläuterung



Pulse sequence

The expression ***Clock * 0 + 1*** generates the sequence of unit pulses u[n] after the measurement starts.

Since the channel's sampling frequency is 1 kHz, the pulse sequence consists of 1000 values per second. By integrating the unity pulses, one obtains a straight line with slope 1. The time "t" thus increases linearly.

The general shape of the sine: **x(t)=A*sin(u*t)** with **u=2*Pi*f=6.283185*f**.

Here it is to be noted that the signal is also discrete and has 1000 values per second. In order to change the resolution, you simply need to change the channel's sampling frequency.

The virtual channels you defined, **t** and **Oscillation** are generated automatically by this assignment.

- Select the Syntax Check and exit imc Online FAMOS.

Download

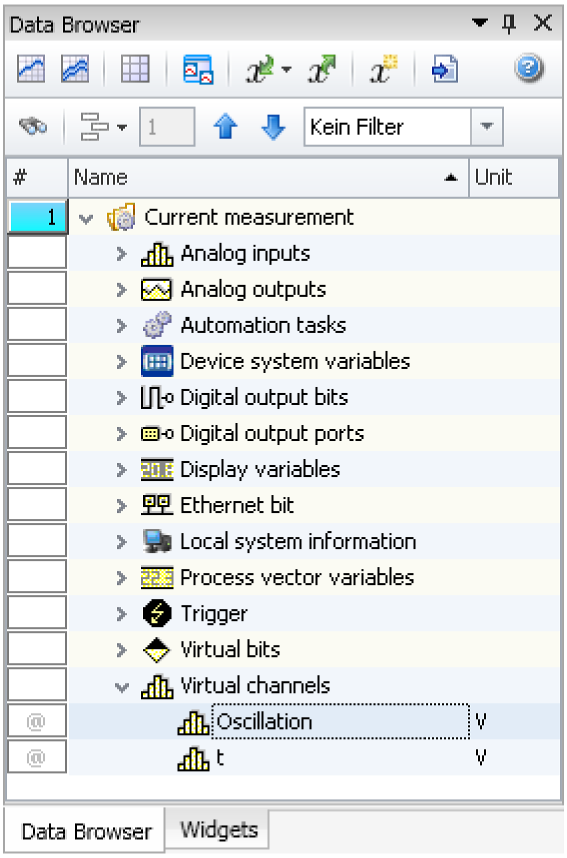
- To transfer the current settings to the device, click on the button **Download** 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).

8.9.6.2 Panel - Settings / Start measurement

Now you can create the Panel page.

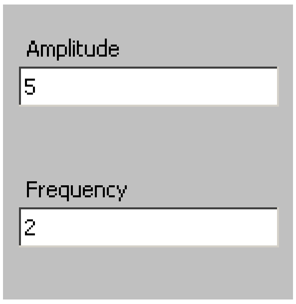
- Open the plug-in **Panel**.
- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

In the tool window: Data Browser you should find the **virtual channel** *Oscillation* created in imc Online FAMOS.



- From the tool window: **Data Browser** drag the variable: *Virtual channels* > *Oscillation* to the Panel page.
- In the Widget-selection list, select: **Standard** (curve window).

In order to change the values of variables *Frequency* and *Amplitude*, these are displayed on the Panel page with suitable Widgets.



- Drag the variable: *Display variables > Amplitude* to the Panel page.
- In the Widget selection list, select: group **Standard** > **Editor box (Single line)**.
- Drag the Widget: "**Label**" to the Panel page:
    - Tool Window: *Widgets* - Group: *Standard > Report > Label*.

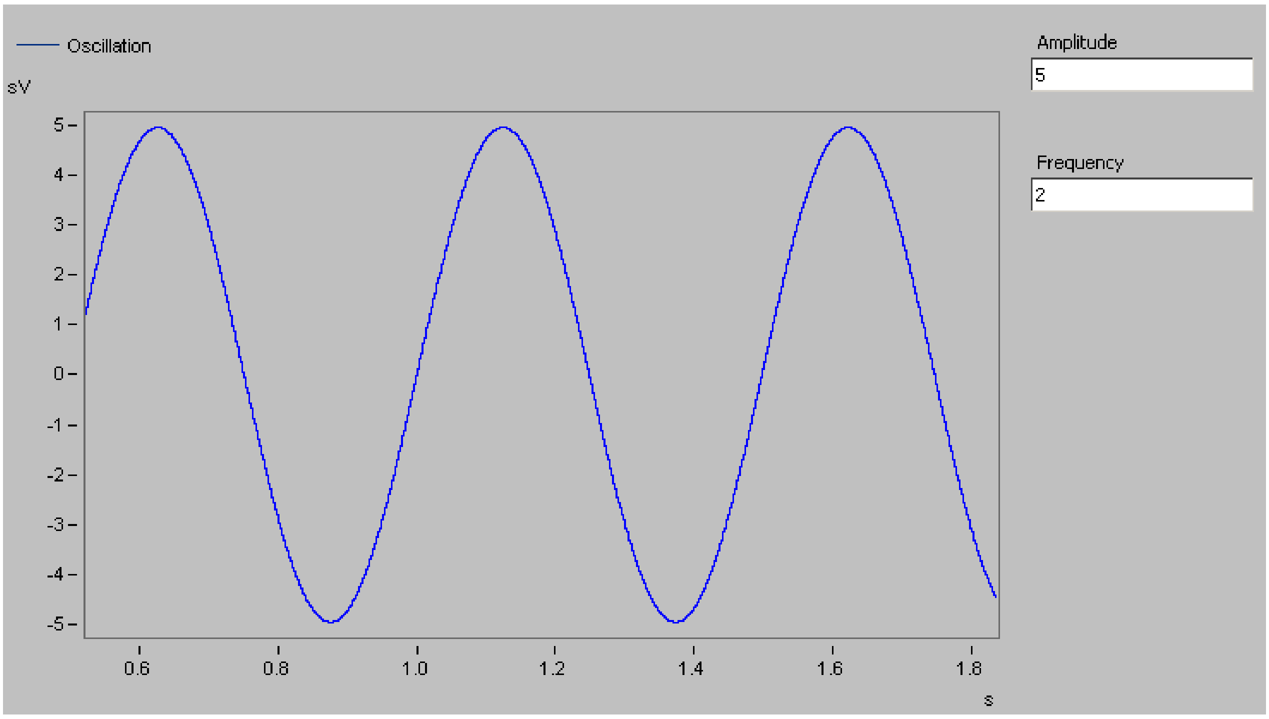
To adapt the **Text**, open the label's Properties.

- In the box **Text**, enter "*Amplitude*".

Display the variable *Frequency* in the same way.

Start measurement, observe results

- Deactivate the Design mode () (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).
- Start the measurement 222 () (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).
- change the *Amplitude* and the *Frequency* and observe how the curve window changes (see Picture 20)



Picture 20: Sinus

Saving

With that, you have completed this example and can save it:

- Stop the measurement () (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).
- Save () the experiment under the name "*Artificial Sine*".

8.9.7 Triggered measurement

Assignment:

The analog channel is to measure for 5 ms if the input signal exceeds the threshold 3 V. Apply a signal at the measurement device's analog input, with adjustable amplitude, e.g. by means of a function generator.

Learning goals:

- Use of a trigger
- Setting a channel according to the expected input signal

Elements used:

- Connection with a device
- Channel settings
- Monitor channel

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an analog channel
- A function generator or other signal source

Procedure:

Setting a function generator: Set up a sine function with a frequency of 1 kHz and initial amplitude of 2 V, for example.

Next, start **imc STUDIO**.

8.9.7.1 Setup - Settings

To begin, the measurement device is configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device

Configuring the channels

- Go to the tab: **Analog channels** .

Under **Channel type: Analog inputs**, select *Channel_001*. Make the following settings for the channel's parameter configuration:

Parameter	Value
Status	Active
Mode	Voltage
Coupling	DC
Input range	± 5 V
Sampling rate	100 kHz
Duration	5 ms

Under **Channel type: Monitor: Analog inputs**, select *Mon_Chan_001*. Make the following settings for the channel's parameter configuration:

Parameter	Value
Status	Active
Sampling rate	10 kHz
Duration	Undefined

Note

The monitor channel's sampling rate can only be set to a value less than the analog input's sampling rate.

Defining triggers

- Go to the tab: **Triggers** .

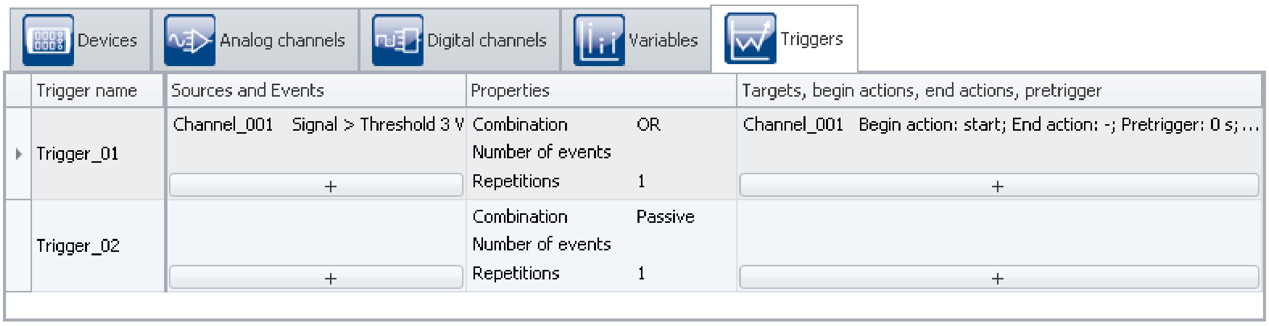
In the column **Sources and Events** set *Channel_001* as the source, with the following event:

Parameter	Value
Event type	Threshold
Event	Signal > Threshold
Event threshold	3 V

In the column **Properties** set the **Combination** to *OR*, since only a single event is used.

In the column **Targets, begin actions, end actions, pretrigger**, set *Channel_001* as well as a target, since it is to be used as a triggered event and measurement channel.

Parameter	Value
Begin action	start
End action	-
Pretrigger	0 s



Picture 21: Settings for the trigger

Download

- To transfer the current settings to the device, click on the button **Download** 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).

8.9.7.2 Panel - Settings / Start measurement

Now you can create the Panel page.

- Open the plug-in **Panel**.
- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Create a curve window containing *Channel_001*:

- From the tool window: **Data Browser** drag the variable: *Analog inputs* > *Channel_001* to the Panel page.
- In the Widget selection list, select: **Standard** (curve window).

Curve window properties

More Waveforms

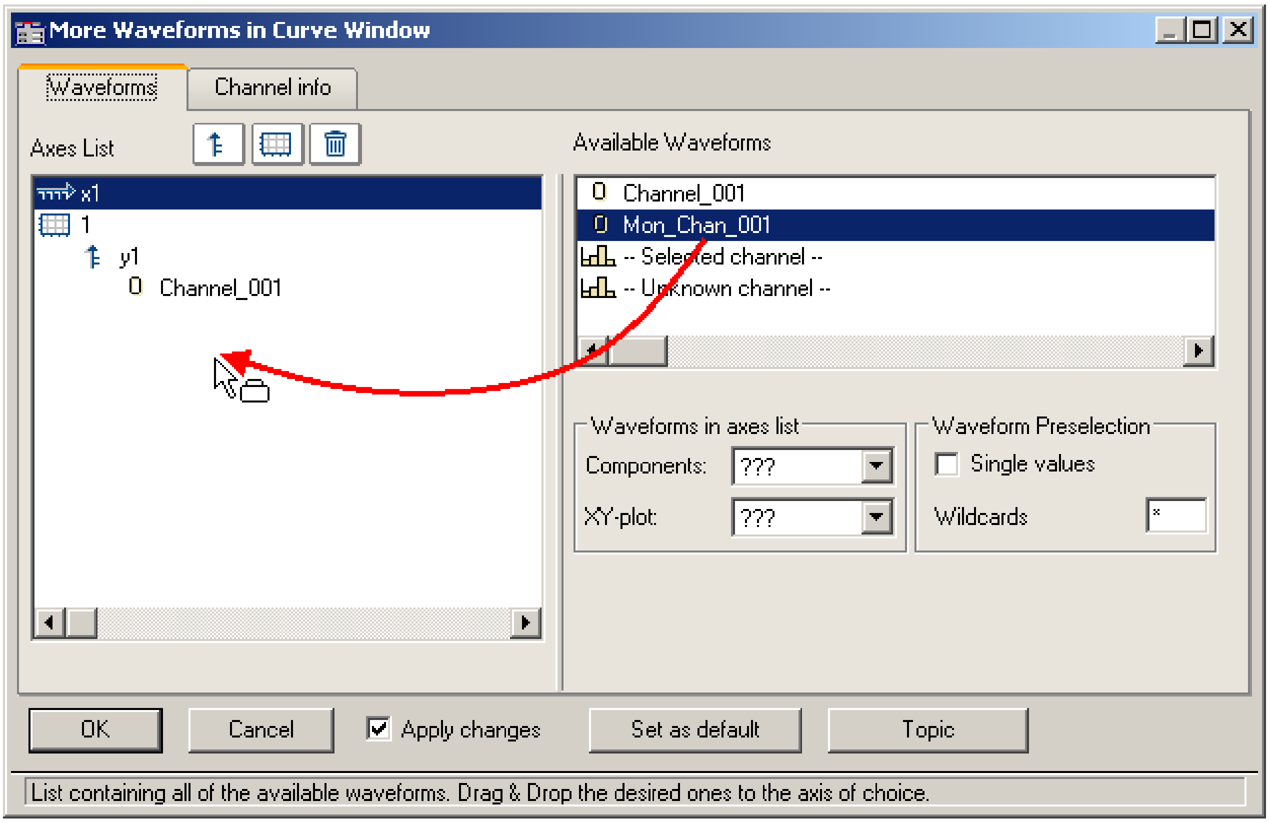
In a curve window it is possible to display more than one channel.

- Right-click the mouse over the curve window (not over the cross ( ) in the center).
- In the context menu which then appears, select **Configuration** and subsequently the command **More Waveforms...**

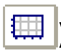
A dialog appears, in which you can select additional channels which are then displayed in the same curve window.

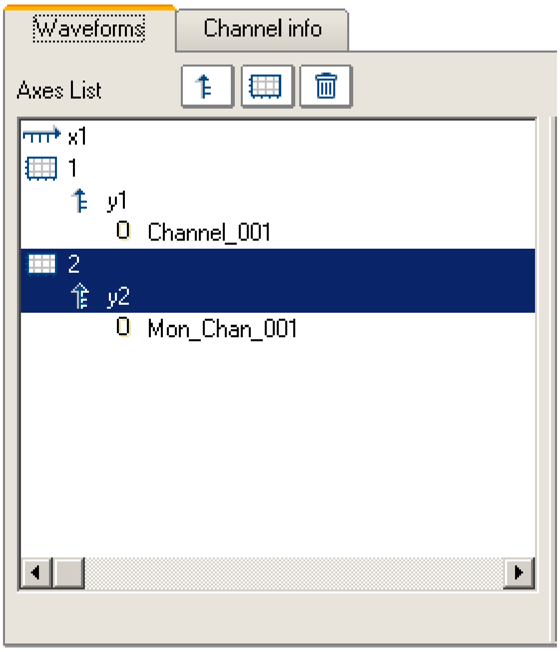
All data sets available for selection are displayed in the list at right (**Available Waveforms**). The data sets already displayed in the curve window are indicated in the list at left (**Axes List**).

- Drag *Mon_Chan_001* from **Available Waveforms** (see Picture 22) to the box **Axes List**.



Picture 22: Waveforms for the curve window

- In order to display the two channels on different Y-axes, click on the coordinate-system symbol ().
- Next, select the channel *Mon_Chan_001*. This now contains a single coordinate system.



To apply the settings, click on the button "*OK*".

Adjusting the axes

The two channels have differing Trigger-times, but by default they are both displayed in the curve window stacked one above the other at x = 0. Thus in this example, each channel begins at x = 0, even if the triggered channel: "Channel_001" is started later.

In order that the two channels' time coordinates to be synchronized, the scale of the x-axis must be adjusted.

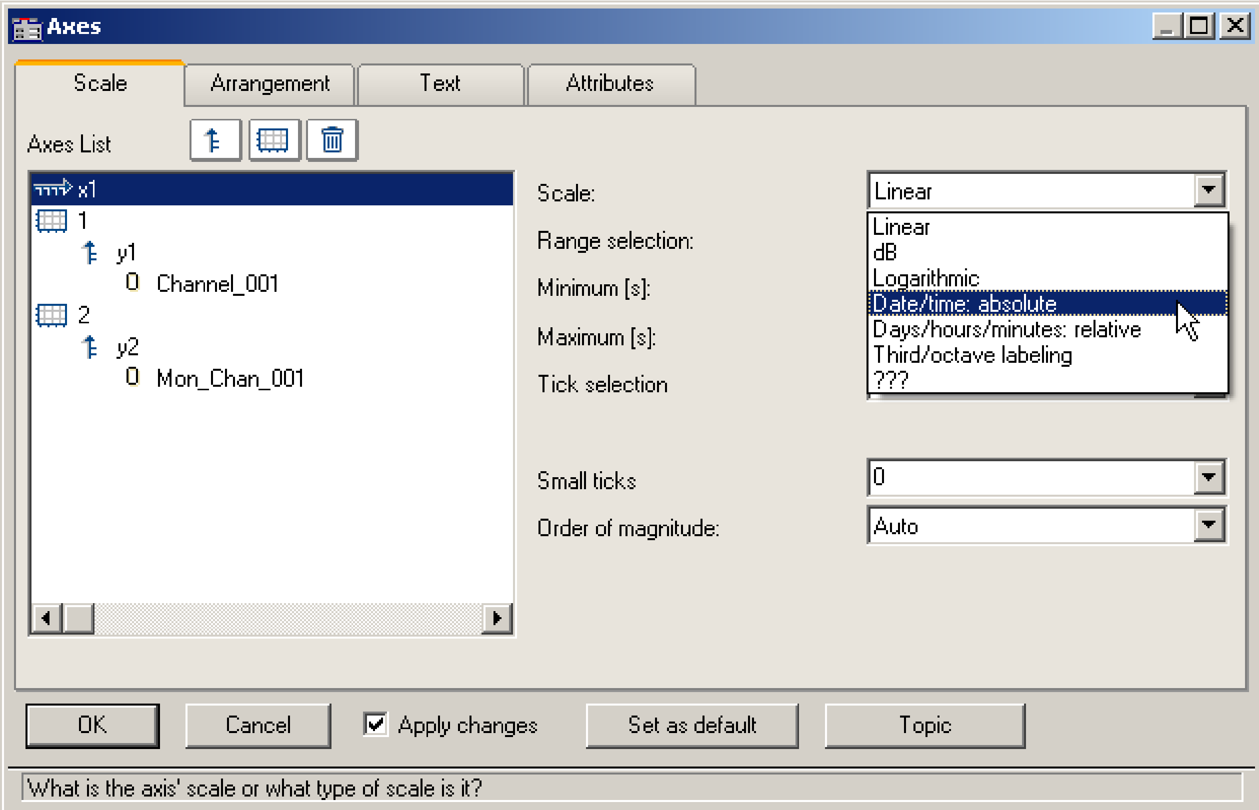
- Right-click he mouse over the curve window (not over the cross () in the center).
- In the context menu which then appears, select **Configuration** and subsequently the command **Axes...**

A dialog appears in which you can adapt the curve window's axes.

- In order to see the x-axis' settings, select the axis *x1* from the list at left (**Axes List**).

Then make the following setting:

Parameter	Value
Scale	Date/time: absolute



Picture 23: Setting the axis for the curve window

To apply the settings, click on the button "*OK*".

Reference

- In the curve window's context menu, extensive help for using the curve window is available.
- The documentation can also be accessed via the imc STUDIO help:
  Panel > Special Widgets > Curve Window 1126

Starting measurement, observing results

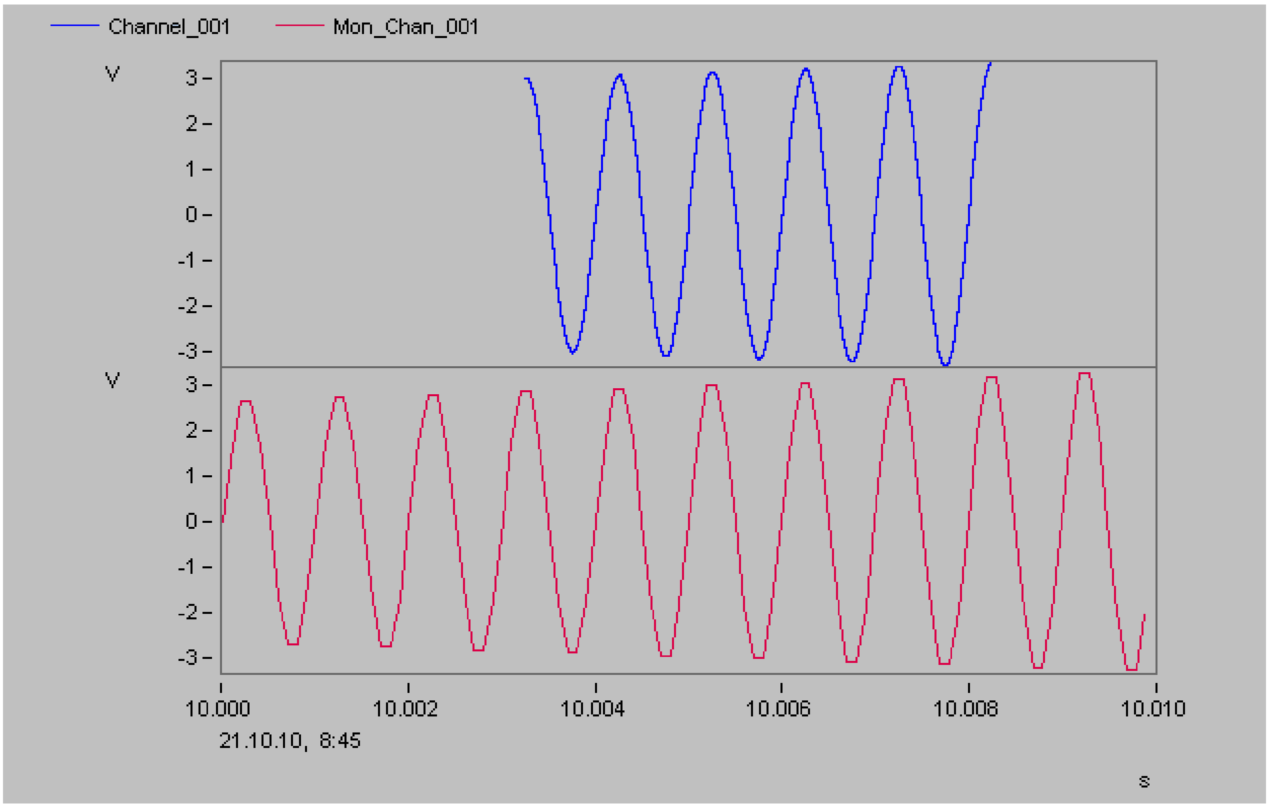
- Deactivate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).
- At the input: *Channel_001*, for example, apply a sinusoidal signal with an amplitude of < 3 V an
- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).
- after a while, change the amplitude to a value > 3 V.

As soon as the amplitude exceeds 3 V, *Channel_001* is recorded for 5 ms duration. *Mon_Chan_001* records the data already upon the measurement's start.

- Stop the measurement () (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).

To investigate the data, you need to zoom in on the correct location in the curve window.

- Use the context menu item **Edit > Zoom**



Picture 24: Measurement of the channel's signal only starts once the trigger event occurs

Saving

With that, you have completed this example and can save it:

- Save () the experiment under the name "*Triggered measurement*".

8.9.8 Thermocouple measurement

Assignment:

A temperature is to be measured by thermocouple.

Learning goals:

- Advanced channel settings

Element used:

- Channel settings
- Sensor & scaling
- Pre-processing of data

Additionally used plug-ins:

- Panel

Prerequisite:

- imc measurement device with an amplifier for temperature measurement
- Type K Thermocouple
- An appropriate connector with which to connect the thermocouple with the imc measurement device

Procedure:

Connect the thermocouple to Channel_001 of the imc measurement device.

Next, start **imc STUDIO**.

8.9.8.1 Setup - Settings

To begin, the measurement device is configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device

Configuring the channels

- Go to the tab: **Analog channels** .

Under **Channel type: Analog inputs**, select *Channel_001*. Make the following settings for the channel's parameter configuration:

Parameter	Value	Dialog (View: *Standard*)	Dialog (View: *Complete*)
Name	Thermocouple	Channel definition	Channel definition
Status	Aktive	Channel definition	Channel definition
Mode	Voltage	Measurement mode	Measurement mode
Coupling	DC	Measurement mode	Measurement mode
Correction	Type K	Measurement mode	Measurement mode
Input range	-270..500 °C	Measurement mode Range & Scaling	Measurement mode Range & Scaling
Filter type	AAF	Sampling & Filtering	Filtering
Sampling rate	1 kHz	Sampling & Filtering	Sampling & Preprocessing
Duration	Undefined	Sampling & Filtering	Sampling & Preprocessing
Function	Arith. Mean	-	Sampling & Preprocessing
Points	50	-	Sampling & Preprocessing

By means of the **correction** , the **input range** and the **unit** are automatically adapted.

The **arithmetic mean** of 50 sampled points produces a **resulting sampling rate** of 20 Hz, since groups of 50 points each are summarized by one point.

Download

- To transfer the current settings to the device, click on the button **Download** 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Download*).

8.9.8.2 Panel - Settings / Start measurement

Now you can create the Panel page.

- Open the plug-in **Panel**.
- Activate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Create a curve window containing *Thermocouple*:

- From the tool window: **Data Browser**, drag the variable: *Analog inputs > Thermocouple* to the Panel page.
- In the Widget selection list: **Standard** (curve window).

Curve window properties

Adjusting axes

Adapt the axis settings:

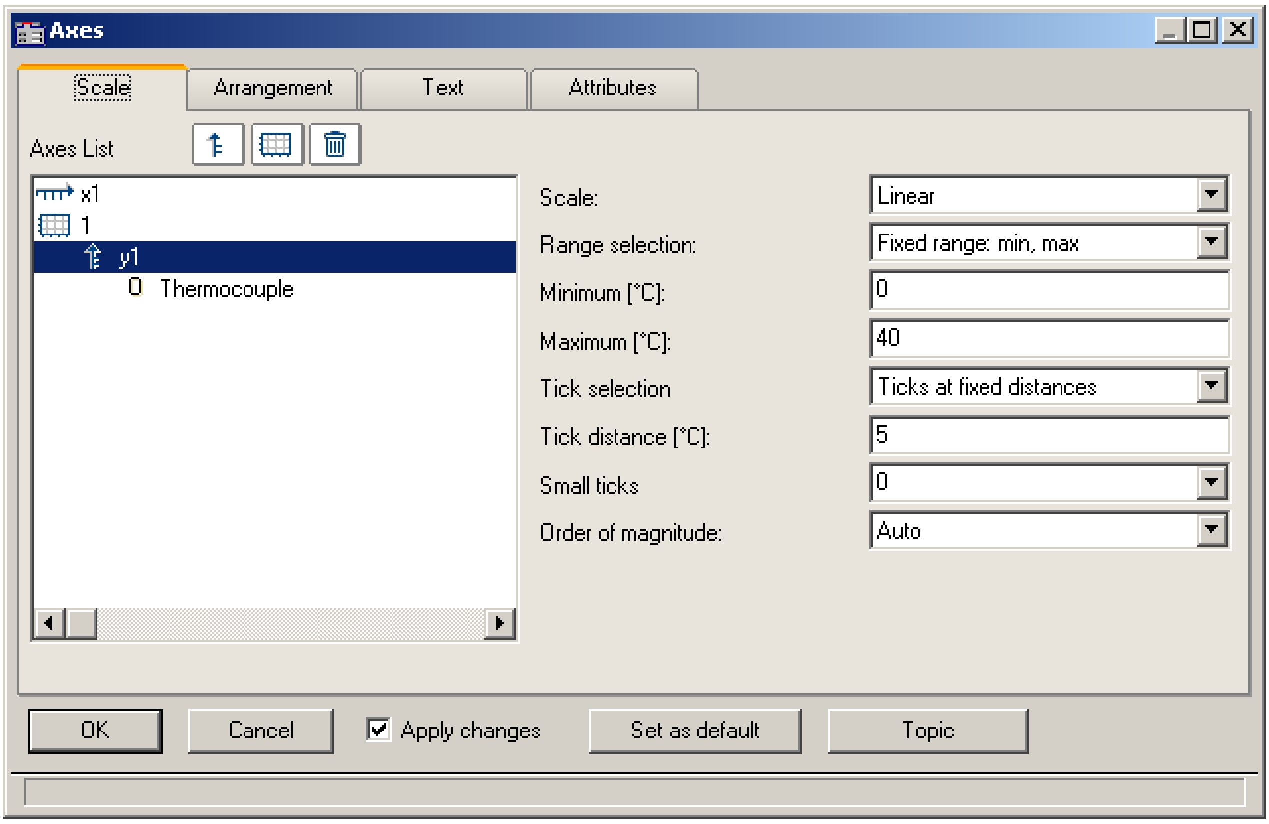
- Right-click the mouse over the curve window (not over the cross (⊕) in the center).
- In the context menu then appears, select **Configuration** and subsequently the command **Axes...**

A dialog appears in which you can adapt the curve window's axes.

- In order to see the y-axis settings, select the axis *y1* from the list at left (**Axes List**).

Now make these settings:

Parameter	Value
Scale	Linear
Range selection	Fixed range: min, max
Minimum [°C]	0
Maximum [°C]	40
Tick selection	Ticks at fixed distances
Tick distance [°C]	5



Picture 25: Settings for the y-axes

In order to apply the settings, click on the button "*OK*".

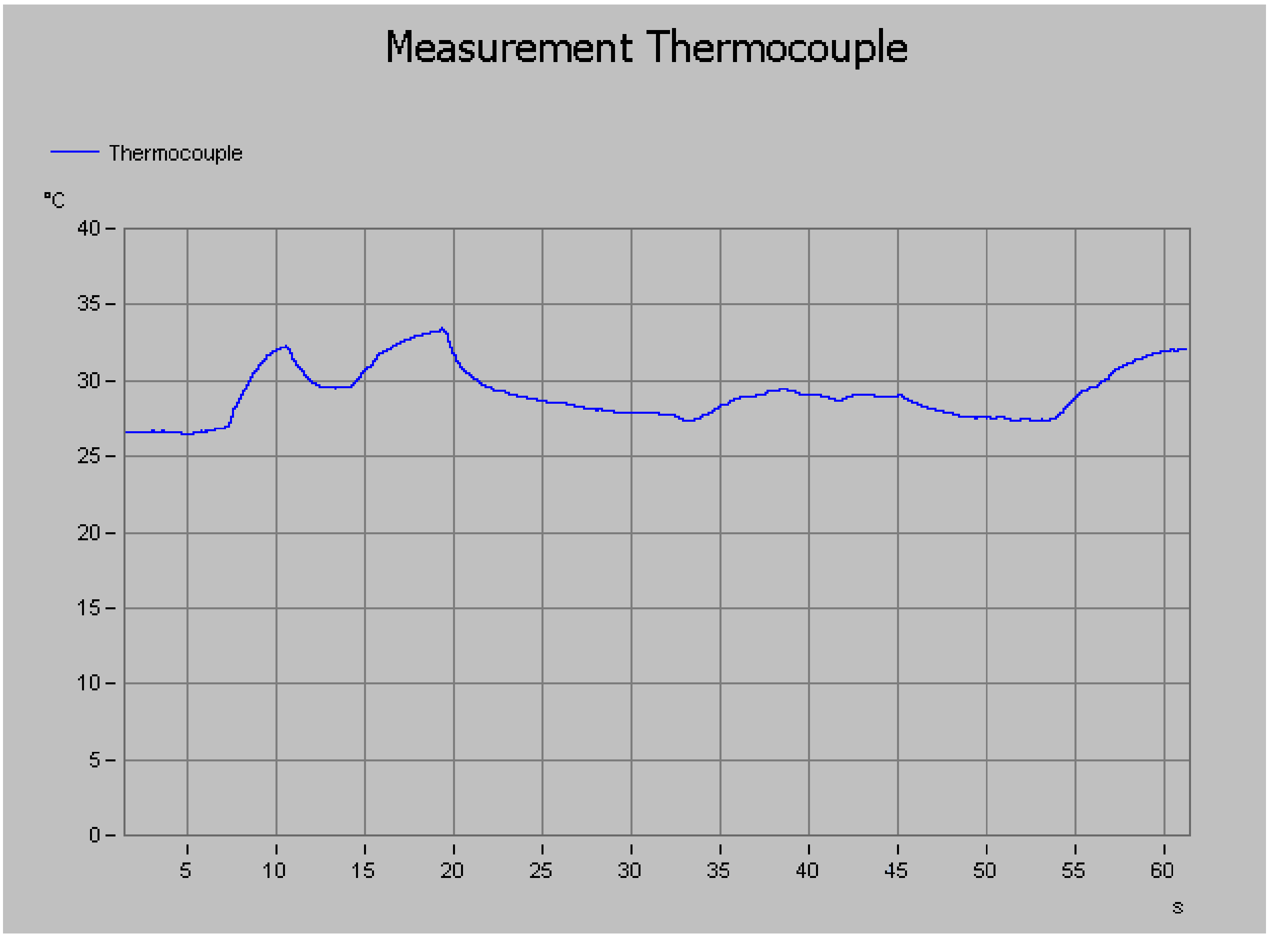
- Display a grid by means of the curve window's context menu item **Configuration > Grid**.
- Insert a **text box** with the text: *Measurement Thermocouple* and adjust the font size and the Widget-size.

- Deactivate the Design mode ( ) (Ribbon *Panel-Design* (or for a simplified view: *Home*) > *Design Mode*).

Starting measurement, observing results

- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).

Picture 26 illustrates one possible display of the course of the temperature signal.



Picture 26: Curve window with plot of temperature

Saving

With that, you have completed this example and can save it:

- Stop the measurement ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Stop*).
- Save ( ) the experiment under the name "*Thermocouple measurement*".

9 Setup - Advanced Device Functions

Here, certain special topics regarding "*Setup*" are presented.

Chapter overview

Synopsis	Chapter
Operation and configuration of the various Fieldbus-systems	• Fieldbusses 476
Saving measured data on the PC and in the device	• Storage Options and Directory Structure 709
Internal data volumes in the device	• Device Hard Disk, removable drive 744
Observing and controlling measurement via the imc Display	• imc Display Editor 757
Sending text messages via the device	• imc Messaging 775
Special topic: Transferring files via FTP to the device. Transferring configurations via FTP.	• Configure via FTP 801
Operating a device via web-browser	• imc REMOTE WebServer 814

9.1 Device Overview

imc STUDIO connects with the imc measurement devices e.g. via the local area network (LAN). For setup of the connection, the devices must be pre-configured (see "*Setting Up - Connect the device*" 43").

Some of the capabilities discussed in this manual only pertain to certain device models. The associated device groups are indicated at the respective locations in the manual. The groups are shown in the following table which can be used with imc STUDIO.

	— not available	● standard	○ optional
CRXT imc CRONOS-XT	CRFX imc CRONOS*flex*	CRC imc CRONOS*compact*	CRPL imc CRONOS-PL

Device	imc CRPL imc CRSL	imc C1 imc C-SERIE	imc SPARTAN	imc BUSDAQ	imc BUSDAQ*flex*	imc SPARTAN-R imc SPARTAN-N imc CRSL-N	imc CRC-400 imc CRFX-400	imc C1-N imc C-SERIE-N	imc C1-FD imc C-SERIE-FD	imc CRFX-2000	imc CRC-2000G	imc CRC-400GP	imc CRFX-2000G	imc CRFX-2000GP	imc CRXT
Group	**2**[1]	**3**		**4**				**5**		**6**			**7**		
Sn[2]	12	12		13				14		16			19		
TCP/IP Interface [MBit/s]	100	100	100	100	100	100	100	100	100	100	1000	1000	1000	1000	1000
Rate[3] [kHz]	400	400	400	400	400	400	400	400	400	2000 / 400 [4]	2000 / 400 [4]	2000 / 400 [4]	2000	2000	2000
Monitor connection	(●)[5]	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connections[6]	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
Data Storage															
CF	—	—	●	●	●	●	●	●	●	—	—	—	—	—	—
PCMCIA	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Express Card	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—
CFast	—	—	—	—	—	—	—	—	—	—	●	●	●	●	●
USB	—	—	—	—	—	—	—	—	—	●	●	●	●	●	—
Storage on network drive	—	—	●	●	●	●	●	●	●	●	●	●	●	●	●
Synchronization															
DCF	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
IRIG-B	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●
GPS	○	○	●	●	(●)[7]	●	●	●	●	●	●	●	●	●	●
NTP	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●
PTP	—	—	—	—	—	—	—	—	—	—	—	●	—	●	●
Phase offset correction	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●

1 to identify on date of manufacture (as of summer, 2003)
2 Extend serial number range by four digits
3 Max. aggregate sampling rate (see data sheet)
4 2000 via EtherCAT else 400
5 Monitor connection as of 2007
6 Number of imc STUDIO Monitor-connections or imc REMOTE (as of 14xxxx) connections
7 not available for imc BUSDAQ*flex*-2-S

9.2 Fieldbusses

This chapter describes the different fieldbusses and their operation with imc STUDIO.

9.2.1 General Notes on Field-Busses

Field-bus channels: Operating methodology

Analog channels are configured using the Setup page.

There is a dialog corresponding to each Field-bus, the Field-bus Assistant. In a sense, these dialogs allows you to configure the "digital signal conditioning" for the field-bus channels. Just like with the amplifier channels, the channels defined in the Field-bus Assistant are also available on the Setup page for the digital channels. For the user, these appear as additional analog inputs.

Therefore, you first need to define how to extract the channels from the messages using the field-bus assistant. Once the field-bus channels have been created, the storage and recording settings can be specified on the Setup page for the digital channels. Field-bus channels can also be used in imc Online FAMOS and imc Inline FAMOS.

9.2.1.1 Field-bus Channels: Synchronization with Analog Channels

Parallel recording of analog data and Field-bus channels is possible.

With Field-busses, it is generally not possible to determine exactly when the AD-conversion at the sending subscriber has taken place. The resulting time offset is not taken into account.

The time of a message's reception is registered in the device with a minimum uncertainty of 100µs. This is the time at which the message reception is complete. As well, due to the various pipelines (AD-converter, time-offset correction, trigger-calculation), there is generally a time uncertainty of one sampling period in determining times. In most Field-busses, it is even two sampling periods.

If the clocks of an analog data recording channel and a Field-bus channel are to be compared, then the possible maximum time offset Δt_{max} is

$$\Delta t_{max} = \max(\,100\ \mu s,\ 2 * \max(t_{samp\text{-}analog},\ t_{samp\text{-}FB})\,) + t_{FB\text{-}delay}$$

max(a,b)	function that returns the larger of two values
$t_{samp\text{-}analog}$	the sampling period used on the analog channels
$t_{samp\text{-}FB}$	the sampling period used on the field-bus channels
$t_{FB\text{-}delay}$	the maximum delay between A/D conversion in field-bus sensor and actual transmission on the field-bus

Example

A CAN channel is sampled every 2ms (sampling rate = 500Hz) and an analog channel every 1ms (sampling rate = 1000Hz). The maximum delay on the field-bus is 3 ms.

Δt_{max} = 2 * 2ms + 3ms = 7ms

9.2.1.2 Treatment of channel names

When importing channel names, it is possible that the naming rules valid for imc devices are not observed. In general, the names are adopted and when used in Online FAMOS or imc FAMOS Enterprise etc. are enclosed with **{...}**.

Only exception: In order to avoid mistaking channels' names with those of process vector variables, any channel names beginning with "***pv.***" are renamed to "***pv_***".

9.2.1.3 General Notes on Sampling and Time Stamping

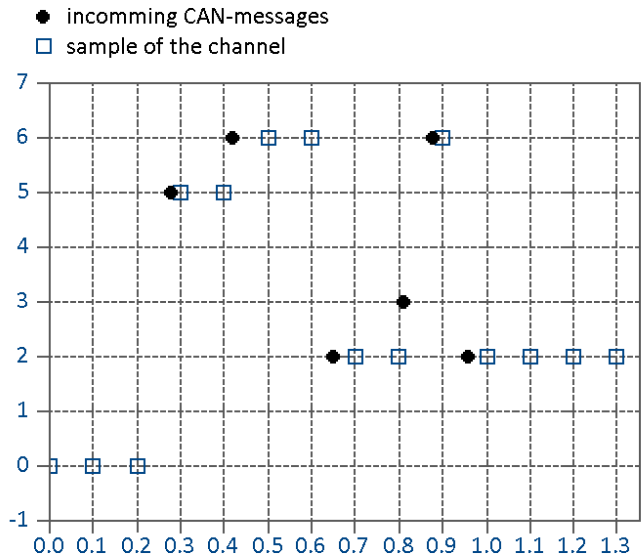
Each channel which is recorded with the field-bus, can be stored in two different ways.

- Sampled with a fixed rare
- Time stamp for each sample

9.2.1.3.1 Data Recording with Sampling

Field-bus messages arrive at more or less irregular intervals, i.e. they cannot be captured at a constant sampling rate. Nonetheless, in many cases it is desirable to record data at regular time intervals. In fact, many field-bus sensors do attempt to send their messages at regular intervals. Even if they do not succeed at doing this, it is often acceptable to assume this to be the case.

For example, many processing algorithms (e.g. digital filters, FFT's) require equidistant data.



imc STUDIO samples fiel-bus channels equidistantly using the following algorithm: if a new message has not arrived after the specified sampling interval, the previous value is copied to the current one.

This resulting data therefore consist of a series of amplitudes and are therefore more compact than data saved using time stamps. The time coordinate can be determined from the start time and sampling period stored in the data header.

This method has important consequences:

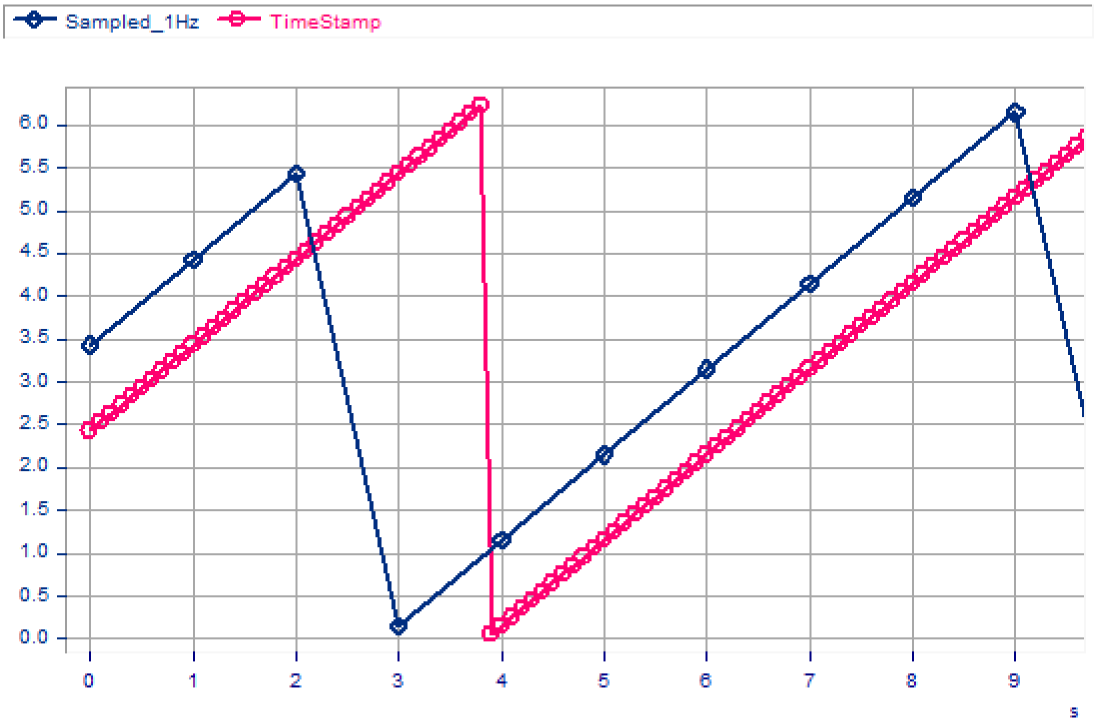
- As long as no messages have been received, the field-bus channel is filled with zeroes. This can only occur at the beginning of an untriggered measurement before the first field-bus messages have been received. When a measurement is stopped and restarted without being re-initialized, there are usually previous messages which are being used. In general, zeroes are not created when messages are being sent every 200ms or less. If the zeroes at the beginning are not desired, we recommend performing a triggered measurement. When you start a triggered measurement, the system is armed and waits until the specified trigger condition (e.g. message value ≠ 0) occurs.
- If the sampling rate is set significantly more rapid than the intervals at which the sensor transmits, you obtain unnecessarily many data, where successive data points have the same value, thus wasting memory and computation resources. If the sampling rate is significantly slower than the intervals at which the sensor transmits data, then the sparse sampling loses data values.
- It is recommended to select as far as possible a sampling interval matching the messages sending interval.
- If the sensor no longer transmits, the last value received is entered in the channel as the current sampling value.

When to use equidistant sampling

- If the sensor transmits at a more or less regular rate, then sampling is the most compact means of storing data and the quickest way of viewing it.
- If the is going to be processed with imc Online FAMOS.

Notes regarding the display in the curve window

When comparing time-stamped data with equidistantly sampled results from the same Fieldbus channel, the equidistantly sampled data appear to be associated with earlier sampling times than the time-stamped data. This would seem to contradict the previously described functioning principle of the system. What is actually happening is that the equidistant channel adopts the value measured at the end of the sampling interval, but places it at the start of that interval. In the example below, a channel's messages are recorded with a time stamp (red: TimeStamp). The messages are sent every 100ms. The same channel is additionally sampled at a fixed sampling rate 1Hz. As the diagram illustrates, both channels begin at 0s. The first value of the 1Hz channel corresponds to the last message in the first sampling interval. The channel thus appears to be running ahead of schedule:



Why is the value placed at the beginning of the interval and not at its end?

With equidistant sampling there is always one sampling interval's worth of uncertainty in the time. For technical reasons, the physically captured value is delayed by the analog input filter, the digitalization, and the process of transfer to the Fieldbus, so it is better to apply at least approximate compensation.

9.2.1.3.2 Data Recording with Time Stamp

In time stamping mode, data values are only created when they are received. A time stamp is assigned to every measured value. This time stamp states the time of reception of the message containing the channel data. The time stamp requires 6 bytes. This is necessary in order to ensure high resolution of the time even for long-term measurements. A single time-stamped sample thus requires 6 bytes more memory than a sample with fixed sampling rate.

When to use time stamping

- When the exact reception times of messages need to be known.
- When the sensor transmits messages at very irregular intervals and equidistant sampling would lead to an unnecessary increase in the amount of data.

Disadvantages of time-stamp data acquisition

- **Field-bus channels recorded in time stamping mode, can't be proceeded in imc Online FAMOS!**
- **Interval saving of time-stamped field-bus-channels to the PC is not supported!** Instead, you can have the data saved at intervals to the internal hard drive
- If a channel sends high volume of data, the memory requirements must be taken into account. In particular, the device's circular buffer memory requires correspondingly more memory for the same buffer duration than equidistant measurement.

9.2.1.3.2.1 Setting the Buffer Duration, Circular Buffer Duration and Pretrigger Duration for Time-stamped Channels

The buffer duration, circular buffer duration and pretrigger duration are specified as a time duration in the "*Setup*". For time-stamped channels, the imc STUDIO software assumes an average sampling rate $S_{assumed}$ of 100 samples per second. This is necessary in order for the software to convert the specified time duration into a buffer size expressed in samples.

If the user knows the actual average sample rate S_{real}, then the duration to set can be calculated according to the following equation:

$t_{toset} = t_{real} * S_{real} / S_{assumed}$

t_{toset}	the buffer duration, circular buffer duration or pretrigger duration [s]
t_{real}	the desired actual circular buffer duration and pretrigger duration [s]
$S_{assumed}$	the average sample rate assumed by the software $S_{assumed}$ = 100 Samples/s
S_{real}	the actual average sample rate in Samples/s

Example

The actual sample rate S_{real} is 1200 Samples/s

The desired buffer duration t_{real} is 1min.

$t_{toset} = t_{real} * S_{real} / S_{assumed}$

t_{toset} = 60s * (1200 Samples/s) / (100 Samples/s)

t_{toset} = 720s

9.2.1.3.2.2 Setting the Buffer Duration, Circular Buffer Duration and Pretrigger Duration for Time-stamped Text Channels (time stamped ASCII, "TSA")

Time-stamped text channels (TSA-channels) are used for, among other things, message protocols of the various Field busses. A sample in such a channel consists of a time stamp and text or payload byte of arbitrary length, plus multiple bytes specific to the TSA format. The buffer duration, circular buffer duration and pretrigger duration for these channels is specified in the dialogs *Configuration or Storage* as a time duration. The program assumes an average sampling rate $S_{assumed}$ of 100 samples per second, where for each sample a size $L_{assumed}$ of 20 bytes per sample is assumed. These 20 bytes correspond to about the size of one sample (or entry) in the Field-busses message protocol. These presumed values are necessary for the program to be able to convert the specified buffer duration to a buffer size in bytes.

In order to determine the buffer duration, circular buffer duration and pretrigger duration t_{toset} to set, the actual average data rate D_{real} must be calculated. This data rate depends on two estimated values.

$D_{real} = S_{real} * (L_{real} + 12$ Bytes/Sample)

D_{real}	the actual average data rate [Bytes/s]
S_{real}	the actual average sample rate [Sample/s]
L_{real}	the actual average number of payload bytes per sample [Bytes/Sample]

If the user knows the actual average data rate D_{real} , then the duration to set can be calculate according to the following equation:

$t_{toset} = t_{real} * D_{real} / D_{assumed}$

t_{toset}	the buffer duration, circular buffer duration or pretrigger duration [s]
t_{real}	the desired actual buffer duration, circular buffer duration or pretrigger duration [s]
$D_{assumed}$	the average data rate assumed by the program [Bytes/s] $D_{assumed} = S_{assumed} * L_{assumed}$ $D_{assumed}$ = 100 Sample/s * 20 Bytes/Sample $D_{assumed}$ = 2000 Bytes/s
D_{real}	the actual average data rate [Bytes/s]

Example

The channel is a TSA channel.

The actual average data rate S_{real} is 150 Samples/s

On average, 48 payload bytes per sample are contained. L_{real} = 48 Bytes/Sample

$D_{real} = S_{real} * (L_{real} + 12 \text{ Bytes/Sample})$

$D_{real} = 150 \text{ Samples/s} * (48 \text{ Bytes/Sample} + 12 \text{ Bytes/Sample})$

$D_{real} = 9000 \text{ Bytes/s}$

The desired buffer duration t_{real} is 1min.

$t_{toset} = t_{real} * D_{real} / D_{assumed}$

$t_{toset} = 60s * (9000 \text{ Bytes/Sample}) / (2000 \text{ Bytes/s})$

$t_{toset} = 279s$

9.2.2 ARINC-Bus Interface

Introduction - What is the ARINC Bus?

The ARINC bus is a fieldbus used primarily in civil aviation. All data sent on the ARINC Bus consist of 32-bit words. Below, the typical data diagram for the ARINC 429 is displayed.

		MSB	LSB		LSB	MSB
32	31 30	29 11		10 9	8 1	
P	SSM	Data		SDI	Label	

The label is transferred beginning with the MSB (most significant bit). In contrast, transfer of the data bits begins with the LSB (least significant bit). The label is a value between 1 and 255, of which most are defined in the specs for **A**ERONAUTICAL **R**ADIO, **INC**.; some few are reserved for future purposes.

Upon request, imc devices can be equipped with the ARINC 429 fieldbus interface (see data sheet). This makes it possible to record and process data on the ARINC bus in parallel with the analog measurement data. With the help of the ARINC-Assistant, all channels can quickly and easily be configured for the ARINC Bus.

The ARINC interface offers the following performance characteristics:

- 8 receiver channels
- both binary- (BNR) and decimal-encoded data (BCD) and discrete data (DSC) can be captured. In fact, these three data types can appear together in a single ARINC word.
- 4 Transmitter channels (via process vector variables)

This chapter is geared for users who are already familiar with the configuration of analog and digital channels in imc STUDIO.

Note

Observe the general Field bus notes regarding the operation methodology 476 of fixed sampling rates 477 versus timestamp 480.

9.2.2.1 ARINC-Bus Assistant

Before the imc device can record an ARINC data channel, the ARINC data word must be defined. This task is accomplished by the ARINC-Bus Assistant. After this step has been taken and the Assistant closed, an additional measurement channel is present in imc STUDIO, which can be used in a manner very similar to that of an analog or digital channel. This means that the channel can, for instance, be subjected to mathematical operations in imc Online FAMOS, or be recorded in response to a trigger working in conjunction with other analog channels. In the Ethernet Assistant, only settings specific to the Ethernet are made.. All other measurement specifications, such as measurement duration or triggering links, are handled just as if they applied to ordinary analog or digital measurement channels.

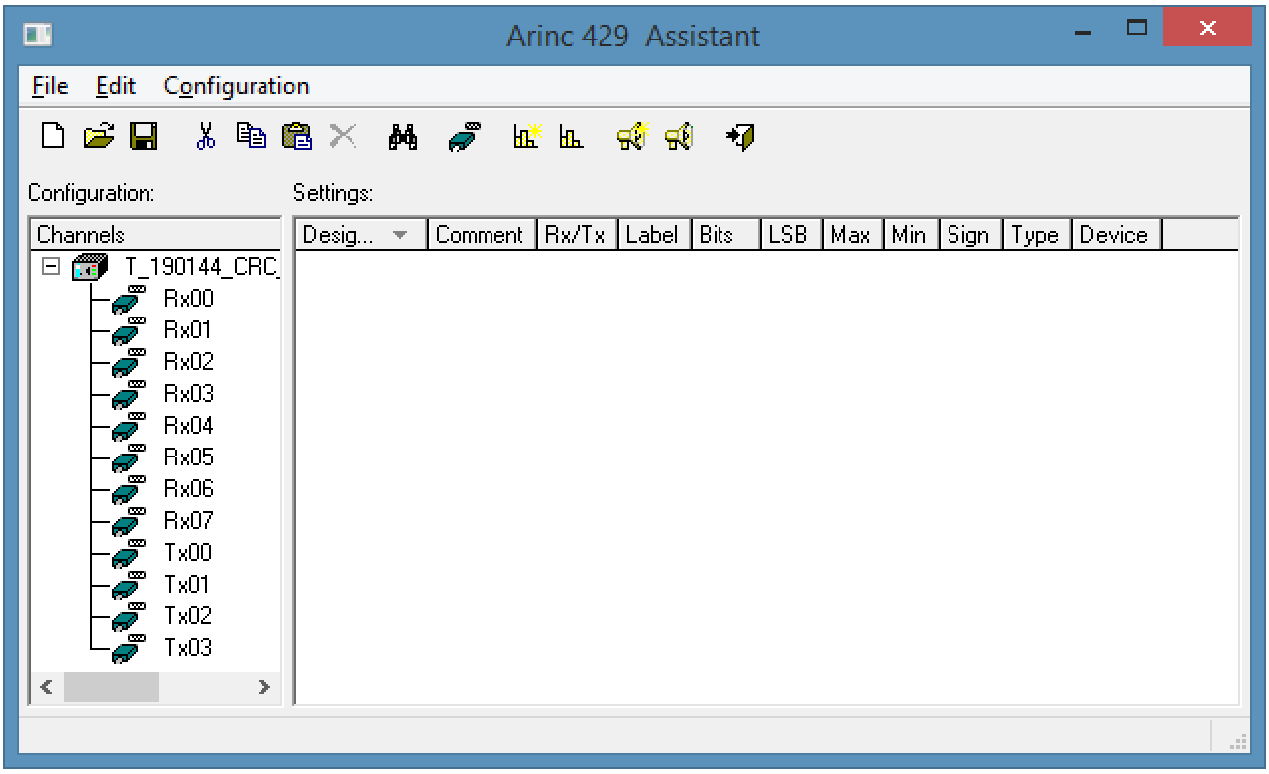
Philosophy of the ARINC-bus

In order to better understand how to work the Assistant, it is useful to review the underlying philosophy of the ARINC-bus. In contrast to the CAN-bus, where several senders can be connected to a bus and the user has broad powers to specify the formulation of the CAN-messages, the arrangement of ARINC signal channels is set by a central authority (AERONAUTICAL RADIO, INC.). This means that the format and interpretation of an ARINC signal normally is unequivocally determined according to its label-number and equipment-ID. For this reason, the format of an ARINC signal in a measurement should be defined only once, and then recorded in a list of available options for measurement procedures.

9.2.2.2 Starting the Assistant

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > ARINC-Assistant*.

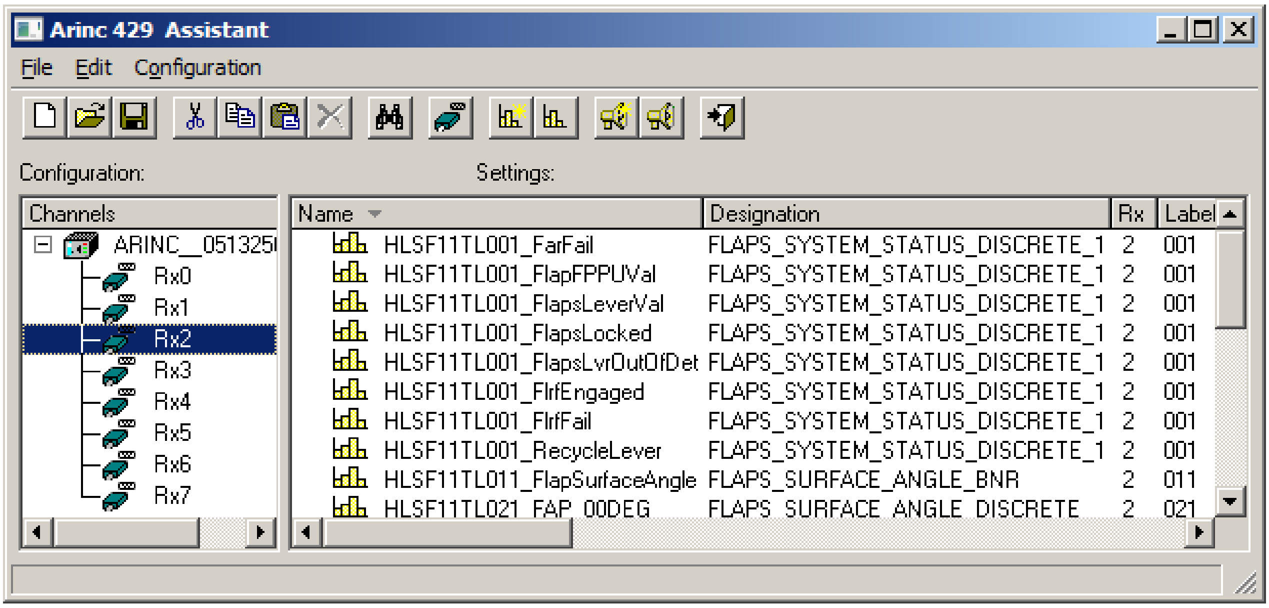
The Assistant begins by displaying the following dialog:



ARINC Assistant

The ARINC-Assistant's main window is divided in halves:

- The left side, designated **Configuration** 504, lists the device and constituent channels.
- The right side with the title **Settings** lists the ARINC-signals which are defined and are assigned to the currently selected Rx-channel.



ARINC Assistant, main window (example)

The definitions made here under **Settings** for the respective ARINC-signals are saved in a separate configuration file (.idb-format) and thus independently of the associated experiment. This configuration file can be considered a sort of database, in which all defined ARINC-signals are saved together with the assignment to the respective channel. Accordingly, in order to configure an experiment with the ARINC-bus, it is enough to load just one ARINC-configuration file and to close the Assistant. All defined ARINC-signals then appear in the imc STUDIO operating software as channels and can be displayed or subjected to further processing in imc Online FAMOS.

9.2.2.3 ARINC Configuration File

All ARINC signal definitions are saved to a configuration file (.idb-format) . This configuration file can be used as a central database, into which you can load every experiment and where you can delete, copy, or move ARINC-signals at will.

Thus, the signal definitions are independent of the experiment. As a matter of principle, it is possible to create a configuration file, tailored to the respective experiment, from an exiting configuration file, quickly and at any time.

The format *.idb2: With this format, the Parity-Bit and SSM are additionally saved.

9.2.2.3.1 Creating a new Configuration File

To create a new configuration file, it’s possible to either click the button in the toolbar or to select the menu item *File > New*.

9.2.2.3.2 Loading a Configuration File

To open an already existing configuration file, click on either the corresponding button in the toolbar or the menu item *File > Open*. The default extension for the file is *.idb. It is also possible to load *.csv-files, in order to import already existing ARINC signal databases of one’s own.

Note

- If protocol channels have been activated (Settings > protocol channel), those channels are listed in the channel list.
- If a new IDB file will be loaded, the protocol channels disappear from the channel list. However they are still active for the bus settings.
- After reloading a ARINC configuration, those protocol channels must be deactivated and reactivated. Settings like saving will be lost and must be redone.

9.2.2.3.3 Save Configuration File (as)

To save a configuration file, click on either the corresponding button in the toolbar or the menu item *File > Save*.

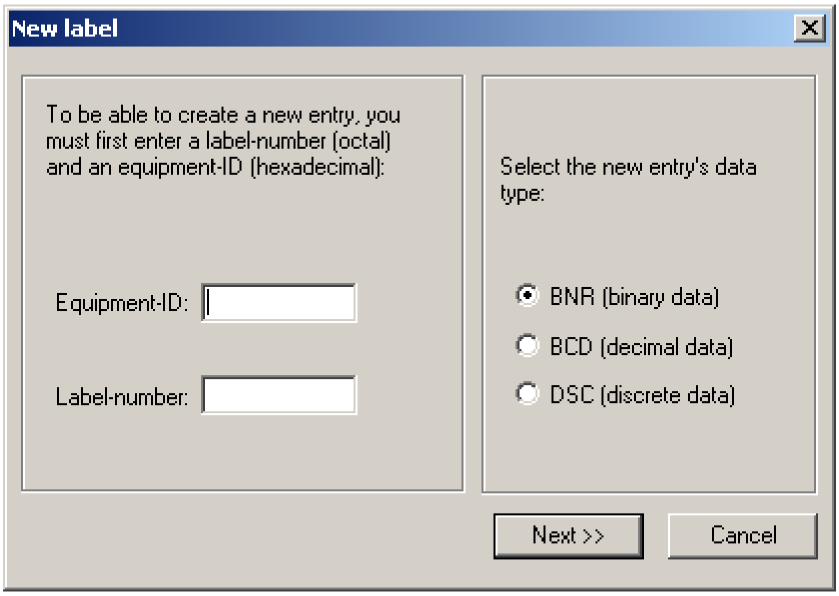
If the open configuration file is to be saved under a different name or in a different directory, menu item *File > Save as* is used. In the Windows file dialog which then appears, the name, without its extension, must be entered. The extension *.idb is appended automatically.

9.2.2.3.4 Receiver Channel (Rx) - Creating a ARINC Label

A new ARINC-signal (referred to in the following as an ARINC-label) can only be created in the configuration file and never directly in the imc STUDIO: Setup.

- To create an ARINC-label, first either open an existing configuration file or create a new one.
- Then, in the left portion, Configurations, select the Rx-channel which is to receive the ARINC-signal.
- Afterwards, either click on the button in the title bar, or select the menu item *Configuration* > *New Label*.

A dialog appears:



New label

On the left side of this dialog, enter the **Equipment-ID** (hexadecimal) and the **Label-number** (octal). The correct entries for these can be found in the ARINC spec sheet.

The following data are presented as an example:

```
LABEL 103
EQPT. ID (HEX) 003
PARAMETER NAME Selected Airspeed
DATA TYP BNR
UNITS Knots
RANGE (SCALE) 512
SIG DIG 11
RESOL 0. 25
MINIMUM TRANSIT INTERVAL (ms) 100
MAXIMUM TRANSIT INTERVAL (ms) 200
MAXIMUM TRANSPORT DELAY (ms)
```

As seen above, the entries to be made in this case would be 103 for the label number and 003 for the equipment-ID. The entries once made, click on the "More >>" button to proceed to the configuration dialog for the ARINC-label.

In the right-hand portion of the dialog, the data type for the encoding of the data on the ARINC-bus is selected. The available options are the data types **BNR** for binary encoding, **BCD** for BCD encoded data and **DSC** for discrete data. Clicking on *Next* >> brings up the next dialog, whose particular setup depends on the respective data type selected. How each of the particular data types are defined is described in a separate section.

9.2.2.3.4.1 Configuring a BNR Data Word

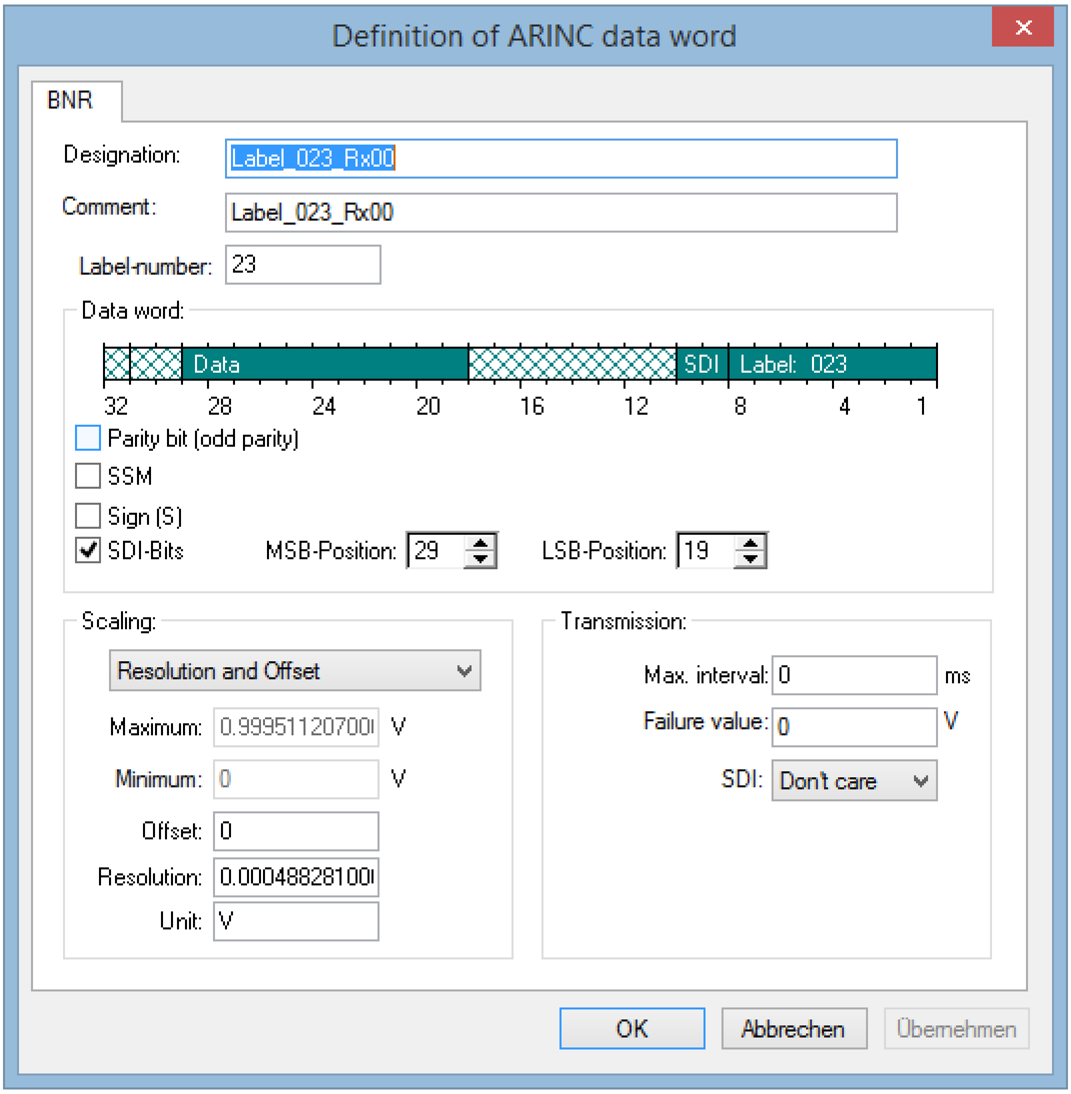
The dialog is thematically arranged in groups each denoted by a gray frame.

The group **Data word** comprises all settings concerning the structure of the ARINC data word. The currently set word structure is visually represented by a green horizontal bar.

In the group **Scaling** the settings are grouped, which are needed for computing the ultimate measured value from the raw data.

In the group **Transfer**, settings are made concerning the timing conventions valid for the transfer of the ARINC data word.

The following is an explanation of the controls:



BNR data word

Settings	Description
Designation	Is an arbitrary, 64 character long string (may not contain quotation marks). It is assigned to the label and displayed in the Assistant-interface. It is also preserved in imc STUDIO as a channel comment. It is analogous to the *PARAMETER NAME* on the ARINC spec sheet, Attachment 2, and should always be specified.

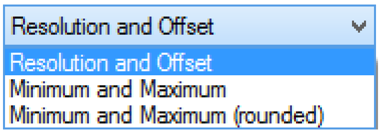
Data word

The checkboxes "*Paritybit*", "*SSM*" and "*Sign*" expand or limit the maximum MSB-position.

Settings - Data word	Description
Paritybit	• If the box is checked, then an maximum MSB-position of 31 can be selected. • If the box is not checked, and the SSM and Sign boxes are also not, then a maximum MSB-position of 32 can be selected for the data word.
SSM	• If this box is not checked, then depending on whether the **Paritybit** box is checked, a maximum MSB-position of 31 or 32 can be set. • If the box is checked, the maximum MSB-position which can be set is 28.
Sign(S)	• If this is active, the sign is evaluated. Otherwise it is ignored. • In general, it is good to leave this option "off" if only a positive value range was specified.
SDI Bits	With this toggle you can determine whether or not SDI-bits are present in the label. This is not where the SDI address is set; that is done in the group *Transfer*. Instead, you can set whether or not the SDI is present at all.
MSB Position	The bit position of the most significant bit. In a BNR data word, the MSB position is usually Bit 28.
LSB Position	Bit-position of the least significant bit. The number of bits between the positions of the MSB and LSB is the number of significant bits. This characteristic number can be found in the *SIG DIG* column in the ARINC spec sheet, Attachment 2.

Scaling

The scaling can be determined by "*Resolution*" and "*Offset*" or by "*Minimum*" and "*Maximum*".



Calculation rule per selection list

Settings - Scaling	Description
Maximum	Largest measured data value. The highest raw data value is mapped to this value.
Minimum	Lowest measured data value. The lowest value from the raw data maps to this value. Typically, with signed values, the input range is symmetric, i.e. Minimum = -Maximum. If the box for value sign is checked, you must verify whether the minimum is correct, since it will not be adjusted automatically.
Offset	This box is computed automatically. • The offset is computed with sign (S) as: *OFFSET = (Maximum+Minimum) / 2*. • The offset is computed without sign (S) as: *OFFSET = Minimum*.
Resolution	This box's value is computed automatically. You may wish to verify that it matches the column *RESOL* of the ARINC specs, Attachment 2. • The resolution is computed as: *RESOL = (Maximum-Minimum) / 2^(SIGDIG + S)*.
Unit	The signal's unit. Corresponds to the column UNITS in the ARINC spec sheet, Attachment 2.

Transmission

Settings - Transmission	Description
Max. interval	The maximum time which may elapse between the transfer of two measurement values. • If this time is exceeded, a zero is transferred to denote a missed measurement value. • If this interval is not known or not important, enter 0. Then no misses will be recorded.
Failure value	The value which is transferred if the maximum permitted interval between two measured values is exceeded.
SDI	If necessary, you can change the SDI-bits for each channel in the ARINC-Assistant. To do this, click on the combobox from which the SDI address is selected.

9.2.2.3.4.2 Configuring a BCD Data Word

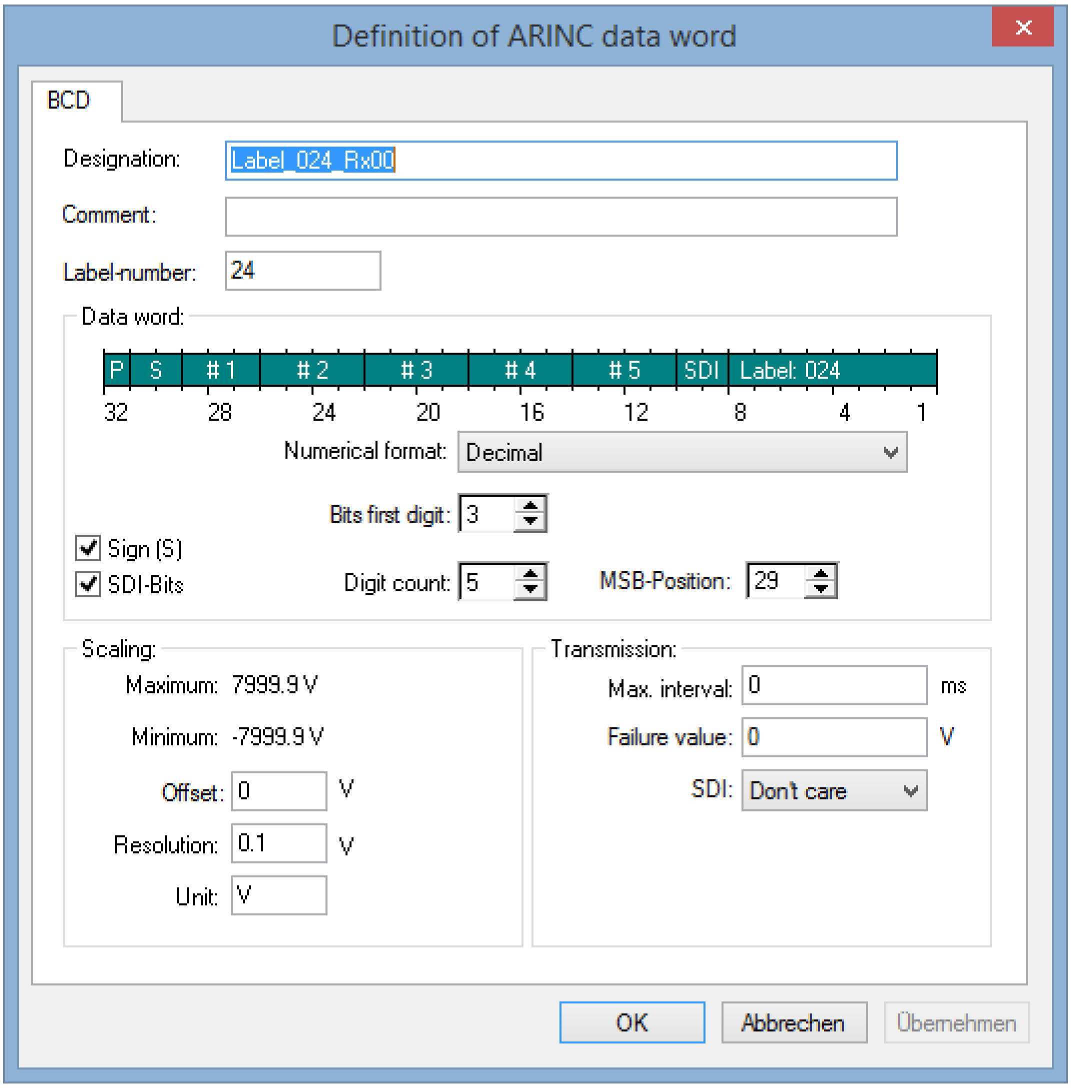
The dialog is thematically arranged in groups each denoted by a gray frame.

The group **Data word** comprises all settings concerning the structure of the ARINC data word. The currently set word structure is visually represented by a green horizontal bar.

In the group **Scaling** the settings are grouped, which are needed for computing the ultimate measured value from the raw data.

In the group **Transfer**, settings are made concerning the timing conventions valid for the transfer of the ARINC data word.

The following is an explanation of the controls:

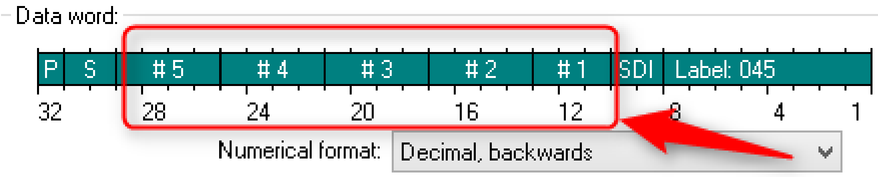


BCD data word

Settings	Description
Designation	Is an arbitrary, 64 character long string (may not contain quotation marks). It is assigned to the label and displayed in the Assistant-interface. It is also preserved in imc STUDIO as a channel comment. It is analogous to the *PARAMETER NAME* on the ARINC spec sheet, Attachment 2, and should always be specified.
Label-number	Here you can change the label number that was entered when the data word was created. 486

Data word

The order of the data word can be reversed for all numerical formats.



<table>
<tr><th>Settings - Data word</th><th>Description</th></tr>
<tr><td>Numerical format</td><td>Is a numerical format. There is a choice among three formats:
<table>
<tr><th>Format</th><th>Beschreibung</th></tr>
<tr><td>Decimal (, backwards)</td><td>The number is interpreted as a normal fixed-point number. This is the default case.</td></tr>
<tr><td>Angle (, backwards)</td><td>The first three digits are interpreted as degrees, the next two as minutes of arc.

Therefore, the minimum number of digits is 5.

Six digits can also be specified if no SDI bits are present, in which case the sixth digit is interpreted as the decimal fraction of a minute of arc.</td></tr>
<tr><td>Time (, backwards)</td><td>The first 2 digits are interpreted as hours (0.. 24) and the next 2 digits as minutes (0.. 60).

Therefore, the minimum number of digits is 4.

Five digits are also possible, in which case the fifth digit is interpreted as the decimal fraction of a minute.</td></tr>
</table></td></tr>
<tr><td>Sign(S)</td><td>If this is active, the sign is evaluated. In general, it is good to leave this option "off" if only a positive value range was specified.

The sign cannot be taken into account when the data exist in time-format.</td></tr>
<tr><td>SDI Bits</td><td>With this toggle you can determine whether or not SDI-bits are present in the label.

This is not where the SDI address is set; that is done in the group Transfer. Instead, you can set whether or not the SDI is present at all.</td></tr>
</table>

Settings - Data word	Description
Digit count	Number of valid BCD digits. • This value matches the column "*SIG DIG*" in the ARINC specs, Attachment 2. • The maximum possible number depends on the numerical format set and on the SDI bits. Example: In decimal representation, a maximum of 5 digits are possible if SDI bits are present. If the SDI bits are switched off (see above), up to 6 digits are possible. Some labels make use of this ability.
MSB-Position	The bit position of the most significant bit. In a BCD data word, the MSB position is usually Bit 28.

Scaling

Settings - Scaling	Description
Maximum	Largest measured data value. The highest raw data value is mapped to this value. The maximum is automatically computed from the Resolution, the Number of digits and the Offset.
Minimum	Lowest measured data value. The lowest value from the raw data maps to this value. Typically, with signed values, the input range is symmetric, i.e. Minimum = -Maximum. If the box for value sign is checked, the minimum it will be adjusted automatically.
Offset	This value can be freely selected. • The offset is computed with sign (S) as: *OFFSET = (Maximum+Minimum) / 2*. • The offset is computed without sign (S) as: *OFFSET = Minimum*.
Resolution	The order of magnitude of the least significant digit. It matches the column *RESOL* in the ARINC specs, Attachment 2. The input range (Maximum and Minimum) is computed automatically from the specified number of digits and the resolution.
Unit	The signal's unit. Corresponds to the column UNITS in the ARINC spec sheet, Attachment 2.

Transmission

Settings - Transmission	Description
Max. interval	The maximum time which may elapse between the transfer of two measurement values. • If this time is exceeded, a zero is transferred to denote a missed measurement value. • If this interval is not known or not important, enter 0. Then no misses will be recorded.
Failure value	The value which is transferred if the maximum permitted interval between two measured values is exceeded.
SDI	If necessary, you can change the SDI-bits for each channel in the ARINC-Assistant. To do this, click on the combobox from which the SDI address is selected.

9.2.2.3.4.3 Configuring a BCD free Data Word

The dialog is thematically arranged in groups each denoted by a gray frame.

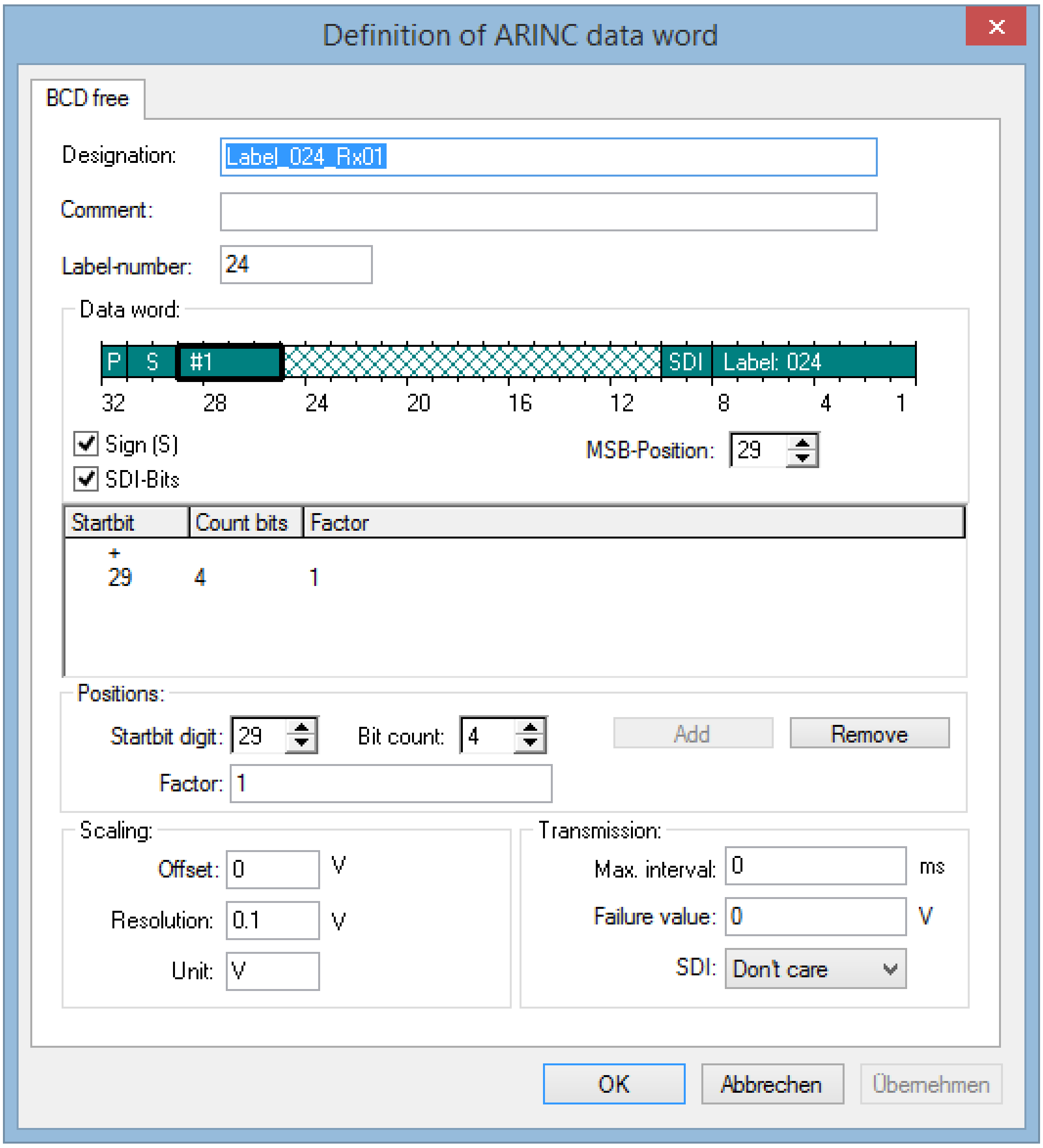
The group **Data word** comprises all settings concerning the structure of the ARINC data word. The currently set word structure is visually represented by a green horizontal bar.

In the **Positions** group the arrangement of the data bits is determined.

In the group **Scaling** the settings are grouped, which are needed for computing the ultimate measured value from the raw data.

In the group **Transfer**, settings are made concerning the timing conventions valid for the transfer of the ARINC data word.

The following is an explanation of the controls:



BCD data word

Settings	Description
Designation, Comment, Label-number, Sign (S), MSB-Position, SDI Bits, Scaling and Transmission	see BCD Dataword 490
Positions	To create a digit, select the "+"line in the list. Define the start with ***Startbit digit*,** the ***number of bits*** and the ***factor*** for the digit. With ***Add***, the settings are transferred to the list and thus to the data word. **Example of Factor:** In the decimal system, you use factor 1 to specify 0-9, factor 10 to specify the tens, and so on. You can use the factor to configure any number format.

9.2.2.3.4.4 Configuring discrete (DSC) Data Words

The dialog is thematically arranged in groups each denoted by a gray frame.

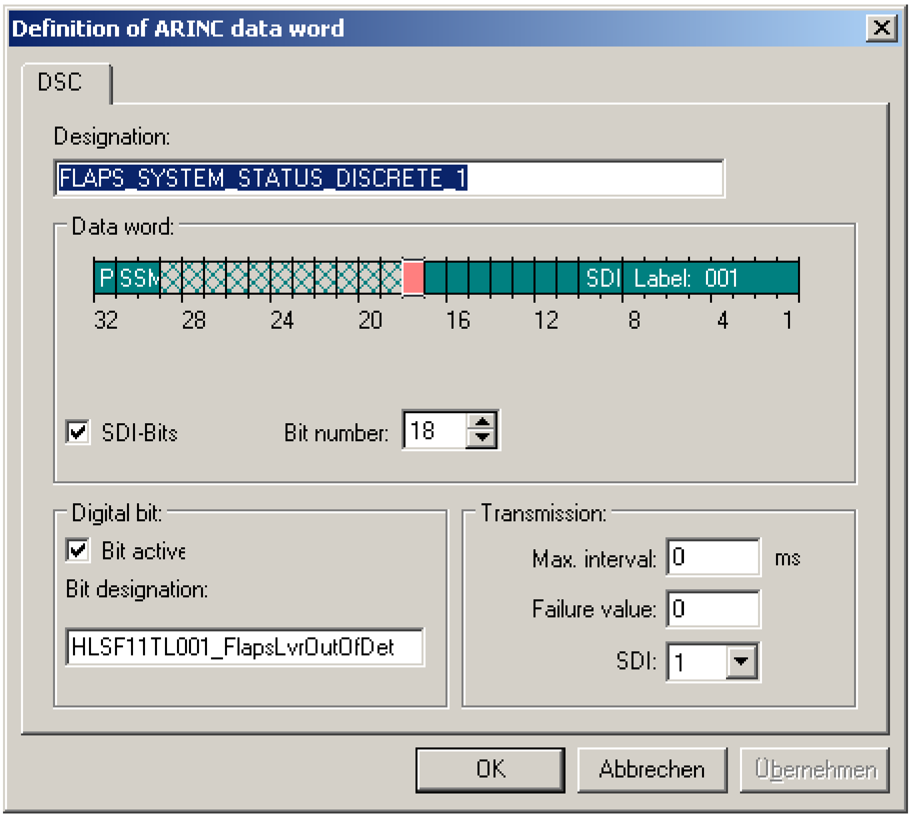
The group **Data word** comprises all settings concerning the structure of the ARINC data word. The currently set word structure is visually represented by a green horizontal bar.

Each bit in the data-carrying portion can be configured individually. To do this, select a particular bit using the control *Bit number* (the bit's image in the green bar will blink).

In the group **Digital bit**, the bit can be manipulated.

In the group **Transfer**, settings are made concerning the timing conventions valid for the transfer of the ARINC data word.

The following is an explanation of the controls:



DSC data word

Settings	Description
Designation	Is an arbitrary, 64 character long string (may not contain quotation marks). It is assigned to the label and displayed in the Assistant-interface. It is also preserved in imc STUDIO as a channel comment.

Data word

Settings - Data word	Description
SDI Bits	With this toggle you can determine whether or not SDI-bits are present in the label. This is not where the SDI address is set; that is done in the group *Transfer*. Instead, you can set whether or not the SDI is present at all. If the SDI bit are not in use, Bits 9 and 10 are available as data bits.
Bit number	Selects one of the bits in the data-carrying portion of the ARINC data word. The contents of the controls in group *Digital bit* are updated accordingly.

Digital bit

Settings - Digital bit	Description
Bit active	Switches the current selection under *Bit number* to an active state. A bit can only be received if it is active. The corresponding bit's image is displayed as a solid, green portion of the green bar. Inactive bits are shown there as green hatching on a gray background.
Bit designation	Here, a descriptive designation of the bit should be entered. Example: Bit 15 of the IRS Discrete Label 270 04 is called "Attitude Invalid". The relationship between the "Designation" for the bit and that for the channel is explained later.

Transmission

Settings - Transmission	Description
Max. interval	The maximum time which may elapse between the transfer of two measurement values. • If this time is exceeded, a zero is transferred to denote a missed measurement value. • If this interval is not known or not important, enter 0. Then no misses will be recorded.
Failure value	The value which is transferred if the maximum permitted interval between two measured values is exceeded.
SDI	If necessary, you can change the SDI-bits for each channel in the ARINC-Assistant. To do this, click on the combobox from which the SDI address is selected.

9.2.2.3.4.5 Mixed Configurations

The ARINC standards allow the highest-valued bits in a label to carry a BNR data word, while discrete signals are assigned to the remaining bits. Conversely, several bits in a discrete label can be coordinated to encode a binary number.

Condition:

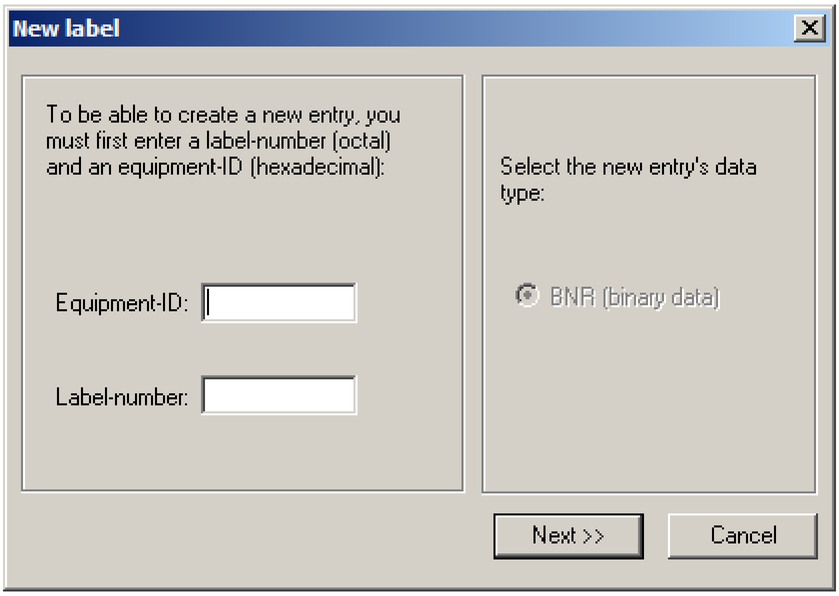
Both instances embody the same irregularity: More than one encoding definition must be made for a single label (one BNR and one DSC).

The Assistant allows any number of definitions to be set for a single label. In this context, even the data type (BNR, BCD or DSC) doesn't matter.

However, for ease of reference, it is good to specify a descriptive name in the **Designation**-control.

9.2.2.3.5 Transmitter Channel (Tx) - Creating a ARINC Label

Icon	Description
	Create a new Transmitter channel by selecting one of the four Tx-channels and click on the button with the speaker symbol.
	Change the properties of an existing channel using this button.



New label

On the **left side**, enter the **Equipment-ID** (hexadecimal) and the **Label-number** (octal). The correct entries can be determined from the ARINC specs.

The only data type available for sending purposes is **BNR** for binary encoding.

9.2.2.3.5.1 Configuring a BNR Data Word

The list **Signalname** (right) offers all data which the measurement device is able to send.

All settings affecting the structure of the ARINC data word appear together in the group **Data word**. The current configuration is denoted graphically as a green bar.

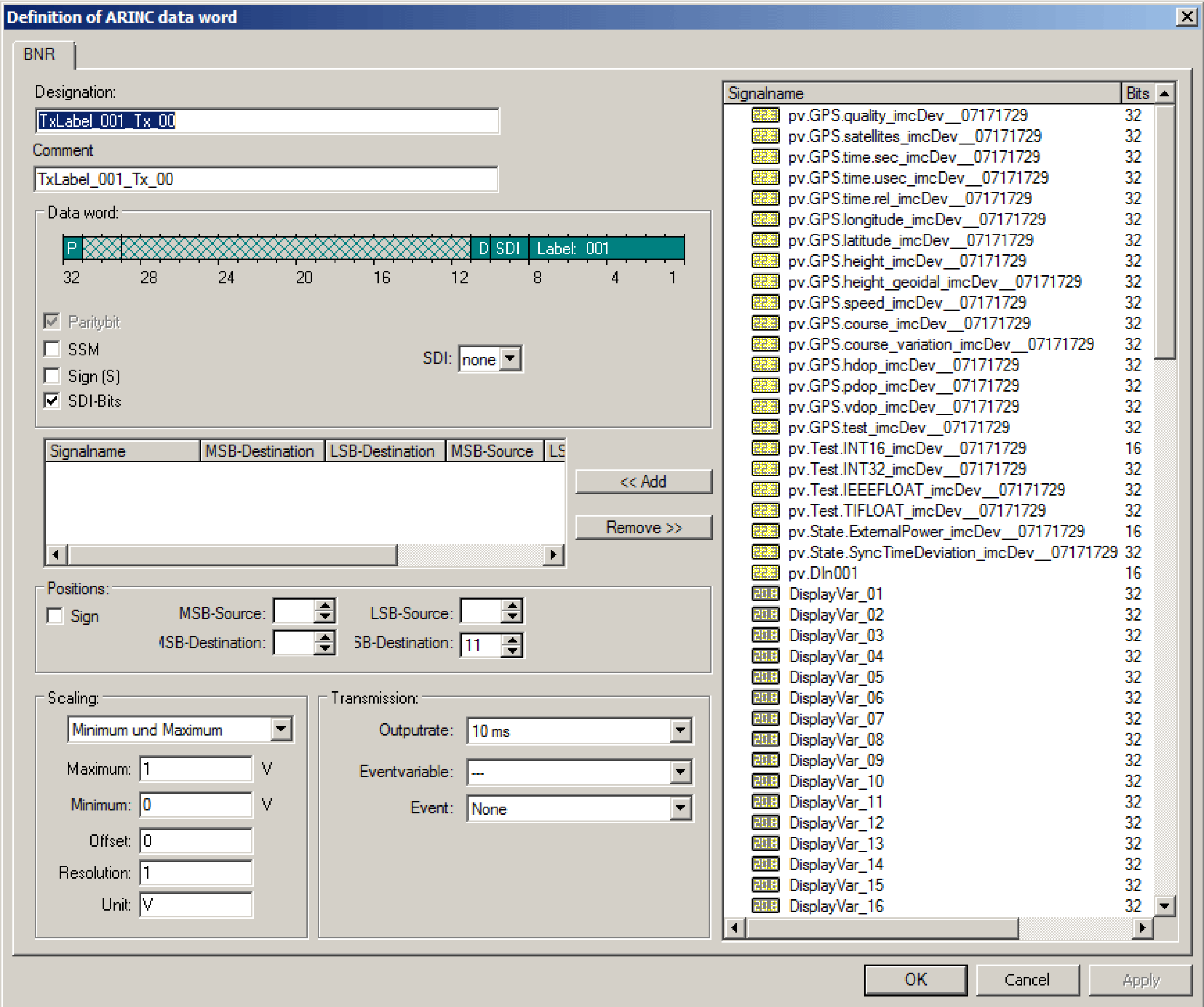
The table at left lists all data which can be added to the message to send.

In the group **Position**, the data type and its bit length are taken into account.

Settings required for calculating the ultimate measured value from the raw data appear in the group **Scaling**.

In the group **Transfer**, it is possible to make settings regarding the transferred ARINC data word's timing.

The following is an explanation of the controls:



Definition of ARINC data word

Settings	Description
Designation	Is an arbitrary, 64 character long string (may not contain quotation marks). It is assigned to the label and displayed in the Assistant-interface. It is also preserved in imc STUDIO as a channel comment. It is analogous to the *PARAMETER NAME* on the ARINC spec sheet, Attachment 2, and should always be specified.

Data word

Settings - Data word	Description
Parity bit	The parity bit is set automatically on the basis of the label contents and its control is therefore disabled.
SSM	• If this box is not checked, then depending on whether the **Paritybit** box is checked, a maximum MSB-position of 31 or 32 can be set. • If the box is checked, the maximum MSB-position which can be set is 28.
Sign (S)	• If there is a check in this box, the sign is transferred, otherwise it is ignored. • As a general rule: if you have specified only a positive value range for an ARINC-label, this option should not be selected. • If this switch is set, the maximum MSB-position is limited to 28.
SDI Bits	With this toggle you can determine whether or not SDI-bits are transferred with the label. This is not where the SDI address is set; that is done in the group *Transfer*. Instead, you can set whether or not the SDI is present at all. If SDI bits are not activated, it is possible to enter a variable at this position.
SDI	If necessary, you can change the SDI-bits for each channel in the ARINC-Assistant. To do this, click on the combobox from which the SDI address is selected.

Position

In the box *Position*, you determine how the variables to be sent are mapped to the label's data portion. If *SSM, Sign* and *SDI* are selected in the area *Data word*, then a maximum of 19 bits are available in the data portion. If the associated options are de-selected, a maximum of 23 bits are available.

The variables to be sent (source data words) take various data formats. Thus, process vector variables can be in the data formats 8, 16 or 32-bit Integer, signed or unsigned, as well as 32-bit Float.

- Display variable always take the data type 32-bit Float.
- DIO-ports consist of one 16-bit word.
- Bits consist of one 1-bit.

Settings - Position	Description
MSB-Source	• If the size of the source data word is **smaller** than the available data portion, then the **MSB-bit is set as the size of the source data word** and can not be changed. The same applies to the data type 32-bit Float. • If the size of the source data word is **greater**, it is possible to set here which payload data from the source data word are to be mapped onto the target data word. In that case, the MSB-source is represented by the highest bit to be evaluated.
LSB-Source	• If the size of the source data word is **smaller** than the available data portion, then the **LSB-bit is set as 1**. The same applies to the data type 32-bit Float. • If the size of the source data word is **greater**, it is possible to set here which payload data from the source data word are to be mapped onto the target data word. In that case, the MSB-source is represented by the lowest bit to be evaluated.
MSB -Target	• If the source data word's data type is Integer, the bits masked out of the payload data portion are copied directly to the target. The MSB-bit target indicates the top bit in the target data word.
LSB-Target	• If the source data word's data type is Integer, the bits masked out of the payload data portion are copied directly to the target. The LSB-bit target indicates the lowest bit in the target data word. The Assistant is used to ensure that the number of bits in the source and the target are the same, if the source is an Integer. If the source data word is of the data type Float, then it must be mapped to an Integer. The number of bits in the Integer is determined by the target data word's upper and lower bit. By means of the factor and offset, or the maximum and minimum, it is possible to change the scaling of the Float number on the mapping. The following rule is applied: `Result = Source word value * Factor + Offset.`

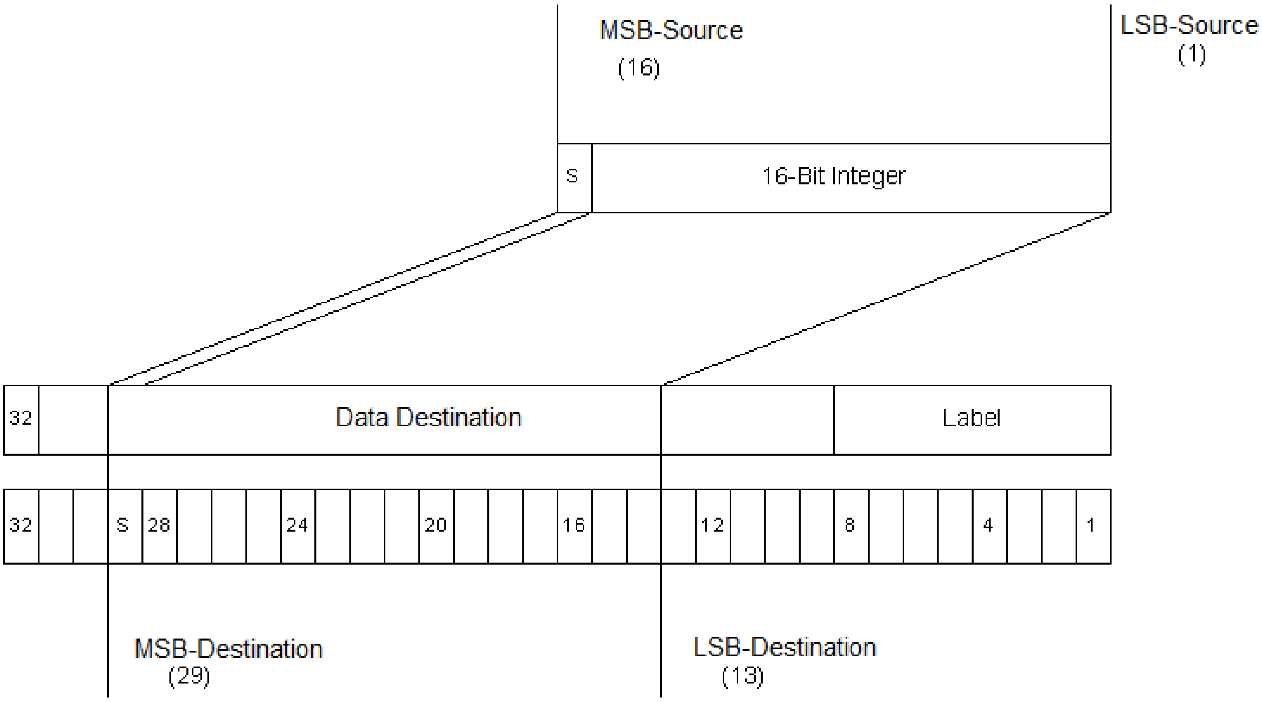
Sign

Multiple variables to be sent can be copied to the label's data portion. They may not overlap.

If the option *Sign (S*) is selected in the area *Data word*, then it is necessary to determine by which variable the sign is determined. I.e. if the variable is negative, then the sign bit is set; for zero or higher, the sign bit is not set.

Even if the option *Sign* is de-selected under *Data word,* it is possible to generate a label with the sign. This is done by arranging the source data word so that the sign (the top bit) is at Bit 29.

The following illustrates how the source word is copied to the data portion.



Copy the source word into the data destination

Scaling

Settings - Scaling	Description
Maximum	Largest measured data value. The highest raw data value is mapped to this value.
Minimum	Lowest measured data value. The lowest value from the raw data maps to this value. Typically, with signed values, the input range is symmetric, i.e. Minimum = -Maximum. If the box for value sign is checked, you must verify whether the minimum is correct, since it will not be adjusted automatically.
Offset	This box is computed automatically. • The offset is computed with sign (S) as: *OFFSET = (Maximum+Minimum) / 2*. • The offset is computed without sign (S) as: *OFFSET = Minimum*.
Resolution	This box's value is computed automatically. You may wish to verify that it matches the column *RESOL* of the ARINC specs, Attachment 2. The resolution is computed as: *RESOL = (Maximum-Minimum) / 2^(SIGDIG + S)* .
Unit	The signal's unit. Corresponds to the column *UNITS* in the ARINC spec sheet, Attachment 2.

Transfer

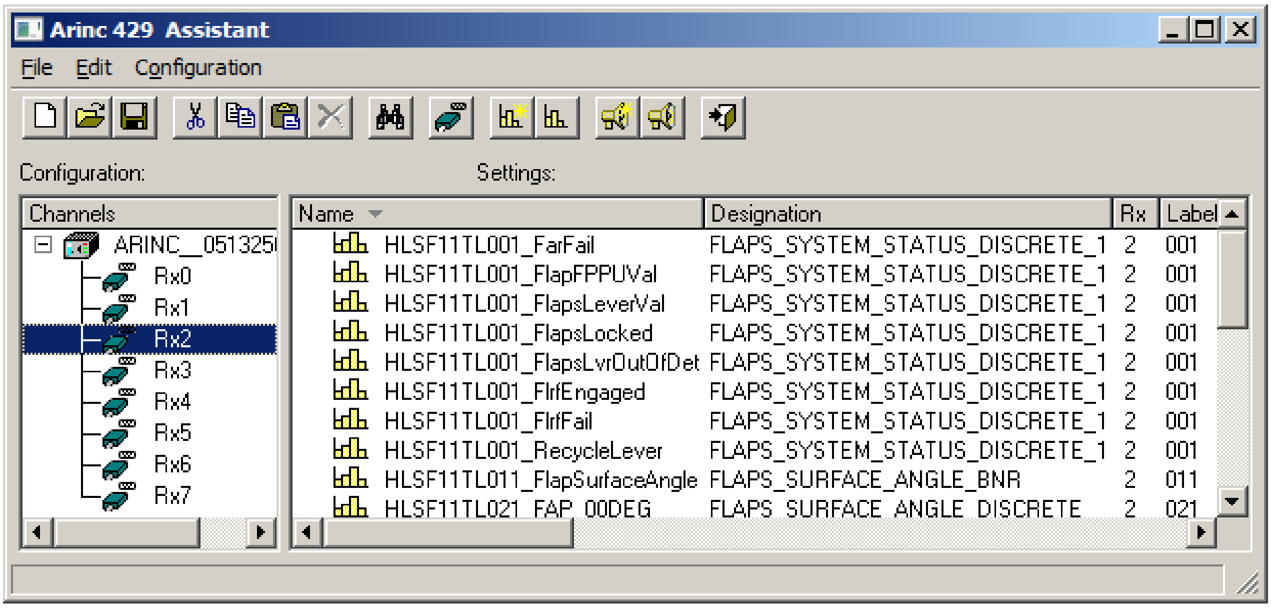
An output rate and a sending condition are defined. The condition is similar to a trigger event in the trigger machine, with the following distinction: there is only one event variable. Conditions defined as combinations of multiple variables linked by the operators AND or OR can only be made using imc Online FAMOS.

Sending is subject to the *Hold-off time* in seconds, where a value of 0 stands for "infinite duration".

Settings - Transfer	Description
Output rate	Cycle time for the output: 500µs - 1h, provided the Baud rate set is adequate.
Event variable	Sending only takes place once the variable entered here meets the condition of the following event.
Event	• For digital event variables: Signal change: 0 -> 1 or 1 -> 0; Signal = 1 or 0. • For analog event variables: Signal < or > Level; Positive or Negative Slope.

9.2.2.3.6 Configuration File List - Settings

If the ARINC configuration file list has been filled with definitions for the desired channels, the list may look like the following:



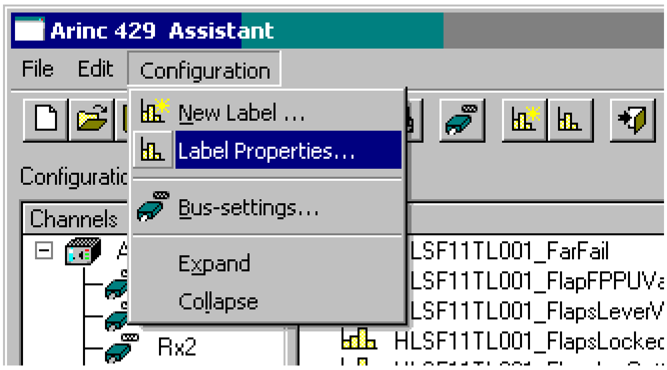
ARINC configration list

All definitions can be sorted as desired by clicking on the corresponding column header.

Each icon stands for one channel definition. After the icon, the name, designation, etc. of the label defined is displayed.

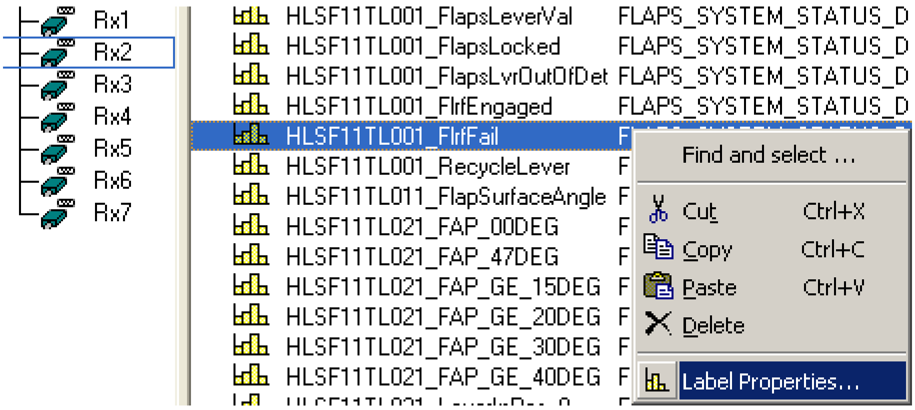
9.2.2.3.7 Editing a Label Definition

To edit an existing label definition, select a line and then select the menu item *Configuration > Label Properties*.



Entering the label properties

or right-click on the mouse to open the context menu and select the item for the configuration dialog.



Open the label properties using the context menu

The dialog for editing the data word then appears, as shown above.

Note

The transmission order is determined by the comment. The labels are processed in alphabetical order of the comment.

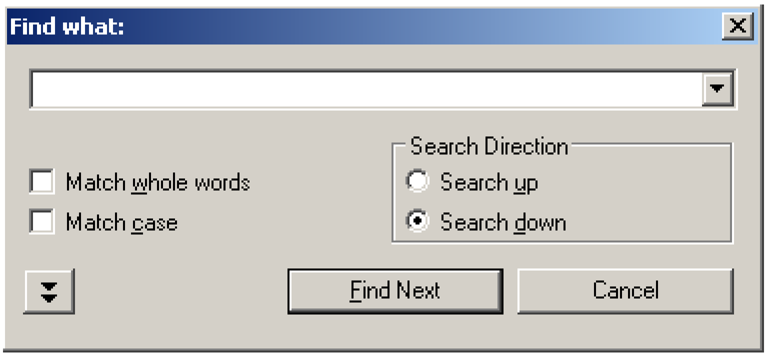
9.2.2.3.8 Cutting, Copying, Pasting or Deleting a Label Definition

To cut, copy, paste or delete a label definition, it is necessary to first select an entry. Then it is possible to select either the corresponding toolbar button, Edit-menu or context menu item to cut, copy, paste, or delete the selected label definition.

9.2.2.3.9 Searching and Selecting a Label Definition

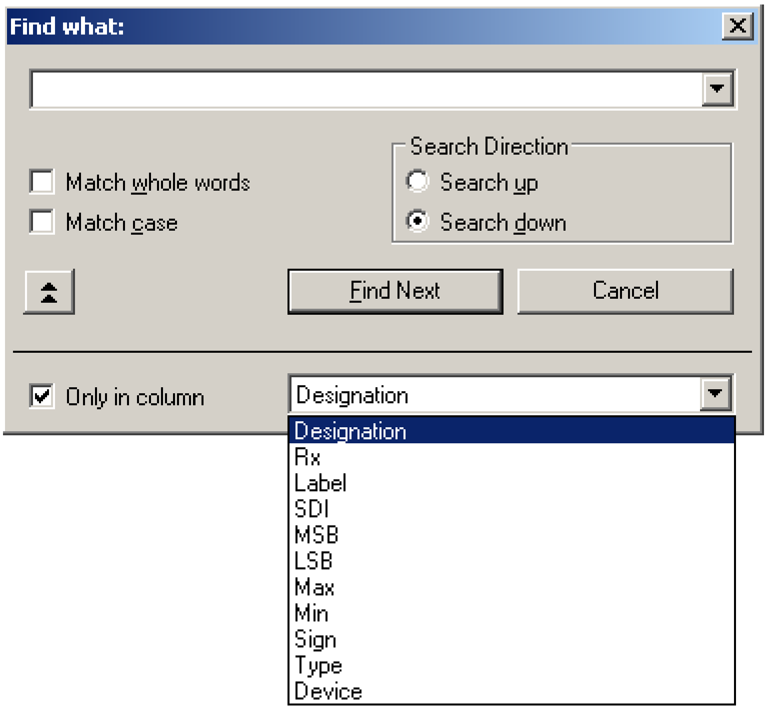
The context menu, called by right-clicking the mouse, also contains an item for the function **Search and select**. Using this function, you can search for a label definition directly.

The **Find** function is available from either the *Edit* menu or by pressing the combination of keys *Ctrl+F*.



Search and find a label definition

Additionally, it is possible to simultaneously search for multiple label definitions having a property in common by activating the function *Only in column,* which is reached via the double-arrow button.



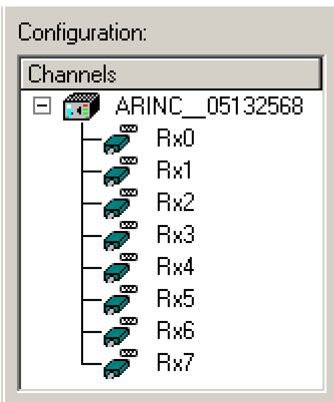
Search in a certain column

9.2.2.4 Configuration

The following sections describe the left side of the Assistant interface, entitled **Configuration**, since all settings made here will be saved by imc STUDIO as the experiment configuration. In the simplest case, a channel (a label definition) from the configuration file is entered when the Assistant is started. When you close the Assistant, this channel is adopted in imc STUDIO. In more complicated cases, the SDI bits and the ARINC bus speed must be set before closing the Assistant. To do this, proceed as follows.

9.2.2.4.1 Configuration List

Entries for all imc measurement devices and their ARINC interfaces are listed here. The figure below presents an example:



Configuration list

The icon represents a measurement device. Next to it is the device name.

The icons connected to it with lines symbolize the device’s ARINC connections.

They are numbered and carry the title "Rx" (receiver).

9.2.2.4.2 Changing Channel Parameters

Channel parameters like channel name, sampling rate, measurement duration etc. are changed in the same way as with an analog channel.

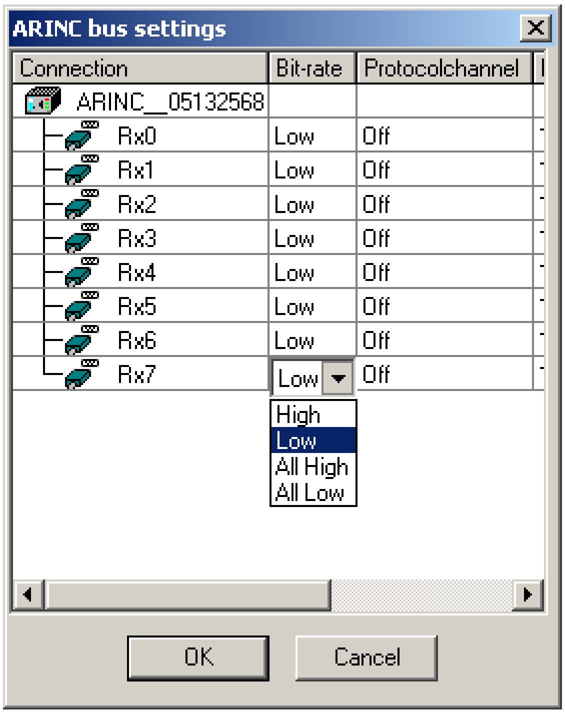
All channels configured with the Assistant are also listed as field bus channels.

9.2.2.4.3 Setting the ARINC Bus Speed

The ARINC bus can be configured for **Low** Speed (12 kbit/s) or **High** Speed (100 kbit/s), **All High** or **All Low**. The dialog for making settings to bus hardware can be called either by selecting the menu item *Configuration > Bus settings* or

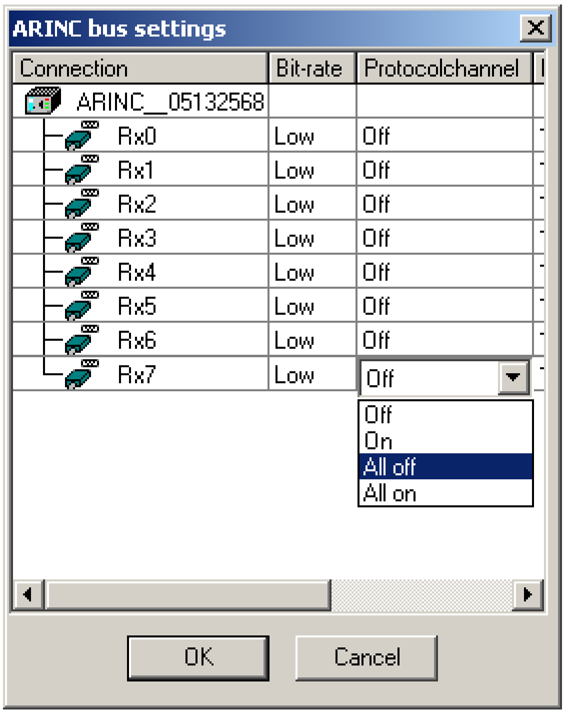
1. by clicking on the button .

2. By clicking in the column *Bit-Rate* on the corresponding row, a combobox, appears from which the associated bus speed can be selected.



Setting the bus speed

If the bus speed is set to the same value for all busses, the option *All High* or respectively *All Low* can be selected.



Record certain Protocol channels

It is also possible to make a record of a node's entire data traffic by selecting the option *On* for the respective node. The Protocol channel is then assigned the same name as the node. If either all nodes or no nodes are to be recorded, the option *All On* or *All Off* can be selected.

Protocol channels can be used for offline analysis of the data traffic, e.g. by means of the program imc FAMOS.

Note

When protocol channels are activated, these are indicated in the channel list.

If a new IDB channel is later imported via the IDB interface, the protocol channels disappear from the channel list, but are still activated in the Bus settings.

Upon each new import of an ARINC-configuration, these must then be first dactivated, then activated again; this will cause all the useal consequences of creating new channels (setting properties, storage options, etc.).

9.2.2.5 Specification IDB Configuration File

9.2.2.5.1 ARINC BNR Parameter

Integer	Label	210
Integer	Equipment ID	7
Integer	Subindex, for multiple "Label"	0
String	Parameter Name	"_278B345A10"
String	Parameter Commentary	"RAM AIR INLET TMP"
Integer	Reserved	0
Integer	Time delay to set drop out value	0
Integer	Reserved	0
Integer	ARINC - FORMAT (0=BNR, 1=BCD, 2= DSC)	0
Integer	Bus Number (0-7) when 8 channel card available	0
Integer	Reserved, bus baudrate (0 Low, 1 High)	1
Integer	SDI Setting: (4=0 00, 0=1 01, 1=2 10, 2=3 11)	4
Float	ARINC MAX WORD RANGE	1000.0
Float	ARINC MIN WORD RANGE	-1000.0
Float	Resolution	0.03
Integer	Number of used Bits	19
Integer	MSB	28
Integer	SDI-bits acitve (0: no 1: yes)	1
Integer	BIT SIGN (0=no, 1=yes)	1
String	UNIT	DEG

Example:

210 7 0 "_278B345A10" "RAW AIR INLET TMP" 0 0 0 0 0 1 4 1000 -1000 0.003 19 29 1 1 DEG

9.2.2.5.2 ARINC BCD Parameter

Integer	Label	210
Integer	Equipment ID	7
Integer	Subindex, for multiple "Label"	0
String	Parameter Name	"_278B345A10"
String	Parameter Commentary	"RAM AIR INLET TMP"
Integer	Reserved	0
Integer	Time delay to set drop out value	0
Integer	Reserved	0
Integer	ARINC - FORMAT (0=BNR, 1=BCD, 2=DSC)	1
Integer	Bus number (0-7) when 8 channel card available	0
Integer	Reserved, bus baudrate (0 Low, 1 High)	1
Integer	SDI Setting: (4->0 00, 0->1 01, 1->2 10, 2->3 11)	4
Float	ARINC MAX WORD RANGE	1000.0
Float	ARINC MIN WORD RANGE	-1000.0
Float	Resolution	0.03
Integer	BIT SETTING (5=11; 29, 4-=5;29, 3=19;29, 2=23;29, 1=27;29) number of digits	3
Integer	MSB	29
Integer	SDI-bits acitve (0: no 1: yes)	1
Integer	BIT SIGN (0=no, 1=yes)	1
Integer	BCD-type: (0=decimal, 1=time, 2=angle)	1
String	UNIT	DEG

Difference to BNR 507

Example:

210 7 0 "_278B345A10" "RAW AIR INLET TMP" 0 0 0 **1** 0 1 4 1000 -1000 0.003 **3** 29 1 **1** 1 DEG

9.2.2.5.3 ARINC DSC Parameter

Integer	Label	210
Integer	Equipment ID	7
Integer	Subindex, for multiple "Label"	0
String	ARINC _LABEL NAME	"Label_210_Rx_00"
String	ARINC _LABEL NAME COMMENTARY	"Label_210_Rx_00"
Integer	Reserved	0
Integer	Time delay to set drop out value	0
Integer	Reserved	0
Integer	ARINC - FORMAT (0=BNR, 1=BCD, 2=DSC)	2
Integer	Bus Number (0-7) when 8 channel card available	0
Integer	Reserved, bus baudrate (0 Low, 1 High)	1
Integer	SDI Setting: (4=0 00, 0=1 01, 1=2 10, 2=3 11)	4
Integer	Bitmask, absolut for complete 32 bit-word	8000
Integer	Number of bits	1
Integer	MSB	20
Integer	SDI-bits acitve (0: no 1: yes)	1
String	BIT NAME	"-279C111B0000"
String	BIT COMMENTARY	"FALSE VENTO A1"

Example:

210 7 0 "_ Label_210_Rx_00" " Label_210_Rx_00 " 0 0 0 2 0 1 4 8000 0 1 20 1 DEG "_ 279C111B000“ “FALSE VENTIL A1”

9.2.3 AFDX-Bus Interface

Introduction - What is the AFDX-Bus?

AFDX: Avionics Full Duplex Switched Ethernet

The ARINC-664 standard uses the fundamental elements of the AFDX, which is based on IEEE 802.3. Since the main elements consist of AFDX end systems, AFDX switches and AFDX links, the AFDX is a kind of network rather than a bus system.

The end systems communicate via so-called Virtual Links (VL), which define the connection in one direction between a source and a destination. The monitoring of the data transfer rates on the AFDX is also performed on the basis of these Virtual Links, since each Virtual Link has a particular bandwidth.

A frame on the AFDX fundamentally consist of the network data such as Mac-address, IP and UDP, as well as the data payload. This payload can consist of up to 1472 8-bit characters. However, only 1471 of the 8-bit characters are used as real payload. The remaining 8-bit character is needed for the sequence number (SN).

The payload data themselves consist of a function status (FS) and the associated data set (DS). In the function status, the associated data set's properties are described. These properties and additional AFDX items can be defined in the AFDX-Assistant.

Note

Also observe the general notes on file buses in regard to control philosophy 476 and the sampling rate either as fixed sampling rate 477 or time stamp 480.

9.2.3.1 AFDX-Assistant

Before it is possible to record an AFDX channel with the imc measurement device, the first step is to define the AFDX data word to be captured. This task is handled by the AFDX-Assistant.

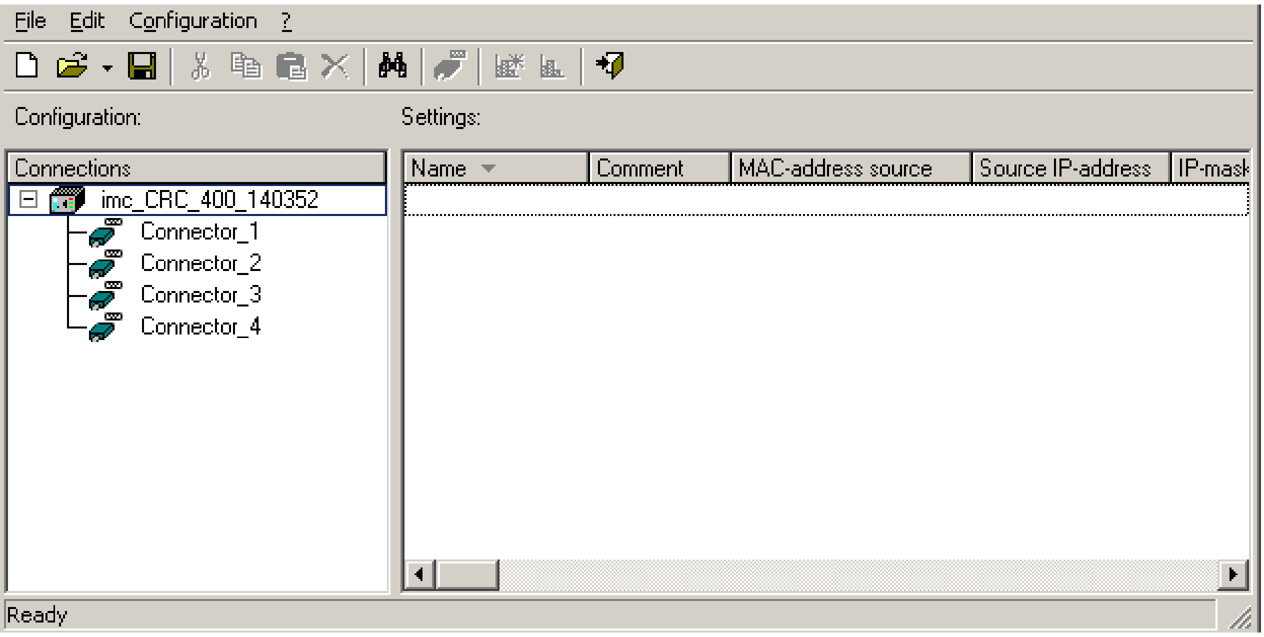
Once this step has been completed and the Assistant closed, an additional measurement channel is available in imc STUDIO, which can be used in a very similar way to any analog or digital channel. This means that the channel can be subjected to operations in imc Online FAMOS, for example, or linked together with analog channels to a trigger and recorded in response to it.

Thus, only the settings specific to the AFDX-bus must be made with the AFDX Assistant. All other properties such as the measurement duration or the trigger linkages are handled in the exact same way as if working with a regular analog or digital measurement channel.

9.2.3.2 Starting the Assistant

In order to launch the Assistant from imc STUDIO, click in the menu ribbon on *Setup-Configuration > AFDX-Assistant*.

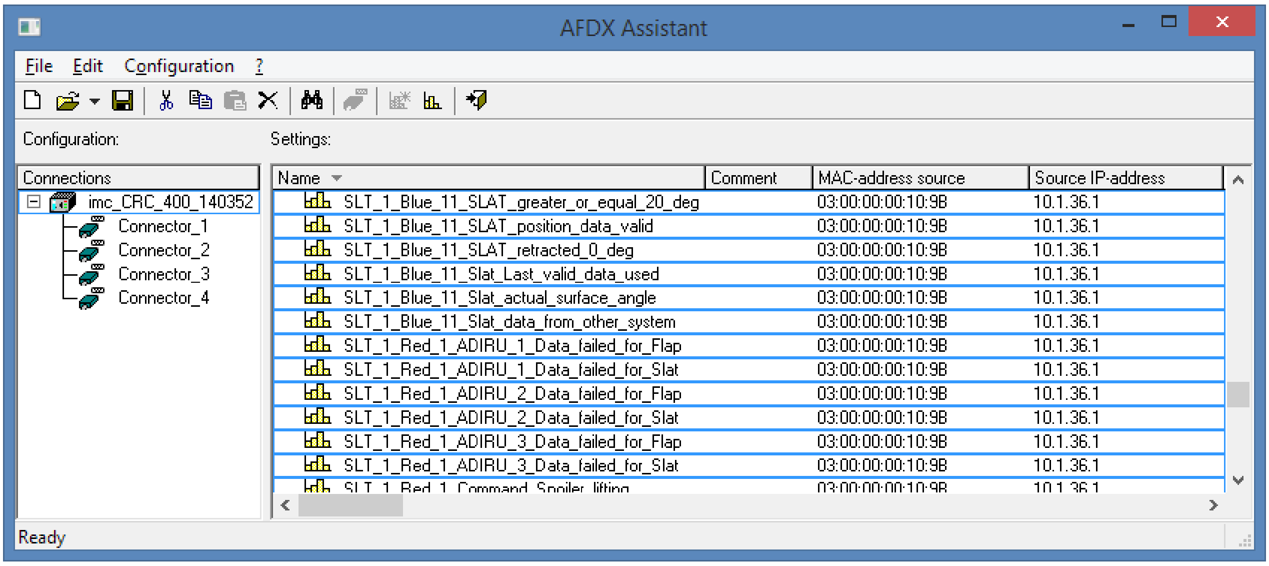
After launching, the Assistant appears with the following dialog:



AFDX-Assistant

The AFDX-Assistant's main window has two tiles:

- The left tile under the heading **Configuration** lists the device and the receiver channels belonging to it.
- The right tile under the heading **Settings** lists the AFDX channels which belong to the currently selected connector-channel and have been defined.



AFDX-Assistant, main window (example)

The definitions for the respective AFDX channels made here under **Settings** are saved in a dedicated configuration file (.xml-format), where they are independent of the particular experiment. This configuration file can be regarded as a sort of database containing all defined AFDX-channels along with their respective channel assignments. Thus, to configure an experiment with the AFDX-bus, one only needs to load an AFDX configuration file and to close the Assistant. All AFDX channels defined then appear in the imc STUDIO operating software as channels and can be either displayed or subjected to further processing in imc Online FAMOS.

9.2.3.3 AFDX-configuration file

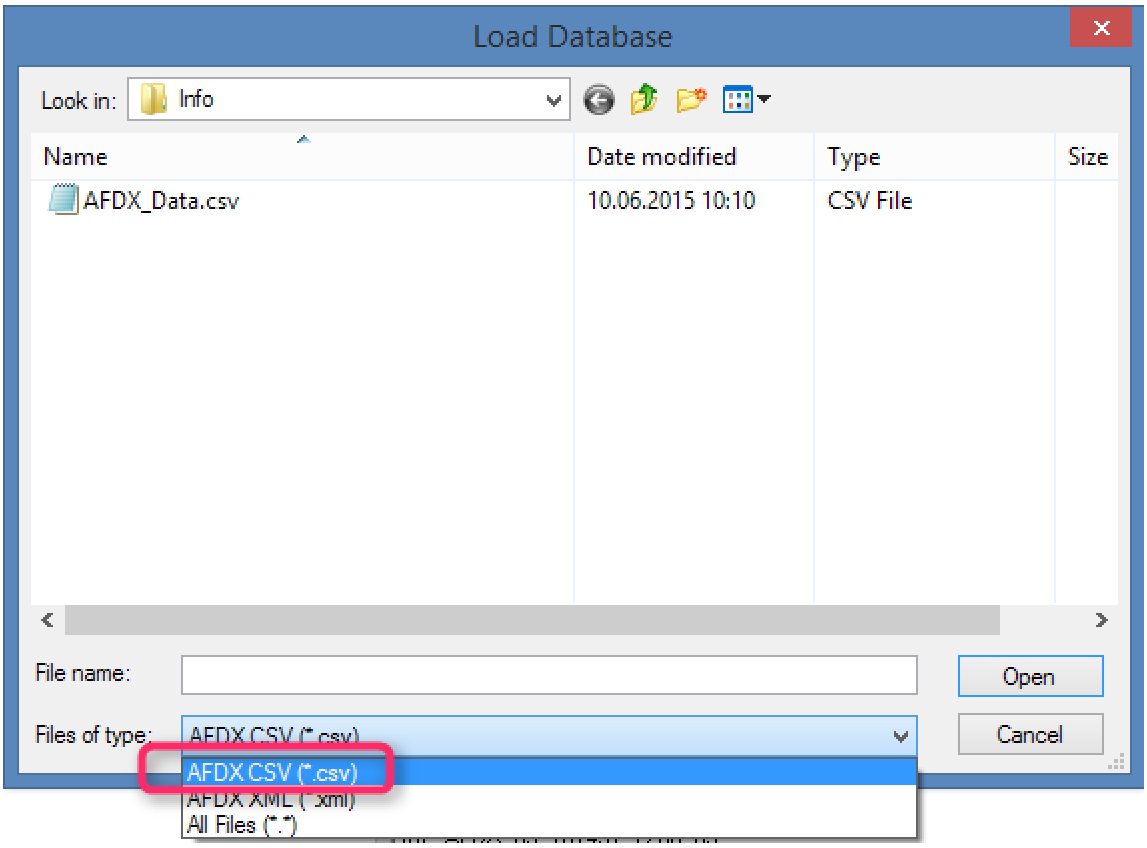
All AFDX channel definitions are saved in a configuration file. This configuration file can be used as a central database. The file can be loaded for every experiment, the AFDX channels can be deleted, copied, or moved as desired. Thus, the signal definitions are independent of the particular experiment. Based on this principle, a custom configuration for a new experiment can quickly be generated at any time from an existing configuration file.

9.2.3.3.1 Creating a new configuration file

To create a new configuration file, either click on the button in the toolbar, or select the menu item *File> New*.

9.2.3.3.2 Loading a configuration file

to load an existing configuration file, either click on the button in the toolbar or select the menu item *File > Load...*. By default, the file has the extension *.xml . It is also possible to load *.csv-files, in order to import one's own personal AFDX channel databases.



Loading a configuration file

9.2.3.3.3 Saving a configuratoin file (Save As...)

To save a configuration file, either click on the button in the toolbar or select the menu item *File > Save*.

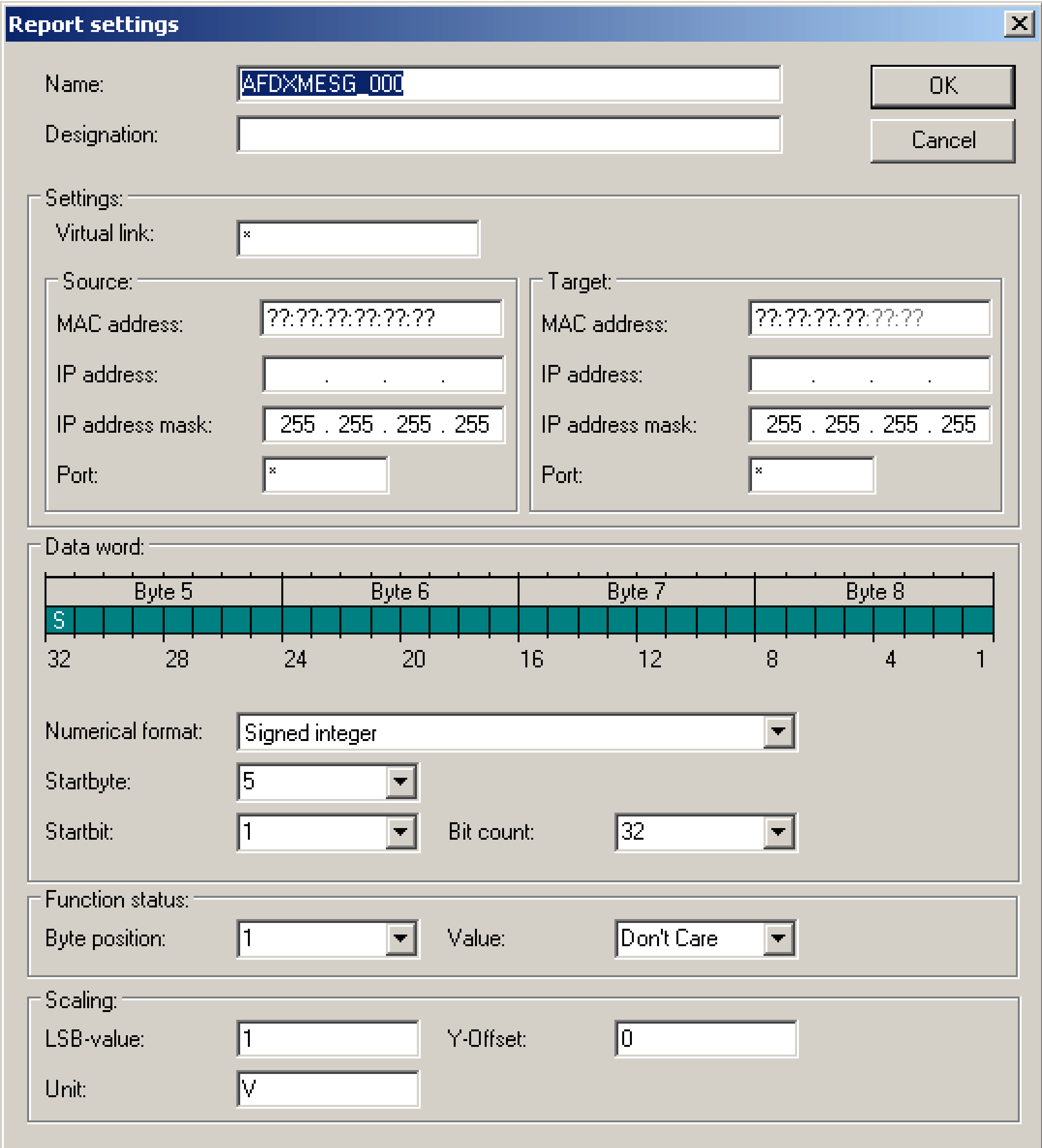
If you wish to save the loaded configuration file under a different name or path, use the menu item *File > Save As...*. In the Windows "File" dialog, you must ehn enter the filename without an extension. The extension *.xml is appended automatically.

9.2.3.3.4 Creating a new AFDX-channel

A new AFDX-channel can only be created in the configuration file and never directly in imc STUDIO: Setup.

- To create a new AFDX channel, either load an existing configuration file or create a new one.
- Next, in the left section of the dialog, Configuration, select the connector-channel on which the AFDX channel is to be received.
- Then either click on the button in the toolbar or select the menu item *Configuration > New Channel*.

A dialog then appears:



Creating an AFDX channel

The dialog is subdivided into 5 regions. In the top region, you can enter the channel's name plus an extra designation for the newly created channel.

The regions Settings 515, Data Word 516, Function Status 516 and Scaling 517 are described further below.

Settings	Description
Name	An arbitrary string of up to 255 characters in length. The usual limitations governing channel names in imc STUDIO apply. The name is assigned to this channel and displayed in the Assistant interface. it will also be used as the channel name in imc STUDIO.
Designation	An arbitrary string of up to 255 characters in length which may contain any characters desired. The designation is assigned to this channel and displayed in the Assistant interface. It is also noted in imc STUDIO as a channel comment.

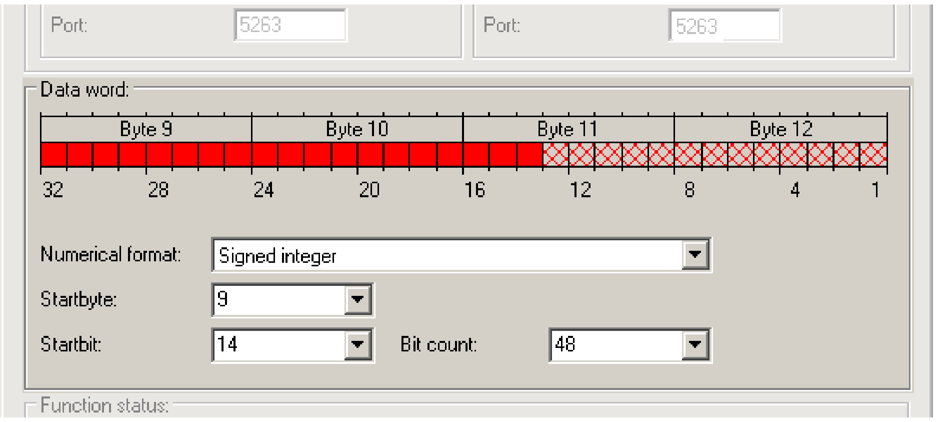
Settings

Settings	Description
Virtual Link	Here, a virtual link can be entered, which defines the connection in one direction from a source to a destination.

Settings - Source and Target	Description
MAC Address	Here, the MAC address of the source/target in the network is specified. The MAC address serves as unique identification in the network and enables more specific monitoring in conjunction with the use of the virtual links. The MAC addresses are 48 bits in size and are entered in hexadecimal format.
IP Address	Here, the IP address of the source/target in the network is specified. The IP address serves the purpose of addressing a subscriber within a network.
IP Address Mask	Here, the IP address mask of the source/target is entered, within which the corresponding IP address is located. The IP address mask denotes the network in which the source/target is located.
Port	Here, the source's/target's port is entered.

Data Word

In a data word, 128 bits are available. Since the data are always sent in 4 Byte-sized Function-Status-sets, the dialog also always displays only 4 Bytes. Bits which are not used are indicated in the dialog by hatched boxes, while bits which are used are represented by filled boxes. The available numerical formats for the data word are Digital, Signed Integer and real.

Settings - Data Word	Description
Numerical format	The available options are **Digital**, **Signed Integer** and **Real**. For all three numerical formats, the start byte can be selected.
Start byte	In the single-line text box, the desired start byte can be selected. Due to the limitation of the message size, only values up to 1496 are possible for the start byte.
Start bit	The start bit can only be selected for the *numerical formats Digital* and *Signed Integer*. The start bit must be ≤ 32.
Bit count	In the numerical format *Signed Integer*, it is additional possible to select the bit count. If the sum of the start bit and the bit count is greater than the number of the 32 available bits, the color of the fill in the bit boxes changes from green to red. In this case, the setting is **not accepted** by the AFDX-Assistant.  **Bit count**

Function Status

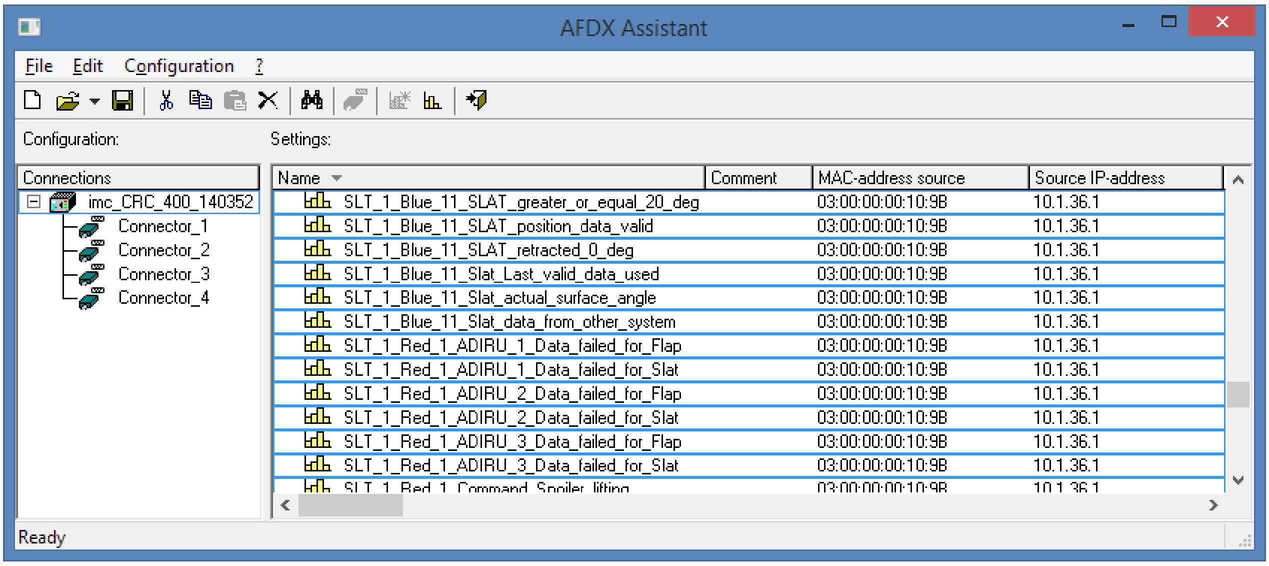
Settings - Function Status	Description
Byte position	Here, the byte position of the corresponding function status can be set. Note that the byte position of the function status proceeds the associated data package. Due to the limitation on message size, the byte position must be below 1500.
Value	Here, it is possible both to select among the three function statuses **No Data**, **Normal Operation** and **Functional Test**, as well as to enter a value ≤ 255 corresponding to the 8 available bits.

Scaling

Settings - Scaling	Description
LSB-value	The LSB-value specifies the factor with which the actual value is multiplied. Along with integer values, it is also possible to enter values in exponential representation such as 1.02e+3 or 1.02e-02.
Unit	The signal's unit of measure.
Y-Offset	Here, an offset can be specified, which in conjunction with the LSB value produces the ultimate result. Result = Value x LSB-Value + Offset

9.2.3.3.5 Configuration file list - Settings

If the AFDX configuration file list was filled with AFDX-channels for the desired connector-channels, the list will appear similar to the example below:



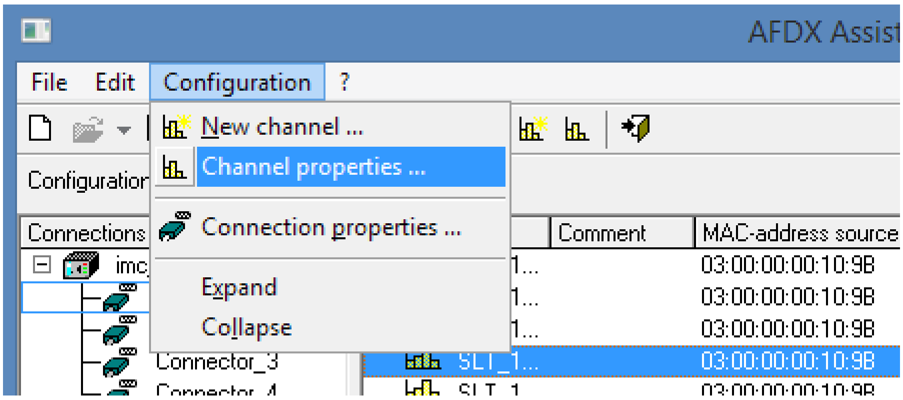
Configuration file list

All AFDX-channels can be sorted however desired by clicking on the corresponding column.

All icons represent the definition of a channel. After the icon, the name, designation etc. of the defined AFDX channel is stated.

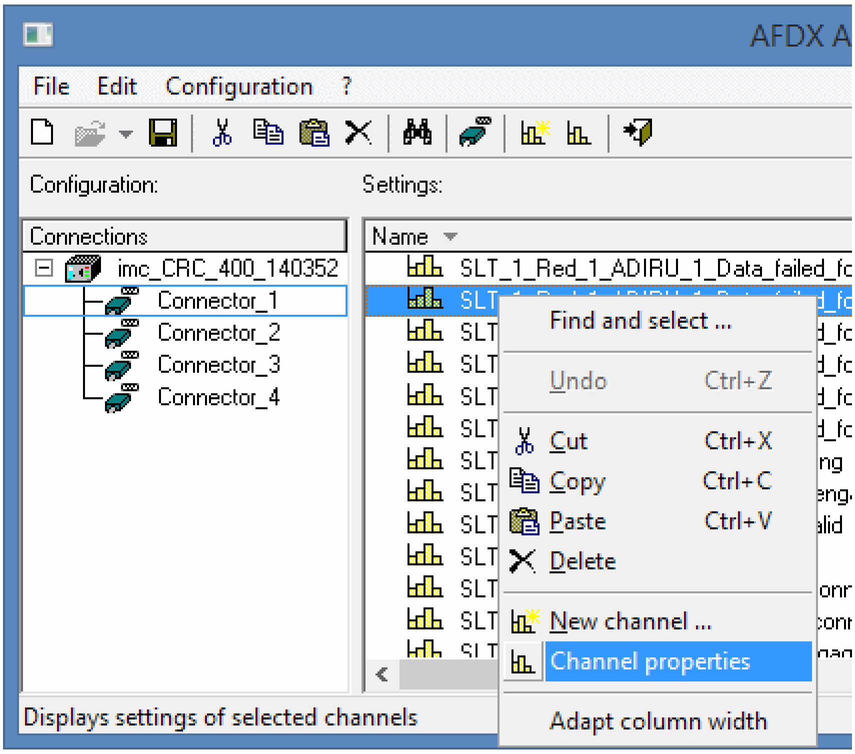
9.2.3.3.6 Editing an AFDX-channel

To edit an existing AFDX-channel, one selects a line and then selects the menu item *Configuration > Properties Channels*



Properties of an AFDX channel via the menu

or one opens the Configuration dialog by right-clicking on the corresponding line.



Properties via the context menu

The dialog for setting an AFDX-channel; see above.

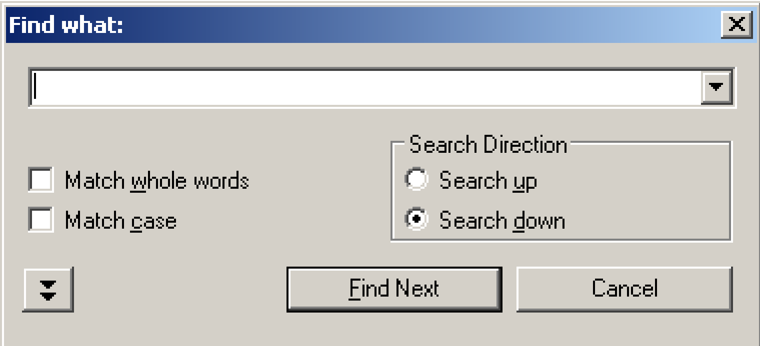
9.2.3.3.7 Cutting, copying, pasting or deleting an AFDX-channel

To cut, copy, paste or delete an AFDX-channel, it is necessary to first select an entry. Then, either by clicking on the corresponding button in the toolbar or by right-clicking on the selected d, it is possible to select one of the choices for editing the AFDX-channel: Cut, Copy, Paste or Delete.

9.2.3.3.8 Finding and selecting an AFDX-channel

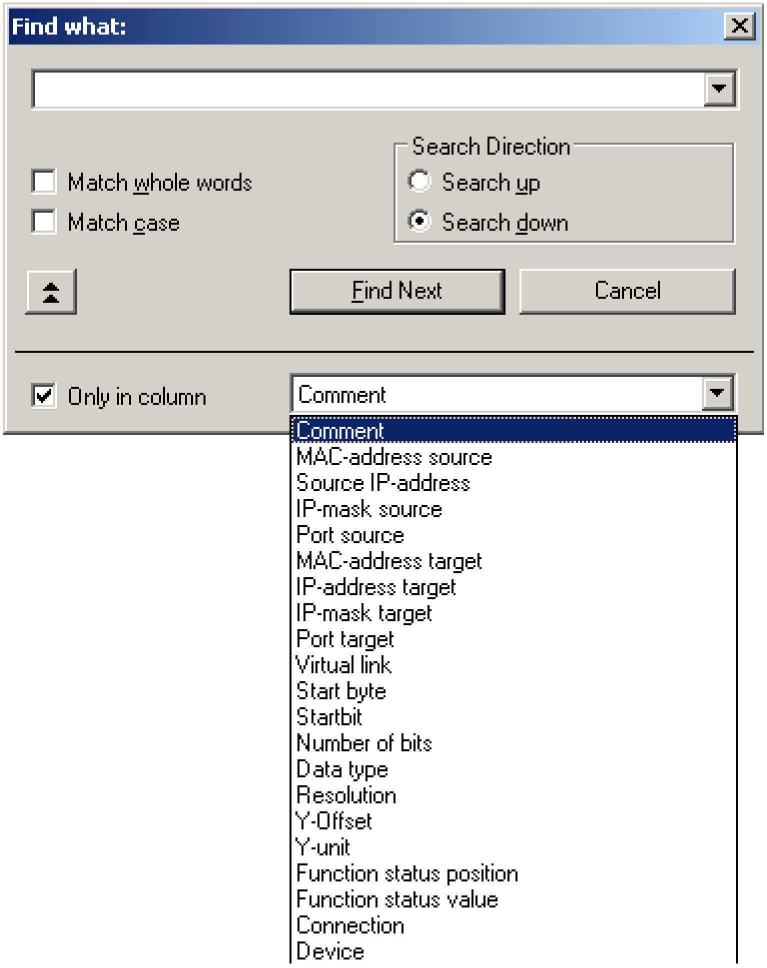
The context menu (accessed by right-clicking the mouse) also offers the function *Find and select...*. Using this, it is possible to directly search for particular AFDX-channels.

By means of the menu item *Edit*, or the keyboard combination *Ctrl+F*, the function **Find** is available.



Searching for an AFDX channel

Additionally, it is possible to select multiple channel definitions having a property in common, by selecting the function **Only in Column**, which is accessed by clicking on the double-arrow button.



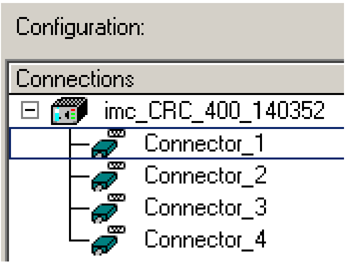
Searching in a particular column

9.2.3.4 Configuration

The next sections describe the left side of the Assistant, which is designated **Configuration**, since everything set in this half of the dialog is saved in the configuration of the imc STUDIO experiment. In the simplest case, after starting the Assistant, an AFDX-channel is added from a configuration file. Closing the Assistant then causes this channel to be adopted in imc STUDIO. The details of how this is done are described next.

9.2.3.4.1 Configuration list

In the (empty) configuration list, all imc devices with their AFDX-interfaces are listed. The following image provides an example:



Configuration list

The icons each represent a measurement device. After each one is the respective device name.

The icons joined by lines to it symbolize the AFDX-channels, which are serially numbered.

9.2.3.4.2 Editing channel parameters

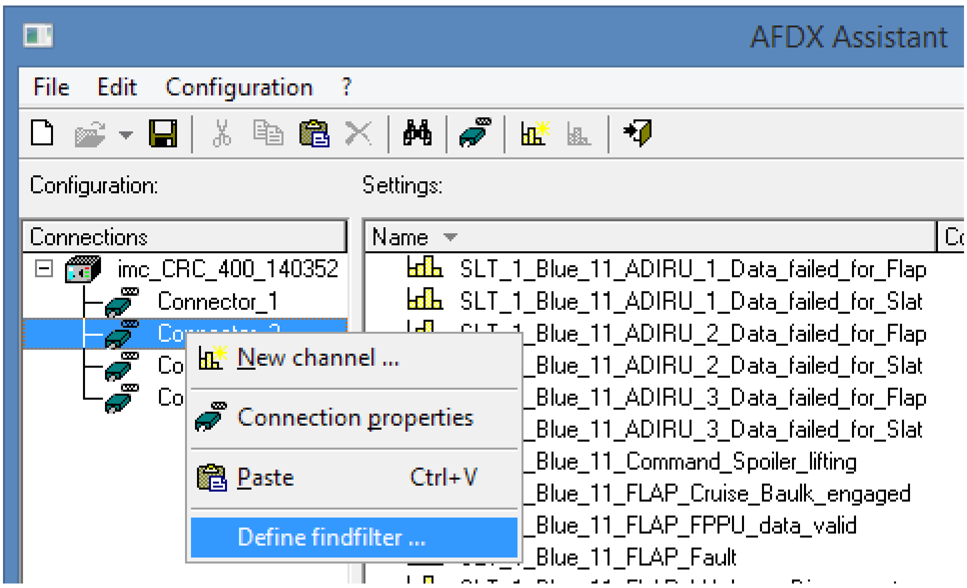
Channel parameters such as the channel name, sampling time, measurement duration and etc. are edited in the same way as for an analog channel.

All channels configured in the Assistant appear with the Fieldbus inputs.

9.2.3.4.3 Defining search filters

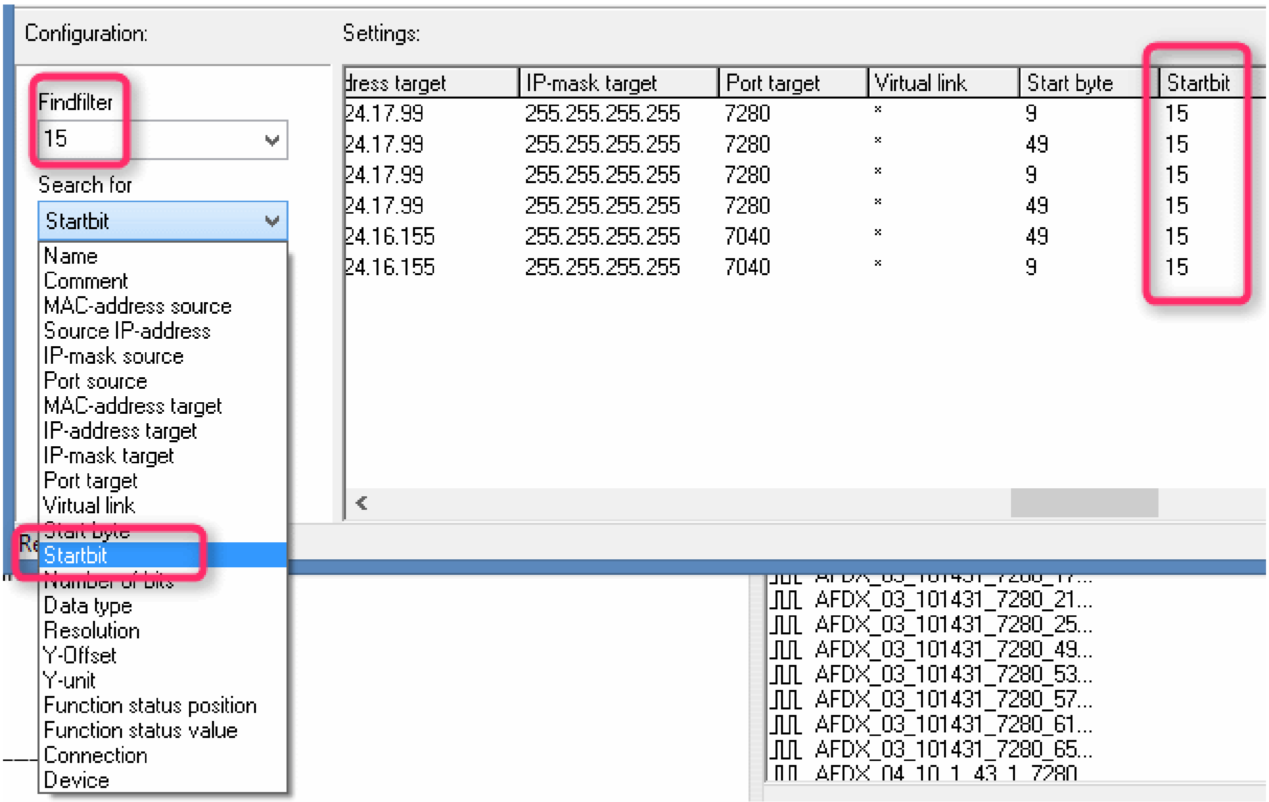
To start the search filter, open the context menu in the Connections list and select **Define FindFilter**.

This Filter supports the display and editing of channels belonging to a particular group by means of a wildcard-based search.



Calling the Search Filter

In the pop-down list **Search for**, select the property, and in the box above it, the value for which to search.



Using a search filter

9.2.4 CAN-Bus Interface

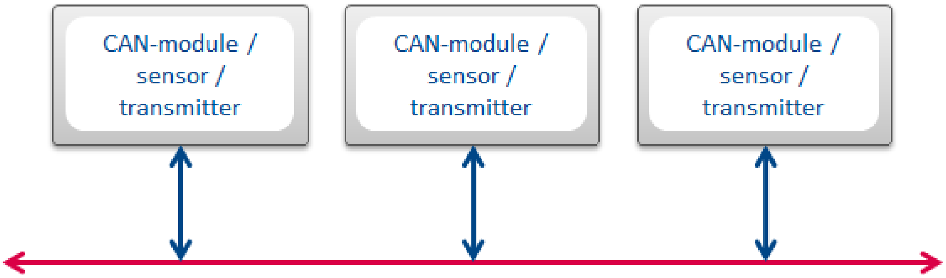
What is the CAN-Bus?

A CAN-Bus interface is optionally available for imc measurement devices, offering full support of CAN-Bus sensors using basic data formats. It is thus possible to take measurements via the CAN-Bus and via the analog and digital inputs practically synchronously.

The CAN-Bus (Controller Area Network) is a serial transmission line connecting all modules in a two-wire circuit. To prevent signal reflection, terminators are connected at the cable ends. The module holder is designed to conform to CAN-Bus operation per CiA standards (CiA Draft Standard 102 Version 2.0, CAN Physical Layer for Industrial Applications).

Multiple sensors and devices can be connected to the CAN-Bus, and can output their measured values at regular intervals onto the bus, for instance. Every device and every sensor sends its data as a ***message*** on the bus. Up to 8 bytes of data can be sent with one message. Every message possesses a unique ***identifier***. A signal's identifying information such as the channel name and units is not sent with the message. Instead it is usually recorded in a database which provides a key to how the message's data is encoded, based on its identifier.

Every CAN-module is connected to the CAN-Bus at a node.



9.2.4.1 Informations

Ordering information

Our standard product package comprises two high-speed CAN-Busses (as per ISO 11898). A low-speed model (ISO 11519-2) is also available. If one or two low-speed busses are desired, please note this in your purchase order, as for instance: "CAN1 = ISO 11898, CAN2 = ISO 11519-2".

Further references

- CiA® Draft Standard 102 Version 2.0: CAN Physical Layer
- CAN Controller Area Network, Wolfhard Lawrenz, Hüthig Verlage, 1994 Heidelberg
- ISO / DIS 11898 (ISO 11519-2) for bus driver
- ISO / OSI reference model
- CAN-FD (ISO 11898-1:2015)

Note	Remote Frame

imc CANSAS actually does not support Remote Frames (RTR) according to CAN specification.

Bus features

The CAN-Bus interface includes the following features:

- CAN Transceiver in accordance with ISO / DIS 11898, isolated
- Baud rate can be adjusted per software
- Standard identifier on CAN-Bus: 11-bit identifier (0..2047)
- Extended identifier on CAN-Bus: 29-bit identifier (0 .. 536870911)
- CAN-FD (ISO 11898-1:2015)

Reference

Observe the general Field bus notes regarding the operation methodology 476 of fixed sampling rates 477 versus timestamp 480.

9.2.4.2 Connection to the device

9.2.4.2.1 CAN port pin configuration

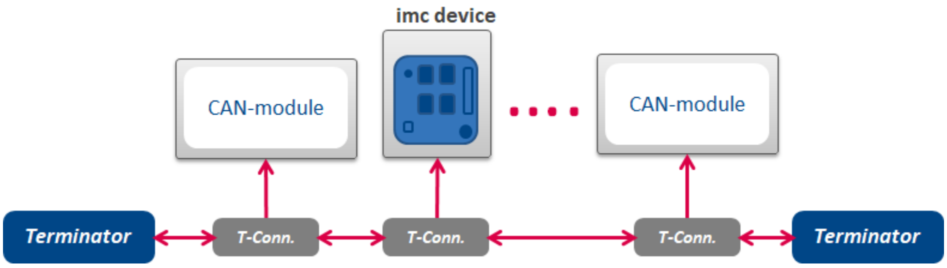
The device comes with a pair of terminals for each CAN-node, configured as follows:

DSUB-PIN	Signal	Description	Usage
1	nc	Reserved	Not used
2	**CAN_L**	**Dominant low bus line**	**Connected**
3	**CAN_GND**	**CAN Ground**	**Connected**
4	nc	Reserved	Not used
5	nc	Optional CAN Shield	Not used
6	**CAN_GND**	**Optional CAN Ground**	**Connected**
7	**CAN_H**	**Dominant high bus line**	**Connected**
8	nc	Reserved (error line)	Not used
9	nc	Optional supply 7V..13V	Not connected

9.2.4.2.2 CAN cabling (Y-adaptor)

Device connection with a Y-adaptor

If your imc device is equipped with at least 2 nodes (DSUB-9), each of them is supposed to be connected with a Y-adaptor.



Device connected with Y-adapter

To guarantee a CAN data transfer rate of 1 Mbit/s, the **maximum length** for the pathway through a Y-adaptor is **30 cm**. Usually the wiring within the device is already 30 cm. If using an external Y-adaptor it has to be attached directly at the connector.

In this case it doesn't matter whether the other sensors are connected with or without a Y-adaptor. The diagram shows just one of several connection possibilities.

9.2.4.2.3 Connecting terminators

Terminators with 124 Ω in accordance with CiA.

Terminators are connected between pin 2 and 7.

Terminators must be used at both ends of the bus. No further terminators are allowed.

With the CAN-bus interface it is possible to terminate the bus within the device controlled by software, see Terminator in device 538.

9.2.4.2.4 Connecting and activating

At first, the CAN-Bus must be completely wired and connected to the measurement device. Only then should the device be activated. During operation, the CAN connector should not be disconnected.

Warning Safety note!

In general, it is OK to pull the CAN-plug during operation. When it is re-plugged afterwards, a reset of the device's CAN-controllers will be carried out. Following that, the device it will resume to collect CAN-Bus data. However, this kind of operation is not specified. Although it normally works, it cannot be guaranteed. For example, re-connecting can lead to an electrostatic discharge where voltages higher than permitted can occur and **cause malfunction of the circuitry**. A person can receive a charge of several thousand volts

Warning

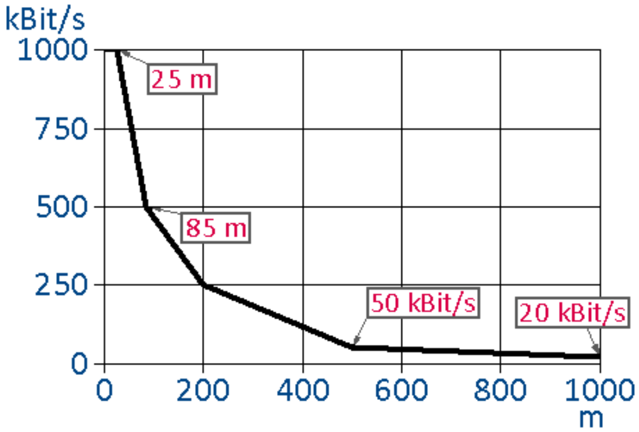
The device can suffer damage as a result of electrostatic discharge! Usually it is necessary to switch the device off and then on again to ensure proper functioning.

9.2.4.3 Technical specification

9.2.4.3.1 CAN transfer rate

With the transfer rate, it is necessary to distinguish between standard CAN and CAN-FD (CAN with flexible data rate). The following description pertains primarily to the classic, standard CAN-Bus.

As signal lead lines become longer, the maximum reliable data transfer rate decreases. Furthermore, the possible data rate depends on the bus timing, which in turn is determined by the hardware configuration and software version.



Data rate for devices with CAN2 interface

The diagram shows the transfer rate for devices with CAN2 interface. Transfer rates for imc-USB, imc CANSAS modules and older CAN interface cards are presented with the technical specs in the device documentation.

Line length [m]	Data rate [kBit/s]
25	1000
85	500
200	250
500	50
1000	20

Devices from imc are built with electrical isolation from the bus. Devices without electrical isolation achieve somewhat higher values for the maximum line length: 40 m at 1000 kBit/s or 100 m at 500 kBit/s.

Net data rate (CAN-standard 1Mbit/s)

Conversely, the net data rate depends on the package size and on whether the Standard Frame or the Extended Frame is used. For instance, if each imc CANSAS message has been optimally packed in 8 Byte chunks, the Standard Frame is used and there are no further subscribers connected to the node, the rate reaches 576.6 kBit/s, amounting to 36kSamples/s. The table shows the net data rates for 1 MBit/s.

Data length	Net data rate with	
	Standard Frame	Extended Frame
0	-	-
1	72,1 kBit/s	61,1 kBit/s
2	144,1 kBit/s	122,1 kBit/s
3	216,2 kBit/s	183,2 kBit/s
4	288,3 kBit/s	244,3 kBit/s
5	360,4 kBit/s	305,3 kBit/s
6	432,4 kBit/s	366,4 kBit/s
7	504,5 kBit/s	427,5 kBit/s
8	576,6 kBit/s	488,5 kBit/s

9.2.4.3.2 CAN FD

CAN-FD (CAN with flexible data rate) offers a **8 higher data rate of up to 8 Mbit/s** and up to **64 Bytes of payload data per message**.

Fundamentally, the same network topology can be used as with the classic CAN-protocol. However, the previous CAN-controllers are not able to send or receive CAN-FD messages > 8 Bytes. For this reason, CAN and CAN FD can work together in one bus-system if:

- no Remote-Frame is sent (something which imc software does not generate),
- no CAN-messages > 8 Bytes are used
- no Switch Bit Rate 552 is used.

Remarks on CAN FD

- It is possible to send and receive larger messages with Online FAMOS 553.
- Fundamentally, all CAN-experiments can be transferred to devices with CAN FD.
- Messages can be sent at a higher baud rate using the option "*Switch Bit Rate* 552".
- CAN FD configurations can be imported to CAN-devices. The configuration is then converted to CAN and resulting errors must subsequently be eliminated by the user.

9.2.4.3.3 Number of CAN nodes

Correlation between line length, number of nodes and cable cross section. The cross section of the line should increase in size as more CAN-nodes are served by the system.

Line length	Number of nodes/ Cable cross section		
	32	64	100
100 m	0.25mm²	0.25mm²	0.25mm²
250 m	0.34mm²	0.5mm²	0.5mm²
500 m	0.75mm²	0.75mm²	1.0mm²

9.2.4.3.4 Specifications imc STUDIO

- Baud rate up to 1Mbit/s; 8Mbit/s with CAN FD.
- Multiple independent CAN nodes (ports)
- A maximum of 512 channels including analog, virtual and CAN channels
- Aggregate sampling rate on CAN channels: typically up to 15000 samples/s, depends heavily on data types, no. of channels and processing. Analog aggregate sampling rate is not affected. CAN channel triggers are computed together with analog channel triggers on the unit's motherboard. This can affect the max. aggregate sampling rate on CAN channels!

9.2.4.3.5 What one needs to know to connect a CAN-Sensor

All CAN-Bus sensors transmit messages on the CAN-Bus using a specific data structure. In order for the messages to be understood, a consistent structure must be used. The following parameters (values serve as an example) must be contained in a parameter:

What is supported?

Baud rate: 500kbit/s

ID: 455

Length: 5 bytes

Repeat rate: every 10ms

The contents of the various messages are usually listed in a table. Consider the following typical CAN application:

Signal Name	Byte	Bit	Value Range	Conversion
Speed	1	0..7	0...255	50*value
Status	2	4	0-1	---
Compressor ON	2	5	0-1	--
Clutch moment specification	3	0..7	-128..127	*20, in N×m
Braking moment	4	0..7	0..255	*0.39
ABS Indicator	5	0	0..1	--

Note

- Bytes are numbered from 0 to 7 in the imc STUDIO software. Byte 0 is the first byte and Byte 7 is the last byte in an 8-byte message. Bit 0 of each byte is the LSB and Bit 7 is the MSB. Some tables (such as the one above) may differ slightly, in that the bits and bytes are indexed from 1 to 8. In these cases, you need to subtract 1 from these values.
- Observe the general Field bus notes regarding the operation methodology 476 of fixed sampling rates 477 versus timestamp 480.

9.2.4.3.6 Supported CAN protocols

What is supported?

- Only layers 1 and 2 of the layer model
- channels which can be identified uniquely from a single identifier and contain exactly one sample per identifier
- sensors which must be commanded via the CAN-Bus to transmit or measure
- device receives data
- device sends data
- data structure as follows:

  Identifier indicates which byte contains channel data and the format of the data. Analog sensor data and binary signals (only 0 or 1) can be read.

Example

The following table illustrates a type of application which is supported:

Signal Name	Byte	Bit	Value Range	Conversion
Speed	1	0..7 unsigned	0...255	50*value
Status	2	4	0-1	---
Compressor ON	2	5	0-1	--

What is not supported?

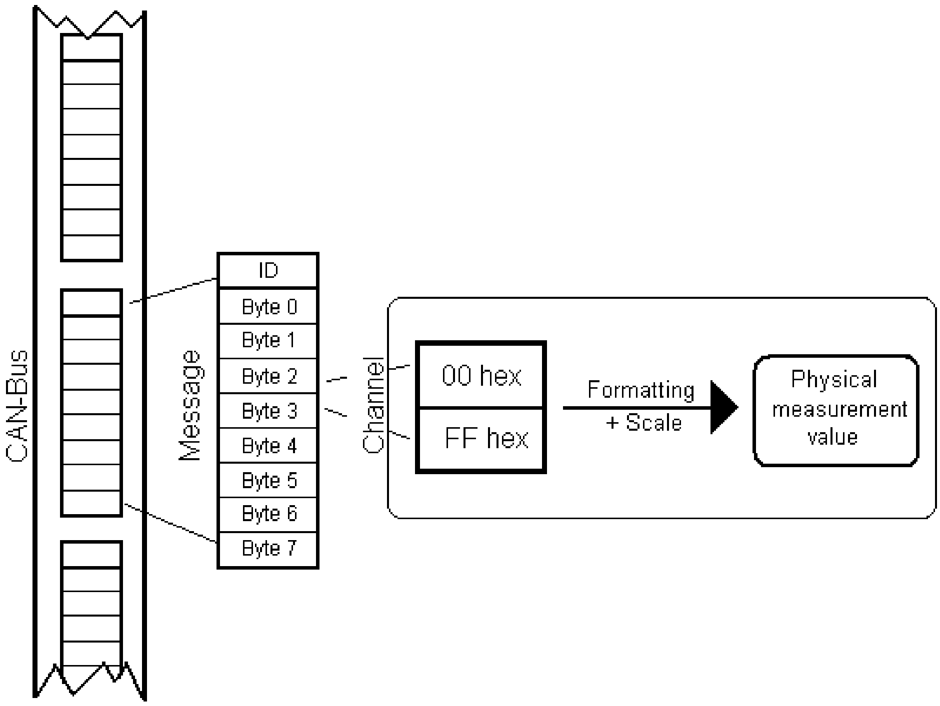
- terminal channels
- recording and analysis of 100-byte error protocols
- control of other devices on the CAN-Bus by the measurement device
- consideration of complex conditions
- compensation for CAN-Bus delay
- multiple protocols
- higher protocols

All major imc STUDIO features available for CAN channels

- Online processing using imc Online FAMOS (incl. Transitional Recording)
- Analog data can be mixed with CAN data for processing
- Data storage on the device internal hard drive and/ or PC hard drive.
- Complete access to the units trigger machine
- The device can be operated as a stand-alone unit, i.e. without a connected PC.
- Binary signals from CAN-Bus possible

How are CAN-Bus channels created in devices?

Several sensors and devices can be connected to a CAN-Bus. Each of these transmits data with an identifier at a constant clock rate to the CAN-Bus. The identifier indicates the origin and meaning of the data. An 8-byte data packet is attached to each of these (64 Byte with CAN-FD).



Format

Individual bits or bytes can be read from a message

- These are usually specific measurement values or conditions
- Supported number formats include: 1 bit, 1-8 Byte, signed/ unsigned integers, real numbers, Intel or Motorola byte orders
- Integer values can be converted to physical quantities

Time stamp alternative

Time stamping enables you to protocol the exact transfer time of a CAN-Bus message

- This data can be saved and visualized
- Data can also be equidistantly resampled for digital filtering, computation of FFT's etc.

CAN error handling

Bus clients, individual client sensors or the bus line itself may be defective

- Complete configuration of error handling

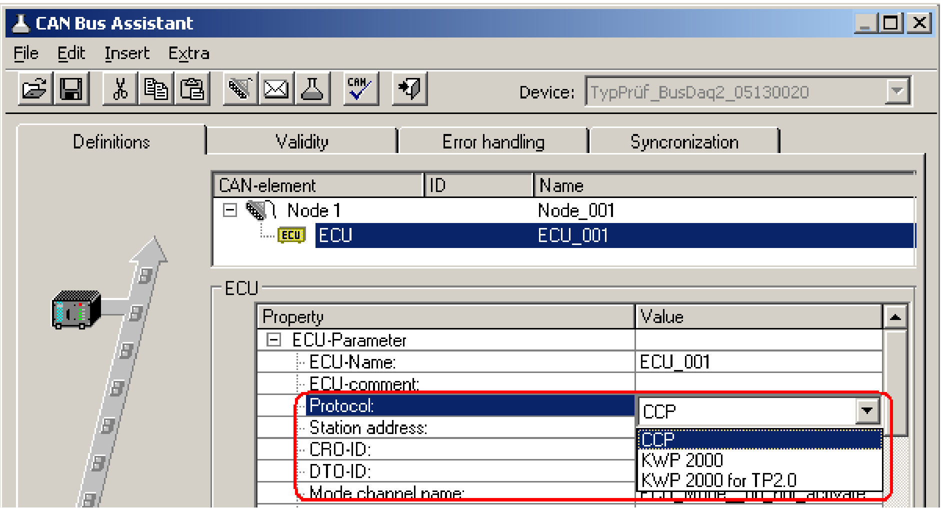
9.2.4.3.7 ECU Control unit protocols

The device software comes with functions for (motor-) control units (ECUs) and special control unit protocols. Using these, it is possible to query and record internal control unit values, and to start special control unit values.

Motor control units are connected via the CAN-Bus. The ability to query internal control unit values requires compliance with special protocols.

System requirements	
Hardware	• A device with CAN-module(CAN2) is necessary with the common device control functions and all desired protocols being enabled or • Devices as of group 4 165 and higher
Software	If the special imc Online FAMOS functions are used, then the device must be enabled for imc Online FAMOS.

The support ECU protocols can be found here 579.



Properties of ECU messages

To capture internal control unit values, it is necessary that the control units and the values (channels) to acquire be configured with the help of the CAN-Bus Assistant.

If the return values of the control unit commands are to be analyzed, or if special control unit functions are to be run, then it is necessary to use special functions in an imc Online FAMOS program with control commands.

For the description of the configuration see Control units in the CAN-Bus Assistant 579.

Basic functions

Keyword Protocol 2000 with ISO Transport Protocol (ISO 14230-3)		Keyword Protocol 2000 with VW TP 2.0 (ISO 14230-3)	
A subset of keyword protocol 2000 is used with addressing modes Normal and NormalFixed.			
10h	StartDiagnosticSession	10h	StartDiagnosticSession
13h	ReadDiagnosticTroubleCodes	13h	ReadDiagnosticTroubleCodes
14h	ClearDiagnosticInformation	14h	ClearDiagnosticInformation
17h	ReadStatusOfDiagnosticTroubleCodes	17h	ReadStatusOfDiagnosticTroubleCodes
18h	ReadDTCsByStatus	18h	ReadDTCsByStatus
20h	StopDiagnosticSession	20h	StopDiagnosticSession
21h	ReadDataByLocalIdentifier	21h	ReadDataByLocalIdentifier
22h	ReadDataByCommonIdentifier	22h	ReadDataByCommonIdentifier
23h	ReadDataByAddress	23h	ReadDataByAddress
27h	SecurityAccess	27h	SecurityAccess
2Eh	WriteDataByCommonIdentifier	2Eh	WriteDataByCommonIdentifier
31h	StartRoutineByLocalIdentifier	31h	StartRoutineByLocalIdentifier
33h	RequestRoutineResultsByLocalIdentifier	33h	RequestRoutineResultsByLocalIdentifier
38h	StartRoutineByAddress	38h	StartRoutineByAddress
3Ah	RequestRoutineResultsByAddress	3Ah	RequestRoutineResultsByAddress
3Bh	WriteDataByLocalIdentifier	3Bh	WriteDataByLocalIdentifier
3Dh	WriteDataByAddress (Maximal zwei Byte Daten)	3Dh	WriteDataByAddress (Maximal zwei Byte Daten)
3Eh	TesterPresent	3Eh	TesterPresent

CCP		XCP		Diagnostics on CAN (ISO 15765)	
01h	CONNECT	D3h	ALLOC_ODT_ENTRY	10h	StartDiagnosticSession
03h	DNLOAD	D4h	ALLOC_ODT	12h	ReadFreezeFrameData
02h	SET_MTA	D5h	ALLOC_DAQ	14h	ClearDiagnosticInformation
04h	UPLOAD	D6h	FREE_DAQ	17h	ReadStatusOfDiagnosticTroubleCodes
07h	DISCONNECT	E0h	SET_DAQ_LIST_MODE	21h	ReadDataByLocalIdentifier
0Fh	SHORT_UP	E1h	WRITE_DAQ	22h	ReadDataByIdentifier
12h	GET_SEED	E2h	SET_DAQ_PTR	23h	ReadMemoryByAddress
13h	UNLOCK	E3h	CLEAR_DAQ_LIST	27h	SecurityAccess
14h	GET_DAQ_SIZE	F0h	DNLOAD	2Ch	DynamicallyDefineLocalIdentifier
15h	SET_DAQ_PTR	F4h	SHORT_UPLOAD	31h	StartRoutineByLocalIdentifier
16h	WRITE_DAQ	F5h	UPLOAD	3Bh	WriteDataByLocalIdentifier
		F6h	SET_MTA	3Eh	TesterPresent
		F7h	UNLOCK		
		F8h	GET_SEED		
		FEh	DISCONNECT		
		FFh	CONNECT		

Standards

Keyword Protocol 2000 with ISO transport protocol

- Keyword protocol 2000: ISO 14230-3
- ISO transport protocol: ISO 15762-2

Options and add-on's

The different protocols are optional.

9.2.4.4 CAN channel data formats

The following data formats are available for recording CAN channels:

CAN-Bus Format	Recording with sampling	Recording with time stamping
Unsigned/ signed integer: 1 to 16 bit	2 byte integer	2 byte integer + 6 byte time stamp
Unsigned/ signed integer: 17 to 32 bit	4 byte real	4 byte real + 6 byte time stamp
Real 4, 8 byte	4 byte real	4 byte real + 6 byte time stamp
Digital port with 1 to 16 bit tracks	2 byte word for compact 16 bits	2 byte word for compact 16 bit + 6 byte time stamp

As you can see, each format has different memory requirements. This is important to know when you are estimating how much memory you will need and how precise the measurement values will be.

Example

A CAN sensor is sending messages consisting of 8-bit numbers. These are to be directly interpreted as the measurement values and equidistantly sampled (i.e. without time stamping). Therefore, a 2 byte integer is stored for each value.

9.2.4.5 Sensor initialization

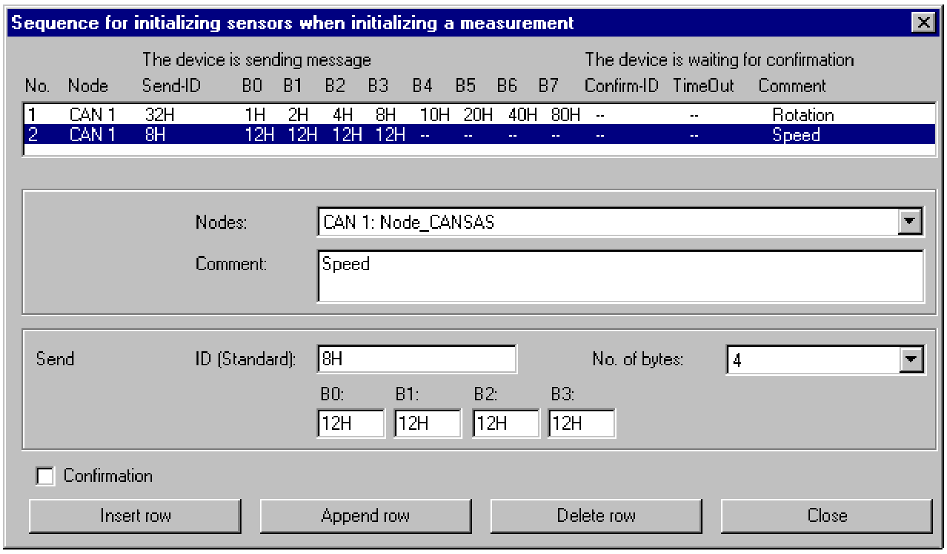
Many CAN sensors need to be initialized after being turned on. The initialization usually consists of one or more messages.

The device can send a defined set of messages to the CAN-Bus. The initialization sequence is performed only once at the very beginning of a measurement once the configuration is complete. Restarting a measurement (i.e. stopping it and starting it again) does not usually re-initialize the sensors. An exception to this is when the configuration is changed and the measurement is reinitialized.

The same applies to Autostart measurements. The initialization consists of a sequence of messages. If hand-shaking (i.e. confirmation from the sensor) is required, time-outs can be used. Many sensors perform hand-shaking by sending a return message. The unit waits for the sensor's response before sending the next message.

Initialization dialog

The initialization sequence can be defined using the *Edit > Sensor-initialization*:



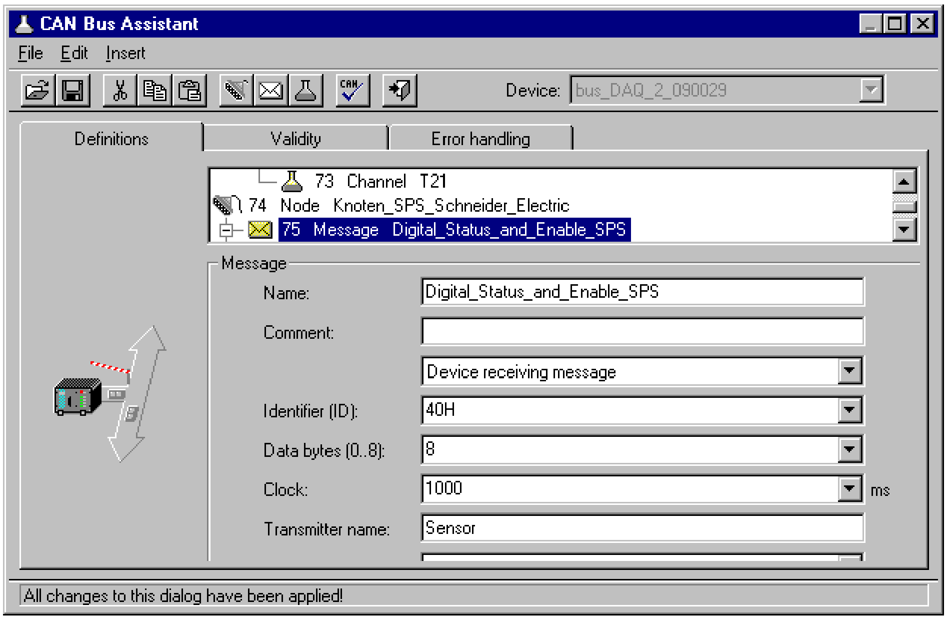
Sensor initialization

For initialization, messages are sent to the sensors. It is possible to specify confirmation of receipt of the messages. The list in the dialog shows the entire initialization sequence.

Parameter	Description
Nodes	Specify which of the nodes (ports) to use.
Comment	Additional description of the initialization sequence or other information - maximum 200 characters.
ID (Send)	An identifier for the message with the initialization sequence. Allowed values are from 0 to 2031 or 0H .. 7efH for Standard-format, for Extended-format 0 .. 536870911 or 0H .. 1fffffffH. The ID is always displayed in hex format but you can enter it as a hexadecimal or decimal number. Numbers entered in Hex-format must be designated as such by using H or h (e.g. 2ah).
No. of bytes (Send)	The number of bytes to use for the message - allowed are 0 to 8 bytes.
Byte 0 to Byte 7 (Send)	The contents of the individual bytes in the initialization sequence. The allowed value range is 0 - 255 (decimal) or 0H - ffH (hexadecimal). The values are always displayed in hex format but you can enter them as a hexadecimal or decimal numbers. Numbers entered in Hex-format must be designated as such by using H or h (e.g. 2ah).
ID (Confirmation)	The identifier for the confirmation (hand-shaking) message which the sensor returns to the device to indicate that the initialization sequence has been carried out. The unit waits for this message before continuing with the next initialization sequence in the list.
Time-out (Confirmation)	The device waits for the confirmation message until the time-out limit has been reached. If the confirmation message is not received, the next initialization sequence in the list is performed. The sensor is then not initialized. The allowable values range is 1ms to 1000ms.

9.2.4.6 CAN-Bus Assistant

The CAN-Bus Assistant provides you for defining nodes, messages and channels. . Start the Assistant by using the Ribbon *Home* (or *Setup-Configuration*) > *CAN*.



CAN-Bus Assistant

Together, the CAN nodes, messages and channels form a CAN configuration. These can be saved for re-use as ASCII configuration files (*.CBA). We recommend creating a separate folder for these files. Each line in a CBA file consists of a code word and a corresponding value. If necessary, some the values can be edited directly using a text editor like the Windows Notepad. In general, we do not recommend changing information concerning the bitmaps - these properties should only be edited using the CAN-Bus Assistant.

The CAN-Bus Assistant does not contain an *OK* button for confirming changes. Instead, all changes are applied directly. Invalid values are shown in red in the status bar. You can also perform a Configuration Check 566 .

Note

It is possible, however, to exit the Assistant without correcting the changes - however, no CAN channels will be created! Therefore, if you wish to create CAN channels, the configuration must be correct before you exit the Assistant.

9.2.4.6.1 Quick Tutorial

The Quick Tutorial shows you how to create a simple CAN-Bus configuration for a single CAN channel. After completing the tutorial, you should be able to create more complex configurations as well.

Step 1: Start the CAN Assistant

Select the Ribbon "*Home*" (or "*Setup-Configuration*") > "*CAN*" to start the Assistant. A single node is visible the first time you start.

Step 2: Define a node

Change the node name to a more suitable name for your project. Specify the baud rate from the drop-down list. Select a format for the node (Standard or Extended format).

Step 3: Create a message

Next, you need to define a message. Select the node and click on the message icon. A message object is added below the node.

Step 4: Configure the message

Change the message name to suit your project. Assign an ID to the message (between 0 and 2031 for Standard format, between 0 and 536870911 for Extended format).

Step 5: Create a channel

Next, you need to define a channel. Select the message and click on the channel icon. A channel object is added below the node.

Step 6: Configure the channel

Change the channel name to suit your project and specify the numerical format of the channel from the drop-down list.

Step 7: Check configuration

Perform a configuration check by clicking on the checkmark button. The results of the check are displayed in the status bar.

Step 8: Quit the Assistant

Once you have exited the CAN-Bus Assistant, you can now use the CAN configuration when measuring via the CAN interface. The CAN-channel you defined now appears in the software interface.

9.2.4.6.2 Editing a CAN configuration

The properties of various CAN objects are arranged in drop-down lists and text boxes. By selecting several objects in the list, you can change their properties all at once. This is only possible, of course, when objects of the same type have been selected. Right-clicking in the list opens a context menu where you can select all objects of a certain type (e.g. nodes, messages or channels).

Note

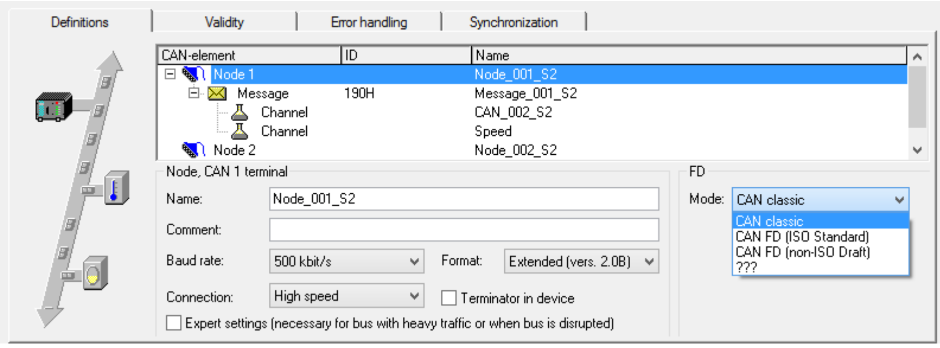
Any changes you make to the properties are applied immediately. Even incorrect settings (e.g. channel names) are applied. Any errors are shown in the status bar at the bottom of the list.

It is not necessary to click on an <*OK*> button to apply any changes or new settings - however, there is no <*Cancel*> button to undo any unwanted changes!

In general, we recommend defining the properties for new objects one-by-one. It is also possible to change settings for several like objects simultaneously, but properties which must be unique (e.g. channel name) will be grayed out.

9.2.4.6.3 Nodes

9.2.4.6.3.1 Definition



Definition nodes

FD-Mode:

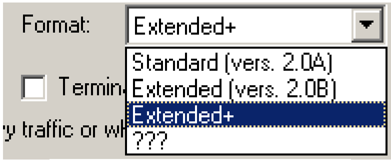
If the device is equipped with a CAN FD interface, the entry for FD appears on the *Definitions* card. Here is where the transfer protocol is defined:

Mode	Description
CAN classic	CAN High Speed in accordance with ISO 11898, CAN Low Speed in accordance with ISO 11519. The symbol for the node is shaded grey-blue.
CAN FD (ISO Standard)	in accordance with ISO 11898-1:2015 The symbol for the node is shaded red-blue.
CAN FD (non-ISO Draft)	according to an earlier draft from BOSCH. The symbol for the node is shaded red-blue.

Note

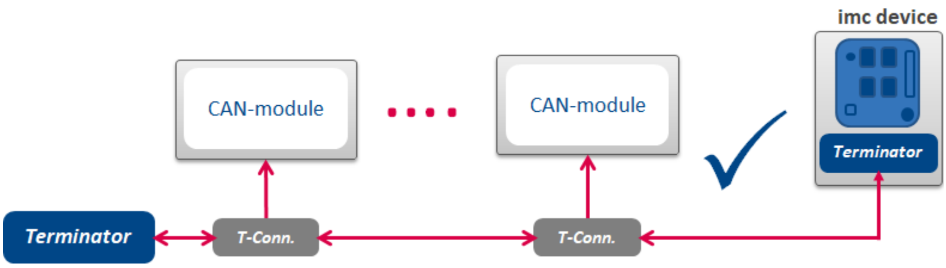
Mixed operation with both classical CAN-modules and CAN-FD are covered in the ISO standard 11898-1:2015, if the CAN-controllers involved support it. Mixed operation with modules which work with "old" controllers, however, is not possible. When receiving CAN-FD messages, these modules would generate error frames.

Parameter	Description
Name	A unique name for each node with up to 65 characters. The default name for a new node is "Node_" + index (e.g. 001). If several devices are being used, a _j is appended to the name, where j is the device index number. All names must be comply with imc FAMOS variable syntax, just as all other device channel names.
Comment	This text accompanies the node name and is usually intended to add a more detailed description of the node. The maximum length of this field is 255 characters.
Baud rate	The baud rate specifies how fast the bits are transferred over the serial bus. All modules in a given CAN-Bus must use the same baud rate! Select the baud rate from the drop-down list: 5kbit/s to 10Mbit/s. The default value is 125kbit/s.
Data rate (with CAN FD)	If CAN FD is set for the FD-mode, the entry for the data rate is shown. If the bus exclusively has subscribers whose controllers support CAN-FD, it is possible to transfer different settings for the Baud rate and data rate. While transferring at the higher data rate, the subscribers using the slower Baud rate rate are then switched to passive.

Parameter	Description
Format	 **Format: Standard or Extended** "*Standard*", "*Extended*" or "*Extended+*". The difference between Standard and Extended is that the Standard-format ID length is 11 bits (IDs from 0 .. 2031 are permitted) and in Extended-format 29 bits (IDs from 0 .. 536870911 are permitted). Extended-format allows for greater distances between consecutive IDs. This makes it possible to extend the system without major changes to the configuration. The "*Extended+*" format is able to receive "*Standard* " and "*Extended*" identifier. For sending the message then select in the Assistant 550 either "*Device sending message*" for a 29-bit identifier or "*Device sending message in Standard-format*" for 11 bits.
Connection	This parameter determines which node is assigned to which port. Node 1 is generally assigned to CAN 1 and Node 2 to CAN 2, no other nodes are assigned to any port and must be deleted from the CAN-configuration in order for it to be consistent.

Terminator in device

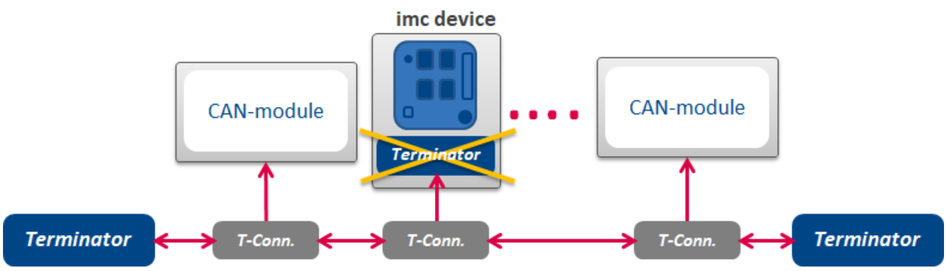
Devices equipped with CAN-bus interface CAN2, can switch a terminator resistor internal via software. If the device is connected at one end of the CAN line, an external Y-cable with terminator is not needed.



Correct termination

Warning

If the CAN-bus is already terminated correctly, that option cannot be used!



Wrong termination

Expert settings

CAN-protocol (classic)

This option is only needed for very rare cases. If there are disturbances on the bus, you can make adjustments for each node here.

Parameter	Description
Slope detection (soft synchronization), width of the time window	All subscribers to the bus have the same basic clock rate. However each module comes with its own quartz. Thus, phase differences can arise. The first edge of a message is used to get all subscribers in phase (hardware synchronization). Edges within a message can be used to compensate subsequently arising phase differences within a message. The width The width of the time window determines by what value a bit is shortened or lengthened in order to re-align the phase. Using this option it's possible to alter the time window in which the edges are expected.
Number of samples per bit	If the bus has achieved a steady state, the level is read by the receiver by means of sampling, and the bit is determined to be either 1 or 0. If there is disturbance on the bus, it's possible that the disturbance will be picked up in a sample. This option helps by increasing the number of samples to three. If the samples show different levels, the majority is taken as the bus level.
Sample location in bit time	Here, the position within the bit time can be altered. By default, it is set to 50%. With long leads, an impulse reaches its level only after a certain delay. With this option, the sampling time can be shifted backward in order to compensate for the delay. The setting is expressed in percent of the total time.

Note

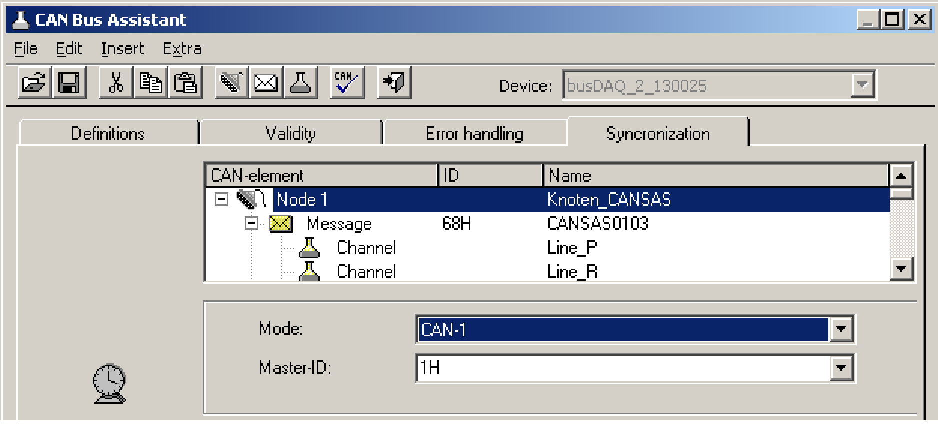
- In most cases, disturbance on the bus can be compensated by shifting the ***position of the sampling time*** backwards.
- Disturbance is usually the result of long cables. The low-pass effect of such long lines prevents voltage levels from changing rapidly. In extreme cases, this can mean that the correct level at the center of the bit time (50%) has not been reliably reached.

CAN-FD

For transfer at the CAN-FD data rate, deviating settings can be made. Only the number of samples per bit is omitted here.

9.2.4.6.3.2 Synchronization

For the purpose of synchronizing any CAN-modules connected, such as imc CANSAS, the measurement system is capable of sending a message in CAN-1 protocol. In such a case, your measurement system functions as the Master. If the imc CANSAS module is configured accordingly, it synchronizes itself to this message.



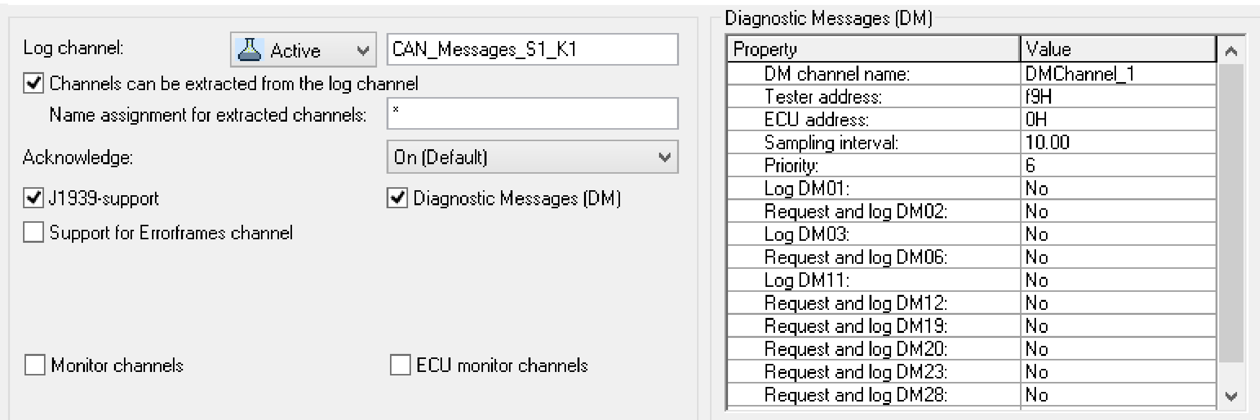
Synchronization of a node

The **CAN-1 Protocol** message is sent at a one-second clock rate by the device working as the Master. imc CANSAS modules working as Slaves receive this CAN message and synchronize themselves to it. The message used takes a format corresponding to the CAN-1 protocol. Other imc CANSAS modules, as well, can work as the CAN-1 Master. It is recommended that the device capturing the measured data works as the CAN-1 Master.

Conditions

- All devices (in other words the Master and all Slaves) are connected to the same CAN-Bus line.
- No gateway or router may be connected between devices. In the CAN-1 protocol, special consideration is given to achieve very high precision.
- For imc BUSDAQ (group 4 165): The imc measurement device may not be operated in Sleep/Resume mode.

9.2.4.6.3.3 Validity



Validity of a node

Log channel

Parameter	Description
Log channel	With Log channel "*Active*", all messages belonging to the node are logged in imc STUDIO. In the input field you can enter the name of the protocol channel. By default, a name with slot and node number is generated. There is exactly one protocol channel per node. Message IDs and data bytes are logged. You can filter a selection of messages by creating receiving messages 551 with specific IDs whose "*Message log*" is set to "*Log CAN bus message*". In this case, only these messages are logged.
Extract all channels from log channel	The option allows the data stream to be unpacked as individual channels in imc STUDIO by the Bus Decoder 549 or via imc FAMOS. For reasons of data security, this option is deactivated by default. In consequence, sensitive information will not be inadvertently incorporated into the log channel's file of measured data. **Beware of the following:** Extraction of individual channel signals from the data stream by means of the Bus Decoder or via imc FAMOS is only possible if the box is check marked. In this case, the option must be explicitly activated.

A global channel for logging CAN-messages is also available in ASCII-time stamp data format. By default, imc STUDIO creates this global channel with the name CAN_Messages_S(i)_N(j), i: slot index (1..8), j: node index (1,2). If you have set messages of different slots and nodes to be logged, a corresponding number of global channels will be created.

Under "*Table*" menu item of the curve window context menu (accessed by right mouse-click), it is possible to set the text format to "*imc DEVICES CAN-message*". At the left of the row in the table, the message ID is stated, to the right of it the message data bytes. The values are displayed in hexadecimal format.

Message log channel can be saved as MDF files to the device disk. See also chapter "Storage Options 714".

Acknowledge

Disables the transmission of Acknowledge messages. The CAN controller usually sends this packages to confirm successful received messages.

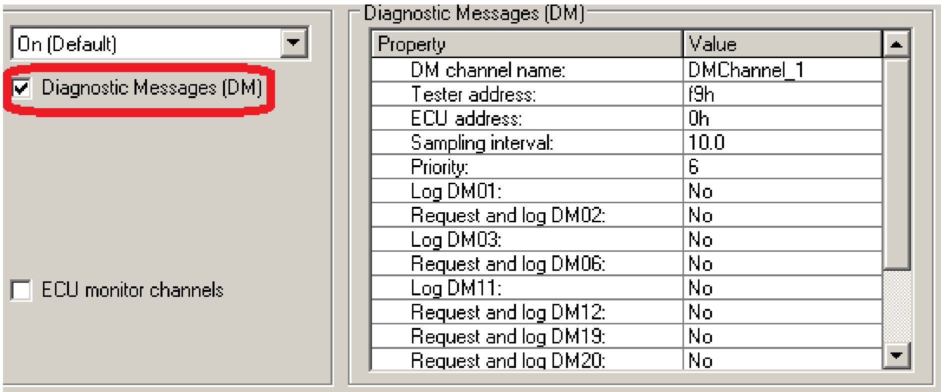
J1939-support

Activated the J1939-support, see also Messages: Validity 554

Note

This option is only available, if the identifier is set to *Extended Format 2.0B* or *Extended+.*

Also, DM-services for J1939 can be set:



Diagnostic Messages (DM)

The error codes are captured with imc STUDIO as Time Stamp ASCII channels. To display the channel in the curve window, select the item "*Table*" in the menu *Configuration\Display*. There, set the *Text Format*: *Hex*.

The error code format is structured as follows:

Byte	Description
Byte: 1: Format specifier	A log entry's first byte is specifies the format • **ach** = ASCII (VIN) • **d1h** = DM1 messages and others with the same structure (DM1, DM2, DM6, DM12, DM23, DM28) • **d0h** = record of a "Clear" command (DM3, DM11) • **d2h** = binary (DM19, DM20) • **dfh** = for errors (currently not used)
Byte: 2: for format specifiers **d1h**, **d2h** and **d0h**	DM-number, pattern: DM# with # equaling 1, 2, 6, ... • 1 = DM1 • 2 = DM2 • 6 = DM6 • ...
Byte: 3: for format specifiers **d1h**, **d2h** and **d0h**	Source
Byte: 4: for format specifier **d0h**	Target
Byte: 4 and subsequent: for format specifiers **d1h** and **d2h**	according to J1939

Example of DM1 and similar:

Byte	Bit	Description
Byte: 1	bits 8-7	Malfunction Indicator Lamp Status
	bits 6-5	Red Stop Lamp Status
	bits 4-3	Amber Warning Lamp Status
	bits 2-1	Protect Lamp Status
Byte: 2	bits 8-7	Flash Malfunction Indicator Lamp
	bits 6-5	Flash Red Stop Lamp
	bits 4-3	Flash Amber Warning Lamp
	bits 2-1	Flash Protect Lamp
Byte: 3	bits 8-1	SPN, 8 least significant bits of SPN (most significant at bit 8)
Byte: 4	bits 8-1	SPN, second byte of SPN (most significant at bit 8)
Byte: 5	bits 8-6	SPN, 3 most significant bits (most significant at bit 8)
	bits 5-1	FMI (most significant at bit 5)
Byte: 6	bit 8	SPN Conversion Method
	bits 7-1	Occurrence Count

Note

When the occurrence count is not available it should be set to all ones which is a value of 127.

Example

The following illustrates the message format for when there is more than one diagnostic trouble code.

Given:

- a=lamp status
- b=SPN
- c=FMI
- d=CM and OC

Message form will be as follows: a,b,c,d,b,c,d,b,c,d,b,c,d....etc.

With format specifier ach = ASCII

Byte	Description
Byte: 2	Higher-value byte of PGN
Byte: 3	Lower-value byte of PGN
Byte: 4	Source
Folgende Bytes	contents according to J1939 standard (ASCII string)

Abbreviations

CM	SPN Conversion Method	
DM1	Diagnostic Message 1	Active Diagnostic Trouble Codes
DM2	Diagnostic Message 2	Previously Active Diagnostic Trouble Codes
DM3	Diagnostic Message 3	Diagnostic Data Clear/Reset for Previously Active DTCs
DM6	Diagnostic Message 6	Emission Related Pending DTCs
DM11	Diagnostic Message 11	Diagnostic Data Clear/Reset for Active DTCs
DM12	Diagnostic Message 12	Emissions Related Active DTCs
DM19	Diagnostic Message 19	Calibration Information
DM20	Diagnostic Message 20	Monitor Performance Ratio
DM23	Diagnostic Message 23	Previously Active Emission Related Faults
DM28	Diagnostic Message 28	Permanent DTCs
FMI	Failure Mode Indicator	
MI	Malfunction Indicator	
MIL	Malfunction Indicator Lamp	
OC	Occurrence Count	
PG	Parameter Group	
PGN	Parameter Group Number	
PID	Parameter Identifier (SAE J1587 or SAE J1979)	
SPN	Suspect Parameter Number	

Errorframes channel

With this option the CAN controller creates a new channel to record the number of error frames within a sample interval. A name can be defined by the edit field *Channel name.*

Wake On CAN

Prerequisites

This function is only available for the new **imc BUSDAQ**, group 4 165. The devices must be configured via the Remote connection in accordance with the description in the device manual.

Description

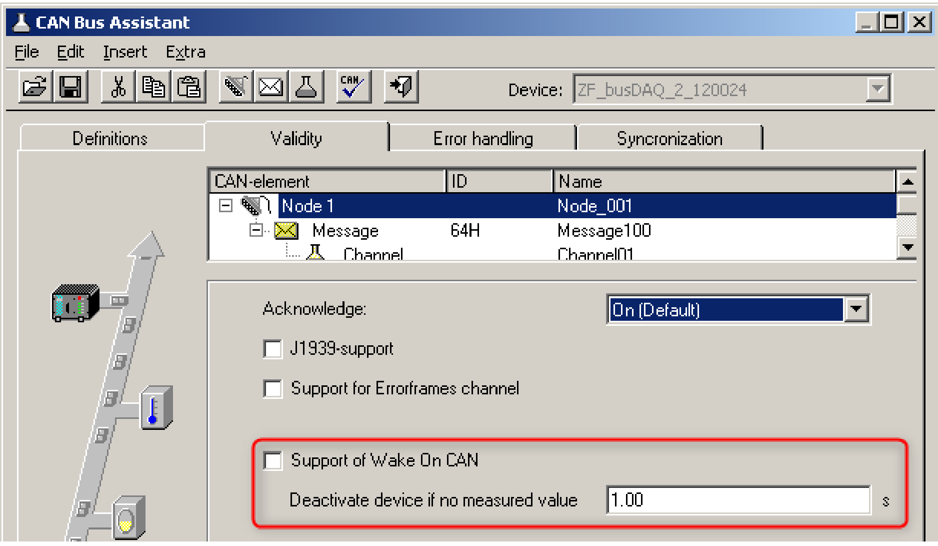
Wake On CAN enables the functionality of Sleep mode in dependence on the CAN-Bus activity. As soon as data arrive at the CAN-node, the device starts measurement. After a specifiable time without bus activity, the device returns to the Sleep mode.

Systems supply or activate the measurement device separately from the connected CAN-bus thus avoid premature startup of data capture and the resulting unnecessary power consumption.

Each node can be adjusted individually.

The prerequisite is the appropriate configuration of the Remote connection, described previously, which enables the hardware-driven Sleep mode.

- Without *Wake On CAN*, the Sleep mode is available without any additional preparation in the operating program.
- The *Wake On CAN* function is a supplemental AND condition and must be activated in CAN-Assistant.



Activation of Wake on CAN

Parameter	Description
Support of Wake On CAN:	The option *Support of Wake On CAN* appears on the page Validity if a node is selected in the CAN-element tree diagram. If it isn't shown, this indicates that your device's hardware isn't set up for this function.
Deactivate device if no measured value x s:	Enter the time interval whose elapse without the arrival of data activate the sleep mode. Intervals between 1ms and 14h (50400s) are possible.

Monitorchannels

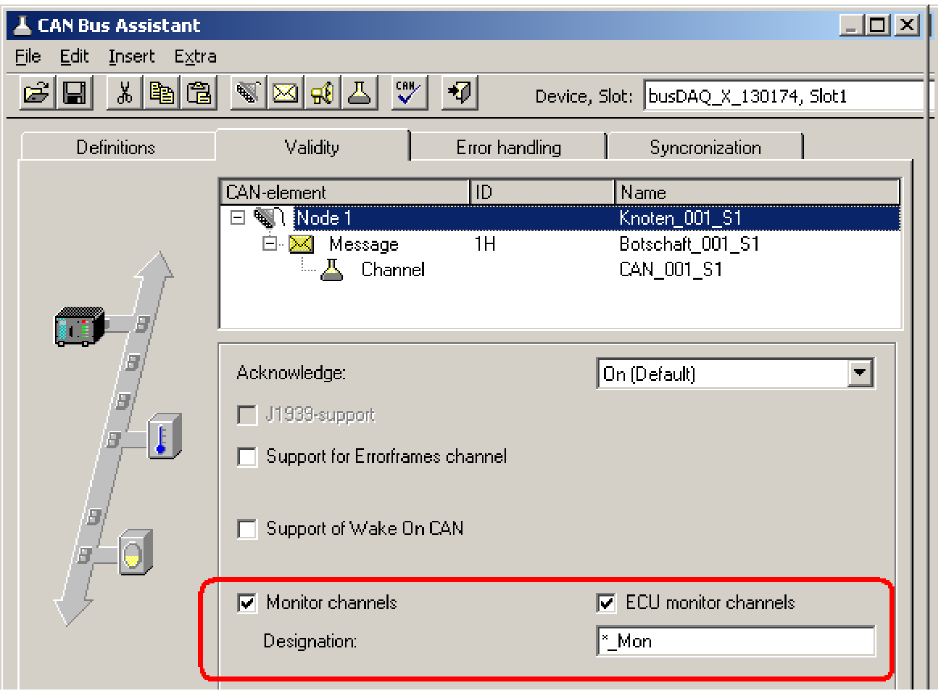
Triggered Field-bus channels are not visible prior to the trigger event. Therefore, for analog channels there are monitor channels which can be started independently of the original channel’s trigger.

Create monitor channels for all channels of a node:

It is possible to create a monitor channel for each CAN channel or ECU channel. To do this, activate the option *Monitor channels* or respectively *ECU monitor channels* on the node's *Validity* page.

Designation:

Monitor channels receive a name extension which can be freely defined in the box *Designation*.



Activate monitor channels for CAN- or ECU-channels

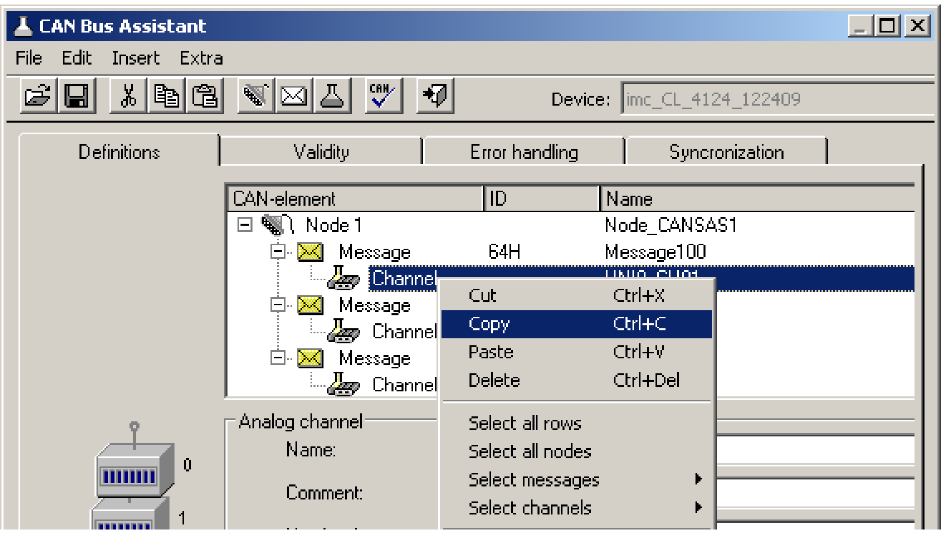
Note

Monitor channels are created for all of a node's CAN- or ECU-channels.

Create monitor channels for <u>single</u> channels:

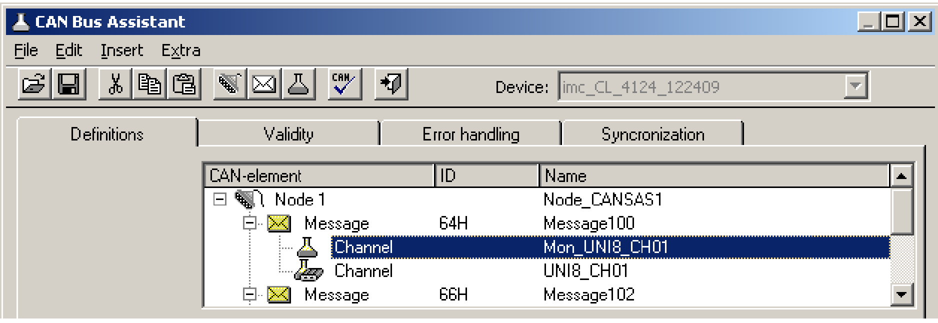
Use the Assistant to create within a channel's message an additional channel having a different name and the exact same settings. This channel can then be captured without triggering.

Copy:



Create individual field-bus monitor channels: copy

and Paste:



Create individual field-bus monitor channels: paste

Note

Monitor channels, created by modules that are synchronized by CAN-1, may not be sampled with a lower sampling rate.

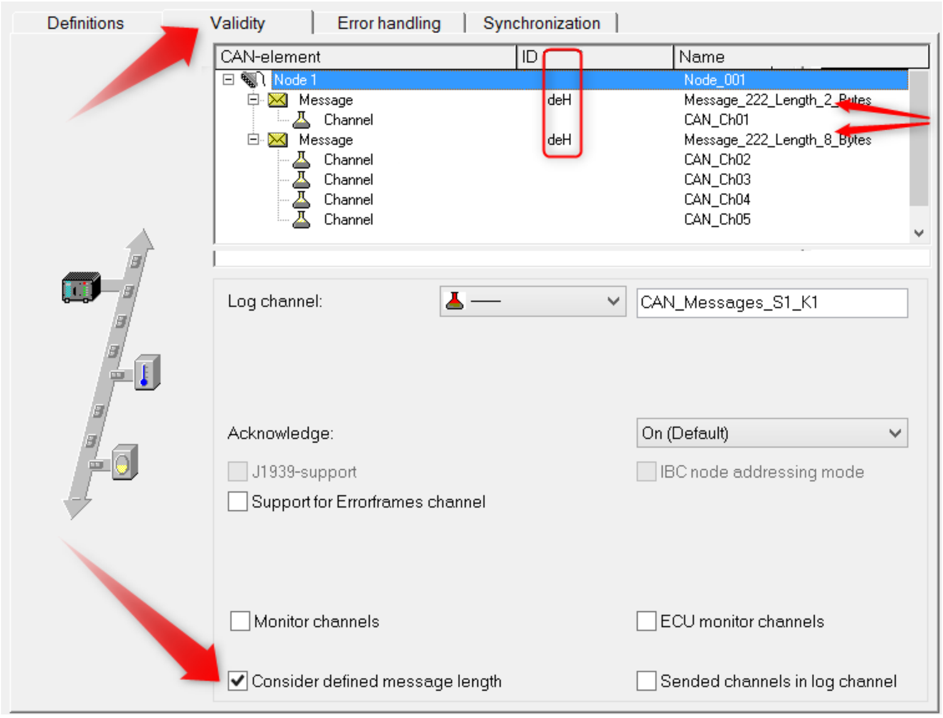
Consider defined message length

Per default, the length of a message defined in the CAN Assistant is not strictly observed and is only checked in some situations. Messages of an ID can only be created once per node, otherwise the syntax check of the CAN Assistant reports an error.

If option "*Consider defined message length*" is activated for a node, the message length transmitted on the bus is compared against the length defined in the CAN Assistant. If different, no channels are extracted from this message. However, the message protocol (protocol channel, CAN bus dump, log file) also records messages with differing lengths.

This option now allows a **message** with **a certain ID** to be assigned to a node **several times with different lengths**. The same ID with the same length is not allowed more than once.

Example:



Consider defined message length

Sended channels in log channel

Transmitted CAN channel data do appear in the log channel and therefore they can be extracted from the log channel and by using `OnCanMessageReceive` in imc Online FAMOS. With this option transmit channels can be extracted from the data stream.

Sended channels in log channel

9.2.4.6.3.4 Blob - Decoding with the Bus Decoder

All data associated with a CAN-node can be captured completely as a log channel. This is a way around the limitation of 512 channels per device instance. Along with separation into individual channel with imc FAMOS, this can be accomplished already with imc STUDIO's Bus Decoder 1683.

To do this, you make the following settings in the CAN-Assistant:

- A log channel which logs all messages 541.
  - On the node's page "*Validity* 541", the option "*Channels can be extracted from the log channel*" must be activated.
- The CAN-channels to be extracted in the Bus Decoder from the log channel must be set to "*Has not been set up in the device, in imc STUDIO, extractable from log channel*" on the "*Validity* 561" page (light blue highlighting).
  To select all channels, use the menu item "*Edit*" > "*Select channels*" > "*Select all receiving channels*".

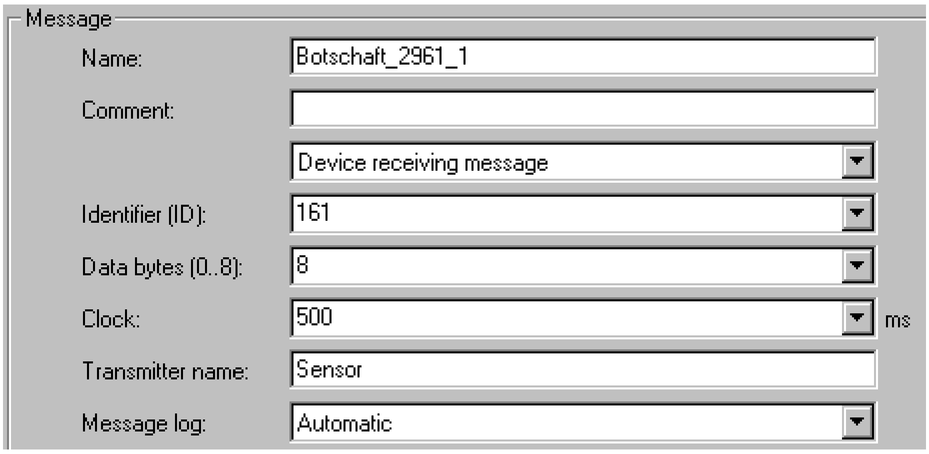
If the log channel is then extracted in the imc STUDIO, then all CAN-channels thus highlighted appear int he Bus Decoder.

If the log channel is extracted in imc FAMOS, then **all** CAN-channels appear in imc FAMOS (not only those specially highlighted).

9.2.4.6.4 Message

9.2.4.6.4.1 Definition

Receiving a message

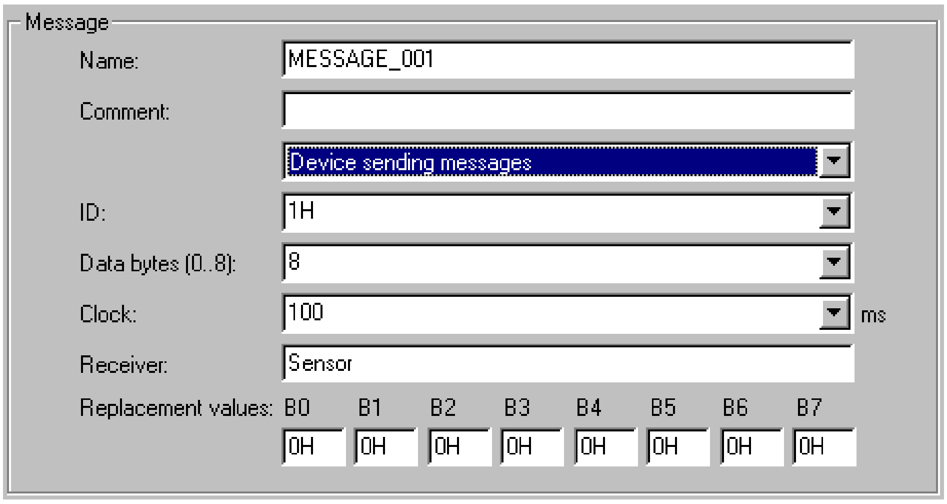


Receiving a message

Parameter	Description
Name	A unique name for each message with up to 65 characters. The default name for a new message is Message_" + index (e.g. 001). If several devices are being used, a _j is appended to the name, where j is the device index number. All names must be comply with imc FAMOS variable syntax, just as all other device channel names.
Comment	This text accompanies the message name and is usually intended for adding a more detailed description of the message. The maximum length of this field is 255 characters.
Device receiving / sending messages	A message can only be reset from sending to receiving or vice versa if there is **no channel** contained in the message. This can be converted via the menu item "*Edit*" > "*Transform message* 566". Depending on whether the *node is set with the format Extended+* 538, there can be an entry "*Device sending message in Standard-format*", which makes it possible to send messages in the **Extended+** format with an 11-bit identifier. In this case, if the setting "*Device sending message*" is selected, the extended identifier having 29 bits is used.

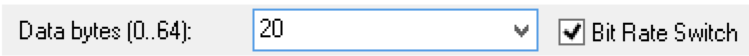
Parameter	Description
ID	Each message on the CAN-Bus contains an identifier (ID) which indicates the origin and meaning of the data. No two messages in a node can have the same ID. The identifier also indicates the priority of the message and, once again, no two messages can have the same priority. When two messages are to be sent at the same time, the message with the lower ID is sent first. Allowed values are: 0 to 2031 (Standard ID format) and 0 to 536870911 (Extended ID format). Identifiers can also be specified as a hexadecimals. Append an "h" or "H" to the hexadecimal, e.g. 2ACH or e4h. If set to *All messages*, information on all messages of the current node are logged. For this purpose, only channels having the format *Log channel* may be assigned to the message (see below for a description of how to make log channel settings). Alternatively, the "*Message log*" control can be set to "*Log CAN-Bus message*". Then all node messages will be logged along with their data types.
Data bytes	This is the number of bytes in the message, 0 to 8 bytes or 64 with CAN FD are allowed. It is not possible to send partial bytes in a message but it is also not necessary that every bit in the byte be occupied.
Clock	Messages are sent via the CAN-Bus at a regular rate. The value for the clock specified here is a set point, not necessarily the actual value. The clock is a property of the sensor. The allowed range is 0.001ms to 100,000ms. The sampling rate of the CAN channel to be created is determined by the clock value specified here.
Transmitter name	The transmitter name describes the transmitting sensor. This name is not used for any other purposes - therefore it need not be unique.
Message log	If you wish to **log all of a node's messages**, activate the log channel on the page with the tab "*Validity* 541". You don't have to do anything else. If you wish to **log individual messages**, again, activate the protocol channel in the "*Validity* 541" tab first. Then create an additional receiving message and select "*Log CAN bus message*" under *Message log*. Select the desired message using the identifier. **Note**: The setting *"Identifier (ID)"* on "*All Messages*" originates from the previous setting method and leads to an error message with the current version. Instead, activate the protocol channel in the Validity tab 541 of the node and remove all protocol messages with specific IDs if necessary. If you set the message-ID to All messages, you obtain a log channel like on the page with the tab "*Validity* 541".

Sending messages



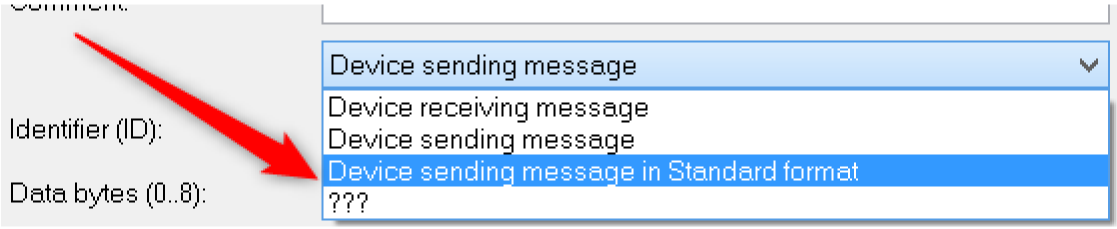
Sending a message

The CAN-Assistant is used to create a formal framework of messages and channels. The message can be set by imc Online FAMOS or with process vector variables (with CAN2 only), see below.

Parameter	Description
Name, Comment, ID, Bytes	As for messages to be received. **Data bytes for CAN FD**: Messages can be sent at the data rate set for FD 537. For this purpose, the option ***Bit Rate Switch*** must be activated, which appears at the CAN FD node. 
Receiving / sending messages	A message can only be reset from sending to receiving or vice versa if there is **no channel** contained in the message. This can be converted via the menu item *Edit\Transform message* 566.
Clock	Messages are sent via the CAN-Bus at a regular rate. The *Clock*-value is the interval between transmission of messages. The interval must be at least 1ms. The value set here serves in imc Online FAMOS as the default setting for the clock rate for cyclic transmission in the Formula-Assistant.
Receiver	The receiver name describes the receiving sensor. This name is not used for any other purposes - therefore it need not be unique.
Replacement values	When messages are transmitted with the help of imc Online FAMOS, the replacement values serve as data bytes if there are no current data or if certain message bytes are not filled. With CAN FD, from the 9th Byte onward, additional boxes for entering replacement values appear.

Note

If a node 538 is set to ***Extended*** or ***Extended+*** **format**, a message can be send as **extended** or as **standard**-format! By default, the message is then sent in **extended** format. To send a message on an **Extend(+)** node in **standard format**, select "*Device sending message in Standard format*".



Device sending messag in Standard format.

Send channels with imc Online FAMOS

The CAN-Assistant is used to create a formal framework of messages and channels. Using imc Online FAMOS, this framework is filled with data and transmitted. The channels or single values are transmitted in the format set in the CAN-Assistant. As for the reception of CAN-messages, channels are defined for each message with their data types, Start-bits, Start-Bytes, number of bits etc. imc Online FAMOS uses these data to generate a transmission function for each message. With the help of this function, for instance, a virtual channel in imc Online FAMOS is assigned to the channel defined here in the CAN-Assistant and in sent in the specified data format.

With imc Online FAMOS, it is also possible to send larger messages in conjunction with **CAN FD**.

CAN messages can be sent **asynchronously** or **synchronously** in imc Online FAMOS.

Asynchronous transmission is performed **without control commands** by the *SendMessage_Message_name* after a transmission message has been created in the CAN assistant. If **control commands** are **activated**, transmission takes place in the *OnTriggerMeasure* of the channel to be transmitted.

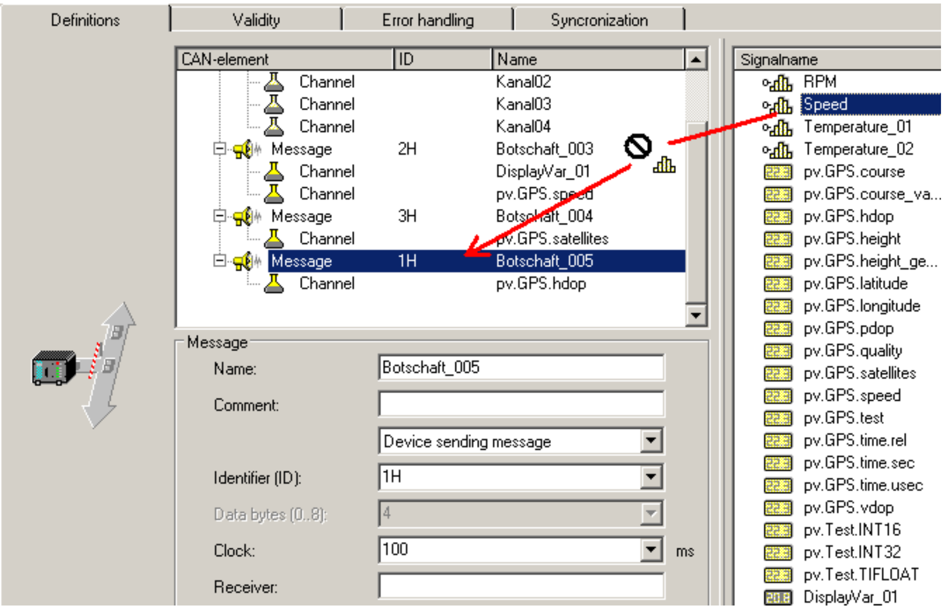
Sending is **synchronous** in a *SyncTask*. Due to the system, only **one** *SyncTask* can send CAN messages at a time. Sending in different synchronous tasks is not allowed.

For examples to send messages, see Sending CAN messages 572.

Send channels with process vector variables

Channels, process vector variables and display variables can be assigned out of the CAN-Assistant directly. If a message is set to send mode, a list with *Sending channel name comes up.* Via double click or drag&drop the channel is assigned to the send message. No further settings in imc Online FAMOS are necessary.

Prerequisite is the activation of imc Online FAMOS, even if the editor is not needed and a CAN interface from version 2.



Sending process vector variables via CAN

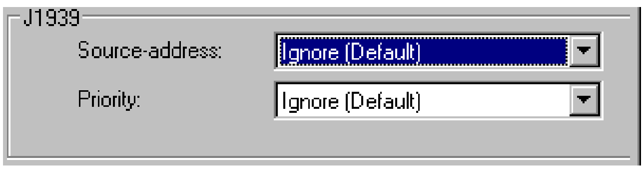
Note

- Only messages can be copied. Single send channels can not be copied.
- When sending messages, if there is no recipient (yet), an error message sometimes appears, indicating that CAN-messages have been lost.

9.2.4.6.4.2 Validity

J1939

For work with J1939, the setting ***J1939-support*** must be activated for the control *CAN-node* on the *Validity* page. In consequence, the settings options for *Messages* become visible on the *Validity* page:



J1939 settings at Message-Validity

Both the source address and the priority of messages can either be accounted for or ignored. With J1939, the source address and priority are ignored by default. The source address is in the bottom 8 bits of the extended identifier and the priority in the top 3 bits.

With *Ignore (Default)*, the corresponding bits are masked out.

In J1939, the extended message identifier is comprised as follows:

`ID_Extended = Source-Address + ProgramGroupNumber * 28 + Priority *` 2^{26}

For standard IDs, the following applies:

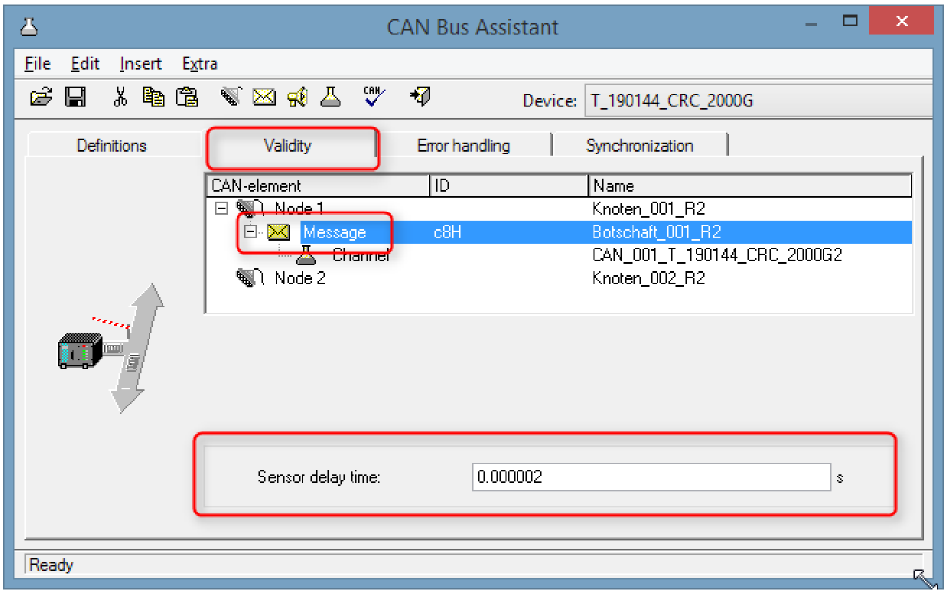
`ID_Standard = PGN-number + Priority *` 2^{8}

When importing from a DBC-file, J1939 messages could be greater then 8 Byte. Those messages can be received into several messages from imcDevices Version 2.7R2.

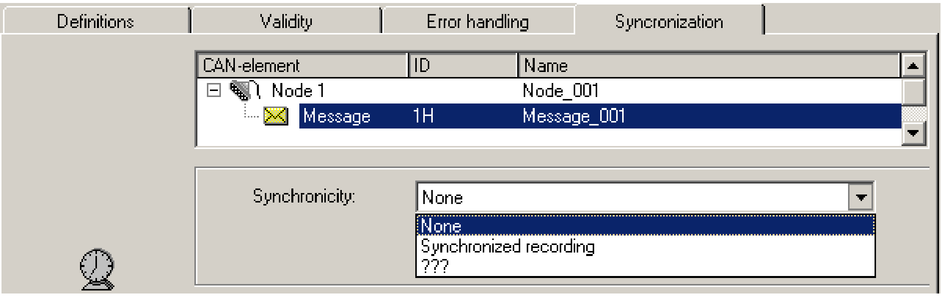
If the import does not return any explicit specification of priority and source address, they are extracted from the DBC file's message-ID. Together with the appropriate bits in the DBC file's message-ID, the message-ID is generated in the CAN-Assistant.

Sensor delay time

Here it is possible to take into account the sensor's delayed response upon reception of CAN-messages. Differences in transit times can be compensated.



9.2.4.6.4.3 Synchronization



Synchronization a message

Synchronization is activated at the node. At this node, other devices which do not understand the CAN-1 protocol can be used alongside imc CANSAS. It should be possible to record these devices' messages, even without monitoring of the synchronization. If synchronized recording is selected for such messages, error messages will be posted whenever the messages fail to arrive at the clock rate expected.

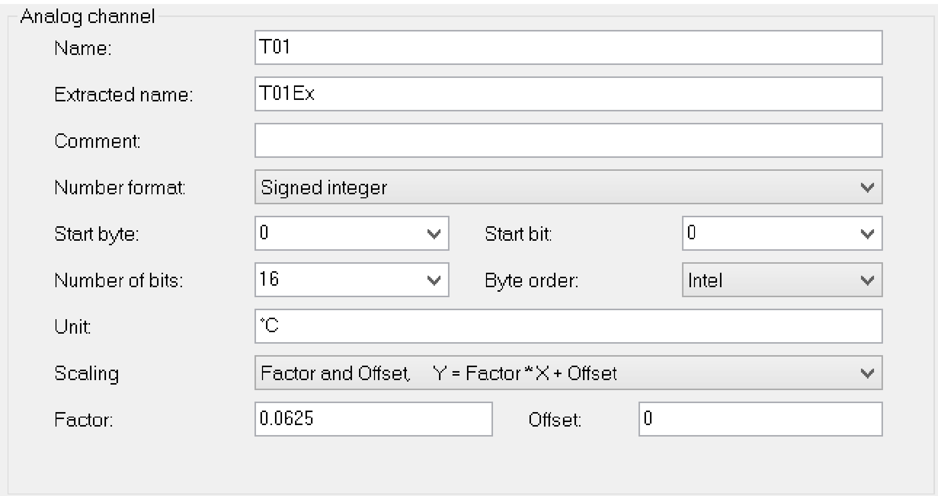
Since the integrated imc CANSAS software knows the scope of the imc CANSAS modules' functions, their messages are automatically pre-set appropriately. For example, if a imc CANSAS module is set as the CAN-1 Slave in the imc CANSAS software, its message is automatically set in the CAN-Assistant to "Synchronized recording".

9.2.4.6.5 Channel

9.2.4.6.5.1 Definition

Analog CAN channels

Analog signals are digitized by the CAN-sensors with a specific number of bits. The numerical format can be set to *signed integer, unsigned integer or real number, or digital (1 bit)*.



Definition of a analog channel

Parameter	Description
Name	See Message 550
Extracted name	Name for channel 561 for transmission channels extracted from the protocol channel 561. To avoid duplicate names in the send dialog 554.
Comment	See Message 550
Numerical format	Data can be sent and received as signed or unsigned integers, real numbers and in digital (1Bit) format. The option 16bits (see below) is only available for receiving mode.

Note **Information about the numerical format**

Some manufacturers may not indicate clearly in their CAN tables which number format they use.

For example, the table may indicate that Bytes 1 and 2 represent the guidance angle and that this value is to be multiplied with 0.0639 to arrive at the actual value in degrees. If no other information has been given, there is no definite way of determining the number format other than trial and error. The imc hotline cannot help you in such cases! Sometimes however, there are implicit clues as to what the format is.

Examples:

- If the range minimum is 0 and the maximum is ffff hex, then unsigned integers are being used because they always start at zero.
- If the range is given as 7fff = -700°C and 8000 hex = +700°C, then signed integers in two's complement form are being used. The zero (0 hex) lies directly in the middle between positive and negative integers.

The most certain method of determining the number format is to run the sensor through its entire range.

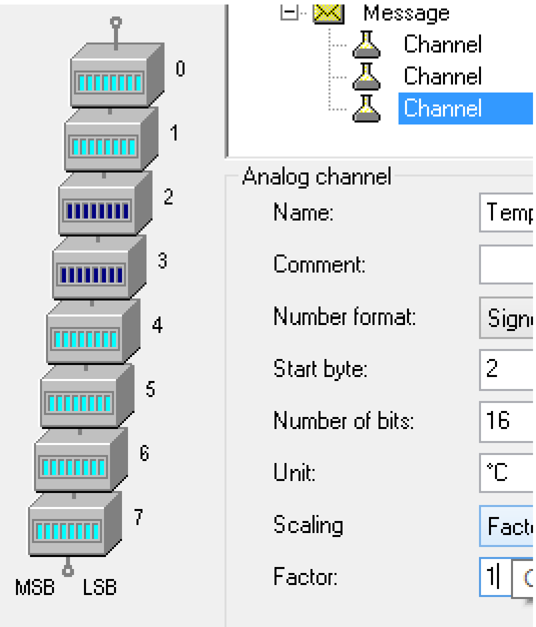
If the correct number format has been selected, the curve that you measure will be continuous. Otherwise, the upper and lower halves are exchanged, which appears as a discontinuity. A discontinuous curve is therefore an indication of the wrong integral format being used.

Parameter	Description
Start Byte	The start byte is the location of the message byte where the channel bits actually begin. It is allowed to have overlapping channels within a message. In other words, two channels can share the same start byte in a message.
Start bit	The start bit specifies where the number starts within the start byte.
Bits	This is the number of bits used in the channel. The remaining bits continue in the direction of the increasing byte indices. For signed and unsigned integers, 1 to 32 bits are allowed. Real numbers can range from 32 (floating point) to 64 (double).

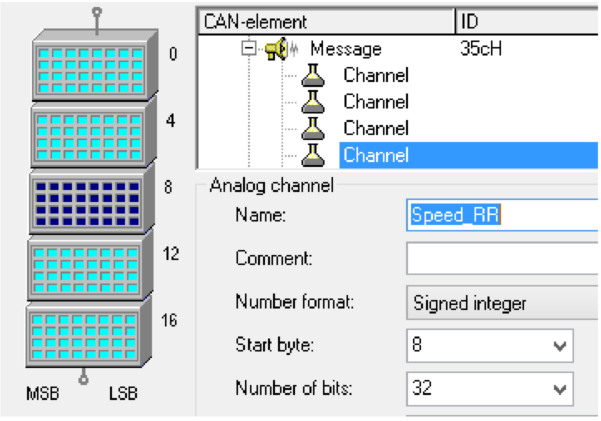
Note Information about the graphical display and the format

Graphical display of the position within the message

The Assistant displays the specified position within the message graphically. In this way, any overlapping position allocations can easily be detected:



Bit allocation in classic CAN-Bus



Bit allocation in CAN-FD

Note Byte Order | Format

This is the bit order used by the CAN module, either **Intel format** or **Motorola format**.

Intel format: The start bit is the LSB. The **LSB** has a **lower byte index** than the MSB.

Example: start byte = 5, start bit = 3, bits = 18

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5	X	X	X	X	**LSB**			
Byte 6	X	X	X	X	X	X	X	X
Byte 7				**MSB**	X	X	X	X

Motorola format: The start bit is the MSB. The **LSB** has a **higher byte index** than the MSB.

Example: start byte = 5, start bit = 3, bits = 18

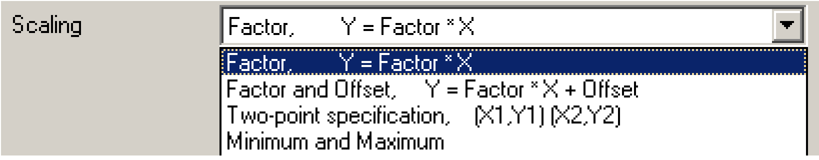
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5					**MSB**	X	X	X
Byte 6	X	X	X	X	X	X	X	X
Byte 7	X	X	X	X	X	**LSB**		

Note on recognizing Intel or Motorola byte order

- **The CAN tables from manufacturers do not always indicate whether Intel or Motorola byte order is used.** It is sometimes possible to determine the byte order indirectly. Within one message typically only one of the variations will be used.
- *Example:* Two byte data packet, message Byte 3 is LOW and message Byte 4 is HIGH
  Intel byte order because HIGH byte contains MSB.
- *Example:* Bits 0 to 14 contain data and Bit 0 is LSB
  Data is contained in Bytes 0 and 1 but only the lowest seven bits in Byte 1 are occupied.
  Therefore, LSB is in the byte with the smaller index which means that Intel format is used.

Parameter	Description
Unit	The physical units of the channel, maximum 24 characters. The units are used when displaying the channel, e.g. on the Y-axis in a curve window. Note that units should be specified without prefixes. Examples of units that you can use are: m, s, kg, N, m/s. If you need to use prefixes (e.g. n-, µ-, M-) or non-SI units (e.g. inches, pounds), always place these between quotation marks (e.g. "inches").
Scaling	Here is determined how to convert the physical value to a CAN bus integer. There are different choices available, to determine the conversion.

Note — Notes for scaling



The Scaling options

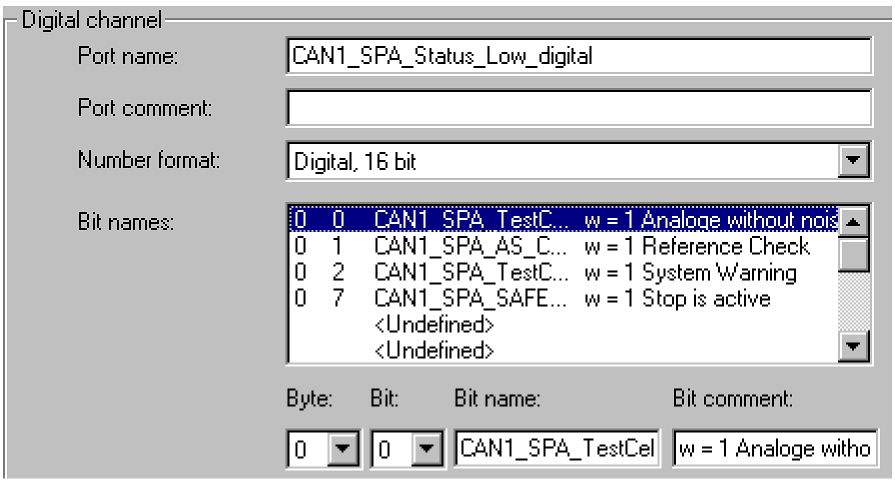
Y = physical measurement value

X = CAN bus integer value

Scaling	Beschreibung
Factor, Y=Factor*X	**Receiving**: for received signals (X) the following applies: Y = Factor * X **Sending**: for physical values (Y) to be sent, the integer value is calculated as follows: X = Y / Factor
Factor and Offset, Y = Factor * X + Offset	**Receiving**: for received signals (X) the following applies: Y = Factor * X + Offset **Sending**: for physical values (Y) to be sent, the integer value is calculated as follows: X = (Y - Offset)/Factor
Two-point specification, (X1, Y1), (X2, Y2)	X1: x-coordinate of 1st point Y1: y-coordinate of 1st point X2: x-coordinate of 2nd point Y2: y-coordinate of 2nd point
Minimum and Maximum	The lower limit of the specified number format with the specified number of bits corresponds to this minimum (e.g. signed integers, 8 bit, range: 0 to 255, minimum corresponds to 0, maximum corresponds to 255)

Digital CAN channels

The number format is set to Digital, 16 bit (only to be set for reception of CAN-Bus messages).



Definition of a digital channel

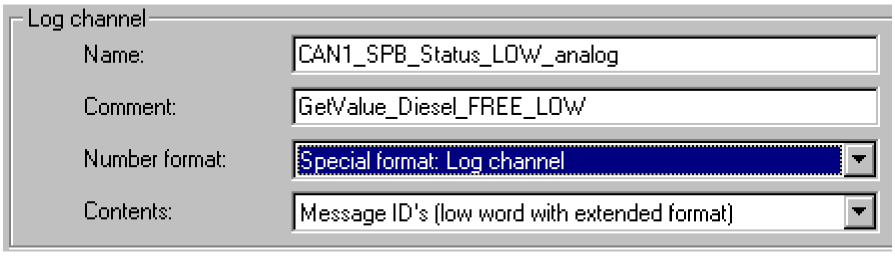
A digital CAN channel is analogous to a digital 16-bit port in imc STUDIO - it consists of 16 separate bits or one **word**. Each bit is of course a binary value, i.e. either 0 or 1. Each bit in the word does not actually have to be used. The entire 16 bit port receives a name as do each of the bits therein. These names are employed when using them in other components of the software, e.g. in triggers and imc Online FAMOS.

Parameter	Description
Name, Comment	see Message 550
Numerical format	must be set to 16 bit
Byte	determines in which of the message's bytes the digital bit is located.
Bit	position of the bit within the selected byte
Bit name, Bit comment	see Message 550

Log-channel

The numerical format is set to *Special format: Log-channel.* This special protocol channel allows filtering by low or high word of the message IDs or the number of data bytes. A protocol channel that contains the complete data transfer is set in Node/Validity 540.

This log channel is only available for messages in **receive mode**. At the same time, the message affected must be set to *All messages*.



Definition of a log-channel

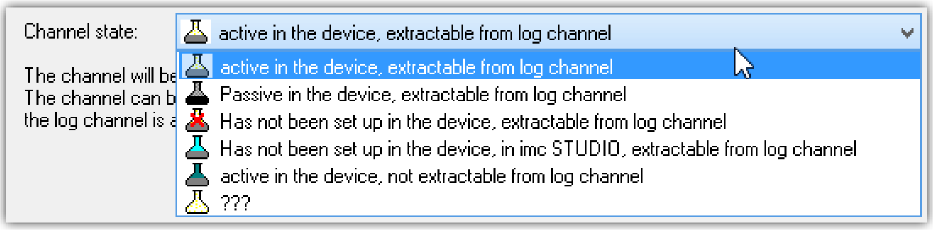
Information about all of the node's messages is logged. The message-IDs or the number of data bytes can be logged. In default format (11-bit message IDs), the message ID's are logged directly. In Extended-format (29-bit message-IDs), the High and Low word of the message ID's can only be logged separately. Each ID must then be constructed by combining the Low word and High word.

> **Contents:** Message-IDs (low word for Extended-format); High word of message-IDs (only for Extended-format) or Number of data Bytes.

9.2.4.6.5.2 Validity

The dialog illustrated below appears if the system is set to receive CAN-Bus messages.

Channel-State



		log channel 551 extractable with		
device setup		e.g. imc FAMOS	imc STUDIO	Comment
	active	yes	no	Normal data acquisition on a CAN-channel. Default: active
	passive	yes	no	Normal data acquisition on a CAN-channel. Default: passive
	no	yes	no	Channel extracted offline, with imc FAMOS for instance.
	no	yes	yes	Channel extracted with imc STUDIO's Bus Decoder (see also "Blob - Decoding with the Bus Decoder 549") or offline, with imc FAMOS for instance.
	active	no	no	Normal data acquisition on a CAN-channel. No data transfer to the log channel.

If a channel is present in the *Device channel list*, it can be either activated or deactivated for recording. I.e., the channel appears as a Fieldbus channel in the Setup.

Extensive CAN-configurations (e.g. *.DBC) may exceed the maximum channel count which the device can administer. In such a case, it is possible to exclude certain channels from the device using the channel status "*Has not been set up in the device*". Then these ones don't appear in the Setup. The data belonging to "not activated" channels can instead be extracted subsequent to the measurement. For this purpose, a ***log channel*** must be activated for the associated node; see here 551.

With imc STUDIO, you also have the option to extract channels from the log channel during a running measurement. This is accomplished by the Bus Decoder 1683. The channels to be extracted must be registered for the Bus Decoder with the channel status "*Has not been set up in the device, ...*".

Validity depends on another channel

Depending on another channel

If the current channel is to depend on another channel in the same message, check the option *Validity depends on another channel*.

The channel on which the current one depends is referred to as a *mode channel*. A mode channel must be contained in the same CAN message and use the unsigned integer number format with less than 16 bits. The drop-down list to the left contains all of the valid mode channels.

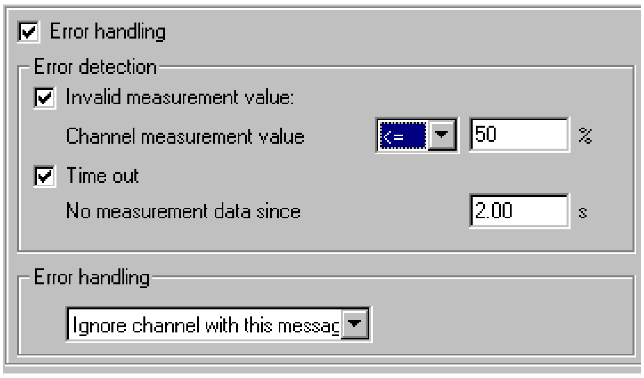
The following two conditions must also be fulfilled by a mode channel:

- A channel cannot depend on itself.
- a mode channel cannot depend on another mode channel.

The value of the current channel is only valid when the mode channel condition (e.g. CAN_001 ≤ 5) has been satisfied. Otherwise, your measurement device behaves as if the message has not been received. Enter the comparison value in real number format using the "analog" range of the mode channel - do not enter an unsigned integer value!

9.2.4.6.5.3 Error Handling dialog

The dialog illustrated below appears if the system is set to *receive* CAN-Bus messages.



Error handling

This dialog allows you to define error handling for invalid measurement values and time-out errors. If an invalid measurement value appears, or if after a certain amount of time has elapsed no further message has arrived in the device, you can perform error handling. To enable it, check the Error handling box and the desired options Invalid measurement value and/or Time out.

Invalid measurement value:

Enter the comparison value for analog channels in real number format using the display range. Select a comparison operator from the drop-down list.

Enter the comparison value for digital CAN channels (ports) using the decimal equivalent of the binary value, i.e. no bits = 0, add $2^{bitindex}$ for each bit which is HIGH. For example if the first and third bits (Bits 0 and 2) are HIGH and all others are LOW, the decimal equivalent is $0 + 2^0 + 2^2 = 5$. If the comparison condition is not met, error handling is performed (see below).

Time out:

Define a time out limit here. This is the maximum time which the sensor has to send the message. Many sensors send messages at regular intervals - this option is often useful for monitoring them.

Error handling:

The error handling box is displayed whenever any of the two above options is checked. Select one the following error handling options from the drop-down list:

- Ignore channel with this message
- Last channel value
- Replacement value

The error handling functions slightly differently, depending whether the channel is continuously sampled or whether time-stamping.

Error correction	Effect with continuous sampling	Effect with time stamping
Ignore channel with this message	Same as *Last channel value*	System behaves as if the message was never received - no time-stamped sample is created.
Last channel value	The last valid channel value is generated each sampling interval until a valid sample arrives.	*Time out error:* a new sample is generated using the last valid channel value and is stamped with the time-out limit. *Invalid value:* a sample is generated using the last valid channel value and is stamped with the message time stamp.
Replacement value	The replacement value is generated each sampling interval until a valid sample arrives.	*Time out error:* a new sample is generated using the replacement value and is stamped with the time-out limit. *Invalid value:* a sample is generated using the replacement value and is stamped with the message time stamp.
No error correction used	Same as *Last channel value*	Same as *Ignore channel with this message*

Note

- **Input range of substitute values for error handling**
  Certain substitute values may lie outside of the input range for the CAN channel.
- Channels with 16 bits or less can be given substitute values having a 16-bit input range. Example: For a CAN channel with 8 bits, a substitute value of up to 16 bits is permitted.
- Channels with more than 16 bits and less than or equal 32 bits can be given substitute values having a 32-bit input range. Example: For a CAN channel with 24 bits, a substitute value of up to 32 bits is permitted.
- Consequently, the following exceptions exist: Channels with exactly 16 bits or 32 bit-channels only permit substitute values having the same input range.

9.2.4.6.6 Menu

File

Menu item	Description
Restart (Ctrl + N)	Clears the node-, message- and channel lists. A single node is created with default settings.
Load (Ctrl + O)	Loads a complete CAN-configuration. A dialog is called which enables you to select a CBA-file from a folder of CBA-files. For the selected device (or the selected slot if there are several in the device), the current CAN-configuration is completely replaced by the one from the file. The current configuration is first deleted and then the new one is loaded from the CBA-file.
Save (Ctrl + S)	Saves the current CAN-Bus configuration as a *.CBA file. If the configuration has not yet been saved, the Save As... dialog is started.
Save as	Saves a CAN-configuration under a new filename.
Import	Loads can configuration a selected node. Beside the CAN assistant format CBA, the DBC is supported, if the PC has the DBC option installed or the device is prepared for ECU (A2L).
Export	With Export, the sendable messages of one node can be saved as DBC file.
Quit	This quits the CAN-Bus Assistant. The CAN-Bus Assistant automatically checks all of the settings first before closing and informs of any errors. You are then given the option of quitting or not. If you decide not to, The CAN-Bus Assistant shows you the error or errors so that you can fix it/ them easily. Note: If you quit the CAN-Bus Assistant without fixing the errors, no CAN channels are created.

Edit

Menu item	Description
Cut (Ctrl + X)	Cuts the selected lines to the Windows Clipboard. Cutting a message also copies all of the channels contained in the message; cutting a node copies all of the messages and all of the channels therein. Once copied to the Clipboard, the lines are deleted from the list.
Copy (Ctrl + C)	Copies the selected lines to the Windows Clipboard. In contrast to the Cut function, only those lines are copied to the Clipboard which have been selected.
Paste (Ctrl + V)	Pastes lines from the Clipboard into the current configuration.
Delete (Ctrl + Del)	Deletes the selected lines from the configuration. Note: Deleting a message also deletes all of the channels contained in the message; deleting a node copies all of the messages and all of the channels therein.
Find	Using the *Find* dialog, you can search by names of channels, messages, nodes, etc.
Select All Lines	This selects all nodes, messages and channels in the current configuration. This makes it easy to cut or copy the entire list.
Select All Nodes	This selects all nodes in the current configuration. This makes it easy to adjust settings in all of nodes simultaneously or to see which settings are identical in all nodes and which differ.
Select All Messages	This selects all messages in the current configuration.
Select All Channels	This selects all channels in the current configuration.

Menu item	Description
Show Messages	In this display mode, only the nodes and messages are visible.
Show Channels	In this display mode, all of the nodes, messages and channels are visible, i.e. the entire configuration.
Sort	Messages can be ordered by the following criteria: • messages by name • messages by IDs • channels by name • channels by start bits
Transform messages	A receive message is converted into a send message. This means that a configuration with reception messages can be used to simply create a sending station. "Empty" transmission messages can also be transformed into receiving messages. This conversion may generate (automatically) unique message names. Therefore, the same CAN Assistant content does not necessarily result from the conversion of receiving to sending messages and subsequent conversion of sending messages into receiving messages.
Sensor Initialization	See detailed description 533.
Apply	This applies the current settings immediately and checks that they're correct. If a setting is incorrect, a message in the status bar indicates this. Most settings in the CAN-Bus Assistant are applied automatically or when you exit the dialog, so this menu option should be rarely needed.
Complete Check	We recommend that you check the configuration often. If any errors are found, they are indicated in the status bar and the incorrect field or fields are highlighted. This makes it easy to fix any incorrect or implausible settings.

Insert

Menu item	Description
Nodes	Inserts a new node into the configuration list. A node is only inserted when exactly one line is selected. If a node is selected, the new node is inserted above it. If a message or channel is selected, the new node is inserted above the next node which follows, or to the bottom of the list if no other nodes exist. The first node is always assigned to CAN Port 1 and the second node to CAN Port 2. None of the other nodes can be assigned to any of the ports. If you create any more than two nodes, they can only be used temporarily and should be deleted before quitting the CAN-Bus Assistant. Otherwise the configuration will be "incorrect" and no CAN channels will be created.
Message	Inserts a new message into the configuration list. A message is only inserted when exactly one line is selected. If a node is selected, the new message is created below any existing ones. If a message is selected, the new message is inserted above it. If a channel is selected, the new message is inserted below the message to which the channel belongs. By default, the message created is always a receiving message. See also Receiving a message 550.
Sendable message	Inserts a new message to send channels. See also Sending messages 552.

Menu item	Description
Channel	Inserts a new channel into the configuration list. A channel is only inserted when exactly one line is selected. If a node is selected, a message is created with the new channel. The new message is created below any existing ones. If a message is selected, the new channel is inserted below any other existing channels in the message. If a channel is selected, the new channel is inserted below it. By default, the channel created is always an analog channel.
ECU	Shows the control unit properties 579 and the values to acquire. That entry is only enabled for devices prepared for the support of ECU.

Extras

Menu item	Description
Options	See "*Options* 570"

9.2.4.6.6.1 Import

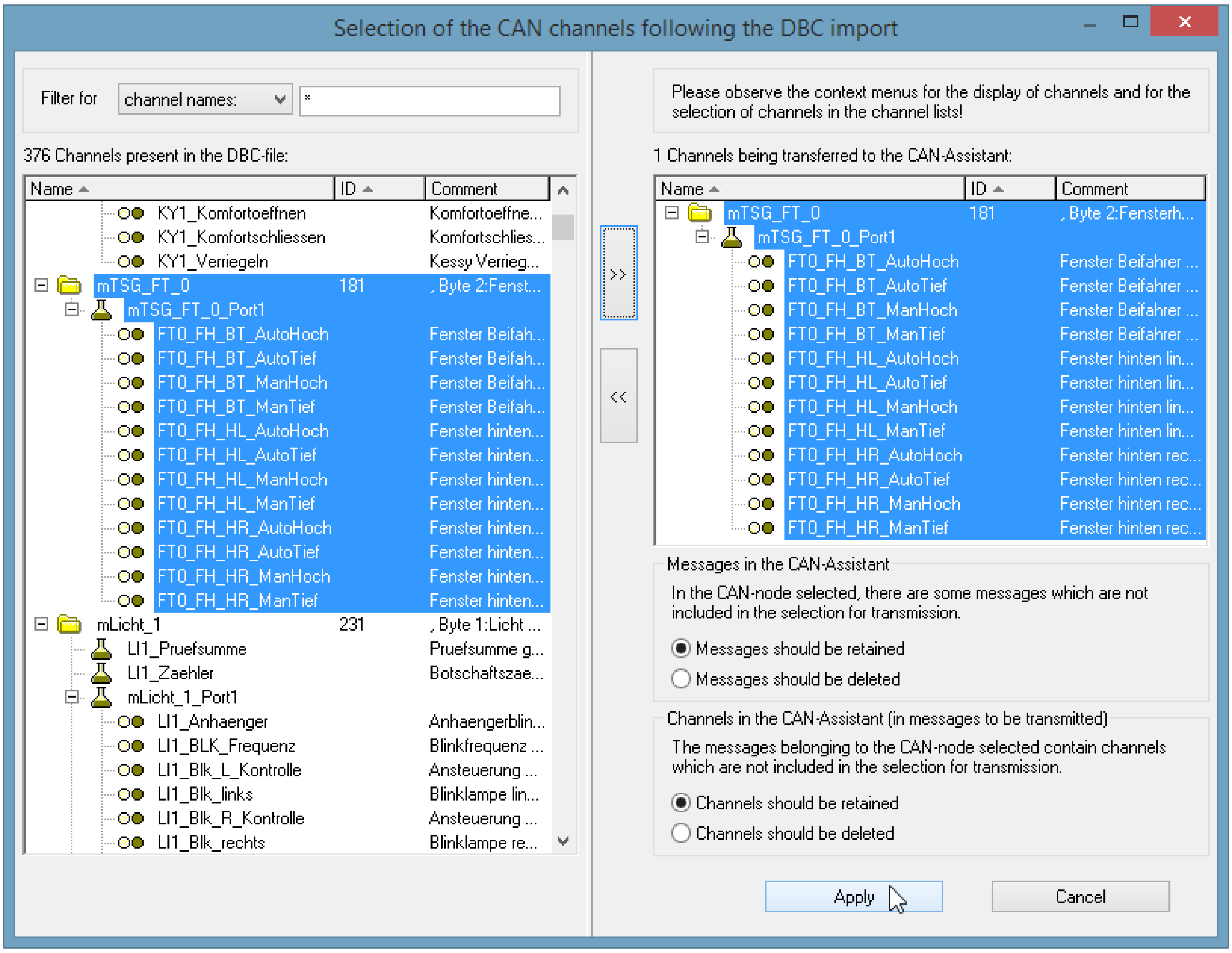
Note

At this time, direct import of more than 1000 channels is not possible. In order that channels from such an import file can still be used, any channels not needed must be blocked for the system. Load the import file, go to the page Channels-Validity 561 and assign to the unneeded channels the status "Do not adopt in system" – .

DBC

The import of CAN-Database (*.DBC) requires the purchased and installed expansion module "Import CAN-Database (*.DBC)". DBC-files can be created using the program CANdb (© Vector Informatik GmbH) from Vector Informatik GmbH. CANdb is a program for administrating the CANalyzer's (© Vector Informatik GmbH) CAN system data base. DBC-files which were created using Versions 3.03 to 3.20 of the CANdb program are supported. These versions of CANdb belong to Versions 2.0a to 3.0 of the CANalyzer.

DBC-files mostly contain all channels sent via a single CAN-node. Upon importing such channels, you have the option to filter for targeted channels relevant to your experiment.



DBC-import filter

The J1939 554 standard will be adhered to with DBC files.

CBA

As with loading a **CBA**-file, the current CAN-configuration for the selected device (or the selected slot if there are several in the device) is completely replaced by the data from the CAN-Database, i.e. the current CAN-configuration is deleted and then the CAN-Database (DBC-file) is imported. In the CAN-Assistant, a node is added as a default because the CAN-Database does not contain imc STUDIO node data such as the Baud rate. If the current configuration already includes a node, the node remains and retains its properties even after the DBC-file is loaded. But the node settings should be re-checked.

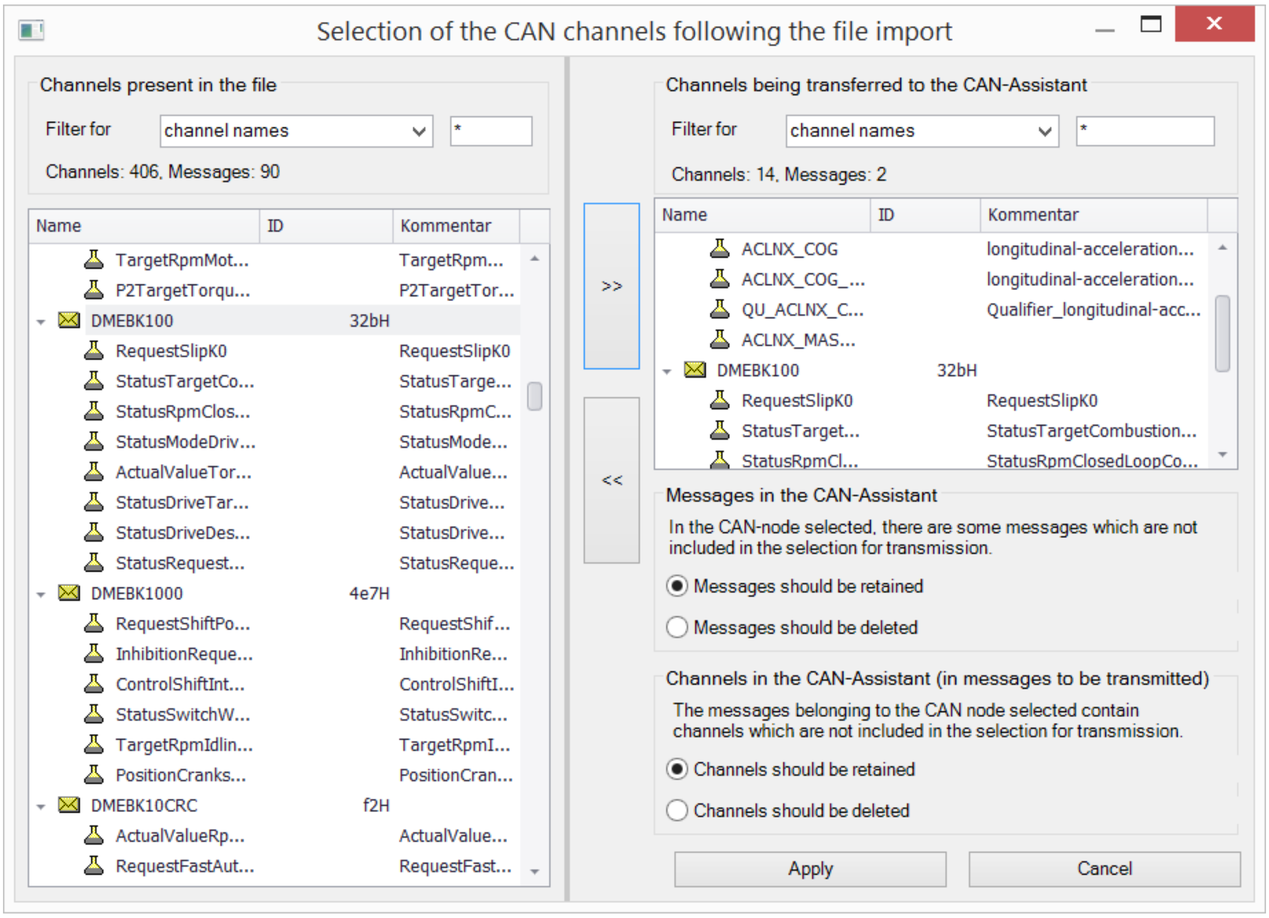
ECU (A2L)

For users of the *Import CAN-Database (*.DBC)* and ***ECU (A2L)***, the same applies as for loading a complete configuration. Additionally when importing ECUs a single ECU can be selected (not only a node). Then that ECU will be replaced. In case the name of the ECU and the one in the file is different, a message box appears to confirm the replacement. If the A2L file contains short and long event names, the long ones are used.

The extended format XCPplus is supported.

ARXML

The ARXML format was defined by the development partnership **AUTOSAR** (***AUT***omotive ***O***pen ***S***ystem ***AR***chitecture). Once the file has been opened, it is possible to import individual messages/channels in the selection assistant.



CAN FD

CAN FD configurations can be exported to CAN-devices. The configuration is then converted to CAN and any resulting errors must be subsequently eliminated by the user.

9.2.4.6.6.2 Options

For changed message clock rate:

If the option "*Apply as sampling interval for respective channels?*" is active, the sampling rate of the Field bus channels in the imc STUDIO software is automatically set.

Example: A CAN database is imported. Further settings for the Field bus channels are made in the CAN-Assistant. The sampling rates on the Base-page are at first set to match the associated channel's message rate. However, the user can make settings on the Base page which deviate from that clock rate. If you then return to the CAN-Assistant and re-load the database, or if you change the message clock rate directly, the sampling rate in the Base page is set equal to the message rate, if the option "Apply as sampling interval for respective channels?" is active. If it isn't active, the sampling rates previously set in the Base page are retained.

CAN-database (*.DBC)import:

Treatment of duplicate channel names

Treatment of duplicate channel names are not allowed in imc STUDIO. In order to load a CAN-configuration with a duplicate name anyway, there are these possibilities:

Configuration	Description
Retain	The names are adopted. But the configuration cannot be applied. The Assistant highlights the duplicate names, which must then be edited manually by the user.
Don't accept	Duplicate channels are marked as defective and ignored by the administration.
Append message ID / Append message name	The message ID or message name is appended to the duplicate names, which are thus rendered unique.
Don't accept in CAN-Assistant	The duplicate channels are not imported to the CAN-Assistant and are thus no longer displayed. The channel with the lowest ID, in other words, with the highest priority, is adopted. Alternatively, these channels can be set to "*Select channels (not in device extractable)* 549", and then selected and deleted.

Channels with invalid properties

Configuration	Description
Don't accept	With "*Don't accept*", channels with incorrect properties (e.g. invalid bit count, invalid start bit, invalid characters in the channel name,...) are not adopted in the administration. The check then doesn't acknowledge any error. But the channels are correspondingly marked in the CAN-Assistant display. The channels can be re-activated if required.
Don't accept in CAN-Assistant	The invalid channels are not imported to the CAN-Assistant and are thus no longer displayed.

Calls dialog for the name extension

If this is selected, when importing a DBC-file, the dialog for the name extension is displayed after the file is selected. This dialog is for the purpose of being able to import the same DBC-files on different nodes (slots) of a device and still have unique names.

Set J1939-Protocol, if byte number of a message > 8 and extended-format

With CAN-FD, the protocol can be set to J1939 in Extended Format automatically.

Import the specified devices as CAN-Senders, filter for device name

Messages of marked device names for send devices will be read as "*Send messages*".

When importing A2L files:

Replace characteristic curves of the type CURVE and VAL_BLK with type VALUE. Further information see here 597.

Replace measurement vectors of ARRAY_SIZE >0 with measurement vector elements.

9.2.4.6.7 imc STUDIO - Configuration / processing of field bus channels

Analog inputs

The channels created using the CAN-Bus-Assistant appear in the channel list under **Analog channels > Field bus: Analog inputs** for further processing.

Digital I/O's

The digital channels created using the CAN-Bus-Assistant appear in the channel list under **Digital channels > Field bus: Digital inputs / outputs**.

9.2.4.6.7.1 Settings

If field-bus channels are selected in the channel list (assuming the device currently allows this), then additional setting options are available.

Parameter	Description		
	long name	*short name*	*column ID*
X-axis	*X-axis*		*eXFormatVariable*
	• *Sampling rate*: The setting Sampling time is related to the settings **Duration** or **Sample count** and **Sampling rate/time** as previously discussed. • *Time stamp*: Data acquisition is handled by external, asynchronous sampling within the field-bus. The corresponding time coordinate for the data point is passed as a time stamp along with the data for subsequent processing. In this case, the parameters **Sample count** and **Sampling rate/time** are irrelevant.		
Duration	*Duration*		*eDuration*
	If the parameter X-axis is set to *Time stamp*, the duration of the measurement depends only on the setting in **Duration**.		
Assignment	*Assignment*		*eAllocation*
	The data can additionally be assigned to a Display variable (only for analog Field-bus inputs).		

9.2.4.6.7.2 Global channels for logging CAN-Bus messages

These channels are for collecting the data from corresponding sensors which are connected to a CAN-Bus. The data are captured via a special CAN-Bus interface. The necessary definitions can be made using the CAN-Bus Assistant. The IDs and data bytes of CAN-messages are logged in these channels. The channels are expressed in ASCII time stamp format. The measurement duration can be adjusted.

9.2.4.7 Application examples

9.2.4.7.1 Sending CAN messages

For this example, an imc measurement device with a CAN-interface is necessary.

9.2.4.7.1.1 Balancing a bridge module via CAN

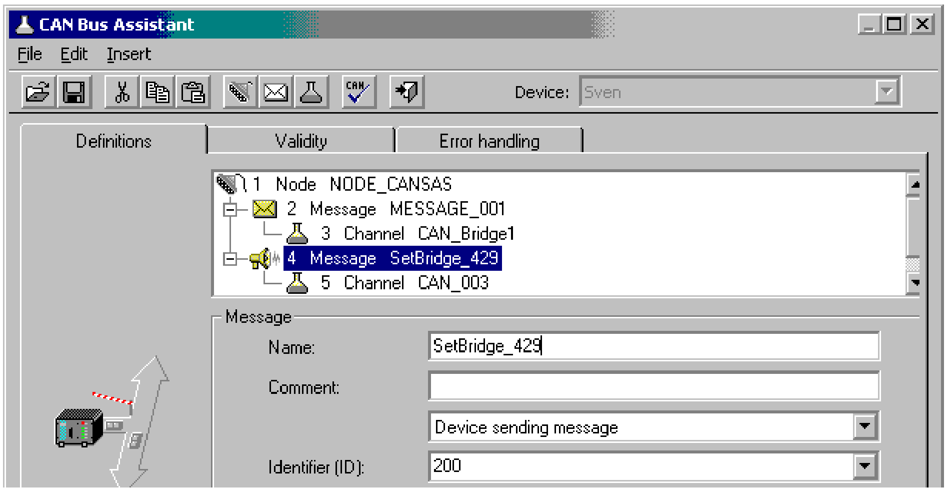
A CANSAS bridge module is used to take a strain gauge measurement. The bridge is to be remotely balanced in its rest state.

Some imc CANSAS-modules arte able to receive CAN-messages for balancing and shunt calibration. The devices must previously be prepared for this by means of the CANSAS configuration software, refer to the CANSAS manual for details. The example assumes that balancing takes place whenever the number 10Hex is sent in a message with the identifier 200.

CAN-Bus Assistant settings:

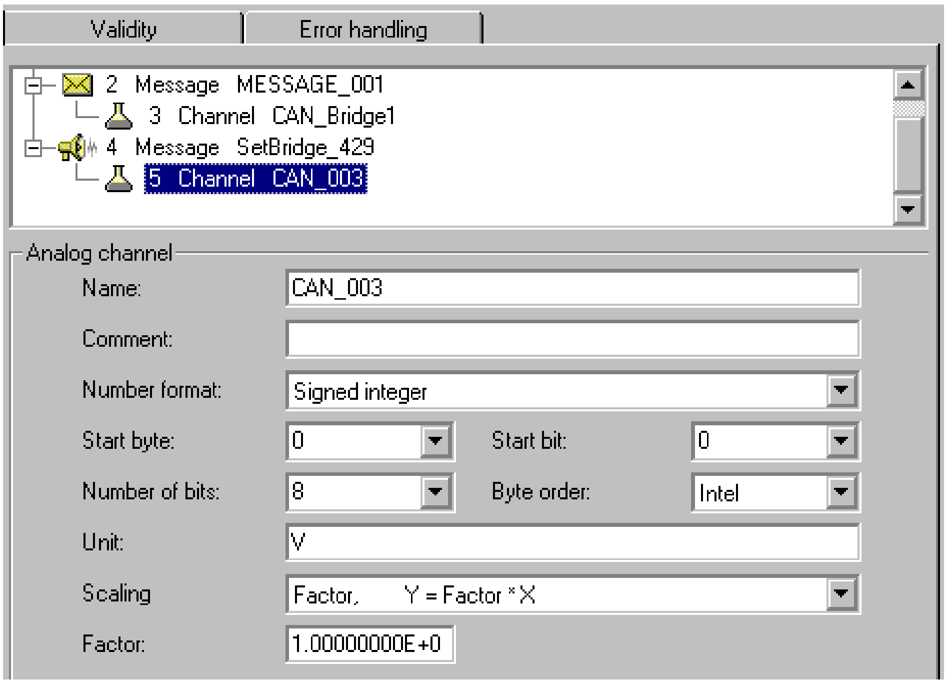
As message "SetBridge_429" is created. The name is arbitrary, the suffix _429 is an aid in locating the module by the serial number. The message must be given the ID which was previously set in imc CANSAS-module for reception purposes, the default is 200.

The channel CAN_Bridge1 measures the strain gauge signal, and thus we will be able to observe how the offset disappears if we balance the bridge while the measurement is running.



Create a message for sending the balance command

The channel "CAN_003" is also created. We intend to send the number 10 Hex via this channel and reserve 8 bits for it.



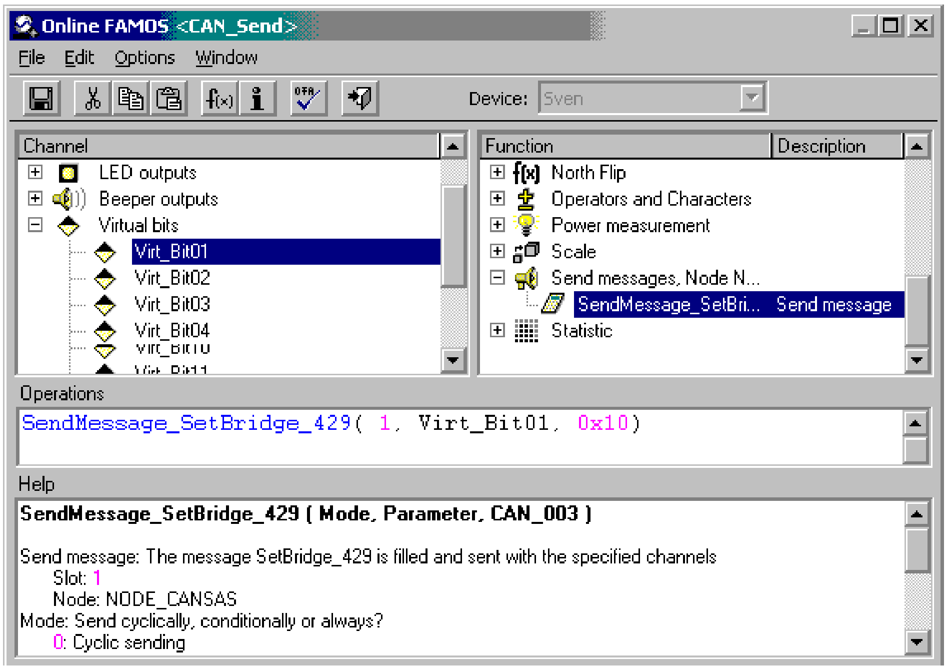
Channel for the balance command

The balancing process is to be carried out on command. For this purpose we use a virtual bit which we rename in the configuration. Later, the DIODAC dialog will provide a convenient way to set this bit. Of course, it would also be possible to use a digital input bit which is set by means of a button.

imc Online FAMOS:

Once a message has been created in the CAN-Assistant (and only then!), a new entry appears in imc Online FAMOS, *Send messages, Nodes N…*. There you will find a function which starts with *SendMessage_* and bears the name of your message, in this case *SendMessage_SetBridge_429*. This function is able to send a message in three different ways: cyclically, condition-dependently, and, if you are working with control commands, permanently.

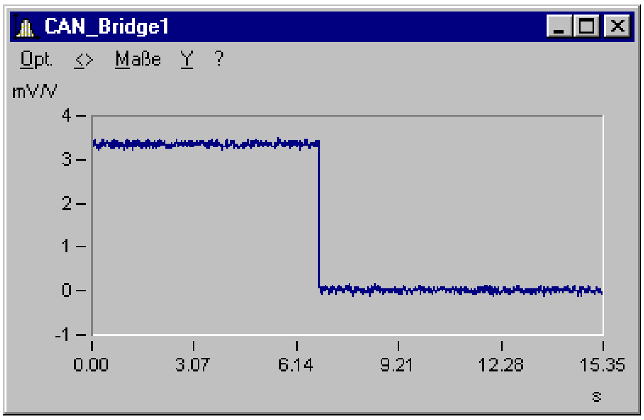
We select the operating type *With condition* and select our virtual bit *Virt_Bit01* as the condition. The number we send is 10 Hex, which causes imc CANSAS-module to be balanced.



SendMessage-command in imc Online FAMOS

We create a Panel page showing the strain gauge and a push button linked with the virtual bit for the balancing. Start the measurement. At first the bridge is unbalanced. Set the virtual balance bit with the push button.

The bridge is balanced:



The bridge is balanced and shows 0 mV/V

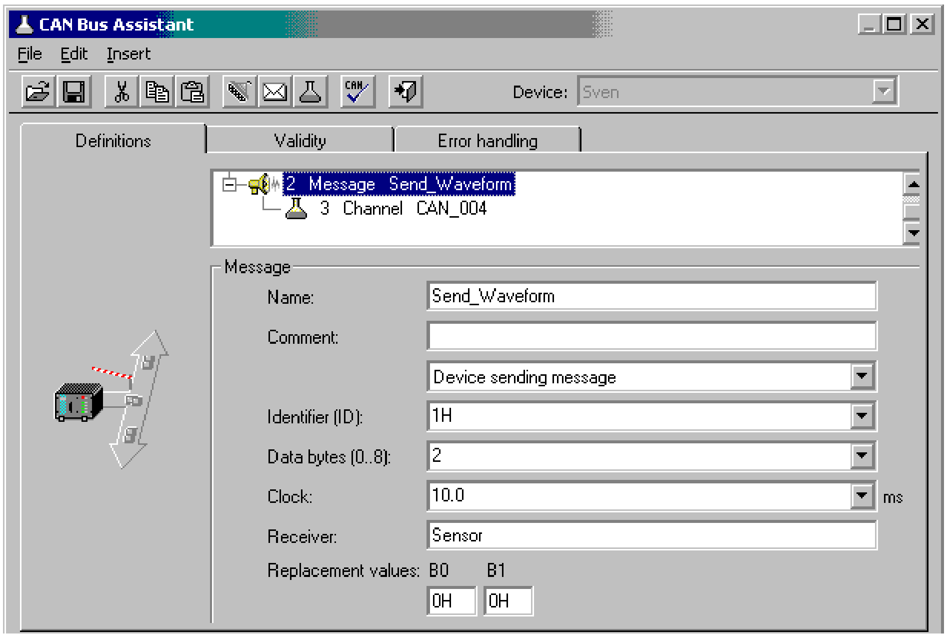
9.2.4.7.1.2 Initiating a shunt calibration for a bridge module via CAN

Proceed as for Balancing a bridge module via CAN 572. Simply substitute the HEX-code to send with 20Hex.

9.2.4.7.1.3 Outputting a waveform to a DAC module

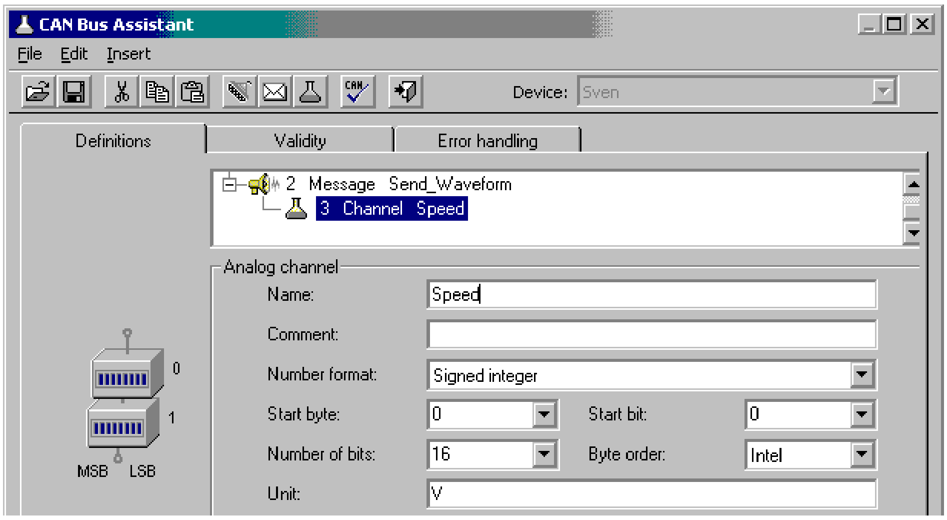
Cyclical output of values is another example. In this example, a ramp is generated. The data set to be outputted is loaded in the form of a characteristic curve. The `Charact` function is used to convert the ramp to the output values. This is sent as a message to a DAC module.

CAN-Assistant settings: Message



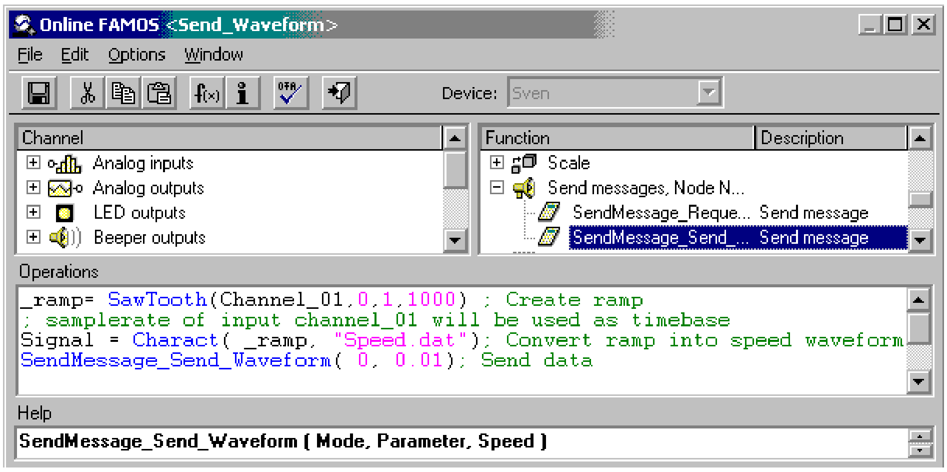
Create a send message with a channel

Channel:



The send channel is configured to the format of the data, that will be transfered by imc Online FAMOS afterwards

The text in imc Online FAMOS then looks like this:



Transfer the data in imc Online FAMOS

Note

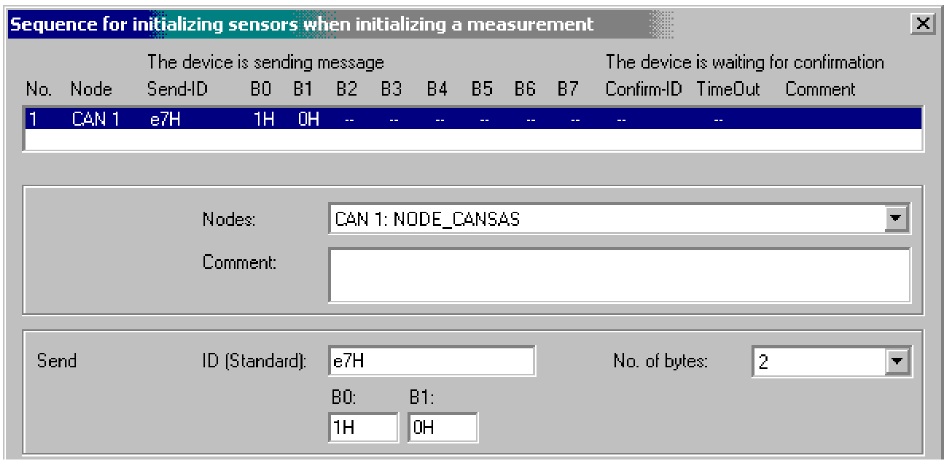
- The ramp must have the same length and same data rate as the data set to be outputted.
- In this example, an underline "_" was prefixed to the ramp. This causes the ramp to be retained in the signal processor as an auxiliary variable and cannot be found by the curve window.
- The data set to output must be in the folder which is specified under Options-Folders.
- The data set to be outputted must be expressed in imc FAMOS format. You can create the data set using imc FAMOS or simply copy data from an already recorded measurement.

9.2.4.7.2 Initializing a sensor and requesting data

Many sensors don't operate cyclically and must be "started". For this purpose, they need information about the initialization ID as well as on the numbers which are sent for the initialization. Both are noted in the description of your sensor.

In order to create an initialization sequence, open the CAN-Assistant. Once you are there, select the menu item Edit > Sensor initialization 533.

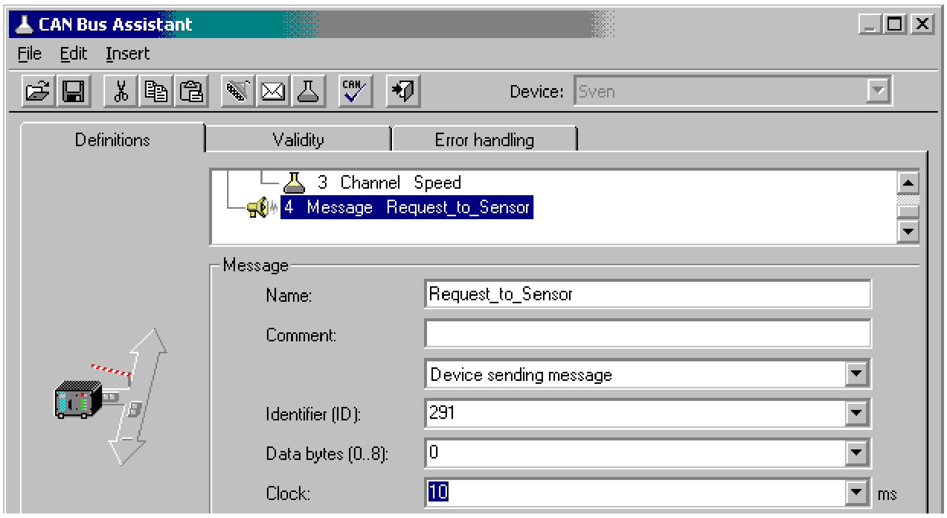
A possible sensor initialization code to enter could be as follows:



Example for initializing a sensor

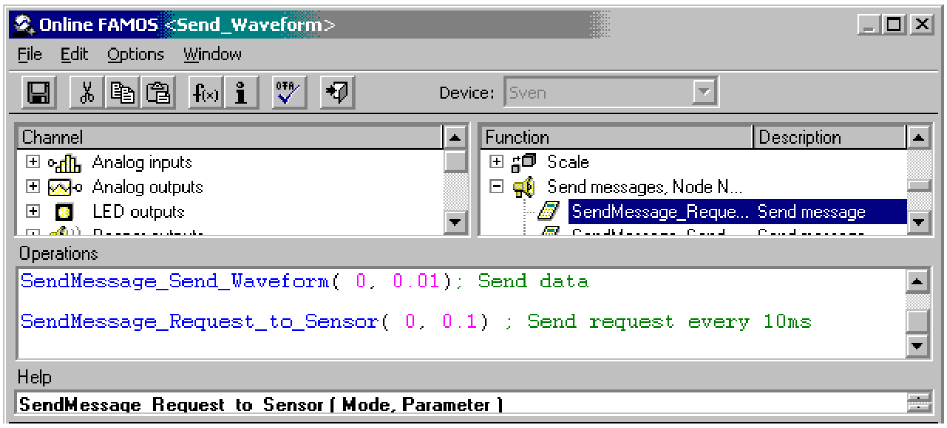
If your sensor requires a request for data, you will need to send a message to it. The ID and contents of the message are stated in the sensor's documentation.

In the CAN-Assistant, you must create a message and then put it in sending mode:

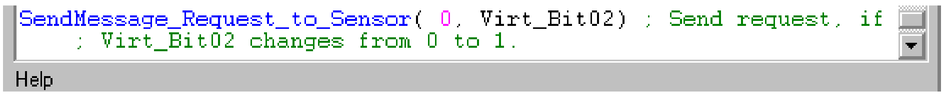


Create a send message

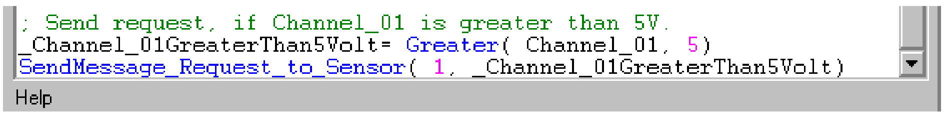
In imc Online FAMOS, select the SendMessage function and specify whether to make the data request cyclical or to make it depend on a state transition:



Example of cyclical sending at a 10ms rate



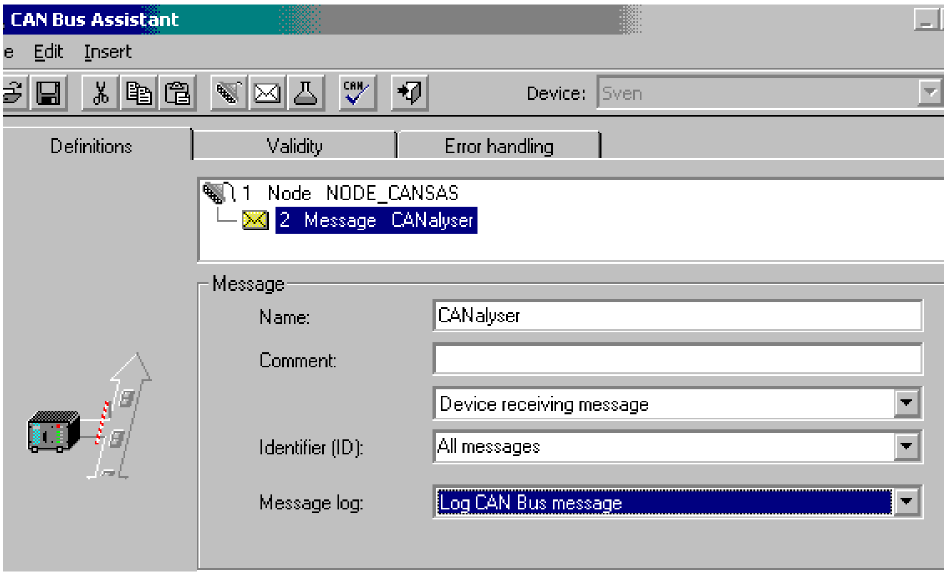
Example of an event-dependent request



Example of a request in response to a virtual bit, for instance by means of the DIODAC dialog.

9.2.4.7.3 Setting imc STUDIO as a CAN analyzer

It is possible to make a comprehensive log of all messages. For this purpose a message must be created in the CAN-Assistant which receives all the IDs. Furthermore you must set *Log CAN-Bus message* under Message log:

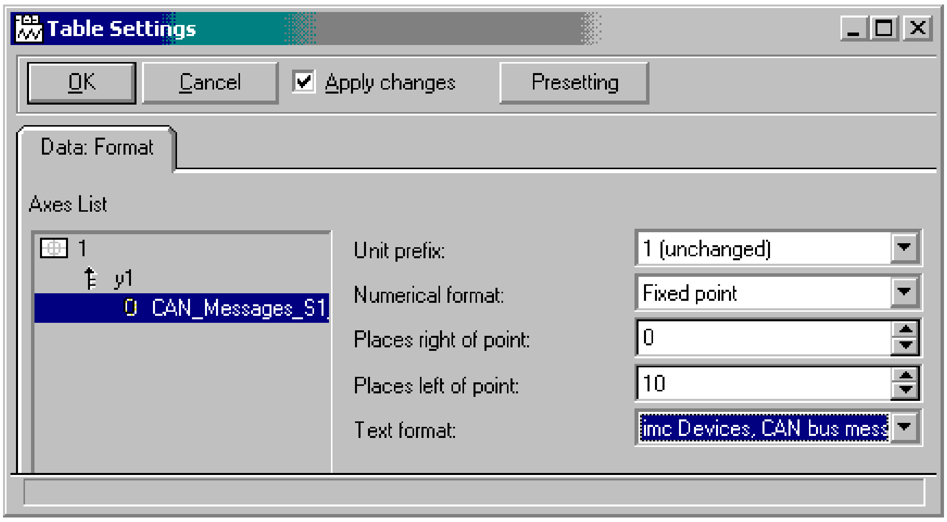


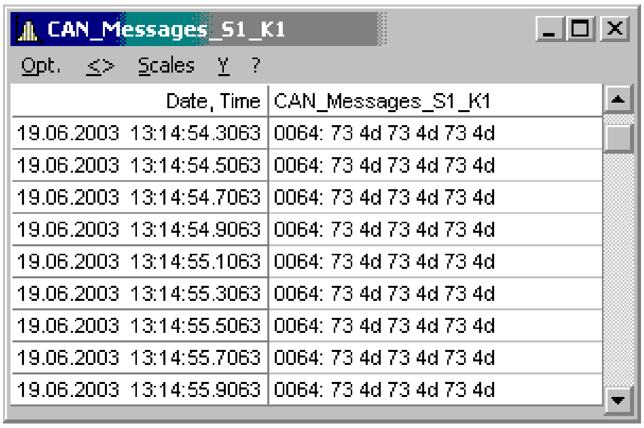
Create a log message

At this point, a channel is created whose tree-diagram entry appears together with the Field-bus inputs.

Display this channel in a curve window in tabular form. Select the menu item *Options Display Absolute Date/Time*.

Right-click the mouse in the table and select *Table...* Select as the text format *imc DEVICES, CAN-messages*.





Date, Time	CAN_Messages_S1_K1
19.06.2003 13:14:54.3063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:54.5063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:54.7063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:54.9063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:55.1063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:55.3063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:55.5063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:55.7063	0064: 73 4d 73 4d 73 4d
19.06.2003 13:14:55.9063	0064: 73 4d 73 4d 73 4d

Display of CAN messages as a CAN analyzer

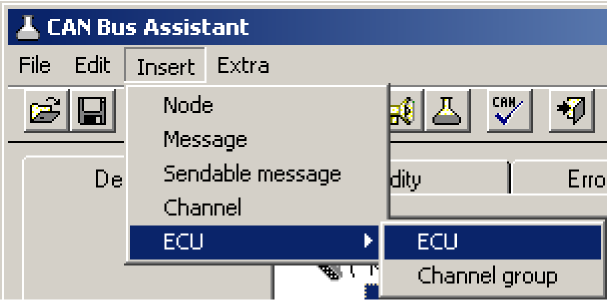
9.2.4.8 Control units in the CAN-Bus Assistant (ECU)

Using the CAN-Bus Assistant, the control unit properties and the values to acquire are selected. This can also be accomplished by importing a file describing the control unit or by configuring step by step.

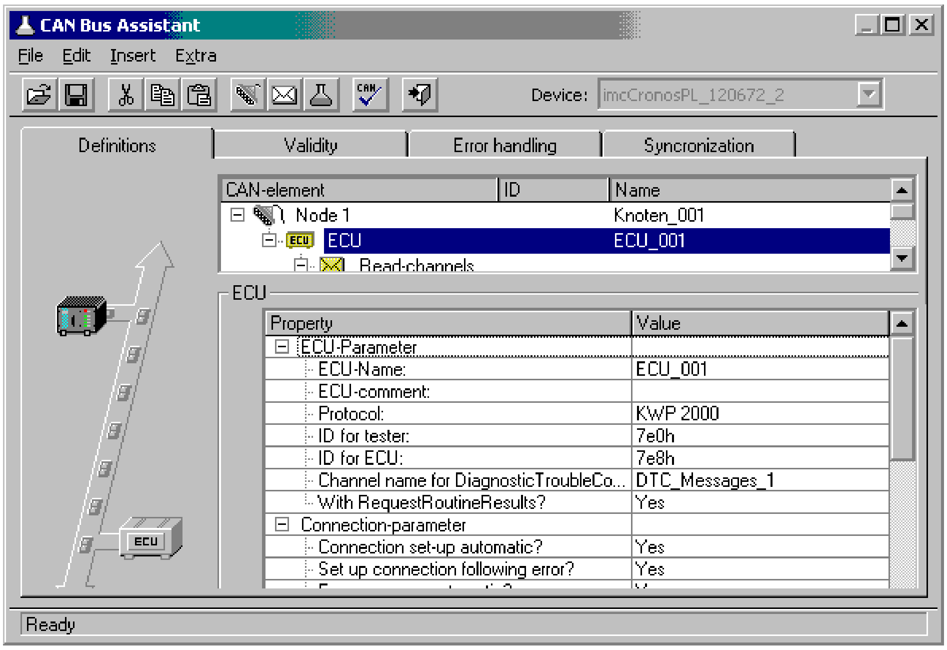
Requirements see here 530.

9.2.4.8.1 Configuring a new control unit

Start by assigning a new ECU to a CAN-node. Next, the ECU's properties must be configured in accordance with the control unit and protocol used. To open the control unit properties select menu *Insert - ECU* 566.

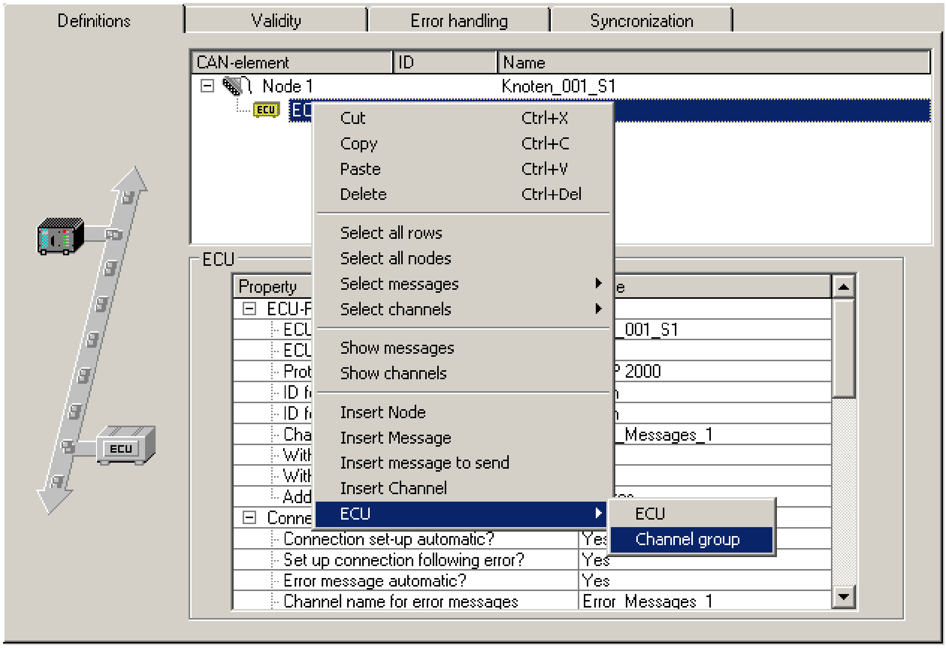


Open control unit properties



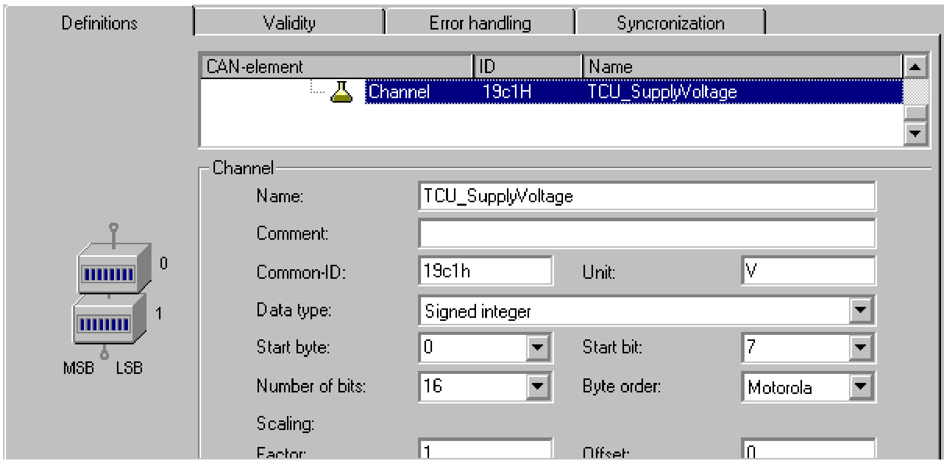
ECU properties

Channels representing the values to be captured can be assigned to the new ECU. For this purpose, a new channel group is created.



Create a channel group

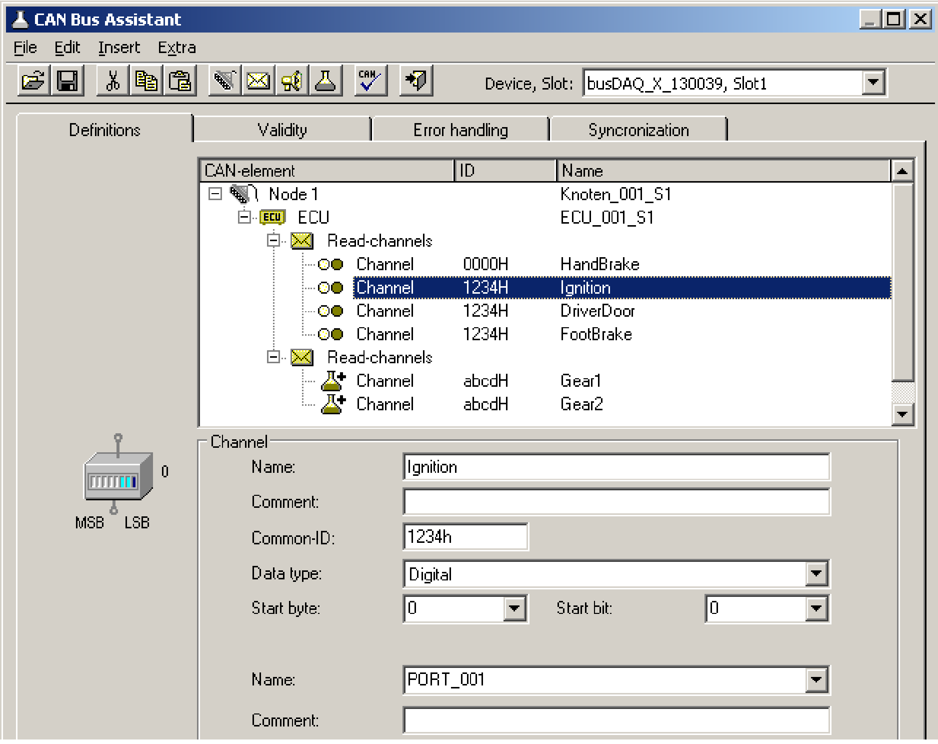
A new channel is automatically created for a new channel group.



ECU channel

An ECU's channels are arranged in channel groups. A channel group determines how the ECU's values are addressed. If the ECU's values are to be addressed using varying addressing modes, ten use multiple channel groups.

It is also possible to use channel groups for one's own organization purposes. If one of the ECU's addresses returns multiple, combined values, for example multiple individual bits each with a different interpretation, then these can be gathered together into one channel group.



Combining several bits

The object (channel) assigned to an ECU-address normally has a fixed size, in bytes. In order for such an object's values to be captured, the right quantity must be used when querying it. To do this, define all of an object's values. Configure any extra channels as passive. Alternatively, define at least one channel in the object's highest-value byte and configure it as passive if no capture is desired.

If the protocol supported by the ECU used allows it, it is also possible to create channel groups for the purposes of importing and/or exporting channels and for starting routines.

Create a separate channel group for each routine, in which the routine's parameters are to be defined.

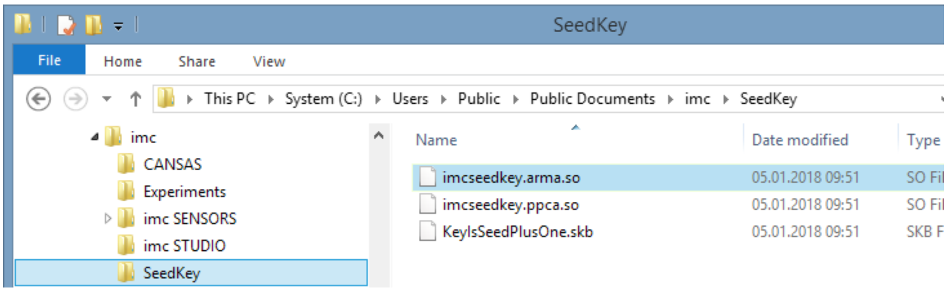
The channels then appear in the Channel-Table.

9.2.4.8.1.1 Seed & Key

Access to certain diagnostic services can be protected using the **See-and-Key method**. This is done either via a **fixed key** or a **random seed value**. The algorithm required to generate the random seed value is stored as a file in the device. For each algorithm, a file must be created according to the following scheme:

- "*name.architecture.so*" (all lower case)
- ***name***: freely defined by user
- *architecture*: designates the platform on which the file can be executed
- "arma" for all platforms to date (devices as of group 4 165 and higher, MBus, ABus)
- ***so***: under Linux, typical file extension for dynamically loadable libraries.
- ***.skb***: Alternative format of Vector-CANape.

This file must be located in the directory "*C:\Users\Public\Documents\imc\SeedKey*".

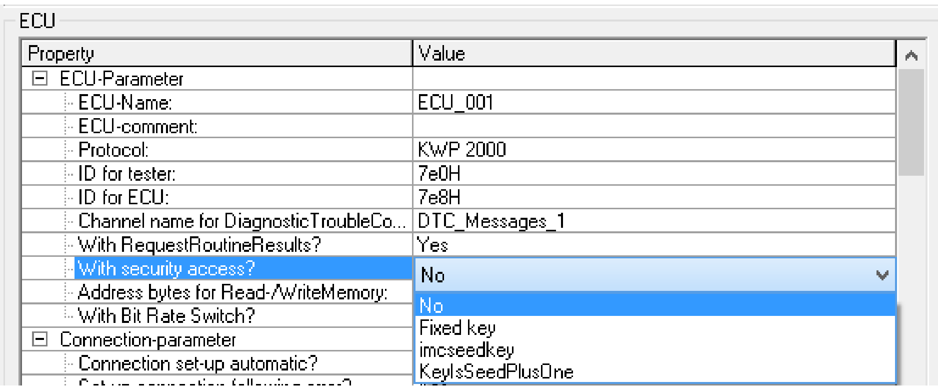


Directory "SeedKey" for "so" and "skb" files

Settings

The following parameters must be set in the settings of the ECU message, whose protocol is supported by the seed-and-key procedure:

- The "*With security access*?" property offers the options "*No*","*Fixed key*" and all file names which are available in the SeedKey directory. If a file is selected, it is transferred within the configuration during preparation.



Settings for "With security access?

- Selection "*Fixed key*": If "*With security access?*" is set to *Fixed Key*, *LogInKey* must be set to the key for the ECU. Only one fixed seed/key pair is supported.
- Selection of an encryption file: If there are ***. so*** or ***. skb*** (*KeyIsSeedPlusOne*) files in the SeedKey directory 583, they are also available at "*With security access?*"

9.2.4.8.2 Control units in imc Online FAMOS

The use of special functions for controlling control units is only possible with **imc Online FAMOS with Control Commands**.

In order to be able to evaluate return values from commands for the control unit, the special control command OnECUCmdReturn_* must be used (* stands for the control unit's designation (e.g. ECU_01)).

OnECUCmdReturn_* (Return, ECUCmd, CmdID)

***Result*: Return value**

The return value is composed of two parts.

kt * 256 + k

	Description
kt = 0	Communication error k = 0: no error, command successfully issued and acknowledged. k = 1: timeout, the control device did not respond in time. k = 2: sequence error, the ECU responses were not received in the correct sequence. k = 3: command buffer overflow. Only twenty commands (function calls) per ECU can be buffered.
kt = 1	protocol error The ECU has responded to the command with the error code k.
kt = 2	Return status The control unit has announced the end of a function which could not be executed successfully with the return status k.

***ECUCmd*: ID of the command**

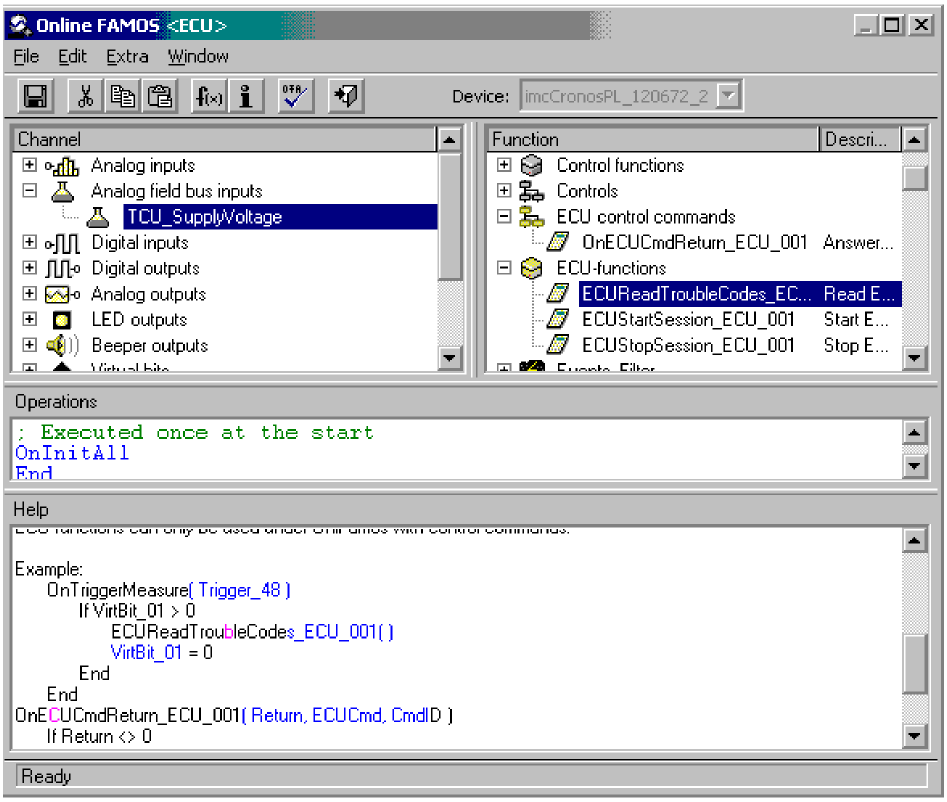
The command's ID consists of three parts.

b * 64 * 1024 + i * 256 + c

	Description
b	the bus node to which the control device is assigned b = 0: the first node in the CAN-Bus Assistant b = 1: the second node
i	index of the ECU i = 0: the first ECU assigned to the bus node
c	the protocol-specific command code

***CmdID*: Identifier or address of the command**

In addition, there are special functions for the control units:



Control units in imc Online FAMOS

```
; Executed during measurement
; By setting the virtual bit Virt_Bit01,
; a function with the ID= 0x68 in the control unit is started.
OnTriggerMeasure(Trigger_48)
    if Virt_Bit01 = 1
        Virt_Bit01 = 0
        ECURoutine_ECU_001( 0x68, 9, 1)
    End
End
; Execute when receiving an answer
OnECUCmdReturn_ECU_001( OECR_Return, OECR_ECUCmd, OECR_ProcCmd )
; Checking the answer of the function with ID = 0x68
    If OECR_Return = 0 AND OECR_ProcCmd = 0x68
        ECUReadTroubleCodes_ECU_001( )
    End
End
```

9.2.4.8.3 KWP2000 (on CAN)

For this protocol, it is generally necessary to configure:

- *ID for tester:* Messages are sent to the ECU with this Identifier.
- *ID for ECU:* Response messages from the ECU having this Identifier are expected.
- Either values, or starting of the desired functions.
- Seed-and-Key settings, see here 582.
- *With RequestRoutineResults?:* If the system is to wait for the results of a routing of long duration, having a particular protocol, enter "Yes".
- *With Bit Rate Switch?*: With CAN FD 537 all send messages can be send with higher baud rate.

Additional parameters

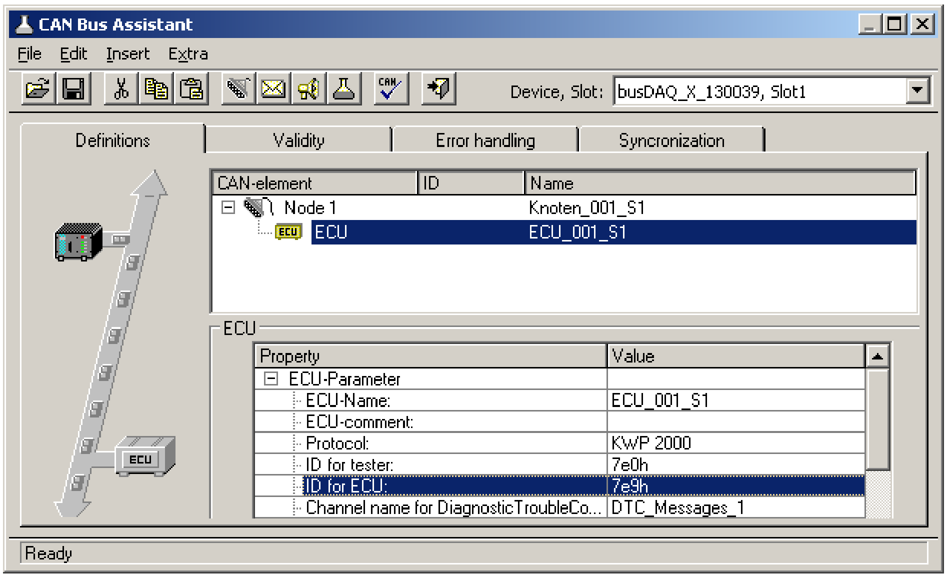
- *Channel name for DiagnosticTroubleCodes:* Unique name for the channel, to which the requested DTCs are written.
- *StartDiagnosticSession:* Here the user enters the byte sequence for a diagnostics session, which can be understood by the ECU. A diagnostics session must be selected which meets the desired requirements. This means exporting of values and starting the desired functions.
- *Addressbytes for Read-/WriteMemory:* The default value for KWP2000 is the address made of three bytes.
- *Tester present:* How to respond to the message notifying the ECU that test personnel is present.
- *don't send:* the message is not sent.
- *send if needed:* only send if no other message has been sent to the ECU for the period of "Tester present cycle".
- *always send:* The message is always set at the rate of the "Tester present cycle", without regard to other messages.
- *send at the start and always*: At the beginning there is no delay by the period "Tester present cycle"; instead the message is sent immediately.
- *Standard-timeout:* Time span in seconds within which the ECU must respond.
- *Expanded timeout:* Time span in seconds within which the ECU must conclude any routines started, which could not be concluded within the Standard-Timeout period.
- *Tester present cycle:* Cycle at which the measurement device sends a life-sign message to the ECU.
- *StartDiagnosticSession:* The second byte determines the "Diagnostic Session". This property is specific to the ECU.
- *LogInKey:* For cases where "*With security access?*" was set to Yes, the key for the Seed/Key procedure is entered here.
- *ReadDiagnosticTroubleCodesByStatus:* The second byte is the status queried. The third and fourth bytes are the High Byte and Low Byte of the queried DTCs group.
- *ClearDiagnosticInformation, ReadDiagnosticTroubleCodes, ReadStatusOfDiagnosticTroubleCodes:* The second and third bytes are the High Byte and Low Byte of the DTCs group.
- *P3 time out*

Special imc Online FAMOS functions for ECU's:

Function	Description
ECUStartSession_*	Performs the service StartDiagnosticSession.
ECUStopSession_*	Performs the service StopDiagnosticSession.
ECUReadTroubleCodes_*	The list of DTCs is imported and entered in the channel for DTCs (e.g. DTC_Messages_1)
ECUSend_*	Exports to ECU objects or starts routines

Sample TCU with KWP2000 protocol (on CAN)

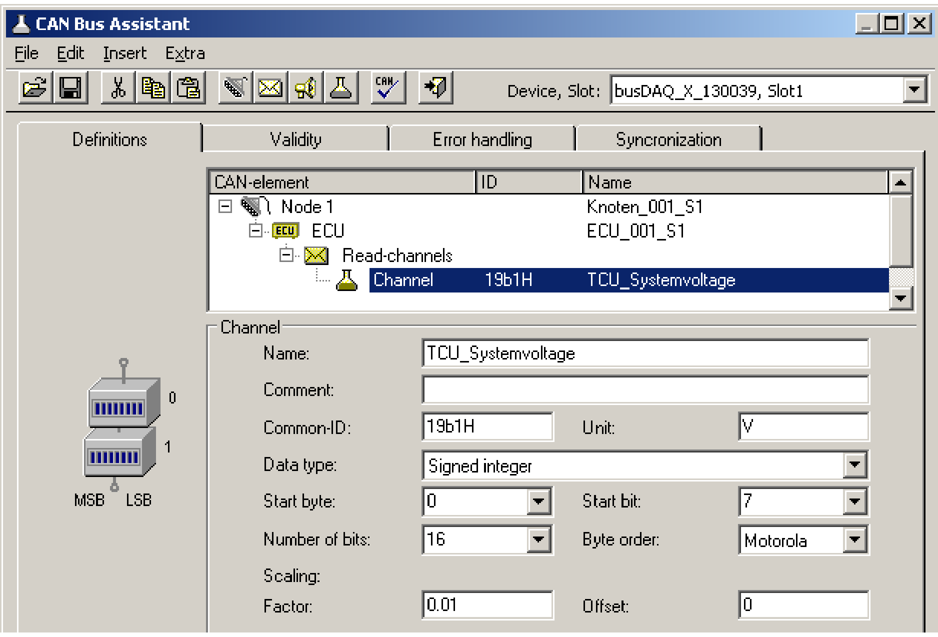
Once a new ECU has been added, the protocol is selected and the ID configured.



Set the identifier of the control unit

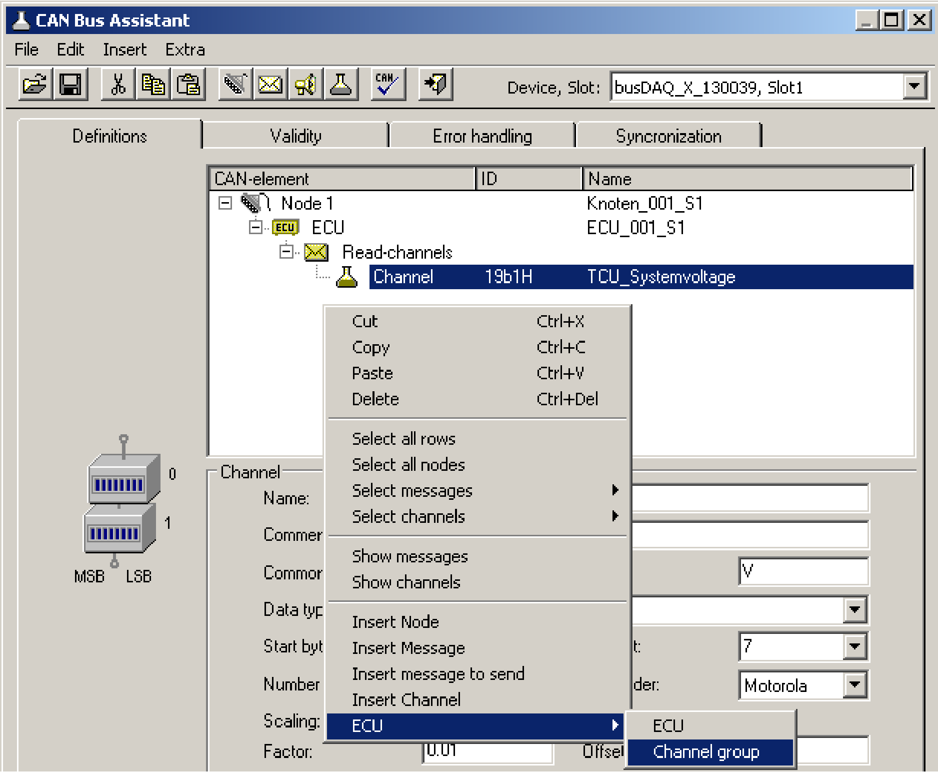
The value for StartDiagosticSession is left at the default setting.

Now the first channel is configured with the name "TCU_Systemvoltage“ and with the Common-ID 0x19C1. This is an unsigned integer with 16 bits and a factor of 0.01.

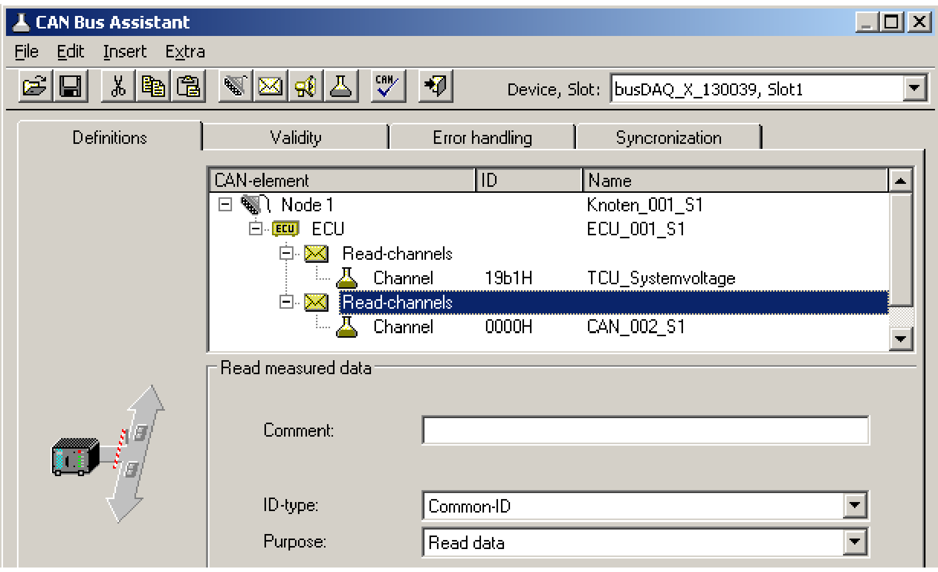


Configuring the channel

In order to be able to start an ECU routine from imc Online FAMOS, the routine must be configured in the CAN-Bus Assistant. For this purpose, a new channel group is first created.

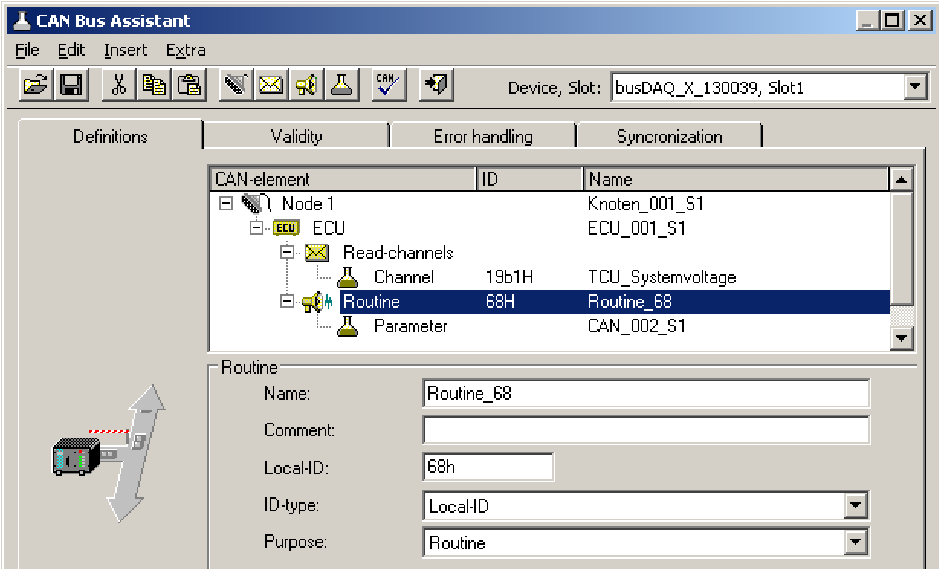


Create a channel goup



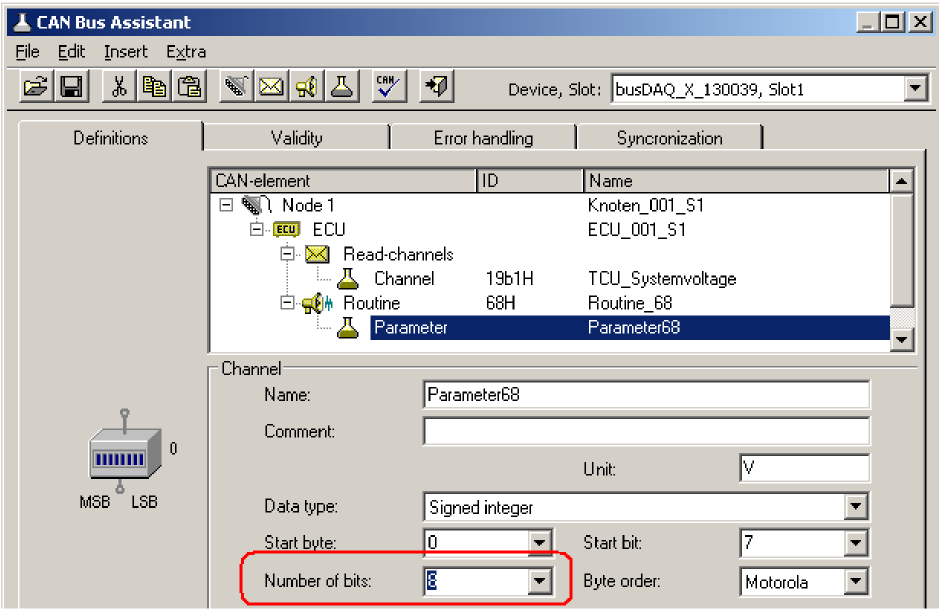
Channels of the channel group

The new channel group s configured as the routine's *Purpose* with a "Local Identifier" of 68h.



Setting the local identifier

Next, the parameter is given a name and configured for 8 bits.



Set paramter to 8 bit

This concludes configuration of the CAN-Bus Assistant.

imc Online FAMOS is now configured so that when the virtual bit 1 is set, the ECU's Routine_68 starts with Parameter 9. If the routine concludes successfully, the list of DTCs is imported.

```
; Initialization before the first measurement
OnInitAll
End

; continuous running
OnAlways
End

; run at start of measurement
OnTriggerStart(Trigger_48)
End
```

```
; run during measurement
OnTriggerMeasure(Trigger_48)
    if Virt_Bit01 = 1
        Virt_Bit01 = 0
        ECUSend_Routine68( 9 )
    End
End

; run at end of measurement
OnTriggerEnd(Trigger_48)
End

; run in response to command
OnECUCmdReturn_ECU_001( OECR_Return, OECR_ECUCmd, OECR_CmdID )
    If OECR_Return = 0 AND OECR_CmdID = 0x68
        ECUReadTroubleCodes_ECU_001( )
    End
End
```

Note

- If the values of the channels to be captured are queried one-by-one from the ECU, then the sampling interval configured for the channel is used. As for other CAN channels as well, the sampling interval can be set to values from 100µs on. ECUs normally require longer to respond (typ. 30 ms). For this reason, configuring a shorter sampling interval than the ECU's capabilities is not sensible.
- An ECU normally only executes one command at a time. If ECU values are captured, it is not possible to query them if any ECU function of long duration has been started. Therefore, the channels displaying the ECU's values can not receive any new values for the duration of the function. Depending on the configuration, they either display the last known value or a dummy value.
- In KWP2000 (on CAN), if a LogInKey is specified, the Key is also sent in response to Seed 00h 00h if the ECU is already enabled.

9.2.4.8.3.1 KWP2000 for TP2.0

Unless otherwise specified, the same descriptions of the properties apply as appearing under KWP2000.

source-address: The source address for the dynamic channel structure. Default: zero; for the tester.

target-address: The target address for the dynamic channel structure. Default: one; for the motor ECU.

Dynamic setup?: States whether to have dynamic channel structure, or whether to use permanent Identifiers instead.

9.2.4.8.3.2 Diagnostic On CAN

For *Diagnostic On CAN*, the same notes apply as for KWP2000, with the following differences:

- The service *ReadFreezeFrameData* is supported.
- The service *DynamicallyDefineLocalID* is supported.
- The service *RequestRoutineResultsByLocalId* is not supported.

DynamicallyDefineLocalID

- For a standards-conformant ECU, the properties for *Dynamically defined lists* can be set as follows:
- *Length of definition message:* -1 for automatic uses the maximum possible length. If the length is limited by the ECU's requirements, make this setting.
- *Defined data length*: -1, for automatic, uses the maximum possible block length. If the block length is limited by the ECU's requirements, make this setting.

- *Nested lists?:* If the lists cannot be used independently of each other, then set *Yes here*. Then, only one list will be queried during import. However, it is possible to use the previous list for definition purposes.
- *With Local- and Common-ID?:* If all Identifier types can be used for definition purposes, set "*Yes*" here. "*No*" is to be set if only addresses can be used.
- *Delete dynamic lists?:* If the dynamic lists need to be deleted before a new definition, then set "*Yes*" here.

Special imc Online FAMOS functions:

Function	Description
ECUStartSession_*	Runs the service StartDiagnosticSession.
ECUReadStatusOfDTC_*	The list of DTCs is imported by Service 17h and adopted in the channel for DTCs (e.g. DTC_Messages_1)
ECUClearDiagInformation_*	Deletes the list of DTCs.
ECUReadFreezeFrameData_*	The data of a particular FreezeFrame-number associated with a 'Diagnostic Trouble Code' are imported.
ECUSend_*	Writes to ECU objects or starts routines

Note

For the DiagOnCAN-protocol 3-byte- and 4-byte-addresses with one or two length bytes are supported.

9.2.4.8.4 OBD-2

OBD-2 enables reading of standardized ECU channels. The ECU protocol OBD-2 is implemented in accordance with the SAE J1979 standard (2017/2019).

In imc Online FAMOS, there is for OBD-2 the function `ECUClearDiagInformation_*`, which deletes diagnostics information saved in the control unit.

Note

Operation requires skills in the OBD-2 protocol.

General notes

On**B**oard**D**iagnostik, abbreviated OBD-2, is a standardized control mechanism enabling quick access to a vehicle's control instruments and sensor data. This interface is legally required in new vehicles.

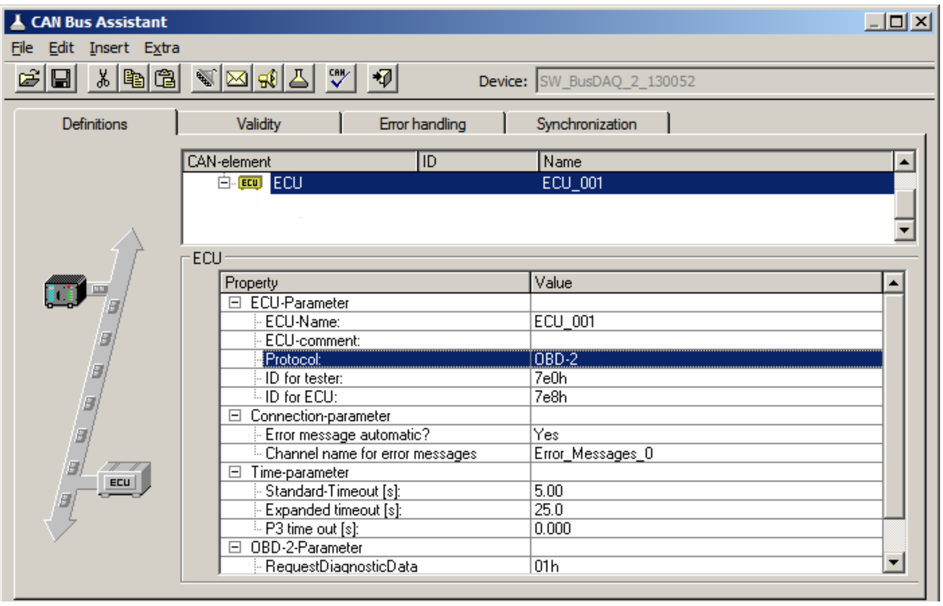
OnBoardDiagnostik monitors and saves even errors occurring during vehicle operation. Certain sensor data are recorded at fault condition.

These so-called freeze frames make quite effective troubleshooting and diagnostics possible. Necessary information must be supplied be the vehicle manufacturer. By this means, the vehicle data can be read out and used for diagnostics purposes.

The signal connection terminal is located in the passenger compartment, never in the hood or trunk.

9.2.4.8.4.1 Settings in the assistant

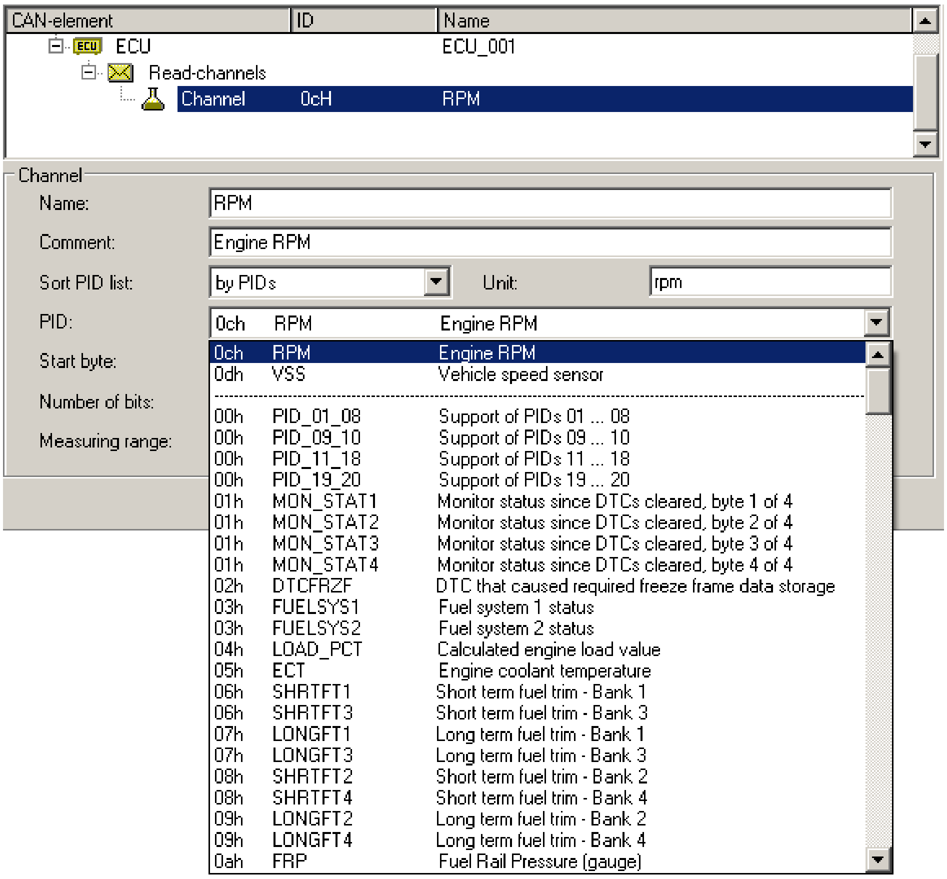
To select OBD-2 channels, add a ECU 580 to the configuration. Under ECU-Parameters, set the protocol type to OBD-2, before adding any channel:



ECU-protocol: OBD-2

With this type, there are only a few ECU parameters to set, e.g. there is no log-in command, no Security and no dynamic lists.

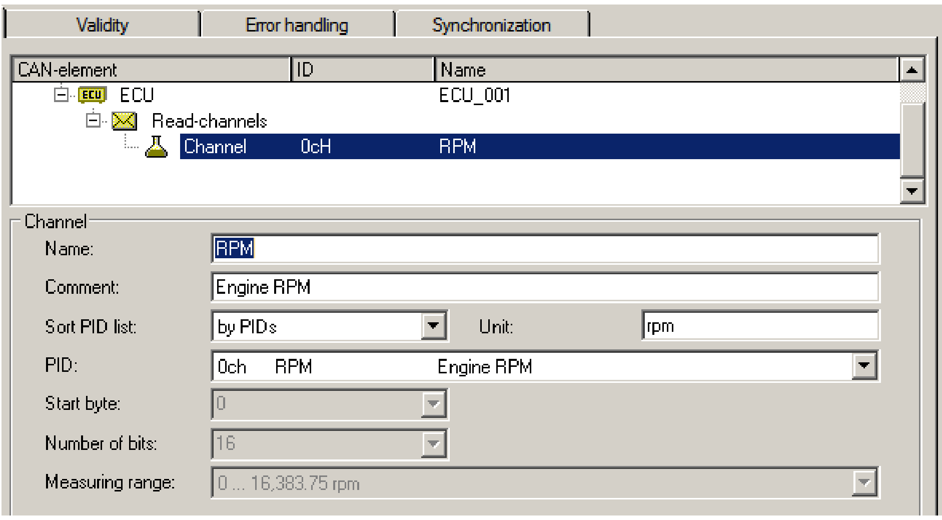
For selection of the ECU channels, permanent PIDs are set. Create a message and a channel and select the channel via the PID list:



Select a OBD-2 channel

The PID can also be sorted by channel names, channel description or PID.

After selecting a PID, the *Name, Scaling, Unit, Comment, Start byte, Number of bits* and *Measuring range* for this PID are set automatically.



Properties of a OBD-2 channel

9.2.4.8.5 CCP

For this protocol, you must usually configure the following:

- *CRO-ID (ID for Tester):* With this Identifier, messages are sent to the ECU.
- *DTO-ID (ID for ECU):* Response messages from the ECU are expected to have this Identifier.
- *Station address:* The station address serves to distinguish the ECUs in cases where multiple ECUs are using the same Identifier.
- Seed-and-Key settings, see here 582.
- *DAQ-lists:* If the ECU supports DAQ-lists, it is possible to use DAQ-lists to relieve the burdens on the ECU and the CAN-Bus.

Additional parameters

- *DAQ-lists only with bytes:* It is necessary to enter "Yes", if only single bytes can be defined in the DAQ-lists. In that case, two entries must be used for a 16-bit wide value.
- *Byte order:* Which sequence of bytes is to be used by default.
- *Mode channel name:* Unique name for the additional channel required for the use of DAQ-lists.
- *With SHORT_UP?:* If the ECU understands the command SHORT_UP, it is an easy way to query data.
- *With START_STOP_ALL?:* If the ECU understands the command START_STOP_ALL, then all DAQ-lists can be started together.
- *ECUs use same IDs?:* If multiple ECUs use the same Identifier, then each time the ECU is accessed, a connection having a specified station address, and subsequent disconnection, are necessary.
- *Standard-Timeout:* Time duration in seconds within which the ECU must respond.
- *LogInKey for send channels:* For the case that "*With security access*?" is set to *Yes*, the key for enabling write access is entered here.
- *LogInKey for DAQ-lists:* For the case that "*With security access*?" is set to *Yes*, the key for enabling the DAQ-lists is entered here.
- *Events:* In order to be able to use DAQ-lists, it is first necessary to define the associated events. An ECU event is a cyclical prompt to send specific DAQ-lists. An event can be triggered by timer or by an RPM-value, for instance, of the crankshaft. imc STUDIO can only process time-domain events.
- *Properties of event:* Name: for designating an event
- *ID:* The identification used by the ECU. Usually begins with zero and ends with the number of events minus 1. For an entry which isn't used, enter -1.
- *base clock:* The minimum time period between two consecutive events.
- *Connection set-up automatic?*: Yes or No

DAQ-lists

In order to be able to use DAQ-lists, it is necessary to define the ECU's 'Events'. These are the sampling intervals available for the ECU. An 'Event' is defined with an arbitrary name, the Event-ID and the event's base clock rate.

To define a DAQ-list, the following must be specified:

- *Number of list:* The identification used by the ECU. Normally begins with zero and ends with the number of DAQ-lists minus 1. For an entry which isn't used, enter -1.
- *Event:* Specifies which event can trigger the DAQ-list. *Variable* is the setting in which the DAQ-list can be triggered by any event. The name of a particular event must be specified if the DAQ-list is to be triggered by only that event.

- *CAN-ID:* Identifier with which messages can be sent; -1 for the DTO-ID. If the DAQ-list can use other Identifiers instead of the DTO-ID, it is possible to set an unused Identifier. For many DAQ-lists, a different, permanent Identifier must be set.
- *MAX_ODT:* The maximum number of tables (Object Descriptor Table) per DAQ-list.
- *MAX_ODT_ENTRY:* The number of possible entries in a table (ODT).
- *FirstPID:* The PID of this DAQ-list's first ODT. The PID is used to identify the associated ODT. For each of the subsequent ODTs, a 1 is added. -1, for automatic, uses 0 for the first DAQ-list, MAX_ODT of the first DAQ-list for the second DAQ-list, etc.
- *With reduction:* Is *Yes*, if the basic clock rate needs to be subdivided. Then, messages are only sent for every n events. An ECU's channels are arranged in the DAQ-lists according to their sampling intervals. The channels with the shortest sampling interval are used first. If the DAQ-lists aren't sufficient for all channels, then the remaining channels are polled (read directly at every sampling instant).

Special imc Online FAMOS functions:

Function	Description
ECUSend_*	writes to ECU objects

Example

1. There are no DAQ lists ore they are not to be used.

The parameter number is set to -1 for all DAQ-lists.

2. A DAQ-list

```
Number:  0
Event:  Variable
CAN-ID:  -1
MAX_ODT: 10
MAX_ODT_ENTRY: 7
First PID: -1
With reduction? No
```

3. Two DAQ-lists each having a fixed event, special "First PID" and different size

```
Number:  1
Event:  0
CAN-ID:  -1
MAX_ODT: 12
MAX_ODT_ENTRY: 7
First PID: 0
With reduction? No

Number:  0
Event:  1
CAN-ID:  -1
MAX_ODT: 8
MAX_ODT_ENTRY: 7
First PID: 16
With reduction? No
```

9.2.4.8.6 XCP

For XCP, the same notes apply as for CCP, with the following differences:

- XCP does not have station addresses
- Seed-and-Key settings, see here 582.
- *Dynamic DAQ-lists:* If DAQ-lists can be created as needed by the ECU, enter "*Yes*" here.

Additional parameters

- *Alignment in bytes:* Which alignment to adhere to in defining the ODTs.
- Messages with XCP standard are supported (short format: only the necessary bytes will be sent). Also messages are supported that are extended to 8 bytes.

9.2.4.8.7 GMLAN

The ECU protocol **GMLAN** resembles KWP2000. Import of A2L-files is possible.

The GMLAN-protocol has been implemented according to GMW 3110 Version 1.5 specifications (04.02.2004).

For dynamic lists, the following commands are additionally supported:

DynamicallyDefineMessage: assignment of a PID-list to a DPID

DefinePIDByAddress: assignment of unique PIDs to the (channel) addresses

ReadDataByPacketIdentifier: definition of DPID-list

With dynamic lists, the parameters in the group *'Dynamically defined lists*' must be set appropriately.

ModeChannelName: For dynamic lists, an additional channel is required (for internal purposes, such as with CCP).

Addressbytes: 2-, 3- and 4-Byte addresses are supported.

Supported imc Online FAMOS functions:

*ECUStartSession_**

*ECUStopSession_**

9.2.4.8.8 UDS

The UDS protocol is similar to the KWP2000 protocol and is implemented according to the ISO 14229-1 standard (04.2007).

- Seed-and-Key settings, see here 582.

Additionally supported commands for dynamic lists:

DynamicallyDefineDataID: Assignment of addresses (channels) to unique PIDs

ReadDataByPeriodicIdentifier: Assignment of a PID-list to one of the specified sampling rates

With dynamic lists, it is necessary to set the parameters in the group *'Dynamically defined lists*' appropriately. The dynamic lists serve the purpose of transmitting multiple channels on the bus as quickly as possible while loading the bus as little as possible.

ModeChannelName: For dynamic lists, an additional channel is needed for internal purposes.

AddressBytes: 2-, 3- and 4-Byte addresses are supported

Functions supported in imc Online FAMOS:

ECUStartSession_* : Executes the service StartDiagnosticSession.

ECUStopSession_* : Executes the service StopDiagnosticSession.

ECUClearDiagInformation_* : The list of diagnostics information is deleted

ECUSend_* : Writes to ECU objects or starts routines

9.2.4.8.9 A2L: CURVE and VAL_BLK

Characteristic curves of the types *CURVE* and *VAL_BLK* of an A2L-file can be imported for the ECU-protocols CCP and XCP.

The option *Replace characteristic curves of the type CURVE and VAL_BLK with type VALUE* (see the menu item *Extra > Options* 567), all characteristic curves of both these types are replaced with characteristic curves of the type *VALUE*. This generates as many characteristic curves of this type as there were values in the original characteristic curve. For each selected characteristic curve of the type VALUE, one write-function is generated in imc Online FAMOS.

Without this option, for each characteristic curve of the type *CURVE* or *VAL_BLK*, a channel with the additional dialog element *Vector length:* is created, which can only be exported. For each characteristic curve, one write-function is automatically generated in imc Online FAMOS, in which the vector index must be supplied when it is called. Thus, there is one write-function imc Online FAMOS per characteristic curve.

Example: imc Online FAMOS:

```
; run during the measurement
OnTriggerMeasure(Trigger_48)
     if IsV02 > 0
         ECUSend_CCP_struct_gen_vector_02( 54.5, 1) ; Index: 1,2
         ECUSend_CCP_struct_gen_vector_02( 58.5, 2)
         IsV02 = 0
     end
end
```

9.2.4.8.10 Properties in common

Property	Description
ECU-name, ECU-comment	An arbitrarily specifiable designation for the ECU, and a comment on the same. If the ECU's settings are imported from an A2L-file, then the ECU-name should not be changed. Upon re-importing a changed A2L-file, it is possible to adopt either only the changes, or also additional channels.
Protocol	This property should be set first, since the protocol used determines the particular properties. The protocol to be used in communicating with the ECU is to be chosen. As soon as a channel group has been created for the ECU, it is no longer possible to change the protocol.
Error messages automatically?	If the setting is "*Yes*", any error messages are automatically outputted in the error message channel. With "*No*", it is possible to evaluate errors occurring in the section "*OnECUCmdReturn*" in imc Online FAMOS.
Connection after error?	For the setting "*Yes*", the system attempts to set up a new connection whenever protocol timeouts occurred or messages containing measured data were delayed too long.
Channel name for error messages	Unique name for the error message channel.

Property	Description
Protocol-parameter	In the protocol-parameters, the command codes for the selected protocol are defined. These settings can mostly be left intact. Settings which need to be edited or checked are explained in conjunction with the protocol-specific properties.

9.2.5 EtherCAT-Interface

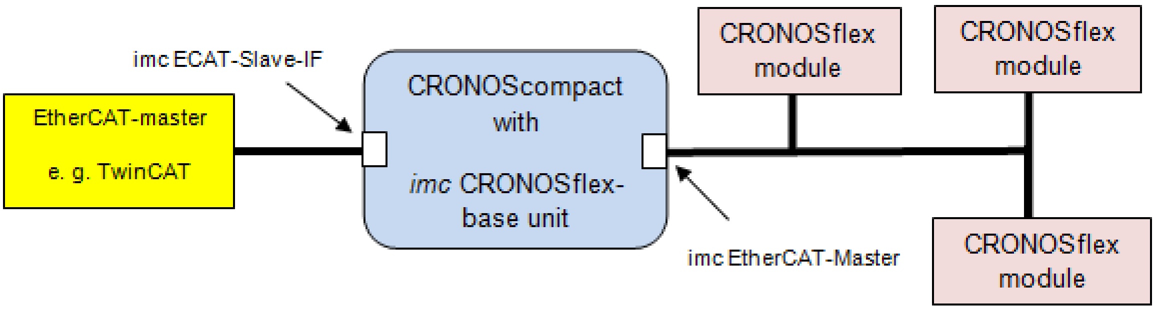
The fieldbus module imc ECAT-Slave-IF provide the integration of imc CRONOS*flex* and imc CRONOS*compact* devices into an automation system with an EtherCAT fieldbus.

The complete imc CRONOS device is integrated via the interface into the in den EtherCAT fieldbus as a Slave module, which is operated by an external EtherCAT Master.

Data from the imc measurement device are thus available throughout an EtherCAT system and integration of the device into other system environments are possible.

Note

The **EtherCAT-Slave-IF** is **not** to be mistaken with the ***imc* CRONOS*flex*-base unit** (the ***imc EtherCAT-Master***), which allows connection of imc CRONOSflex 353 modules. imc CRONOS*flex* is a distributed measurement system, in which the EtherCAT Field-bus is used as a transfer medium between imc amplifiers and the imc basis device. In such applications, the connected EtherCAT-bus is to be viewed as an internal imc bus, to which only EtherCAT modules are connected.



Configuration:

- For the configuration, a dedicated software assistant is provided.
- As the signal source, the imc device's process vector is used. This means that the measurement channels and virtual channels represented by process vector variables are available to external subscribers and systems via EtherCAT. The data are available and valid directly after preparation, independently of trigger releases.
- Via the interface, it is possible to read and write process vector variables (pv.Variables) of the imc system. Reading and writing can occur either cyclically or irregularly.
- Cyclical data are transmitted cyclically after the Fieldbus and the imc measurement system start.
- Irregular data can be queried sporadically by the EtherCAT Master by means of the protocol CoE (CANopen over EtherCAT), which is supported by the imc system.
- Configuration and parameterization of the imc measurement system are easy to perform using the device software imc STUDIO, by means of which an "EtherCAT-Slave-Information" document (ESI) can be created or exported in XML-format. This serves the purpose of system configuration for the EtherCAT Master.
- Alternatively or additionally, parameterization of the imc systems via the CoE protocol is possible.

9.2.5.1 EtherCAT general

EtherCAT (**Ether**net for **C**ontrol **A**utomation **T**echnology)

EtherCAT is an Ethernet-based Field-bus. EtherCAT is distinguished by high performance and real-time capability and thus enables open-and closed-loop control mechanisms which classical Field-bus systems could not achieve. EtherCAT uses the principle of a Master-Slave communication system. The Master in this case is a regular commercially available PC with a network card. The Slaves use special EtherCAT-hardware as the interface which enables data exchange on the hardware level. This saves considerable time in processing the protocol by means of an interface program.

CoE (**C**ANopen **o**ver **E**therCAT)

To map the process data and to set up a communication channel to each bus subscriber, EtherCAT uses the communication profile CANopen (*Controler Area Network*). By the use of the communication channel, the cyclical real-time operation is configured whenever necessary, and the acyclical transfer of data is enabled. The basis for communication by means of the CANopen protocol is the CANopen object directory, which exists on every bus subscriber. Each object in the object directory is uniquely defined by means of a so-called CANopen object index (UINT16 value). In the EtherCAT standard, use of the CANopen standard is referred to as *CANopen over EtherCAT* (CoE*).* If communication by CoE is not supported by a Slave, the data mapping is saved in an ESI document.

Data map

In the EtherCAT protocol, data exchange between the EtherCAT-Master and EtherCAT-Slave takes place via so-called Sync-Managers. A Sync-Manager defines a storage area of specific length within the EtherCAT Slave hardware, from which the Master can read or write data cyclically. To map the structure and size of a Sync-Manager's process data to be transferred, an EtherCAT-Slave's CANopen object directory contains SyncM objects (SM-objects), which assign process data objects (PDOs) to the individual SyncManagers. Together the SM-objects and PDOs produce the process data mapping.

A SyncManager object has the structure of a *UINT16 array*. Every entry in the *SM-object* corresponds to a PDO-index. A PDO has the structure of a *UINT32 array*. Each PDO entry references a subobject of an object in the object directory. The entry comprises the object's index, the subobject's subindex and its bit length.

Example: Sync Manger3 (0x1c13) , 2 PDOs (0x1A00;0x1A01) , 2 data objects (0x2000 , 0x2001) subobjects 1-3 data length 16 bits

```
<0x1c13>
        < 0x1A00>
                <0x20000110>(0x2000;1,16)
                <0x20000210>(0x2000;2,16)
                <0x20000310>(0x2000;3,16)
        < 0x1A00/>
        < 0x1A01>
                <0x20000110>(0x2000;1,16)
                <0x20000210>(0x2000;2,16)
                <0x20000310>(0x2000;3,16)
        < 0x1A01/>
<0x1c13/>
```

9.2.5.2 Prerequisites

For operation of imcECAT-IF the module **CRC/ECAT-Slave** is required.

The module is supported by imc CRONOS*compact* and imc CRONOS-PL.

9.2.5.3 Configuring the EtherCAT interface

Configuration of the Field-bus module is performed with the help of the imcECAT-IF Assistant which comes with the device software. By means of this Assistant, the user sets which PVVs on the imc device are mapped in the imcECAT-IF's CANopen object directory. Additionally, the Assistant offers the ability to define the data mapping (CoE-mapping) of the cyclical data transfer.

The following two configuration variants are possible:

Variant 1:

No complete mapping is defined. The EtherCAT Master performs the mapping via CoE.

Configuration work performed with the Assistant:

- Definition of PVVs
- Definition of CoE process data objects (PDOs)

Configuration work for the EtherCAT-Master (via CoE):

- Definition of the PDO-contents
- Definition of the Sync-Manager contents (see CoE)

Variant 2:

Complete mapping is defined (no CoE communication necessary).

Configuration work performed with the Assistant:

- Definition of PVVs
- Definition of CoE process data objects (PDOs)
- Definition of PDO contents
- Definition of Sync-Manager contents (see CoE)

The data mapping created in the Assistant can be imported by the Master via CoE, or be exported to the Master by means of an ESI document supplemented with the mapping. The Assistant can be used to create this device-specific ESI-document. The assignment of the device-specific ESI-document to the corresponding imcECAT-Slave-IF can be determined by the EtherCAT-Master on the basis of the device's VendorID, ProductCode and **serial number**.

9.2.5.4 CANopen object directory

The *CANopen* objects contained in the object directory can be subdivided into two function groups. To the first group, objects are assigned whose function, CANopen-index and name are permanently determined by the CANopen-standard or EtherCAT-standard. To the second group, all *imc*-specific objects are assigned. To which group an object belongs can be found out on the basis of the CANopen-index. All objects whose index lies in the range 0x2000 …..0x6000 belong to the group of *imc*-specific CANopen objects.

The main part of the object directory consists of objects which describe defined PVVs in the configuration. A channel is completely described by one data object and one parameter object. The association of an "object pair" is determined by an object's name. An *imc* measurement channel's data object consists of at most 1 sub objects, where a subobject maps the instantaneous value of the PVV. An *imc* parameter object consists of multiple subobjects. The individual subobjects contain the properties of the PVV, such as the sampling interval, scaling etc. Each subobject can be imported via CoE. Parameter objects can not be assigned ("mapped") to a PDO.

Object directory contents

Index	Name	Access	Amount	Function
0x1000	device type	RO	1	specific to device type
0x1008	device name	RO	1	device name
0x1009	Hardware version	RO	1	indicates the device's hardware version
0x100A	Software version	RO		indicates the currently operable software version in the device
0x1018	Identity	RO	1	object indicates the vendor ID, product code, revision number and serial number
0x1600 0x1601 ... 0x17ff	RxPDO	RW	depends on configuration	defines process data received by EtherCAT-Slave
0x1A00 0x1A01 ... 0x1BFF	TxPDO	RW	depends on configuration	defines process data sent by EtherCAT-Slave
0x1C00	SM-Comm Type	RW	1	Defines the communication type of the individual Sync-Managers, where each subindex stands for one SyncManager. Subindex 1 = SM 0 Subindex 2 = SM 3 etc.
0x1C12	SM2-PDO-assign	RW	1	contains the index of the PDOs assigned to the Sync-Managers
0x1C13	SM3-PDO-assign	RW	1	contains the index of the PDOs assigned to the Sync-Managers
0x1C32	SM2-Parameter	RW	1	contains the Sync-Manger's transfer properties
0x1C33	SM3-Parameter	RW	1	contains the Sync-Manger's transfer properties
0x2000 0x2001 ... Ox5ffff	pv_"name"_DATA pv_"name"_DATA ... pv_"name"_DATA	RW	depends on device type	maps a PVV's measurement data
0x2000 0x3002 ... Ox5ffff	pv_"name"_PARAMETER pv_"name"_PARAMETER ... pv_"name"_PARAMETER	RW	depends on device type	contains a PVV's properties

9.2.5.5 Parameterobject

An imc parameter with its associated sub-objects represents the properties of a PVV. The object contains the properties of the channel associated with the PVV (e.g.the sampling rate), as well as transmission properties pertaining to the EtherCAT interface. The seven sub-objects in the object have a variety of data types (in accordance with CANopen REC structure).

The parameter object contains the following properties:

Subindex	Description
0	Subobjekt 0
1	Status
2	imc Source
3	CANopen Data Type
4	Factor
5	Offset
6	Unit
7	Sample Rate

Subobject 0

The function of the value in Subobject zero, as well as its data type, has a fixed definition for all CANopen objects in the CANopen standard. The subobject's value specifies how many subobjects are contained in a CANopen object.

Status

The subobject "Status" indicates whether the PVV mapped in the object library is saved in the device configuration of the imc STUDIO Software.

Example

A PVV defined in the imc Online FAMOS source code is mapped in the EtherCAT-Slave-IF's object library. If the PVV definition is deleted due to modification of the imc Online FAMOS source code, the PVV in the EtherCAT-Slave-IF's object library is indicated as "*passive*". If the representation of the deleted PVV is also to be deleted in the object library, the EtherCAT-Slave-IF configuration must be changed.

Data type: UNSIGNED 8

Property representation type: ENUM

Value	Description
1	active
0	passive

imc Source

imc Source contains the information on which resource type the PVV is associated. By means of this information, it is possible to determine, for example, whether a PVV represents an amplifier channel's measurement value.

Data type: UNSIGNED16

Value	Description
6	not definied
7	Amplifier-channel
8	Online FAMOS
9	Test variables
10	Fieldbus-channel
11	Device variable
12	Device variable
13	Device variable
14	Test variable
15	Synthesizer
16	CoE Dummy
17	multiple sources

CANopen Data Type

Contains the PVV's data type.The data type is represented in the form of a CANopen index. The data types and the assigned ("associated"?) indices are defined in the CANopen standard.

Data type: UNSIGNED16

Value	Description
0x0003	INTEGER16
0x0004	INTEGER32
0x0006	UNSIGNED16
0x0007	UNSIGNED32
0x0008	REAL32

Factor (only defined for Resource-Type Amplifier channel and fieldbus-channel)

The content of the subobject pertains to the channel associated with the PVV.

Data type: REAL32

Offset (only defined for Resource-Type Amplifier channel and Fieldbus-channel)

The content of the subobject pertains to the channel associated with the PVV.

Data type: REAL32

UNIT (only defined forResource-TypeAmplifier channel and Fieldbus-channel)

The content of the subobject pertains to the channel associated with the PVV.

This contains the unit of the physical variable applied at the channel input/output. The condition for displaying the unit is prior definition of the unit in the imc Device Configuration.

Data type: String

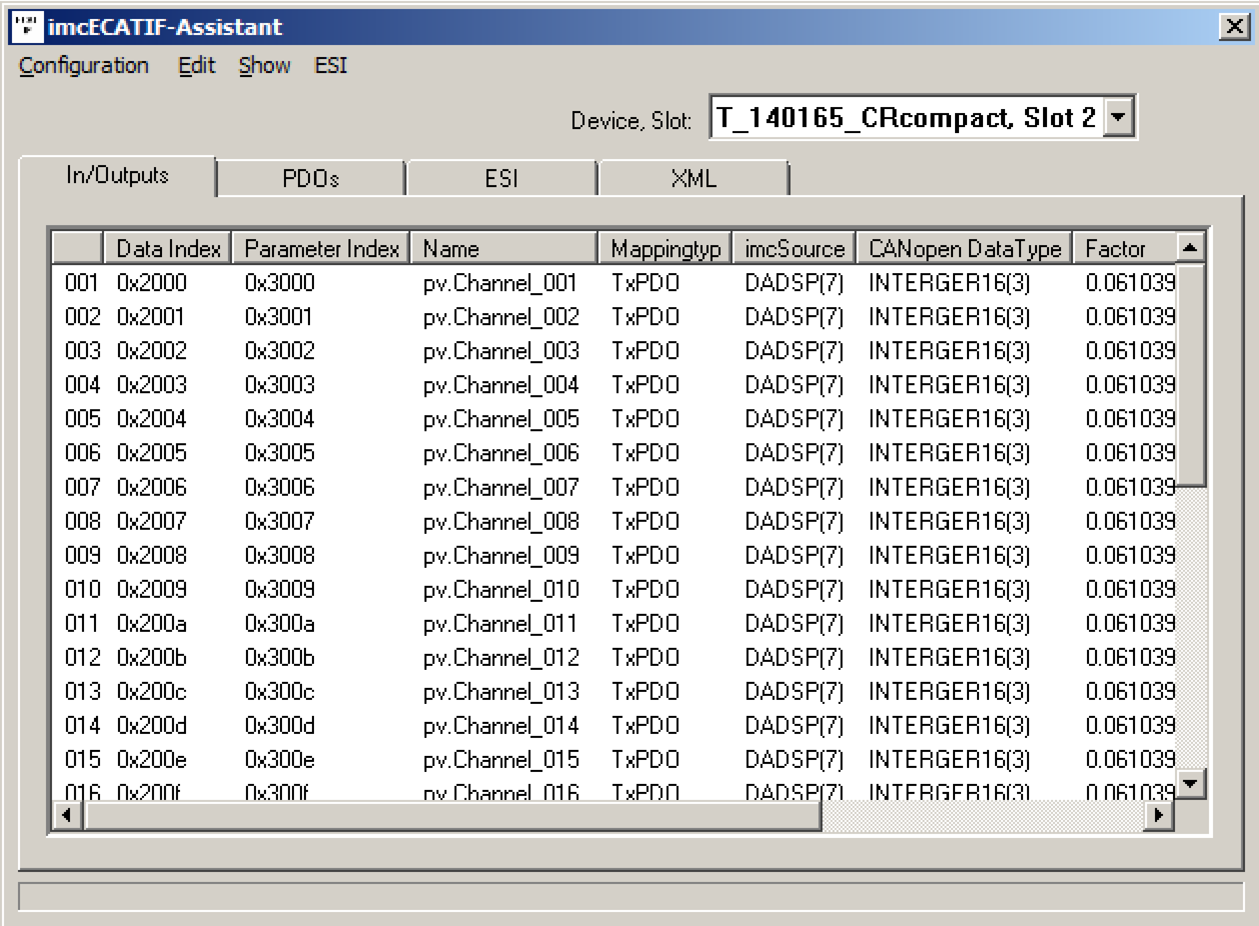
Sample Rate (only defined forResource-TypeAmplifier channel and Fieldbus-channel)

The content of the subobject pertains to the channel associated with the PVV.

Data type: UNSIGNED32

9.2.5.6 EtherCAT-IF Assistant

The EtherCAT Assistant uses the experiment set to generate an XML file which makes all process vector variables available as EtherCAT channels.



	Data Index	Parameter Index	Name	Mappingtyp	imcSource	CANopen DataType	Factor
001	0x2000	0x3000	pv.Channel_001	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
002	0x2001	0x3001	pv.Channel_002	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
003	0x2002	0x3002	pv.Channel_003	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
004	0x2003	0x3003	pv.Channel_004	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
005	0x2004	0x3004	pv.Channel_005	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
006	0x2005	0x3005	pv.Channel_006	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
007	0x2006	0x3006	pv.Channel_007	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
008	0x2007	0x3007	pv.Channel_008	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
009	0x2008	0x3008	pv.Channel_009	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
010	0x2009	0x3009	pv.Channel_010	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
011	0x200a	0x300a	pv.Channel_011	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
012	0x200b	0x300b	pv.Channel_012	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
013	0x200c	0x300c	pv.Channel_013	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
014	0x200d	0x300d	pv.Channel_014	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
015	0x200e	0x300e	pv.Channel_015	TxPDO	DADSP(7)	INTERGER16(3)	0.061039
016	0x200f	0x300f	pv.Channel_016	TxPDO	DADSP(7)	INTERGER16(3)	0.061039

EtherCAT-IF assistant

It is possible to subsequently remove any EtherCAT channels from the XML file.

In the first step, pv.Variables appear as EtherCAT outputs. Process vector variables created in imc Online FAMOS can be converted to EtherCAT inputs.

9.2.5.6.1 Procedure - Configuration variants

Configuration variant I (no mapping)

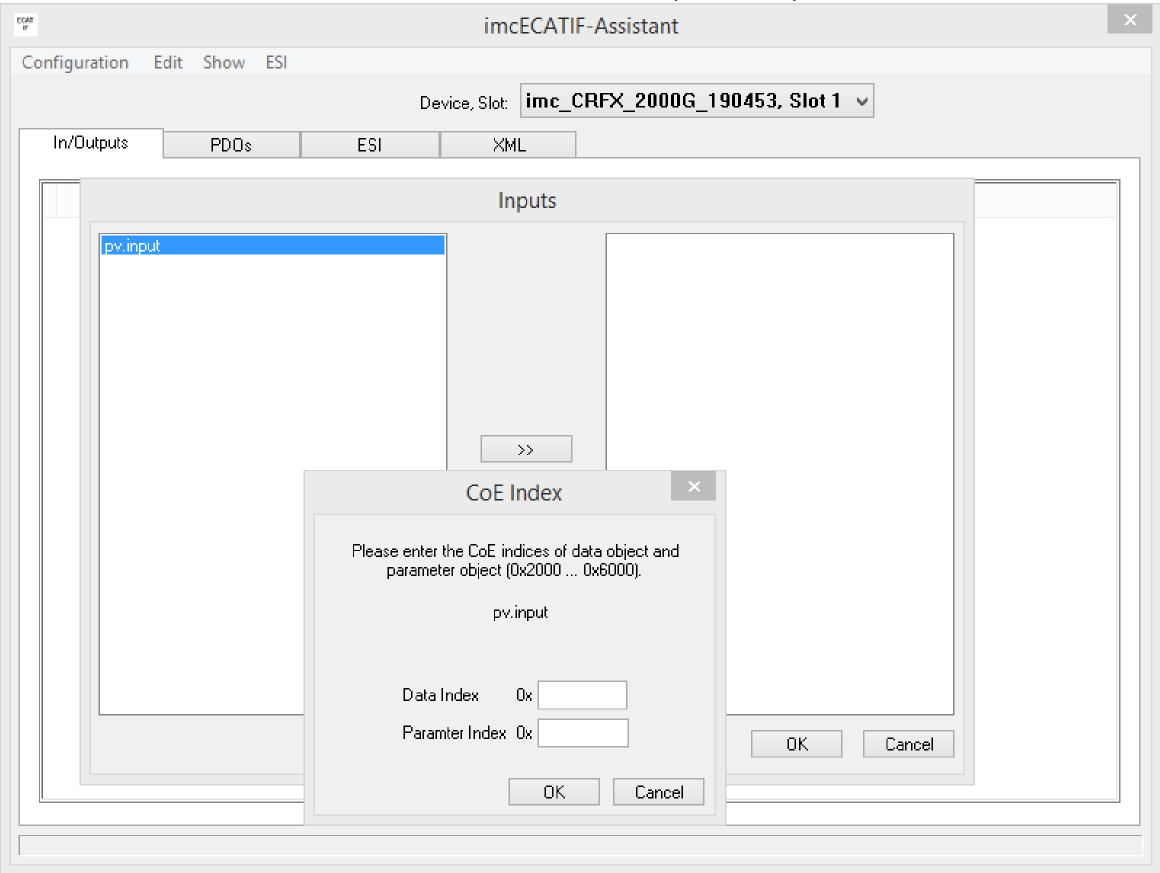
1. Create an experiment with all channel settings etc.
2. Under Edit > Outputs 609 or Edit > Inputs 609, define which PVVs in the imcECAT-IF's CANopen object directory are to be mapped.
3. Using Edit > Add PDO 609, define the PDOs needed for the mapping. If the PDOs don't correspond to any specific structure, they can be generated automatically using Edit > Create PDOs 609 automatically
4. Save the configuration created by means of Configuration > Accept changes 609.
5. With ESI > Save device specific ESI 610, you can, if desired, save an ESI document containing a map of the CANopen object directory.
6. Close the Assistant. Upon the next preparation, the EtherCAT interface is configured.

Example:

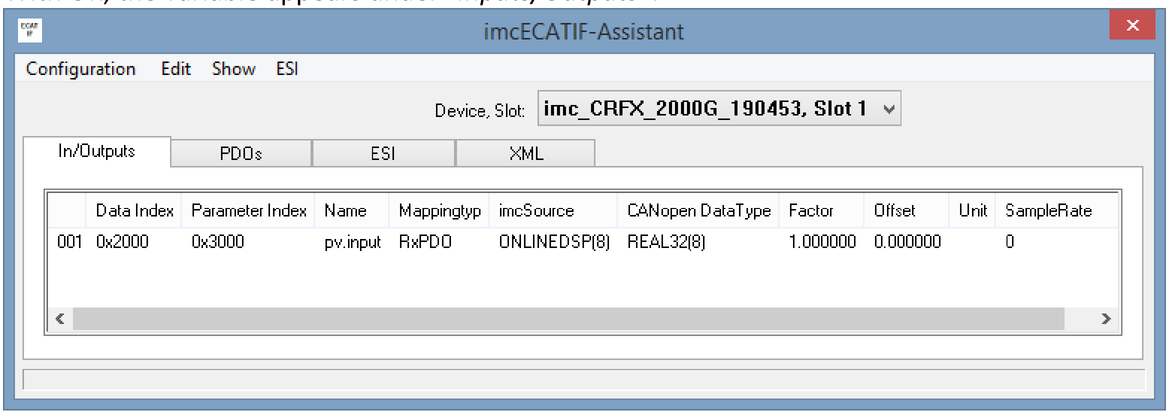
- Define target variable(s) (PV) in Online FAMOS. Activate "*With control commands*" under "*Extra*" and create the variable:

```
; Executed one single time after the task is started
OnInitAll
    pv.input= 0
End
```

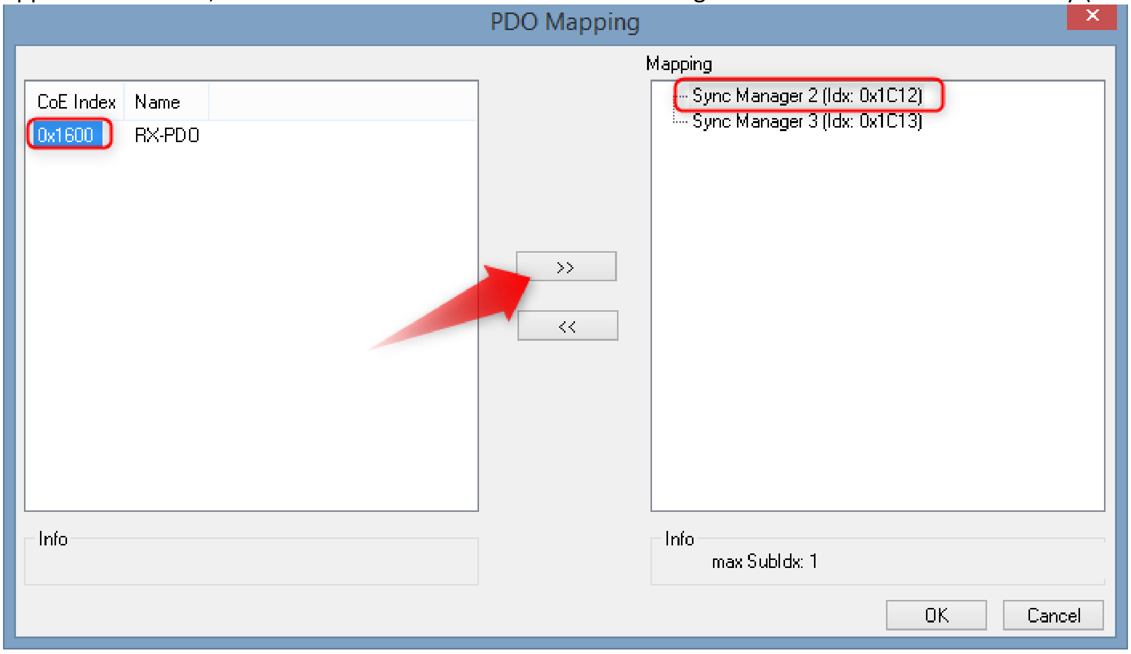
- Open the ECATIF Assistant. In the menu "*Edit*" under "*Inputs*" move the PV variable to the right side (">>"). The information about *Data Index* and *Parameter Index* should be provided by the ECat Master.



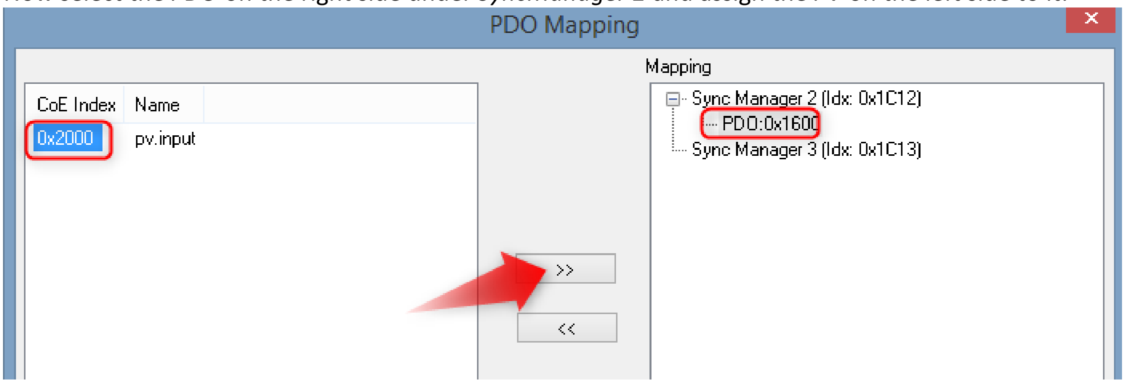
- With OK, the variable appears under "*Inputs/Outputs*":



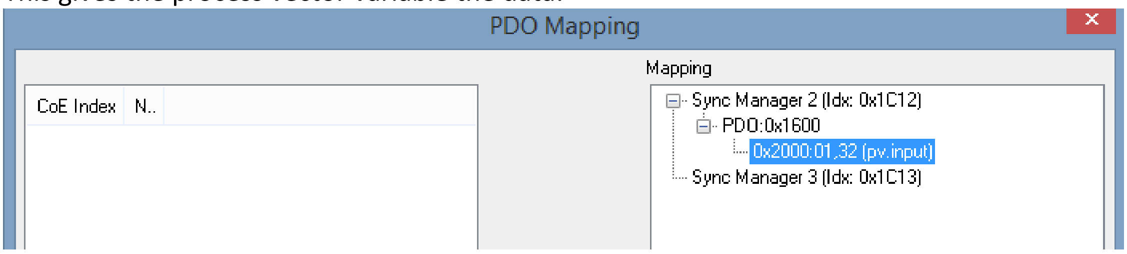
- The PDOs are then generated. Use the "*Edit*" menu to select either automatic ("*Automatic build PDOs*")" or manual ("*Insert PDO*"). In the example, it is selected automatically.
  Select "*Edit*" --> "*Mapping*" in the menu. Click on *SyncManager 2* on the right side and assign the *Rx-PDO* that appears. To do this, the *Rx-PDO* must be marked before the assignment is made with the arrow key (">>").



- Now select the *PDO* on the right side under *SyncManager 2* and assign the *PV* on the left side to it:



- This gives the process vector variable the data:



- With Online FAMOS a virtual channel can be created from this variable:

```
; Constantly repeated between the trigger start and the trigger end
OnTriggerMeasure(Trigger_48_imc_CRFX_2000G_190453)
    vc_ECAT_Input= CreateVChannelInt(Channel_001, pv.input)
End
```

Configuration variant II

1. Create an experiment with all channel settings, imc Online FAMOS etc.
2. Under Edit > Outputs 609 or Edit > Inputs 609, define which PVVs in the imcECAT-IF's CANopen object directory are to be mapped.
3. Using Edit > Add PDO 609, define the PDOs needed for the mapping. If the PDOs don't correspond to any specific structure, they can be generated automatically using Edit > Create PDOs automatically 609.
4. Under Edit > Mapping 609 create the mapping of the cyclical data transfer.
5. Save the configuration created by means of Configuration > Accept changes 609.
6. With ESI > Save device-specific ESI 610, you can, if desired, save an ESI document containing a map of the CANopen object directory.
7. Close the Assistant. Upon the next preparation, the EtherCAT interface is configured.

9.2.5.6.2 Creation and editing of a configuration

The connection between the EtherCAT Interface and data acquisition channels is established by channel names. Configured channels which are subsequently deactivated or renamed remain in the EtherCAT configuration for later use without causing any problems.

Note

Once an EtherCAT configuration has been created, any changes to the experiment are not reflected in the EtherCAT configuration. This means that additional channels and channels having new names must be set up in the EtherCAT Assistant in a separate procedure.

Once the configuration set has been prepared for the EtherCAT Interface by means of the menu item New 609, the channels can be set as either outputs or inputs with data and parameter addresses.

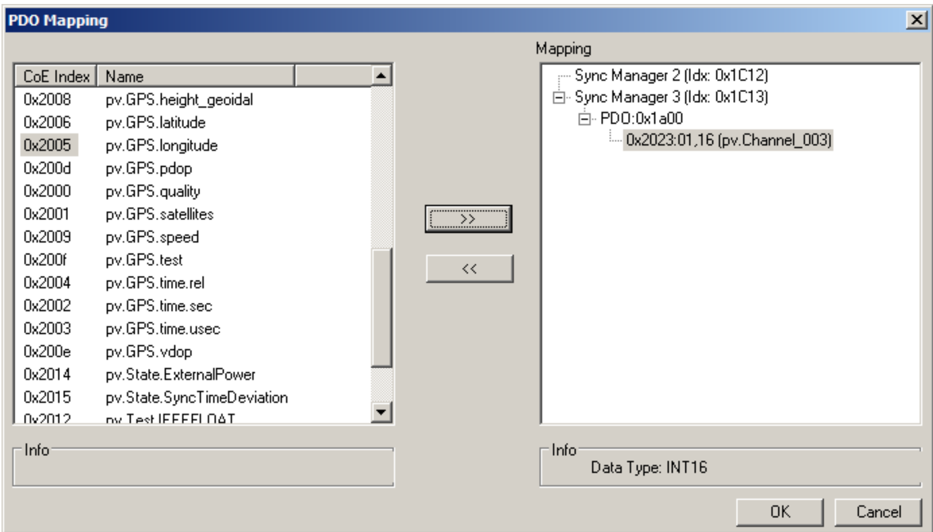
Alternatively, you can generate a complete EtherCAT configuration using the menu item Create PDOs automatically 609.

9.2.5.6.3 Menu

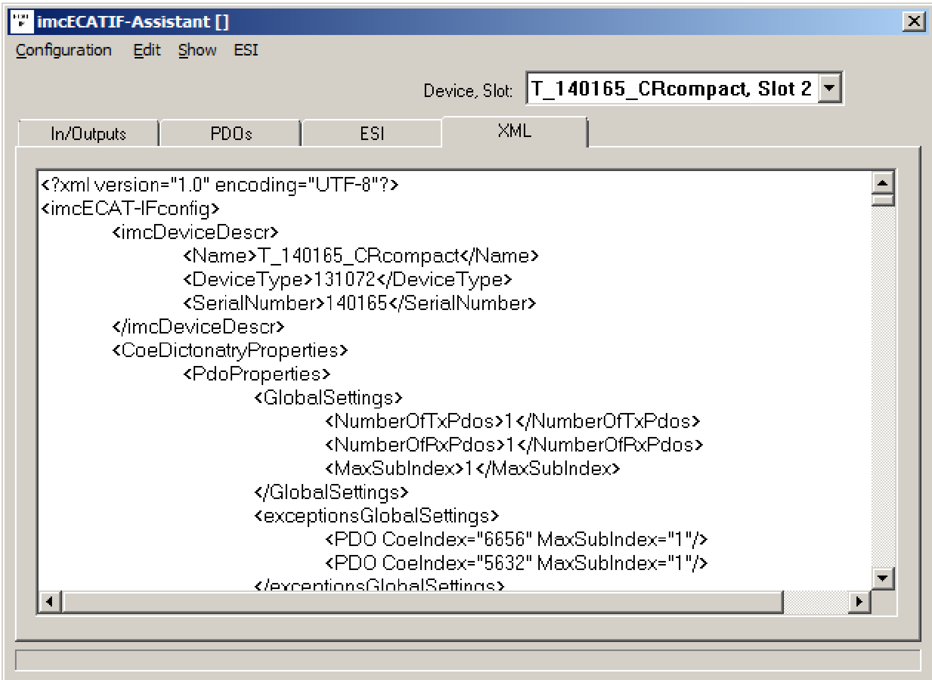
Configuration

Menu item	Description
New	This creates a new configuration. Existing settings are reset. Next, the channels must be set as either outputs 609 or inputs 609 under Edit.
Accept changes	Saves the current EtherCAT configuration within the experiment.
Import	Loads a previously saved configuration. Note that the channel names are decisive for the connection between the data acquisition channels and the EtherCAT Interface. If you use an existing EtherCAT configuration, make sure that the channel names match.
Export	Saves the current EtherCAT configuration. Thus the configuration can be used for an experiment that will be loaded for a different device.

Edit

Menu item	Description
Outputs	Device channels outputted via EtherCAT must be configured as outputs 611.
Inputs	Device pv.Variables which are written via EtherCAT must be configured as inputs.
Add PDO	The PDOs act as the containers in which the inputs and outputs are organized. The menu item allows manual configuration.
Delete PDOs	Use this menu item to delete any PDOs no longer needed.
Create PDOs automatically	PDOs can also be generated automatically.
Mapping	 **Mapping dialog** Create the configuration as described in the section Configuration variant II 608. Subsequently, you can adapt the mapping.

Show

Menu item	Description
Inputs/Outputs	Display of all inputs and outputs in the Editor.
Inputs	Display of all inputs in the Editor.
Outputs	Display of all outputs in the Editor.
PDOs	Display of all Rx- and TxPDOs in the Editor.
RxPDOs	Display of all RxPDOs in the Editor.
TxPDOs	Display of all TxPDOs in the Editor.
Xml	Display of the XML-configuration generated.  **Show configuration as XML**

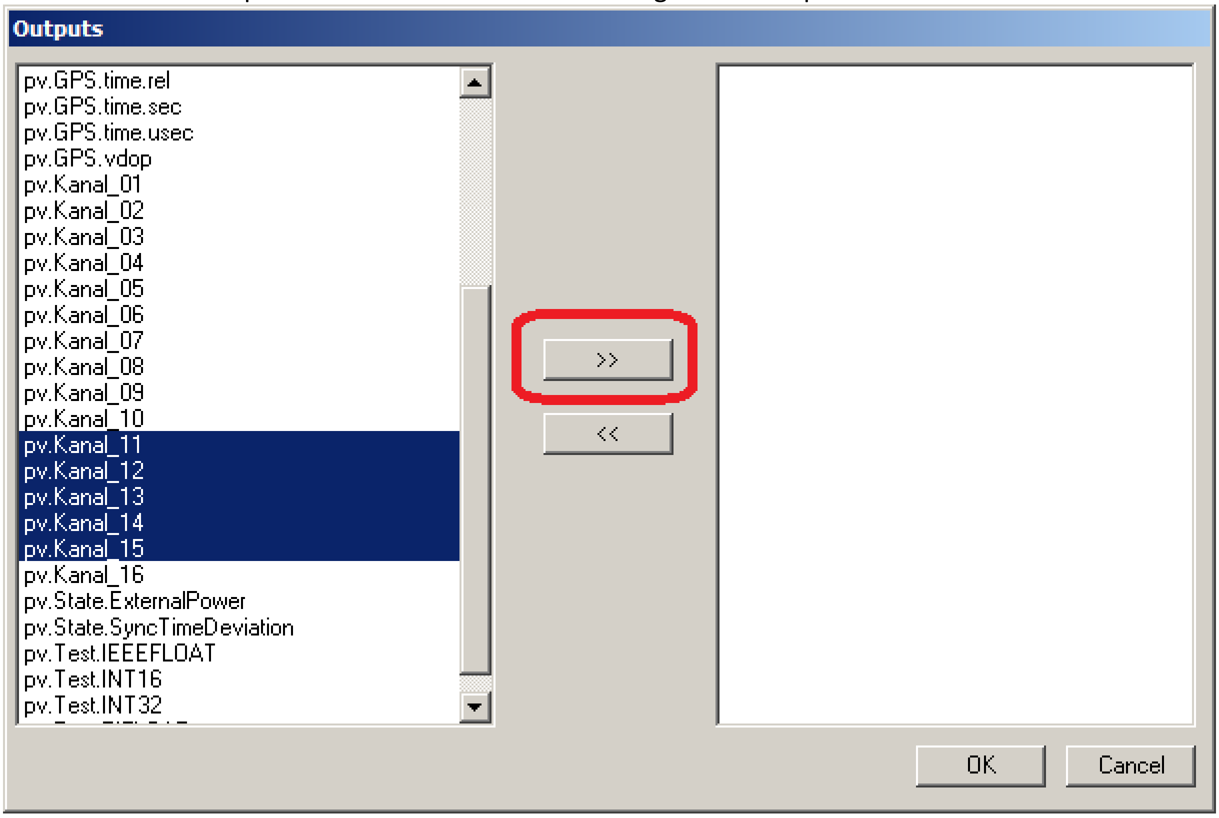
ESI

The EtherCAT interface's transfer properties can be transferred as an ***E****therCAT-****S****lave-****I****nformation* document (ESI).

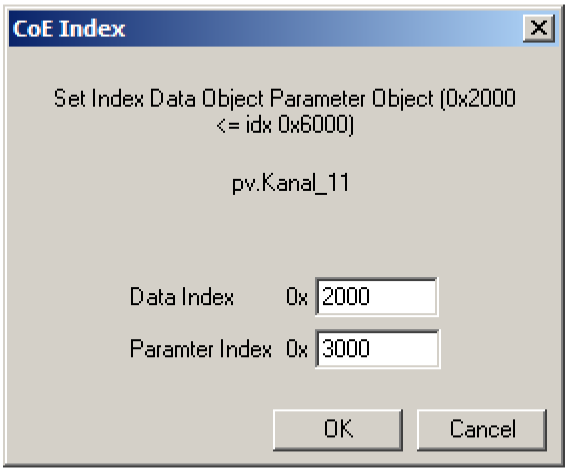
Menu item	Description
Save general ESI	Saves the current EtherCAT configuration as general EtherCAT-Slave-Information configuration.
Save device-specific ESI	Saves the current EtherCAT configuration as ESI configuration for a certain device. The device-specific ESI-documents include information on the VendorID, ProductCode and **serial number**.

9.2.5.6.3.1 Configured as outputs

Device channels outputted via EtherCAT must be configured as outputs.



Select one or more pv.channels and click >>



Set object index

A unique index must be specified both for the data part and for the parameters.

The parameters contain such information as unit, offset, etc.

When multiple channels are selected, the option *Auto Index* is offered. If it is active, you set the addresses for the first channel. Subsequent channels are automatically incremented up.

The addresses are specified in EtherCAT's usual numerical format **Hex**, in other words with "0x" preceding the number. The number range is fixed from **0x2000 through 0x6000**.

When you click on *OK*, the outputs are configured and listed on the right side.

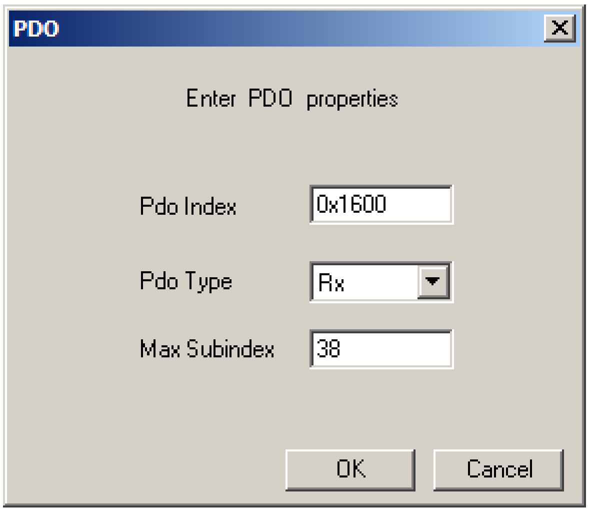
Outputs generated with *Create PDOs automatically* 609 can be brought to the left side using the button <<. Subsequently, these appear under *Edit > Inputs* 609 and can be configured as inputs there.

9.2.5.6.3.2 Add PDO

The PDOs act as the containers in which the inputs and outputs are organized. The menu item Create PDOs automatically 609 also generates these. The menu item *Edit > Add PDO* allows manual configuration.

PDOs for sending contain **outputs** and are called **RxPDOs**.

PDOs for receiving contain **inputs** and are called **TxPDOs**.



Add PDO

Creation of an RxPDOs with index 0x1600 and subindex 38.

9.2.6 FlexRay-Bus Interface

What is the FlexRay-Bus?

FlexRay is a Field-bus system used for high-speed, deterministic data transfer in automobiles.

For configuration of imc devices connected with FlexRay, imc STUDIO offers the FlexRay Assistant 615.

9.2.6.1 Definitions

Term	Description
Bus	obsolete: see Cluster or Channel
Channel	(two interpretations) 1. FlexRay has two physical channels per cluster (Channel A and Channel B). A channel is an independently operating "DataBus”. The two channels operate in synchronization, i.e. the cycles at Channel A and B begin and end simultaneously. 2. imc-specific: this refers to a measurement channel in imc STUDIO
Cluster	(two interpretations) 1. In accordance with FIBEX: All nodes involved with the Field-bus system and their interconnections. 2. In the Assistant: an element in the overview window which makes the properties of the respective selected imc-FlexRay node accessible. ATTENTION: node and cluster properties are set jointly here

Term	Description
Cycle	The data stream in the channels is subdivided in cycles. Each cycle has a Cycle-ID [0...63]. If the cycle having the ID 63 was sent, then the cycle having the ID 0 is sent next. Thus, a period is 64 cycles long. The cycle subdivisions include the static and dynamic segments. In these two segments, slots are defined in which one can send or receive frames. See also [1] 614
Cycle-Multiplexing	This provides the ability to send different Frame types to the same slot of different cycles. See also [1] 614
Frame	A data package in which multiple signals can be defined. When and where a frame can be sent or received is determined by a frame triggering. Since a frame of a particular type may be scheduled to be sent at different times, multiple frame-triggerings can be assigned to the same frame..
Frame-Triggering	Determines in which slot (Slot-ID) and in which cycle (Cycle-Basis, Cycle-repetition) the assigned frame is to be received or sent.
KeySlot-ID	The Slot-ID of the slot in the cycle's static segment at which the cold-start or Sync frame is to be sent.
Node	Cluster (bus) subscriber. • A node is a Field-bus terminal at a device. • A device can have multiple nodes. • Not every node must be connected with both channels (A and/or B). • Often there is exactly one node in a device.
Node-mode	A property of every FlexRay-node. see also: *FlexRay rules for KeySlotID and the NodeMode* 629 Normal Node • No KeySlotID needs to be specified, since no Cold-start frame or Sync frame is sent • Sync Node: A KeySlotID must be specified. The node will/must send its Sync frame to the specified slot. • Cold-start node: A KeySlotID must be specified. The node will/must send its Cold-start frame to the specified slot.
Signal	A bit series at a particular position in a repeating frame, interpreted as a physical measurement quantity.
Slot	(two interpretations) 1. imc-specific: bay for an imc Field-bus board in an imc device 2. FlexRay-specific: A particular time segment on a channel, in which a specific frame having the associated Slot-ID is sent by a node in the cluster, or which can be received by all other nodes in the cluster.
Slot-ID	See also: Slot, Cycle

9.2.6.2 Reference Literature and Standards

[1]	FlexRay - Protocol Specification V2.1.rev A, Copyright © 2004-2005 FlexRay Consortium
[2]	FlexRay - EPL-Specification - V2.1.rev A, Copyright © 2004-2005 FlexRay Consortium
[3]	FlexRay - EPL-Application Notes - V2.1.rev A, Copyright © 2004-2005 FlexRay Consortium
[4]	FIBEX - Field Bus Exchange Format, AE[FBX] Version 2.0, Release Version, Association for Standardisation of Automation and Measuring Systems, © ASAM e.V

9.2.6.3 Capabilities / Constraints

- **Recording** of the bus data received
- **Deconstruction** of the bus data into signals (measurement channels)
- Measurement of maximum 512 channels per device (total over all channels: analog, incremental etc.)
- Frame and data sending capability
- Sync and cold-start frame sending capability
- No cycle-multiplexing capability in cold-start or sync-frames (KeySlot-frames)
- Import capability for FlexRay-FIBEX files 628, Version 2.0.1 (*.xml)
- Import of FlexRay-FIBEX-Plus 628 files based on the FIBEX version 2.0.1 (*.xml)
- Import of Version 3.0.0 and 3.1.0 FlexRay FIBEX files (*.xml)
- XCP-Master
- Import of A2L 629-files for FlexRay
- Supported XCP-specifications:
  - ASAM_AE_MCD-1_XCP_BS_Protocol-Layer_V1-2-0.pdf “ASAM MCD-1 (XCP); Universal Measurement and Calibration Protocol; Protocol Layer Specification; Version 1.2.0 Date: 2013-06-20”
  - ASAM_AE_MCD-1_XCP_AS_Flexray-Transport-Layer_V1-2-0.pdf “ASAM MCD-1 (XCP on FlexRay); Universal Measurement and Calibration Protocol; FlexRay Transport Layer; Version 1.2.0; Date: 2013-06-20”

Constraints on FIBEX-import:

- no implementation of CODING.COMPU-METHOD.CATEGORY "TEXTTABLE", "SCALE-LINEAR","TAB-NOINTP", "FORMULA"
- no implementation of FRAME.MULTIPLEXERS (with FIBEX 2.0.1) and PDU.MULTIPLEXERs (with FIBEX 3.0.0, 3.1.0)
- no implementation of multiple COMPU-METHOD.COMPU-INTERNAL-TO-PHYS.COMPU-SCALEs per signal; only one COMPU-SCALE is evaluated.
- no implementation of UPDATE-BITs in PDUs and SIGNALs

Note

Observe the general Field bus notes regarding the operation methodology 476 of fixed sampling rates 477 versus timestamp 480.

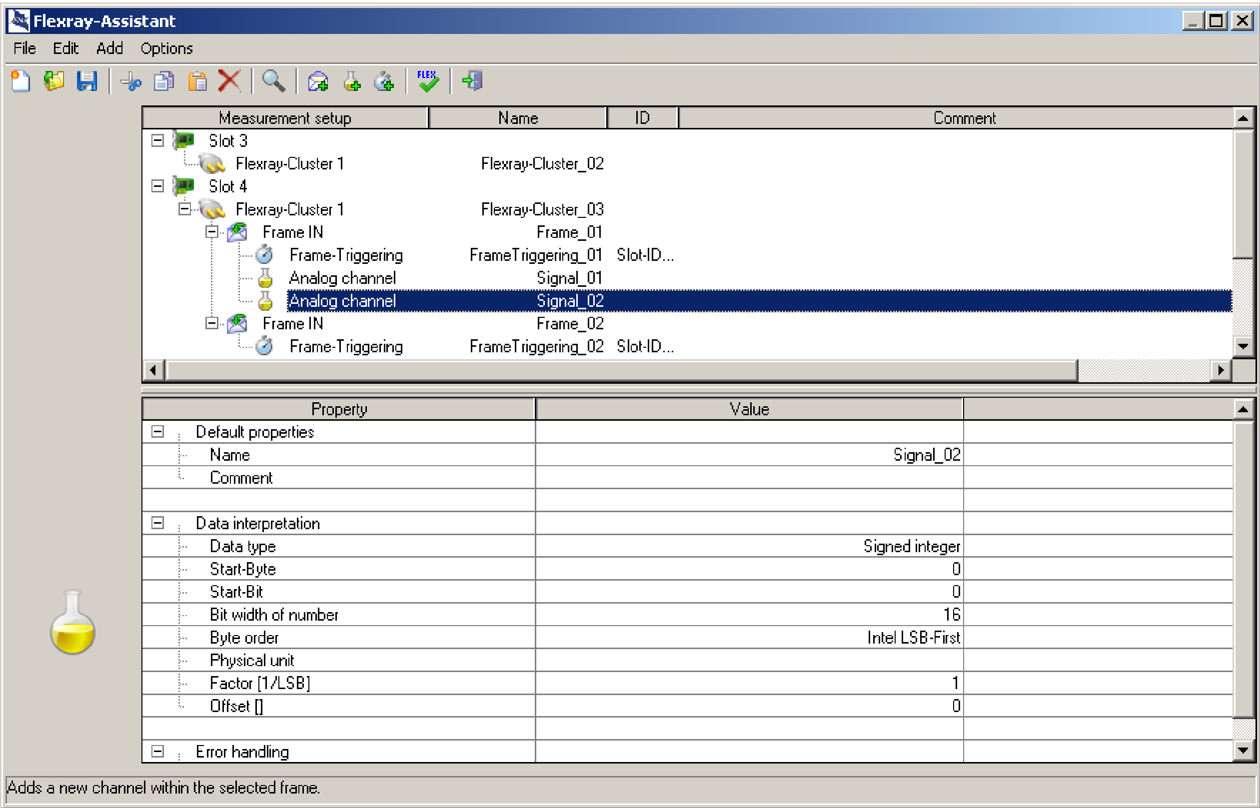
9.2.6.4 DSUB-9 Pin Configuration

Pin	DSUB-9
1	n.c.
2	BM Channel A
3	GND
4	BM Channel B
5	GND
6	n.c.
7	BP Channel A
8	BP Channel B
9	n.c.

9.2.6.5 FlexRay Assistant

To set the FlexRay connections (clusters), as well as to define frames and channels (signals), the *FlexRay-Assistant* is used.

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > FlexRay-Assistant*.



FlexRay Assistant

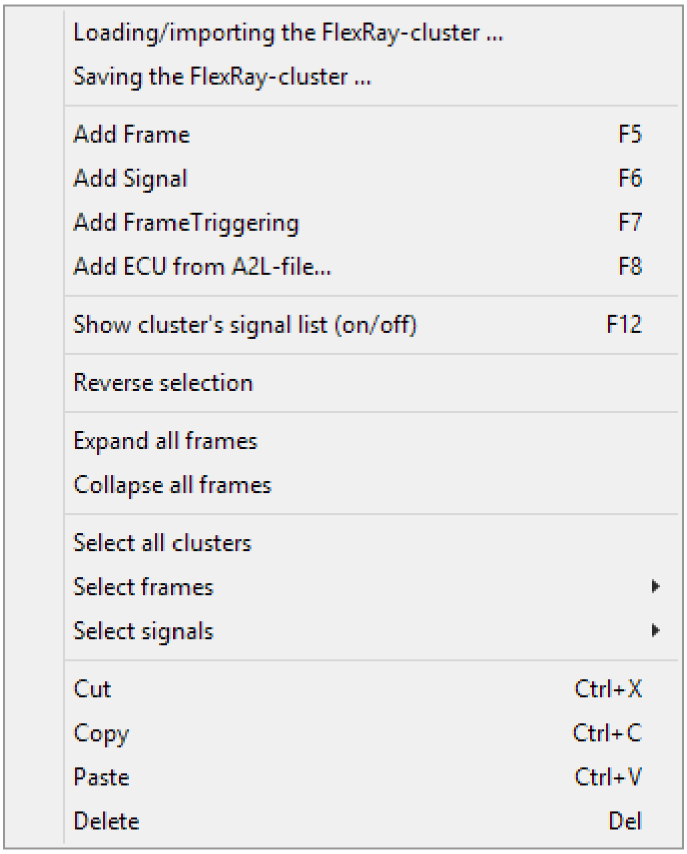
9.2.6.5.1 Overview Window

The Overview window is the upper list box, in which the measurement setup is illustrated schematically as it relates to the FlexRay configuration. What is shown is the measurement devices ( ) with the experiment along with their names. If there is only one FlexRay-capable device in the experiment, it will not be displayed, in the interest of clarity.

Below each measurement device, its built-in FlexRay modules (slots) ( ) with their FlexRay connections (FlexRay clusters) ( ) are shown.

For each FlexRay cluster, the previously defined frames with their associated signals (channels) are shown.

The selection of frames and signals can be made by means of the context menu, also inverted.



Context menu of the overview window

9.2.6.5.2 Properties Window

The Properties window is visible in the lower portion. It displays the editable properties and the settings options for the object currently selected in the Overview window. If multiple objects are selected at the same time, the Properties window shows a selection of suitable properties.

To change a property's value, click on the desired value.

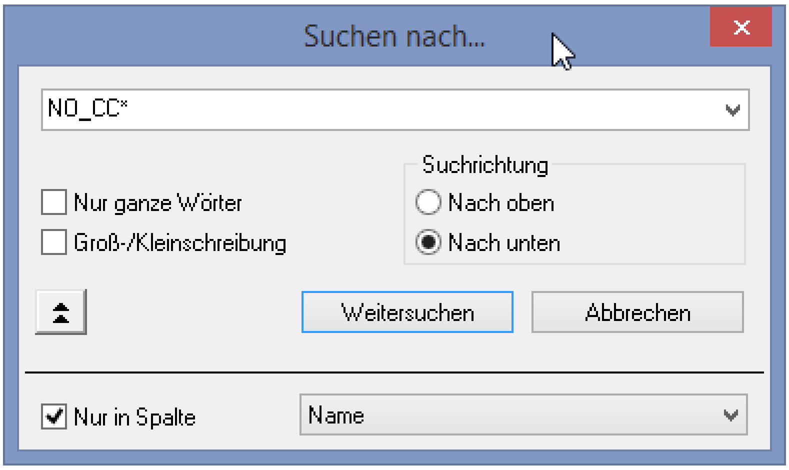
Depending on the property, either a pop-down list or a text box is used.

9.2.6.5.3 Items in the main menu

File

Menu item	Description
New	Deletes any previously created frames and channels and creates an empty FlexRay configuration.
Loading/Importing the selected FlexRay-Cluster	The configuration will be loaded from a file for the selected cluster. Enables the import of an entire FlexRay configuration from a file. Two file extensions are supported. • FRY: an imc proprietary format • XML: FIBEX-XML, see Loading FIBEX-files 628
Saving the selected FlexRay-Cluster	The configuration will be saved into a file for the selected cluster. Only supports FRY; xml-FIBEX not supported.

Edit

Menu item	Description
Copy Paste Cut Delete	These commands only affect elements visible in the overview window. Frames, Frame-Triggerings and signals can only be copied, deleted and pasted. Devices, slots and clusters can not be pasted.
Find Find next [F3]	 In the overview window can be searched for words or part of words. When there are many defined frames/signals, it is reasonable to search for their names. It is also possible to perform a targeted search in the columns selected.

Add

Menu item	Description
Frame	Adds an additional frame to the selected cluster.
Frame- Triggering	Here you can add an additional Frame-Triggering to the selected frame.
Signal	This menu item lets you add an additional signal to the selected frame.
ECU from A2L-file	Adds an additional ECU channel 629.

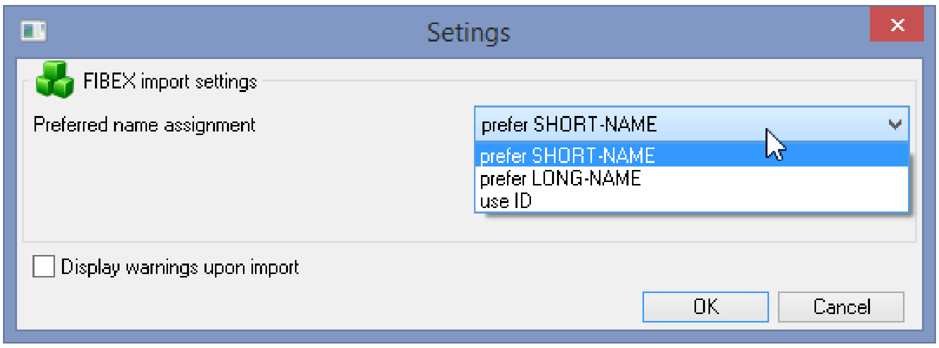
View

Menu item	Description
Display tree diagram Display the cluster's signal list	Toggling between the tree diagram and the list of signals.

Configuration

Menu item	Description
Test FlexRay configuration	Tests whether the settings are valid as they are made. If not, the overview window skips to the invalid object and a message is posted in the Status bar.
Create ECU configuration	Prepares the configuration for the ECUs.

Options

Menu item	Description
Font	Font for the overview window.
Settings	*Preferred name assignment*: As a matter of principle, you can set up the name assignment with either short or long names, or use an ID. All names are constructed in accordance with the construction rule in the cluster properties 619. To display warnings upon importing, activate the corresponding option.  **Options menu: Settings**

9.2.6.5.4 Properties of Clusters

Here, parameters of FlexRay clusters and nodes can be set.

Cluster parameters are parameters which must be the same for all nodes in the cluster in order for the cluster to work without problems. The node parameters only pertain to the node (connection) of the imc device affected. They need not necessarily be the same in all of the cluster's nodes.

Some of the node parameters are only provided as information for certain users. These cannot be edited since they are derived automatically from the settings for the other parameters.

Describing the meaning of every parameter would go beyond present purposes. For more information on this, please see: [1] FlexRay - Protocol Specification 614.

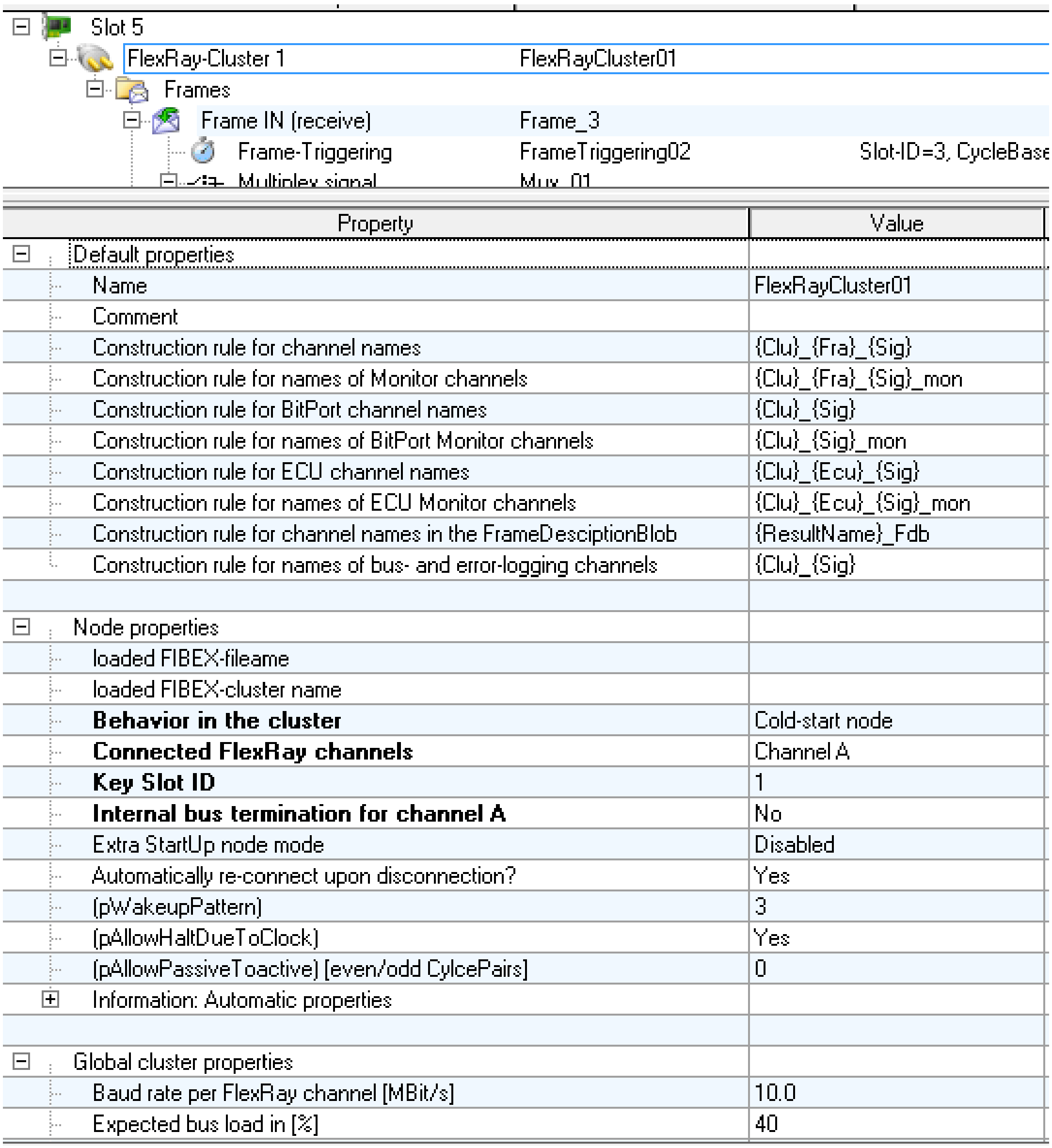
Multiple frames can be created in a cluster.

Construction rule for names of channels

The channel names can be composed from the name entries with placeholders: {Clu} for **Cluster**, {Frm} for **Frame** 621 and {Sig} for **Signal** 623 and **ECU-channels** 629.

Example: Name of the clusters = "*FR_Cl01*", name of the frame= "*Frame01*" and name of the signal = "*Sig01*"

from *{Clu}_abc_{Frm}_{Sig}_123,* the resulting name is: "*FR_Cl01_abc_Frame01_Sig01_123*"



Property	Value
Default properties	
Name	FlexRayCluster01
Comment	
Construction rule for channel names	{Clu}_{Fra}_{Sig}
Construction rule for names of Monitor channels	{Clu}_{Fra}_{Sig}_mon
Construction rule for BitPort channel names	{Clu}_{Sig}
Construction rule for names of BitPort Monitor channels	{Clu}_{Sig}_mon
Construction rule for ECU channel names	{Clu}_{Ecu}_{Sig}
Construction rule for names of ECU Monitor channels	{Clu}_{Ecu}_{Sig}_mon
Construction rule for channel names in the FrameDesciptionBlob	{ResultName}_Fdb
Construction rule for names of bus- and error-logging channels	{Clu}_{Sig}
Node properties	
loaded FIBEX-fileame	
loaded FIBEX-cluster name	
Behavior in the cluster	Cold-start node
Connected FlexRay channels	Channel A
Key Slot ID	1
Internal bus termination for channel A	No
Extra StartUp node mode	Disabled
Automatically re-connect upon disconnection?	Yes
(pWakeupPattern)	3
(pAllowHaltDueToClock)	Yes
(pAllowPassiveToactive) [even/odd CylcePairs]	0
Information: Automatic properties	
Global cluster properties	
Baud rate per FlexRay channel [MBit/s]	10.0
Expected bus load in [%]	40

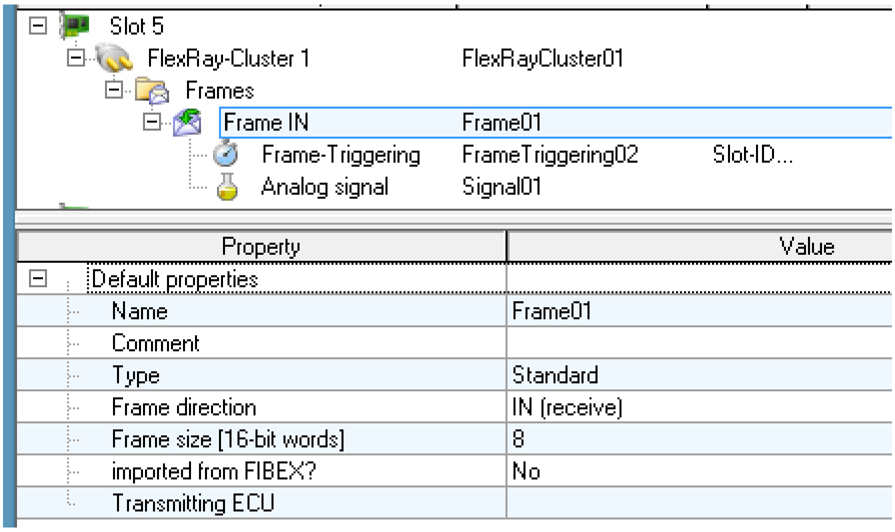
Properties of Clusters

Note

If *Recording of null- or data frames* is activated, then all frames are processed on the bus, which can lead to performance problems if the data load on the bus is high. If the logging is deactivated, then only such frames which are listed in the FlexRay Assistant are processed.

9.2.6.5.5 Properties of Frames

In the frame parameters only the length and direction can be specified. Within a frame, multiple signals and multiple frame triggerings can be created.



Properties of Frames

Parameter	Description
Name	Here, an arbitrary name can be entered for the frame. It will also be displayed in the Overview window under the Name column. This property represents a brief description. With the option "always prefix with the frame name", then frame name is automatically prefixed to the channel name.
Comment	The comment is for providing a more detailed description of the frame.
Typ	Standard, XCP-pre configured or XCP-runtime configured.
Frame direction	This property determines whether the frame is to be received and interpreted by the measurement device (incoming, receiving, IN) or whether this frame is to be assembled and sent (outgoing, sending, OUT).
Frame size [16-bit-words]	This property sets the number of data bytes the frame has. This must be between 0 and 127.
imported from FIBEX?	Info on whether the frame is loaded from FIBEX.
Transmitting ECU	Designation of the ECU if available

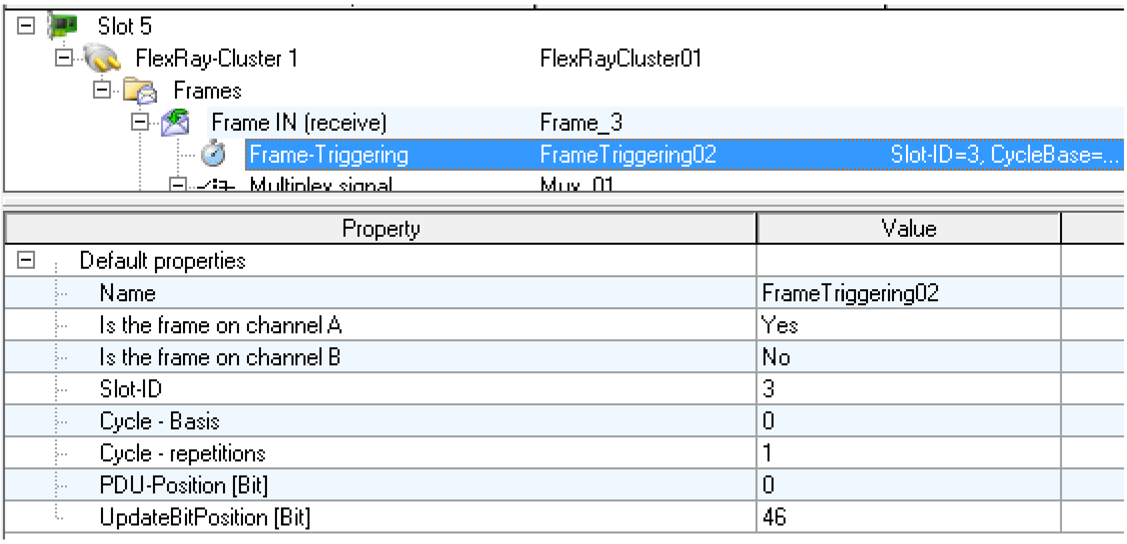
9.2.6.5.6 Properties of Frame-Triggerings

A Frame-Triggering determines when and where a frame is to be sent or received. For this reason, the Slot-ID, Cycle-Base, Cycle-Repetition and the channel assignment are found here.

The separation of frames and the triggering is due to the fact that it allows one to specify multiple points in time at which to send / receive a frame, without needing to define (enter) new frames with all the associated signals each time.

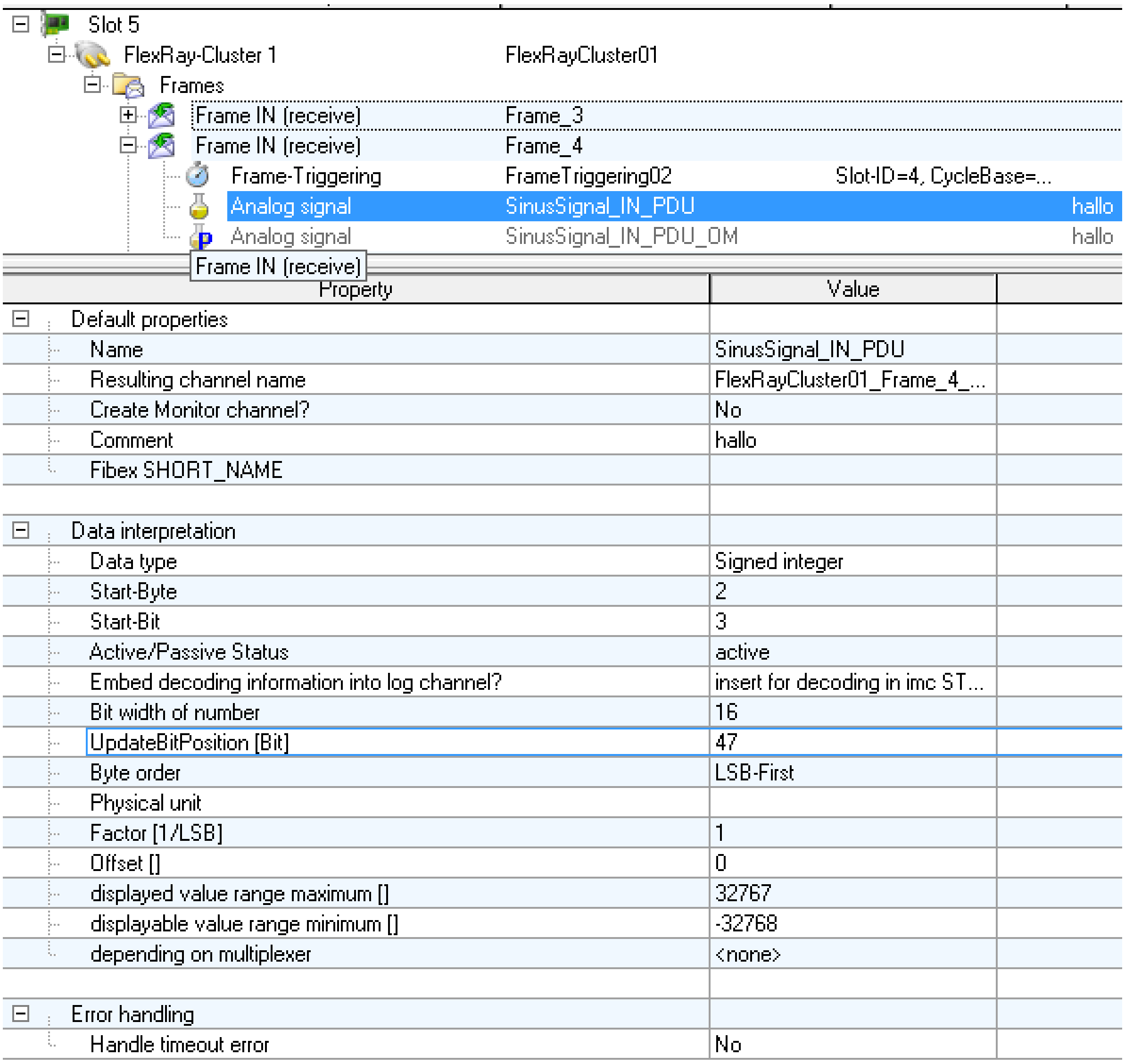
The property PDU-Position indicates a shift of all signals in the frame. The signals are shifted backwards by the specified value in bits. This means that the signal positions can be different for each Frame-Triggering.

The *UpdatedBitPosition* sets the position of the PDU's validity control bit. The signals in this frame are only evaluated if the bit (here at position 46) is set to "1". In addition, the signal-specific UpdateBit 624 must also be set to "1.



Properties of Frame-Triggerings

9.2.6.5.7 Properties of Signals



Properties of Signals

Default properties	Description
Name	Sets the channel's name, with which one works in imc STUDIO. This name must conform to the rules and the format applicable to a imc STUDIO channel name.
Resulting channel name	The channel name which results from the construction rule 619 in the Cluster properties.
Create Monitor channel?	If "Yes", a copy of the channel is generated. The name is determined according to the construction rule 619.
Comment	Specifies the comment for this channel.
Fibex SHORT_Name	Specifies the short name of the signal as it appears in the FIBEX file.

<table>
<tr><th>Data integration</th><th>Description</th></tr>
<tr><td>Data type</td><td>This sets the signals type, or rather, how the data on the bus are interpreted. The following data types are possible:
<table>
<tr><th>Data type</th><th>Description</th></tr>
<tr><td>Signed Integer</td><td>The bit widths available for this data type are 2 to 32 bits.</td></tr>
<tr><td>Unsigned Integer</td><td>The bit widths available for this data type are 2 to 32 bits.</td></tr>
<tr><td>Floating point</td><td>Either 32-bit or IEEE 64-bit floating point format are available.</td></tr>
<tr><td>Bit</td><td>A single bit as a digital signal.</td></tr>
</table></td></tr>
<tr><td>Active/Passive Status</td><td>Allows signals to be hidden

The configuration files to be imported often contain multiple thousands of signals. Up to 990 Field-bus channels can be registered for each imc device. There is a limit of 512 active channels per device. Once the count of signals belonging to a device has been exceeded, it is necessary to select which ones are important for the measurement.
<table>
<tr><th>Active/Passive Status</th><th>Remarks</th></tr>
<tr><td>active</td><td>The signal is set as an active channel and recorded.</td></tr>
<tr><td>passive</td><td>The signal is registered in the system as a channel, but set to passive. No measured data are recorded.</td></tr>
<tr><td>Do not register with administration</td><td>The signal is not registered in the system. This signal only exists in the Assistant. No measured data are recorded.</td></tr>
</table></td></tr>
<tr><td>Embed decoding information into log channel?</td><td>The option allows the data stream to be unpacked as individual channels in imc STUDIO by the Bus Decoder 1683 or via imc FAMOS. This setting is independent of the setting: "Active/Passive Status".

The exception is "XCP over Flexray"-channels.
<table>
<tr><th>Information</th><th>Description</th></tr>
<tr><td>don't insert</td><td>Decoding is not possible.</td></tr>
<tr><td>insert</td><td>The channel can be extracted offline, e.g. with imc FAMOS.</td></tr>
<tr><td>insert für decoding in imc STUDIO</td><td>The channel can be extracted with the Bus Decoder or offline, e.g. with imc FAMOS.</td></tr>
</table></td></tr>
<tr><td>Bit-width of number</td><td>This property sets the signal’s length. Different maximum and minimum values can be entered, depending on the data type.</td></tr>
<tr><td>UpdateBitPosition (Bit)</td><td>If a bit position is entered here, the signal is only evaluated if the relevant update bit is set. With the value"-1", the signal is always evaluated.</td></tr>
<tr><td>Byte order</td><td>Intel (LSB first) or Motorola (MSB first)</td></tr>
<tr><td>Start-Byte and Start-Bit</td><td>These two properties determine at which position within the frame the signal begins. Outgoing signals may not occupy the same bits in the frame; for incoming signals this is not a problem.</td></tr>
</table>

<table>
<tr><th>Data integration</th><th>Description</th></tr>
<tr><td>Physical unit</td><td>Here you can enter a physical unit or its abbreviation, e.g. "V" for Volt. Use SI-units wherever possible. It is not advised to enter any scaling prefix such as m for milli-. Instead, adjust the factor correspondingly. The imc STUDIO curve windows automatically add such prefixes to correspond to the measured values.</td></tr>
<tr><td>Factor and Offset</td><td>If the signal currently selected happens to be of the integer data type, signed or unsigned, then both the properties Factor and Offset are displayed.

These values are parameters for linear transformation, which are computed by the following formulas.

<table>
<tr><th>Incoming signal</th><th>Outgoing signal</th></tr>
<tr><td>$y = f \cdot x + a$</td><td>$x = \frac{y}{f} - \frac{a}{f}$</td></tr>
</table>

Variable definition
y - physical value
x - integer on the Field-bus
f - factor
a - offset

An incoming signal is a 16-bit unsigned integer. Thus, the integer's numerical range is 0 LSB to 65535 LSB. The physical quantity which it represents is a voltage between 10 V and 20 V. The factor is thus given by the equation
$f = \frac{20\ \mathrm{V}\ - 10\ \mathrm{V}}{65535\ \mathrm{LSB}} = 1.526 \cdot 10^{-4} \frac{\mathrm{V}}{\mathrm{LSB}}$
and the offset is
$a = 10\ \mathrm{V}$
Supposing the following integer were imported from the bus,
$x = 13483\ \mathrm{LSB}$
it would correspond to a voltage of
$y = f \cdot x + a = 12.057\ \mathrm{V}$</td></tr>
<tr><td>displayed value range minimum, maximum</td><td>Boundaries of the value range. This is calculated in observance on the factor, the offset and the bit width.</td></tr>
<tr><td>depending on multiplexer</td><td>Reference to the Multiplexer signal on which this signal depends.</td></tr>
</table>

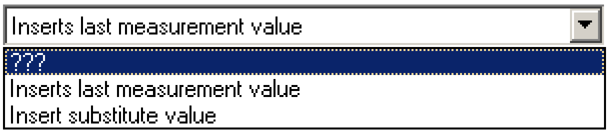
Handle timeout error

The term timeout-error refers to a case where no measured value is received from the field-bus after a certain period; error handling can be set to deal with such an occurrence.

Parameter	Description
Handle timeout error	This settings option determines whether error handling of any timeout error would be performed.
Timeout Interval [s]	This is where to set the time limit after which a timeout-error is considered to have occurred.

Error handling action

This setting determines the action to be performed in case the timeout time limit elapses.



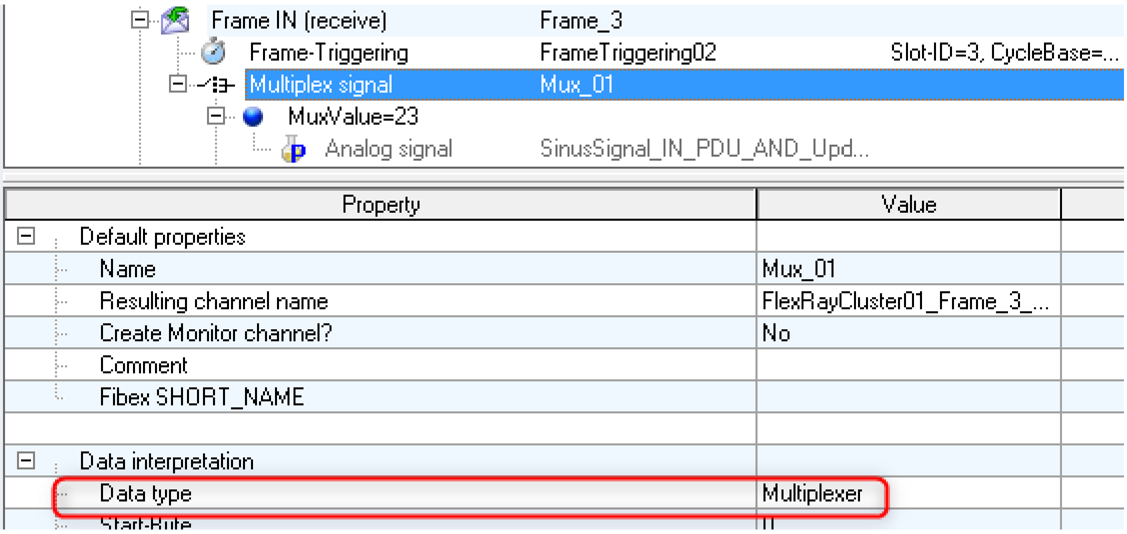
For this purpose, the following options are available, whose effects depend on whether a channel is sampled equidistantly or recorded with a time stamp.

Error handling	Equidistant sampling	Samples with time stamp
Last value	The last valid value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the last value.
Substitute value	The substitute value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the substitute value.

9.2.6.5.7.1 Multiplexer Signal

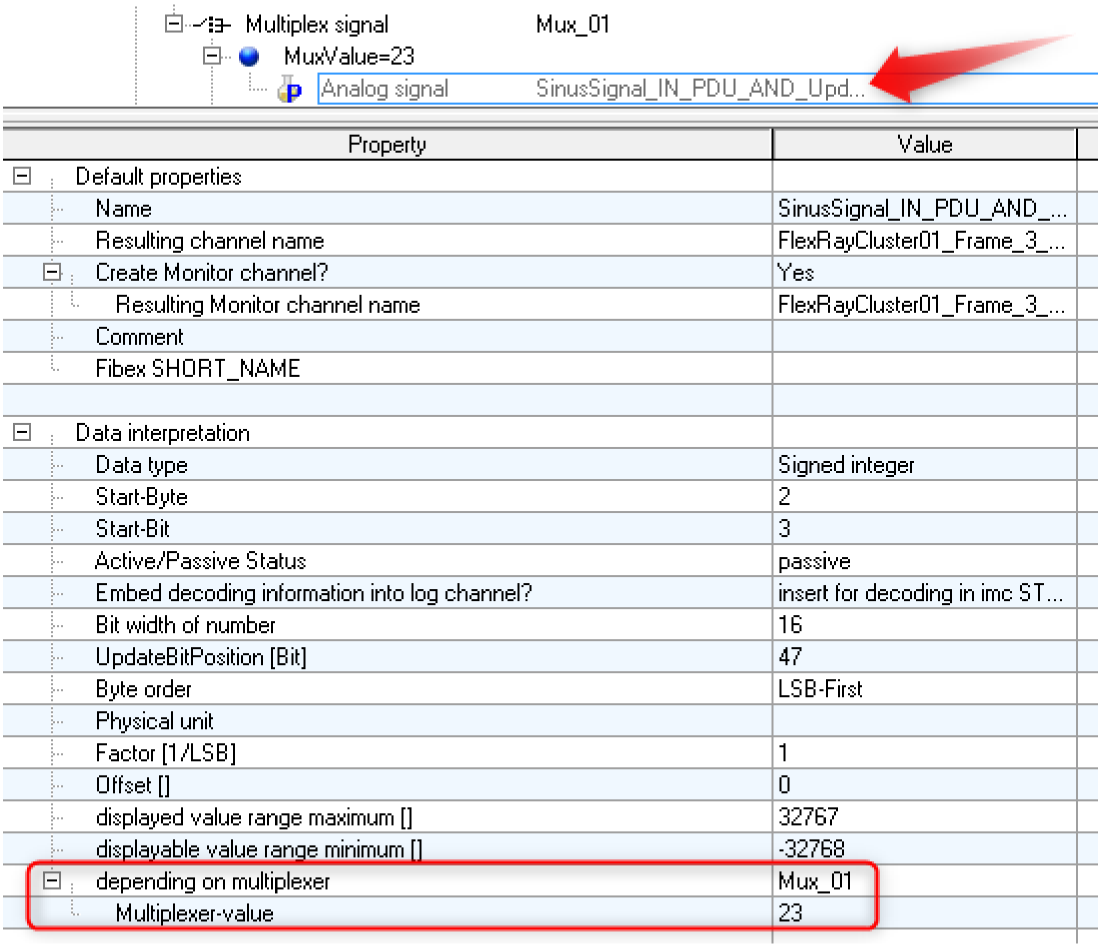
If the data type of a signal is set to "*Multiplexer*", the frame can be evaluated depending on an UpdateBbit.

1. First, a signal is created whose data type is set to "*Multiplexer*":



Set "Data type" of signal to "Multiplexer"

2. Another signal is applied. In the "*Data interpretation*" branch, the previously created multiplexer is selected in the property "*depending on multiplexer*". A further line for the "*Multiplexer-value*" is then inserted, in which the value for the validity of the signal must be entered.



Property	Value
Default properties	
Name	SinusSignal_IN_PDU_AND_...
Resulting channel name	FlexRayCluster01_Frame_3_...
Create Monitor channel?	Yes
Resulting Monitor channel name	FlexRayCluster01_Frame_3_...
Comment	
Fibex SHORT_NAME	
Data interpretation	
Data type	Signed integer
Start-Byte	2
Start-Bit	3
Active/Passive Status	passive
Embed decoding information into log channel?	insert for decoding in imc ST...
Bit width of number	16
UpdateBitPosition [Bit]	47
Byte order	LSB-First
Physical unit	
Factor [1/LSB]	1
Offset []	0
displayed value range maximum []	32767
displayable value range minimum []	-32768
depending on multiplexer	Mux_01
Multiplexer-value	23

Select multiplexer and set "Multiplexer-value"

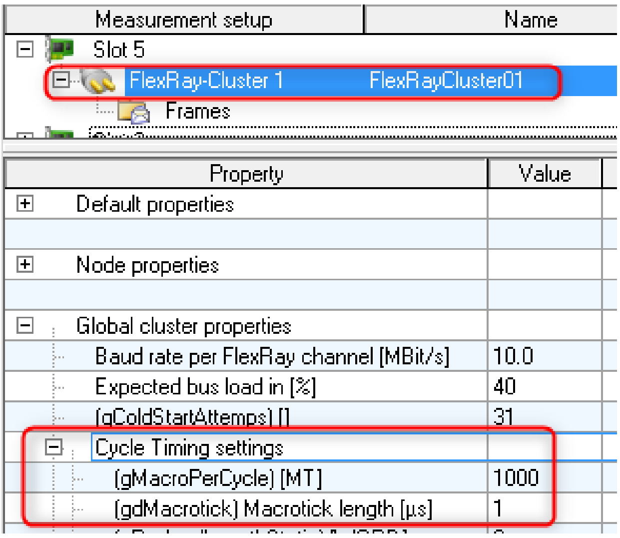
9.2.6.5.8 Blob - Decodieren with the Bus Decoder

All data associated with a FlexRay-node can be captured completely as a log channel. This is a way around the limitation of 512 channels per device instance. Along with separation into individual channels with imc FAMOS, this can be accomplished already with imc STUDIO's Bus Decoder 1683.

To do this, you make the following settings in the FlexRay-Assistant:

- The FlexRay channels to be extracted from the protocol channel in Bus Decoder must be set to "*insert for decoding in imc STUDIO* " in the properties under "*Embed decoding information into log channel*". With "*insert for decoding in imc STUDIO*", the channels in imc STUDIO and imc FAMOS can be extracted. With "*insert*" they are only visible in imc FAMOS.
- With FlexRay, a protocol channel is created with the first insertion of an incoming signal. There is no active/passive switch in the FlexRay Assistant.

Note — Notes on the sampling rate (cycle time)



In FlexRay, a channel's sampling rate is not entered directly but results from a formula applied to the following parameters:

Sampling interval = *gMarcoPerCycle* * *gdMarcotick* * *CycleRepetition*

Example: 1000 * 1µs * 2 = 2ms

In this way, sampling rates can result which could not be set directly due to the specified steps as multiples of 1-,2-, and 5. Instead, the device applies the next higher permitted sampling rate.

Example:

Calculated sampling rate Bus Decoder = 333Hz

Sampling rate set in the device = 500Hz

For this reason, different sampling rates may be shown for the same signal when comparing data from the device with data from the Bus Decoder.

9.2.6.5.9 Loading FIBEX-files

Only a FIBEX file having FlexRay-Cluster description may be imported. Files with Field-bus descriptions of other bus systems are omitted.

If multiple clusters are to be described in the FIBEX-file, then the first configuration is loaded on the Assistant's first cluster, the second configuration is loaded on the second cluster and so on.

Loading of the FIBEX files is completed when there are no more cluster configurations in the file or no more free clusters in the Assistant (device).

Import of FIBEX-Plus files

When importing FIBEX-Plus files it is also possible to load and apply PDU (Protocol Data Unit) positions. This data element determines the Byte position of a group of signals within a frame. The data element is set up in the frame triggering structure. This means that the previous incoming frames may become PDUs.

When sending frames, the property PDU-Positions belonging to the Frame-tiggerings is ignored. For this reason, only complete frames can be sent.

When importing signals, the following properties are displayed: Short-Name, sending ECU, Frame-Name, Signal- and Frame-Comment.

After loading

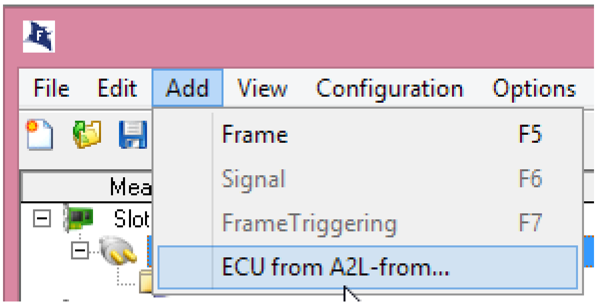
After loading a FIBEX-file, the following issues/ settings should be considered, since the imported FIBEX does not contain any information on the imc measurement system.

- Should the internal terminators be connected?
- With which channels (A and/or B) is the imc device connected?
- Should the imc device's connection work as a "Normal-", "Coldstart-" or as a "Sync-node"?
- **If** the device must work as a "Coldstart-" or as a "Sync-node", the "KeySlotID" must be specified additionally, see also FlexRay rules for the KeySlotID and node mode 629.

These settings can be found in the properties of each cluster. To make them easier to find, they appear in bold letters.

9.2.6.5.10 Loading A2L files (XCPoFlexRay)

XCP over FlexRay.



The Import Assistant for A2L files displays all the available names and their associated address and comment.

9.2.6.5.11 FlexRay rules for the KeySlotID and node mode

- At least two and at most three Coldstart-nodes must be configured in a cluster.
- Each Coldstart-node is at the same time a Sync-node.
- Each Sync-node (and thus each Coldstart-node) has **its own unique** KeySlotID.
- A KeySlotID is a SlotID located in the cycle's static segment (never in the dynamic segment).

Note

- The FlexRay Assistant is only familiar with the FlexRay nodes which exist in the imc device.
- Nodes which otherwise only exist in the connected FlexRay-cluster are not known to the Assistant.
- For this reason, they cannot be checked according to the rules stated above.

9.2.6.5.12 Procedure for connecting and recording

General Procedure

- Connect the imc device at the cluster, otherwise no recording/measurement is possible.
- Preferably **do not** be connect the imc device at the ends of the bus line, otherwise the internal terminator for the connected channel(s) (A, B) must be activated, which may lead to excessive bus terminations, since the bus may already be terminated in the connection lines used or in the other bus subscribers.

9.2.6.5.12.1 Recording (measuring) an entire cluster

Example:

- A FIBEX-file has been loaded.
- The cluster is completely present, i.e. all devices described in the FIBEX file are present and connected as described in the FIBEX-file.

Procedure:

- see General Procedure 629
- In the cluster-settings, set the Node-mode ("behavior of Cluster") to "Normal node".

9.2.6.5.12.2 Cluster with missing Coldstart-node

Example:

- A FIBEX-file has been loaded.
- The cluster is only partially present. A (Coldstart-) node (device) is missing.

Procedure:

- See General procedure 629
- First, find out whether the missing device was a Coldstart-node.
- Find out how many Coldstart-nodes are still present.
  It may be that there were originally three, and that there are now still two. In that case, the bus is still operational; see FlexRay rules for the KeySlotID and node mode 629.

If there are still 2 Coldstart-nodes:

- In the Cluster-settings, set the Node-mode ("behavior of cluster") to "Normal mode".

If there is only one Coldstart-node left:

- In the cluster-settings, set the Node-mode ("behavior of cluster") to "Coldstart-node".
- Since the cluster is missing a Coldstart-node, the imc devcie must take on its function, otherwise the cluster cannot boot up (see also FlexRay rules for the KeySlotID and node mode 629).
- A Coldstart-node must have an assigned KeySlotID.
  In this KeySlotID's slot, the Coldstart node will then send a Coldstart frame. It can be difficult to select the appropriate KeySlotID without knowing the missing Coldstart-node's KeySlotID. Any Fibex file which was previously imported will at least contain descriptions of all Coldstart nodes with their KeySlotIDs.
- As an aid, a list of the KeySlotIDs specified in the Fibex file, along with their associated Coldstart-node names, is displayed when entering the KeySlotID. You can now select the missing Coldstart-node on the basis of its name. This means that the imc device takes its place.
- Next, select the KeySlotID of the missing device. The imc device will then always send its Coldstart-frame in this slot.
- Since a Coldstart-frame is now to be sent, a corresponding send-frame must be configured.

Toward this end, there are 2 possibilities:

1. If no important signals must be sent in this KeySlot (the quick way)
   - Create a new frame
   - Set the frame's direction to "OUT (send)"
   - Go to the frame-triggering of the new frames, and set the Slot-ID here to the KeySlotID determined above.
   - Optional: find all incoming frames (frame-triggerings) having the same SlotID as the KeySlotID, and delete the frame-triggerings and any associated frames (search function: "Slot-ID=???"). Reason: Frames sent by the imc device can not be received. By removing frames, fewer channels may be registered. This increases the performance, and provides clarity in the Assistant.
2. If there are important signals to be sent in this KeySlot (the hard way)
   - Find all incoming frames (frame-triggerings) having the same SlotID as the KeySlotID, and delete all frames except the one which has defined the necessary signals. (Search function: "Slot-ID=???")
   - Set the direction of the frame to "OUT (send)"
   - Set a signal source or a constant value for each signal in the KeySlot-frame.
   - **NOTE**: It is unfortunately not possible to run cycle-multiplexing of KeySlots to be sent. For this reason, only one frame-triggering may exist for this frame. This Frame-Triggering also may only have a Cycle-Base of zero and a Cycle-Repetition of 1.

9.2.7 imc Application Module

The imc Application Module serves to **integrate measurement channels from "third party" devices or systems** into an imc CRONOS*compact* respectively imc CRONOS*flex* system via standard hardware interfaces.

Examples of possible channel sources include:

- Specialized complex sensors
- "third party" devices
- Bus systems (e.g. field busses)

The standard interfaces supported include, in particular:

- Ethernet
- serial interfaces (RS-232, RS-485, RS-422)

The systems to be integrated are typically user-customized or dedicated devices by third-party manufacturers. The integration is achieved by means of a standard hardware module (APPMOD), which comes with a dedicated processor for which a custom application is programmed. This program is either created by imc on commission or can also be created and implemented by qualified partners or trained users provided with specialized development tools.

This user-specific hardware and software expansion is supported by the device software (imc STUDIO). A special version of the device software is not necessary.

Characteristics:

- encapsulated, custom hardware + software solution, embedded in a standard system
- Standard system with complete software support
- Flexible support by unaltered standard operating software
- Standard hardware component
- Stand-alone, autonomous system environment

Reference	Manual

The imc Application Module describe the use and initiation of the module, such as the RS-232, RS-485, RS-422.

9.2.8 imc HiL: Hardware in the Loop

The imc HiL hardware is a supplemental component for the imc CRONOS measurement systems. imc HiL unites the functionalities of simulation, data capture, and open- and closed-loop control in a single compact system. The hardware basis for this component is a processor embedded in the measurement device, which is exclusively reserved for running MATLAB Simulink® models (Simulink Real-Time applications).

On the software side, the MATLAB Simulink® library is supplemented with imc connection blocks which represent an interface to the imc devices. By means of this expansion, it is possible to create Simulink applications in the customary way and to transfer them to imc devices. The interface for this purpose is the imc device software (imc STUDIO), in conjunction with the imc HiL Assistant, which is connected with all other imc components.

Highlights

- imc HiL **integrates** existing **MATLAB Simulink® models** (Simulink Real-Time)
- **Real-time simulation** of application situations with direct feedback to the object under test
- Provides a dedicated processor integrated into the measurement system:
  - CPU: Intel Atom
  - Clock: 1.1 GHz
  - Memory: 512 MB
- Expanded MATLAB Simulink ® library representing an interface to the imc devices
- imc STUDIO provides all settings and configurations for data acquisition and subsequent processing of signals within imc CRONOS measurement systems
- Support of tunable parameters
- No separate MATLAB license for the target system required

Prerequisites

You can download the current data sheet (PDF) from our website. This data sheet specify the prerequisites to the Developer (User)-PC of the MATLAB / Simulink models. You will also find the required licenses and the supported MATLAB versions and more details.

Reference	Manual

The imc HiL device manual describe the use and initiation of this interface.

9.2.9 LIN-Bus Interface

What is the LIN-Bus?

- Affordable automobile-bus for low-speed open- and closed loop control (e.g. air conditioning, automatic window, outside mirrors, etc.)
- Single-wire bus (return line is vehicle mass (chassis))
- Data transfer rates: 1kBit/s to 20kBit/s
- Master-Slave access control
- A master device serially polls the Slave devices for the frames to be transferred.
- Related to CAN-Bus, thus affordable gateways
- Uses frame-identifier similarly to CAN
- Up to 8 data bytes can be transferred in one frame.

Note

Observe the general Field bus notes regarding the operation methodology 476 of fixed sampling rates 477 versus timestamp 480.

Reference Literature and Standards

[1]	LIN specification Revision 1.3 and 2.0, 2.1
[2]	"LIN-Bus", Andreas Grzemba, Hans-Christian von der Wense, Franzis Verlag, 2005, Poing (a German language book)
[3]	ISO / OSI reference model

9.2.9.1 DSUB-9 Pin Configuration

The LIN terminals on the device are 9-pin D-Sub plugs (male). Therefore, they require cables equipped with a female terminal.

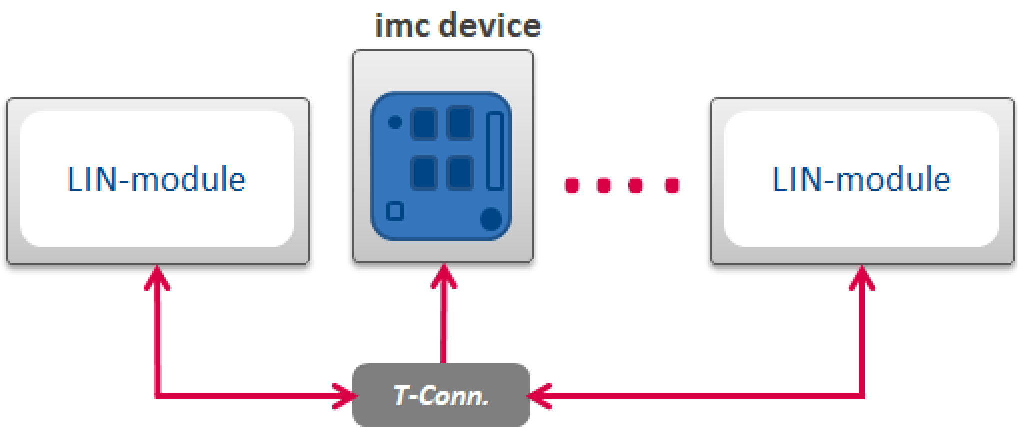
DSUB-PIN	Signal	Description
1	NC	
2	NC	
3	**LIN_GND**	**LIN Ground**
4	NC	
5	NC	
6	**LIN_GND**	**Optional LIN Ground**
7	**LIN_INPUT/OUTPUT**	**LIN bus line**
8	NC	
9	NC	

Note

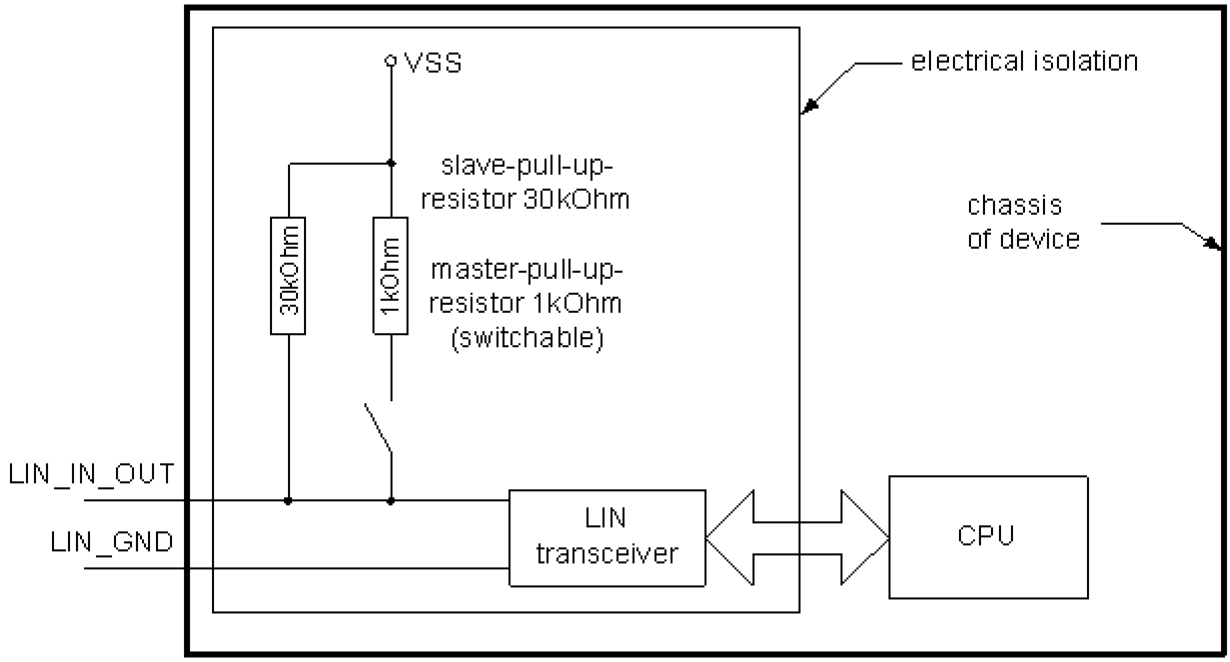
Since the Pin configuration is similar to that of the CAN-Bus, you can also use any CAN-Bus cables already available for the LIN-Bus. However CAN- and LIN-modules may not be connected together to one node!

9.2.9.2 LIN Hookup and Circuiting

Unlike with the CAN-Bus, no terminators are needed



LIN hookup



Circuiting and isolation for LIN-bus

The illustration shows how a LIN-bus connection is wired. The LIN transceiver with its two signal lines leading outside, LIN_GND and LIN_INPUT/OUTPUT, is electrically isolated from the rest of the imc measurement device; see LIN technical specifications.

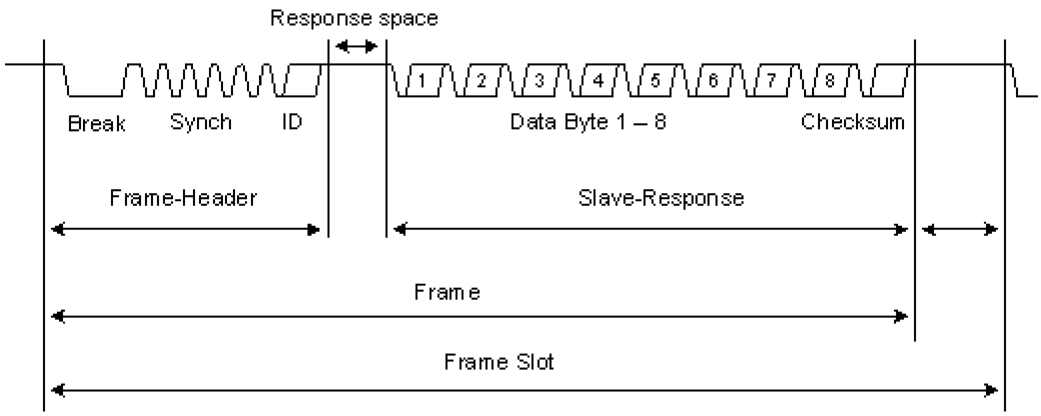
Warning

No LIN-bus should ever be connected whose potential level deviates further from the imc measurement device's potential level by more than this isolation strength.

Pull-Up resistors:

The illustration shows two pull-up resistors. According to LIN specifications, a LIN-Master device must have a 1kΩ pull-up resistor and a LIN-Slave device must have a 30kΩ pull-up resistor. Since imc's LIN devices can alternate between being Master and Slave, according to their configuration, the Master pull-up resistor is switchable.

9.2.9.3 Data Transfer on the LIN-Bus



Structure of a frame on the LIN-Bus

The frame is the basic element of data transfer on the LIN-Bus. A view of the frame is the best illustration of how data transfer on the LIN-Bus works.

The LIN-Bus transfers the data by means of a Master-Slave scheme. At each LIN-Bus, there is exactly one Master, which retrieves all frames to be transferred from all the Slaves. The Master generates the frame header. The frame header contains the frame identifier which determines the frame to be transferred.

The Slaves connected to the bus receive this frame header, and a certain Slave will normally append its own matching Slave-Response to this frame header. The Slave-Response consists of one or up to eight data bytes and one concluding checksum.

The Master determines when it generates the header when a frame is transferred. Thus, a Slave cannot send transmissions independently.

Note

The checksum can be computed in either of two different ways. In the calculation, Version 2.x incorporates the *Protected-Frame-Identifier* into the checksum, while Version 1.3 does not.

9.2.9.4 Sample Applications and Operation Options

Logging (Monitoring)

The imc measurement device offers the user the ability to monitor an existing LIN-bus. This means that all frames sent by the LIN-bus can be logged as raw data and/or that interesting signals can be extracted from these frames. The signals and the log are set up in the system as measurement channels, and thus can be analyzed subsequent to the measurement.

In the process, the transferred data are not changed. The device behaves passively with respect to the LIN-bus.

Such an application requires that the LIN-bus monitored has a master, without which no data transfer can take place.

Example

Suppose you wish to analyze the data exchange concerning measurements performed on a prototype car door. The master and all slave actuators and -sensors are provided, and their functioning is not to be disturbed.

Slave

Another option which the imc measurement device offers is to act as a slave. The imc measurement device responds by sending the requested frame. The answer can consist of constants and/or variables in a variety of data formats. The variables concerned are Display-variables and virtual bits, which can be computed in Online FAMOS, for example.

Example

You wish to analyze the data exchange concerning measurements performed on a prototype car door. The master and some slave actuators and/or -sensors are provided. In order for the LIN-bus system to be able to run, some frames of missing Slaves must be substituted. The imc measurement system can perform this task.

Master

Another possibility is to substitute a missing master. The imc measurement system itself then prompts the slaves to send data by generating frame headers for the frames to be sent, at the time intervals set.

Example

Suppose you wish to monitor a slave's data traffic, and don't have an appropriate master. In order for the slave to be able to run, particular frame headers must be generated on the bus to which the slave can respond. The imc measurement system can perform this task.

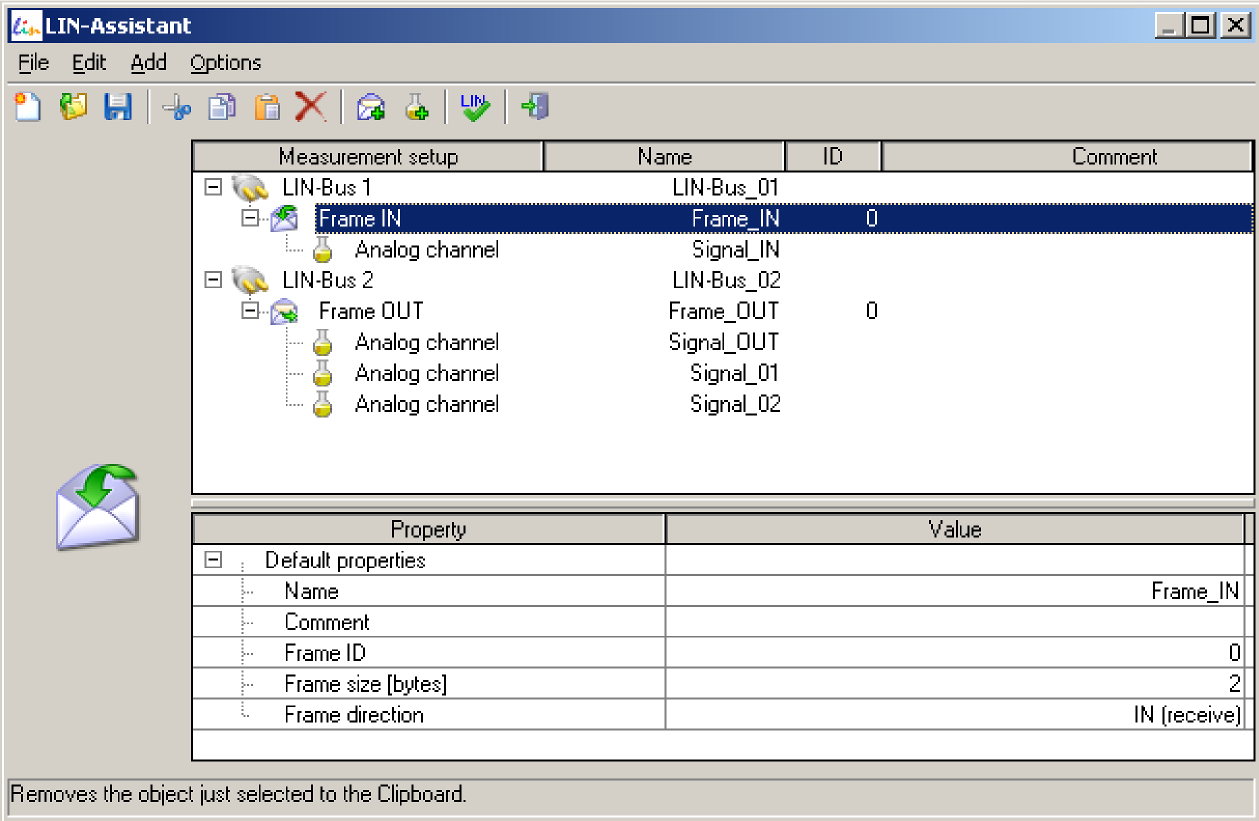
Combination

The imc measurement system is able to handle any combination of the above three scenarios. Thus, LIN-master operation can be carried out with simultaneous logging and simultaneous slave simulation.

9.2.9.5 LIN-Assistant

The *LIN-Bus Assistant* is where settings for the LIN-bus terminals are made and frames and channels (signals) are defined.

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > LIN-Assistant*.



LIN-Bus-Assistant

Short Description of the LIN-Bus-Assistant

- The LIN-Assistant is a part of the imc STUDIO software without which it is unable to operate
- It offers easy configuration setting for the data to be received or sent
- Settings for measurement channels in imc STUDIO to which received data are to be written

9.2.9.5.1 Properties of the LIN-Assistant

- Simultaneous functioning as LIN-Slave and as LIN-Master (the master is limited, see Limitations of the LIN-Assistant 639)
- Configuration of the frame and of the signals
- The following data types can be received and sent:
  - Individual bits
  - Unsigned integers from 2 to 32 bits.
  - Signed integer from 2 to 32 bits
  - Floating point (real number) with 32 bits and 64 bit as per IEEE 754: Standard for Binary Floating-Point Arithmetic

- Conversion of the received LIN-bus data (integers) with factor and offset (linear transformation), floating point numbers cannot be transformed
- Conversion of the data to be sent (integers) with factor and offset, before they are written to the bus (linear transformation), floating point numbers are not transformed.
- Data to be sent can be:
  - Constant values stored in the LIN-Assistant
  - Values which are stored as a Display-variable, Process-Vector-variables or virtual bit at the moment of the Master request. These variables are calculated Online FAMOS and written to this variable. The values can also be entered directly into the Display-variables with the help of a Display, if one is connected.
- Exchange of LIN-bus configurations between different experiments: Saving and loading of the configurations on the hard drive as a *.LCF file
- Import of *.LDF – files possible, (not all the LDF-features are supported)
- Configurations can be created without a mouse (using keyboard only)
- A bus protocol is possible: all frames along with their ID and data bytes are listed with a time-resolution of 100µs
- All measurement devices in the experiment which are equipped with LIN-nodes are displayed simultaneously with their LIN-boards and connectors
- A comment can be entered for each frame
- Visual display of the signal positions in the frame (familiar from the CAN-Assistant)
- Check of configuration settings for feasibility (no duplicate assigned FrameIDs, no invalid signal positions within the frame, etc.)
- Error handling
  - Timeout error > replacement values can be inserted

9.2.9.5.2 Limitations of the LIN-Assistant

Only incomplete LIN 1.3 transformation

- No nodes can be defined, only signals in the frames
- No diagnostic signals definable
- No diagnostic frames definable
- No event-triggered frames definable
- No freely definable schedule-tables can be defined for the normal operation as Master. A frame polling sequence is automatically created from the configured frames.

Only incomplete LIN 2.0, 2.1 transformation

- No nodes can be defined, only signals in the frames
- No diagnostic signals definable
- No diagnostic frames definable
- No event-triggered frames definable

When acting as Slave:

- No acceptance of or response to AssignNAD, AssignFrameID ...etc. possible

When acting as Master:

- No automatic configuration of all connected nodes possible when starting with AssignNAD, AssignFrameID ...etc.
- No freely definable schedule-tables definable for normal operation. A frame polling sequence is automatically created from the configured frames.
- No diagnostic schedule tables
- No configuration schedule tables
- No sleep-schedule tables

9.2.9.5.3 Overview Window

The Overview window is the upper window in the dialog. In it, the structure of the measurement setup as it relates to the LIN-configuration is displayed schematically. You are shown the measurement devices ( ) connected with the experiment, and its name. If there is only one LIN-capable device in the experiment anyway, there is no extra icon for it.

The LIN-modules ( ) (slots) installed are indicated under each measurement device, along with the two LIN-connections ( ) (LIN-busses, LIN-nodes) which these have.

For each LIN-bus, the frames ( ) already defined with its associated signals ( ) (channels) are indicated.

9.2.9.5.4 Properties Window

The Properties window is visible in the lower portion. It displays the editable properties and the settings options for the object currently selected in the Overview window. If multiple objects are selected at the same time, the Properties window shows a selection of suitable properties.

To change a property's value, click on the desired value.

Depending on the property, either a pop-down list or a text box is used.

9.2.9.5.5 Items in the Main Menu

Menu item	Description
New	Removes all previously created frames and channels and creates an empty LIN-configuration.
Load	Enables import of an entire LIN-configuration from a file. The file extension for such a file is *.LCF. The files are written in ASCII format and can be viewed in a text editor. However, it is not recommended to edit the files by hand. The second file extension is *.LDF. This file format has been defined by the LIN Consortium. The Revision 2.0 and 2.1 is supported. In an LDF file, only one LIN-Bus is described, and whenever an LDF file is loaded afterwards, this description is on the first LIN-Bus in the overall system. All other LIN-busses are deleted. Since the LIN-Assistant does not support all the capabilities and properties demanded by the LDF files, only the capabilities and properties which are supported are loaded. The following data are not loaded but ignored: • Nodes (assignment of nodes to frames discarded.) • Node_attributes (only LIN-Version 1.3 or 2.0, 2.1 is loaded, and the corresponding frames are used) • Node_composition, init_value and published_By for signals • Byte Arrays are converted to individual byte signals • Diagnostic_signals, Diagnostic_frames, Signal_goups, dynamic_frames, Sporadic_frames, Event_triggered_frames, schedule_tables • With the signal_encoding_types, only one physical_value and no logical_values, bcd_values and no ascii-values can be loaded.
Loading a LIN-Bus	Enables import of a LIN-Bus (node) from an LCF- or LDF file. To do this, select the LIN-Bus to load and click on the menu item "*File*" > "*Load a LIN-Bus*". The system prompts you for the file to load, and the selected LIN-Bus is filled with the data from the file. For LCF files, the following applies: only the first LIN-Bus found in the specified file is used for the substitution.
Save as	Saves the complete LIN-configuration in an LCF-file. (rf. Load...)

9.2.9.5.6 Further Menus

Edit - menu

Menu item	Description
Copy Paste Cut Delete	These are the familiar Windows Clipboard commands.

Add - menu

Menu item	Description
Add a frame	To add a frame, select in the Overview window either • a LIN-bus , • an already existing frame or • an already existing signal , and click on "*Add*" > "*Frame*". The new frame is set up under the selected LIN-bus below all previously existing frames.
Add a signal	To add signals, select in the Overview window either • an already existing frame or • an already existing signal and click on "*Add*" > "*Signal*". The new signal is set up under the selected LIN-bus below all previously existing signals.

Options - menu

Menu item	Description
Testing the LIN configuration	When this command is carried out, the entire LIN-configuration is checked for errors. Any error is written in the status bar in red typeface. In most cases, the focus shifts to the defective object in the Overview window, to enable quicker debugging.

9.2.9.5.7 LIN-Bus (Connection) Properties

Property	Value
⊟ Default properties	
Name	LIN-Bus_01
Comment	
Baud-rate [BPS]	19200
⊟ Master settings	
Master type	Master
Time for one polling cycle [ms]	500
INFO: fastest possible polling cycle [ms]	5
Sleep-WakeUp-Command-Display-Vari...	
Duration of the Master-Break [Bit-times]	13
Duration of the Master-Break-Delimiter [...	1
Duration of a Wakeup-Break [us]	1000
⊟ Log settings	
Log all frames on the bus	Yes
Channel name for the log	LIN_FrameProtocol01

LIN bus properties

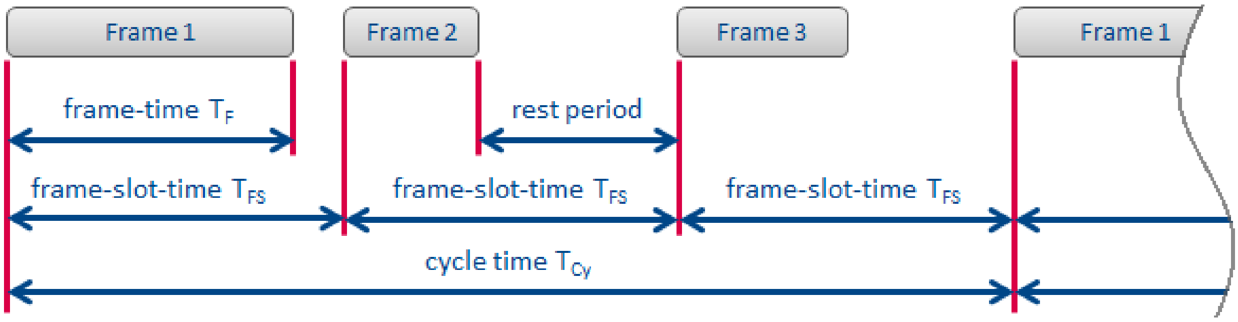
Default properties

Default properties	Description
Name	Here you can enter an arbitrary name for the LIN-bus, which will appear in the Overview window’s Name column. This property serves the purpose of providing a brief description.
Comment	The comment property can contain a detailed description of the LIN-Bus.
Baud rate	This property specifies the LIN-bus's bit transfer rate. There is a pop-down list containing pre-defined standard values, but arbitrary values can also be entered. According to LIN-specifications, Baud rates of 1000 to 20000 bits per second are permitted.

Master settings

Master settings	Description
Master Typ	Here you can set whether the imc measurement device is to be the master on the LIN-bus. If Master mode is set, then as soon as the measurement is prepared, the imc measurement device polls all frames defined in the LIN-bus at user-set intervals. See Sample applications and operation options 636. The following parameters only appear if "*Master type*" is set to "*Master*".

Time for one polling cycle [ms]



Setting the polling cycle time $\mathbf{T_{Cy}}$ determines how much time is taken for polling all frames defined. The number of frames to poll is referred to here as **n**. The cycle time consists of **n** equally large time chunks which to which we refer here as frame-slot-time. Exactly one frame is transferred in each frame-slot. Since not all frames are of the same size, after transfer of one frame, a pause of varying length occurs.

The longest frame's required transfer time $\mathbf{T_{FMax}}$ determines the minimum frame-slot-time $\mathbf{T_{FSMin}}$. Taking into account the frame count **n**, the smallest possible cycle time $\mathbf{T_{CyMin}}$ can be found according to the following equation:

Where:

$$T_{CyMin} = n \cdot T_{FSMin}$$
$$T_{FSMin} = T_{FSMax}$$

The transfer time $\mathbf{T_F}$ for one frame is calculated according to the equation below:

$$T_F = 1.4 \cdot \frac{34\ \text{Bits} + 10 \cdot \frac{\text{Bits}}{\text{Bytes}} \cdot (n_{DataBytes} + 1\ \text{Byte})}{v_{Bit}}$$

Key to variables and numbers:

1.4	Safety factor as per LIN specifications
34 Bits	The frame header requires approx. 34 bit times
$10 \cdot \frac{\text{Bits}}{\text{Bytes}}$	10 bits per byte (8 bits + Start- and Stop-bit)
$n_{DataBytes}$	Number of data bytes to be transferred in the frame *[Byte]*
1 Byte	One byte needed for the checksum
v_{Bit}	Baud rate of the LIN-bus *[Bits/s]*

One can transform this equation to obtain this formula for the frame transfer time:

$$T_F = \frac{14 \cdot n_{DataBytes} + 61.6}{v_{Bit}}$$

The units' quantities must be stated as above.

Master settings	Description
INFO: fastest possible polling cycle [ms]	This table row indicates the smallest polling interval currently possible. This time interval changes if frames are added or removed. It also changes if you change the number of bytes in the longest frame, see "*Polling cycle time [ms]*".
Sleep-WakeUp-Command-DisplayVariable	A Display variable selected in the LIN-Assistant can be used to activate the Sleep- or WakeUp-mode. See "*LIN-PowerManagementCommands* 653"
Duration of a Wakeup-Break (µs)	250µs – 9000µs Specifies the duration of the Wakeup-break in microseconds. This break is sent either by the Master or a Slave during a LIN-wakeup. Sending a WakeUp-break is possible by writing certain values to the Sleep/WakeUp-command Display variable.
Duration of the Master-Break (bit times)	13- 15 Bit Specifies the duration of the MasterRequest's break. Unit: bit-times (see also LIN-Secification-Package Rev2.1 Section 2.3.1.1 Break Field).
Duration of the Master-Break Delimiter (bit times)	1-3 Bit Specifies the duration of the Master-Request's Break-Delimiters in bit-times (see also LIN-Secification-Package Rev2.1 Section 2.3.1.1 Break Field).

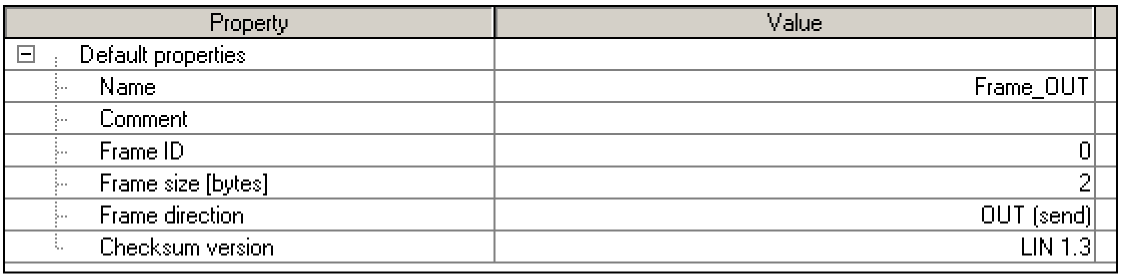
Note Possible combinations

	Break=13 BT	Break=14 BT	Break=15 BT
Delimuter= 1BT	x		
Delimuter= 3BT	x	x	x

Log settings

Log settings	Description
Log all frames on the bus	If this is set to Yes, a log channel is created which records all messages on the LIN-bus, as long as the checksum is correct upon reception. If a frame-header is received on the LIN-bus, to which no slave responds, then this is also entered into the protocol so that the corresponding Frame-ID can be determined.
Channel name for the log	This property sets the name for the log channel.

9.2.9.5.8 Frame (Message) Properties



Property	Value
Default properties	
Name	Frame_OUT
Comment	
Frame ID	0
Frame size [bytes]	2
Frame direction	OUT (send)
Checksum version	LIN 1.3

Frame properties

Default properties	Description
Name	Here, an arbitrary name can be entered for the frame. It will also be displayed in the Overview window under the Name column. This property represents a brief description.
Comment	The comment is for providing a more detailed description of the frame.
Frame ID	The Frame-Identifier is an integer from 0 to 63. A Frame-ID can appear only once in the group of incoming and once in the group of outgoing frames. The same Frame-IDs can be defined in different LIN-busses, however. Either a decimal or, if "0x" is prefixed, a hexadecimal number must be entered. IDs are always displayed as numbers in decimal format.
Frame size	This property sets the number of data bytes the frame has. This must be between 0 and 8. The specification V1.3 applies, according to which the **Frame-ID** and the **frame size** can be selected independently of each other. • If more bytes are set for the definition of the incoming frame than which are actually received for the frame via the LIN-bus, the missing bytes are filled with zeroes at the end of the frame. • If fewer bytes are set for the definition of the incoming frame than which are actually received for the frame via the LIN-bus, then the surplus bytes are ignored.
Frame direction	This property determines whether the frame is to be received and interpreted by the measurement device (incoming, receiving, IN) or whether this frame is to be assembled and sent (outgoing, sending, OUT).
Checksum version	For the case that the frame is to be sent or received, it is possible to use this property to set the type of checksum calculation. If the computation of the checksum is to be calculated as per the LIN-specification V1.3, then set the value to **LIN 1.3**. For the calculation as per the LIN-specification V2.0/2.1, this value is to be set to **LIN-2.0**. For received frames, the value **Either** is possible: If a frame with the ID of the selected frame is received, it must conform to the checksum rules according LIN-Spec V1.3 OR LIN-Spec V2.0 in order to be recognized as valid. As the default setting, this mode is also referred to as the compatibility mode.

9.2.9.5.9 Signal (Channel) Properties

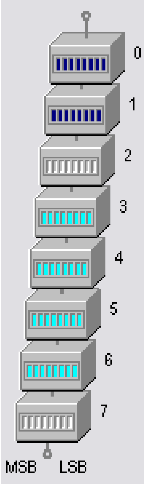
Property	Value
⊟ Default properties	
Name	Signal_IN
Comment	
⊟ Data interpetation	
Data type	Signed integer
Start-Byte	0
Start-Bit	0
Bit width of number	16
INFO: Byte order	Intel
Physical unit	
Factor [1/LSB]	1
Offset []	0
⊟ Error handling	
Handle timeout error	No

Signal properties

Default properties	Description
Name	Sets the channel's name, with which one works in imc STUDIO. This name must conform to the rules and the format applicable to a imc STUDIO channel name.
Comment	Specifies the comment for this channel.

Data integration	Description
Data type	This sets the signals type, or rather, how the data on the bus are interpreted. The following data types are possible:

Data type	Description
Signed Integer	The bit widths available for this data type are 2 to 32 bits.
Unsigned Integer	The bit widths available for this data type are 2 to 32 bits.
Floating point	Either 32-bit or IEEE 64-bit floating point format are available.
Bit	A single bit as a digital signal.

Data integration	Description
Start-Byte and Start-Bit	 These two properties determine at which position within the frame the signal begins. To simplify the positioning of the signals, a signal position representation is displayed as with the CAN-Assistant. This display is always shown whenever you select a signal in the Overview window. It shows the frame and its individual bytes, which in turn contain the bits. • The bits appearing in dark blue represent the bits which are in use by the signal currently selected. • The bits appearing in light blue represent the bits which are already in use by other signals belonging to the frame. • If any signal is so configured that it would overlap the end of the frame, that signal appears red in the display. Outgoing signals may not occupy the same bits in the frame; for incoming signals this is not a problem.
Bit-width of number	This property sets the signal's length. Different maximum and minimum values can be entered, depending on the data type.
Byte order	Per the LIN-specification, only data conforming to the INTEL byte order should be transmitted on the LIN-bus. For that reason, this property cannot be changed and is only intended for the user's information.
Physical unit	Here you can enter a physical unit or its abbreviation, e.g. "V" for Volt. Use SI-units wherever possible. It is not advised to enter any scaling prefix such as m for milli-. Instead, adjust the factor correspondingly. The imc STUDIO curve windows automatically add such prefixes to correspond to the measured values.

<table>
<tr><th>Data integration</th><th>Description</th></tr>
<tr><td>Factor and Offset</td><td>
If the signal currently selected happens to be of the integer data type, signed or unsigned, then both the properties Factor and Offset are displayed.

These values are parameters for linear transformation, which are computed by the following formulas.
<table>
<tr><th>Incoming signal</th><th>Outgoing signal</th></tr>
<tr><td>$y = f \cdot x + a$</td><td>$x = \frac{y}{f} - \frac{a}{f}$</td></tr>
</table>
Variable definition
y - physical value
x - integer on the Field-bus
f - factor
a - offset

An incoming signal is a 16-bit unsigned integer. Thus, the integer’s numerical range is 0 LSB to 65535 LSB. The physical quantity which it represents is a voltage between 10 V and 20 V. The factor is thus given by the equation
$f = \frac{20\ \mathrm{V}\ - 10\ \mathrm{V}}{65535\ \mathrm{LSB}} = 1.526 \cdot 10^{-4} \frac{\mathrm{V}}{\mathrm{LSB}}$
and the offset is
$a = 10\ \mathrm{V}$
Supposing the following integer were imported from the bus,
$x = 13483\ \mathrm{LSB}$
it would correspond to a voltage of
$y = f \cdot x + a = 12.057\ \mathrm{V}$
</td></tr>
</table>

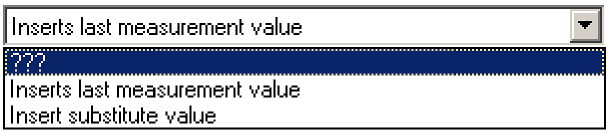
Handle timeout error

The term timeout-error refers to a case where no measured value is received from the field-bus after a certain period; error handling can be set to deal with such an occurrence.

Parameter	Description
Handle timeout error	This settings option determines whether error handling of any timeout error would be performed.
Timeout Interval [s]	This is where to set the time limit after which a timeout-error is considered to have occurred.

Error handling action

This setting determines the action to be performed in case the timeout time limit elapses.



For this purpose, the following options are available, whose effects depend on whether a channel is sampled equidistantly or recorded with a time stamp.

Error handling	Equidistant sampling	Samples with time stamp
Last value	The last valid value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the last value.
Substitute value	The substitute value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the substitute value.

9.2.9.5.9.1 Special Properties of the Bit Data Type

Property	Value
Default properties	
Name	Signal_IN
Comment	
Data intepretation	
Data type	Bit
Start-Byte	0
Start-Bit	0
Name of the 16-bit port	LIN_BitPort01
Error handling	
Handle timeout error	Yes
Timeout-interval [s]	1.0
Error handling action	Insert substitute value
Substitute value	0

Special properties of the bit data type

Name of the 16-Bit-Port

If you have set the data type for an **incoming** signal to Bit, this editable property is displayed. It is the name of the digital 16-bit port into which the individual bit is sorted. With this data type, 16 individual bits are bundled for data reduction reasons. In the trigger machine, it is always only possible to trigger the entire port at once.

An editable drop-down list box is used to change the setting; all bit ports defined for this LIN-bus appear in the list.

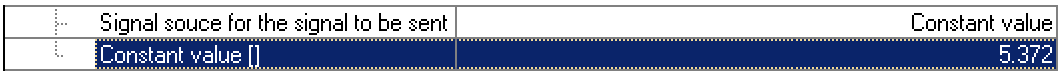
A variety of actions can be taken here:

Action	Description
Renaming the bit-port in which the selected bits are located	The 16 bit-port assigned to this bit signal can be renamed by entering a new name. In that case, the bit-port is renamed for all signals which it contains.
Assigning the selected bits to another, already existing bit-port	By selecting a bit port already indicated in the list, the selected bits in this bit-port are moved. If the target bit-port is already full, then an error notification is posted in red in the status bar.
Assigning the selected bits to a new bit-port	By selecting the list item "*New...*", the selected bits are moved to a new bit-port. Their name is automatically generated and can subsequently be renamed by clicking once again on this property.

Note

Empty bit-ports are automatically deleted. In such cases, the settings made in the imc STUDIO: Setup are deleted along with them. This means that settings such as the sampling rate, time stamp and triggering are lost even if a new bit port with the same name is created immediately afterward, before exiting the LIN-Assistant.

9.2.9.5.9.2 Special Properties for Sending



Signal source for the signal to be sent

If you have defined signals within a frame to be sent, then the signal source is set by means of this property.

There are different options available depending on the data type.

Data type	Available selection
Integers Floating point number	All of the measurement device's **Display-variables** in which the signal was created; and constant value.
Integers, Bits Floating point number	Process vector variables (PV-variables). See also the note on data type conversion further below 652.
Bits	All of the measurement device's virtual bits in which the signal was created; and constant value.

By means of a particular frame-header, the Master determines the point in time at which the data are to be transmitted. The values to be send extracted from the Display-variables and/or virtual bits upon reception of a frame-header and joined with the constant values into a frame. Then the data bytes are appended to the frame-header and sent along with them.

An imc Online FAMOS command such as `CAN_Send(...)` is not sensible for this bus, since the slave isn't able to send independently.

Note

- The values in the Display-variable are expected to be expressed in **physical units**, because if integers are to be sent, they are processed with a factor and offset and afterwards transmitted.
- With PV-variables, there are limitations due to the conversion between data types. This is necessary because the source and target each can use different data type.
  In the data acquisition device, PV-variables with the following data types can be administered: Bit16, INT16, UINT16, INT32, UINT32, FLOAT and Bit1. By contrast, the LIN receiving device can only process SINT, UINT, FLOAT and BIT. In the conversion, it can occur that the numerical range of the sent data type is either not, or only partially, covered in the receiving data type. Such cases are indicated by the software with a warning message. For a detailed description of this topic, please contact the imc Hotline.

Constant value

If for the property "**Signal source for the signal to be sent**" the value "**Constant value**" was selected, then this property is visible. The constant value to be sent can be entered here.

Note

The constant value is expected to be expressed in **physical units**, because if integers are to be sent, they are processed with a factor and offset and afterwards transmitted.

9.2.9.5.10 LIN-PowerManagementCommands

Issuing Sleep-/ WakeUp-commands via a Display-variable

General notes

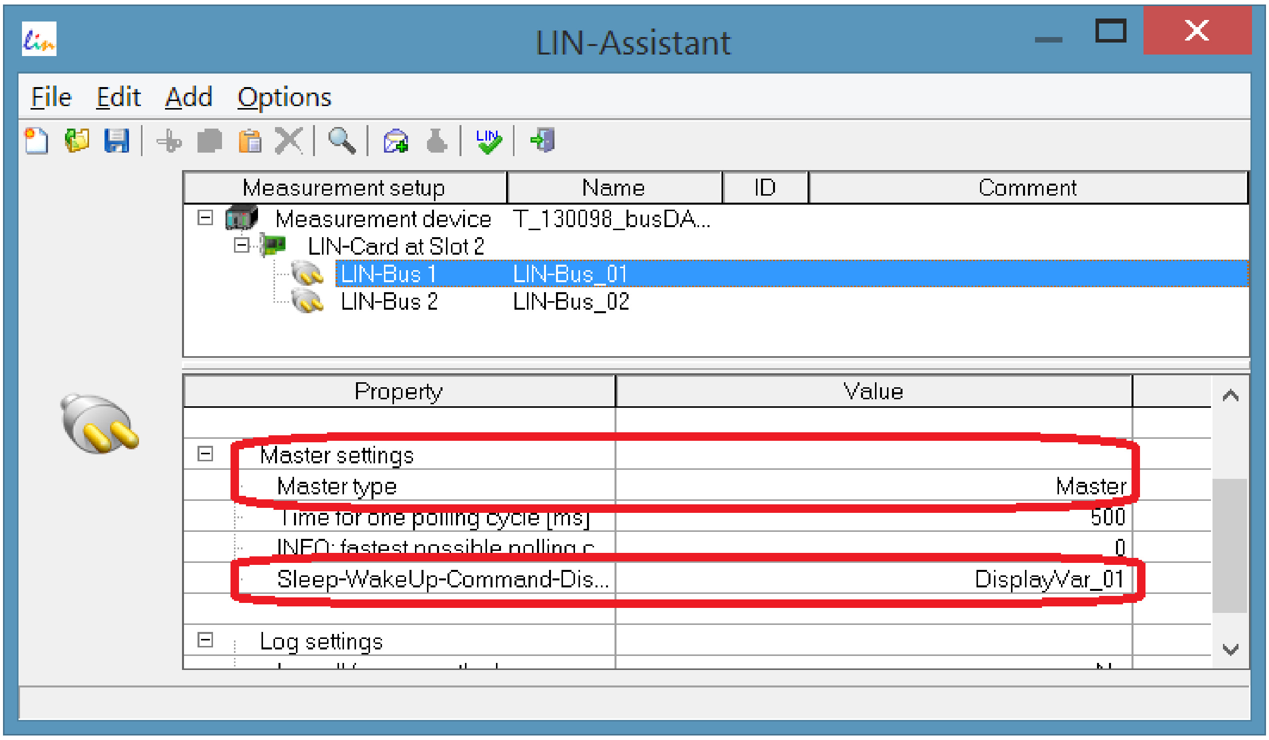
The capabilities described here pertain to the section "2.6 NETWORK MANAGEMENT" of the LIN-specifications "LIN Specification Package Revision 2.1". That is where the functioning of "Wake up" and "Go to sleep" are defined.

Note that *Sleep/WakeUp-mode* here pertains to the LIN-Bus and should not be confused with the *Sleep/Resume*-function of an imc BUSDAQ unit.

A Display variable selected in the LIN-Assistant can be used to activate the Sleep- or WakeUp-mode. This function is only available if the imc LIN interface (port) is configured as the LIN-Master. To change the Sleep/WakeUp-mode, a 16-bit word is written to the Display-variable. If only one LIN-interface (port) is addressed, then once the command has been applied, the value of the Display-variable reverts to zero.

Executing the command

The Display Variable is polled cyclically. As soon as its value becomes nonzero, the command is executed. It is only necessary to set the *Master Type* to *Master* and to select a Display Variable. Assignment of the Display Variable's value is performed by means of Online FAMOS, or the input/output dialog under imc DEVICES, or by setting a variable in imc STUDIO, as examples.



Structure of the 16-bit word:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
4 Bit `Status`				4 Bit `Slot`				4 Bit `Port`				4 Bit `ommand`			

Description of the bitfields:

Bits	Description
0-3	Command; available values: 0 -no function 1 -Sleep 2 -Wake Up 4 -Status query (only possible for individual ports, Slot may not be 15) 5 -Status response
4-7	Port; available values: 0 -no function 1 -Port1 (LIN-interface 1 of the LIN-Bus-card(n) selected as Slot) 2 -Port2 (LIN-interface 2 of the LIN-Bus-card(n) selected as Slot) 15 all ports of the LIN-Bus-card(n) selected as Slot
8-11	Slot; specifies the Fieldbus-slot of the LIN-Fieldbus card addressed. Other field buses are counted. 0 -no function 1 -Slot1 ... N -SlotN ... 8 -Slot8 15-all slots in the device with LIN-Fieldbus cards
12-15	Status; returns the port’s status. Available values: 0 -no function 1 -The port enters Sleep mode. 2 -The port is in Sleep mode. 3 -The port is in operational mode.

Example

The commands for the example in the image are then:

0x0211: Sleep

0x0212: Wake up

9.2.10 MVB-Bus Interface

What is the MVB-Bus?

MVB is an abbreviation for "Multipurpose Vehicle Bus". This bus is a serial communication bus for rail vehicles. It interconnects control devices with each other as well as with simple sensors and actuators.

MVB conforms to the standards of the International Electrotechnical Commission (IEC) and the German Deutsches Institut für Normung (DIN).

Reference Literature and Standards

[1]	DIN EN 61375-3-1: Elektronische Betriebsmittel für Bahnen - Zug-Kommunikations-Netzwerk -Teil 3-1: MVB - Multipurpose Vehicle Bus (IEC 9/1276/CDV:2009) English version: FprEN 61375-3-1:2009 The official English original of the international document IEC 9/1276/CDV:2009 "Electronic Railway Equipment - Train Communication Network - Part 3-1: MVB - Multipurpose Vehicle Bus" (draft in the survey) has been adopted in this design draft unchanged.

Prerequisites

Prerequisites	
Hardware	An imc device with a MVB-Bus interface.
Software	The system requirements are described in the data sheet of our fieldbus connection options.
Password	Normally not required. Only when customer-specific files are to be imported, the possibility of password protection 659 is available. When in doubt, contact the Hotline 10.

9.2.10.1 Definitions

Term	Description
MVB	Multipurpose Vehicle Bus
Controller	A controller can be connected to exactly one MVB. To date, one controller is attached per MVB interface.
Frame	A collection of certain individual signal values in a single data block. A frame also has a Frame-Identifier (FrameID) which enables inferences about the data (signals) it contains. A frame is often also referred to as a message.
FrameID	Frame-Identifier. This is a 16-bit value subdivided into the (4-bit) FCode and the (12-bit) Port Address. See also [1] "DIN EN 61375-3-1"
F-Code	Describes the frame's type. There are 16 different possible (4-bit) values. For example, the frame's length is encoded in the F-code for process data-frames. See also [1] "DIN EN 61375-3-1"
Port Address	This is the lower 12 bits of the FrameID. These 12 bits, however, are only the Port Address if the F-Code is 0 through 4. Otherwise, these bits mean something else.

Term	Description
Process data-Frames	Frames with FCodes 0 through 4. The frame's "payload" is divided among individual signals. See also [1] "DIN EN 61375-3-1"
"Special-Frames"	These are frames with FCodes 5 through 15: Mastership-Transfer-Frames, General-Event-Frames, Message-Data-Frames, Group-Event-Frames and Device-Status-Frames. See also [1] "DIN EN 61375-3-1"
Field-bus card (Interface)	This is a circuit board produced by imc which can be installed in an imc device. This card serves to connect the associated Field-bus.
Channel	A channel is assigned to a signal which is registered with the system. The channel is the timed sequence of individual signal values received via the bus.
Signal	A signal is a part of a frame.

9.2.10.2 Capabilities and Limitations

- Logging of process data frames from the bus. (I.e. frames with the FCodes 0 through 4)
- Disassembly of process data frames received into signals (measurement channels)
- No reception of "Special-Frames" having FCodes from 5 through 15. Thus, no Mastership-Transfer-Frames, General-Event-Frames, Message-Data-Frames, Group-Event-Frames or Device-Status-Frames are received.
- No sending of frames and data possible
- Import of customized bus configuration files (*.xml)
- Measurement of up to 512 signals per device possible (including all other channels)
- The aggregate sampling rate per MVB interface is about 40000 samples/second

9.2.10.3 General description of MVB

The **M**ultipurpose **V**ehicle **B**us (MVB) is a "multi-purpose"-Field bus for use within a rail vehicle. In the 1990s, this Field-bus was developed as a diagnostics system.

The MVB links up programmable systems with each other and provides a direct connection to simple sensors. It conforms to the *standard IEC, TC9, WG 22 in the standard Electric Traction Equipment - Train Communication Network, Parts 1 through 3.*

It is a true data bus by means of which multiple bus nodes can be connected to one line. At any one time, only one of these nodes may send data. These data are then received by all other nodes. The data are sent using the time multiplex procedure at a gross transfer rate of 1.5 MBit/s. The signal levels on the line are the RS485 levels.

There are three different transmission media:

- EMD (**E**lectrical **M**iddle **D**istance bus): Twisted wire pair with insulation of the bus interfaces by means of transducers.
- ESD (**E**lectrical **S**hort **D**istance bus): Twisted wire pair with additional uninsulated ground line or insulated by optical coupler. Due to the optical coupler's limited input voltage range, a compensation line is needed for bridging the grounds of the optical coupler components.
- OGF (**O**ptical **G**lass **F**ibre): Fiberglass line. Point-to-point connections with so-called star couplers.

EMD is the simplest bus.

Practically all rail vehicles by the manufacturers Siemens and AEG/ABB/Adtranz/Bombardier since around 1995 are equipped with MVB as the Field bus. In such cases, the MVB connects the most important components of the guidance engineering. This includes the drive control, train protection, driver cabin indicators, central control units, decentralized input/outputs, automatic door control, air conditioning, auxiliary converters, as well as others.

The MVB's role is to transmit as its "process data" the control and status commands for the train's automation (such as the time or the speed), which are short but whose timing is absolutely critical, in real time (cycles of typically 16 ms to 512 ms). It is also used for transmission of diagnostics messages, etc.

Requirements and features

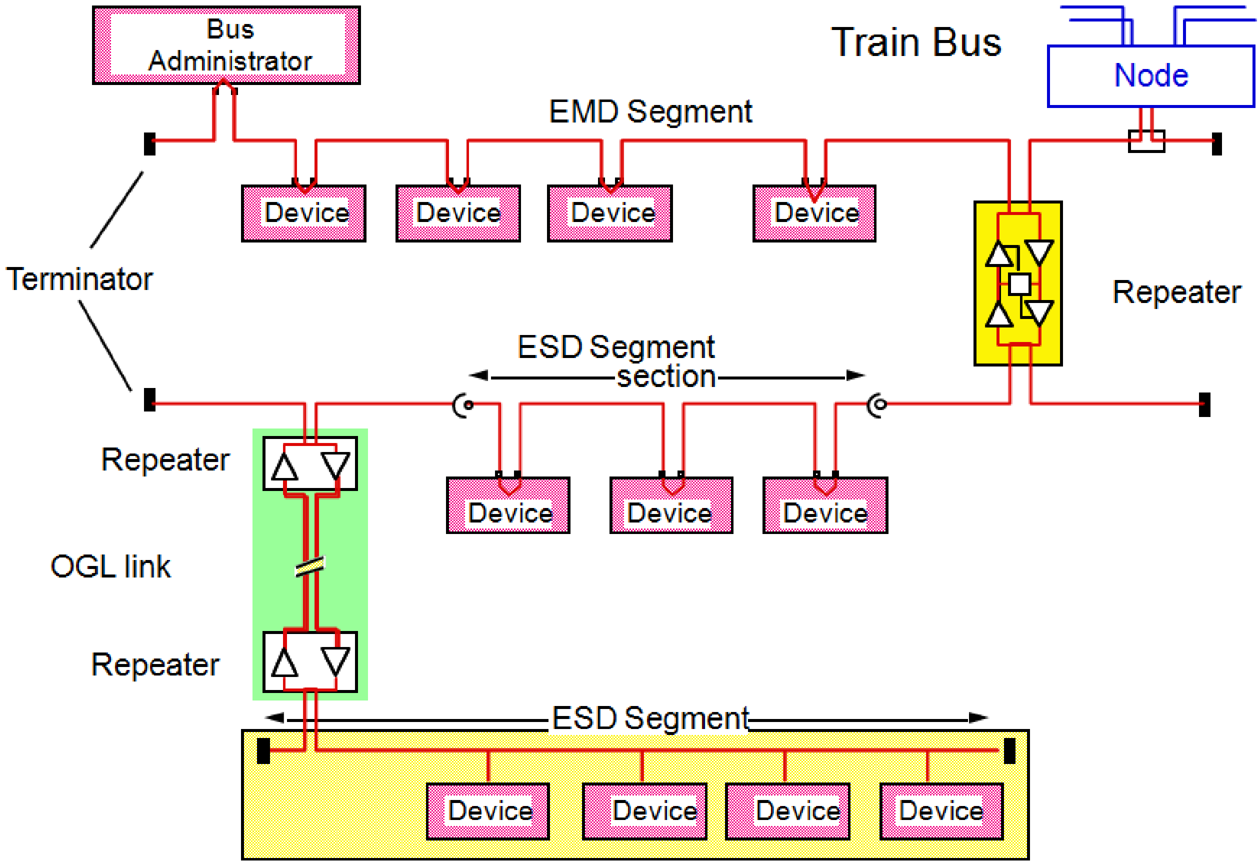
Rail vehicles present electronic equipment with difficult conditions. For this reason, the MVB bus has properties not possessed by normal computer systems' busses.

- Protection against strong **magnetic fields**
- Expanded **operating temperature range**
- High **mechanical stability** for controllers, cables and sensors
- For short line lengths, copper lines are used; optical fiber lines for long lines. With copper wire, it is possible to conduct the supply in the same line.
- **Redundant layout** and cabling
- The MVB uses a medium-independent signal transmission with **Manchester encoding**.
- The Bus management can be be switched among different positions by means of a **Token Frame**.
- The data can be sent either cyclically or sporadically.

Summary of properties

Property	Characteristics	
Transmission medium	Copper: twisted pair, RS485	Optic lines
Topography	Bus	Star
Line length	30 m with up to 32 subscribers	2000 m
Redundancy	Duplication: messages sent on both lines, received on only one. Redundancy by means of alternating master	
Gross data rate	1.5 MBit/s	
Reaction time	typically 4 µs, max. 43 µs	
Address room	4095 physical devices, 4095 logical ports, 8-bit station addresses for messages	
Frame size	16,32, 64, 128 and 256 Bit	
Access control	Central master. Control can be exchanged between different masters.	
Operation mode	Cyclical for process data, sporadic for message data with arbitration	

9.2.10.3.1 MVB Topology



MVB uses one baudrate for the complete system.
The segments are connected via repeater.

9.2.10.3.2 Connection and Activation

- The MVB-Bus may only be connected with the measurement device once it has been completely wired up.
- Only then may the device be activated.
- During operation, the MVB connectors must not be unplugged.

9.2.10.4 MVB-Assistant

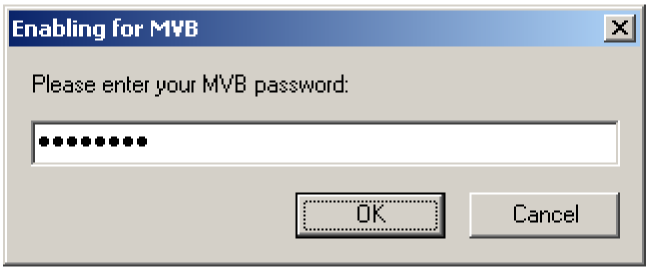
The MVB-Assistant offers the ability to make settings for the imc device's MVB terminals. This includes definitions for the frames and channels (signals) to be received.

The entire MVB-configurations of all controller in the experiment or even only the configuration of a controller can be saved/loaded to a file (*.mvbaf).

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > MVB-Assistant*.

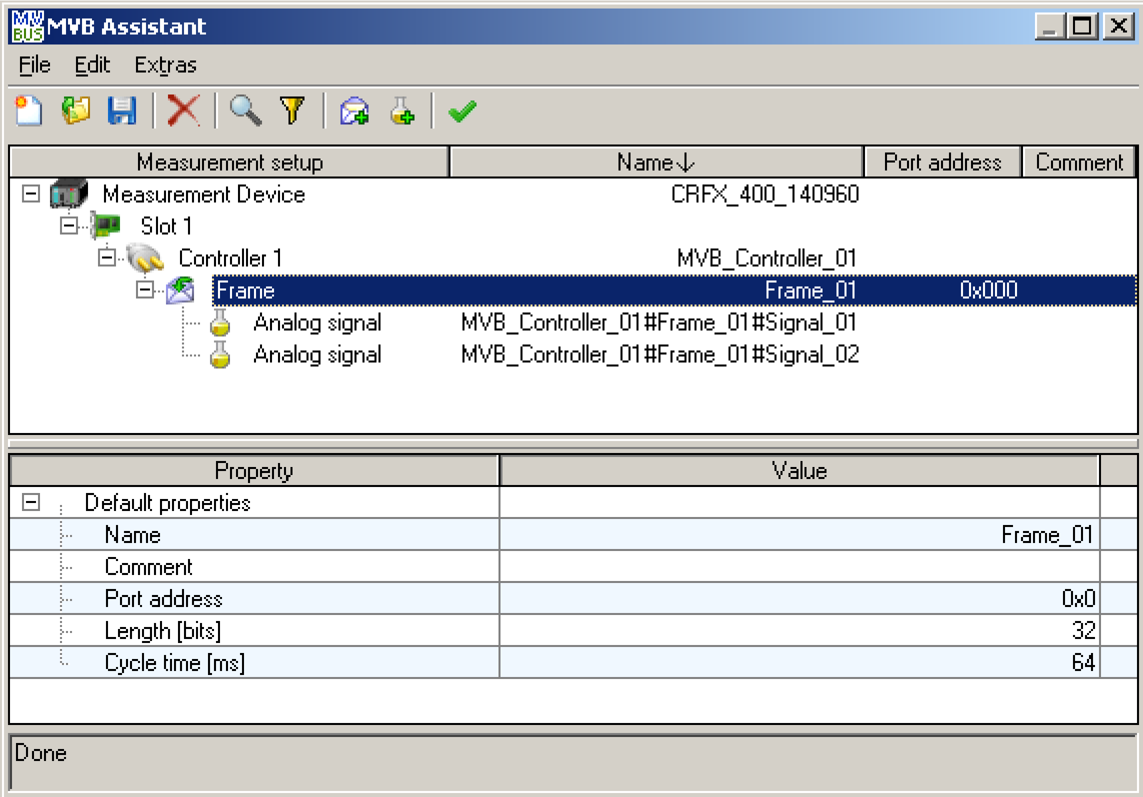
Password

Further, a controller's configuration can be imported from customized files. In order to enable import of customer-specific formats, passwords varying for respective customers are required. In that case a password is demanded, the first time the Assistant is called. When in doubt, contact the Hotline 10.



Entering the password

9.2.10.4.1 Overview Window



In the Assistant's upper region, the overview is displayed. In it, the structure of the measurement setup as it relates to the MVB-configuration is displayed schematically. You are shown the measurement devices () connected with the experiment, and its name.

The MVB interfaces ( ) (slots) installed are indicated under each measurement device, along with their respective MVB-controller () which these have.

For each MVB-cluster, the frames ( ) already defined with its associated signals ( ) (channels) are indicated.

9.2.10.4.2 Properties Window

The Properties window is visible in the lower portion. It displays the editable properties and the settings options for the object currently selected in the Overview window. If multiple objects are selected at the same time, the Properties window shows a selection of suitable properties.

To change a property's value, click on the desired value.

Depending on the property, either a pop-down list or a text box is used.

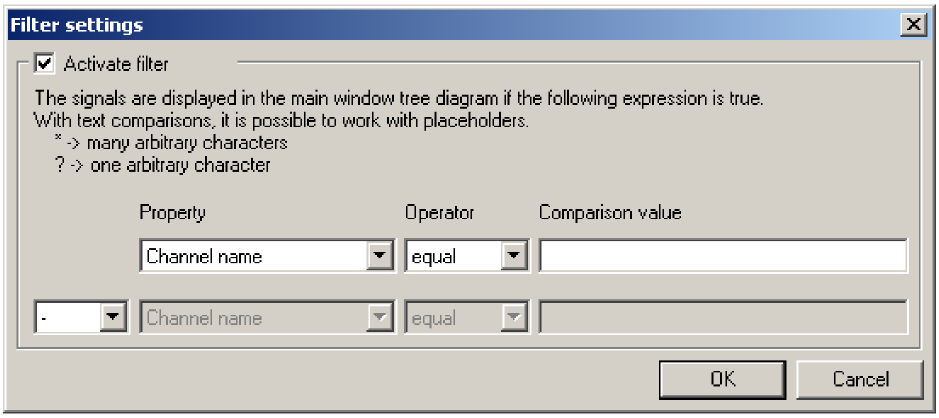
9.2.10.4.3 Menu

9.2.10.4.3.1 File

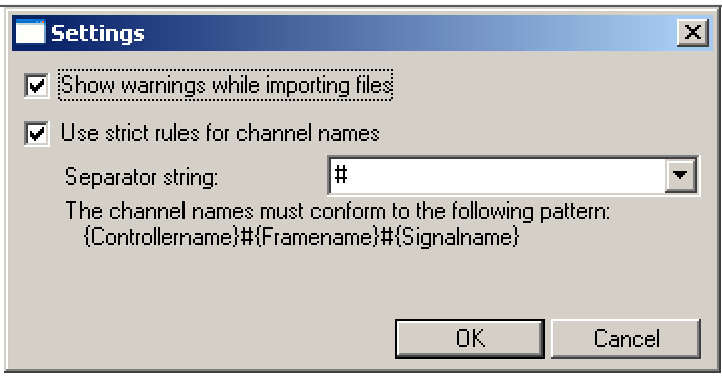
<table>
<tr><th>Menu item</th><th>Description</th></tr>
<tr><td>New</td><td>Removes all previously created frames and signals and creates an empty MVB-configuration.</td></tr>
<tr><td>Load All</td><td>The entire MVB-configurations of all devices and MVB-controllers in the experiment are loaded from a file. The file extension for this is MVBAF (*.mvbaf) "MVB-Assistant-File".</td></tr>
<tr><td>Save All As</td><td>This is the counterpart to "Load All...". The entire MVB-configurations of all devices and MVB-controllers in the experiment are written to a file. The file extension for this is MVBAF (*.mvbaf) "MVB-Assistant-File"</td></tr>
<tr><td>Load/import the selected controller</td><td>Imports the configuration of the controller currently selected from a file. The other controllers in the experiment are not affected.

The following file formats are available for selection.
<table><tr><th>File format</th><th>Remarks</th></tr><tr><td>MVB-Assistant-File (*.mvbaf)</td><td>If the file contains multiple controller-configurations (if these were generated by means of the "Save All As..."-command), the file's first controller is loaded to the currently selected controller. The file's other controllers are ignored.</td></tr></table></td></tr>
<tr><td>Save the selected controller</td><td>Saves the selected controller in MVB-Assistant-File (*.mvbaf) –format to a file. In this way, it is possible to subsequently load the configuration to a different controller.</td></tr>
</table>

9.2.10.4.3.2 Edit

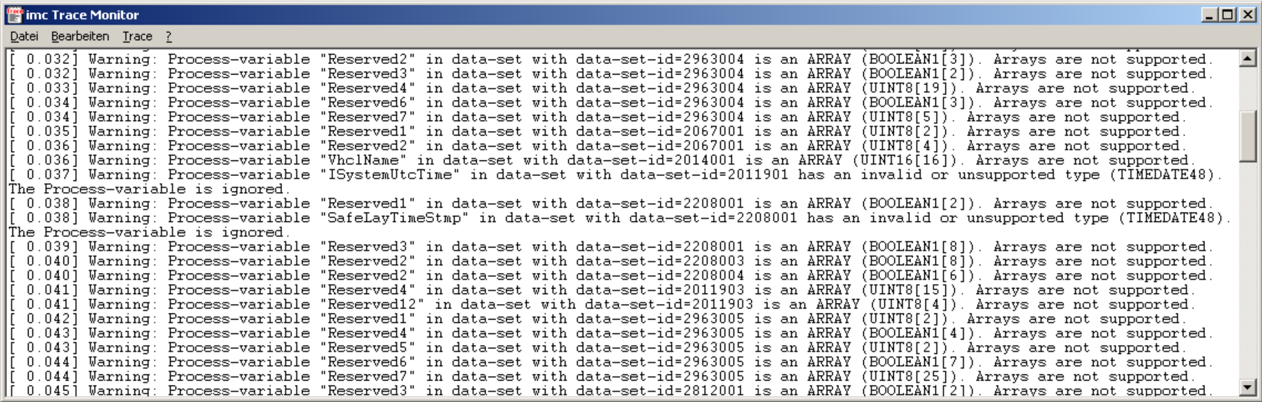
Menu item	Description
Delete	Removes the selected entry
Add new frame	Adds an additional frame to the selected cluster.
Add new signal	With this menu item, you can add an additional signal to the selected frame.
Find	It is possible to search for words or word fragments in the overview window. When many frames/signals have been defined, it is helpful for searching for them by name.
Find Next	Searches for the next instance of the text entered.
Filter	 The signals are displayed in the main window's tree diagram if a logical expression's condition is met.

9.2.10.4.3.3 Extras

Menu item	Description
Test configuration	Checks whether the settings are valid as they are made. If not, the cursor skips to the faulty object in the Overview window and a message is posted in the status bar.
Settings	 **Dialog: Settings**

Settings: Show warnings while importing files

If the option "Show warnings while importing files" is active, then upon import of customized files, a list of messages indicating problems found is displayed.



imc Trace Monitor

9.2.10.4.3.4 Tree diagram context menu

Right-clicking the mouse over the tree calls a context menu. Some of the commands listed here are also available in other menus. For this reason, only unique menu items will be discussed here.

Menu item	Description
Expand all frames	Opens all frames in the tree.
Collapse all frames	Closes all frames in the tree.
Select all subordinate controllers	Selects all controllers belonging to the currently selected measurement device.
Select all subordinate frames	Selects all controllers belonging to the currently selected measurement device.
Select all subordinate signals	Selects all signals belonging to the currently selected measurement device, controller or even only those of the frame.

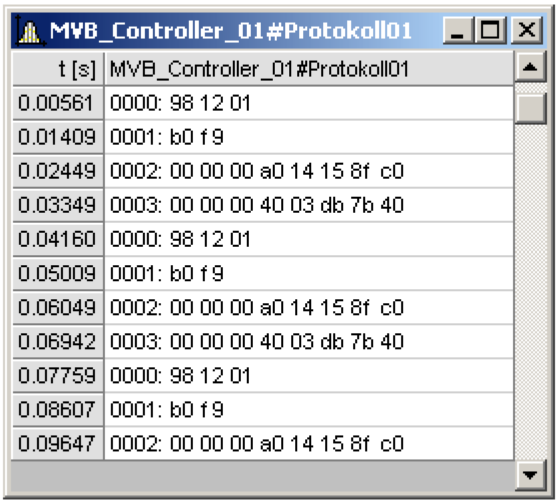
9.2.10.4.4 Properties of Controllers

Property	Value
⊟ Default properties	
Name	MVB01
Comment	
Construction rule for the message-log-channel	{CTRL}_{SIG}
Construction rule for Signal- and Bit-Port- names	{CTRL}_abc_{FRM}_{SIG}_123
⊟ Log settings	
Log all data received on the MVB?	Yes
⊟ Base name of the message-log-channel	Log01
Resulting name of the message-log-channel	MVB01_Log01

Properties of a Controller

Default properties	Description
Name	Freely definable name for the Controller.
Comment	Comment on the Controller
Construction rule for names of log channels and signal channels	The channel names can be composed from the name entries with placeholders: {CTRL} for Controller 664, [FRM} for Frame 666 and {SIG} for Signal 667. The placeholders must always be spelled in capital letters. Example: Name of the controller = "*MVB01*", name of the frame= "*Frame01*" and name of the signal = "*Sig01*" from *{CTRL}_abc_{FRM}_{SIG}_123,* the resulting name is: "*MVB01_abc_Frame01_Sig01_123*"

<table>
<tr><th>Log settings</th><th>Description</th></tr>
<tr><td>Logging of all configured and received data</td><td>
Enables recording of a bus log of all configured and received frames with this controller's FCodes 0...4.
In this log, not only the frame's payload data are recorded but also the time received and the port address.
The option allows the data stream to be unpacked as individual channels in imc STUDIO by the Bus Decoder 1683 or via imc FAMOS.



t [s]	MVB_Controller_01#Protokoll01
0.00561	0000: 98 12 01
0.01409	0001: b0 f 9
0.02449	0002: 00 00 00 a0 14 15 8f c0
0.03349	0003: 00 00 00 40 03 db 7b 40
0.04160	0000: 98 12 01
0.05009	0001: b0 f 9
0.06049	0002: 00 00 00 a0 14 15 8f c0
0.06942	0003: 00 00 00 40 03 db 7b 40
0.07759	0000: 98 12 01
0.08607	0001: b0 f 9
0.09647	0002: 00 00 00 a0 14 15 8f c0

Bus log example
</td></tr>
<tr><td>Base name of the message-log-channel</td><td>Freely definable channel name of the bus log channel.</td></tr>
<tr><td>Resulting name of log channel</td><td>The log name resulting from the Construction rule 664.</td></tr>
</table>

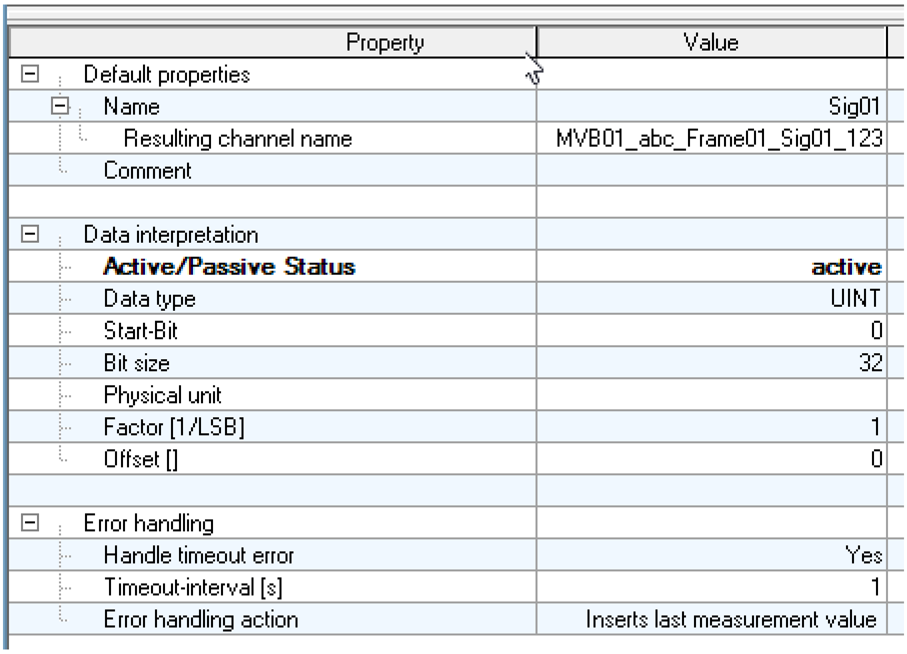
9.2.10.4.5 Properties of Frames

Property	Value
Default properties	
Name	Frame_01
Comment	
Port address	0x0
Length [bits]	32
Cycle time [ms]	64

Properties of a Frame

Standard Eigenschaften	Beschreibung
Name	Freely definable name for the frame.
Comment	This is a text box for saving comments on the frame.
Port address	The Port address identifies the frame on the bus. This can take values of 0 through 4095.
Length [bits]	This specifies the frame's length in bits. The following values are possible: 16, 32, 64, 128 and 256
Cycle time [ms]	This is the planned time interval between two successive frames having this port address. This value is read from the files to be imported. This value is used if one of this frame's channels is registered for the first time. In this case, it is used to calculate the channel's sample time, which must always be less than or equal to the cycle time specified here. Example: The cycle time is 64ms. The system then sets the next lower sampling rate of 50ms.

9.2.10.4.6 Properties of Signals



Propertie of a signal

Default properties	Description
Name	Freely definable name for the signal.
Resulting channel name	The channel name which results from the construction rule 664 in the Controller properties.
Comment	This is a text box for saving a comment on the signal. This comment may have a maximum of 255 characters. It is the same comment which will be visible with the registered channel.

Data integration	Description
Active/Passive Status	Allows signals to be hidden The configuration files to be imported often contain multiple thousands of signals. Up to 990 Fieldbus channels can be registered for each imc device. There is a limit of 512 active channels per device. Once the count of signals belonging to a device has been exceeded, it is necessary to select which ones are important for the measurement.

Active/Passive Status	Remarks
active	The signal is set as an active channel and recorded.
passive	The signal is registered in the system as a channel, but set to passive. No measured data are recorded.
Do not register with administration	The signal is not registered in the system. This signal only exists in the Assistant. No measured data are recorded.

<table>
<tr><th>Data integration</th><th>Description</th></tr>
<tr><td>Data type</td><td>This sets the signals type, or rather, how the data on the bus are interpreted. The following data types are possible:
<table>
<tr><th>Data type</th><th>Remarks</th></tr>
<tr><td>SINT</td><td>Signed Integer, negative numbers in two's complement</td></tr>
<tr><td>UINT</td><td>Unsigned Integer</td></tr>
<tr><td>BOOL</td><td>Single bit - If this data type is set, there is another signal property to set: the name of the 16-bit port channel</td></tr>
<tr><td>FLOAT</td><td>Floating point number with 32 bit conforming to "IEEE 754 (ANSI/IEEE Std 754-1985; IEC-60559:1989 - International version)"</td></tr>
</table></td></tr>
<tr><td>Start-Bit</td><td>Specifies the bit-offset within the frame before the start of the current signal.</td></tr>
<tr><td>Bit size</td><td>Specifies how many bits from the start-bit on belong to the signal. What value range is possible for this property depends on the data type.
<table>
<tr><th>Data type</th><th>Possible value range for "Bit size"</th></tr>
<tr><td>SINT, UINT</td><td>Minimum 2 bits; Maximum 32</td></tr>
<tr><td>BOOL</td><td>Property not available, since only 1 bit.</td></tr>
<tr><td>FLOAT</td><td>always 32-Bit</td></tr>
</table></td></tr>
<tr><td>Physical unit</td><td>Here you can enter a physical unit or its abbreviation, e.g. "V” for Volt. Use SI-units wherever possible. It is not advised to enter any scaling prefix such as m for milli-. Instead, adjust the factor correspondingly. The imc STUDIO curve windows automatically add such prefixes to correspond to the measured values.</td></tr>
<tr><td>Factor and Offset</td><td>If the signal currently selected happens to be of the integer data type, signed or unsigned, then both the properties Factor and Offset are displayed.

These values are parameters for linear transformation, which are computed by the following formulas.
<table>
<tr><th>Incoming signal</th><th>Outgoing signal</th></tr>
<tr><td>$y = f \cdot x + a$</td><td>$x = \frac{y}{f} - \frac{a}{f}$</td></tr>
</table>
Variable definition
y = physical value   f = factor
x = integer on the Field-bus   a = offset</td></tr>
</table>

Data integration	Description
	An incoming signal is a 16-bit unsigned integer. Thus, the integer's numerical range is 0 LSB to 65535 LSB. The physical quantity which it represents is a voltage between 10 V and 20 V. The factor is thus given by the equation $f = \frac{20\ \mathrm{V} - 10\ \mathrm{V}}{65535\ \mathrm{LSB}} = 1.526 \cdot 10^{-4} \frac{\mathrm{V}}{\mathrm{LSB}}$ and the offset is $a = 10\ \mathrm{V}$ Supposing the following integer were imported from the bus, $x = 13483\ \mathrm{LSB}$ it would correspond to a voltage of $y = f \cdot x + a = 12.057\ \mathrm{V}$

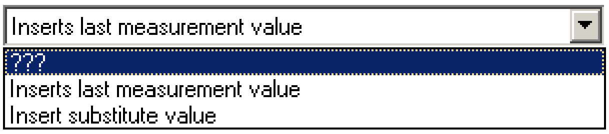
Handle timeout error

The term timeout-error refers to a case where no measured value is received from the field-bus after a certain period; error handling can be set to deal with such an occurrence.

Parameter	Description
Handle timeout error	This settings option determines whether error handling of any timeout error would be performed.
Timeout Interval [s]	This is where to set the time limit after which a timeout-error is considered to have occurred.

Error handling action

This setting determines the action to be performed in case the timeout time limit elapses.



For this purpose, the following options are available, whose effects depend on whether a channel is sampled equidistantly or recorded with a time stamp.

Error handling	Equidistant sampling	Samples with time stamp
Last value	The last valid value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the last value.
Substitute value	The substitute value is returned until a new value arrives.	After elapse of the timeout time, a new sample is generated with the substitute value.

9.2.11 Profinet Interface

Profinet stands for ***Proc***ess ***Fi***le ***Net***work-***I***sochronous-***R***eal-***T***ime. This technology, developed by member companies of the Profibus user organization in conjunction with Siemens is based on Ethernet-TCP/IP and UDP/IP and conforms to the standards IEC 61158 and IEC 61784.

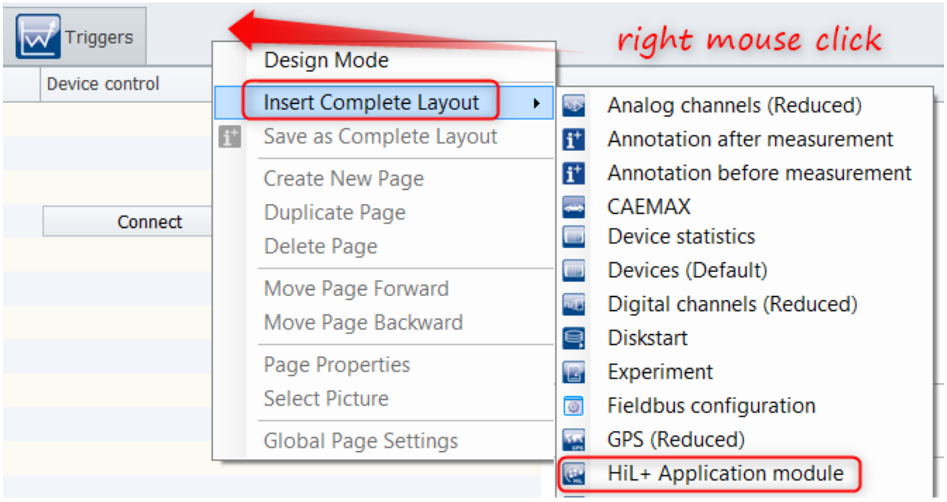
Integration in imc CRONOS*compact* is provided by means of the interface module **imc PROFINET-IRT**. For configuration purposes, the complete-layout "*HiL + Application module*" is used, which enables the necessary configuration steps.

9.2.11.1 Preparation

Integration in the experiment

In order for imc STUDIO to be able to load the following Assistant, the device hardware configuration must be declared.

The Assistant for configuring the Profinet Interface is inserted from the "*Complete Layouts*":

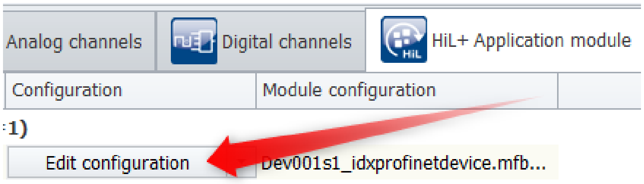


Calling the Assistant

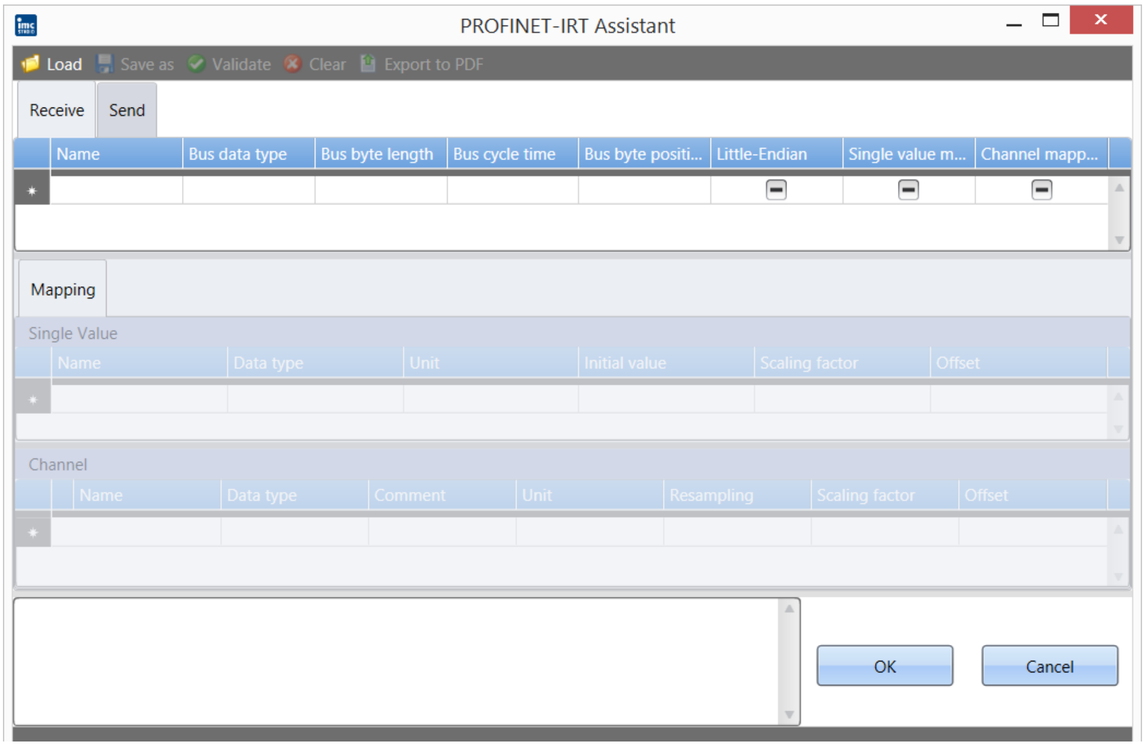
imc STUDIO automatically loads the module configuration for Profinet-IRT and enables the configuration by its assistant.

9.2.11.2 PROFINET-IRT Assistant

In order to start the Assistant from imc STUDIO, click on "*Edit configuration*" under "*Setup-HiL + Application module*".



Edit configuration opens PROFINET-IRT Assistant



PROFINET-IRT Assistant

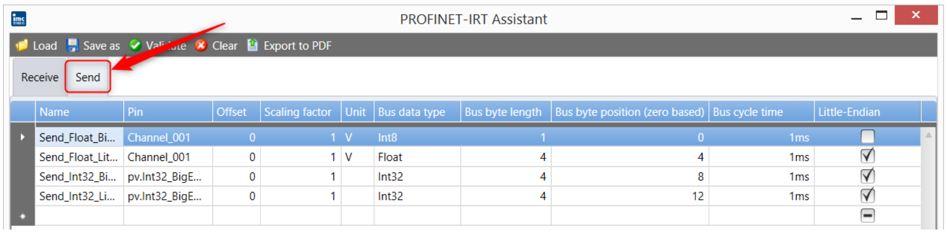
9.2.11.2.1 Menu

PROFINET-IRT assistant menu

Menu item	Description
Load	Here, a Profinet configuration having the extension *.**dcz** can be loaded.
Save as	Saves the current Profinet configuration with the file extension *.**dcz**.
Validate	Checks the current Profinet configuration for duplicate or faulty names, and plausibility.
Clear	Resets the Profinet configuration.
Export as PDF	Creates a PDF with listed parameters.

9.2.11.2.2 Send

Under the page *Send*, selected channels captured by the imc system are sent to the PROFINET-IRT receiver. From the perspective of the SPS, this is referred to as the **input-measurement data space**.

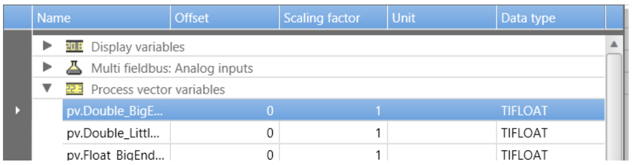


PROFINET-IRT Send-dialog

PROFINET-IRT uses the Ethernet-network and sends up to 20 blocks having 64 Bytes each (for a maximum of 1280 Bytes) in a data package. The data are addressed by the position of the first Byte and the count of Bytes in the signal.

It is possible to send channels, process vector variables and Display variables. Digital channels can not be sent bit-by-bit, but only as Bytes.

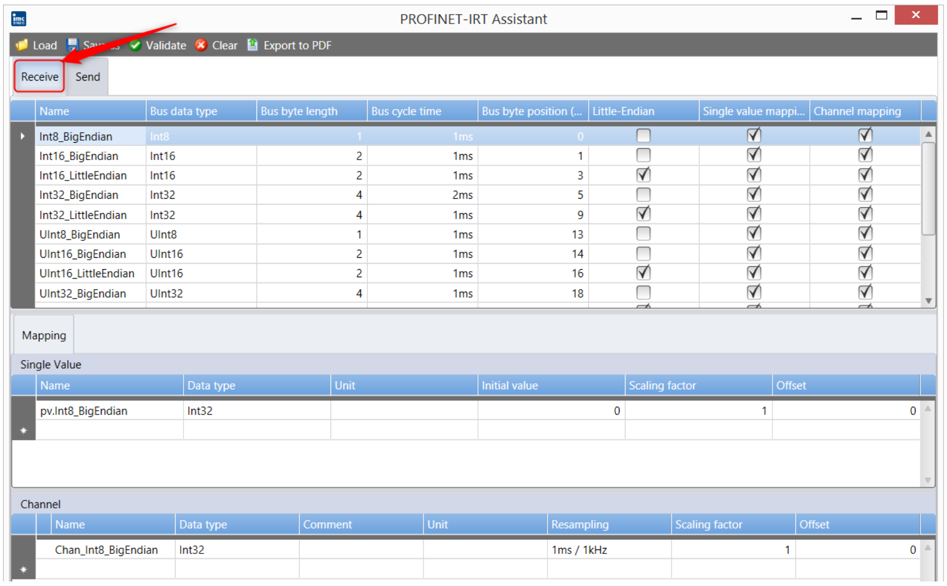
Selected lines can be deleted by means of the Delete-key. Caution: "*Clear*" deletes not only the selected line but the complete list!

Parameter	Description
Name	Designation of the signal as information for the receiving device.
Pin	A click in the cell of the column *Pin* opens a sub-dialog with all signals which can be sent by the imc system.  **PROFINET-IRT Pin-dialog** Channels, process vector variables and Display variables can be sent.
Offset/Scaling factor/Unit	These parameters can not be edited. Once the signal has been selected in the Pin-column, the offset, scaling factor and unit are entered by the system. For signals of the data type Float, the offset and the scaling factor are already reflected in the value and therefore Offset= 0 and Scaling factor = 1 always applies. For integer values, there is a resulting offset and scaling, which is entered by the system.
Bus-data type	Data type: Int16, Int32, Float etc. This is set in the Pin-column upon selection of the signal.
Bus-Byte length	This is set in the Pin-column upon selection of the signal. For Int16, = 2 Byte; for Int32, = 4 Byte; etc.
Bus-Byte position	Position of the signal's first Byte. The system consecutively adds the signals to the column as they are selected. The position can be re-assigned later if desired.

Parameter	Description
Bus cycle time	The signal's updating interval. This determines the frequency at which the signal is read for PROFINET-IRT. In actual fact, the signal is updated at intervals of half of the cycle time, in order to avoid losing any update. Different bus cycle times may be entered for signals belonging to the same data packet. **Remarks**: Since all signals are sent as a complete packet, signals having relatively long cycle times are not always actually updated, meaning that the most recent value is sent repeatedly for a few intervals. The receiver is aware of the interval through the configuration file (*.dcz), so that the value there is only read whenever the cycle time associated with the signal has elapsed.
Little Endian	You must specify whether the order of Bytes is sent according to Little-Endian format (activated), or in Big-Endian format (inactive). Little-Endian is the order in which the "Little End" (lowest value in the Byte sequence) is saved first. **Example**: The hexadecimal number 3F56hex is saved at the memory addresses 1000 and 1001: Little Endian system: 56 at the address 1000 and 3F at the address 1001 Big Endian system: 56 at the address 1001 and 3F at the address 1000

9.2.11.2.3 Receive

On the page "*Receive*", signals are extracted from the PROFINET-IRT data packet and made available for the imc system as either channels or single values. From the perspective of the SPS, this is referred to as **output-measurement data space**.



PROFINET-IRT Receive-dialog

PROFINET-IRT uses the Ethernet-network and sends up to 20 blocks having 64 Bytes each (for a maximum of 1280 Bytes) in a data package. The signals are addressed by the position of the first Byte and the count of Bytes in the signal.

The data received are mapped in the imc system to channels or single values (process vector variables). It is not possible to write to Display variables directly. Digital signals can only be mapped to 2-Byte channels or 32-bit process vector variables.

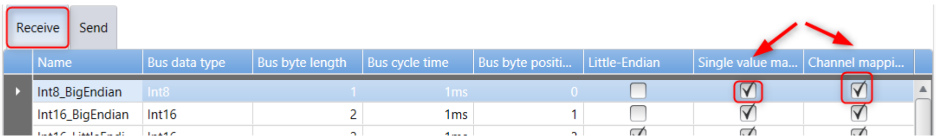
Selected lines can be deleted by means of the Delete-key. Caution: *Clear* deletes not only the selected line but the complete list!

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Name</td><td>The designation of a signal as it is registered with the sender . This entry is only used for documentation purposes. The name of the channel or process vector variable which is mapped and visible in the imc software is set under "Mapping 675".</td></tr>
<tr><td>Bus-data type</td><td>Selection of the data format expected for the signal
<table>
<tr><th>Data type</th><th>Variants</th><th>Bit count</th></tr>
<tr><td>Integer</td><td>Int8, Int16, Int32</td><td>with 8, 16 or 32 bits</td></tr>
<tr><td>Unsigned Integer</td><td>UInt8, UInt16, UInt32</td><td>with 8, 16 or 32 bits</td></tr>
<tr><td>Floating point numbers</td><td>Float, Double</td><td>32-bit and 64-bit</td></tr>
</table></td></tr>
<tr><td>Bus-Byte length</td><td>Byte length of the signal.</td></tr>
<tr><td>Bus-Byte position</td><td>Start position of the signal's first Byte.</td></tr>
</table>

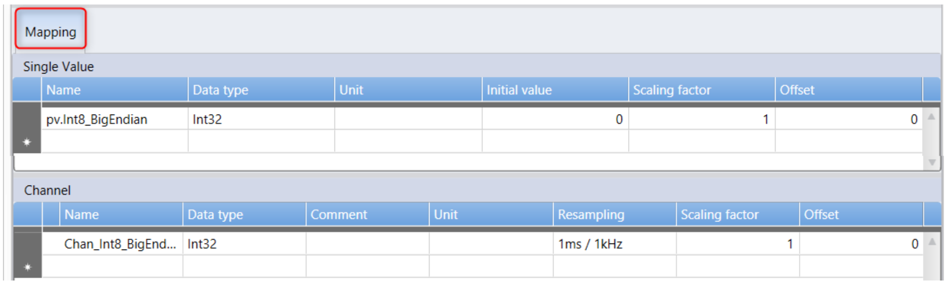
Parameter	Description
Bus-cycle time	The signal's updating interval. This determines the frequency at which the signal is read for Profinet. In actual fact, the signal is updated at intervals of half of the cycle time, in order to avoid losing any update. **Remarks**: Different bus cycle times may be entered for signals belonging to the same data packet. Since all signals are sent as a complete packet, signals having relatively long cycle times are not always actually updated, meaning that the most recent value is sent repeatedly for a few intervals.
Little Endian	You must specify whether the order of Bytes is received according to Little-Endian format (activated), or in Big-Endian format (inactive). See also "*Send* 673".
Single value-/channel-mapping	When this option is activated, a process vector variable and/or a channel is created, for which you can make settings under "*Mapping* 675".

9.2.11.2.3.1 Mapping

Depending on whether the respective option is activated in the column **Single Value-** or **Channel-mapping**, the signal selected under "*Mapping*" is listed as *Single Value* and/or *Channel*. The signal can be provided as a channel, a process vector variable or both.



In the lower area under "*Mapping*" the signals of the PROFINET-IRT data packet are defined for the imc system.



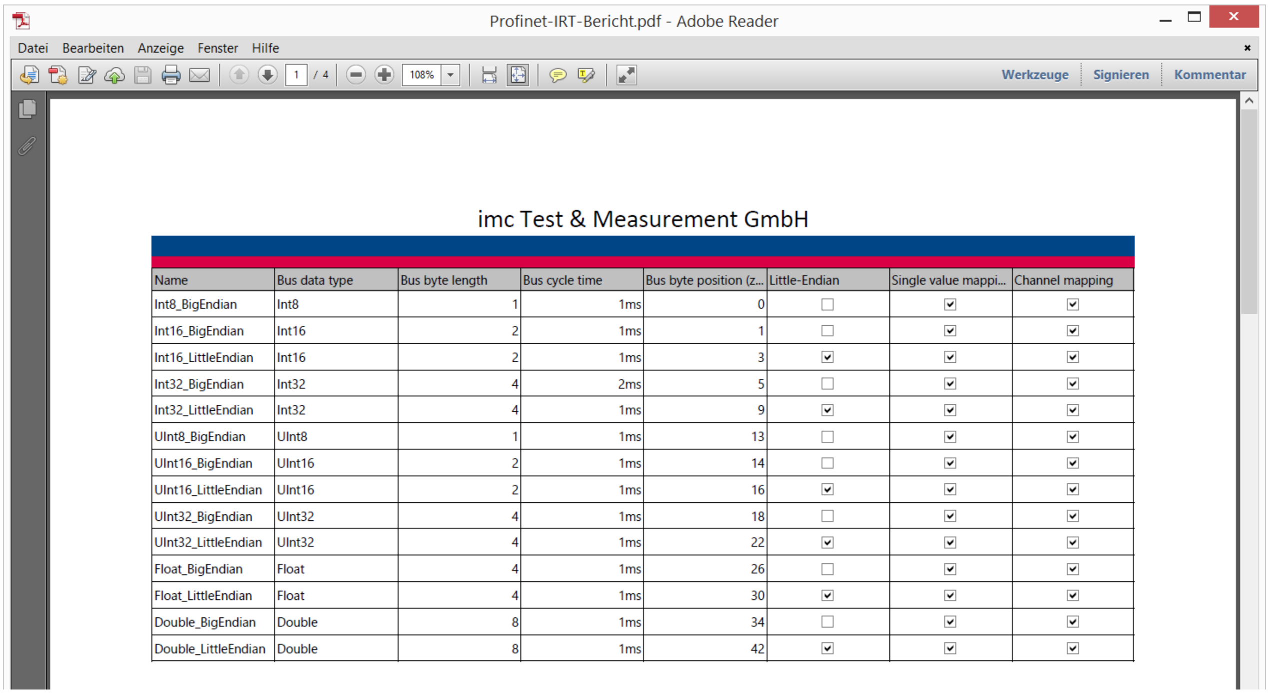
PROFINET-IRT Receive dialog

Parameter	Description
Name	The signal's designation as a channel or process vector variable in the imc system.
Bus-data type	Selects the data format to be used in the imc system **Data type** / **Variants** / **Bit count** Integer / Int32 / 32 bits Floating point numbers / Float / 32 bits
Offset/Scaling factor/Unit	The offset and scaling factor for integer formats. These are to be adopted from the specs of the sending device, and the unit as well.
Initial value for single values	Preset which applies until arrival of the first data packet.

Parameter	**Description**
Comment for Channel	A comment to be saved as a property with the channel. Freely defined text having up to 255 characters.
Resampling for Channel	Output rate. No interpolation performed. The signal is updated at the "*Bus-cycle time*" and outputted at the rate specified under "*Resampling*". If *Resampling* > *Bus-cycle time*, the same value is used repeatedly. If *Resampling* < *Bus-cycle time*, not all values received from the Profinet bus are processed.

9.2.11.2.4 Export as PDF

The table is exported as a PDF file.



imc Test & Measurement GmbH

Name	Bus data type	Bus byte length	Bus cycle time	Bus byte position (z...	Little-Endian	Single value mappi...	Channel mapping
Int8_BigEndian	Int8	1	1ms	0	☐	☑	☑
Int16_BigEndian	Int16	2	1ms	1	☐	☑	☑
Int16_LittleEndian	Int16	2	1ms	3	☑	☑	☑
Int32_BigEndian	Int32	4	2ms	5	☐	☑	☑
Int32_LittleEndian	Int32	4	1ms	9	☑	☑	☑
UInt8_BigEndian	UInt8	1	1ms	13	☐	☑	☑
UInt16_BigEndian	UInt16	2	1ms	14	☐	☑	☑
UInt16_LittleEndian	UInt16	2	1ms	16	☑	☑	☑
UInt32_BigEndian	UInt32	4	1ms	18	☐	☑	☑
UInt32_LittleEndian	UInt32	4	1ms	22	☑	☑	☑
Float_BigEndian	Float	4	1ms	26	☐	☑	☑
Float_LittleEndian	Float	4	1ms	30	☑	☑	☑
Double_BigEndian	Double	8	1ms	34	☐	☑	☑
Double_LittleEndian	Double	8	1ms	42	☑	☑	☑

9.2.12 PROFIBUS Interface

Using the PROFIBUS Configurator 677, you can create a configuration for the Assistant in imc STUDIO

With PROFIBUS Assistant 685 you setup the fieldbus interface for the imc devices accordingly.

Note

PROFIBUS configurator and assistant **has not been available in English** at the time of printing this manual.

9.2.12.1 PROFIBUS Configurator

Unfortunately, there is no universal standard for the exchange of PROFIBUS configurations.

However, there are standardized module descriptions: GSD (General Station Description) files. GSD files contain so-called basic device data which characterize a PROFIBUS subscriber's properties. The PROFIBUS Configurator joins the modules present with the GSD files in the configuration.

The resulting configuration is exported from the PROFIBUS Configurator in csv format and then re-imported into imc STUDIO by the PROFIBUS Assistant.

Installation

This program is not automatically installed with the rest of the package. It is on the imc STUDIO installations medium in the folder: Products\imc DEVICES\Tools\imcPROFIBUSConfigurator.

Start the setup and follow the instructions which appear. The program can then be installed at an arbitrary location on your hard drive.

9.2.12.1.1 First start

When you start the software, you are prompted to select a GSD folder. This folder contains the GSD files of the system you wish to configure. Alternatively, the GSD folder can contain a complete collection of your system's GSD files and serve as a library.

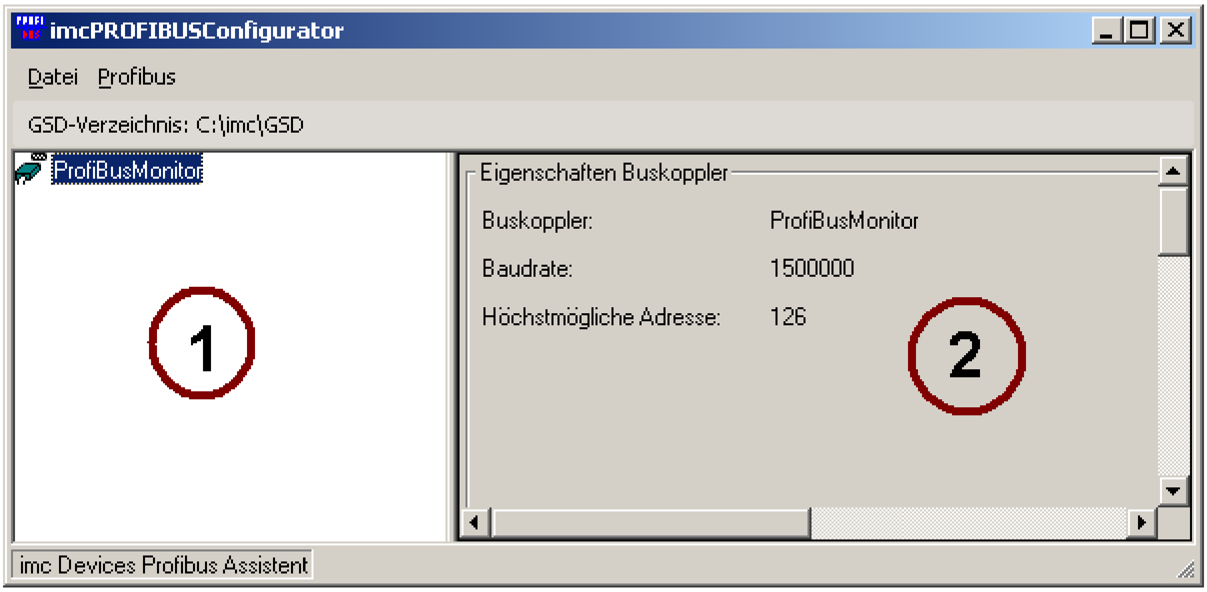
If necessary, create such a folder on your PC and copy your module's files to there.

Selecting the GSD folder

9.2.12.1.2 Main window

The main menu consists of two parts:

- **Part 1** maps the bus structure. Right-clicking the mouse over one of its elements opens the editable options belonging to it. For example, the element properties or adding subordinate elements.
- **Part 2** shows the properties of the respective element, while not allowing any changes.



Main PROFIBUS Configurator window

File menu

Menu item	Description
Open	Loads a previously stored configuration in XML format.
Save configuration	Saves the configuration as a XML file
Export	Exports the configuration as a CSV file. In this format the configuration is subsequently imported in PROFIBUS Assistant 684.
GSD Verzeichnis wählen	Selects the GSD (General Station Description) 677 files.

Profibus menu

Menu item	Description
Add Master	Opens the dialog for selecting the Master 679.
Add Slave	Opens the dialog for selecting the modules 679.
Monitor settings	Settings dialog for the Bus monitor 683.

9.2.12.1.3 Adding a Master / Slave

The menu items *Profibus > Add Master* and *Add Slave* each cause a settings dialog to appear.

The dialog lists all master or slave modules located in the GSD folder. If the GSD folder is not set 678 or not contain any GSD files, the list remains empty.

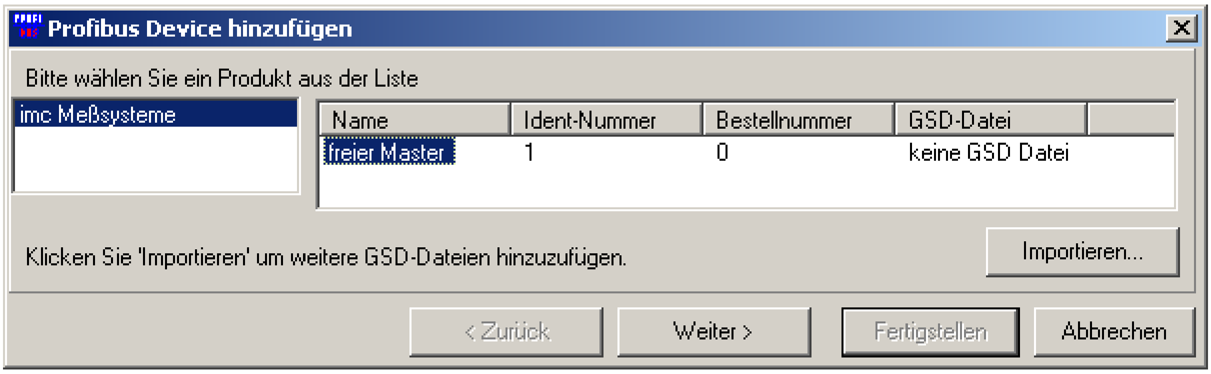
Click on the desired system and then on *Next*. In the next window, you can set any desired properties, such as the name or PROFIBUS addresses. Using the *Import* button, you can add additional GSD files.

Note

Notice that only such elements are listed whose GSD files are located in the GSD folder.

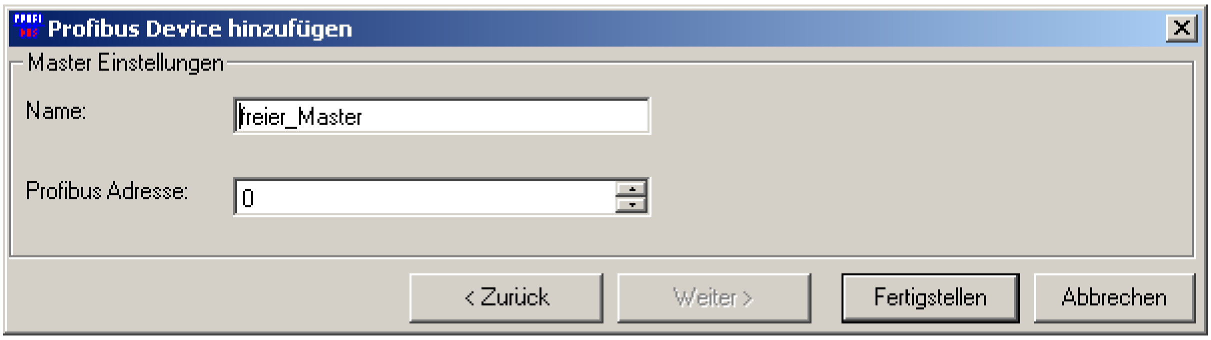
Configuring the Master

If you wish to add a new Master, you don't necessarily need a GSD file. The software recognizes a *free Master* which is able to function without a GSD file.



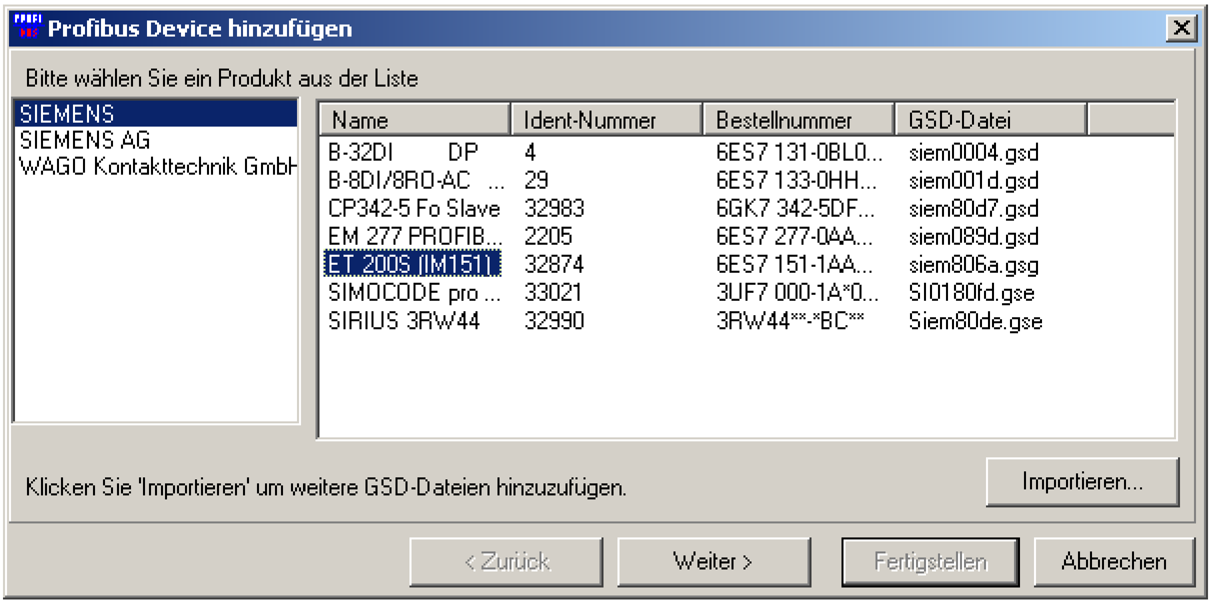
Configuring the Master

Click on *Next >* and set the name and ID.



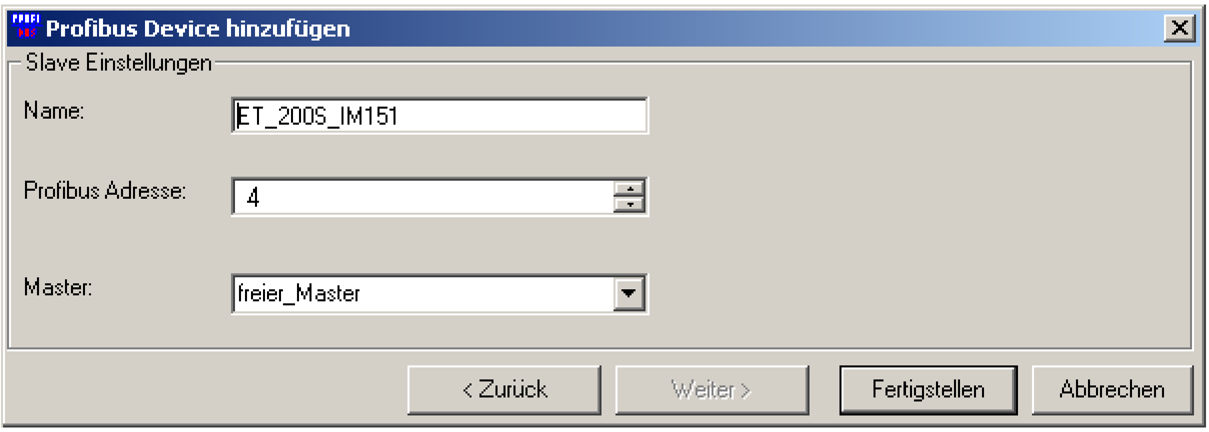
Setting the Master ID

Configuring the Slave



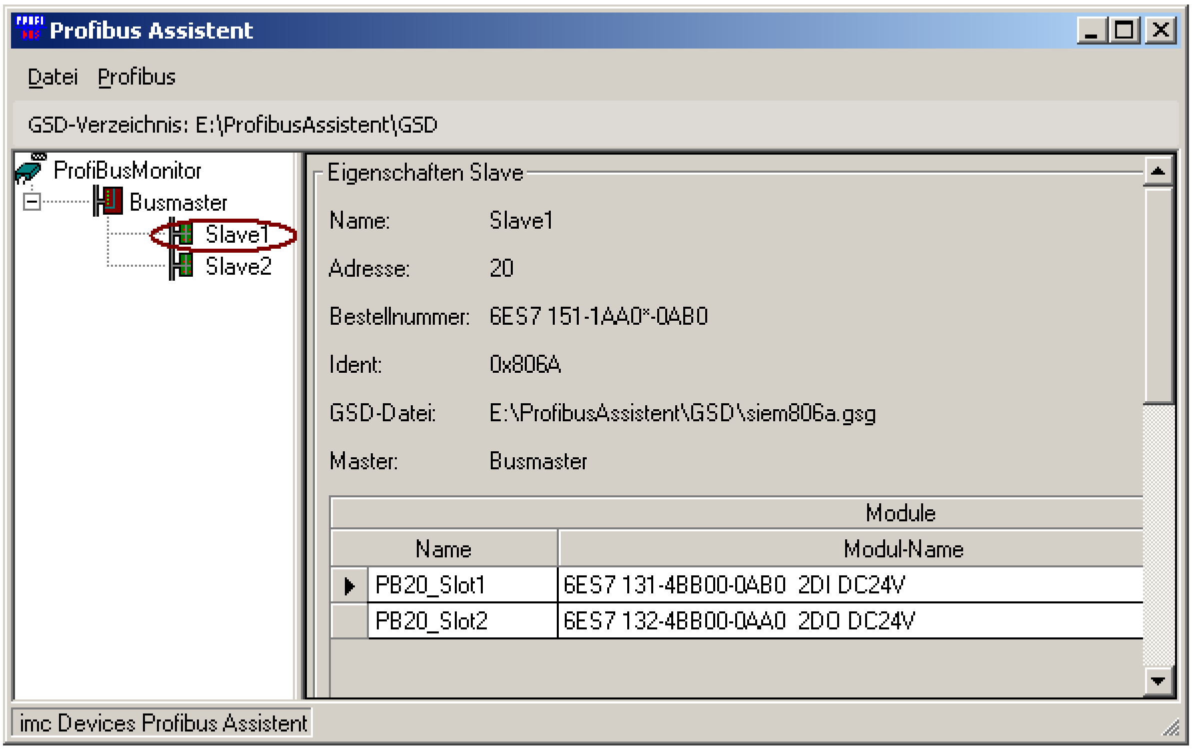
Adding elements

Select the connection terminal and click on *Next>*.



Set the Profibus address and the designation here

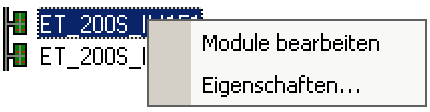
The modules entered now appear in the main window:



Modules in Profibus assistant

With modular Slaves, you need to enter their configuration manually. This concept assumes that there are usually **Bus terminals** as PROFIBUS-Slave subscribers available. These are equipped with a variety of **input**- or **output terminals**.

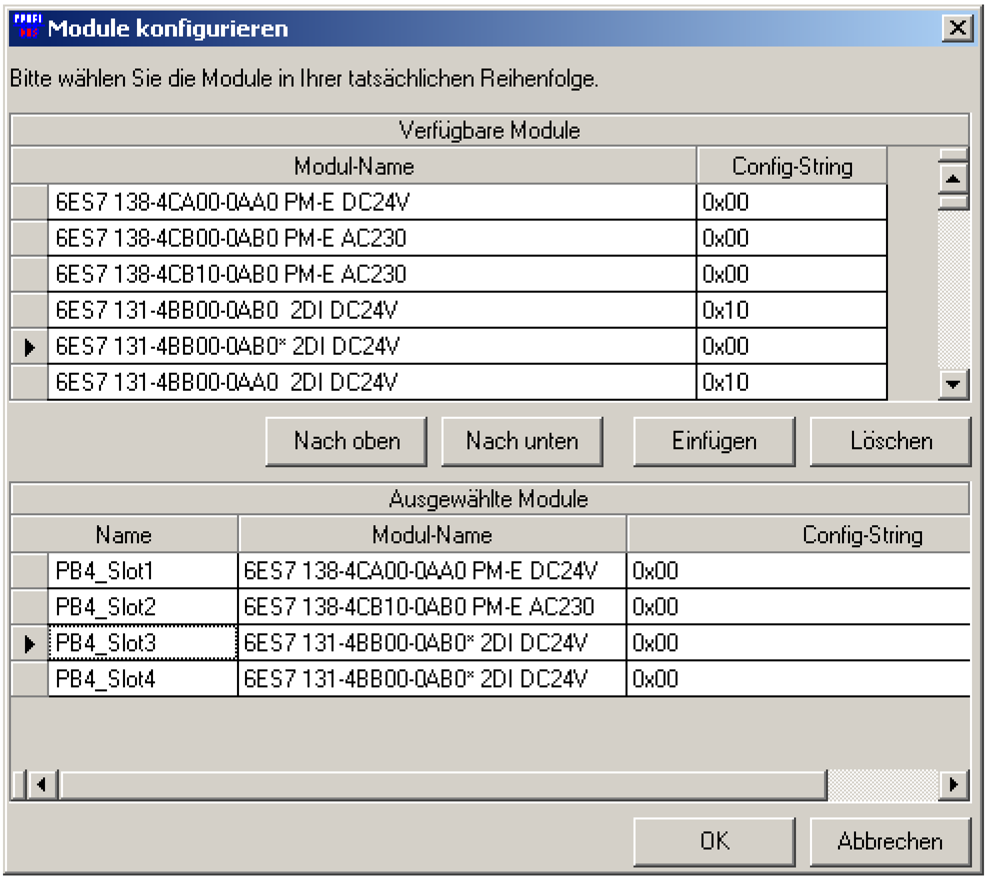
Right-clicking over the Master or the Slave opens the context menu:



Properties enables direct editing of the ID and name.

To change individual elements' properties separately, select **Module bearbeiten.**

The dialog for configuring the module appears.



Module configuration

Use the *Add* button to add the desired modules. Change the order using the buttons *Nach oben* and *Nach unten*.

Note

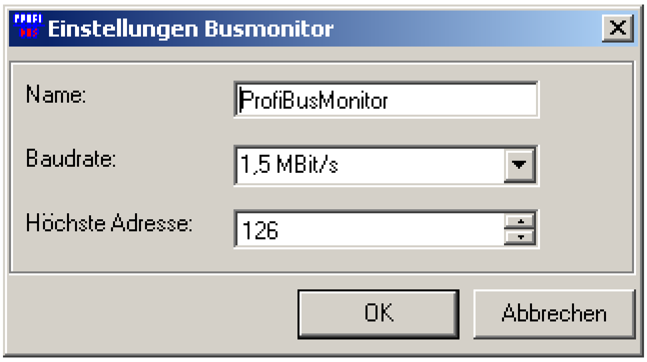
Note that it is absolutely necessary to order the modules in their actual order.

The selected modules are provided with names automatically; this naming can be altered by the user and it later reflected in the imc STUDIO channel names.

9.2.12.1.4 Monitor settings

Using the menu item Profibus/Monitor Settings, you can set the name, Baud rate and highest address.

The Baud rate set here and the name appear in the PROFIBUS Assistant in the connection settings 685.



Monitor settings

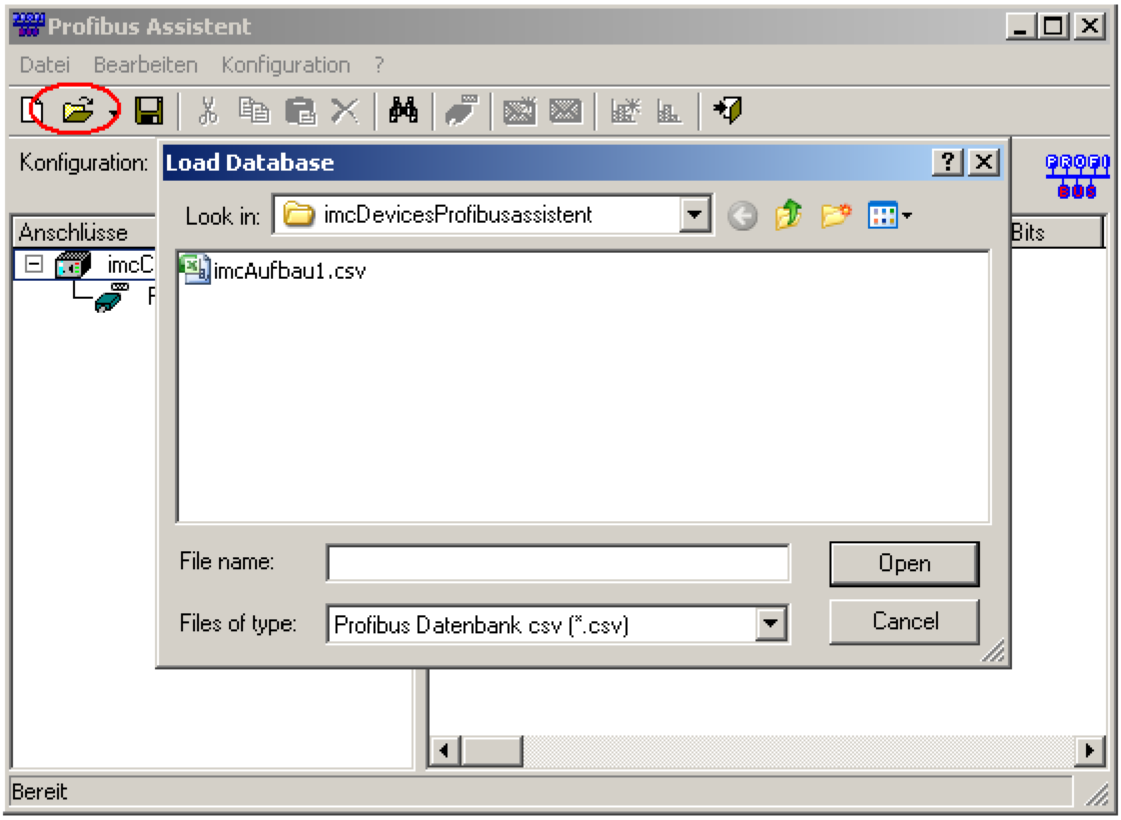
Settings	Description
Baud rate	Transfer speed in bits per second. The Baud rate used by the bus must match the one used by the device. Otherwise, the bus is disturbed and unable to read data.
Name	Designation of the respective PROFIBUS port. This is mainly for the purpose of distinguishing multiple PROFIBUS-monitor connections.
Highest address	The highest address refers to the highest possible subscriber address in the Bus. Normally, it is set to 126. If you have fewer subscribers, you can reduce the highest address. When you try to access a higher address, an error message appears. We recommend leaving this entry at 126, since there are no advantages to reducing it.

9.2.12.2 Transferring the configuration to imc STUDIO

Once you have modeled your system with the PROFIBUS Configurator, add the configuration to an imc STUDIO experiment.

To do this, proceed as follows:

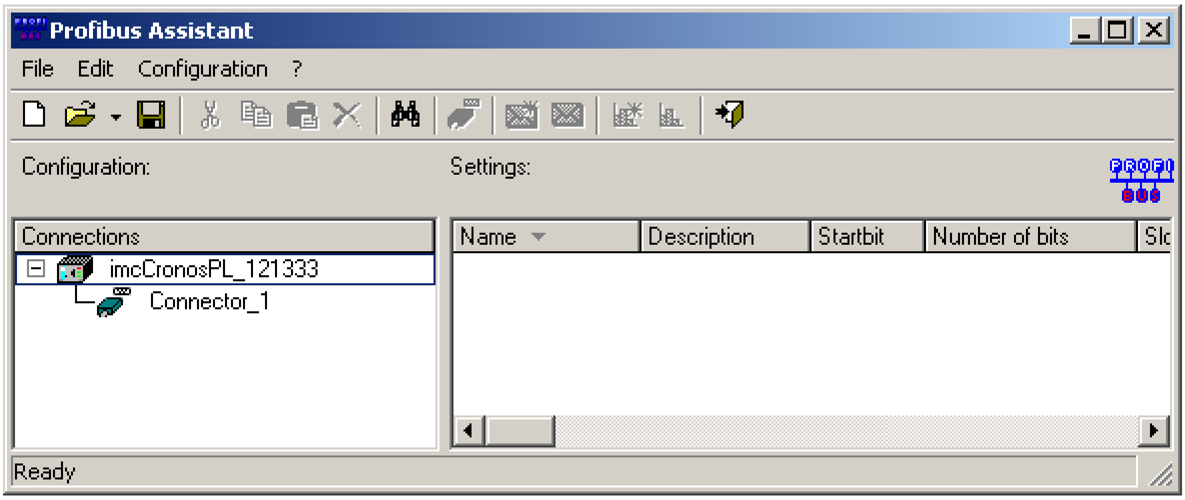
1. In the main PROFIBUS Configurator window, select the menu item *File > Export*
2. Save the file wherever desired
3. Start imc STUDIO
4. Start the PROFIBUS Assistant 685
5. Open the file saved in step 2 above



Loading the configuration

9.2.12.3 PROFIBUS Assistant

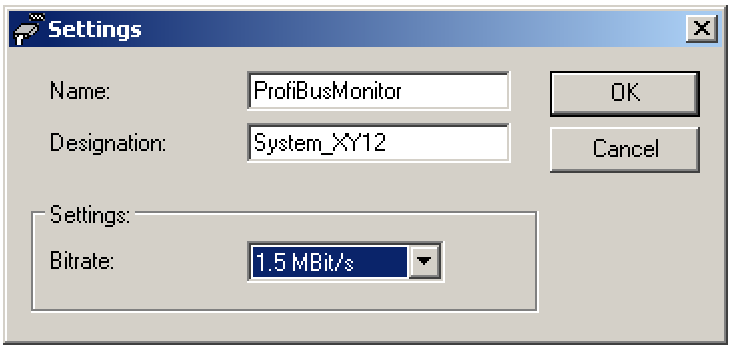
Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration* > *Profibus-Assistant*.



PROFIBUS Assistant

Menu	Description
File menu	Here you will find the usual items for opening and saving a configuration in the CSV format. The configuration is saved in XML format. However, the loading dialog is preset to "CSV" and hides XML files. To display the XML files, select "*.*".
Edit menu	Along with copy and paste, functions for searching and for selecting list entries are here.
Configuration menu	contains the functions for creating a PROFIBUS configuration. The functions are described further below.

9.2.12.3.1 Connection settings

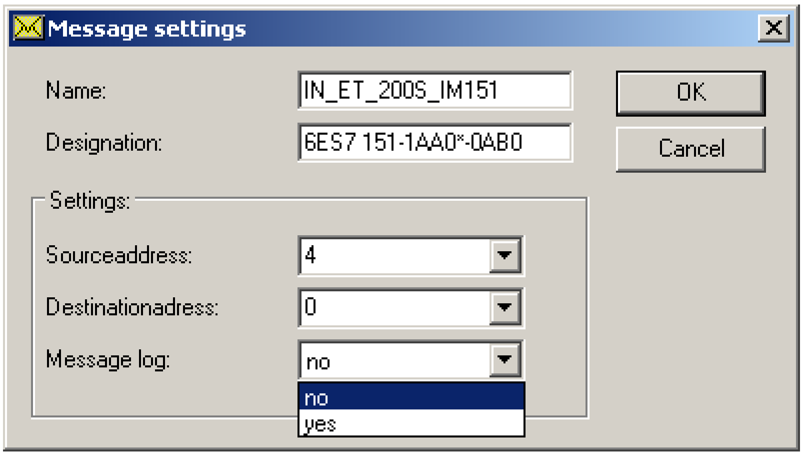


Connection settings

Name, Designation and Bitrate of the connection. The settings 683 created in the PROFIBUS Configurator appear here automatically.

9.2.12.3.2 Message settings

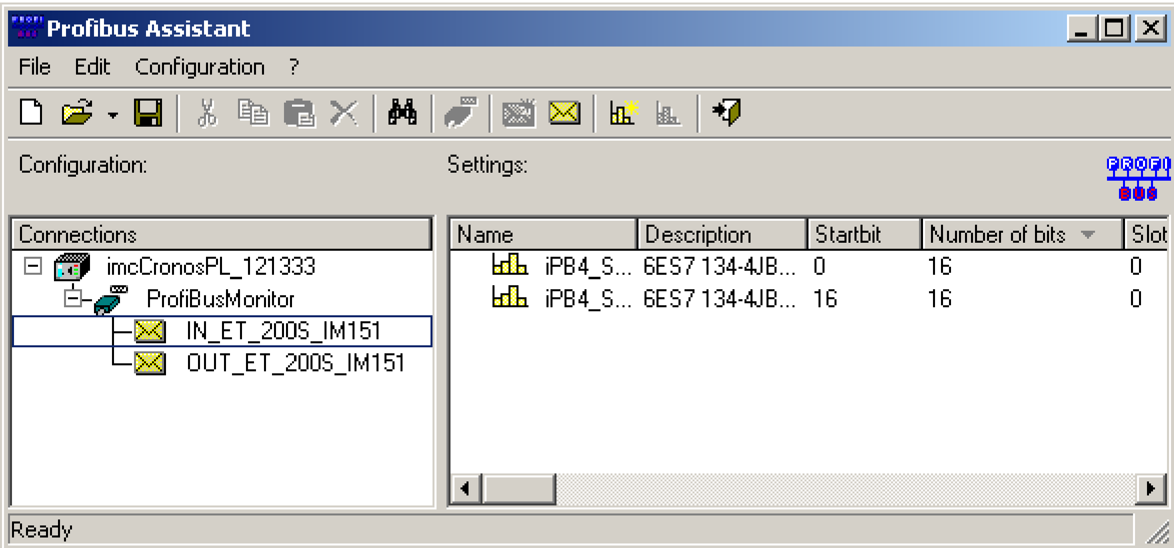
The configuration file created with the PROFIBUS Configurator 677 already contains definitions for all available messages in the system.



Message settings

If you wish to view all of a message's raw data, activate the control Message log in the message settings. The protocol channel is then available as a separate channel in imc STUDIO.

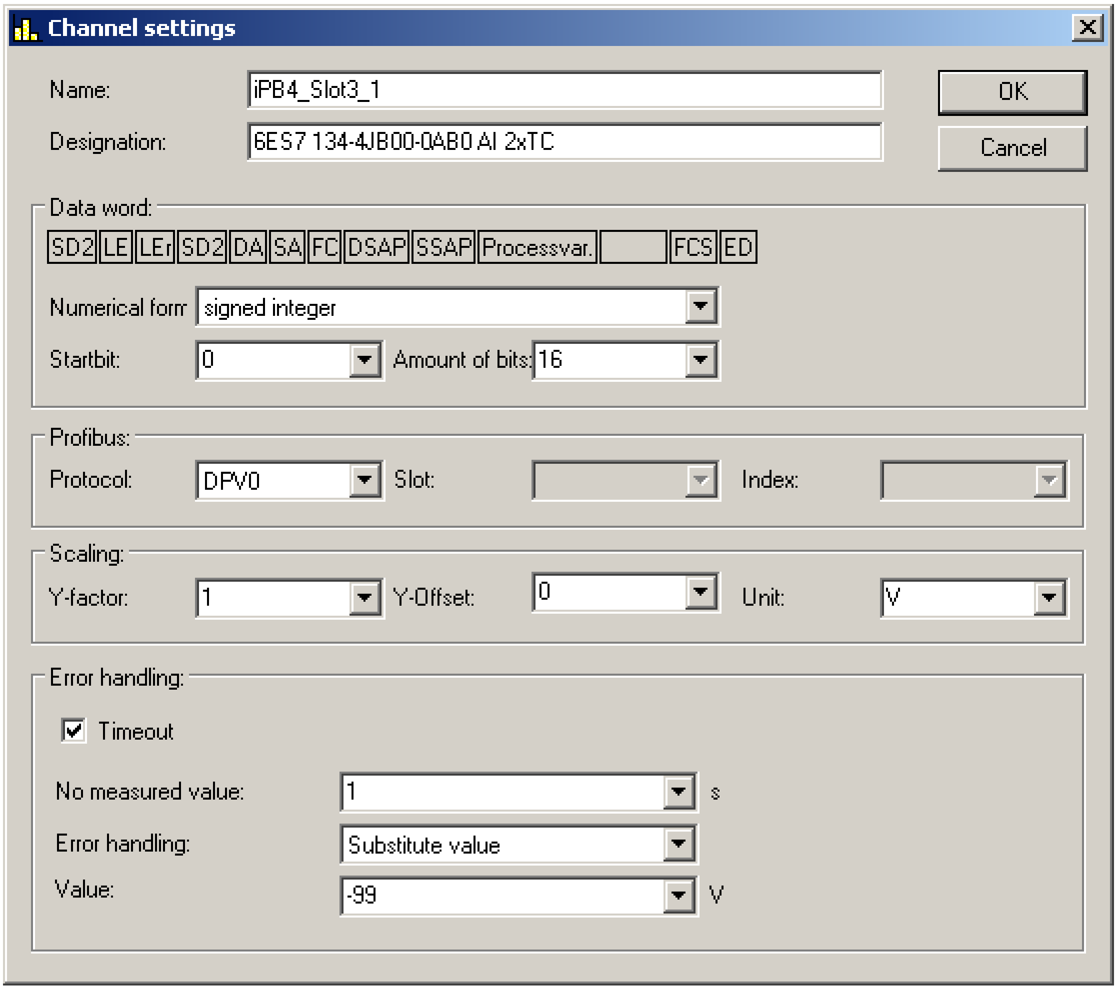
9.2.12.3.3 Channel settings for imc STUDIO



Profibus Assistant

Messages are shown on the left side. The messages are actually the PROFIBUS telegrams extracted from the recorded data stream. They are identified by their address data (source / target address).

Each message contains multiple channels, which are displayed on the right side. By right-clicking on the respective channel, you open the channel's context menu. This menu contains the item *Channel properties...* By clicking on this menu item you access the settings dialog below.



Channel settings

With this dialog you set the scale for the channel's data and name the units. You also filter individual bits out of the channel by changing the entries for the start bit and stop bit values. This procedure is especially sensible for binary data.

Once you have parameterized all the channels desired, exit the PROFIBUS Assistant. The parameterized channels then are available in imc STUDIO in the usual way.

Setting	Description
Name	Channel name for imc STUDIO. The usual constraints on variable names apply: no special characters, the first character must not be a number, no spaces etc.
Designation	Additional description appearing in imc STUDIO as a comment. Maximum of 256 characters, otherwise no constraints.
Data word	Message which is uniquely identified by the name. • Numerical format: Signed or unsigned integer, 32 or 64 bit or digital. • Startbit: Position of the channel's first bit, beginning with 0. • Amount of bits: Selection by means of list or by direct numerical entry.
Profibus	DPV0 or DPV1 protocol. With DPV1, entry of the slot- and index is accessible.
Scaling	Entry of the factor, offset and unit: Resulting value = number in the data word x Factor + Offset [unit]
Error handling	Only taken into account of timeout is activated. • No measured value since: Duration since when a missing value was regarded as an error • Error handling: Last value as a number, substitute value or ignore message • Value: Substitute value if this was the setting under Error handling

9.2.13 RoaDyn Interface

This RoaDyn Interface provides the interface between the wheel force transducer system from Kistler with an imc measurement system, which is equipped with this RoaDyn Interface. The RoaDyn 2000 as well as the KiRoad Performance System are supported. The compatible Kistler unit versions are 4.01a, 4.01b and c with DSP-Type_ VC33.

Along with the RoaDyn system's (3x force, 3x torque, angle, angular velocity, temperature, supply voltage) main channels, all additional service channels (single force components, errors etc.) are available.

9.2.13.1 What is the RoaDyn system?

The RoaDyn-On-board electronics system 2000 is a "RACK"-based series of devices for connection to RoaDyn wheel force transducers.

The wheel force transducers are mainly used in endurance strength tests and for in-vehicle measurements of dynamic road traction. This typically includes measurements of performance profiles, friction coefficients, and air resistance. The collaboration between the RoaDyn 2000 system and the RoaDyn wheel force transducers in test drive settings provide insight into the performance of both the engine and the power train.

KiRoad Performance

The KiRoad Performance provides the power supply for all RoaDyn wheel force transducers. It also processes the raw signals from the load cells with crosstalk and lever-arm compensation. The control unit delivers data in digital and analog form to maximize the accuracy of measurement results. See the manufacturer's documentation for notes on operation of the system.

imc Online FAMOS as an enhancement of the imc measurement device comes with a large variety of real-time functions for the purpose of analysis and evaluation of measurement results. The imc Online FAMOS Class-Counting Kit provides functions for calculating endurance strength. imc Online FAMOS makes it possible to immediately transform incoming measured data into results, and to accomplish this without a PC directly in the measurement device. With synchronization across multiple channels, imc Online FAMOS is able to perform comparisons and other mathematical operations on incoming data and compile statistics. Configuration settings for RoaDyn can be made by Remote control. See the manufacturer’s documentation for notes on operation of the system.

9.2.13.2 Prerequisites

imc Hardware (imc measurement device)

- device with RoaDyn Interface

Signal interconnections

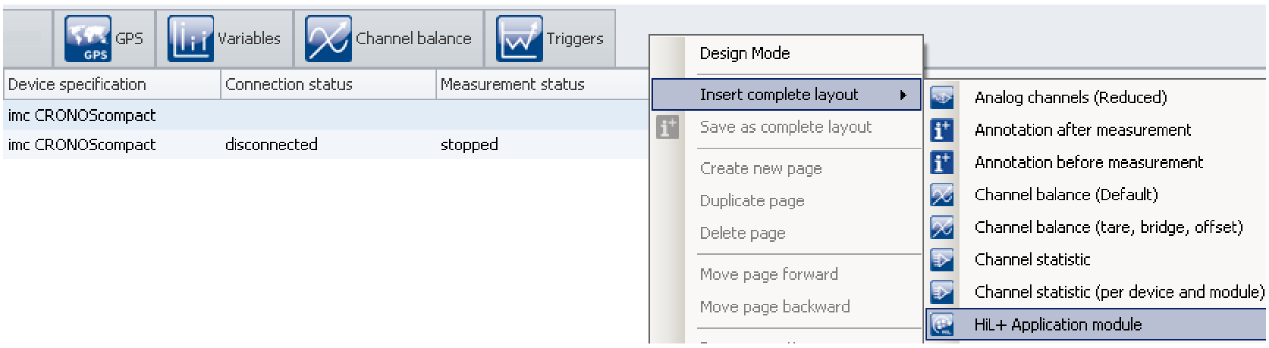
- RoaDyn 2000’s BNC terminals Clock and Trigger (CLK and TRG) are to be connected to the Application module’s respective BNC terminals of the same name CLK and TRG.
- The CRFX/RoaDyn Application module’s network jack (RoaDyn) is to be connected to the RoaDyn-On-board electronics System 2000’s Ethernet interface (ETH).

Note

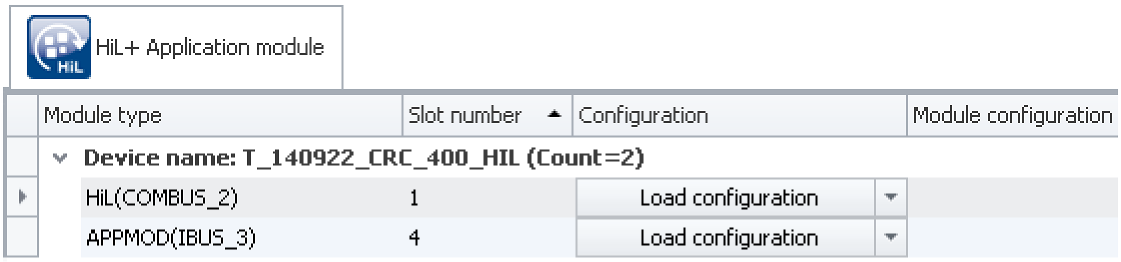
Carefully check the signal connections. The Application module’s Ethernet socket must not be confused neither with the imc measurement device’s standard terminal (LAN) nor with EtherCAT OUT.

How to open the assistant with the desired application?

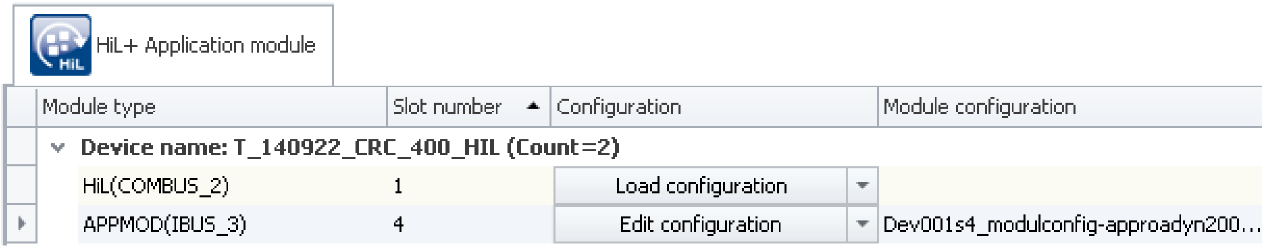
First of all it is necessary to add an additional pre-configured setup page. In order to add the needed page to your user interface open the context menu over a page-tab or over the empty space to the right. Select the following page entry in the list under *Insert complete layout*: *HIL + Application module*.



In consequence, the page is inserted to the right of the selected locations:



Now you can load the APPMOD configuration, please select the file ***ModulConfig-AppRoaDyn2000.appmod.zip*** that contains the application and is located on your data carrier in the folder: ..\Products\imc DEVICES\Tools\imcAppMod\Applications.



Now you can open the assistant by clicking the button "*Edit configuration*".

9.2.13.3 Configuration mode

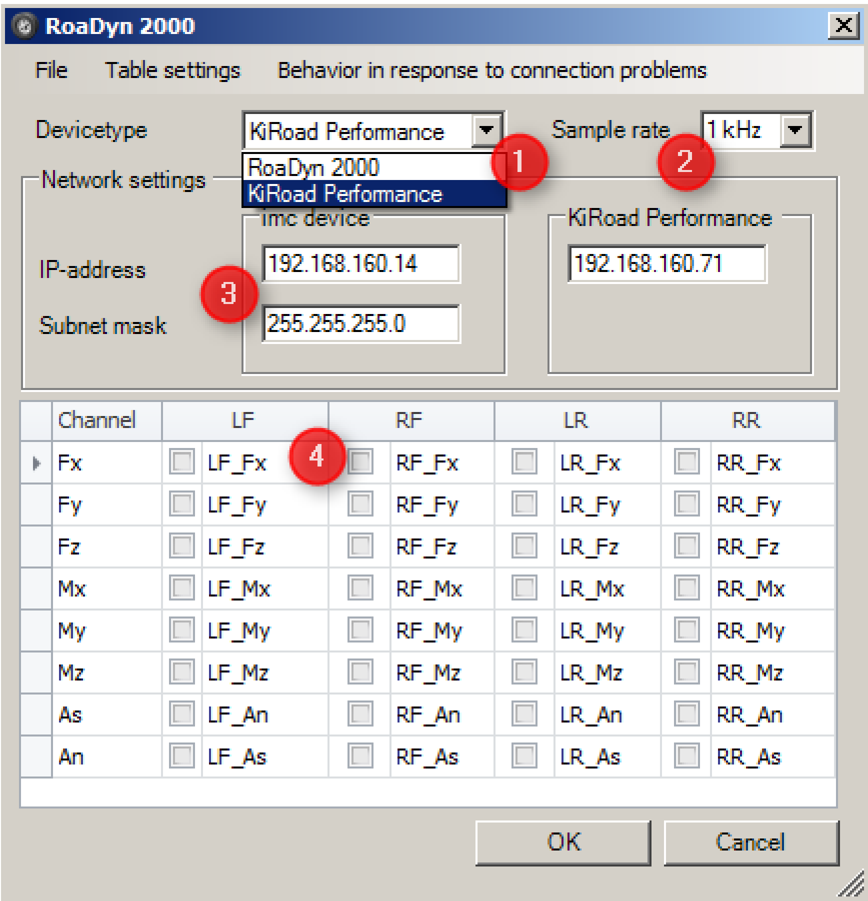
In Configuration mode of the AppRoaDyn2000 application, the following settings are available:

[1] Devicetype (RoaDyn 2000 or KiRoad Performance)

[2] Sample rate

[3] Network settings

[4] Selection of wheel signal channels



[1]: Please select your device:

RoaDyn 2000 or

KiRoad Performance

The wheel signal channels for the individual wheels are arranged in columns **[4]**:

LF: left front wheel, RF: right front wheel,

LR: left rear wheel, RR: right rear wheel

The channel names are assigned according to the RoaDyn 2000 designations. In the displayed dialog (see above), the x-direction force on each wheel force transducer is selected. The channels appear as fieldbus channels and are available for the purposes of triggering and for imc Online FAMOS calculations, etc.

At this time, the following **sample rates [2]** are available as settings for any channel: 1 ms (1 kHz), 2 ms (500 Hz), 5 ms (200 Hz), 10 ms (100 Hz) and 20 ms (50 Hz).

Note

Changing the sampling interval during measurement leads to malfunctions.

When configuring the network **[3]**, the Application module’s and the RoaDyn 2000’s or KiRoad Performance system's IP-addresses must be entered.

Note

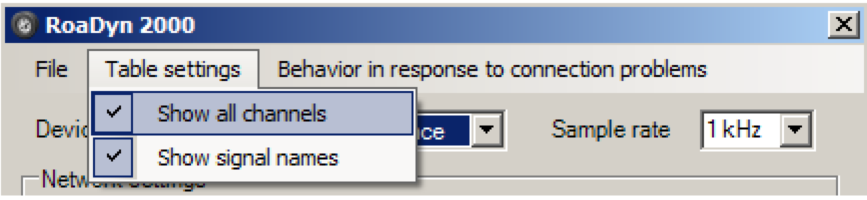
In the Configuration dialog (see above), the imc measurement device appears above the box in which you must enter the Application module’s IP-address.

In addition to the IP-address, you must enter the network mask for the Application module, e.g. 255.255.255.0. The RoaDyn System 2000’s or KiRoad Performance system's IP-address can not be changed using the application "AppRoaDyn2000". This address is preconfigured and can be imported by means of the RoaDyn Remote control.

Note

The Application module and the RoaDyn System 2000 or KiRoad Performance must be located in the same net mask with different IP-addresses.

For **special tasks**, such as accessing individual hub channels (in cases of servicing the wheel force transducers), all channels can be activated for the AppRaoDyn2000 Assistant.



9.2.13.3.1 Editing a configuration procedure and simulation mode

The following module parameter: "***Operation Mode"*** can be configured with three values. This module parameter is preconfigured with the value "0". This value is also used whether a valid module parameter could not be found.

0	If the RoaDyn 2000 respectively the KiRoad Performance could be found, possible configuration errors of the RoaDyn 2000 device will be announced during measurement preparation. If the RoaDyn 2000 respectively the KiRoad Performance could not be found, the simulation mode will be activated and will commit alternate values ("0.0") into the channels.
1	In this mode there will be no configuration problems with the RoaDyn 2000 respectively the KiRoad Performance announced during measurement preparation. The first configuration problem with the RoaDyn 2000 respectively the KiRoad Performance will activate the simulation mode.
2	Each configuration problem / communication problem with RoaDyn 2000 respectively the KiRoad Performance will abort the measurement preparation.

Once the simulation mode is activated the configuration circle will terminate without errors. The activation of the simulation mode will be reported with application specific error code #15 (-5447) when the measurement starts.

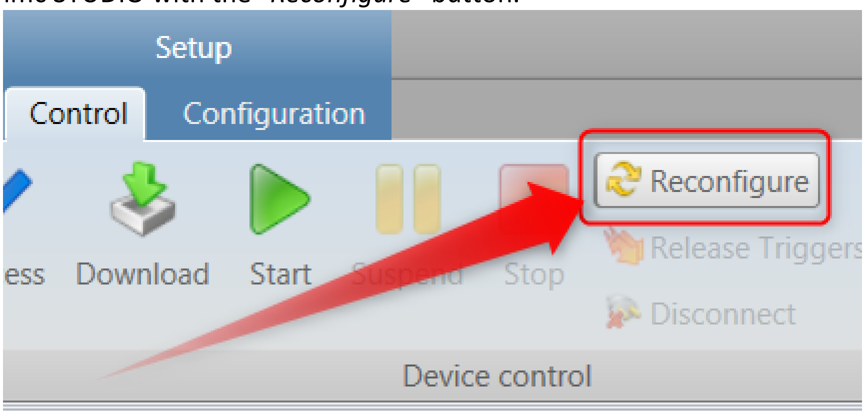
Note — Note on the wiring of *KiRoad Performance*

If the "Synchronization Cable 55135189" from Kistler is used, the BNC line "1" must be used for clock and the BNC line "2".

9.2.13.3.2 Prerequisites for transferring the configuration

If the RoaDyn is in measurement mode, a changed configuration cannot be transferred directly. The following steps must be observed here:

1. Activate the configuration mode *KiRoad Performance* 690.
2. It is recommended to establish the Ethernet connection to the KiRoad Performance control unit via a switch so that the IP configuration is safely retained.
3. To enable the transfer of the configuration, the data transfer must be stopped. To do this, execute the imc STUDIO with the "*Reconfigure*" button.



Now the external configuration of the sensor is possible.

9.2.13.4 Application update

In the case of operation on a standard Application module, an application update is performed as described in the instructions for the Application module assistant. In the version of the Application module defined for the operation of the AppRoaDyn2000, the application is updated during the normal software update of the device. If adjustments to the configuration have to be made, this is done by the assistant.

9.2.13.5 Troubleshooting

Possible messages appearing during a measurement procedure

The following errors affecting the Kistler- System 2000 can cause an error message to be posted:

Message	Description
(-)5408	The configuration is not in order; —> Check the configuration using the Assistant. This message is generated for KiRaod Performance and RoaDyn 2000 if the simulation mode is not desired in such a case.
(-)5410	Initialization of RoaDyn® 2000 is not possible; —> Check the RoaDyn® 2000’s network settings and the configuration, restart RoaDyn® 2000 This message is generated for KiRaod Performance and RoaDyn 2000 if the simulation mode is not desired in such a case.
(-)5434	Communication problem with the STOP message; Unable to stop the running RoaDyn® 2000 measurement. —> Check the RoaDyn® 2000’s network settings and the configuration.
(-)5435(3)	Internal software problem. —> Switch the devices off and then on again.
(-)5436(4)	Communication problem with the device: The HELLO message was not answered or no connection to the device could be established (Socket connections fail). —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again. This message is generated for KiRaod Performance and RoaDyn 2000 if the simulation mode is not desired in such a case.
(-)5437(5)	Communication problem with the GETMAC message: Query of the RoaDyn 2000’s MAC-address failed. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5438(6)	Communication problem with the AUTO message: RoaDyn® 2000 unable to activate the channel setting. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5439(7)	Communication problem with the DCC message: RoaDyn® 2000 has not processed the channel selection. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.

Message	Description
(-)5440(8)	Communication problem with the AUTO message (after preparation of DCC message): —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5441(9)	Communication problem with the SetMode message. RoaDyn® 2000 unable to set the measurement mode. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5442(10)	Communication problem with the SetSampleRate message: RoaDyn® 2000 unable to set the sampling rate. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5443(11)	Communication problem with the SetClock message: RoaDyn® 2000 did not apply the Clock-setting. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5444(12)	Communication problem with the SetClock message: RoaDyn® 2000 did not accept the Clock-setting query. —> Check the RoaDyn® 2000 configuration; switch RoaDyn® 2000 off and on again.
(-)5445(13)	Problem with setting the Clock-Mode. RoaDyn® 2000 did not accept the Clock-setting. —> Check the RoaDyn® 2000 configuration, check the Trigger- and Clock-lines. During the measurement, this error code is reported if KiRoad Performance has stopped the "Data Stream" at TCP level.
(-)5446(14)	During measurement preparation, RoaDyn® 2000 device either DID NOT respond to the channel poll or reported an error. This is generally due to the RoaDyn® 2000's operating terminal not being in the basic screen. This must first be resolved and then the measurement preparation is to be repeated after a waiting time of at least 15 seconds.An error occurred while saving the configuration in KiRoad (Run: <store></store> has failed). During the measurement, this error code is reported if errors occur when reading the "Data Stream" from KiRoad Performance.
(-)5447(15)	RoaDyn® 2000 device was not configured correctly, the application is in simulator mode and reports with the configured sample rate a "0"-value as alternative. Note: This message will only be generated after a measurement initialization.

Note Important notes for KiRoad performance

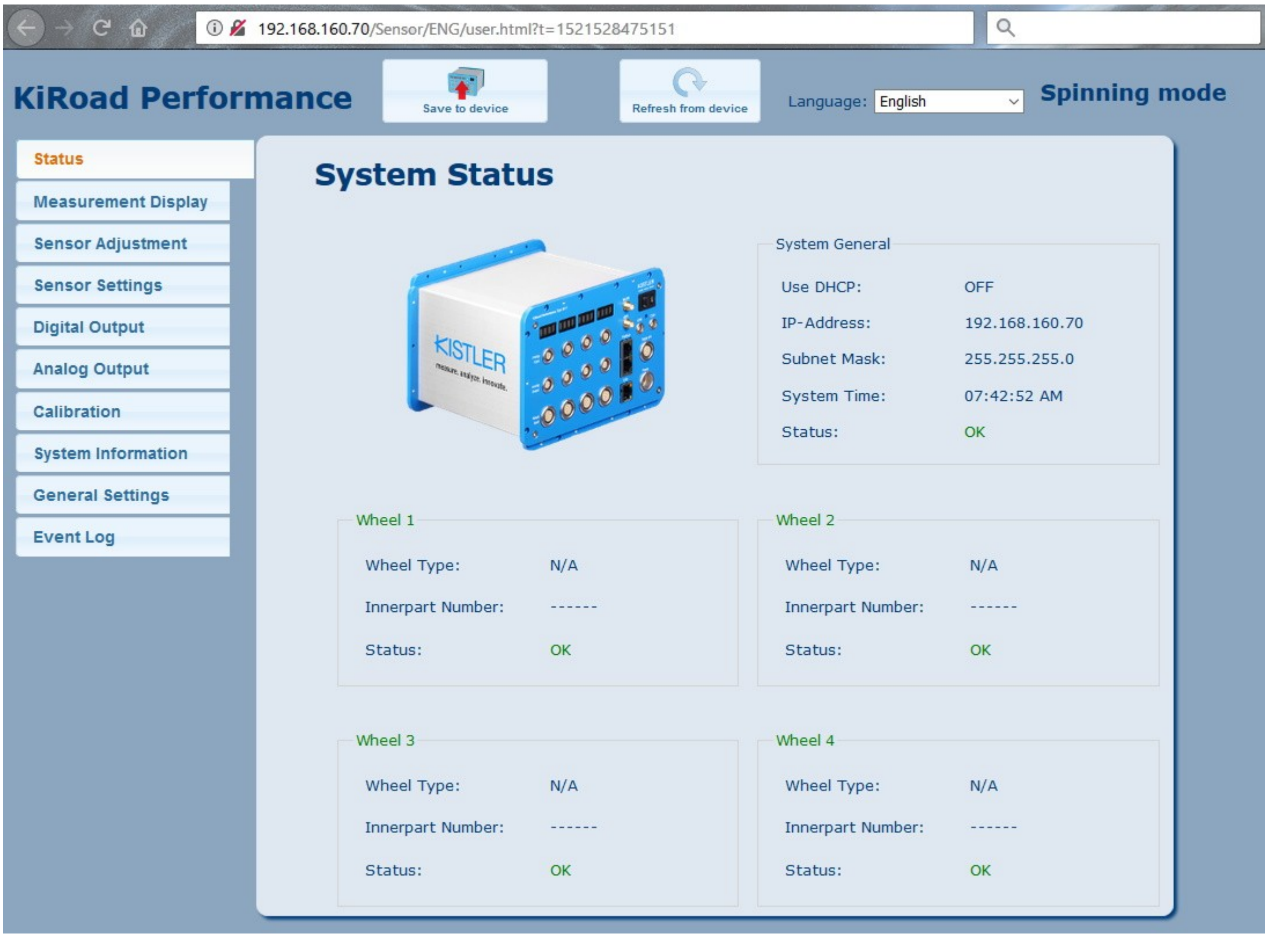
Operation with KiCenter

While working with KiRoad Performance, problems can occur if the KiCenter is open. In this case, terminate all active KiCenter instances in the KiRaod Performance network.

WEB interface

KiRoad Performance can be configured with a user interface in the web browser. With this you can read and download the EventLog of the KiRoad Performance. In the EventLog you can also find notes on malfunctions, the meaning of which can be requested from Kistler.

Example of the KiRoad Performance web interface:



9.2.14 SPI-Bus Interface

What is the SPI-bus?

The Serial Peripheral Interface (SPI) is a bus-system for a synchronized serial data bus, by means of which digital circuitry is connected according to the Master-Slave principle.

The SPI-module's firmware is supported by FPGAs in processing the command lists. This includes configuring the chip selects and generating the correct bit sequence for the frames on the MOSI signal line. The MISO frames coming from the sensor are captured, time-stamped and written to a log channel along with an identifier. One log channel is generated for every chip select on each SPI. If multiple sensors are addressed via different chip selects on the same SPI interface, one log channel is generated per sensor. The focus is on achieving good performance even when there are many sensors and a high clock rate, so that the rated maximum data rates on the log channel can be assured over the long term.

Reference

The description of the hardware and the pinouts of the terminals are presented in the special documentation of your SPI. These specs will be amended to future editions of the device manuals.

What settings are needed?

- Hardware parameters
- Assignment of the SPI lines to the connectors (which signal to which pin?)
- SPI clock
- ECLK clock rate
- Adjustability of polarity and phase of the SPI-communication
- Signal conditioning settings on the board, e.g. High signal level and switch
- "In Frame" and "Out of Frame" communication
- Channel name and sample interval (100 ms to 1 s) for the frequency counter (measured frequency at the WDGI input); one frequency counter per SPI is possible.
- Linkage with a Display variable for specifying the internal VDDA and one additional specification of VDDDD. You can use the same Display variable for multiple SPI interfaces.
- Common sampling interval (100 ms to 1 s) for the four analog channels and their channel designations
- Definition of frames
  - Frames based on MOSI and on MISO are defined pair-by pair
- Bit width (8 to 128 Bit) MOSI and MISO

Note

The Bus Decoder 1683 is opened via the plug-in Data Processing 1665.

Prerequisites

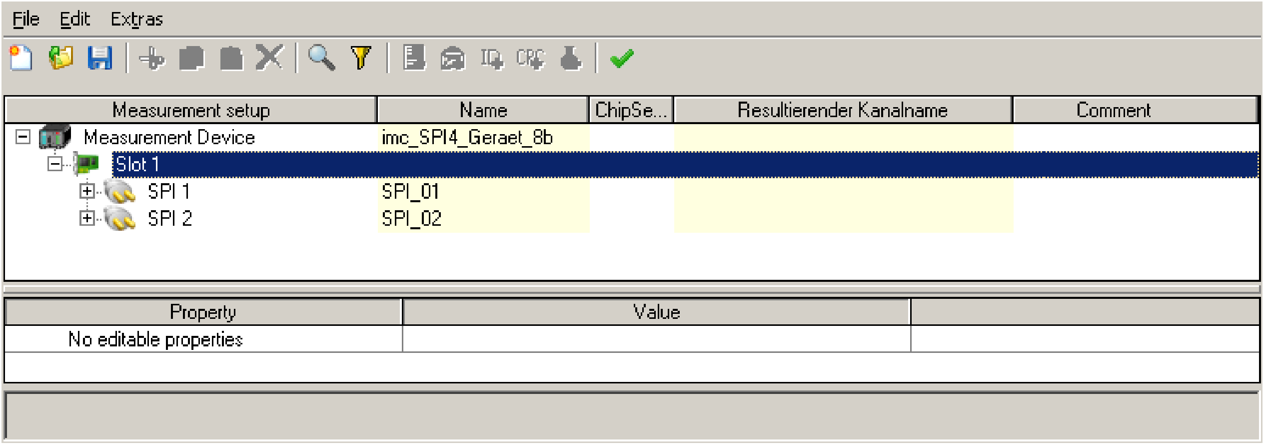
Prerequisites	
Hardware	An imc device with a SPI-Bus interface.
Software	The system requirements are described in the data sheet of our fieldbus connection options.

9.2.14.1 Definition of terms

Term	Description
Bus Decoder	The Bus Decoder shows the channels created upon selection of the data log channel.

9.2.14.2 SPI Assistant

For the purpose of creating your configuration, the SPI Assistant displays all SPI interfaces which the experiment contains. These individual base units are selected by navigating in the Assistant.

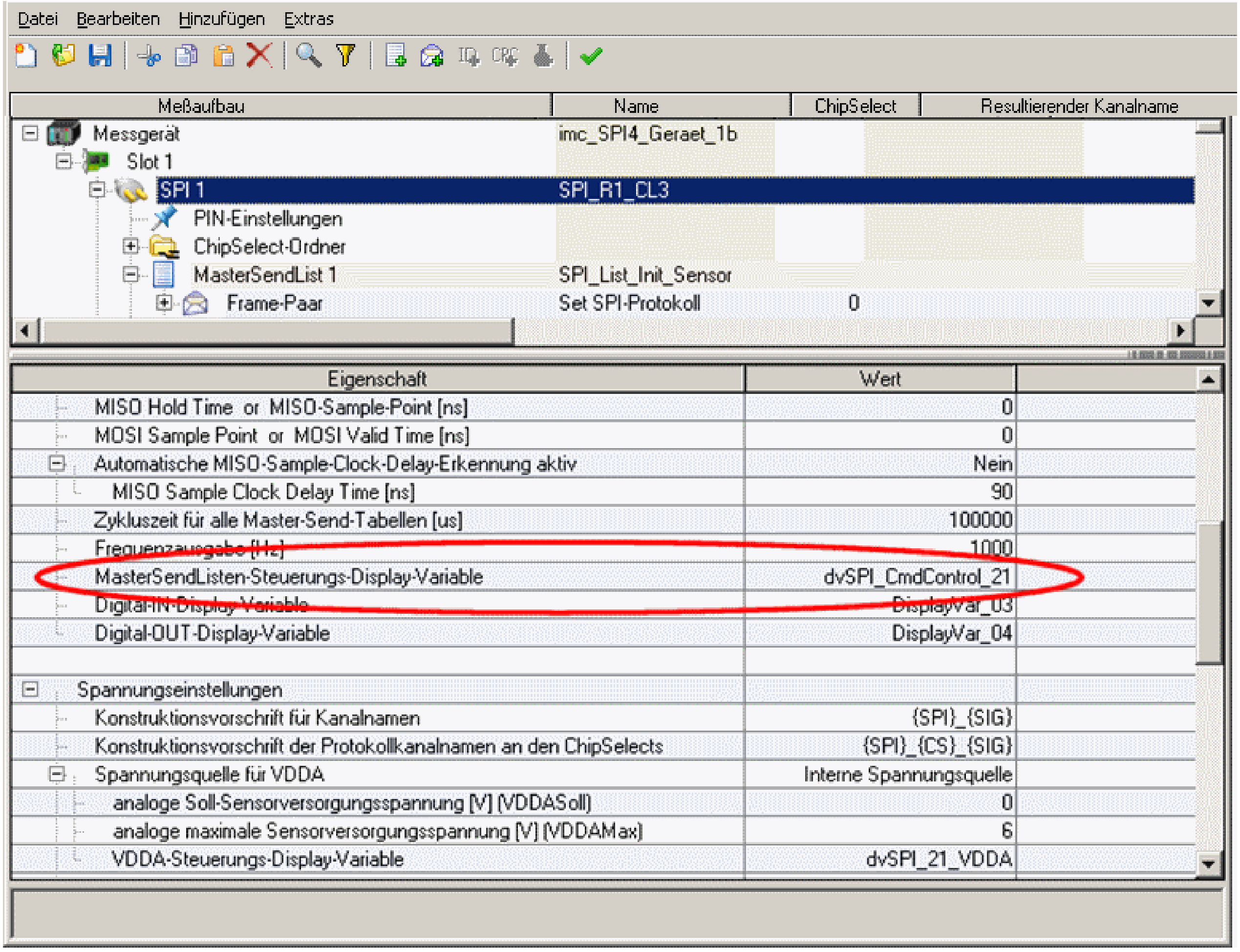


The Assistant is structured in tables, in order to present a large number of parameters in a clear way and to make them available for editing. The Assistant graphically displays the structure of the frame currently being edited.

9.2.14.2.1 Activating and deactivating the Master-Send-lists via Display variable

General

In the SPI-Assistant, you can select a Display variable at each SPI-interface. This can be used to activate/deactivate already configured Master-Send-lists.



During a running measurement, it is possible to write activation/deactivation commands to these Display variables. To do this, a 16-bit word is written to the Display-variable. Once the command has been successfully adopted by the SPI system, the value of the Display-variable is reset to zero.

Structure of the 16-bit word

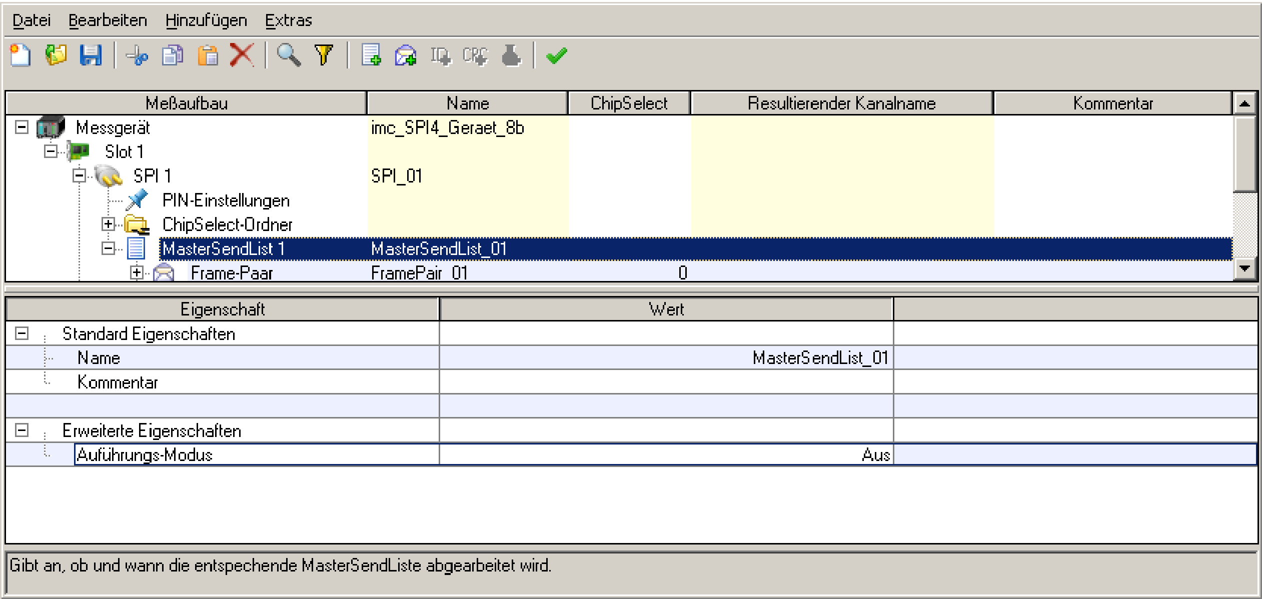
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
4-bit Port				**4-bit** command				**8-bit** list index							

Description of the bitfield

Bits	Description
0-7	List index States the index of the list. The first list has the index 0. Valid values include: 1 through 16, or 0 for all lists
8-11	Command States the command. Valid values include: 0 no function 1 activate Master-Send list as specified for "Execution-mode upon Start/Initialize" (off/once/cyclical) (like command 5)* 2 deactivate Master-Send-list (like command 6)* 3 activate Master-Send-list once 4 activate Master-Send-list cyclically 5 activate Master-Send-list as specified for "Execution-mode upon Start/Initialize" (off/once/cyclically) (like command 1)* 6 deactivate specifies (like command 2)* 7 activate Master-Send-list as specified for "Execution-mode Preset1" (off/once/cyclical) 8 activate Master-Send-list as specified for "Execution-mode Preset2" (off/once/cyclical) 9 activate Master-Send-list as specified for "Execution-mode Preset3" (off/once/cyclical) 10 activate Master-Send-list as specified for "Execution-mode Preset4" (off/once/cyclical)
12-15	Port Specifies the index of the SPI-interface. Valid values include: 1-2, or 15 for all ports

Notes

In the SPI-Assistant, up to 4 presets can be configured for each Master-Send-list. The commands 7 through 10 can be used to switch back and forth among these presets. A single command can replace laboriously switching from list to list each time. This makes the imc Online FAMOS programs smaller and independent of the SPI-Assistant's configuration.



If the voltages VDDD and/or VDDA are also controlled by Online FAMOS for the sensors, it makes sense to set the Execution mode to "OFF" at the start of all Master-Send-lists. Otherwise, SPI-data are sent to the sensors, even though no voltage supply is activated, or while the sensors are still booting.

Examples of complete 16-bit commands

Example	Command	previously
Switch off all lists in all ports:	0xF200 or 0xF600	only 0xF600
Switch off all lists in all ports as with prepare (Download):	0xF100 or 0xF500	only 0xF500
Switch on List 1 in Port 1 as with prepare (Download):	0x1101 or 0x1501	only 0x1101
Switch on List 1 in Port 2 as with prepare (Download):	0x2101 or 0x2601	only 0x2101
Switch on List 1 in Port 2 cyclically:	0x2401	0x2401
Switch all lists in all ports to Preset 4:	0xFA00	
Switch List 5 in Port 2 to Preset 1:	0x2705	

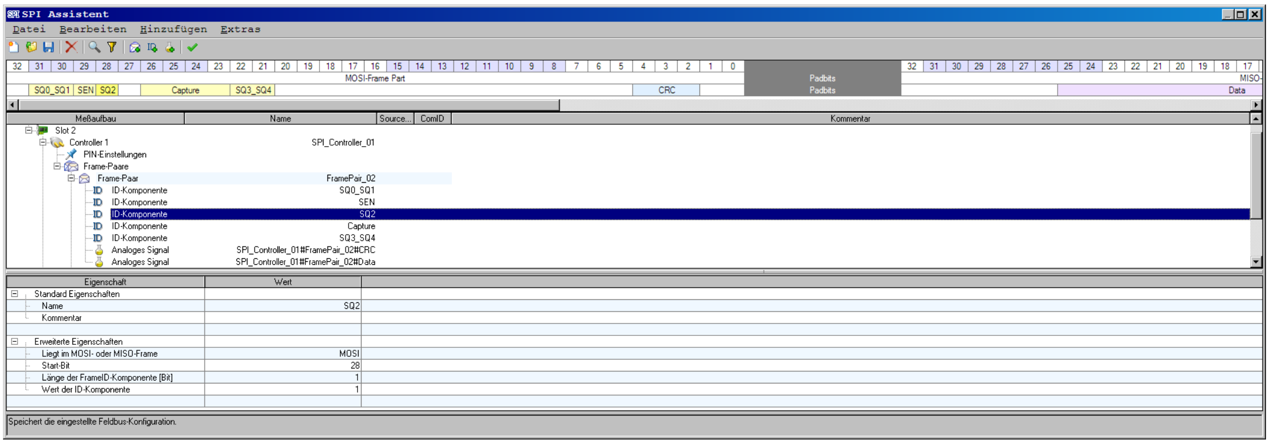
9.2.14.2.2 Chip select settings

Signal output (constant output on MOSI).

Here, you can configure the MOSI frame to be sent, e.g. "SEN" = 1, "SQ_3_4" = 2. These selected value uniquely identify the frame.

- Start bit
- Bit width
- MSB first/last
- Default value or in case of ID: reference value

Multiple such default values can be defined for each frame. The individual defaults may not overlap each other.



9.2.14.2.3 SPI Assistant error handling

Start/Stop log: imc STUDIO logs the measurement's starts/stops.

Lost Ethernet connection: imc STUDIO logs whether the Ethernet connection to the device is still intact.

Error in signal:

Checksum and Parity are not logged as separate channels. Instead, they are joined into a common error channel. If for special applications' purposes, the content of the checksum and parity need to be available for the analysis, they are both additionally extracted from the frame like a normal signal.

If a sensor does not respond as expected, a NO_DATA error is reported like for a CRC-error. This error is recognized when a certain bit combination is not present in the sensor's response.

9.2.14.2.4 Special features

Special provisions for conveniently performing the typical editing when there is a large number of sensors which are (almost) the same, without losing the flexibility of connecting multiple different sensors.

- Multi-selection among many signals/frames
- Filter for designation of signals/frames.
- Placeholders for numbering in the name. This provides fast assignment of channel names when there are a number of similar sensors where the channel names only differ by a sequential number. Example: for an SMB460 in the frame RD_SENSOR_DATA, you assign to channel 1 the name RD_SENSOR_DATA_CH1_#. Using multi-selection for all sensors in the Assistant, you obtain the names RD_SENSOR_DATA_CH1_1, RD_SENSOR_DATA_CH1_2, RD_SENSOR_DATA_CH1_3.

- SPI-Timeout of each channel
  If no more SPI-data (MISO/MOSI frames) are received within a defined time interval (**Timeout-time**), the channel's value can automatically jump to a pre-set error replacement value. A Timeout occurs, for example, if the channel is deactivated.

9.2.15 XCPoE-Bus Interface

The XCP Specification documents describe an improved and generalized version of CCP. The generalized protocol definition serves as standard for a protocol family and is called "XCP" (Universal Measurement and Calibration Protocol).

The "X" generalizes the "various" transportation layers that are used by the members of the protocol family e.g "XCP on CAN", "XCP on TCP/IP", "XCP on UDP/IP", "XCP on USB" and so on.

Before continuing reading, it is advisable to have at least skimmed the technical literature named below. This documentation is oriented towards readers possessing some knowledge of the field.

Since "*XCP on Ethernet*" is not truly a standard defined in ASAM, consider the phrase "*XCP on Ethernet*" to mean the conjunction of "*XCP on TCP/IP*" and "*XCP on UDP/IP*".

The imc measurement device can implement either "*XCP on TCP/IP*" or "*XCP on UDP/IP*". The choice can be amended using the Assistant.

Reference Literature and Standards

[1]	"XCP -Part 1- Overview"; Ver. 1.0; ASAM e.V.
[2]	"XCP -Part 2- Protocol Layer Specification" Ver. 1.0; ASAM e.V.
[3]	"XCP -Part 3- Transport Layer Specification XCP on Ethernet (TCP_IP and UDP_IP)"; Ver. 1.0; ASAM e.V.
[4]	"XCP -Part 4- Interface Specification"; Ver. 1.0; ASAM e.V.
[5]	"XCP -Part 5- Example Communication Sequences"; Ver. 1.0; ASAM e.V.
[6]	"Interface ASAP2 Detailed Specification"; "Applications Systems Standardization Working Group"; "Interface Specifications"; "Interface 2"; Ver. 1.40 of 03/31/2000

Prerequisites

Prerequisites	
Hardware	• XCPoE Interface Slave (for sending imc channels via XCP) • XCPoE Interface Master(for receiving XCP with the imc device)

9.2.15.1 Definitions

Term	Description
XCP	Derived from CCP where "X" stands for the different transport layers ("XCP on CAN", "XCP on TCP/IP", "XCP on UDP/IP")
CCP	Can Calibration Protocol
XCPoE	XCP on Ethernet

9.2.15.2 XCPoE Slave

Sends channels which are **captured by the imc device** and **sent via XCPoE**.

Operating in "*Slave*" mode specifies that the communication is essentially governed by the external XCP-master and not by the imc-system. However, Slave mode does not actually determine in which direction (in/out) this communication flows. In principle, not only the the outputting of variables is defined for an XCP-slave, but also the receiving (input, stimulus). However, the latter is not supported by the imc Slave-Module at this time!

9.2.15.2.1 Transfer of variables

The Assistant for the XCPoE-Slave Module, offered by imc STUDIO, provide a global option 704 with which all of the imc system's "variables" are activated for transfer. These are embedded in an automatically generated *.A2L 704 file, which can then be transferred to the XCP-Master for configuration.

- All **measurement channels** (FIFO-channels, not process vector variables) of the system are made available:
  - analog channels
  - digital channels
  - Fieldbus-channels
  - Virtual channels from imc Online FAMOS (OFA)
- Channels to be transmitted via XCP **must be assigned to "Trigger_48"**! This means that they may not be linked to any trigger event or begin upon the measurement's "START".
- The channels are outputted **at their specified sampling rate *as far as possible***, even on XCP:
  - For the OFA channels, the rule is: Output = **sampling rate of the OFA-output**, which allows more than 2 data rates in the system.
  - **Max. 5 different output rates** are supported! This limit is determined by the XCP-protocol.
  - **Max. 100 kHz per channel**: The limit is determined by the XCP-Module's performance.
- The **XCP-messages** are assigned a **time stamp**, which refers to their acquisition date in the imc-system. ***All channels*** in the XCP-message are mutually in ***perfect synchronicity***.
- The moment of output, meaning of the data transport via Ethernet, can vary (latency). All of the system's channels (incl. OFA) must be valid in order that the data can be outputted via XPC consistently with each other at this moment in time.

Note

When OFA channels are transferred to the Master, Online FAMOS should not change their sampling intervals. Any sampling intervals changed by Online FAMOS will **not** be treated separately.

When the measurement is ended, the following error message may appear: "*Overflow of measurement data!*"

The Master should no longer be connected when the measurement is stopped. In all cases observed where this applied, **no overflow** occurred while the Master was connected.

9.2.15.2.1.1 Update from imc STUDIO before 5.0R1

The design of XCPoE under versions of imc STUDIO prior to 5.0R1 was based on process vector variables. With this design, the channels could be transmitted independently of the trigger. Triggered channels belonging to these configurations would be adopted in the A2L-file and the interface-configuration, but would cause a blockage (wait for the trigger) there.

Note

If there are any existing configurations, based on older versions, having **triggered channels**, then these need to be modified on the occasion of the software update and be **converted to** completely **untriggered measurements**.

9.2.15.2.2 Dynamic creation of the A2L-file

Every XCP-device will usually have an **A2L-file** stating

- how to address the device,
- which data can be queried via XCP,
- and how the data are to be interpreted.

Since the number of channels and their settings such as the factor and offset can be very different from experiment to experiment with imc, the A2L-file is generated only once the data are certain.

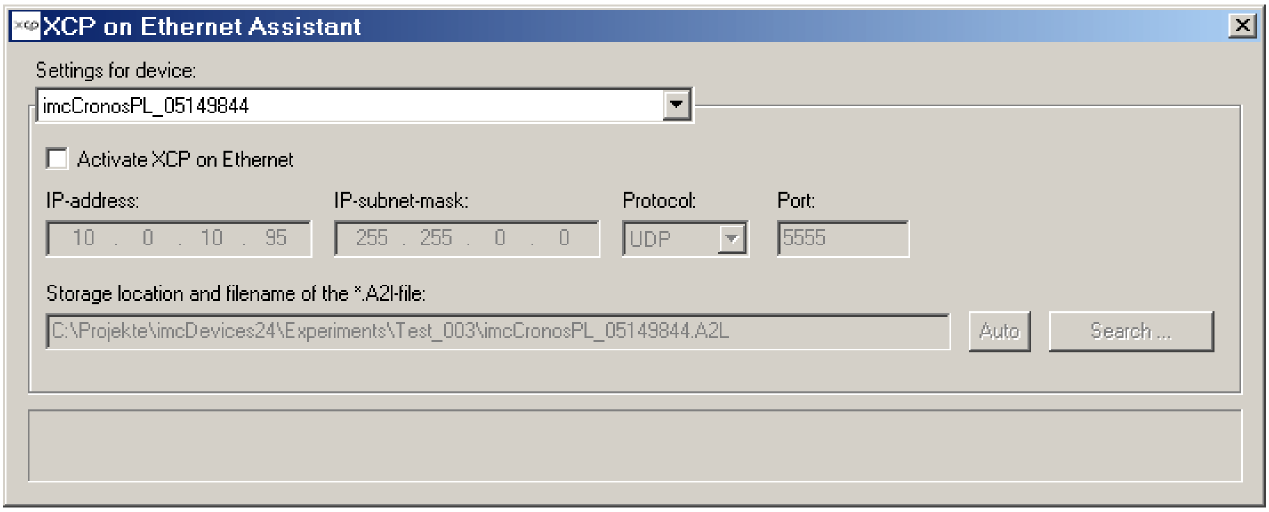
This is the case when the experiment is prepared. In the preparation process, one A2L-file per XCPoE-capable device used in the experiment is written to the storage location specified in the XCPoE-Assistant.

There, the XCP-receiver can retrieve the file.

9.2.15.2.3 XCP on Ethernet Assistant - Slave

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > XCPoE-Slave*.

Then the XPCoE Assistant opens:



XCPoE Assistant

Setting	Description
Settings for device	Selection of the device if there are multiple devices in the experiment.
Activate XCP on Ethernet	Using this checkbox, the XCPoE can be activated/deactivated at the next preparation procedure. For instance, XCPoE must be deactivated if you wish to assign the IP-address set in the connected network to another device. This is because when the XCPoE is deactivated, the IP-address which the device may be using is released for use. Also, when XCPoE is deactivated, no A2L-file is written during the preparation process. If XCPoE is activated for an imc measurement device, then the following types of channels can **not** be queried via XCPoE: • TimeStampASCII channels (e.g. Fieldbus-logs)
IP-address & IP-Subnet mask	Here, the IP-address and the Subnet mask which the device is to use for XCPoE are set.
Protocol	This list box control determines whether "*XCP on TCP/IP*" or "*XCP on UDP/IP*" is to be used.
Port	Depending on the protocol setting, the TCP- or respectively UDP-port via which the device is to be addressed is set.
Storage location and filename of the *.A2L-file	Since the A2L-file is generated during the preparation process, it’s possible to set this file’s storage location here. **Button: Auto** This button resets the storage location back to the current experiment folder and the A2L file’s name back to the device’s name, with a A2L file extension. **Button: Search** Enables the selection of a different storage location and a different name for the A2L-file.

9.2.15.3 XCPoE Master

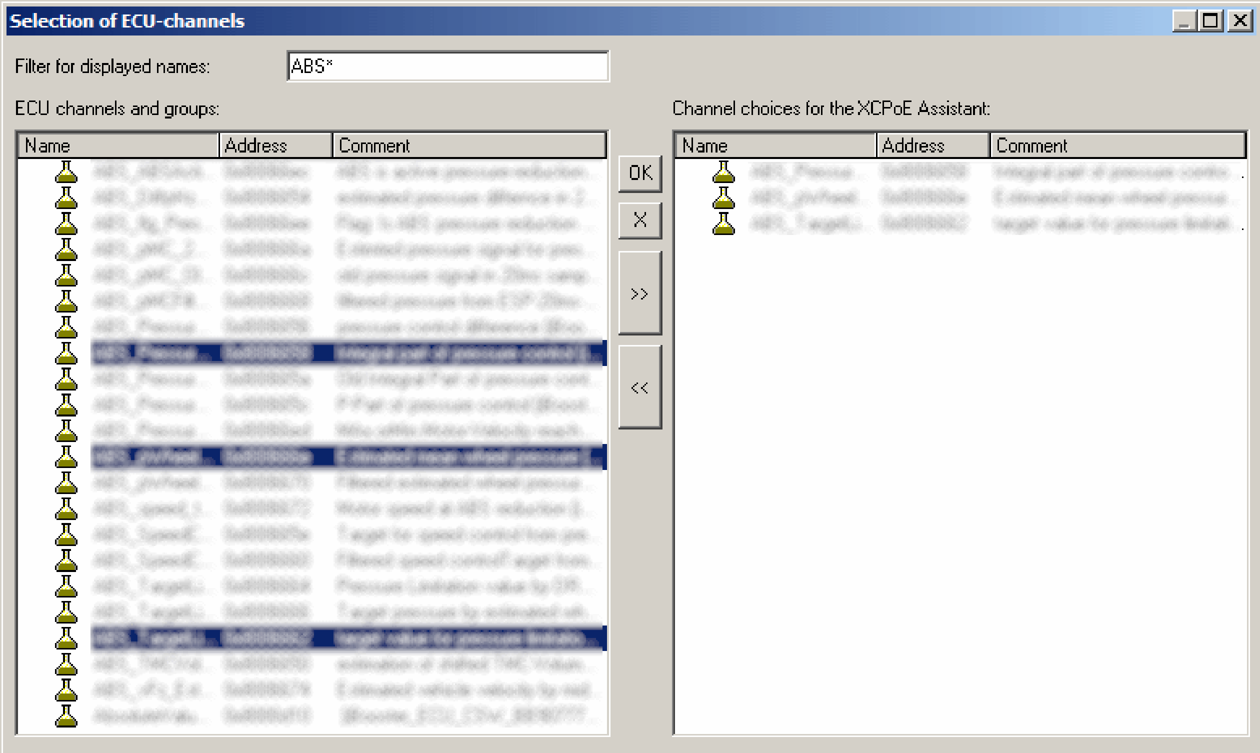
Capture of field bus channels via XCP

9.2.15.3.1 XCP on Ethernet Assistant - Master

Start the Assistant from within the imc STUDIO software via the Ribbon *Setup-Configuration > XCPoE-Master*.

9.2.15.3.2 Loading an A2L-file

Select the A2L file by selecting *File > Import*. Find the channels desired by means of the Filer. Select the channels by moving them to the right side.

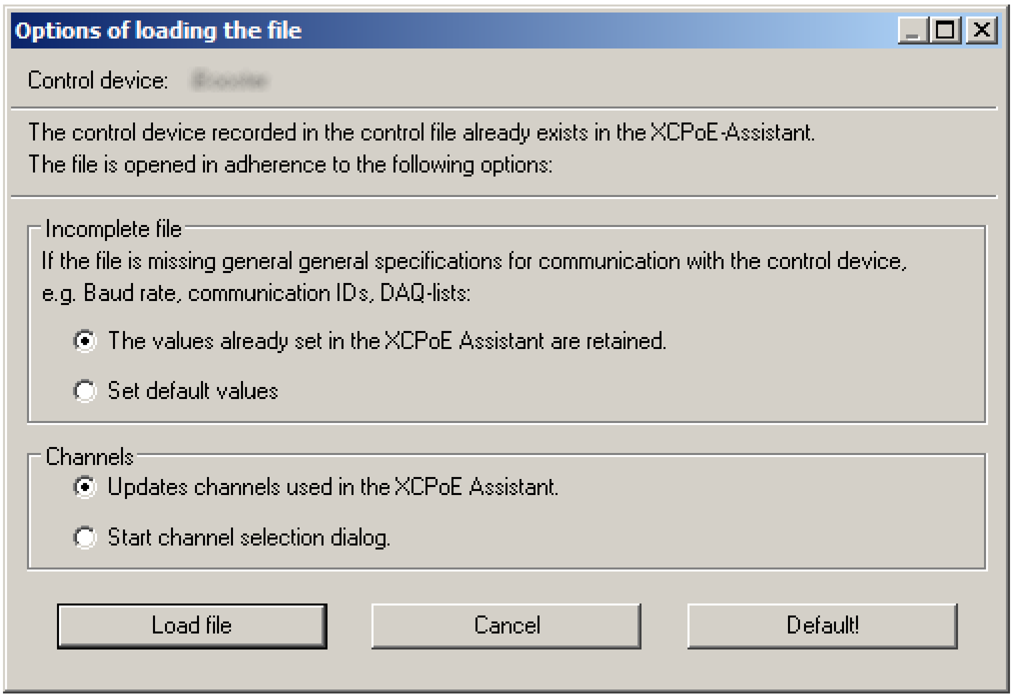


Channels selection

Note XCPplus

The extended format XCPplus is supported.

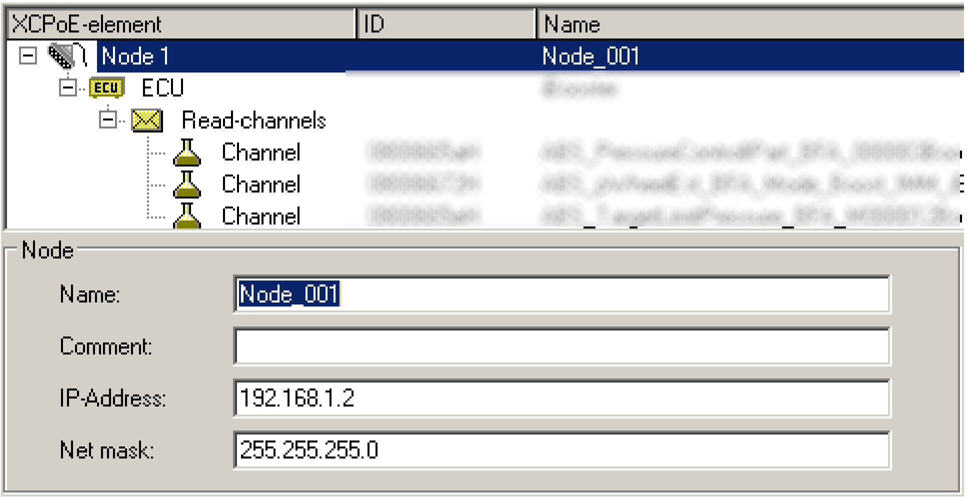
If an ECU branch exists already, an additional dialog appears initially:



Import dialog, if another ECU is already configured

9.2.15.3.3 Node settings

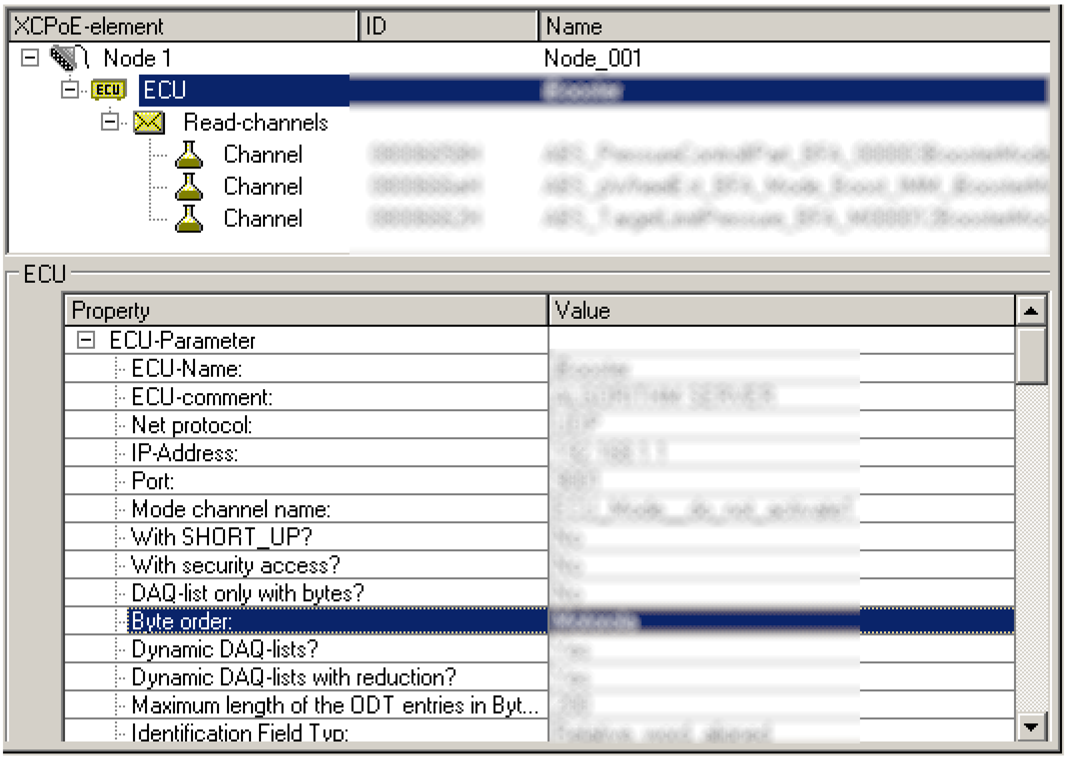
At the node, set the IP-address and the subnet mask.



XCPoE settings: node

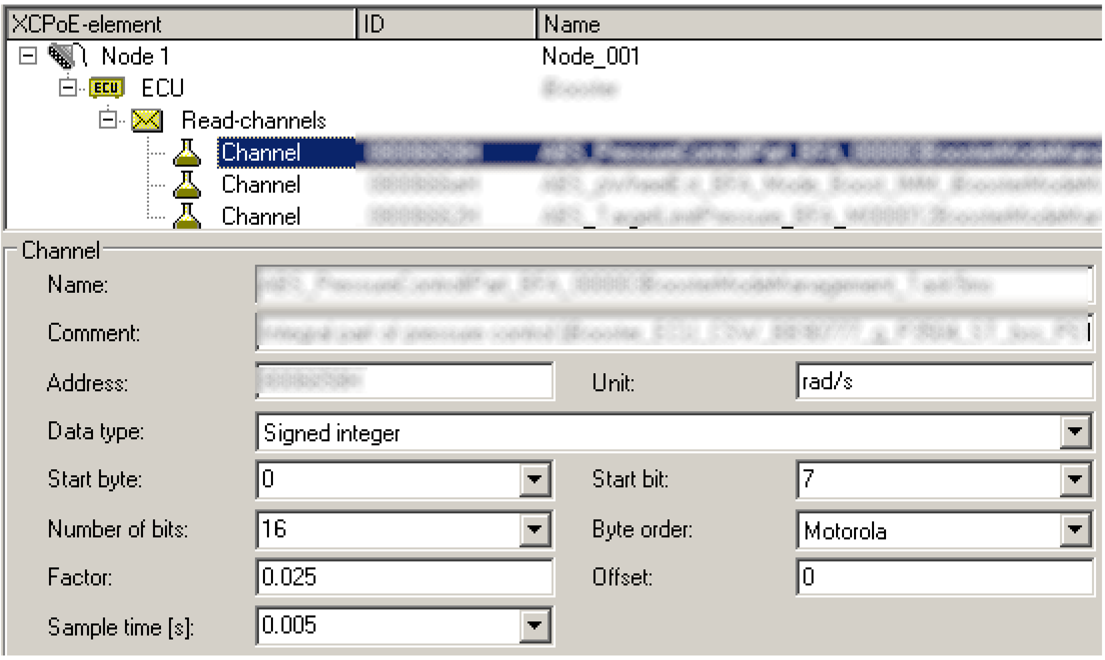
9.2.15.3.4 ECU-settings

Upon selecting the ECU branch, an editable table of the ECU's settings appears.



ECU-settings

9.2.15.3.5 Channel settings



Channel settings

9.2.16 GPS

Reference

See chapter: "*Setup pages - Configuring Device*" > "*Configuring Channels and Variables*" > ... > "*GPS*" 360

9.3 Storage Options and Directory Structure

This chapter describes the different options for saving measurement data with imc STUDIO.

Note The data stream

Once the measurement starts, the measurement device generates a data stream. The goal in every measurement is to process this data stream without losses and to observe and or save it.

- The data stream is first written to RAM buffer memory 718 in the device.
- This RAM buffer is read by a signal processor ("DSP").
  - If you use an imc Online FAMOS 835 program in the experiment, the data stream is read and processed at this point of the data stream.
  - For closed-loop control applications, it can make sense to interrupt the data stream at this point already (deselect "*Transfer to the PC* 710").
- After this step, the data can either be saved by the device itself, or transmitted to the control-PC and saved if desired.
  - Whether or not data are transferred to the PC and whether they can be saved can be set for each channel separately.
  - To save a channel, you must always set the appropriate options both for the channel and for the device.

Note Display without Data Storage

Data storage isn't necessary in such settings as system setup or trial readings. Using "*Transfer to PC*", you can view the data without storing them.

Saving by the device 714

The device can save the measured data to the internal storage medium 714 or to a network computer 715 (network sharing). What options are available depends on the particular device model and configuration.

Data storage by the device enables autonomous operation without connection with any controlling PC, e.g. in disconnected mode or in Autostart 179.

Saving and displaying data on the PC 717

Here, the data stream is transferred to the controlling PC via the **connection** (mostly LAN) (Transfer to the PC 710). By default, this option is activated.

The data can be displayed using the **Panel pages**. Additionally, the transferred measurement data can be saved on the PC. By default, the **data for the display** are saved on the PC in a **circular buffer**. For **data storage purposes**, the circular buffer memory is **not activated**. The use of the circular buffer prevents the data stream from totally exhausting the PC's available working memory.

Data saving by the PC and by the device

By default, data saving

- to the PC is activated.
- to the device is deactivated.

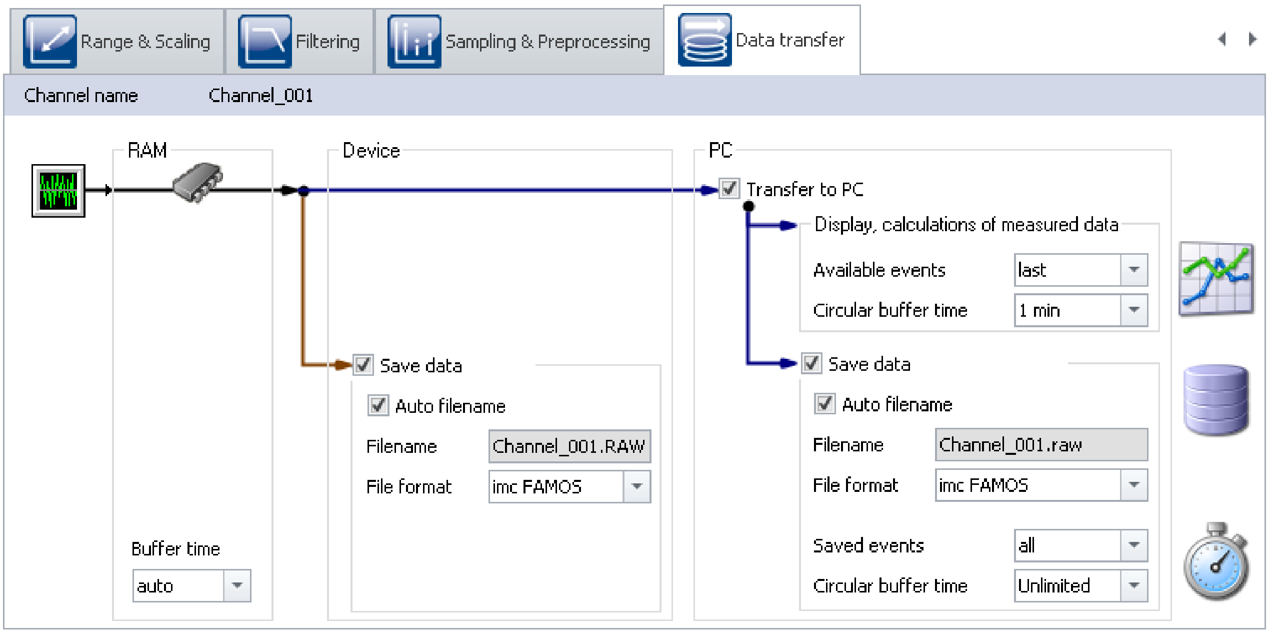
There are a variety of data storage settings.

Appearing below are links to descriptions of the most important parameters:

Channel-specific parameters	Device-parameters
File-Name 711 and File-Format 712	Interval storage 721
Circular buffer memory 711	Save trigger events in individual files 731
Available and saved events 711	Storage location 714
Transfer to PC 711	

9.3.1 Storage Options - Settings for the Channels

Setting the storage options for the channels is performed on the Setup page: "*Analog/digital channels*" in the dialog: "*Data transfer*".



Accumulating measured data are temporarily stored in the device until they are transferred to the PC for purposes of display, analysis or storage.

imc STUDIO offers the following options located under the dialog: "**Data transfer**":

1. Only online processing (no transfer to or display on the PC)
2. Saving on internal storage medium (device drive)
3. Display and calculation of the data on the PC (with or without Circular buffer[1])
4. Saving on the PC's hard drive

Items 2 through 4 above can be combined in any way desired. All storage options can be set for each channel separately.

[1] Circular buffer: the data are saved on the PC's memory for the specified amount of time and then deleted (first in first out).

Parameter	Description
Transfer to PC	When the box is checked, the data are transmitted to the PC. This is a prerequisite for displaying , calculating and storing data on the PC. • **Only online processing:** When the box is **not** checked, the data are **not** transferred to the PC. The data are only available for calculations in imc Online FAMOS or for storage in the device. No display of the measured data in the curve window or in the "Data Browser".
Save data	• **Saving on the PC** 717**:** Saving of the measured data on the PC hard drive according to the folder structure 728 set. • **Saving on the device hard drive** 714**:** Saving of the measured data device hard drive according to the folder structure 728 set. Channels using this option are recorded under the current experiment name on the device's internal drive.
Auto filename	If the box is checkmarked, imc STUDIO will create a file name: • **PC** and **Device:** The channel name will be used as file name
Circular buffer memory on the PC	For the amount of time specified, the data are held in the PC. When using this option, the required memory is known from the beginning of the measurement. • The circular buffer memory can be set separately for display on a Panel page (and calculation), or for data storage. **Deactivating circular buffering:** If you enter "0", the circular buffer is deactivated and all data are saved. • easured data intended for display and for calculations should always be handled in circular buffer mode. • The circular buffer duration set is also valid for segmented channels such as the FFT. After the time period set, the count of segments no longer increases, since the first segments are deleted instead.
Available events (Display)	With this setting, you determine whether all events (triggered events) can be displayed, or only the last one. • **all:** As soon as the setting is set to "all", the channel is an **event-based** data set. E.g., it is possible in this way to display all events in one curve window. • **last:** Only the last event is available for display or calculations (recommended). • It is only possible to set the amount if the respective channel is not set for circular buffer memory, which means it is set to "*Unlimited*". • Note on analysis using imc FAMOS: If possible, use the measured data saved on the hard drive for analysis purposes.

Parameter	Description
Saved events (Storage)	With this setting, you determine whether all events (triggered events) are to be saved, or only the last one. • **all:** As soon as multiple events can occur (multi-triggering), the channel becomes an **event-based** data set. If multi-triggering is not activated or no triggering at all, then an event-based data set will usually not be generated (the exception is a data overflow). All events will always be saved (recommended). • **last:** Only the last event is saved. See also: Save trigger events in individual files 731. It is only possible to set the amount if the respective channel is not set for circular buffer memory, which means it is set to "*Unlimited*".
File format	Format of the saved measured data (see: Data file format 712).

9.3.1.1 Data File Format

By default, the measured data are saved in the file format imc FAMOS. The desired file format can be set in the file format selection list:

Format	Description
imc FAMOS	Default format for all device variables.
imc FAMOS ZIP 713	Compressed format for many Field-bus variables.
CANAlyse-MDF 714	CANAlzser-MDF format for CAN-Log data.

imc FAMOS

The file format **imc FAMOS** is based on the file format.

Each channel is saved in a separate file with the extension *.RAW. RAW stands for raw data, meaning the original data returned by the measurement device.

The header in each file of measured data contains ***version information*** on imc STUDIO and firmware (imc DEVICES). When ***Saving to device*** w, the devices serial number is additionally recorded.

Reference

Detailed documentation on this file format is presented in the manual:
"imcSharedComponents.pdf" > File Assistant > File Format.
There you will find descriptions of the modules which jointly use imc FAMOS and imc STUDIO.

Measured data saved by your device can be read directly by imc FAMOS (5.0 Revision 8 or higher).

Note

If you want to convert the imc measurement data into a EXCEL table or a ASCII file see the ImcFrmtCvrt program located on the imc DEVICES installation CD in *Tools*, or use the command: **Format Converter** 1569.

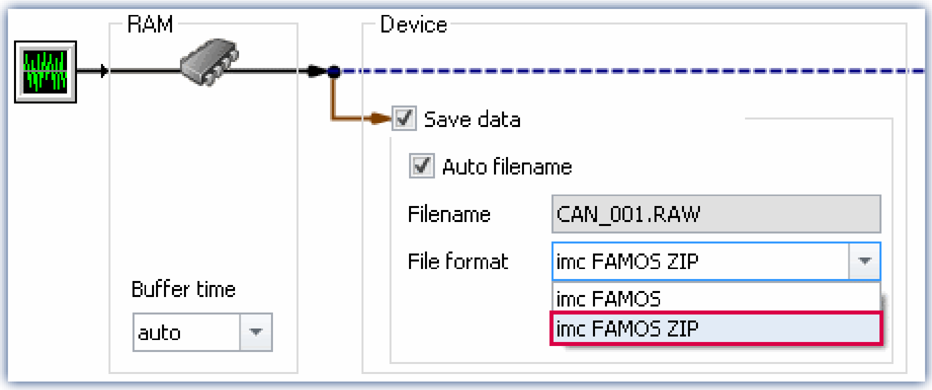
imc FAMOS ZIP

For certain channel types, it is possible to **reduce the disk space requirements** (file format: "imc FAMOS ZIP"). In the background, the file size is minimized by means of zip-compression. The result depends accordingly on the nature of the signal.

The filename remains unchanged. As well, the handling of the file, for instance with imc FAMOS is still the same.

Data compression is possible for the following channel types:

- analog/digital field-bus channels
- log channels of the CAN-Field-bus
- digital input-ports



Note limitation: computing power of the basic system

The compression of the data is limited by the computing power of the basic system. An **overload due to too many individually compressed channels can lead to a restart of the system!** The number of channels is the most important factor. Typical measurements with an imc BUSDAQ-4 showed that up to 60 channels can be successfully compressed permanently.

If the compression is limited to the log channels, an overload does not lead to a restart. However, it is possible that compression may take so long that the data cannot be retrieved in time. In this case, the system reports a data overflow.

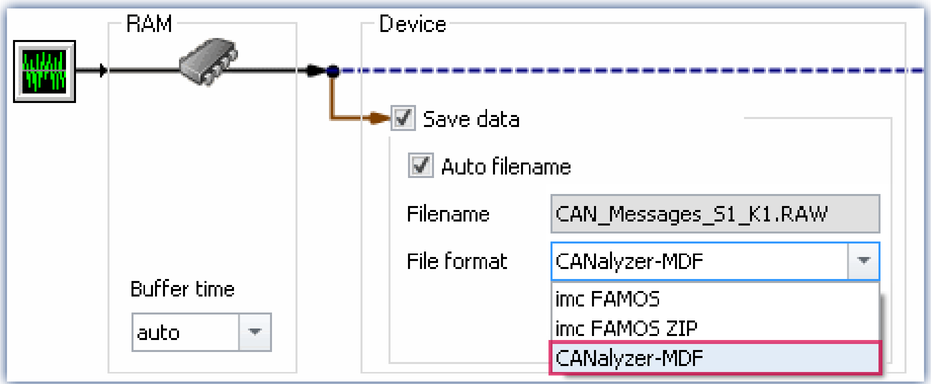
Note imc FAMOS version

The file can be loaded with imc FAMOS from version 7.2R4 onward. Loading with older versions can be possible in some cases when the current imc STUDIO version is installed on the computer. Contact our hotline to find out about such cases.

CAN-Log Data in CANAlyser-MDF-Format

Logs of CAN messages can be saved either in imc FAMOS format or in the CANAlyse-MDF file format.

This option is only available for the device.



Note

- The maximum possible measurement duration is 11 hours, 55 minutes and 49.67 seconds.
- This format is only available if "Log channel" is activated for the node in the CAN Assistant.

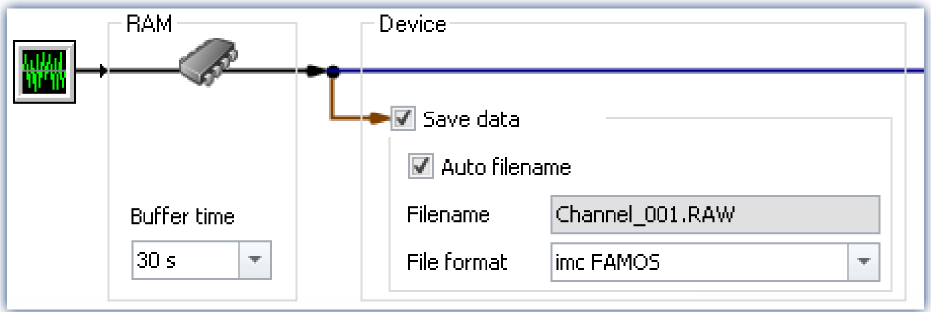
9.3.2 Data Processing and Storage in the Device

Setting the storage options for the channels is performed on the Setup page: "*Analog/digital channels*" in the dialog: "*Data transfer*".

Saving to the internal storage medium

You can save the measured data directly in the device. For this purpose, an appropriate data storage medium is necessary (see Device Hard Disk, removable drive 744).

Data saving by means of the device enables autonomous operation, without needing connection with a controlling PC, e.g. in disconnected mode or in Autostart 179.



By default, data saving by the device is deactivated. To activate the data saving, set a check in the box for **Save data**.

The channels are saved to the internal device drive under the current experiment name according to the folder structure 728 set.

Storage location

There are four options for saving data by the device:

- Saving on a **hard drive**, which is built into the device housing.
- Saving on a **removable data carrier** which can only be exchanged while the device is deactivated (**not Hotplug-capable**)
- Saving on a **removable data carrier** which can be exchanged during operation (**Hotplug**)
- Saving on a **network computer** (network enabled)

Which possibilities are available depends on the device hardware configuration and type.

To set the storage location, open the dialog: "**Storage**" on the Setup page: "**Devices**".

Reference

Data transfer

The transfer of the internal data to the PC is described in chapter "Device Hard Disk, removable drive 749".

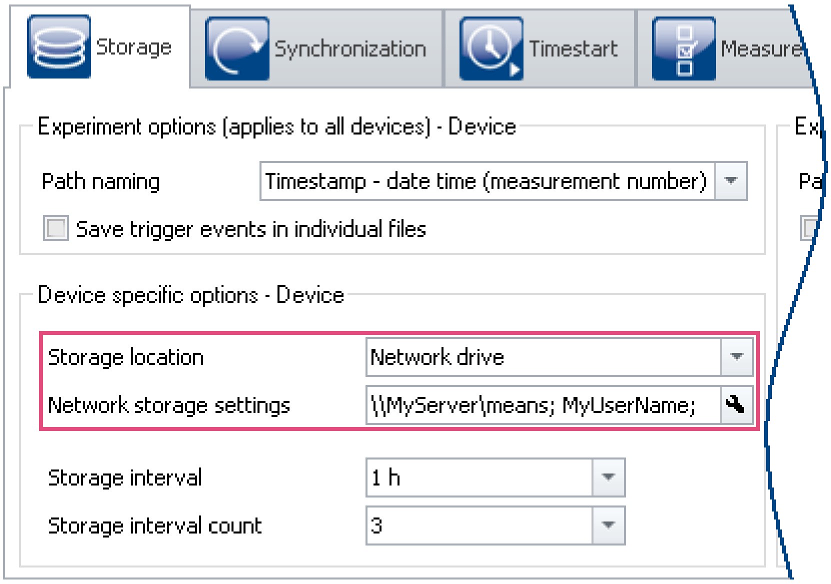
Storage Options

Information on the options for storage of the measured data is presented in the channel: "Storage Options - Settings for the Channels 710".

9.3.2.1 Saving Data on the Network

With the storage with the device, you can also specify a network drive as the target. I.e. the device can independently save the measured data to the network without that the program is running on the PC.

However, the device must support network data storage, otherwise the option is not available. (Devices as of group 4 165 and higher)



"Storage" dialog
Network storage

The data are not saved in the device, but on a centralized data collector.

Systems which use the Common Internet File System (CIFS) can be addressed as the target location (see "Prerequisites 716").

In order to set data saving on a network drive, open the dialog: "**Storage**" on the Setup page: "**Devices**".

Fundamental differences from data storage on the PC:

- In contrast to storage on the PC, it is not necessary for the measured data to be saved in the imc STUDIO database with the experiment.
- The measurement results are not displayed as a saved measurement in the Data Browser.
- Technically, there is an additional difference between data storage on the PC and data storage in the device/network drive:
  - With data storage on the PC, the operating program handles the data saving.
  - Data storage on the network drive is administered by the measurement device.

This means it is no longer necessary for the operating software to be running during measurement.

Advantages:

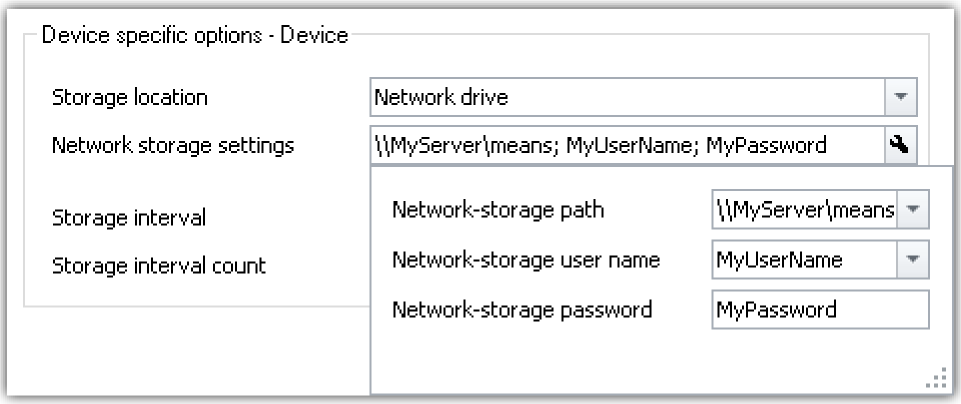
- The operating program does not need to be running during the measurement.
- Data storage in a PC via the network thus now also works in Autostart and in Sleep/Resume modes (e.g. imc BUSDAQ 165).
- Centralized data storage, independent of the experiment's storage location.
- Copying of the internal drives to the central data storage area following a measurement is omitted.

Prerequisites:

- Devices as of group 4 and higher 165
- Sharing of a network drive with writing permissions
- Secure network
- Target system using the Common Internet File System(CIFS): LINUX, WIN2000 and Windows XP/Vista/7/8/10

Setting

The network drive is specified by means of the target PC's IP-address and the name of the folder shared. The network storage path must be stated in UNC notation (\\server\share\).



Dialog "Storage"
Network storage settings

Ensure that write access to the network storage path (clearance, "share") is possible with the specified user name and password. If you did not protect the target system with a password, leave the field blank (WIN2000 and Windows XP/Vista/7/8/10 do not support this at present).

The measurement instrument creates a subfolder on the network drive for the data, which is composed of the device's name and the experiment's name.

The "*Waiting time [s]*" refers to the maximum time available for mounting the network drive when preparing the measurement.

Example

The following network path is selected (**\\MyServer\means**)

The device has the name: **imcCronosPL_123368**

The experiment has been saved under the name: **Test1**

When you start the measurement, the measurement results are saved to the following path:

\\MyServer\means\imcCronosPL_123368\Test1.

Note

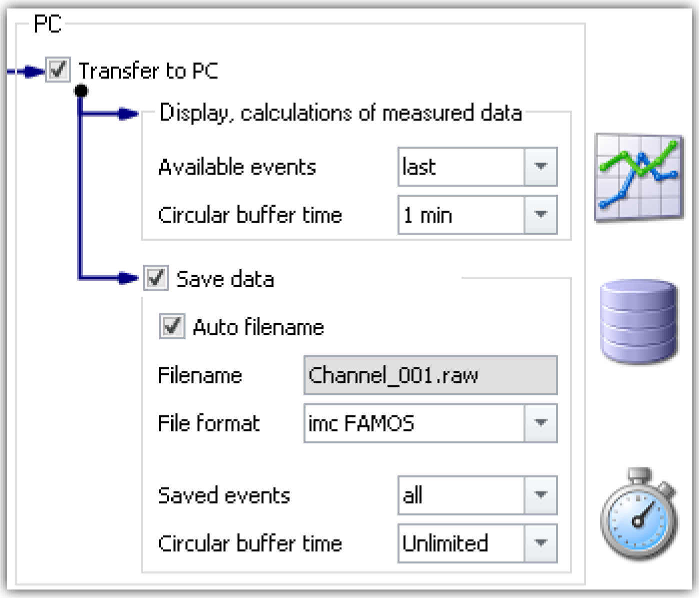
If the target PC is not available, the system reports a WINSOCK error. This disables the device for approx. 5 minutes and can only be prematurely canceled by rebooting.

9.3.3 Data Processing and Storage on the PC

Setting the storage options for the channels is performed on the Setup page: "*Analog/digital channels*" in the dialog: "*Data transfer*".

Transfer to PC

The measured data are transferred to the PC if the option "*Transfer to PC*" is activated. During measurement, you can also have the data displayed on the PC while being saved on the hard drive.



Display and calculations of measured data

The measured data available for display on Panel pages and for calculations.

Save data

To activate data storage on the PC, set a check in the box for "*Save data*".

Storage location

The **measurement files** are saved in a defined folder structure **together** with the **experiment**. There are a variety of available options for modifying the folder structure 728. Additionally, it is possible to **personally adapt how and where data are saved** using the options for the "User-defined Measurement Storage Area 736".

After conclusion of the measurement, display the data thus saved e.g on Panel pages, or with imc FAMOS.

Note

Make sure, that there is enough free memory on the selected drive for the expected measurement data.

Reference

- Information on the options for display and storage of the measured data is presented in the channel: "Storage Options - Settings for the Channels 710".
- Information on display of the stored measurement data is presented in the chapter: "Viewing saved measurement data 744".

9.3.4 RAM Buffer Duration - Outage of the network connection

Loss of the network connection between the PC and the device often causes measured data to be lost.

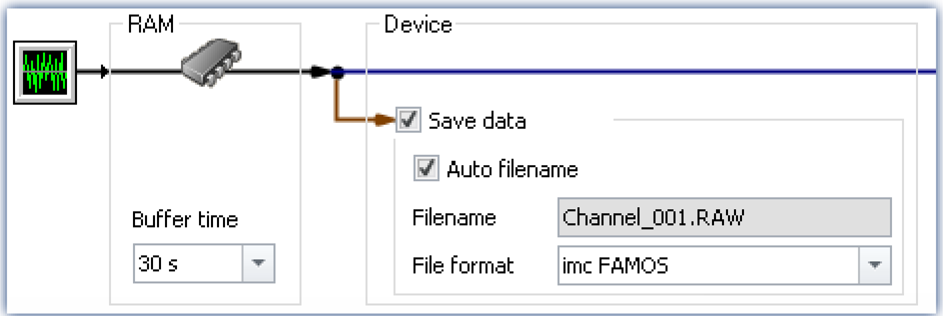
Note Saving measured data in the device

Remedy: Save an extra copy of the measured data in the device. In this way, the measured data can be compared and reconstructed.

The RAM buffer duration is a time interval reserved for each channel, for the duration of which the data are stored in the measurement device's RAM. The longer this time interval is, the less likely data overflow is to occur if the PC's connection to the measurement device is interrupted.

For example, if a faulty connection to the PC prevents the data from being transferred to the PC, data overflow will occur after elapse of the RAM buffer duration set. Adjusting the setting for this time interval would make sense for working with very elaborate online programs. The same applies if you intend to switch the internal storage medium during the course of a measurement (Hot-Plug).

Setting the RAM options for the channels is performed on the Setup page: "*Analog/digital channels*" in the dialog: "*Data transfer*".



Example

The active channel's data are assigned a RAM buffer duration of 10s. If the PC doesn't retrieve any data from the Ethernet-interface for 10s, the buffer overflows, i.e. data to be transferred to the PC are lost. The message *Data overflow* is posted. Therefore it is best to set the buffer duration to an adequately high value.

A channel's RAM buffer volume is computed by multiplying sampling rate x buffer duration. For instance, a channel sampled at 5kHz for the recommended RAM buffer duration requires 10s 5000 x 10= 50.000 Samples. When preparing for measurement, the system checks among other things whether there is enough free RAM available for the requirements of all channels.

If **error messages are posted during the preparation process**, then reduce the number of active channels are the buffer duration of individual channels, such as those which are not saved to the PC.

Reference Time-stamped data

Also observe the notes on the RAM buffer duration with time-stamped CAN data, in the chapter "*Time stamping* 480" (CAN-Bus Interface).

Behavior upon outage of the network connection

At regular intervals, imc STUDIO attempts to restore the connection with the device. If this is not possible, a message is posted accordingly. Once the connection has been re-established, data acquisition on the individual channels resumes. This happens on each channel separately and can thus lead to differing results, for instance, if the RAM-buffer sizes are different.

Result	Possible causes
Data storage resumes seamlessly from the previously saved data. The data are retrieved from the RAM; there is **no loss of data**.	For example, the RAM-buffer may be set to a sufficient volume, so that the data could be retained in the device.
A **new "event"** is generated (event-based data sets). The RAM-buffer data are not retrieved. The **measurement data** acquired during interruption of the network connection **are missing** and are not saved. In accordance with the applicable settings, either all events or only the last event is saved/displayed 711.	For instance, if a gap in the data is detected. A data overflow, because the RAM-buffer duration was exceeded.
A new measurement folder is created and has the extension ".002". The **measurement data** acquired during interruption of the network connection **are missing** and are not saved.	E.g if the saved data can not be opened or if the data type does not permit events.

Automatic adjustment of the RAM-buffer

When **multiple high-sampling-rate channels** are used, the **RAM-buffer** in the device may eventually become **insufficient**. When the buffer size is fixed, the following error will often occur: "*Insufficient memory in device! Please observe the RAM buffer time of the channels and the number of triggers.*".

By means of the **setting "*auto*"**, the RAM buffer duration is **dynamically adjusted** between 2 seconds and 10 seconds.

If one of the calculated **buffer duration times falls below 2 s**, the **error message** stated above also appears.

"*auto*" is the default setting. If the buffer is set to a **fixed value**, it is **no longer adjusted automatically**.

RAM Buffer - Data Overflow on the Internal (removable) Storage Medium

Data transfer to the PC is performed by means of the same procedure which also writes data to the internal storage medium. For this reason, interrupted communication with the PC can cause a data overflow on the internal data storage no matter whether or not the channels involved are transferred to the PC.

If **connection problems** are anticipated, we recommend the following settings:

Case 1: At an aggregate sampling rate of about 50% of the maximum (200kHz), a RAM buffer duration of 10s per channel is sufficient to avoid data overflow.

Case 2: With the maximum aggregate sampling rate (400kHz), it is recommended to run the measurement in autostart mode.

RAM Buffer Duration and Synchronization

Absolutely synchronized recording of multiple channels, e.g. for computing power from a current signal and its associated voltage signal, is ensured in one of the three following ways:

1. Select for the channels to be mathematically combined the **same sampling interval** and the **same RAM buffer duration**. Assign these channels to the same trigger.
2. Avoid multiple triggers and perform **Download** of the measurement before starting it, even if the configuration has not been changed. To force a repeat **Download**, select the Ribbon *Setup-Control > Reconfigure*.
3. Select a **RAM buffer duration** resulting in a **buffer volume less than 65,536**. Example: 20kHz sampling rate: 65,536 / 20,000= 3.3s. You can use the keyboard to enter this value in the input box next to the suggested values. At very high sampling rates, the measurement system may need to be run in autostart mode in order to avoid data overflow; see "RAM Buffer - Data Overflow on the Internal (removable) Storage Medium 720", above.

If none of these options was implemented, there may be a time offset between the channels. The cause for this is as follows:

There are 2^16 = 65,536 addresses available for a channel's RAM buffer. This means that for a RAM buffer volume of up to 65,536 samples, each sample can be addressed individually. If a greater value results from sampling rate x buffer duration, the RAM buffer is organized in blocks.

Example

A sampling rate of 10kHz x 10s buffer duration results in 100,000 > 65,536 samples. Here, the RAM buffer must be organized in 50,000 blocks of 2 samples apiece. This results in a tolerance in the addressing of magnitude block size-1, in this example, 1 sample.

In rare cases, this tolerance can cause a time offset between two channels. The possible time offset is then in the range between 0 and (block size-1) samples.

9.3.5 Saving Interval

Saving interval - What is it (for)?

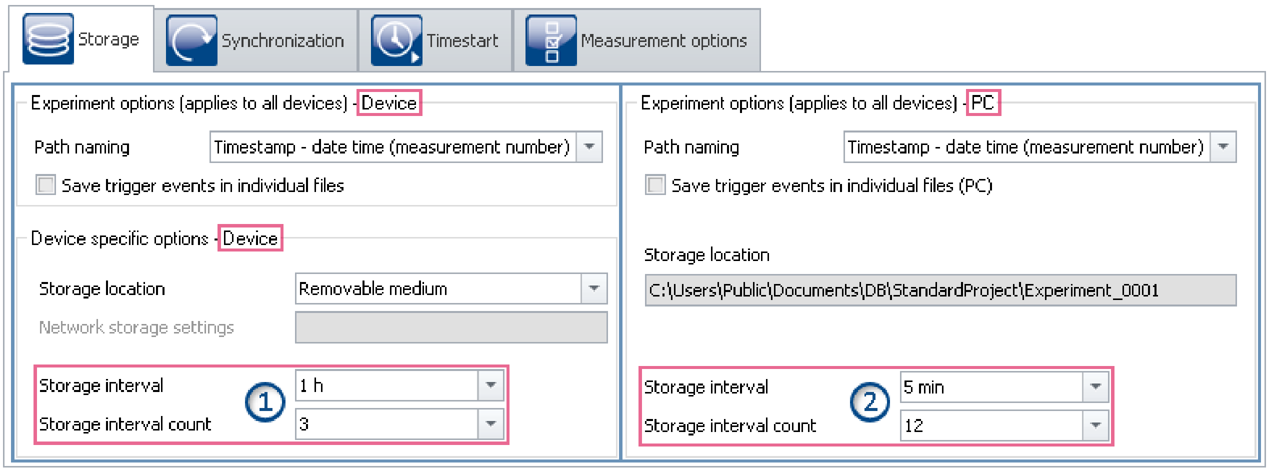
Upon the elapse of a certain time interval, a running data set is closed and a new file created.

- A number of saving intervals is specified. This number times the duration of the interval equals the maximum memory depth. When this number of intervals has been exceeded, the recordings of the oldest respective intervals are deleted.
- The setting is valid for all of a device's channels.

Suppose that there is a power outage during a running measurement; there is no guarantee that the files are closed properly. Therefore the last recorded experiment can not be evaluated. By setting a saving interval, you determine the maximum possible data loss due to a system failure.

Activating interval data saving

To activate interval data saving, open the dialog: "**Storage**" on the Setup page: "**Devices**".



Interval saving can be set for data storage on both the devices and on the PC separately.

- On the left side, you see the settings for the Data storage on the devices 724: The interval saving can be set **for each device** separately (1).
- On the right side, you see the settings for storage on the PC: the storage interval set **applies to all the devices** (2).
- The interval storage setting **not for each channel separately**!

Note

- Activating the interval storage does not activate the storage for each channel separately.
- Activate additional data storage 710 on the PC or in the device for the channels desired!

Storage interval / Storage interval count

Parameter	Description
Storage interval / Storage interval count	With these two parameters, you can limit the amount of data and number of files. In this way, it is possible to prevent complete exhaustion of available memory even during long-term measurements. **Storage interval:** After this much time elapses, a new file is created for the duration of the next saving interval. **Storage interval count:** Save the last x intervals sets the desired number of intervals. Once this number is reached, the oldest interval is deleted. Multiplying the count and the interval determines which measurement duration is available after the measurement has been run. **Example:** Storage interval = 5 min, Storage interval count = 12. The measurement duration is set to 24 h. This ensures that after one day (24 h) **at least** the last 60 min of the measurement are available in intervals of **a maximum of** 5 min.

Note Amount of data saving intervals

Once the measurement is concluded, you usually obtain **one data saving interval more** than your settings specified. This ensures that at minimum the desired amount of data are available at the end of the measurement.

- Example:
  Measurement duration: 60 s; with **intervals** of 10 s; and an **interval count** of 3 -> result in 30 seconds of expected data.
- Measurement start: 00:05
- The intervals are allocated as follows:
  00:05 to 00:10 <- deleted
  00:10 to 00:20 <- deleted
  00:20 to 00:30 <- deleted
  00:30 to 00:40
  00:40 to 00:50
  00:50 to 01:00
  01:00 to 01:05

In order for at least 30 seconds to be available after the measurement ends, the last 4 intervals must remain saved. In this example, that means 35 seconds of measured data. If the oldest interval were deleted, then there would only be 25 seconds.

- Incomplete intervals can be avoided by means of a **Timed start**. By this means, start measurement exactly at an **interval boundary**.
  For technical reasons, with some data types, one extra interval is created. This mostly affects such data types as matrices, histograms or TimeStampASCII (TSA) data.

During the measurement the PC usually contains **two extra saving intervals**, since it is not yet possible to access the current interval. As a result, in this case at least the desired data are always available for display/analysis.

Warning Measured data will be deleted

- When interval storage is active, all **folders are deleted except for the specified number** of intervals!
- If you **download or start** a measurement, **the number of existing measurement folders is reduced** to the number of storage intervals.
  This also applies if the number of intervals is decreased.
- Only measurements which are not loaded are automatically deleted in this way. Any measurements which are loaded are ignored. Thus, any measurements which are currently being viewed or analyzed on the Panel are not automatically deleted.
  In consequence, it may happen that more saved measurements remain in existence than were specified. The measurements will only be automatically deleted if the particular measurement has been closed.
- The measurements can be deleted manually at any time via the context menu of the Data Browser.

FAQ

Why is the first interval shorter?

Answer: To achieve a standardization of interval folders on the PC and on the device, the first interval is cut at the next interval.

Example:

- The measurement starts at 8:55:03, the saving interval has been set to 10 minutes.
- The first interval will be closed at the next whole-number 10 minute interval, that is 9:00:00. From here it will be in steps of 10 minutes: 13:10:00, 13:20:00 etc.

Reference

See also:

- Pretriggers in conjunction with intervals 410

9.3.5.1 Saving Interval on the Internal Device Storage Medium

By means of the settings "*Storage interval*" and "*Storage interval count*", you specify a defined storage space. A **limited count** produces the same data storage effect as **circular buffer storage**. Once the count specified has been reached, the **oldest data are deleted**.

Special feature of circular buffer operation (limited count of data saving intervals)

There is a special feature with **Storage in the device** if a defined interval count is set (not applicable if "*all*" is set). If the **free memory is already exhausted** before the required folder count has been reached, the **circular buffer saving is performed with fewer intervals**! However, this only happens if there are at least four intervals.

Implementing the circular buffer operation

- A loop is used to test whether there are at least four measurement-folders in the current experiment folder.
- The oldest folder is deleted and a check is made of whether sufficient memory is now free.
- If this is not the case, the process is repeated.
- As soon as sufficient memory is available, data recording continues.
- If only three or fewer folders are left, data recording to the storage medium stops and the error message "Disk full" is posted.

FAQ

Under what circumstances will circular buffer operation not work?

Answer:

1. If the storage medium is already full and a new experiment is to be created.
2. If a measurement is of indefinite length and no saving interval was set.
3. If the storage medium memory allotted to the current experiment is so little that it is exhausted before at least four folders are saved. This is true even if the folders require different amounts of memory.

Why must there be at least four folders?

Answer:

1. For ring-operation, only the storage medium memory is used which was occupied by old folders belonging to the same experiment, or which is still free.
   As a rule: no data belonging to another experiment are deleted.
2. At all times, at least two closed folder containing readable data must exist.
3. In consequence, the current folder doesn't count, because it may not contain data. Then, if at least two valid folder must exist when deletion occurs, three folders must be present before deletion. Together with the current folder, that makes four folders necessary before deletion can take place!

Note

- The number of samples per saving interval may vary, especially for heavy data throughput. However no sample will be lost.
- A concluded interval is denoted by the file DirClosed 732.

9.3.6 Overview Storage and Display Options

Analog, digital, or other equidistantly sampled or time-stamped channels (e.g data-reduced channels)

0/1 = deactivated / activated | --- = Option is ignored

For display and calculation (with or without storage of measured data)

Multiple triggering?	Circular buffer	Circular buffer Time	Available events
No	unlimited		---
	activated	any (3)	---
Yes	unlimited		Last / All (2)
	activated	any (3, 4)	Last (1)

Storage of measured data on the PC

Multiple triggering?	Circular buffer	Circular buffer Time	Saved events	Storage interval	Storage interval count
No	unlimited		---	any (3)	1..n or all
	activated	any (3)	---	--- (6)	---
Yes	unlimited		Last / All	any (3)	1..n or all
	activated	any (3, 4)	Last (1)	--- (6)	---

Storage of measured data on the device

Multiple triggering?			Saved events	Storage interval	Storage interval count
No			---	any (3)	1..n or all
Yes			All	any (3)	1..n or all

(1) For channels with multi-triggering, circular buffering pertains to the last trigger-event. The circular buffer memory does NOT extend across multiple trigger-events! Only the last event is displayed/saved.

(2) The default setting is: Display of the "last" event (also for channels with an unlimited trigger-event count). By this means, overflow of memory during long measurements is to be avoided. Regardless of this setting, for the display in the curve window, you can set the displayed events to "All/last/some".

(3) The circular buffer length and the number of saving intervals can take 'any' value in the framework of the storage options for the PC used. The minimum storage size is 2 data samples.

(4) The buffer memory size is limited by the channel's trigger length. Since the amount of data on a trigger is limited, more memory space would be useless.

(6) Interval storage is ignored for channels saved to a circular buffer.

FFT or similar virtual channels

0/1 = deactivated / activated | --- = Option is ignored

SL = Segment length (length of the FFT or similar)

For display and calculation (with or without storage of measured data)

Multiple triggering?	Circular buffer	Circular buffer Time	Available events
No	unlimited		---
	activated	n*SL	---
Yes	unlimited		Last / All (2)
	activated	n*SL	Last (1)

Storage of measured data on the PC

Multiple triggering?	Circular buffer	Circular buffer Time	Saved events	Storage interval	Storage interval count
No	unlimited		---	any (3)	1..n or all
	activated	n*SL	---	--- (6)	---
Yes	unlimited		Last / All	any (3)	1..n or all
	activated	n*SL	Last (1)	--- (6)	---

Storage of measured data on the device

Multiple triggering?			Saved events	Storage interval	Storage interval count
No			---	any (3)	1..n or all
Yes			All	any (3)	1..n or all

(1) For channels with multi-triggering, circular buffering pertains to the last trigger-event. The circular buffer memory does NOT extend across multiple trigger-events! Only the last event is displayed/saved.

(2) The default setting is: Display of the "last" event (also for channels with an unlimited trigger-event count). By this means, overflow of memory during long measurements is to be avoided. Regardless of this setting, for the display in the curve window, you can set the displayed events to "All/last/some".

(3) The circular buffer length and the number of saving intervals can take 'any' value in the framework of the storage options for the PC used. The minimum storage size is 2 data samples.

(6) Interval storage is ignored for channels saved to a circular buffer.

Matrix or histograms

0/1 = deactivated / activated | --- = Option is ignored

For display and calculation (With or without storage of measured data)

Multiple triggering?	Circular buffer	Circular buffer Time	Available events
No	unlimited		---
	activated	---	---
Yes	unlimited		Last / All (2, 5)
	activated	---	Last (1, 5)

Storage of measured data on the PC

Multiple triggering?	Circular buffer	Circular buffer Time	Saved events	Storage interval	Storage interval count
No	unlimited		---	any (3)	1..n or all
Yes	unlimited		Letztes / Alle (5)	any (3)	1..n or all

Storage of measured data on the device

Multiple triggering?			Saved events	Storage interval	Storage interval count
No			---	any (3)	1..n or all
Yes			Alle (5)	any (3)	1..n or all

(1) For channels with multi-triggering, circular buffering pertains to the last trigger-event. The circular buffer memory does NOT extend across multiple trigger-events! Only the last event is displayed/saved.

(2) The default setting is: Display of the "last" event (also for channels with an unlimited trigger-event count). By this means, overflow of memory during long measurements is to be avoided. Regardless of this setting, for the display in the curve window, you can set the displayed events to "All/last/some".

(3) The circular buffer length and the number of saving intervals can take 'any' value in the framework of the storage options for the PC used. The minimum storage size is 2 data samples.

(5) The calculations of matrices and histograms are based only on the data measured for the current trigger event.

(6) Interval storage is ignored for channels saved to a circular buffer.

9.3.7 Data Storage and Directory Structure

To change the folder structure in which measurement results are saved, open the dialog: "*Storage*" in the Setup page: "*Devices*".

This dialog set s the options for saving the measured data to the device and to the PC. You can decide how to name folders and where to place them. You can also set at what intervals 721 to save the measured data.

Note Notes on Data overflow

With interval data saving:

If a data overflow occurs when the measurement data are retrieved, resulting in a data gap larger than the sampling interval, a new file is created rather than an empty file for the missing data.

With and without interval data saving:

If data overflow occurs **within an interval**, or in the **absence of interval data saving**, there are multiple approaches:

Data storage in the device:
No gap in the measured data will be generated. The new samples continue to be appended to the existing measured data, no matter how many samples are lost. For this reason, they are assigned an incorrect time stamp (the samples have a time offset). In the "SysLog"-file 732, it is exactly specified when a data overflow occurred and how many data points are missing. Thus, the file can be corrected.
As soon as a new file is started, the time stamp is again accurate (e.g. interval boundary).

Data storage on the PC: The behavior depends on the setting: "*Saved events* 712" in the "*Data transfer*"-settings for the respective channels.

- **all:** The channel becomes an event-based data set. The new samples are saved in a new event. They thus have a correct time stamp. All data from before and after the overflow are present. The time stamp is correct.
- **last:** Already existing data in the file are overwritten. Thus, only the data from after the overflow are saved. The time stamp is correct.

Note The maximum file size: 2 GB

Per interval or measurement, one file is created per channel, which contains the respective measurement files.

If this file reaches **2 GB** in size, then a new measurement folder with a new file is created automatically. This folder has the same name as the first one, however it is appended with a suffix 002, e.g. "*2014-08-05 14-30-00 (1).002*".

If this new file, too, reaches 2 GB in size, then a new file is created again, this time with the suffix 002.

9.3.7.1 Designation of the Measurement Data Folders

By default, the folders are named along with their date and time. Additionally, there can be a running number. It is also possible to create subfolders for each trigger event 731.

Using the parameter **Path naming**, you set the folder structure for the measured data. Additionally, it is possible to **personally configure the data storage style and location** on the PC side by modifying the options for the "User-defined Measurement Storage Area 736" .

Timestamp - date time (measurement number)	Continuous numbers
The path name is formed from the start time.	
\2011-06-12 17-01-30 (1)	\00000001
\Channel_001.raw	\Channel_001.raw
\Channel_002.raw	\Channel_002.raw
\Channel_003.raw	\Channel_003.raw
\---.raw	\---.raw
\2011-06-16 14-01-30 (2)	\00000002
\---.raw	\---.raw
\Starttime (measurement number)	\Number
\Filename.raw	\Filename.raw

Note — Notes on parallel saving on the PC and in the device

If parallel data storage both in the device and on the PC is selected, it makes sense to provide identical names to the two corresponding measurement data folders.

This is accomplished by means of the path naming selection: "Timestamp".

With the path naming option: "Continuous numbers", discrepancies can occur.

1. The consecutive numbering reflects existing measurement data folders. For example, if some measurements were deleted from the PC, there can be discrepancies in the naming of subsequent measurements.
2. In the initialization (downloading) process, the system finds the highest number used. Then when the measurement is started, the next higher number is used.
   The process of data storage **on the PC** includes inspecting upon each start which number is the highest. For instance, if following a measurement, the folder with the highest number is deleted, then this number is used again upon the next start.
   Searching the storage medium **on the device** for the highest number - before each start - cannot be performed quickly enough. For this reason, the number is incremented for each measurement. Even if the last measurement was deleted. The system only checks what the highest number is upon the next initialization.

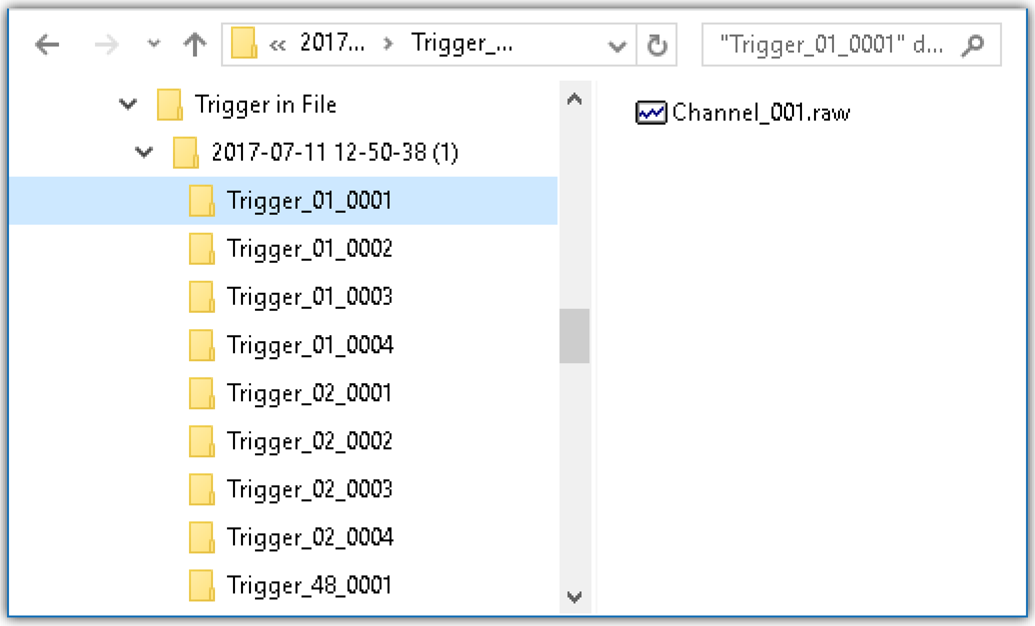
This can lead to different results if measured data are deleted after a measurement.

9.3.7.2 Save Trigger Events in individual Files

The option: "*Save trigger events in individual files*" lets you set the system's data saving behavior with triggered Events:

Not activated	Activated
Every triggered event is saved to the same file.	Each occurring trigger event is saved to a new file.
• If multiple triggered events are saved (see: "*Storage Options*" > "*Saved events*" 710") , an event-based data set is generated. • If only the last event is saved, the previous trigger events are deleted.	• For each trigger event, a separate folder is generated, in which the associated triggered channel data are saved. • Already while the measurement is still running, it is possible to access data on events which have already been completed.
\2011-06-12 17-01-30 (1) \Channel_001.raw \Channel_002.raw \Channel_003.raw \2011-06-16 14-01-30 (2) \---.raw \Starttime (measurement number) \Filename.raw	\2011-06-12 17-01-30 (1) \Trigger_48_0001\Channel_001.raw \Trigger_01_0001\Channel_002.raw \Trigger_01_0002\Channel_002.raw --- \Trigger_02_0001\Channel_003.raw \2011-06-16 14-01-30 (2) \Trigger_48_0001\---.raw \Starttime (measurement number) \TriggerName_TriggerNumber\Filename.raw

With this setting active, the folder structure for the measured data may appear as shown below:



Note

All triggers with the combination: "*1-Trigger*" are always saved in the folder of "*Trigger_48*". They are not assigned a separate folder.

Warning

- It is necessary to be very careful when using this option. Inconvenient selection of trigger conditions may cause the hard drive to quickly be filled with trigger folders.
- The time which the system needs to access data increases along with the number of folders.
  - For this reason, regarding data storage in the device, when **1000 trigger folders** accumulate, a **new measurement data folder** is created. This does not apply to storage on the PC.

9.3.7.3 Supplemental Files: DirClosed and imcSyslog

In addition to files of measured data, the measurement system also creates two system files.

DirClosed

On the device hard drive, the file "*DirClosed*" is created as soon as a measurement data folder is completely concluded. The file has no content. If this file exists, it is possible to access the measured data. For imc LINK or any personally created transfer programs, reliable copying and deleting are ensured.

imcSyslog

While a device is operating without being connected to any PC, the device is not able to report any errors. So if for instance a data overflow 754 occurs during online processing or when saving the data, this information must be saved in the device.

Such information is saved in the file "*Syslog*", which is located in the respective measurement data folder. At this time, only important information regarding cases of data overflow are recorded. By this means, the measured data can be reconstructed except for the lost samples.

Name of the file

DeviceXXXXXX.syslog, "XXXXXX" standing for the device's serial number, e.g. Device120345.syslog.

Structure of the file when functioning normally

```
imcSyslog Version 1.0
imc Devices 2.8R3 SP6 (8.4.2013)
Nothing to report!
```

Structure of the file in case of data overflow

```
imcSyslog Version 1.0
2010-12-21 11:08:06.929190 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:206 L#:1253
2010-12-21 11:08:08.147645 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:1459 L#:1800
2010-12-21 11:08:11.029787 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:3259 L#:1113
2010-12-21 11:08:16.071192 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:6918 L#:1304
2010-12-21 11:08:22.906673 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:10111 L#:1054
2010-12-21 11:08:24.630697 M#:Data overflow on disk! F#:V006_G01.raw E#:1 FE#:0 O#:11186 L#:1100
Log closed!
```

The structure is designed so that the information can be both read and also processed by a repair program.

2010-12-21 11:08:06.929190	M#:	Data overflow on disk!	F#:	V006_G01.raw	E#:	1	FE#:	0	O#:	206	L#:	1253
1	2	3	4	5	6	7	8	9	10	11	12	13

	Description	Example
1	Date and time of the event	e.g. 2010-12-21 11:08:06.929190
2	Identifier for the message text	M#
3	Report as an English-language text	e.g.: Data overflow on disk!
4	Identifier of the filename	F#
5	Name of the file in which the overflow occurred	e.g. V006_G01.raw
6	Identifier of the absolute event number	E#
7	Absolute number of the event in which the data overflow occurred	e.g. 1 for the first trigger release on this channel since the measurement start
8	Identifier of the relative event number	FE#
9	Relative number of the event, in reference to the events in the file affected	e.g. 0 for first event in this file; 1 for second event in the file...
10	Identifier for the offset	O#
11	Offset of the overflow within the file in 16-bit words	e.g.: 206. -1 -> The overflow is located between the file for the last interval and this one
12	Identifier for the length of the data overflow	L#
13	Length of the data overflow in 16-bit words	e.g.: 1253

9.3.7.4 Incomplete Measurement Files

Measurement files being written during the measurement process are not complete and can neither be deleted or copied. If either of the options "*Saving interval*" or "*Save trigger events in individual files*" is used, it is possible to access the data even during a running measurement. However, this only applies to data from completed events. The current interval or trigger event is subject to the same limitation.

Note

Once all files have been concluded, the system creates an additional file DirClosed 732. As soon as it is present, you have reliable access to the measured data.

9.3.8 Controlling Data Storage

9.3.8.1 Targeted Data Saving, or Saving Subsequent to Measurement

In addition to the optional automatic data saving, you can also perform targeted saving of the data currently in the PC (Current measurement) either during or subsequent to the measurement.

Targeted saving of the current measurement is only possible until a new measurement has been prepared or started!

In order to save the measured data in this way, select the ribbon item "*Project*" > "*Save current measurement data/as*".

Note

- **No single values can be saved in this way.** These include, for instance, Display-variables.
- Be aware that with this function, only such variables are saved, which are found in the Data Browser under **Current measurement**. For these variables, a **circular buffer memory** is usually activated, so that not all results since the measurement start are available.
  For device-variables, therefore, the Data Transfer Settings 381 are applicable. The storage type: "*Display, calculation of measured data*" is used.

Save current measurement data

By default, the measured data are saved in the database. If the automated saving of measured data was activated, the results of data saving and of targeted saving are located in parallel next to each other.

When the button is clicked, a dialog appears in which the folder name can be entered. The folder is created automatically and whatever measurement results are already available at the time are saved.

Save current measurement data as

When the button is clicked, a folder selection dialog appears, in which the target folder can be selected. The measurement results available up to that point in time are saved there.

Options

In the Options 117, it is possible to configure how the data saving works.

- **Folder name / Path**

  Here, a folder can be specified or a path entered, in which to save the variables. It is a preferable choice to use placeholders such as `SYSTEM.TIME`, so that the path can vary. Otherwise, the results will always be overwritten. In this way, you can also integrate the metadata into the folder path.
  Path: You can pre-define the data storage path in which the data storage dialog is to launch. If the folder doesn't exist, it is created temporarily. But if you don't save the files in it, the folder is deleted once the dialog is closed. However this only happens when it had been created by this method and if it is really empty.

- **Show dialog**

  The dialog for entering the folder name / path can be deactivated. The condition for this is: the option *Folder name / Path* has been filled in.

- **Save to one file per file format (Save all in a single file)**

  If this option is activated, all variables are saved to a single (multi-channel) file. The file name can be specified. The file format for the file does not need to be specified. However, if no file name is specified, all variables are automatically saved to the file *data.dat*. Furthermore, for each file format a separate file is created.

  If the option is not activated, each variable is saved in a separate file.

- **Overwrite existing files without confirmation prompt**

  If this option is activated, files having the same name in the destination folder will be overwritten without a confirmation prompt. This option is useful for automated routines.

- **Mapping instruction**

  If desired, you can provide you own personal mapping instruction according to which to determine the channel type selection.

9.3.8.2 Suspend and Resume Data Storage

If the saving of measured data is activated 381, then you are able to govern the data storage **during the running measurement**. You can **interrupt (suspend) data storage** and **resume it again** at a later time.

Ribbon	View
Home > Suspend data storage ( )	all
Setup-Control > Suspend data storage ( )	Complete
Home > Resume data storage ( )	all
Setup-Control > Resume data storage ( )	Complete

Effect

If you **suspend data storage**, the **files are closed** and appear in the Data Browser (as if the measurement had been concluded). Any **more data** which arrive or are calculated subsequently **are not saved**.

When you **resume data storage**, then **new files are created** in a **new measurement folder** (as if the measurement had just been started). Any data arriving before "resumption of data saving" are not saved.

This function is designed for **interrupting data saving for longer periods of time**. Please do **not use it to make "cuts" of data records** (concluding one measurement folder and immediately beginning a new one).

Note

- Data storage **con only be controlled** if it was previously **activated**.
- This **suspension/resumption** of data storage **is not synchronized** across the devices! Thus, the respective **data excerpt boundary points** of different devices/channels **may differ by a few measurement points**.

Scope

These actions **apply to all devices and to the PC**. No separation is possible. Any additional components which return data to be saved (such as 3rd-party devices) are also affected.

Note Video-files are not affected

The **saving of Video files** is **not affected** by this function. Video files are always recorded.

Reference Data storage state after download

Using the option "Data storage state after download", you can control the function’s state. E.g. it is possible to make data storage generally active following "Download".

See the option: "*Setup*" > "*General*" > "*Data storage state after download* 115".

9.3.8.3 User-defined Measurement Storage Area

When data storage is activated, the measurement results are normally saved to the database in the Experiment-folder.

According to the particular data storage settings, a Directory Structure 728 is established in the Experiment-folder.

It is possible for you to define your own data storage structure. The settings for this purpose are available at "*Options*" > "*Project Management*" > "*Measurement storage area* 114".

Even if the measurement folder is changed within an experiment (e.g. by means of placeholders), all measurements saved are listed in the Data Browser. On the hard drive, the measurements are located at a variety of positions. In the Data Browser, they are all displayed together.

Warning

- When you change these settings, some data storage settings may no longer be used. For example, the "*Path naming*" (e.g. "*Continuous numbers*"). The settings can be used in conjunction with placeholders, but don't necessarily need to be.
- You define the structure's appearance. This may mean that the measurement results are always saved to the same folder. In order to avoid data being overwritten, a post-fix is automatically appended.
- Ensure that you possess reading and writing privileges for the data storage drive.

Definition of terms

Measurement storage path

By default, this is the Experiment-path. This denotes the folder in which all measurements are saved (according to the measurement folder structure specified).

Measurement folder structure

This refers to the structure below the measurement storage folder. For instance, folders are set up here according to the settings for "*Path naming*" (e.g. "*Continuous numbers*").

Preview

The preview provides an example of where the measurement would be saved according to the current settings. Be aware that the preview is for demonstration purposes only and may not reflect certain settings for the "*Path naming*" (e.g. instead of "*Continuous numbers*", the time stamp is displayed).

Use a user-defined measurement storage path

Default setting: `<EXPERIMENT.PATH>`

- Returns the Experiment-path. All measurement results are saved with the experiment.

If you specify a different folder, all measurement results are saved to this new folder and no longer according to the Experiment-path.

Examples of measurement storage paths

Example 1

`C:\Measurement\<EXPERIMENT.NAME>\Results`

- Measurement results for the experiment: *Experiment_0001* are saved as follows, for example:
  C:\Measurement\Experiment_0001\Results2013-01-01 08-00-00 (1)
  C:\Measurement\Experiment_0001\Results2013-01-01 09-00-00 (2)
  C:\Measurement\Experiment_0001\Results2013-01-01 10-00-00 (3)

Example 2

`C:\Measurement\<EXPERIMENT.NAME>`

- Measurement results for the experiment: *Experiment_0002* are saved as follows, for example:
  C:\Measurement\Experiment_00022013-01-02 08-00-00 (1)
  C:\Measurement\Experiment_00022013-01-02 09-00-00 (2)
  C:\Measurement\Experiment_00022013-01-02 10-00-00 (3)

Example 3

<EXPERIMENT.PATH>\Results

In a case where the database was moved to the following path:
c:\DB

- Measurement results for the experiment: *Experiment_0003* are saved as follows, for example:
  C:\DB\StandardProject\Experiment_0003\Results2013-01-03 08-00-00 (1)
  C:\DB\StandardProject\Experiment_0003\Results2013-01-03 09-00-00 (2)
  C:\DB\StandardProject\Experiment_0003\Results2013-01-03 10-00-00 (3)

Use a user-defined measurement folder structure

Default setting: `\<STORAGE.FOLDERNAME>\`

- Returns the experiment's data saving settings (e.g. the *Path naming* such as *Continuous numbers*)

If you specify a different folder structure, all measurement results will be save according to the specified folder structure.

Useful placeholders for the measurement folder structure:

- `<STORAGE.FOLDERNAME>`

  Generates a folder from the data storage settings (e.g. *2013-01-01 08-00-00 (1)*)

  The result can change during a measurement, for instance when interval saving is activated. This placeholders ensures that each measurement result is assigned its own folder.

- `<STORAGE.MEASUREMENT>`

  Returns the data and time of the measurement start (e.g. *2013-01-01 08-00-00*). The result remains unchanged until the end of the measurement. By means of this placeholder, it is possible for instance to assign each measurement its own permanent folder.

- `<VARS.VALUE>`

  Returns a variable's value. The placeholder may serve as its own counter or as a metadatum representing the module serial number for the path.

- `<SETUP.SQL>`

  Returns the value of a cell in a Setup-page. This could be uses as, for instance, a metadatum representing the module serial number for the path.

Examples of measurement folder structure

In all examples, no user-defined data storage folder for the measurements is used. This means that the Experiment-folder is used.

Additionally, the database for all examples was moved to the following path: *c:\DB*

Example 1

`\Results\<STORAGE.FOLDERNAME>\`

- Measurement results for the experiment: *Experiment_0004* are saved as follows, for example:
  C:\DB\StandardProject\Experiment_0004**\Results\2013-01-01 08-00-00 (1)**
  C:\DB\StandardProject\Experiment_0004**\Results\2013-01-01 09-00-00 (2)**
  C:\DB\StandardProject\Experiment_0004**\Results\2013-01-01 10-00-00 (3)**
- In the Data Browser, the results are displayed as follows:
  Results\2013-01-01 08-00-00 (1)
  Results\2013-01-01 09-00-00 (2)
  Results\2013-01-01 10-00-00 (3)

Example 2

`<STORAGE.MEASUREMENT>\<STORAGE.FOLDERNAME>\`

Interval saving (1 min) is activated. After every three intervals the measurement is stopped.

- Measurement results for the experiment: *Experiment_0005* are saved as follows, for example:
  C:\DB\StandardProject\Experiment_0005**\2013-01-02 08-00-00\2013-01-02 08-00-00 (1)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-02 08-00-00\2013-01-02 08-01-00 (1)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-02 08-00-00\2013-01-02 08-02-00 (1)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-05 08-00-00\2013-01-05 08-00-00 (2)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-05 08-00-00\2013-01-05 08-01-00 (2)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-05 08-00-00\2013-01-05 08-02-00 (2)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-10 08-00-00\2013-01-10 08-00-00 (3)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-10 08-00-00\2013-01-10 08-01-00 (3)**
  C:\DB\StandardProject\Experiment_0005**\2013-01-10 08-00-00\2013-01-10 08-02-00 (3)**
- In the Data Browser the results are displayed as follows:
  2013-01-02 08-00-00\2013-01-02 08-00-00 (1)
  2013-01-02 08-00-00\2013-01-02 08-01-00 (1)
  2013-01-02 08-00-00\2013-01-02 08-02-00 (1)
  2013-01-05 08-00-00\2013-01-05 08-00-00 (2)
  2013-01-05 08-00-00\2013-01-05 08-01-00 (2)
  2013-01-05 08-00-00\2013-01-05 08-02-00 (2)
  2013-01-10 08-00-00\2013-01-10 08-00-00 (3)
  2013-01-10 08-00-00\2013-01-10 08-01-00 (3)
  2013-01-10 08-00-00\2013-01-10 08-02-00 (3)

Example 3

```
\Object <SETUP.SQL("SELECT TestPartNo FROM Project")>\Measurement
<VARS["Measurement_No"].VALUE("0")>\
```

The *SETUP*-placeholder returns the content of the column *Test part number*.
The *VARS*-placeholder returns the content of the variable *Measurement_No*.

Attention: The user must ensure that the Setup column is filled and that the variable has a value, which is raised automatically once per measurement.

- Measurement results for the experiment: *Experiment_0006* are saved as follows, for example:
  C:\DB\StandardProject\Experiment_0006**\Object 12\Measurement 1**
  C:\DB\StandardProject\Experiment_0006**\Object 12\Measurement 2**
  C:\DB\StandardProject\Experiment_0006**\Object 12\Measurement 3**
  C:\DB\StandardProject\Experiment_0006**\Object 13\Measurement 1**
  C:\DB\StandardProject\Experiment_0006**\Object 14\Measurement 1**
- In the Data Browser, the results are displayed as follows:
  Object 12\Measurement 1
  Object 12\Measurement 2
  Object 12\Measurement 3
  Object 13\Measurement 1
  Object 14\Measurement 1

Note — Point in time for determining target folder

The target folder is only determined once data which are to be saved arrive at the PC. Up until this point in time, it is possible to control the folder path. E.g. by means of the Setup pages, which had been called via the "*Metadata-Assistant*" before the measurement. When columns of this Setup page are used to set the path (via `<SETUP.SQL>`), the new values are observed.

Using the menu action: "*Suspend/Resume data storage*", data storage is interrupted/resumed. Upon the start of the resumed storage, the target folder is also determined again from the beginning.

This means you can change the target folder during the measurement.

FAQ

Why not use a <SYSTEM.*> placeholder?

Answer: The `<STORAGE.*>`-placeholders should be used here instead of the `<SYSTEM.*>`-placeholder. The `<STORAGE.*>`-placeholders are resolved once and then apply to all devices. The `<SYSTEM.*>`-placeholders are resolved anew each time. This means that they are resolved again for each device and in consequence that may lead to a different folder for each device.

The results of previous measurements are deleted although their origin is a different experiment

Answer: If you have activated interval-saving, it doesn't matter where the measurement results located in the target folder come from.

If the specified amount has been reached, older measurement results are deleted.

This can also happen when different PCs use the same measurement data folder and the same experiment name.

9.3.8.4 imc Online FAMOS Function CloseSaveInterval()

If imc Online FAMOS is set to control commands, you'll find the function `CloseSaveInterval` in group **system**. That command is closing the current folder of measurement data and create the next folder. The function is executed with a delay, that depend on the load of the device.

9.3.9 Saving - Miscellaneous

9.3.9.1 Memory Requirements for Measurement Data

For measurements saved to the internal storage medium, note:

If the available memory is exhausted during measurement, the measurement continues anyway (display and additional saving to PC-hard disk, in some cases).

In order to estimate the memory requirement for a measurement of a particular length, one must first distinguish among the various data types. There are distinctions between **analog** and **digital**, **reduced** and **equidistant** data, as well as between **untriggered** and **triggered measurement**. Additionally, the "*cluster size*" of the storage medium used plays a role.

Data type:

- Analog data require 16 bits per sample (or for the data type: Float 4 Byte pro Sample (whether your device supports the data type: Float is stated in the respective device manual)
- Digital data require 16 bits per 16 bit port
- Virtual channels in imc Online FAMOS require 32 Bit per sample
- The same applies to channels reduced using Transitional Recording.
- When estimating the memory requirements for virtual waveforms, it is necessary to take the function used into consideration. For example, the simple RMS-value of 1000 readings reduces the data mount by that factor.

Trigger:

- For each triggering event, a file header is saved, which provides additional information on the stored data (imc FAMOS file format).
- The size of this header depends on the particular settings (e.g. header of the first Event: 1536 Byte, header of the subsequent Events: 512 Bytes)

Note

- The calculated memory requirement is the minimum memory space requirement.
- For each file on the hard drive, there is a series of entries in the FAT (file allocation table) which determine which clusters are occupied by the file, i.e., where the file contents are physically located on the disk.
- The folders, subfolders and files they contain are administered separately and occupy at least one cluster.

Data Types

Data Type	Memory Requirement	Comment
Analog channels	2(4) byte / sample *	4 Byte for the data type: float
Digital channels (16 bit DIO port)	2 byte / sample *	
Virtual channels (Data computed in imc Online FAMOS)	4 byte / sample *	
Analog channels reduced using Transitional Recording	4 byte / saved sample *	depends also on imc Online FAMOS functions
Digital channels reduced using Transitional Recording	4 byte / saved sample *	2 byte / saved sample + 2 byte for the time information

* + any file header for trigger events (size is variable)

Cluster Size

With **FAT16** formatting of the **storage medium**, the cluster size depends on the size of the storage medium. It is clear that small clusters make better use of the memory space, since less space is wasted at the ends of files by partially empty clusters.

The **PC-Hard disk** (e.g. WIN98), by contrast, has **FAT32**-formatting, in which the cluster size is constant at **4k**.

Cluster Size (FAT16)	Maximum Logical Drive Size
2 k = 2048 byte = 4 sectors	128 MB
4 k = 4096 byte = 8 sectors	256 MB
8 k = 8192 byte = 16 sectors	512 MB

DOS configures the cluster size to be as small as possible when formatting a drive. For example, if you format a 500 MB partition, you get 8 K clusters, for a 170 MB medium 4 K clusters, for a 340 MB medium 8 K clusters.

Examples

Example 1

- An analog channel is recorded with multiple triggered events. Each event is to comprise 2000 samples. A total of 100 events are recorded.
- A "naive" calculation which assumes that the data can be arbitrarily compressed would yield the following results:

Analog channel: 2 byte / sample 100 events x 2000 samples x 2 byte = 100 x 2000 x 2 byte	400 000 byte
1st file header: 1 x 1536 byte*	+ 1 536 byte
Each additional file header: 99 x 512 byte*	+ 50 688 byte
1 cluster for the directory allocation info and 32 bytes there for file allocation info	+ 32 byte
Data size (cannot be stored this compactly!)	**= 452 256 byte***

* File header for trigger events (size is variable)

- In actual fact, the data can not be packed with any arbitrary degree of compression. Instead, the storage medium's cluster structure must be taken into account. Thus, the storage of each individual measurement (trigger release, event) starts at a new cluster.
- Thus in reality the following results would emerge in an example of a 340MB hard drive:

1st event: 1536 bytes (header) + 4000 bytes (samples) = 5536 bytes => 2 x 4 KB	8 KB
Next events: 512 bytes (header) + 4000 bytes (samples) = 4512 bytes => 2 x 4 KB => 99 x 8 KB	792 KB
Directory and file allocation info in FAT (1 cluster)	8 KB
True memory requirement	**= 808 KB***

* File header for trigger events (size is variable)

The results illustrate that the space requirements for this example's files are almost twice the actual data volume.

Example 2

If the measured data are not recorded as multiple triggered events, then a folder is created for each measurement (340MB hard drive). In total, 100 measurements each comprising 2000 samples are performed:

For each measurement: 1536 byte + 4000 byte = 5536 byte = 2 x 4 KB => 100 x 8 KB	800 KB
Directory and file allocation info in FAT (1 cluster) => 100 x 8KB	800 KB
True memory requirement	**= 1.600 KB**

Example 3

In this example, 3 analog channels are recorded with multiple triggered events. Each event contains 2000 samples. A total of 100 events are recorded. Two of the channels are saved directly to the internal storage medium and the other is filtered online (imc Online FAMOS) before being saved (only filtered results are saved). The data is to be stored to an unpartitioned 340MB hard drive (8KB cluster size):

2 analog channels à 2 byte + 1 virtual channel à 4 byte	
1st event:	
1536 byte* + 1 x 2000 x 2 byte = 5,5 KB => 8 KB	8 KB
1536 byte* + 1 x 2000 x 2 byte = 5,5 KB => 8 KB	8 KB
1536 byte* + 1 x 2000 x 4 byte = 9,5 KB => 16 KB	16 KB
Next events:	
512 byte* + 1 x 2000 x 2 byte = 4,5 KB => 8 KB => 99 x 8 KB	792 KB
512 byte* + 1 x 2000 x 2 byte = 4,5 KB => 8 KB => 99 x 8 KB	792 KB
512 byte* + 1 x 2000 x 4 byte = 8,5 KB => 16 KB => 99 x 16 KB	1584 KB
1 cluster for directory and 3 file allocation infos	8 KB
True memory requirement:	**= 3208 KB**

* File header for trigger events (size is variable)

9.3.9.2 Viewing Saved Measurement Data

imc STUDIO enables the **viewing of measured data during the running measurement** by means of the Panel 1058. As well, it is possible to view **measurements previously saved to the PC** (by means of the tool window Data Browser 1069) or to the device drive (by means of Command "Load/Import Variable 1620" via the Data Browser). You are also able to load and analyze files of measured data by means of imc FAMOS.

9.4 Device Hard Disk, removable drive

This chapter describes details of the internal data carriers of imc measurement devices and how to operate them with imc STUDIO.

For saving measured data, all devices support an internal storage medium. Depending on the device type, this storage medium could be a removable drive, e.g. ***PCMCIA-HD, PCMCIA-Flash-Card, CF-Card, ExpressCard*** or ***USB-storage*** medium. Card-Bus interface are not recommended. Some devices can be equipped with an ***hard drive*** (see "Device overview 165").

The internal storage medium is exclusively for data acquisition with imc STUDIO. Removable storage media can of course be purchased subsequently. **The hard drive** is not a removable drive, it is ordered along with the device and can only be retrofitted by imc.

Note

The functional capabilities of imc STUDIO depend on both the model and production date. A list of all device types and their distinctive properties is presented in a list in in the "*Device Overview* 165".

Swapping the Storage Medium

Pressing the LED-button 746 signalizes to the system that you intend to remove the storage medium. Once this is done, the device stops access to the storage medium. If you were to remove the drive without prior announcement, it could produce defective clusters. And if you were to remove the storage medium while a measurement is running, the waveforms would be incomplete! Therefore, always proceed as follows when swapping the storage medium:

1. Press the LED-button.
2. Once the button blinks, remove the storage medium.
3. Insert the new data carrier. Devices indicate by a short flash that the new drive has been successfully recognized.

Errors in accessing the Storage Medium

Errors can have the following causes, among others:

- The data rate is too high, the storage medium can't keep up and data overflow results.
- The storage medium is full.

The device signalizes any error by flashing this LED-button. Its further responses depend on whether or not the device is connected to the PC.

- If no PC is connected, for instance in cases involving automatic self-start capability, the **button lights continuously**. At the end of an experiment, always check for this if measurements are taken without PC aid.
- If the PC is connected to the measuring device, imc STUDIO documents the error with an **message in the Logbook** and switches the LED-button off. Any one-time data overflow only shows up in the Logbook, since the LED is reset afterwards. If data overflow occurs repeatedly, The LED is activated again, the PC records the message again, and as a result the LED **blinks intermittently**.

Hot-Plug (Exchanging the Storage Medium during a measurement)

It's possible to exchange the storage medium during a running measurement. This makes it possible to carry out a measurement without a PC practically without any limitations. It is only necessary to check the amount of memory available using imc Online FAMOS. To do this, use the function `DiskFreeSpace` belonging to the group "*System*". You can set an LED, for instance, or a digital output or a beeper to be activated when less than the minimum amount remains. One convenient solution would be to have a readout of the remaining space outputted by a display variable, which would indicate by a display on the device how the remaining memory decreases.

While swapping the storage medium during a running measurement, the data are stored in the measurement device's internal memory. If you complete the process within the specified RAM buffer duration, this is certain to work without any loss of data (see Chapter "RAM buffer time 718"). Note that not only the time for the swap must be buffered, but that the buffered data must also be transferred to the new disk once the swap has been completed.

Swapping the storage medium

1. **IMPORTANT!** Before removing the storage medium from the measurement device, first announce the procedure to the system by pushing the LED-button, in order to avoid data loss and damage to the storage medium. The LED button will **shine continuously** in green.
2. Once the device is ready for removal of the storage medium, the LED-button **blinks**.
3. Remove the already full storage medium.
4. No announcement is necessary for inserting a storage medium.

Note

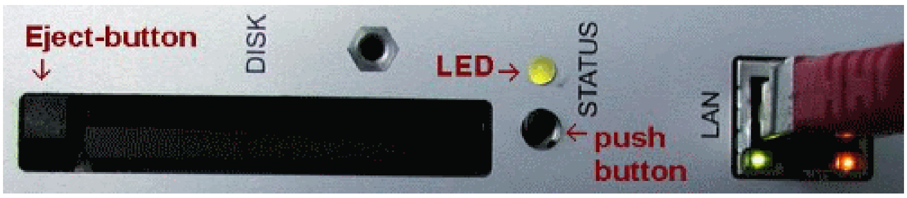
The Hot-Plug function is not possible with "*Compact Flashcards*" (CF) if the device is equipped with a PCMCIA slot, too! To exchange the CF-Card, the device must be deactivated! Otherwise the data carrier may be damaged!

9.4.1 LED-Button / Push Button

The LED-button at the storage medium slot serves multiple purposes.

PCMCIA-slot

With devices having a Compact Flash slot, ExpressCard or USB, the function is divided between a push-button and an LED.



Compact Flash slot

9.4.2 Memory Volumes

Storage media larger than 16 GB are possible (see "Device Overview 165"), but see the notes on the use of the storage media 754. When the formatting is FAT32, the maximum address space is 8.8 TB.

9.4.3 Storage Media

CF Cards (Compact Flash)

For devices of group 2 and 3 165:

- ***CF-CARD in the PCMCIA slot:*** The devices are in principle designed for CF-Cards in the PCMCIA-adapter. However, due to the large number of CF-card manufacturers, correct functioning cannot be assured for all of them. When in doubt, you can consult with the imc-Hotline.

- ***CF-CARD at the internal IDE port:*** If the PCMCIA-slot is already being used for a WLAN connection, a CF Flash Card can be connected at the internal IDE port using the ***CF-Adapter (SL 836)***.
  This option is subject to the following constraints:
  - With CF Cards in the CF-Adapter, no ***Hot-Plug*** 745 function is possible. It isn't sufficient to just stop the measurement! The device must be deactivated in order to exchange the CF Card!
  - The card appears in the software interface as an IDE hard drive

For devices of group 4-6 165**:**

The device group exclusively uses CF cards for storage medium.

USB Storage Medium

Concerning devices with USB (see "Device overview 165"). Memory sticks or external hard drives can be connected at this terminal.

Remarks:

- **Always set only one storage medium unit!** Devices belonging to **group 6** 165 have two USB terminals and a slot for the ExpressCard. However, the device can use only one data storage medium. The system determines which one it is upon activation, and there is no fixed order of precedence among the media. For this reason, delete any which you do not wish to use for the measurement before switching the device on.
- With USB, the ***Hot-Plug*** 745 functionality is available. Make sure that sufficient time is available for swapping the data carrier. How much time is required for de-registering and re-registering with the system depends on the particular data carrier and on the number of channels. As an orientation value, we recommend at least 30 s, even for simple configurations!

Warning — Do not use USB hard drives with external power supply

Please do **not use** any USB hard drive **which has an external power supply**. Such a drive may not be connected at the imc USB-port. Otherwise, when the measurement device is powered down, the imc USB-port's current limiting mechanism may be destroyed.

ExpressCard

Applicable to devices having ExpressCard slot (see "Device overview 165").

Remarks:

- **Remove any connected USB storage medium!** Devices belonging to **group 6** 165 have two USB terminals and a slot for the ExpressCard. However, the device can use only one data storage medium. The system determines which one it is upon activation, and there is no fixed order of precedence among the media. For this reason, delete any which you do not wish to use for the measurement before switching the device on.
- With ExpressCards, the ***Hot-Plug*** 745 functionality is available.

CFast

Concerning devices with CFast slot (seeDevice overview 165).

Remarks:

- **Remove a connected USB storage medium!** The device can use only one data storage medium. The system determines which one it is upon activation, and there is no fixed order of precedence among the media. For this reason, delete any which you do not wish to use for the measurement before switching the device on.
- With CFast cards, the ***Hotplug*** 745 functionality is available.

SSD

Applicable to devices having a hard drive (see "Device overview 165").

Remarks:

- **SSD hard drives** can be used in **CRONOScompact-400, -400GP, -2000G** and in **CRONOSflex-400, -400GP, -2000G** and **-2000GP** and **CRONOS-XT-2000**.
- With **SSD hard drives**, ***Hot-Plug*** 745 is **not possible**! If the SSD is used in a **frame for removable data carrier**, it can be exchanged while the **device is deactivated**.
- SSD hard drives appear in the device software as a hard drive and an be read out via the Explorer-shell 749. SSD hard drives can only be formatted in the device 753.
- Due to the formatting, the content of the SSD in the PC is **not displayed** when the SSD is connected directly in the PC.
- **In addition to** the SSD, a CF/CFAST-card can be inserted in the measurement device and used **alternatively**.

9.4.4 Data Transfer

a) Retrieving data with the PC connected

Normal procedure. This is the fastest method for small data volumes.

- Using the Explorer, copy the data from the internal storage medium.
- Erase the storage medium.

b) Retrieving data via modem

Remote data retrieval. Can take a long time if the data volume is correspondingly large.

- Like a) only connected via modem

c) Retrieving data from the storage medium of a disconnected device (measuring under Autostart)

(see Hot-Plug 745) E.g. in long-term remote operation. Copy data using another imc measurement device a) or in the PC d).

d) Copying storage medium via the card reader of a PC

Suitable for large data volumes due to the high-speed transfer.

1. Insert storage medium into the PC-slot.
2. Use Microsoft Explorer to copy the storage medium's data.
3. Erase the storage medium.
4. Insert storage medium back into the imc device.

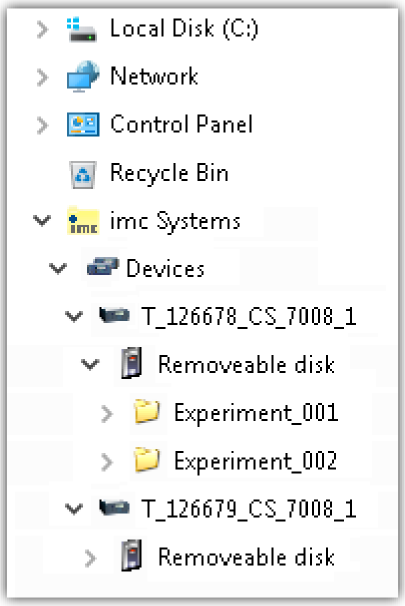
Warning

Do not use force to insert or remove the device storage medium.

Note

A tip on **interval saving**: Supposing the system's power supply suffers an outage during a measurement, it would not be possible to guarantee that the data file on the storage medium is terminated properly. This may lead to a failure to record the last measurement taken. Saving at intervals is a way to reduce this risk (see chapter Saving Interval 721).

9.4.4.1 imc Systems - Shell Extension



While installing the operating software, if the option "*Extension for Windows-Explorer* 27" is activated, you are able to copy, display or delete the files of measured data saved within the device (e.g. on the removable storage medium). The method of doing this is the familiar one under Windows.

This function is independent of the device software. As well, selection of the devices in the tree diagram is independent of the device list in the operating software.

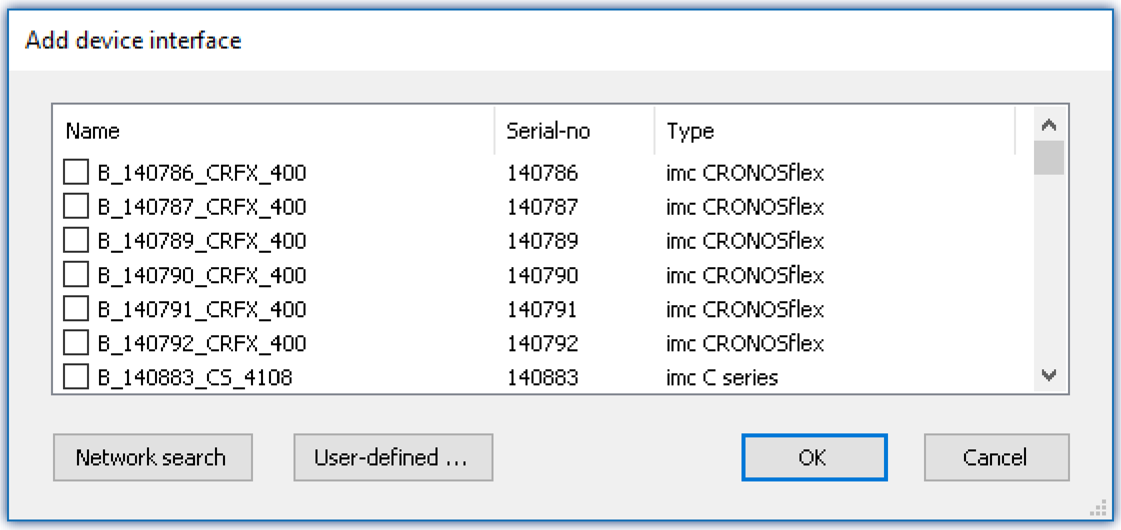
In order to get access to your device's storage medium, you must first add it to the tree diagram (see "*Adding a Device* 750"). Subsequently, you are able to navigate to the desired data in the storage medium and thus to work with them.

Adding a Device (New...)

Even if you have already been connected with the device by means of the imc STUDIO software, it is still not listed in the Explorer. It's possible to measure with one device while copying data from another.

- Click on "*Devices*" under "*imc Systems*" to highlight that entry.
- Open the context menu over the "*Devices*"-area and select "*Add*".

The "*Add device interface*" dialog appears:



Add Device interface

Search for devices	Description
Network search	"*Network search*" causes the system to search the network for any suitable devices. How long this will take depends on how many devices are connected and on the network type. Ultimately, the devices found are listed. Select your measurement device and confirm your selection with "*OK*". The measurement device is then available.
User-defined	In a structured network (network with routers, Internet, ...), imc devices could not be integrated by means of a network search. With the knowledge of the IP-address or of the domain name (DNS name), it is now possible to integrate a device into the list.

Reference

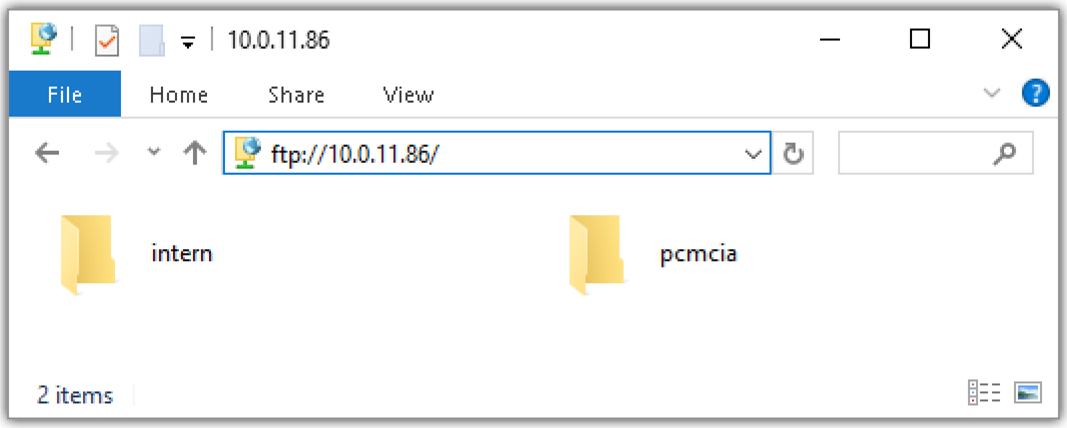
More information is presented in the chapter: "*Setting Up - Connect the device*"

- General: "*TCP/IP, PPP via a router* 60"
- "*Using imc REMOTE SecureAccess* 61"

9.4.4.2 FTP Access

It is also possible to access the device's internal data via FTP, as well as to transfer data. Other goals are to change the configuration of devices via FTP and to restart the device for measurement with the altered configuration. Application areas include test drives, where there is no way to connect the devices directly with the device software. The Diskstart/Autostart capabilities are applied and enhanced. For this purpose, the device is usually configured for autostart. Upon activation, the configuration is loaded and the measurement, as well as data transmission, starts automatically.

Start the explorer and enter "*ftp://*" and the IP-address of the device:



Note

- In general it is a read only operation. If you intend to delete files via FTP, you have to add "*imc@*" between "*ftp://*" and the IP-address:

  Example: ftp://imc@10.0.10.219

- Furthermore, a password can be assigned to protect access via FTP. This password is entered into the Device Properties 195.

Warning

The following limitations apply when accessing the storage media in a device via an FTP-client:

- The device can't delete folders, accessed by a FTP-client.
- It is not possible to replace the storage medium during measurement (Hot-Plug).

9.4.5 Partition and File System

Fundamentals of FAT16/FAT32

Before using a data storage medium, it should be formatted and maybe also partitioned. The file systems FAT16 (maximum 2 GB) and FAT32 are available for selection.

- The devices support both FAT16 and FAT32.

Note

Regular formatting is recommended

Take every opportunity to format the storage medium. In this way, any damaged media are recognized in time and repaired if necessary. **A damaged file system may cause data loss or to failure of the measurement system to start up correctly.**

To avoid data loss, begin by saving all necessary data!

Using a storage medium in different kinds of device

There are no known limitations. However, **formatting is always recommended** when changing, as a precaution against data loss.

Additional notes

- To select the appropriate file system for the respective application, observe the notes on the data rate 754 and on "avoiding data overflow 754".
- No limitations regarding the currently available data carrier volumes are known.
- The maximum filesize is 2 GB. In case a signal would exceed that limit, use interval saving 721.

Reference General limitations of the file systems

Please be aware of the general restrictions pertaining to the respective file system. Information on this topic is presented, among other places, at the Help and Supportarea on the Microsoft homepage.

9.4.5.1 Formatting

The formatting can be performed directly in the PC's hard drive by the Windows operating system, or in the device using the Explorer shell.

Note Recommendation

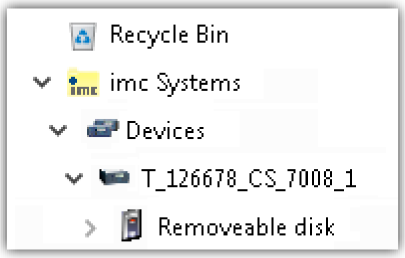
imc recommends formatting in the device.

In comparison to formatting by Windows, this provides higher data writing rates for high-speed channels.

Warning Please back up the data first

Formatting causes all data on the data carrier to be deleted. Before performing the formatting, ensure that all data have been saved on a different storage medium.

Formatting in the device (Recommended)



For **formatting in the device**, navigate via the Explorer shell "imc Systems" 749 to the desired device.

There, open the properties of the drive: context menu > "*Properties*" (not via the Navigation pane in the Explorer).

Go to the Property dialog under the tab: "*Tools*".

Start the formatting by clicking on "Format now!".

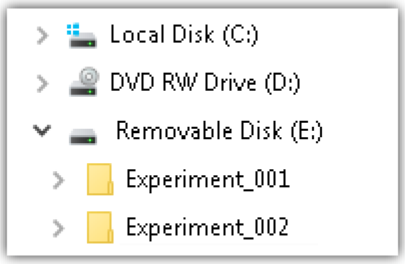
The device performs the formatting according to the following rule:

Drive Size	Cluster Size	File System
<= 128 MB	2 kB	FAT16
<= 256 MB	4 kB	FAT16
<= 4 GB	8 kB	FAT32
> 4 GB	16 kB	FAT32

Note

Formatting the internal data storage is not allowed if an experiment whose data are to be saved internally has just been prepared.

Formatting using the Windows-Explorer



To perform **formatting of a removable data carrier via the Windows-Explorer** 750, navigate to the desired removable data carrier. Run the formatting by means of the context menu, for example.

Select one of the following two file systems: "FAT32" or "FAT" ("FAT16").

The file system "FAT32" is designed for media **larger** than 32 MB. Under no circumstances can smaller media can be formatted to "FAT32". With "FAT32", Windows generates 4 kByte clusters when the drive size is up to 8 GB, which is inconvenient for high-speed writing rates.

SSD hard drives are inherently formatted with Ext2 and for that reason **can not be formatted directly in the PC** , but only in the device 753.

However the Ext2 format offers these advantages:

- Mistaken duplicate occupation of individual clusters is not possible.
- Integration into the operating system is accomplished much more quickly than with FAT32.
- Higher writing output than with FAT32.

9.4.5.2 Possible Problems

Due to the limitations discussed previously, the following problems can occur:

- It is possible that the increasing number of folders 756 slows down the saving process in a way that a loss of data can't be avoided.
- With a storage medium formatted by Windows to FAT32, data overflow can occur if a high aggregate sampling rate is generated by a few high-speed channels.
- With a storage medium formatted in the device, data overflow can occur if a high aggregate sampling rate is generated by very many low-speed channels.

Other limitations are presented here 756.

9.4.6 Notes on the use of the Storage Media

9.4.6.1 Data Overflow

In case of data overflow on the internal data medium, the position and amount of lost samples is recorded in the "SysLog-file 732".

9.4.6.2 Avoidance of Data Overflow

Very many factors can contribute to a data overflow.

The accumulating data volume can **not** be exactly calculated for the following settings:

- Triggers, especially ones with long pre-trigger times
- imc Online FAMOS functions
- CAN protocol channels

There is a concrete correlation to the following factors:

1. Data Rate, Channel Count and Formatting 755
2. Occupied Memory, Measurement Duration and Folder Count 756
3. Manufacturer and Age of the Storage Medium 756
4. RAM buffer duration of the channels 718

Note

- In order to avoid data loss, it is urgently recommended to **test** whether the anticipated accumulating data volume within a specified time frame can reliably be saved on the desired storage medium!
- During a running measurement having a high sampling rate, you should **never** try to **access the storage medium in the device** using the Windows Explorer shell. Otherwise, this additional burden could cause a data overflow.

Data Rate, Channel Count and Formatting

Every storage medium has a maximum data rate at which data can be continuously written to the medium. The manufacturers commonly state maximum values which cannot be achieved in practise.

Every storage medium has a maximum data rate at which data are continuously written to the medium. The maximum data rate is normally stated in kByte/s. Note that the size of a measured value (sample) can vary from 2 Bytes (e.g. signal conditioner channels) to 4 Bytes (e.g. virtual channels) all the way to 10 Bytes (e.g. Float values with time stamp). With an aggregate sampling rate of 400 kSample/s (only signal conditioner channels), this results in a data rate of 800kByte/s for the storage medium! Older flashcard memory models are not able to go that high; flashcards "age" over the duration of their use.

The size and number of assignment units (clusters) and thus also the file system 753 used have a substantial effect on the storage medium's speed! Small clusters can dramatically reduce the speed! If high data rates are required, it is normally recommended to have a size of 8kB/cluster.

The optimum size of the clusters must be determined for each storage medium separately. For all of them, the following applies:

- **Few channels having a high data rate**

  If a few channels having a high data rate are being recorded, then large clusters on the data carrier provide better advantage. Formatting with FAT32 on the PC and drive sizes < 8 GB creates disadvantageously small clusters, which in conjunction with the full aggregate sampling rate can lead to a data overflow.

  Whenever using cards of up to 8 GB, always use the formatting by the device.
  In the device, cards from 256 MB on are formatted with 8-kByte clusters and from 4 GB on with 16-kByte clusters. Cards of up to 1GB can alternatively be formatted by the PC with FAT16. With cards of 16 GB onward, there is no difference whether the formatting is done in the PC or in the device.

- **Very many channels with a low data rate**

  If hundreds of channels having a low data rate (e.g. CAN channels) are saved, the exact opposite is rue. Here, small clusters are an advantage. This means that drives with up to 8 GB should in such cases be formatted in the PC with FAT32.

Occupied Memory, Measurement Duration and Folder Count

The larger the data volume and the more folders on the storage medium, the longer it takes to find free clusters. In order to ensure high data rates, it is recommended that the storage medium be deleted from the measurement or be re-formatted. This also applies to large card volumes such as 16 or 32 GByte.

Make an estimate of the prospective number of folders. Particularly in the modes "Interval data saving 721" and "Trigger events in separate folders 731", a great many folders can be created in a short time.

Note

Creating more than 1000 folders is to be avoided, since this significantly slows down the file system.

Manufacturer and Age of the Storage Medium

In recent years, manufacturers have succeeded in raising the maximum data rate per second. Be certain to check your card before using it. The cards offered by imc are tested for their data rate and functionality.

Note

- imc has no way to affect the quality of the removable storage media provided by the various manufacturers.
- Storage media which come with newly purchased devices have been inspected in the framework of quality assurance and have passed the relevant tests.
- We expressly declare that the use of removable storage media is at the user's own risk.
- imc and its resellers are only liable within the framework of the guarantee and only to the extent of providing a substitute.
- imc expressly declines any liability for any damages resulting from loss of data.

9.4.6.3 Known Issues and Limitations

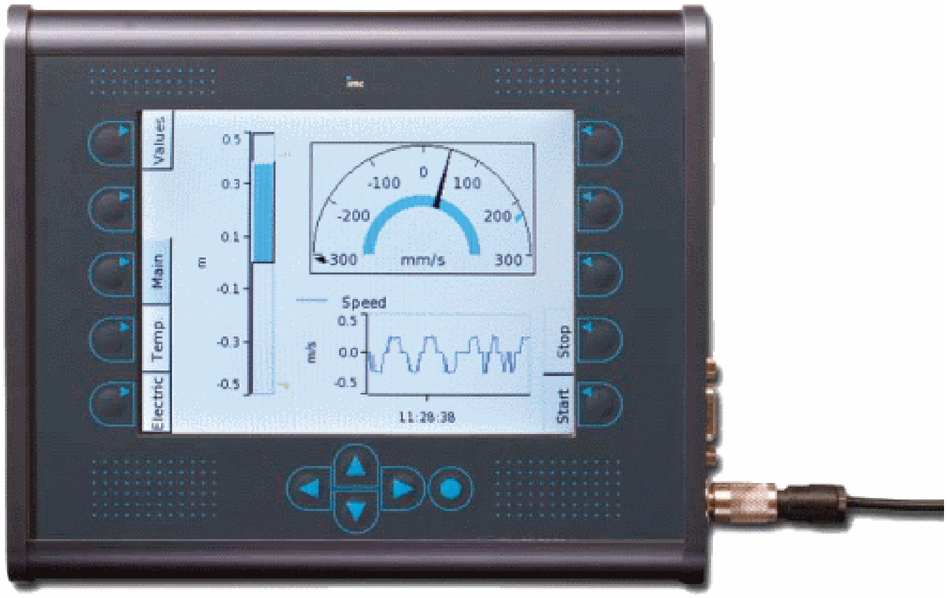
- Even when the above instructions are followed, in certain circumstances and with storage media above 2 GByte can lead to **data overflows**. This particularly affects devices belonging to groups 2 and 3 165. For this reason, to be safe always use the current software versions. These are available for you in the download area of the website www.imc-tm.com.
- If the memory card can not be read under Windows:

  The memory cards must first be partitioned (formatted) under Windows. Windows automatically generates the correct partitioning information. Subsequently, the memory card should be formatted again in the device.

When in doubt, please contact the imc Hotline 10.

9.5 imc Display Editor

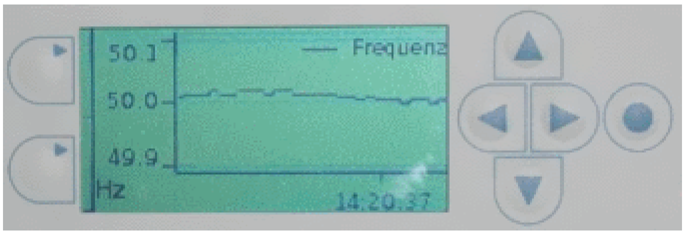
This chapter describes the operation of imc displays (external and integrated graphical display).



External display 320 x 240 pixel

The display offers, besides textual readouts, the display of such graphical objects as curve plots, bar charts, virtual gauges and digital status readouts. The resolution of display is 320 x 240 pixels.

Graphic Displays built into the device are monochrome with 160 x 80 pixels:



Integrated display 160 x 80 pixel

9.5.1 Overview

The optional display screen enables interaction between the user and a running measurement process by posting read-outs of system states and allowing parameter adjustments via the membrane touch panel.

If the measurement device is prepared in such a way that it loads a certain configuration upon being activated, it's possible to run a measurement without any PC. The Display serves as a comfortable status indicator device and can replace or complement imc STUDIO when it comes to controlling the measurement. It can even be used where no PC can go, e.g. at temperatures of -20°C or +70°C.

The Display can be connected or disconnected at any time without affecting a running measurement. This makes it possible, for example, to check the status of multiple devices running simultaneously one at a time.

Interaction with the measurement device is provided by means of Display variables or bits, which can either be evaluated to obtain status indications or modified in order to influence the measurement process.

Reference

The technical data you will find in the device manual.

Note

- Devices which only support the alphanumeric Display can use the graphical Display in the compatibility mode 758
- Control of a Display is exerted via a serial connection. For external display, a normal zero-modem cable can be used.
- It is not possible to adjust the **refresh rate**, which rather depends on the measurement device's performance demands. At top performance, the data are updated 15 times per second.
- The measurement device is not able to independently recognize the Display type. Instead, it must be specified beforehand in the software. Once the Display type has been changed, the device must be rebooted. (See: Ribbon "*Devices-Configuration*" > "*Device Properties* 194")

9.5.2 Compatibility Mode

Devices which do not support the graphical Display can use the Display as an alphanumeric Display.

In the Display's System menu 760, select "*Text mode*" under "*Display Mode*". Then the graphical Display can be configured and used as an alphanumeric Display.

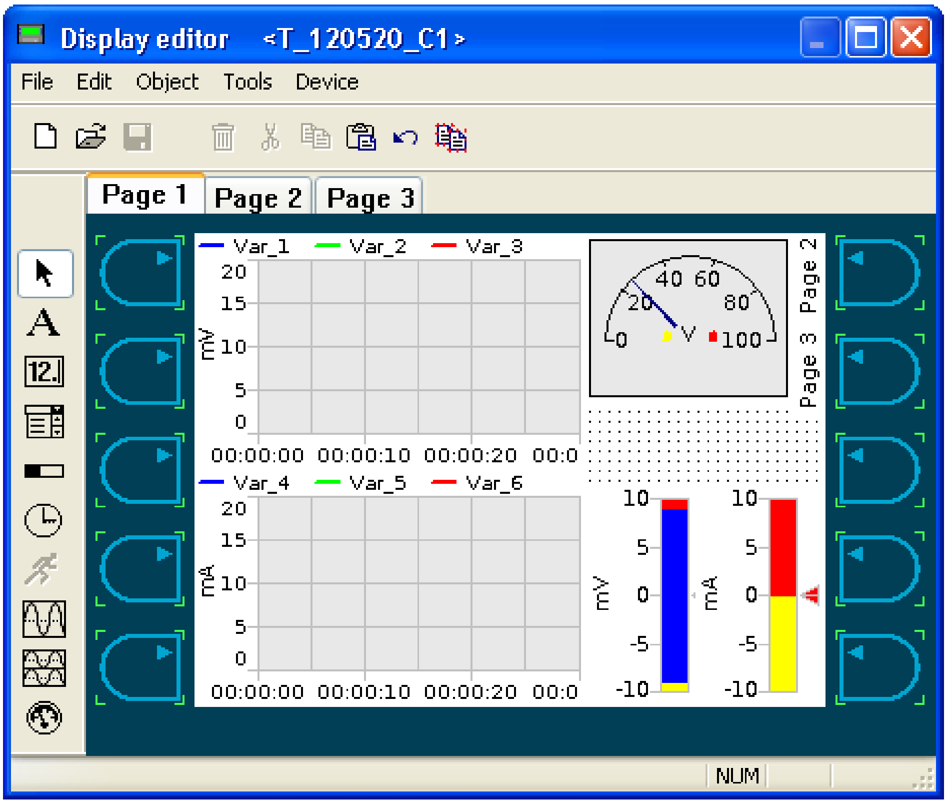
When the Display is run in this mode, it is in the so-called compatibility mode with the alphanumeric Display. In that case, the Display can be run with every measurement device for which the Display Type 1 (40 characters x 16 rows) is entered in the device configuration.

For details, see System Menu 760.

9.5.3 Display Editor in imc STUDIO

The display is organized in multiple pages. One or more controls can be positioned on each page. The available elements for interfacing with the measurement process are the Display variables, virtual bits and ether bits.

Along with the display controls, it is also possible to configure function buttons. Every key-combination command is associated with a particular page, so that one and the same key can call different functions depending on what page is currently open.



Under Edit, more Pages can be created. Each page works like a separate Display. Page selection is made using the Display's Function Keys 770 or by remote control by means of the imc Online FAMOS function `DisplaySetPage` 923.

9.5.3.1 Menu

Menu	Description
File	Import/Export: The Display's configuration can be imported and exported via the Display Editor. The configuration file is an XML document. By this means, one experiment's Display configuration can be copied for a different experiment. The item ***Save to configuration*** saves the Display's current settings with the experiment. Saving also takes place when the Editor is exited.
Edit	Along with the usual editing functions such as *Copy/ Delete/ Cut* and *Undo*, there are also functions for arranging objects in case they overlap each other. Here you will also find the important function *Add page* and *Delete page* for creating new pages in an experiment. To copy an object within a page, click on it while holding down the *Ctrl* key and drag the object to another location; a copy will automatically be created there.
Object	The object menu contains the same items which are offered in the toolbar.
Extras	The item "*Firmware update* 775" enables you to update a display to the same version as the measurement device. Normally, the *Firmware update* affects all of a device's components. However, it's not always likely for an external Display to be connected to the device during the update. This item can handle this issue retroactively.
Device	Selection of the device whose Display is to be configured.

9.5.4 System Menu

If the Enter button is held down for about 3 seconds, the System menu appears. It contains the following items:

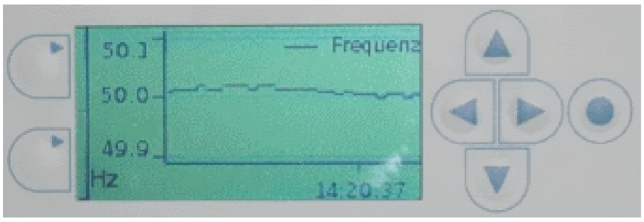
Item	Description
start display demo	Starts a **Display Demo**. • The demo encompasses multiple pages and displays generated measurement data. • The demo automatically scrolls through the pages. • The demo can also be turned off via the System menu.
backlight	Sets the **background lighting**
display mode	Choice of Mode as **graphical display** or **alphanumeric display**
page timer	Sets the time interval for the **automatic page scrolling**
exit	Exits the System menu

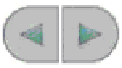
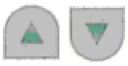
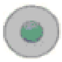
9.5.5 Keyboard

External (Handheld) display

Button	Beschreibung
Enter key	(solid circle) • Starts Input mode (sets the focus to an input element) • Ends Input mode (Enter)
Arrow keys	• Up/ down to navigate through different elements (focus), or to scroll within a selection/ menu • Right/ left to scroll through pages
Function keys	• freely configurable

Integrated display

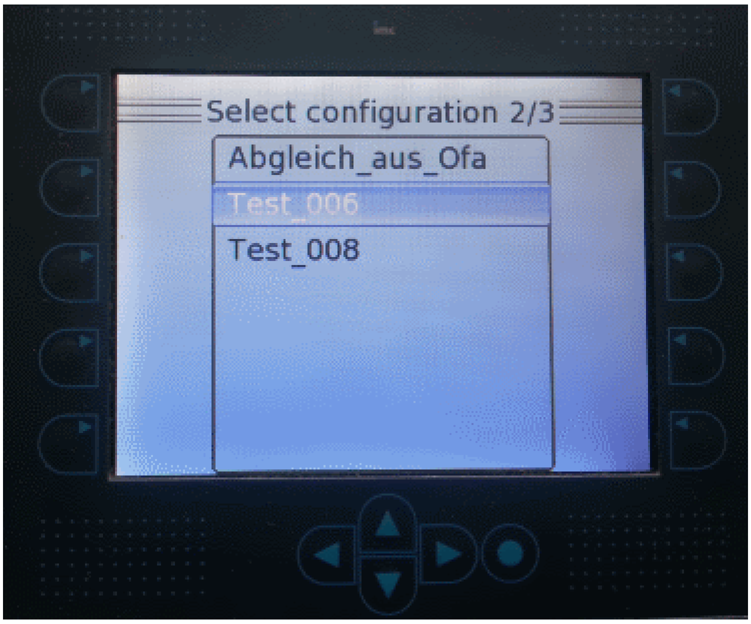


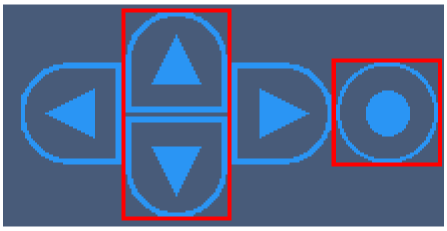
Button	Description
	Using the vertical arrow buttons on the right side, it's possible to scroll through the various pages of the display. All pages can be reached in this way.
	For quicker navigation, the upper of the buttons just left of the display screen can be used to avoid scrolling through every single page; instead, display skips to the overview windows
	The horizontal arrow buttons on the right side serve as cursors and for scrolling through a list box if a line in the box is selected/highlighted.
	The round button is equivalent an ENTER key. This allows you to make the selection. A prolonged push of this button during measurement opens the selection menu, which also offers the choice of stopping measurement. A picture is provided with the description of the Diskstarts 762.
	Using the lower of the buttons at the left of the display screen, it's possible to jump directly back to page 1. If page 1 is already currently selected, this button can be used to stop the running measurement.

9.5.6 Diskstart

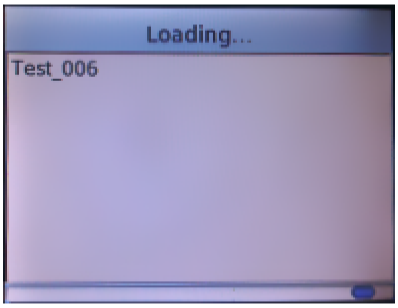
If the device memory contains ***Diskstart configurations***, they can be selected in the display. If a Diskstart configuration was saved as an ***Autostart*** configuration, the selection procedure is skipped and the experiment starts immediately.

Once the device is activated, the experiment appear in a list.





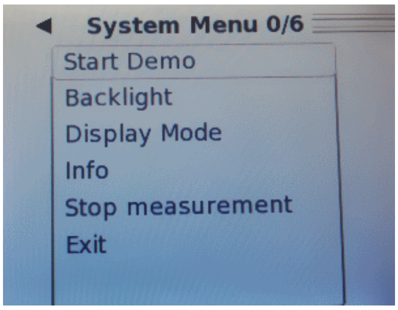
Using the UP/Down arrow keys, you can select the desired entry. Open the experiment using the round button.



Loading the experiment...

During running measurement, the round "*Enter*"-button takes you to the Display-menu.

There, you can conclude the measurement and start a different configuration.



9.5.7 Graphical Display Elements

For every display element there is a configuration dialog for making its settings. For the display of texts and numbers, the fonts indicated at right are available for selection.

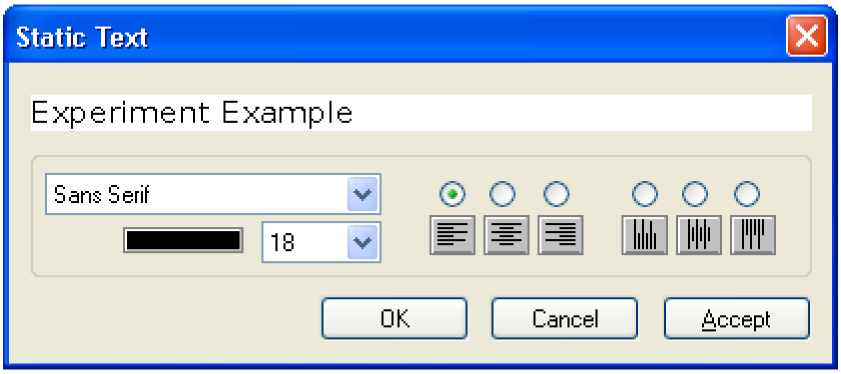
The types presented below are common to all dialogs.

Serif
Serif Bold
Sans Serif
Sans Serif Oblique
Sans Serif Bold
Sans Serif Bold Oblique
Sans Serif Mono
Sans Serif Mono Oblique
Sans Serif Mono Bold
Sans Serif Mono Bold Oblique

9.5.7.1 Static Text

This element generates a static text on the Display which cannot be edited form the standard interface.

It should be used mainly for adding comments to active dialog elements.



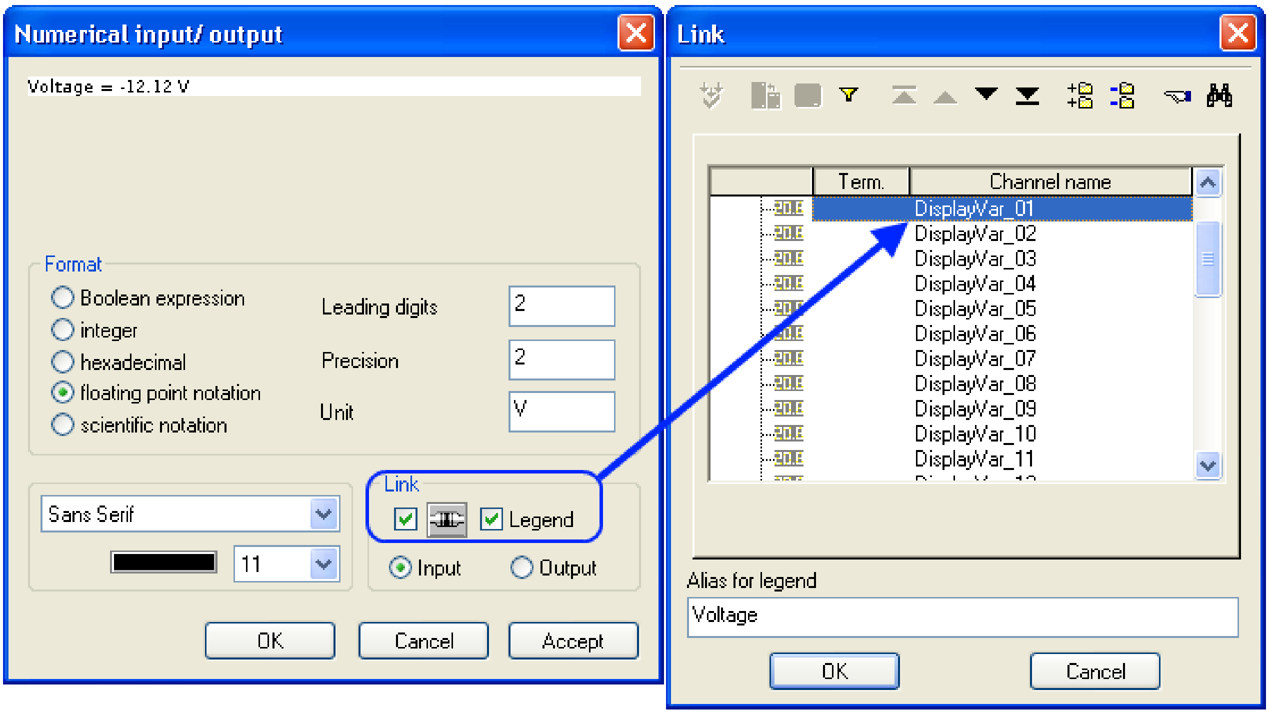
- horizontal text
- 90°-rotated text
- 3 different fonts (Serif, Sans-Serif, Sans-Serif-Mono)
- normal, cursive, bold, bold-cursive

9.5.7.2 Time

Display of the time with the selected font.

9.5.7.3 In-/Output (Numerical)

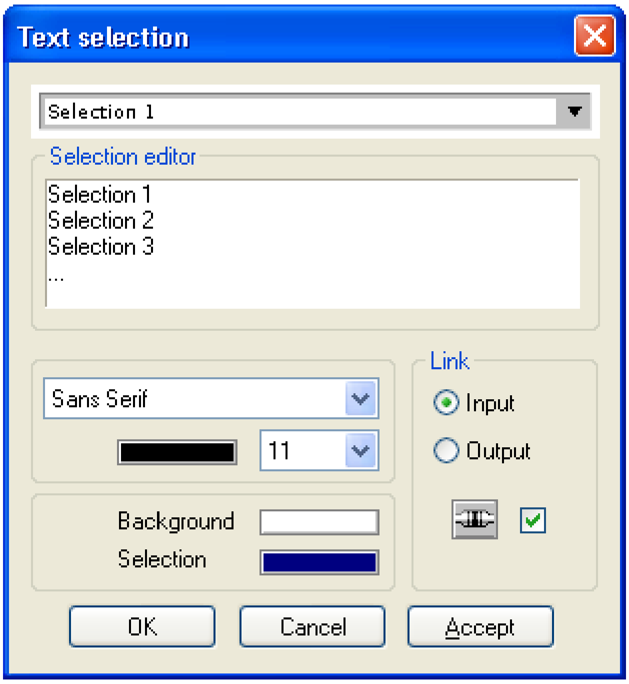
This object, which is linked to a variable, comes with a box for display of a unit to go with the numerical value is displays. The legend states the displayed quantity's name.



If the box is not only used for display of numerical values, but also for making inputs, the option *Input* must be activated. In the Display, the values can then be entered by means of cursor keys.

9.5.7.4 Combobox (Text Selection)

A combobox enables you to make a "1 from n" selection, where n is the total number of entries. The entry selected depends on the value of the linked Display variable.

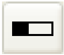


Enter one line of text for each expected state of the linked variables.

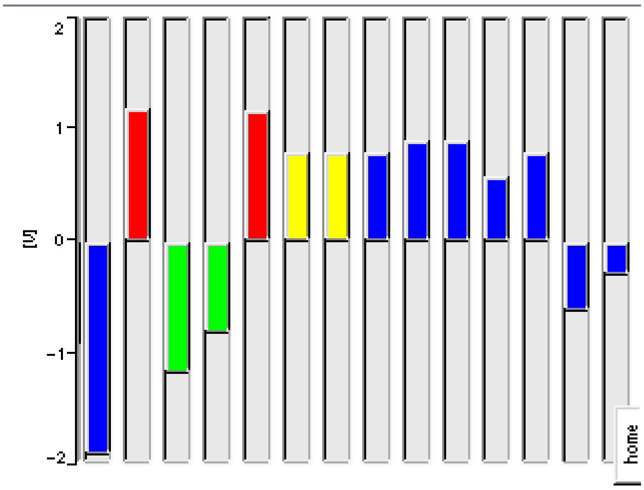
Note that the system work with indices: if the variable has the value "0", this corresponds to the first line. The value "1" corresponds to the second line, "2" corresponds to the third line, etc..

In the box Link, define the channel connection and designate the configuration either as an input or an output.

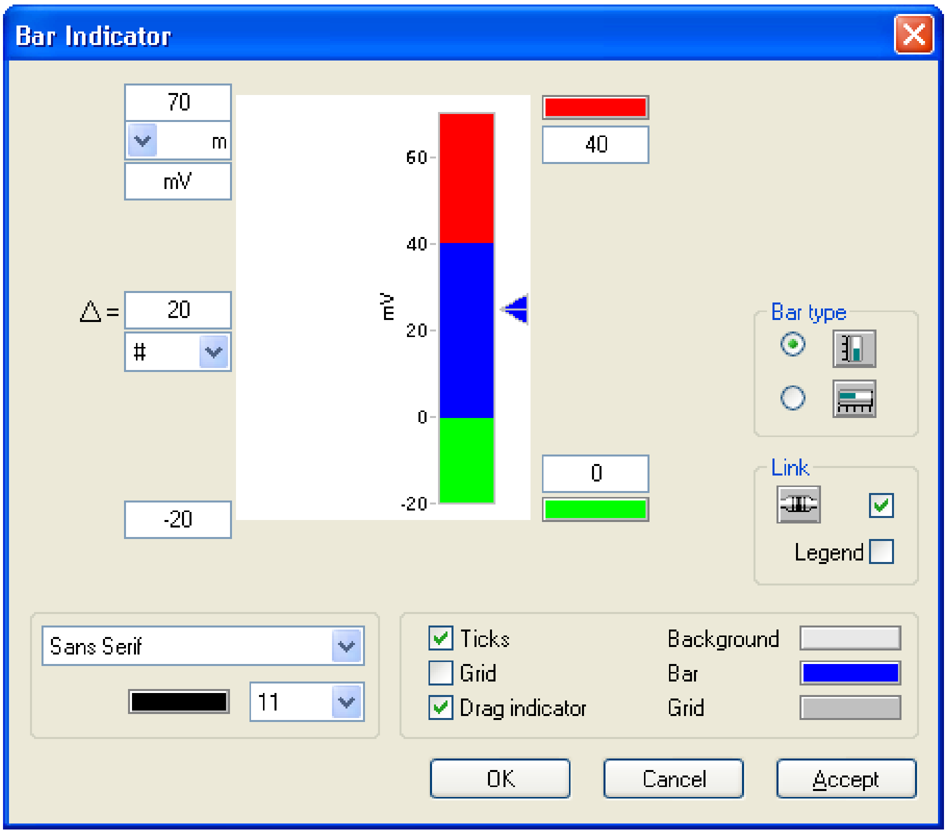
9.5.7.5 Bar Meter



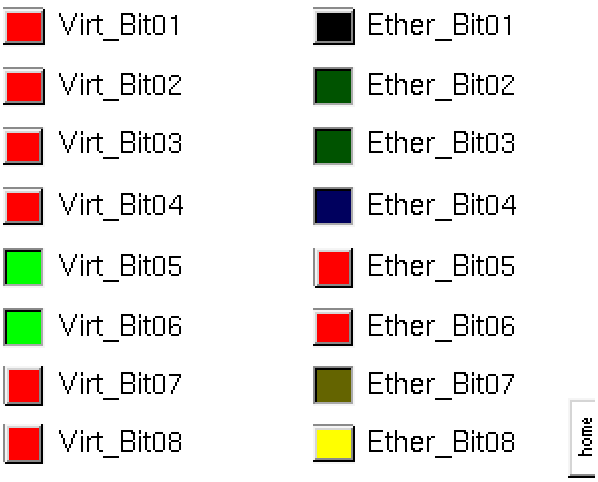
The bar meter is an output element which lets you graphically display a value which varies within a certain range (like a level indicator). The bar can run horizontally or vertically.



Specify the minimum and maximum value of the associated channel. Within this range, the variable's value will be indicated. Depending on the variable's momentary value, the bar will turn colors; the particular colors and associated value limits can be freely selected. The slave pointer's initial point and its precision can also be set.

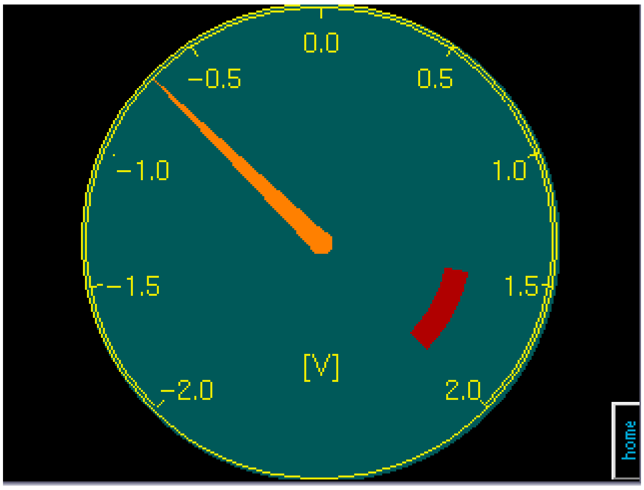


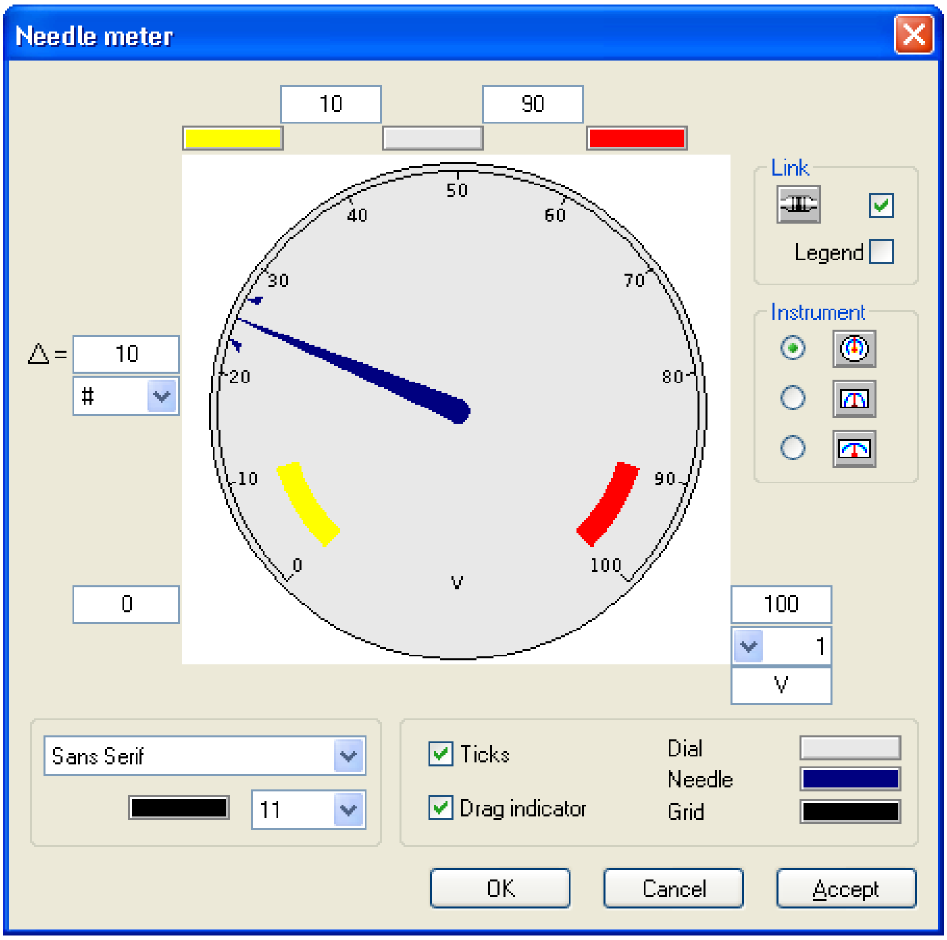
The bar meter can also be used to display digital states. In this case, there is simply no slave pointer or numerical values.



9.5.7.6 Needle Meter


Needle meters are set in a similar manner to the bar meters. They additionally feature a scale; the available options are 270°, 180° and 120°-display. The color shading along the scale can be set as desired.

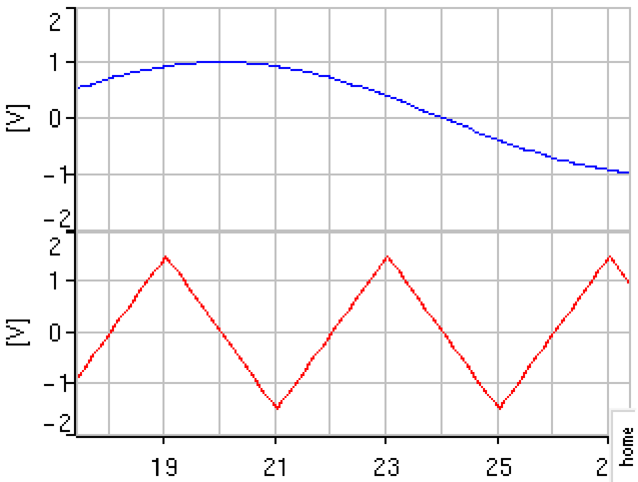




9.5.7.7 Curve Window/Line Chart

The curve window can display the signal curves of up to eight channels. E.g., the signal course of a channel can be displayed in the curve window with the help of a Display variable.

In contrast to the curve window in imc STUDIO, here only the channel's signal value is transferred to the Display. Other information such as the name and unit must be entered in the Editor.

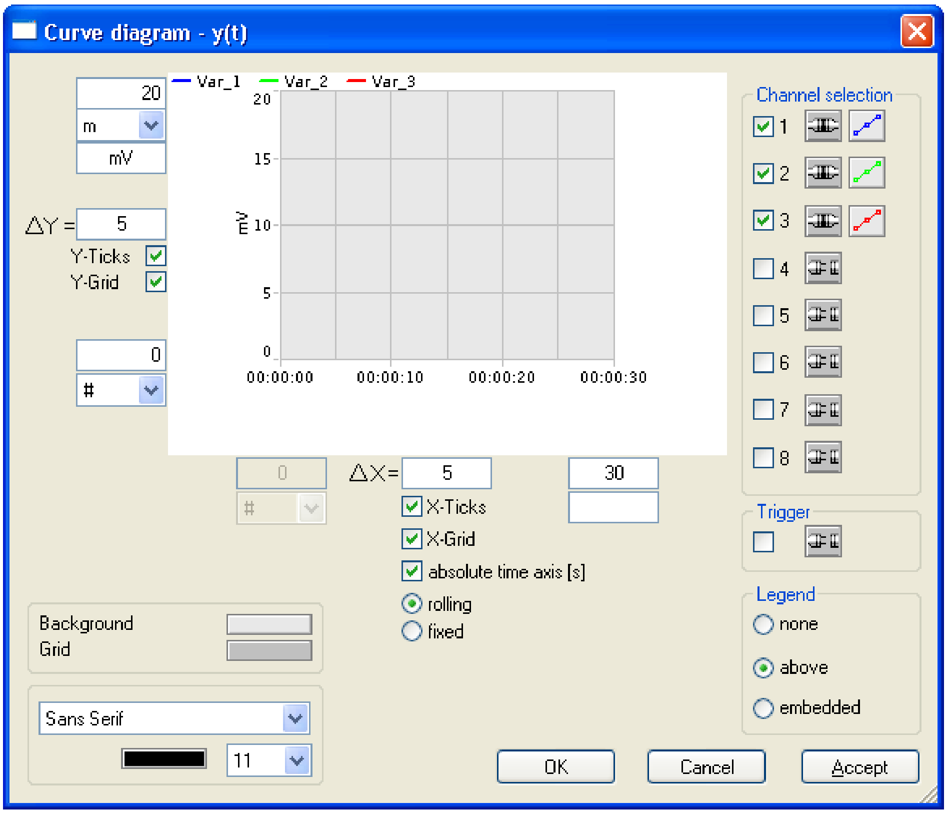


Each channel has a link to a Display variable, which can be activated or deactivated as desired. The dialog for making links has a control Legend, in which, for instance, the channel's name can be entered.

The scaling for the Y-axis is set in the editor, as well as the unit and the number of ticks.

The time axis can refer to either absolute or relative time and be set to either remain stationary or to scroll. Below the X-axis, a permanent text can be added if desired.

Both horizontal and vertical grid lines, either together or separately, can also be displayed.



Note

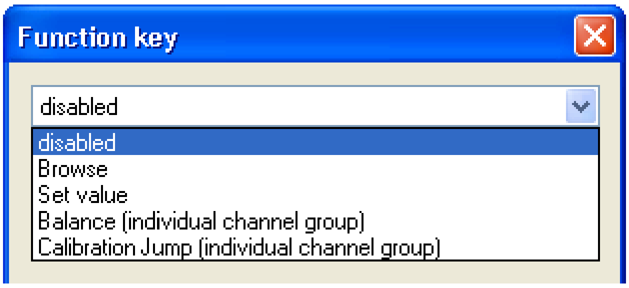
- The curve window in the display is reproduced on the PC. However, no information on the measurement process is available to the display besides the data stream which is transferred by means of display variables. This means that the display knows nothing about the unit, data structure or trigger machine.
- As soon as a trigger stops data acquisition on a channel, imc Online FAMOS stops writing to the associated display variable. If the measurement continues, because other channels haven't stopped, the display simply continues to scroll on with the last value measured.

9.5.8 Function Keys on the Display

There are keys on the display's left and right edges which can be configured as desired.

The keys are disabled per default. With the listbox you determine, whether the key:

- scrolls to a certain page
- sets the value of a variable
- or performs balancing and shunt calibration for dedicated channels.

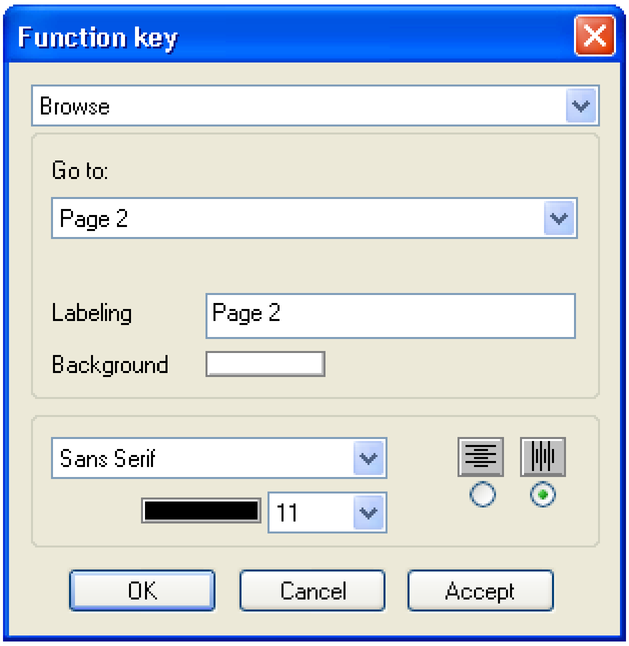


Note

Using the imc Online FAMOS function DisplaySetButton 923, the following functions can be executed by imc Online FAMOS as well.

9.5.8.1 Browse

If you have created several pages (Menu Edit 759), you can call those pages via function keys in mode *Browse*.

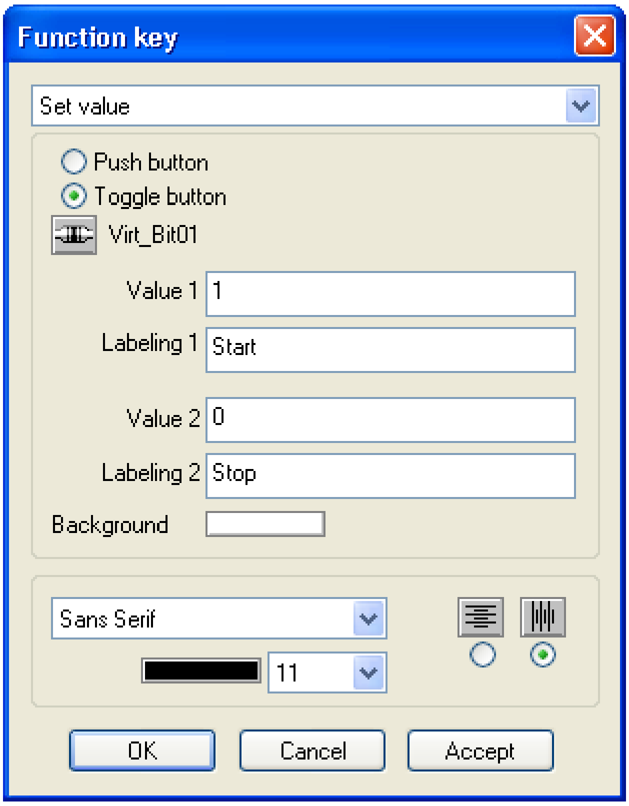


9.5.8.2 Set Values

In mode *Set value*, a function key can be linked to a virtual bit or a display variable.

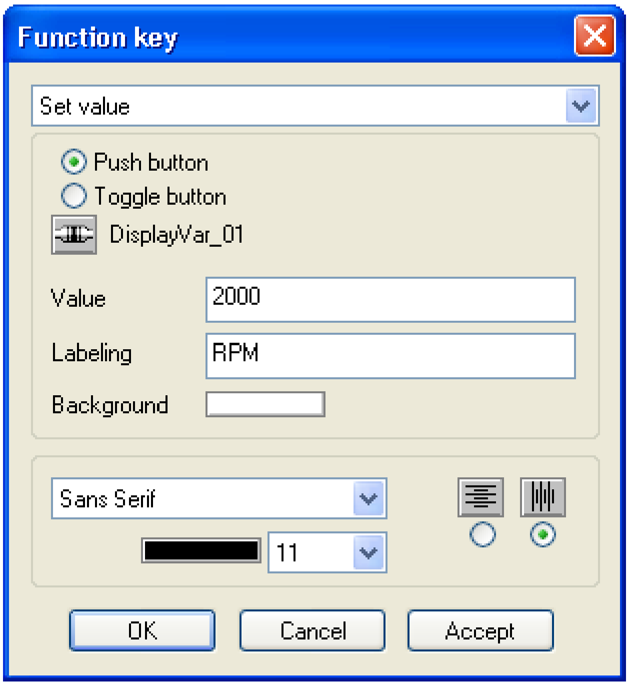
Toggle button:

Using the key as toggle button, e.g. a single key can start and stop a measurement.



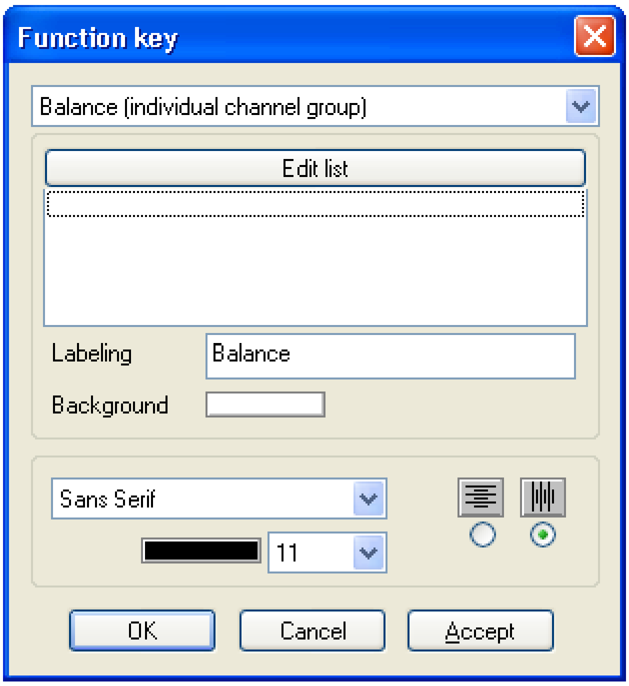
Push button:

A key linked to a display variable, a certain value could be assigned to the variable that could control a process in imc Online FAMOS.

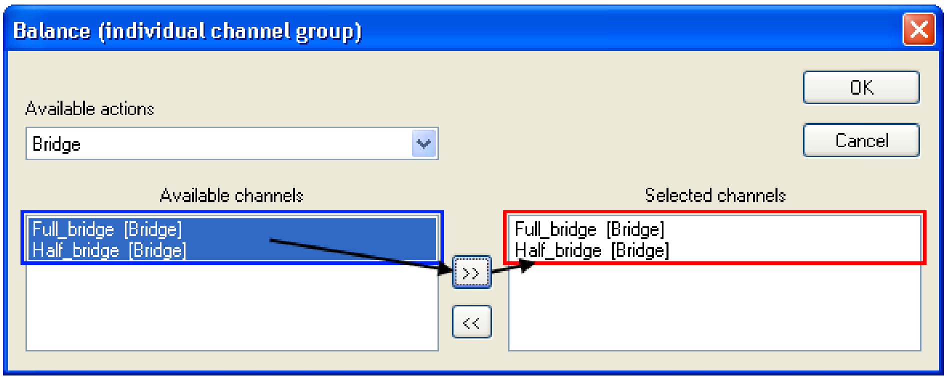


9.5.8.3 Balance (Individual Channel Group)

The Display can be used to perform balancing of either all or selected channels. Each button can have a selection of channels assigned to it. It is also possible to make a distinction between a true bridge balancing and taring.



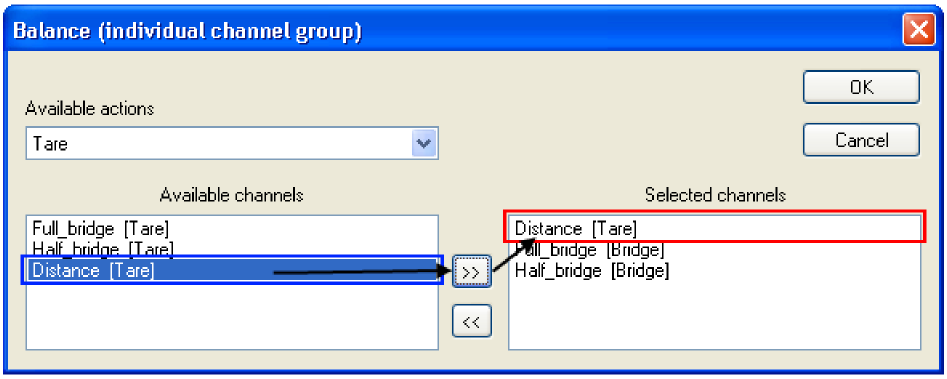
Clicking on the button "*Edit list*" opens a channel selection dialog.



Balancing can also be carried out channel-by-channel. This selection dialog sets which channels are balanced when the Display function key is pressed.

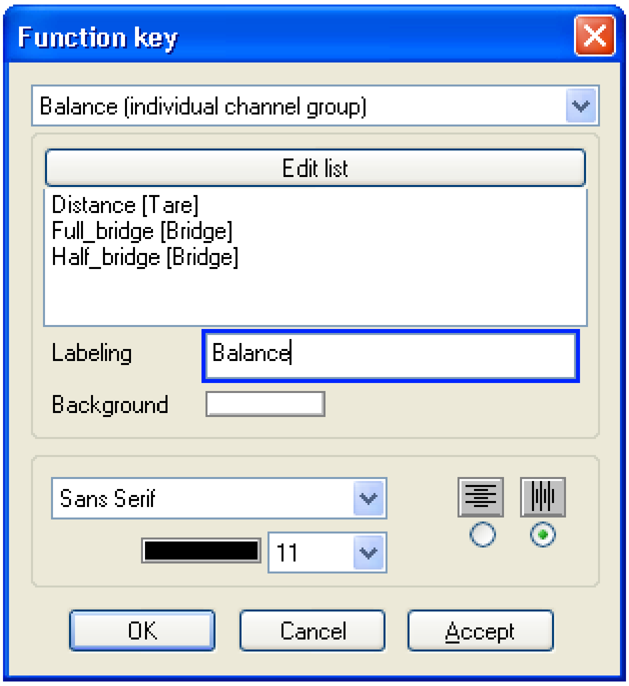
Under *Available actions*, you have the choice between *Bridge* and *Tare*. Bridge channels can be either balanced or tared. For detailssee the manual: Plug-in: Setup > Channel balance 387.

When *Bridge* is selected, as in this example, two active bridge channels appear. Double-clicking on a channel or making a selection and subsequently clicking on the >> button makes the channel assignments.



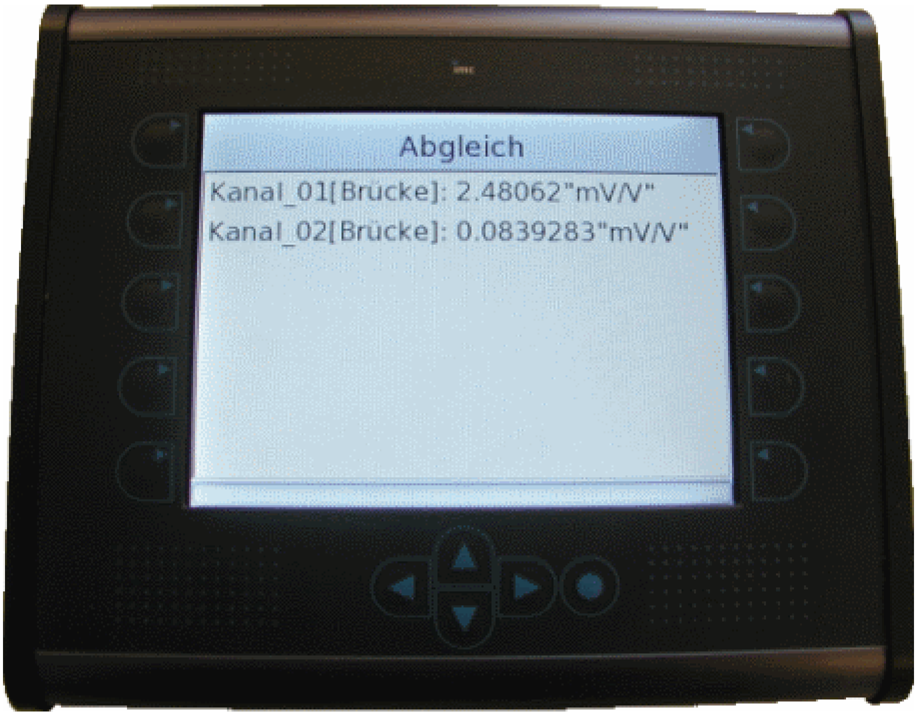
Under Available actions: *Tare*, an additional channel for capturing distance data appears.

After exiting the selection dialog with *OK*, the channels appear in the Display function key's main dialog.



Under "*Labeling*", the key has a visible caption of selected font size and background.

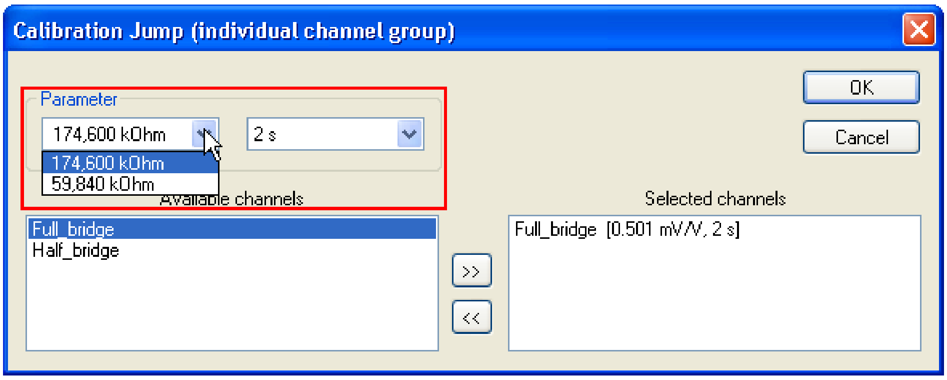
To carry out the action, the Display switches to balancing mode. Next, the compensated values are displayed:



Pressing the round button returns the screen to the normal view.

9.5.8.4 Shunt Calibration (Individual Channel Group)

To check the functioning of the bridge channels connected, a shunt calibration can be performed. Assignment of the channels to the Display button is performed in the same way as Balance 772. However, a shunt calibration 391 includes additional settings options:



Under *Parameter*, the calibration resistance value and the duration of its application are set. The calibration resistance selected, in conjunction with a known bridge resistance, produces a computable unbalance. This is the reason why in the plug-in: **Setup** on the page: **Analog channels** in the Dialog: **Measurement mode** is able to indicate the bridge impedance even for full and half bridges:

However, the actually measured unbalance usually deviates from the computed one, since the line resistances are not taken into account.

The shunt calibration is performed without any indication in the Display.

9.5.9 Firmware Update

The display is running on its own operating system, that is updated with the firmware update 83. If the display has not been connected during updating all other components, the update of the display is executed with the first configuration using a display setup.

In case the display does not work properly after an update, it has to be restarted. If a measurement configuration with a display setup has been started, but the display had not been connected, the display will be ignored when connected to the running measurement.

9.6 imc Messaging

This chapter describes the extensive features of imc measurement devices for sending text messages using different media (Email, FAX) and their operation using imc STUDIO.

9.6.1 Overview

What is imc Messaging?

Devices having the appropriate interface support sending of text messages in response to specified events. The available events are any signal changes of the virtual bits and network bits. In any bit, the transitions both from 0 to 1 and from 1 to 0 can be linked with one or more message texts.

Each such message can have its own target defined for it. The available message types include email and FAX in any combinations.

Along with obligatory text components, the message texts can also contain the current values of the network bits, virtual bits and Display variables from the device. Other available text components include the date, time, device name and certain imc Messaging variables, which can be filled with the currently valid values at the moment the message is generated. The information for imc Messaging is comprised of these specifications:

Information	Description
AllMessageCounter	number of all generated messages
AllMessageLosses	number of messages which were rejected because undeliverable or due to lack of resources
EventOverruns	number of events which could not be processed because they accumulated too quickly in succession
ThisMessageCounter	placeholder in message text for the number of times this message was generated
ThisMessageLosses	placeholder in message text for the number of times a generated message of this kind was lost

What can imc Messaging be used for?

Practically any event occurring during a measurement can determine the values of virtual or network bits, either directly or with the help of an imc Online FAMOS program. Among other things, this makes it possible to use trigger events, digital inputs or conditions defined in imc Online FAMOS as the release for messages.

In the simplest case, this can be used to alert a service technician by means of an email when a threshold is exceeded or a similar event occurs.

The ability to place the current values of the network bits, virtual bits and Display variables from the device in the message makes it possible to generate simple reports as well as malfunction messages. With appropriate programming, time-controlled messages, for example, can be sent, which could contain the most important data on processes current state.

Note, however, that imc Messaging is conceived exclusively for occasional sending of messages. It should generate only a few messages per hour or even per day! For more information, refer to the section on reliability, and the technical specs.

How does imc Messaging work?

The devices cyclically examine the virtual bits and network bits for changes. If a change is detected, a check is made of whether there are any message configurations defined for that event.

If there are, then in addition to the virtual bits and network bits already read in, the Display variables, the date, and the time are saved. This ensures that the values are as up-to-date as possible for any later generating of messages.

The detected events and all their data are entered into an event queue. All of this queue's entries are later evaluated and all necessary message texts are generated. In the process, the variables in the message texts are replaced with the stored values.

The messages thus generated are saved in a sending queue, from where they can be sent via the respective suitable interface.

Note

- Virtual bits and network bits should not change their value for durations under 50ms; better yet 200ms.
- Renamed virtual bits or network bits must be entered in the MSG-file under their default name (e.g.Virt_Bit01).
- The messages may not be sent in the order they were made (see Delivery of the messages 779)!

imc Messaging begins its activities already after preparation for measurement. Be aware, therefore, that messages could be sent even before a measurement starts if a bit for which a message is configured changes. imc Messaging remains active even after stopping the measurement. In particular, it continues to try sending messages generated during the measurement! Also the counter variables of imc Messaging are not affected by the measurement's start or stopping. Only upon preparing the next measurement are the counter variables reset and any unsent messages discarded!

In order to deactivate imc Messaging, a measurement must be prepared which contains no message configurations.

How to configure imc Messaging?

The configuration of imc Messaging is accomplished by means of one ASCII-file per device, each has to be imported as supplemental file 185. The designation is "*DEV*"+"*XXX.msg*", where *XXX* stands for the device number with a preceding 0, e.g. "*Dev012.msg*".This file must contain a description for each message which contains not only the actual text but also determines the triggering event and the message's destination.

What particular specifications are needed depends on the respective message type. The syntax of the configuration file and all details on the necessary parameters are described in detail under Configuration 780.

System requirements for imc Messaging

FAX In order to send a ***FAX***, a modem which supports G3-Fax Version 2 or 2.0 is needed. The fax machine must also be compatible with one of the two standards. This shouldn't present any problem for most current machines.

Email ***Email*** can be sent either via ***modem***, or via a ***network interface***, if an appropriate server can be reached via the network.

If either a GSM-modem or a GSM mobile phone is used, then ***it's not necessary to enable data transfer***.

There are no further requirements.

9.6.2 Message Types

The message types Email and FAX come with different strengths and weaknesses which can be considered when making a selection.

FAX

A fax is the most direct message form since it doesn't have an intermediary provider. The device dials the fax machine's number directly. There is also no time delay between the device's sending of the message and the arrival of the message at its destination. However, the fax machine would have to be permanently watched in order to use this advantage. Since a fax is transmitted as a bitmap graphic, the data volume transferred is much greater than that of an email. Therefore, transmitting a fax can take several minutes when using a GSM modem. A fax is only very conditionally suited to archiving, and re-processing is practically not possible at all. A fax message's size is limited to one page in imc Messaging. A modem is absolutely necessary for sending a FAX.

For the constraints on the rows and columns, see the technical specs.

Email

An email can contain almost any amount of text, with the size of the configuration file, however, setting certain limits. Transmission of email by the provider usually occurs after a few seconds, though there is no guarantee for this. By contrast, the email-client may be set to retrieve messages only at longer intervals. In terms of archiving and re-processing, emails are best suited. In addition, sending an email doesn't require a modem if a mail server is accessible via the LAN interface. In this way, the slow process of dialing via modem is also omitted, so that the emails are sent much more quickly.

If, for instance, the modem is occupied by a PC dialing in, it is still possible to send emails via the LAN. On the other hand, all messages which rely on the modem are detained until the modem is available again.

However, to send an email, an account with a mail server is necessary so that the device can be identified by the server by means of a login name and password.

Devices having serial numbers 16xxx or 19xxx support ***StartTLS encryption***, which is a necessary requirement for most E-mail providers. For devices not supporting it, it is recommended to use either a local E-mail server which transmits the messages with encryption to the E-mail provider, or one of the remaining providers who continue to allow unencrypted transmission.

A Step by Step tutorial can be found at the end of this chapter: e-mail via LAN 800 and e-mail via Modem 801

9.6.3 Reliability

9.6.3.1 Recognizing events (time response)

There is a limit to how many events for which messages are configured can appear in rapid succession. While one message is being sent, any other events occurring can only be stored. However, the event queue has only a limited amount of space. Once this is used up, all subsequent events are discarded. These lost events are counted in the imc Messaging variable `EventOverruns`.

It isn't possible, however, to reconstruct afterwards which messages were lost due to discarded events!

In order for a bit's signal transition to even be recognized, the transitions must not occur too quickly in succession. otherwise the event will be lost, as if it never happened; it can't even be counted as a lost event in `EventOverruns`. Therefore, use appropriate programming or use holdoff times to ensure that any event remains intact for a long enough time.

As soon as imc Messaging is no longer occupied with sending a message, the accumulated events are translated to message texts and entered into the sending queue. This queue's volume is also limited, so that messages can be lost if they are generated more rapidly than they can be sent.

How long a message must be kept in the queue depends on the one hand on the actual sending duration (a few seconds up to approx. 5min) and on the other hand on the receiver's accessibility, since the message is repeated several times if there is an error (see Delivery of the messages 779).

If the modem is busy because a PC has dialed in, then all messages which require that modem will be delayed until it's free. Thus in this case, the messages could stay in the queue indefinitely!

In this way, the transmitting is delayed and the queue's available space can be exhausted, for which reason no new messages may be able to be accommodated.

All lost messages are counted in the imc Messaging variable `AllMessageLosses`. In addition, the variable `ThisMessageLosses` records for each individual message configuration how often a message stemming from this configuration was lost.

9.6.3.2 Delivery of the messages

As soon as there is a message in the queue ready to be sent, an attempt is made to send it. If an attempt fails, the message is returned to the queue for a repeat attempt later following a pause.

This process is repeated several times, each time increasing the pause between delivery attempts. Once a certain number of repeat attempts have failed, the message is considered undeliverable and deleted. The imc Messaging variable `AllMessageLosses` and the corresponding instance of `ThisMessageLosses` are updated accordingly.

If the modem is busy, for instance due to a PC dialing in, all messages to be sent via modem must be held back until it's once again available. Therefore, an occupied modem won't lead to failed delivery!

Emails which can be sent via the LAN are delivered even if the modem is busy. If appropriate, they can be bumped up in the sending queue. Thus, the messages aren't necessarily sent in the order they were created!

If a message can't be delivered due to configuration errors such as a wrong telephone number or password, then multiple attempts to deliver it may come at (substantial) monetary cost.

Note

Therefore it is strongly recommended to test every message configuration under authentic conditions. imc is not liable for any costs resulting from the use of imc Messaging!

9.6.3.3 Storing unsent messages

If a message must be discarded because there's no more room in the sending queue or because it can't be delivered, it is stored on a data carrier in the device, if possible. Even if the device is deactivated or if messages must be discarded due to preparation of a new measurement, storage in the device should still take place if at all feasible. Towards that end, the messages are saved even upon generating the message text and only deleted from the backup folder after being successfully sent.

If the device has an internal hard drive, it will be used for storage. Otherwise the system will check the device for the presence of a removable storage drive to which to save the messages.

For storage of the messages, a folder with the name "UnsentMessages" is created in the data carrier's main directory. All unsent messages are saved in this folder under filenames which provide indication of when and how the message was generated.

The filenames take the following form:

Date	Time	Number	Event	Event count	Type
2004-07-05	09-31-46	#4	Virt_Bit03=1	#2	EMAIL

Example: `2004-07-05 09-31-46 #4 Virt_Bit03=1 #2.EMAIL`

The first number corresponds to `AllMessageCounter`. It represents the incremental counter of messages since a measurement was last prepared. The second number is the message's `ThisMessageCounter`. It states how often the event occurred.

The filename extension indicates whether the message is an email or a FAX.

Note

If a folder has been created by a firmware version 2.5R1SP9 or older, the device is not able to overwrite the folder with new information!

9.6.4 Configuration

The configuration of imc Messaging is accomplished by means of one ASCII-file per device, each has to be imported as supplemental file 185. A configuration file's name consists of the prefix "DEV", the three-digit device number (under imc STUDIO always "001") and the ending ".MSG". The filename is not sensitive to upper/ lower-case spelling.

Example: `DEV001.MSG`

The next chapter may create the impression that creating a configuration is a difficult process requiring specialized knowledge. In fact, however, obtaining the necessary information is very easy. Additionally, the chapter Templates 796 lists the necessary entries for a variety of providers, making it possible to perform the configuration through simple cutting and pasting.

9.6.4.1 Basics of configuration file structure and syntax

This section may give the impression that making a configuration is quite complicated, requiring special skills. However, the necessary information is actually easy to obtain. Additionally, from p. 11-24 Templates onward, the necessary specifications for a variety of service providers are presented, making it possible to accomplish the configuration by simple copying and pasting.

For each message, a separate segment must be entered in the configuration file defining all details such as the trigger event, message type, addressee and the text. A segment describes exactly one message! Even if an single event generates multiple messages, a corresponding number of separate segments must be created.

A segment is always prefaced by the designation of a bit, written inside square brackets. All subsequent lines are in reference to this bit, until a new segment begins.

Example: `[Virt_Bit04]`

Within a single segment, each line contains a keyword followed by an 'equals'-sign and the relevant value. The keyword must stand at the beginning of the line without any preceding spaces or tabs. There may not even be any other characters between the 'equals'-sign and the value! The values are entered without quotation marks.

The order of the lines isn't relevant. All keywords within a segment can be ordered in any way desired. However, it is recommended to arrange the keywords in convenient groups.

A line beginning with the character "#" is considered a comment line. Empty lines and comments are allowed at any location in the file and are ignored.

The following specifications must be present in every segment:

Parameter	Keyword	Possible values
Trigger event	`Event`	TransitionToOne, TransitionToZero
Message type	`MessageType`	EMAIL, FAX
Message destination	`Destination`	Telephone number or Email address
Message text	`Message`	Any text with variables. Special characters are not supported.

The keyword "`Event`" determines what event triggers the message. The value "`TransitionToOne`" stands for a rising edge or a bit's transition from 0 to 1. Accordingly, "`TransitionToZero`" means the reverse transition triggers a message.

Example: `Event=TransitionToOne`

"`MessageType`" states whether an "`EMAIL`" or a "`FAX`" is to be sent. Depending on the message type selected, various additional specifications are needed.

Example: `MessageType=FAX`

The specification of the message recipient is made under the keyword "`Destination`". For a faxed message, the value in question is the fax machine's number. The number's digits must be entered without spaces. The recipient of an email may be one or more email addresses, separated by commas.

Example: `Destination=030123456`

or

`Destination=Hans.Mustermann@Firma.de, Fritz.Froh@Home.de`

The message text is entered line-by-line. Each line begins with the keyword "`Message`". The maximum number of lines and characters depends on the particular message type. A space can be inserted into the message by simply not specifying any text to follow the keyword. But the 'equals'-sign may not be omitted by any means.

Quotation marks are regarded as components of the message text and are sent unchanged to the recipient. As a rule, then, the text should be entered without any quotation marks.

Certain variables can be entered in the message text, which are replaced by updated values at runtime (see chapter Variables 787).

Example:

```
Message=This is the message's first line.
Message=This is the message's second line.
Message=
Message=This is the message's fourth line.
```

(Blank line!) — refers to `Message=`

9.6.4.2 Specifics of the different message types

9.6.4.2.1 Email

Emails are the only form of messages for which no modem may be necessary. If a mail server is available in the LAN, then only a few data are sufficient for sending an email. On the other hand, if the email is to be sent via modem, this requires entering a whole series of parameters in addition to the specifications already described in chapter Templates 796.

Parameter	Keyword	Possible values
Modem initialization	`InitScript*`	(see below)
Dial-in number of the Internetprovider	`ProviderPhoneNumber*`	Telephone number
Login name for Internet access	`ProviderLoginName*`	Login name for the account with the Internet provider
Password for Internet access	`ProviderPassword*`	Password for the account with the Internet provider
Mail server	`SMTPServer`	Name or IP-address of mail server
Login protocol for the mail server	`SMTPLoginMethod*`	login, cram-md5
Login name for the mail server	`SMTPLoginName*`	Login name for the account with the Mail server
Password for the mail server	`SMTPPassword*`	Password for the account with the mail server
Port available [1]	`SMTPServerPort*`	Unencrypted: 25 STARTTLS: 587
Connection encryption [1]	`SMTPServerSecurity*`	STARTTLS
Sender address	`SenderAddress`	An email address which is accepted by the mail server as a return address
Email's subject line	`Subject*`	Any text with variables

* optional; [1] only for devices with serial number 16xxx and higher

Note

Since the firmware-version 2.8R5SP9 the new keyword "*SMTPLoginMethod*" replaced "*SMTPAuthentication*".

For the "*SMTPAuthentication*" parameter, "*cram-md5*" and "*login*" were mixed up. This has been corrected with "*SMTPLoginMethod*".

For compatibility "*SMTPAuthentication*" is as previously supported. For example, "*SMTPAuthentication=cram-md5*" still activates "*login*". Thus, an existing configuration is still functional after software update . But in the future "*SMTPLoginMethod*" should be used instead.

InitScript

An "`InitScript`" is only needed in special cases. As a rule the script can be omitted entirely.

Entering a script can be necessary if the modem requires special preparation prior to the dialing procedure. Thus, it may be necessary to operate an ISDN modem with the protocol X.75 by default, and only to temporarily change to Sync-PPP for dialing in to the Internet provider.

Example: `InitScript="" ATE0 OK ATS96=16 OK`

To understand the script's syntax, it's easiest to ignore the quotation marks at first. Then, the script can be regarded as a sequence of commands sent by the device to the modem, each separated by a space from the response which the device expects from the modem. In the example, the modem should answer each command with "`OK`".

Since scripts are also used where, for example, the modem's status message "`RING`" is awaited so that the call can be accepted with "`ATA`", they always start with a string which the modem must send before the subsequent command is transferred to it.

In cases where commands transfer is to begin right away, two empty quotation marks are used to indicate that no status message from the modem is to be awaited.

ProviderPhoneNumber

If an email is to be sent by modem, the device must log in with the Internet provider for that purpose. The provider's phone number is specified in conjunction with the keyword "`ProviderPhoneNumber`".

Example: `ProviderPhoneNumber=00193670`

ProviderLoginName and ProviderPassword

Internet access also requires a login name and password. The respective values are passed in conjunction with "`ProviderLoginName`" and "`ProviderPassword`".

Example:

```
ProviderLoginName=msn@easysurfer-power.de
ProviderPassword=msn
```

If an email is sent via the LAN interface, the login and password for the Internet provider are skipped.

SMTPServer

The keyword "`SMTPServer`", by contrast, must always be present and determines which mailserver is used to send the email. The mail server can either be specified by its IP-address or by its host name.

Example:

```
SMTPServer=10.0.0.13
SMTPServer=mx.freenet.de
```

SMTPLoginMethod

To prevent abuse (spam), almost every mail server requires logging in with a user name and password. The servers carry out this identity check according to a variety of protocols, of which one that is supported by the selected server must be specified in conjunction with "*SMTPLoginMethod*".

Example:

```
SMTPLoginMethod=cram-md5
```

SMTPLoginName and SMTPPassword

When the mail server prompts for login, the login name and password are entered in conjunction with "`SMTPLoginName`" or "`SMTPPassword`", respectively. Otherwise, this step is skipped.

Example:

```
SMTPLoginName=MyLoginName
SMTPPassword=MyPassword
```

SMTPServerPort

Specifies the port. If the keyword is not specified, the following ports are used automatically:

Unencoded: 25

STARTTLS: 587

SMTPServerSecurity

Selection of the connection encryption. Only for devices of serial number 19xxx and higher. The following encryption settings are possible:

STARTTLS: communication begins unencrypted, but immediately switches to encrypted mode. Prompting for the password and transfer of the E-Mail are performed with encryption.

SenderAddress

When sending an email, a return address must always be given, otherwise delivery is denied. Some servers also check whether the email address is even valid. In extreme case, the server only permits sending from return addresses in the same domain as the server itself, or which belong to the account into which you've already logged in. These steps are taken to prevent the misuse of mail servers.

The return address is denoted by the keyword "`SenderAddress`". In order to provide the email client with a more recognizable designation of the sender, the actual return address can be preceded by an extra text. In that case, however, the true return address must be bracketed by the characters "<>".

Example:

```
SenderAddress=MyDevice@Firm.de
SenderAddress=TestRig No.2 <MyDevice@Firm.de>
```

In the second example, the email client states the sender as "TestRig Nr.2". Note that the text of this extra, identification aid must conform to the required character set of the server. For instance, German umlauts may not be accepted. You may need to find out what letters the servers involved accept!

Certain PC programs solve this issue by replacing the umlauts with a sequence of control characters, which are correctly reverse-translated by the email client's system to display to original letters. However, imc Messaging does not support this capability!

Subject

Stating content for a subject line in conjunction with the keyword "`Subject`" is optional. The subject has the same syntax as "`Message`" and may also contain variables. The same constraints in terms of umlauts and special characters apply as for "`SenderAddress`".

(see chapter Variables 787)

Example:

```
Subject=Limit violation in test Rig No.2
```

Destination

With emails, the recipient's address is given with "`Destination`". In contrast to all other messages, emails can be sent to multiple recipients. For this purpose, the various target addresses are separated by commas.

As with the return address, the recipient's address can be preceded by a descriptive text which appears in the email client as the addressee. The recipient's actual address must then be bracketed between the characters "<>".

For umlauts and special characters, the same constraints apply as for "`Subject`" and "`SenderAddress`".

Example:

```
Destination=Hans.Mustermann@Firma.de
Destination=Administrator <Hans.Mustermann@Firma.de>
```

Example

In the simplest case, the email is passed to a server in the local network which requires neither any login nor a valid return address. In that case, the configuration would be, for example, as follows:

```
# Send an email if Ether_Bit09 changes to 1.
[Ether_Bit09]
Event=TransitionToOne
MessageType=EMAIL

# IP-address of mail server
SMTPServer=10.0.0.13

# Sender: If the mail server doesn't check the address, a
# pretend address can be entered here. (no umlauts)
SenderAddress=MyDevice@NoWhere.de

# Email address of recipient (no umlauts)
Destination=Hans.Mustermann@Firma.de

# Subject line (no umlauts)
Subject=Notification from Test Rig No.2!

# An example of a message text.
Message=This is an email generated by an imc measurement device.
```

Example A configuration having all specifications

```
# Send an email if Ether_Bit32 changes to 0.
[Ether_Bit32]
Event=TransitionToZero
MessageType=EMAIL

# Set Synch-PPP as the protocol for the ISDN modem.
# Usually not necessary. The commands are modem-specific.
InitScript="" ATBS96=16 OK

# Data for Internet access
# 0 for dial tone
ProviderPhoneNumber=00193670
ProviderLoginName=msn@easysurfer-power.de
ProviderPassword=msn
# Data for mail server access
SMTPServer=mx.freenet.de
SMTPLoginMethod=login
SMTPLoginName=Hans.Mustermann@freenet.de
SMTPPassword=qt3TzW

# Return address: Checked for validity by Internet servers!
SenderAddress=My Device <Hans.Mustermann@freenet.de>

# Email addresses of recipient (no umlauts)
Destination=Hans.Mustermann@Firma.de, Fritz <Fritz.Froh@Firma.de>
# Status line (no umlauts)
Subject=Notification from Test Rig No.2!

# An example of a message text.
Message=This is an email generated by an imc measurement device.
```

Example A configuration encrypted with STARTTLS

```
# Send an email if Virtual_Bit01 changes to 1.
# email without dialing in
[Virt_Bit01]
Event=TransitionToOne
MessageType=EMAIL

SMTPServer=smtp.gmx.net
#SMTPServerPort=587
SMTPLoginMethod=login
SMTPServerSecurity=STARTTLS
SMTPLoginName=MyName@gmx.de
SMTPPassword=MyPassword
SenderAddress=My device <MyName@gmx.de>
Destination=Info@MyCompany.de
Subject=Message from test bench {DeviceName}!
Message={DeviceName}   {DateTime, %Y-%m-%d %H:%M:%S}
Message=Hallo!
Message=Keep smiling!
```

9.6.4.2.2 FAX

For a FAX, only the specifications described 778 are necessary. The fax machine's telephone number, alone, conveys all that is necessary for sending the message. You must only be sure to include any digits necessary to obtain a dialing tone, or any area codes.

Example

```
# sends a fax if Ether_Bit04 changes to 1.
[Ether_Bit04]
Event=TransitionToOne
MessageType=FAX

# 0 for dialing tone, area code 030 for Berlin, phone number 4567890
# All without spaces!
Destination=00304567890

# An example of a message text.
Message=Hello!
Message=
Message=This is a fax generated by an imc measurement device.
```

Note that both your modem and your fax machine must support the standard G3-Fax Version 2 or 2.0. However, this is usually the case anyway.

9.6.4.3 Default configuration

It is possible to save a default imc Messaging configuration in the device. It will be used whenever no measurement has been prepared or whenever the current measurement does not contain any imc Messaging configuration.

A complete configuration including UDP Status Monitoring and various Email- and FAX-messages can be specified.

For creating, editing and deleting the default configuration, the XmlRpc-method "`SetimcMessagingDefaultConfig`" has been implemented. This command is automatically called when files are exchanged. By this means it is possible to set the default configuration solely by using FTP. For details, see the section "*Configure via FTP* 801".

9.6.4.4 Variables

The message texts and the subject lines of an email can contain both permanent text portions and also variables which are replaced by updated values when the message is generated. A line may contain any desired number of embedded variables. The only limitations are the configuration file's maximum line length and the particular constraints affecting the message type concerned.

The following **variables** are available for **imc Messaging** 775 and **UDP Status Monitoring** 792:

Variable	Description
`AllMessageCounter`	Total count of messages generate. Format numerical 789.
`AllMessageLosses`	Total count of messages which were discarded because undeliverable or due to lack of resources. Format numerical 789.
`DateTime`	Date and time in any format 791.
`DeviceName`	User-defined name for the device.
`DirCounter`	Counts all closed folders which contain measured data and which were created since the last preparation procedure. Folders which contained no measured data upon being closed and which were consequently deleted are not counted. Format numerical 789.

Variable	Description
DisplayVar_01-32	the display variable's current contents Format numerical 789.
Ether_Bit01-32	the network bit's current state Format numerical 789.
EventOverruns	total number of events which couldn't be processed because the came too quickly in succession. Format numerical 789.
MeasurementStatus	Indicates one of the following device states: 1: No measurement was started. It is not possible to distinguish whether a measurement has been prepared. 2: A timed start was set up, but the start time has not yet been reached. 3: A measurement has started and data capture is running. It is not possible to see whether a trigger has already been released. Format numerical 789.
SerialNumber	Returns the device's serial number as a text. For this variable, no formatting can be specified.
SoftwareDateTime	Returns the day on which the software was created. For formatting the output, the same formatting instructions are available as for the variable DateTime. If output of the time is demanded in the formatting instructions, then 0 is always returned, since the time is not available.
ThisMessageCounter	Placeholder in message text for the number of times this message was generated. Format numerical 789.
ThisMessageLosses	Placeholder in message text for the number of times a generated message of this kind was lost. Format numerical 789.
TimeOfFirstStart	Contains the starting time of the first measurement following the last preparation procedure in any format 791.
Virt_Bit01-32	the virtual bit's current state. Format numerical 789.

The values of the bits and display-variables, as well as of the date and time, are saved immediately when it is determined that a message must be generated. Even if the message can only be generated later, its text will reflect the values of the variables at the instant in time when the message was triggered.

By contrast, imc Messaging's counter variables are replaced with updated values only when the message text is actually generated.

The count begins when the message is prepared. Even if the measurement is stopped and restarted, this doesn't cause the counter to be reset! Only upon a measurements preparation are the counters all reset to zero.

All numerical variables can be expressed both in integer and floating-point format. If a display-variable is formatted as an integer, it will be rounded up for a decimal value of 0.5 and above, otherwise it's rounded down.

Since the bits can only take the values 0 or 1, only integer format makes sense for them. The counter variables' input range is 32-bit. Thus it's possible to tally up about $4*10^9$ events before a counter overflows and returns to zero. Nevertheless, these variables should preferably be formatted as integers.

But due to their somewhat greater complexity, the variables "ThisMessageCounter" and "ThisMessageLosses" are described in more detail here.

There are equally many instances of these variables as there are message configurations. A message configuration is always able to access only its own counters. Thus, it isn't possible to send a message stating the state of another message configuration's lost message counter.

If these counters are used in a message, it's possible to tell immediately how often the event concerned has already occurred, and how many messages generated in response were lost.

In contrast, the variables "`AllMessageCounter`" and "`AllMessageLosses`" pertain to every message and can be used for global monitoring of imc Messaging.

The a new variable **`DirCounter`**, which counts all closed folders which contain measured data and which were created since the last preparation procedure. Folders which contain no measured data upon being closed and which were consequently deleted are not counted!

The purpose of this new variable **`TimeOfFirstStart`** is to determine whether the device has undergone a new preparation procedure since the last session (Autostart, Suspend/Resume). This indicates whether the **`DirCounter`** is still increasing monotonously, or whether it has been reset since the device's last message. Otherwise, the receiver would not be able to distinguish whether, for instance, a counter reading of 3 on the **`DirCounter`** still refers to the last reading which the receiver was aware of, or whether the device has been restarted in the meantime and that there are 3 new closed folders ready to be retrieved. This case would otherwise only be recognized when the counter reads 4, since that is the next time when a connection to the device would be made – and the memory's exact state would be checked. The resulting delay could become intolerably long, depending on the circumstances.

Note that the variable contains the value 01.01.1900 00:00 immediately upon preparation! Only when the moment for starting the measurement is known, the variable's contents change accordingly.

For formatting the output, the same format instructions are available as for the variable `DateTime`.

9.6.4.5 Syntax

A variable is distinguishable in the text by appearing inside of curly brackets. The brackets contain the variables' pre-defined names, followed by a formatting instruction. For clearer visibility, commas and spaces can be inserted after the variable names.

The device's name ("`DeviceName`") is an exception. This doesn't need any formatting instruction because it is always outputted as a string. With the other variables, one distinguishes among simple numerical values and statements of the date and time.

Formatting of numerical variables

The formatting instructions always begin with a percent-symbol, followed, in the simplest case, by a single letter. This letter determines the numerical format as per the table below:

Format type	Definition
%d or %i	signed integer in decimal format
%u	unsigned integer in decimal format
%o	integer in octal format
%x	integer in hexadecimal format (0-9, a-f) without prefix (0x)
%X	integer in hexadecimal format (0-9, A-F) with prefix (0X)
%f	real number in fixed-point format
%e	real number in exponential format (e.g. 1.0e+4)
%E	real number in exponential format (e.g. 1.0E+4)
%g	like %f or %e, whichever is shorter
%G	like %f or %E, whichever is shorter

The complete syntax of the format specification takes the following form:

%	modifier	minimum width	.	Precision	Format type
necessary	optional	optional	optional	optional	necessary

Modifier:

Modifiers can be combined wherever it makes sense. They affect the output as follows:

Modifier	Effect	
-	left justified (default is right justified)	
0	output is zero-padded instead of filled out with spaces	
+	a plus-sign precedes positive numbers	
space	a space precedes positive numbers	
#	depends on the format type:	
	%#o (octal)	output prefixed with a zero
	%#x (hexadecimal)	output prefixed with "0x"
	%#X (hexadecimal)	output prefixed with "0X"
	%#f,%#e,%#E,%g,%#G	ensures output of a decimal point

Minimum width:

By default, as many characters are outputted as are necessary to display the value. For a formatted output it may be desirable to set a minimum width. The output is then filled up with spaces to achieve this width. The modifier "0" causes the output to be padded with zeroes instead of spaces.

Example:	`%d`	Value = 734	Output = "734"
	`%10d`	Value = 734	Output = " 734"
	`%010d`	Value = 734	Output = "0000000734"

Precision:

If a real number is to be rounded to a certain number of decimal places, a period followed by the number of places (digits) must be entered.

Example:	`%f`	Value = 734.458	Output = "734.458"
	`%.1f`	Value = 734.458	Output = "734.5"
	`%8.2f`	Value = 734.458	Output = "734.46"

In the third example, the output is intended to have a width of at least 8 characters, including the decimal point.

Example:

```
Message=The temperature is {DisplayVar_01, %5.1f}°C.
Message=Message Number {AllMessageCounter, %d}
```

Sample result:

The temperature is 23.4°C.

Message Number 4

Formatted output of date and time

In the message texts, the date and time can be inserted in practically any format imaginable. Specifying the formatting of the date and time is accomplished in a totally different manner from that of numerical values.

It is possible to specify multiple formats for a single variable of the type "`DateTime`", so that the variable is replaced by that many different statements of the time. Each formatting specification consists of a percent-symbol followed by a letter which stands for the desired time representation. In the message text design, the formatting specification can be embedded among other text elements as desired (see examples below).

The following time representations are available:

Formatting specification	Definition
%d	day (01 – 31)
%e	day (1 – 31) with preceding space if single-digit
%m	month (01 – 12)
%y	two-digit year (00 – 99)
%Y	four-digit year
%G	four-digit year in conformance to the calendar week as per %V
%g	like %G but two-digit
%C	two-digit century
%F	as per %Y-%m-%d (ISO 8601 date format)
%D	as per %m/%d/%y (American date format)
%j	ordinal day of the year (001 – 366)
%u	weekday (1 – 7, Monday is 1)
%w	weekday (0 – 6, Sunday is 0)
%W	calendar week (00 – 53) beginning on first Monday
%U	calendar week (00 – 53) beginning on first Sunday
%V	ISO 8601:1988 calendar week (01 – 53) beginning with the first week having 4 days. The weeks begin on Monday
%H	hour (00 – 23)
%k	hour (0 to 23) with preceding space if single-digit.
%I	hour (01 – 12)
%l	hour (1 – 12) with preceding space if single-digit.
%M	minute (00 – 59)
%S	seconds (00 – 61) 60 & 61 only appear in special cases
%P	am/pm 12:00; noon is "pm", midnight "am"
%p	AM/PM 12:00; noon is "PM", midnight "AM"
%R	corresponds to %H:%M
%T	corresponds to %H:%M:%S

Formatting specification	Definition
%r	corresponds to %I:%M:%S %p (American time representation)

The variable "%t" adds a tab stop to the output, "%n" causes a line break.

Example

```
Message=Date: {DateTime, %Y-%m-%d} Time: {DateTime, %H:%M:%S}
Message={DateTime, Year: %Y Month: %m Day:%d}
```

Example result:

Date: 2004-07-28 Time: 16:15:32

Year: 2004 Month: 07 Day:28

9.6.5 Special characteristics of using network bits

When multiple devices are used jointly in a network, the transitions of the network bits affect all of the devices. This can be exploited to cause messages to be triggered by devices for which no modem is available.

For this purpose, the device having the modem is thus configured that it responds to a change of network bits by sending a message. The bits can then be controlled by any device in the network. Thus, only a single file containing all message configurations is necessary for the configuration.

Note that message preparation must be completed for all devices before the network bits can function as expected. Also be sure to consider that all devices, in fact, affect the network bits, even ones tasked with a completely other measurement.

In particular, preparation of a measurement resets all the network bits. In other words, if someone else prepares a measurement, this can cause your devices to already begin sending messages!

9.6.6 UDP Status Monitoring

UDP Status Monitoring has been developed to create data traffic within a certain time interval. That is necessary to hold a modem line, that would be interrupted by the provider, if there is no data transfer.

Therefore an entry in the messaging file "Devxxx.msg" has to be entered. This file must be imported as a supplemental file 185 into the experiment.

Example

```
[UDP Status Monitoring]
DestinationIP=x.x.x.x
DestinationPort=XXXX
Interval=x in seconds
NoLineFeed
```

```
[UDP Status Monitoring]
DestinationIP=10.0.2.7
DestinationPort=1205
Interval=10
NoLineFeed
```

As the target of an UDP Status Monitoring data package, it is now possible to specify either an IP-address (`DestinationIP`) or a DNS-name (`Destination`) with the keyword Destination.

This is very useful if the target computer has no fixed IP-address, but it does have a DynDNS name. The old keyword DestinationIP continues to be supported and works in the same way as always.

Note that the device requires a DNS-Server in order to convert the DNS name into an IP address! This must be announced to the device either via If-Config, DHCP or, when dialing into the internet, by the provider server.

The name is converted every time a package is to be sent, because it is impossible to anticipate whether the target's IP-address has changed. Therefore, it is sensible to provide a permanent IP-address directly!

UDP Status Monitoring now supports all imc Messaging variables 787 with the exception of **`ThisMessageCounter`** and **`ThisMessageLosses`**. Due to the fixed time grid and the unsecured transmission without failure notification, these variables are not very useful. All other imc Messaging variables, particularly the two new variables mentioned above, are accepted by UDP Status Monitoring in the exact same way as by all other message types. However, the message text from UDP Status Monitoring is limited to 300 characters, as before. See also example here 793.

See also: "*Configure via FTP* 801"

9.6.6.1 Syntax / example /Limitations

`[UDP Status Monitoring]`	Keyword for section UDP Status Monitoring

`Destination`
or
`DestinationIP`
	DynDNS-Name
	or
	IP-address for the destination PC, e.g. `DestinationIP= 192.168.0.1`

`DestinationPort`	Destination port that receive the data, e.g.`DestinationPort=9`. Port 9 is a reserved port of the PC. There the data are discarded and should work without problems.
`Interval`	Time interval in seconds, e.g. Interval=240 (every 4 minutes). Possible intervals are 1s to 4000000s (recommend: at least 10s)
`NoLineFeed`	If this command is entered, no automatic line breaks are inserted after the messages ("Message=...").

Afterwards, data can be sent. The message is divided by line feed, unless prevented by "`NoLineFeed`". The device name can be transferred by {Devicename}.

Example

```
[UDP Status Monitoring]
Destination=MyDNS_Name
DestinationPort=5000
Interval=10
Message={Devicename}
Message=This could be any text
Message=Last start {TimeOfFirstStart, %Y-%m-%d %H:%M:%S}
Message=Directories number = {DirCounter, %u}
Message=Temperature = {DisplayVar_01, %5.2f}
Message=State of measurement = {MeasurementStatus, %d}
```

Note: If a fixed IP is used instead of a dynamic DNS name, the line `Destination=MyDNS_Name` must be replaced with `DestinationIP=192.168.0.1`.

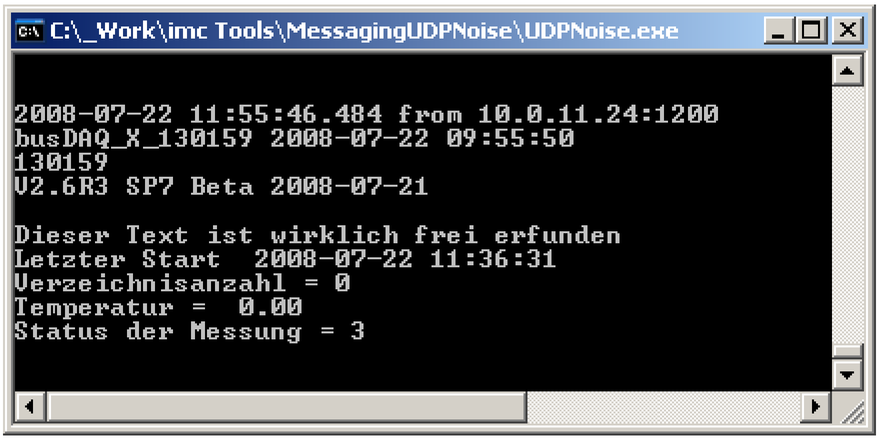
Find the variables and their format in chapter Variables 787.

Limitations

- The maximum pack of data is 300Bytes at max. Greater packages will be cut.
- Only one UDP Status Monitoring configuration can be defined per device.
- UDP Status Monitoring and imc Messaging has to be defined in one msg-file. It is possible to create UDP Status Monitoring packages in fixed intervals and conditionally send e-mails.
- The source port of the UDP Status Monitoring is always 1200.

9.6.6.2 Test of UDP Status Monitoring

For testing the UDP Status Monitoring, the program *UDP Status Monitoring.exe* is provided (included in the DVD).



Messages arriving via UDP

9.6.7 WakeOnLAN (Magic Packets)

The entry *WakeOnLAN* enables automated starting of a computer when an imc measurement device is switched on. For this purpose, the section [WakeOnLAN] can be added in the Devxxx.msg file 780. The condition for this is that the target-PCs are configured for WakeOnLAN in the BIOS and under Windows!

The following parameters are necessary:

DestinationIP: The **Subnet-Broadcast-address**, e.g. 10.0.*255.255* or the **limited Broadcast address** *255.255.255.255.* When there is only one **target PC in Suspend mode**, it is also possible to use its IP-address.

DestinationMAC: The MAC address(es) of the computer(s) to be woken up, the **maximum** count is **20** MAC addresses.

RepeatCount: The number of repetitions which the imc device performs after being activated. The repetitions are performed at a intervals of 3 seconds and are limited to a maximum of 200. In each repetition, three packets are sent at intervals of 300ms.

Example

```
[WakeOnLAN]
DestinationIP=10.0.255.255
DestinationMAC=00:0a:33:fd:41:01
DestinationMAC=00:0a:33:fd:41:02
DestinationMAC=00:0a:33:fd:41:03
DestinationMAC=00:0a:33:fd:41:04
RepeatCount=100
```

After the initialization (the self-starting), a series of 3 Wake On LAN packets are sent 100 times at intervals of 3 seconds. The 3 packets repetitions are sent at intervals of ca. 300ms. Up to 20 Mac-addresses can be specified.

In the example, four MagicPakets are sent with the respective MAC-addresses. After ca. 300ms, they are repeated. This process is repeated 100 times at intervals of 3s.

9.6.8 Possible error sources

To avoid problems arising in actual practice, you absolutely should test your message configurations!

Once you have checked your accessing data for an Internet provider or mail server, all you should still need to do is to copy and paste them into the configuration file. This way, you can avoid typing errors. The same applies to the phone numbers and email addresses of the recipients.

Below are presented some familiar problems, their possible causes and the associated remedies:

Problem: The device doesn't send a message for every change of the bit. Only isolated messages are generated or none at all.

Cause: Either the bit changes too quickly, so that the change isn't recognized, or the sending queue is full.

Remedy: Ensure that the bits' states remain stabile long enough to be recognized reliably. Don't let too many messages be generated in rapid succession, and make sure that the messages can be sent without any problems.

Problem: The device sends every fax numerous times, spread out over a large time frame.

Cause: Your fax machine isn't totally compatible with the modem used, so that it seems to the device that the fax was lost. Thus, the device repeats the message for such a long time that it finally gives up.

Remedy: Replace the modem or fax machine!

Problem: The variables aren't replaced by updated values in the message. The line does appear as it was entered in the configuration file.

Cause: There is probably a syntax error.

Remedy: Check the spelling of the variables and check the formatting instructions for errors.

Problem: When using imc Messaging in conjunction with automatic callback, it sometimes takes unusually long for the device to call back.

Cause: The device may send a message between your call and the return call. Due to this, the return call may be delayed by as much as approx. 5min.

Remedy: None.

Problem: Having configured messages for network bits, these messages are now constantly triggered although the bits can't have changed.

Cause: The network bits are affected by every device in the network. It may happen that a device in use by someone else has changed some network bit(s).

Remedy: Construct a separate network, or use the virtual bits.

Problem: When working with multiple devices, the first messages triggered by the network bits aren't sent.

Cause: If you set a bit by means of imc Online FAMOS already during preparation of a measurement, it may not be recognized by all of the devices, since some of the devices may not have been prepared.

Remedy: Make sure that you don't make any changes to network bits before concluding preparations for all of the devices.

9.6.9 Technical Specifications imc Messaging

The following data reflect the state in effect in August, 2004. imc reserves the right to change the data in response to further developments.

Parameter	min. / max.
Event duration	min. 50ms; > 200ms preferred setting
Delay between occurrence of event and saving of updated value of variable	min. 20ms, max. approx. 200ms
Line length of the configuration file	max. 512 characters
Size of a configuration file	max. 300000 characters
Number of message configurations	max. 128 per device
Size of event queue	128 entries
Size of sending queue	128 messages
Number of sending attempts before message loss	30
Interval between successive sending attempts	1,4,9,16,25,36,49,60,60, ... 60min
Duration of attempt to dial in to Internet	maximum permitted: 60s
Email sending duration	maximum permitted: 80s
Number of characters in an email	limited only by size of configuration file
FAX sending duration	maximum permitted: 280s
Line length of a FAX	maximum: 75 characters
Number of lines in a FAX	maximum: 75 lines
Input ranges	
Bit variables	0 or 1
Counter variables	32 bits unsigned (0 to 4294967295)
Display-variables	32 bits floating point (-3.4e+38 to +3.4e+38)

9.6.10 Templates

In order to keep the imc Messaging configuration as simple as possible, the following templates are offered, which contain the relevant access codes for a variety of service providers. You can adopt these data as appropriate in your configuration files. The examples refer to German providers. For access codes outside of Germany, inquire with the pertinent service providers.

Internet provider

These are some examples for internet providers. Check the WEB for further information of the supplier.
No responsibility is taken for the correctness of this information!

Call by Call Internet access from land lines (ISDN and analog)

MSN (Easysurfer power)

```
ProviderPhoneNumber=0193670
ProviderLoginName=msn@easysurfer-power.de
ProviderPassword=msn
```

Call by Call Internet access via GSM

Inquire with your GSM provider as to the least expensive Internet access.

D1 T-Com Inland (Registration required!)

```
ProviderPhoneNumber=4122
ProviderLoginName=(assigned upon registration)
ProviderPassword=(assigned upon registration)
```

D1 and D2 Domestic (Germany): Freenet Call by Call

```
Per-minute price: 20 Cent + any fees for special numbers (debitel)
ProviderPhoneNumber=22243
ProviderLoginName=freenet
ProviderPassword=mobil
```

D1 Abroad (outside Germany): Freenet Call by Call (not available within Germany)

```
Costs: depends on provider
ProviderPhoneNumber=+491712522224 (substitute the appropriate country prefix for +49!)
ProviderLoginName=freenet
ProviderPassword=mobil
```

Free mail servers

You must apply for an email address with a provider, in order to obtain a login name. This can be done via the provider's website.

GMAIL

```
#For GMAIL, "Less secure app access" must be enabled in the security settings.
MessageType=EMAIL
SMTPServer=smtp.gmail.com
SMTPServerPort=587
SMTPLoginMethod=login
SMTPServerSecurity=STARTTLS
SMTPLoginName="your login name with this provider"
SMTPPassword="your password with this provider"
SenderAddress="your email address with this provider"
Destination=name@provider.de
Subject=My test message
Message=Hello!
#all sent emails are saved automatically!
```

GMX

```
MessageType=EMAIL
SMTPServer=mail.gmx.net
SMTPServerPort=587
SMTPLoginMethod=login
SMTPServerSecurity=StartTLS
SMTPLoginName="your login name with this provider"
SMTPPassword="your password with this provider"
SenderAddress="your email address with this provider"
```

WEB.DE

```
MessageType=EMAIL
SMTPServer=smtp.web.de
SMTPServerPort=587
SMTPLoginMethod=login
SMTPServerSecurity=StartTLS
SMTPLoginName=user #without @web.de
SMTPPassword="your password with this provider"
SenderAddress="your email address with this provider"
```

Smart-Mail (unencrypted)

```
MessageType=EMAIL
SMTPServer=smtp.smart-mail.de
SMTPLoginMethod=login
SMTPLoginName="your login name with this provider"
SMTPPassword="your password with this provider"
SenderAddress="your email address with this provider"
```

Freenet

```
MessageType=EMAIL
SMTPServer=mx.freenet.de
SMTPServerPort=587
SMTPLoginMethod=login
SMTPServerSecurity=StartTLS
SMTPLoginName="your login name with this provider"
SMTPPassword="your password with this provider"
SenderAddress="your email address with this provider"
```

9.6.11 Step by Step

9.6.11.1 Setup Connection

Modem

1. Prepare modem with SIM Card.
2. Choose initialization script with IF-Config and enter the correct PIN, see Manual: "*Setting Up - Connect the device*" > "*Special options for connecting to the device*" > "*Modem connection (TCP/IP with PPP)*" > "*Configuring devices as a PPP-Server* 70".
3. Prepare the device and connect the modem. Wait until the modem starts blinking with about 1 Hz.

WLAN

See Manual: "*Setting Up - Connect the device*" > "*Special options for connecting to the device*" > "*Device connection via WLAN* 62".

LAN

See Manual: "*Setting Up - Connect the device*" > "*Special options for connecting to the device*" > "*Device connection via LAN* 56".

9.6.11.2 Sending an Email

An Email will be sent, if virtual bit 01 will be set from 0 to 1. Replace the entries with blue background.

Save the following text as a text file that is called DEV001.msg. This file must be imported as a supplemental file 185 into the experiment.

Sending an Email via LAN

For this example, the device must be connected to the internet via LAN.

Example

```
# Send an Email, if Virtual_Bit01 is set to 1
[Virt_Bit01]
Event=TransitionToOne
MessageType=EMAIL

# IP-address of mailserver
SMTPServer=mx.freenet.de
SMTPLoginMethod=cram-md5
SMTPServerSecurity=StartTLS
SMTPLoginName=TestMail@freenet.de
SMTPPassword=MyPassword

# Sender: If the mailserver does not check the destination, it can be used as
imaginary address.
SenderAddress=My device <TestMail@freenet.de>

# Email addresse of recipient
Destination=john.smith@imc-tm.de

# reference line
Subject=This mail is send by an imc device {DeviceName}

# Example for message text
Message=The temperature is {DisplayVar_01, %3.1f}°C
```

Sending an Email via modem

For this example, a **modem** 799 is necessary.

Example

```
# Send an Email, if Virtual_Bit01 is set to 1
[Virt_Bit01]
Event=TransitionToOne
MessageType=EMAIL

# Data for Internet access
# 0 for dial tone
ProviderPhoneNumber=22243
ProviderLoginName=freenet
ProviderPassword=mobil

# Data for mail server access
SMTPServer=mx.freenet.de
SMTPLoginMethod=cram-md5
SMTPServerSecurity=StartTLS
SMTPLoginName=TestMail@freenet.de
SMTPPassword=MyPassword
SenderAddress=My device <TestMail@freenet.de>

# Email addresse of recipient
Destination=john.smith@imc-tm.de

# reference line
Subject=This mail is send by an imc device {DeviceName}

# Example for message text
Message=The temperature is {DisplayVar_01, %3.1f}°C
```

9.7 Configure via FTP

It is possible to transfer any desired files to the device via FTP. This method can be used to write configuration files to the device. The device is configurable via FTP.

Warning

- When overwriting a file via FTP, any interruption of the transmission can cause the file to become invalid/damaged. If the file affected is the autostart configuration, the device will from that time on always attempt to carry out an autostart with the invalid file, each time the device is activated. It is even possible that the device will crash every time this happens. As a result, the devices may no longer be remotely accessible and may require repair.
- For this reason, **we strongly recommend that the autostart configuration(s) never be overwritten via an insecure (FTP) connection!**
- **imc STUDIO can not connect to the measurement!**

XmlRpcCmd

For configuration of devices via FTP, a **command interface** has been implemented. The command is called by **transmitting a text file to the root of the internal disk** which contains the command call incl. the associated parameters (xmlrpc method call, file: "xmlrpccmd.call").

A new configuration is transmitted as a separate file.

After the command is run, the result is saved in the form of a text file (xmlrpc response, file: "xmlrpccmd.response") which can be retrieved. To ensure the integrity of these files, their validity is confirmed by the creation of new files of length 0: "xmlrpccmd.call.valid" or respectively "xmlrpccmd.response.valid".

Possible configurations

1.Reconfiguring and starting the device

The ***autostart configuration*** will be started. Without autostart configuration, the device will be started but without recording.

2. Reconfiguring and starting the device with the specified configuration

The ***configuration must be present on the device***.The configuration may have been overwritten via FTP or newly created. A diskstart configuration (ume.zip) or autostart configuration (ums.zip) may be specified.

3. Reconfiguring and starting the device with the transmitted configuration

The new configuration is transmitted to the device via FTP. However, the configuration is only overwritten when the command is run in the device itself. This means that even a configuration in the internal Flash can be altered! An interrupted connection has no effect and the security is significantly increased.

This is the method recommended for altering an autostart configuration!

Constraints:

- The experiment to be altered must already exist.
- An autostart configuration (ums.zip) can only be overwritten with an autostart configuration.
- A diskstart configuration (ume.zip) can not be overwritten with an diskstart configuration.

9.7.1 Procedure

All file actions on the device are located directly in the ***root folder of the internal disk***.

1. User:

- If necessary,
  - delete from the device the files "*xmlrpccmd.call", "xmlrpccmd.call.valid", "xmlrpccmd.response"* and *"xmlrpccmd.response.valid".*
  - copy the new *configuration file* to the internal data storage medium.
- Copy the file
  - "*xmlrpccmd.call*". This file must contain a valid command description (see examples supplied).
  - "*xmlrpccmd.call.valid*". This file should be empty. It only serves to confirm that "*xmlrpccmd.call*" has been copied successfully.

2. Device:

- The files "*xmlrpccmd.call"* and *"xmlrpccmd.call.valid*" are read and subsequently deleted .
- If necessary, the new configuration file is copied to the target folder and deleted.
- The devices configures and starts the experiment.
- The device creates the file "*xmlrpccmd.response*", in which the results of the command is returned.
- To indicate that "*xmlrpccmd.response*" is valid, the file "*xmlrpccmd.response.valid*" is created.

3. User:

- Wait for "*xmlrpccmd.response.valid*". Provide a timeout! At least 1 min, but preferably 3 min., depending on the connection speed and quality.
- Copy "*xmlrpccmd.response*" for evaluation on the PC.
- Delete the files "*xmlrpccmd.response*" and "*xmlrpccmd.response.valid*" from the device.
- In case of a timeout, delete any files no longer needed.

9.7.2 Example of a configuration via FTP

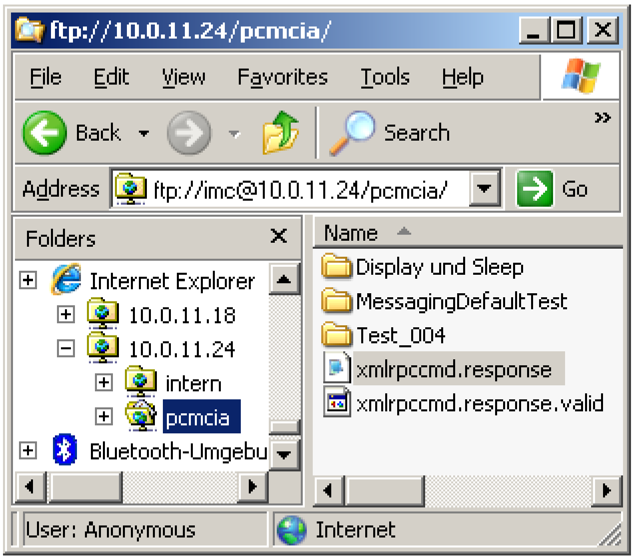
The following example shows how an *imcMessaging default configuration* is activated. At the same time, the device is instructed to perform cyclical transmission of information via UDP Status Monitoring.

1. First create a small "autostart" experiment.

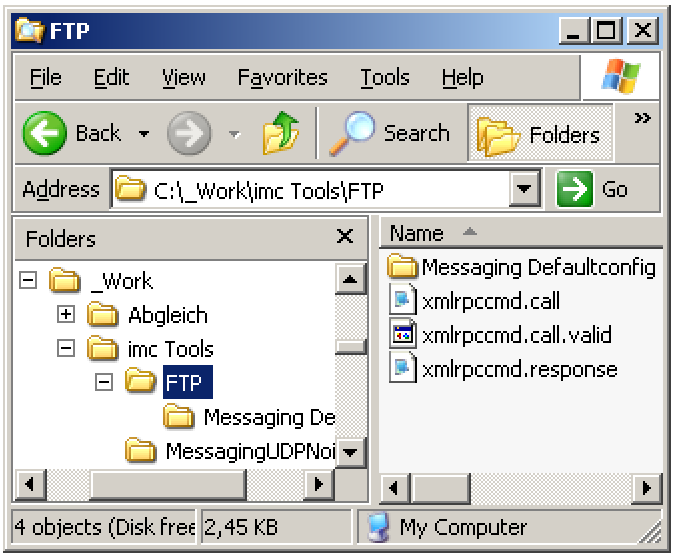
In the example, an e-mail is sent when virtual bit 1 changes from 0 to 1. Therefore, Virtual Bit 1 must be set while the experiment is running. The performance of this event can be automated with imc Online FAMOS, for example, using a timer or a ramp function. Save this experiment to the device as a self-activation configuration.

2. Open two instances of your Explorers. One window shows your device. To do this, enter "ftp://" and the device's IP-address, e.g. "ftp://imc@10.0.11.24/pcmcia/".

The second window shows your local folder in which the files to be transmitted are located.



The measurement device's data carriers



Source directory of the FTP configuration files

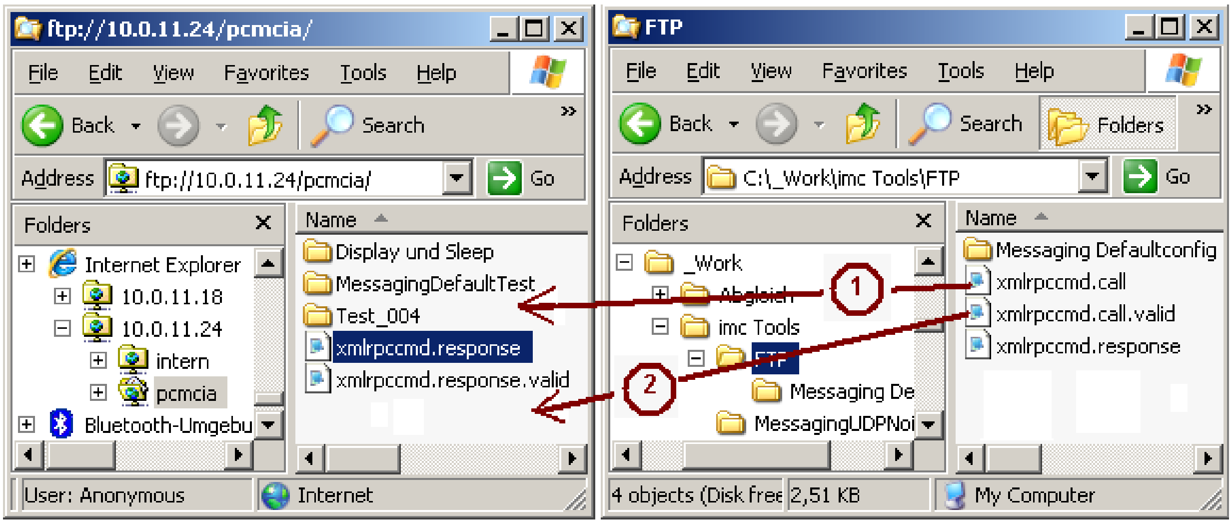
3. Create a text file "xmlrpccmd.call" and copy the following sample text to this file:

The segments of code appearing below in boldface must be adapted. The comments, appearing in green, are to be deleted subsequently.

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
   <methodName>SetimcMessagingDefaultConfig</methodName>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value>2008-06-02 13:29:38</value>
           </member>
           <member>
             <name>Configuration</name>
<value>[UDP Status Monitoring]
# The IP address of the destination PC
DestinationIP=15.0.1.17 ; here, enter your PC's target address.
# The UDP port to send the data to
# Port 9 is the "discard" port and should do no harm to the PC
DestinationPort=9 ; here. enter the port via which your computer receives UDP.
# The interval in seconds (e.g. send every 4min)
Interval=10 ; interval in seconds. Here, enter how often to send a UDP message.

# The data to send:
Message={DeviceName} {DateTime, %Y-%m-%d %H:%M:%S}
Message={SerialNumber}
Message={SoftwareVersion} {SoftwareDateTime, %Y-%m-%d}
Message={MeasurementStatus, %u}


[Virt_Bit01]
Event=TransitionToOne
MessageType=EMAIL
; here, enter your mail server's address
SMTPServer=15.0.0.19
; origin address of the e-mail sent. It is not applied and is merely for your own information.
SenderAddress=CS-7008SN122399@imc-tm.de
; e-mail address to which the device sends the message generated.
Destination=Max.Mustermann@imc-tm.de
Subject=Message from device {DeviceName}!
Message={DeviceName} {DateTime, %Y-%m-%d %H:%M:%S}
Message={SerialNumber}
Message={SoftwareVersion} {SoftwareDateTime, %Y-%m-%d}
Message={MeasurementStatus, %u}
</value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value>2008-06-02 13:29:38</value>
           </member>
           <member>
             <name>Result</name>
             <value>
               <i4>0</i4>
             </value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodResponse>
```

4. Create a text file with the name xmlrpccmd.call.valid. This file has no content!

5. Next, copy the file xmlrpccmd.call and then the file xmlrpccmd.call.valid to the device folder.



Transfer of the configuration files

6. Wait a few seconds and then update the Explorer [F5].

Now the copied files disappear and **xmlrpccmd.response** and **xmlrpccmd.response.valid** appear. The response file can be read with a text editor, and its return value is 0 if everything worked. Otherwise, an error code is returned. In this case, check your xmlrpccmd.call file again. If you don't find any errors, please contact our hotline.

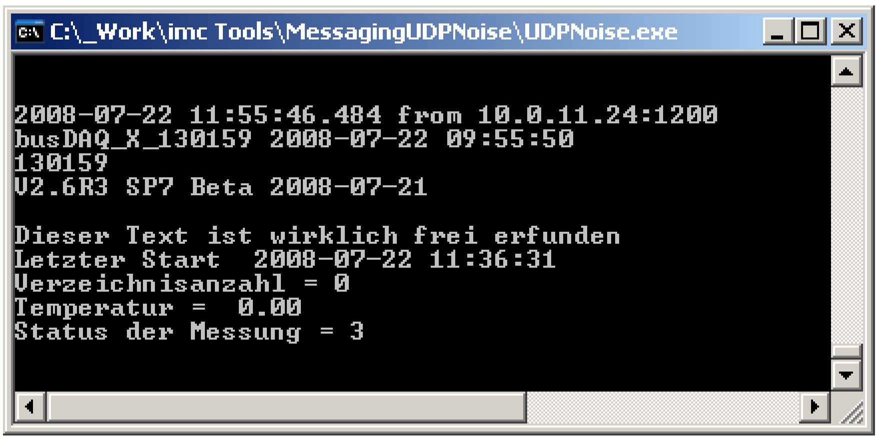
```
...
- <member>
<name>Result</name>
- <value>
  <i4>0</i4>
</value>...
```

<---- here you find the return value

7. The changes only take effect upon the next preparation procedure.

Cause a new preparation process by restarting, either by re-activation or by wakening from the SleepMode (only for busDAQ).

Check whether the e-mails arrive. The UDP messages can be checked using the program *UDP Status Monitoring.exe*.



Messages arriving via UDP

9.7.3 Syntax of command call and response

The following commands are implemented:

XmlRpcCmdReconfigure Reconfiguring and starting the device.

The following parameters can be specified in the command call (file: "xmlrpccmd.call"):

SourceDrive:

"Removable" -> PCMCIA or CF-Card
"Nonremovable" -> IDE or CF-Adapter

SourceFile:

"devXXX.ums.zip" or "devXXX.ume.zip", XXX refers to the device number.

DestinationDrive:

"Removable" -> PCMCIA or CF-Card
"Nonremovable" -> IDE or CF-Adapter
"Internal" -> Flashdisk of the interface

Experiment:

Experiment name

RequestID (optional):

An arbitrary string, copied to "xmlrpccmd.response" by the device. If appropriate, unique strings are used, it is possible to recognize unambiguously, whether "xmlrpccmd.response" belongs to the current command.

The response (file: "xmlrpccmd.response") contains the following values:

- *Result*: The imc STUDIO error code, or respectively 0, if no error occurred.
- *RequestID*: The string from "xmlrpccmd.call", or empty, if no RequestID was specified.

SetimcMessagingDefaultConfig: Default configuration for imc Messaging 787

The following points must be observed:

1. The command "SetimcMessagingDefaultConfig" does not immediately reconfigure the device. The changes only take effect the next time a measurement is prepared!
2. The return value only indicates whether the command was able to be executed properly. There is no syntax check of the configuration supplied!

RequestID (optional): An arbitrary string adopted by the device in "xmlrpccmd.response". If appropriate, non-repeating strings are used, it is possible to detect with certainty whether "xmlrpccmd.response" belongs to the current command.

Configuration: The new default configuration for the imcMessaging as an XML-encoded string. It is important for the configuration to be XML-encoded, since this means that some characters are replaced by Escape sequences which would otherwise lead to syntax errors. Within the configuration, the line formatting must be retained and indents must be avoided, since they would either lead to syntax errors or to corresponding extra indents in the messages. If an empty string is submitted as a configuration, the default configuration is deleted!

The response (file: "xmlrpccmd.response") contains the following values:

- *iRet:* The imc STUDIO error code or 0, if no error has occurred.
- *Result:* Identical to iRet, still retained for compatibility purposes
- *RequestID*: The string from "xmlrpccmd.call", or empty, if no RequestID has been specified.

GetSoftwareVersion

RequestID (optional): An arbitrary string adopted by the device in "xmlrpccmd.response". If appropriate, non-repeating strings are used, it is possible to detect with certainty whether "xmlrpccmd.response" belongs to the current command. The response (file: "xmlrpccmd.response") contains the following values:

- *iRet:* The imc STUDIO error code or 0, if no error has occurred.
- *Result:* Identical to iRet, still retained for compatibility purposes
- *RequestID*: The string from "xmlrpccmd.call", or empty, if no RequestID has been specified.

SoftwareVersion: The software version of the device as a string on the format "Version 2.6R3 SP7 Beta (31.5.2008)".

Note

- The **capitalization** of the parameter names is relevant!
- To see the exact syntax, observe the following examples.

9.7.4 Templates

Use the following templates and complete the necessary information. The explanation of the commands can be accessed via a link.

9.7.4.1 Reconfiguring and starting the device

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
   <methodName>XmlRpcCmdReconfigure 807</methodName>
</methodCall>

"xmlrpccmd.response":

<?xml version="1.0"?>
<methodResponse>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value/>
           </member>
           <member>
             <name>Result</name>
             <value>
               <i4>0</i4>
             </value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodResponse>
```

9.7.4.2 Reconfiguring and starting the device with the specified configuration

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
   <methodName>XmlRpcCmdReconfigure 807</methodName>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID 807</name>
             <value>2007-10-18 12:34:38</value>
           </member>
           <member>
             <name>DestinationDrive 807</name>
             <value>Removable</value>
           </member>
           <member>
             <name>Experiment 807</name>
             <value>Test_001</value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value>2007-10-18 12:34:38</value>
           </member>
           <member>
             <name>Result</name>
             <value>
               <i4>0</i4>
             </value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodResponse>
```

9.7.4.3 Reconfiguring and starting the device with the transmitted configuration.

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
   <methodName>XmlRpcCmdReconfigure 807</methodName>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID 807</name>
             <value>2007-10-18 15:49:06</value>
           </member>
           <member>
             <name>SourceDrive 807</name>
             <value>Removable</value>
           </member>
           <member>
             <name>SourceFile 807</name>
             <value>dev002.ume.zip</value>
           </member>
           <member>
             <name>DestinationDrive 807</name>
             <value>Removable</value>
           </member>
           <member>
             <name>Experiment 807</name>
             <value>Test_001</value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value>2007-10-18 15:49:06</value>
           </member>
           <member>
             <name>Result</name>
             <value>
               <i4>0</i4>
             </value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodResponse>
```

9.7.4.4 Get version with GetSoftwareVersion

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
   <methodName>GetSoftwareVersion 808</methodName>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID 807</name>
             <value>2008-06-02 14:23:56</value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
   <params>
     <param>
       <value>
         <struct>
           <member>
             <name>RequestID</name>
             <value>2008-06-02 14:23:56</value>
           </member>
           <member>
             <name>Result</name>
             <value>
               <i4>0</i4>
             </value>
           </member>
           <member>
             <name>SoftwareVersion 808</name>
             <value>V2.6R3 SP7 Beta (31.5.2008)</value>
           </member>
         </struct>
       </value>
     </param>
   </params>
</methodResponse>
```

9.7.4.5 imc Messaging default configuration

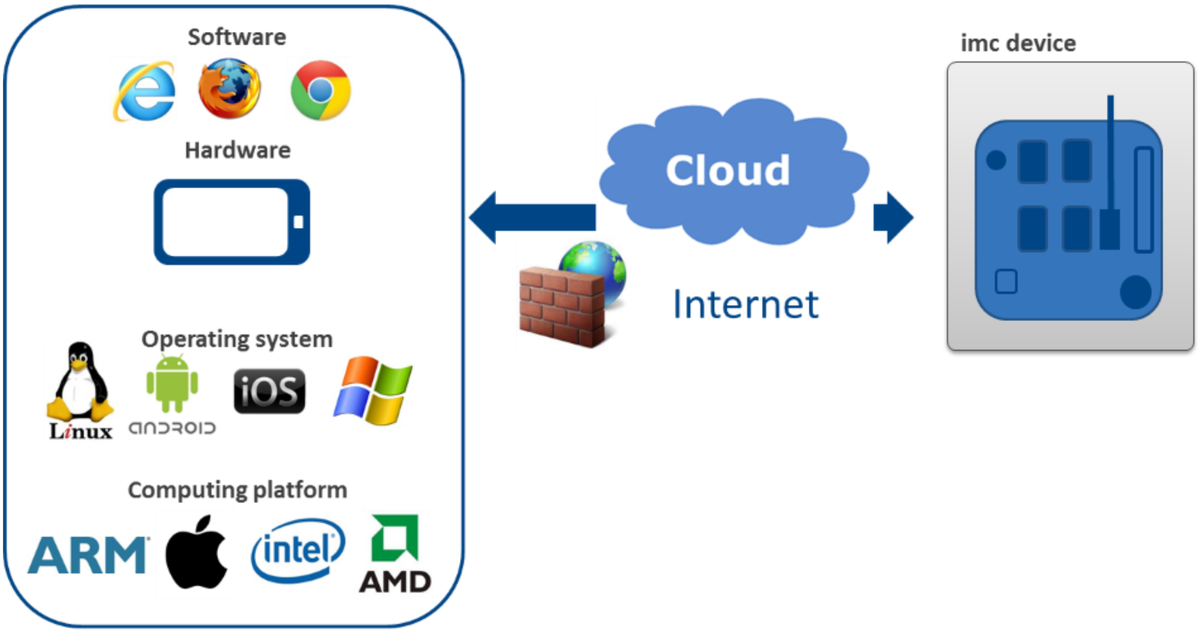
9.7.4.5.1 Delete default configuration


```
""xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
  <methodName>SetimcMessagingDefaultConfig 807</methodName>
  <params>
    <param>
      <value>
        <struct>
          <member>
            <name>RequestID 807</name>
            <value>2008-06-02 13:25:12</value>
          </member>
          <member>
            <name>Configuration 807</name>
            <value></value>
          </member>
        </struct>
      </value>
    </param>
  </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
  <params>
    <param>
      <value>
        <struct>
          <member>
            <name>RequestID</name>
            <value>2008-06-02 13:25:12</value>
          </member>
          <member>
            <name>Result</name>
            <value>
              <i4>0</i4>
            </value>
          </member>
        </struct>
      </value>
    </param>
  </params>
</methodResponse>
```

9.7.4.5.2 Set default configuration

```
"xmlrpccmd.call":
<?xml version="1.0"?>
<methodCall>
  <methodName>SetimcMessagingDefaultConfig 807</methodName>
  <params>
    <param>
      <value>
        <struct>
          <member>
            <name>RequestID 807</name>
            <value>2008-06-02 13:29:38</value>
          </member>
          <member>
            <name>Configuration</name>
<value>[UDP Status Monitoring]
# The IP address of the destination PC
DestinationIP=10.0.2.7
# The UDP port to send the data to
# Port 9 is the &quot;discard&quot; port and should do no harm to the PC
DestinationPort=9
# The interval in seconds (e.g. send every 4min)
Interval=240
# The data to send:
Message={DeviceName} {DateTime, %Y-%m-%d %H:%M:%S}

Message={SerialNumber}
Message={SoftwareVersion} {SoftwareDateTime, %Y-%m-%d}
Message={MeasurementStatus, %u}

[Virt_Bit01]
Event=TransitionToOne
MessageType=EMAIL
SMTPServer=smpt.company.com
SenderAddress=Sender name &lt;sender@company.com&gt;
Destination=destination@company.com
Subject=Message from device {DeviceName}!
Message={DeviceName} {DateTime, %Y-%m-%d %H:%M:%S}
Message={SerialNumber}
Message={SoftwareVersion} {SoftwareDateTime, %Y-%m-%d}
Message={MeasurementStatus, %u}
</value>
          </member>
        </struct>
      </value>
    </param>
  </params>
</methodCall>

"xmlrpccmd.response":
<?xml version="1.0"?>
<methodResponse>
  <params>
    <param>
      <value>
        <struct>
          <member>
            <name>RequestID</name>
            <value>2008-06-02 13:29:38</value>
          </member>
          <member>
            <name>Result</name>
            <value>
              <i4>0</i4>
            </value>
          </member>
        </struct>
      </value>
    </param>
  </params>
</methodResponse>
```

9.8 imc REMOTE WebServer



imc REMOTE provides platform-independent remote access to imc measurement systems. This extension enables the imc system on which it is activated and running to be accessed by a terminal device/computer via a network connection, without the terminal device needing either to have imc STUDIO installed or to meet the usual requirements regarding its operating system. For communication with the imc system via its web-server, all that is required is a standard Internet browser which may run on any desired terminal device platform (e.g. MS Windows, Linux, iOS, Android etc.), so that hand-held mobile Internet-capable devices such as Tablet PCs, smart phones etc. can be used.

imc REMOTE WebServer is designed for remotely accessing measurement systems via Internet and in particular across the network's Firewall boundaries, because it communicates by means of secure https protocols.

Important properties and applications:

- Communication by means of html web pages
- Display of system variables (Display variables, pv-variables, virtual bits)
- Intervention in the device status/measurement process and interaction with the measurement parameters by setting (writing) Display variables, digital outputs, virtual bits and network bits (Ether bits)
- Altering of the system configuration by selection among Auto- and Diskstart experiments pre-loaded to the measurement device
- Downloading of measured data (files)

9.8.1 System requirements

License Management and Activation

- **imc REMOTE** includes two components **imc REMOTE WebServer** and **imc REMOTE LinkSecure.** imc REMOTE is a system extension permanently installed in a measurement device, which must be enabled with a serial number activation code. Users with multiple systems must obtain a separate activation code for each system.
- **imc REMOTE WebDesigner**, to create or change panels of websites that are provided via the **imc REMOTE Webserver** with a **imc measurement device**. imc REMOTE WebDesigner will be activated on your PC with an activation code.

System requirements

Internet Browser	Device software
• Firefox Version 16 • Internet-Explorer Version 9 • Google Chrome 26.0 • Opera 12.02 • Safari 5.1.7	• Firmware (imc DEVICES) Version 2.9R2 and higher • imc STUDIO Version 5.0 and higher • Option imc REMOTE with imc REMOTE WebServer (including LinkSecure)=3 198 (one license per device required)

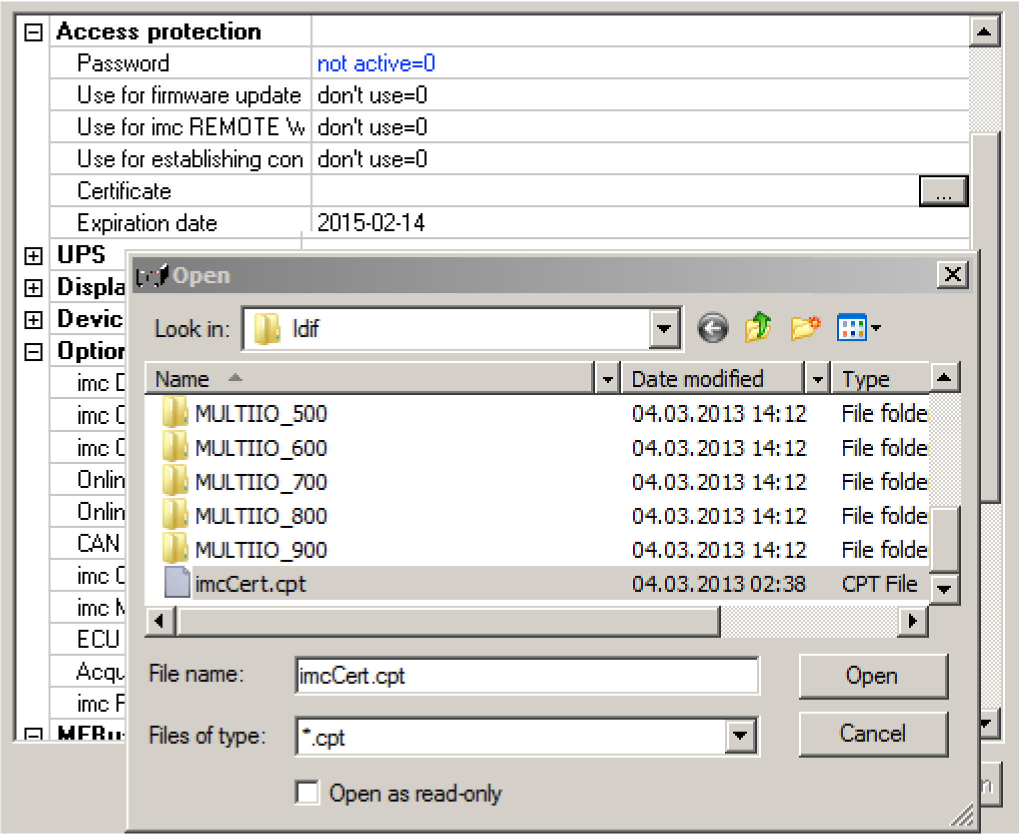
Measurement devices for imc REMOTE WebServer	Measurement devices for imc REMOTE WebDesigner
• The following devices are supported: • imc CRONOS*compact* • imc CRONOS*flex* • imc CRONOS-XT • imc BUSDAQ*flex* • imc SPARTAN • imc C-SERIES-FD	• Devices from group 7 on are supported: • imc CRONOS*compact* • imc CRONOS*flex* • imc CRONOS-XT

9.8.2 Activation

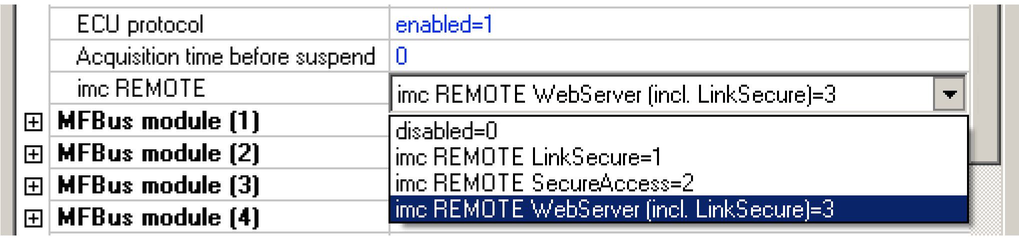
imc REMOTE WebServer is an optional product available for purchase. Upon purchase, you are supplied with an activation code which must be entered in the device properties.

1. Open the dialog **Device Properties** (Ribbon *Setup-Configuration* > *Device Properties*.

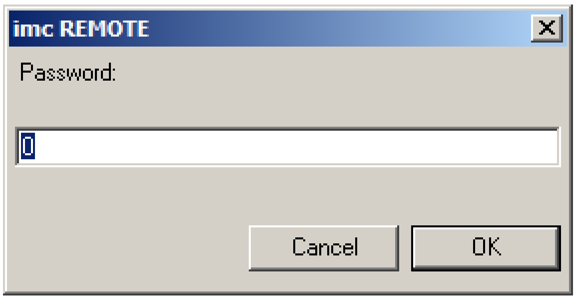
2. Load the certificate *imcCert.cpt*, which is required for secure access via https. The software points directly to the correct folder.



3. Activate imc REMOTE : imc REMOTE WebServer (including LinkSecure)=3



4. Enter the activation code which you obtained by purchasing the option.



5. If access is provided via Internet, we recommend that in the branch *Access protection*, you set the setting *Password* to "*active = 1*."

6. Close the dialog *Device Configuration* by clicking on *OK.*

7. The imc REMOTE WebServer 61 is activated. Remember the password for the purpose of subsequent calls of WebServer.

9.8.3 Calling from the Browser

Access to the WebServer from an Internet browser is provided via the device's IP-address.

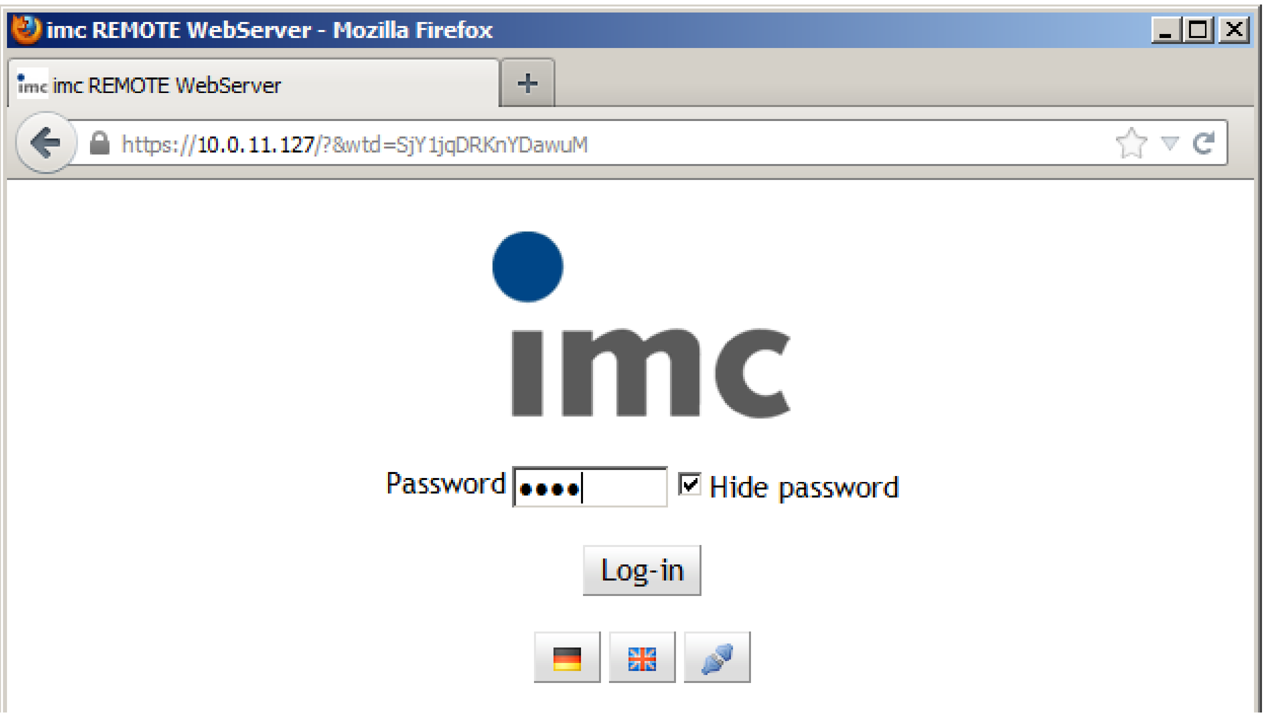
Enter https://IP-address in the address bar, e.g. https://10.0.20.132.

Note Find out the IP address

The IP-address for the device can be viewed and set using the dialog "*Device interface configuration* 53 ".

Ribbon	View
Setup-Configuration > Device interfaces ()	Complete

The input mask for the password you previously entered for the user-defined device 61 appears.

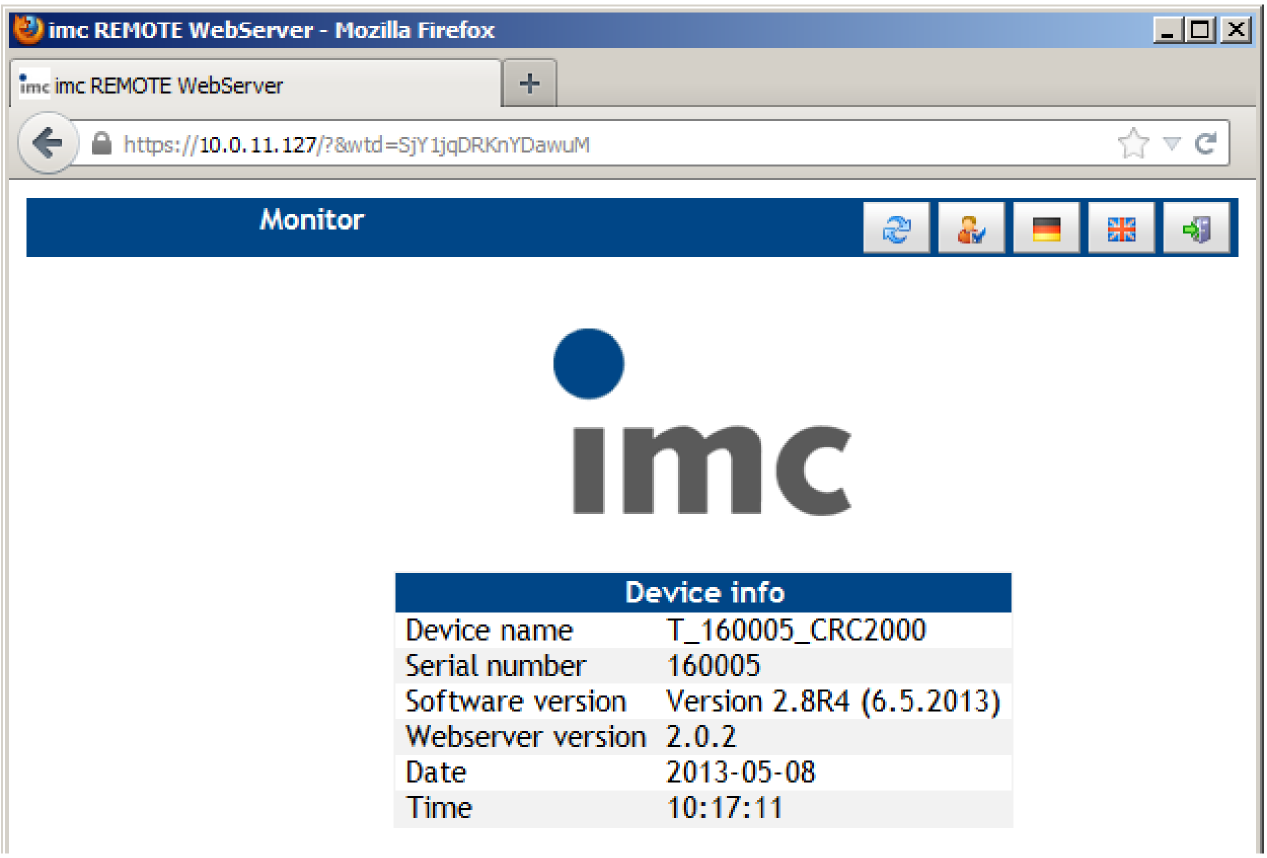


Access to the device and Log-in

Note

The **password** for the Web server is assigned via Device properties:Access protection:Password 195. With ccess protection:Use for establishing connection 195 , the query is activated or deactivated.

After successfully entering the password, the device information appears in the user role 819 "Monitor".



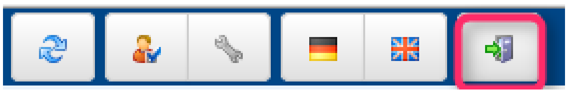
Main page of WebServer

9.8.3.1 Language Selection

The language displayed can be changed at any time:

9.8.3.2 Closing a session

Always close a session by clicking on the Close symbol at the upper right corner.

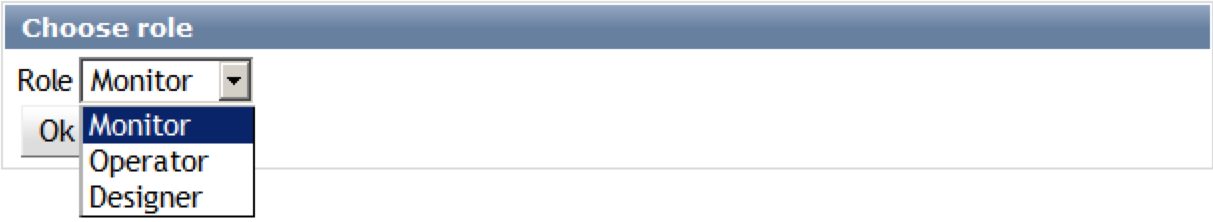


Note

It is better not to simply close the Browser to end a session. If you do, the device receives no notification. The server program continues to run and is blocked from allowing re-login with Designer privileges until the device closes the session by Timeout.

9.8.4 User Role

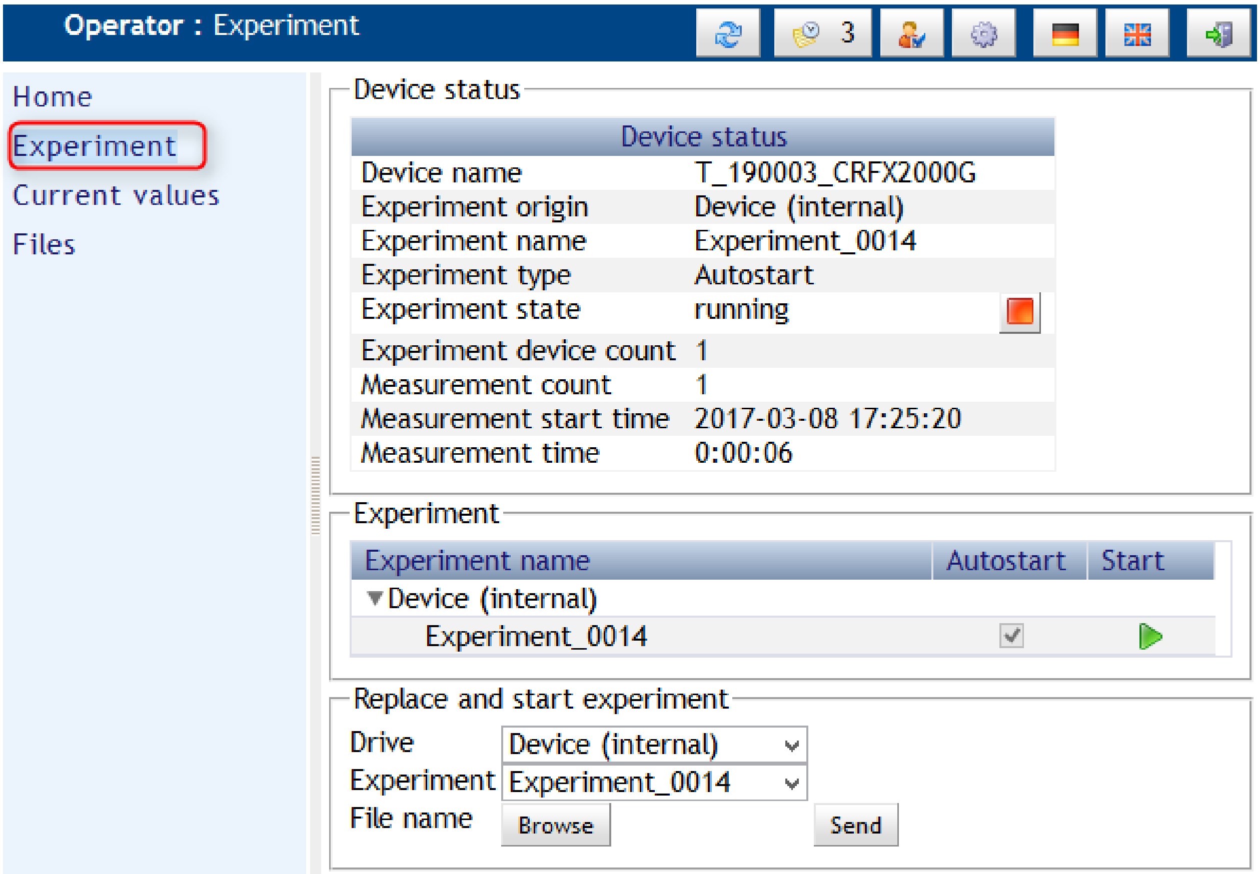
Version 2.0 and higher: There are three different user roles. By clicking on this icon, it is possible to change the selection of the user role.



User Role	Description
Monitor *(no password)*	• Observation of the system and measurement status • Querying of the device firmware-version (imc DEVICES) and the imc REMOTE WebServer version • Querying of system time and date • Downloading of measured data (files stored on onboard storage media) and the system experiment (configuration) • The Monitor role is read-only, i.e. interaction with the measurement (e.g. virtual bits or display variables) or changing of the running experiment (configuration) is prohibited. • It is not possible to change the selection for the current experiment. No intervention in the measurement state (start / stop) allowed.
Operator *(password optional)*	The Operator mode comes with the following functionality beyond that of Monitor: • Changing of the current configuration of the system/measurement, by selection and start of Diskstart-experiments • Changing of Auto-Start and Diskstart-configurations (experiments) by replacing experiments (upload/overwrite) • Starting/stopping the measurement (if the device is not connected and controlled by the user operation software imc STUDIO). • Ability to interact with a running measurement. For example, you can remotely intervene in a test by triggering a measurement, or to modify a calculation in imc Online FAMOS through a display variable, virtual bits, Ether bits, digital outputs and analog outputs.
Designer *(password protected*)*	• Configuration of which areas are accessible to the Operator role. • Creating and editing Panel pages • Display widgets: curve diagram, bar meter, pointer instrument, LED • I/O widgets: buttons, toggles, numerical input/output • Elements for graphical design: lines, circle, ellipse, etc. • License for imc REMOTE WebDesigner required • * The password is distributed by purchasing the "*imc REMOTE WebDesigner*" option.

9.8.5 Experiment

Experiments already present on the system can be replaced via the WebServer. This is only possible in Operator mode.



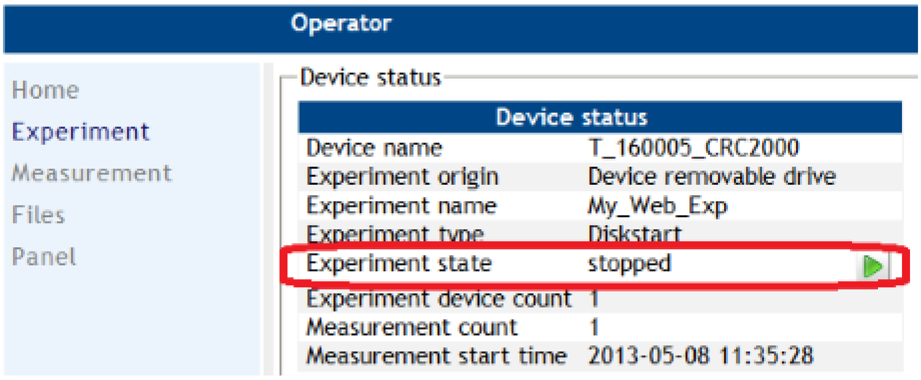
Step by step:

1. Create an Autostart- or Diskstart experiment 179 using the user operation software imc STUDIO. The experiment ("*.ume.zip" or "*.ums.zip"file) must be saved to the PC.
2. In the WebServer, select either the device's removable storage medium or its internal drive as the storage location.
3. Select the previously saved Auto-/Diskstart experiment by clicking on *Find*.
4. When you click on *Send*, the configuration is saved to the system and the measurement starts.
5. If you wish to keep multiple experiments available on the measurement system, repeat these steps for the other experiments.

9.8.5.1 Starting / stopping measurement

The measurement starts immediately once the experiment has been sent to the measurement system.

Otherwise, the measurement can be stopped at any time as well as restarted by clicking on the button next to *Experiment state*.

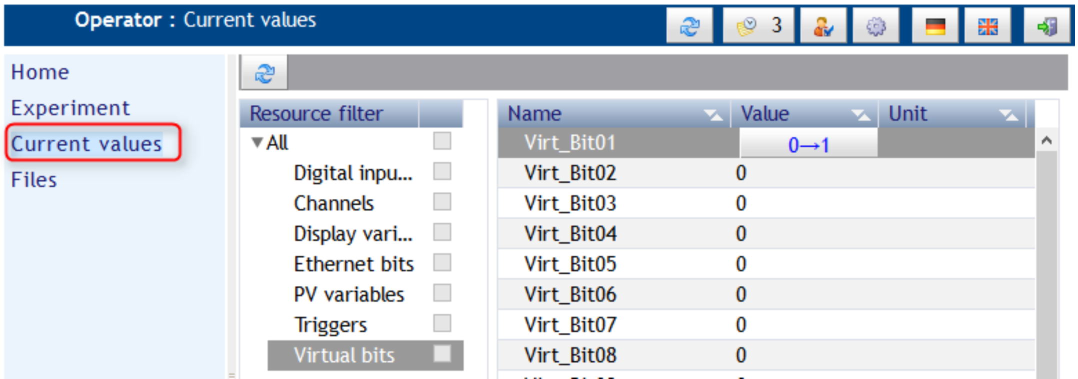


Note

If the measurement device is additionally connected with imc STUDIO, the function Start/Stop with imc Remote WebServer is deactivated. In this case, the Start/Stop button is hidden.

9.8.6 Current values

In both Operator and Designer modes, it is possible to influence the running measurement.



In Operator mode, you can change certain values and bits in the device. For instance, you can change a virtual bit's value, which can cause a trigger to be released in accordance with the respective configuration.

The same applies to digital output bits and network bits.

You can also set the value of the Display variable.

It is not possible to change PV-variables from imc STUDIO-AUTOMATION or imc Online FAMOS here. Changing of the PV-variables can be performed in the Panel using either of the widgets *Bar meter* 831 or *Numerical input/output* 832.

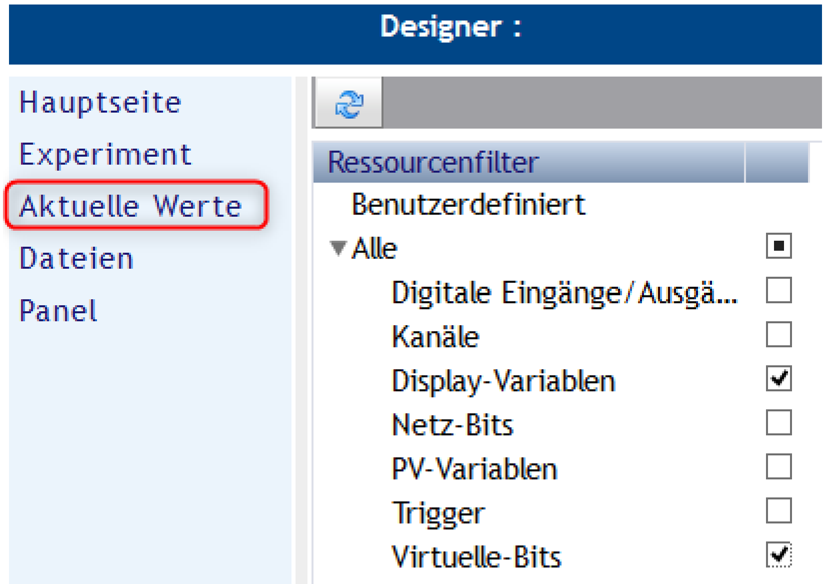
It is not possible to write values triggers.

Note

The values of the channels are **not** updated in this dialog. The channels' current values are displayed by the PV-variables.

9.8.6.1 Adapting the design

In the Designer mode 819, you set which resources are visible to the Operator.



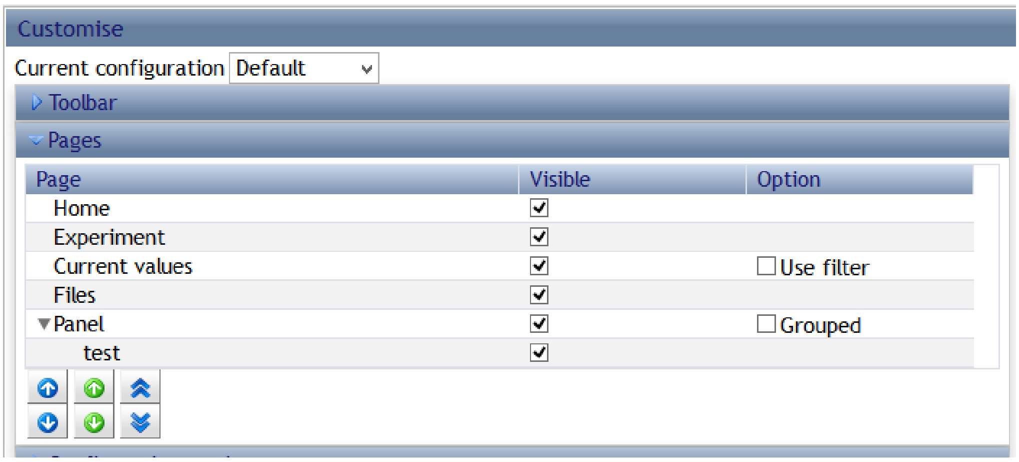
Only resources activated here are visible in Operator mode and can be changed (on the right side).

You can block either complete resources or individual elements such as bits or Display variables.

The dialog for the settings is only available in Designer mode 819:

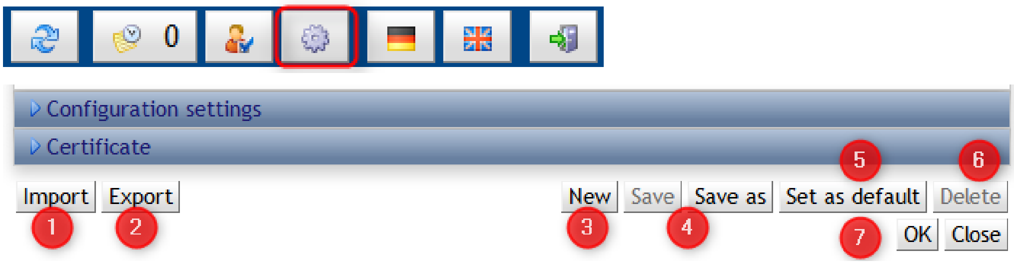
Pages

In the column *Visible*, you can restrict the selection of pages (*Home, Experiment, Current values, Files, Panel)*. However, the pages are only effectively hidden once you activate the option *Use filter*.



9.8.7 Settings im-/export, save

All settings can be set as default, imported and exported if Designer mode 819 is enabled:



New, Save, Set as default, OK

Settings for the current session are adopted when you click on the button *OK (7)*.

To adopt the settings in a permanent way, select *Set as default (5).*

Using the button *New (2)*, you can set up a new configuration. This will be initialized with the settings which were last adopted by *Set as default*.

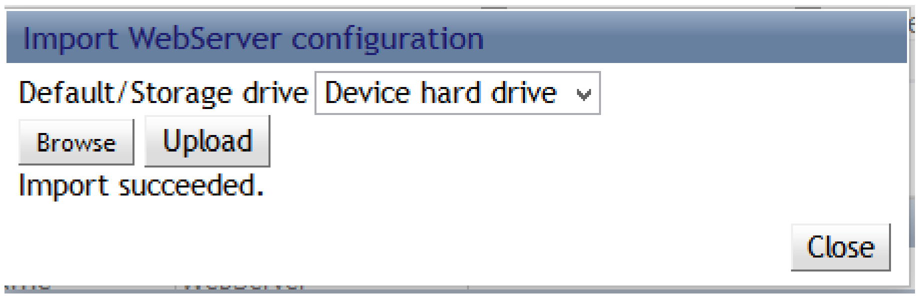
By means of *Save* and *Save as (4)*, the current configuration can be saved in the device's memory.

Using *Delete*, the current configuration can be deleted from the device memory.

Import, Export

You can *export (2)* the settings: A dialog having a link appears. Once you click on this, the selection dialog for saving the file *WebServer.imcwsc* appears*.*

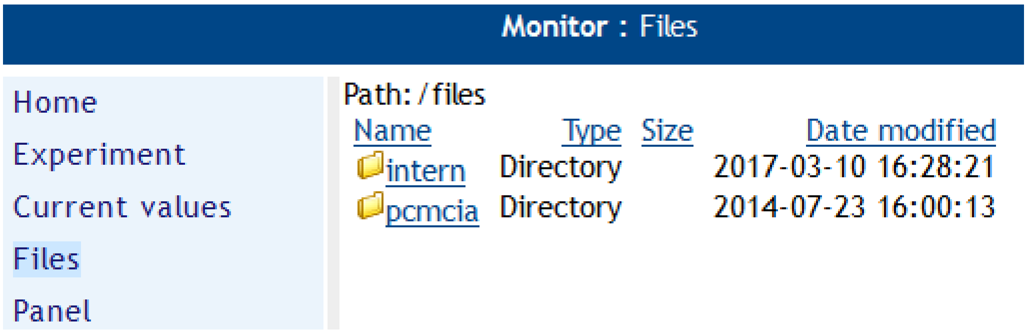
Import (1) also opens a dialog for selecting *WebServer.imcwsc.* Import is performed when you click on the button *"Upload"*.

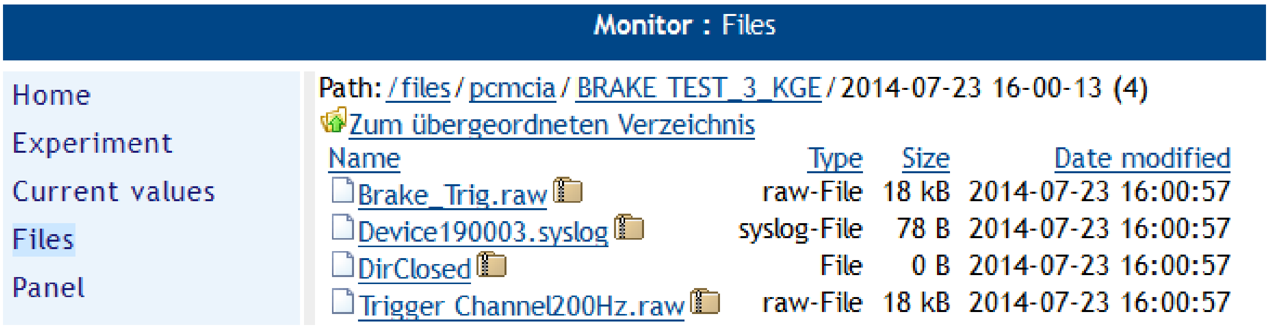


When you copy the file ***WebServer.imcwsc*** to the experiment's folder on the PC, the settings are applied upon the next upload.

9.8.8 Files

The item Files provides access to the internal and to the removable data storage.





The single files can be downloaded.

9.8.9 Panel

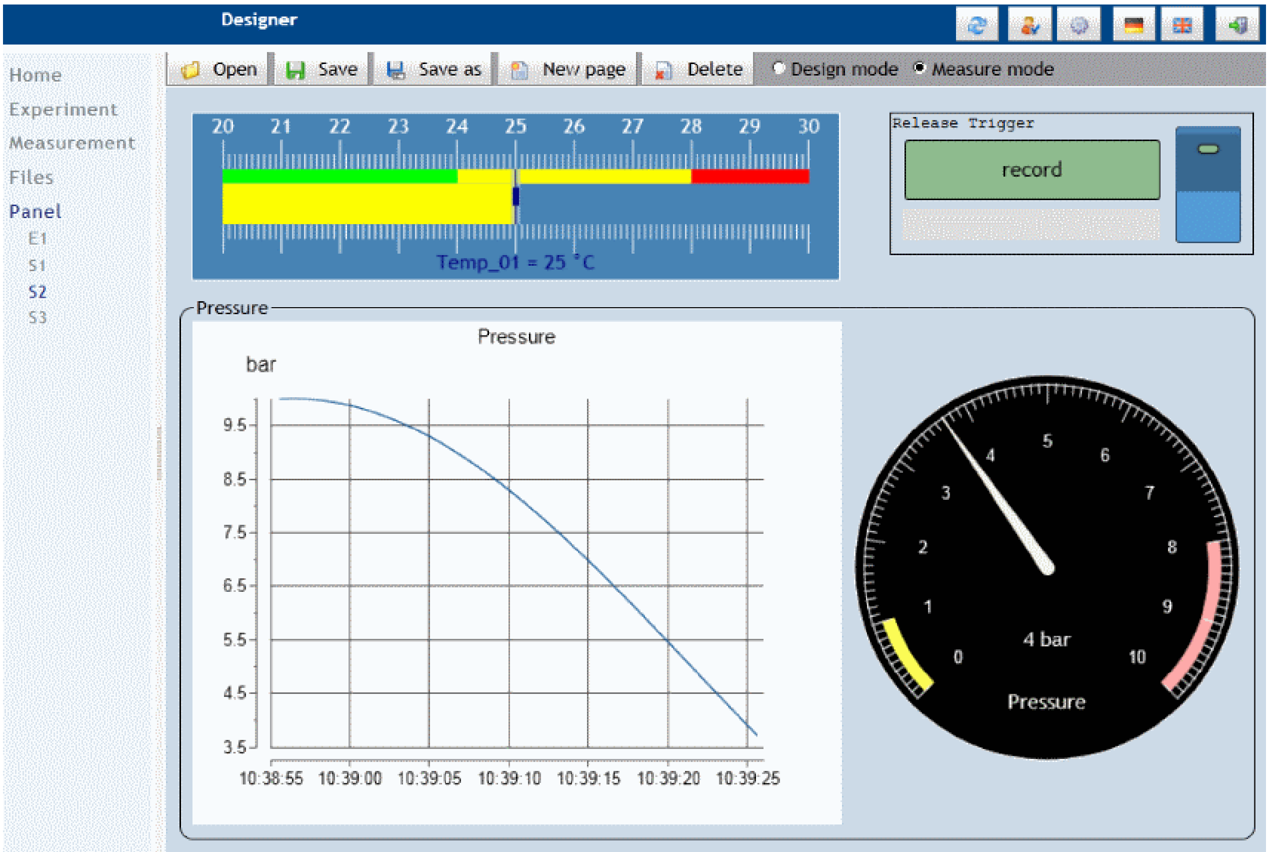
The web server from version 2.3 allows the use of panels. In the panel pane, it is possible to create multiple pages, by means of which the measurement's status can conveniently be displayed.

Note

We recommend stopping measurement while designing the web-pages. This can prevent possible performance bottlenecks, which, especially on smaller devices (CRC/CRFX-400, BUSDAQ), can cause Out-Of-Memory exceptions or overflow of measurement data to occur.

Note

For the purpose of creating Panel-pages, the option **imc REMOTE WebDesigner** is required and for the *User Role* 819, the selection *Designer* must be chosen.



Panel pages are saved in the device (Save As...) and can also be deleted from there. Saved Panel pages can be selected by mouse click, if they are made visible by adapting the design. Furthermore, saved Panel pages can be loaded using the button "Open".

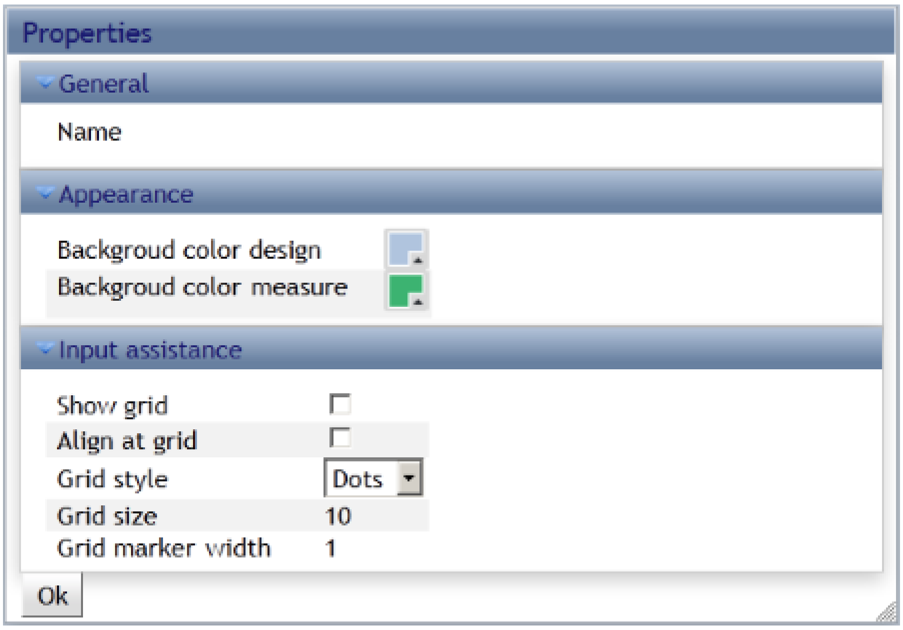
Note

- Panel pages are not saved along with the experiment. Once a page has been deleted, it can not be retrieved. Links with variables' names only work after switching to a different experiment if the same ones exist in that experiment.
- An Export/Import function for Panel pages is in preparation.

The Panel Page pane is only available in **Designer Mode**. In order that the Panels also be displayed in Monitor and Operator modes, they need to be set as visible in the configuration 822.

Once again the Panel itself distinguishes between Design and Measurement mode. In Design mode, the widgets are created. In Measurement mode, the data is exchanged with the device.

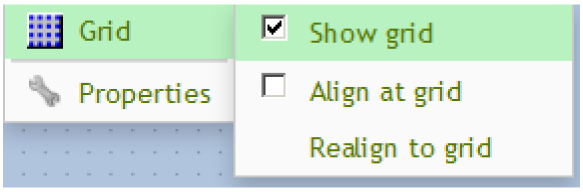
By right-clicking on the Panel page, the Properties become available for editing:



Panel properties

Along with the background color, the grid is also defined here.

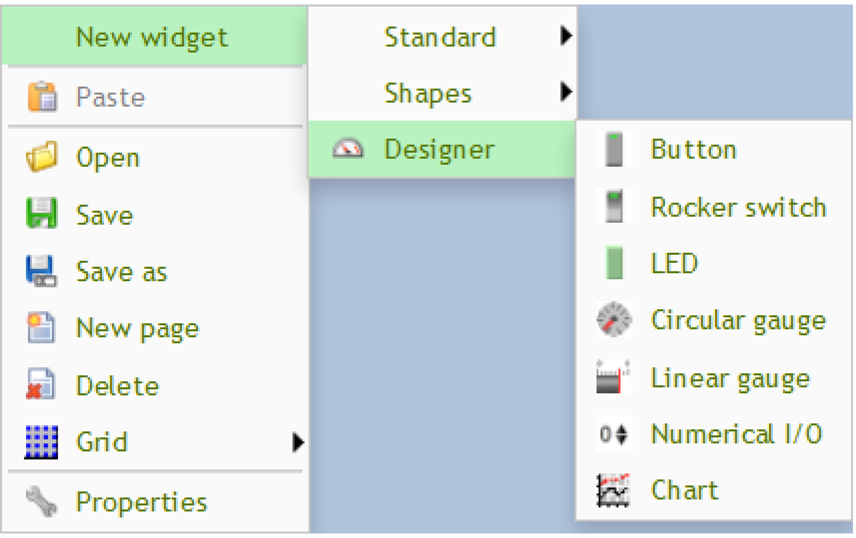
However, the grid can also be used by means of the menu item Grid:

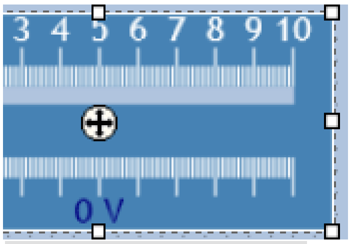


Grid context menu

9.8.9.1 Widgets

Widgets are created by right-clicking the mouse over the Panel.



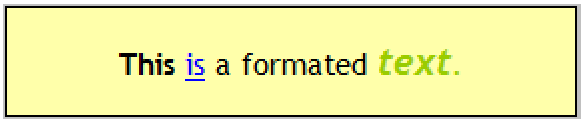


To call the widget's properties, right-click the mouse on the crosshairs in the center.

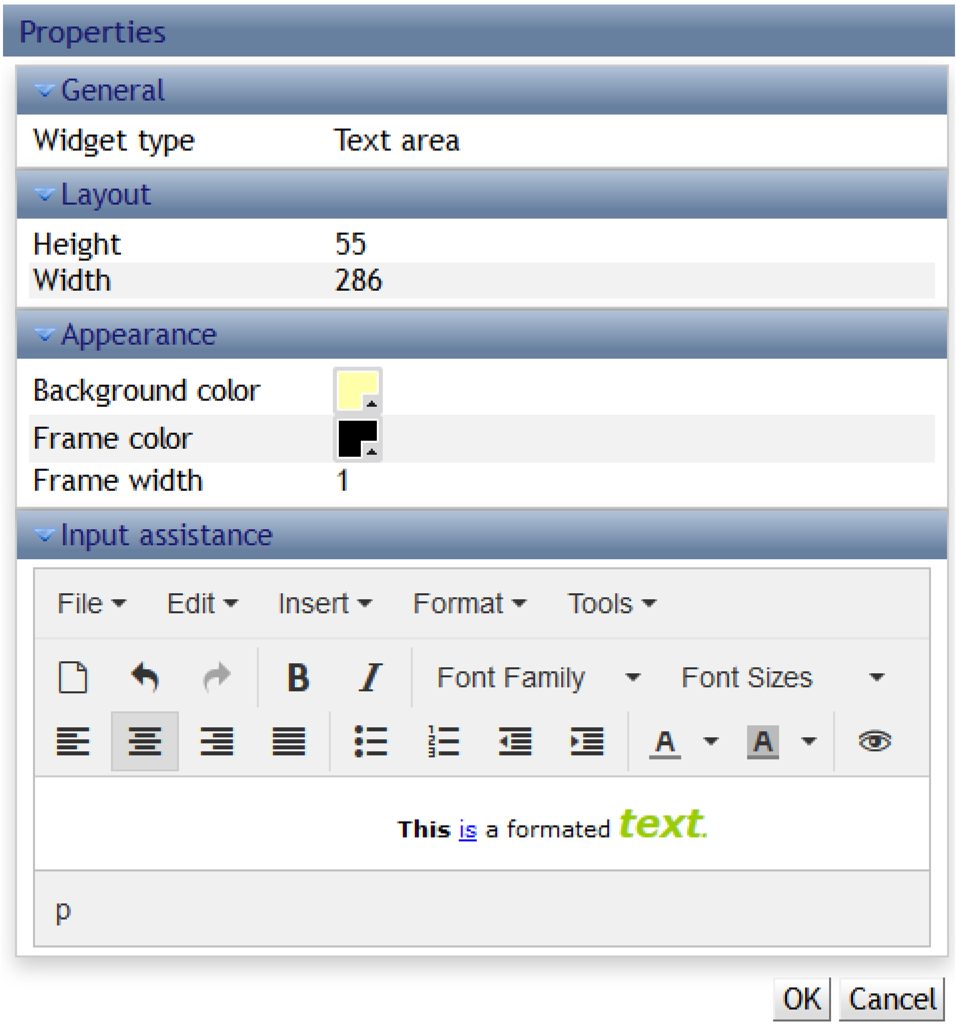
Note

- Note that the Web-Browser only receives single values from the device. Other channel parameters such as the sampling rate, unit or input range are not available. For this reason, these parameters must be entered manually in the widgets' properties.
- Although the Panel closely resembles a program's GUI, you are working with an Internet browser. For this reason, there are certain constraints on operation which can vary according to the browser selected. Thus, many key functions, such as Delete, are not supported but must be called via a context menu.

Standard - Text area

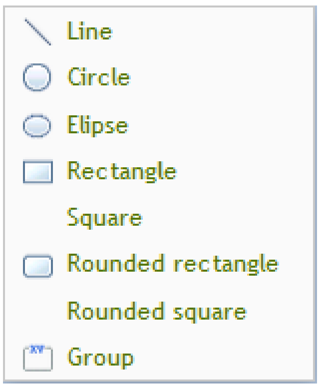


Widget for displaying text. It is possible to set font and colors, background and frame, as well as the frame width. The frame can be shaped by means of the mouse or entered directly in terms of pixels.

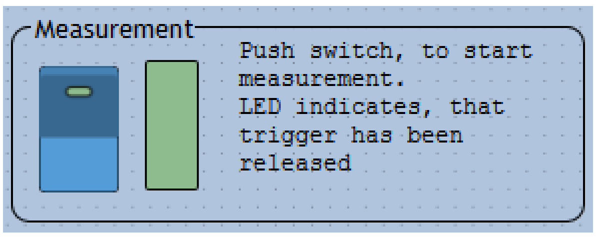


Shapes

As graphics elements, a variety of shapes are available.



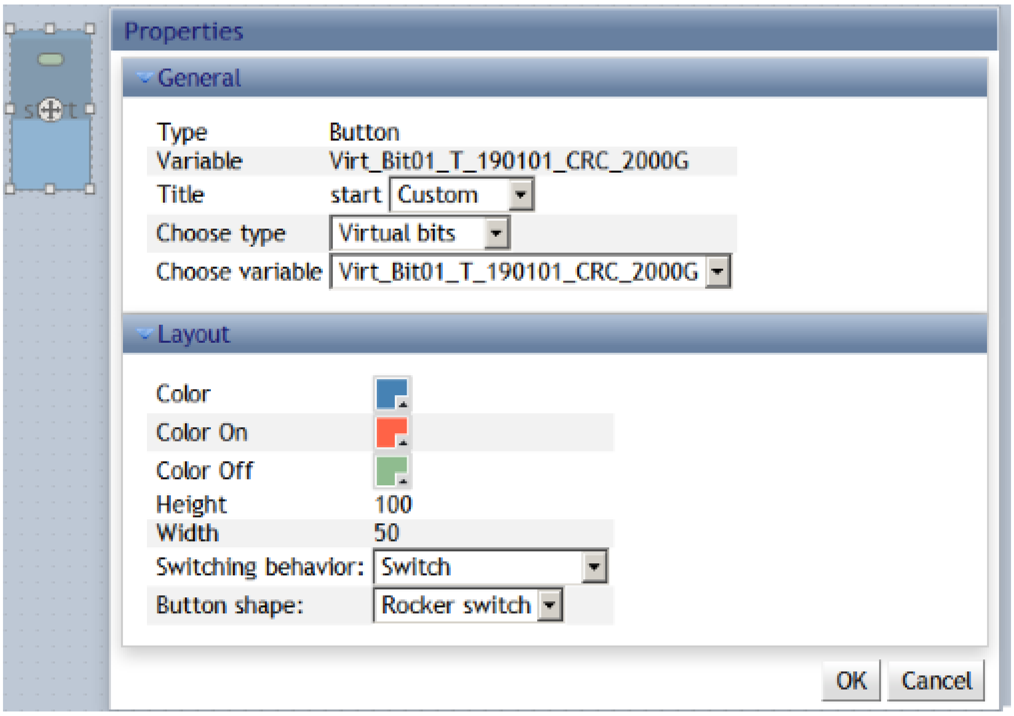
The group box can additionally be supplied with text.



Designer - Press key/toggle switch

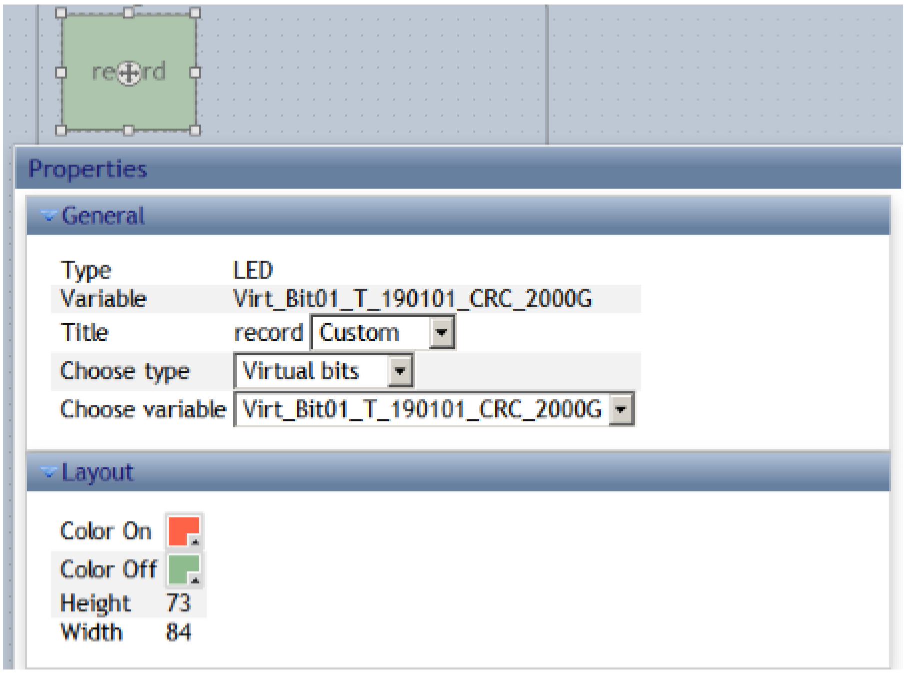
Switches/Pushbuttons can be linked with any digital variable (Virtual_Bits, Etherbits, digital inputs)

Their behavior and appearance can be set in the properties: Switch/Pushbutton and Rocker switch/Button.



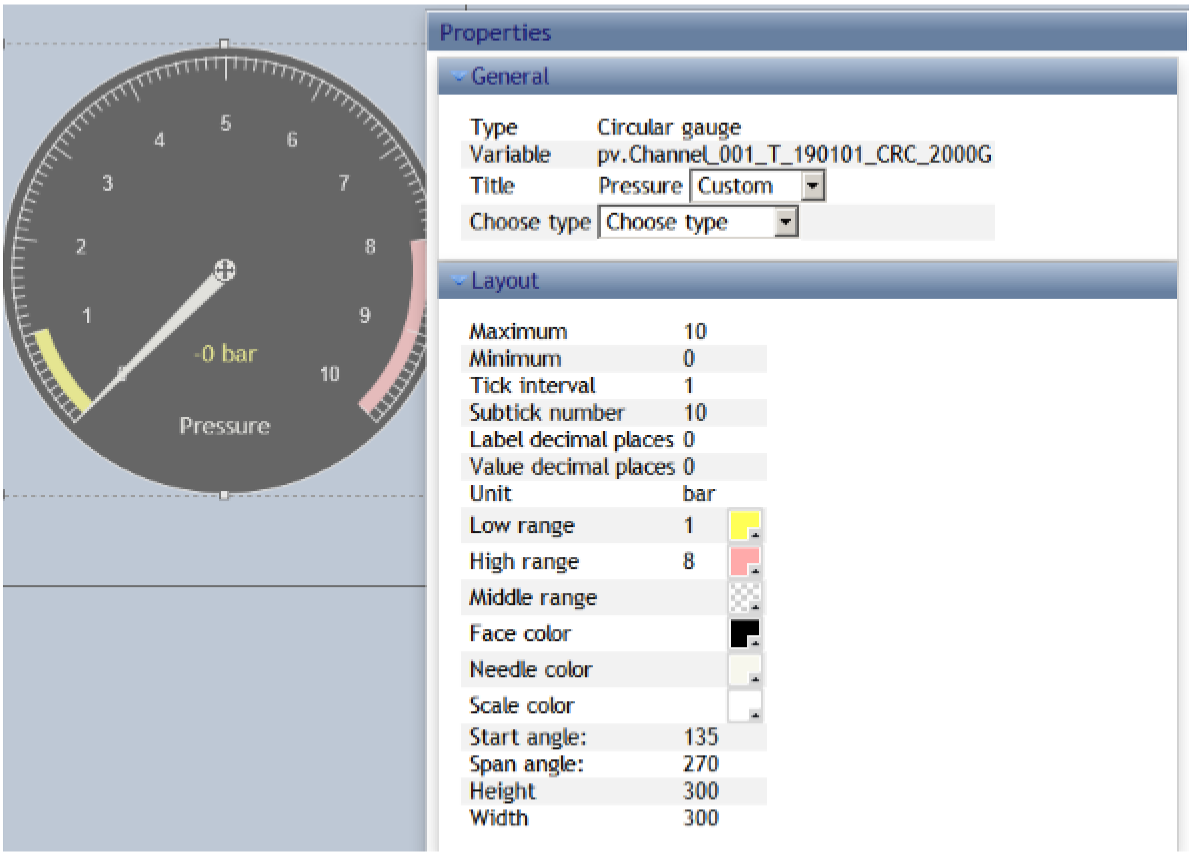
Designer - LED

LEDs can be linked with any digital variables (Virtual_Bits, Etherbits, digital inputs)



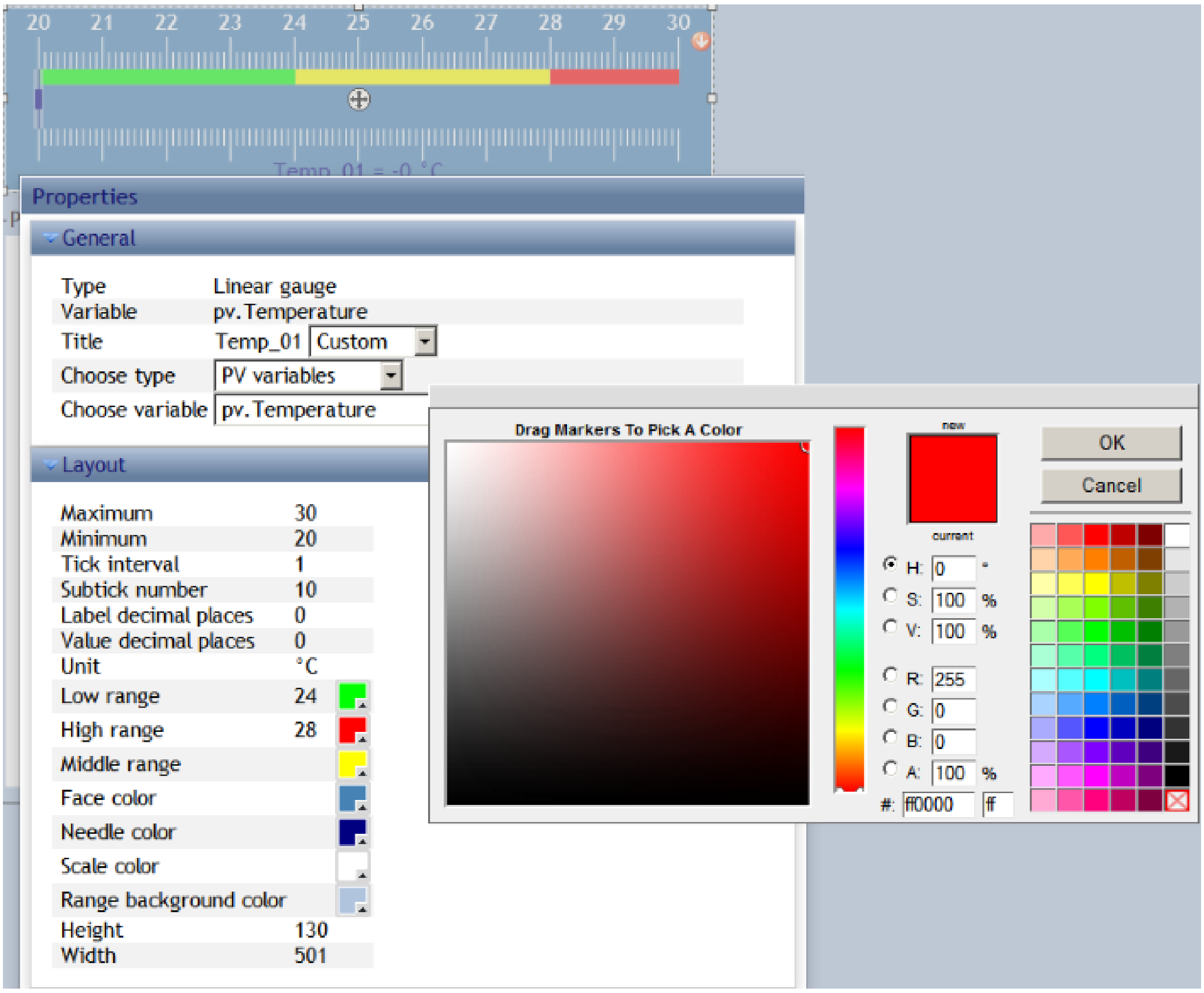
Designer - Pointer instrument

The available settings for the pointer instrument correspond to those of the bar meter.



Designer - Bar meter

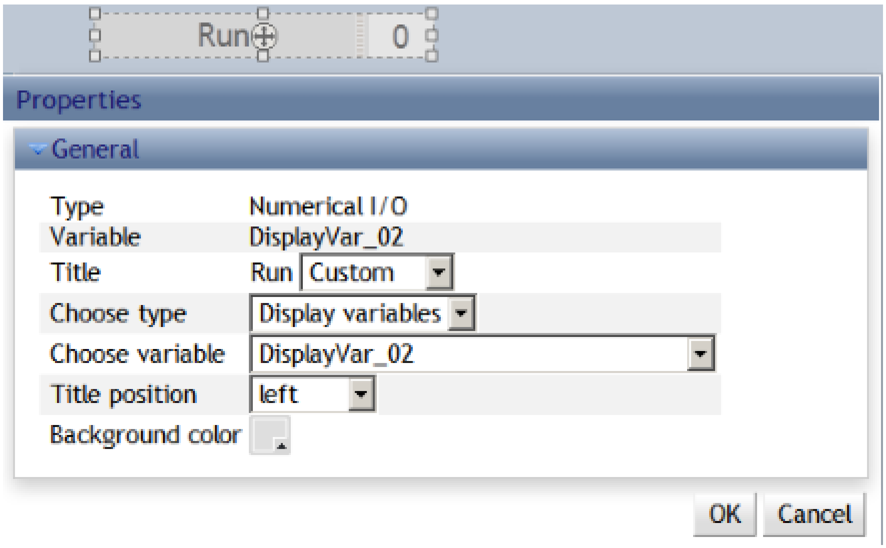
Display of the instantaneous value by a bar meter



Enter the minimum and maximum value of the linked channel. This is now the range in which the variable will be displayed. The colors change according to the current value; the value boundaries and colors can be freely selected.

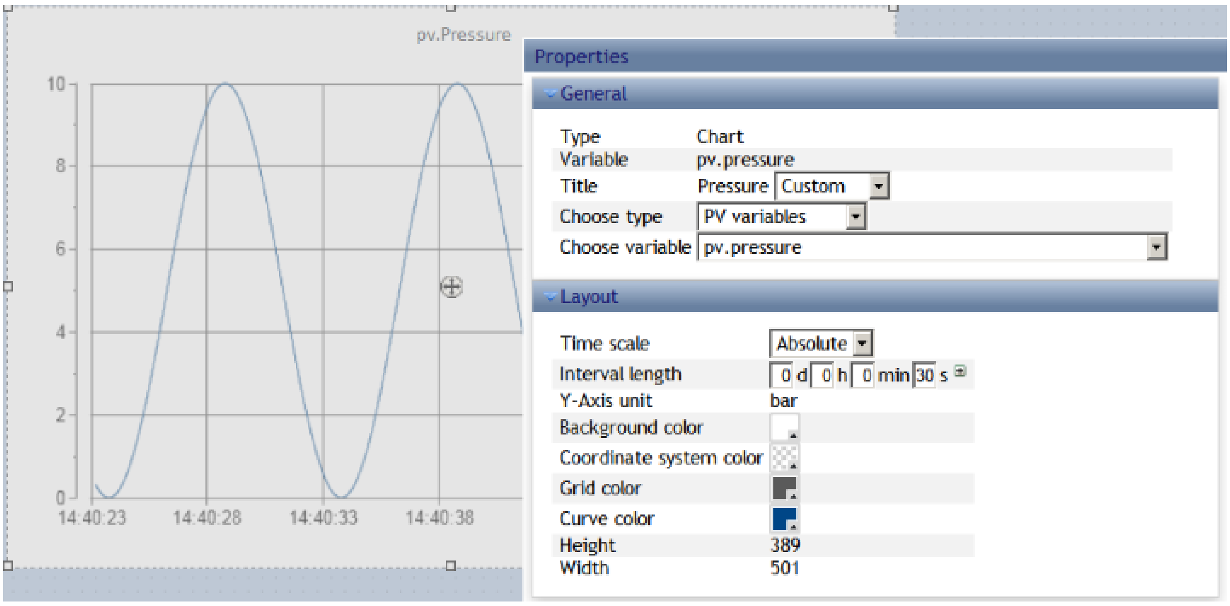
Designer - Numerical input/output

For the purpose of numerical input and output, Display variables and PV.Variables can be used.



Designer - Curve diagram

The curve window can display exactly one parameter. This parameter may come from a Display variable, a PV.Variable, or even from digital variables(Virtual_Bits, Etherbits, digital inputs)



The scaling is set automatically along with the maximum and minimum values of the data measured.

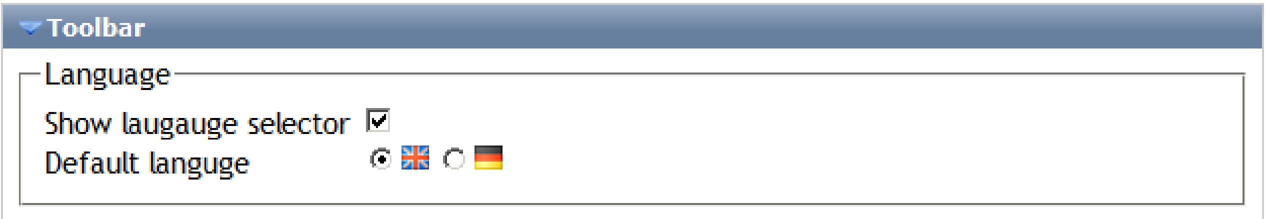
The x-axis can be set to relative or absolute.

9.8.10 Miscellaneous

To apply miscellaneous settings, call the settings dialog via the associated button, which is only visible in ***Designer mode***:

Toolbar

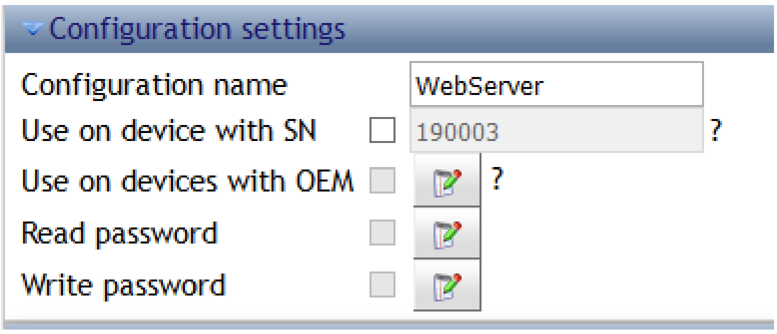
Set the display language in which the WebServer starts up.



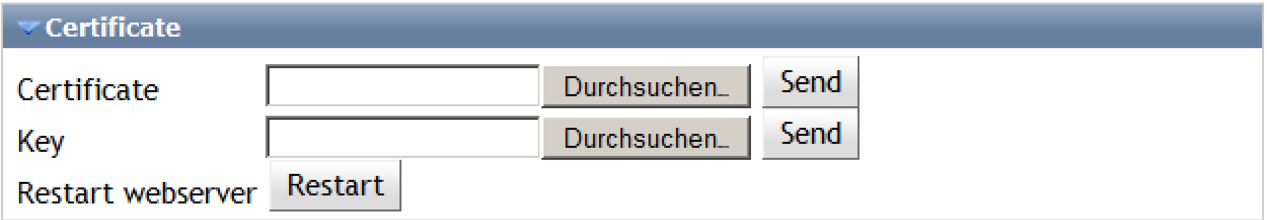
Configuration

Protect the settings by assigning passwords.

The **OEM identifier** is required for custom devices and applications in order to enable fixed Panel configurations (e.g. imc POLARES, imc WAVE etc.). If this setting is active, the configuration can only be used in devices having the specified OEM identifier.



Certificate



The certificate required for running WebServer can be renewed using this function. This entails exchanging the certificates saved in the device and uploading ("sending") a valid certificate and key.

In the uploading process, the Webserver verifies whether the certificate and the key match each other. The validity can only be checked the next time the Webserver is started. if the certificate is not valid, it is rejected and the old one remains in force.

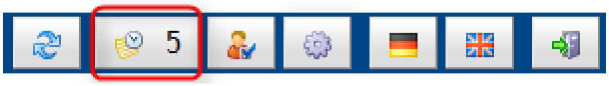
This can only be performed in either ***Operator*** or ***Designer mode***.

For the encrypted connection to the device, use an X.509 certificate in the form of a certificate and key file in PEM format.

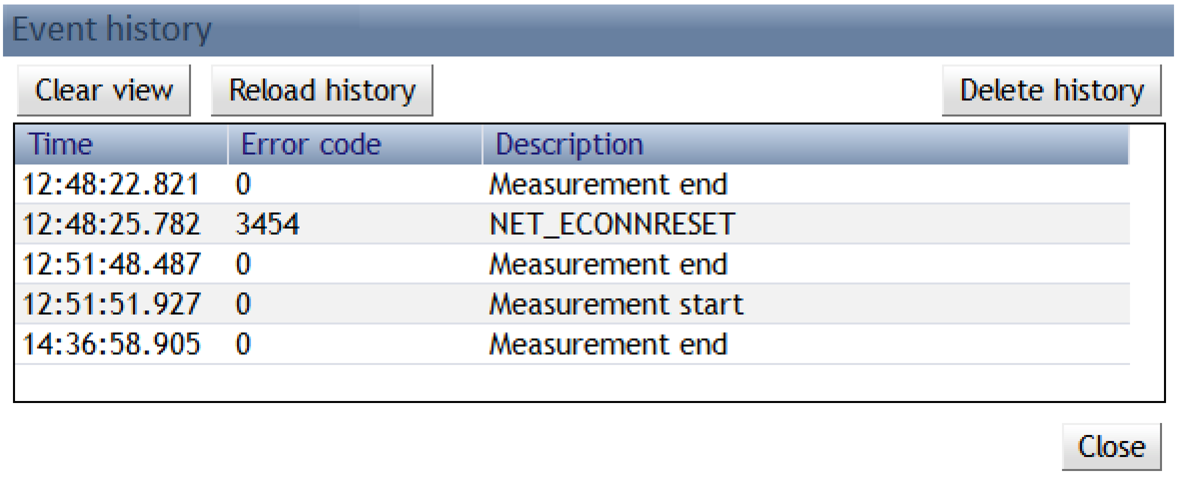
If you have any questions, please contact the imc customer service / hotline 10.

9.8.11 Event history

The event history is opened via the toolbar. Here, the entry count is already displayed.



The event history is a log of the course of the procedures and error messages:



10 imc Online FAMOS and imc Inline FAMOS

imc Online FAMOS

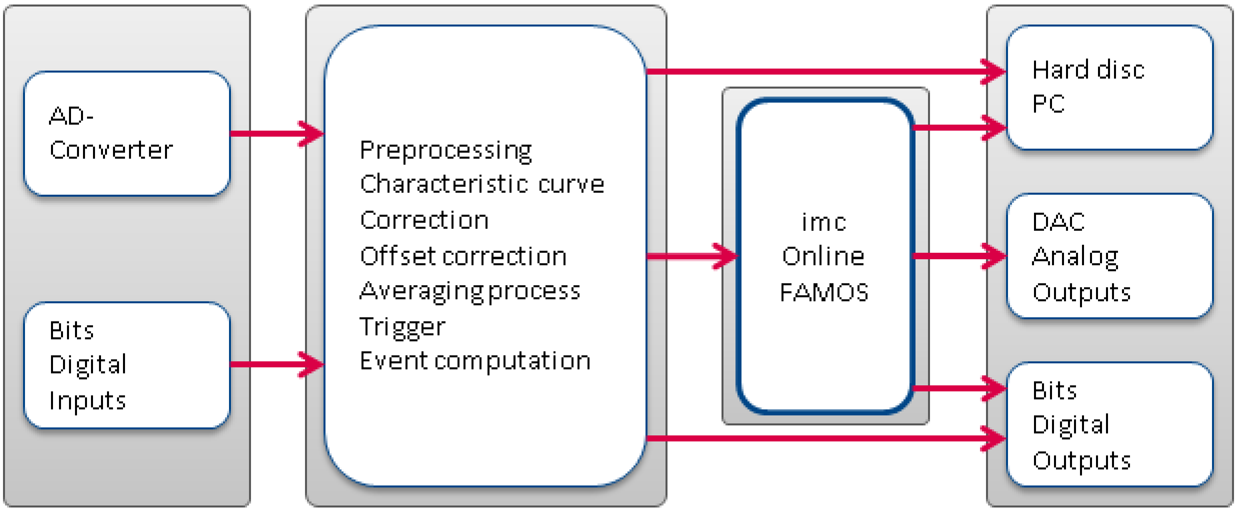
imc Online FAMOS is an expansion for imc measurement devices, offering a large number of real-time functions for pre-processing of data. The pre-processing is performed by a digital signal processor (DSP) in the device. This means that the functions are carried out quickly, independently of the PC.

The data volume between the device and the PC can be substantially reduced by the pre-processing.

The results are available in imc STUDIO as virtual channels. Virtual channels contain data calculated on the basis of existing input channels. This may be, for example, an averaged input channel, or the difference between the signal values form two input channels.

The virtual channels can be redirected to DAC (digital-analog-converter) or DIO (digital input/output, bits) outputs on the device. For example, you compute the difference between two analog input signals (digitally), and convert the result back to an analog signal at the DAC output. The DIO outputs can be used, for example, to set a digital bit whenever a certain signal level has been reached.

The following diagram shows how data stream through the device and which of them can be accessed by imc Online FAMOS:



Analog/ digital conversion of analog input data and/ or acquisition of digital input data is carried out on the unit's main board. All of these input data are usually subjected to a certain amount of preprocessing, for example, characteristic and offset correction, event and trigger computations etc. The trigger system can also be used to directly set output bits.

Instead of direct transfer to the PC, the data streams with measured channels signals are rerouted through imc Online FAMOS. These are imc Online FAMOS's inputs. Results calculated by imc Online FAMOS are mostly virtual channels which are passed on to the PC like other input channels. Additionally, note that even digital output bits and the DACs can be outputted as virtual channels.

imc Inline FAMOS

Processing and analysis of measured data during a running measurement

imc Inline FAMOS is a functions package for Data Processing.

imc Inline FAMOS enables calculations to be performed on data streams from the measurement currently runnning. The calculations are performed on the PC, taking advantage of the PC's processing power. By contrast, with imc Online FAMOS, the calculations are performed by the device.

Scope of functions 842**:**

A number of pre-defined functions are available for calculation purposes. Most of the imc Online FAMOS functions are available in the same way and with the same syntax as in imc Inline FAMOS. There are a few additional functions exclusively in imc Inline FAMOS.

Cross-device calculations

In contrast to imc Online FAMOS, imc Inline FAMOS provides the ability to apply calculation operations to channels belonging to different devices, if the channels are assigned to Trigger_48 (measurement Start/Stop).

Displaying results:

The results generated are treated as device variables/channels. They are configured on the Setup pages (e.g. Storage) and can be displayed on Panel pages.

Tasks:

Multiple independent, complete calculation sequences (**Tasks**) can be processed in parallel. The maximum possible scope/amount of these tasks depends on the computational resources required by the functions used, in conjunction with the computational resources available to the PC used.

Note	Notes on the product names

This documentation applies to imc Online FAMOS and imc Inline FAMOS. For the purpose of easier readability, the product names are not spelled out in their entirety when referring to both products.

imc Online FAMOS: OFA

imc Inline FAMOS: IFA

10.1 Overview

OFA/IFA works with streams of binary data.

Take a simple example where the difference between two channels is computed:

```
Difference = Input1 - Input2
```

If data from both `Input1` and from `Input2` are present, then the `Difference` is computed and assigned to the virtual channel `Difference`.

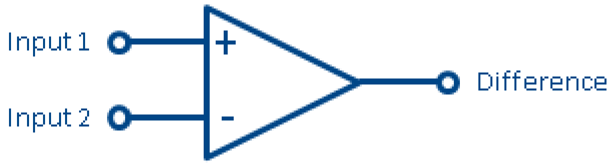
When measurement is started, the device performs the following procedure:

Repeat while measurement continues
Wait for **`Input1`** data
Wait for **`Input2`** data
Retrieve last value of **`Input1`** from memory
Retrieve last value of **`Input2`** from memory
Compute difference
Assign computed difference to virtual channel: **`Difference`**

The virtual channel only contains values if the channels on which its calculations are based contains measured values. This means that only after the input channel is triggered is it possible for the virtual channel to be calculated. When the input channel's signal is concluded, the virtual channel is also concluded.

In the diagram of the internal process above, you see a "Repeat while..." loop. In the equation defined, `Difference = Input1 - Input2`, however, there is no loop. In spite of this, a loop is running internally in order for the term `Difference` to be calculated while the input channels are returning input channels.

Calculation of the difference can be compared to the following simplified electrical circuit diagram:



Schematic circuit diagram of a calculated difference

Output of an analog output

We now consider assigning the difference to an analog output channel (DAC channel):

```
DAC1 = Input1 - Input2
```

The following steps are executed internally:

Repeat while measurement continues
Wait for **`Input1`** data
Wait for **`Input2`** data
Retrieve last value of **`Input1`** from memory
Retrieve last value of **`Input2`** from memory
Compute difference
Assign computed difference to **`DAC1`**

The procedures for calculating a virtual channel and for generating a DAC output are the same. Thus, the DAC can be referred to as a virtual channel identified by its permanent name (a system name). The DAC is not saved but outputted directly to the respective output terminal. The output to digital output bits proceeds in the same way.

10.1.1 System Requirements and Limitations

imc Online FAMOS and imc Online FAMOS Professional

With the exception of imc BUSLOG, all devices which support imc STUDIO are also able to run imc Online FAMOS (or imc Online FAMOS Professional).

Maximum amount of variables in imc Online FAMOS:

Internally, imc Online FAMOS administers up to 999 variables (single values + virtual channels). However, be aware that only a maximum of 512 channels can be administered per device.

Note

If more than 500 variables are renamed when performing editing in the imc Online FAMOS Assistant before the Assistant is closed, an administration error occurs. This effect does not occur if the Assistant is closed and then later reopened before more than 500 variables were altered.

When imc Online FAMOS is Available?

imc Online FAMOS and imc Online FAMOS Professional can be accessed as an option. It must be enabled for each device individually. If the device is ordered with imc Online FAMOS or imc Online FAMOS Professional, it will be delivered already enabled.

If you wish to upgrade a device with imc Online FAMOS or imc Online FAMOS Professional subsequent to delivery, contact our imc Hotline 10 for more details.

imc Inline FAMOS

The limitations of imc Online FAMOS do not apply to imc Inline FAMOS!

The amount and scope of the tasks which can be performed depends on the computational demands of the functions used and on the power of the PC used. Since all calculations are performed by the PC, the PC's performance determines the possible scope.

Minimum PC requirements[1]	Recommended PC configuration [2]
The minimum requirements for imc STUDIO apply here.	The recommended configuration of imc STUDIO applies here. Additional recommendation: Processor with at least 2+n processor core, where n is the number of Tasks.

1 A system with the minimum requirements is not sufficient for intensive calculations.

2 To ensure smooth performance of calculations, storage and visualization of the measured data, one processor core per Data Processing-Task should be available. Ideally 2+n; where n is the number of Tasks.

Which channels can be combined in calculation operations?

1. Channels belonging to one device

Here, the same prerequisites apply as for imc Online FAMOS. Channels can be combined together when they are subject to the same trigger. E.g. Start/Stop-trigger (Trigger 48) or a trigger x.

2. Channels belonging to different devices

Channels which are assigned to the Start/Stop trigger (Trigger 48) can be combined in calculations across multiple-devices.

Calculations on combinations of triggered channels from different kinds of devices will not work because:

- Trigger x may be defined differently on differing devices
- Device triggers do not propagate and synchronize globally, i.e.: a device "A" channel can not be triggered by a device "B" trigger

Process vector and other device variables

All device variables, including process vector and Display variables, network and virtual bits can be processed and set like in imc Online FAMOS.

Process vector variables can not be set up in imc Inline FAMOS. Process vector variables are device variables explicitly created for a specific device, e.g. via imc Online FAMOS, via the plug-in Setup or via Automation.

Process vector variables can be is saved and restored exclusively on the device.

Refresh/writing rate of the device variables

The reading and writing access to the devices is limited.

10.1.2 What kind of tasks can be accomplished?

Any task which could be performed by an electrical circuit can be handled. A circuit doesn't include loops or conditions, which are inappropriate to the streaming data we are dealing with. The data streams can only be processed and subjected to operations jointly with other data streams. The data streams can be transferred to the PC, to the storage medium, to DACs and to digital output bits.

If, instead of digital processing by OFA/IFA, we put a complex analog circuit (e.g. filter, ...) in front of the device' inputs and digitalize the outputs of such a system, the channels recorded directly correspond to the virtual channels. They also possess all properties of a normal channel. Furthermore, if we consider logic operations and filtering (mean value, etc.) to be the main OFA/IFA functions, then this is comparable to an analog circuit. Thus, OFA/IFA can be viewed as a substitute for a freely configurable analog pre-processing circuit.

What can OFA/IFA not do?

- It is impossible to formulate any processes which do **not** utilize **continuously streaming data**.
- OFA/IFA does not replace a synthesizer! For output rates of up to 10kHz, the Synchronous Task 847 can be used. For this purpose, imc Online FAMOS Professional is necessary.
- OFA/IFA works asynchronously. It processes data according to the formula that you have entered as quickly as possible. If the formula that you specify is somewhat long or involved, however, it may lead to delays. It is impossible to state a fixed time interval within which the loop can be processed. If your application requires definite response times, then these can be guaranteed with an Synchronous Task 847 of imc Online FAMOS Professional.

- Fieldbus channels recorded in **time stamping mode, can't** be proceeded!
- **Unsigned 32-bit integer values** (32-bit UINT) are not calculated correctly.
  - Workaround: The channel must be set up in the CAN Assistant as an unsigned 31-bit integer.
    32-bit UNIT channels are mostly created when a DBC file is imported. If such a channel is processed any further in OFA/IFA, the bit count must be set to 31 bits following import of the DBC file.

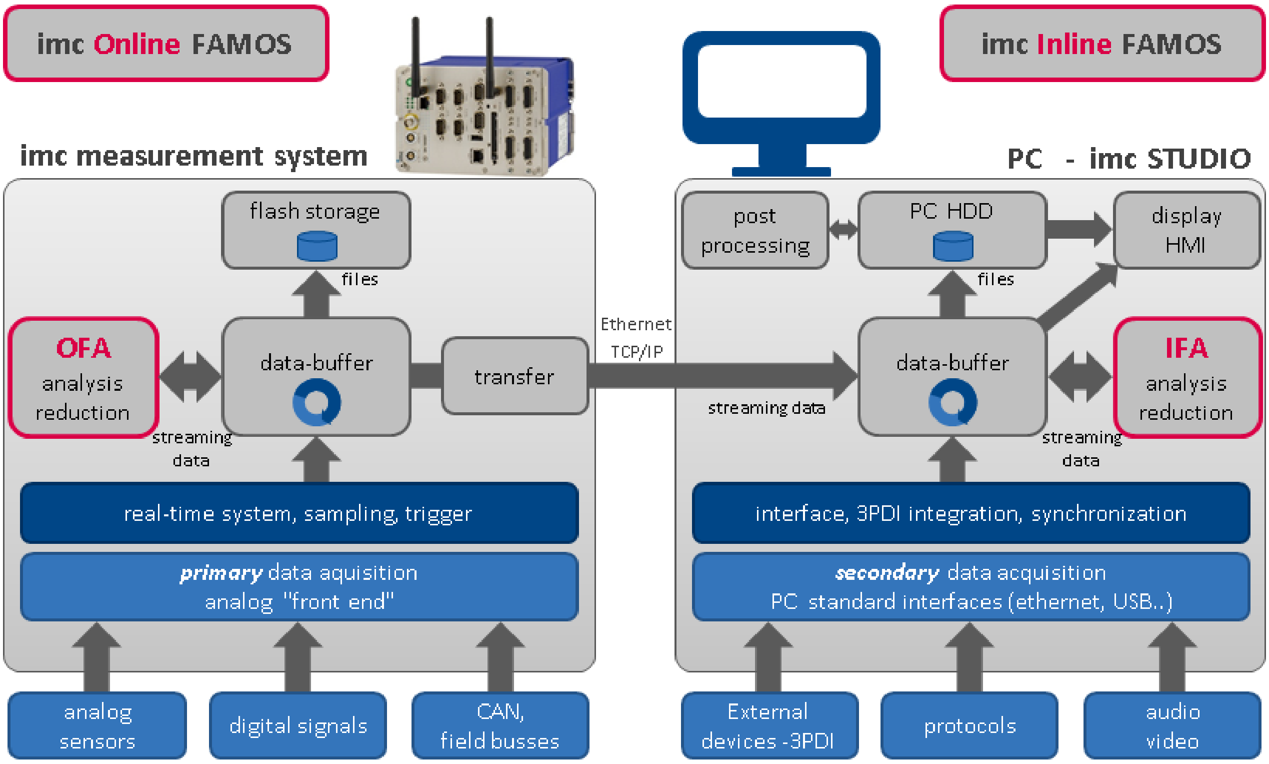
10.1.3 Comparison: imc Online FAMOS with imc Inline FAMOS

imc Online FAMOS	imc Inline FAMOS
Device-based, classical real-time analysis	PC-based analysis of live streaming data diametrically different from imc FAMOS (post-processing of completed data sets)
Processing occurs where the data are captured, inside of the measurement device • no calculations across multiple devices possible • stand-alone capability	Processing occurs on the PC, and **not** where the data are captured. • Calculations across multiple devices possible (applies to all channels which are captured as of measurement start (Trigger 48)), optionally also of 3rd-party devices (via 3PDI) • not stand-alone capable • correspondingly reduced real-time reaction • conversely: use of the powerful and scalable PC-platform
Resolution of the calculations and results: 4 byte	Resolution of the calculations and results: 8 byte
Commonalities: • Live-analysis: immediate visual feedback • Processing of live data streams: running, not concluded, measurements (not post-processing) • Unified syntax, same scope of functions • Application of calculation operations to combinations of multiple channels assigned to the same trigger	

Professional-Version

In imc Inline FAMOS, there are no version grades as with imc Online FAMOS (imc Online FAMOS / imc Online FAMOS Professional).

Data flow schematic



Data flow schematic

Comparison measurement

An example is presented in the chapter"*Information and Tips*" > "*Comparison: imc Online FAMOS with imc Inline FAMOS - Example* 886".

Comparison with (PC) imc FAMOS

This section is intended for those of you who are already familiar with imc FAMOS (imc signal processing software, functioning off-line). We explain here some of the main differences between imc Online FAMOS/imc Inline FAMOS and imc FAMOS.

imc FAMOS processes entire data sets. When you load a measurement to imc FAMOS, you load the complete measurement. You have equal access to the first and last values of a measurement. And you can also write imc FAMOS-sequences consisting of various loops and conditions for processing data.

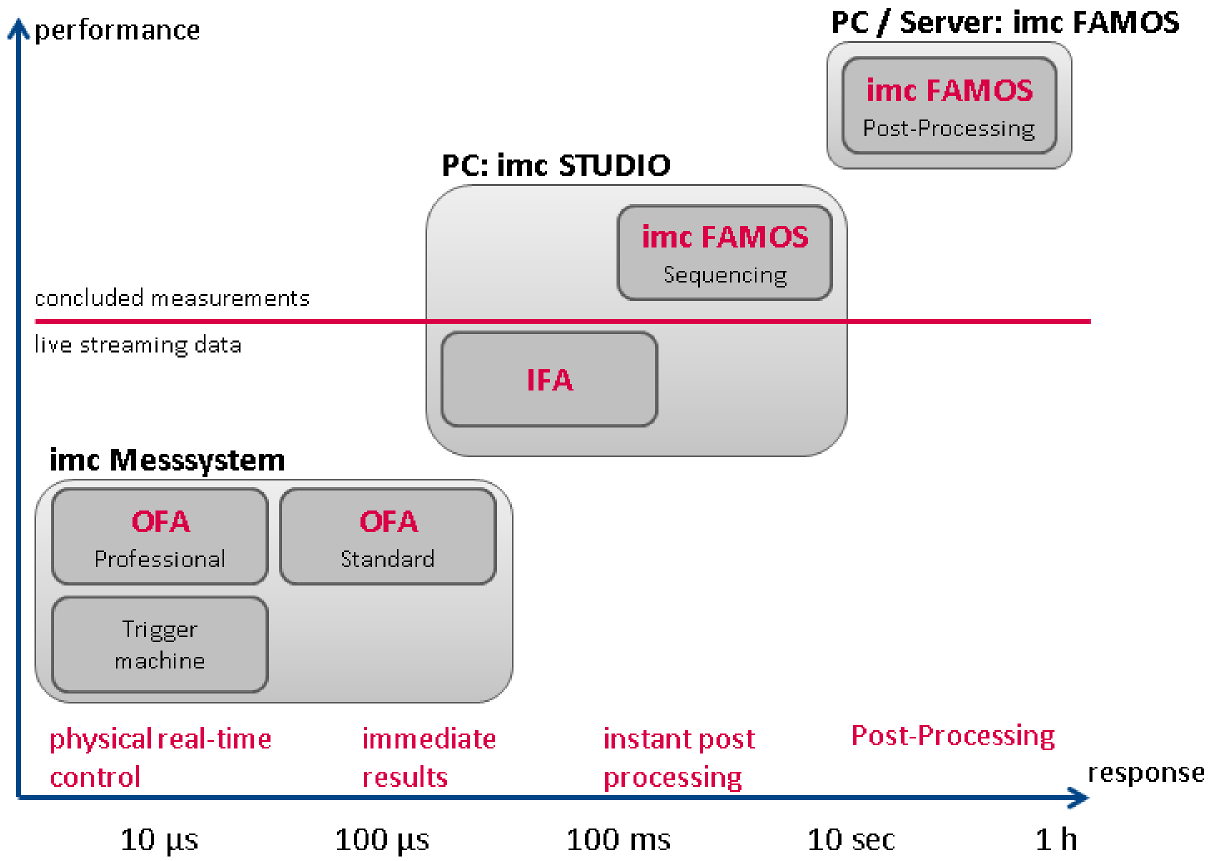
In OFA/IFA, data are processed already while being captured. This means that the raw data are **no longer** in memory. The current raw data are used to generate calculation results.

For all applications having online functionality requirements, it is not adequate to wait until the end of the measurement.

When should imc Inline FAMOS, imc Online FAMOS or imc FAMOS be used?

Application fields:

- Real-time analysis and brief reaction time: imc Online FAMOS
- Complex scope of functions (calculation-intensive): imc Inline FAMOS
- Calculation-intensive subsequent analysis (post-processing): imc FAMOS



Scope of Functions

Most imc Online FAMOS functions are also available in imc Inline FAMOS in the same way and with the same syntax. Additionally, there are some functions available only in imc Inline FAMOS.

Among others, the following function groups are not provided:

- all closed-loop control functions and many system functions
- all CAN-functions and all ECU-functions
- ReadyForPowerOff, SyncOverload
- OnSyncTask (Synchronous Tasks), OnPowerOff
- IntegralP/IntegralP2

In the Functions Reference, it is noted if a particular function is available only in imc Online FAMOS or only in imc Inline FAMOS.

10.1.4 What happens when imc Online FAMOS overflows?

General notes on data overflow in software

OFA/IFA operates without synchronization to the data capture. This means that OFA/IFA works through it program in an uninterrupted loop.

OFA/IFA working without overflow

If the data rate is low enough, and there are no new samples available for calculations, then there is nothing for OFA/IFA to do.

If the online calculation is so complex that new samples accumulate by the time the calculation is done, then OFA/IFA enters the new data into the next calculation iteration. If the average number of new samples remains equal, there is no overload.

OFA/IFA overflows

So what happens if the data rate is so high that the number of new samples increases after every iteration? In such a case, OFA/IFA falls behind in performing the calculations. The amount of data increases and with it the time required for calculation.

You will notice this overflow if you display the input data and the virtual channels in a curve window. The virtual channels' values are still pending calculation and are not yet visible, while the input data is already on display. In consequence, the gap between the input data and the virtual data grows at the end of the channel graph.

The following applies to imc Online FAMOS: For brief measurements, of course, this is tolerable if the RAM-buffer duration 718 is adequate. But if the accumulated data exceeds the RAM buffer depth, the software will announce a data overflow!

Special case applicable to imc Online FAMOS: Overflow in the synchronous task

When using the Synchronous Task 847, it is necessary to additionally ensure that the commands are performed within the allocated time interval. If this does not succeed, the device announces the overflow with `LED_06` and activation of the beeper. When the function `SyncOverload` is called in the synchronous task, neither `LED_06` nor the beeper are activated. Instead, the overflow can be indicated using a virtual channel.

Example

```
OnSyncTask( 0.01 )
    if Greater( pv.Channel_002, 5)
        Virt_Bit01 = 1
        ; More functions...
    else
        Virt_Bit02 = 1
        ; More functions...
    end
    ; Upon overflow, the virtual channel changes from 0 to 10
    Overload_Sync10ms = SyncOverload( 10 ) + Channel_002 * 0
End
```

10.1.5 Source Text with Control Commands

Conventional **source text without control commands** mainly provided the ability to define virtual channels and subject them to calculations. An OFA/IFA program is executed line-by-line; all instructions entered are carried out in the order they appear in the program.

If the **Control Commands** are activated, the ability to use branching instructions is provided. Program branching can be achieved using conditions and case differentiation, for instance: "if condition is fulfilled, carry out one operation, otherwise carry out other operation". Thus, different procedures can be defined in OFA/IFA to depend on values of variables.

Also, operations can be directly assigned to various states within the course of a measurement (e.g. at the start, end, or during the measurement). An example shall illustrate the difference between "with" and "without" control commands:

Example

```
OnTriggerStart( Trigger_48 )      ; to be carried out at start of measurement
    Reset = 1                     ; Reset is a digital output
End

OnTriggerMeasure( Trigger_48 )    ; to be carried out during measurement
    If Temperature > 25           ; branch, querying temp. channel signal
        Reset = 1
    Else
        Reset = 0
    End
End
```

At the start of the measurement, the digital output bit *Reset* is activated. During the measurement, Reset will be set depending on the Temperature.

More information on syntax is presented in the section: "*Variables and Syntax with Control Commands* 862".

10.1.5.1 Transforming to imc Online FAMOS with/without Control Commands

By default, OFA/IFA starts without control commands.

Activate the Control Commands via the context menu 855 in the Editor or the menu item "*Extra*" > "*With control commands*" (via the menu applies only to imc Online FAMOS):

Menu item	Description
With control commands	Deactivates/activates the Control Commands.

Upon making this switch, control commands are automatically added to the source text in the Editor. To prevent making this switch inadvertently, it must first be confirmed in order to take effect.

The control commands added automatically are:

Control command	Description
`OnInitAll`	initialization prior to first measurement, or for imc Inline FAMOS: after starting the Task
`OnAlways`	for code segment performed constantly
`OnTriggerStart`	for code segment performed once at the start of a measurement
`OnTriggerEnd`	for code segment performed once at the end of a measurement
`OnTriggerMeasure`	for code segment performed for duration of measurement

If operations were already in the editor when the switch is made, these operations are automatically assigned to the control commands `OnAlways` and `OnTriggerMeasure`. Usually, no revisions are necessary.

Deactivating Control Commands

Deactivation of the control commands is also effected by means of the menu item stated above.

Only such operations are directly transferred which can also be used "*without control commands*", while all other operations still appear, but commented out. After such a transformation, alteration of the source text is usually also necessary, and will sometimes cause significant reduction of functionality.

As a rule, it is inadvisable to port a program created with control commands to "*without control commands*".

10.1.5.2 Additional Groups in the Function List

When you activate the Control Commands, then among others, the following three additional groups appear in the function list: "*Controls*", "*Control functions*" and "*Comparison operators*".

The "*Controls*" group lists all control commands supported. This comprises control commands for conditions and case differentiation (e.g. `IF`), on the one hand, and on the other hand control commands concerning various measurement process states, e.g. `OnTriggerStart` (for operations performed at the start of a measurement).

The "*Control functions*" group contains special functions; such as timer functions.

The "*Comparison operators*" group contains comparison operators such as `>`, `<`, `<>` and `=`. As well, the logic operators `AND`, `OR` and `NOT` are provided here.

Reference	Function Reference
The functions are described in the chapter "*imc Online/Inline FAMOS Function Reference*" 887".	

10.1.6 imc Online FAMOS Professional

imc Online FAMOS Professional is the package for effective use of the process vector and for operation of the measurement device on the test station. By this means, it is possible to perform monitoring, and open- and closed loop control functions. The package also provides a significant performance enhancement for all purely measurement engineering applications (data-logger operation) in calculating virtual channels.

With imc Online FAMOS Professional you have

- Performance enhancement 846
- Synchronous Tasks 847 including accessories
- Direct access to the Process Vector 355
- PID-Controller 878

10.1.6.1 Performance Enhancement

imc Online FAMOS Professional serves to accelerate online computations. Thus it increases the system's maximum possible throughput without causing data overflow in long-term measurements. The accuracy is not reduced by that feature. The increased speed is achieved by as many functions as possible using the signal processor's internal memory. Accessing commands in such memory space can happen much more quickly.

However, this memory is much smaller, so that it's usually not possible to keep all program components within it. By means of the imc Online FAMOS Professional, the compiler shifts the functions into the internal memory until it's full. Therefore those functions whose gain on speed is the highest will be preferred.

In general all functions are considered. But memory intensive functions will be preferred, because they speed up most.

Examples

- FFT: 1,5 –2,5x
- Basic calculations: 2x
- Digital filters: 3-4x

10.1.6.2 Synchronous Tasks

Along with the control command OnTimer, imc Online FAMOS Professional **with control commands** includes a control command for deterministic reactions. At a specified clock rate, imc Online FAMOS' otherwise asynchronous evaluation process is interrupted by a higher priority task. During this interrupt, the command lines entered for the synchronous task are executed.

```
OnInitAll...

OnAlways...

OnSyncTask(0.1)
    Virt_Bit01 = 1 - Virt_Bit01
    DOUT001_Bit01 = Virt_Bit01
End

OnTriggerStart(Trigger_48)...
```

- Enhancement of OnTimer
- True interrupt handler
- Precise timing
- Access to input channels via the Process Vector
- Loop control

The user can configure up to **5** synchronous tasks. The cycle times extend from **100µs up to 1s** in steps of 1-2-5. With Synchronous Tasks, there is an effective way to access the current measurement values with the help of the Process Vector.

By this means, monitoring, and open- and closed-loop control functions can be realized. In particular, the switch/case control commands can be used to achieve state control.

In Synchronous Tasks, not all of imc Online FAMOS' functions are allowed. This pertains to functions, which use a collection of samples like FFT, Mean, RMS etc. But comparison functions, basic math functions and control functions are possible.

In imc Online FAMOS, *closed-loop control* is only possible in a Synchronous Task: two-point controls and PID-controls are included with the Synchronous Task functions. The PID-controls are provided with a variety of additional functions, e.g. controller block, output limiting, and change of input parameters during operation.

It is possible to use the vector functions VMax, VMean, VMin, VSum, VRMS, VIsAnyGreater, VValueAtXValue, VXValueOfMax, VXvalueOfMin, VXValueWithYValue in synchronous tasks. In the synchronous task, the functions named can be used on vectors generated using the function VectorFromFile. Also supported are functions Monoflop, MonoflopRT, JKFlipFlop and RSFlipFlop.

Restrictions

LEDs can't be controlled inside a synchronous task. Instead a virtual bit has to be controlled inside the SyncTask. Than, that virtual bit set the LED in OnAlways.

10.2 Operation

10.2.1 Opening the Editor

imc Online FAMOS

Select "imc Online FAMOS" from the Ribbon "*Home*" (or "*Setup-Configuration*") to start imc Online FAMOS.

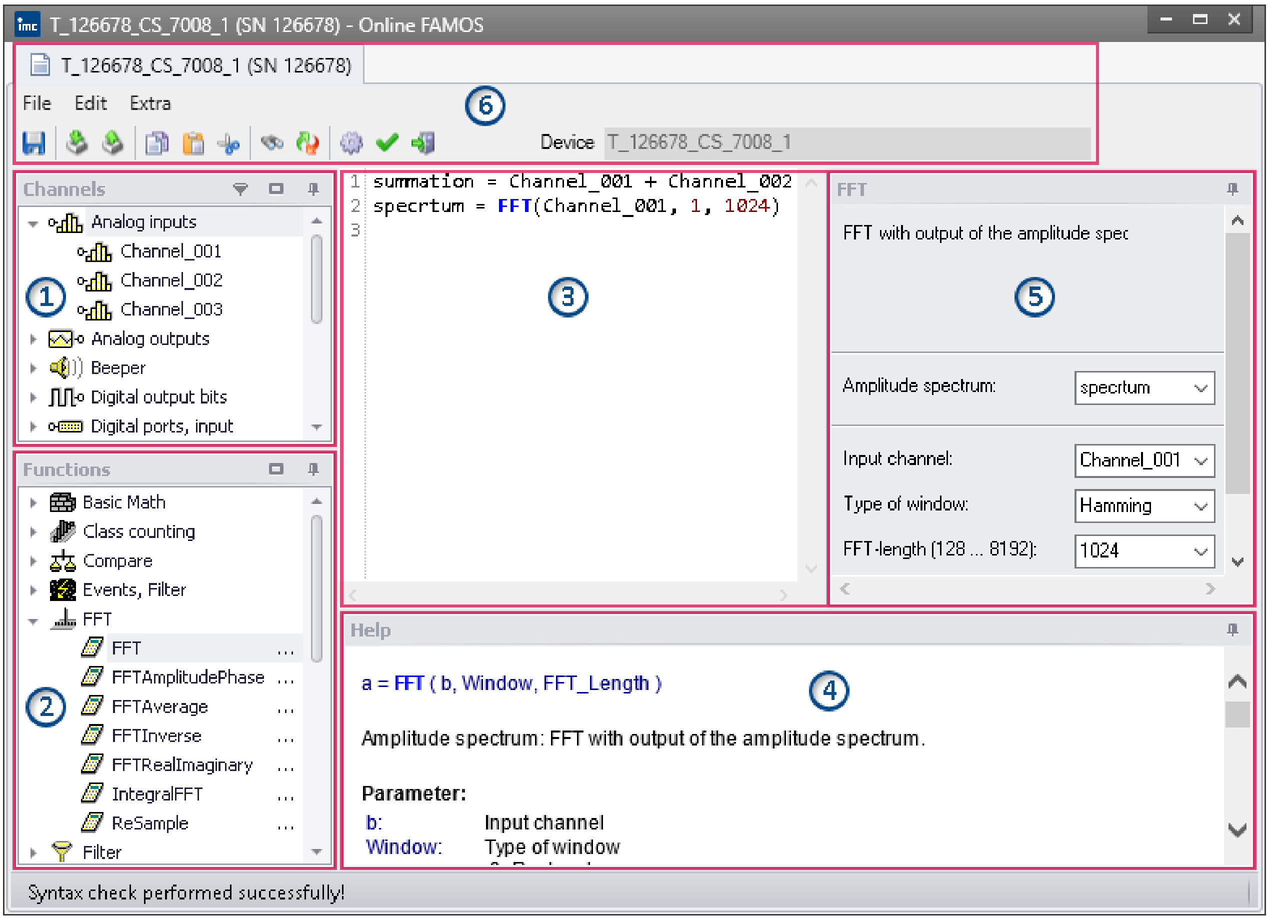
Note

If the menu item imc Online FAMOS is not accessible, check in your calibration certificate whether your device comes with this optional feature. For the software to detect whether imc Online FAMOS is available, the device must have been connected at least once.

imc Inline FAMOS

Go to the Data Processing via the Navigation pane. There is a page tab (Task:) for the respective function package imc Inline FAMOS . If it is not yet selected, click the left mouse button on the Task name. The imc Inline FAMOS Editor is displayed in the main window.

10.2.2 User Interface



The window is subdivided into six regions:

1. Variables List 850
2. Function List 849
3. Editor 849 (Text box) for the calculation operations
4. Help 849
5. Formula Assistant 849
6. Menu and actions 853 (only in imc Online FAMOS)

Region 1: Variables List

Here is the list of all available variables supported (imc Online FAMOS: device variables | imc Inline FAMOS: among others device variables and user-defined variables).

You can group the variables according to the variable type. With or without grouping, a symbol indicating the respective variable type appears before each name. Variables which were created in the current Task have a green symbol.

Icon	Description	Icon	Description
	active analog input channels and incremental encoder channels		digital output bits (of all DIO-ports)
	DIO ports, input		analog outputs (DACs)
	DIO ports, output		housing LED's
	calculated virtual channels		virtual bits
	calculated local channels		ethernet bits
	calculated local single value variables		display variables
	process vector variables 355		beeper (miniature speaker)
	digital input bits (of all DIO-ports set for bit-input)		trigger which starts an analog channel. Only those triggers are listed to which at least one channel is assigned.

Region 2: Functions List

Here is a list of all available mathematics functions and characters. With the help of the functions, you can perform calculations on the channels and variables. As a result, you obtain virtual and local channels or local variables.

The mathematical functions are always updated instantaneously. To learn about their workings, see the Help-box or the Functions Reference.

Region 3: Editor for the calculation operations

In the text box, enter the calculation operations. You may insert carriage returns and spaces as desired. However, any instruction must be coded in its entirety on one line!

Adding a variable or function to the editor

There are multiple ways to add an element to the editor:

- by **double-clicking** on the element
- by applying the **Drag&Drop** technique to the editor
- by calling the **Formula Assistant**: using the Formula Assistant, it is easy to set function parameters and enter the functions into the editor.
- by **input** with **auto-completion** support
  The "first suggestion" from the list is applied by means of the Tab-key. When the ENTER-key is pressed for the "first suggestion", a line break is inserted. When navigating through the list of suggestions, either TAB or ENTER can be used to apply the suggestion.

Functions are entered into the editor along with parenthesis.

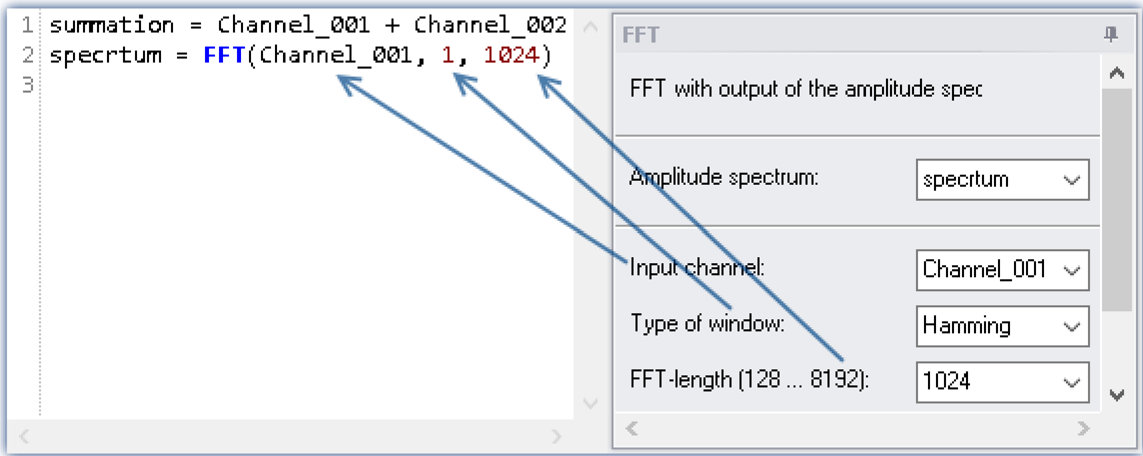
Region 4: Help

Here you find an explicit description of the functions and of the variables' properties.

To open the help text for a variable or a function, left click the mouse to select the desired item. The editor remains unchanged.

Region 5: Formula-Assistant

The Formula-Assistant provides support in parameterizing the functions. The Assistant shows the function selected in the editor.



Formel-Assistent

What parameters are needed depends on the math function selected. For instance, for the Rainflow-function, there are 10 parameters to set. Procedures, in contrast to functions, don't have result values.

For the result, a variable name can be entered manually or an output channel can be selected from the pop-down list.

Changes to the parameters in the Formula-Assistant are immediately adopted in the editor and vice versa.

10.2.3 Brief Introduction

The Formula Assistant helps you in selecting and parameterizing a mathematical function.

Clicking on a function in the Function List calls a help window displaying the associated help text. You can magnify the help window if desired.

Enter the function along with its parameters in the Editor. You may wish to use the Formula Assistant for this purpose. To assign an operation to a virtual channel, use an equals sign. The name for the virtual channel can be freely specified.

Example

```
summation = Channel_001 + Channel_002
difference = Channel_003 - 5
DAC_01 = difference
```

In the example, we have assigned a sum and a difference to two virtual channels as well as outputting channels on a DAC channel.

Note — **Note on analog outputs (DAC)**

The analog outputs of the measurement device have an output voltage range of -10 V...10 V. You can therefore only assign values lying within this range! A scaling in the plug-in Setup for the DAC channels is taken into account.

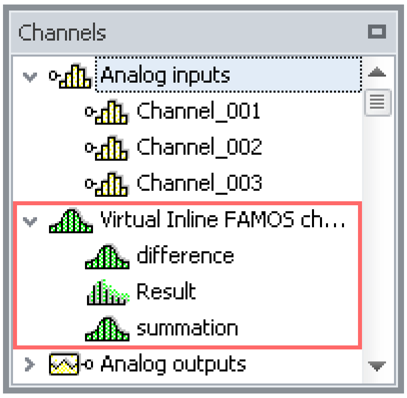
Adding a variable or function

- You can use Drag&Drop to take names from the Variables list into the Editor. Or, alternatively, double-click on the name to insert it in the editor.
- Analogously, you can move functions from the Function List to the editor using Drag&Drop. Just double-clicking on a function's entry in the Function List move the function into the editor.

Definitions for each individual function are made on its own **separate line**.

Check / Syntax check ✔ |

Click on the button to perform a *Syntax check*. If an error occurs, a notification will appear in the status bar! The faulty portion will appear highlighted in the Editor.



If the syntax check concludes without an error, all newly defined virtual channels and variables will be adopted in the Channels list.

Optional: Saving the source text

Extra saving of the source text is not necessary, since the entries are saved with the experiment. However, it is possible to create an extra copy of the source text. This file can be stored externally, but is not used in the experiment. The source text file can be re-imported at a later time or used in a different experiment.

To save the source text, open the Editor's context menu and select "*Save source text*" ().

imc Online FAMOS - Close

Close imc Online FAMOS now. In the table of channels in the Setup, the newly defined channels appear as additional **virtual channels**.

Applying the imc Inline FAMOS-configuration

If the Syntax-Check concludes without finding an error, the Task will still not run. As soon as the configuration has been **applied**, the Task starts and calculations are performed. To do this, click on the button *Apply* ( ).

In the table of channels in the Setup, the newly defined channels appear as additional **virtual channels**.

10.2.4 Menu

The menu is not included in imc Inline FAMOS. All functions can be accessed via the "context menu 855". The description of the Data Processing menu ribbon is presented here: "*Data Processing*" > "*Ribbon* 1666"

File - Menu

Menu item	Hot key	Description
Load source text	(Shift + F2)	Loads a text file.
Save source text	(Shift + F3)	The contents of the editor are saved in a text file. This does not replace the Save to Configuration command!
New	-	This clears the contents of the editor and deletes the virtual channels from the Variables List.
End	-	Ends imc Online FAMOS.

Edit - Menu

Menu item	Hot key	Description
Undo	(Ctrl + Z)	Reverses the last change in the Editor. This function can be used multiple times in succession.
Redo	(Ctrl + Y)	Restores the previously reversed change. This function can be used multiple times in succession.
Find	(Strg + F)	Finds texts in the imc Online FAMOS editor.
Find and Replace	(Strg + H)	Finds and replaces texts in the imc Online FAMOS editor.
Copy	(Ctrl + C)	Copies the highlighted region in the Editor to the Clipboard.
Paste	(Ctrl + V)	Inserts the contents of the Clipboard at the highlighted location.
Cut	(Ctrl + X)	Extracts the highlighted region of the Editor and moves it to the Clipboard.
Delete	(Ctrl + Del)	This deletes the selected area from the editor.
Properties 872	(F5)	Opens the Properties window. There, the properties of virtual channels can be edited subsequently.
Syntax check	(F6)	The source text is checked for errors. If an error occurs, a notification appears in the status bar! The faulty spot is highlighted in the Editor. If the Syntax-Check concludes without any error located, the status bar reads: "Syntax-Check performed successfully!". All newly defined virtual channels and variables are adopted into the Variables list.

Extras - Menu

Menu item	Description
Options	It is possible to deactivate automatic LED-flashing. (See LED-flashing during measurement 885)
Directories	In imc STUDIO, the default folder can not be changed. See "Supplemental Files 883".
imc Online FAMOS with control commands	Activate control commands 844.
imc Online FAMOS without control commands	Deactivate control commands 844.

10.2.5 Context Menu

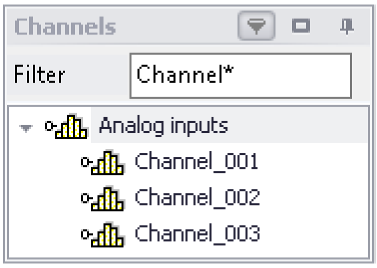
Editor

Right-clicking in the editor calls the following context menu:

Menu item	Hot key	Description
Load source text	(Shift + F2)	Loads a previously saved source text file and thus overwrites the current configuration.
Save source text	(Shift + F3)	Saves the source text and/or the properties at a specific location.
Copy	(Ctrl + C)	Copies the highlighted region in the Editor to the Clipboard.
Paste	(Ctrl + V)	Inserts the contents of the Clipboard at the highlighted location.
Cut	(Ctrl + X)	Extracts the highlighted region of the Editor and moves it to the Clipboard.
Undo	(Ctrl + Z)	Reverses the last change in the Editor. This function can be used multiple times in succession.
Redo	(Ctrl + Y)	Restores the previously reversed change. This function can be used multiple times in succession.
Syntax check	(F6)	The source text is checked for errors. If an error occurs, a notification appears in the status bar! The faulty spot is highlighted in the Editor. If the Syntax-Check concludes without any error located, the status bar reads: "Syntax-Check performed successfully!". All newly defined virtual channels and variables are adopted into the Variables list.
With control commands	-	Deactivates/activates the Control Commands 844.
Properties	(F5)	Opens the Properties window. There, the properties of virtual channels can be edited subsequently (see Virtual channels 857).
Show line numbers	-	Turns the display of line numbers in the Editor on/off.
Show folding	-	Turns on/off the code-folding in the Editor for the control commands, used to group logically associated source text sections. 
Collapse foldings	(Ctrl + J)	All folds are folded.
Unfold foldings	(Ctrl+Shift + J)	All folds are folded out.

Variables List

Right-clicking in the Variables List calls the following context menu:

Menu item	Description
Tree view	The variables are displayed in groups by channel type.
List view	All variables are displayed in a list. The channel types are not indicated explicitly. The type is denoted by the symbol in front of the name.
Expand tree	Expands the groups in the Tree view.
Collapse tree	Collapses the groups in the Tree view.
Sort by types	Sorts by channel type in the List view.
Sort by names	Sorts by name in the List view.
Filter	Shows a filter bar.  **Filtering the channel list with Wilcards**

Function List

Right-clicking in the Function List calls the following context menu:

Menu item	Description
Tree view	All functions are displayed in alphabetical order by function group.
List view	All functions are displayed as an alphabetically ordered list.
Expand tree	Expands the function groups in the Tree view.
Collapse tree	Collapses the function groups in the Tree view.

Help

Right-clicking in the Help box the following context menu:

Menu item	Description
Copy all	Copies the complete text from the current help text to the Clipboard.
Copy example	Copies any existing examples from the current help text to the Clipboard.

10.3 Variables and Syntax

10.3.1 Virtual Channels and Local Variables

Defining virtual channels

Virtual channels are defined in the editor.

A channel assignment consists of

- the virtual channel's freely selected name,
- the equals sign, and
- an arithmetic expression, which may, for example, include an already existing channel.

Example

```
Sum = Channel_001 + Channel_002
CorrectedOffset = Channel_001 + 5
Stretch = 2 * Channel_003
```

You can also use parentheses and minus signs:

```
Complicated = -( 3 + 4 * ( Channel_001 + 1 ) )
```

Function arguments must be written in parentheses:

```
SquareRoot = sqrt ( Channel_001 )
```

Formulas which are not permitted:

Incorrect	Explanation
`a = 1`	This is not allowed because **1** is a constant and cannot represent a data stream. The virtual channel **a** requires a sampling time just as a physical channel does. If you want to set a virtual channel to a fixed value, use a formula similar to the following: `a = Channel_001 * 0 + 1` **Attention:** If you use activated "*Control Commands*", the formula `a = 1` is allowed 863. In this case, **a** is a "*Local variable*".
`b = DAC1`	This is not allowed because an analog output (DAC) can **only be written** to but not read from.

Local Channels and Variables

If you need intermediate results to compute a virtual channel, it is possible to keep them local in the DSP by prefixing an **underline** to their names. This applies both to single values and to channels.

Access to local variables is twice as fast as normal virtual channels or single values. This increases the computation power. The disadvantage is that these variables are then no loinger visible to the PC.

Local variables appear in the Variables List with a trash bin symbol when they were created but no longer used. For example, if they became obsolete in the process of developing the source text but were forgotten rather than deleted.

Creating local channels

A virtual channel remains local if the variable's name begins with an underline "_".

Example

```
_LocalChannel = Channel_001 * 3
Virtual1 = _LocalChannel + 1
Virtual2 = _LocalChannel + 2
Virtual3 = _LocalChannel + 3
```

Creating local variables or single values

Local single values are assigned once and can later be used in subsequent lines.

A single value is an isolated number without any further properties. Single values only exist locally.

Example

```
_Constant1 = 3 + 4 * sqrt ( 5 )
Virtual1 = Channel_001 * _Constant1
Virtual2 = Channel_002 * _Constant1
Virtual3 = Channel_003 * _Constant1
```

Note Note for Single Values

Note that **single values must be prefixed with an underline**, as long as OFA/IFA **without Control Commands** is used!

With **Control Commands activated**, the underline is not needed for single values, since they are not transferred to the PC.

10.3.2 Polling Digital Inputs

Digital inputs can be polled by imc Online FAMOS. However, they are not polled at a fixed sampling rate, but rather as fast as the DSP can process the internal loop. The digital inputs are thus not a data stream, but are in the nature of single values.

A data stream can only be created in conjunction with a channel.

Example

```
BitStream = Channel_001 * 0 + DIO01_Bit11
```

Virtual bits can also be polled:

```
Constant1 = Virt_Bit_04 ; SW only locally possible
```

The return value of a digital bit is 0 for "LOW" and 1 for "HIGH".

10.3.3 Setting System Outputs

The system outputs must be defined in a single statement. The left side of the assignment contains the system output name. The following system outputs are possible (as long as they are displayed in the Variables List):

- DAC
- Digital outputs
- Beeper
- LED
- Virtual bit and Ethernet bits
- Display variables
- Triggers

DAC

The analog outputs of the measurement device have an output voltage range of -10V...10V. You can therefore only assign values lying within this range! A scaling in the plug-in Setup for the DAC channels is taken into account.

Definition:

`DAC1 = 5` `DAC2 = Channel_001 / 2`	You can assign constants or data streams to a DAC. With data streams, the most recent valid value appears at the DAC.

Not allowed:

`Virtuell = DAC3`	appearance on the right side of an equation
`DAC1 = 1` `DAC1 = 2`	multiple assignment
`DAC4 = 125`	exceeding the value range

Digital outputs

For digital outputs, the assignment may take either of the values zero or one. 0 for LOW and 1 for HIGH. Internally, any assignment not equal to zero is set to 1. Only exactly zero equals 0.

Definition:

`DIO02_Bit01 = 1`
`DIO02_Bit02 = 0`
`DIO02_Bit03 = STRI(Channel_001, -5, 5)`
	If you use mathematics functions, ensure that the resulting return value is either exactly 0 or 1.
	The Schmitt trigger function is particularly suited for generating digital signals from analog signals.

Not allowed:

`Virtuel1 = DIO02_Bit04`	appearance on the right side of an equation
`DIO02_Bit01 = 1` `DIO02_Bit01 = 0`	multiple assignment

Beeper

The beeper is to be considered a digital output which is directly connected with the beeper. Only a tone of fixed pitch can be emitted.

Definition:

`BEEP1 = 1`
`BEEP1 = 0`
`BEEP1 = STRI( Channel_001, -5, 5 )`
	Assigning 1 (TRUE) to the beeper turns it on and assigning 0 (FALSE) to it turns it off.

LED

Some imc measurement devices have LEDs on the housing, which can be operated as a form of digital output. An LED can either shine or be off. (See also "LED-flashing during measurement 885")

Definition:

`LED1 = 1`
`LED1 = 0`
`LED1 = STRI( Channel_001, -5, 5 )`
	Assigning 1 (TRUE) to the LED turns it on and assigning 0 (FALSE) to it turns it off.

Virtual bits and Ethernet bits

Virtual bits and Ethernet bits are set in the same way as digital outputs:

Definition:

`Virt_Bit_01 = 1`
`Virt_Bit_01 = 0`
`Virt_Bit_01 = STRI(Channel_001, -5, 5)`
	Assigning 1 (TRUE) or 0 (FALSE).

Display variables

Display variables are set in the same way as digital outputs. However, they can take on a wider (4Byte) range of values.

Definition:

`DisplayVar_01 = 1`
`DisplayVar_01 = 123.456`
`DisplayVar_01 = STRI(Channel_001, -5, 5)`
	Assigning a number.

Triggers

A trigger can be released not only in response to events as defined in the plug-in Setup, but also by OFA/IFA.

As soon as an assignment of 1 is made to an armed trigger, this trigger is released.

This does not change the arming of the trigger. A trigger can initiate recording of data. OFA/IFA releases the trigger just as if a different event had released the trigger.

Passive triggers and 1-Triggers can not be released.

Definition:

`Trigger_01 = 1`
`Trigger_01 = 0`
`Trigger_01 = STRI( Channel_001, -5, 5)`
	By assignment of a 1 (TRUE), the trigger is released.

10.3.4 Syntax: Channel Name

Usually the channel name can be used as variable name directly.

Example

```
; Channel name "My_channel"
Res= FFT( My_channel, 2, 1024)
```

If a channel name begins with a number or contains special characters such as \?+! or a space, the channel name must be set into **curly braces**.

Example

```
; Channel name "123 My channel 100% display"
Res= FFT( {123 My channel 100% display}, 2, 1024)
```

10.3.5 Syntax: Comment

Single line comment

A complete line or a part of a line can be turned into a comment with a ***semicolon***.

Example

```
; Computation begins here
Sum = Channel_001 + Channel_002 ; Computes the sum
; Computation ends here
```

Multiline comments / Block comments

Several lines can be commented using `(* .....*)`.

Example

```
(* the following lines are commented
Sum1 = Channel_001 + Channel_002 ; computes the sum
Sum2 = Channel_003 + Channel_004 ; computes the sum
Sum3 = Channel_005 + Channel_006 ; computes the sum
this is the end of the commented block *)
```

10.3.6 Syntax: Multiple Channels in a Formula

Time Base for Channels in a Formula

If multiple channels are jointly subjected to a function, they must all have the same time base. Since the calculation functions process all a channel's data points one-by-one, the following parameters must be the same for all channels in a formula:

- Sampling Time
- Trigger Affiliation
- Pretrigger
- Measurement Duration

Processing a function on two channels having different sampling rates would require the function to use interpolation. This would vastly increase the demands on the system.

The data must be simultaneous. This means that the channels must be started by the same trigger and with the same pre-trigger duration.

Note

If it is impossible to avoid having differing sampling intervals for the input channels, there are various functions to use to compensate. Two good possibilities are `ReSample` and `Mean`.

10.4 Variables and Syntax with Control Commands

The following descriptions apply to **OFA/IFA with Control Commands**.

In order to be able to use the advanced functions and options offered by the control commands, activate them. More information is presented in the section: "*Source Text with Control Commands* 844".

10.4.1 Creating a Variable

With activated Control Commands, it is additionally possible to generate single values, process vector variables, as well as local and global data arrays. The values each occupy 4 Byte or 8 Byte and can be created in either Integer or Float format.

They are created in the `OnInitAll` block (see: Types of Variables 870).

Note

Notes on precision

- **int**: a pure numerical value (disregarding factor and offset)
  with 32-bit precision
- **float**: a scaled numerical value (factor and offset are applied)
  imc Online FAMOS: with 24-bit precision
  imc Inline FAMOS: with 52-bit precision

Double-initialization

Avoid double-initialization in the OnInitAll-block. However if this is necessary, the first statement defines the type; e.g.

```
OnInitAll
   int pv.x = 0
   ...
   pv.x = 5
End
```

In any subsequent lines, any differing type will not be applied.

Example 1 Process vector

```
OnInitAll
    ; int creates a variable in Integer format:
    int pv.NewEntryA = 0

    ; without int, the variable is in Float format:
    pv.NewEntryB = 0
    float pv.NewEntryC = 0
End
```

Example 2

```
; Executed once at the start
OnInitAll
   v[2] ; local array
   vs          = VectorStatic( Trigger_48, 4)
   int VarInt  = 1
   VarFloat    = 0.0
   int pv.Var1 = 0
   pv.Var2     = 0
   VChanReal   = SingleValueChannel( Trigger_48, 1000 )
End

; run upon start of the measurement
OnTriggerStart(Trigger_48)
   v[1]  = pv.Channel_001 ; Channel values upon start
   v[2]  = pv.Channel_002

   vs[1] = 0
   vs[2] = 0
   vs[3] = 0
   vs[4] = 0

   VarInt   = 0
   VarFloat = 0.0
   pv.Var1  = 0
   pv.Var2  = 0
End

; Executed during a running measurement
OnTriggerMeasure(Trigger_48)
   ;...
   if Virt_Bit01
      Virt_Bit01  = 0
      VChanReal   = pv.Channel_001
   end
End

; Executed at the end of every measurement
OnTriggerEnd(Trigger_48)
   DisplayVar_01 = pv.Channel_001 - v[1] ; difference end - start
   DisplayVar_02 = pv.Channel_002 - v[2] ; difference end - start
End
```

10.4.2 Comparison Operators

Comparison operators are used for queries within condition statements. Here, we will describe only the `>` operator (Greater), and the other comparison operators `≥`, `<`, `=`, `≤` and `<>` are used in an analogous manner. Comparison operators return results of the BOOL data type, as required for condition statements. Single values and channels can also be used as operands.

```
IsGreater = a > b
```

Greater-operator. Is the first operand greater than the second operand? `IsGreater = 1`, if the first operand is greater, otherwise it is 0.

a: 1. Operand

b: 2. Operand

IsGreater: result

Example

```
OnInitAll
    Value = 0
    VrtBit_01 = 0
End
OnTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    If Value > 5
        VrtBit_01 = 1
    End
End
```

Combinations of different conditions can be implemented using the operators `AND` or `OR`, for instance, `IF VirtBit_01 > 0 AND VirtBit_02 = 0`.

10.4.3 Defining Virtual Channels with Conditions

- **Deactivated Control Commands:** Virtual channels are always filled with values (according to the clock rate of the parameter channels, etc.).
- **Activated Control Commands:** Virtual channels are only filled with values if they are defined by the currently operable branch of the condition. If the condition in the example below is met (the virtual bit `VrtBit_01` is set), then the virtual channel `VrtChannel_001` is filled with values, otherwise it remains empty:

```
If VrtBit_01 > 0
    VrtChannel_001 = Channel_001 + 10
End
```

If the condition's default branch also defined the virtual channel, then the virtual channel is always filled with values. But then, the virtual channel's particular values depend on the operative branch of the condition, for example,

```
If VrtBit_01 > 0
    VrtChannel_001 = Channel_001 + 10
Else
    VrtChannel_001 = Channel_001 + 20
End
```

If a virtual channel is used in a formula (or if a virtual channel is queried), the virtual channel must be defined in every program branch which leads to the formula or query in question. The following example is only permitted if the default branch of the condition is called. Otherwise, the virtual channel `VrtChannel_001` wouldn't be defined for `VrtBit_01 = 0`.

```
If VrtBit_01 > 0
    VrtChannel_001 = Channel_001 + 10
Else
    VrtChannel_001 = Channel_001 + 20
End
VrtChannel_002 = 2*VirtChannel_001 + Channel_001
```

10.4.4 Conditions, Case-differentiation and CAN-transmission with Channels

If conditions, case-differentiation or CAN-transmission with channels is called in `OnTriggerMeasure`, then the respective current (or most recent) value in the channel is used for the query or transmission. For this purpose, OFA/IFA automatically inserts a `CurrentValue`-function before the querying expression, and then the resulting current value of the channel is retrieved. The following examples illustrate channels subjected to conditions. The behavior of channels in case-differentiation and CAN-transmissions is analogous.

If a physical input channel is used in at least one query (e.g. `If Channel_001 > 0`), the current value of the input channel is noted at the start of `OnTriggerMeasure`. Whenever the physical channel is queried, the single value noted stands in for it:

Coded in OFA/IFA	OFA/IFA automatically transforms this to

`LED_01 = 1`
`If Channel_001 > 0`
`    .....`
`If Channel _001 < 0`
`    .....`
	`LED_01 = 1`
	`_cv = CurrentValue(Channel_001, 0, 0.0)`
	`If _cv > 0`
	`    .....`
	`If _cv < 0`
	`    .....`

If an expression is queried, e.g. `Channel_001 - 1 > 0`, the current value of the expression `Channel_001 - 1` is automatically generated by OFA/IFA and placed before the query, and the single value generated is then queried:

Coded in OFA/IFA	OFA/IFA automatically transforms this to

`LED_01 = 1`
`If Channel_001 + 1 > 0`
`    .....`
`If Channel_001 - 1 < 0`
`    .....`
	`LED_01 = 1`
	`_cv = CurrentValue(Channel_001 + 1, 0, 0.0)`
	`If _cv > 0`
	`    .....`
	`_cv = CurrentValue(Channel_001 - 1, 0, 0.0)`
	`If _cv < 0`
	`    .....`

If virtual channels are queried, e.g. `If VrtChan_001 > 0`, then the current value in the channel is determined and noted after each definition (with activated control commands, virtual channels can be defined at various points in the source text). If the virtual channel is queried, the query retrieves the noted current value of the virtual channel rather than the channel itself:

Coded in OFA/IFA	OFA/IFA automatically transforms this to

`If VrtBit_01 > 0`
`    VrtChannel_001=Ch01+3`
`Else`
`    VrtChannel_001=Ch01+5`
`End`
`LED_01 = 1`
`If VrtChannel_001 > 0`
`    .....`
`If VrtChannel_001 < 0`
`    .....`
	`If VrtBit_01 > 0`
	`    VrtChannel_001 = Channel_001 + 3`
	`    _cv = CurrentValue(VrtChannel_001, 0, 0.0)`
	`Else`
	`    VrtChannel_001 = Channel_001 + 5`
	`    _cv = CurrentValue(VrtChannel_001, 0, 0.0)`
	`End`
	`LED_01 = 1`
	`If _cv > 0`
	`    .....`
	`If _cv < 0`
	`    .....`

Note | **Note on CurrentValue-funktion**

The `CurrentValue`-functions automatically generated by OFA/IFA reflect the option "last value". However, a high sampling rate can lead to situations where many sample values from a channel are still being processed. If "last value" is the valid option for the `CurrentValue` function, this can lead to values being ignored.

To avoid this, there are other options which can be set for the `CurrentValue` function (e.g. use of maximum value, if multiple values are available for the channel). But then, the `CurrentValue`-function, along with the corresponding setting for the option, must be written into the source text; it isn't added automatically.

Note **Boolean variables from files**

Boolean (True/False) variables can be queried in `If` conditions without comparison:

```
Switch_A = Channel_01 > 5
If Switch_A
    ...
```

OFA/IFA allows this, because the compiler makes the result `Switch_A` a boolean variable by comparing `Channel_01 > 5`.

When **importing variables from files**, however, the compiler cannot always clearly recognize them as boolean variables.

Earlier versions of OFA/IFA accepted this, but this could lead to incorrect queries. The following construct leads to an error message in current OFA/IFA versions:

```
Bools= VectorFromFile("Bools.dat")
Switch_B= Bools[2]
...
If Switch_B ; -> Error message
    ...
```

Therefore If queries in current OFA/IFA programs must always be written with comparison, e.g. :

```
Bools= VectorFromFile("Bools.dat")
Switch_B= Bools[2]
If Switch_B = 1 ; -> OK
    ...
```

This change may cause old experiments that worked with earlier imc STUDIO versions to generate error messages in current versions. In this case the OFA/IFA code must be changed according to the last example.

10.4.5 Example - Simplified Motor Simulation

The use of various control commands is illustrated (in imc Online FAMOS) below in reference to a simplified motor simulation. The voltage and current signals from a motor during run-up, normal operation and wind-down are simulated (for 5 s each). The current state of the simulation can be frozen using a Pause-bit.

```
;-----------------------------------------------------------------------
; In the OnInitAll block, initializations are performed prior to the
; first measurement. All single value variables used in the formulas
; must be initialized here.
;-----------------------------------------------------------------------
OnInitAll
    Status   = 0        ; Initialization of single value variables
    Counter  = 0
    Data     = 0
    PauseOld = 0
    PauseNew = 0
End
```

```
;-----------------------------------------------------------------------
; The block OnAlways is run constantly. The Pause-function is
; implemented here. If you click on the Pause bit, the timer is stopped.
; If the Pause-bit is currently deactivated, clicking on it starts the
; periodic timer. After 10ms, the timer ticks at 10ms intervals.
;-----------------------------------------------------------------------
OnAlways
    ; PauseNew is the 1st virtual bit
    if PauseNew <> 0 AND PauseOld = 0           ; Pause-bit is clicked on
        RecordText ( "Pause!!!" )               ; output text
        StopTimer ( 1 )                         ; stop timer
    end
    if PauseNew = 0 AND PauseOld <> 0           ; Pause-bit is clicked off
        RecordText ( "Pause finished!!!" )      ; output text
        StartTimerPeriodic ( 1, 0.01 , 0.01 )   ; start periodic timer
    end
    PauseOld = PauseNew
End

;-----------------------------------------------------------------------
; The OnTriggerStart block is executed at the start of
; the measurement. When the measurement starts, a periodic timer is
; set up. After 10ms, the timer ticks at 10ms intervals.
;-----------------------------------------------------------------------
OnTriggerStart ( Trigger_48 )
    LED_01 = 1                                ; switch on LED_01
    StartTimerPeriodic ( 1, 0.01 , 0.01 )     ; start timer
End

;-----------------------------------------------------------------------
; The OnTriggerEnd block is executed at the end of a measurement.
; Here, the timer is stopped and LED_01 switched off.
;-----------------------------------------------------------------------
OnTriggerEnd ( Trigger_48 )
    LED_01 = 0                        ; switch off LED_01
    StopTimer ( 1 )                   ; stop timer with the ID 1
End

;-----------------------------------------------------------------------
; The OnTriggerMeasure block runs constantly during measurement.
; The virtual channel Voltage is created under the control of a timer,
; and the virtual channel Current is computed from the channel Voltage.
;-----------------------------------------------------------------------
OnTriggerMeasure (Trigger_48 )
    Voltage = channel_001 * 0 + Data
    _x = Voltage + sin ( sawtooth ( Voltage, 0, 1, 10000 ) )
    rpm = upper ( 0, filtlp ( _x, 0, 0, 3, 1 ) * 60 + _x * 20 )
    _y = diff ( _x )
    Current = 10*filtlp ( _y, 0, 0, 2, 2 )
    if Voltage > 5        ; queries virtual channel Voltage. If the
                          ; current value is greater than 5,
        LED_05 = 1        ; switch on LED_05
        LED_06 = 0        ; switch off LED_06
    else                  ; otherwise (current value in channel Voltage <= 5)
        LED_05 = 0
        LED_06 = 1
    end
End
```

```
;--------------------------------------------------------------------------
; The OnTimer block is run upon every click of Timer 1. The periodic
; timer, Timer 1, was set up either in OnTriggerStart or OnAlways
; using the function StartTimerPeriodic. In the OnTimer block,
; the numerical values for the virtual channel Voltage are computed.
;--------------------------------------------------------------------------
OnTimer ( 1 )                   ; OnTimer-Block for Timer 1
    switch Status               ; case differentiation based on the
                                ; single value Status
        case 0                      ; case: Status = 0
            Data = Data + 0.02      ; compute the data
            Counter = Counter + 1   ; increment counter
            if Counter > 500        ; query counter
                Counter = 0         ; re- initialize counter
                Status = 1          ; set Status
            end                     ; finish condition
        end                         ; finish case-differentiation
        case 1                      ; case: Status = 1
            Counter = Counter + 1
            if Counter > 500
                Counter = 0
                Status = 2
            end
        end
        case 2                      ; case: Status = 2
            Data = Data - 0.02
            Counter = Counter + 1
            if Counter > 500
                Counter = 0
                Status = 0
            end
        end
        default                     ; default treatment for Status,
                                    ; if Status is not equal to 0, 1 or 2
        end
    end
End
```

10.5 Types of Variables

The following is a list of the usual variable types which you can define in OFA/IFA. Special types of variable such as CAN-structures, controller-structures, ... are not mentioned here. These are presented in the respective chapters.

Virtual channels ( )

Description	Example	Syntax	Definition
Virtual channel, (Datenfeld equidistant)	`Virt = Channel_001`	various functions	Without control command Otherwise: OnTriggerMeasure
Data array global	`vs = VectorStatic (Trigger_48, 10)`	Array = VectorStatic (Trigger#, Size)	OnInitAll
Data array dynamic	`vsChan = SingleValueChannel (Trigger_48, 1000)`	Array = SingleValueChannel (Trigger#, DataRate) various additional functions	OnInitAll
Vector series dynamic	`vChan = VectorChannel (Trigger_48, 100, 5)`	Array = VectorChannel (Trigger#, DataRate, Size)	OnInitAll
Vector series equidistant	`Virt_fft = FFT (Channel_001, 0, 1024)`	various functions	Without control command Otherwise: OnTriggerMeasure

Local channels ( )

Description	Example	Syntax	Definition
Local channel	`_Local_Virt = Channel_001`	various functions	Without control command Otherwise: OnTriggerMeasure
Local vector, Data array local	`v[10]` `int v[10]`	Array[Size] various additional functions	OnInitAll

Local variables (single value;)

Description	Example	Syntax	Definition
Single value as Float	`_Lokal_Var1 = 4` `_Lokal_Var2 = 0xA5 ; hex`	_Variable = 0	Without control command Otherwise: OnInitAll
Single value as Integer	`int Var1= 1` `int Var4= 0xA5 ; hex`	int Variable = 0	OnInitAll

Single value as Float	`Var2= 0.0`
	`float Var3= 0`
	`Var4= 0xA5 ; hex`
		VariableA = 0
		
		float VariableB = 0
			OnInitAll

pv-variables 355 (single value;) (only in imc Online FAMOS)

Description	Example	Syntax	Definition
Single value as Integer	`int pv.Var1= 1` `int pv.Var4= 0xFFFF ; hex`	int pv.Variable = 0	OnInitAll

Single value as Float	`pv.Var2= 0.0`
	`float pv.Var3= 0`
	`pv.Var4= 0xFFFF ; hex`
		pv.VariableA = 0
		
		float pv.VariableB = 0
			OnInitAll

Local texts ( )

Description	Example	Syntax	Definition
Text	`Text = "Hello"`	various functions	

10.5.1 Local Vectors

Local Vectors in OnInitAll-Block

Local vectors can be created using the function `VectorFromFile` and now also in the `OnInitAll` block:

```
OnInitAll
    Vector = VectorFromFile( "Vector_01.DAT" )
    ; or
    int sv1[VectorLength]
    ; or
    sv2[VectorLength]
End
```

- The vector elements are initialized at 0.
- The vector length of `sv` must be selected appropriately. Make sure to use only possible vector indexes, especially for variable vector indexes.
  `sv[1]…sv[vector length]`
- Local vectors can be used in synchronous tasks, too.
- Elements of local vectors can be used on the left or right side of an expression:

  `Virt_Bit01 = sv[1]`

  or

  `if sv[2] > 0`

  or

  `sv[1] = sv[1] + 1`

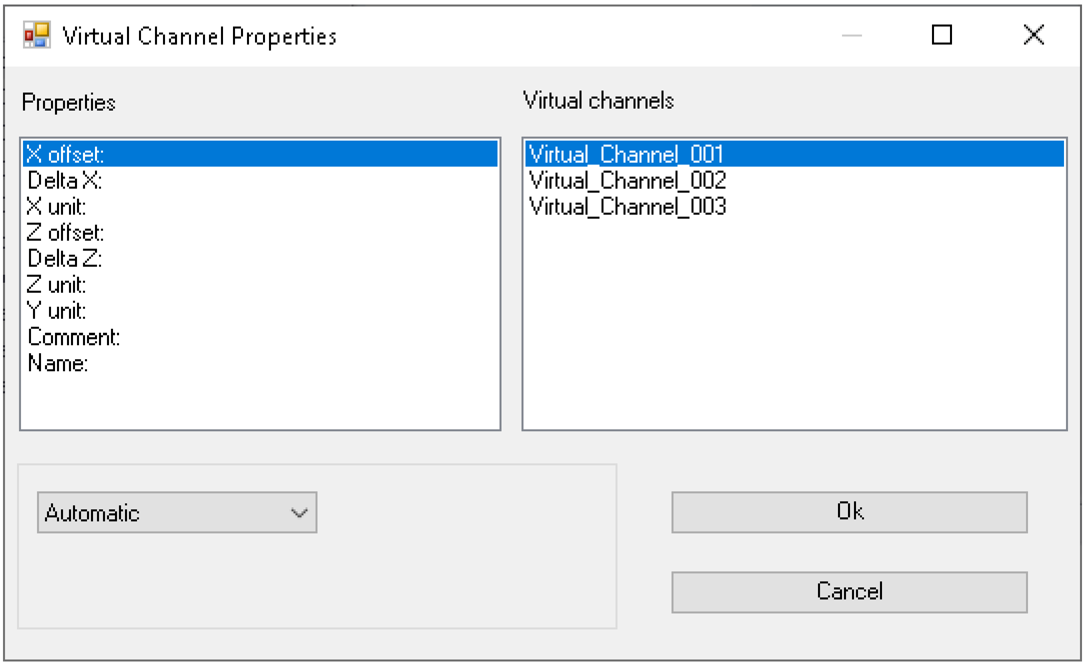
- The elements of local vectors can be addressed with variable indexes, e.g.:
  `sv[Index + 2] = sv[Index + 1]`
- Functions which return streaming vectors can be assigned to static vectors:
  `sv2 = FFT(...)`
- The function `GetSampleCount` of group Control functions returns for local vectors the length of the vector. This is useful, if the a local vector has been created with the function `VectorFromFile`. Thus the possible vector indexes for this vector can be checked.

10.6 Properties of Virtual Channels

Already defined virtual channels can subsequently be assigned certain properties. A virtual channel's name, comment and units can be set. If any virtual channels are available as vectors, it is additionally possible to set special vector properties.

To do this, open the dialog: "*Virtual Channel Properties*" via the context menu 855 in the Editor, or via the menu item "*Edit*" > "*Properties*" (via the menu item applies only to imc Online FAMOS):

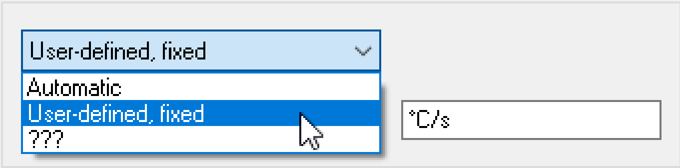
Menu item	Description
With control commands	Deactivates/activates the Control Commands.



The virtual channels appear on the right side of the window. Multiple selection is possible for assigning the same properties to several channels.

The various properties are displayed on the left side of the list. You can define one property at a time for the selected virtual channel(s) on the right.

The options for the selected property are made in the drop-down list boxes at the bottom of the window. The default setting for all properties is *automatic*. To define a property select *User-defined* in the list box. Then, a text box will appear in which you can enter the value desired.



The properties of virtual channels can only be set in this dialog. If you wish to change properties which were already set or to make settings for new virtual channels, call the dialog again.

Property	Description
X-offset	The offset in the x-direction can be set to a fixed value for purposes of display in the curve window. Otherwise, the value is automatically determined. This property can only be set for **vectors**.
Delta-X	The distance between two sample values in the x-direction can be set to a fixed value for purposes of display in the curve window. Otherwise, the value is automatically determined. This property can only be set for **vectors**.
Defining X-axis units	For the display of a virtual channel in the curve window, the units of the X-axis can either be determined automatically or given a fixed setting by the user. It is best to specify only SI-units. Do not specify any orders of magnitude such as milli- and kilo- (exception: kg). The same guidelines for units are valid as for defining the units of input channels. For channels whose X-axis is the time-axis, it is recommended to leave the X-axis unit on automatic. In that case, the unit displayed will be "s" for seconds.
Z-offset	The z-offset is the z-value given for the "front" curve in a 3D curve window. The z-offset can either be determined automatically or given a fixed setting by the user. This property can only be set for **vectors**!
Delta-Z	Delta-Z is the distance between two adjacent curves in the curve window. This property can only be set for **vectors**!
Comment	Comments can be added to virtual channels in the same way as with normal input channels. You can use any characters in this field - you can also leave it blank.
Name	Instead of the virtual channel's name which you used when defining it, you can specify a different name here. This saves you the work of renaming all names in the entire source text, for example for the purpose of the display in the curve window. It also makes sense to insert a shorter name in the formulas while stating the whole name here. The names of all channels must be unique within the system. The same limitations apply for constructing a name as for the input channels.

10.7 Calculation examples

10.7.1 Determining the RMS of a Mixed Signal's Alternating Component

The root-mean-square (RMS) of the signals alternating components is to be determined; the signal contains a direct as well as an alternating component.

For example, it is possible to determine the RMS of a noise signal in an amplifier which has an offset voltage. Another use would be for determining the noise component in a supply current.

Problem background:

The signal *u(t)* consists of direct and alternating components and can be represented as $u(t) = u\_(t) + u_0$ where u_0 is the signal's direct component.

If one tries to find the alternating component's RMS by using the equation

$$U_{\_} = \sqrt{\frac{1}{T}\int_{t-T}^{T}[u(t) - Meanvalue(u(t))]^2 dt}$$

directly, T being the time over which the data are collected, an error message will be generated when the source text is compiled. The reason is that the RMS, a single value, is to be subtracted from $u(t)$, which is a vectored data stream.; in other words, the data types don't match.

Solution:

If the initial equation $u(t) = u\_(t) + u_0$ is incorporated into the definition of the RMS, and it is noted that the mean of the alternating quantity is eliminated, it follows that the sum of the RMS components' squares $U^2 = U_\sim^2 + U_0^2$ equals the square of their sum. This makes it possible to determine $U_\sim$ as the difference of two data sets of matching type.

Example

Letting Ch_01 designate the complete signal, the RMS of the alternating component can be computed as

```
Rms_noise= Sqrt(mean(Ch_01*Ch_01, 1000,1000)- mean(Ch_01, 1000, 1000)^2)
```

10.7.2 Determining one or more Frequencies' Contributions to a Signal

Purpose:

The 150 Hz contribution to a non-sinusoid current of mains frequency is to be displayed as a curve plotted over time. A digital output could additionally be set in response to this contribution's exceeding a threshold value.

Problem background:

If the FFT function is applied directly to a measurement, the resulting frequency spacing is given by

$$\Delta f = \frac{f_T}{N}$$

where f_T is the sampling rate and N is the number of data points used, which must be expressed as a power of two (e.g., 1024 = 210). If, for instance, the sampling rate 1 kHz and N=1024 are specified, the frequency spacing is 0.9765625 Hz. This means that it is impossible to determine the 150 Hz line exactly.

Solution:

One could extract exactly 1000 values from the continuous stream of measurement data. This excerpt can afterwards be extended to 1024 points by resampling. The resulting, resampled data set then has a sampling frequency of 1.024 kHz, and the 150th spectral line is located exactly at 150 Hz.

Example

Declare `Current` as the measurement channel to be analyzed, which is sampled at a rate of 1 kHz and whose 150 Hz spectral line is to be charted over time. One appropriate source text would be the following:

```
_I_Channel=VectorizeAndSkip(Current ,1000 , 0 )
_I_Res=ReSample(_I_Channel ,1024 )
Spec = FFT(_I_Res, 0, 1024)
I_150 = VValueAtXValue(Spec, 150)
```

With the function `VectorizeAndSkip`, 1000 samples are extracted from the continuous data stream designated by the variable "Current". A data "skip" is not performed in this instance, as indicated by the zero as the last parameter in the function call.

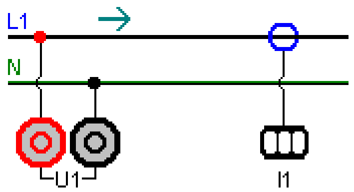
The assigned name, `_I_Channel`, begins with an underline, identifying it as an internal variable. This isn't strictly necessary, but it helps to conserve memory.

Next, the ReSample function is employed to produce 1024 samples. Now the FFT calculation can be performed. The function `VValueAtXValue` makes it possible to extract the Y-value at a specified X-value. In this case, the spectral line #150 is at 150 Hz, since the frequency spacing is 1 Hz, and it is designated by the variable `I_150`. All available functions such as triggering in response to threshold crossing, can be applied to this variable.

10.7.3 Power Measurements

Here follows the description for the Single-phase, Two-phase- and Three-phase-power measurement.

10.7.3.1 Single-phase Measurement Power1()



Single-phase power measurement

Effective value (root-mean-square)

$$y = \sqrt{\frac{1}{T}\int_T x^2 dt}$$

The effective value is the square root of the mean-square of the input signal.

Instantaneous power

$$p = u \cdot i$$

The operation Instantaneous Power supplies the product of two respective sampling values.

Active power

$$P = \frac{1}{T}\int_T (u \cdot i) dt$$

The active power is the average of the instantaneous powers during an averaging interval. This describes the actual power recorded by the user.

Apparent power

$P_S = U \cdot I$

The apparent power is the product of the root-mean-squares for current and voltage. The root-mean-squares are calculated according to the algorithm described under the operation effective value (root-mean-square).

Reactive Power

$Q = \sqrt{S^2 - P^2}$

The reactive power is the geometric difference between apparent and active power. Apparent and active power are calculated according to the above algorithm. The reactive power is the portion of the apparent power not recorded by the user.

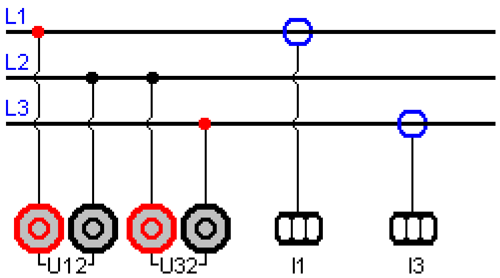
Power Factor

$\cos(\varphi) = \frac{P}{S}$

The power factor is the ratio between active power and apparent power. Active power and apparent power are calculated according to the above algorithm. The power factor corresponds to the cosine of the phase shift between current and voltage.

10.7.3.2 Two-phase Measurement Power2() (ARON)

The power can be determined from only two phase voltages and two conductor currents, assuming that the zero-wire of the three-phase circuit has no current. For that balanced load the third quantity is thus clearly defined. This type of power measurement will be referred to below as an ARON measuring circuit. The ARON measuring circuit is often the only way to measure the power on a user whose star point is not accessible.



ARON measuring circuit

In the triangular circuit, the connection of the measurement unit results analogous to the illustrated star circuit.

Instantaneous power

The operation instantaneous power (ARON) supplies the sum of the products of two respective sampling values.

$p = u_{12} \cdot i_1 + u_{32} \cdot i_3$

Active power

The active power is the average of the instantaneous powers during an averaging interval.

$$P = \frac{1}{T} \int (u_{12} \cdot i_1 + u_{32} \cdot i_3) dt$$

This describes the actual power recorded by the user.

Apparent power

The apparent power results from the sum of the products of the effective values (root-mean-squares) for the currents and voltages during the individual phases.

$$S = \frac{\sqrt{3}}{2} \int (U_{rms\,12} \cdot I_{rms\,1} + U_{rms\,32} \cdot I_{rms\,3}) dt$$

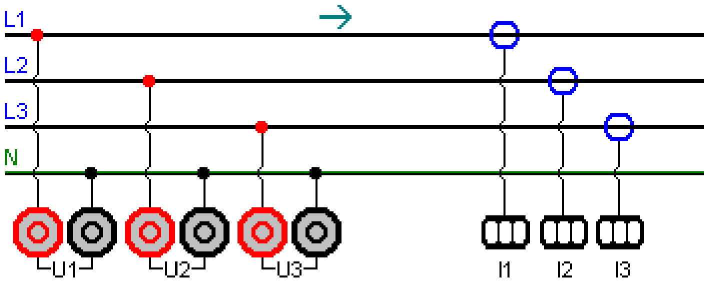
It is required that the symmetry of the supply circuit (three equal voltages with phase shifts of 120°) be stable. The root-mean-squares are calculated according to the algorithm under the operation effective value (root-mean-square).

Reactive power and **Power Factor**

See Single-phase power measurement 875

10.7.3.3 Three-phase Measurement with N: Power3()

Measurements on the three-phase circuit **with** N result according to the following diagram. For measurements on the three-phase circuit **without** N use ARON measuring circuit 876.



with N (Y-connection)

Instantaneous power

The operation instantaneous power supplies the sum of the products of two respective sampling values.

$$p = u_1 \cdot i_1 + u_2 \cdot i_2 + u_3 \cdot i_3$$

Active power

The active power is the average of the instantaneous powers during an averaging time.

$$P = \frac{1}{T} \int (u_1 \cdot i_1 + u_2 \cdot i_2 + u_3 \cdot i_3) dt$$

This describes the actual power recorded by the user.

Apparent power

The apparent power results from the sum of the products of the effective values (root-mean-squares) for the currents and voltages during the individual phases.

$$S = U_{rms\,1} \cdot I_{rms\,1} + U_{rms\,2} \cdot I_{rms\,2} + U_{rms\,3} \cdot I_{rms\,3}$$

The root-mean-squares are calculated according to the algorithm under the operation effective value (root-mean-square).

Reactive power and **Power Factor**

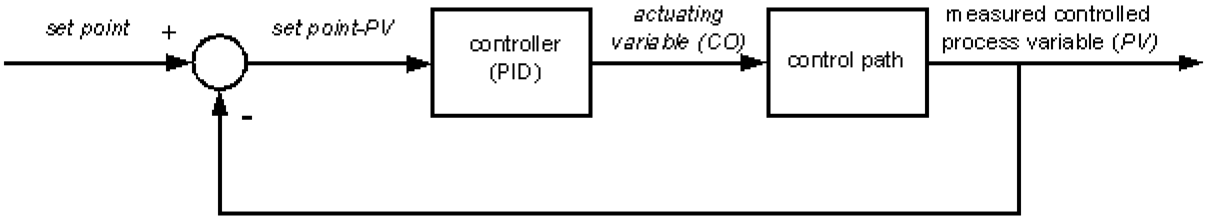
See Single-phase power measurement 875

10.7.4 PID-Controller

The controller functions are only available if imc Online FAMOS Professional is enabled for the device.

In a controller, a process value (PV) measured by sensors is continually compared with a specified setpoint value. If a system deviation (setpoint – PV) occurs, the controller generates a controller output (CO) which affects the system's energy flow in such a way to cause the process value to approach the setpoint. Then the system remains unaffected by the controller until the setpoint is changed or a disturbance occurs. Whether and how the controlled variable/ process value reaches the setpoint depends on the controller. Depending on the quantity to be controlled and the desired control response, a variety of different types of controller can be employed.

The following is a simplified sketch of a control loop:



Simplified sketch of a control loop

A pure *P-controller* is not able to completely correct disturbances, and can cause oscillation if the P-component (KP) is too large. It may react immediately to disturbances or changed setpoints, but still operates inexactly due to the remaining system deviation.

An *I-controller* (integrator), on the other hand, can completely correct a system deviation, but it does so much more slowly and also has a tendency to lead to oscillations.

A *D-controller* working alone is useless due to its differentiating response, since it only puts out a controller output when the system deviation changes, and thus doesn't correct system deviation as such. It is used in conjunction with other controllers in order to accelerate the correction of system deviations.

A *PI-controller* unites the advantages of a P- with an I-controller, since the P-component quickly reacts to system deviations and the I-components ensures that no system deviation remains. A PD-controller is very quick in providing adjustment thanks to its P- and D-components, but it leaves a persistent system deviation.

A PID-controller is constructed by combining the three basic elements P-controller, I-controller and D-controller. It possesses the positive properties of the individual controllers, i.e. it adjusts quickly, leaves no deviation and reaches the setpoint without overshooting it. However, it has the drawback that the D-component amplifies high-frequency disturbance signals. To prevent this, there is the possibility of specifying an upper cutoff frequency for the D-component. This type of controller is known as continuously acting, since it reacts to any change. Because each component or proportional coefficient like P-component (KP), I-component (KI) and D-component (KD) can be defined separately, then all types of controllers from the simple P-controller to the PID-controller can be achieved. The controller output CO then results from the addition of the three outputs of the P-, I- and D-controllers:

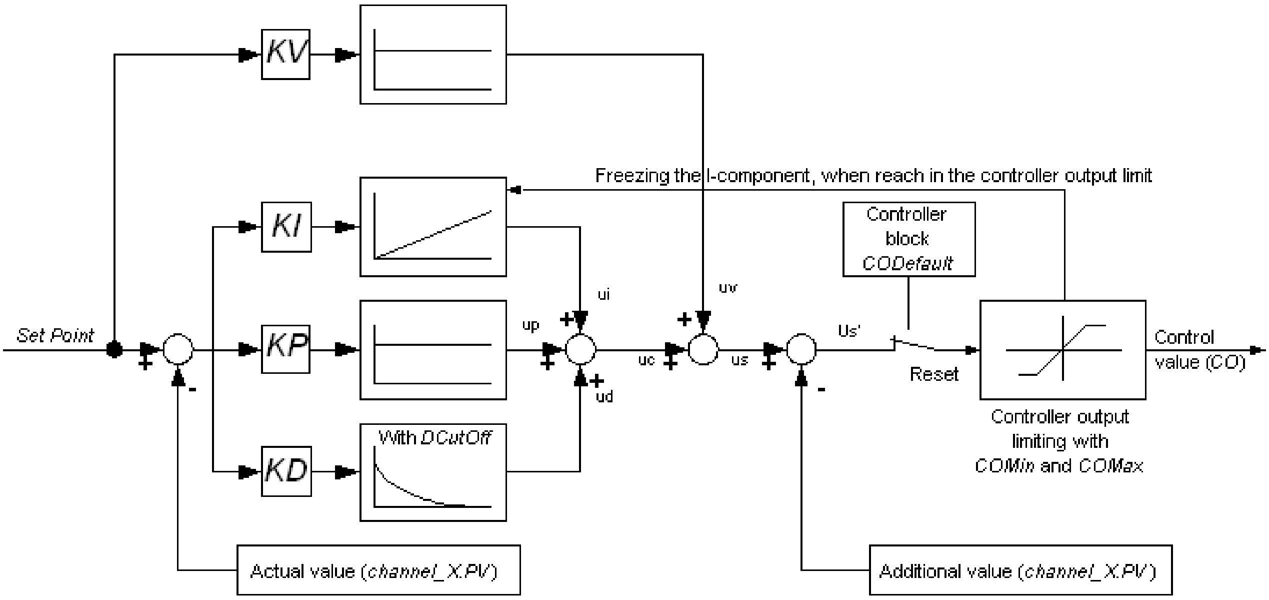
$$CO = KP*(SetPoint-PV) + KI*\int(SetPoint-PV) + KD*(SetPoint-PV)'$$

10.7.4.1 The PID-Controller in imc Online FAMOS Professional

The constants KP, KI and KD are specified for a continuous (non-discrete) controller and can be changed online at any time during the control process. The PID-controller is computed in the *synchronous task* with the selected cycle time, and the process value PV (any input channel) is provided to it in a process vector.

The entire controller structure in imc Online FAMOS consists, besides the PID-controller, of:

- an input control element (P-element with proportional coefficient KV),
- an additional summation point, via which a further measurement channel can be inputted in the form of an extra value,
- a controller block with adjustable default value and controller output limiting. The controller output limiting also comes with tracking of the I-component when the control variable limit has been reached. Toward this end, the I-component is frozen until the control variable limit is canceled.
- Additionally, it's possible to set an upper cutoff frequency (DCutOff) for the D-component, in order to avoid amplifying noise signals.



This as well as all of the PID-controller's other configuration possibilities are described below and can also be found in the imc Online FAMOS help dialog.

Parameter	Description
KP	**P-component** Use in the controller equation: CO = KP * (SetPoint - PV) + ... with PV = process value, CO = control output, SetPoint = setpoint KP's unit is: [unit for CO] / [unit for PV]
KI	**I-component** Use in the controller equation: CO = ... + KI * Integral (SetPoint - PV) + ... with PV= process value, CO = control output, SetPoint = setpoint KI's unit is: [unit for CO] / (s * [unit for PV]) When the function .Calc is called, one integration step is carried out. The synchronous task's cycle time is used as the basis.
KD	**D-component** Use in the controller equation: CO = ... + KD * differentiator (SetPoint - PV) + ... with PV= process value, CO = control output, SetPoint = setpoint KD's unit is: s * [unit for CO] / [unit for PV] When DCutOff is not equal to 0, be sure that the differentiator is band-limited.

Parameter	Description
KV	**Factor for the input control** Use in the controller equation: CO = ... + KV * SetPoint + ... with CO = control output, SetPoint = setpoint KV's unit is: [unit for CO] / [unit for PV]
SetPoint	**setpoint** The setpoint is used when the .Calc function is called.
Reset	**Controller block** if = 0, the controller is working normally. if = 1, the controller is blocked. When the controller is blocked, its output is set to the default output value .CODefault (generally = 0). Also, when the controller is blocked, the integrator is reset. The integral is thus kept at zero. If .Reset is changed, it only takes effect the next time the function .Calc is called.
CODefault	**Default for the controller output** When a controller block is in effect, the controller's output is set to this default value. This value is generally = 0. This value should lie within the range [COMin...COMax].
COMin	**Lower limit for the setpoint** The controller output is limited to the range [COMin...COMax]. When controller output limiting is in effect, the PID-controller's integrator is frozen at its current value.
COMax	**Upper limit for the setpoint** The controller output is limited to the range [COMin...COMax]. When controller output limiting is in effect, the PID-controller's integrator is frozen at its current value.
Xinput	**Extra input**, fed into the controller after the P-, I-, D-components. Use in the controller equation: CO = ... - Xinput + ... With CO = controller output. Xinput's unit is: [unit for CO]
DcutOff	**Upper cutoff frequency** (in Hz) for the D-component To prevent amplifying the noise, the D-component is frequency-limited. Thus it is then only effective up to a certain frequency .DCutOff. While at lower frequency components the gain is proportional to the frequency, at higher frequency components the gain is constant. This constitutes a 1st order high-pass filter whose cutoff frequency is located just at .DCutOff. If this value is set to 0, the frequency limiting is deactivated. In that case, a digital differentiator is computed. Use in the controller equation: for DCutOff <> 0: CO = ... + KD * high-pass (SetPoint - PV) + ... for DCutOff = 0: CO = ... + KD * differentiator (SetPoint - PV) + ...

Parameter	Description
CO	**controller output** The controller output can be queried as .CO. It is also already returned by the function .Calc.
PV	**process value** The process value is the instantaneous value measured for the controlled variable and is queried as .PV. It is already set when the function .Calc is called and therefore generally needs not be set explicitly.

The controller is computed in imc Online FAMOS *with Control Commands* in the command OnSyncTask with the function .Calc. It must be initialized previously, since it initially contains no values, but already needs values upon the first cycle pass in order to compute the PID-controller.

Initialization is performed in the *OnInitAll*-block with the values specified for KP, KI and KD. All other elements are initialized as 0.0, except DCutOff, which is set to approx. 0.1 / [controller cycle interval].

```
Controller = CtPID( P_component, I_ component, D_ component )
Controller output = CtPID.Calc( Process Value)
```

Example

```
OnInitAll
    EngineController = CtPID( 20.0, 0.5, 0 ) ; P, I, D
    EngineController.SetPoint = 6000         ; set rpm to 6000
    EngineController.COMin = 0.0             ; min and min range must be defined
    EngineController.COMax = 10000.0
    ; DiplayVar_11 - 13 pass KP, KI and KD values if Virt_Bit03 is set by the user.
End
OnTriggerMeasure( Trigger_48 ) ; when the measurement is running
    If Virt_Bit02 = 1 ; take new set point from display variable
        EngineController.SetPoint = DisplayVar_01
        Virt_Bit02 = 0
    End
    If Virt_Bit03 = 1 ; Read K-components from display variable
        EngineController.KP = DisplayVar_11
        EngineController.KI = DisplayVar_12
        EngineController.KD = DisplayVar_13
        Virt_Bit03 = 0
    End
End
OnTriggerStop()
     EngineController.SetPoint = 0
End
OnSyncTask( 0.1 )
    ; controller output scaled for DAC
    DAC_VoltageEngine = EngineController.Calc( pv.Speed )

    If Virt_Bit01 = 1 ; reset controller
        EngineController.Reset = 1
        Virt_Bit01 = 0
    End
End
```

The `.Calc` function calculates exactly one controller step. For the currently transferred process value, the new controller output is determined as the return value. The return value is then typically outputted at a DAC. The process value is subsequently available `.PV`, the controller output in `.CO`.

If controller parameters are changed, then these changes only take effect upon the next call of the function `.Calc`, because then and only then is a new controller output computed.

The function `.Calc()` is only allowed in synchronous tasks. The synchronous task's cycle interval is used to discretize the controller.

10.7.4.2 Two-position Controller

The two-position controller (discrete controller) is, like the PID-controller, computed in the synchronous task with the function `.Calc`. However, it must previously be initialized in the `OnInitAll`-block by creating the necessary controller structure along with it. In the process, the controller's setpoint `.SetPoint` is set `= 0`, and the controller output `.CO` is set `= 0`.

The controller's method of functioning: It only outputs specific controller outputs when pre-defined conditions are met. If the process value is greater than the upper reversal point, then the controller *output = 1* is generated and returned by the function *.Calc()*. If the process value is lower than the lower reversal point, then the resulting controller *output* is = 0. If the process value is between the two reversal points, the controller output remains unchanged. By means of the parameter *Output_Inversion*, the controller output can normally be inverted, so that when the process value is too high, the resulting controller *output* is = 0; and when the process value is too low, the resulting *CO* is = 1.

```
Controller = CtTwoPos(Hysteresis, Output_Inversion )
```

Example

```
OnInitAll
    Thermostat = CtTwoPos( 2, 0 )  ; Hysteresis, invert output
    Thermostat.SetPoint = 20       ; optional: set setpoint
    DigitalOut_01 = 0              ; optional: output in rest state
End
OnSyncTask( 0.1 )
    DigitalOut_01 = Thermostat.Calc( pv.Temperatur_01 )  ; set controller output
    ...
    If VirtBit_01 <> 0
        Thermostat.SetPoint = 22.0 ; change setpoint
        VirtBit_01 = 0
    End
End
```

The hysteresis is the distance between the upper and lower reversal points. It should be > 0. The two reversal points lie symmetrically around the setpoint. If, for instance, the setpoint is = 20 and the hysteresis = 2, then the resulting reversal points are 21 and 19.

10.8 Information and Tips

10.8.1 Transferring a configuration

The possible configurations depend on how the device is equipped:

When imc Online FAMOS configurations are copied to other devices, their behavior may well be altered. This also applies when copying the imc Online FAMOS configuration to imc Inline FAMOS. For instance, an assignment `LED_01 = Greater(Channel_001, 5)` will cause LED_01 to be switched on, if the device has LEDs, otherwise a virtual channel by that name will be created.

The same goes for beepers, DAC-outputs and DIO-bits.

10.8.2 Virtual Channels and the Trigger Machine

Virtual channels don't appear along with the channel selections in the Trigger dialog. Thus, a virtual channel cannot be triggered directly. To trigger the value of such a computed channel, the pertinent event must be detected in OFA/IFA, e.g. using the function `Greater`. The event sets a virtual bit, which in turn can be used by the trigger machine:

```
Virtual_Bit01 = Greater(Temp_difference, 5)
```

10.8.3 Supplemental Files

Supplemental file such as characteristic curves for functions, must be imported to the experiment.

Reference

On this topic, see the description for: "*Setup*" > "*Ribbon*" > "*Supplemental Files* 185".

10.8.4 Comments for Class-Counting Functions

To apply class-counting functions, a number of parameters need to be specified. However, the data presented in a curve window are not sufficient to determine all of these parameters. For this reason, the parameters for class-counting functions, in particular, are automatically inserted in the comment for the class-counting result. To save space, code-words corresponding to the various parameter settings options are used. The comment is produced when a syntax-check is successfully performed. The class-counting function names all begin with "Cl", e.g. ClRainflow.

With class-counting functions which return a matrix and a residue as their results, the automatic comment is produced only for the virtual channel containing the matrix.

If you write your own comment for a virtual channel which results from a class-counting function (Properties dialog in OFA/IFA), the comment will be displayed in the curve window. The comment which would otherwise be made automatically is then no longer available.

List of possible code-words and their meanings for class-counting function comments:

Code-word	Definition
OFA:	Comment intro for any class-counting function
RowMin	Lower limit of bin range (for rows)
RowMax	Upper limit of bin range (for rows)
ColMin	Lower limit of bin range (for columns)
ColMax	Upper limit of bin range (for columns)
Hyst	Hysteresis width
RowCl	Axis arrangement: X-axis is target class
RowAmplitude	Axis arrangement: X-axis is amplitude
RowClStart	Axis arrangement: X-axis is start class
RowMeanValue	Axis arrangement: X-axis is mean value
UnitCl	Result unit: classes
UnitInput	Result unit: as input channel
EndClOpen	Open-ended outer bins
EndClClosed	Closed outer bins
OptAlgBasic	Calculating method: base algorithm
OptAlgClor	Calculating method: with Clormann-Seeger correction
RowUnitStr	Unit (row-wise); in the comment: <Unit>
ColUnitStr	Unit (column-wise); in the comment: <Unit>
Level	Reference level
RowRevs	Axis arrangement: rpm in X-axis
RowNotRevs	Axis arrangement: rpm in Z-axis
Func	Function name of class-counting function

After the code words RowMin, RowMax, ColMin and ColMax, the corresponding value is stated, e.g. RowMax 1.00000E+2.

After the code words RowUnitStr and ColUnitStr, the unit is stated. The unit text is framed by "greater than" and "less than" symbols, e.g. RowUnitStr <Unit>.

10.8.5 Nesting depth, maximum stack

For conditions, etc., the maximum nesting depth is 90.

```
If (...)
  If (...)
    If (...) ...
```

With formulas, it is also possible to keep up to 90 expression elements.

For example: Result = a+b comprises 4 elements: a, b, + and "Result"

Note that there is **no** improvement of performance if the entire expression is written in one line. Instead it only reduces clarity!

10.8.6 LED-flashing during measurement

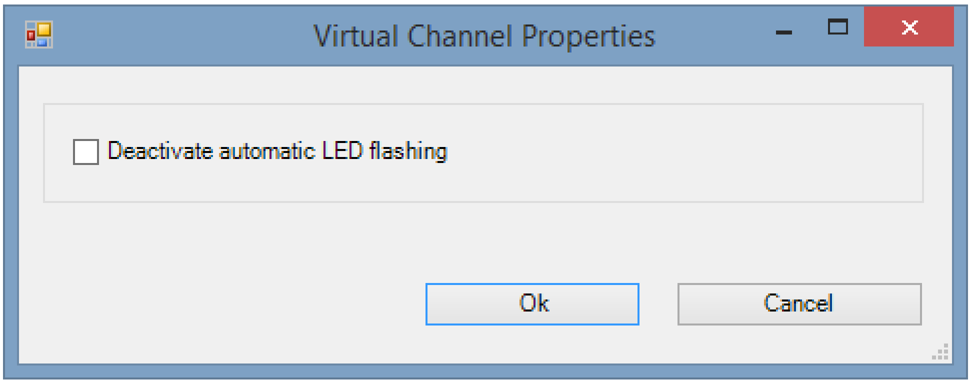
During a running measurement, LED 6 flashes at a 1-second rhythm. This provides a simple visual indication of whether the measurement is running.

LED 6 does not flash,

- if it is used in the imc Online FAMOS source code,
- if flashing is deactivated in the Options,
- if imc Online FAMOS is disabled.

Deactivating flashing in the Options

- Open the imc Online FAMOS options: Menu "*Extra*" > "*Options*"
- Activate the option: "*Deactivate automatic LED flashing*"



10.8.7 Using an external program editor

It's possible to enter the imc Online FAMOS source text using an external program editor (e.g. Notepad++, ...).

- Open the imc Online FAMOS options: Menu "*Extra*" > "*Options*"
- Activate the option: "*Edit imc Online FAMOS source text in the external program editor?*"
- Select the editor

Open the external editor by menu "*Edit*" > "*Start External Editor*" or push function key "*F4*".

Exchange of the imc Online FAMOS source text is performed by means of a temp file. This file is deleted as soon as the external editor is closed.

Note

In order that the content in the imc Online FAMOS editor and in the external editor match, the external editor may not keep the exchange file open after import, but should be able to automatically recognized any changes in the file.

- Example: WINWORD doesn't keep files open upon loading them. Automatic update of the temporary file in WINWORD is not possible, because imc Online FAMOS cannot access the open file.
- Example: NOTEPAD opens file and displays their contents. The file can later be altered by imc Online FAMOS, but the editor doesn't recognize the file alteration.

10.8.8 Comparison: imc Online FAMOS with imc Inline FAMOS - Example

A test comparing the performance of imc Online FAMOS with that of imc Online FAMOS is conducted using familiar hardware.

Test devices and configuration

Hardware used

Computer:

- WINDOWS 10
- Intel(R) Xeon(R) CPU E3-1270 V2 @ 3.50GHz 3.50GHz
- RAM: 8 GB
- Normal magnetic hard disk drive (not SSD)

Device:

- imc CRONOS compact 400 with two amplifiers of model UNI2-8

Test – configuration:

- Channel_001: 100kHz
- Online FAMOS: 2x FFT and 5x filtering, second order (bandpass, band-stop, high-pass, low-pass)
- RAM-buffer duration of all channels: 1s

```
; initialization prior to first measurement
OnInitAll
    sample = 0
End

OnTriggerMeasure(Trigger_48)
    FFT_001 = fft(Channel_001, 1, 1024)
    FFT_002 = fft(Channel_001, 1, 1024)

    Res_BP = FiltBP(Channel_001, 0, 0, 2, 100.0, 1000.0)
    Res_BS = FiltBS(Channel_001, 0, 0, 2, 100.0, 1000.0)
    Res_HP = FiltHP(Channel_001, 0, 0, 2, 100.0)
    Res_LP = FiltLP(Channel_001, 0, 0, 2, 100.0)

    Res_LP_ = FiltLP(Channel_001, 0, 0, 2, 100.0)

    sample = GetSampleCount(Channel_001)
    GetSample = Channel_001 * 0 + sample
End
```

Test procedure and results

imc Online FAMOS:

Handling a 100kHz channel, the imc Online FAMOS test program is at the edge of its capacities. The virtual channel "GetSample" continuously shows the limit value. In the curve window, the distance between the analog channel "Channel_001" and the calculated channel continually increases. As soon as the RAM-buffer of 1 second is no longer sufficient, data overflow occurs. This results in a **loss of data**.
Endurance test (= 24h) capability is just possible in this example with 2xFFT + 4 filters.

imc Inline FAMOS:

Endurance test capability still prevailed with 25xFFT + 50 filters, which is more than 12 times the performance of imc Online FAMOS.
Here, the qualification for endurance test capability is considered to be simultaneous display of the analog and the virtual channel in the curve window.

As well, significantly more substantial calculations are possible in imc Inline FAMOS. However, depending on the performance of the computer's respective hardware configuration, the curve window will **eventually no longer display the data in real time**.
Since the data storage management is handled by Windows, this moment in time is not predictable. With a 24-fold load (50xFFT + 100 filters) by comparison with the OFA experiment, this hardware experienced a **data overflow in the curve window** after 1.5 hours. However, there was no resulting loss of data since the data can be retrieved after the end of the measurement. When true data loss would occur in the computer is not possible to determine.

This result applies exclusively for the hardware and software settings specified!

Conclusion

The dynamic data storage management provided by WINDOWS enables multiple times the computation power of the fixed RAM-buffer structure in the device. This is scalable in accordance with the processor speed and PC's RAM size. imc Inline FAMOS is thus future-proof, able to keep pace with technological progress without requiring replacement of the actual measurement hardware.

10.9 imc Online/Inline FAMOS Function Reference

This document contains the reference for the imc Online FAMOS and imc Inline FAMOS functions.

The functions are sorted in alphabetical order.

Functions for imc Online FAMOS or imc Inline FAMOS with control commands are listed in one group.

10.9.1 Operators and Symbols

(+) Addition

Addition: Basic arithmetic

Sum = Summand1 + Summand2

If one of the two summands is a real number, the result is also a real number. In the addition of two integers, the result is an integer.

No handling mechanism is provided against potential data overflow; the user is required to take precautions for this possibility.

(-) Subtraction

Subtraction: Basic Arithmetic

Difference = Subtrahend - Minuend

If the subtrahend or the minuend is a real number, the result is a real number. In the subtraction of one integer from another integer, the result is an integer.

No handling mechanism is provided against potential data overflow; the user is required to take precautions for this possibility.

(*) Multiplication

Multiplication: Basic Arithmetic

Product = Factor1 * Factor2

If either of the two factors is a real number, the result is a real number. In the multiplication of two integers, the result is an integer.

No handling mechanism is provided against potential data overflow; the user is required to take precautions for this possibility.

(/) Division

Division: Basic Arithmetic

Quotient = Numerator / Denominator

With division, the result is always a real number.

For division between integers, please us the operator `iDiv` 943.

(^) Power

Power: Base raised to exponent;

Result = Base ^ Exponent

0 ^ 0 is defined to be 1.

(%) Modulus

Modulus: Remainder from division of two variables

Result = Numerator % Denominator

Example

```
Result = 10 % 3 ; Result = 1
```

If either the numerator or the denominator is a real number, the result is a real number.

When using the Modulo operator on two integers, the result is an integer. See also: iDiv 943.

(=) Equal Sign (Assignment)

Equal sign: The "=" (equal sign) is used for making assignments to local and virtual channels.

Character: "=" (equal sign)

Example

```
_LocChan = Data + 1
VirtChan = _LocChan * 2
```

(=) Equal Operator (Comparison)

"Equals"-operator. Compares the two operands for equality.

Prerequisite:
Only usable with control commands!

IsEqual = a = b

IsEqual: Result	**a**: 1st operand
	b: 2nd operand

IsEqual = 1, if both operands are equal, else 0.

Example

```
OnlTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    If Value = 1
        VirtChannel = Channel_001 + 10
    Else
        VirtChannel = Channel_001 + 5
    End
End
```

(<>) Inequality operator

Inequality-operator. Compares the two operands for inequality.

Prerequisite:
Only usable with control commands!

IsUnequal = a <> b

IsUnequal: Result	**a**: 1st operand
	b: 2nd operand

IsUnequal = 1, if the two operands are unequal, else 0.

(<) Less than operator

"Less than"-operator. Compares the two operators to check whether the first is less than the second.

Prerequisite:
Only usable with control commands!

IsLess = a < b

IsLess: Result	**a**: 1st operand
	b: 2nd operand

IsLess = 1, if the first operand is less than the second, else 0.

Example

```
OnlTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    If Value < 1
        VirtChannel = Channel_001 + 10
    Else
        VirtChannel = Channel_001 + 5
    End
End
```

(<=) Less than or equal operator

"Less than or equal to"-operator. Compares the two operands to check if the first is either less than or equal to the second.

Prerequisite:
Only usable with control commands!

IsLessEqual = a <= b

IsLessEqual: Result	**a**: 1st operand
	b: 2nd operand

IsLessEqual = 1, if the first operand is either less than or equal to the second, else 0.

(>) Greater than operator

"Greater than"-operator. Compares the two operands to check if the first is greater than the second.

Prerequisite:
Only usable with control commands!

IsGreater = a > b

IsGreater: Result	**a**: 1st operand
	b: 2nd operand

IsGreater = 1, if the first operand is greater than the second, else 0.

(>=) Greater than or equal operator

"Greater than or equal to"-operator. Compares the two operands to check if the first is either greater than or equal to the second.

Prerequisite:
Only usable with control commands!

IsGreaterEqual = a >= b

IsGreaterEqual: Result	**a**: 1st operand
	b: 2nd operand

IsGreaterEqual = 1, if the first operand is either greater than or equal to the second, else 0.

( ) Opening Closing Bracket

Opening parenthesis: The parentheses "(" and ")" are used in nested expressions and with functions.

Character: "(" (opening parenthesis)

Example

```
VirtChannel1 = 2 * ( Data + 1 )
VirtChannel2 = Max( Data, 5, 10 )
```

(;) Semicolon

Semicolon: A semicolon ";" is used to precede remark comments. Any information to the right of a semicolon is ignored by the program.

Character: ";" (Semicolon)

Example

```
VirtChan = Data + 1 ; first virtual channel
```

10.9.2 Functions (alphabetic)

10.9.2.1 A

ABCRating

ABC-Rating: Conducts either an A-, B- or C-frequency evaluation of a signal according to DIN IEC 651. In addition, subsequent time-rating (moving RMS-value with exponential averaging) and resampling can be performed.

a = ABCRating(b, FrequencyRating, TimeConstant, ReductionFactor)

a: Results **b**: Input channel (Signal to be evaluated) **FrequencyRating**: The signal's frequency rating 1: A-rating 2: B-rating 3: C-rating	**TimeConstant**: Time constant for averaging **In imc Online FAMOS:** ≥ 0.0: Time constant is defined by the user in s e.g. 0.125 for FAST-weighting, 1.0 for SLOW-weighting **In imc Inline FAMOS:** -1: Fast (0.125s) -2: Slow (1s) -3: Pulse -4: Peak -5: RMS in interval -6: RMS from start ≥ 0.0: Time constant is defined by the user in s **ReductionFactor**: Factor for resampling, ≥ 1 for a ReductionFactor = 1, no resampling

For a time constant = 0, no subsequent time weighting is performed. The reduction factor must in this case be exactly 1.

The A-rating corresponds to IEC 61672-1, 1st edition, 2002-05, Class1 and DIN IEC 651, 1981, class 0.

Example

```
SignalA = ABCRating ( Signal, 1, 0.125, 1000 )
```

- The signal is subjected to A-rating.
- The frequency-weighted signal is then time-weighted with a time constant of 0.125 s (FAST) and resampled with a factor of 1000.
- The signal originally has a sampling frequency of 20 kHz
- The A-rated result has a sampling frequency of 20 Hz.

Abs

Absolute value of input channel

a = Abs(b)

a: Results channel	**b**: Input channel

General information about the Accu* functions

The functions determine result over the entire measurement duration.

The result is a virtual channel or a single value.If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

It is possible to perform calculations on the results of the Accu-functions. Toward this end, be aware that these results of the Accu-functions are only available once the measurement is finished.For this reason, the results of the Accu-functions can not be taken into account in virtual channels which are calculated during the measurement.However, it is also possible to generate new virtual channels from the results of the Accu-functions, which are only available at the end of the measurement.

Example — Example of including results of the Accu-functions in a calculation

Determining the input signal's minimum and maximum values and sample count over the entire measurement duration. The results are subjected to calculations afterwards.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuLength1 = AccuLength( signal )
Res1 = (AccuMax1 - AccuMin1) * 10
Res2 = AccuLength1 / 2 )
```

Example — Example of an incorrect application

Determining an input channel's count of samples throughout the entire measurement duration.

The result of the AccuLength-function is determined at the end of the measurement. This result is generated too late to be used in generating calculated virtual channels during the measurement.

The virtual channel Res returns 0 as its result.

```
AccuLength1 = AccuLength( signal )
Res = signal*0 + AccuLength1
```

AccuLength

Count of samples over the entire measurement

Result = AccuLength(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the count of samples in the input signal over the entire measurement.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determining the input signal's minimum and maximum values and sample count over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuLength1 = AccuLength( signal )
```

AccuMax

Maximum value of entire measurement

Result = AccuMax(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the maximum value of the input signal over the entire measurement duration.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determines the minimum, maximum and mean value of the input signal over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuMean1 = AccuMean( signal )
```

AccuMean

Mean value over entire measurement

Result = AccuMean(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the mean value of the input signal over the entire measurement duration.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determines the minimum, maximum and mean value of the input signal over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuMean1 = AccuMean( signal )
```

AccuMin

Minimum value of entire measurement

Result = AccuMin(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the minimum value of the input signal over the entire measurement.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determines the minimum, maximum and mean value of the input signal over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuMean1 = AccuMean( signal )
```

AccuRMS

RMS-value over the entire measurement

Result = AccuRMS(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the RMS-value of the input signal over the entire measurement duration.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determines the minimum, maximum and RMS-value of the input signal over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuRMS1 = AccuRMS( signal )
```

AccuStDev

Standard deviation over the entire measurement

Result = AccuStDev(Signal)

Result: Results channel	**Signal**: Input signal

Remarks:

The function determines the standard deviation of the input signal over the entire measurement duration.

The result is a virtual channel or a single value. If the result is a virtual channel, this virtual channel is filled with exactly one result value at the end of the measurement.

Example

Determines the minimum, maximum and standard deviation of the input signal over the entire measurement duration.

"*signal*" is the input channel.

```
AccuMin1 = AccuMin( signal )
AccuMax1 = AccuMax( signal )
AccuStDev1 = AccuStDev( signal )
```

Acos

Inverse cosine of input channel

a = Acos(b)

a: Result; in radians	**b**: Input channel

AND

Logical And. Logical conjunction of b and c.

Prerequisite:
Only usable with control commands!

a = b AND c

a: Result	b: 1st operand
	c: 2nd operand

a = 1, if the first operand is unequal to 0 and the second operand as well, else 0.

The And-operator may only be used on operands of type BOOL.

A result of type BOOL is returned by the operators <, <=, >, >=, =, <>, AND, OR and NOT.

Example

```
OnlTriggerMeasure( Trigger_48 )
    Value1 = CurrentValue( Channel_001, 0, 0.0 )
    Value2 = CurrentValue( Channel_002, 0, 0.0 )
    If Value1 > 0 AND Value2 > 0
        VirtChannel_001 = Channel_001 + 10
    Else
        VirtChannel_001 = Channel_001 + 5
    End
End
```

Asin

Inverse sine of input channel

a = Asin(b)

a: Result; in radians	b: Input channel

Atan2

Inverse tangent of b/c

a = Atan2(b, c)

a: Result	b: Numerator
	c: Denominator

AudioBoardThirds

Third-octave-vector: Creates a third-octave vector.

Prerequisite:
Only available in: imc Online FAMOS!

a = AudioBoardThirds(b)

a: Vector with 33 elements	**b**: Input channel whose values are to be transformed into a vector

The input channel data are given in the following format:

..... Framebit1 Framebit2 HW1 LW1 HW2 LW2 ... HW33 LW33 .....

Two frame bits are always prefixed to the input's raw data potion. Next come 2 * 33 values as the raw data. A return value is determined from the sequence of HIWORD (HW) and LOWORD (LW) in the raw data.

Each set of 68 input values is used to generate a result vector with 33 elements.

It is not possible to combine data generated by the function with other data formats by, for instance, using the Addition function.

10.9.2.2 B

BitAnd

Bit wise AND connection of b and c

a = BitAnd(b, c)

Example

```
lownibble = BitAnd( DIO_Port01, 0x0f )
```

Extracts the DIO-Port's bottom four bits.

BitNot

Negation, bit-wise

a = BitNot(b [,Dataformat])

a: Result **b**: Argument	**Dataformat**: Assumed (integer) data format (only in imc Inline FAMOS) Allowed data types -32: 32 bit signed -16: 16 bit signed -8: 8 bit signed 1: 1 Bit (digital)

Bitwise inversion of the parameter's value.

A logical inversion is performed for each bit. The result bit is 0 if the input bit is 1, else 1. Negative integers are represented as a two's complement.

For imc Inline FAMOS applies: Each value is converted to the specified integer data format. When converting to the data type "*Digital*", all values which do not equal 0 are regarded as 1. The result is identical to that of the logical NOT-operator.

Example imc Online FAMOS

Bit-wise Negation of DIO_Port_01.

```
Res = BitNot( DIO_Port_01 )
```

Example imc Inline FAMOS

Inversion of the digital bit 'Virt_Bit01'.

```
Res1 = BitNot( Virt_Bit01, 1 )
```

All bits of the 2-Byte wide physical channel 'Signal_01' are inverted.

```
Res2 = BitNot( Signal_01, -16 )
```

All bits of the 4-Byte wide CAN channel 'CAN_01' are inverted.

```
Res3 = BitNot( CAN_01, -32 )
```

BitOr

Bit wise OR connection of b and c

a = BitOr(b, c)

BitXor

Exclusive OR, bit-wise: Bit-wise exclusive OR operation on b and c

a = BitXor(b, c)

10.9.2.3 C

Charact

Characteristic: The input channel is corrected using a characteristic curve. For each original value, a result is calculated from the characteristic in the file.

a = Charact(b, "Filename")

"Filename": characteristic in file

Values which lie between two characteristic points are linearly interpolated.

It is possible to calculate characteristic curves from **equidistant** data sets and from **XY**-data sets in imc FAMOS format. The X-coordinates of an XY-characteristic curve must be monotonically increasing. If they are not strictly monotonically increasing, then for one x-value there are multiple possible y-values; this means that the characteristic curve has a vertical portion at this location. If the input channel has such a value, then one of the associated y-values is arbitrarily selected as the result.

Driving cycle: This function can be used to output a waveform to a analog output or field bus.

Reference

See the example in the chapter: "*CAN-Bus Interface* 522" > ... > "*Outputting a waveform to a DAC module* 575".

Load the file

In imc STUDIO, the file of the characteristic curve is permanently integrated in the experiment.

- Import this file using the ribbon "*Setup-Configuration*" > "*Supplemental files*".

Note

imc Online FAMOS: The characteristic curve is limited to 50000 values.

imc Inline FAMOS: The characteristic curve is not limited.

ClHistogram

Classification histogram: amplitude time-of-stay procedure

a = ClHistogram(b, MinValue, MaxValue, Total, ResUnit, EndClass)

a: Results	**ResUnit**: Result units 0: classes 1: like input channel
b: Input channel	
MinValue: Lower limit of range	**EndClass**: End classes are 0: closed 1: open
MaxValue: Upper limit of range	
Total: Number of classes; ≥ 1	

The classification results are not complete until the end of measurement and therefore cannot be used in further computations.

This data classification procedure is based on DIN 45667 (German standard).

- For each class, the sum of the times during which the signal lies within the respective class boundaries is averaged separately.

In effect, this function counts the number of samples which occur in each class during a measurement.

- The time-of-stay in a class is computed by dividing the no. of samples.

Example

```
Histo1 = ClHistogram( Chan01, -10.0, 10.0, 32, 0, 0 )
```

- The input channel is divided into 32 classes ranging from -10 to 10, with closed end classes.
- The results are displayed as classes 0 to 31.

ClLevelCrossing

Level crossing histogram: Class counting with the level crossing method.

a = ClLevelCrossing(b, MinValue, MaxValue, Total, Reference, Hysteresis, ResUnit, EndClasses)

a: Results

b: Input channel

MinValue: Lower limit of range

MaxValue: Upper limit of range

Total: Number of classes; ≥ 1

Reference: Reference level

Hysteresis: hysteresis for peak identification; ≥ 0.0
specified in percent of class width

ResUnit: Result units
- 0: classes
- 1: like input channel

EndClass: End classes are
- 0: closed
- 1: open

The number of class level crossings are being counted, thus the result is divided into the number of classes + 1.

- If closed end classes are specified, the end classes of the result will necessarily be empty.
- With open end classes, level crossings through the upper and lower classes are counted.

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations.

Example

```
Histo1 = ClLevelCrossing( Chan01, -10.0, 10.0, 64, 0.0, 10.0, 0, 0 )
```

- The input channel is divided into 64 classes ranging from -10 to 10. Level crossings relative to 0.0 are counted with 10 percent hysteresis relative to the class width.
- The end classes are closed. The results are displayed as classes 0 to 64

ClMarkov

Data classification using Markov procedure

a = ClMarkov(b, MinValue, MaxValue, Total, Hysteresis, Axes, ResType, ResUnits, EndClass, Option)

a: Results

b: Input channel

MinValue: Lower limit of range

MaxValue: Upper limit of range

Total: Number of classes; ≥ 1

Hysteresis: Hysteresis for peak identification; ≥ 0.0

Axes: Axes configuration, x-axis is

- 0: target class or amplitude
- 1: starting class or mean value

ResType: Result matrix is of type

- 0: target/starting class
- 1: amplitude/mean

ResUnits: Result units

- **0**: classes
- 1: like input channel

EndClass: End classes are

- 0: closed
- 1: open

Option: Algorithm versions

- 0: main algorithm

The classification results are not complete until the end of measurement and therefore cannot be used in further computations.

Class-counting according to the Markov procedure counts all consecutive class transitions between local signal extrema, e.g. from Maximum 1 to Minimum 1, from Minimum 1 to Maximum 2, ...

The hysteresis suppresses noise and minor (i.e. unimportant) cycles. A new peak or valley is recognized only when the distance to the previous one is larger than the specified hysteresis width.

The result matrix can use the starting/target class or amplitude/mean as dimensions.

Example

```
Matrix1 = ClMarkov(Chan01, -10.0, 10.0, 64, 0.15, 0, 0, 0, 1, 0)
```

- The input channel is divided into 64 classes ranging from -10 to 10 with open end classes.
- The results are stored in a starting / target class matrix with classes from 0 to 63.
- The hysteresis width is approx. one-half the class width.

CloseSaveInterval

With this function, a new storage folder is set up on the internal storage medium. The folder is closed along with all data captured up to this time.

All subsequent measurement data are then saved in the new folder.

Prerequisite:
Only available in: imc Online FAMOS!
Only usable with control commands!

CloseSaveInterval()

If this function occurs within a pre-set saving interval, then the saving interval in progress is terminated, a new folder is created and filled with measured data until the actual end of the interval is reached. Subsequently, interval storage resumes according to the usual procedure.

The function can be used when data storage in the device is activated. At each call, an additional folder is created. For this, a command is triggered whose execution can be delayed depending on the configuration.

Constant calling of the function may cause the creation of an uncontrolled amount of folders.

Example

```
OnTriggerMeasure( Trigger_48 )
    If Virt_Bit01 > 0
        CloseSaveIntervall()
        Virt_Bit01 = 0
    End
End
```

ClRainFlow

Data classification using rainflow procedure

a = ClRainFlow(b, MinValue, MaxValue, Total, Hysteresis, Axes, ResType, ResUnits, EndClass, Option)

a: Results

b: Input channel

MinValue: Lower limit of range

MaxValue: Upper limit of range

Total: Number of classes; ≥ 1

Hysteresis: Hysteresis for peak identification; ≥ 0.0

Axes: Axes configuration, x-axis is

- 0: target class or amplitude
- 1: starting class or mean value

ResType: Result matrix is of type

- 0: target/starting class
- 1: amplitude/mean

ResUnits: Result units

- 0: classes
- 1: like input channel

EndClass: End classes are

- 0: closed
- 1: open

Option: Algorithm versions

- 0: main algorithm
- 1: with Clormann-Seeger correction

The classification results are not complete until the end of measurement and therefore cannot be used in further computations.

The rainflow procedure counts the cycles in a measured signal. Each cycle consists of a peak-valley pair (e.g. maximum and minimum).

The hysteresis suppresses noise and minor (i.e. unimportant) cycles. A new peak or valley is recognized only when the distance to the previous one is larger than the specified hysteresis width.

The result matrix can use the starting/target class or amplitude/mean as dimensions.

Example

```
Matrix1 = ClRainFlow( Chan01, -10.0, 10.0, 64, 0.15, 0, 0, 0, 1, 0 )
```

- The input channel is divided into 64 classes ranging from -10 to 10 with open end classes.
- The results are stored in a starting / target class matrix with classes from 0 to 63.
- The hysteresis width is approx.one-half the class width.

ClRainFlowRes

Rainflow with residues: data classification using rainflow procedure, output of remainder

ClRainFlowRes(a, Remainder, b, MinValue, MaxValue, Total, Hysteresis, Axes, ResType, ResUnits, EndClass, Option)

a: result matrix

Remainder: remainder

b: input channel

MinValue: lower limit of range

MaxValue: upper limit of range

Total: number of classes; ≥ 1

Hysteresis: hysteresis for peak identification; ≥ 0.0

Axes: axes configuration, x-axis is

0: target class or amplitude

1: starting class or mean value

ResType: Result matrix is of type

0: target/starting class

1: amplitude/mean

ResUnits: result units

0: classes

1: like input channel

EndClass: end classes are

0: closed

1: open

Option: algorithm versions

0: main algorithm

1: with Clormann-Seeger correction

The classification results are not complete until the end of measurement and therefore cannot be used in further computations. The remainder is not output until the end of the measurement.

The rainflow procedure counts the cycles in a measured signal. Each cycle consists of a peak-valley pair (e.g. maximum and minimum).

The hysteresis suppresses noise and minor (i.e. unimportant) cycles. A new peak or valley is recognized only when the distance to the previous one is larger than the specified hysteresis width.

The result matrix can use the starting / target class or amplitude / mean as dimensions.

Example

```
ClRainflowRes( Matrix1, Res1, Chan01, -10.0, 10.0, 64, 0.15, 0, 0, 0, 1, 0)
```

- The input channel is divided into 64 classes ranging from -10 to 10 with open end classes.
- The results are stored in a starting target class matrix with classes from 0 to 63. The remaining partial cycles are also displayed.
- The hysteresis width is approx. one-half the class width.

ClRainFlowTM

Rainflow with TrueMax filter: Rainflow class counting with TrueMax filter and hysteresis in percent of the class width.

a = ClRainFlowTM(b, MinValue, MaxValue, Total, Hysteresis, Axes, ResType, ResUnits, EndClass, Option)

a: Results

b: Input channel

MinValue: Lower limit of range

MaxValue: Upper limit of range

Total: Number of classes; ≥ 1

Hysteresis: Hysteresis for peak identification; ≥ 0.0

Specify as a percentage of the class width.

Axes: Axes configuration, x-axis is

0: target class or amplitude

1: starting class or mean value

ResType: Result matrix is of type

0: target/starting class

1: amplitude/mean

ResUnits: Result units

0: classes

1: like input channel

EndClass: End classes are

0: closed

1: open

Option: Algorithm versions

0: main algorithm

1: with Clormann-Seeger correction

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations.

The rainflow procedure counts the cycles in a measured signal. Each cycle consists of a peak-valley pair (e.g. maximum and minimum).

The hysteresis suppresses noise and minor (i.e. unimportant) cycles. A new peak or valley is recognized only when the distance to the previous one is larger than the specified hysteresis width.

The dimension of the result matrix can be the starting/target class or the amplitude/mean.

Because the extreme points of a signal are not usually accurately sampled, the TrueMax filter attempts to interpolate them more accurately.

Example

```
Matrix1 = ClRainFlowTM( Chan01, -10.0, 10.0, 64, 50.0, 0, 0, 0, 1, 0)
```

- The input channel is divided into 64 classes ranging from -10 to 10 with open end classes.
- The results are stored in a starting/target class matrix with classes from 0 to 63.
- The hysteresis width is one-half the class width.

ClRainFlowTMRes

RainflowTM with Residue: Data classification using rainflow procedure, output of remainder. With TrueMax filter and hysteresis in percent of the class width.

ClRainFlowTMRes(a, Remainder, b, MinValue, MaxValue, Total, Hysteresis, Axes, ResType, ResUnits, EndClass, Algorithm)

a: Result matrix

Remainder: Remainder

b: Input channel

MinValue: Lower limit of range

MaxValue: Upper limit of range

Total: Number of classes; ≥ 1

Hysteresis: Hysteresis for peak identification; ≥ 0.0

in % of class width

Axes: Axes configuration, x-axis is

0: target class or amplitude

1: starting class or mean value

ResType: Result matrix is of type

0: target/starting class

1: amplitude/mean

ResUnits: Result units

0: classes

1: like input channel

EndClass: End classes are

0: closed

1: open

Algorithm: use

0: main algorithm

1: main algorithm with Clormann-Seeger correction

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations. The remainder is not outputted until the end of the measurement.

The rainflow procedure counts the cycles in a measured signal. Each cycle consists of a peak-valley pair (e.g. maximum and minimum).

The hysteresis suppresses noise and minor (i.e. unimportant) cycles. A new peak or valley is recognized only when the distance to the previous one is larger than the specified hysteresis width.

The dimensions of the result matrix can be the starting/target class or amplitude/mean.

Because the extreme points of a signal are not usually accurately sampled, the TrueMax filter attempts to interpolate them more accurately.

Example

```
ClRainflowTMRes(Matrix1, Res1, Chan01, -10.0, 10.0, 64, 50.0, 0, 0, 0, 1, 0)
```

- The input channel is divided into 64 classes ranging from -10 to 10 with open end classes.
- The results are stored in a starting/target class matrix with classes from 0 to 63. The remaining partial cycles are also displayed.
- The hysteresis width is one-half the class width.

ClRangePairCount

Classification histogram: Using the range pair counting procedure.

a = ClRangePairCount(b, MinValue, MaxValue, Total, Hyst, ResUnit)

a: Results	**Hyst**: Hysteresis; in physical units, ≥ 0
b: Input channel	**ResUnit**: Unit of the Result 0: classes 1: like input channel
MinValue: Lower limit of range	
MaxValue: Upper limit of range	
Total: Number of classes; ≥ 2	

The class width is calculated according to the following equation:

Classwidth = (MaxValue - MinValue) / (Total + 1)

In other words, with a range from -10 V to 10 V, it is necessary to create 19 classes in order to achieve a class width of 1 V. The lowest, 'zero-th class' would represent a range from 0 V to 1 V, and since nothing is ever counted in that range, it is omitted and the remaining total is 19 instead of 20 classes.

Only the magnitude is counted. So all classes would range from 1 V to 20 V.

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations. This data classification procedure is based on DIN 45667 (German standard): the sum of the range-pairs is counted and allocated in classes.

Example

```
Histo1 = ClRangePairCount( Chan01, -10.0, 10.0, 19, 0.1, 0 )
```

- The input channel is divided into 19 classes ranging from 1 to 20.
- The results are displayed as Classes 1 to 19.

ClRevolutionsHistogram

Revolutions histogram: Counts the revolutions into the classes of the input channel.

a = ClRevolutionsHistogram(b, c, MinValue, MaxValue, Total, ResUnit, EndClass)

a: Result	**ResUnit**: Result units 0: classes 1: like input channel
b: Input channel	**EndClass**: End classes are 0: closed 1: open
c: speed in rpm	
MinValue: Lower limit of range	
MaxValue: Upper limit of range	
Total: Number of classes; ≥ 1	

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations.

ClRevolutionsMatrix

Two-channel revolutions matrix: counts the revolutions in a matrix.

a = ClRevolutionsMatrix(b, c, MinValue1, MaxValue1, Total1, MinValue2, MaxValue2, Total2, Axes, ResUnits, EndClasses)

a: Results

b: first input channel

c: Speed in rpm (second input channel)

MinValue1: Lower limit of range

MaxValue1: Upper limit of range

Total1: Number of classes; ≥ 1

MinValue2: Lower limit of range

MaxValue2: Upper limit of range

Total2: Number of classes; ≥ 1

Axes: Axis order, speed is

0: Z axis

1: X axis

ResUnits: Result units

0: classes

1: like input channel

EndClasses: End classes are

0: closed

1: open

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations.

ClTrueMax

Extreme value approximation: Approximates extreme values using interpolation.

a = ClTrueMax(b)

ClTwoChannelHistogram

Two channel histogram: Amplitude time-at-level procedure with two input channels and result matrix.

a = ClTwoChannelHistogram(b, c, MinValue1, MaxValue1, Total1, MinValue2, MaxValue2, Total2, ResUnit, EndClass)

a: Results

b: first input channel

c: second input channel

MinValue1: Lower limit of range 1

MaxValue1: Upper limit of range 1

Total1: Number of classes; ≥ 1

MinValue2: Lower limit of range 2

MaxValue2: Upper limit of range 2

Total2: Number of classes; ≥ 1

ResUnit: Result units

0: classes

1: like input channel

EndClass: End classes are

0: closed

1: open

The class counting results are not complete until the end of measurement and therefore cannot be used in further computations.

CodeRange

Returns specifiable values in response to a signal's value falling inside certain ranges.

a = CodeRange(b, Delay, "Filename")

a: Result	**Delay**: delay time
b: Input channel	**"Filename"**: coefficient vector file

The coefficients must be supplied in a group of three in the following manner (Minimum, Maximum, Code value). If the input channel lies within one of the specified ranges, the result is the code value, otherwise the result is zero.

If a switching time is specified, the output of the result values' data stream is delayed by this switching time. The result is only then a code value, if the input value stays within the corresponding range for at least the duration of the switching time, otherwise it is zero.

If the resulting data stream and other channels are to be used together as parameters of functions, the other channels must also be supplied with a delay (Function DelayLine).

Example

```
Transmission = GearRatio (Nin, Nout, 1, 1, 10, 0 )
Gears = CodeRange( Transmission, 0.1, "CoGear.dat")
DelayedLoad = DelayLine( Stress, 0.1 )
Gear1Load = SamplesGate( DelayedLoad, Gears, 1 )
```

In the channel Gear1Load, all loading measured while the vehicle was in first gear is recorded.

Cos

Cosine of input channel

a = Cos(b)

a: Result	**b**: Input channel; in radians

CreateVChannel

By means of this function, measurement channels which are represented by only a single value can be provided with a time track. In this way, it is possible to trace how a value changes over time.

To this end, a virtual channel (*real numbers*) is generated with the specified value. This channel has the properties of the input channel.

a = CreateVChannel(b, Value)

a: Virtual channel **b**: input channel	**Value**: single value, which is supplied to the virtual channel

The value supplied must be a single value. It can be a number or also, for instance, a virtual bit or a process vector element.

Example

```
Virt1 = CreateVChannel( Channel_001, 2.5 )
Virt2 = CreateVChannel( Channel_001, Virt_Bit01 )
Virt3 = CreateVChannel( Channel_001, pv.X123 )
```

CreateVChannelInt

By means of this function, measurement channels which are represented by only a single value can be provided with a time track. In this way, it is possible to trace how a value changes over time.

To this end, a virtual channel (*integers*) is generated with the specified value. This channel has the properties of the input channel.

a = CreateVChannelInt(b, Value)

a: Virtual channel	**Value**: single value, which is supplied to the virtual channel
b: input channel	

The value supplied must be a single value. It can be a number or also, for instance, a virtual bit or a process vector element.

Example

```
VirtInt1 = CreateVChannelInt( Channel_001, 2 )
VirtInt2 = CreateVChannelInt( Channel_001, Virt_Bit01 )
VirtInt3 = CreateVChannelInt( Channel_001, pv.X123 )
```

CrossCorrelation

Cross-correlation between a test channel and a reference channel.

Prerequisite:
Only available in: imc Inline FAMOS!

Result = CrossCorrelation(Reference, Test, BlockLength)

Result: Results of the cross correlation	**Test**: test channel
Reference: Reference channel	**BlockLength**: Maximum delay (128 ... 131072)

The cross-correlation function (CCF) indicates how similar two data sets are for different shifts in the x direction. The cross-correlation function returns values between -1 and +1.

A value of 1 at the location t signifies that shift the test channel in the x-direction by t from the reference channel achieves the maximum correlation between the two channels. The two signals then have the same curve plot. A value of -1 signifies that the two signals are equal opposites (where one signal is positive, the other is negative by the same magnitude). A value of 0 signifies that the two signals are entirely uncorrelated at this shift. All values between -1 and +1 are possible.

Using the cross-correlation function, it is possible to determine whether one signal is present (hidden) within another, and additionally, by what delay one signal appears in another channel. For this purpose, the maximum of the cross-correlation function is of particular interest. Its location indicates the size of the delay by which the signal appears within the other channel. Its magnitude indicates how similar the signal having the delay is to the other.

In order to be able to interpret the delay between signals correctly, it is important to specify the parameters of the function `CrossCorrelation` in the correct order. The first parameter represents the reference channel containing the original signal (having no delay. The second parameter represents the test channel which contains a signal having a delay (and sometimes also interference) compared to the original. The x-coordinate of the cross-correlation function's maximum value directly indicates the shift between the test channel from the reference channel.

During calculation of the cross-correlation, the input channel is factorized into vectors. The length of these vectors represents the maximum delay between the test channel and the reference channel which can be determined by using the function `CrossCorrelation`.

Another effect of factorizing the input channel is that the data generated are considered periodic; i.e. the vectors are imagined to extend in both directions (left and right) in a periodic pattern. Thus, if one vector (window) contains one single pulse, the signal is interpreted as representing a chain of multiple pulses. One particular consequence is that when the cross-correlation function returns a large shift of 0.9 periods, this has the same meaning as a small shift in the negative direction, namely by -0.1 periods.

The x-scaling of the function `CrossCorrelation` is that of the two channels specified. Both channels should have the same x-scaling, otherwise the results may not have any sensible interpretation.

The function `CrossCorrelation` is normalized to the product of the RMS (root-mean square) of the two channels specified. Thus, the channel generated has no y-unit.

Example

```
Res = CrossCorrelation( RefChannel, TestChannel, 1024 )
```

The function `CrossCorrelation` is applied to a reference channel and a test channel (which may feature interference and a delay).

For example, if the channels have a sampling rate of 100 Hz, then due to the window width of 1024 samples, maximum delays of 10 s can be detected.

CurrentValue

Current value: A single value is isolated from out of the given channel.

Prerequisite:
Only usable with control commands!

SingleValue = CurrentValue(Channel, Option, Init)

SingleValue: Result	**Option**: Which value?	**Init**: Initialization value
Channel: Channel from which the value is to be taken	0: Last value 1: Minimum 2: Maximum 3: Mean value	

The return value is the initialization value, until an actual value from the channel is obtained. The parameter "Option" is important if, due to a high sampling rate for the channel, there are multiple values which were not processed yet. In that case, the parameter "Option" decides how the return value is derived from these values. The selection "last value" refers to the current value, the data point most recently measured on the channel.

Example

```
OnTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 2, 0.0 )
    If Value > 100
        VrtChannel_001 = Channel_001*0 + 100
    Else
        VrtChannel_001 = Channel_001*0
    End
End
```

10.9.2.4 D

dB

Converts input channel to decibel

a = dB(b)

The calculation is performed according to the formula: a = 20 * log(abs(b))

General information about the DelayBuffer functions

Prerequisite:
Only usable with control commands!
To use the `DelayBuffer` function, a `DelayBuffer` structure in the `OnInitAll` segment must be defined by means of the function `DelayBuffer`.

DelayBuffer

Initialization of the delay buffer: Sets up a delay line while specifying the maximum delay.

a = DelayBuffer(MaxSize)

a: The result is a DelayBuffer structure	**MaxSize**: Maximum buffer size, maximum size of the delay line

A signal can be delayed by N clock pulses. A buffer for measurement values is created having a defined length. In a processing step the current measured value is appended to the end of the buffer and the oldest measured value is retrieved from the start of the buffer. The buffer's length and the pulse rate of the processing steps determines the effective delay (see example).

The buffer's size is set to the specified maximum size. The buffer is completely pre-initialized with the default value 0.0. The actual delay can be set at any time using the function `DelayBuffer.SetSize`. The buffer also be completely refilled at any time with the specified value using the function `DelayBuffer.Fill`.

The most recently accumulated measured value are always held in the buffer, whose size is MaxSize. It is necessary to take account of the delay line's warmup time. This is because it must first be filled with a sufficient number of measured values before properly delayed values can be read out.

The function `DelayBuffer` must be called in the `OnInitAll` segment. In the process, a DelayBuffer structure is created and initialized.

Example

```
OnInitAll
    Dlb1 = DelayBuffer( 100 )
    Value = 0
    DelayValue = 0
End

OnSyncTask( 0.01 )
    ...
    ; delay of the output values by 1s (100*0.01s):
    DelayValue = Dlb1.Next( Value )
End

; Alternatively to the synchronized task, it is also possible to call
; the function .Next() within the timer:
OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 1, 0.1, 0.0 )
End

OnTimer( 1 )
    ...
    ; delay of the output values by 10s (100*0.1s):
    DelayValue = Dlb1.Next( Value )
End
```

DelayBuffer.Fill

Fill buffer: The entire buffer is filled with the value specified.

DelayBuffer.Fill(Value)

Value: The value with which the entire buffer is filled

All values ever previously stored in the buffer are overwritten.

Example

```
OnInitAll
    Dlb1 = DelayBuffer( 100 )
    Value = 0
    DelayValue = 0
End

OnSyncTask( 0.01 )
    If Virt_Bit01 > 0
        Dlb1.Fill( -1000.0 )
        Virt_Bit01 = 0
    End
    ...
    ; delay if the output value by 1s (100*0.01s):
    DelayValue = Dlb1.Next( Value )
End

; Alternatively to the synchronized task, it is also possible to call
; the function .Next() within the timer:
OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 1, 0.1, 0.0 )
End

OnTimer( 1 )
    ...
    ; delay of the output values by 10s (100*0.1s):
    DelayValue = Dlb1.Next( Value )
End
```

DelayBuffer.Next

Perform processing step: The new measured value (b) is appended to the end of the buffer and the oldest measurement value at the beginning of the buffer is returned.

a = DelayBuffer.Next(b)

a: The result is the delayed value, the oldest measurement value at the start of the buffer	**b**: The new measured value to be appended at the end of the buffer

The warmup time must be taken into account. If a delay of N measured values is set, then the very first N calls of this function only return the pre-initialized value.

Example

```
OnInitAll
    Dlb1 = DelayBuffer( 100 )
    Value = 0
    DelayValue = 0
End

OnSyncTask( 0.01 )
    ...
    ; delays the output value by 1s (100*0.01s)
    DelayValue = Dlb1.Next( Value )
End

; alternatively to the synchronous task, it is also possible to call
; the function .Next() within the timer:
OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 1, 0.1, 0.0 )
End

OnTimer( 1 )
    ...
    ; delay of the output value by 10s (100*0.1s)
    DelayValue = Dlb1.Next( Value )
End
```

DelayBuffer.SetSize

Set buffer size: Changing the buffer's size

DelayBuffer.SetSize(Size)

Size: New number of values in the buffer, new size of delay line

The size specified determines the delay. The signal is delayed by this many steps. The size can be changed at any time. A value of 0 means no delay. The maximum size specified in `DelayBuffer` may not be exceeded, however.

If the size is reduced, then stored values are skipped the next time `DelayBuffer.Next` is called. If the size is increased, then an older value which is still saved is fetched from the buffer the next time `DelayBuffer.Next` is called.

Example

```
OnInitAll
    Dlb1 = DelayBuffer( 100 )
    Value = 0
    DelayValue = 0
End

OnSyncTask( 0.01 )
    If Virt_Bit01 > 0
        Dlb1.SetSize( 50 )
        Virt_Bit01 = 0
    End
    ...
    ; delay of the output values by 1s (100*0.01s):
    DelayValue = Dlb1.Next( Value )
End

; Alternatively to the synchronized task, it is also possible to call
; the function .Next() within the timer:
OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 1, 0.1, 0.0 )
End

OnTimer( 1 )
    ...
    ; delay of the output values by 10s (100*0.1s):
    DelayValue = Dlb1.Next( Value )
End
```

DelayLine

Delay stream: The data stream is delayed by the specified time.

a = DelayLine(b, Delay)

a: result	**Delay**: delay time
b: input channel	

The result value data stream is delayed, a value from the input channel only appears at the output after a delay interval.

If other functions used produce delayed results, and the channel in question is to be combined with others in computations, then it is necessary to amend the channel with the same delay time that the others have.

Example

```
Gears = CodeRange (Transmission, 0.1, "CoGear.dat" )
DelayedLoad = DelayLine( Load, 0.1 )
Gear1Load = SamplesGate( DelayedLoad, Gears, 1 )
```

- In the channel Gear1Load, all loading which occurs while the vehicle is in first gear is recorded.
- Since the function `CodeRange` delays its result by 0.1 seconds, the Loading-channel must also be delayed by 0.1s.

DFilt

Digital filter: sends input channel through a digital filter

a = DFilt(b, "Filename")

a: Result	**"Filename"**: Coefficient vector file
b: Input channel	

The file of coefficients must be saved in imc FAMOS format.

The coefficients come in two different formats:

1. Product sum format

$y[t] = b_0 / a_0 * x[t] + ... + b_n / a_0 * x[t-n] - a_1 / a_0 * y[t-1] - ... - a_n / a_0 * y[t-n]$

The a_n terms must lead, followed by the b_n terms.

The coefficient vector must include the same number of denominator and numerator terms. Set any non-appearing terms to zero.

The denominator coefficients are to be specified first and the first value of the denominator coefficients a_0 must be equal to 1. All higher order denominator coefficients a[n] are assumed equal to zero.

2. Biquad format

The filter consists of 2nd order elements connected in "series". Each of these filters is defined as a biquad term of the form

$y[t] = b_0 * x[t] + b_1 * x[t-1] + b_2 * x[t-2] + a_1 * y[t-1] + a_2 * y[t-2]$

The coefficient vector must be specified in the following form:

$0\ a_2\ a_1\ b_2\ b_1\ b_0\quad a_2\ a_1\ b_2\ b_1\ b_0\quad \ldots\quad a_2\ a_1\ b_2\ b_1\ b_0$

The 0 in the first position designates the biquad format.

Example

Suppose the filter coefficients for a Butterworth 2nd-order low pass filter with a cutoff frequency of 100 Hz are given. The filter is to process a channel sampled at 5 kHz. The file of coefficients contains the following numbers:

```
0
-0.950212 a2
1.94894 a1
0.000317864 b2
0.000635728 b1
0.000317864 b0

y[t] = b0 * x[t] + b1 * x[t-1] + b2 * x[t-2] + a1 * y[t-1] + a2* y[t-2]

y[t] = 0.000317864 * x[t] + 0.000635728 * x[t-1] + 0.000317864 * x[t-2] + 1.94894 *
y[t-1] + -0.950121* y[t-2]
```

The file of coefficients must be saved in imc FAMOS format. If you have an ASCII table, load that file into imc FAMOS first and save it as *.dat file.

Note

- `DFilt` is initialized in imc Online FAMOS and imc Inline FAMOS as if the first measured value has already existed for a long time. With "quiet" signals, then, such as temperatures, transients are barely noticed. The drawback becomes clear, however, if a disturbance pulse is the first value and causes the filter to oscillate strongly.
- The `DFilt` function in the analysis software imc FAMOS initializes the filter with zeroes. For this reason, the two varieties respond differently during filter transient times.

Diff

Differentiation of argument

a = Diff(b)

a: Results	**b**: Input channel

The result values are the difference of the last and next to last input value divided by the sampling rate.

For the first input value a zero is returned.

DiskFreeSpace

Returns the free disk space on internal storage medium.

Prerequisite:
Only available in: imc Online FAMOS!

a = DiskFreeSpace(b)

a: Free disk space in kBytes (1 kByte = 1024 Bytes).	**b**: Reserved parameter (set to 0)

Zero will be returned in case of failure or absent storage medium.

DiskFreeTime

Free time: Estimate of time remaining for recording measurement data until internal storage medium is full.

Prerequisite:
Only available in: imc Online FAMOS!

a = DiskFreeTime(b)

a: Remaining free time in s	**b**: Reserved parameter (set to 0)

In general, the remaining free time cannot be determined exactly. The accuracy of the approximation made by this function depends on several factors. If you doubt the accuracy of this function, try using the function `GetDiskFreeSpace` which returns a more reliable estimate.

The approximation assumes that all triggers have been released and that data from these events is being recorded continuously to the hard drive.

Note the following:

- This function makes use of the function `DiskFreeSpace`. Consequently, its maximum resolution is 32 kByte.
- If new triggers are released, the hard drive space is used up more quickly.
- This function cannot make accurate predictions when data is not streaming at a constant sampling rate. In these cases the following mean data rates can be used as approximations:
  - Transitional Recording: 50% reduction
  - DIO Port reduced: 20 bytes/s
  - CAN data with time stamps: 50 bytes/s
  - Alarm channels: 1 byte/s
  - Histograms, matrices: not possible (space required one time only at trigger event)
  - Residues: not possible (space required one time only at the end of the measurement)

If clusters on the hard drive are defective, this also reduces the remaining time from the function estimate.

If you expect large deviations, the return value of the function has to be corrected!

For example, you could multiply the function result with an appropriate factor to account for uncertainties.

Example

Note that the result is a single value and cannot be treated as a channel.

```
Display_01 = GetDiskFreeTime (0) * 0.9 / 60 ;remaining time in min, 10% uncertainty
Duration_Channel = Channel_001 * 0 + GetDiskFreeTime ( 0 )
; returns time duration continuously
```

DiskRunDir

Gets the number of the current directory on the internal storage medium

Prerequisite:
Only available in: imc Online FAMOS!

a = DiskRunDir(b)

a: Current directory number	**b**: Reserved parameter (set to 0)

Zero will be returned in case of failure or absent storage medium.

DisplaySetButton

Function for setting a display button

Prerequisite:
Only available in: imc Online FAMOS!

DisplaySetButton(Page, Button)

Page: Page number The enumeration of the page number starts at 1. This corresponds to the enumeration in the function `DisplaySetPage`.	**Button**: Button index. The enumeration of the button number starts at 0. This corresponds to the preset enumeration that one obtains by using the option 'Quick Edit' in the display editor.

Note

If a display button is linked to a function like balance of channels or jump calibration, such a procedure can be executed with `DisplaySetButton` by imc Online FAMOS also.

DisplaySetPage

Function to show a new Displaypage

Prerequisite:
Only available in: imc Online FAMOS!

DisplaySetPage(Page)

Page: Pagenumber

10.9.2.5 E

General information about the ECU functions

Prerequisite:
Only available in: imc Online FAMOS!
Only usable with control commands!
ECU-functions are only available if the measurement device has a CAN-MultiIO.

When the function is called several times in succession, the commands are carried out separately one at a time. For this purpose, there is a small buffer which is sufficient for a few commands.

The following ECU functions are evaluated with `OnECUCmdReturn_ECU_001`. There you will find a comprehensive example.

ECUReadTroubleCodes_ECU_*

The function runs the ECU-command 'ReadDiagnosticTroubleCodesByStatus'.

ECUReadTroubleCodes_ECU_*

When the function `ECUReadTroubleCodes_ECU_001` is called, only one command is activated, and then the online configuration is processed further.

The activated command is only completed when `OnECUCmdReturn_ECU_001` returns the value ECU command 18h.

ECUStartSession_ECU_*

The function runs the ECU-command 'StartDiagnosticSession'.

ECUStartSession_ECU_*

When the function `ECUStartSession_ECU_001` is called, only one command is activated, and then the online configuration is processed further.

The activated command is only completed when `OnECUCmdReturn_ECU_001` returns the value ECU command 10h.

ECUStopSession_ECU_*

The function runs the ECU-command 'StopDiagnosticSession'.

ECUStopSession_ECU_*

When the function `ECUStopSession_ECU_001` is called, only one command is activated, and then the online configuration is processed further.

The activated command is only completed when `OnECUCmdReturn_ECU_001` returns the value ECU command 20h.

ECUClearDiagInformation_ECU_*

The function runs the ECU-command 'ClearDiagnosticInformation'.

ECUClearDiagInformation_ECU_001()

When the function `ECUClearDiagInformation_ECU_001` is called, only one command is activated, and then the online configuration is processed further.

The activated command is only completed when `OnECUCmdReturn_S1` returns the value ECU command 4h.

When the function is called several times in succession, the commands are carried out separately one at a time. For this purpose, there is a small buffer which is sufficient for a few commands.

Example

```
OnTriggerMeasure( Trigger_48 )
    If Virt_Bit01 > 0
        ECUClearDiagInformation_ECU_001( )
        Virt_Bit01 = 0
    End
End

OnECUCmdReturn_S1( Return, ECUCmd, CmdID )
    ECUCmd1     = BitAnd( ECUCmd, 0x0000FFFF )
    ECUIndex1   = BitAnd( ECUCmd, 0x00FF0000 )
    NodeIndex1 = BitAnd( ECUCmd, 0x0F000000 )
    If Return <> 0
        If ECUCmd1 = 0x4
            RecordText( "Error occurred in command 0x4" )
        Else
            RecordText( "General error occurred" )
        End
    End
End
```

OnECUCmdReturn_ECU_*

Return-treatment: Evaluation of the command-return values

OnECUCmdReturn_ECU_001(Return, ECUCmd, CmdID)

Return: return value; possible options: = 0: performed successfully = 1: timeout error occurred > 1: protocol-specific error occurred, referred to in the manual under the pertinent protocol	**ECUCmd**: ID of the ECU command, see below on list of ECU commands with associated IDs **CmdID**: ID or address of the ECU command (e.g. for routines), else 0

The function parameters Return, ECUCmd and CmdID are treated as local variables in the `OnECUCmdReturn_ECU_001` block, and may only be used within this command. These three variables are filled when the command is carried out and can be inquired in the `OnECUCmdReturn_ECU_001` block. They are single values.

With compound commands, the parameter ECUCmd returns the ID of the last command carried out. For instance, for the compound command ECU-Start with security access, the parameter ECUCmd returns the security access ID and not the ID of the ECU-Start command.

Example

```
OnTriggerMeasure( Trigger_48 )
    If VirtBit_01 > 0
        ECUReadTroubleCodes_ECU_001( )
        VirtBit_01 = 0
    End
    If VirtBit_02 > 0
        ECUStartSession_ECU_001( )
        VirtBit_02 = 0
    End
    If VirtBit_03 > 0
        ECUStopSession_ECU_001( )
        VirtBit_03 = 0
    End
End
OnECUCmdReturn_ECU_001( Return, ECUCmd, CmdID )
    If Return <> 0
        If ECUCmd = 0x18
            RecordText( "Error occurred in command...!" )
        End
    End
End
```

KWP 2000 commands set in the CAN-Assistant, IDs hexadecimal:

StartDiagnosticSession: 10 86	ReadMemoryByAddress: 23
SecurityAccess: 27	WriteDataByLocalID: 3b
LogInKey: 00 00	WriteDataByCommonID: 2e
StopDiagnosticSession: 20	WriteMemoryByAddress: 3d
TesterPresent: 3e	StartRoutineByLocalID: 31
ReadDiagnosticTroubleCodesByStatus: 18 00 ff 00	StartRoutineByAddress: 38
ReadDataByLocalID: 21	RequestRoutineResultsByLocalID: 33
ReadDataByCommonID: 22	RequestRoutineResultsByAddress: 3a

Equal

Compares for equality

a = Equal(b, c)

a: Result	**b**: 1. argument
	c: 2. argument

a = 1 if the arguments are equal, otherwise 0.

ExpoRMS

Moving RMS: Computes moving root-mean-square of an exponentially-weighted data window and applies reduction.

a = ExpoRMS(b, tau, RF)

a: Result	**tau**: Time constant for exponential weighting **In imc Online FAMOS:** ≥ 0.0: Time constant is defined by the user in s **In imc Inline FAMOS:** -1: Fast (0.125s) -2: Slow (1s) -3: Pulse -4: Peak -5: RMS in interval -6: RMS from start ≥ 0.0: Time constant is defined by the user in s
b: Input channel	**RF**: Reduction factor in samples; ≥ 1

The ExpoRMS function computes the root-mean-square of an exponentially weighted window.

A new result value is generated for every RF values.

- If RF > 1, then data reduction is applied.

Example

```
eff = ExpoRMS( Channel_001, 0.125, 1000 )
```

Computes RMS of exponentially weighted window and reduces by 1000.

10.9.2.6 F

FFT

Magnitude spectrum: FFT with output of the magnitude spectrum

a = FFT(b, Window, FFT_length)

a: Result; Magnitude spectrum	**Window**: Type of window	**FFT_length**: FFT-length
b: Input channel	0: Rectangle	**In imc Online FAMOS:**
	1: Hamming	128 ... 8192
	2: Hanning	**In imc Inline FAMOS:**
	3: Blackman	128 ... 131072
	4: Blackman-Harris	
	5: Flat-Top	

The FFT length may only take one of the following values:

In imc Online FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192.

In imc Inline FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131072.

The length of the result vector is determined as 1+(FFT_Length/2).

Example

```
Res = FFT( Signal_01, 3, 1024 )
```

Calvculation of an FFT with Blackman window and an FFT-length of 1024. The result is a streaming vector of length 513.

FFTAmplitudePhase

Magnitude-phase spectrum: FFT with output of magnitude and phase

FFTAmplitudePhase(Amplitude, Phase, b, Window, FFT_length)

Amplitude: Result 1; Amplitude (magnitude) spectrum **Phase**: Result 2; Phase spectrum **b**: Input channel	**Window**: Type of window 0: Rectangle 1: Hamming 2: Hanning 3: Blackman 4: Blackman-Harris 5: Flat-Top	**FFT_length**: FFT-length **In imc Online FAMOS:** 128 ... 8192 **In imc Inline FAMOS:** 128 ... 131072

The results of the procedure are the two first parameters: Magnitude and Phase. The FFT length may only take one of the following values:

In imc Online FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192.

In imc Inline FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131072.

The length of the result vectors is determined as 1+(FFT_Length/2).

Example

```
FFTAmplitudePhase( Amplitude, Phase, Signal_01, 1, 2048 )
```

Calculation of an FFT with Hamming window and an FFT length of 2048. The results are streaming vectors of length 1025.

FFTAverage

Returns averages FFTs

Spectra = FFTAverage(Data, Width, Window, Overlap, Average, Count)

Spectra: Result; Averaged FFTs

Data: Input channel, time-domain data

Width: window width

In imc Online FAMOS:

100 ... 8192

In imc Inline FAMOS:

100 ... 131072

Window: Type of window

0: rectangle

1: Hamming

2: Hanning

3: Blackman

4: Blackman-Harris

5: Flat-Top

Overlap: stated in percent

-400: every 5th FFT

-100: every 2nd FFT

0: every FFT

50: 50% overlap

75: 75% overlap

90: 90% overlap

Average: averaging type

0: none

1: arithmetic mean

2: maximum

3: minimum

4: average from beginning

Count: number of data averaged

If the count is given as 10, then at first, 10 time data spectra are taken and averaged. The average spectrum is returned. All averages are carried out with the spectrum's magnitude.

The window width need not be an exponent of 2; internal interpolation is possible. It is thus possible, for example, for a sampling rate of 5 kHz and 1000 points window width, to obtain spectral lines at exact multiples of 5 Hz.

- If the overlap is > 0, then the time windows overlap by the amount specified. However, in that case the computation time increases greatly!
- If the overlap is negative, not all time data are considered when forming the spectra.

The result values are to be interpreted as effective values.

Example

```
Res = FFTAverage( Signal_Vib, 1000, 3, 0, 1, 100 )
```

Calculation of averaged FFTs with a Blackman window and window widths of 1024. Every FFT is factored in and the arithmetic mean of 100 spectra is taken.

FFTInverse

Inverse FFT: Inverse FFT from complex data

a = FFTInverse(RealPart, ImaginaryPart)

a: Result, Output time signal	**RealPart**: Real part of complex spectra **ImaginaryPart**: Imaginary part of complex spectra

The internal FFT function works with up to 4096 (actually complex) points.

A special technique deconstructs 8192 real (time-domain) points so that the spectrum can be computed by means of the 4 k internal FFT. The 4 k internal FFT contains a 4 k Real part and a 4 k Imaginary part.

However, the technique can not be used on complex data in the frequency domain. The data are already complex, for which reason it is not possible to transfer 8 k complex data.

Example

```
FFTRealImaginary( Real1, Imag1, Signal_01, 3, 1024 )
Res = FFTInverse( Real1, Imag1 )
```

Calculation of a complexe FFT with Real- and Imaginary parts. Subsequently, determination of the time signal from the Real- and Imaginary parts.

FFTRealImaginary

Complex FFT: FFT with real- and imaginary part output

FFTRealImaginary(RealPart, ImaginaryPart, b, Window, FFT_length)

RealPart: Result 1; Real part of the spectrum (returned vector) **ImaginaryPart**: Result 2; Imaginary part of the spectrum (returned vector) **b**: Input channel	**Window**: Type of window 0: Rectangle 1: Hamming 2: Hanning 3: Blackman 4: Blackman-Harris 5: Flat-Top	**FFT_length**: FFT-length **In imc Online FAMOS:** 128 ... 8192 **In imc Inline FAMOS:** 128 ... 131072

The FFT length may only take one of the following values:

In imc Online FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192.

In imc Inline FAMOS: 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131072.

The length of the result vectors is determined as 1+(FFT_Length/2).

Example

```
FFTRealImag( Real1, Imag1, Signal_01, 5, 8192 )
```

Calculation of a complexen FFT with Flat-Top window and an FFT length of 8192. The results are streaming vectors of vector length 4097.

General information about the filters

The filter functions `FiltBP`, `FiltBS`, `FiltHP` and `FiltLP` are like their analog examples. It is recommended to set the parameters in a way, the analog circuit would be chosen. Parameters like order and cutoff frequency could create filters, that couldn't be build as a real analog circuit. However, usually extreme settings don't end in practicable results and stress the online processor unnecessary.

Due to numerical problems, the ratio of the sampling frequency to the cutoff frequency with filters may not exceed a certain amount.

The following rule applies:

fsample/fg < (Order)th Root(1000000); where fsample = sampling frequency and fg = cutoff frequency

See also Miscellaneous 1935 > *Tuning, Tips and Tricks* > imc Online FAMOS - Digital Filters 1939.

FiltBP

Processes channel data with a band pass filter

Result = FiltBP(Data, Characteristic, Para, Order, CutoffFreqLow, CutoffFreqUp)

Result: Filtering result

Data: Channel to be filtered

Characteristic: Filter characteristic

0: Butterworth
1: Bessel
2: Chebychev
3: Critical damping

Para: Reserved

Order: Filter order

Bessel: 1..40
otherwise: 1..100

CutoffFreqLow: Lower cutoff frequency (Hz)

CutoffFreqUp: Upper cutoff frequency (Hz)

FiltBS

Processes channel data with a band stop filter

Result = FiltBS(Data, Characteristic, Para, Order, CutoffFreqLow, CutoffFreqUp)

Result: Filtering result

Data: Channel to be filtered

Characteristic: Filter characteristic

0: Butterworth
1: Bessel
2: Chebychev
3: Critical damping

Para: Reserved

Order: Filter order

Bessel: 1..40
otherwise: 1..100

CutoffFreqLow: Lower cutoff frequency (Hz)

CutoffFreqUp: Upper cutoff frequency (Hz)

FiltHP

Performs high pass filtering of channel data

Result = FiltHP(Data, Characteristic, Para, Order, CutoffFreq)

Result: Filtering result

Data: Channel to be filtered

Characteristic: Filter characteristic

0: Butterworth
1: Bessel
2: Chebychev
3: Critical damping

Para: Reserved

Order: Filter order

Bessel: 1..20
Chebychev: 1..50
otherwise: 1..100

CutoffFreq: Cutoff frequency (Hz)

FiltLP

Performs low-pass filtering of channel data

Result = FiltLP(Data, Characteristic, Para, Order, CutoffFreq)

Result: Filtering result

Data: Channel to be filtered

Characteristic: Filter characteristic

0: Butterworth
1: Bessel
2: Chebychev
3: Critical damping

Para: Reserved

Order: Filter order

Bessel: 1..20
Chebychev: 1..50
otherwise: 1..100

CutoffFreq: Cutoff frequency (Hz)

Floor

Truncates the argument to the next smallest or equal integer.

a = Floor(b)

This function returns the **next lower integer** for a real number input, i.e. it rounds down to the next lower integer.

Example

The function returns

Input channel value	Result value
1,2	1
1,9	1
-1,2	-2
-1,9	-2

10.9.2.7 G

GearRatio

Transmission ratio: A gear system's transmission ratio is calculated on the basis of the engine rpm and the live axle rpm.

a = GearRatio(Ne, Na, MinNe, MinNa, Ft, Code)

a: result	**MinNe**: minimum input rpm
Ne: input rpm, engine	**MinNa**: minimum output rpm
Na: output rpm, live axle	**Ft**: low-pass cutoff frequency
	Code: code value, output less then minimum

The two rpm values are filtered with a low-pass and the transmission ratio Ne to Na is computed. Additionally, the rpm values are checked against their respective minima.

If the output rpm value falls short of MinNa or both of the minima are fallen short of, the output is a specified result value.

If only the input rpm value falls short of the minimum, the output is zero.

Example

```
Transmission = GearRatio( Nin, Nout, 1, 1, 10, 0 )
Gears = CodeRange( Transmission, 0.1, "CoGear.dat" )
DelayedLoad = DelayLine( Last, 0.1 )
Gear1Load = SamplesGate( DelayedLoad, Gears, 1 )
```

In the channel Gear1Load, all loading measured while the vehicle was in first gear is recorded.

GetDateTime

The function determines the current date and time.

Prerequisite:
Only usable with control commands!

GetDateTime(SecondsDecimal, Seconds, Minute, Hour, Day, Month, Year)

SecondsDecimal: current fraction of seconds in decimal notation, 0.0 ... 0.99	**Day**: current day, 1 ... 31
Seconds: current seconds, 0 ... 59	**Month**: current month, 1 ... 12
Minute: current minutes, 0 ... 59	**Year**: current year, e.g. 2009
Hour: current hours, 0 ... 23	

The decimal fraction of seconds is precise to within one 64th of a second.

The function parameters may be local single values, display variables or process vector elements.

Channels are not permitted as parameters. If any parameter is not required, a zero can be entered in its place.

Example

```
OnInitAll
    FindDate = 0
    FindTime = 0
    pv.Minute = 0
    pv.Hour = 0
    Time1 = ""
End

OnTriggerMeasure( Trigger_48 )
    If FindDate > 0
        GetDateTime( 0, 0, 0, 0, DisplayVar_Day, DisplayVar_Month,
DisplayVar_Year )
        FindDate = 0
    End

    If FindTime > 0
        GetDateTime( 0, 0, pv.Minute, pv.Hour, 0, 0, 0 )
        FindTime = 0
        ; output as text "Time: ss:mm"
        Time1 = "Time: "
        If pv.Hour < 10
            Time1 = TextAdd( Time1, "0" )
        End
        Time1 = TextAdd( Time1, TextFormatI( pv.Hour ) )
        Time1 = TextAdd( Time1, ":" )
        If pv.Minute < 10
            Time1 = TextAdd( Time1, "0" )
        End
        Time1 = TextAdd( Time1, TextFormatI( pv.Minute ) )
        RecordText( Time1 )
    End
End
```

Example

```
OnInitAll
    SecondsDp = 0
    Seconds = 0
    Minute = 0
    Hour = 0
End

OnSyncTask( 0.1 )
    If Virt_Bit01 > 0
        GetDateTime( SecondsDp, Seconds, Minute, Hour, 0, 0, 0 )
        Virt_Bit01 = 0
    End
End
```

GetDuration

A channel’s measurement duration: Finds the duration of measurement for a physical channel.

MeasurementDuration = GetDuration(InputChannel)

MeasurementDuration: Measurement duration for the physical channel in s.	**InputChannel**: Physical channel

The measurement value can be determined for all physical channels.

In particular for analog inputs, incremental counter inputs, Field-bus inputs, digital Field-bus ports and digital ports.

If no measurement duration is defined, the value 0 is returned.

Example

```
; measurement duration of physical channel Channel_001 in s
_MeasDuration_01 = GetDuration( Channel_001 )
```

GetHistoValue

Value from a histogram: Extracts the value from the specified index of a histogram.

HistogramValue = GetHistoValue(Histogram, Index)

HistogramValue: Histogram value at specified index **Histogram**: Histogram from which the value at the specified index location is to be extracted	**Index**: Index of histogram position; 0, 1, ..., number of classes -1

Example

```
OnTriggerMeasure( Trigger_48 )
    Histo = ClHistogram( Channel_001, -10.0, 10.0, 32, 1, 1 )
    ; 1st histogram value, histogram index: 0
    Histo_0 = Channel_001*0 + GetHistoValue( Histo, 0 )
    ; Last histogram value, histogram index: 31
    Histo_1 = Channel_001*0 + GetHistoValue( Histo, 31 )
End
```

GetHistoValue2

Value from a histogram: Extracts the value from the specified column index (X_Index) and row index (Y_Index) of a histogram.

HistogramValue = GetHistoValue2(Histogram, X_Index, Y_Index)

HistogramValue: Histogram value at specified indices **Histogram**: Histogram from which the value at the specified index locations is to be extracted.	**X_Index**: Column index in the histogram; 0, 1, ..., number of x-classes -1 **Y_Index**: Row index in the histogram; 0, 1, ..., number of y-classes -1

The histogram must be given in the form of a matrix of dimensions (number of x-classes) * (number of y-classes).

The histogram's X-index denotes the index in the X-direction in the curve window (histogram column index), the histogram's Y-index denotes the index in the Y-direction in the curve window (histogram row index).

Example

```
OnTriggerMeasure( Trigger_48 )
    Histo = ClRainFlow( Channel_001, -10.0, 10.0, 32, 0, 0, 0, 1, 1, 0 )
    ; 1st histogram value, histogram index: 0, column index: 0, row index: 0
    Histo_0 = Channel_001*0 + GetHistoValue2( Histo, 0, 0 )
    ; 69th histogram value, histo index: 68, column index: 4, row index: 2
    ; Histogram index = row index * 32 + column index = 2 * 32 + 4 = 68
    Histo_68 = Channel_001*0 + GetHistoValue2( Histo, 4, 2 )
End
```

GetLastError

Determines the error number of the last error. Determines the error number of the last error depends on what filter is configured.

GetLastError(ErrorNumber, ErrorOrigin, Filter)

ErrorNumber: Result. Error number of last error. The result values are <= 0, e.g. -5613.

ErrorOrigin: Result. Denotes where error occurred. The result values are >= 0 and <= 11.

0: No error
1: Error in Field-bus system, Slot 1
2: Error in Field-bus system, Slot 2
3: Error in Field-bus system, Slot 3
4: Error in Field-bus system, Slot 4
5: Error in Field-bus system, Slot 5
6: Error in Field-bus system, Slot 6
7: Error in Field-bus system, Slot 7
8: Error in Field-bus system, Slot 8
9: Error in the online-system
10: Error on the internal drive
11: Error in data capture

Filter: Which errors are accounted for?

-1: All errors
0: All errors in the Field-bus system
1: Errors in the Field-bus system, Slot 1
2: Errors in the Field-bus system, Slot 2
3: Errors in the Field-bus system, Slot 3
4: Errors in the Field-bus system, Slot 4
5: Errors in the Field-bus system, Slot 5
6: Errors in the Field-bus system, Slot 6
7: Errors in the Field-bus system, Slot 7
8: Errors in the Field-bus system, Slot 8
9: Errors in the online-system
10: Errors on the internal drive
11: Error in data capture

Each time the function is called, the last occurring error number and the error origin are found, in accordance with the specified filter. If no error occurred, the function returns a value of 0 as the result. The result values can be outputted in a single value variable (see example) or in a device variable (e.g. DisplayVar_01). Instead of a return variable for the error origin, the value 0 is also allowed. Then the error origin is not determined.

Any occurring error number is overwritten the next time the function is called. For purposes of analysis, having an additional variable can be useful (see example).

The function can only be applied in imc Online FAMOS with control commands and dependent upon the device. As a fundamental rule, the function `GetLastError`() may only be called once per device with a particular parameter. If the function `GetLastError`(..., -1) is called, there may not be any further calls of the function `GetLastError`(). If the function `GetLastError`(..., 0) is called, then only the functions `GetLastError`(..., 9) and `GetLastError`(..., 10) may additionally be called.

To avoid burdening the device's computational power, it is recommended to call the function `GetLastError`()with a controlling timer (see example).

Excerpt of possible error numbers

CAN-Bus	Description
-5100	Overflow in an int. data repository of the CAN-Bus system, e.g. data red. of channels needed.
-5101	Aggregate sampl. frequ. of the CAN channels is too high, e.g. longer sampl. intervals needed.
-5102	At least one CAN-message has been lost.
-5103	Access to the CAN-Bus has been interrupted due to too many bus errors, e.g. wrong Baud rate.
-5106	Failure to send message during the starting phase of the synchronization.
-5107	Measurement values for a synchr. channel were discarded, e.g. the sampling rate is too low.
-5108	For a synchr. channel, supplem. readings were provided (bus error, or sampl. rate too high).
-5109	A CANSAS module has failed to execute a command, e.g. due to data transmission error.
-5110	No acknowledgement received from a CANSAS module!
-5111	Other bus nodes have been detected. Unable to convert the baud rate!
-5112	The modules are not suitable to the modules connected to the bus. Unable to convert Baud rates!
-5113	After conversion of the Baud rate, a module was no longer found!
-5114	A CANSAS unit's firmware is not up-to-date.
-5115	A received norm display number does not correspond to the configuration. The value is ignored.
-5116	A CAN-channel's bits lie outside of the message received. No value is generated.
-5117	Error in loading a SeedKey-library.
-5118	Unable to find a SeedKey-function.

EtherCAT	Description
-5600	Internal error of imc CRONOSflex DAQ-system.
-5601	Overflow in an internal hardware data volume belonging to the imc CRONOSflex system.
-5602	The aggregate sampling frequency of the channels is too high.
-5603	The number of events (trigger inputs) to calculate is too high.
-5604	The max. channel count has been exceeded. Reduce number of act. channels/Mon. channels.
-5605	Error of imc CRONOSflex system in setting the synchronization.
-5606	Error in synchronizing the CRFX-modules connected to the imc CRONOSflex system bus.
-5607	Synchronization error, VCXO outside of capture range.
-5610	Communication error 1 in the imc CRONOSflex system. Please re-initialize the device.
-5611	Communication error 2 in the imc CRONOSflex system. Please re-initialize the device.
-5612	Communication error 3 in the imc CRONOSflex system. Please re-initialize the device.
-5613	Communication between imc CRONOSflex system and CRFX module failed.
-5614	Communication between imc CRONOSflex system and CRFX module back in order.
-5615	Overload of imc CRONOSflex system. Reduce data load and re-initialize device.
-5616	Error in event calculation in the imc CRONOSflex system.
-5617	A CRFX-module connected to the imc CRONOSflex system is in an invalid state.
-5618	Unable to process data transmitted via the imc CRONOSflex system bus.
-5619	Capture of meas. data by CRFX-modules o the CRONOSflex system bus no longer synchronized.
-5620	Interference on the imc CRONOSflex system bus. Please check the cabling.

Example

```
; If an error occurred, the error number and slot of the respective last fieldbus
; error are outputted as a virtual channel

OnInitAll
    DisplayVar_32 = 0
    int LastError = 0
    int Slot = 0
End

OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 1, 0.1, 0 )
End

OnTriggerMeasure( Trigger_48 )
    V_Error = CreateVChannelInt( Channel_001, DisplayVar_31 )
    V_Slot = CreateVChannelInt( Channel_001, DisplayVar_32 )
End

OnTimer( 1 )
    GetLastError( LastError, Slot, 0 )
    If LastError = -5613 or LastError = -5618
        DisplayVar_31 = LastError
        DisplayVar_32 = Slot
    End
End
```

GetSampleCount

Sample counting: Determines the number of values in a channel, which were not yet processed.

Samplenumber = GetSampleCount(Channel)

Samplenumber: Result	**Channel**: Input channel

If the parameter channel contains no values which apply, the function returns the value 0.

Example

```
OnInitAll
    sc = 0
End
OnTriggerMeasure( Trigger_48 )
    sc = GetSampleCount( Channel_001 )
    If sc > 1
        RecordText( "Proceeding more than 1 sample..." )
    End
End
```

GetSamplingTime

Channel sampling interval: Determines the sampling interval for a physical channel.

Samplinginterval = GetSamplingTime(Inputchannel)

Samplinginterval: Sampling interval of the physical channel	**Inputchannel**: Physical channel

The sampling interval can be found for any physical channel.

This means for any analog, incremental encoder, or field bus inputs, as well as digital and digital field bus ports.

Example

```
_Samplinginterval_01 = GetSamplingTime( Channel_001 )
```

Greater

Checks whether the first argument is greater than the second argument

a = Greater(b, c)

a = 1 if b is greater than c, otherwise 0.

Example

```
LED_01 = Greater( Channel_001, 8 )
```

The LED lights up whenever the signal value exceeds 8.

GreaterEqual

Checks whether the first argument is greater than or equal to the second argument

a = GreaterEqual(b, c)

a = 1 if b is greater than or equal to c, otherwise 0.

10.9.2.8 H

HighLowRatio

The pulse duty ratio of the signal in a window, with reduction

a = HighLowRatio(b, RF)

a: Result	**RF**: Reduction factor in samples; ≥ 1
b: Input channel	

The function returns a value for each set of RF input samples as the result.

The ratio is the number of samples not equal to zero divided by the number of samples equal to zero, for all complete pulses.

A complete pulse is a sequence of three edges, an edge being a transition from zero to a non-zero value, or vice versa.

Analog signals should be preprocessed (STri 1010).

Hyst

Hysteresis: Applies a hysteresis filter to the input channel

a = Hyst(b, Width)

a: Result	**Width**: Hysteresis width
b: Input channel	

If the slope of the input channel changes sign, the output channel follows only if the difference between the last two samples is larger than the hysteresis width. Otherwise the output channel stays constant.

If the slope does not change sign, the result is equal to the input channel. This filters out all vibrations with amplitudes smaller than the hysteresis width.

10.9.2.9 I-J

iDiv

Integer division: Division of two integer values. The result is an integer value. Decimal places are omitted.

Result = Numerator iDiv Denominator

Both the numerator and denominator must be of data type Integer, numbers in Real-format are not permitted.

Single value variables of type Integer may only be defined with control commands.

Example

```
Quotient1 = 14 iDiv 4  ; Quotient1 = 3
Quotient2 = 14 / 4     ; Quotient2 = 3.5
```

Integral

a = Integral(b)

The result values are the sum of all current input samples multiplied by the sampling rate.

Integral2

Integral with reset to 0. The return values are the respective sums of all input values accumulated since the last reset to 0 or since the start of the measurement, multiplied by the sampling interval.

Result = Integral2(Channel, Reset)

Result: Integral	**Reset**: If this value is not 0, the integral is reset to 0
Channel: Input channel	

In contrast to the function `Integral`, the function `Integral2` offers the option to reset the integral to 0 during measurement. Otherwise, the behavior of the two functions is the same.

Example

```
Result = Integral2( Channel_001, VrtBit_01 )
```

IntegralFFT

Integral over amplitude spectrum: Integration in the amplitude spectrum's frequency range.

IntFFT = IntegralFFT(Vector)

IntFFT: Result of integration	**Vector**: Amplitude spectrum Magnitude spectrum

Integration is performed by multiplying the amplitude spectrum with an appropriate weighting function.

For a frequency of 0 Hz, the result of integration is 0 and thus meaningless.

Example

```
vFFT = FFT( InputChannel, 0, 1024 )
IntFFT = IntegralFFT( vFFT )
```

Calculation of an FFT with rectangular window and an FFT-length of 1024. The result is a streaming vector of length 513.

Subsequent integration in the frequency domain of the amplitude spectrum

IntegralP

Precise integral

Prerequisite:
Only available in: imc Online FAMOS!

a = IntegralP(b)

a: result	**b**: input channel

The respective result values are the sum of all previous input values multiplied by the sampling interval.

Internally, the precise integral uses a numerical notation with higher precision in order to suppress the compounding of errors in longer integrations.

However, `IntegralP` is significantly slower than the function `Integral`.

IntegralP2

Precise integral with reset to 0. The return values are the respective sums of all input values accumulated since the last reset to 0 or since the start of the measurement, multiplied by the sampling interval.

Prerequisite:
Only available in: imc Online FAMOS!

Result = IntegralP2(Channel, Reset)

Result: Precise Integral	**Reset**: If this value is not 0, the integral is reset to 0
Channel: Input channel	

In contrast to the function `IntegralP`, the function `IntegralP2` offers the option to reset the integral to 0 during measurement.

Otherwise, the behavior of the two functions is the same.

In contrast to the function `Integral2`, the function `IntegralP2` calculates the integral precise.

The function `IntegralP2` requires much more calculating time.

Example

```
Result = IntegralP2( Channel_001, VrtBit_01 )
```

General information about the interval funktions

Interval functions enable analysis of one or more channels in relation to the signal plot of one channel.

- For example, in taking measurements of a motor, the RPM values, vibration, etc. are only interesting if the RPM exceeds a certain level.
- Or, in conjunction with the particular angular ranges of a rotating system, the static values of associated channels are to be determined.

Using the trigger machine and imc Online FAMOS, it would be possible to do this calculation for one range. The interval functions can achieve the same thing with fewer command lines, no trigger and for a variety of ranges.

The example below illustrates this:

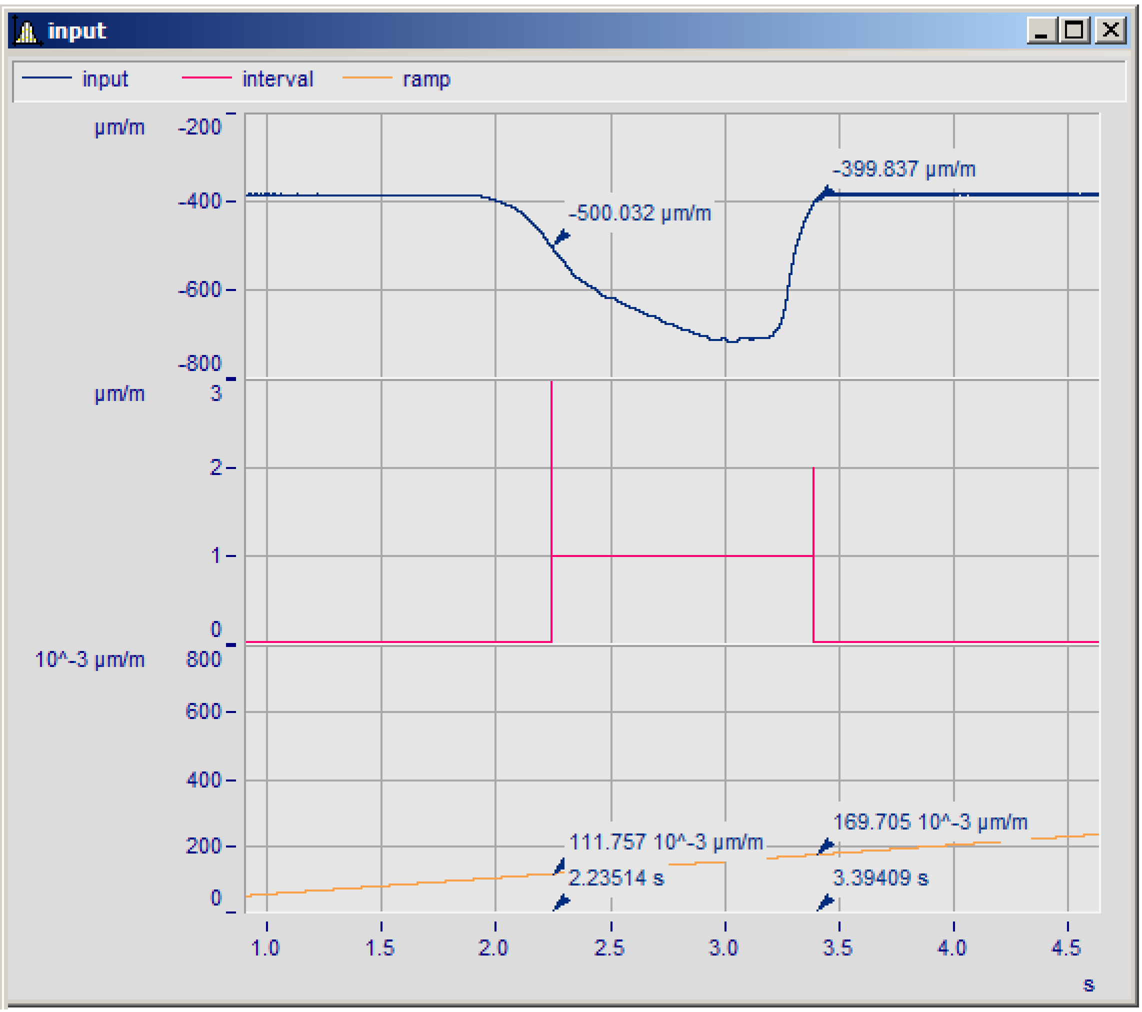
Example

An input channel is analyzed in the interval from one descending edge at -500 µm/m until an ascending edge at -400 µm/m. In this interval, the maximum and minimum of a different channel (ramp) are determined.

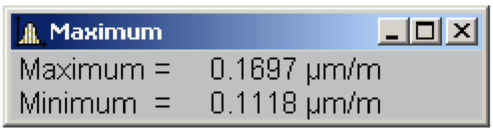
The program for this appears as follows:

```
ramp     = sawtooth( input, 0, 0.00001, 62800 )
interval = IntervalFromLevels( input, -500, -400, 1)
Maximum  = IntervalMax( ramp, interval )
Minimum  = IntervalMin( ramp, interval )
```

The interval channel is only an auxiliary channel which can only be used internally.



The functions IntervalMax, IntervalMin, etc. return exactly one result per interval and have no more time reference.



Note

Result channels created with *IntervalMax, -Min, Mean* and *RMS* no longer have a time reference and **cannot be sent via XCPoE!**

IntervalFrom1Level

Generates a channel specifying whether the signal's values are within a specifiedinterval.

Result = IntervalFrom1Level(Signal, Level, Levelcode)

Result: results channel	**Level**: interval limit
Signal: input channel	**Levelcode**: Reserved, always set to 0

Depending on the specified Levelcode, the interval limit must be crossed either in the rising or falling direction to count as entering the interval.

Subsequent interval functions use the results of `IntervalFrom1Level` to limit their calculations to the resulting intervals. The interval channel that is generated by `IntervalFrom1Level` contains, unlike `IntervalFromLevels`, additional data that interpolate the exact point in time when the interval limit is crossed between 2 samples of the given input signal. Subsequent interval functions may evaluate these data to increase their precision.

Example

```
; Determine the mean value of a squared sine signal
; Theoretical value = 0.5, independent of the interval limit
; set in IntervalFrom1Level
saw1 = SawTooth(Channel_001, 0, 0.01, 628)
signal1 = Sin(saw1)
signal2 = signal1 * signal1
interval = IntervalFrom1Level(saw1, 1.0, 0)
iMean1 = IntervalMean(signal2, interval)
```

IntervalFromLevels

Generates a channel stating whether the signal's values are located within the specified interval.

Result = IntervalFromLevels(Signal, Level1, Level2, Levelcode)

Result: results channel	**Level1**: first interval limit
Signal: input channel	**Level2**: second interval limit
	Levelcode: Levelcode

Depending on the specified Levelcode, the first interval limit must be crossed either in the rising or falling direction to count as entering the interval. Correspondingly, the second interval limit must be crossed in the rising or falling direction in order to count as leaving the interval.

Permissable values for Levelcode:

0	Level1 must be crossed in rising direction, so that the interval is considered entered, Level2 must be crossed in rising direction, so that the interval is considered left.
1	Level1 must be crossed in falling direction, so that the interval is considered entered, Level2 must be crossed in rising direction, so that the interval is considered left.
2	Level1 must be crossed in rising direction, so that the interval is considered entered, Level2 must be crossed in falling direction, so that the interval is considered left.
3	Level1 must be crossed in falling direction, so that the interval is considered entered, Level2 must be crossed in falling direction, so that the interval is considered left.

`IntervalFromLevels` designates the beginning and end of the resulting intervals by special values so that it is possible to append the intervals directly to each other.

Subsequent interval functions use the results of `IntervalFromLevels` to limit their calculations to the resulting intervals.

Example

```
; Determine min and max of a periodic signal between 20 and 40 degrees.
; the angle is obtained from an incremental counter in Angle-absolute-mode
intervall = IntervalFromLevels( angle, 20, 40, 0 )
iMin = IntervalMin(signal, interval)
iMax = IntervalMax(signal, interval)
```

IntervalFromPulse

Creates an interval channel from a incremental encoder signal.

Result = IntervalFromPulse(Impulse time, Period duration, Multiplier)

Result: Virtual channel with result	**Period duration**: Length of period
Impulse time: Incremental encoder channel set to measurement mode impulse time.	**Multiplier**: Reserved, always = 0

The input signal comes from an incremental counter in pulse-time mode. `IntervalFromPulse` uses this to generate interval codes indicating the exact pulse time which can be used by subsequently called functions, for example, ones which use these time points for interpolation.

The interval is entered upon arrival of the first pulse and is only exited when the measurement ends or when more than one pulse arrives during a sampling interval. In the latter case, the system waits for the number of pulses associated with the period length before entering the interval again.

This serves to prevent any phase shift due to periodic data. For nonperiodic data, a period length of 0 must be specified.

Example

```
ivl = IntervalFromPulse( Inc_Counter_01, 60, 0 )
res = IntervalResample( Channel_001, ivl, 360.0, 60, "Deg", 1 )
```

IntervalMax

Determines the input signal's maximum within the specified interval.

Result = IntervalMax(Signal, Interval)

Result: result channel	**Intervall**: interval channel
Signal: input signal	

The interval channel is generated by the functions `IntervalFromLevels` or `IntervalFrom1Level`.

`IntervalMax` determines the input signal's maximum, while limiting this computation to the intervals specified by the interval channel. Since the time reference is lost, the result cannot be charged any further in many Online FAMOS functions and cannot be sent via XCPoE 945.

Example

```
; Determine min and max of a periodic signal between 20 and 40 degrees.
; the angle is obtained from an incremental counter in Angle-absolute-mode
interval = IntervalFromLevels( angle, 20, 40, 0 )
iMin = IntervalMin(signal, interval)
iMax = IntervalMax(signal, interval)
```

IntervalMean

Determines the mean of the input signal within the given interval.

Result = IntervalMean(Signal, Interval)

Result: results channel	**Interval**: interval channel
Signal: input signal	

The interval channel is generated by the functions `IntervalFromLevels` or `IntervalFrom1Level`.

`IntervalMean` determines the mean of the input signal, while limiting this computation to the intervals specified by the interval channel.

`IntervalMean` incorporates the additional data provided by `IntervalFrom1Level` to increase the precision of the computed results.

Since the time reference is lost, the result cannot be charged any further in many Online FAMOS functions and cannot be sent via XCPoE 945.

Example

```
; Determine the mean of a squared sine signal
; Theoretical value = 0.5, independent of the interval limit specified by
; IntervalFrom1Level
saw1 = SawTooth(Channel_001, 0, 0.01, 628)
signal1 = Sin(saw1)
signal2 = signal1 * signal1
interval = IntervalFrom1Level(saw1, 1.0, 0)
iMean1 = IntervalMean(signal2, interval)
```

IntervalMin

Determines the input signal's minimum value within the specified interval.

Result = IntervalMin(Signal, Interval)

Result: result channel	**Interval**: interval channel
Signal: input signal	

The interval channel is generated by the functions `IntervalFromLevels` or `IntervalFrom1Level`.

`IntervalMin` determines the input signal's minimum, while limiting this computation to the intervals specified by the interval channel. Since the time reference is lost, the result cannot be charged any further in many Online FAMOS functions and cannot be sent via XCPoE 945.

Example

```
; Determine min and max of a periodic signal between 20 and 40 degrees.
; the angle is obtained from an incremental counter in Angle-absolute-mode
interval = IntervalFromLevels( angle, 20, 40, 0 )
iMin = IntervalMin(signal, interval)
iMax = IntervalMax(signal, interval)
```

IntervalMult

Pulse count multiplier: From the input interval channel, generates a new interval channel with multiple pulse count.

Results = IntervalMult(Intervals, MinFrequency, Multiplier)

Result: Channel containing the multiplied interval codes **Intervals**: Input channel containing the original interval codes. Sampling interval stated in s.	**MinFrequency**: Minimal frequency of the pulses contained, stated in Hz. **Multiplier**: The pulse count is multiplied by this factor.

The function is mainly used for signals from sensors which generate one pules per revolution. Many algorithms (such as Resampling, ...) however require a higher pulse count per revolution. For this purpose, an interval signal is generated from the pulse signal, which this function in turn multiplies by the pulse count. The results can only be processed with other interval functions.

Multiplication only occurs if the frequency of the pulses the signal contains is low enough. The reason is that the results channel can only contain a single pulse per sampling interval. If the input signal has one pulse every 10 samples, for instance, then the maximum multiplication factor is 10, since in that case each result sample contains one pulse. To compensate small variations and to avoid numerical problems, this maximum resulting pulse frequency has to be reduced by the factor 0.999. So, for an input signal of 1000 samples per pulse the multiplicator may be at most 999, for 100 samples per pulse at most 99, and for the 10 samples per pulse in the example above at most 9.

If the input signal contains a too rapid sequence of pulses, the pulses are deleted. The function either multiplies, or discards. Thus, in the result, either there are no pulses or the multiplied amount.

Also, the multiplication only takes place if the signal has enough pulses per time unit. The parameter MinFrequency specifies the minimum pulse frequency which is enough for multiplication to take place.

If the pulses arrive at a slower rate, they will be deleted. Thus, the pulse frequency may only lie within the range [MinFrequency ... SamplingFrequency/Multiplier].

The function requires temporary memory of the size [SamplingFrequency / MinFrequency], for which reason the minimum frequency may not be chosen too low.

Example

```
; A drive shaft sensor connected to the incremental counter interface returns
; one pulse per revolution. For subsequent resampling by the angle, however,
; 120 pulses per revolution are needed.
; The shaft spins at 600..6000 RPM. 600 RPM = 10 Hz = MinFrequency.
; SamplingFrequency = 20 kHz > 12 kHz = 120*100 Hz, 100 Hz = 6000 RPM.
ivl1 = IntervalFromPulse(ImpulseTime, 0, 0) ; create intervals
ivl120 = IntervalMult(ivl1, 10, 120) ; multiply pulses
res = IntervalResample(Channel_001, ivl120, 360, 120, "Degree", 1) ; resampling
```

IntervalResample

Resampling of a periodic signal

Result = IntervalResample(Signal, Interval, MaxAngle, AmtPoints, Unit, IsSegmented)

Result: Results channel

Signal: Measurement signal

Interval: Interval signal

MaxAngle: Value of total angle or unit length

AmtPoints: Number of encoder pulses per total angle or unit length

Unit: Value of the result

IsSegmented: Is the result segmented?

0: no

1: yes

Two channels are captured simultaneously which contain time-domain data: one channel with the actual measured signal returning position-dependent measured data, and one channel with the associated interval data.

These interval data were generated from an incremental counter's signal using the function IntervalFromPulse, which works in the impulse time mode. By means of IntervalResample, values for the measurement signal at the time points of interest are linearly interpolated from the pulse time data. In the process, no more values may be generated than specified y the sampling interval.

MaxAngle is the value to which the number of pulses corresponds, e.g. 60 encoder pulses per 360 degrees, per 2*pi or per revolution (for oscillation signals) or even 2 encoder pulses per meter.

Example

```
interval = IntervalFromPulse(Inc_Encoder_01, 60, 0) ; Interval codes
res = IntervalResample( Channel_001, interval, 360.0, 60, "Deg", 1) ; resampling
```

IntervalRMS

Determines the root mean square of the input signal within the specified interval.

Result = IntervalRMS(Signal, Interval)

Result: results channel	**Interval**: interval channel
Signal: input signal	

The interval channel is generated by the functions `IntervalFromLevels` or `IntervalFrom1Level`.

`IntervalRMS` determines the root mean square of the input signal, while limiting this computation to the intervals specified by the interval channel.

`IntervalRMS` incorporates the additional data provided by `IntervalFrom1Level` to increase the precision of the computed results.

Since the time reference is lost, the result cannot be charged any further in many Online FAMOS functions and cannot be sent via XCPoE 945.

Example

```
; Determine the root mean square of a sine signal
; Theoretical value = 0.707107, independent of the interval limit specified
; by IntervalFrom1Level
saw1     = SawTooth( Channel_001, 0, 0.01, 628 )
signal1  = Sin( saw1 )
interval = IntervalFrom1Level( saw1, 1.0, 0 )
iRMS1    = IntervalRMS( signal1, interval )
```

IsSynchronized

This function returns whether the internal device clock is synchronized.

Prerequisite:
Only available in: imc Online FAMOS!

a = IsSyncronized(b)

a: Result 1: synchronized 0: not synchronized -1: unable to determine/no clock present	**b**: clock, only for establishing the data rate.

JKFlipFlop

JK flip-flop function

a = JKFlipFlop(J, K)

a: Result	**J**: J input
	K: K input

Returns a 1 for HIGH (H) state or 0 for LOW (L) state.

A change to HIGH state occurs if J is not equal to zero and K is equal to zero.

Likewise, a change to LOW state occurs if J is equal to zero and K is not equal to zero.

If both J and K are both equal to zero, the state does not change.

If neither J nor K are equal to zero, the state changes.

The function may also be called with single values (e.g. virtual bit or Display-variable) as its parameter. In order to obtain useful results in such a case, calls of the function should occur at constant time intervals, e.g. in a Timer or a synchronous task.

Example

```
; The LED flashes while the signal is larger than 9.
res = Greater( Channel_001, 9 )
LED_01 = JKFlipFlop( res, res )
```

10.9.2.10 L

LEQ

LEQ-value: The function determines the LEQ-value in dependence on the time. The result states the LEQ for all previously processed values of the input signal.

LEQSignal = LEQ(Signal, FrequencyRating, ReductionFactor)

LEQSignal: Evaluated signal **Signal**: Signal to be evaluated	**FrequencyRating**: Frequency rating of the signal 0: no rating 1: A-rating 2: B-rating 3: C-rating	**ReductionFactor**: Factor for resampling, ≥ 1. For a reduction factor = 1, no resampling

At the end of the measurement, the last value of the LEQ-signal displays the LEQ for the entire measurement. The signal is first frequency-weighted, e.g. with an A-rating according to DIN IEC 651.

The function requires a sound signal expressed in the unit Pa (Pascal). The result is referenced to $20*10^{-6}$ Pa and expressed in dB. The result can always be interpreted as the mean sonic pressure level of all data already captured.

For display in a curve window, representation as "Last value as number" is recommended. This way, the number appearing will gradually level off at the ultimate value, which can then be read at the end of the measurement.

The reduction factor can be selected in such a way that multiple values per second are generated.

Example

```
LEQ_Chan1 = LEQ( Chan1, 1, 1000 )
```

The signal is subject to an A-rating and resampled by the factor 1000. The signal originally had a sampling frequency of 20kHz, the result only has 20 Hz. The result is the mean sound pressure level LEQ, expressed in dB.

Less

Checks whether the first argument is less than the second argument

a = Less(b, c)

a = 1 if b is less than c, otherwise 0.

LessEqual

Checks whether the first argument is less than or equal to the second argument

a = LessEqual(b, c)

a = 1 if b is less than or equal to c, otherwise 0.

Ln

Natural logarithm of input channel

a = Ln(b)

The logarithm with the base e (Euler number) is formed.

LogAnd

Logical And of b and c.

a = LogAnd(b, c)

a = 1, if b is not equal to zero and c is not equal to zero, else 0

LogNot

Gives the inverse argument b

a = LogNot(b)

LogOr

Logical Or.

a = LogOr(b, c)

a = 1, if b is not equal zero or if c is not equal zero, else 0.

LogXor

Logical And of b and c.

a = LogXor(b, c)

a = 1, if b is inverse to c; else 0.

Lower

Returns the lesser value of the arguments

a = Lower(b, c)

10.9.2.11 M

Max

Maximum of a window, with reduction

a = Max(b, WS, RF)

a: result **b**: input channel	**WS**: window size in samples; **In imc Online FAMOS:** 1 * RF, 2 * RF, ... ,10 * RF **In imc Inline FAMOS:** 1 * RF, 2 * RF, ... ,1000 * RF **RF**: reduction factor in samples; ≥ 1

Returns the maximum value in a window with WS samples for every RF input samples.

Thus for RF > 1, data reduction is performed.

The window size must be an integer multiple (1 to 10/1000) of the reduction factor.

Example

```
high = Max( Channel_001, 20, 4 )
```

Returns for every fourth input sample the maximum of the last 20 input samples.

Note

If the windows size is not 1*RF, there are not enough input samples in the beginning. The result is then computed with the available input samples.

Mean

Mean value of a window, with reduction

a = Mean(b, WS, RF)

a: result	**WS**: Window size; in samples;
b: input channel	**In imc Online FAMOS:**
	1 * RF, 2 * RF, ... ,10 * RF
	In imc Inline FAMOS:
	1 * RF, 2 * RF, ... ,1000 * RF
	RF: Reduction factor in samples; ≥ 1

The mean function returns the mean value of a window with WS samples for every RF input samples. Thus for RF > 1, data reduction is performed.

The window size must be an integer multiple (1 to 10/1000) of the reduction factor.

Example

```
average = Mean( Channel_001, 6, 2 )
```

Returns for every second input sample the mean value of the last 6 input samples.

Note

If the windows size is not 1*RF, there are not enough input samples in the beginning. The result is then computed with the available input samples.

Internal calculation precision: 40 bit.

Median3

Median of three values: The input channel is smoothed using the median of the last three samples

a = Median3(b)

Each group of three samples is sorted by amplitude in decreasing order. The result is the middle element of the sorted list.

Median5

Median of five values: The input channel is smoothed using the median of the last five samples

a = Median5(b)

Each group of five samples is sorted by amplitude in decreasing order. The result is the middle element of the sorted list.

Min

Minimum of a window, with reduction

a = Min(b, WS, RF)

a: result	**WS**: Window size in samples; **In imc Online FAMOS:** 1 * RF, 2 * RF, ... ,10 * RF **In imc Inline FAMOS:** 1 * RF, 2 * RF, ... ,1000 * RF
b: input channel	**RF**: Reduction factor in samples; ≥ 1

The minimum function gives the minimum of a window with WS samples for every RF input samples.

Thus for RF > 1, data reduction is performed.

The window size must be an integer multiple (1 to 10/1000) of the reduction factor.

Example

```
Low = Min( Channel_001, 10, 2 )
```

Returns for every second input sample the minimum of the last 10 input samples.

Note

If the windows size is not 1*RF, there are not enough input samples in the beginning. The result is then computed with the available input samples.

Monoflop

a = Monoflop(b, Duration)

a: result	**Duration**: Pulse duration in samples; ≥ 1
b: input channel	

If Monoflop detects a positive edge in the input signal (a transition of zero to non-zero) it produces a pulse of predetermined duration with amplitude 1.

Not retriggerable, i.e. signal edges are only evaluated after the end of the pulse.

The function may also be called with a single value (e.g. virtual bit or Display-variable) as its first parameter. In order to obtain useful results in such a case, calls of the function should occur at constant time intervals, e.g. in a Timer or a synchronous task.

MonoflopRT

Retriggerable monoflop

a = MonoflopRT(b, Duration)

a: result	**Duration**: Pulse duration in samples; ≥ 1
b: input channel	

If MonoflopRT detects a positive edge in the input signal (a transition of zero to non-zero) it produces a pulse of predetermined duration with amplitude 1.

Additional positive edges within this duration prolong the output pulse.

The function may also be called with a single value (e.g. virtual bit or Display-variable) as its first parameter. In order to obtain useful results in such a case, calls of the function should occur at constant time intervals, e.g. in a Timer or a synchronous task.

10.9.2.12 N

NorthCorrection

Correction of north transition in a window with WF samples.

a = NorthCorrection(b, WF)

a: result	**WF**: window size in samples; ≥ 1
b: argument	

The function NorthCorrection corrects the discontinuity at due North according to the addition method. It prevents skipping from 360° to 0° in the averaging interval.

For values fluctuating around 360°, an average of 180° is avoided.

The result of averaging could lie outside of the wind rose range 0°..360°, e.g 365°.

The function WindRoseCorr 1034 returns the result to the wind rose range (0°..360°), e.g. changes 365° to 5°.

This procedure is conditional on the wind direction not changing more than 100 degrees.

The only sensible way to use the functions NorthCorrection and WindRoseCorr 1034 is in a combination as illustrated in the example below. Instead of averaging, the standard deviation, i.e. the function StDev 1009, can be used.

Example

```
NC = NorthCorrection( Channel, 10 )
NC_Mean = Mean( NC, 10, 10 )
Result = WindRoseCorr( NC_Mean )
```

NOT

Negation of a.

Prerequisite:
Only usable with control commands!

LogicalNot = NOT a

LogicalNot: Result	**a**: Operand

LogicalNot = 1, if the operand is equal to 0, else 0.

Example

```
OnlTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    If NOT Value > 0
        VirtChannel_001 = Channel_001 + 5
    Else
        VirtChannel_001 = Channel_001 + 10
    End
End
```

NumberOfPulses

Returns the number of pulses in reduction window

a = NumberOfPulses(b, RF)

a: Result	**RF**: Reduction factor in samples; ≥ 1
b: Input channel	

Returns the number of pulses in the window of RF samples and does a reduction with a factor of RF.

A pulse is a sequence of two edges, an edge being a transition from zero to non-zero or vice versa.

Analog signals should be preprocessed (STri 1010).

Example

```
_tmp = Stri( Channel_001, 0, 0 )
pulses = NumberOfPulses( _tmp, 100 )
```

Returns for every 100th input sample the number of pulses in the last 100 input samples.

10.9.2.13 O

OnECUCmdReturn_ECU_001

See ECU-functions 925.

OR

Logical Or. Logical disjunction of a and b.

Prerequisite:
Only usable with control commands!

LogicalOr = a OR b

LogicalOr: Result	**a**: 1st operand
	b: 2nd operand

LogicalOr = 1, if the first operand is unequal to 0 or the second operand is unequal to 0, else **LogicalOr = 0**.

The Or-operator may only be used on operands of type BOOL.

A result of type BOOL is returned by the operators <, <=, >, >=, =, <>, AND, OR and NOT.

Example

```
OnlTriggerMeasure( Trigger_48 )
    Value1 = CurrentValue( Channel_001, 0, 0.0 )
    Value2 = CurrentValue( Channel_002, 0, 0.0 )
    If Value1 > 0 OR Value2 > 0
        VirtChannel_001 = Channel_001 + 10
    Else
        VirtChannel_001 = Channel_001 + 5
    End
End
```

General information about the Otr functions

Prerequisite:
Only available in: imc Online FAMOS!
Device enabled for: "*Online Order tracking*"

OtrAngleAdd

Addition of an angle to an angle signal

Result = OtrAngleAdd(Angle, Add)

Result: results channel

Angle: angle signal

Add: angle to be added

The function adds a user-specified angle to the angle signal supplied, which is derived from an incremental sensor operating in absolute angle mode. The resulting angle channel can be processed by `OtrResampleAngle`.

Changes to the angle to be added are always made only when the resulting angle signal's negative signal edge arrives. This results in segments having a negative angle, which are ignored by `OtrResampleAngle`.

Example

```
; angle offset for zero correction
angle = OtrAngleAdd(Inc_encoder_01, -0.1)
; resampling
res = OtrResampleAngle(Channel_001, angle, 360.0, 360, "Degrees", 1)
```

OtrEncoderPulsesToRpm

Determines the RPM-value: The function determines an RPM time history from a pulse signal.

a = OtrEncoderPulsesToRpm(b, Signal_Type, EncoderType, EncoderPulse, RPM_Min, Reduction)

a: Result - RPMHistory: Time-history of RPM-signal

b: Input channel - Pulse_Signal: Time-history of the pulse signal

Signal_Type: Type of pulse signal

- 0: Number of events
- 1: Time of pulse
- 2: Sampled rectangle
- 3: Sine signal

EncoderType: Type of encoder, how many missing teeth?

- 0: Default
- 1: 1 tooth missing
- 2: 2 teeth missing

EncoderPulse: Pulses per revolution, ≥ 1

RPM_Min: Minimum occurring RPM-value

Reduction: Factor by which the number of data points in the result is less than the input data

The time-history of the RPMs is determined. The function returns 0.0 until at least 2 pulses have been detected. Only then is a computation of RPM possible. The quality of the computation depends on the signal type. For instance, Time of pulse measurement allows very good computation. Since the function is carried out online in the device, it must return an estimated value in some instances (due to unknown location of future).

Notes on Signal_type

0	Number of events. The pulse signal reflects the number of pulses counted in a sampling interval. The signal is received if the device's incremental encoder input is set to "Event counting". The signal comprises a sequence of integers. Each number represents the number of pulses counted within the current sampling interval. The RPM-value is assumed to be directly proportional to the number of pulses counted. The function smoothes the RPM signal in order to allow a better RPM estimate. If the signal consisted of the sequence of values { ...., 3, 4, 4, 4, 3, 4, 4, 4, 3... }, then for this portion, a RPM-value of approx. 3.75 can be estimated. The function treats each value of the signal as an number of pulses. If the signal consisted of the sequence of values { 0, 0, 1, 0, 1, 2, 1 }, this amounts to 5 pulses detected. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the pulses were counted.
1	Time of pulse. The signal is received if the device's incremental encoder input is set to "Time of pulse". In this mode, an encoder pulse's exact position in time in the frame of the sampling interval is determined. This involves very precise capture of the pulse. Only this signal type allows such precise sampling in relation to the angle. In this mode it is also important that the measured RPM value be small enough so that there is never more than one encoder pulse per sampling interval. The sampling interval may have to be adjusted to a small enough value for this purpose. RPM_Max must then also be set to a correspondingly low value. Maximum possible RPM [revs/min] = 60 / (encoder pulses * sampling interval [s])
2	Sampled rectangle. One of the device's digital inputs is used to sample the time-history of the encoder's digital output. At every transition from zero to nonzero, the encoder is assumed to have turned by one increment. If the signal consisted of the sequence of values { 0, 0, 1, 1, 1, 0, 0, 1, 1, 0 }, this amounts to 2 pulses detected. If an analog voltage is sampled and there is no hardware comparator, the analog voltage data must be converted to a digital data sequence. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the edge occurred.
3	Sine signal. One of the device's digital inputs is used to sample the time-history of the encoder's (sinusoid) analog output. Sinusoid or other signals with zero-crossing in a positive slope can be processed. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. A zero-crossing in a positive slope is interpreted as a pulse from the encoder. If the signal consisted of the sequence of values { -3.0, -1.0, +1.5, +2.8, +1.3, +0.1, -0.6 }, a pulse is detected at the transition from -1.0 to +1.5.

Note Notes on EncoderType

Special features of encoders with missing pulses:

The number of encoder pulses is always specified to include the missing tooth. E.g. for an encoder emitting a pulse every 10 degrees of rotation, which should then have 36 teeth, the number of encoder pulses to specify is then also 36. But the encoder only generates 35 pulses because one is missing. Also typical are encoders generating a pulse every 6 degrees. In this case, 60 teeth are to be specified although 2 are missing and only 58 actually present. The first tooth after the gap is interpreted as the zero-pulse. This marks the start of sampling. Encoders with missing pulses can only be used with the signal type "Time of pulse". Recognizing the missing teeth is only possible if the RPM-value is relatively constant in the region around the gap. Particularly with extremely low RPM-values, this cannot be guaranteed. Since in that case, the gap cannot be clearly recognized, the minimum RPM must be set to a non-zero value. At higher RPM-values, the gap is usually clearly recognizable due to mechanical inertia. The function tries to re-synchronize itself after any error in the pulse sequence (or a presumably incorrectly interpreted pulse sequence). However, incorrect sampled values may occasionally occur.

Note — **Notes on the RPM-range**

If a value for RPM_Min > 0 is set, then signal components up to that RPM-value are disregarded for the result, and whole periods of OrderRef can be skipped in the process. The minimum RPM must not be set too low since the tracking filter is dynamically limited. RPM_Max may only be set so high that the data rate after sampling isn't greater than that of the input data. When OrderRef or Oversampling have high values, this generally is accompanied by a high data rate. In this case, the maximum RPM-value must be set correspondingly low.

Note — **Notes on Reduction**

The number of data points can be reduced by this factor. Default is 1. Since a high sampling rate sometimes must be used to pinpoint the location of the pulses, a correspondingly large reduction factor can be used to adapt the data rate to the RPMs. This is because the RPM-value often doesn't change so quickly.

Example 1

The RPMs of a toothwheel are to be determined. To this end, an inductive encoder is used to generate a rectangular voltage signal. This voltage is recorded at a constant sampling rate of 1 kHz. The voltage is about 0 V .. 3 V in the tooth-gap, and about 18 V .. 22 V at the tip of the tooth. The toothwheel has 8 teeth.

```
_Pulses = stri( Voltage, 15, 5 )
Revs = OtrEncoderPulsesToRpm( _Pulses, 2, 0, 8, 0, 1 )
; _STyp = 2 ; sampled rectangle signal
; _ETyp = 0
; _EPulse = 8 ; number of teeth
; _MinRevs = 0
; _Red = 1
; Revs = OtrEncoderPulsesToRpm( _Pulses, _STyp, _ETyp, _Pulse, _MinRevs, _Red )
```

Since the voltage isn't in an appropriate format, it is altered to produce a proper 0-1sequence.

Example 1

The device records the signal "Tacho1" of an encoder with 128 pulses using the Time-of-pulse mode. The sampling time is 0.1ms.

```
Revs = OtrEncoderPulsesToRpm( Tacho1, 1, 0, 128, 0, 1 )
; _STyp = 1 ; Time-of-pulse
; _ETyp = 0
; _EPulse = 128 ; Pulses per revolution
; _MinRevs = 0
; _Red = 1
; Revs = OtrEncoderPulsesToRpm( Tacho1, _STyp, _ETyp, _EPulse, _MinRevs, _Red )
```

The RPM-value may reach up to 4680 revs/min [= 60 / (128 * 0.0001)].

OtrFrequLine

Determines the frequency line: The function finds the magnitude or phase of a sinusoidal oscillating signal having a fixed period duration.

a = OtrFrequLine(VibrationSignal, PeriodLength, PeriodAmount, Option)

a: Result - Magnitude or phase time history

VibrationSignal: Signal with sinusoidal oscillation

PeriodLength: Number of samples per period; ≥ 2.0

PeriodAmount: The number of periods over which an average is taken

Option: Determines what is calculated

0: Magnitude (effective value)

1: Phase (in degrees)

The function finds the value for the magnitude or for the phase of the oscillation for each interval of length PeriodLength * PeriodAmount. In other words, the number of oscillation in such an interval is given by PeriodAmount. The duration of the oscillations must be fixed and constant. PeriodLength does not have to be a integer number of samples. But the Product PeriodLength*PeriodAmount must be of a integer number of samples in length, determined by PeriodLength*PeriodAmount divided by the sampling interval.

The function finds one line of the discrete Fourier-spectrum (DFT) using Hanning-windowing.

If the signal contains significant components at other frequencies, a large number should be set for the number of periods in order to reduce the distorting effects of these other frequencies. If only a small number of periods is used, it may be advisable to connect a bandpass filter in front.

PeriodLength ≥ 2.0, PeriodAmount ≥ 1. The product of these two parameters may not exceed 2e9. The phase is stated in the range -180 degrees .. +180 degrees. the value of the phase is 0 degrees for a cosine oscillation, -90 degrees for a sine oscillation.

Example

A vibration signal is sampled in reference to the rotation angle (vib_revs), so that all oscillation components up to the 8th order are present. The signal thus contains 16 points per revolution. The phase of the 1st order is to be determined. One value for the phase is desired for every 5 revolutions.

```
Phase = OtrFrequLine( vib_revs, 16, 5, 1 )
```

OtrFrequLine2

Determining frequency lines: A signal containing an vibration of fixed period duration is approximated by a sinusoidal waveform. The magnitude and phase of this approximation are determined.

OtrFrequLine2(Magnitude, Phase, OscillationSignal, PeriodLength, PeriodCount)

Magnitude: Result of calculation (RMS-value)

Phase: Result of calculation (in degrees).

The phase is determined as in the range -180 degrees ... +180 degrees.
The phase's value is 0 degrees for a cosine oscillation, -90 degrees for a sine oscillation.

VibrationSignal: Input channel with vibration

PeriodLength: Number of sampling values in a period; ≥ 2.0

PeriodCount: Averging over this many periods; ≥ 1.

The product of PeriodLeng and PeriodCount may not exceed 2e9.

Within every interval of length PeriodLength * PeriodCount, this function determines the magnitude and the phase of the oscillation. This interval contains exactly the number PeriodCount oscillations.

The duration of the oscillations must be fixed and constant. The period length does not have to be an integer number of samples. But the Product PeriodLength*PeriodAmount must be an integer number of samples in length, determined by PeriodLength*PeriodAmount divided by the sampling interval.

The function determines a line of the discrete Fourier transform (DFT) with rectangular windowing.

If the signal additionally contains significant other frequency components, a large number of periods should be selected in order to reduce their distorting effects. When working with a low number of periods, it may be necessary to connect a bandpass filter upstream.

Example

A vibration signal is sampled over the angle (vib_revs), so that all vibration components up to the 8th order are included.

The signal thus comproses 16 points per revolution. The magnitude and phase of the 1st order are to be determined.

Every 5 revolutions, a value for the magnitude and phase each is to be returned.

```
OtrFrequLine2( mag, phase, vib_revs, 16, 5 )
```

OtrFrequLine3

Determining frequency lines: A signal containing an vibration of fixed period duration is approximated by a sinusoidal waveform. The magnitude and phase of this approximation are determined. Also, a sinusoidal oscillation is formed based on these results.

OtrFrequLine3(Magnitude, Phase, Sine, VibrationSignal, PeriodLength, PeriodCount, SampleCount)

Magnitude: Result of calculation (RMS-value)

Phase: Result of calculation (in degrees).

The phase is determined as in the range -180 degrees ... +180 degrees.
The phase's value is 0 degrees for a cosine oscillation, -90 degrees for a sine oscillation.

Sinus: Results of the calculation (sinusoidal oscillation)

VibrationSignal: Input channel with sinusoidal oscillation

PeriodLength: Number of sampling values in a period; ≥ 2.0

PeriodCount: Averging over this many periods; ≥ 1.

SampleCount: Length of the sinusoidal oscillation found as the results (in Samples)

The product of PeriodLeng and PeriodCount may not exceed 2e9.

The function determines in each interval of length PeriodLength * PeriodCount the value of the magnitude and phase of the oscillation. In each such interval, there are PeriodCount oscillations.

The duration of the oscillations must be fixed and constant. The period length does not have to be an integer number of samples. But the Product PeriodLength*PeriodAmount must be an integer number of samples in length, determined by PeriodLength*PeriodAmount divided by the sampling interval.

The function determines a line of the discrete Fourier transform (DFT) with rectangular windowing.

If the signal additionally contains significant other frequency components, a large number of periods should be selected in order to reduce their distorting effects. When working with a low number of periods, it may be necessary to connect a bandpass filter upstream.

The resulting sinusoidal oscillation can only be used to display instantaneous values. E.g. in the curve window by means of "last N samples". An interpretation of this channel to indicate time is generally not possible.

Example

A vibration signal is sampled over the angle (vib_revs), so that all vibration components up to the 8th order are included. The signal thus comproses 16 points per revolution. The magnitude and phase of the 1st order are to be determined. Every 5 revolutions, a value for the magnitude and phase each is to be returned.

A resulting oscillation with 50 points resolution is to be generated.

```
OtrFrequLine3( mag, phase, sinus vib_revs, 16, 5, 50 )
```

OtrOrderSpectrum

Order spectrum over RPMs: The order spectrum is determined from the vibration and pulse signal time-histories referenced to the RPMs.

OrderSpectrum = OtrOrderSpectrum(Vibration, RPM, RPM_Min, RPM_Max, RPM_Bin_Width, Resolution, OrderMax, AveragingType)

OrderSpectrum: Order spectrum referenced to the RPMs

Vibration: Time-history of vibration signal

RPM: Time-history of the RPMs. In scaled to U/min

RPM_Min: Lower limit of desired RPM-range

RPM_Max: Upper limit of desired RPM-range

RPM_Bin_Width: Width (interval) of an RPM-class

Resolution: Resolution of the order spectrum [1, 1/2, 1/3, 1/4, ...]

OrderMax: The highest order (line) in the order spectrum

AveragingType: The processing of all spectra within one RPM-class

- 0: Arithmetic mean
- 1: Maximum
- 2: Minimum

RPM_Min, RPM_Max and RPM_Bin_Width are scaled in revs/minute. For sampling, the absolute value of the RPMs is used, but the original RPM value is used for assignment to an RPM-class.

Resolution: 0.1, if 0.1 orders is the distance between lines in the order spectrum. The resolution must be an integer fraction of 1.0, in other words, 1, 1/2, 1/3, 1/4, ... The inverse value of the resolution is a measure of how many revolutions are used to determine the order spectrum. For example, with a resolution of 0.1, each spectrum is determined from 10 revolutions.

The spectral lines are stated as rms-values. Since the FFT is internally calculated from a somewhat larger number of data (a power of 2), some spectral lines are truncated. The first line in the spectrum is always set as zero. Rectangular windowing is used for the FFT.

The averaging works on the magnitude spectrum. The average RPM-value in a spectrum determines the RPM-class.

A tracking Butterworth lowpass filter is used for anti-aliasing. The signal thus filtered is sampled at intervals of rotational angle. Then, an FFT is computed. As a result of this procedure, higher intermediate order lines may show up during sampling than are present in the ultimately returned spectrum. The 3dB-order of the anti-aliasing filter is located, i.e., at the end of the spectrum. The FFT can consist of anywhere between 16 and 8192 points. A rectangular window is used.

The function works properly for:

OrderMax < 16 / (SampleTime_Vibration * RPM_Max)

...

OrderMax < 32 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling time of the signal 'Vibration'.

Use the value 16 for a worst case estimate. But, depending on the current number values, it can be as high as 32. The factor of 2 for feasible values is due to the internal rounding up to a power of 2 of values for the FFT used. Obtaining the highest possible order is sometimes possible by changing the resolution.

The RPM's should change only slowly. The RPM's should not fall far below 1% of capacity. The RPM's must be used to compute a good approximation of the rotational angle by means of integration (summing up). Therefore, the RPM values should be reasonably exact.

If no spectrum is computed in a certain RPM class, this spectrum is filled with zeroes. During measurement, the results are transferred like a histogram, i.e., regular but infrequent transmission of intermediary results to the PC. The result is a segmented waveform. Each segment is an order spectrum.

Example

From the time-history of a vibration vib and of the RPMs rpm, the order spectrum is to be determined in relation to the RPMs. The RPM-time trace is sampled at a rate of 0.2 ms.

```
_Min = 1000.0  ; minimum of RPM range
_Max = 6000.0  ; maximum of RPM range
_Delta = 100.0 ; bin spacing of RPM classes
_Res = 0.1     ; spectrum resolution, i.e. 1/10 order visible, calculated
               ; from 10 revolutions
_OMax = 6.0    ; up to this order, lines in the spectrum are to be displayed.
_MeanType = 0  ; 0 (arithmet. mean)
OSpectrum = OtrOrderSpectrum( vib, rpm, _Min, _Max, _Delta, _Res, _OMax, _MeanType)
; _OMax = 6.0 < 16 / ( 0.0002 * 6000 ) = 13.3
```

OtrOrderSpectrumP

Order spectrum over RPMs: The order spectrum is determined from the vibration and pulse signal time-histories referenced to the RPMs.

a = OtrOrderSpectrumP(Vibration, PulseSignal, SignalType, EncoderType, EncoderPulse, RPM_Min, RPM_Max, RPM_Bin_Width, Resolution, OrderMax, AveragingType)

a: Result - Order spectrum referenced to the RPMs

Vibration: Time-history of vibration signal

PulseSignal: Time-history of pulse signal

SignalType: Type of pulse signal

- 0: Number of events
- 1: Time of pulse
- 2: Sampled rectangle
- 3: Sine signal

EncoderType: Type of encoder, how many missing teeth?

- 0: Default
- 1: 1 tooth missing
- 2: 2 teeth missing

EncoderPulse: Pulses per revolution, ≥ 1

RPM_Min: Lower limit of desired RPM-range

RPM_Max: Upper limit of desired RPM-range

RPM_Bin_Width: Width (interval) of an RPM-class

Resolution: Resolution of the order spectrum [1, 1/2, 1/3, 1/4, ...]

OrderMax: The highest order (line) in the order spectrum

AveragingType: The processing of all spectra within one RPM-class

- 0: Arithmet. mean
- 1: Maximum
- 2: Minimum

The RPM-values are derived from the pulse signal by aggregating the angle contribution of each pulse. The vibration signal is sampled in reference to the rotational angle. Then the spectrum is determined. That is the complicated, but exact algorithm.

RPM_Min, RPM_Max and RPM_Bin_Width are scaled in revs/minute. For sampling, the absolute value of the RPMs is used, but the original RPM value is used for assignment to an RPM-class.

Resolution: 0.1, if 0.1 orders is the distance between lines in the order spectrum. The resolution must be an integer fraction of 1.0, in other words, 1, 1/2, 1/3, 1/4, ...

The inverse value of the resolution is a measure of how many revolutions are used to determine the order spectrum. For example, with a resolution of 0.1, each spectrum is determined from 10 revolutions.

The spectral lines are stated as rms-values. Since the FFT is internally calculated from a somewhat larger number of data (a power of 2), some spectral lines are truncated. The first line in the spectrum is always set as zero. Rectangular windowing is used for the FFT.

The averaging works on the magnitude spectrum. The average RPM-value in a spectrum determines the RPM-class.

A tracking Butterworth lowpass filter is used for anti-aliasing. The signal thus filtered is sampled at intervals of rotational angle. Then, an FFT is computed. As a result of this procedure, higher intermediate order lines may show up during sampling than are present in the ultimately returned spectrum. The 3dB-order of the anti-aliasing filter is located, i.e., at the end of the spectrum. The FFT can consist of anywhere between 16 and 8192 points. A rectangular window is used.

The function works properly for:

OrderMax < 16 / (SampleTime_Vibration * RPM_Max)

...

OrderMax < 32 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling time of the signal 'Vibration'.

Use the value 16 for a worst case estimate. But, depending on the current number values, it can be as high as 32. The factor of 2 for feasible values is due to the internal rounding up to a power of 2 of values for the FFT used. Obtaining the highest possible order is sometimes possible by changing the resolution.

Notes on signal type

0	Number of events. The pulse signal reflects the number of pulses counted in a sampling interval. The signal is received if the device's incremental encoder input is set to "Event counting". The signal comprises a sequence of integers. Each number represents the number of pulses counted within the current sampling interval. If the signal consisted of the sequence of values { 0, 0, 1, 0, 1, 2, 1 }, this amounts to 5 pulses detected. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the pulses were counted.
1	Time of pulse. The signal is received if the device's incremental encoder input is set to "Time of pulse". In this mode, an encoder pulse's exact position in time in the frame of the sampling interval is determined. This involves very precise capture of the pulse. Only this signal type allows such precise sampling in relation to the angle. In this mode it is also important that the measured RPM value be small enough so that there is never more than one encoder pulse per sampling interval. The sampling interval may have to be adjusted to a small enough value for this purpose. RPM_Max must then also be set to a correspondingly low value. Maximum possible RPM [revs/min] = 60 / (encoder pulses * sampling time [s])
2	Sampled rectangle. One of the device's digital inputs is used to sample the time-history of the encoder's digital output. At every transition from zero to nonzero, the encoder is assumed to have turned by one increment. If the signal consisted of the sequence of values { 0, 0, 1, 1, 1, 0, 0, 1, 1, 0 }, this amounts to 2 pulses detected. If an analog voltage is sampled and there is no hardware comparator, the analog voltage data must be converted to a digital data sequence. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the edge occurred.
3	Sine signal. One of the device's digital inputs is used to sample the time-history of the encoder's (sinusoid) analog output. Sinusoid or other signals with zero-crossing in a positive slope can be processed. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. A zero-crossing in a positive slope is interpreted as a pulse from the encoder. If the signal consisted of the sequence of values { -3.0, -1.0, +1.5, +2.8, +1.3, +0.1, -0.6 }, a pulse is detected at the transition from -1.0 to +1.5.

Note Notes on EncoderType

Special features of encoders with missing pulses:

The number of encoder pulses is always specified to include the missing tooth. E.g. for an encoder emitting a pulse every 10 degrees of rotation, which should then have 36 teeth, the number of encoder pulses to specify is then also 36. But the encoder only generates 35 pulses because one is missing. Also typical are encoders generating a pulse every 6 degrees. In this case, 60 teeth are to be specified although 2 are missing and only 58 actually present. The first tooth after the gap is interpreted as the zero-pulse. This marks the start of sampling. Encoders with missing pulses can only be used with the signal type "Time of pulse". Recognizing the missing teeth is only possible if the RPM-value is relatively constant in the region around the gap. Particularly with extremely low RPM- values, this cannot be guaranteed. Since in that case, the gap cannot be clearly recognized, the minimum RPM must be set to a non-zero value. At higher RPM-values, the gap is usually clearly recognizable due to mechanical inertia. The function tries to re-synchronize itself after any error in the pulse sequence (or a presumably incorrectly interpreted pulse sequence). However, incorrect sampled values may occasionally occur.

The RPM-value should change only slowly. It should not sink substantially below 1% of the maximum value. It follows that the minimum RPM-value must be > 0.0.

If no spectrum is determined for a particular RPM-class, this spectrum is filled with zeroes. During measurement, the result is transferred like a histogram, i.e., regular but few transfers of intermediate results to the PC. The result is a segmented data set. Each segment is an order spectrum.

Example

The order spectrum referenced to the RPMs is to be determined from a vibration signal vib and the pulse signal Inc01. The time signals are sampled at rate of 0.2 ms. Inc01 is recorded in the Time-of-pulse mode of the incremental encoder input. The encoder has 8 markings per revolution.

```
OSpectrum = OtrOrderSpectrumP( vib, Inc01, 1, 0, 8, 1000, 6000, 100, 0.1, 6.0, 0 )
; _SType = 1       ; time-of-pulse
; _EType = 0
; _EPulse = 8      ; number of markings
; _Min = 1000.0    ; minimum in RPM range
; _Max = 6000.0    ; maximum in RPM range
; _Delta = 100.0   ; bin-width of RPM classes
; _Res = 0.1       ; resolution of spectrum, meaning 1/10 order is visible,
                   ; computed over 10 revolutions
; _OMax = 6.0      ; lines in the spectrum up to this order are to be displayed
; _Mean = 0        ; 0 (arithmet. mean)
; OSpec = OtrOrderSpectrumP( vib, Inc01, _SType, _EType, _EPulse, _Min, _Max,
; _Delta, _Res, _OMax, _Mean )
; _OMax = 6.0 < 16 / ( 0.0002 * 6000 ) = 13.3
```

OtrPulseDuration

Pulse time measurement: Measurement of pulse duration for Incremental Encoders

Result = OtrPulseDuration(InputSignal, DxResult)

Result: Pulse duration

InputSignal: Signal from Incremental Encoder

DxResult: Delta-X for the result channel, > 0

The time that passes between two pulses of the input signal is determined with a precision of 1/32000 of the sample time. The input signal comes from an incremental encoder that operates in pulse time mode.

An output occurs only when there is a pulse on the input, that is, the result may not be combined with other channels.

When multiple pulses fall into one sample interval, a 0 is returned.

Example

```
; 1 increment per pulse
pulse_dur = OtrPulseDuration( Ink_Geber_01, 1 )

; 10 increments per revolution
pulse_dur = OtrPulseDuration( Ink_Geber_01, 0.1 )

; 10 increments per 360 degrees angle
pulse_dur = OtrPulseDuration( Ink_Geber_01, 36 )
```

OtrResample

Angle sampling: Sampling of a vibration signal in reference to the rotation angle, given a pulse signal. A tracking, anti-aliasing filter is used.

AngleSignal = OtrResample(Vibration, Pulse_Signal, Signal_Type, EncoderType, EncoderPulse, OrderRef, Oversampling, Order3dB, FilterOrder, RPM_Min, RPM_Max, DelayTime)

AngleSignal: The signal sampled by angle

Vibration: Time-history of a vibration signal

Pulse_Signal: Time-history of the pulse signal

Signal_Type: Type of pulse signal

- 0: Number of events
- 1: Time of pulse
- 2: Sampled rectangle
- 3: Sine signal

EncoderType: Type of encoder, how many missing teeth?

- 0: Default
- 1: 1 tooth missing
- 2: 2 teeth missing

EncoderPulse: Pulses per revolution, ≥ 1

OrderRef: A visible order (line) in the result

Oversampling: Oversampling for OrderRef

Order3dB: Order, at which the low-pass filter dampens by 3dB

FilterOrder: The filter-order of the low-pass filter (1..10)

RPM_Min: Minimum occurring RPM-value

RPM_Max: Maximum occurring RPM-value

DelayTime: Delaytime, stated in seconds

The rotational angle is derived from the pulse signal by aggregating the angle increment of each pulse. The resulting signal trace over the angle is scaled to the x-coordinate, reflecting the number of revolutions made. The x-coordinate starts at 0, has the value of 0.5 after half a revolution, after a full revolution 1.0, after 2 whole revolutions 2.0 etc. The data rate for the result : 0.5 / (OrderRef * Oversampling) The absolute value for the RPMs is used. A Butterworth low-pass filter is used for anti-aliasing.

The function works properly for:

OrderMax < 24 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling interval of the signal 'Vibration'.

Note that the highest frequency components of the resulting signal are already very heavily dampened.

Order3dB << OrderMax = OrderRef * Oversampling

<< means: much less than.

The RPM's should change only slowly. The RPM's should not fall far below 1% of capacity. The upper cutoff frequency of the low-pass filter must always be substantially below half of the vibration signal's sampling rate. Above about (0.4 * sampling rate), filtering cannot be performed.

If the current RPM-value rises above RPM_Max during measurement, whole oscillations of the order given by the parameter OrderRefare rejected.

The rotation angle is derived from the pulse signal by integration (aggregating the values). The function works with constant accuracy even for long-term measurements and is preferable to the function `OtrResampleFromRpm`.

Linear interpolation is used to find intermediate values. Between 2 pulses, the RPM-value is assumed to be constant. Interpolation is possible up to a maximum factor of 100 .

The function disregards the first 32 (approximately) measurement values in the signal.

Notes on signal type

0	Number of events. The pulse signal reflects the number of pulses counted in a sampling interval. The signal is received if the device's incremental encoder input is set to "Event counting". The signal comprises a sequence of integers. Each number represents the number of pulses counted within the current sampling interval. If the signal consisted of the sequence of values { 0, 0, 1, 0, 1, 2, 1 }, this amounts to 5 pulses detected. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the pulses were counted.
1	Time of pulse. The signal is received if the device's incremental encoder input is set to "Time of pulse". In this mode, an encoder pulse's exact position in time in the frame of the sampling interval is determined. This involves very precise capture of the pulse. Only this signal type allows such precise sampling in relation to the angle. In this mode it is also important that the measured RPM value be small enough so that there is never more than one encoder pulse per sampling interval. The sampling interval may have to be adjusted to a small enough value for this purpose. RPM_Max must then also be set to a correspondingly low value. Maximum possible RPM [revs/min] = 60 / (encoder pulses * sampling interval [s])
2	Sampled rectangle. One of the device's digital inputs is used to sample the time-history of the encoder's digital output. At every transition from zero to nonzero, the encoder is assumed to have turned by one increment. If the signal consisted of the sequence of values { 0, 0, 1, 1, 1, 0, 0, 1, 1, 0 }, this amounts to 2 pulses detected. If an analog voltage is sampled and there is no hardware comparator, the analog voltage data must be converted to a digital data sequence. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the edge occurred.

3	Sine signal. One of the device's digital inputs is used to sample the time-history of the encoder's (sinusoid) analog output. Sinusoid or other signals with zero-crossing in a positive slope can be processed. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. A zero-crossing in a positive slope is interpreted as a pulse from the encoder. If the signal consisted of the sequence of values { -3.0, -1.0, +1.5, +2.8, +1.3, +0.1, -0.6 }, a pulse is detected at the transition from -1.0 to +1.5.

Note Notes on OrderRef and Oversampling

The maximum order in the result is OrderRef * Oversampling

For the maximum order, 2 points in the angle signal are allotted per period. OrderRef denotes the order line in the angle signal which can be clearly recognized. Also, this order should always be displayed in-phase as far as possible even if the RPM-value is so high that some signal components have to be skipped over. If the data rate of the angle signal becomes too high, whole periods of OrderRef are skipped. Oversampling may only be an integer factor ≥ 1. OrdRef can also be a fractional order.

Note Notes on EncoderType

Special features of encoders with missing pulses:

The number of encoder pulses is always specified to include the missing tooth. E.g. for an encoder emitting a pulse every 10 degrees of rotation, which should then have 36 teeth, the number of encoder pulses to specify is then also 36. But the encoder only generates 35 pulses because one is missing. Also typical are encoders generating a pulse every 6 degrees. In this case, 60 teeth are to be specified although 2 are missing and only 58 actually present.

The first tooth after the gap is interpreted as the zero-pulse. This marks the start of sampling. Encoders with missing pulses can only be used with the signal type "Time of pulse". Recognizing the missing teeth is only possible if the RPM-value is relatively constant in the region around the gap. Particularly with extremely low RPM-values, this cannot be guaranteed. Since in that case, the gap cannot be clearly recognized, the minimum RPM must be set to a non-zero value. At higher RPM-values, the gap is usually clearly recognizable due to mechanical inertia. The function tries to re-synchronize itself after any error in the pulse sequence (or a presumably incorrectly interpreted pulse sequence). However, incorrect sampled values may occasionally occur.

Note Notes on the filter

If no low-pass filter is to be used, the following settings must be made:

```
Order3dB = 0
FilterOrder = 0
```

Always use a 1st or 2nd order filter.

Note Notes on the RPM-range

If a value for RPM_Min > 0 is set, then signal components up to that RPM-value are disregarded for the result, and whole periods of OrderRef can be skipped in the process. The minimum RPM must not be set too low since the tracking filter is dynamically limited.

RPM_Max may only be set so high that the data rate after sampling isn't greater than that of the input data. hen OrderRef or Oversampling have high values, this generally is accompanied by a high data rate. In this case, the maximum RPM-value must be set correspondingly low.

Note — Notes on DelayTime

DelayTime = 0.0 Default ≥ 0.0

A delay refers to when the vibration signal lags behind the RPM-signal because of analog circuitry such as filters and amplifiers. A constant lag in the time signal results in a RPM-dependent delay in the angle signal. This can be compensated. The delay time is assumed to be constant. This isn't true exactly, but as a good approximation. The time lag is not a property of the device, but rather of the measurement chain and must be determined empirically by a control measurement.

Example

A vibration signal vib is sampled at a rate of 1 ms. The RPMs can go up to 4000 revs/min. The vibration is to be plotted over the rotation angle. There should be signal components up to the 5th order. The device's incremental encoder input is set to "Time of pulse", the pulse signal is entitled Inc01. The encoder has 12 markings per revolution. RPM-values below 10 revs/min are to be ignored.

```
res = OtrResample( vib, Inc01, 1, 0, 12, 5.0, 1, 2.7, 8, 10.0, 4000.0, 0.0 )
```

The 8th-order anti-aliasing filter is designed to dampen the 2.7th order by 3 dB, th 5th order by 60 dB. For the 2.3th order, the amplitude error is already less than 5%.

The following holds: OrderMax = 5.0 * 1 ≤ 24 / (0.001 * 4000) = 6.0

Calculation of maximum order: The result has a resolution of 0.5 / OrderMax = 0.1 revolution.

It has 10 sample values per revolution.

OtrResampleAngle

Resampling of a periodic signal

Result = OtrResampleAngle(Vibration, Angle, MaxAngle, AmtPoints, Unit, IsSegmented)

Result: results channel	**Unit**: unit of the results
Vibration: Measurement signal	**IsSegmented**: are the result data segmented? 0: no 1: yes
Angle: angle signal	
MaxAngle: angle maximum	
AmtPoints: number of points	

Two channels containing time-based data arrive simultaneously: One channel with the actual measurement signal returning periodic measured data, and one channel with associated angle data coming from an incremental sensor operating in absolute angle mode.

Resampling generates a channel which represents the measured data as a function of the angle, where the angle-based data result from interpolation from the time data.

The magnitude of the angle maximum serves the purpose of scaling the results and states whether a revolution is interpreted as 360°, 720° or 2*pi.

The amount of points determines how many measurement points on the angle axis are to be generated by resampling. This number may not be so large that the data volume would be increased by resampling.

Example 1

The signal of the incremental encoder, corrected by -0.1°, is passed to the function `OtrResampleAngle`, together with the periodic measurement signal on Channel_001. The result of resampling is a segmented record that maps the measurement signal to the angle in the range of 0°...360°. The amount of points for one revolution is 360, i.e. the angle resolution is 1°.

```
; angle offset for zero-point correction
angle = OtrAngleAdd(inc_encoder_01, -0.1)
; resampling
res = OtrResampleAngle(Channel_001, angle, 360.0, 360, "°", 1)
```

Example 2

In the following example, the result is displayed over the number of revolutions, i.e. a complete revolution gets a value of 1, and the unit is set to "Rev". The result is resolved with 100 points per revolution. The resulting record is non-segmented, so it counts the number of revolutions along the measurement.

```
res = OtrResampleAngle(Channel_001, inc_encoder_01, 1, 100, "Rev", 0)
```

OtrResampleFromRpm

Angle sampling: A vibration signal is referenced to the rotation angle. The RPM signal must be given.

AngleSignal = OtrResampleFromRpm(Vibration, RPM, OrderMax, RPM_Max)

AngleSignal: Result, the vibration signal plotted over rotation angle	**OrderMax**: Maximum order (line) contained in result
Vibration: Time history of the vibration signal	**RPM_Max**: Maximum desired RPM-value in revs/min
RPM: Time history of the RPMs. Scaled in rotations/minute.	

The resulting signal trace over the angle is scaled to the x-coordinate, reflecting the number of revolutions made. The x-coordinate starts at 0, has the value of 0.5 after half a revolution, after a full revolution 1.0, after 2 whole revolutions 2.0 etc. The data rate for the result: 0.5 / (OrderRef * Oversampling). The absolute value for the RPMs is used.

The function doesn't come with anti-aliasing filtering. `OtrTrackingLowPass` should be called beforehand. Linear interpolation is used to determine intermediate values.

The function works properly for:

OrderMax ≤ 30 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling interval of the signal 'Vibration'.

The RPM's should change only slowly. The RPM's should not fall far below 1% of the maximum value.

If the momentary RPM-value rises above RPM_Max during the measurement, whole revolutions are rejected. The rotation angle is computed from the RPM-values by means of integration (aggregation), therefore the RPM-values must be available and highly precise.

The signal processor works with 32 bit real numbers at a relative accuracy of 1e-7. In long-term measurements, a variable phase-shift tends to occur.

The same effect appears even more pronounced in the case of inexact RPM-values or values which cannot be integrated to a rotational angle.

Example

A vibration signal vib is sampled every 0.5 ms. The RPM-value rpm can rise to up to 3000 revs/min. The vibration is to be plotted over the angle. Signal components up to the 15th order are supposed to be included.

```
tlp = OtrTrackingLowPass( vib, rpm, 8.0, 4 )
res = OtrResampleFromRpm( tlp, rpm, 15.0, 3000.0 )
```

It is seen that: OrderMax = 15.0 ≤ 30 / (0.0005 * 3000) = 20.0

The resolution of the result is 0.5 / OrderMax = 0.0333 revolutions. There are 30 samples per revolution.

The anti-aliasing filter is configured to dampen the signal by 3dB in the 8th order, in the 14.4th order by 20 dB. At the 6.1th order the amplitude error is already less than 5%.

OtrRpmComplexOrder

Complex order line: Determines magnitude and phase of an order line referenced to the RPMs. The desired RPM range is divided into classes of equal width.

OtrRpmComplexOrder(Magnitude, Phase, Vibration, Pulse_Signal, Signal_Type, EncoderType, EncoderPulse, RPM_Min, RPM_Max, RPM_Bin_Width, OrderMed, WidthPercent, FilterOrder, Interpolation, DelayTime)

Magnitude: Result, magnitude referenced to RPMs

Phase: Result, phase referenced to RPMs

Vibration: Time-history of vibration signal

Pulse_Signal: Time-history of pulse signal

Signal_Type: Type of pulse signal

- 0: Number of events
- 1: Time of pulse
- 2: Sampled rectangle
- 3: Sine signal

EncoderType: Type of encoder, how many missing teeth?

- 0: Default
- 1: 1 tooth missing
- 2: 2 teeth missing

EncoderPulse: Pulses per revolution, ≥ 1

RPM_Min: Lower limit of desired RPM-range

RPM_Max: Upper limit of desired RPM-range

RPM_Bin_Width: Width (interval) of an RPM-class

OrderMed: The order (line) to be filtered out

WidthPercent: Width of the bandpass filter in percent, 10..100%

FilterOrder: The filter order of the bandpass filter

Interpolation: Specifies whether the result is interpolated

- 0: No interpolation
- 1: Constant interpolation (centered around reference values)
- 2: Linear interpolation

DelayTime: DelayTime, stated in seconds

The function finds whole periods for the specified order line. For each period, the magnitude, phase and mean RPM-value are determined. These value-pairs are filed in the result. If a value for the particular RPM-value was already filed, an average is taken. The function works with a signal plotted over rotation angle, to which a fixed-frequency bandpass filter is applied.

The root-mean-square value of the magnitude is determined. The phase is stated in the range -180 degrees ... +180 degrees. the value of the phase is 0 degrees for a cosine oscillation, -90 degrees for a sine oscillation. If a "0" is specified as the value for the Magnitude or Phase parameter, the respective quantity is not determined.

The RPM-range starts at RPM_Min, the resolution is always RPM_Bin_Width. The value for RPM_Max is used only to determine the number of result values. RPM_Min, RPM_Max and RPM_Bin_Width must all be scaled in revs/min.

For each RPM-class (of width RPM_Bin_Width) there should be enough periods in the vibration signal. If there are no values, the result for such a RPM-class is zero. If the interpolation parameter is not selected as zero, unfilled RPM-classes are filled by interpolating between adjacent values. If interpolation is selected, even unfilled outer bins (classes at the margins) are filled by means of extension.

The value range for the parameter WidthPercent is [10 ... 100.0]. E.g. at 30% width, the ratio of upper to lower cutoff frequency for the bandpass is 1.30 .

The parameter OrderMed is the order (line) at which the medium frequency of the bandpass is situated. The internally set medium frequency of the filter is:

Mediumfrequency = OrderMed * (Current_RPM/ 60)

The upper cutoff frequency is above the medium frequency and results for the filter width.

The function works properly for:

OrderMax << 10 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling time of the signal 'Vibration'.

OrderMax = OrderMed * sqrt (1 + WidthPercent / 100)

<< means that the specifiable order should be substantially smaller.

The RPM's should change only slowly. The RPM's should not fall far below 1% of capacity.

Note that the bandpasses need some time for the transients to subside. This time increases strongly with the narrowness of the filter. A bandpass of width 10% is in this sense already extremely narrow. A width of 25% corresponds to a third-octave filter, a width of 100% to an octave filter.

During measurement, the results are transferred like a histogram, i.e., regular but infrequent transmission of intermediary results to the PC. Any interpolation procedure set will only take effect upon completion of the measurement.

Notes on signal type

0	Number of events. The pulse signal reflects the number of pulses counted in a sampling interval. The signal is received if the device's incremental encoder input is set to "Event counting". The signal comprises a sequence of integers. Each number represents the number of pulses counted within the current sampling interval. If the signal consisted of the sequence of values { 0, 0, 1, 0, 1, 2, 1 }, this amounts to 5 pulses detected. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the pulses were counted.
1	Time of pulse. The signal is received if the device's incremental encoder input is set to "Time of pulse". In this mode, an encoder pulse's exact position in time in the frame of the sampling interval is determined. This involves very precise capture of the pulse. Only this signal type allows such precise sampling in relation to the angle. In this mode it is also important that the measured RPM value be small enough so that there is never more than one encoder pulse per sampling interval. The sampling interval may have to be adjusted to a small enough value for this purpose. RPM_Max must then also be set to a correspondingly low value. Maximum possible RPM [revs/min] = 60 / (encoder pulses * sampling time [s])

2	Sampled rectangle. One of the device's digital inputs is used to sample the time-history of the encoder's digital output. At every transition from zero to nonzero, the encoder is assumed to have turned by one increment. If the signal consisted of the sequence of values { 0, 0, 1, 1, 1, 0, 0, 1, 1, 0 }, this amounts to 2 pulses detected. If an analog voltage is sampled and there is no hardware comparator, the analog voltage data must be converted to a digital data sequence. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. This signal type comes with a certain amount of imprecision, since it doesn't reflect at what time within the sampling interval the edge occurred.
3	Sine signal. One of the device's digital inputs is used to sample the time-history of the encoder's (sinusoid) analog output. Sinusoid or other signals with zero-crossing in a positive slope can be processed. If the signal is noisy, it may need to be smoothed beforehand and then have a Schmitt-Trigger performed. A zero-crossing in a positive slope is interpreted as a pulse from the encoder. If the signal consisted of the sequence of values { -3.0, -1.0, +1.5, +2.8, +1.3, +0.1, -0.6 }, a pulse is detected at the transition from -1.0 to +1.5.

Note Notes on EncoderType

Special features of encoders with missing pulses:

The number of encoder pulses is always specified to include the missing tooth. E.g. for an encoder emitting a pulse every 10 degrees of rotation, which should then have 36 teeth, the number of encoder pulses to specify is then also 36. But the encoder only generates 35 pulses because one is missing. Also typical are encoders generating a pulse every 6 degrees. In this case, 60 teeth are to be specified although 2 are missing and only 58 actually present. The first tooth after the gap is interpreted as the zero-pulse. This marks the start of sampling. Encoders with missing pulses can only be used with the signal type "Time of pulse". Recognizing the missing teeth is only possible if the RPM-value is relatively constant in the region around the gap. Particularly with extremely low RPM-values, this cannot be guaranteed. Since in that case, the gap cannot be clearly recognized, the minimum RPM must be set to a non-zero value. At higher RPM-values, the gap is usually clearly recognizable due to mechanical inertia. The function tries to re-synchronize itself after any error in the pulse sequence (or a presumably incorrectly interpreted pulse sequence). However, incorrect sampled values may occasionally occur.

Note Notes on DelayTime

DelayTime = 0.0 Default ≥ 0.0

A delay refers to when the vibration signal lags behind the RPM-signal because of analog circuitry such as filters and amplifiers. A constant lag in the time signal results in a RPM-dependent delay in the angle signal. This can be compensated. The delay time is assumed to be constant. This isn't true exactly, but as a good approximation. The time lag is not a property of the device, but rather of the measurement chain and must be determined empirically by a control measurement.

Example

The magnitude and phase of the 1.5th order line, plotted over the RPMs, are to be determined from this order line's time-history.

Given: vibration signal vib sampled at a rate of 0.0005 ms and the pulse signal Inc01. The device's incremental encoder input is set on "Time-of-pulse" mode. The encoder has 8 markings along its circumference.

```
OLine = OtrRpmOrder( vib, Inc01, 1, 0, 8, 1000, 6000, 100, 1.5, 30, 6, 0, 0 )
; _STyp = 1        ; Time-of-pulse
; _ETyp = 0
; _EPulse = 8      ; number of markings
; _Min = 1000.0    ; minimum of RPM-range
; _Max = 6000.0    ; maximum of RPM-range
; _Delta = 100.0 ; width of individual RPM-classes
; _om = 1.5        ; the 1.5th order is selected
; _width = 30      ; 30% of total width
; _fo = 6          ; a 6th-order bandpass filter is used
; _Ipl = 0         ; 0 default (no interpolation)
; _Delay = 0       ; no delay

; OLine = OtrRpmOrder( vib, Inc01, _STyp, _ETyp, _EPulse, _Min, _Max, _Delta, _om,
_width, _fo, _Ipl, _Delay )
```

Calculation of maximum order: OrderMax = 1.5 * sqrt(1 + 30 / 100) = 1.7

and thus: OrderMax = 1.7 << 10 / (0.0005 * 6000) = 3.33

OtrRpmOrder

OrderLine: Determines the effective (r.m.s.) value of an order line in relation to the RPMs. The desired RPM range is subdivided in classes of equal width.

RpmOrderLine = OtrRpmOrder(Vibration, RPM, RPM_Min, RPM_Max, RPM_ClassWidth, OrderMiddle, WidthPercent, FilterOrder, Interpolation)

RpmOrderLine: Representation in relationship to RPMs

Vibration: Time history of the vibration signal

RPM: Time history of the RPMs. Scaled in rotations/minute

RPM_Min: Lower end of desired RPM-range

RPM_Max: Upper end of desired RPM-range

RPM_ClassWidth: Bin spacing (class width) of RPM classes

OrderMiddle: The order (line) to be isolated

WidthPercent: Bandpass filter bandwidth in percent, 10% ... 100%

FilterOrder: The filter order of the bandpass filter

Interpolation: Specifies whether the results are interpolated?

0: No interpolation

1: Constant interpolation (centered around auxiliary values)

2: Linear interpolation

The RPM-range always begins with RPM_Min, the resolution is always RPM_ClassWidth. The parameter RPM_Max is only used to specify the number of values in the result. RPM_Min, RPM_Max and RPM_ClassWidth must also be scaled in RPMs.

There should be an adequate number of measurement values in the vibration signal for each RPM-class (of bin spacing RPMClassWidth). Where no values are present, the result for the RPM-class is zero. Only if a nonzero value is selected for the interpolation parameter, the unfilled RPM-classes are filled by means of interpolation of adjacent values. If a form of interpolation is selected, even unfilled classes at the margins are filled by extending the curve at a constant level.

The value range for the parameter WidthPercent is [10 ... 100.0]. For instance, at 30% width, the relationship of upper to lower cutoff frequency of the bandpass is 1.30.

The parameter OrderMiddle is the order (line) in which the medium frequency of the bandpass is located. The internally selected medium frequency of the filter is:

MediumFrequency = OrderMiddle * (Momentary_RPM / 60)

The upper cutoff frequency is located above the medium frequency and is derived from the filter bandwidth.

The function works properly for:

OrderMax << 10 / (SampleTime_Vibration * RPM_Max)

where SampleTime_Vibration is the sampling interval of the signal 'Vibration'.

OrderMax = OrderCenter * sqrt (1 + WidthPercent / 100)

<< which indicates that the order to be specified is substantially smaller.

The RPM's should change only slowly. The RPM's should not fall far below 1% of capacity.

Note that bandpasses need a certain amount of time for transients to subside. This time increases markedly as the filter bandpass bandwidth becomes more narrow. In this context, a bandpass bandwidth of 1% is extremely narrow. A width of 25% corresponds to a third-octave filter, a width of 100% to an octave filter.

During measurement, the results are transferred like a histogram, i.e., regular but infrequent transfer of intermediary results to the PC. Any interpolation specified takes effect only after completion of the measurement.

The function works on a signal which is sampled at intervals of rotational angle and to which a fixed frequency bandpass filter is applied, and from which an r-m-s value is then derived for each RPM-class.

Example

The effective (r.m.s.) value of the 1.5th order line in relationship to the RPMs. The input data are the vibration signal vib with the sampling interval of 0.0005 ms and the RPM signal rpm.

```
_RPM_Min = 1000.0     ; RPM-range minimum
_RPM_Max = 6000.0     ; RPM-range maximum
_RPM_Delta = 100.0    ; width of individual RPM-classes
_om = 1.5             ; the 1.5th order is selected
_width = 30           ; 30% of total width
_fo = 6               ; a 6th order bandpass filter is used
_Interpolation = 0    ; 0 default no interpolation)
OLine = OtrRpmOrder( vib, rpm, _RPM_Min, _RPM_Max, _RPM_Delta, _om, _width, _fo,
_Interpolation )
```

Calculation of maximum order: OrderMax = 1.5 * sqrt(1 + 30 / 100) = 1.7

and thus: OrderMax = 1.7 << 10 / (0.0005 * 6000) = 3.33

OtrRpmPresentation

RPM-based signal representation: The time histories of a vibration signal and of the RPM are evaluated to determine the vibration behavior in reference to the RPMs. The desired RPM-range is subdivided into classes of equal width.

RPMRepresentation = OtrRpmPresentation(Vibration, RPM, RPM_Min, RPM_Max, RPM_ClassWidth, Calculation, Interpolation)

RPMRepresentation: Signal recorded in reference to momentary RPM-value

Vibration: Time history of the vibration signal

RPM: Time history of the RPMs. Scaled in rotations/minute.

RPM_Min: Lower end of desired RPM-range

RPM_Max: Upper end of desired RPM-range

RPM_ClassWidth: Bin spacing (class width) of RPM classes

Calculation: How are the values of an RPM-class represented mathematically?

- 0: Root-mean square (default)
- 1: Arithmetic mean
- 2: Minimum
- 3: Maximum

Interpolation: Is the result interpolated?

- 0: No interpolation
- 1: Constant interpolation
- 2: Linear interpolation

Vibration values corresponding to RPM-values outside of the desired range are ignored (closed outer bins).

The RPM-range always begins with RPM_Min, the resolution is always RPM_ClassWidth.

The parameter RPM_Max is only used to specify the number of values in the result. The results are similar to a histogram in nature, and it is often appropriate to represent them in the form of bar or step graphs.

"Vibration" and "RPM" can either both be in the time domain or in the domain of rotational angle. The RPMs need not be scaled in revs/min. But the RPM-signal, and the parameters RPM_Min, RPM_Max and RPM_ClassWidth must all be scaled to a common y-unit.

There should be an adequate number of measurement values in the vibration signal for each RPM-class (of bin spacing RPMClassWidth). Where no values are present, the result for the RPM-class is zero. Only if a nonzero value is selected for the interpolation parameter, the unfilled RPM-classes are filled by means of interpolation of adjacent values.

If a form of interpolation is selected, even unfilled classes at the margins are filled by extending the curve at a constant level.

During measurement, the results are transferred like a histogram, i.e., regular but infrequent transfer of intermediary results to the PC.

Any interpolation specified takes effect only after completion of the measurement.

Example

The time history of a vibration is to be used to derive a representation of the rms-value of the vibration in reference to the RPMs. Given: vibration signal vib and RPM-signal rpm.

```
rms_rpm = OtrRpmPresentation( vib, rpm, 1000, 6000, 100, 0, 0 )
```

OtrRpmPresentVector

RPM-representation of a spectrum: The time-history of a spectrum and corresponding RPM-signal is determined. The desired RPM-range is divided into bins of equal width.

RPMRepresentation = OtrRpmPresentVector(Spectrum_Sequence, RPM, RPM_Min, RPM_Max, RPM_Bin_Width, Processing)

RPMRepresentation: Representation of the spectrum in reference to the RPMs

Spectrum_Sequence: Time-history of a spectrum

RPM: Time-history of RPM signal

RPM_Min: Lower limit of desired RPM-range

RPM_Max: Upper limit of desired RPM-range

RPM_Bin_Width: Width (interval) of an RPM-class

Processing: How are the values from a single RPM-class processed?

0: Arithmetic mean

1: Maximum

2: Minimum

This function takes a sequence of spectra as its input data. This is the spectrum's time-history, determined, for instance with the function `FFT`. The function also requires the corresponding set of RPM-values. This is the RPM's time-history. There is, then, a corresponding spectrum for each RPM value. Each spectrum-RPM pair is written to the result-matrix. The result-matrix contains a spectrum for each RPM range.

The RPM range always begins at RPM_Min, the resolution is RPM_Bin_Width. The specification for RPM_Max determines the number of values for the result.

If an RPM value is outside of the specified range, the corresponding spectrum is disregarded. (closed outer bins).

There should be enough spectra for each RPM-class (of width RPM_Bin_Width). If there is no spectrum, the result in this RPM-class is zero. During the measurement, the results are transmitted like a histogram, i.e. regular but infrequent transfer of intermediate results to the PC.

Example

Given: a vibration signal channel "Vibration" and a RPM-signal channel "Revolutions". Both have the sampling interval 1ms. The spectrum is computed on the basis of the vibrations. This spectrum is to be represented as a function of the RPMs.

```
Spectra     = fft( Vibration, 0, 1024 )
_Revs       = mean( Revolutions, 1024, 1024 )
Spectrum_N = OtrRpmPresentVector( Spectra, _Revs, 1000, 6000, 100, 0 )
;_Min = 1000 ; Minimum of RPM-range
;_Max = 6000 ; Maximum dof RPM-range
;_Delta = 100  ; bin-width of RPm-classes
;_Calc = 0 ; 0 = Arithmetic mean
; Spectrum_N = OtrRpmPresentVector( Spectra, _Revs, _Min, _Max, _Delta, _Calc )
```

Every 1024 values of the vibration channel, a spectrum is determined. In other words, after 1024 ms a corresponding value for the RPMs is needed. The channel Revs is averaged so as to return one RPM-value per spectrum.

OtrRpmSpectrum

Spectrum: The FFT-spectrum (rms-values!), determined from the time histories of Vibration and RPM in relationship to the RPM's. The desired RPM range is subdivided in classes of equal width.

RPMSpectrum = OtrRpmSpectrum(Vibration, RPM, RPM_Min, RPM_Max, RPM_ClassWidth, WindowWidth, WindowType, AveragingType)

RPMSpectrum: Spectrum in relation to RPM

Vibration: Time history of the vibration signal

RPM: Time history of the RPMs. Scaled in rotations/minute

RPM_Min: Lower end of desired RPM-range

RPM_Max: Upper end of desired RPM-range

RPM_ClassWidth: Bin spacing (class width) of RPM classes

WindowWidth: Width of the time-window in data points, 100 ... 8192

WindowType: Window function for the FFT used

0: Rectangular

1: Hamming

2: Hanning

3: Blackman

4: Blackman / Harris

5: Flat Top

AveragingType: How are the multiple spectrum computations of each RPM-class averaged?

0: Arithmetic mean

1: Maximum

2: Minimum

RPM_Min, RPM_Max and RPM_ClassWidth are scaled to revs/minute just as RPM. The window width need not be a power of 2. Window widths of, say, 500 or 1000 samples also produce "pretty" frequency line distances. The spectral lines are given as rms-values.

The averaging works on the magnitude spectrum. The mean RPM value during a spectrum determines the RPM-class. Therefore, the RPMs should change only slowly.

If no spectrum is computed in a certain RPM class, this spectrum is filled with zeroes. During measurement, the results are transferred like a histogram, i.e., regular but infrequent transmission of intermediary results to the PC. The result is a segmented waveform. Each segment is a spectrum.

Example

From the time-history of a vibration vib and of the RPMs rpm, the spectrum is to be determined in relation to the RPMs.

```
_RPM_Min = 1000.0    ; minimum of RPM range
_RPM_Max = 6000.0    ; maximum of RPM range
_RPM_Delta = 100.0   ; bin spacing of RPM classes
_WindowWidth = 1000  ; width of window for the FFT, in number of measurement values
_WindowType = 3      ; 0 Rectangular, 3 Blackman
_AveragingType = 0   ; 0 (arithmet. mean)
FFTSpectrum = OtrRpmSpectrum( vib, rpm, _RPM_Min, _RPM_Max, _RPM_Delta,
_WindowWidth, _WindowType, _AveragingType )
```

A spectrum is computed which has a frequency line spacing of 2 Hz, a sampling interval of 0.5ms and a window width of 1000 points.

OtrSynthSin

Internal function for imc Online FRAME.

OtrTrackingLowPass

Smoothing: Tracking low-pass filter. A vibration signal is low-pass filtered, and the filter cutoff frequency depends on the RPM-value.

Filtered = OtrTrackingLowPass(Vibration, RPM, Order3dB, FilterOrder)

Filtered: Low-pass filtered signal	**Order3dB**: Order at which the low-pas filter dampens the signal by 3dB
Vibration: Time history of vibration signal	**FilterOrder**: The low-pass filter order
RPM: Time history of RPMs. Scaled in revs/min	

The absolute value for the RPMs is used. The internally set cutoff frequency of the filter is CutoffFrequency = Order3dB * (Current_RPM / 60)

The cutoff frequency must always be substantially less than half the sampling rate of the vibration signal in order for the filtering effect to be achieved.

The function works properly for:

Order3dB << 24 / (SampleTime_Vibration * max (RPM))

where SampleTime_Vibration is the sampling interval of the signal 'Vibration' and max (RPM) is the maximum RPM-value occurring.

<< means that the specifiable order should be substantially smaller.

Conversely, the maximum RPM-value may not be too high. The RPM's should change only slowly. The RPM's should not fall far below 1% of the maximum value.

The upper cutoff frequency of the low-pass filter must always be substantially less than half the sampling rate of the vibration signal. Above about 0.4 times the sampling rate, no filtering can be performed.

Example

A vibration signal vib is is sampled every 0.2 ms. The RPM-signal rpm can get up to 6000 revs/min. Components above the 10th order are to be suppressed.

```
tlp = OtrTrackingLowPass( vib, rpm, 10.0, 6 )
```

A 6th order low-pass filter is used. It dampens by 3dB at the 10th order. It is seen that:

OrderMax = 10.0 << 24 / (0.0002 * 6000) = 20.0

The low-pass filter is configured to dampen the signal by 3dB in the 10th order, in the 22nd order by 40 dB. Below th 8.3th order the amplitude error is already less than 5%.

10.9.2.14 P

Poll

POLL-Operator: A single value is generated from a DIO-bit in the acquisition mode. This single vlaue can be used like a DIO-bit in the input mode.

DIOBitInput = POLL DIOBitAcquisition

The generated single value can also be subjected to computation operations without the trigger having been released. With control commands, for instance, the single value can be subjected to calculations in the segment `OnTimer`.

Example

```
LED_01 = LogNot( POLL DIO_Bit01 )
```

If DIO_Bit01 = 0, the first LED in the device lights up although no triggers were released.

Power1

Computes a single-phase power measurement

Power1(InstPower, P, S, Q, PowerFactor, uRMS, iRMS, Time, u, i)

InstPower: Name of the virtual channel with instantaneous power

P - TruePower: Name of the virtual channel with true power data

S - AppPower: Name of the virtual channel with apparent power data

Q - ReacPower: Name of the virtual channel with reactive power data

PowerFactor: Name of the virtual channel with power factor data

uRMS: Channel with RMS voltage data

iRMS: Channel with RMS current data

Time: Variable containing averaging time in seconds (single value)

u: Channel with voltage data

i: Channel with current data

If a channel (e.g. reactive power in example above) is not needed, then enter 0 for its parameter.

Example

```
Power1( IP, P, S, 0, PF, Urms, Irms, 5, Voltage, Current )
```

Reference

A general description is found in the documentation on imc Online FAMOS:
"*Information and Tips*" > "*Power Measurement* 875".

Power2

Computes a two-phase power measurement

Power2(InstPower, P, S, Q, PowerFactor, uRMS1, iRMS1, uRMS2, iRMS2, Time, u1, i1, u2, i2)

InstPower: Name of the virtual channel with instantaneous power

P - TruePower: Name of the virtual channel with true power data

S - AppPower: Name of the virtual channel with apparent power data

Q - ReacPower: Name of the virtual channel with reactive power data

PowerFactor: Name of the virtual channel with power factor data

uRMS1: Channel with 1st phase RMS voltage data (u1)

iRMS1: Channel with 1st phase RMS current data (i1)

uRMS2: Channel with 2nd phase RMS voltage data (u2)

iRMS2: Channel with 2nd phase RMS current data (i2)

Time: Variable containing averaging time in seconds (single value)

u1: Channel with 1st phase voltage data

i1: Channel with 1st phase current data

u2: Channel with 2nd phase voltage data

i2: Channel with 2nd phase current data

If a channel (e.g. reactive power in example above) is not needed, then enter 0 for its parameter.

Example

```
Power2( IP, P, S, 0, PF, Urms1, Irms1, Urms2, Irms2, 5, Voltage1, Current1,
Voltage2, Current2 )
```

Reference

A general description is found in the documentation on imc Online FAMOS:
"*Information and Tips*" > "*Power Measurement*" 875".

Power3

Computes a three-phase power measurement

Power3(InstPower, P, S, Q, PowerFactor, uRMS1, iRMS1, uRMS2, iRMS2, uRMS3, iRMS3, Time, u1, i1, u2, i2, u3, i3)

InstPower: Name of the virtual channel with instantaneous power

P - TruePower: Name of the virtual channel with true power data

S - AppPower: Name of the virtual channel with apparent power data

Q - ReacPower: Name of the virtual channel with reactive power data

PowerFactor: Name of the virtual channel with power factor data

uRMS1: Channel with 1st phase RMS voltage data (u1)

iRMS1: Channel with 1st phase RMS current data (i1)

uRMS2: Channel with 2nd phase RMS voltage data (u2)

iRMS2: Channel with 2nd phase RMS current data (i2)

uRMS3: Channel with 3nd phase RMS voltage data (u3)

iRMS3: Channel with 3nd phase RMS current data (i3)

Time: Variable containing averaging time in seconds (single value)

u1: Channel with 1st phase voltage data

i1: Channel with 1st phase current data

u2: Channel with 2nd phase voltage data

i2: Channel with 2nd phase current data

u1: Channel with 3nd phase voltage data

i1: Channel with 3nd phase current data

If a channel (e.g. reactive power in example above) is not needed, then enter 0 for its parameter.

Example

```
Power3( IP, P, S, 0, PF, Urms1, Irms1, Urms2, Irms2, Urms3, Irms3, 5, Voltage1,
Current1, Voltage2, Current2, Voltage3, Current3)
```

Reference

A general description is found in the documentation on imc Online FAMOS:
"*Information and Tips*" > "*Power Measurement*" 875".

PulseDuration

A signal's average pulse duration within a window, with resampling.

a = PulseDuration(b, RF)

a: Result	**RF**: Reduction factor; in samples; ≥ 1
b: Input channel	

The function works in a window of RF values and generates a result value after every RF values.

The ratio is the number of samples not equal to zero divided by the number of samples equal to zero, for all complete pulses. A complete pulse is a sequence of three edges, an edge being a transition from zero to a non-zero value or vice versa.

Analog signals should be preprocessed (STri 1010).

If no pulse is completed within a window, the last pulse duration is returned or, if the window size multiplied by the number of pulses windows is greater than the last pulse frequency, the product of window size and the number of windows.

PulseFrequency

A signal's average pulse duration within a window, with reduction.

a = PulseFrequency(b, RF)

a: Result	**RF**: Reduction factor; in samples; ≥ 1
b: Input channel	

The function works in a window of RF values and generates a result value after every RF values.

The average pulse frequency is calculated on the basis of all complete pulses in the window. A 'complete impulse' is defined as a sequence of three edges, where 'edge' denotes a transition from zero to non-zero or vice-versa.

Analog signals should be preprocessed (STri 1010).

If no pulse is completed within a window, the last pulse frequency is returned or, if the sampling rate of the result divided by the number of pulses windows is lesser than the last pulse frequency, the quotient of sampling rate and number of windows.

PulsePhase

The average phase difference between two signals in a window, with resampling.

a = PulsePhase(b, c, RF)

a: Result	**c**: Input channel 2
b: Input channel 1	**RF**: Reduction factor; in samples; ≥ 1

The function works in a window of RF values and generates a result value after every RF values.

The phase difference is calculated on the basis of two corresponding positive slopes, and the difference is stated in seconds. A positive slope denotes a transition from zero to a non-zero value.

Analog signals should be preprocessed (STri 1010).

10.9.2.15 R

RangeMax

Returns the input channel’s **upper measurement range limit**.

a = RangeMax(b)

a: Upper limit of input channel measurement range (single value)	**b**: input channel

Note Balancing

After channel balancing, this function only returns the **correct value**, if "**Prepare**" **was performed**.

Background: Balancing can be performed either during measurement or before a measurement. Afterwards, "Prepare" is not always necessary. In these cases, the measurement range is not determined correctly. Instead, the same measurement rage which had been displayed before the balancing continues to be displayed.

RangeMin

Returns the input channel’s **lower measurement range limit**.

a = RangeMin(b)

a: Lower limit of input channel measurement range (single value)	**b**: input channel

Note Balancing

After channel balancing, this function only returns the **correct value**, if "**Prepare**" **was performed**.

Background: Balancing can be performed either during measurement or before a measurement. Afterwards, "Prepare" is not always necessary. In these cases, the measurement range is not determined correctly. Instead, the same measurement rage which had been displayed before the balancing continues to be displayed.

ReadyForPowerOff

Device ready for deactivation: The device can be turned off now.

Prerequisite:
Only available in: imc Online FAMOS!
Only usable with control commands!
The function `ReadyForPowerOff` may only be called in the control command `OnPowerOff`.

ReadyForPowerOff( )

This function is called in the section `OnPowerOff` which is activated when the device is turned off. The device's internal battery then provides the power for a maximum of 8 s. Within this time, the program can be closed correctly in the section `OnPowerOff`. When the function `ReadyForPowerOff` is called, the device is ready to be turned off. Before the device is really turned off, it may be necessary to conclude other processes, e.g. saving to the hard drive.

Example

```
OnSyncTask( 0.01 ) ; cycle time of 0.01s
    DisplayVar_01 = pv.Channel_001
End

OnPowerOff( 0.01 ) ; cycle time of 0.01s
    DisplayVar_01 = 0
    DOut01_Bit01  = 0
    DOut01_Bit02  = 0
    ReadyForPowerOff()
End
```

RecordEvent

Record event: Records a transition from zero to not zero as an event

RecordEvent(b, "c")

b: Event channel	**c**: Event text

As a result a TimeStampAscii channel (OfaEvents) will be created. The event messages can be displayed with a curve window as table or graphical over time.

There must be at least one source channel for Trigger 48; acquisition continues only as long as the channels for Trigger 48 are are taking measurements.

For each device/imc Inline FAMOS-task, only **one log channel is created**. The function can be called multiple times, and all entries it makes are deposited in this channel.

Example

```
RecordEvent( Greater( Channel_001, 9 ), "High water mark passed" )
```

If the level on Channel_001 exceeds 9, this is recorded as an event.

Note — Modifying the name

Tip: Assign an appropriately distinct name to the channel. The log channel has a default name which cannot be changed by means of the function (e.g. "*OFA_Events*"). To do this, open the OFA/IFA-Editor and there, open "*Properties*" (F5). Here, you can change the log-channel’s name.

RecordText

Return text: The specified text is output.

RecordText ("Text")

Text: Text to output

This function should only be used as a message following certain events, for example when a certain value in the control command Switch is reached. If the function is called repeatedly, the output memory for texts can quickly overflow.

Example

```
OnInitAll
    Value = 1
    StartTimerPeriodic( 5, 0.1, 0.1 )
End

OnTimer( 5 )
    Switch Value
        Case 1
            RecordText( "Value = 1" )
            Value = 2
        End
        Case 2
            RecordText( "Value = 2" )
            Value = 3
        End
        Default
            Value = Value + 1
        End
    End
End
```

In contrast to the `RecordEvent`-function, the `RecordText` function always outputs the text (in the `RecordEvent` function, a transition of the channel parameter from 0 to non-zero is necessary for output of text). Otherwise, the function `RecordText` has the same constraints as the function `RecordEvent`: there must be at least one source channel for Trigger 48, acquisition continues only as long as the channels for Trigger 48 are are taking measurements.

For each device/imc Inline FAMOS-task, only **one log channel is created**. The function can be called multiple times, and all entries it makes are deposited in this channel.

Note Modifying the name

Tip: Assign an appropriately distinct name to the channel. The log channel has a default name which cannot be changed by means of the function (e.g. "*OFA_Events*"). To do this, open the OFA/IFA-Editor and there, open "*Properties*" (F5). Here, you can change the log-channel’s name.

Red

Reduction: reduces the number of values in the input channel

a = Red(b, RF)

a: Result	**RF**: Reduction factor in samples; ≥ 1
b: Input channel	

The function reduces the amount of values by the factor RF. RF must be an integer. To avoid aliasing effects, the input channel should be previously low-pass filtered.

Example

```
Red = Red( FiltLP( Channel_001, 0, 0, 4, 125 ), 4 )
```

A channel sampled at 1 kHz is reduced by a factor of 4. It is previously filtered with a low-pass which has half the resulting sampling frequency, in other words 125 Hz, as its cutoff frequency.

ReplaceFirstValues0

Replaces signal values with the value 0.0: During the phase of signal transients due to filtering at the measurement's start, the initial signal values are replaced with 0.0.

Prerequisite:
Only available in: imc Inline FAMOS!

a = ReplaceFirstValues0(Signal, Count)

a: Result	**Count**: Number of values to replace
Signal: Input channel	

This function is used to suppress the undesired signal fluctuations due to filtering, which occur at the measurement's start. For this purpose, as many initial values are replaced with 0.0 as specified in the parameter Count.

The signal parameter may be either a channel or a single value (e.g. a PV-variable).

In contrast to the function `SkipFirstValues`, the values during the transients' phase are replaced instead of skipped.

Example

```
Signal_Filtered = FiltHP( Signal_01, 1, 0, 4, 100 )
Signal_Corrected = ReplaceFirstValues0( Signal_Filtered, 1000 )
```

A high-pass filter is applied to the sine signal Signal_01 (the sampling rate of Signal_01 is 1 kHz).

When the measurement is started, a signal spike occurs (whose height depends on the phasing).

This signal spike would not occur once the filter's transients had subsided.

The transients are suppressed for the duration of one second.

For this purpose, the first 1000 values of the filtered signal are replaced with the value 0.0.

ReplaceFirstValuesN

Replaces signal values with n-th value: During the filter's transients phase at the measurement's start, the initial signal values are replaced with the n-th value.

Prerequisite:
Only available in: imc Inline FAMOS!

a = ReplaceFirstValuesN(Signal, Count)

a: Result	**Count**: Number of values to replace
Signal: Input channel	

This function is used to suppress the undesired signal fluctuations due to filtering, which occur at the measurement's start. At the start of the measurement, this function does not return any results. After the first n values accumulated, all previous values are retroactively replaced with the n-th value.

Only channels are permitted as the signal parameter.

In contrast to the function `SkipFirstValues`, the values during the transients' phase are replaced instead of skipped.

Example

```
Signal_Filtered = FiltHP( Signal_01, 1, 0, 4, 100 )
Signal_Corrected = ReplaceFirstValuesN( Signal_Filtered, 1000 )
```

A high-pass filter is applied to the sine signal Signal_01 (the sampling rate of Signal_01 is 1 kHz).

When the measurement is started, a signal spike occurs (whose height depends on the phasing).

This signal spike would not occur once the filter's transients had subsided.

The transients are suppressed for the duration of one second.

For this purpose, the first 1000 values of the filtered signal are replaced with the 1000th value.

ReSample

Sampling rate conversion: Re-sampling of vectorized data.

a = ReSample(b, VectorLen)

a: result	**VectorLen**: Length of result vectors
b: Vectorized input channel	

The vectors of a vectorized input channel are modified to a new vector length by means of resampling. The new vector elements are determined by interpolating from the existing vector elements. The curve shape remains unchanged as a result of the resampling

Example

```
FFT513 = FFT( Signal, 0, 1024 )
Res500 = ReSample( FFT513, 500 )
```

Vectorization of a signal with a vector length of 1024, and calculation of the FFT. Subsequent alteration of the result's vector length from 513 to 500 by means of resampling.

Restore

Restore pv.x = 0

With this attribute, the value of a process vector element can be restored in the device automatically if the device is prepared for a measurement.

For instance, a process vector element’s last value can be restored in the device, if the measurement will be restarted, also if the device has to be prepared again.

Reference

For more information see in the documentation on imc Online FAMOS: "*Types of Variables*" > "*Process Vector Variables*" > "*Saving/Restoring pv-Variables*" 355".

Example

```
OnInitAll
    Int Restore pv.x = 0  ; for Integer process vector elements
    Restore pv.y = 0.0    ; for Float process vector elements
End
```

With the syntax `Restore pv.x = 0`, the process vector variable is loaded with the last value upon each start, even if "= 0" seems to imply that the variable is set to 0.

RMS

Root-mean-square value of a window, with reduction

a = RMS(b, WS, RF)

a: Result	**WS**: Window size in samples; **In imc Online FAMOS:** 1 * RF, 2 * RF, ... ,10 * RF **In imc Inline FAMOS:** 1 * RF, 2 * RF, ... ,1000 * RF
b: Input channel	**RF**: Reduction factor in samples; ≥ 1

The RMS-function calculates the RMS-value for the last FG values (window) and generates one result value after every RF values.

For RF > 1, then, there is a reduction of data.

The window size must be an integer multiple (1 to 10/1000) of the reduction factor.

Example

```
eff = RMS( Channel_001, 50, 10 )
```

Returns for every tenth input value the RMS-value of the last 50 input values.

Note

If the window size is not 1*RF, then there aren't enough values available initially. In that case, the available values are taken as the calculation basis.

Rosette1

Rosette calculation: Analysis of strain measurements with rosettes, Eps1 ≥ Eps2.

Rosette1(Eps1, Eps2, Sig1, Sig2, SigV, Phi, Grid_A, Grid_B, Grid_C, Type, Poisson, EModul, AngleR)

Eps1: Result Principal strain ε_1 [µm/m]

Eps2: Result Principal strain ε_2 [µm/m]

Sig1: Result Principal stress σ_1 [N/mm^2]

Sig2: Result Principal stress σ_2 [N/mm^2]

SigV: Result reference stress per Mises, σ_v [N/mm^2]

Phi: Result Grid A angle $\phi_{P,Q}$ [°]

Gitter_A, _B, _C: Channel for Grid A, B, C (ε_a, ε_b, ε_c) with measured strains in µm/m

Type: Rosette type

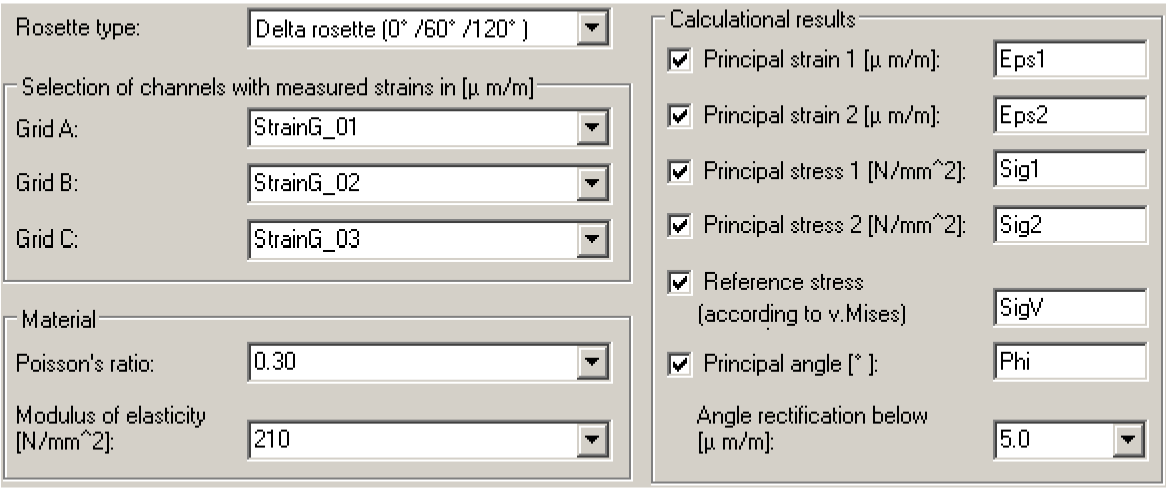
1: Rectangular rosette (0°/45°/90°)

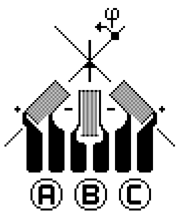
2: Delta rosette (0°/60°/120°)

Poisson: Poisson's ratio υ

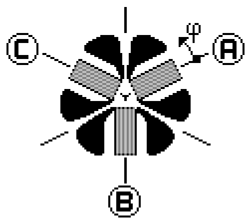
EModul: Modulus of elasticity in GPa υ

AngleR: Angle rectification below, in µm/m





Rosette type 0°/45°/90°



Rosette type 0°/60°/120°

Angle rectification below: For determining the Grid A angle, the arctan of a fraction is found. If both the numerator and denominator of this fraction are very small, small changes of the values could cause large angle changes.

If the sum of the absolute amounts of the numerator and denominator are less than or equal to the specified angle rectification, the angle is internally assigned to the value 0°.

Numbering of the measurement grid: In order to obtain correct values from measurement with 3-element rosettes, the measurement grid must be numbered in a very particular way. The numbering of the measurement grid must proceed as in the illustrations in the Formula Assistant.

Angle measurements in counterclockwise direction are assigned positive sign here, while clockwise measurements get negative sign.

The input channels for Grids A, B and C must be stated in µm/m, the angle rectification must also be stated in µm/m.

The results Eps1 and Eps2 are then also stated in µm/m, the principal stress and the reference stress according to Mises in N/mm^2 and the Grid A angle in ° (degrees).

For the principal strains the relationship Eps1 ≥ Eps2 applies, i.e. Principal strain 1 is the greater of the two principal strains.

If no virtual channel is needed, instead of the channel name, a 0 can be entered.

For parameterization of the Rosette1-function the formula-assistant is recommended.

Example

```
Rosette1( Eps1, Eps2, Sig1, Sig2, SigV, Phi, Grid_A, Grid_B, Grid_C, 1, 0.3, 210,
5.0 )
```

Formulas used	
Principle strain at 45°	$\varepsilon_{1,2} = \frac{\varepsilon_a + \varepsilon_c}{2} \pm \frac{1}{\sqrt{2}}\sqrt{(\varepsilon_a - \varepsilon_b)^2 + (\varepsilon_c - \varepsilon_b)^2}$
Principle strain at 60°	$\varepsilon_{1,2} = \frac{\varepsilon_a + \varepsilon_b + \varepsilon_c}{3} \pm \sqrt{(\frac{2\varepsilon_a - \varepsilon_b - \varepsilon_c}{3})^2 + \frac{1}{3}(\varepsilon_b - \varepsilon_c)^2}$
Principle stress 1	$\sigma_1 = \frac{E}{1 - v^2}(\varepsilon_1 + v\varepsilon_2)$
Principle stress 2	$\sigma_2 = \frac{E}{1 - v^2}(\varepsilon_2 + v\varepsilon_1)$
Reference stress as per Mises	${\sigma_v}^2 = {\sigma_1}^2 + {\sigma_2}^2 - \sigma_1\sigma_2$
Angle grid at 45°	$\phi_{P,Q} = \frac{1}{2}\arctan(\frac{2\varepsilon_b - \varepsilon_a - \varepsilon_c}{\varepsilon_a - \varepsilon_c})$
Angle grid at 60°	$\phi_{P,Q} = \frac{1}{2}\arctan(\frac{\sqrt{3}(\varepsilon_b - \varepsilon_c)}{2\varepsilon_a - \varepsilon_b - \varepsilon_c})$
Angle rectification	(Magnitude(Numerator)+Magnitude(Nominator)) > Angle rectification, the compute; else 0.

Rosette2

Rosette calculation: Analysis of strain measurements with rosettes, |Eps1| ≥ |Eps2|.

Description: see Rosette1 998

Difference: For the principal strains the relationship **|Eps1| ≥ |Eps2|** applies, i.e. the **absolute value** of Principal strain 1 is the greater of the two principal strains.

Round

Rounds the argument to the nearest integer

a = Round(b)

This function returns the **nearest integer** for a real number input.

Example

The function returns

Input channel value	Result value
1,2	1
1,5	2
1,8	2
-1,2	-1
-1,5	-1
-1,8	-2

RSFlipflop

RS flip-flop function

a = RSFlipFlop(R, S)

a: Result	**R**: Reset
	S: Set

Returns a 1 for HIGH (H) state or 0 for LOW (L) state.

A state change from L to H occurs if S is not equal to zero and R is equal to zero.

Likewise, a state change from H to L occurs if S is equal to zero and R is not equal to zero.

Otherwise, the state does not change.

The function may also be called with a single value (e.g. virtual bit or Display-variable) as its first parameter. In order to obtain useful results in such a case, calls of the function should occur at constant time intervals, e.g. in a Timer or a synchronous task.

Example

An LED lights up when the signal exits the range from 0 to 8, and goes off again once the signal is in the range from 0.5 to 6.

```
_R= LogAnd( Less( Channel_001, 6 ), Greater( Channel_001, 0.5 ))
_S=  LogOr( Greater( Channel_001, 8), Less( Channel_001, 0))
LED_01 = RSFlipFlop( _R, _S)
```

RunAutoBalance

Function for calling the automatic balancing for the selected channels.

RunAutoBalance()

The function does not require any parameters.

The channels to be balanced are selected before calling the function.

Activate the property "*Balance at device startup*" (Setup page: "*Channel balance*" or "*Analog channels*") for the desired channels. If you wish, you can also display the parameter of the same name as an additional column by using the "*Column chooser* 254".

Parameter Category: Channel	Description *long name* / *short name* / *column ID*
Balance at device startup	*Balance at device startup* / *Balance at startup* / *eBalanceAtDeviceStart* This parameter has two purposes: • Before a Diskstart/Autostart measurement starts, it is possible to perform **balancing** for selected channels. • The channels selected can be balanced using the **imc Online FAMOS function** `RunAutoBance()` 1001. This balancing operation starts automatically before every Diskstart-measurement. The type of balancing performed is set on the following page: Setup page: "*Channel balance*" > "*Balance* 387". Available options: Taring or bridge balancing (depending on the hardware).

`RunAutoBance()` should not be called at each run of the program. One way to ensure this is by means of a virtual bit.

Example

```
; Executed during a running measurement
OnTriggerMeasure( Trigger_48 )
If Virt_Bit01 = 1
   RunAutoBalance()
   Virt_Bit01 = 0
   End
End
```

RunAutoShuntCalibration

Function for calling the automatic shunt calibration of the selected channels

RunAutoShuntCalibration()

10.9.2.16 S

SamplesGate

Gate for values: The input channel's values are only transferred, if the current value of the control channel is equal to the reference value.

a = SamplesGate(b, c, d)

a: result	**c**: control channel
b: input channel	**d**: reference value

The function sometimes yields output values at irregular intervals. Therefore, the result is generally difficult to combine with other channels in calculations.

Sawtooth

Converts input channel to a saw tooth waveform.

a = SawTooth(b, y0, dy, P)

a: Result	**dy**: Increment
b: Input channel	**P**: Cycle count in samples
y0: Start value	

An input is used to set the sampling rate of the sawtooth.

SendMessage

A message (e.g. "Message_001") is filled and sent with the specified channels.

Prerequisite:
Only available in: imc Online FAMOS!
This function will appear only, if a send message has been defined at the CAN-assistant!

SendMessage_[Message_001](Mode, Parameter, CAN_001, [CAN_002], [...])

Mode: Send cyclically, conditionally or always? 0: Cyclic sending 1: Conditional sending 2: Send always (only for Control commands)	**Parameter**: Depending on Mode: Pulse rate, condition or reserved If mode = 0: Pulse rate in s If mode = 1: Condition If mode = 2: Reserved, 0	**CAN_001**: 1st channel to send [**CAN_002**], [**...**]: If 2 channels, for instance, are defined in the CAN-Assistant

Operation Mode 2 can only be used with control commands.

Configuring a message to transmit is the condition for applying this function (see chapter "*Fieldbusses*" > "*CAN-Bus Interface*" > "*CAN-Bus Assistant*" > ... > "*Sending messages* 552"). In the CAN-Assistant, a formal framework of messages and channels is constructed. The function SendMessage is used to fill this framework and send it. The channels and single values in imc Online FAMOS are sent in the format set in the CAN-Assistant. The SendMessage function can be used, for instance, to assign a virtual channel created in imc Online FAMOS to the channel defined in the CAN-Assistant and send it in the data format defined.

The SendMessage function is automatically set up and listed in the Functions directory tree in response to the CAN-Assistant data. The actual function name SendMessage is extended with a suffix (e.g. `SendMessage_Message_001`).

The first two parameters (Mode and Parameter) are contained in each SendMessage-function. The other channel parameters are dependent on the configuration in the CAN-Assistant: The channels defined in the CAN-Assistant for this message are themselves the additional parameters of the function. If 2 channels, for instance, are defined in the CAN-Assistant, the SendMessage function has 4 parameters.

In cyclical message-sending, one message containing the current channel data is sent periodically at each sending-pulse interval. With conditional sending, exactly one message is sent if the specified condition is fulfilled (the condition is fulfilled by a transition from 0 to non-zero). Conditions must be fulfilled by channels; single values don't count. Other permissible parameters (the data to be sent) are channels and single values.

Example

The following parameter description of the function SendMessage is based on a message with 2 channels.

```
_Co = Greater( Test1, 500 )
SendMessage_Message_001( 1, _Co, Channel_001, Channel_002 )
```

or

```
SendMessage_Message _001( 0, 0.1, Channel_001, Channel_002 )
```

Sin

Sinus: Sine of the input channel

a = Sin(b)

a: Result	**b**: Input channel; in radians

SingleValueChannel

A virtual channel is created from a single value.

Prerequisite:
Only usable with control commands!

VirtualChannel = SingleValueChannel (Trigger, DataRate)

VirtualChannel: Result **Trigger**: Trigger to be assigned to the channel	**DataRate**: Average ... max. number of readings in a second; allowed: 1 ... 10000

The function `SingleValueChannel` is used to declare a virtual channel. The declaration is made as an `OnInitAll` sequence. In the curve window, this virtual channel is also represented as a virtual channel, in imc Online FAMOS or imc Inline FAMOS it is regarded as single value. In `OnTriggerStart`, `OnTriggerMeasure` and `OnTriggerEnd` the single value can be redefined as desired. Every time a value is assigned to the single-value variable, it is written to the virtual channel as a sample. If a value is continuously assigned, the output memory for the virtual channel can overflow.

This virtual channel cannot be retrieved but may only appear on the left side of an assignment statement.

Example 1

Virtual channels can be created with integers or with real numbers.

```
OnInitAll
    VChanReell = SingleValueChannel( Trigger_48, 1000 )
    int VChanInt = SingleValueChannel( Trigger_48, 1000 )
End

OnTriggerMeasure( Trigger_48 )
    If Virt_Bit01 > 0
        VChanReell = 10.5
        Virt_Bit01 = 0
    End
    If Virt_Bit02 > 0
        VChanInt = 10
        Virt_Bit02 = 0
    End
End
```

Example 2

```
OnInitAll
    MinMax = SingleValueChannel( Trigger_48, 1000 )
End

OnTriggerMeasure( Trigger_48 )
    If Channel_001 > 100
        MinMax = 100
    End
    If Channel_001 < 5
        MinMax = 5
    End
End
```

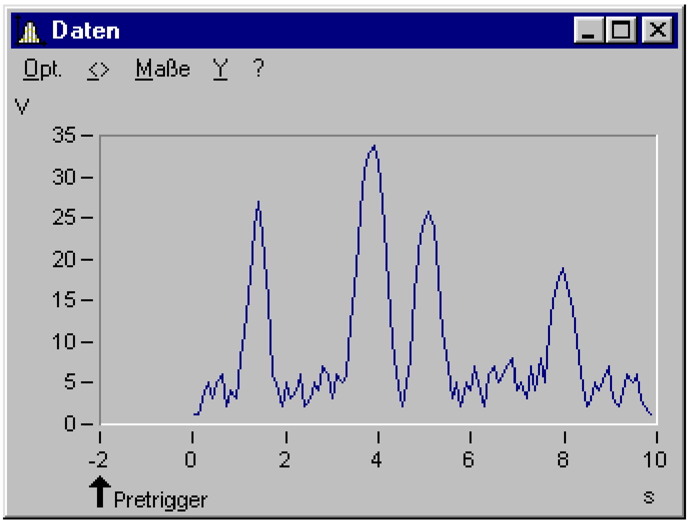
The virtual channel created is filled according to assignments of single values. Whenever an assignment is carried out, this single value is added to the virtual channel as a sample value. Thus it can happen that the virtual channel contains no samples. On the other hand, a large number of samples can accumulate in a short time. The data rate should be dimensioned correspondingly.

The unit and the clock rate (Delta-X) of this virtual channel can be set in the Properties dialog. The X-offset is fixed at 0, pretrigger time is not allowed for.

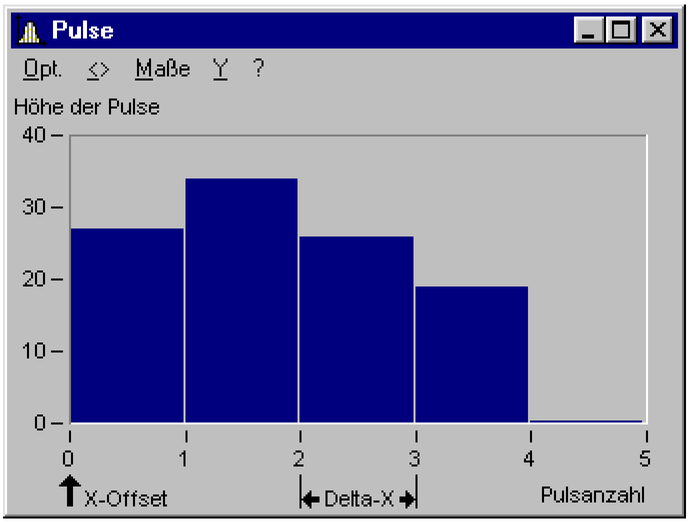
By default, the clock rate is set to 1s and no units are displayed in the curve window.

Example

As an example, voltage data (with a 2 s pretrigger) are displayed below in a curve window.



The voltage channel's big impulses are extracted using the function `SingleValueChannel` (here, there is one value representing each impulse, for a total of 4). The virtual channel "Pulse" is the result.



The x-offset is 0, delta-X in this example is 1.

SkipFirstValues

Skip signal values: During the filter's transients phase at the measurement's start, the initial signal values are skipped.

Prerequisite:
Only available in: imc Inline FAMOS!

a = SkipFirstValues(Signal, Count)

a: Result	**Count**: Number of values to skip
Signal: Input channel	

This function is used to suppress the undesired signal fluctuations due to filtering, which occur at the measurement's start. For this purpose, as many values are skipped as specified in the parameter Count.

The results of the function can only be combined with channels having the same number of values to be skipped.

In contrast to the functions `ReplaceFirstValues0` und `ReplaceFirstValuesN`, the values during the transients' phase are skipped instead of replaced.

Example

```
Signal_Filtered = FiltHP( Signal_01, 1, 0, 4, 100 )
Signal_Corrected = SkipFirstValues( Signal_Filtered, 1000 )
```

A high-pass filter is applied to the sine signal Signal_01 (the sampling rate of Signal_01 is 1 kHz).
When the measurement is started, a signal spike occurs (whose height depends on the phasing).
This signal spike would not occur once the filter's transients had subsided.
The transients are suppressed for the duration of one second.
For this purpose, the first 1000 values of the filtered signal are skipped.

SlopeClip

The maximum slope dy/dx between two adjacent values is clipped

a = SlopeClip(b, Max)

a: Result	**Max**: Maximum slope
b: Input channel	

Smo3

Three-point smoothing: The input channel is smoothed by the weighted average of the three last samples

a = Smo3(b)

a: Result	**b**: Input channel

Smo5

Five-point smoothing: The input channel is smoothed by the weighted average of the five last samples

a = Smo5(b)

a: Result	**b**: Input channel

SoundPressureLevel

Sound pressure level: The function finds the course of the sound pressure level over time.

a = SoundPressureLevel(Signal, FrequencyRating, TimeConstant, ReductionFactor)

a: Result - The signal's sound pressure level **Signal**: signal to be evaluated **FrequencyRating**: signal's frequency rating 0: no rating 1: A-rating 2: B-rating 3: C-rating	**TimeConstant**: Time constant for averaging **In imc Online FAMOS:** ≥ 0.0: Time constant is defined by the user in s e.g. 0.125 for FAST-weighting, 1.0 for SLOW-weighting **In imc Inline FAMOS:** -1: Fast (0.125s) -2: Slow (1s) -3: Pulse -4: Peak -5: RMS in interval -6: RMS from start ≥ 0.0: Time constant is defined by the user in s **ReductionFactor**: Factor for resampling; ≥ 1 For a ReductionFactor = 1, no resampling

The function requires a sound signal expressed in the unit Pa (Pascal). The signal is first frequency rated, e.g. with an A-rating according to DIN IEC 651. Next, time-weighting (moving RMS with exponential averaging) and resampling are performed.

The result is referenced to $20*10^{-6}$ Pa and expressed in dB.

Example

```
SPL = SoundPressureLevel ( Signal, 1, 0.125, 1000 )
```

The signal is subjected to A-rating.

The frequency-weighted signal is then time-weighted with a time constant of 0.125 s (FAST) and resampled with a factor of 1000.

The signal originally has a sampling frequency of 20 kHz; the A-rated result has a sampling frequency of only 20 Hz.

The result SPL is the sound pressure level over time and expressed in dB.

SpecThirds

1/3 octave spectrum in reference to time: From the time-histories of a vibration, the 1/3 octave spectrum referenced to time is determined.

Prerequisite:
Only available in: imc Inline FAMOS!

a = SpecThirds(Vibration, f1, f2, Frequency weighting, Time rating, Output interval)

a: Result - 1/3 octave spectrum referenced to time

Vibration: Time-history of vibration signal, the time scaled in seconds

f1: Center frequency of lowest 1/3 octave in Hz

10, 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80, 100, ...

f2: Center frequency of highest 1/3 octave in Hz

1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000, ...

Frequency weighting: Frequency weighting for the result

0: linear

1: A-weighting

2: B-weighting

3: C-weighting

4: D-weighting

Time rating: Averaging time, time rating of filtered data

-1: Fast (0.125s)

-2: Slow (1s)

-3: Pulse

-4: Peak

-5: RMS in interval

-6: RMS from start

> 0.0: Time constant is defined by the user, given in seconds

Output interval: 1/3 octave spectra are calculated using this time increment (delta-time, dt). Integer multiple of the vibration's sampling time. Specified in seconds.

Remarks:

The two frequency limits f1 and f2 are to be given as the 1/3-octave center frequencies, e.g. f1 = 8 Hz and f2 = 12500 Hz. f1 < f2.The upper 1/3-3-octave with its frequency band must lie entirely within half of the sampling frequency.

The individual 1/3-octave values are stated as root mean square (RMS) values.

While the transients in the individual 1/3-octave (band-pass) filters are subsiding at the start of the measurement, the input signal's values are ignored.The transient time for the 1 kHz 1/3-octave is is assumed to be 20 ms.This time interval is inversely proportional to the 1/3-octave frequency.For very low 1/3-octaves, this time interval becomes considerable.A correspondingly long measurement must then be expected.

During the settling phase the RMS is assumed to be 0.0.The result is a segmented data set. Each segment contains one 1/3-octave spectrum.The x-coordinate of the result counts the 1/3-octave bands (just like the Famos-function OctA).For good representation in the curve window, 1/3-octave labeling should be selected.

The z-coordinate of the result represents time. The first spectrum is taken where time is equal to the output interval.

The 1/3-octave filter and analyses are in accordance with DIN IEC 651 (sound level measurement), DIN 45652 (1/3-octave filter for electro-acoustic measurements) and DIN EN 61260 or IEC 1260 (band-pass filter for octaves and fractions of octaves, filter Class 0).

Time rating "Pulse": For increasing amplitudes the time constant is 35 ms, for decreasing amplitudes 1.5 s.Thus impulse-shaped signals are captured quickly, the response decays slowly.

Time rating "Peak": Extreme response for very short impulses; ensuring capture of the peak value.Time constant is zero during increasing amplitude (can be performed exactly by computer, by analog operation only in approximation);during decreasing amplitude 3 s.

Example

The 1/3-octave spectrum is to be calculated from the time-history of the vibration every 0.1 s.

The signal is sampled every 0.025 ms.

```
fEval = 1 ; 0 (linear) 1 (A-weighting)
f1 = 10
f2 = 12500
tEval = -1 ; -1 (Fast)
tInterval = 0.1 ; [s]
Thirds = SpecThirds( vib, f1, f2, fEval, tEval, tInterval )
```

Sqrt

Square root of argument

a = Sqrt(b)

a: Result	**b**: Input channel

StDev

Standard deviation of a window, with reduction.

a = StDev(b, WS, RF)

a: Result **b**: Input channel	**WS**: Window size in samples; **In imc Online FAMOS:** 1 * RF, 2 * RF, ... ,10 * RF **In imc Inline FAMOS:** 1 * RF, 2 * RF, ... ,1000 * RF **RF**: Reduction factor in samples; ≥ 2

The standard deviation function gives the standard deviation of a window with WS samples for every RF input samples.

The window size specified must be an integer multiple of RF up to 10/1000*RF.

Example

```
erg = StDev( Channel_001, 10, 2 )
```

Returns for every second input sample the standard deviation of the last 10 input samples.

Note

If the windows size is not 1*RF, there are not enough input samples in the beginning. The result is then computed with the available input samples.

STri

Schmitt trigger with upper and lower threshold

a = STri(b, S_upper, S_lower)

a: Result	**S_upper**: Upper threshold
b: Input channel	**S_lower**: Lower threshold

If the previous result was 0, the new result is:

0, if the current value is less than S_upper

otherwise 1

else (if the previous result was 1) the new result is:

1, if the current value is greater than S_lower

otherwise 0

For computing the first value, the previous result is assumed to be 0.

Example

Computes a clean TTL signal

```
res = STri( Channel_001, 4, 1 )*5
```

Sum

Sum of input channel with reduction

a = Sum(b, RF)

a: Result	**RF**: Reduction factor in samples; ≥ 1
b: Input channel	

The summation function reduces the number of values by the factor RF and computes the moving sum of the input values.

Example

Converts the distance increments in a total distance.

```
distance = Sum( Inc_01, 1 )
```

Note

Adding small numbers to proportionally much larger numbers

Observe the limitations of the resolution of numbers in 32-bit Float format.

Sum2

Summation with reset to 0. Finds the sum of all input channel values since the last reset to 0 since the start of the measurement with reduction.

Result = Sum2(InputChannel, Reduction, Reset)

Result: Sum	**Reduction**: Reduction factor
InputChannel: Channels whose values are to be summated.	**Reset**: If unequal to 0, reset sum to 0

The function `Sum2` reduces the number of values by the factor "Reduction". In contrast to the function `Sum`, the function `Sum2` offers the option to reset the accumulated sum to 0 during measurement. Otherwise, the behavior of the two functions is the same.

Example

```
Result = Sum2( Channel_001, 10, VrtBit_01 )
```

The parameter 'Reset' may be either a single value (e.g. virtual bit) or a channel.

If the parameter 'Reset' is a single value, and resetting is executed, the input channel samples accumulating during this processing step are ignored in the summation. Multiple samples in one processing step can accumulate especially in the case of high sampling rates or where there are extensive calculations (e.g. use of FFTs). The summation result is afterwards zero.

If the parameter 'Reset' is a channel and resetting is executed, then any input channel samples accumulating after the reset are captured correctly. Even if there arrive during the same processing step.

SyncOverload

Synchronous task is overloaded: Sets the specified value if the synchronous task is overloaded.

Prerequisite:
Only available in: imc Online FAMOS!
Only usable with control commands!
The function SyncOverload() may only be called in the synchronous task.

Overloaded = SyncOverload(Value)

Overloaded: Result	**Value**: Fixed value to which the result is set

If the synchronous task is overloaded, the result variable is set to the value specified in the function `SyncOverload`. The function can be called at any point in the lowest level of a synchronous task. No combinations with other functions are permitted. The parameter Value must take a fixed value (e.g. 1, 2 or 3).

As results, Display variables, virtual bits, Ethernet bits, digital outputs, process vector elements and vector elements generated with the function `VectorChannel` are all permitted. If the result is a vector element, then if the synchronous task is constantly overloaded, no channels and thus no vectors can be outputted any longer (in the curve window).

If multiple synchronous tasks are going and data overload is detected in one of them, the overload will be indicated for this synchronous task or possibly for a faster synchronous task.

Example

```
OnSyncTask( 0.0001 )
    Virt_Bit01 = SyncOverload( 1 )
    pv.SyncOverloaded = SyncOverload( 10 )
    ...
End

OnSyncTask( 0.001 )
    ...
    DisplayVar_32 = SyncOverload( 20 )
End
```

10.9.2.17 T

Tan

Tangent of input channel

a = Tan(b)

a: Result	**b**: Input channel; in Radians

TextAdd

Join texts. Two texts are conjoined. Text2 is appended to Text1.

Text = TextAdd(Text1, Text2)

Text: Result	**Text1**: Text, to which to append Text2
	Text2: Text, to which Text1 is appended

Instead of the function `TextAdd`, the operator '+' can be used, see example.

Text-functions require large amounts of processing time and therefore should only be used for isolated outputs of text, rather than continually.

Example

```
OnInitAll
    Text1 = "Number"
    Text3 = ""
    IsText = 0
    Number = 1000
End

OnTriggerMeasure ( Trigger_48 )
    ...
    If IsText
        Text3 = Text1 + TextFormatH( Number, 8 )
        RecordText( Text3 )
        ; The text "Number = 0x000003E8" is returned
        IsText = 0
    End
    RecordEvent( Channel_001, "Index = " + TextFormatI( 250 ) )
    ; If the event occurs, the text "Index = 250" is returned
End
```

TextFormatE

Converts a real number to text. A real number is converted to text in floating point notation.

Text = TextFormatE(Number, DecPlace)

Text: Result	**DecPlace**: Number of digits after the decimal
Number: Real number to be converted to text	

The text contains as many significant digits as the parameter supplied to the function.

E.g. with four decimal places, the number 35 is represented as "3.5000E01" and the number 32767 as "3.2770E04".

Text-functions require large amounts of processing time and therefore should only be used for isolated outputs of text, rather than continually.

Example

```
OnInitAll
    Text1 = "Number"
    Text3 = ""
    IsText = 0
    Number = 1000
End

OnTriggerMeasure ( Trigger_48 )
    ...
    If IsText
        Text3 = Text1 + TextFormatE( Number, 6 )
        RecordText( Text3 )
        ; The text "Number = 1.000000E03" is returned
        IsText = 0
    End
    RecordEvent( Channel_001, "Index = " + TextFormatE( 250, 4 ) )
    ; If the event occurs, the text "Index = 2.5000E02" is returned
End
```

TextFormatF

Translates a real number to text. A real number is converted to text with fixed point notation.

Text = TextFormatF(Number, DecPlace)

Text: Result	**DecPlace**: Number of digits after the decimal
Number: Real number to be converted to text	

The text contains as many decimal places as the corresponding parameter function contains.

E.g., with four decimal places, the number 35 is represented as "3.5000" and the number 32767 as "32767.0000".

Text-functions require large amounts of processing time and therefore should only be used for isolated outputs of text, rather than continually.

Example

```
OnInitAll
    Text1 = "Number"
    Text3 = ""
    IsText = 0
    Number = 1000
End

OnTriggerMeasure ( Trigger_48 )
    ...
    If IsText
        Text3 = Text1 + TextFormatF( Number, 6 )
        RecordText( Text3 )
        ; The text "Number = 1.000000" is returned
        IsText = 0
    End
    RecordEvent( Channel_001, "Index = " + TextFormatF( 250, 4 ) )
    ; If the event occurs, the text "Index = 250.0000" is returned
End
```

TextFormatH

Converts a number to text. A number is converted to text with hexadecimal notation.

Text = TextFormatH(Number, Places)

Text: Result	**Places**: Number of decimal places
Number: Number to be converted to text	

The text contains as many digital places as as the parameter supplied to the function.

E.g. with four significant digits, the number 35 is represented as "0023" and the number 32767 as "7FFF".

Text-functions require large amounts of processing time and therefore should only be used for isolated outputs of text, rather than continually.

Example

```
OnInitAll
    Text1 = "Number"
    Text3 = ""
    IsText = 0
    Number = 1000
End

OnTriggerMeasure ( Trigger_48 )
    ...
    If IsText
        Text3 = Text1 + TextFormatH( Number, 8 )
        RecordText( Text3 )
        ; The text "Number = 0x000003E8" is returned
        IsText = 0
    End
    RecordEvent( Channel_001, "Index = " + TextFormatH( 250, 4 ) )
    ; If the event occurs, the text "Index = 0x00FA" is returned
End
```

TextFormatI

Converts a number to text in integer notation.

Text = TextFormatI(Number)

Text: Result	**Number**: Number to be converted to text

The text only contains as many digits as needed to represent the integer.

E.g. the number 35 appears as "35" and the number 32767 as "32767".

Text-functions require large amounts of processing time and therefore should only be used for isolated outputs of text, rather than continually.

Example

```
OnInitAll
    Text1 = "Number"
    Text3 = ""
    IsText = 0
    Number = 1000
End

OnTriggerMeasure ( Trigger_48 )
    ...
    If IsText
        Text3 = Text1 + TextFormatI( Number )
        RecordText( Text3 )
        ; The text "Number = 1000" is returned
        IsText = 0
    End
    RecordEvent( Channel_001, "Index = " + TextFormatI( 250 ) )
    ; If the event occurs, the text "Index = 250" is returned
End
```

Tolerance

Function that returns logical value of whether each input channel value is within the given tolerance.

a = Tolerance(b, min, max)

a: Result	**min**: Minimum
b: Input (channel or single values)	**max**: Maximum

Example

```
Res1 = Tolerance( Signal_01, pv.Min1, pv.Max1 )
Res2 = Tolerance( Signal_02, 2.5, 6.5 )
```

For example, Res2 takes the value 1 if Signal_02 is 4.1.

For example, Res2 takes the value 0, if Signal_02 is 2.1.

TransRec

Transitional Recording: Data reduction for analog data

a = TransRec(b, Precision)

a: result	**Precision**: Precision in units of the argument
b: input channel	

To perform long-term measurements at high resolution, a special computational algorithm has been designed. The principle on which it operates is to only save such data (data points) which are necessary for reconstructing the original signal at a given level of precision.

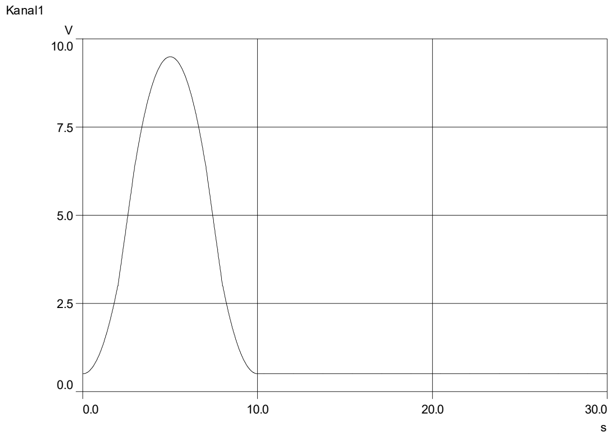
This means that rapid signal movements are sampled at a high sampling rate. However slow-paced signal movements are sampled at as few points as will still allow the signal to be reconstructed.

Whether a measured value is saved depends on the signal and on the tolerance threshold set. Data are only saved if the measured signal can not be represented by a substitute curve within the tolerance demanded. The data-reduced channel never deviates from the input signal by more that the amplitude difference demanded.

Data reduction factors of up to 254 can be achieved by means of this procedure.

Example 1

The following input signal, consisting over a period of 10s of a long period of constancy and then a peak at 9.5V, is to be measured.

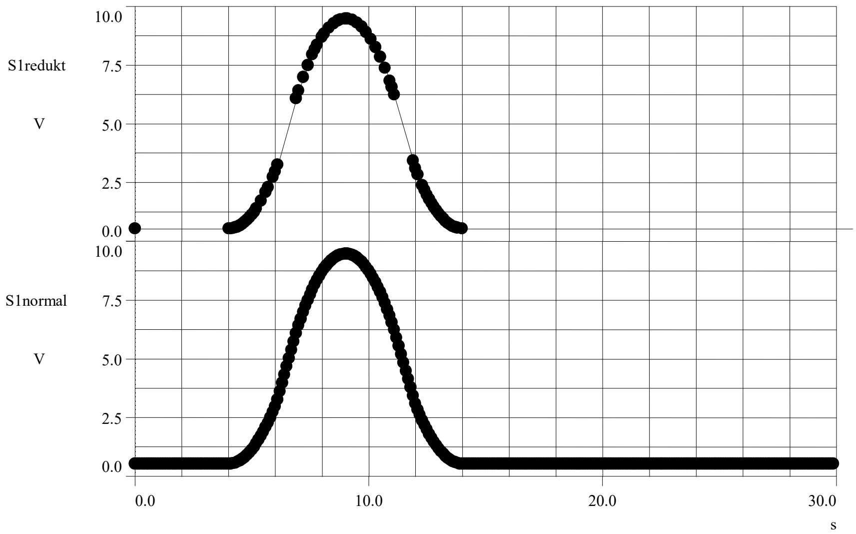


In this example, the signal is recorded once with and once without `TransRec` and saved.

As tolerance threshold set for the data reduction is 10mV.

S1reduct is measured with data reduction

S1normal is measured without data reduction



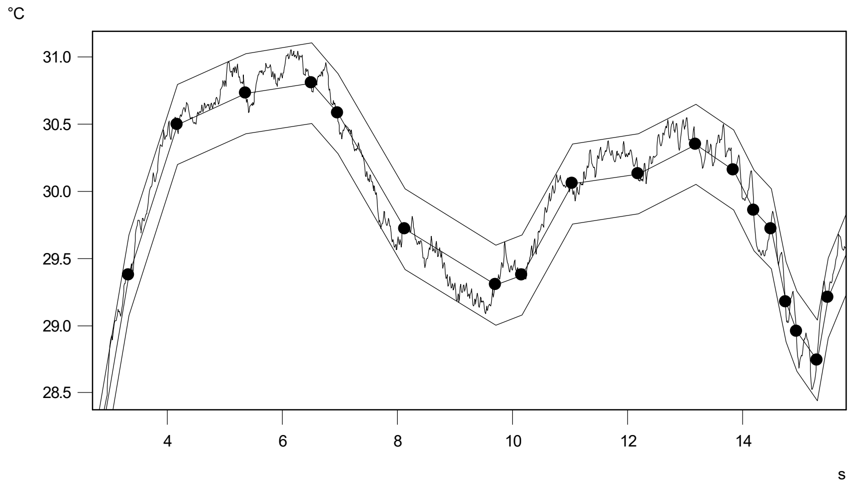
The curves are displayed on top of each other. The filled circles represent sample values, the lines between them are interpolations

The data reduction only adds measured points wherever the curve features significant curvature. Straight-line signal plots of any slope are recognized and summarized as a straight line between two measured points.

Example 2

In the illustration below, the results from a temperature measurement are shown. The original data (zigzag line) was recorded with a tolerance of 0.3°C. The reduced data are shown using solid circles, joined by straight lines.

To demonstrate the effectiveness of the algorithm, a tolerance band of ±3°C has been parallel to the interpolated line. As you can see, the original signal never exceeds the tolerance bounds.



The filled circles are derived by Transitional Recording.
The original signal never leaves the tolerance band.

For what sort of signals is Transitional Recording used?

Signals which feature movement only rarely or at constant slope, but in which major changes need to be sampled at a high rate. If a certain amount of imprecision (e.g. 1% of the input range) is acceptable, then this procedure is especially effective. Since temperature measurement often meets these criteria, the use of this procedure is very useful for this case.

`TransRec` is particularly suited to long-term measurements which would probably result in data overload in the absence of data reduction.

Precision

If you have defined a scaling for the reduced channel, then the precision should be selected accordingly.

Example

Scaling factor: 0.03 A/V

Input range: 0.3 A

Precision: 10 mA

Setting to make: 0.01

The unit of your signal is "A", so the tolerance (precision) is also specified in "A". 10 mA takes the notation 0.01 A, but the unit "A" must not be stated in the function.

Post calculations

The calculation results of the function TransRec can not be subject to further calculation in imc Online FAMOS or imc Inline FAMOS. Therefore it is best to first have all other calculations with data from a virtual channel performed and have TransRec executed last.

Example

```
_Difference_tmp = Channel_001 - Channel_002
Difference = TransRec (_Difference_tmp, 0.1)
```

In this example, the difference between two channels is first calculated.

The underline at the beginning indicates that the signal "_Difference_tmp" is not to be used as a virtual channel. Only after performing data reduction, we obtain the virtual channel with its correct name "Difference".

Maximum Reduction

The TransRec function produces resulting data sets with reduction factors between 1 and 254. Even with a constant signal, every 254th data point is recorded, thereby limiting the maximum reduction factor to 254.

Digital channels

The function TransRec can be applied to digital signals. However, this is not recommended.

Wherever possible, use the pre-processing for digital signals: **Reduction**. This option is available in the Setup dialog: **Sampling & Preprocessing**.

File format / Data type

The result of the TransRec-function takes the data type: **XY-waveform**. Like the other data types, it can be processed by other imc software packages (e.g. imc FAMOS).

Limitations

Buffer memory size in the device is limited to 128 kBytes. This means that the maximum buffer duration may be somewhat limited, depending on the sampling rate. However, if the technique is used properly and a significant reduction factor is achieved, that will not matter any more.

Note

Storage of measurement data always automatically generates sets of 64 samples. Therefore, when a measurement (or file) is closed after a fixed space of time, it usually happens that data points from before or after the fixed time interval are also saved in the file. If there is no data value which would normally be saved at the moment that the file is to be closed, the file is closed anyway. This means that the last data point in a file may be from a point in time significantly preceding the stopping time specified.

10.9.2.18 U

UnEqual

Checks whether the first argument is not equal to the second argument

a = UnEqual(b, c)

a: Result	**b**: 1. argument
	c: 2. argument

a = 1 if b is not equal to c, otherwise 0.

Upper

Returns the greater value of the arguments

a = Upper(b, c)

a: Result	**b**: 1. argument
	c: 2. argument

Example

```
sound = Upper( dB( Channel_001 ), -100 )
```

The input channel is converted into decibel and restricted to a lower border of -100 dB.

10.9.2.19 V

General information about the VectorChannel functions

Prerequisite:
Only usable with control commands!

A virtual channel is declared with the function `VectorChannel`. All elements are initialized as zero. Declaration is performed in the OnInitAll-Block. In the curve window, this virtual channel is also represented as a virtual channel, but in imc Online FAMOS or imc Inline FAMOS it's treated as a static vector. The vector elements can be assigned and queried like single values.

Whenever the function `VectorChannelSet` is called, the complete vector is transferred to the virtual channel. The function `VectorChannelSet` can be called in `OnTriggerStart`, `OnTriggerMeasure` and `OnTriggerEnd` as well as in blocks which don't depend on triggers, e.g. in `OnSyncTask`. If the function `VectorChannelSet` is called too quickly and too often in succession, the memory allocation for the virtual channel can overflow.

Virtual channels can be generated from vectors with numbers and from vectors with real numbers (see example).

From version imc STUDIO 5.0 vector-handling has been enhanced with local vectors. Now, functions with 2 results vectors are supported, e.g. `FFTAmplitudePhase`(AmlSpec_Local, PhasSpec_Local, ...), where AmlSpec_Local and PhasSpec_Local must be declared as local vectors in the `OnInitAll`-block.

Example

Example, generating virtual channels from vectors

```
OnInitAll
    int v1 = VectorChannel( Trigger_48, 1000, 3 ) ; vector with integers
    ; v1[1] = 0, v1[2] = 0, v1[3] = 0  happens automatically
    v1[3] = 2

    v2 = VectorChannel( Trigger_48, 1000, 3 ) ; vector with real numbers
    ; v2[1] = 0, v2[2] = 0, v2[3] = 0  happens automatically
    v2[3] = 2.5
End

OnSyncTask( 0.5 )
    v1[1] = v1[1] + 1
    v1[2] = VirtualBit_01
    v1[3] = 1
    VectorChannelSet( v1 ) ; the vector is transferred to the virtual channel

    v2[1] = v2[1] + 1
    v2[2] = VirtualBit_01
    v2[3] = 1.5
    VectorChannelSet( v2 ) ; the vector is transferred to the virtual channel
End
```

VectorChannel

Virtual channel from vector: A segmented virtual channel is generated from a vector.

Prerequisite:
Only usable with control commands!

VirtualChannel = VectorChannel(Trigger, DataRate, ElementCount)

VirtualChannel: Result **Trigger**: Trigger to which the channel is to be assigned.	**DataRate**: Average... max. count of vectors in a second; Allowed: 1 ... 10000 **ElementCount**: Number of elements in the vector; Allowed: 1 ... 100000

A virtual channel is declared with the function `VectorChannel`. All elements are initialized as zero. The declaration is performed in the `OnInitAll`-Block. In the curve window, this virtual channel is also represented as a virtual channel, but in imc Online FAMOS it's treated as a static vector. The vector elements can be assigned and queried like single values.

Whenever the function `VectorChannelSet` 1025 is called, the complete vector is transferred to the virtual channel. The function `VectorChannelSet` can be called in `OnTriggerStart`, `OnTriggerMeasure` and `OnTriggerEnd` as well as in blocks which don't depend on triggers, e.g. in `OnSyncTask`. If the function `VectorChannelSet` is called too quickly and too often in succession, the memory allocation for the virtual channel can overflow.

Virtual channels can be generated from vectors with numbers and from vectors with real numbers (see example).

Example 1

```
; Generating a virtual channel from a vector with integers:
OnInitAll
   int v1 = VectorChannel( Trigger_48, 1000, 3 )
   ; v2[1] = 0, v2[2] = 0, v2[3] = 0  performed automatically
   v1[3] = 2
End

OnSyncTask( 0.5 )
   v1[1] = v1[1] + 1
   v1[2] = Virt_Bit01
   v1[3] = 1
   VectorChannelSet( v1 )
End
```

Example 2

```
; Generating a virtual channel from a vector with real numbers:
OnInitAll
   v2 = VectorChannel( Trigger_48, 1000, 3 )
   ; v2[1] = 0, v2[2] = 0, v2[3] = 0  performed automatically
   v2[3] = 2.5
End

OnSyncTask( 0.1 )
   v2[1] = v2[1] + 1
   v2[2] = Virt_Bit02
   v2[3] = 1.5
   VectorChannelSet( v2 )
End
```

VectorChannelSet

Writing a vector: A vector is written to a segmented virtual channel.

Prerequisite:
Only usable with control commands!

VectorChannelSet(Vector)

Vector: A segmented virtual channel generated with the function `VectorChannel`

VectorFromFile

Read vector from file

Vector = VectorFromFile("Filename")

Vector: Resulting vector	**"Filename"**: Name of a file containing the vector elements

Load the file

In imc STUDIO, the file of the vector data is permanently integrated in the experiment. Import this file using the ribbon.

Ribbon	View
Setup-Configuration > Supplemental Files	Complete

Notes

- The vector data is limited to 50000 values.
- Data formats (Float, Integer, Bool) can under certain circumstances be converted by imc Online FAMOS during loading. See also the notes on Boolean variables in IF conditions. 867

Example

```
Vector = VectorFromFile( "Vector_01.DAT" )
```

VectorizeAndSkip

Create vector series: groups input samples into a series of vectors

Vector = VectorizeAndSkip(b, VLength, SkipLength)

Vector: Output vector series	**VLength**: Number of samples per vector; > 1
b: Input channel	**SkipLength**: Number of samples to be skipped; ≥ 0

The input samples are grouped into a series of vectors.

A fixed number of samples can be skipped between successive vectors.

VectorizeOverlapped

Creates an overlapping sequence of vectors from the input channel

Vector = VectorizeOverlapped(b, VLength, Increment)

Vector: Result vector sequence	**VLength**: Length of a vector; > 1
b: input channel	**Increment**: Distance to the next vector; ≥ 1, ≤ VLength

The input channel is converted to a vector sequence.

The vectors can overlap each other, i.e. values from the input channel are entered multiple times in the vector sequence.

After every 'Increment' (e.g. 100) input channel values the subsequent 'Vlength' (e.g. 1024) input channel values are converted to a vector.

At a sampling rate of 1kHz, a vector of the length 1024 is created from these samples every 100ms.

Example

The vector a returns a vector with 1024 values for every 100 input values.

This results in an overlap ratio of (1024-100) / 1024 * 100% = 90.23%.

```
a = VectorizeOverlapped( Channel_001, 1024, 100 )
b = FFT( a, 0, 1024 )
```

VectorStatic

Creates a static vector. A static vector whose elements can be changed during the measurement is created.

Prerequisite:
Only usable with control commands!

VectStat = VectorStatic(Trigger, Element Count)

VectStat: Result **Trigger**: Trigger to which the vector is to be assigned	**Element count**: Number of the vector's elements; Allowed: 1 ... 100000

A static vector is declared using the function `VectorStatic`. All elements are initialized at "0". The declaration is made in the `OnInitAll` block.

The vector elements are treated as single values. Whenever an assignment is made to a vector element, the vector element's current value is transferred to the result vector. Assignments to vector elements can be called in `OnTriggerStart`, `OnTriggerMeasure` and `OnTriggerEnd` as well as in the blocks which do not depend on triggers, such as `OnTimer` or `OnSyncTask`.

Static vectors can be generated with integers and with real numbers (see examples).

Example

```
OnInitAll
    int vs1 = VectorStatic( Trigger_48, 3 ) ; vector with integers
    ; vs1[1] = 0, vs1[2] = 0, vs1[3] = 0  performed automatically

    vs2 = VectorStatic( Trigger_48, 3 ) ; vector with real numbers
    ; vs2[1] = 0.0, vs2[2] = 0.0, vs2[3] = 0.0  performed automatically
End

OnSyncTask( 0.5 )
    If Virt_Bit01 > 0
        vs1[1] = 4
        vs1[2] = 5
        vs1[3] = 6
    Else
        vs1[1] = 1
        vs1[2] = 1
        vs1[3] = 2
    End

    vs2[1] = pv.Channel_001
    vs2[2] = pv.Channel_002
    vs2[3] = pv.Channel_003
End
```

Access to vectors via variables

It is possible to access the elements of the vector with the help of variable. Thus, different values can be read according to the variable's value.

Example

In the following example, the value is **written** to the vector by means of the "pointer"-variable: "DisplayVar_01":

```
; writing to a vector at a variable position
Vektor[DisplayVar_01] = DisplayVar_02+10
```

In the following example, the value is **read** from the vector by means of the "pointer"-variable: "DisplayVar_01":

```
; reading from the vector at a variable position
DisplayVar_03 = Vector[DisplayVar_01]
```

Note

Notes on assignment

The first element is addressed with the value "1". The second with "2", etc.

Size of vector

The maximum number of values is limited to 100 000 values.

VibrationFilter

Vibration-weighting: A signal is filtered according to the frequency weighting set. Additionally, retroactive time weighting (moving RMS-value with exponential averaging) and resampling can be performed.

VibSignal = VibrationFilter(Signal, FrequencyWeighting, TimeConstant, ReductionFactor)

VibSignal: Filtered signal **Signal**: Input signal to be weighted; the time scaled in seconds. **FrequencyWeighting**: Frequency weighting for the signal	**TimeConstant**: Time constant for the exponential RMS-calculation in seconds, ≥ 0. e.g. 0.125 with FAST-weighting 1.0 with SLOW-weighting	**Reduction** factor: Factor for resampling, ≥ 1. With ReductionFactor = 1, no resampling. This enables the data volume of the result to be conveniently reduced when the time constant is large.

For a time constant = 0, no subsequent time weighting is performed. The reduction factor must in this case be exactly 1.

For numerical reasons, there are constraints on the input signals' sampling intervals which depend on the frequency weighting (see above).

Frequency weighting for the signal

per ISO 2631-1, 2nd edition, 1997:	
10	Wk, z direction and for vertical recumbent direction, except head. Recommended signal's sample time: ≥ 0.5ms and ≤ 5ms or ≥ 200Hz and ≤ 2kHz
11	Wd, x and y directions and for horizontal recumbent direction. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
12	Wf, motion sickness. Recommended signal's sample time: ≥ 5ms and ≤ 500ms or ≥ 2Hz and ≤ 200Hz
13	Wc, seat-back measurement. Recommended signal's sample time: ≥ 0.5ms and ≤ 10ms or ≥ 100Hz and ≤ 2kHz
14	We, measurement of rotational vibration. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
15	Wj, vibration under the head of a recumbent person. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz

per DIN 45671 Part 1, Sept. 1990:	
16	Hx, Whole-body vibrations, standing, seated position, measurement direction: x, y, Recumbent position, measurement direction: y, z. Recommended signal's sample time: ≥ 0.2ms and ≤ 50ms or ≥ 20Hz and ≤ 5kHz
17	Hz, Whole-body vibrations, standing, seated position, measurement direction: z Recommended signal's sample time: ≥ 0.5ms and ≤ 10ms or ≥ 100Hz and ≤ 2kHz
18	Hxl, Whole-body vibrations, recumbent position, measurement direction: x Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
19	Hb, Whole-body vibrations, body position not specified Recommended signal's sample time: ≥ 0.5ms and ≤ 10ms or ≥ 100Hz and ≤ 2kHz
20	Hh, Hand transmitted vibration, for all measurement directions Recommended signal's sample time: ≥ 0.02ms and ≤ 2ms or ≥ 500Hz and ≤ 50kHz

per ISO 7505, 1st edition, 1986-05-01:	
20	hand transmitted vibration, weighting filter. Recommended signal's sample time: ≥ 0.02ms and ≤ 2ms or ≥ 500Hz and ≤ 50kHz

per ISO 2631-1, 1st edition, 1985:	
21	Weighting factors for transverse (x, y) vibrations, see table 3. Recommended signal's sample time: ≥ 0.5ms and ≤ 100ms or ≥ 10Hz and ≤ 2kHz
22	Weighting factors for longitudinal (z) vibrations, see table 3. Recommended signal's sample time: ≥ 0.5ms and ≤ 50ms or ≥ 20Hz and ≤ 2kHz

per ISO 2631-4, 2001:	
23	Wb, passenger and crew comfort in fixed-guideway transport systems. Recommended signal's sample time: ≥ 0.5ms and ≤ 5ms or ≥ 200Hz and ≤ 2kHz

per ISO 2631-2, 2003:	
24	Wm, human exposure to vibration in buildings. Recommended signal's sample time: ≥ 0.2ms and ≤ 5ms or ≥ 200Hz and ≤ 5kHz

per ISO 6954, 2000:	
25	Acceleration input. Recommended signal's sample time: ≥ 0.2ms and ≤ 5ms or ≥ 200Hz and ≤ 5kHz
26	Velocity input. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz

per ISO 5349-1, 2001:	
27	Hand transmitted vibration, weighting filter. Recommended signal's sample time: ≥ 0.02ms and ≤ 2ms or ≥ 500Hz and ≤ 50kHz

per ISO 8041, 2005:	
28	Wb, passenger and crew comfort in fixed-guideway transport systems. Recommended signal's sample time: ≥ 0.5ms and ≤ 5ms or ≥ 200Hz and ≤ 2kHz
29	Wc, seat-back measurement. Recommended signal's sample time: ≥ 0.5ms and ≤ 10ms or ≥ 100Hz and ≤ 2kHz
30	Wd, x and y directions and for horizontal recumbent direction. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
31	We, measurement of rotational vibration. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
32	Wf, whole body low-frequency vibrations, motion sickness. Recommended signal's sample time: ≥ 5ms and ≤ 500ms or ≥ 2Hz and ≤ 200Hz
33	Wh, hand transmitted vibration. Recommended signal's sample time: ≥ 0.02ms and ≤ 2ms or ≥ 500Hz and ≤ 50kHz
34	Wj, vibration under the head of a recumbent person. Recommended signal's sample time: ≥ 0.5ms and ≤ 2ms or ≥ 500Hz and ≤ 2kHz
35	Wk, z direction and for vertical recumbent direction, except head. Recommended signal's sample time: ≥ 0.5ms and ≤ 5ms or ≥ 200Hz and ≤ 2kHz
36	Wm, human exposure to vibration in buildings. Recommended signal's sample time: ≥ 0.2ms and ≤ 5ms or ≥ 200Hz and ≤ 5kHz

Example

```
SignalVib = VibrationFilter( Signal, 10, 0.125, 1000 )
```

Wk Weighting per ISO 2631-1

The signal is subjected to vibration weighting. The frequency-weighted signal is then time-weighted at a time constant of 0.125 s (FAST) and resampled with a factor of 1000.

The signal originally has a sampling frequency of 20 kHz, the vibration-weighted result has a sampling frequency of only 20 Hz.

VIsAnyGreater

Return value is 1 if a vector element of b is larger than the corresponding element in c. Otherwise, the return value is 0.

a = VIsAnyGreater(b, c)

a: Return value	**b**: Input vector series **c**: Input vector series

Example

```
_tmpV1 = VectorizeAndSkip( Channel_001, 512, 0 )
_tmpV2 = VectorizeAndSkip( Channel_002, 512, 0 )
a = VIsAnyGreater(_tmpV1, _tmpV2 )
```

a: 1 when a sample of Channel_001 larger than Channel_002

VMax

Maximum from vector: returns the maximum value from each input vector

a = VMax(b)

a: Output value	**b**: Input vector series

VMaxV

Maximum from vector series: maximum values from a reduced vector series

a = VMaxV(b, WindowOption, RF)

a: Output vector series **b**: Input vector series	**WindowOption**: Compute maximum vector from 1: RF input vectors 2: All current input vectors	**RF**: Reduction factor (RF) in vectors; ≥ 1

For each element of the vector, the maximum value of the element for a vector sequence is determined. The result is another vector and over time a vector sequence.

For a window option of 1, the maxima over RF vectors are found and one output vector is generated after each RF input vectors.

For a window option of 2, the maxima of all previous input vectors are found. After every RF input vectors, one result vector is found.

VMean

Mean from vector: returns the mean value from each input vector

a = VMean(b)

a: Output value	**b**: Input vector series

VMeanV

Mean from vector series: mean values from a reduced vector series

a = VMeanV(b, WindowOption, RF)

a: Output vector series **b**: Input vector series	**WindowOption**: Compute mean vector from 1: RF input vectors 2: All current input vectors	**RF**: Reduction factor (RF) in vectors; ≥ 1

For each element of the vector, the mean value of the element for a vector sequence is determined. The result is another vector and over time a vector sequence.

For a window option of 1, the means over RF vectors are found and one output vector is generated after each RF input vectors.

For a window option of 2, the means of all previous input vectors are found. After every RF input vectors, one result vector is found.

VMin

Minimum from vector: returns the minimum value from each input vector

a = VMin(b)

a: Output value	**b**: Input vector series

VMinV

Minimum from vector series: minimum values from a reduced vector series

a = VMinV(b, WindowOption, RF)

a: Output vector series **b**: Input vector series	**WindowOption**: Compute minimum vector from 1: RF input vectors 2: All current input vectors	**RF**: Reduction factor (RF) in vectors; ≥ 1

For each element of the vector, the minimum value of the element for a vector sequence is determined. The result is another vector and over time a vector sequence.

For a window option of 1, the minima over RF vectors are found and one output vector is generated after each RF input vectors.

For a window option of 2, the minima of all previous input vectors are found. After every RF input vectors, one result vector is found

VRedV

Reduction from vector series: reduces a vector series

a = VRedV(b, RF)

a: Output vector series **b**: Input vector series	**RF**: Reduction factor as vectors; ≥ 1

Every RF input vectors are reduced to a single output vector.

VRMS

RMS from vector: returns the RMS value of each input vector

a = VRMS(b)

a: Output value	**b**: Input vector series

VSum

Sum from vector: returns the sum of the elements in each input vector

a = VSum(b)

a: Output value	**b**: Input vector series

VValueAtXValue

Y-value at x-value: returns the y-value for a specified x-value

a = VValueAtXValue(b, XValue)

a: output value	**XValue**: X-value
b: Input vector series	range: x-offset up to delta-x * vector_length - x-offset

Example

```
frqPos = VXValueOfMax( SPEK_PosA ) ; frqPos = Display-Variable
phaPos = VValueAtXValue( SPEK_PosP, frqPos )
```

VXValueOfMax

X-value of maximum: returns x-value of the maximum element in a vector

a = VXValueOfMax(b)

a: Output value	**b**: Input vector series

VXValueOfMin

X-value of minimum: returns x-value of the minimum element in a vector

a = VXValueOfMin(b)

a: Output value	**b**: Input vector series

VXValueWithYValue

X-value with y-value: Returns x-value for a specified y-value

a = VXValueWithYValue(b, YValue, ErrorValue)

a: Output value	**YValue**: Y-value to find
b: Input vector series	**ErrorValue**: Error value to return if y-value not found

10.9.2.20 W

WindRoseCorr

To Values less than zero 360 is added and from values greater than 360, 360 is subtracted.

a = WindRoseCorr(b)

a: result	**b**: argument

The function NorthCorrection 961 corrects the discontinuity at due North according to the addition method. It prevents skipping from 360° to 0° in the averaging interval.

For values fluctuating around 360°, an average of 180° is avoided.

The result of averaging could lie outside of the wind rose range 0°..360°, e.g 365°.

The function WindRoseCorr returns the result to the wind rose range (0°..360°), e.g. changes 365° to 5°.

This procedure is conditional on the wind direction not changing more than 100 degrees.

The only sensible way to use the functions NorthCorrection 961 and WindRoseCorr is in a combination as illustrated in the example below. Instead of averaging, the standard deviation, i.e. the function StDev 1009, can be used.

Example

```
NC = NorthCorrection( Channel, 10 )
NC_Mean = Mean( NC, 10, 10 )
Result = WindRoseCorr( NC_Mean )
```

10.9.3 Functions with Control Commands

Prerequisite:
Only usable with control commands!

Function Groups	Operators and Symbols	Additional functions
Measurement Process States 1035	(=) Equal Operator (Comparison) 889	AND 897
Loops, Conditions 1042	(<>) Inequality operator 890	CloseSaveInterval 905
Timer Functions 1046	(<) Less than operator 890	CurrentValue 914
CanMsg 1049	(<=) Less than or equal operator 890	DelayBuffer* 915
Controller Functions 1053	(>) Greater than operator 891	ECU* 924
	(>=) Greater than or equal operator 891	GetDateTime 934
		NOT 961
		OnECUCmdReturn_ECU_* 925
		OR 963
		ReadyForPowerOff 993
		SyncOverload 1012
		VectorChannel 1024
		VectorChannelSet 1025
		VectorStatic 1026

10.9.3.1 Measurement Process States

Operations can be carried out in response to different states of the measurement process. Calculations of channel data can only be performed in `OnTriggerMeasure`. In the other states, only operations with single values (state variables (single values), bits, DACs, LEDs etc.) are allowed.

Variables for single values must be initialized in the `OnInitAll`-block if they are used in a formula. Each measurement state must be concluded with an `End` command.

OnInitAll

Executed once at the start

OnInitAll

All commands within this section are executed once at the start. This section is executed exactly one time after the configuration is loaded to the device. This makes this section suitable for initializations. Global variables (single values) in particular are initialized here for later use. Digital bits also can be initialized here.

Loops and conditions are supported within the `OnInitAll` routine.

All global variables later used for calculations in imc Online FAMOS or imc Inline FAMOS must first be initialized in the `OnInitAll` block.

Example

```
OnInitAll
    Virt_Bit01 = 1
    Voltage    = 10
    Counter    = 0
    LED_01     = 0
    int v[8]
    int i      = 0

    For i = 1 Till 8 Step 1
        v[i] = 1
    End
End
```

OnAlways

Executed constantly

OnAlways

The command lines in this section are constantly executed after the commands in `OnInitAll`.

This is not a one-off event, but is constantly repeated whether or not measurements are in progress.

This section works with global variables (single values) and digital bits. If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnInitAll
    Reset = 0
End

OnAlways
    Virt_Bit10 = 1
    If DisplayVar_01 > 0
       DisplayVar_02 = 0
       Reset = 1
    Else
       DisplayVar_02 = 1
       Reset = 0
    End
End
```

Note

Writing to the device like"LED_01 = 1" should be avoided in `OnAlways`. It could cause an bus-overload.

OnMeasureStart

Executed at the push of the Start-button

OnMeasureStart

The command lines in this section are carried out one time only if the measurement is started, meaning that the button for starting the measurement is pressed.

This section works with global variables (single values) and digital bits. If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnInitAll
    Reset = 0
End

OnMeasureStart
    Virt_Bit10 = 1
    If DisplayVar_01 > 0
       DisplayVar_02 = 0
       Reset = 1
    Else
       DisplayVar_02 = 1
       Reset = 0
    End
End
```

OnMeasureEnd

Executed at the push of the Stop-button

OnMeasureEnd

The command lines in this section are carried out one time only if the measurement is completed, meaning that the button for ending the measurement is pressed or the test carried out finished independently.

This section works with global variables (single values) and digital bits. If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnInitAll
    Reset = 0
End

OnMeasureEnd
    Virt_Bit10 = 1
    If DisplayVar_01 > 0
       DisplayVar_02 = 0
       Reset = 1
    Else
       DisplayVar_02 = 1
       Reset = 0
    End
End
```

OnSyncTask

Run exactly upon elapse of the time interval set.

Prerequisite:
Only available in: imc Online FAMOS Professional!

OnSyncTask(CycleTime)

This segment forms the synchronous task, which is activated cyclically in synchronization with the device's AD converter. The command lines contained in this segment are performed exactly one time once the specified cycle time has elapsed again. A maximum of 4 synchronous tasks are possible.

The parameter Time is stated in s.

The following entries are allowed: 0.0001s, 0.0002s, 0.0005s, ..., 0.1s, 0.2s, 0.5s, 1s.

Example

```
OnSyncTask( 0.1 ) ; Cycle time of 0.1s
    If VirtBit_01 <> 0
       VirtBit_02 = 1
    Else
        VirtBit_02 = 0
    End
End
```

If the cycle time is insufficient for performing the commands, the beeper and LED_06 are activated. Alternatively, this can be monitored using the command `SyncOverload` 1012.

Reference

For more information on **controller** see in the documentation on imc Online FAMOS: "*imc Online FAMOS Professional*" > "*PID-Controller*878".

OnTriggerStart

Run upon start of the measurement

OnTriggerStart(TriggerName)

The command lines in this section are executed a single time at the start of every measurement, at the exact moment the trigger is released.

This section works with global variables (single values) and digital bits. If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnInitAll
    Counter = 0
    VirtBit_02 = 1
End

OnTriggerStart( Trigger_48 )
    Counter = Counter + 1
    If VirtBit_01 > 0
        VirtBit_02 = 0
    End
End
```

OnTriggerEnd

Executed at the end of every measurement

OnTriggerEnd(TriggerName)

The command lines in this section are carried out one single time at the end of every measurement, at the moment that no more data are arriving due to the trigger.

This section works with global variables (single values) and digital bits. If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnInitAll
    Counter = 0
    VirtBit_02 = 0
End

OnTriggerEnd( Trigger_48 )
    Counter = Counter + 1
    If VirtBit_01 < 1
        VirtBit_02 = 1
    End
End
```

OnTriggerMeasure

Executed during a running measurement

OnTriggerMeasure(TriggerName)

The command lines in this section are executed during a running measurement. This is not a one-off event, instead, the execution of this section is constantly repeated between the trigger start and the trigger end.

This section works with channels and virtual channels, but also with single values and digital bits.

If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

Example

```
OnTriggerMeasure( Trigger_48 )
    VirtChannel_001 = Channel_001 + 5
    If VirtBit_01 > 0
        VirtChannel_002 = Channel_002 + 10
    Else
        VirtChannel_002 = Channel_002 + 5
    End
End
```

OnTimer

Run upon elapse of the time interval set

OnTimer(Timer_ID)

The command lines in this section are executed once for each time the appropriate timer is released. A timer can be created using `StartTimerPeriodic` or `StartTimerSingle` (see Timer functions 1046).

If calculations are performed on global variables (single values), they must first be initialized in the section `OnInitAll`.

The specified timer-ID must exactly match the one for the corresponding timer start function; the values permitted are 1 ... 8.

Example

```
OnTriggerStart( Trigger_48 )
    StartTimerPeriodic( 5, 0.1, 0.1 )
End

OnTimer( 5 )
    If VirtBit_01 > 0
        VirtBit_02 = 1
    Else
        VirtBit_02 = 0
    End
End
```

OnPowerOff

Run upon switch off the device.

Prerequisite:
Only available in: imc Online FAMOS!

OnPowerOff(cycle time)

This section performs the power off procedure which comes into effect when the device switched off. The battery in the device then takes over supply for a maximum of 8 s. Within this time, the application can be closed properly in the section `OnPowerOff`. When calling the function `ReadyForPowerOff`, device supply via the internal battery is ready to disabled.

One `OnPowerOff` section per synchronous task is allowed. The `OnPowerOff` section associated with the synchronous task is identified by the stated cycle time.

The cycle time parameter is stated in seconds. Any of the following cylcle times may be specified: 0.0001 s, 0.0002 s, 0.0005 s, ..., 0.1 s, 0.2 s, 0.5 s, 1 s.

Example

```
OnSyncTask( 0.01 ) ; Cycle time: 0.01s
    DisplayVar_01 = pv.Channel_001
End

OnPowerOff( 0.01 ) ; Cycle time: 0.01s
    DisplayVar_01  = 0
    DOut01_Bit01   = 0
    DOut01_Bit02   = 0
    ReadyForPowerOff()
End
```

10.9.3.2 Loops, Conditions

If condition, Else

This control command sets the operations appearing underneath to be carried out conditionally.

The operations are only executed if the condition is fulfilled. If the single value passed to it is not equal to 0, the condition is fulfilled. The operations must be concluded by End or Else.

Else denotes the start of operations to be performed if the prior If-condition is not fulfilled. The operations must be concluded by End.

Example

```
OnTriggerMeasure( Trigger_48 )
    If VirtBit_01 > 0
        VirtChannel_001 = Channel_001 + 1
    End
    If VirtBit_05 = 0
        VirtChannel_002 = Channel_002 + 5
    Else
        VirtChannel_002 = Channel_002 + 10
    End
End
```

A condition is usually employed in the manner shown in the example: two operands are compared according to a comparison operator. Naturally, a condition in the form of "If a" is also possible. In such a case, a must be a single value of type BOOL, or the Boolean result of a calculation.

The comparison operators "<", ">", "=" etc. also return variables of type BOOL. Instead of "`If VirtBit_01 > 0`", the command lines "`a = VirtBit_01 > 0`" and "`If a`" can be coded. Combinations of different conditions are also allowed, e.g. "`If VirtBit_01 > 0 AND VirtBit_02 = 0`".

Example Functions and Bit-variables in conditions

Functions in conditions

```
If Greater(Current_RPMs, 2200) = 1
```

or the following alternative:

```
If Greater(Current_RPMs, 2200)
```

Bit-variables in conditions

```
If Virt_Bit01 = 1
```

or the following alternative:

```
If Virt_Bit01
```

Example — Calculation results in conditions

If the results of a calculation are certain to be in Boolean format, the variable can be used in the subsequent conditions without any assignment, as if it were a bit-variable.

```
a = b > c
If a = 1
```

or the following alternative:

```
a = b > c
If a
```

The variable "a" is a local variable which is created in `OnInitAll`. "`b > c`" always returns either 1 or 0 as its result. Even if the variable contains a non-boolean result at a different location, it can be used in this case.

This behavior only applies to local variables and not to device-variables.

Note — Boolean variables from files

See also the notes when using imported variables in If conditions 867.

Switch

This control command can be used to perform operations in dependence upon the value of the parameter b. In the list of case-blocks, different values for the parameter b are treated.

A Case-block is executed each time the numerical value of the parameter b is equal to the Case-command's numerical value. Any numerical values for the parameter b not explicitly listed are treated in the default case.

The Switch command is concluded with an End-command.

The parameter for a Case-command must be an integer ≥ 0. Real numbers are not allowed as Case-command parameters.

Example

```
OnTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    Switch Value
        Case 1
            VirtChannel_001 = Channel_001 + 1
            VirtChannel_002 = Channel_002 + 1
        End
        Case 2
            VirtChannel_001 = Channel_001 + 10
            VirtChannel_002 = Channel_002 + 2
        End
        Default
            VirtChannel_001 = Channel_001 + 100
            VirtChannel_002 = Channel_002 + 3
        End
    End
End
```

For

For Counter = Start Till End Step Iteration

A For-loop enables repeated execution of operations. The number of loop runs is always fixed in For-loops. The loop is carried out, starting when Counter = Start, until Counter is smaller than or equal to the value "End". After each run of the loop, the Counter is iterated upward by the number "Iteration".

The counter must be defined as an **integer single value** in the `OnInitAll`-block. The **maximum loop count** can also be specified by a **variable**. In that case it must be declared in an the `OnInitAll`-block as an integer and can be changed during the measurement.

Start, End and Iteration must be integers. The For-block is concluded by an "End" command. Single values and digital bits can be processed in loops, channel definitions are not permitted here.

Example

```
OnInitAll
    int i = 0
    HistoSum = 0
    int MaxLoops= 15
End

OnTriggerMeasure( Trigger_48 )
    Histo = Histogramm( Channel_001,  -10, 10, 16, 1, 1 )
    HistoSum = 0
    For i = 0 Till MaxLoops Step 1
        HistoSum = HistoSum + GetHistoValue( Histo, i )
    End
    VrtSum = Channel_001*0 + HistoSum
End
```

While condition

While condition

A While-loop enables repeated execution of operations. The number of loop runs for "While" depends on the condition, so the number isn't necessarily known when the loop call comes. The operations in the While-block are carried out until the condition is met, i.e. the parameter of the While instruction is not equal to 0. The While-block is concluded by an "End" command.

Single values and digital bits can be processed in loops, channel definitions are not permitted here.

Example

```
OnInitAll
    int i = 0
    HistoSum = 0
End

OnTriggerMeasure( Trigger_48 )
    Histo = ClHistogram( Channel_001,-10,10,16,1,1)
    HistoSum = 0
    i = 0
    While i <= 15
        HistoSum = HistoSum + GetHistoValue( Histo, i )
        i = i + 1
    End
    VrtSum = Channel_001*0 + HistoSum
End
```

The While-loop is carried out until the condition is fulfilled. If the condition is always fulfilled, the While-loop is never exited. While-loops are commonly used in the manner illustrated by the example: two operands are compared using a comparison operator. Combinations of conditions are also allowed: e.g "While i ≤ 15 AND HistoSum ≤ 5000".

Default

The Case-command states the particular value of the variable specified by a prior switch command. In the list of case-blocks, different values for the parameter of the switch command are treated. A Case-block is executed each time the numerical value of the parameter of the switch command is equal to the Case-command's numerical value. Any numerical values for the parameter of the switch command not explicitly listed are treated in the default case. The Default command is concluded with an End-command. The parameter for a Case-command must be an integer ≥ 0. Real numbers are not allowed as Case-command parameters.

Example

```
OnTriggerMeasure( Trigger_48 )
    Value = CurrentValue( Channel_001, 0, 0.0 )
    Switch Value
        Case 1
            VirtChannel_001 = Channel_001 + 1
            VirtChannel_002 = Channel_002 + 1
        End
        Case 2
            VirtChannel_001 = Channel_001 + 10
            VirtChannel_002 = Channel_002 + 2
        End
        Default
            VirtChannel_001 = Channel_001 + 100
            VirtChannel_002 = Channel_002 + 3
        End
    End
End
```

10.9.3.3 Timer Functions

Up to eight different timers can be implemented. Each timer must be started by a function. Both periodic timers (the timer is released periodically at fixed intervals) and one-off timers (the timer is released after a specified interval) can be realized. To stop a periodic timer, the function StopTimer must be used. Timers can be started and stopped in any state of the measurement process.

In the `OnTimer` block, only single values (e.g. single value variables, bits, LEDs, DACs, ...) can be subjected to calculations.

StartTimerPeriodic

Periodic timer. Creates a periodic timer.

StartTimerPeriodic (Timer_ID, TimeInterval, TimeInterval_1)

Timer_ID: Identifies the timer (1..8)	**TimeInterval**: Release upon elapse of time interval, in seconds **TimeInterval_1**: Time in seconds, after which release occurs

The time-count begins when this function is called. When the time TimeInterval_1 has elapsed, the timer is released one single time. After that, the timer is released repeatedly after each interval of duration TimeInverval. When the timer is released, the `OnTimer` section of the corresponding Timer_ID is executed.

The time intervals can be specified to a precision of 0.0001 s (0.1 ms). TimeInterval must be at least 0.0001 s; TimeInterval_1 can also be 0 s.

The permitted maximum values for the parameters TimeInterval and TimeInterval_1 depend on the device types used.

Example

```
OnTriggerStart( Trigger_48 )
    ; Create periodic timer
    StartTimerPeriodic ( 5, 0.5, 0.0 )
End

OnTimer( 5 )
    If VirtBit_01 > 0
        LED_01 = 1
    Else
        LED_01 = 0
    End
End
```

StartTimerSingle

Single-use timer. Creates a timer for one-off use.

StartTimerSingle (Timer_ID, TimeInterval)

Timer_ID: Identifies the timer (1..8)	**TimeInterval**: Time in seconds, after which release occurs

The time-count begins when this function is called. When the time TimeInterval has elapsed, the timer is released one single time. Then, the `OnTimer` section of the corresponding Timer_ID is executed.

The time interval can be stated to a precision of 0.0001 s (0.1 ms) and must be at least 0.0001 s.

The permitted maximum value for the parameter TimeInterval depends on the device type currently in use.

Example

```
OnTriggerStart( Trigger_48 )
    ; Create a one-off timer
    StartTimerSingle( 1, 5.0 )
End

OnTimer( 1 )
    If VirtBit_01 > 0
        LED_01 = 1
    Else
        LED_01 = 0
    End
End
```

StopTimer

Deletes a timer. The timer cannot be released. It no longer exists.

StopTimer (Timer_ID)

Timer_ID: Identifies the timer (1..8)

Example

```
OnTriggerMeasure( Trigger_48 )
    If VirtBit_01 > 0
        ; Create periodic timer
        StartTimerSingle( 5, 0.0 )
    End
    If VirtBit_02 > 0
        StopTimer( 5 ) ; Delete timer
    End
End

OnTimer( 5 )
    If VirtBit_05 > 0
        LED_01 = 1
    Else
        LED_01 = 0
    End
End
```

10.9.3.4 CanMsg

Prerequisite:
Only available in: imc Online FAMOS!

CanMsg

CanMsg-initialization: Initialization of the CanMsg-structure with default values.

CanMsg1 = CanMsg()

CanMsg1: CanMsg-structure	

To send CAN- messages with CanMsg-structures, the function `CanMsg` must be called in the `OnInitAll` section. In the process, a `CanMsg`-structure is created and initialized. MessageID, message-length and message-content must be set before the CAN-message is sent. The message-ID and message-length are set with the variables `.ID` and `.Len`. The individual message bytes are set with the variables `.Byte0` ... `.Byte7` or with the function `.SetData`. The CAN-message thus created is sent by means of the `.Transmit1_S1`.

Example sending a CAN-message

```
OnInitAll
    CanMsg1 = CanMsg()
End

OnAlways
    If VirtBit_01 > 0
        CanMsg1.ID = 100
        CanMsg1.Len    = 2
        CanMsg1.Byte0 = 10
        CanMsg1.Byte1 = 20
        CanMsg1.Transmit1_S1()
        VirtBit_01     = 0
    End
End
```

Example receiving a CAN-message

```
OnInitAll
    CanID    = 0
    CanLen   = 0
    CanByte0 = 0
    CanByte1 = 0
End

OnCanMessageReceive1_S1( CanMsg1 )
    CanID    = CanMsg1.ID
    CanLen   = CanMsg1.Len
    CanByte0 = CanMsg1.Byte0
    CanByte1 = CanMsg1.Byte1
End

OnTriggerMeasure( Trigger_48 )
    VID    = Channel_001*0 + CanID
    VLen   = Channel_001*0 + CanLen
    VByte0 = Channel_001*0 + CanByte0
    VByte1 = Channel_001*0 + CanByte1
End
```

Note

The `CanMsg` functions only appear if the CAN-Assistant had previously been opened. No changes to or operations in the CAN-Assistant need to have happened, but only once it has been opened does imc Online FAMOS learn that there is a CAN Bus interface.

CanMsg.GetData

Value from CAN-message: A value is extracted from a CAN-message.

Result = CanMsg.GetData(StartByte, StartBit, BitCount, BitSequence, Format)

Result: Value extracted from the CAN-message

StartByte: Initial byte in the message, 0..7

StartBit: Initial bite in the message, 0..7

BitCount: Number of bits in the value to be sent, 1..32

ByteSequence: Intel- or Motorola-format

1: Intel

2: Motorola

Format: Numerical format of the value to be sent,

1: signed integer

2: unsigned integer

3: real number (32 bit)

4: digital bit

To use this function, it's necessary to generate a `OnCanMessageReceive1_S1`-section, in which the function `.GetData` is called. The content of the received CAN-messages is extracted from the message with the variables `.Byte0` ... `.Byte7` or with the function `.GetData`.

Example

```
OnInitAll
    CanID    = 0
    CanLen   = 0
    CanByte0 = 0
    CanByte1 = 0
End

OnCanMessageReceive1_S1( CanMsg1 )
    CanID    = CanMsg1.ID
    CanLen   = CanMsg1.Len
    CanByte0 = CanMsg1.GetData( 0, 4, 16, 1, 1 )
    CanByte1 = CanMsg1.GetData( 2, 4, 16, 1, 1 )
End

OnTriggerMeasure( Trigger_48 )
    VID    = Channel_001*0 + CanID
    VLen   = Channel_001*0 + CanLen
    VByte0 = Channel_001*0 + CanByte0
    VByte1 = Channel_001*0 + CanByte1
End
```

CanMsg.SetData

Value in message: A value is inserted into a CAN-message.

CanMsg.SetData(Value, StartByte, StartBit, BitCount, ByteSequence, Format, Factor, Offset)

Value: Value to be sent

StartByte: Initial byte in the message, 0..7

StartBit: Initial bit in the message, 0..7

BitCount: Number of bits in the value to be sent, 1..32

ByteSequence: Intel- or Motorola-Format,

1: Intel

2: Motorola

Format: Numerical format of the value to send,

1: signed integer

2: unsigned integer

3: real number (32 bit)

4: digital bit

Factor: Weighting of the value to be sent with a factor

Offset: Weighting of the value to be sent with an offset

To use the function, a `CanMsg`-structure must be defined in the `OnInitAll` section.

Message-ID, message-length and message-content must be set before the CAN-message is sent. The message-ID and message-length are set with the variables `.ID` and `.Len`. The individual message bytes are set with the variables `.Byte0` ... `.Byte7` or with the function `.SetData`. The CAN-message thus created is sent by means of the function `.Transmit1_S1`.

Example

```
OnInitAll
    CanMsg1 = CanMsg()
End

OnAlways
    If VirtBit_01 > 0
        CanMsg1.ID = 100
        CanMsg1.Len = 4
        CanMsg1.SetData( 1000, 0, 4, 16, 1, 1, 1.0, 0.0 )
        CanMsg1.SetData( 2000, 2, 4, 16, 1, 1, 1.0, 0.0 )
        CanMsg1.Transmit1_S1()
        VirtBit_01 = 0
    End
End
```

CanMsg.Transmit1_S1

Send a CAN-message: A CAN-message is sent to Node 1.

CanMsg.Transmit1_S1( )

To use the function, a `CanMsg`-structure must be defined in the `OnInitAll` section.

Message-ID, message-length and message-content must be set before the CAN-message is sent. The message-ID and message-length are set with the variables `.ID` and `.Len`. The individual message bytes are set with the variables `.Byte0` ... `.Byte7` or with the function `.SetData`. The CAN-message thus created is sent by means of the function `.Transmit1_S1`.

Example 1

```
OnInitAll
    CanMsg1 = CanMsg()
End

OnAlways
    If VirtBit_01 > 0
        CanMsg1.ID = 100
        CanMsg1.Len   = 2
        CanMsg1.Byte0 = 10
        CanMsg1.Byte1 = 20
        CanMsg1.Transmit1_S1()
        VirtBit_01    = 0
    End
End
```

Example 2

```
OnInitAll
    CanMsg1 = CanMsg()
End

OnAlways
    If VirtBit_01 > 0
        CanMsg1.ID = 100
        CanMsg1.Len = 4
        CanMsg1.SetData( 1000, 0, 4, 16, 1, 1, 1.0, 0.0 )
        CanMsg1.SetData( 2000, 2, 4, 16, 1, 1, 1.0, 0.0 )
        CanMsg1.Transmit1_S1()
        VirtBit_01  = 0
    End
End
```

OnCanMessageReceive1_S1

This section deals with CAN-messages which are received from the device and can't be permanently set in the CAN-Assistant.

OnCanMessageReceive1_S1(CanMsg1)

CanMsg1: CanMsg-structure to be newly created	

The `CanMsg`-structure passed in is created and initialized for this section. The elements of the `CanMsg`-structure are treated like local variables in the section `OnCANMessageReceive_S1` and may also be used only within this section. These variables are filled when the command for reading CAN-messages is run, and can be used and queried in the section `OnCANMessageReceive_S1` on the right side of formulas. They are single values.

The content of the CAN-message can be extracted from the message either with the variables `.Byte0` ... `.Byte7` or with the function `.GetData`.

Example

```
OnInitAll
    CanID    = 0
    CanLen   = 0
    CanByte0 = 0
    CanByte1 = 0
End

OnCanMessageReceive1_S1( CanMsg1 )
    CanID    = CanMsg1.ID
    CanLen   = CanMsg1.Len
    CanByte0 = CanMsg1.Byte0
    CanByte1 = CanMsg1.Byte1
End

OnTriggerMeasure( Trigger_48 )
    VID    = Channel_001*0 + CanID
    VLen   = Channel_001*0 + CanLen
    VByte0 = Channel_001*0 + CanByte0
    VByte1 = Channel_001*0 + CanByte1
End
```

10.9.3.5 Controller Functions

Prerequisite:
Only available in: imc Online FAMOS Professional!

Reference

For more information on **controller** see in the documentation on "*imc Online FAMOS and imc Inline FAMOS*" > "*Calculation examples*" > "*PID-Controller* 878".

CtPID

Create and initialize a PID-controller: Initializes a PID-controller with the specified values.

Controller = CtPID(P_component, I_component, D_component)

Controller: the controller-structure to be created	**I_component**: I-component
P_component: P-component	**D_component**: D-component

This function is called once for each controller used in the section `OnInitAll`. It creates a controller-structure. The constants passed are stated for a continuous (non-discrete) controller. They serve to initialize the elements `.KP`, `.KI`, `.KD`. All other elements are initialized as 0.0.

Except for `.DCutOff`, which is set to approx. 0.1 / [controller's cycle time].

The PID-controller's structure has been enhanced: In particular, input control, controller output limiting, and band limiting of the D-component are all possible.

Computation of the controller is performed in the `OnSyncTask`-block with the function `.Calc`. The elements of the structure can be queried and changed at any time, and the set point `.SetPoint` as well.

Example

```
OnInitAll
    EngineController = CtPID( 20.0, 0.5, 0 ) ; P, I, D
    EngineController.SetPoint = 6000
End

OnSyncTask( 0.1 )
    DAC_VoltageEngine = EngineController.Calc( pv.Speed )
    If VirtBit_01 <> 0
        EngineController.Reset = 1
    End
    If VirtBit_02 > 0
        EngineController.SetPoint = 2000
    End
End
```

CtPID.Calc

Compute PID-controller: calculation of the PID-controller.

ControllerOutput = CtPID.Calc(ProcessValue)

ControllerOutput: the controller's output	**ProcessValue**: instantaneous measurement value, process value for the controller

The function calculates exactly one step of the controller. For the currently passed process value, the new controller output is determined as the return value. The return value is then typically passed to a DAC. The controller output is subsequently available in `.PV`; the controller output also in `.CO`.

When the controller's parameters are changed, these changes only take effect upon the next call of the function `.Calc`, because that is the first (and only) time a new controller output is computed.

The function `.Calc` is only allowed in synchronous tasks.

Example

```
OnInitAll
    EngineController = CtPID( 20.0, 0.5, 0 ) ; P, I, D
    EngineController.SetPoint = 6000
End

OnSyncTask( 0.1 )
    DAC_VoltageEngine = EngineController.Calc( pv.Speed )
    If VirtBit_01 <> 0
        EngineController.Reset = 1
    End
    If VirtBit_02 > 0
        EngineController.SetPoint = 2000
    End
End
```

CtTwoPos

Create and initialize a two-point controller: Initializes a two-position controller with the specified values.

Controller = CtTwoPos(Hysteresis, Output_Inversion)

Controller: The newly created controller structure	**Output_Inversion**: Should the output be inverted?
Hysteresis: The distance between two reversal points	0: Default 1: Invert output

This function is called once for each two-position controller used in the section `OnInitAll`. It creates a controller structure.

The controller structure contains a number of elements which are initialized by this function. Thus, the controller's set point `.SetPoint` is set = 0, and the controller output `.CO` is set = 0. With the output inverted, `.CO` is set = 1.

The hysteresis is the distance between the upper and the lower reversal point. It should be > 0.

The two reversal points lie symmetrically around the setpoint. If the setpoint is = 20, for instance, and the hysteresis = 2, then the resulting reversal points are 21 and 19.

The controller's method of functioning: If the process value is greater than the upper reversal point, then the controller output = 1 is generated and returned by the function `.Calc`. If the process value is lower than the lower reversal point, then the resulting controller output is = 0. If the process value is between the two reversal points, the controller output remains unchanged.

By means of the parameter Output_Inversion, the controller output can normally be inverted, so that when the process value is too high, the resulting controller output is = 0; and when the process value is too low, the resulting CO is = 1.

Computation of the controller is performed in the `OnSyncTask`-block with the function `.Calc`. The elements of the structure can be queried and changed at any time, and the set point `.SetPoint` as well.

Example

```
OnInitAll
    Thermostat = CtTwoPos( 2, 0 ) ; Hysteresis, invert output
    Thermostat.SetPoint = 20 ; optional: set setpoint
    DigitalOut_01 = 0 ; optional: output in rest state
End

OnSyncTask( 0.1 )
    DigitalOut_01 = Thermostat.Calc( pv.Temperature_01 ) ; set setpoint
    ...
    If VirtBit_01 <> 0
        Thermostat.SetPoint = 22.0 ; change setpoint
    End
End
```

CtTwoPos.Calc

Calculate two-point controller: computation of a two-point controller.

ControllerOutput = CtTwoPos.Calc(ProcessValue)

ControllerOutput: the controller's output	**ProcessValue**: instantaneous measurement value, process value for the controller

The function computes exactly one controller step. For the currently passed process value, the new controller output is determined as the return value. The return value is then typically passed to a digital output. The process value is subsequently available in `.PV`; the controller output in `.CO`.

The controller output can take values between 0 and 1.

When the controller's parameters are changed, these changes only take effect upon the next call of the function `.Calc`, because that is the first (and only) time a new controller output is computed. The function `.Calc` is only permitted in synchronous tasks.

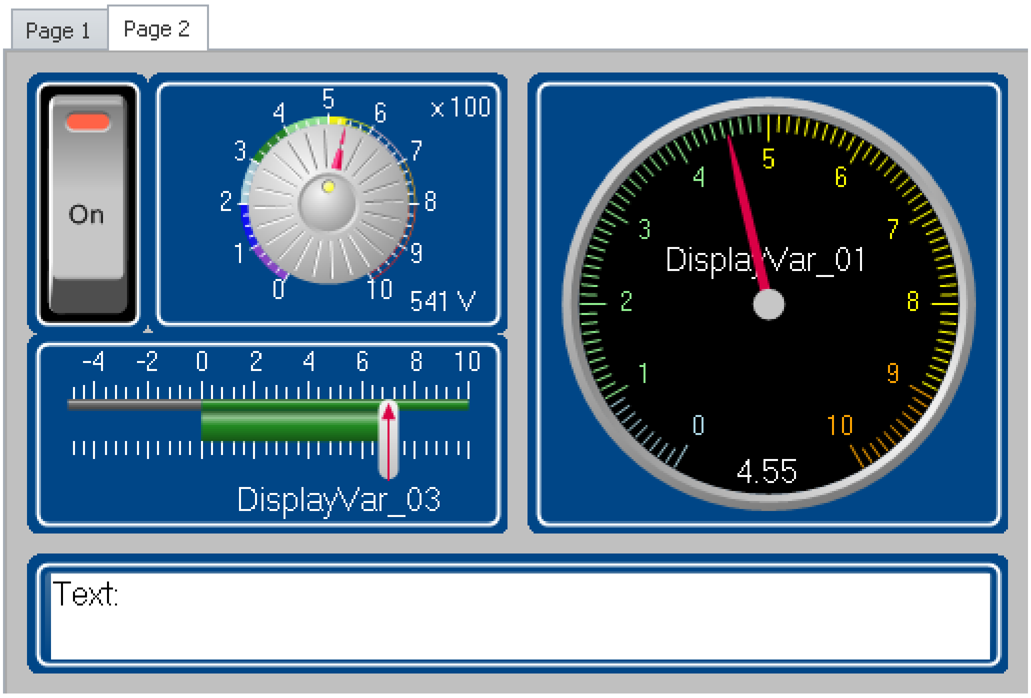
Example

```
OnInitAll
    Thermostat = CtTwoPos( 2, 0 ) ; Hysteresis, invert output
    Thermostat.SetPoint = 20 ; optional: set setpoint
    DigitalOut_01 = 0 ; optional: output in rest state
End

OnSyncTask( 0.1 )
    DigitalOut_01 = Thermostat.Calc( pv.Temperature_01 ) ; set setpoint
    ...
    If VirtBit_01 <> 0
        Thermostat.SetPoint = 22.0 ; change setpoint
    End
End
```

11 Panel

Panel is the imc STUDIO component with which **measured data and events** can both be **displayed** in instruments, and influenced using other controls (both controls and instruments are called Widgets).

With the Panel you can achieve **personalized user interfaces** (called Panel pages 1375), which are optimized for your specific needs.



imc STUDIO Panel with two pages (example)

Panel page

The Panel consists of one or more Panel pages. On a page, it is possible to layout various Widgets.

There are two kinds of Panel pages available:

- Dialog pages 1375 optimized for on-screen display
- Report pages 1375 optimized for printouts

Widgets

Various Widgets 1068 are available as instruments and controls. The amount of Widgets varies by the product configuration. Even the curve window 1126, familiar from other programs, can be placed on a page.

By means of the Widgets, you can affect the measurement interactively. It is also possible to assign actions (commands) 1124 to Widgets such as switches and buttons.

Operation

For the positioning of Widgets 1068 and the assignment of channels and variables 1390, a variety of operation techniques can be used, such as Drag&Drop or context menus.

The Widgets can be operated by keyboard or mouse.

11.1 Ribbon

11.1.1 Control

Device control

Here you find the menu actions for device control.

For a detailed description, see the manual:
"*Setup - Manual*" > "*Ribbon*" > "*Control* 166".

View

Menu item	Description
Panel Fullscreen Mode	The Panel is displayed in fullscreen mode. The imc STUDIO **user interface is hidden** and can thus no longer be operated or accessed (excepting the Panel pages). See chapter "*Fullscreen* 1384".

Export

Menu item	Description
As PDF (Export)	Saves the current Panel page in PDF format.
As Graphics (Export)	Saves the current Panel page as a graphics file. You can select among the following graphics formats: • Portable Network Graphics (*.png) • Windows Bitmap (*.bmp) • JPEG (*.jpg)

Print

Menu item	Description
Print Preview	Opens a print preview. Here you can see the possible appearance of printing results. This can be helpful when Widgets such as the curve window are used, which have their own color settings for the printout.
Print	Opens the dialog for printing the Panel pages.

11.1.2 Navigation

Control

Menu item	Description
Post-Processing	Activates/deactivates the Post-processing mode. • **Activates:** In the Post-processing mode, entries into the Report channel are inserted at the navigation time point (time point corresponding to the Position slider 1401). In the case of saved measured data, also after the measurement. • **Deactivated:** The Report channel entries are written to the channel at the current point in time (current time point = time stated by the "Virtual clock/VRTC 315").
Find in Variables	**Search for** (Report channel) **variables** which are linked with the Navigation bar. Using this function, you can **perform a targeted search for entries** and **skip** to them. See also the segment "*Find in Variables* 1403".
To Beginning	Sets the position slider to the beginning of the maximum visible range of the Navigation bar. This corresponds to the first data point of a curve window which is linked with the Navigation bar.
Start	Begins playback of the measured data from the location of the position slider. The position slider indicates the point in time currently being played back. All widgets linked with the Navigation bar play back the measured data associated with the time point represented by the position slider.
Stop	Stops playback of the measured data. The position slider remains stationary at its current location. The playback may later be resumed from that location.
To End	Sets the position slider to the end of the maximum visible range of the Navigation bar. This corresponds to the last data point of a curve window which is linked with the Navigation bar.
Repeat	Begins playback again from the beginning once it has reaches the end ("loop").
Faster	The measured data are played back at a somewhat faster speed.
Slower	The measured data are played back at a somewhat slower speed.

Curve window

Menu item	Description
Zoom	Specify here which **time window** (in seconds) you wish to **display**. All linked curve windows automatically display the time set (starting from the right edge).
Absolute Time	Sets the X-axis of all linked curve windows to absolute time. The channels are displayed with a **date and time**.
Relative Time	Sets the X-axis of all linked curve windows to relative time. The **time elapsed** since the **start of channel's data acquisition** is displayed (in days, hours, minutes and seconds). Thus, what is displayed is the time locations of measured points in reference to the triggering time. The time may also be specified as negative numbers to indicate points in time prior to the trigger ("pretrigger").
Scroll	All curve windows linked with the Navigation bar change their mode to: "Scroll" In Scroll mode, the **time window** displayed always **has the same width**. Thus, the plot of the data set progresses through the time window in the manner of a digital readout scrolling across a marquee screen.
Stretch	All curve windows linked with the Navigation bar change their mode to: "Stretch" In Stretch mode, the complete data set is displayed **starting from a defined x-value up to the last value**. As long as the measurement is running, the time axis range continues to extend, so that the signal plot appears increasingly compressed. For the setting "Stretch", the right edge of the window does not automatically jump to the last value. Only once new data arrive, the displayed range "stretches" (e.g. during a running measurement, or when other measured data are loaded which are to be displayed in the same curve window).
Pause	All curve windows linked with the Navigation bar change their mode to: "Pause" (in the curve window, this corresponds to the Scroll mode: "No") In Pause mode, all curve window's linked with the Navigation bar are frozen. Measurement continues in the background without being displayed. **Exception:** In the curve window, the **time axis is set to "automatic"**. This causes a similar situation as the "Stretch" mode. The difference is that then the complete data set is always shown (the left side also adjusts accordingly.) This mode is **suitable for reports** when measured data are to be loaded in succession and **displayed completely in a curve window**.

Design

Menu item	Description
Design Mode	• Activated: the Panel page can be edited, the Widgets can not be operated. • Deactivated: The Panel page can not be edited. The Widgets can be operated.
Navigation Bar	Shows/hides the Navigation bar 1394.
Selection	Tool for linking Widgets with the Navigation bar 1400
Variables	It is possible to **link variables with the Navigation bar**. This is needed in particular for report channels in order to be able to navigate through entries in the report channel. See section "*Linking variables* 1401".

Export

Menu item	Description
As PDF (Export)	Saves the current Panel page in PDF format.
As Graphics (Export)	Saves the current Panel page as a graphics file. You can select among the following graphics formats: • Portable Network Graphics (*.png) • Windows Bitmap (*.bmp) • JPEG (*.jpg)

Print

Menu item	Description
Print Preview	Opens a print preview. Here you can see the possible appearance of printing results. This can be helpful when Widgets such as the curve window are used, which have their own color settings for the printout.
Print	Opens the dialog for printing the Panel pages.

11.1.3 Design

New

Menu item	Description
Insert Page	Selection window for creating a new Dialog- or Report-page is opened. (siehe: Einfügen - Dialog / Report 1375)
Standard Dialog	Creates a new Standard dialog page.

Edit and Clipboard

Menu item	Description
Design Mode	• Activated: the Panel page can be edited, the Widgets can not be operated. • Deactivated: The Panel page can not be edited. The Widgets can be operated.
Lock/Unlock Page	Lock/Unlock the current page. Individual pages can be protected against changes (see Lock and unlock page 1383).
Undo	Reverses the last change.
Redo	Restores a previously reversed change.
Delete	Deletes the selection (the page or the selected Widgets).
Select all	Selects all of the page's Widgets.
Cut	Clips out the selection or the selected Widgets and moves them to the Clipboard.
Copy	Copies the selection or the selected Widgets to the Clipboard.
Paste	Inserts the content of the Clipboard at the selected position.

Navigation

Menu item	Description
Navigation Bar	Shows/hides the Navigation bar 1394.
Selection	Tool for linking Widgets with the Navigation bar 1400
Variables	It is possible to **link variables with the Navigation bar**. This is needed in particular for report channels in order to be able to navigate through entries in the report channel. See section "*Linking variables* 1401".
Zoom	Specify here which **time window** (in seconds) you wish to **display**. All linked curve windows automatically display the time set (starting from the right edge).
Absolute Time	Sets the X-axis of all linked curve windows to absolute time. The channels are displayed with a **date and time**.
Relative Time	Sets the X-axis of all linked curve windows to relative time. The **time elapsed** since the **start of channel's data acquisition** is displayed (in days, hours, minutes and seconds). Thus, what is displayed is the time locations of measured points in reference to the triggering time. The time may also be specified as negative numbers to indicate points in time prior to the trigger ("pretrigger").
Scroll	All curve windows linked with the Navigation bar change their mode to: "Scroll" In Scroll mode, the **time window** displayed always **has the same width**. Thus, the plot of the data set progresses through the time window in the manner of a digital readout scrolling across a marquee screen.
Stretch	All curve windows linked with the Navigation bar change their mode to: "Stretch" In Stretch mode, the complete data set is displayed **starting from a defined x-value up to the last value**. As long as the measurement is running, the time axis range continues to extend, so that the signal plot appears increasingly compressed. For the setting "Stretch", the right edge of the window does not automatically jump to the last value. Only once new data arrive, the displayed range "stretches" (e.g. during a running measurement, or when other measured data are loaded which are to be displayed in the same curve window).
Pause	All curve windows linked with the Navigation bar change their mode to: "Pause" (in the curve window, this corresponds to the Scroll mode: "No") In Pause mode, all curve window's linked with the Navigation bar are frozen. Measurement continues in the background without being displayed. **Exception:** In the curve window, the **time axis is set to "automatic"**. This causes a similar situation as the "Stretch" mode. The difference is that then the complete data set is always shown (the left side also adjusts accordingly.) This mode is **suitable for reports** when measured data are to be loaded in succession and **displayed completely in a curve window**.

View

Menu item	Description
Panel Fullscreen Mode	The Panel is displayed in fullscreen mode. The imc STUDIO **user interface is hidden** and can thus no longer be operated or accessed (excepting the Panel pages). See chapter "*Fullscreen* 1384".

Im-/Export

Menu item	Description
Import Page	This lets you import a saved page (file type: dbv). If the page's designation is identical to that of an already existing one, you are prompted whether to overwrite the existing page. If you answer "No", the imported page is appended along with a new page title (incremented number).
As Panel Page (Export)	Saves the current Panel page as a file (file type "Panel pages (*.dbv)").
As PDF (Export)	Saves the current Panel page in PDF format.
As Graphics (Export)	Saves the current Panel page as a graphics file. You can select among the following graphics formats: • Portable Network Graphics (*.png) • Windows Bitmap (*.bmp) • JPEG (*.jpg)

11.2 Tool Windows

The following tool windows are available for the purpose of configuring the Panel pages:

Tool Windows	Description
Widgets	Depending on the product configuration, a certain amount of display and control elements (**Widgets**) in various groups.
Data Browser	The tool window **Data Browser** shows the available data such as measurement channels, Display-variables or process vectors in a hierarchical tree diagram. With this tool window you can also set the variable linkage 1390 for a Widget.
Properties 1066	The Properties window changes its contents in response to the object selected. If no Widget is selected, the page properties 1378 are displayed.
Page templates 1093	Ti create new pages there are templates for **dialogs** (optimized for screen display) and **reports** (optimized for printout).

11.2.1 Properties (general)

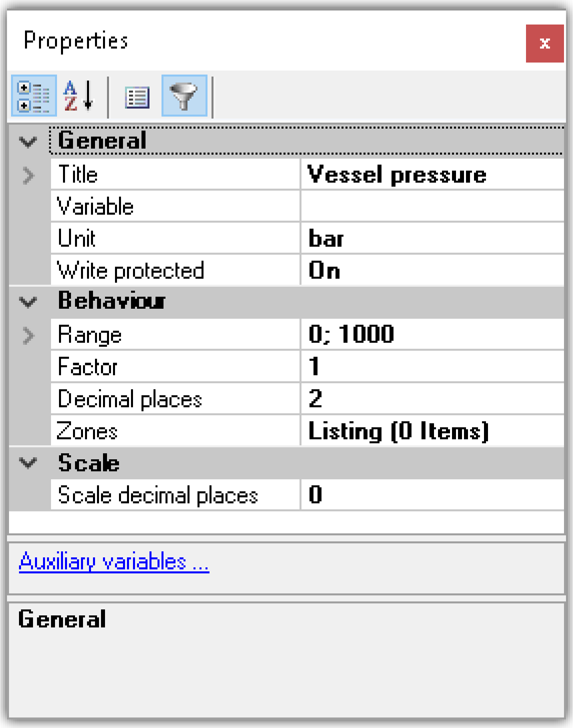
In the tool window "**Properties**" (or via the context menu of the selected Widget, (see context menus of the Widgets 1100), the individual Widgets or the Panel pages can be adapted. The content of the Properties window depends on the respective element.

There are two display modes:

Icon	Description
	Display of the important properties. Properties which normally are adapted to the specific requirements are displayed (e.g. measurement range and variable).
	Display of all properties.

Example

Below, one possible configuration of a *Standard meter (Automotive)* is described, with the important properties indicated.



In the window *Properties*, these properties can be adapted to your wishes. Here, for instance, the title *Vessel pressure* has been added, the unit set to *bar*, and the display range set to 0 through 1000.

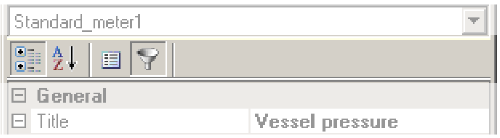
Structure and operation

Selection list

Shows the name of the selected element. By means of the selection list, it is possible to select a different element. The selection on the Panel page assimilates itself to the selection.

Only shown in the tool window. Not in the "free-floating" "Properties" window.

Toolbar



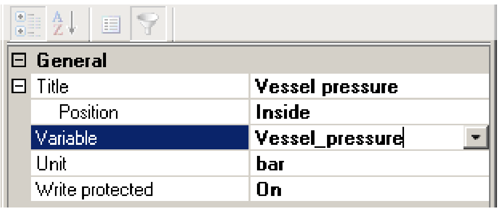
 Alphabetical sorting of the properties list.

 Grouping of the properties by property type.

 Display of all properties.

 Display of the important properties. Properties which normally are adapted to the specific requirements are displayed (e.g. measurement range and variable).

Properties



List of all properties.

- Left column: Name of the property
- Right column: Current setting

To edit a setting, click in the associated text box. The desired values can be entered on the keyboard. If there are selection from which to choose, a corresponding button appears at the right margin:

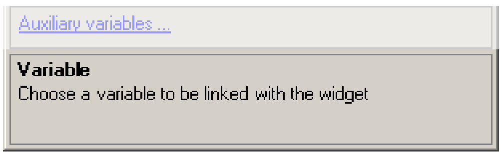
 Opens a selection dialog (a list or the Data Browser)

 Opens a dialog (for instance Zones-dialog or event)

More dialogs

This area lists Options-dialogs which can be opened at the click of the mouse. Here you will find dialogs in addition to that for the Properties.

Description



Here you have a description of the selected property.

11.2.2 Widgets

The tool window "Widgets" provides the building blocks from which to construct a Panel page. The window contains multiple groups. In general, the groups **Curve window**, **Standard**, **Shapes** and **Devices handling** are available. Furthermore, there are specially designed Widgets in groups such as **Automotive**, **Industrial**, **Designer**, **Aviation**.

Note	Which groups are visible
Which groups are available depends on the product configuration. (see Product Configuration / Licensing 29 or Technical Data Sheet)	

Widgets are placed (inserted) 1099 on the Panel page.

- Widgets - Operation and Properties 1098: Select this link to go to further information on operation of the Widgets.
- Special Widgets 1365: The descriptions of certain special Widgets are presented here.

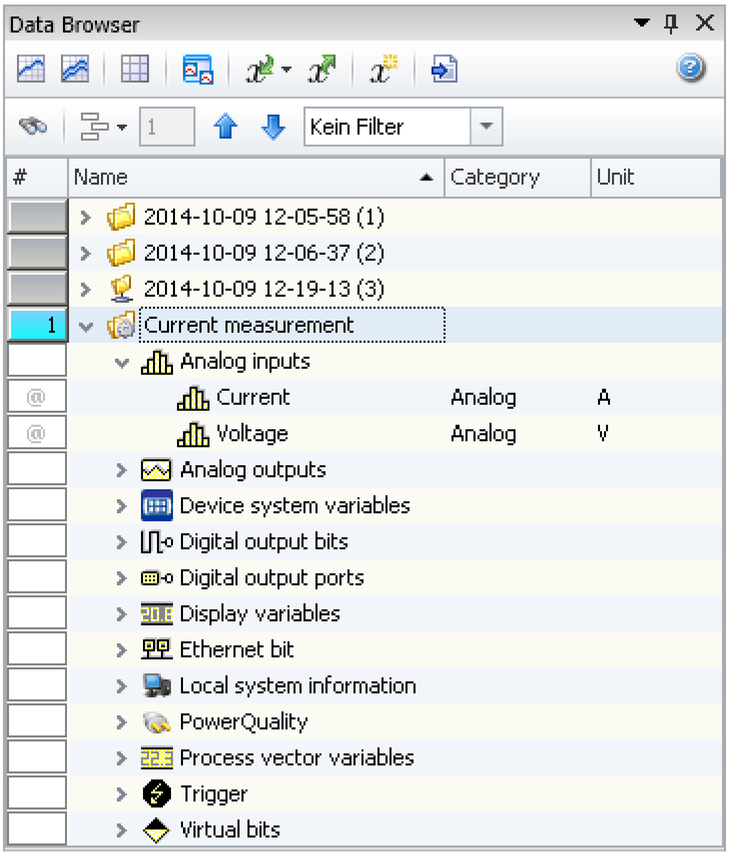
11.2.3 Data Browser

The tool window Data Browser **shows the available data (called variables)** such as measurement channels, Display variables or process vectors in a hierarchical tree diagram. From this tool window, you can move the variables by means of Drag & Drop 1391 to a Panel page and link them with Widgets. You can also navigate through measurements 1076 and assign measurement numbers 1075.

FAQ

Why are the current channels not displayed?

Answer: The tool window Data Browser **only shows changed device configurations (e.g. channels) once** the menu action "***Process configuration***" has been selected. On this topic, see the chapter "*Process configuration* 222" in the documentation on the component Setup.



Data Browser in the Panel

Structure

The Data Browser has **two toolbars** ("Variable 1077" and "Search/Navigation 1077") and a table with multiple columns. Columns can be hidden or shown, according to the user's choice.

The **Table** presents the measurements and measured data in a tree diagram. The table features the following columns:

Column	Description
Numbering column (#)	Here, the assigned measurement numbers are displayed. Additionally, it is possible to lock in the measurement number (see "*Assigning / Locking measurement numbers* 1075").
Name	In this column, the measurement name and the variable name are displayed. The measurement name is determined by the data storage settings, but can be edited subsequently.
Event time	If a measurement has multiple channel-start-times (event-times), one entry appears in the column "*Event time*" for each different event time. Click on the column entry in order to select the desired event from the dropdown-list. The associated Widgets then show the selected event along with the associated variables/channels (see "*Event time* 1073").
Comment	Displays the content of the variable's property: *Comment*. With device variables, this can be defined by means of the plug-in Setup.
Category	Shows the content of the variable's property: *Category*.
Unit	Displays the content of the variable's property: *Unit*. With device variables, this can be defined by means of the plug-in Setup.
Metadata columns (optional)	If metadata about the measurement are exported, they can be added by means of additional columns in the Data Browser (see "Metadata-Assistant 246").

Note Showing columns

By default, not all columns are shown. You are able to add columns by means of the contextmenu item "Column selection". After any changes, use **save** to preserve the **View**.

Variable groups

The following is a list of the most important variable groups:

Groups	Description
Device variables such as: analog inputs, Display-variables, Field-bus variables, ...	A list of the device variables is provided here: "*Setup - Device Configuration*" > "*Configuring Channels and Variables*" > "*Channel table* 350".
User-defined variables	You can create your own local (PC-) variables. For more info, see the chapter : "*User-Defined Variables* 1087".
Complex variables, such as: Triggers, System-variables	"Complex variables" make a hierarchical structure within the Data Browser possible. For more info see the chapter: "*Complex variables* 1085".
Virtual channels	Results channel of imc Online FAMOS and imc Inline FAMOS.
Bus Decoder	Results channel of Bus Decoder.
Power Quality	Results channel of Power Quality.
imc FAMOS	Results channel of imc FAMOS.
...	...

Using personally customized groups

You can deactivate grouping according to category and create your own grouping system instead.

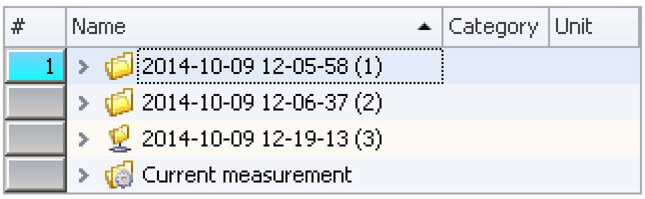
The setting "*Grouping by categories*" can be deactivated in the Options (under "*Data Browser*" > "*Categories*"):

Ribbon	View
Extra > Options ( )	All

Options - Categories	Description
Grouping by categories	The variables are grouped in the Data Browser according to their respective categories (e.g. "Analog inputs", "User-defined variables"). This can be deactivated in order to sort the variables by their names. You can create your own groups by naming the variables according to the following syntax: "Group.Name". For instance, if there are two channels: MeasPoint1.Temperature and MeasPoint1.Voltage, these variables are automatically grouped in the group: "MeasPoint1".

Measurements and measurement names

The Data Browser, along with the entry for the **Current measurement** ( ), displays all **measurements saved** with the experiment.



Measurement	Description
Current measurement	The variables under "*Current measurement*" always reflect the current status. While a measurement is being performed, you can view the current measured data as these variables under "*Current measurement*". **Notes on circular buffer memory** By default, the circular buffer memory in the plug-in Setup is activated for display of the channels. **Under "*Current measurement*", only the content of the circular buffer memory is displayed.**
Saved measurements	The measurements are arranged as list entries on the same level as Current Measurement. Among other factors, the measurement's name depends on the data storage settings (Setup). It may, for example, consist of a time stamp and take the form "*yyyy-MM-dd HH-mm-ss (x)*". (year-month-day hour-minute-second); x: measurement number **Notes regarding measurement** • The measurement name can be arranged to be defined by the user. On this topic, see the settings for the "*Measurement storage area* 114". Here, you can save measured data in subfolders in order to improve the sorting of data in the Data Browser. • Display of saved measurements in the Data Browser can be deactivated. On this topic, see the option: "*Project Management*" > "*General options*" > "*Load measurements* 113". This can be helpful, for instance when very many measurements are performed. In such a case, very many entries would appear in the Data Browser. If these measurements do not need to be loaded, then it can provide better clarity of overview to deactivate the display of the saved measurements.

Measurement name, and renaming measurements

The names of the saved measurements correspond to the folder names as they appear on the hard drive. It is possible to rename the measurements subsequently via the Data Browser.

- To do this, open the measurement's context menu and click on "*Rename*".
- Or select the measurement and press the key <F2>.

When you perform renaming, the corresponding **folder on the hard drive is also renamed**.

Note that you may only use symbols which are allowed. The exception is the Backslash (\). If you use a Backslash (\) in the name, a subfolder is created. E.g. "Motor_X\Measurement_1". This creates a folder : "Motor_X", which contains an additional folder: "Measurement_1". The measured data are saved in this latter folder.

Event time

If a measurement has multiple channel-start-times (event-times), one entry appears in the column "*Event time*" for each different event time. Click on the column entry in order to select the desired event from the dropdown-list. The associated Widgets then show the selected event along with the associated variables/channels.

The selection is available if the individual channels' **start times** are **different**. An example of this is a triggered measurement in which the channels are each associated with different triggers, which fire in succession.

Generally an attempt is made to select as many channels as it is possible to display.

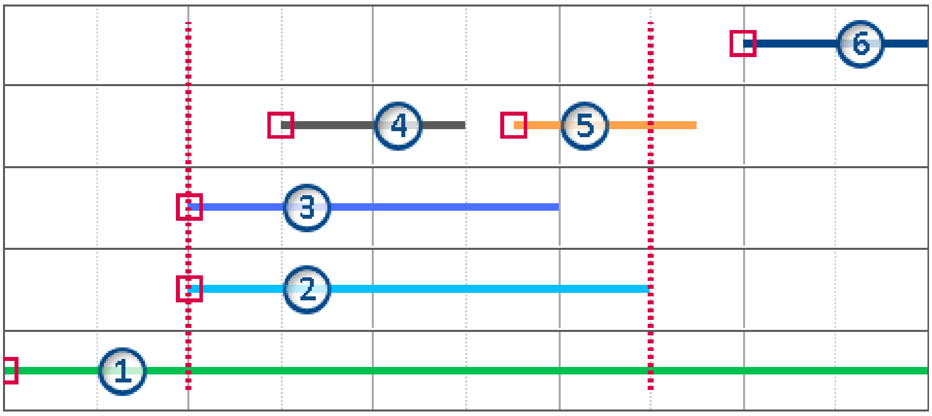
Example: A channel starts at 14:00 and ends at 15:00.

If this channel's event time is selected, all channels are displayed which have any measured data at the time 14:00. It doesn't matter, when they conclude.

Exception: "*Save trigger events in individual files*".

With this setting, each trigger-event for the channels is saved in a separate folder. In consequence, the same channel-name can exist in multiple trigger folders. In his case, only the channel associated with the first pertinent event is displayed.

Example



Dotted lines: Start and stop-times of channel 2; e.g. 14:00 and 15:00 from the above example

5 channels are recorded. Counting from the bottom to the top:

- Event 1: The first channel responds to "*Trigger_48*" (start button).
- Event 2 and 3: The second and third channels are linked to the same trigger (e.g. "*Trigger_01*"). This produces one single event-time.
- Event 4 and 5: The fourth channel has two events. This produces 2 event-times if "*Save trigger events in individual files*" is activated. Otherwise, only one event time.
- Event 6: The fifth channel was triggered once all other channels governed by the triggers have concluded (except the first channel).

Thus, the Events-list shows 4 or 5 event times, depending on the setting "*Save trigger events in individual files*".

Depending on the selection, the relevant individual channels among these are loaded and displayed.

Example: The second event time is selected (Channels 2 and 3). All channels which have any values at the moment of the event time are displayed (1, 2, 3).

Operation - Loading/unloading messages

Saved measurements are located on the hard drive. Operating from the Data Browser, it is possible load and display these measurements. Since the saved measurements can be arbitrarily large, by default they are not loaded. The software knows the path to their storage location, but the data located there are not in the software's own memory.

However, only measurements which are already loaded can be displayed or processed.

Note

It is best to only load measurements which are currently needed. Loaded measurements make demands on the memory. If any measurement is no longer needed, it is best to unload it.

To load measurements, there are multiple methods:

- open the measurement's context menu and click on the corresponding item,
- select the measurement by double-clicking or click on the symbol in front of the measurement's folder,
- or use the arrow keys and Enter key.

To unload measurements

- open the measurement's context menu and click on the corresponding item.

Folder symbol - Measurement status

The folder symbol in front of the measurement's entry reflects the measurement's status:

Status	Description
Current measurement	The is the current measurement, not a stored measurement.
Saved measurement status: unloaded	This stored measurement is not loaded; it would need to be loaded, for its contents to be displayed.
Saved measurement status: loading	This stored measurement is in the process of being loaded. This is a temporary condition which will last until all the measurement's data have been loaded to the program's memory. Subsequently the status changes automatically to "loaded".
Saved measurement status: loaded	This is a stored measurement which has been loaded. Loaded measurements can be viewed and processed.

Note

Automatic loading on demand

If a Widget is linked with a variable belonging to a saved measurement, this measurement is loaded automatically.

Loaded measurement

When a measurement is loaded, its associated files are loaded from the hard drive in a single action.

To apply changes made to these files from outside/by other programs, the file must be re-loaded.

To do this, open the measurement's context menu and select the item: "*Reload measurement(s)*".

Operation - Assigning/Locking measurement numbers

When a saved measurement or "*Current measurement*" is **selected** in the Data Browser, a **measurement number is automatically assigned** to this entry. The measurement number is displayed in the left-hand numbering column (#). E.g., for the measurement number 1: 1. You may assign numbers from 1 through 99.

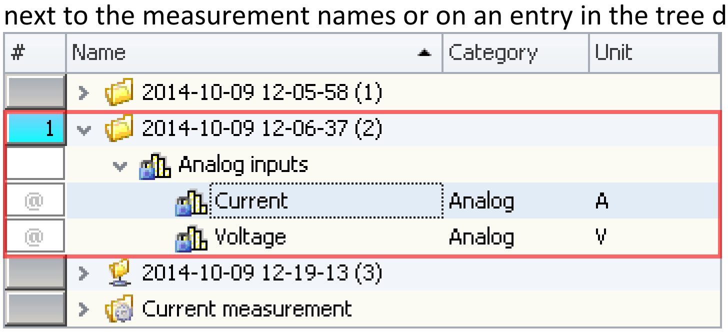
By means of the measurement number, it is possible to access measurements without using or even knowing their respective assigned names.

Example

- You intend to **display all saved measurements in succession** on a Report page. You have a curve window which always displays the channel: "*Channel_001*". However, instead of showing the channel belonging to the current measurement here, you want to display the saved measurement with measurement number: 1. When any measurement is selected, the curve window shows Channel_001 of the selected measurement, since it has the number 1.
- You wish to perform an imc FAMOS analysis on a saved measurement. The imc FAMOS sequence is configured so that the measurement results are obtained from the measurement with the measurement number 1. The imc FAMOS results are then saved back with the measurement having the number 1.
- Each measurement in a curve window is to be compared with a reference measurement (comparison measurement 1078). The comparison measurement is associated with the measurement number 1. The number is locked and remains with this measurement. Any other selection will now be assigned the number 2. The curve window is linked with two channels: one from the measurement having the number 1, and one from the measurement having the number 2. If a different measurement is selected, the reference channel remains in the curve window and the second measurement corresponds to the current selection.

Assigning a measurement number

- To assign a measurement the measurement number 1, click on the cell in the numbering column (#) next to the measurement names or on an entry in the tree diagram.



- To assign multiple measurement numbers, hold down the SHIFT key while clicking on the cells.

Locking/unlocking a measurement number

- If you click again on a previously assigned measurement number, the assignment is locked (1). As a result, the respective number can no longer be assigned.
- To undo the locking, click on the same cell again.

Navigating

The assigned numbers (measurement number) can be transported through the list of measurements.

This means that by using the (cursor) arrow keys, or by means of the buttons in the toolbar ( ), you can make the respective numbers appearing in the "#" column move up and down through the list of measurements. Doing this associates the assigned number(s) with the measurement(s) corresponding to the current list position(s) (see "*Operation - Control and Navigation* 1076").

Operation - Control and Navigation

To open or close a branch (e.g. "*Analog inputs*"),

- use the arrow keys: left/right (cursor),
- use the "+" and "-" keys on the numeric keypad
- click on the corresponding symbol (/)

To navigate between the measurements, use

- the mouse or
- the arrow up/arrow down (cursor) keys or the arrows in the toolbar 1077 ( ).

Navigation using the mouse button

When a measurement or variable is selected by mouse click, it receives the current measurement number (see: "*Operation - Assigning/Locking measurement numbers* 1075").

Navigation by arrow key/button (cursor or toolbar)

Using the cursor keys or by means of the toolbar, you can navigate according to the **Navigation mode** set. All assigned measurement numbers are relocated upward or downward by the step size specified.

In the drop-down list in the toolbar ( ), you can select the navigation mode:

Navigation mode	Description
Default	The selection skips from cell to adjacent cell.
Over measurements	The measurement number is relocated from one measurement to the next.
Over events	The measurement number remains with the measurement selected. If the measurement consists of multiple events, the focus navigates through the events.
Over measurements and events	The measurement number is relocated from one measurement to the next. If a measurement consists of multiple events, the focus navigates through the events first, before the focus moves to the next measurement.

Navigation step size

In the input box (1) in the toolbar, you can specify a step size (≥ 1) for the navigation.

Operation - Checkout and Check-in

Saved measurements are available for subsequent processing. You can save the results of imc FAMOS analyses along with the measured data, or also process the measured data and save the returned results back on the hard drive.

When a measurement is loaded, the file is imported once from the hard drive. The variables belonging to the same loaded measurement can be processed in imc STUDIO. However, the changed are automatically discarded when the measurement is unloaded.

You can also write changes back to the file. To do this, proceed as follows:

- **Load** 1074 **the measurement**, e.g. by means of the context menu item: "*Load measurement(s)* 1080" ( )
- **Obtain writing authorization** via Checkout, e.g. via the context menu item: "*Checkout* 1080" ( )
- **Edit** the variable
- **Write the changes to the file** via Check-in, e.g. via the context menu item: "*Check-in* 1080" ( )
- Unload 1074 the measurement, e.g. via the context menu item: "*Unload measurement* 1080" ( )

Variable symbol - State

The extra character in the variable's symbol in front of the variable's name reflects the variable's state:

State	Description
Loaded variable (protected)	This is a loaded variable (e.g. analog input), which can not be processed. Any changes will be discarded. To perform editing, select the context menu item: "*Checkout* 1080" ( ).
Loaded variable (with write-permission)	This is a loaded variable (e.g. analog input), which can be processed. Changes can be saved using the context menu item: "*Check-in* 1080" ( ).

11.2.3.1 Toolbar

Toolbar: Variable

Menu item	Description
Show individually	All selected channel variables (e.g. analog inputs) are opened **in separate** "free-floating" curve windows 1368. All other selected variables (e.g. Display variables) are added to the window "*Current values* 1083".
Show together	All selected channel variables (e.g. analog inputs) are opened **in a shared** "free-floating" curve window 1368. All other selected variables (e.g. Display variables) are added to the window "*Current values* 1083".
Show current values	Opens the dialog Current values 1083, which displays the values of selected variables.
Always on top	If this button is pressed, new display windows ("*Curve windows*" and "*Current values*") are always displayed in the foreground

Menu item		Description	
	Load/Import variables	Load:	Creates variables with values from a file.
		Import:	Imports values from a file to existing variables.
		(See "*Load/Import Variable* 1078")	
	Export variables	Exports variables' values to a file. (See "*Export variable* 1618")	
	Create user defined variable	Creates user-defined variables, including single value- and text-variables, or report channels. (More info is provided in the chapter "*User-Defined Variables* 1087")	
	Shows comparison measurement	Allows viewing and comparison with measurements from other experiments. Selected measurements from other experiments can be displayed in the current experiment's Data Browser. This makes comparisons possible.	

Toolbar: Search/Navigation

Menu item		Description
	Find	Displays a search box for the purpose of locating elements in the Data Browser. Enter the text to be located. When you click on the <ENTER> key or the button ( ) at right, the search starts. The first element is selected. To select the next element, click again on the Enter key or on the button ( ) at right.
	Navigation Mode	Selection of Navigation mode (see "*Operation - Control and Navigation* 1076")
	Navigation step size	Step size for the Navigation (see "*Operation - Control and Navigation* 1076")
	Step up/down	Navigate one step up/down (see "*Operation - Control and Navigation* 1076")

11.2.3.1.1 Load/Import variable

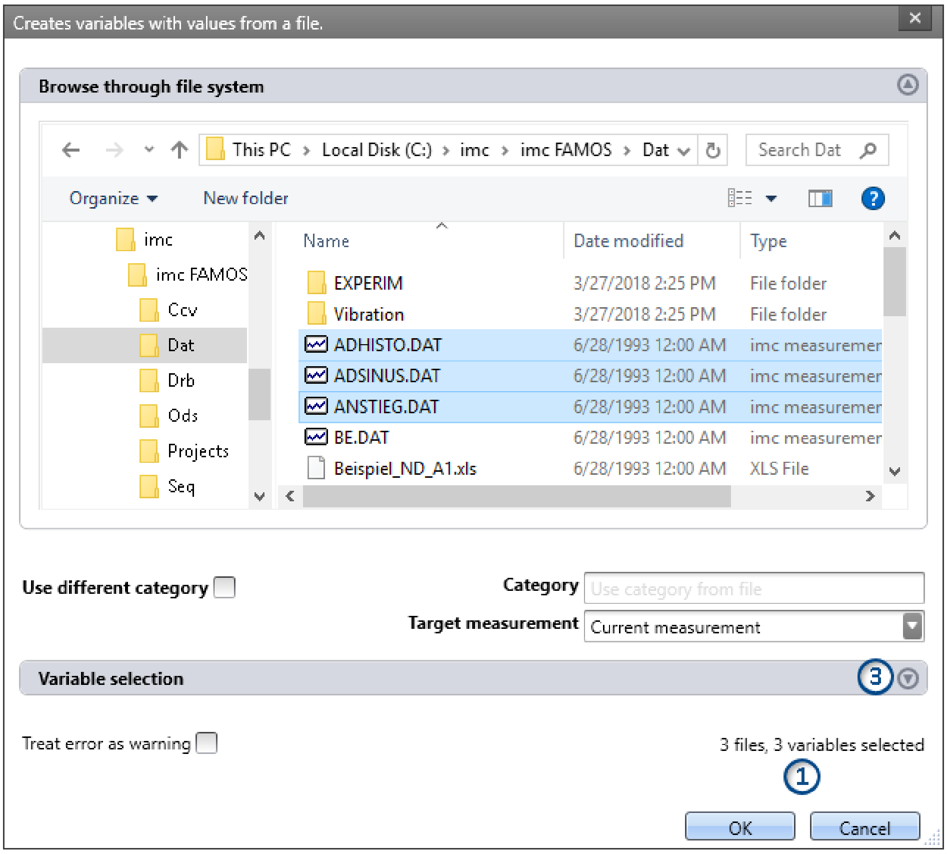
Load Variable: The action enables **creation of user-defined variables with pre-defined values** from saved files. The variable may not exist before the command is run.

Import Variable: The action enables **setting the values of an existing variable** from saved files. The variable must already exist before the command is run.

The values must be saved in a suitable file, for example one which was created using the commando: "*Export Variable*". It is possible to select one or more variables to be imported or loaded. If you wish to use multiple files, they must all be located in one folder.

Brief description:

In the upper region, there is an Explorer for selecting files:



Here you can use the "Explorer"-functions to **navigate to the files and select them**. After making a selection, you can close the dialog by clicking "OK". **All file selected are loaded** or alternatively selected for the Import command.

Exception: If you don't select any file in the Explorer, all importable files belonging to the current folder are automatically selected.

File count (1): At the bottom right there is a readout of how many files are selected and how many variables belonging to these files are selected.

Variables-box (Variable selection) (3): Using the buttons ( ) near the right edge, you can, for example, expand the Variables area. You can also make additional settings such as

- **de-/selecting** specific files or **variables** using the checkbox ( ) , for cases where not all variables belonging to a file are to be loaded. This means that the are present in the list but will not be imported. They can be activated for import again at any time.

Variables list	Description
Variable name	Name of the file/variable as found in the file.
Target variable name	Name of the variable as it is to be found in the Data Browser following import.

Other options

Category	Description
Only for: Load Variable	
Use different category	Put a checkmark in the box if you wish to create the variables in a deviating category. An input box for the new category appears. This category is applicable for all variables loaded. • **deactivated:** The variable is displayed **in the variable's category, or without any category** under "no category". • **activated:** The variable is displayed **in the specified category or without any specification under "User-defined variable"**.

<table>
<tr><th>Target measurement</th><th>Description</th></tr>
<tr><td>Current measurement</td><td>Load: The variable appears in the Data Browser under "Current measurement".
Import: The variable overwrites any variable existing under "Current measurement".</td></tr>
<tr><td>Last completed measurement</td><td rowspan="3">Load: The variable appears temporarily in the Data Browser. The variable is not saved along with the measurement.
Import: The variable temporarily overwrites any existing variable in the measurement. You are able to write any changes back into the file. See the section: "Data Browser" > "Operation - Checkout and Check-in 1077".</td></tr>
<tr><td>Measurement number Measurement#<No></td></tr>
<tr><td>Fixed measurement name</td></tr>
</table>

Other options	Description
Treat error as warning	If the command is executed even though not all selected variables exist, error messages are posted. In normal cases, the Sequencer is exited when an error message appears. Das führt auch dazu, dass keine Variable importiert wird. In order that the command always imports all variables, it is possible to activate this option. In this case, no error messages appear in the logbook, but warnings instead. Warnings do not cause the Sequencer to close.

11.2.3.2 Context Menu

Context menu in the table - General

By right-clicking on the mouse over the table, the following context menu appears. Depending on the particular position, some of the items are hidden.

Menu item	Description
Update Data Browser	
Filter	Opens the Editor for creating a filter. The Data Browser then shows only the appropriate content according to the filtering.
Measurement number #x	Only in the Numbering column. Opens an input box for entering the desired lowest measurement number for the subsequent selection. I.e. if the number "5" is selected, at the next selection the "1" is not assigned to any measurement, but instead "5", if it is still available.

Menu item	Description
Export the selected variables	Exports values of variables to a file.
Create variable	Creates user-defined variables, including single value- and text-variables, or report channels. (More info is provided in the chapter "*User-Defined Variables* 1087")
Delete selected variables	Deletes the selected variables from the Data Browser. Note that device variables and system variables can not be deleted.
Edit selected variables	Opens the Editor for changing the properties of user-defined variables. The dialog matches that of "*Create variable*". With some changes, the variable is newly created. In these cases, the current value is discarded. A corresponding warning is issued first. When a device or system-variable is selected, the dialog opens. Here you can view the variable's properties, but not make any changes. (More info is presented in the chapter "*User-defined Variables* 1087")
Show individually	All selected channel variables (e.g. analog inputs) are opened **in separate** "free-floating" curve windows 1368. All other selected variables (e.g. Display variables) are added to the window "*Current values* 1083".
Show together	All selected channel variables (e.g. analog inputs) are opened **in a shared** "free-floating" curve window 1368. All other selected variables (e.g. Display variables) are added to the window "*Current values* 1083".
Find	Displays the Search box. See the matching description for the toolbar 1077.
Navigation mode	Selection of Navigation mode (see "*Operation - Control and Navigation* 1076")
Add Metadata column	Metadata columns can be displayed if saved along with the measured data. Here, you can activate existing metadata columns for display.
Delete Metadata columns	Opens the dialog for deactivating the display of activated metadata column.

Context menu table - Save measurement

By right-clicking the mouse over the table on saved measurements, more context menu items become available:

Menu item	Description
Load measurement(s)	Loads saved measurements for viewing and/or processing purposes (see "*Operation - Loading/unloading measurements* 1074")
Unload measurement(s)	Unloads loaded, saved measurement(s) (see "*Operation - Loading/unloading measurements* 1074")
Reload measurement(s)	Reloads already loaded measurements in order to undo changes or to load changes of the data to the hard drive (see "*Operation - Loading/unloading measurement* 1074")
Delete measurement(s)	Deletes saved measurement(s). When a measurement is deleted, it is deleted from the hard drive. Undo is not possible.

Menu item	Description
Load measurement settings	Loads the appropriate experiment settings for the measurement. When traceability is activated, all experiment settings of the respective measurement are saved separately. Thus, each measurement's own configuration can be loaded subsequently (see the description: "*imc STUDIO (general): Options*" > "*Traceability of measurements* 113")
Rename	Opens the input dialog for changing the measurement's name. If the name is changed, the associated folder on the hard drive is changed as well (see: "*Measurements and measurement names* 1071").
Copy name	Copies the name of the measurement to the Clipboard.

Table context menu - Saved variable (type)

Right-clicking the mouse over the table on saved variables or their category causes additional context menu items to appear:

Menu item	Description
Checkout	Obtains writing rights to saved variables, so that they can be processed (see "*Operation - Checking in/out* 1077")
Check-in	Writes changes to variables, which have been checked out, to the file. Subsequently, the writing rights are deleted (see "*Operation - Checking in/out* 1077")
Undo	Discards changes to variables which have been checked out.

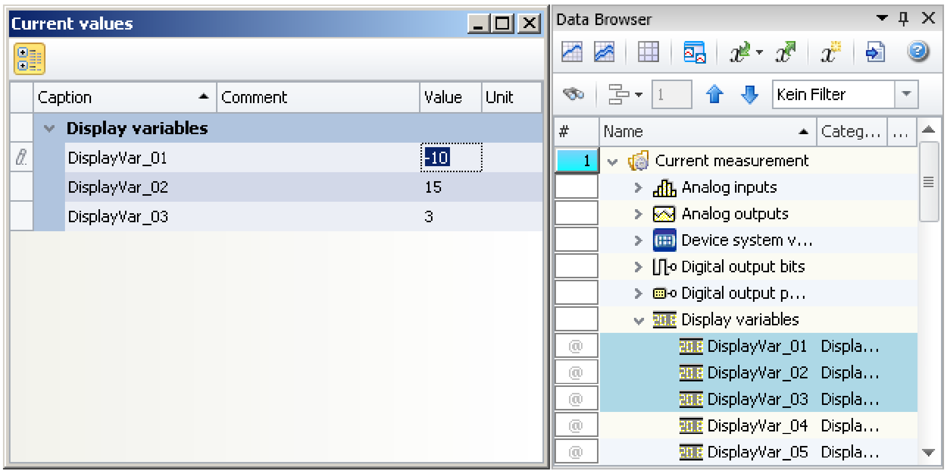
11.2.3.3 Current values - Inspecting/changing variables

The following description applies to variables which can not be viewed in the curve window, e.g. Display variables.

To directly display a variable's values, or to interactively alter them independently of a Widget,

- double-click on the entry in the variable in the tool window Data Browser
- or, select the desired variables and click on the "*Show* 1077"-Button (/) in the toolbar of the tool window Data Browser.

Subsequently, a dialog opens, as shown below:



Inspecting or interactively altering variables
Example: three Display variables

Changing values

To change the value of variables (except bits), proceed as follows:

- click in Edit box
- enter a new value or the new text
- confirm the input with the <ENTER> key

To change a bit's value, proceed as follows:

- click in the checkbox

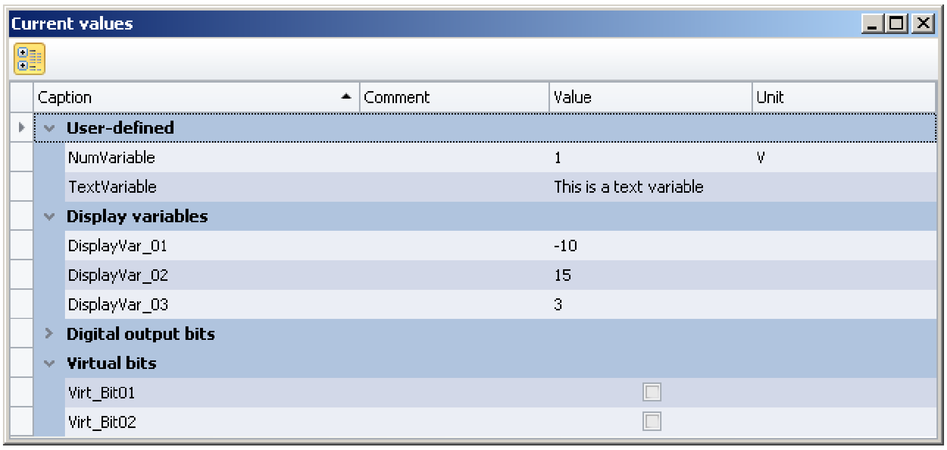
Structure and configuration

The dialog **current values** shows the desired variables in a table with multiple **columns**.

The variables are organized in groups. To activate or terminate the grouping, click on the Grouping button ( ).

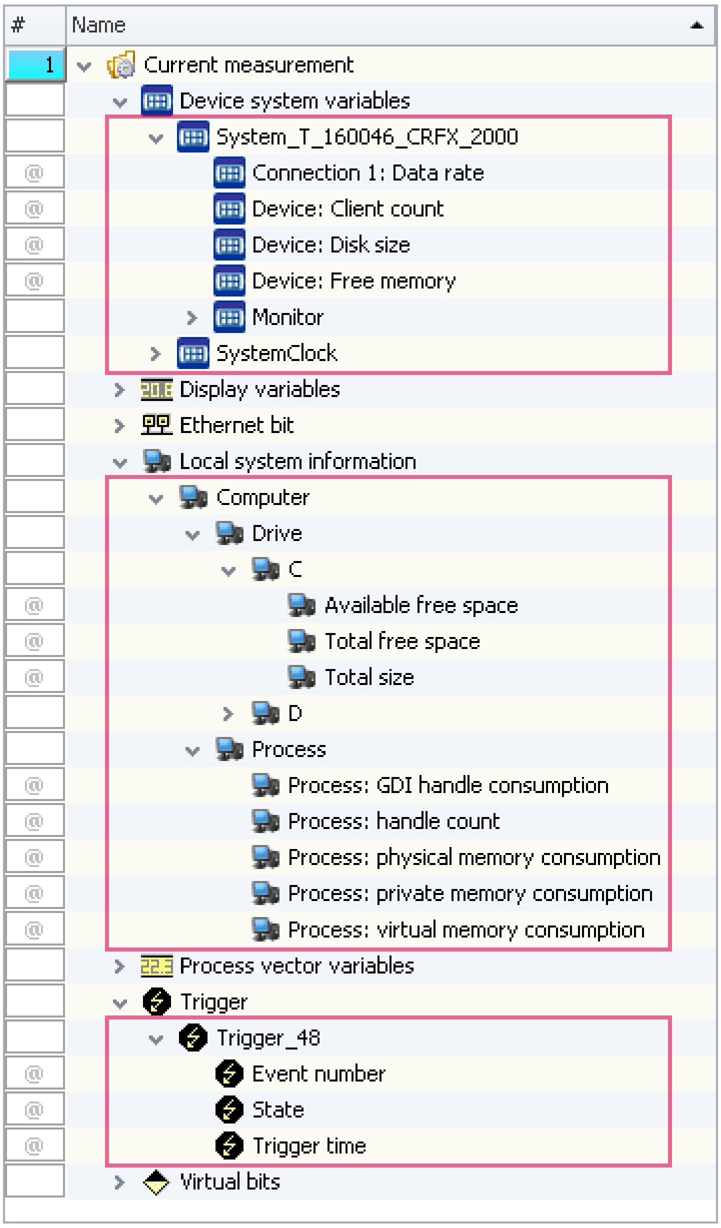
The **table** contains, among other things, the variable names and their current value. The value is displayed in the Edit box as a number or text. For Ethernet bits there is a checkbox.

The dialog settings are saved with the experiment and displayed along with it too, if it was open.



Dialog: Current Values
Sample variables

11.2.3.4 Complex variables



Complex variables make a hierarchical structure within the Data Browser possible. The following variables are displayed as "Complex variables":

- device system variables
- local system information, and
- triggers.

These variables contain various kinds of information which are each displayed separately and which can easily be moved to the Panel by means of Drag&Drop.

Trigger		Description
Trigger Name e.g. Trigger_48	Event number	With multi-triggering: count of previous trigger releases
	State	Current state of the trigger: armed, released, stopped
	Trigger time	Time when the state last changed

Device system variable	Description
System_DeviceName	
Free memory	Available memory in internal data storage medium
Disk size	Capacity of internal data storage medium
Client count	Count of active connections to the device. E.g. imc STUDIO, imc STUDIO Monitor or imc REMOTE connections or a data storage medium used.
Connection 1	First detected connection with the device (imc STUDIO).
Data rate	Currently transmitted Bytes/s at the receiver (instantaneous value)
Critical channel fill level	Proportional (in percent) fill level of the "critical channel's" FIFO. The "critical channel" is the channel with the highest fill level. The fill level is allowed to rise temporarily and have high peaks. However, it may never reach 100%, or a data overflow occurs in consequence. If the fill level rises not temporarily but constantly, this indicates an overflow will occur later. To prevent data overflows, see the notes in these chapters/sections: "*Miscellaneous*" > "*Tuning, Tips and Tricks*" > "*Data Overflow - Tips* 1937".
Critical channel name	Name of "critical channel", see "*Critical channel fill level*".
Connection 2 Monitor 1	First connection with imc STUDIO Monitor (corresponds to "*Connection 1*").
Connection x Monitor n	Additional connections
SystemClock	
PC time	Current PC clock time
System time	Current clock time of imc STUDIO ("VRTC 315"). This time is used for all components of imc STUDIO.

Local system information	Description
Computer	
Drive n	Information about the local data carrier. Pay attention to the free memory space if you are trying to save large volumes of data.
Total free space	Free memory on the local data carrier. This property reflects the total amount of free memory on the drive, not just the portion available to the current Windows user. In most cases, the parameter "Available free space" is to be used.
Total size	Data storage capacity of the local data carrier.
Available free space	Free memory space on the local data carrier. This property reflects the amount of free memory space available to the current Windows user.
Process	Various kinds of system information. For information and value limits, see the associated Internet forums. Monitoring these values can be of interest in long-term testing.

11.2.3.5 User-Defined Variables

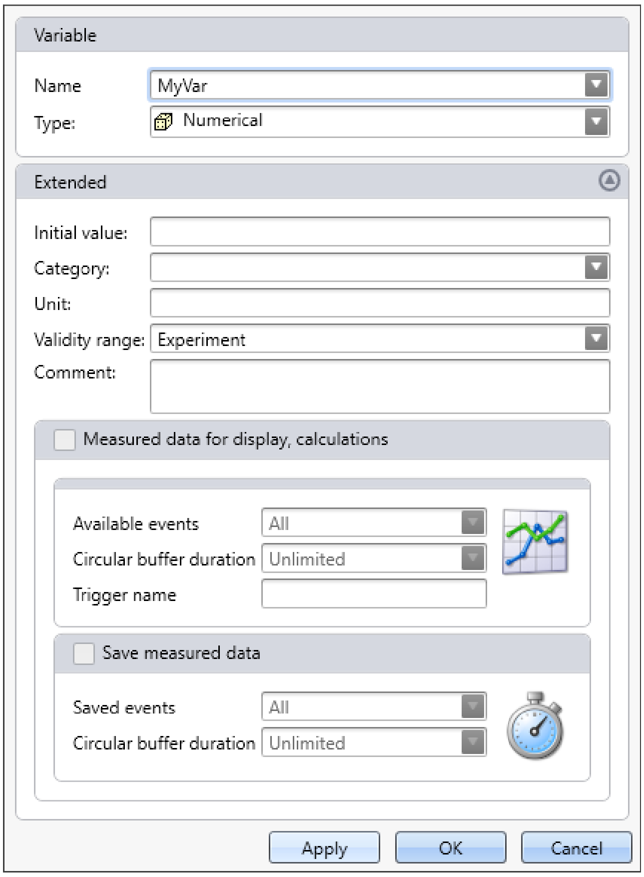
imc STUDIO provides the user with the ability to **create** and use **user-defined variables**.

Note — Variables are not available in the device

User-defined variables only exist on the PC. It is not possible to access them from the device.

Creating variables

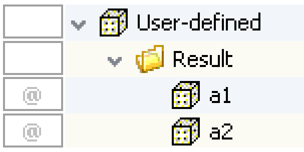
You can create user-defined variables in the Data Browser by clicking on the symbol . Furthermore, at certain locations where variables can be used, you will find a button with the caption "*Create*", for example in the command "*Set Variables*1624". A dialog opens which helps you in setting up the variable.



Create User-defined Variable dialog

The dialog contains two regions. "*Variable*" contains an input box for the name and a selection box for the type. In the lower region "*Extended*", you can specify additional properties such as the "*Initial value*" and "*Unit*".

Variable

Parameter	Description
Name	Here, enter a name for your variable. All alphanumeric characters are permitted. If you use the name of an already existing variable, the existing one is deleted and a new one with the specified properties is created.  **Display in the Data Browser** To join multiple variables together in a group, you can use the character '.' in the variable's name. E.g. *Result.a1*, *Result.a2* results in this display in the Data Browser.
Type	For your user-defined variable, you can choose among various types:

Typ	Description
Numerical	Saves a **number**; this type suitable both for integer values and for floating points numbers. Under *Initial value*, you can set the value with which to initialize the variable (see the section *Extended*). The default for this value is 0.0.
Text	Saves an **arbitrary text**. Under *Initial value*, you can set the value with which to initialize the variable (see the section *Extended*). The default for this value is an empty string, represented by the readout *Empty Value* in gray letters.
Data table	In order to save data which you import from a **database** by means of SQL, use this data type. The data table is empty when created. Here, you can't specify any initialization value.
Channel	Creates a channel. In these, you can save **contiguous**, time-referenced data. The channel is empty when created; here, no initialization value is possible. Information on the data storage options is provided under *Extended*.
Report channel	Saves **textual commentary**; for more information on their use, see the section "*Report Channel* 1091".

Extended

Parameter	Description
Initial value	Your variable is initialized with this value. This means that when creating the variables, when loading an experiment and upon resetting of the variables ("*Set Variables* 1624"), the value entered here is written in the variable. In this box, it is only possible to enter anything if the variable's type is **Numerical** or **Text**. With all other types, this box is disabled and the variable is empty when created.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Category</td><td>Assigning a category gives you the ability to structure the variables in the Data Browser.

If there are already categories of user-defined variables, then to display them, click on the symbol in the box Category after entering the name. This expands a selection list of all previously existing categories. The categories only serve structuring purposes and do not influence what values the variables can take.</td></tr>
<tr><td>Unit</td><td>You can assign a unit to your variables.</td></tr>
<tr><td>Validity range</td><td>The setting Validity Range determines the availability of your variable. What is saved is always only the variable itself, not the current value!
<table>
<tr><th>Validity Range</th><th>Description</th></tr>
<tr><td>Temporary</td><td>Temporary variables are associated with the session, which means they only exist until imc STUDIO is closed. Upon the next start they are no longer available.</td></tr>
<tr><td>Experiment</td><td>Variables with this validity range are associated with the current experiment. They are saved along with it and are available again after loading.</td></tr>
<tr><td>Sequencer</td><td>Variables with this validity range are associated with the Sequencer. You should use this validity range if you intend to load other experiments via the Sequencer. Your variables remain intact even if the new experiment has its own variables.</td></tr>
<tr><td>Project</td><td>Variables with this validity range are associated with the current project. They are thus available for all of a project's experiments.</td></tr>
<tr><td>Persistent</td><td>Persistent variables are project-dependent and globally available for all projects and experiments.</td></tr>
</table>
Any "higher-level" variables are not overwritten if a variable of the same name but from a different validity range is loaded.

Example: Suppose a variable exists with the validity range "Project" or "Sequencer". An experiment is loaded by means of the command: "Open experiment". A variable having the same name exists in this experiment and has the validity range "Experiment". This variable is not loaded from the experiment when the command is run.</td></tr>
<tr><td>Comment</td><td>It is possible to add a comment to a variable. It is seen in the Data Browser in the column Comment, or can be displayed in a Widget with the help of placeholders 145, for example.</td></tr>
</table>

Parameter	Description
Measured data for display, calculations	These settings are only relevant if you wish to create a variable of either of the types **Channel** or **Report Channel**. For the type **Report Channel**, this property is permanently and unalterably selected. A description of the settings for *Saved events* and *Circular buffer duration* is presented under Setup in the chapter "*Data Transfer* 381". **Trigger:** Report channels must always be associated with a trigger, while channels can be associated with a trigger. Ensure that you use a a name which also exists in the Setup.
Save measured data	These settings are only relevant if you wish to create a variable of either of the types **Channel** or **Report Channel**. Additionally, the option *Measured data for display, calculations* must be selected in order to be able to select this option. In order to save your measured data (channels) on the PC, select this option. The saved data are stored in the same folder as the data from your other saved channels (e.g. analog channels). A description of the settings for *Saved events* and *Circular buffer duration* is presented under Setup in the chapter "*Data Transfer* 381".

11.2.3.5.1 Report Channel

Report channels provide the ability to save textual commentary as a channel, along with your measured data. Report channels can be displayed like any other channel, e.g. in the curve window.

Creating a Report Channel

To create a Report channel, first create a user-defined variable of the type **Report Channel**.

Note Trigger name

- Report channels are **always associated with a trigger** and can only be written to while the respective trigger is active.
- If you don't enter a trigger name, then when you click on *OK* or *Apply*, then ***Trigger_48*** is automatically suggested. In the default case, this is the start-trigger of the first device. However, it may be in some circumstances that this trigger has been renamed and that **no** *Trigger_48* exists. Ensure that the trigger specified here exists and is active when data are written to the Report channel!
- You can associate the Report channel with any arbitrary trigger, on the condition that at least **one additional active measurement channel** is dependent on this trigger.

If you wish to save the Report channel along with your measurement data, then when you create it, select the option "*Save Measured Data*". The measurement settings (e.g. storage location, interval data saving) will be applied to you measurement channel.

Note Data storage

Report channels are by nature **PC-side variables**, which means they can only be saved on the PC; saving to the device is not possible!

Writing to a report channel

While data are being written to the report channel, the trigger to which the channel was assigned when it was created must be active. You can add the text commentary either via special Widgets, or use commands:

Widgets

For text-based report channels, there is the Widget "*Text input for report channel* 1365", which is found in the category *Input, Output.*

Note Context

Report channels containing text entries can additionally save a context along with the text entry. The context is typically the channel(s) in which the event to which the comment refers occurred. How to use the context is described under the Widgets "*Text input for report channel* 1365".

Commands

It is possible to write to text-based report channels by means of the command Set Variables 1624.

FAQ

Question: At what point in time are the entries written to the channel?

Answer: If neither the Widget nor the curve window is linked to the Navigation bar 1394, the entry is always issued the **time stamp of transmission** (initiation of the command, clicking on the Widgets).

If both are linked with the Navigation bar, it is possible to set by means of the Navigation bar's settings 1404 whether the behavior described above is desired or whether the entry is to be inserted at a marker (Slider 1401).

Searching for, and subsequent changing of entries

Note

Navigation

In order to be able to navigate through the channel entries, the channel must be linked with the **Navigation bar**. Explanations of this topic, as well as of navigation through the entries, are presented in the chapter Panel in the section Navigation Bar 1394.

Post-processing

In order to edit the report channels belonging to concluded measurements, the respective channels must be checked out by means of the ***Data Browser*** (context menu > Check Out). Next, make the desired changes. In order for the changes to be saved, the channels must be checked in after the editing (context menu > Check In).

The next paragraph describes subsequent editing of report channels. **More detailed information** on the Navigation bar, the slider and the **navigation capabilities** are presented in the chapter Panel in the section Navigation Bar 1394.

In order for the channels to be edited, the following three conditions must be met:

- The channel to be edited must be linked with a corresponding *Widget*; symbolic measurement names (Measurement #x) are also possible.
- The channel to be edited must be linked with the **Navigation bar**; symbolic measurement names (Measurement #x) are also possible.
- The Widget linked with the channel must also be linked with the Navigation bar.

FAQ

Question: Why do the measurements need to be checked in/out?

Answer: Saved measured data are **write-protected**. By means of **checking out**, a writable **copy** of the original data is created which can then be edited. By means of **checking in**, this copy is saved and displayed as a new, valid version. However, since the editing is performed on a copy, the original state can be restored at any time.

Changing entries

Open the dialog "*Find in Variables* 1403". There, you can alter the values and times however you wish.

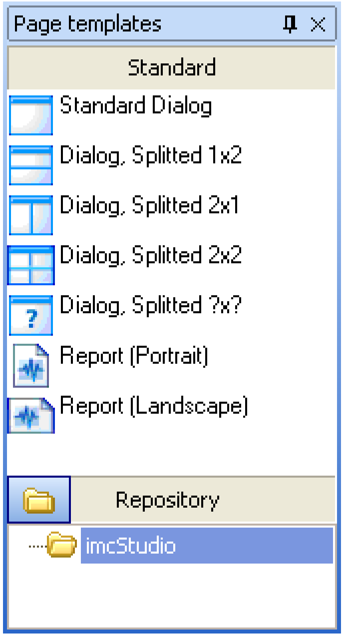
Inserting entries

To insert an entry, first use the Navigation bar to set **where** the entry is to be inserted. The insertion position of the new value corresponds to that of the **slider**. Once the slider is at the desired location, apply the linked Widget to insert the value.

Deleting entries

Open the dialog "*Find in Variables* 1403". There, highlight the entry to be deleted using the mouse, and click on the Delete key.

11.2.4 Page templates



Page templates

In this tool window, you find templates for a new page. The available choices are the same as in the dialogs for adding 1375 a new page.

11.2.5 Repository

The tool window Widgets and page templates each have their own repository. You can export completed pages and Widgets, in order to be able to insert them at other locations later.

Both repositories use the file system for the structuring and naming of the elements in the repository.

By default, the stored files are located here:

- Widget repository: %HOMEPATH%\Documents\imc\imc STUDIO\Widgets
- Page repository: %HOMEPATH%\Documents\imc\imc STUDIO\PanelPages

Note — **The Repository is user-dependent**

The default path is in My Documents. Consequently, it is user-dependent. If all users are to have access to the same repository, relocate it accordingly.

Suggestion:

- %PUBLIC%\Documents\imc\imc STUDIO\...

Adding elements to the Repository

Elements can be added to the Repository via the context menu or by using the Drag&Drop technique while holding down the <CTRL>-key. The elements in the Repository are assigned a distinctive name, for instance, the current page’s name. If the name already exists, a prompt appears regarding whether to overwrite the existing file. If overwriting is denied, a "*Save as*" dialog appears.

It is also possible to add multiple Widgets to the Repository together as a single element. For this purpose, all desired Widgets must be selected when performing the adding procedure.

Importing elements from the Repository

You can use the Drag&Drop technique to move elements from the Repository to the desired location.

Menu items

You can perform the following actions by means of the Repository’s menu items:

Menu item	Description
Set the Root Directory	This enables you to change the path to the respective repository. Note that the existing repository is not automatically copied in the process. You can copy it manually.
Delete	Deletes the selected element. This action can not be reversed.
Rename	Renames the element. If the name of a saved page is changed in this way, the page title also adapts itself accordingly when the page is re-imported from the Repository back to the Panel.
Delete	Deletes the selected folder along with all elements belonging to it. This action can not be reversed.
New Folder	Creates a folder which can be used for the purpose of grouping elements.
Rename	Renames the folder.

11.3 Context Menu

Context menu: The Panel page's tab

Right-clicking the mouse over the page's tab or on the empty region at right calls the following context menu:

Menu item	Description
New Page	Selection list for creating a new Dialog or Report-page is opened. (see: Insert - Dialog / Report 1375)
Import Page	This lets you import a saved page (file type: dbv). If the page's designation is identical to that of an already existing one, you are prompted whether to overwrite the existing page. If you answer "No", the imported page is appended along with a new page title (incremented number).
Export Page:	
As Panel Page	Saves the current Panel page as a file (file type "Panel pages (*.dbv)").

Menu item	Description
As Graphics	Saves the current Panel page as a graphics file. You can select among the following graphics formats: • Portable Network Graphics (*.png) • Windows Bitmap (*.bmp) • JPEG (*.jpg)
As PDF	Saves the current Panel page in PDF format.
Into the Repository	Saves the current Panel page in the repository (Tool Window: Page templates 1093).
Show Page on Monitor	• embedded: The page is displayed in the plug-in's Panel main window (default selection) • <Monitor name>: The page is displayed in fullscreen mode on the monitor selected. Independent of the opened main window.
Zoom Zoom (All pages)	Zooms the Panel page for the purpose of better display of, for example, Report-pages (see Zooming Panel pages 1384).
Page Options:	
Page Layout for Printing	Opens the dialog: "*Page Setup*" Here, you can change the setup and printout settings for Report-pages (including paper size, source, orientation, margin).
Access Rights to the Page	The authorization to edit and display specific pages can be linked to specific user roles. What settings for user rights apply to a page when it is created in "*imc Standard User*" status? Example: All pages are write-protected. You can edit any pages which you yourself have made. With the access rights level "*Panel*" it is possible, for instance, for even the "*imc Standard User*" to create or import custom pages (by default, this is refused). The rights to the individual page depend on the respective user level. Thus, an "*imc Standard User*" who creates a page also has the right to edit and delete it. If a user on a different level creates the page, then these rights remain with an "*imc Advanced User*". The rights to execute these menu actions can be modified at a later time.
Lock Page	Lock/Unlock the current page. Individual pages can be protected against changes (see Lock and unlock page 1383).
Page	Deletes the selection (the page or the selected Widgets).

Context menu: Panel page

Right-clicking the mouse over the Panel page when the Design-mode is active calls the following context menu:

Menu item	Description
Insert element	Creates a Widget (operating or display widget) at the selected location.
Undo	Reverses the last change.

Menu item	Description
Redo	Restores a previously reversed change.
Paste	Inserts the content of the Clipboard at the selected position.
Design Mode	• Activated: the Panel page can be edited, the Widgets can not be operated. • Deactivated: The Panel page can not be edited. The Widgets can be operated.
Skin:	You can choose among multiple pre-defined color schemes (Skin). The color scheme influences the foreground and background colors of the Widgets and pages.
Blue, Grey, ...	Widget-colors and the background colors of the current page align to the selected skin.
Report Standard	Skin specially adapted to printout. Widget-colors and the background colors of the current page align to the selected skin.
Save skin as	A user-defined skin is generated from the current colors of the Widgets. For this purpose, a dialog appears which prompts for confirmation before saving, since this affects all Widgets on the current page. The effects are displayed temporarily on the current page.
Delete skin	Deletes the user-defined skin used.
Grid	For the purpose of more easily positioning and moving Widgets, a grid can be imposed over the page (see Aligning to grid 1383).
Adapt Page Size	See Adapt/automatically adapting the size of pages and Widgets 1381.
Properties	Opens the Properties window of the Panel page 1378.

Context menu: Widgets

Right-clicking the mouse on the "crosshairs" (⊕) within the selected Widget calls the following context menu:

Menu item	Description
Copy	Copies the selection or the selected Widgets to the Clipboard.
Cut	Clips out the selection or the selected Widgets and moves them to the Clipboard.
Delete	Deletes the selection (the page or the selected Widgets).
Arrangement:	
To Foreground	Moves the selected Widget all the way to the foreground, on top of all other Widgets. (see: Widget-levels - Foreground/Background 1104)
To Background	Moves the selected Widget all the way to the background, beneath all other Widgets. (see: Widget-levels - Foreground/Background 1104)
Align	Aligns all selected Widgets to a line. (see: Align and Cascade 1105)
Cascade	Widgets are in stacked at the upper left corner of the Panel page according to their respective Widget-levels. (see: Align and Cascade 1106)
Group	Groups Widgets together (see: Grouping Widgets 1108)

Menu item	Description
Dock	The selected Widget is docked at the respective edge (see: Docking 1107)
Remove Unused Channels from Curve Windows	If curve windows are associated with channels which no longer exist, these associations can be deleted.
Curve Window Toolbar	• Activated: The curve window's toolbar is always displayed if a curve window is selected. • Deactivated: The toolbar is not displayed. All functions can be accessed via the context menu.
Events	Opens the Editor for linking commands with switches/buttons (see Linking commands with switches 1124)
Into the Repository	Saves the selection or the selected Widgets in the repository (Tool Window: Widgets 1068).
Properties	Opens the Properties window of the Widget 1108.

11.4 Design Mode

To edit Widgets on a Panel page, the Panel must be in "*Design Mode*". The Design Mode is recognized by the appearance of the associated symbol.

Ribbon	View
Panel-Navigation > Design Mode ( )	Complete
Panel-Design > Design Mode ( )	Complete
Home > Design Mode ( )	Compact, Standard

Or at the associated symbol next to the page name.

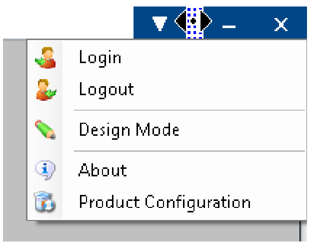
By default, this mode is **deactivated following the program start**. Activation/deactivation of the mode always applies **for all pages**.

Activating Design-mode

- via the menu item, or
- by moving a Widget to a Panel page by means of Drag&Drop.

Activation while in Full-screen mode:

Open the context menu over the bar on the top. In this menu, select the item "*Design Mode*".



Deactivating Design-mode

- by means of the associated menu item, or
- when you start the measurement.

Protecting against changes

You can have a selected page completely locked out of editing 1383 (independently of Design Mode).

Note — No protection against deletion of the page

Even when Design Mode is deactivated you can delete or add pages. The Design Mode is not a way to "lock" the Panel component. Only the content of the pages is protected from changes.

11.5 Widgets - Operation and Properties

Widgets are placed (1099 **inserted** 1099) 1099 on the Panel page.

They offer a variety of **context menus** 1100 and **properties** 1108

In general, there are multiple ways to operate the Widgets:

- Move and change size 1101
- Select 1101
- Editing of Widget-elements 1102
- Move to background/foreground (Widget-levels) 1104
- Align and Cascade 1105
- Docking 1107
- Grouping 1108

Some Widgets have special functions, such as:

- link to variables (see the chapter: Variable linkage 1390)
- Extra variables (multiple scales/pointers and calculations of variables, e.g. Difference)
- Zones 1114
- Linking commands with switches 1124
- Use of placeholders 145

The structure

Each Widget consists of different ***elements*** 1102:

- Boxes displaying the **title** or the current **value**
- **Scales**
- **Numbers**
- **Meters**, **bar meters**, ...

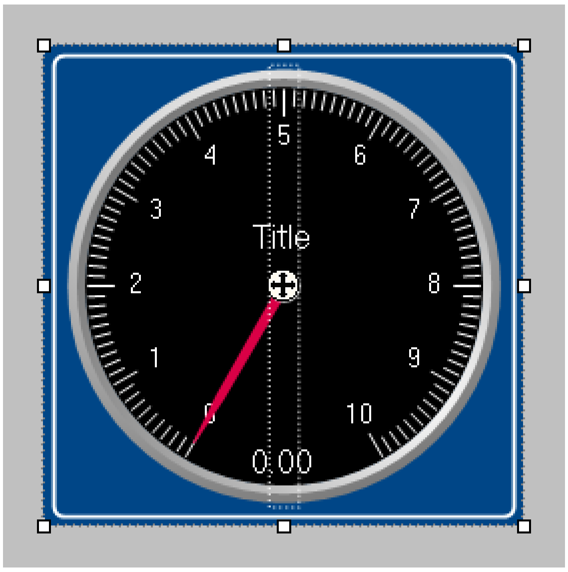
Some of these element have their own context menu 1100 and can be edited 1102. Among other things, they can be moved, or their size and color can be changed. Some of these changes can also be made through the use of the Widget's properties 1108.

11.5.1 Insert Widget

There are various ways to create a Widget on the page:

- Use Drag&Drop to move the Widget from the tool window "*Widgets*" to the Panel page
- Select the desired Widget in the tool window "*Widgets*". Use the mouse to drag a frame (of the desired size) to the Panel page
- Open the context menu 1095 belonging to the Panel page and select "*Insert Element*". Select the desired Widget.
- Use Drag&Drop to move a variable from the tool window **Data Browser** 1069 to Panel page and select the desired Widget (see: Variable linkage by Drag&Drop 1391)

Once you are finished positioning, the Widget appears as selected, as shown in the image below:



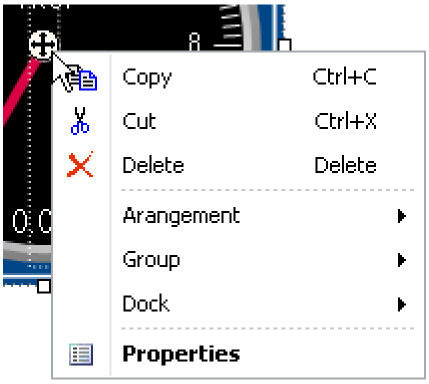
Widget in selected state (example)

Note	Aligning to the grid can help

An easy way to position and move Widgets is to use a grid on the page (see Aligning to grid 1383).

11.5.2 Context menus of the Widgets

Widget Opening the context menu



Context menu of a Widget example)

To open this context menu, select the Widget and right-click on the "crosshairs" (⊕).

The context menu for the Widget appears.

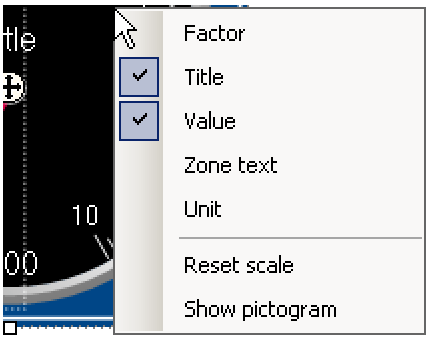
By this means, you can also open the Properties 1108 without using the tool window.

Other context menus

Some Widgets also have additional context menus:

- to show or hide Widget-elements 1102, such as boxes, and for resetting some properties
- to edit selected Widget-elements 1102

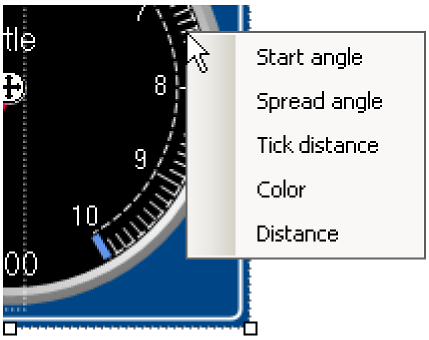
Here, using the example of a *standard meter*.



Context menu for the background

To open this context menu, select the Widget and right-click over the background.

A context menu appears, by which it is possible to show/hide Widget-elements 1102, for example.



Context menu for the Widget element

To open this context menu, select the Widget-elements 1102 and right-click over the background or the control.

A context menu appears, using which the Widget-elements 1102 can be edited.

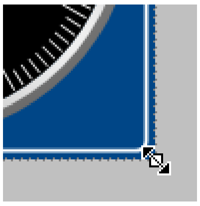
11.5.3 Operation

Moving and changing size

Moving a Widget

You can move the Widget by clicking on it and dragging it by the "crosshairs" ().

Changing the size of a Widget


Changing size

To change the size/proportions, use the mouse to drag it by the square grips on its edge.

Note — Aligning to the grid can help

An easy way to position and move Widgets is to use a grid on the page (see Aligning to grid 1383).

Selection

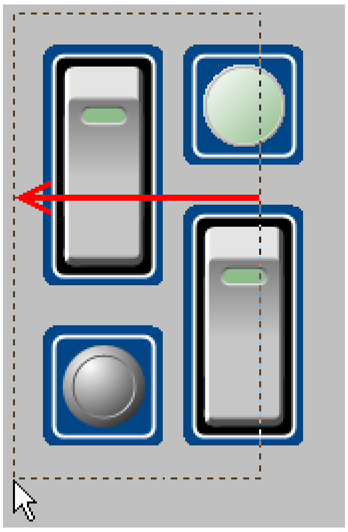
On a single page, you can select either one or multiple Widgets. The operations below can be performed as desired in any order.

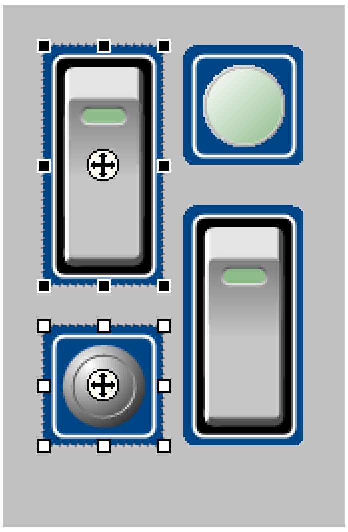
- To **select a Widget**, click on the desired Widget.
- To **de-select an individual Widget**, press the <Ctrl>-key while clicking on the desired Widget.
- To **de-select all Widgets**, click on an empty region of the Panel page.

Selecting multiple Widgets

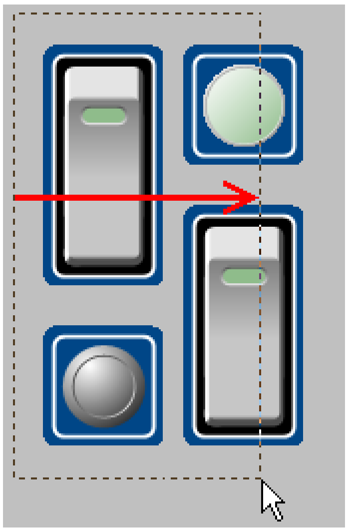
- Method 1, dragging the frame:

  To select multiple Widgets, use the mouse to drag a rectangular frame around the desired Widgets. The starting point for dragging must be in an empty area of the page:

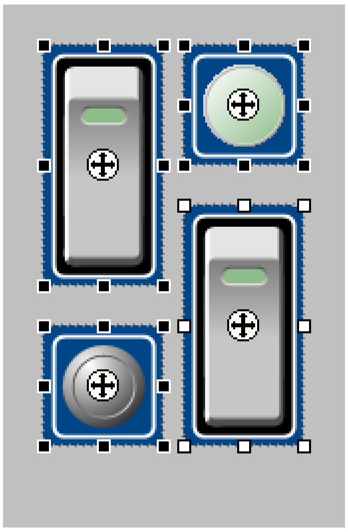

Dragging the frame from right to left


Completely framed Widgets are selected

If you drag the frame from right to left, only Widgets are selected which are completely encompassed within the frame.



Dragging the frame from left to right

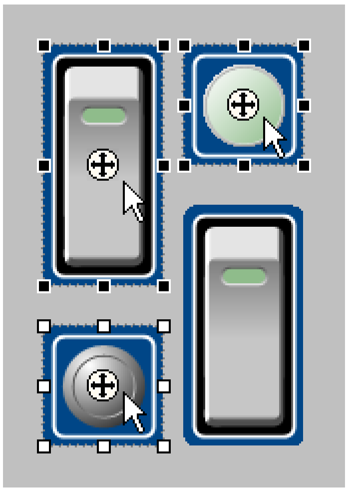


Any Widgets touched are selected

If you drag the frame from left to right, even such Widgets are selected which are only touched by the frame.

- Method 2, <Ctrl>+click

  To select multiple Widgets, you can also hold down the <Ctrl>-key and click on the desired Widgets.



Multiple selected Widgets

Editing Widget-elements

Each Widget consists of various **elements**:

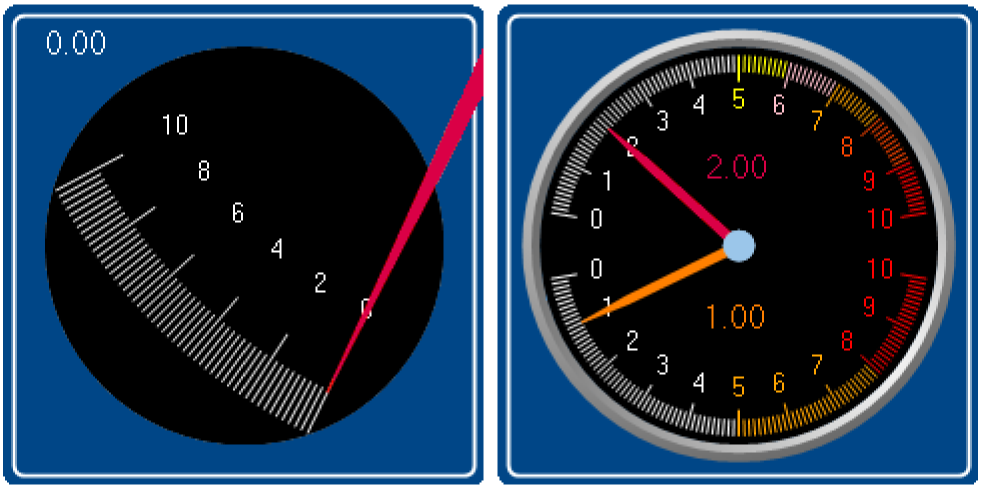
- Boxes indicating the **title** or the current **value**
- **Scales**
- **Numbers**
- **Meters, bar meters**, ...

Editing elements

The various Widgets offer many ways to vary the appearance without having to set the Properties 1108. You can:

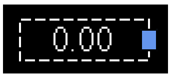
- move and enlarge boxes
- edit various Widgets elements

Example	Example of three edited Widgets The one at right consists of two *Standard meters*



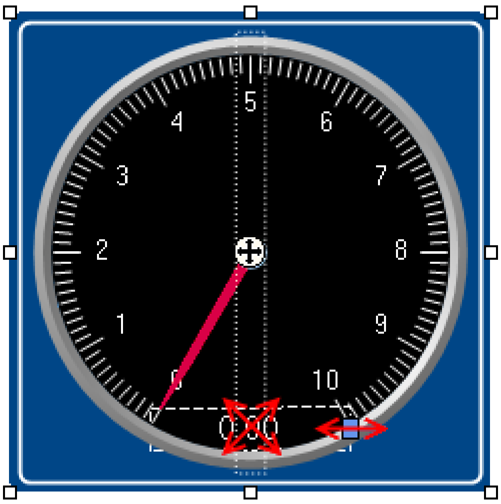
Example of three edited Widgets

Each Widget also has other options. To edit the element, you must first select it. Normally a frame around the element and a blue bar, for gripping it, appear.



To illustrate, the images below use the Widget *Standard meter* as an example:

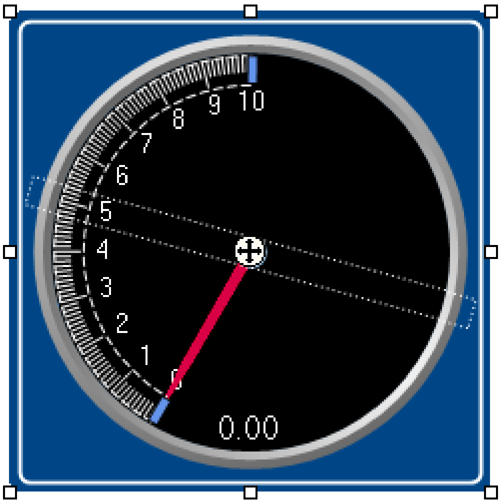
Example 1	Move and change the size of boxes



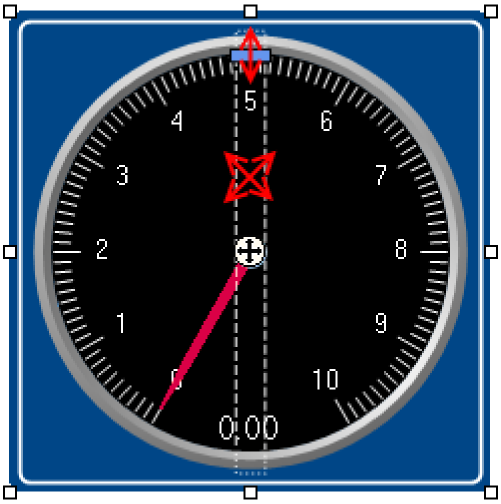
Move and change the size of boxes

Example 2	Changing the scale angel and the sweep angle

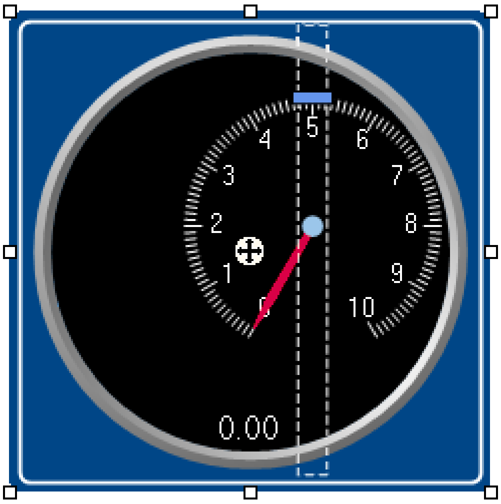
(see also Properties 1108)



Example 3	Changing scale position and radius



(see also Properties 1108)



Widget-levels - Foreground/Background

The Widget-level is redefined upon inserting the Widgets. Each newly inserted Widget is positioned in front of all other Widgets. The levels are important if Widgets overlap or multiple Widgets are **docked** 1107
.

By means of the level, you determine whether a Widget appears above or behind another one.

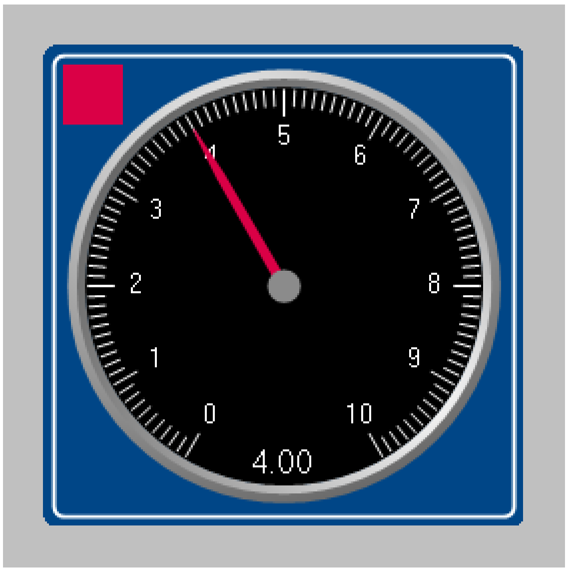
To do this, open the context menu of the"crosshairs" (⊕) within the selected Widget.

- Select *Arrangement*:

Action	Description
To Foreground	Moves the selected Widget all the way to the foreground, in front of all other Widgets
To Background	Moves the selected Widget all the way to the background, behind all other Widgets

Example

Thus, for instance, you can place a *Graphical switch* in the empty space belonging to a *Standard meter*:



Example of Widget-levels

Align and Cascade

Aligning Widgets

Widgets can be aligned along a line.

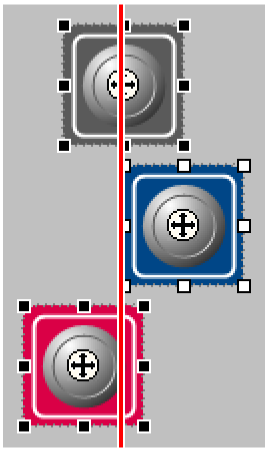
To do this, open the context menu of the "crosshairs" (⊕) within the selected Widget.

- Select *Arrangement*:

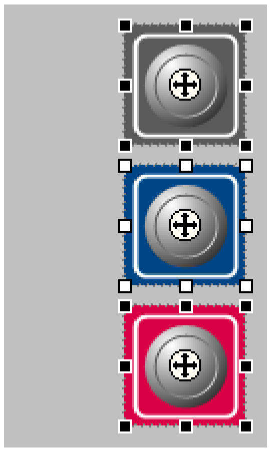
Action	Description
Align top	Alignment to the upper edge of the last Widget selected
Align left	Alignment to the left edge of the last Widget selected
Align Right	Alignment to the right edge of the last Widget selected
Align Bottom	Alignment to the bottom edge of the last Widget selected

Example

Three Widgets are selected. The middle one was selected last. The Widgets are to be aligned to the left edge:



Widgets are aligned to the left edge of the last Widget selected



Alignment results

Cascade Widgets

Widgets can be stacked on top of each other.

To do this, open the context menu of the "crosshairs" () within the selected Widget.

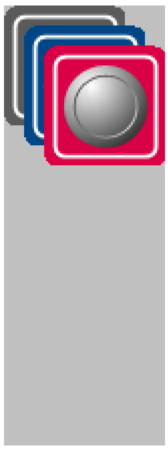
- Select *Arrangement*:

Action	Description
Cascade	Selected Widgets are stacked in the upper left corner of the Panel page according to their respective Widget-levels.

Example

Three Widgets are selected. The Widgets are to be stacked:

Widgets to be stacked



Results of stacking

Docking

With these commands, you can dock a Widget at your choice of edges. The dimensions of the Widget are adapted to the available width. The size can only be reduced from there and depends on the other Widgets and the page size.

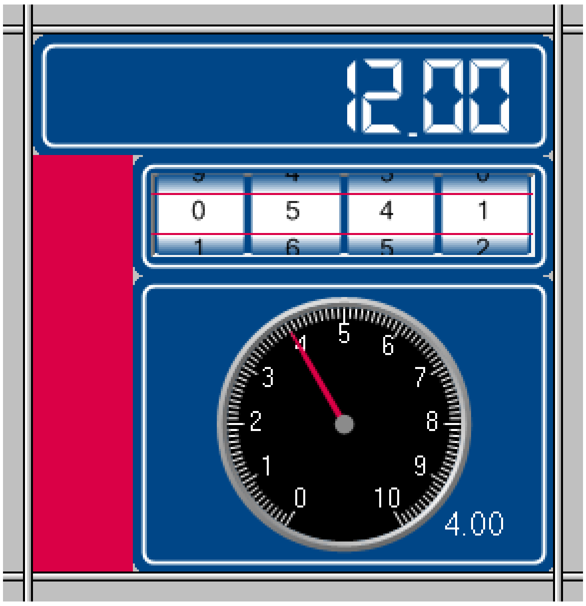
To do this, open the context menu of the "crosshairs" () within the selected Widget.

- Select *Dock*:

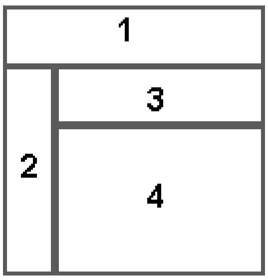
Action	Description
Free	The Widget is not permanently docked to any edge, but can be freely moved. The size can be varied toward any side.
Top	The Widget is permanently docked to the upper edge. The size can only be varied toward downward.
Left	The Widget is permanently docked to the left edge. The size can only be varied toward rightward.
Right	The Widget is permanently docked to the right edge. The size can only be varied toward leftward.
Below	The Widget is permanently docked to the top edge. The size can only be varied toward upward.
Fill	The Widget is extended in size to fill all available room. The size cannot be varied.

If multiple Widgets are docked, their respective positions depend on the **Widget-level**. Widgets positioned further in the background are closer to the edge.

Example | Example for docking in a cell of the split Panel page



Widget-levels:



The docking of the Widgets is as follows:

1 - Top

2 - Left

3 - Top

4 - Fill

Grouping Widgets

Widgets can be grouped together. Grouped Widgets can be moved and magnified jointly. Shared properties can be set in concert.

To do this, select the desired Widgets and open the context menu of the "crosshairs" () within a selected Widget.

- Select *Group*:

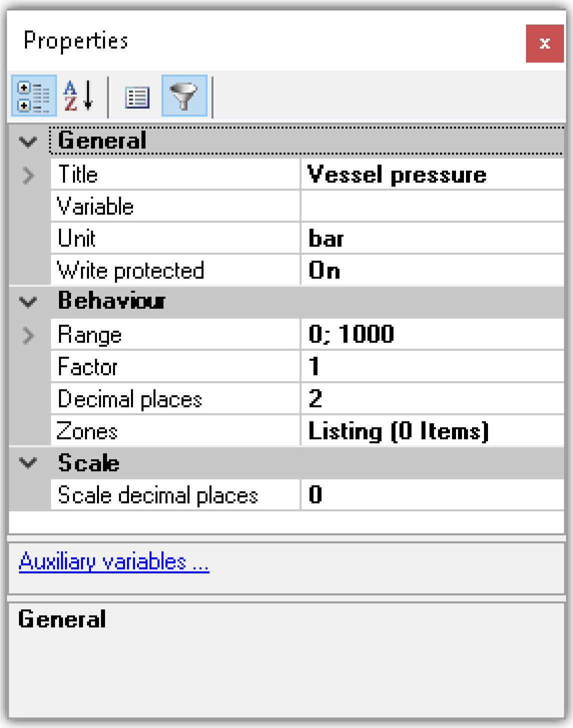
Action	Description
Create Group	Selected Widgets are joined to a group.
Dissolve Group	Dissolves the grouping. The Widgets can then each be edited separately.
Enter Group	Opens the existing group. The properties of the individual Widgets can be edited separately.
Leave Group	Closes an open group.

In order to edit the respective Widgets individually, select *Enter Group*. Then it is possible to edit the Widgets belonging to the groups. In order to exit the group again, select *Leave Group* or reverse the selection.

11.5.4 Properties - Widget

If you have selected a Widget, its properties can be adjusted in the tool window 1065 **Properties** (or via the context menu of the selected Widget, see "*context menus of the Widgets* 1100").

The content of the Properties window depends on the respective Widget selected. For info on the window structure, see "*Properties (general)* 1066".



Below, certain commonly occurring properties are listed.

Note **Special properties**

- The Widgets each possess only some of these properties.
- Special Widgets have additional properties not listed here.

General

Property	Description
Name	Name of the Widget. Each Widget possesses has a unique name on every page. The name may contain the following characters: letters, underlines, numbers.
Refresh rate	Updating of data. Placement of many Widgets burdens the PC's capacity. You may need to adjust the refresh rates of some Widgets if, for instance, the curve in the curve window shakes. The times are defined as follows: • very fast — 50ms — 20Hz • fast — 200ms — 5Hz • standard — 1s — 1Hz • slow — 10s — 0.1Hz • never — -- — -- Reading and outputting of the new values may be delayed in proportion to the utilization of the PC's resources. With the option "*Refresh rate of newly created Widgets* 113", you specify the default refresh rate of newly created Widgets.
Status	Switches the Widget active/passive. • Active: Widget works normally. • Passive: Widget can not be operated and its color is altered to indicate that it is passive. The current value remains displayed. • ...: depends on a variable 0: Passive 1: Active
Title	Displayed title of the Widget.
Color	Title font's color
Default Source	Source for the title • User-defined: Any text • Name: Name of the variable • Long name: Name of the variable followed by the measurement name. If the Widget is linked to a variable via a measurement number, the measurement name displayed always assimilates to the measurement selected. • Comment: Comment of the variable
Font	Here the name, size and font style can be changed.
Multilingual Title	The title can be pre-defined for multiple languages 1405.
Position	Position of the title (can change the position of the Widget.)
Unit	Displayed unit. If this property is empty, the variable's unit is displayed in the Widget. Otherwise, this unit is always displayed.

Property	Description
Variable	How to link a Widget with a variable is described in the chapter "*Variable linkage* 1390".
Visible in printout	The Widget is hidden in the printout. this also applies to export as PDF or graphic. • Show: Displayed in the export or printout • Hide: Omitted from the export or printout
Write protected	Protects against changed values. • On: The value cannot be changed by this Widget (display element) • Off: The value can be changed by this Widget (control and display element) • ...: depends on a variable 0: Off 1: On

Layout

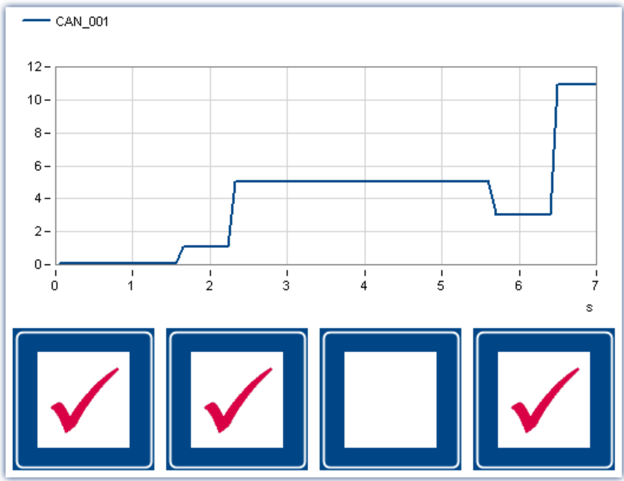
Property	Description
Dock	Docks Widget at the specified edge. See "*Docking* 1107".
Operable	Protects against editing (supported by the curve window) • Yes: The curve window can be operated and configured. • No: The curve window can no longer be modified. All options are disabled, e.g. axis scaling, Zoom, ... • ...: depends on a variable 0: operable: no 1: operable: yes
Orientation	Displayed when the Widgets can be oriented either horizontally or vertically.
Position	Position and size of the Widget.
Visible	Shows/hides the Widget (not enabled in Design Mode). • Yes: shown • No: hidden • ...: depends on a variable 0: No 1: Yes

Appearance

Property	Description
Appearance	Different ways to display the Widgets. Usually only affects the appearance (2D/3D). An exception is the clock: here you can toggle between analog and digital clocks.
Background	Some Widgets can change their design. E.g. some Automotive-Widgets can adopt the design of Industrial-Widgets. Note: The Widgets will not look exactly the same and offer all the same settings as the corresponding Widget from the other design. Additionally, not all combinations are possible.
Border	This option lets you activate/deactivate the borders. Additionally, some Widgets can be displayed with sharp and some with round corners. (Only affects Automotive-Widgets)

Property	Description
Coloring	There are different color properties for the individual elements of the Widgets. The colors of most elements can be set separately. In order to apply the colors for other Widgets and for future ones, save the colors in a color scheme.
Font	Here you can adjust the font's name, size and style. This setting overwrites the title's font style.
Pictogram	The standard meter can be provided with a pictogram. This can be an icon for quick visual association. Similar to a speedometer or fuel gauge in a car.
Polygon needle	The design of the standard meter's needle can be modified. You can personally define the needle in terms of various x-y-coordinates. As an example, the coordinates of the standard needle can be loaded (form: "Standard").
Text Off/On	Texts for switch-states. There are advanced settings in the Zones-dialog 1114.
Value representation	If "Value representation" is activated, the value is displayed larger than the caption. (Input, output > Numeric ...)

Behavior

Property	Description
Autosize	Adapts the size of the Widget to the size of the current picture. (e.g. Graphical switch)
Bitmask	Displaying variables' individual bits Selected Widgets offer the option of only displaying individual bits in a variable. Example: A Field-bus channel returns multiple channel states with: • 0th bit: Sensor connected • 1st bit: Value exceeded • 2nd bit: Error • ... With the property, it is possible to select which bit to display. If the 1st bit is selected, the Widget only shows the value of the 1st bit. Thus, with status indicators on the Panel page, it is easy to present an overview of the status of the various channels.  **A Fieldbus channel returns multiple channel states at one time. In the end, the bits 0, 1, and 3 are set for a total of = 11.**
Decimal places	Number of decimal places for display of the value. (See also "Scale decimal places")

Property	Description
Edit box color	Graphical display of the zones in text boxes. (Input, output > Numeric ...) The text background can be made to depend on the zones' properties. When you select "Zone color", the corresponding zone color is displayed as the background. When you select "Standard color", the background color set for text is displayed.
Events	Certain Widgets can be linked with commands 1124 which are carried out at state transitions (called events).
Factor	Factor with which the value is to appear. The available selection options depend on the Widget and on the unit. When a unit is specified, you can select "*milli*", "*kilo*", "*mega*", ... for example. If no unit is specified, you can select "*1e-3*", "*1e3*", "*1e6*", ... Additionally, the following selection options are available: • **1:** Output of the variable's unit • **Automatic Formatting:** Depending on the value, an appropriate factor is selected. For "*0.01 V*" for example, the factor "*milli*" is used, and "*10 mV*" is displayed. Example: The variable's value is "*0.1*" and the unit "*V*". If you select "*milli*" as the factor, then "*100 mV*" is displayed. If you select "*1*" as the factor, no conversion calculation is performed; the displayed output is "*0.1 V*". **Unit conversion calculations** The following procedure is applied by the Widgets "*Table*" and "*Numeric input*" belonging to the groups: Automotive, Industrial and Designer. 1. Certain units containing a factor, e.g. "*kg*" are converted in calculations. Other units which by chance have the same initial letter as a factor are not processed in this way; for instance "*Gallon*", where the "*G*" is not interpreted as "*giga*". 2. Using the property "*Factor*", you can specify the target factor, even if the variable's unit is "*kg*", for instance. Correct conversion to grams or tons is performed. By means of the factor "*1*", the exact unit entered is outputted. The same applies to many other units. Example: The unit is set to "*kV*", the value to "*0.005*". If the factor is set to "*1*" or to "*kilo*", the Widget displays "*0.005 kV*". If the factor is set to "*milli*", then "*5000 mV*" is displayed. For "*Automatic Formatting*", the displayed output is "*5 V*" (the factor selected by the system then depends on the magnitude of the value).
Increment	Increment size for Widgets with buttons for up and down.
Range	The display range, or the range of valid entries. E.g., for a standard meter, the min- and max-values for the scale. If the range is to be indefinite, you can enter "Infinite" or "-Infinite".

Property	Description
Of the Variable	The range can be made to depend on the variable, if the variable has its own range (e.g. Analog Channels). The range could always match the measurement range, for example. By default, the channels do not return any range. If the measurement range is to be used, please change the setting on the following page: Setup page "Analog channels"; Dialog: "Curve properties")
Maximum	Maximum value of range
Minimum	Minimum value of range
Scale center	For some bar charts and Widgets with level indicator, the midpoint of the scale can be modified. The display of the bar is based on this value. As the midpoint, any value can be specified or the fixed minimum or maximum value.
Switching behavior	Behavior of the switches/buttons upon clicking the mouse. Some of the Widgets are defined by default as switches, others as pushbuttons. The behavior can be changed by this setting. • Switch: Mouse click -> Widget pressed (on); Mouse click -> Widget comes back (off) • Push-button: mouse button pressed -> Widget pressed (on); Mouse button released -> Widget comes back (off)
Text format	Here you can format the value display. Some Widgets also support placeholders 145.
Zones	Displays existing zones. See "*Zone dialog* 1114" See also the display settings: "Zone representation" and "Edit box color"
Zone representation	Graphical display of the zones. Some Widgets offer various display types for the zones, e.g. standard meter, or potentiometer.

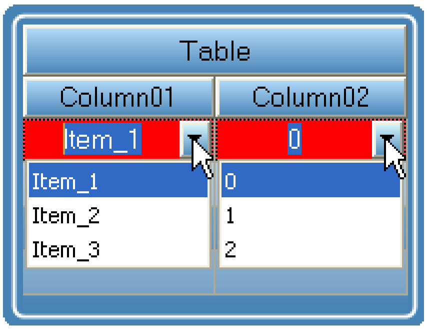
Scale

Property	Description
Interval	Smallest step between two values. The values in between are not displayed. E.g. standard meter with an "interval" of 0.5: The pointer always jumps at interval steps: 0; 0.5; 1; 1.5; ...
Scale angle	Opening and starting angle for the scale display. Start angle: 0° -> Horizontal rightwards Spread angle: clockwise
Scale decimal places	Number of decimal places for the scale display
Scale position	X; Y: Positioning of the scale midpoint to the Widget-midpoint Radius: distance of the scale from the scale-midpoint
Tick distance	Distance between main ticks. The value is automatically aligned to the "range". I.e. when the range is changed, the changed value is discarded.

11.5.4.1 Zone dialog

In this dialog, you can **define which values** are available for selection in a "*selection box*", for example. You can also specify **colored display** for the **value ranges** of various Widgets:

Example of a standard meter

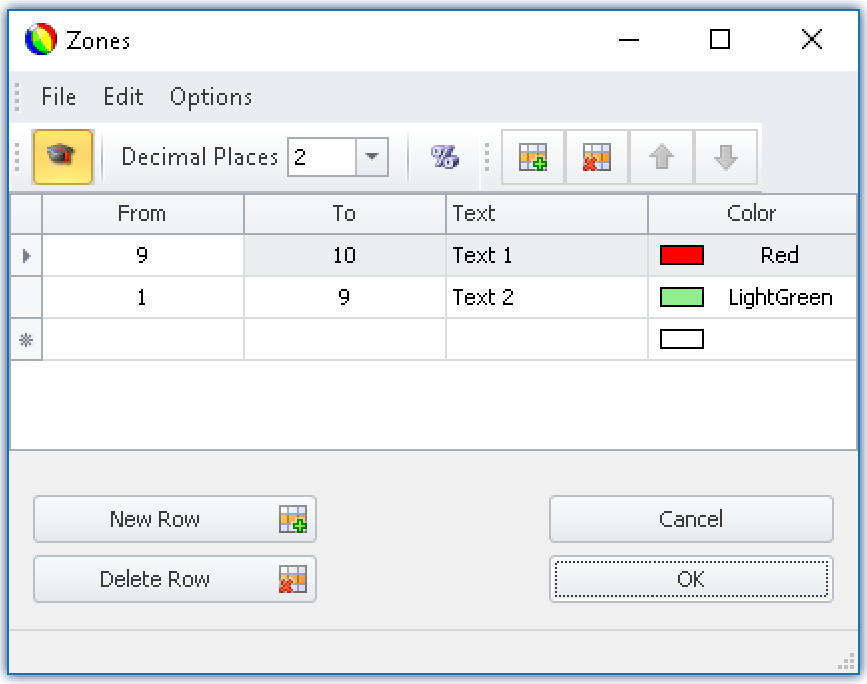


Example of a table with list boxes

To open the dialog, proceed as follows:

- Open the properties of the Widget.
- Click on the button in the box "*Zones*"

The Zones-dialog is called, which appears as shown below:



Setting zones for a Widget (example: standard meter)

Note The dialog sometimes appears different

The dialog's structure and the displayed columns 1116 depend on:

- the Widget (control elements require different settings than display elements)
- the Widget property "*Write protected* 1108" (preset values are not required)
- the option "*Advanced display* 1120" (hidden and automatically calculated columns are displayed)

Here, the value ranges of the Widget can be distinguished by color. In the example, the "*standard meter's*" value range is subdivided as follows:

< 1	default (not defined) e.g. white
1 - 9	green
9 - 10	red
> 10	default (not defined) e.g. white

The image below shows the "*standard meter*" set accordingly:

Example: standard meter

Changing/creating zones

Changing values, texts and colors

To change an entry,

- click in the corresponding box
- perform the change desired

By default, the values are to be entered as absolute quantities. For some Widgets, the values can also be entered as a percentage 1120 of the range.

Adding or deleting a zone

In order to create or delete a zone, use the items: "*New Row*" / "*Delete Row*" (e.g. via the context menu or the menu items).

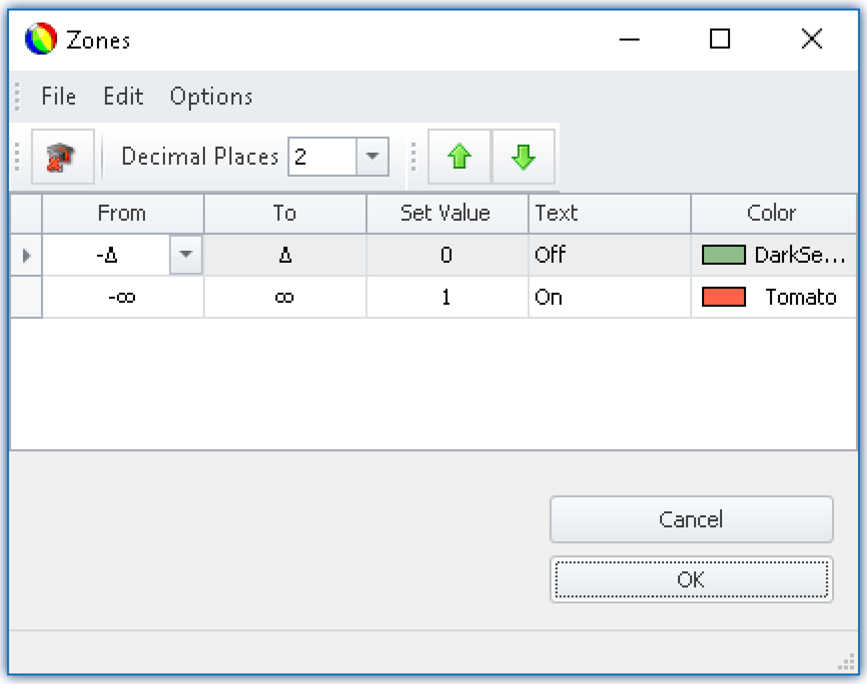
Moving the zones

The top zone has top priority 1118.

To change the order, use the items: "*Move Row Up*" / "*Move Row Down*" (e.g. via the context menu or the menu items).

Infinity and zero

In special cases, symbols are used for *Zero* and *Infinity*. Below, the zones for a **switch** are shown with "*Advanced display* 1120".



Zones of a switch with "Advanced display"

The switch should be "*Off*" when near "*Zero*" and for all other values "*On*".

11.5.4.1.1 The columns and their interdependencies

Some columns are hidden

The structure of the dialogs depends on the Widget:

- If **values are set** with Widget, the column "*Set Value*" is displayed (e.g. "*Listbox*" and "*Switch*")
- If the Widget usually **displays values**, the columns "*From*" and "*To*" are displayed (e.g. "*standard meter*")

The dialog's structure depends on the property "*Write protected*":

- If the Widget is **write-protected**, then **no value can be set** with this Widget. In this case, even for a *Switch* only the columns "*From*" and "*To*" are displayed.

If the "Advanced display 1120" is activated, the columns "*Set Value*", "*From*" and "*To*" are displayed if present.

Relationship between set values and value range

The values in the columns are mutually interrelated. The values entered in the column "*Set Value*" should normally lie within the range between "*From*" and "*To*".

If only the column "*Set Value*" is displayed and you change the value, the values in the columns "*From*" and "*To*" change accordingly.

Note Automatic adaptation

- If you have **activated "*Advanced display*" 1120, this automatic adaptation is deactivated**. This means you can also set values outside of the range. If you close and then re-open the dialog, the "*Advanced display*" 1120 is deactivated again. Each change to the values re-adjusts all the values again!
- Make note that because of the above fact, the Widget may get into an inoperable state.

Example Example of automated adjustment of the ranges: "*Listbox*"

The Widget has four zones:

Set Value	Text	From (not displayed)	To (not displayed)
0	Eintrag_1	-0,5	0,5
1	Eintrag_2	0,5	1,5
2	Eintrag_3	1,5	2,5
3	Eintrag_4	2,5	3,5

If you change the value sin the column **Set Value** and have not activated the **Advanced display**, the other values adjust themselves.

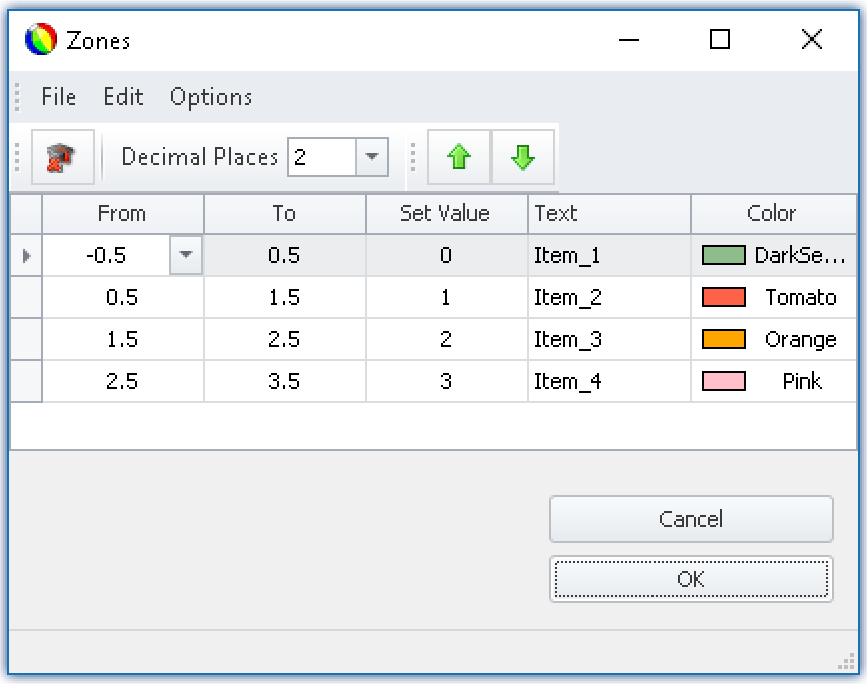
Set Value	Text	From (not displayed)	To (not displayed)
0 > 1	Entry_1	-0.5 > -∞	0.5 > 1.5
1 > 2	Entry_2	0.5 > 1.5	1.5 > 2.5
2 > 3	Entry_3	1.5 > 2.5	2.5 > 3.5
3 > 4	Entry_4	2.5 > 3.5	3.5 > ∞

Additional example of automatically calculated values:

Set Value	Text	From (not displayed)	To (not displayed)
1	Entry_1	-∞	1.5
2	Entry_2	1.5	3.5
5	Entry_3	3.5	12.5
20	Entry_4	12.5	∞

11.5.4.1.2 Order and priority / Overlapping zones

In order that no values be omitted, the zones mostly **overlap**. The **top zone has higher priority**. Below an example:



Zone dialog with "Advanced display"

The first zone has the range -0.5 through 0.5. The second has 0.5 through 1.5. The value 0.5 appears in both zones. However the top zone has higher priority.

If the value is exactly 0.5, the zone is displayed with the text "*Item_1*".

Example — Example of an LED with overlapping zones

We intend for the LED to shine "*red*" for a value of 5. And "*green*" for all other values:

This amounts to three zones:

1: -infinity to 5

2: 5 to 5

3: 5 to infinity

Ensure that Zone 2 (5 to 5) is not covered over by the others. For that reason, it must be placed on top:

1: 5 to 5

2: -infinity to 5

3: 5 to infinity

It is then also possible to define just two zones:

1: 5 to 5

2: -infinity to infinity

If the value is "5", it lies in the first zone. If it is not "5", it lies in the second zone.

Beispiel
Example 例

Example of a pointer instrument with overlapping zones

The ideal value lies between 4 and 6 ("*green*").

One value beyond that range in either direction is still OK ("*yellow*").

Anything else is either too high or too low ("*red*").

This amounts to five zones:

1: 4 to 6

2: 3 to 4

3: 6 to 7

4: -infinity to 3

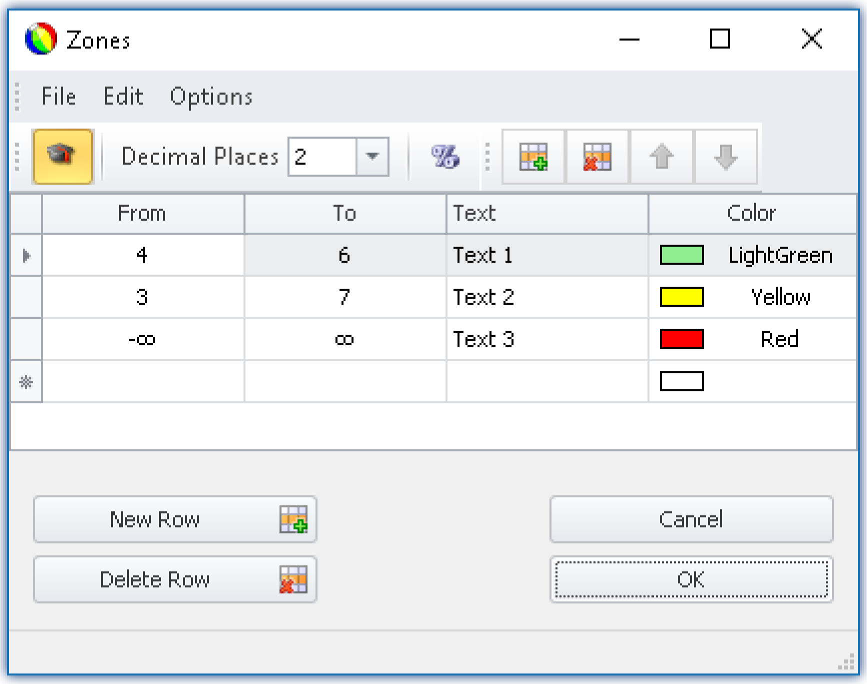
5: 7 to infinity

One can make these into three zones:

1: 4 to 5 ("*green*")

2: 3 to 7 ("*yellow*")

2: -infinity to infinity ("*red*")



11.5.4.1.3 Other options and settings

Advanced display

By default the Zones dialog has a **simple display**. The structure is adapted to the normal operating style for the Widget. Accordingly, not all columns are always displayed.

The "*Advanced display*" is required for some complex applications. When the display is activated, all columns are displayed.

Application examples:

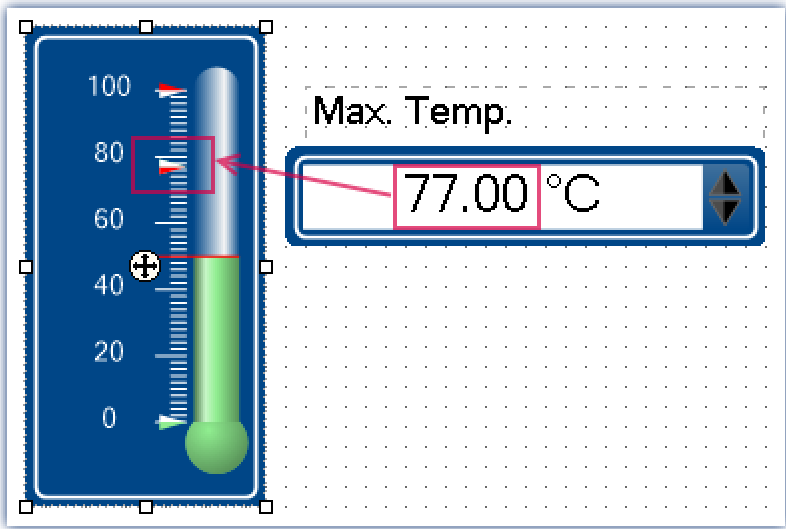
- The "*Listbox*", which is to be used as an input/output element (ranges and set values need to be defined).
- Switches or LEDs having more than two zones (e.g. multi-colored lighted pushbutton)
- Ranges and set values can be defined by variables (e.g. value limits which depend on certain settings)

Activating Advanced Display

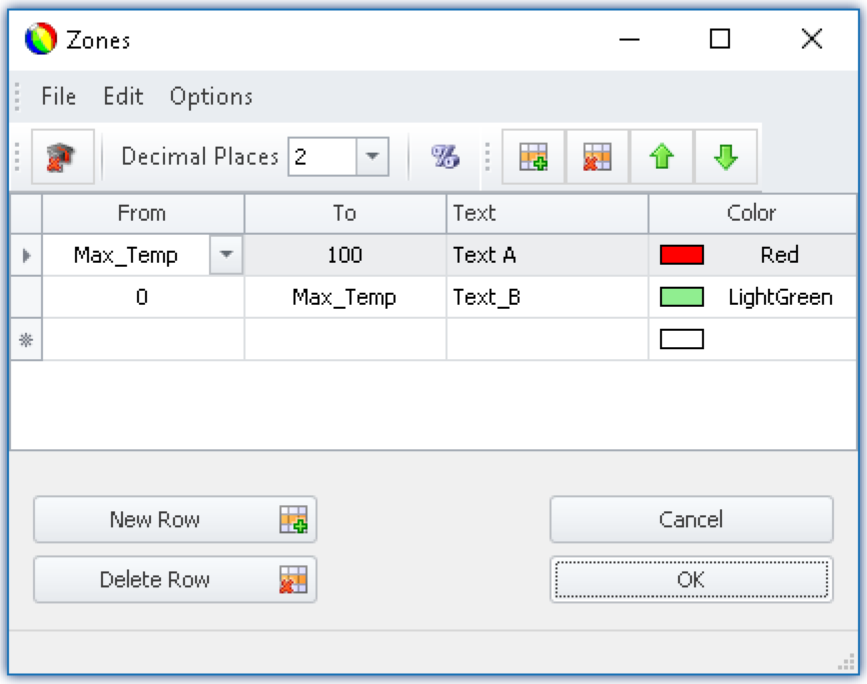
In order to activate "*Advanced display*", use the entry: "Extended display" (e.g. via the menu entry).

Example Variable value limits in a Widget

When a maximum temperature level is exceeded, the thermometer is to turn "red".



Example: Thermometer with user-defined ranges



Zone-settings
The variable: "Max_Temp" is used as the range boundary

Percentage

By default, the values are entered in absolute terms. For some Widgets, you can also enter the values as a percentage of the range.

If at a later time the Widget's display range changes, the zones adjust proportionally. However this means that fixed midpoint values can not be specified (all values adapt to the range).

Activating Percentage Entry

In order to activate "*Percentage entry*", use the entry: "*Percentage*" (e.g. via the menu entry).

Example

Display range of the Widget: 0-10

Zone: 0-5, 5-7, 7-10 (0%-50%, 50%-70%, 70%-100%)

The range changes to: 0-50

New zones: 0-25, 25-35, 35-50

Numeric Zone / Textual Zone

Some Widgets can **display texts or numerical values** (for instance "*Tables*" belonging to the group Automotive, Industrial and Designer).

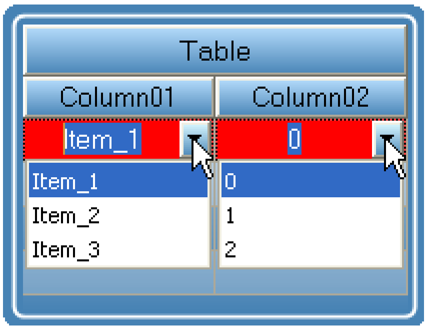


Table with numerical and textual zones

The variable is assigned the same value in both cases. However, it is often necessary to have the user select a text while internally writing a number.

Switching between numeric and textual display

In order to switch between "*Numeric*" and "*Textual Zones*" display modes, use the entry: "*Numerical zones*" 123 / "*Textual zones*" ABC (e.g. via the menu entry).

Text as set value

Some Widgets can **set texts** (e.g. "*Tables*" of the groups Automotive, Industrial and Designer). By contrast, most Widgets can only set numbers.

With this setting, all that remains is the set value , and when "*Textual Zone*" is activated, the display value also. It is no longer possible to enter a range. The set value is written to the variable as text, for which purpose a text-variable is needed.

Activating the writing of texts

In order to activate "*Text as set value*", use the entry: "*Text as set value*" AB (e.g. via the menu entry).

Decimal places

Here you set how many decimal places are to be shown in the dialog. The values can also be expressed in exponential notation. For instance, select "*E3*".

The following values can be entered: 0, 1, 2, ..., E0, E1, E2, ...

This setting only refers to the display of numbers in this dialog and has no effect on the Widget.

Setting the amount of decimal places

To change the number of decimal places, select the menu item: "*Decimal places*" (e.g. via the context menu or the menu).

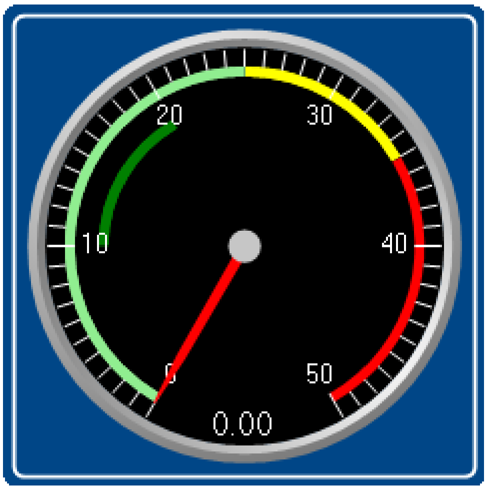
Zone ring

The pointer instrument can have multiple "*Zone rings*".

To **show** the zone ring, the Widget-property: "Zone display" is used. By default, the ring is deactivated.

By means of the menu item "*Edit*" > "Create *Zone Ring*" **you can create an additional zone ring**. If zone display had previously been deactivated, it is activated automatically. Now, two rings are shown (if the second zone ring is supplied with zones).

In the "*Edit*" menu, you can **switch between the zone rings** or **delete a zone ring**.



Two zone rings are displayed. The dark green area is the second ring.

11.5.4.2 Linking commands with switches

Certain Widgets can be linked with ***commands*** which are carried out at state transitions (called ***events***).

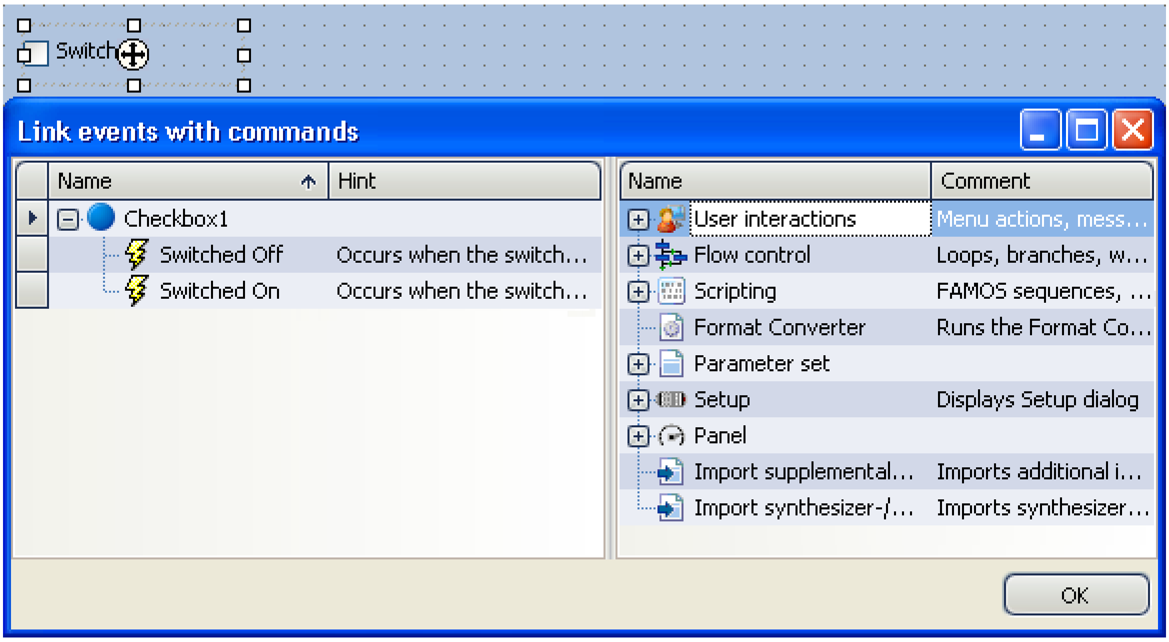
As an example, the two events ( ) belonging to a ***Switch*** from the group ***Standard***:

- ***Switched off*** (from On to Off)
- ***Switched on*** (from Off to On)

The Widgets include ***Pushbutton*** and ***Switch*** from the group ***Standard*** and various switches/buttons from other Widgets (***Automotive, Industrial, Designer*** if these are installed).

To assign a **command**:

- Select the Widget
- Open the Properties 1108 of the Widget
- In the Properties window, click on "Events ..." at the lower left. Subsequently, the dialog: **Event Dialog** opens, as seen in the image below:



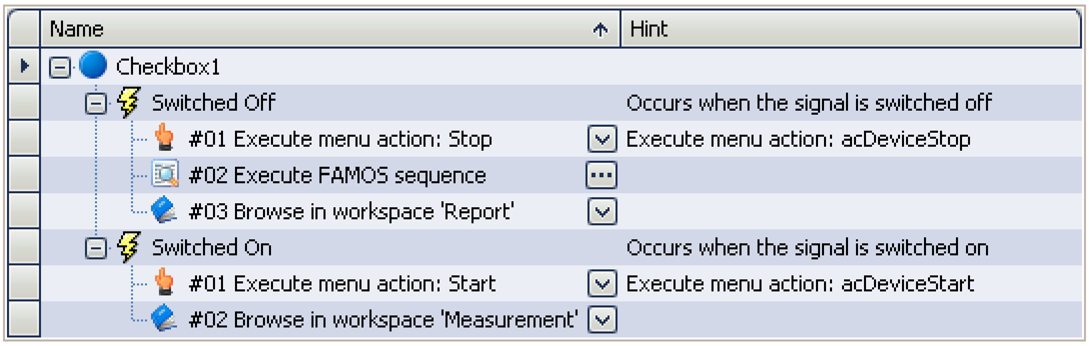
Event dialog:
Events belonging to a switch from the group Standard

Reference Commandos and Sequences

- The workings of the individual commands are described in the chapter **Command Reference**.
- A **sequence of commands** can be created in various imc STUDIO plug-ins and is described separately (see the chapter "*Sequencer, Events and Commands* 1524").

Example

Below an example with multiple commands



After switch on:

- the measurement starts
- the Panel page *Measurement* is opened

After switch off:

- the measurement stops
- a imc FAMOS analysis is performed (if installed; see *Technical data sheet* > *Additional imc Software Products*)
- the Panel page *Report* opens

11.6 Curve Window

11.6.1 Introduction

Curve Window shows the graphic representation of measurement signals and computed waveforms, in the simplest case as a labeled coordinate system and a curve. The curve window displays individual and independent objects, which can be positioned, enlarged and edited as desired. The curve window possesses the conventional characteristics of windows in Windows applications.

The curve window has an extensive menu offering a multitude of options for display and graphical evaluation of waveforms. The virtual multi-tasking operation in Windows allows the curve window to always display the most recent data. Curve windows can be operated with the mouse, the keyboard, or a combination of both.

The following offers a short overview of the main features of the curve window:

Function	Description
scaling	**Automatic or manual scaling** of the x- and y-axes
Zoom	allows detailed viewing of a curve section
Unzoom	returns to entire curve window display
Measurement values	Two independent measurement cursors are available, which display the x- and y-values of the curves, as well as value differences and slopes. These cursors can be used to select sections of a curve for special processing. Measurement values can be transferred to a report.
Markers	markers can be set to display comments or indicate the coordinates of individual points of a curve in the curve window.
Overview Window	Shows the position within the entire curve of a zoomed curve section.
More Curves	Displays additional curves in the curve window to allow comparisons.
Print	Prints out the curve window's content with the resolution of the designated printer.
Report Generator	Enables the user to design measurement reports: text, curve graphs and other graphics can be combined and positioned as desired. The entire page can be printed as a data sheet.
Clipboard	Curve window graphs can be copied to the Windows Clipboard. These can be pasted to word processing and DTP applications and combined with text and additional graphics. Several options are available for copying curve graphics to the clipboard or the printer, including font type, line width and dimensions.
Export	The waveform displayed in the curve window can be exported to other imc applications. This is a fast and simple method of data transfer analogous to the Windows clipboard.
Transfer to imc FAMOS	Waveforms can be transferred directly from the curve window to imc FAMOS. A sequence in imc FAMOS can be automatically initiated with a transfer. Since the curve window is used by all imc products, it would be possible, for example, to send data from imc STUDIO to imc FAMOS in this way, and to process them there directly by means of a sequence.
Logarithmic, dB and linear axes	
XY, polar and locus plots	
Colors	The colors for graphics can be set as desired

Function	Description
Grid	The coordinate system can be overlaid with a grid.
Configurations	Curve window configurations can be saved in a file and loaded again.
1/3-octave or octave	The x-axis of a curve window can be set to normal scaling for a **1/3-octave** or **octave** analysis.
overlapping, stacked or waterfall diagram	Several curves can be displayed together for comparison: **overlapping, stacked** or in a **waterfall diagram**. Various options are available for **waterfall display**, e.g. the **angle of view**.
symbols	Curves can be **marked with symbols** to help differentiate between curves in a monochrome display.
periodic waveforms	An option is available for **periodic** waveforms in which all periods are compared with each other. This helps to identify trends and aberrations.
Color maps	A "bird's-eye view" of a colored 3D plot; color-coding indicates height.

Note

Some screen shots appearing in the text were adopted from older imc FAMOS versions.

Therefore, the appearance of the user interface as depicted in this manual may be slightly different from the actual appearance of the user interface of your system.

11.6.2 Display variants of the curve window

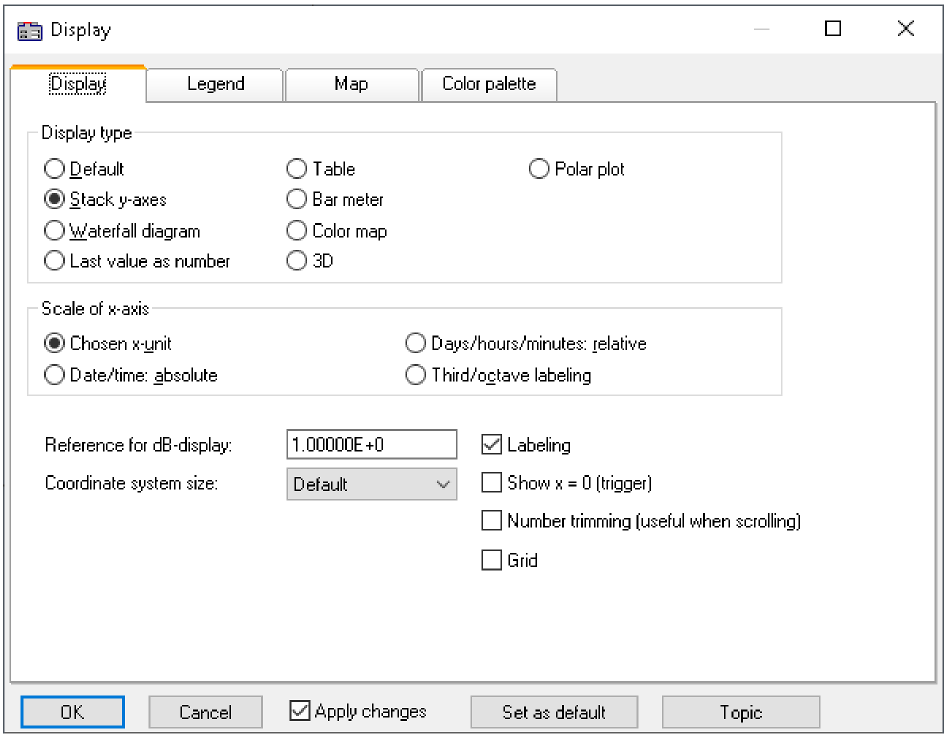
Function

The display mode of a curve window can be defined in a variety of ways. The display options include the appearance of the coordinate system, selection of date/time labeling or 1/3-octave labeling. Several special attributes are also available, including number of secondary ticks, period-comparison, marking of lines with symbols and definition of the reference value for dB displays.

Calling the dialog

Select menu option "*Configuration*" > "*Display*" in the curve window. A dialog appears in which the curve window display can be defined.

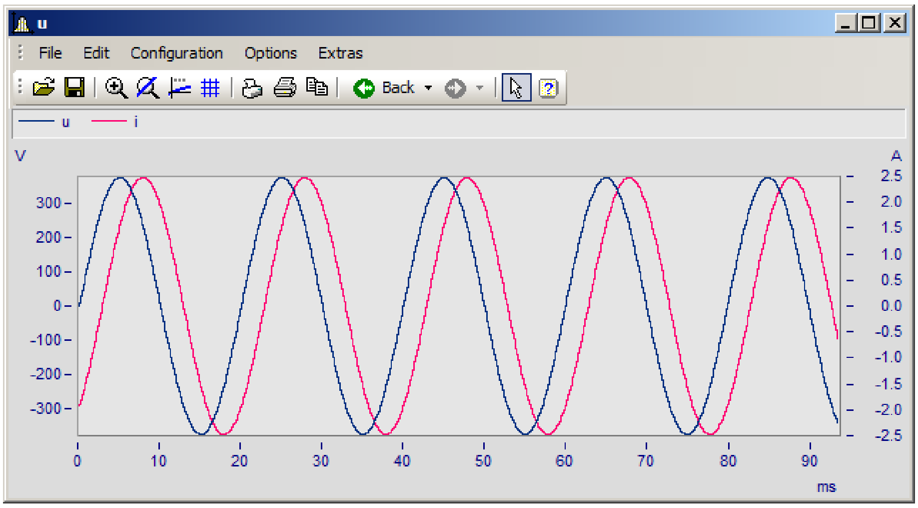
Tap	Description
Display 1128	Display variants of the curve window
Legends 1234	All curve windows can include a legend, with the channel (variable) name, line color etc.
Map 1237	Map lets you place a picture in the background. It is additionally possible to layout the picture in specified coordinates.
Color palette 1250	A channel's color can be governed by a reference signal's amplitude.



Display type

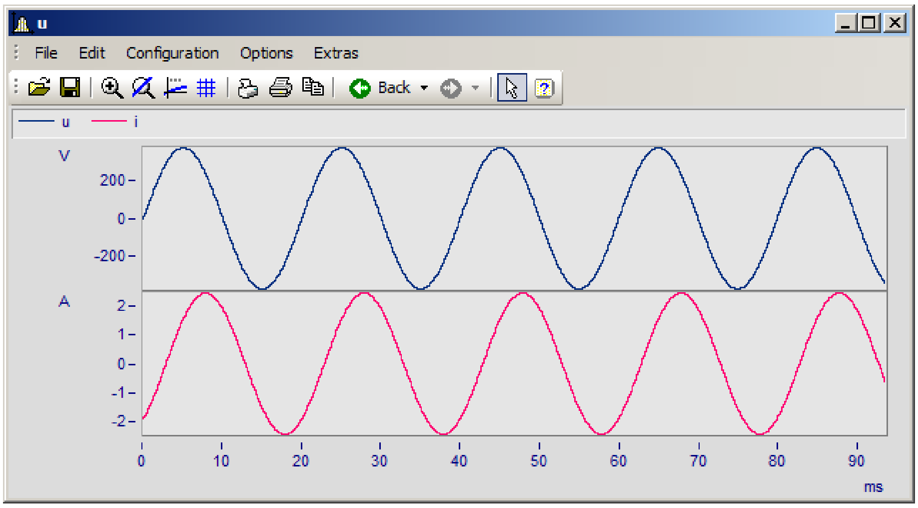
Default

In *Default* display, curve windows with more than one y-axis will show the different axes side-by-side. Several curves are then displayed in the same space.



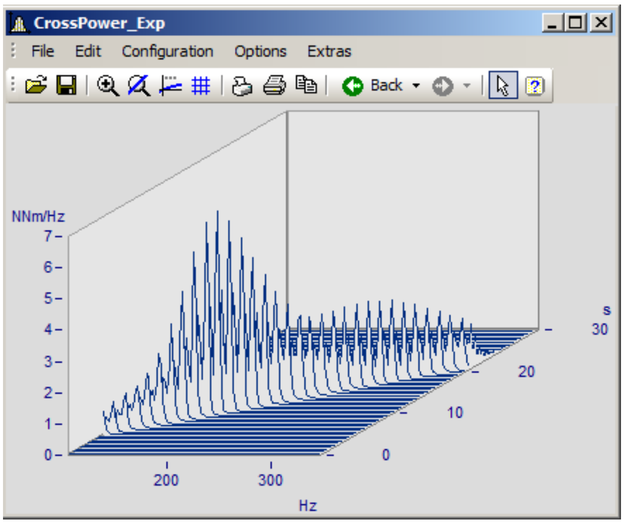
Y-axes stacked

An alternative to the *Default* setting is the *y-axes stacked*. Here, the y-axes are displayed stacked vertically, so that each curve is displayed in its own space, separated from the other curves in the window.



Waterfall Diagram

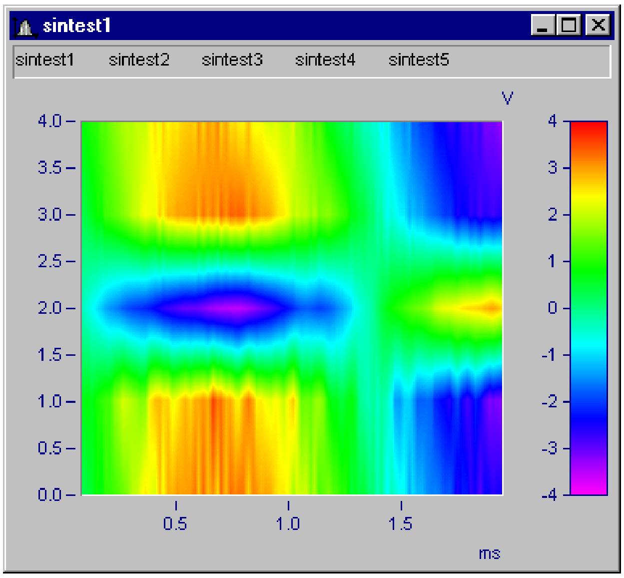
Another alternative is the waterfall diagram, which is especially suited to comparing similar curves. The curves are drawn in a diagonal procession from the front of the screen, with the curves at the back (partly) obscured by those at the front, creating the illusion of a three-dimensional perspective.



See "Waterfall Diagrams 1138"

Color Map

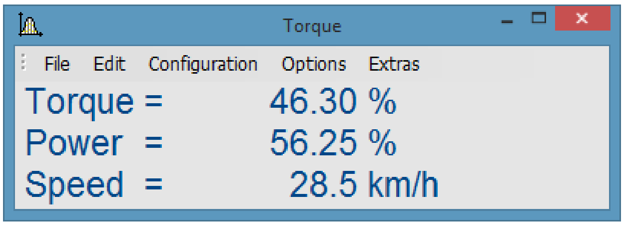
This is a bird's-eye-view of a colored, three-dimensional region. Multiple data sets are each plotted along the horizontal direction, stacked over each other along the y-direction, while their amplitude values are represented by different colors. This style of display is analogous to a geographical map where the landscape contours are indicated by shading or coloring.



See "Color Map Display 1163".

Last value as number

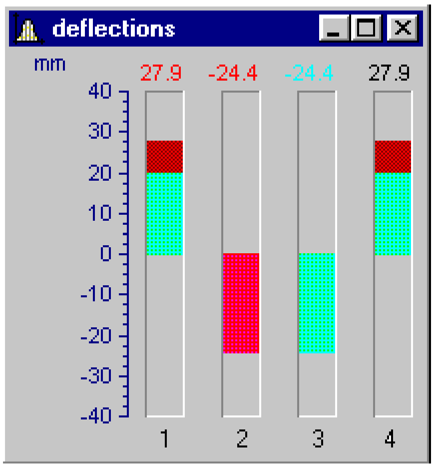
Particularly for online display of measured data, in this mode the last value is displayed as a number. The last value in a waveform is always the most recent measurement value in online display. This mode of display is particularly suited for slowly changing quantities. For example, the amplitude of a spectral line, effective power, or temperature can be monitored as a numerical value. The display of numerical values can be formatted. The corresponding numerical value is displayed for each curve in the curve window.



See "Last Value As Number 1144".

Bar meter

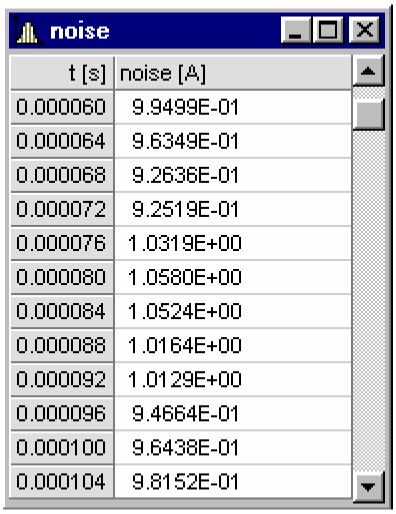
Particularly for online display of measured data, in this mode the last value is displayed in a bar meter.



Section 'Bar gauge' 1154

Table

The readings are displayed in tabular form, in chronological order.

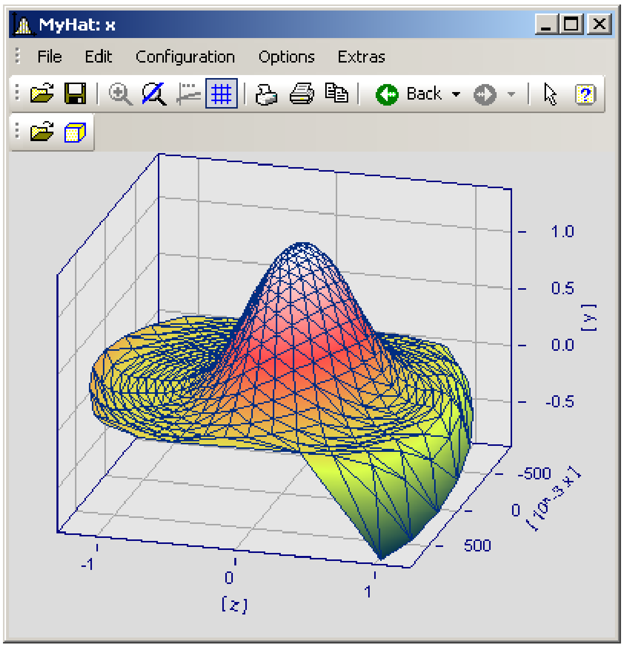


t [s]	noise [A]
0.000060	9.9499E-01
0.000064	9.6349E-01
0.000068	9.2636E-01
0.000072	9.2519E-01
0.000076	1.0319E+00
0.000080	1.0580E+00
0.000084	1.0524E+00
0.000088	1.0164E+00
0.000092	1.0129E+00
0.000096	9.4664E-01
0.000100	9.6438E-01
0.000104	9.8152E-01

Section "Tabular display 1149"

3D

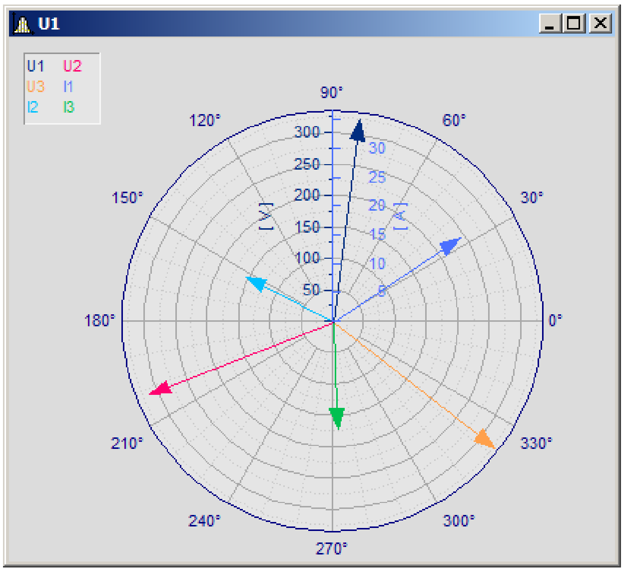
3-D display of waveforms having x,y,and z coordinates with various color map surface patterns, and rotating perspective in all dimensions.



Section on [3D display](#) 1175

Polar plot

Complex data sets can be displayed as a polar diagram.



Complex single values as vector diagram

Section on ["Polar plot"](#) 1175

Scale of x-axis

The following settings for scaling the x-axis can also be made using the x-axis' own settings dialog; see the section "Axes 1204".

Selected x-unit

The x-axis is labeled in the x-unit of the waveform, e.g. in "s" (seconds) for measurement over time, or in "A" (amperes) for a characteristic dependent on the current. If several curves are displayed in the window, all waveforms should have the same x-unit.

For example, if a normal waveform with x-offset = 10s, x-delta = 1s and 20 samples is displayed, the x-axis is displayed from 10s to 30s and labeled accordingly.

Date/time: Absolute

For data in the time domain, instead of labeling of the value expressed in seconds, a display of the absolute date and time can be selected. The absolute time is not determined exclusively from the measurement points, but also gives consideration to the generation time of each waveform. This time is recorded in files in the imc FAMOS format and can be inquired and changed with imc FAMOS functions.

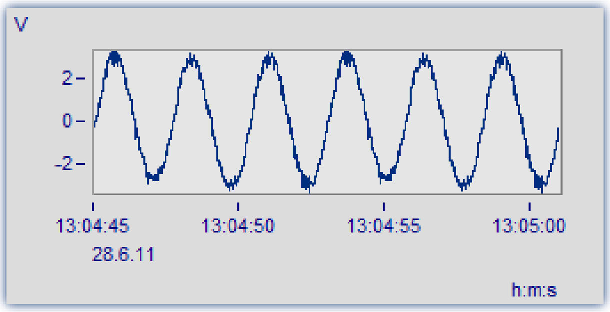
The generation time of a waveform along with the x-coordinate in "s" determines the resulting axis labels.

For example, if the generation time of a waveform is 1.1.92 at 12:00:00, and the waveform has an x-offset of 3600s and a sampling rate of 1800s for 48 measurement values, the range from

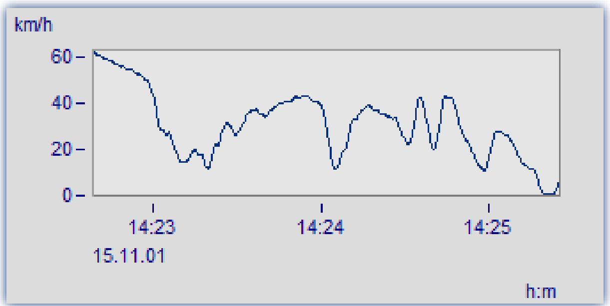
1.1.92, 13:00:00 to 2.1.92, 13:00:00

is displayed (3600s equals one hour). The waveform extends over 48 measurement values, each with a half-hour time difference, resulting in exactly one day of samples.

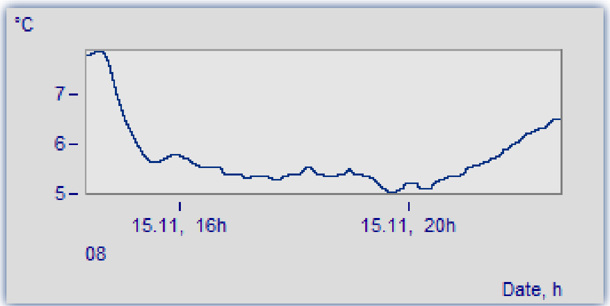
The labeling of the x-axis depends on the length of the displayed time interval, for example:



The segment between 13:04:45 and 13:05:00 encompasses several seconds.



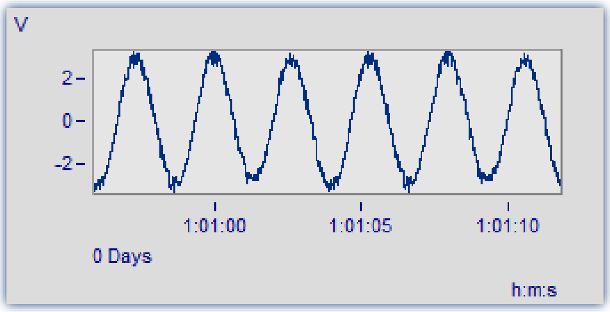
The segment between 14:23 and 14:25 comprises a few minutes.



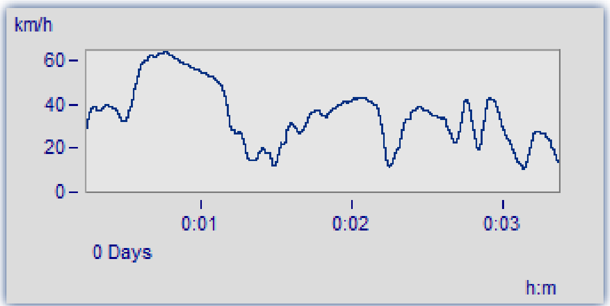
The segment between 4 am and 8 pm encompasses a few hours.

Days/hours/minutes: Relative

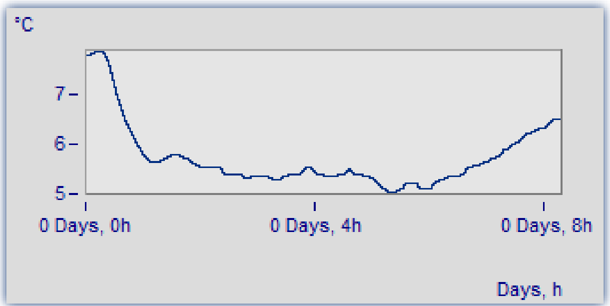
If you wish to view the whole duration of a long-term measurement, then display of relative time in days, hours, minutes and seconds is recommended. The selected unit depends on the interval. Possible variations of this labeling are as follows:



A very narrow section is shown, significantly less than one minute



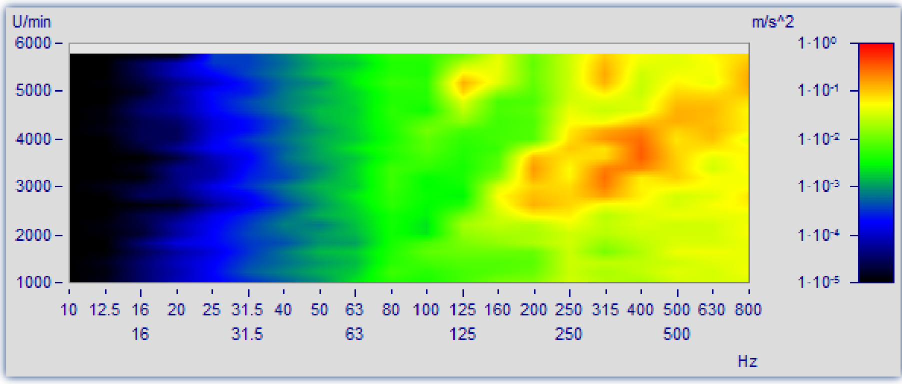
This section is 3 minutes long. The display no longer includes decimal places after the seconds.



The section from 0 to 8 hours is displayed without minutes

1/3-octave, octave labeling

When a waveform contains a 1/3-octave or an octave spectrum, and the x-axis of the waveform is scaled in 1/3-octave, the x-axis can be drawn with the numerical values of the 1/3-octave and octaves according to industry standards.



See "Third-Octave Display 1181".

Further settings

Settings	Description
Axis labeling	Axis labels can be switched off completely, allowing the curve to be displayed in its maximal expanse. When curve windows are reduced significantly in size, the display automatically switches off display of the axis labels.
Show x=0 (trigger)	When this option is selected, a dotted vertical line is displayed in the curve window at x=0. The trigger is very often located at x=0.
Number trimming (useful when scrolling)	When this option is selected, the labeling at the ends of the axes are displayed partially, since the labeling box is too small to display it completely. When scrolling, the numbers "flow" into view. This option may also remain inactive if it is not needed.
Grid	Grid 1256 as default setting.
Reference for dB value	All dB displays in a curve window have the same reference value. This value is "1" as a standard, but can be changed. Each number greater than zero in the valid range can be a reference value. For example, if a value of 10 is specified, all dB values on the axes become 20dB smaller. When decibels are calculated, values are first divided by this reference value. The displayed waveforms are not changed; only the axes labeling is adjusted.
Coordinate system size	Along with the *Default*-view, it is also possible to select a *Maximum*-view in which the axis labels are placed within the coordinate system and the coordinate system fills the entire curve window.

OK, Cancel, Set as default

For details on operation, see the chapter Confirmation bar 1273

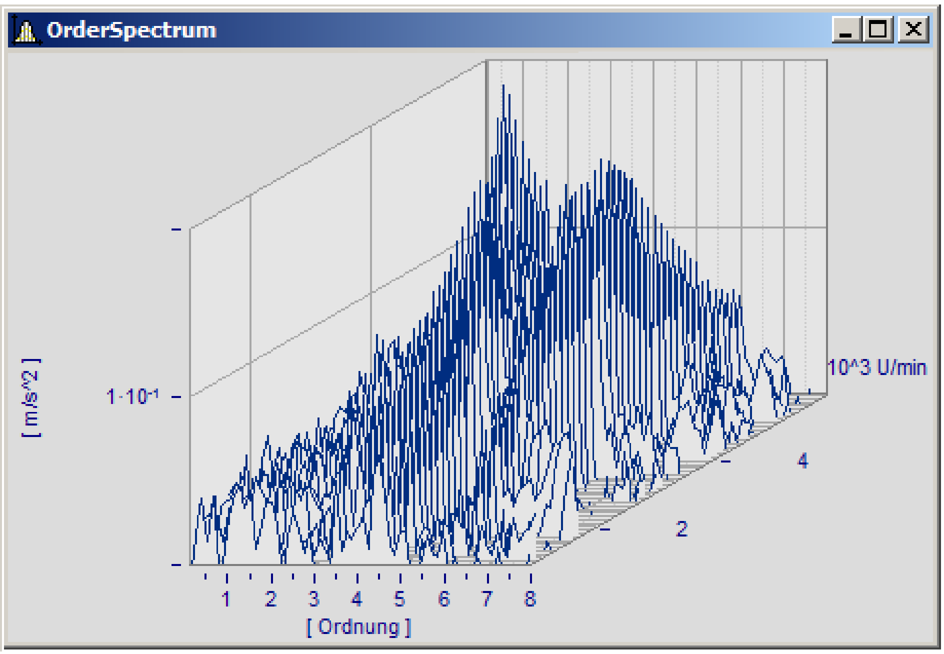
Remarks

Note

- If a waveform is not scaled in seconds, but is to be displayed in absolute or relative time, adjust the sampling time, the x-offset and the x-unit to provide the desired unit "s". For instance, if the waveform has a sampling time of 1h (1 hour), divide the sampling time by 3600 to set the x-unit to "s".
- The modes *Date/time: Absolute* and *Days/hours/minutes: Relative* cannot be implemented if an interval of less than 1ms is set for display of absolute or relative time. The program switches automatically to axis labeling in seconds.

11.6.2.1 Waterfall Diagrams

The waterfall diagram serves as a simple tool for displaying a series of curves as arrayed one behind the other, and viewed from a vantage point that makes their line-up appear diagonal. This allows a close comparison of the individual curves, so that trends and deviations are easily recognized. Curves are drawn in a rectangular coordinate system with three axes (x, y, z). The z-axis has a directional component parallel to the angle of view. It is drawn diagonally toward the upper right of the screen at an angle specified by the user.



Not all curves are completely visible in waterfall display. The viewer sees a range of curves from above, with some valleys hidden by peaks. The relative angles and distances between the curves are not always apparent due to overlapping.

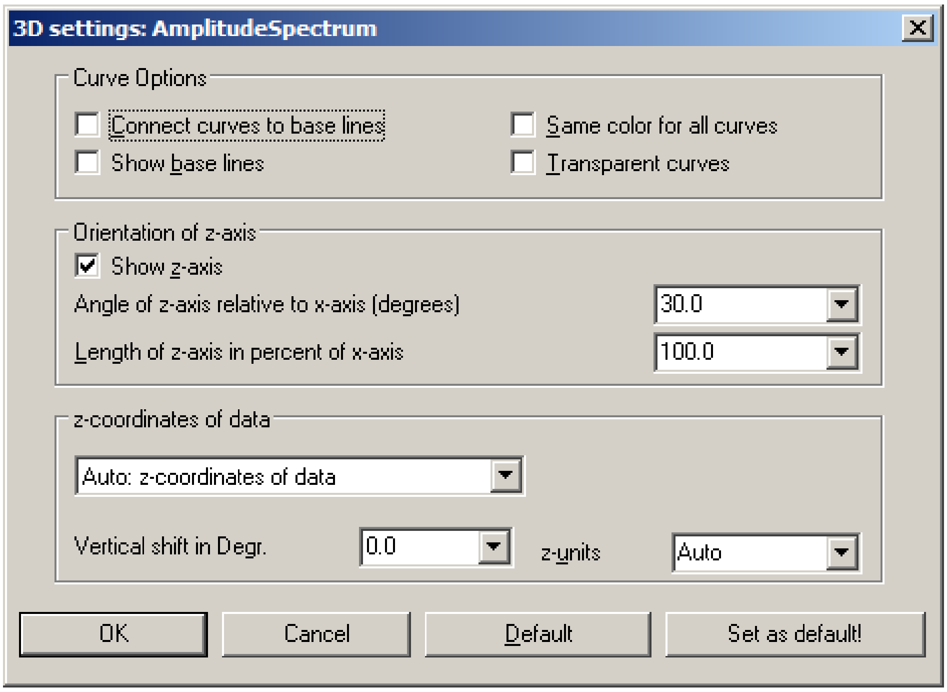
A waterfall display is drawn from back to front. When a new curve is drawn, the area under the curve is filled in with the color of the screen background, covering all lower parts of curves behind it.

The waterfall display is especially useful for comparing:

- multiple spectra; spectra are drawn at regular intervals, so that their development over time can be observed.
- multiple periods in a waveform.
- signals of several sensors on the same object, e.g. multiple temperature recorders arranged on a long pipe, delivering similar signals at different points in time.
- several consecutive measurements of a channel measured with the same trigger.

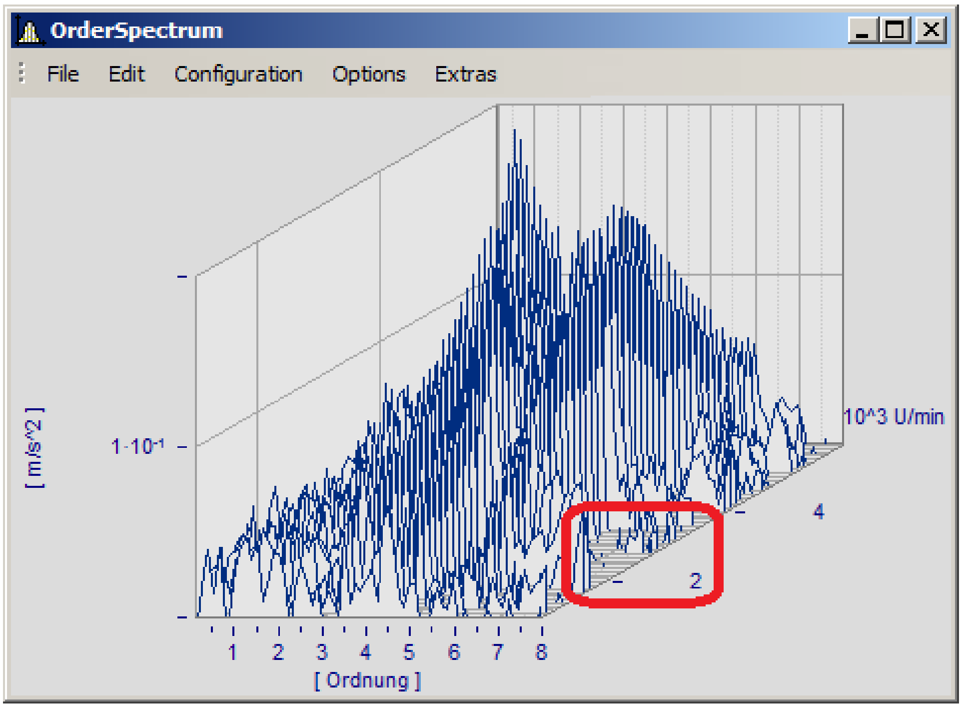
Mouse Operation

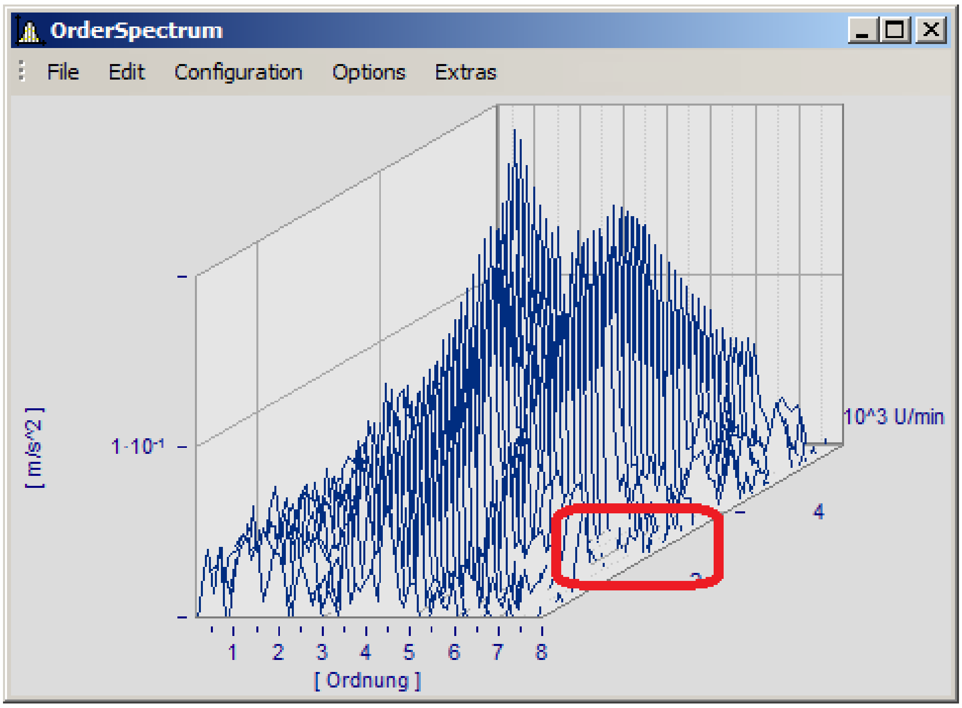
- Call the dialog for setting the type of display using the menu option *Configuration/ Display*.. Select *Waterfall* and end the dialog with *OK*.
- The curves displayed in the window are shown in a waterfall diagram with the effective presettings.
- A dialog is available to change the settings of the waterfall diagram. Select menu option *Configuration/ 3D*.... The following dialog appears:



Curve options

Enter here the settings for the appearance of the curves in the window.

Parameter - Curve options	Description
Connect curves to base lines	This option connects the ends of the curve plot to the base line. The base line runs under the curve, parallel to and in the height of the x-axis. It is the projection of the curve on the plane defined by the labeled x- and z-axes. This option is not active in the following illustration: 

Parameter - Curve options	Description
Show base lines	Base lines are drawn when this option is selected. A base line runs under the curve, parallel to and at the height of the x-axis. It is a projection of the curve on the plane defined by the labeled x- and z-axes. Base lines are also obscured by curves in front of them. Base lines are present in the above illustration; the illustration below shows no base lines: 
Same color for all curves	Select this option to draw all curves in the color of the first (foremost) curve. Otherwise the colors are assigned according to the selected color settings. The color composite is important for a three-dimensional appearance.
Transparent	When this option is selected, there are no hidden lines. However, the three-dimensional effect of the graph is reduced significantly. When this option is not selected, analog data sampled equidistantly are drawn in overwrite mode.

Orientation of z-axis

The options in this group refer to the display of the z-axis.

Parameter - Orientation of z-axis	Description
Show z-axis	Enter here whether the z-axis should be displayed.
Angle in degrees	The angle of the z-axis can be set to between 1 and 89 degrees. An angle of 30 degrees is recommended.
Length of z-axis in percentage of x-axis	The length of the z-axis is specified in percentage of the length of the x-axis. The minimum value is 10%

z-coordinate of curve

Select here between the options *Fixed values: 0,1,2,3,...* and *Fixed range z0, dz*,.... In the former case, the first (foremost) curve takes the z-coordinate 0, the next takes 1, etc. The following settings are available when the latter option is selected:

Parameter - z-coordinate of curve	Description
z0	Enter the z-value here; the foremost curve will be displayed at this value.
dz	Enter the z-distance of adjacent curves in this box.
z-unit	A unit for the z-axis can be specified here.

Other options are also provided

Options	Description
Auto: z-coordinates of data	This employs a waveform's z-coordinate. In the imc FAMOS-dialog *Properties* of variables you can assign a z-coordinate to a waveform. The default is "0" The waveforms thus displayed must have unique and increasing z-coordinates. When handling structured waveforms (segmented, events..), this is the best choice. No further settings are necessary; the matrix will automatically be plotted with correct z-scaling.
Ditto with events: relative to first event	Only for multishot waveforms. The z-coordinate is determined from the various trigger times. The first shot is assigned the time 0 and all subsequent ones are designated accordingly. The other, related options listed make reference to other shots (events). E.g., the last, the first displayed, or the last displayed. The z-coordinate of each waveform absolutely must be greater than the last. Otherwise the display will not include all waveforms!
z-axis scaling	To scale the z-axis, double click on this option. Settings for the x- and y-axes, as well as for ticks and marking of the range can be made here.

Reference	Scaling the x-axis
Section 'Scaling the x-axis' 1204	

Default

Clicking on this button sets all dialog elements to default values.

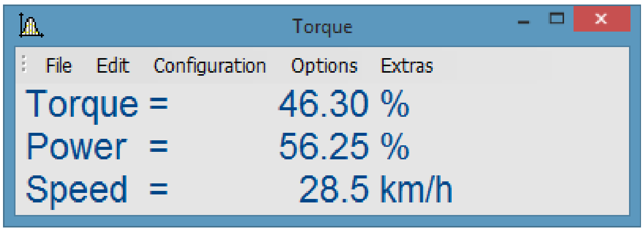
OK, Cancel, Set as default

For details on operation, see the chapter Confirmation bar 1273

Remarks

- Select an appropriate viewing angle. An angle of 30 degrees is a good starting point.
- A distorted display results if the angle is very small or very large; often the axes can no longer be labeled.
- The axes are labeled only when the coordinate system is large enough in every direction, i.e. when each axis exceeds a certain length. Enlarge the curve window if no labels appear. If there are still no labels, make any necessary changes to the angle and then the length of the z-axis. If an extremely long z-axis results, the window often has no room left for the labels.
- The area below the curve is **NOT** filled for XY-plots, digital data and reduced data. These displays always use the *Transparent* mode.
- Waterfall diagrams are often more legible when the y-axis is scaled upward very generously. Assume that the curves displayed have a value range from 3 to 12, the y-axis could be scaled from 3 to 30 (or 20 or 40). The axes need not be extended downward, since this <Shift>s the curves upward. Depending on the kind of data, appropriate y-axis scaling can greatly improve legibility.
- Not all data can be represented in a waterfall diagram. For example, noisy data can produce a chaotic image of overlapping lines. Waveforms which are relatively smooth and similar are best for waterfall display.
- When several curves are displayed, the first curve is always drawn in the foreground of the window; all additional waveforms appear behind the first curve.
- Waveforms with different x-axis scaling can be displayed together (i.e. waveforms sampled at different speeds). All curves are displayed correctly with the respect to time on the x-axis, as in all other curve windows.
- Only one y-axis is used for all curves in a waterfall diagram.
- A line display is always implemented for waterfall diagram, even if data were represented with symbols. The symbols are not displayed. The selection of *representation with symbols* is recorded and will be reactivated whenever the waterfall mode is ended.
- Waveforms displayed with a dotted line are interpreted as transparent in the waterfall display.
- Curve display settings such as dots, bar graphs or stair-steps can be set for each waveform individually, or for all waveforms in a window with the option *Valid for all axes* selected in the dialog for scaling the y-axis.
- Only transparent graphics can be outputted to plotters. The algorithm used here, which draws lines and subsequently draws over them with the next plane of display, does not produce the desired effect with plotters.
- Drawing lines which are then covered by the next graphics takes considerably more time than drawing transparent graphics. First try to output transparent graphics before experimenting with various settings and scaling methods.

11.6.2.2 Last Value As Number

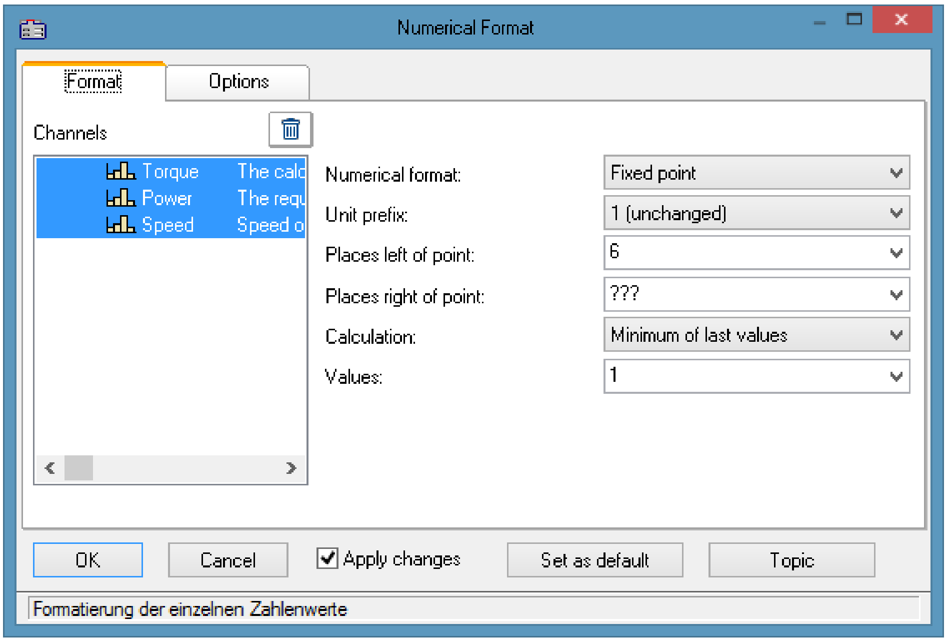


This mode, displaying the last value in a waveform as a numerical value, is especially suited for use of the curve manager in data acquisition and on-line display of these data. The last value in a waveform is always the most recent measurement value in on-line display. This mode is especially convenient for display of slowly changing quantities, allowing the user to monitor the amplitude of a spectral line, the effective power or a temperature as a numerical value. The display of the numerical value can be formatted and several channels can be compared with each other.

Mouse Operation

- Select *Configuration/ Display*...
- Select the option *Last value as number* and end the dialog with *OK*
- The curve window now shows the variable's name along with a numerical value. If you display more curves in the window, multiple numerical values appear stacked one above the other:

The format of this display can be changed by double-clicking on the curve window or selecting *Configuration/ Numerical Format....* The following dialog appears for defining the number format:



Waveforms

A list of all waveforms displayed in the window is found on the left side of the dialog. Select waveforms from this list by moving the mouse to the desired waveform's listing while holding the mouse button. Multiple waveforms can be selected by holding down the <Ctrl> button and clicking on the desired waveforms.

Format (For all selected waveforms)

All settings made here only affect waveforms in the *Waveforms* list.

If the the waveforms selected have differing format settings, question marks appear in the associated boxes. Any settings you enter to replace the question marks will be applied to all waveforms selected.

<table>
<tr><th>Settings - Format</th><th>Description</th></tr>
<tr><td>Numerical format</td><td>Representation as fixed point is customary. But the numerical values can also be formatted as Floating point, in Hex-format, or as Date/Time.
<table>
<tr><th>Numerical format</th><th>Description</th></tr>
<tr><td>Floating point</td><td>Floating point-representation uses the E-character to express the exponent, followed by the sign and a two-digit exponent.</td></tr>
<tr><td>Hex (1, 2, 4 Byte)</td><td>Hex always displays the lowest selected Bytes, thus for example, the 1027 and 1 Byte is represented as 03h.</td></tr>
<tr><td>Time relative-,
Date/time auto</td><td>The point in time when the last sample was recorded is formatted in accordance with the display option applicable to the x-axis 1128.</td></tr>
<tr><td>Time relative-,
Date/time fixed</td><td>The formatting of the time and date is specified by means of placeholders, see the chapter "Scale 1205".</td></tr>
</table></td></tr>
<tr><td>Magnitude</td><td>Numerical values can be associated with a fixed order of magnitude. Take as an example a current of 0.1A. To display the current in mA, select milli. The numerical value is then multiplied by 1000 and the prefix milli (m) is set in front of the unit, if it is not empty. Selectable prefixes range from pico (p) to giga (G). Select 1 if numerical values and unit should be displayed unchanged. Selecting a fixed order of magnitude is recommended for fixed-comma notation; if numbers vary greatly in their order, it is recommended to use floating-point notation with unchanged order.</td></tr>
<tr><td>Fixed-point, floating-point notation</td><td>Floating point notation uses the exponential notation, "e" and a two-digit signed power of 10.

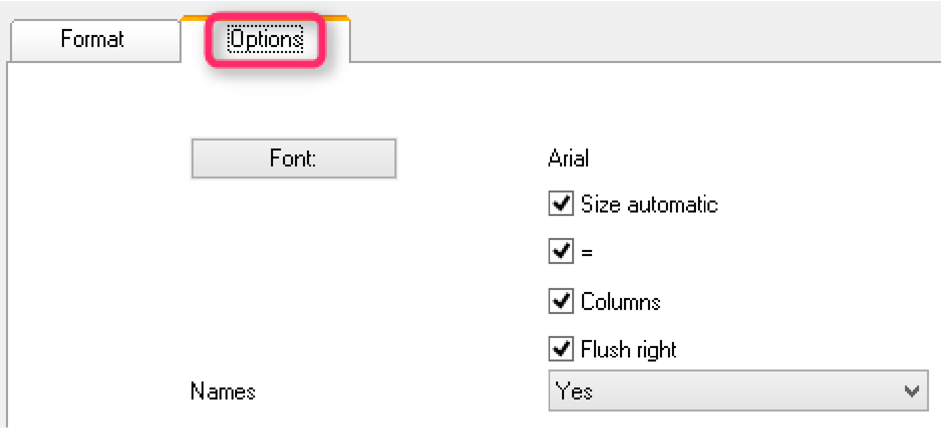
Fixed-point example: 0.123, -123, 888.987
Floating-point example: 1.45E+03, -1E-01, 1.4444E+00

Select Yes for Fixed-point or no for Floating point. With floating point, one digit always appears before the decimal.</td></tr>
<tr><td>Places left of point</td><td>The amount of digits before the decimal point, max. 15. With Fixed-point notation, sufficient digits must always be specified, otherwise a black bar appears. With floating-point format, one digit before the decimal point is sufficient.</td></tr>
<tr><td>Places right of point</td><td>The amount of digits after the decimal point, between 0 and 20. If no digits (0) appear after the decimal point, it is omitted.</td></tr>
</table>

<table>
<tr><th>Settings - Format</th><th>Description</th></tr>
<tr><td>Calculation</td><td>The numerical value displayed can be calculated from the most recent values:
<table>
<tr><th>Calculation</th><th>Description</th></tr>
<tr><td>Maximum of the last values</td><td>The maximum is calculated from the last n values in the waveform. This function can be interpreted in on-line-display as peak hold.</td></tr>
<tr><td>Minimum of the last values</td><td>The minimum is calculated from the last n values in the waveform.</td></tr>
<tr><td>Average of last values</td><td>The arithmetic mean is calculated from the last n values in the waveform. The reduces possible noise in display of the measurement data.</td></tr>
</table></td></tr>
<tr><td>Values</td><td>Specify here the number of values from which the average, minimum or maximum is calculated. Any number from 1 to 30000 can be specified. If the waveform has fewer values than specified here, all values in the waveform are used for the calculation. Note that with larger numbers, the calculation must be performed for display of the curves.

When 1 is specified, the result of calculating the minimum, maximum and mean value is always the last value in the waveform.</td></tr>
</table>

Options (Curve Window Defaults)



Settings made in this group of elements are effective for the entire curve window and are not made individually for each waveform. The font and several other basic display types can be set here.

Settings - Options	Description
Font	For selecting the font, font size and style. The size set here is ignored if the option Size: auto is activated.
Size automatic	The font size is automatically selected to be as large as will fit. However, only the size is adjusted.
Columns	The name, equals sign, numerical values, and units are displayed in columns for a clearer presentation. Without the option *Columns*, the entries are separated by spaces.
"=" (equal sign)	An equal sign appears after the variable's name, or else a colon. The colon appears directly with the name, but the equal sign appears in its own column.
Flush right	All numerical values appear flush along the right margin, independently of the format set. Without *Flush right*, all decimal periods are aligned one above the other. The condition for the aligned writing is that the *Columns* option is selected!
Names	Variables names and or comments which appear before the numerical value. If only one variable is in the window, the designator can be switched off since it is already in the title bar.

Set as default

The settings made initially only apply to the current window. If you click on the button *Set as Default*, any new curve windows created apply these settings whenever the display stye *Last value as number* is selected. You should only click on this button if no question marks are showing in the dialog.

The defaults for the format are **NOT** saved for each data set individually.

OK, Cancel

For details on operation, see the chapter Confirmation bar 1273.

Remarks

- Several menu items in the curve window, such as Measure, Scale and Overview Window cannot be selected when the numerical value display option is selected.
- Displaying numbers in fixed-point notation may have two effects in connection with the range of numbers. If the size of a number is too small, only zeros are displayed. On the other hand, when a number is too large to be displayed in the available space, a symbol appears which indicates an overflow. In this case, select more digits left of the decimal point or floating-point notation.
- With numerical display of online measurement data at high sampling rates, it can occur that the numbers change so fast that they are no longer visible. In that case, select a calculation and control the update rate for the values by making the appropriate setting under Values. Then select an appropriately small number of places right of the decimal. Usually only the digits to the right of the decimal point change strongly because the measurement signal changes only slightly.
- When time-stamped data are subjected to data reduction, the amount of values on which the calculation is performed is the same as the amount of measured points before the data reduction. Thus, specifying the amount of values to which the calculation is applied always fixes the time segment on which the calculation is performed, independently of how much the measured data are reduced.
- The color of the texts and the background in numerical display can be changed uniformly for all curve windows in the dialog *Options/ Colors...*. The following elements are available for selection:
  - *Numbers: foreground* or *background*

11.6.2.2.1 Single Value Display

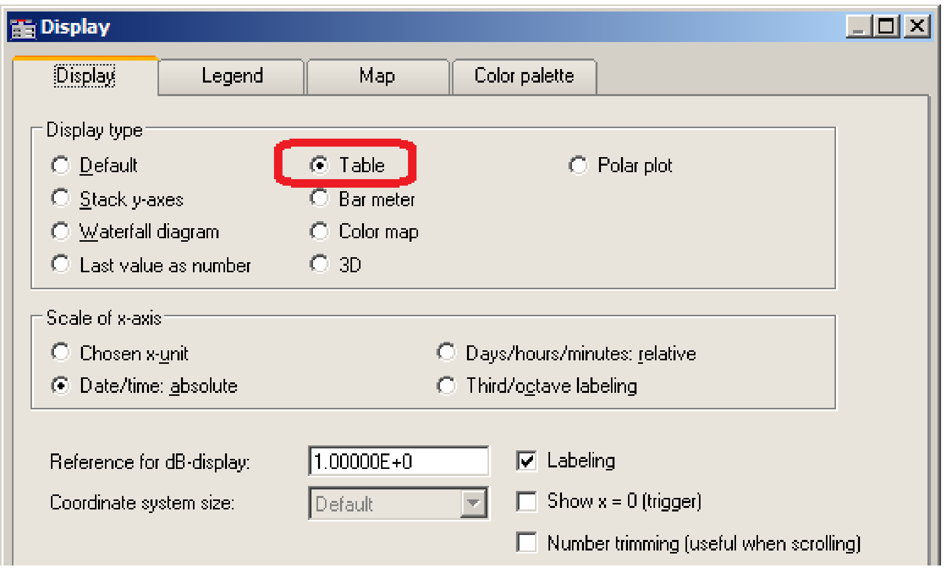
The display mode *Last value as number* is automatically activated if real waveforms with a length of 1 are displayed.

11.6.2.3 Tabular representation

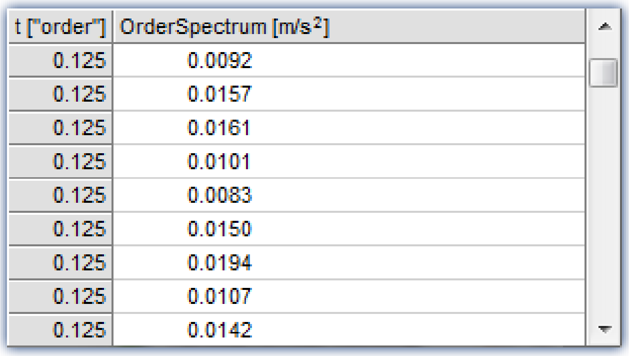
Measurement readings can also be displayed in a table, where the readings are listed in chronological order. This can appear as a protocol readout or as a log book.

Operation

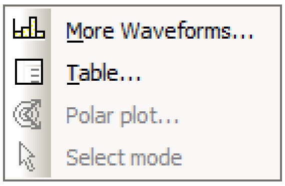
Select the curve window menu item *Configuration / Display...*. This calls a dialog for defining the curve window's display style. Select the entry, *Table*. Even the time display types *Chosen x-unit* and *Date/time absolute*, are applied in a tabular display.



The curve window then appears as shown below:



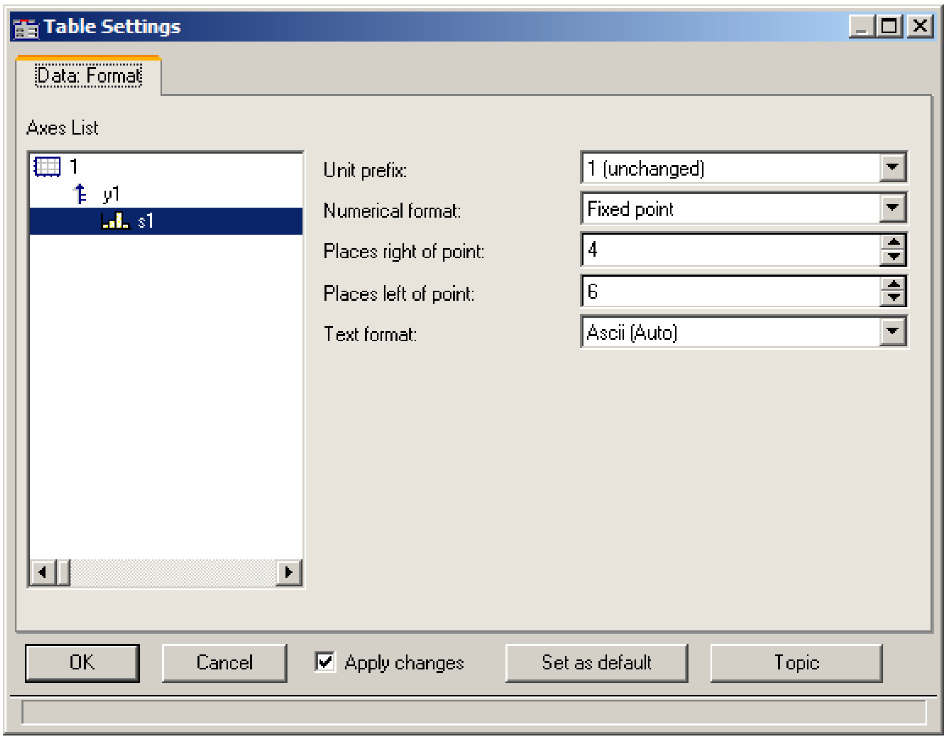
t ["order"]	OrderSpectrum [m/s²]
0.125	0.0092
0.125	0.0157
0.125	0.0161
0.125	0.0101
0.125	0.0083
0.125	0.0150
0.125	0.0194
0.125	0.0107
0.125	0.0142



It's possible to move through the list using the scrollbar at right.

Right-clicking the mouse on the curve window calls the context menu which now looks like this.

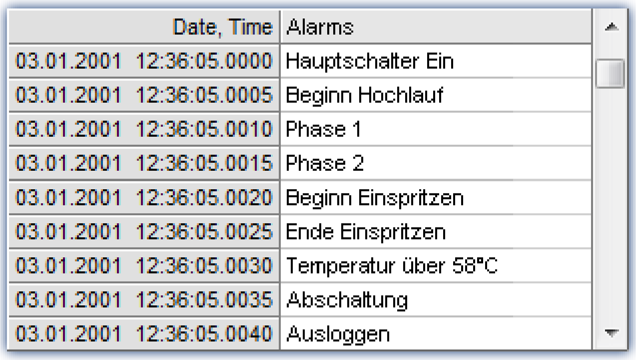
The menu item *Table...* calls the dialog offering controls as shown below:



The left portion of the dialog indicates all the channels displayed in the curve window. How these channel listings are arranged in terms of axes and coordinate systems doesn't matter here. On the right side of the dialog, the controls are located, which are for making settings for the channels selected in the left part.

11.6.2.3.1 Settings

If the curve window displays channels with measurement readings (default), then you need to deal with the settings for the *numerical format*, *namely Unit prefix*, *Numerical format*, *Places*, *right/left of point*. If texts are displayed (time stamp-ASCII data), then the text format becomes relevant.

Settings	Description
Unit prefix	This consists of the order of magnitude and, if appropriate, a prefix such as kilo, milli, Mega or even just 1 (default, use of unit without prefix), which appears after the number before the unit. If the reading is 10 and takes the unit V (Volts), then for a selection of "m" (milli), a value of 10000mV is returned.
Numerical format	Fixed point can be selected for readout with a fixed number of decimal places and without an exponent; e.g. 17, 17.35, -0.0017. Floating point can be selected for readout with fixed relative precision and an exponent, e.g. -1.28E-7 or 3.4E+0
Places right of point	This is the number of decimal places to show. 0..15 places are possible.
Places left of point	Only for fixed point format, a specified amount of places before (to the left of) the decimal point. The number should be large enough to ensure that the numerical value is indicated with all its digits.
Text format	This setting only pertains to channels with information presented as strings, in other words on the case of time stamp-Ascii data. Such data are, for instance, generated by imc Online FAMOS , but also by functions belonging to the Time Stamp Ascii Kit (TSA-Kit). This data type contains texts, where each text has a time stamp, e.g. log-book entry representation with absolute time selected: 

Date, Time	Alarms
03.01.2001 12:36:05.0000	Hauptschalter Ein
03.01.2001 12:36:05.0005	Beginn Hochlauf
03.01.2001 12:36:05.0010	Phase 1
03.01.2001 12:36:05.0015	Phase 2
03.01.2001 12:36:05.0020	Beginn Einspritzen
03.01.2001 12:36:05.0025	Ende Einspritzen
03.01.2001 12:36:05.0030	Temperatur über 58°C
03.01.2001 12:36:05.0035	Abschaltung
03.01.2001 12:36:05.0040	Ausloggen

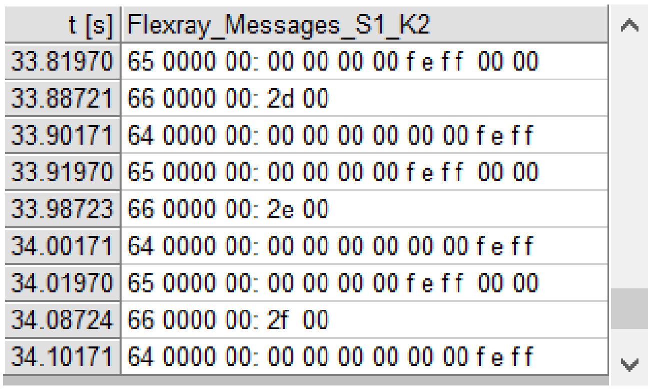
Text format

The following options are available:

Text format	Description
Ascii (Auto)	Display of ASCII characters in legible form (see above.).

<table>
<tr><th>Text format</th><th>Description</th></tr>
<tr><td>Hex</td><td>Display of hexadecimal values 00H .. FFH.
<table>
<tr><th>t [s]</th><th>Alarms</th></tr>
<tr><td>-4.8</td><td>48 61 75 70 74 73 63 68 61 6c 74 65 72 20 45 69 6e</td></tr>
<tr><td>-4.1</td><td>42 65 67 69 6e 6e 20 48 6f 63 68 6c 61 75 66</td></tr>
<tr><td>-4.1</td><td>50 68 61 73 65 20 31</td></tr>
<tr><td>-1.1</td><td>50 68 61 73 65 20 32</td></tr>
<tr><td>2.3</td><td>42 65 67 69 6e 6e 20 45 69 6e 73 70 72 69 74 7a 65 6</td></tr>
<tr><td>4.6</td><td>45 6e 64 65 20 45 69 6e 73 70 72 69 74 7a 65 6e</td></tr>
<tr><td>6.7</td><td>54 65 6d 70 65 72 61 74 75 72 20 fc 62 65 72 20 35 3</td></tr>
<tr><td>10.3</td><td>41 62 73 63 68 61 6c 74 75 6e 67</td></tr>
<tr><td>12.4</td><td>41 75 73 6c 6f 67 67 65 6e</td></tr>
</table>
</td></tr>
<tr><td>CAN, LIN message</td><td>For all devices with a CAN/LIN-connection: display with identifier and contents of the CAN/LIN-messages. The identifier (appearing before the colon) and the bytes belonging to the message are displayed as hexadecimal values.
<table>
<tr><th>t [s]</th><th>CanBus_Messages</th></tr>
<tr><td>1.3</td><td>034: 00 00 00</td></tr>
<tr><td>2.9</td><td>034: 78 88 0F</td></tr>
<tr><td>3.4</td><td>129: 00 00 00 00 11 11 00 00</td></tr>
<tr><td>3.5</td><td>001: 01</td></tr>
<tr><td>4.4</td><td>034: 90 90 00</td></tr>
<tr><td>4.9</td><td>034: 78 88 0F</td></tr>
<tr><td>5.4</td><td>129: 00 00 00 00 11 11 00 00</td></tr>
<tr><td>6.5</td><td>001: 01</td></tr>
</table>
</td></tr>
<tr><td>4 byte abs. time</td><td>For all devices which can read in 4 Byte time stamp data (seconds since 1.1.1980), there is a specialized display style.
<table>
<tr><th>t [s]</th><th>TimeStampUmsx4Byte</th></tr>
<tr><td>6.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>7.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>8.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>9.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>10.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>11.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>12.0</td><td>14.04.2001 19:41:55</td></tr>
<tr><td>13.0</td><td>14.04.2001 19:41:55</td></tr>
</table>
</td></tr>
<tr><td>3-number sets (hex)</td><td>Display of hexadecimal values in 3-number sets.
<table>
<tr><th>t [s]</th><th>Hex_3er_Messages_S1_K2</th></tr>
<tr><td>2.70843</td><td>64 00 00 00 00 00 00 00 00 00 f e f f</td></tr>
<tr><td>2.72640</td><td>65 00 00 00 00 00 00 00 f e f f 00 00</td></tr>
<tr><td>2.79394</td><td>66 00 00 00 22 00</td></tr>
<tr><td>2.80843</td><td>64 00 00 00 00 00 00 00 00 00 f e f f</td></tr>
<tr><td>2.82641</td><td>65 00 00 00 00 00 00 00 f e f f 00 00</td></tr>
<tr><td>2.89394</td><td>66 00 00 00 23 00</td></tr>
<tr><td>2.90843</td><td>64 00 00 00 00 00 00 00 00 00 f e f f</td></tr>
<tr><td>2.92641</td><td>65 00 00 00 00 00 00 00 f e f f 00 00</td></tr>
<tr><td>2.99396</td><td>66 00 00 00 24 00</td></tr>
</table>
</td></tr>
</table>

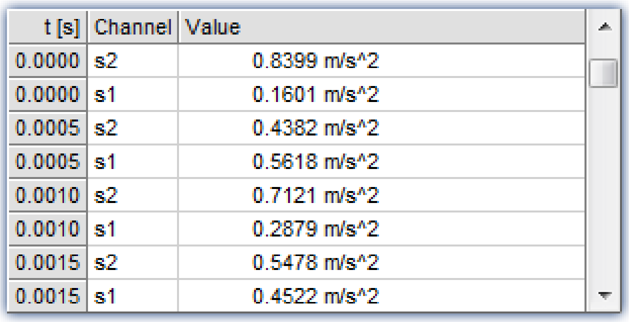
Text format	Description
Flexray-message	For all devices with a Flexray-connection: display with identifier and contents of the Flexray-messages. The identifier (appearing before the colon) and the bytes belonging to the message are displayed as hexadecimal values.



t [s]	Flexray_Messages_S1_K2
33.81970	65 0000 00: 00 00 00 00 f e f f 00 00
33.88721	66 0000 00: 2d 00
33.90171	64 0000 00: 00 00 00 00 00 00 f e f f
33.91970	65 0000 00: 00 00 00 00 f e f f 00 00
33.98723	66 0000 00: 2e 00
34.00171	64 0000 00: 00 00 00 00 00 00 f e f f
34.01970	65 0000 00: 00 00 00 00 f e f f 00 00
34.08724	66 0000 00: 2f 00
34.10171	64 0000 00: 00 00 00 00 00 00 f e f f

Multi-channel displays

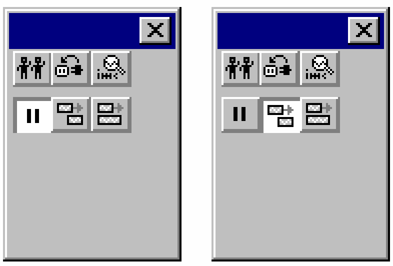
Display of multiple channels at once also uses correctly synchronized ordering. For every measurement reading, the source channel is indicated:



t [s]	Channel	Value
0.0000	s2	0.8399 m/s^2
0.0000	s1	0.1601 m/s^2
0.0005	s2	0.4382 m/s^2
0.0005	s1	0.5618 m/s^2
0.0010	s2	0.7121 m/s^2
0.0010	s1	0.2879 m/s^2
0.0015	s2	0.5478 m/s^2
0.0015	s1	0.4522 m/s^2

Online-Display

If a table is displayed during a running measurement, it may be advantageous to have a readout of the current readings, at the bottom of the table. For this purpose, the roll-mode is provided, just like for time-based displays in coordinate systems.



OK, Cancel, Set as default

For details on operation, see the chapter Confirmation bar 1273

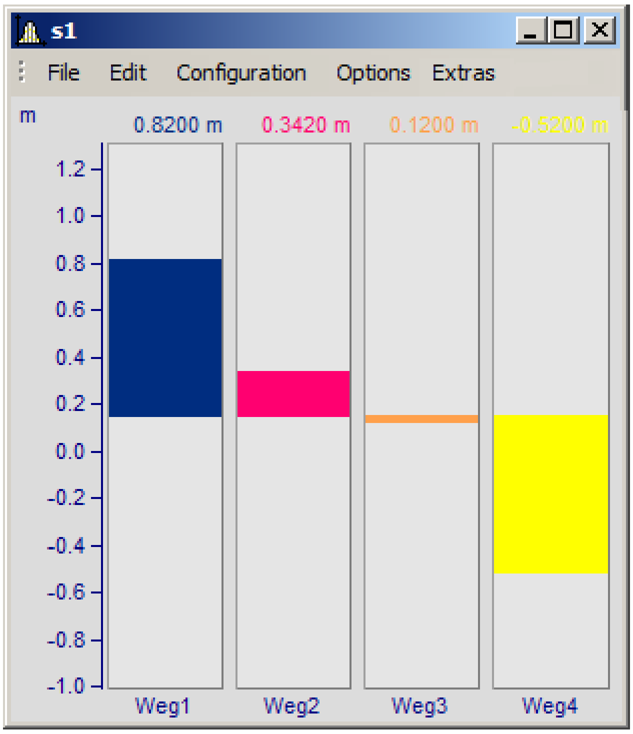
Remarks

- The entries are always ordered chronologically.

- The condition for using this display type is that the time coordinate in each channel behaves like time, in other words, increases continuously.
- If the time coordinate decreases in a data set, for example, in the case of a characteristic curve which is an XY-waveform, this display type cannot be used.
- For information on the buttons *Ok*, *Cancel* and *Set as default*, refer to the chapter on Confirmation bar 1273.

11.6.2.4 Bar meter

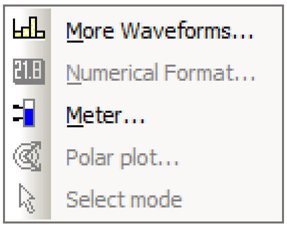
In addition to the numerical data display *Last value as number*, there is also a data display style having the form of a vertical meter bar. The height of the bar is determined from the last value in the waveform. This representation style is particularly useful for online viewing, as it offers a convenient overview of signal developments in multiple channels. The representation style incorporates graphical features such as different colors, slave pointers, margin checking etc.



Settings

Select menu item *Configuration/ Display* in the curve window. Select the *Bar Meter* radio button.

It is possible to display several channels together using a common y-axis. Select the channels to be displayed in the curve window.



To configure the bar meter itself, right-click on the curve window to open the context menu:

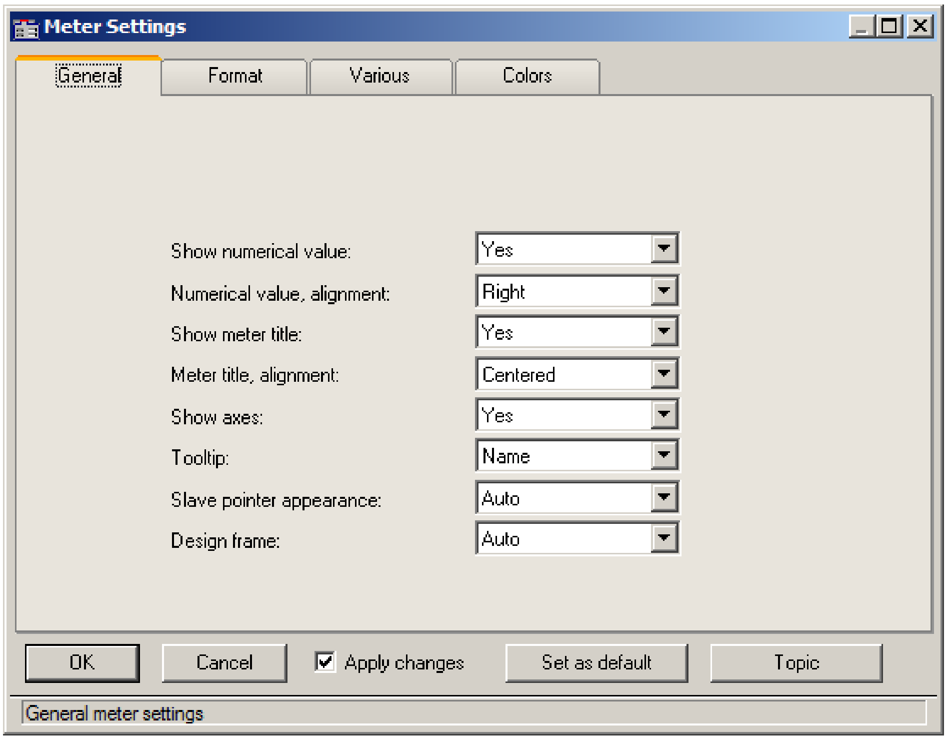
Select *Meter...* to open the *Meter Settings* dialog. This dialog consists of several sub-dialogs, each of which contains controls for different settings.

If you have preferences for certain settings, use the *Set as default* button. These settings will be implemented automatically each time bar meter display mode is used.

The following is a description of each sub-dialog in the *Bar Meter Settings* dialog.

Settings: General

This is where settings are made which affect all bars in the curve window alike.



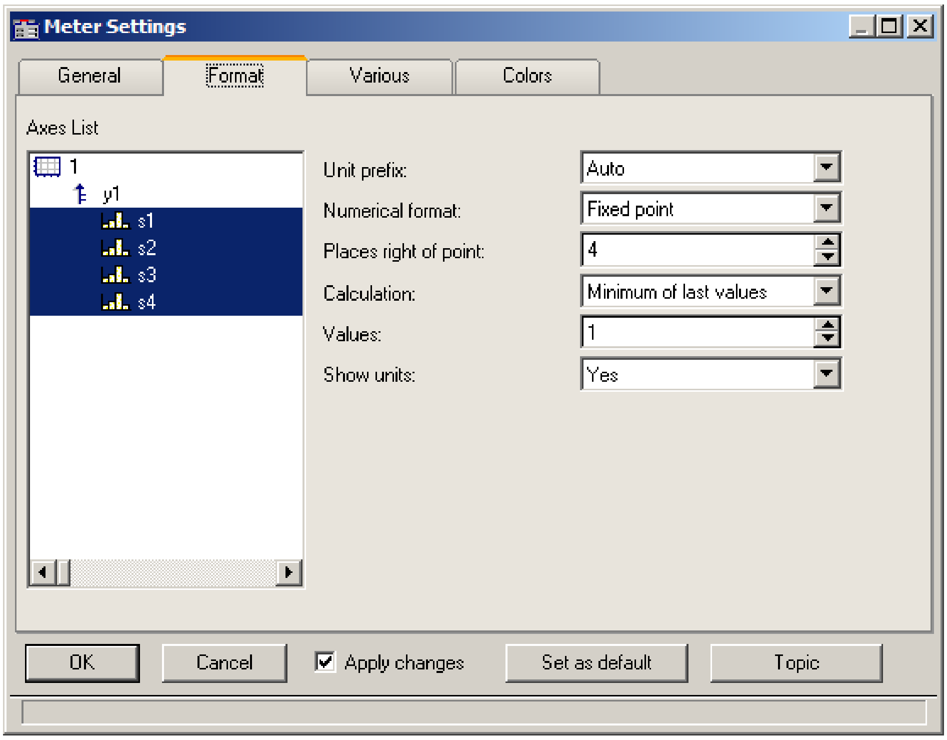
Settings	Description
Show numerical value	This setting governs whether to display the numerical value of a signal together with its bar meter representation. The numerical value is written above the bar.
Numerical value, alignment	This controls the horizontal alignment of the numerical value (in case it is specified to appear). The recommended setting is *right*, but *left* and *centered* are offered.
Show meter title	This determines whether to display the corresponding channel name under the bar meter of a signal. This is particularly useful when multiple channels' signals are being shown.
Meter title, alignment	The horizontal alignment of the title text, which is always written in one line. Choices offered are *left*, *right* and *center*.
Show axes	A y-axis can be specified to appear adjacent to the bar meter at left. The scaling of the axis can be set by the usual method for curve windows. This axis determines the value range of the bar (lower-limit physical value at the bottom edge, upper-limit physical value at the top edge). This is also where to specify whether the scale is indicated or not. Even if the scale is not depicted, it is still applied to the bar's value range. The settings in the curve window's menu item Configuration/ Axes must be made afterwards.
Tooltip	For *Name*, the channel name is displayed; for *no*, it is not.
Slave pointer appearance	*Line*, or a clamp for *auto*.

Settings	Description
Design frame	With *auto*, each channel has its own frame; with *Common frame*, not. 

Settings: Format

This filecard mainly concerns the settings for the numerical format and for computing the numerical value. The numerical value is used for the readout above the bar and for determining the height of the bar.

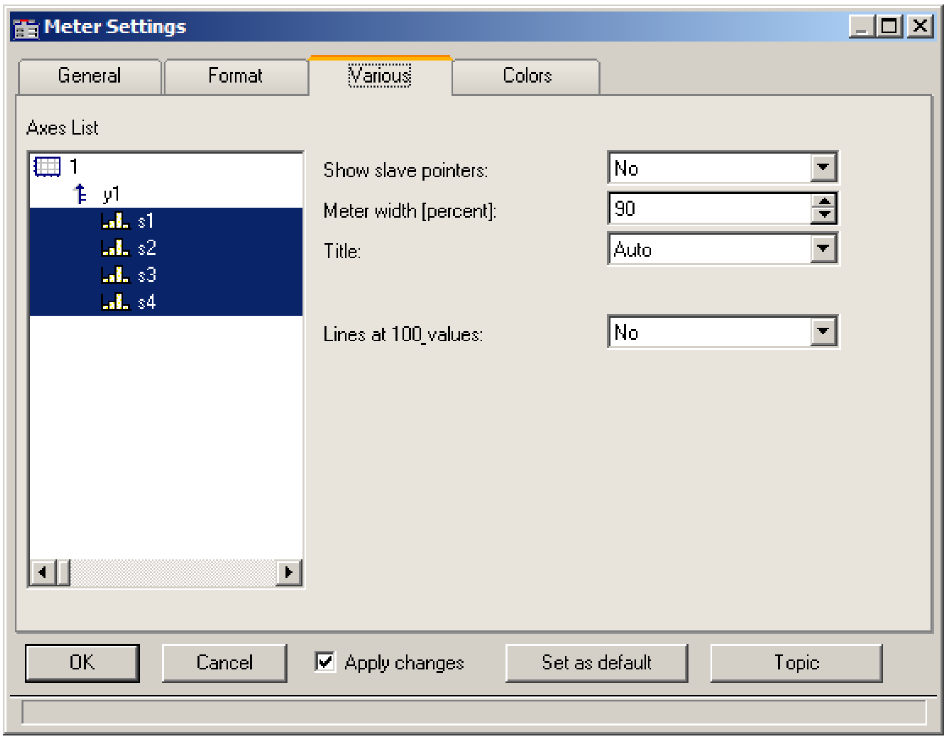
On this and the following sub-dialogs, the first step is to select all the channels to which the settings made should apply in common. Multi-selection can be performed as described in the instructions for the *axes list* 1194. If multiple, selected channels have mutually different settings for a property, the setting indicated for that property will be "???".



Settings	Description
Unit prefix	You can specify a unit prefix, reflecting the 10-based exponent of the signal value, to accompany the displayed numerical value. Prefixes from piko (p) to Giga (G) are supplied. When *auto* is set, the exponent is oriented to the exponent of the y-axis scaling, which is the recommended setting. For fixed point notation, a fixed exponent is recommendable, as well as for the y-axis scaling - see the description of the y-axis. Example: the waveform involved is a power measurement taking units of Watts and extending in range from 1e4 to 1e6 W. As the fixed unit prefix we choose "kilo" (k), resulting in values of 10kW to 1000kW. This setting is unnecessary if the numerical value of the signal isn't set to be displayed.
Numerical format	Fixed point (e.g., 0.01, 100, 365.25) or floating point notation (e.g., 3.5E-3) are available. If the value range of the signal is known, fixed point notation is better. This setting is unnecessary if the numerical value of the signal isn't set to be displayed.
Places right of point	Zero to fifteen places after the decimal point can be specified. This setting is unnecessary if the numerical value of the signal isn't set to be displayed.
Calculation	The displayed numerical value can be the most recently measured value, or can be a function of the N most recent values. The functions of N values offered are mean, minimum and maximum. If the waveform has fewer than N values, all available values are used in the calculation. If N = 1, the particular function used is irrelevant. The height of the meter bars, as well, is derived from the setting made here.
Values	Enter the number N of values, from which the mean, minimum, or maximum is to be calculated. Only integers >= 1 are permitted. A large value for N needs much time for computation, but 100 values is an amount the system can comfortably and quickly handle.
Show units	This determines whether the physical unit, together with the exponential prefix (p, n, µ, m, ...) is to be displayed with the numerical measurement value. It is sometimes necessary to include an indication of the physical unit, in order to identify the value's order of magnitude. The unit should be omitted only if it is already accurately reflected by the y-axis scaling.

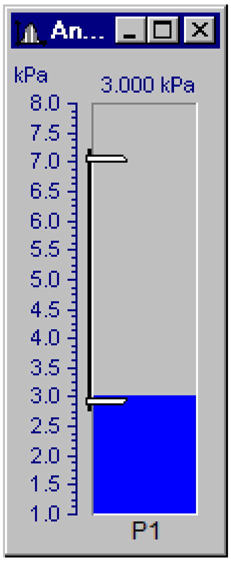
Settings: Various

This sub-dialog contains an assortment of setting controls, such as the width of the meter bars, or settings concerning the slave pointer.



Settings	Description
Show slave pointers	Specify here whether a meter bar should be equipped with slave pointers. These are markings appearing along a bar, which at any given time are situated where the signal's minimum and maximum encountered values were.
Meter width (percent)	Specify here the width of the meter bar relative to the width of the bar's "cell", which is the approximate width of the curve window divided by the number of bars in the window. Any fraction of the cell width, from 0% to 100% can be entered; a setting of 100% causes the bars to touch each other and thus 90% is recommended for greatest clarity.
Title	The title of the bar meter can be the channel to which its signal belongs (setting: *auto*), or any arbitrary name (*Fixed title*). If you select *Fixed title* from the list box, the entry box of the same name will appear below. Fixed title: Enter here an arbitrary designation for a bar meter. Up to 20 characters are allowed.

Slave Pointers



Slave pointers display the largest and smallest levels of a channel. At the beginning of a measurement, they lie together. They generally move away from each other during a measurement - the top one follows the largest values while the bottom one follows the smallest values. The slave pointers may also lie outside of the currently visible region.

The bar's slave pointers are represented by a graphic resembling a bar clamp. The slave pointers may also be located outside of the visible range.

Whenever a curve window is first opened or a new curve configuration is loaded, the slave pointers in that window are reset. The slave pointers are also not displayed when no data is present.

Slave Pointer: Computation

The slave pointers are rapidly computed by simply tracking the minimum and maximum values in a waveform. Therefore, slave pointers can be updated quickly even with large amounts of data. In typical online measurement applications, where the incoming data is simply appended to the data record, the use of slave pointers is appropriate. In off-line data analysis, however, they are not particularly useful because the entire data record is loaded at once.

Starting a new measurement on a channel with slave pointers does not reset them. They retain their former value until new data forces them to a new position.

Slave pointers are computed from the actual measurement data and not from a value computed from the channel for the bar meter. For example, consider a bar meter which is configured to display the average of the last 10 values. Although the meter is unlikely to show transient maximum values, these will affect the position of the slave pointers.

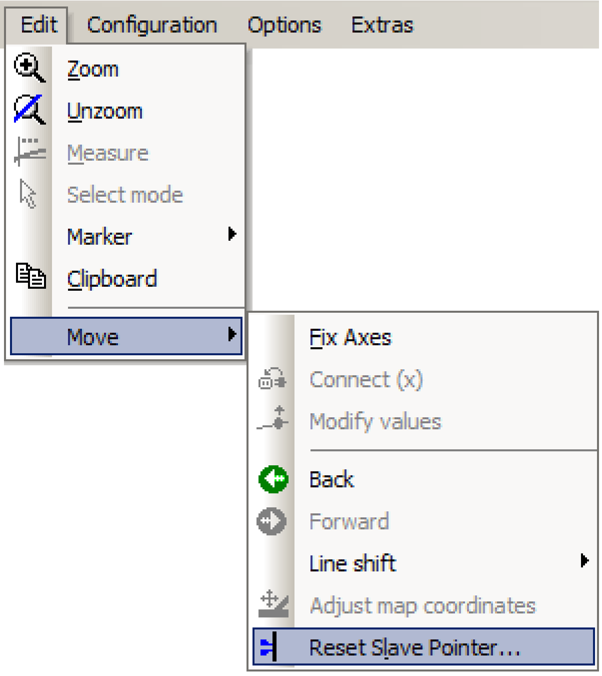
To avoid this effect from occurring, compute the average *online* and then display the resulting *virtual channel* in a bar meter. The slave pointers will then agree with the displayed maximum and minimum values.

Slave pointers are accurate to 6 significant figures, i.e. they use 4 Byte representation.

Slave Pointer: Reset

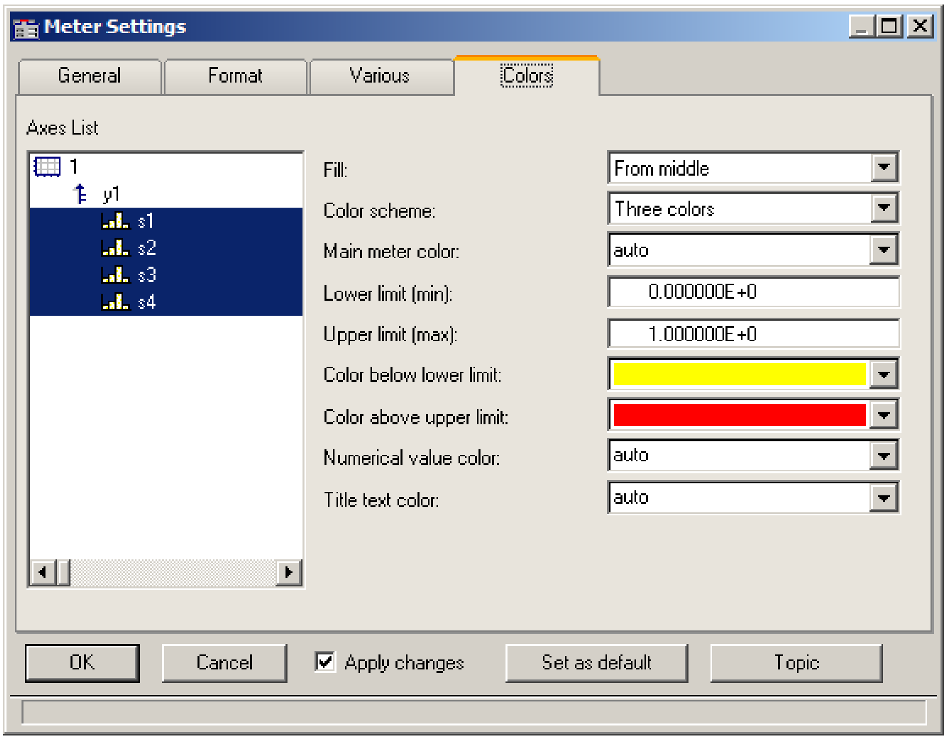
Resetting a slave pointer causes *all* slave pointers in that curve window to be reset. When you reset a slave pointer, it slides back to the current measurement value. Slave pointers have to be reset manually in each window. When a new measurement is started, this does *not* automatically reset the slave pointers!

To reset the slave pointers in a curve window, select *Edit / Move / Reset Slave Pointer...*.



Settings: Colors

This sub-dialog lets you decide on colors for the bars.

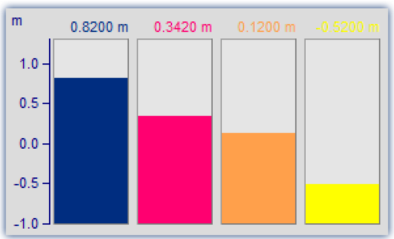


Fill

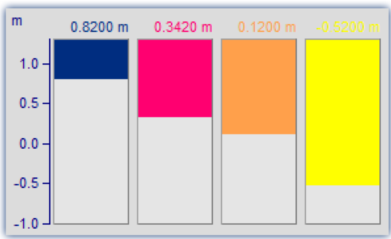
This setting determines from where the meter bars grow with increasing signal measurement values, as represented visually by a column filling with color.

The available options are from the top, from the bottom, from the center, and from y = 0 (the height along the bar, where the y-axis is equal 0.0).

From below



From above



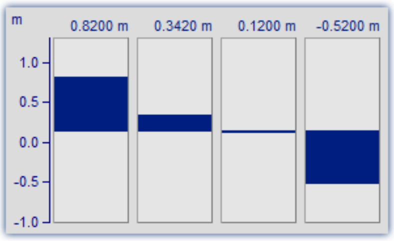
From y = zero

Alternating up and down from the 0 line of the axis

Color scheme

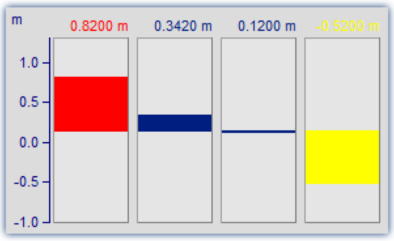
The bar can have only one color, three colors in succession or up to three colors at once. Three colored bars are used to indicate whether the measurement signal is currently within a tolerance range, which can be specified by the user in terms of an upper and a lower threshold value.

One color



A one-colored bar has the same color at all times.

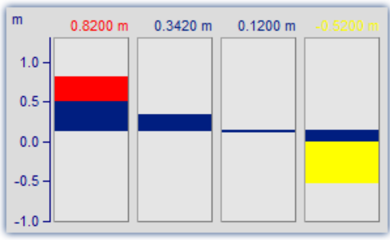
Three colors



The three color bar (*one color at a time*) shows the whole filled area in one color, which depends on whether the signal is below range, within range, or above range.

- The 1st color, if: Value <= Lower limit
- The 2nd color, if: Lower limit < Value < Upper limit
- The 3rd color, if: Value <=Upper limit

Three colors



Where a bar has *Three colors together*, each of its colors is shown only within a certain range of the bar's height, as outlined below:

- The 1st color, in the range: fill height <= Lower limit
- The 2nd color, in the range: Lower limit < fill height < Upper limit
- The 3rd color, in the range: Upper limit <= fill height

Depending on the circumstances, therefore, up to all three of the colors can be visible in a bar.

Settings	Description
Main meter color	This is the only color of the meter bar if only one color style is specified; for three color style it is the middle color (the color of the bar indicating a signal within the limits set by the user). When the valid setting is *auto*, the automatic selection which would have been made for a waveform in the curve window is applied to the bar. The background color of the bar is the background color of the coordinate system, which is set via dialog Options/ Colors 1341 of the curve window. If a waveform doesn't contain any values, the bar meter remains empty as well.
Lower limit (Minimum)	For three-color display modes, a lower limit must be specified in this entry box. If there shouldn't be any lower limit, it is possible to enter -1e30, which is generally lower than any signal which will ever be measured.
Upper limit (Maximum)	For three-color display modes, an upper limit must be specified in this entry box. If there shouldn't be any upper limit, it is possible to enter 1e30, which is generally higher than any signal which will ever be measured. The upper limit must be greater than the lower limit.
Color below lower limit	In three-colored bars, this is the first color.
Color above upper limit	In three-colored bars, this is the last color.
Numerical value color	The numerical value, if it is specified to be displayed above the bar meter, can be assigned a fixed color. Or, if set to *auto*, the color is the same as of the bar itself.

Settings	Description
Title text color	The title below the bar can be assigned a fixed color. Or, if set to *auto*, the color is the same as of the bar itself.

Note

- **Reducing flicker:** If flickering occurs in a bar meter during a measurement, then you should use averaging (Meter Settings dialog: *Format/ Calculation/ Average of last values*). Be sure to set the numerical format to floating point. Restrict the decimal places right of the comma to just a few and use right alignment.
- **Appearance:** In general, tall, slim meters appear better than short, wide ones. If necessary, the curve window should be resized.

Limitations

- With data containing events or segments, the structure is ignored. If results are being computed from the last N values, the data set is simply considered a long waveform. Thus, computations can be performed on more than one event. IMPORTANT: Because this behavior may be changed in upcoming versions, we do not recommend that you use it.
- Only one y-axis is possible. All bar meters in a curve window have to use the same y-scaling. If you wish to use different y-scaling, than use separate curve windows.
- Slave pointers are only appropriate for online measurements. If data is processed off-line (e.g. with imc FAMOS), the slave pointers will not always function properly, i.e. they will not display the maximum / minimum values. However, if values have only been appended to a data record, the slave pointers will function properly. At the beginning of a new measurement, the data record has to be emptied before appending new data. This allows the slave pointers to correctly interpret the new data.
- With XY-data as well as with data reduced using Transitional Recording, computations over the last N values always use a different time interval. This behavior may be changed in upcoming versions.
- The slave pointers can only properly interpret data which has been correctly appended to a data record. For example, data which has not been recorded via the measurement device and therefore has not passed through the Data Manager is not properly interpreted.

11.6.2.5 Color Map Display

This style of data representation is analogous to a geographical map with color-coding of surface relief.

Multiple waveforms are arranged in a stacked layout (in the y-direction), where each one's values are plotted from left to right (in the x-direction). The amplitude is plotted in the z-direction, in other words, extending vertically out from the screen. The result is a contoured surface extending out from the xy-plane, onto which the observed looks with a bird's-eye view. The hight of the surface is indicated by color coding, where different ranges of height correspond to specific colors.

There is additionally the possibility of superimpose x-y waveforms over the color map, and to have the map bordered by the waveforms. For more on this topic, see the section *Lines / Extras* 1229.

Prerequisites

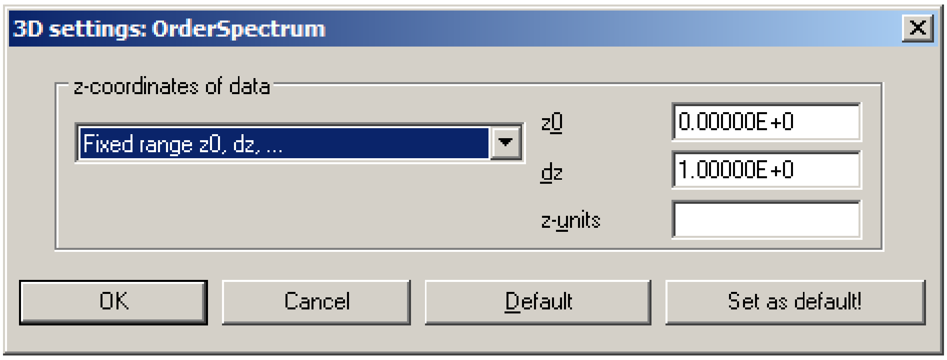
- Color video card with more than 256 colors, in other words 16 bit or 24 bit colors.
- Color printer of DIN A4 format.
- A fast PC (>= 586, 100MHz) with plenty of RAM (>= 32MB)
- Since the graphics display is based on large bitmaps (pixel graphics), large displays in particular require much storage space and computation
- With a DIN A4 color printer having 300dpi, one has about 2000 by 3000 pixels and with 24 bits per pixel one already arrives at about 18Mbytes!

Operation

First display all desired channels in the curve window. Then select the menu option *Color Map* in the dialog *Configuration / Display...*.

Setting the Z-coordinate

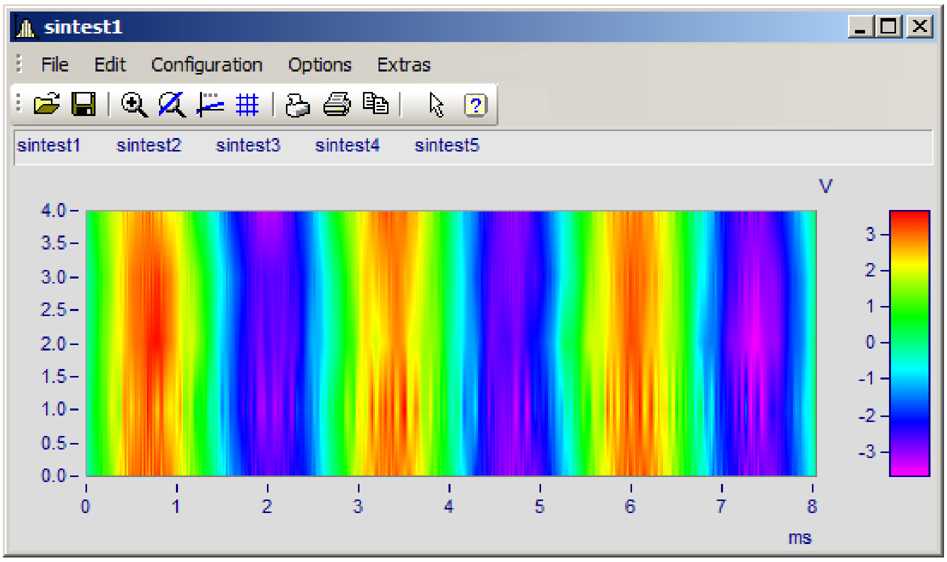
In the dialog: *Configuration / 3D* 1175 of the curve window, select an appropriate z-coordinate (see below):



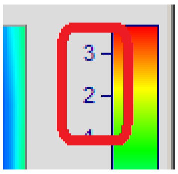
Reference   Waterfall diagrams z-coordinate

More on the topic of Waterfall diagrams z-coordinate 1138

Result



Z-Axis Scaling



To adjust the color axis, double click on the scaling of the colored legend. The color axis is the same thing as the z-axis and is scaled as such.

Color Selection

The colors are set by means of the Color Map dialog: *Configuration/Color Map Display* 1166.

Interpreting the Z-coordinate

The z-coordinate of the data (an otherwise undefined coordinate in imc FAMOS) is to be set via the dialog Configuration/ 3D in the curve window (see above). For example, The z-coordinate of the first waveform (channel) in a group could be set to z-min, the next to z-min + dz, the next to z-min + 2dz etc.

Orientation of the Coordinates

The component waveforms in the map are represented as multicolored horizontal lines, whose x-range is plotted from the x-minimum on the left edge of the graph to the x-maximum on the right edge. The height on the screen of a waveform's line or strip is determined by that waveform's specified z-coordinate; a waveform's z-coordinate is thus plotted along the y-axis, in a manner of speaking. Conversely, a waveform's y-coordinate, being its measurement value, is represented by a color; thus one can say a waveform's y-coordinate is plotted along the color axis, which for these purposes is also referred to as the z-axis. The scaling of the y-axis, then, serves to landmark regions of the pictorial representation, without pinpointing the location of any physical value in that representation.

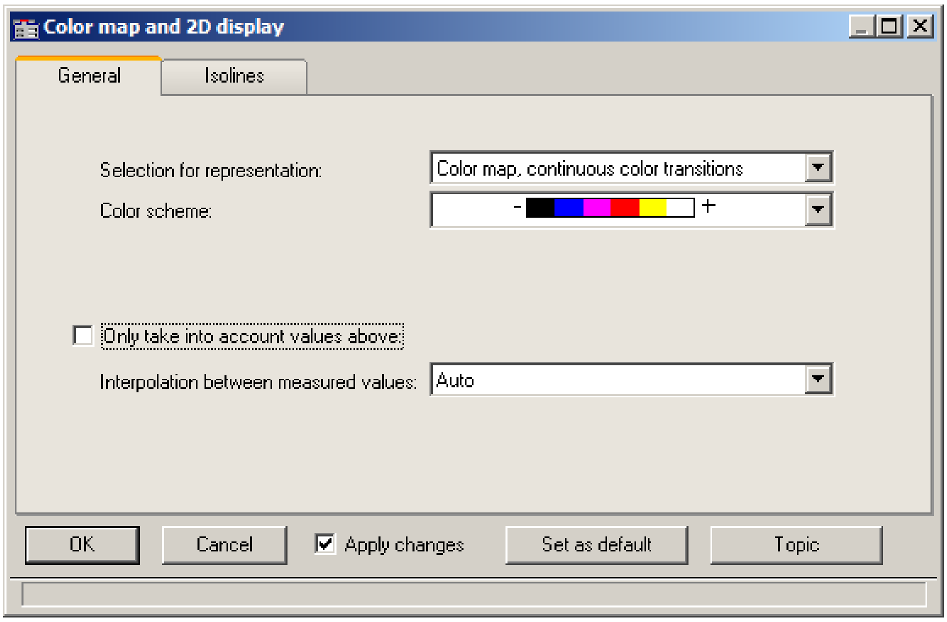
We thus achieve the illusion of a colorful landscape depicted on a map with green signifying valleys, the mountains brown and the snowy peaks white (in our case the colors follow the order of the physical spectrum).

Limits

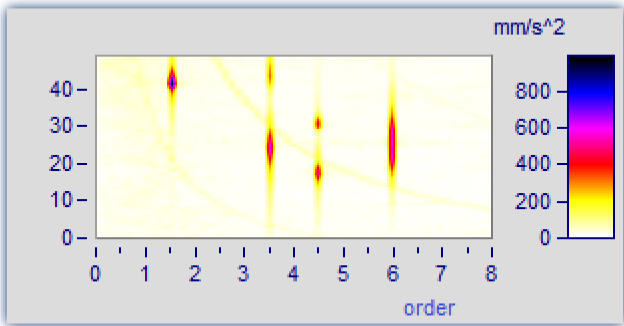
- With locus and XY plots a measurement cursor is not available for the z-coordinate.
- The colored map representation is somewhat slow by comparison with other representation styles. Printing in particular requires large amounts of storage capacity. This may also require patience, therefore.
- The interpolation between two neighboring waveforms is fixed.
- The data's z-coordinate must increase strictly monotonically.

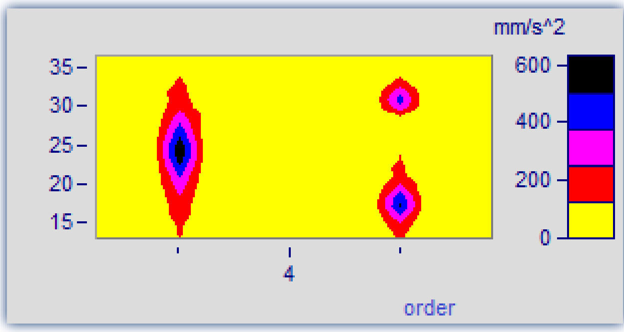
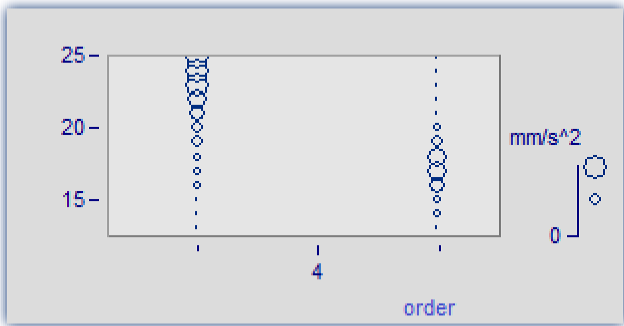
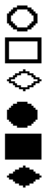
11.6.2.5.1 Color map dialog, "General"

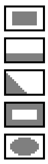
The options for color map display are set in the dialog called by means of the menu item *Configuration/Color Map*:



Selection for representation

Representation	Description
auto	Default colors from magenta to red, or from white to black for B/W display. No other options.
Color map, continuous color transitions	Interpolated color transitions. For each amplitude to represent, an appropriate color is calculated. The color scheme can be selected. 

Representation	Description
Color map, graduated colors	Specified fixed number of colors without interpolation. The color scheme can be selected. **Number of different colors:** The amount of different colors must be between 2 and 1000. The suggested values in the list can be overwritten. 
Symbols, size corresponds to filling (Campbell)	Each measured value is represented by a symbol, e.g. a circle. The **size** of the symbol represents the respective amplitude. The minimum symbol size represents a value of zero, while the maximum represents the maximum value. The intermediate transitions are linear. The symbol is centered around the measured value.   The *Color of the symbol* corresponds to that of the first curve and can not be changed here. Under *Symbol selections*, ellipses, rectangles and diamonds, either drawn as outlines or filled, are available.
Remarks on display as symbols	• With symbol display, the appearance of the symbol's size in the legend is as true to reality as is possible, however, in consideration of how much space in the curve window is taken up by the legend, there are limits to the size. • With symbol display, the readings must increase in the x-direction strictly monotonously. Otherwise, no display is possible. • If XY-data having varying dx increments, or data with varying distance in the z-direction are graphed, then there is no determined size for symbols with (actually constant) size but variable filling. In the legend, an automatically determined value is used for the size.

Representation	Description
Symbols, filling corresponds to amplitude	Each reading is represented by a symbol, e.g. a box. The degree of the symbol's **filling** depends on the signal's amplitude, where an empty symbol (box) corresponds to the minimum and the maximum is represented by the largest size symbol available. The scaling between these extremes is linear. The *Fill color* and *Frame color* can be adjusted. For the frame, the setting *auto* is available, which represents the color of the first curve. For *transparent*, the frame is omitted.   The filling increases, depending on the style chosen, either from the outside to the inside, or vice-versa, or from one side or corner to the other. The measurement value is located at the symbol's lower left corner. For the display with symbols of varying size, the maximum symbol size can be set. The size then depends on the font size (of text appearing as labels in the curve window): The value is specified in percent. The size denotes the maximum diameter of the symbols. A size of 50% .. 200% is usually best.

Color scheme

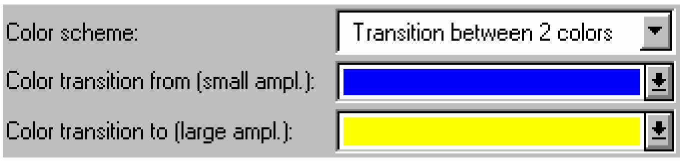
The options depend on what display type is selected.

The color scheme can be set for color map display with graduated or continuous color transition.

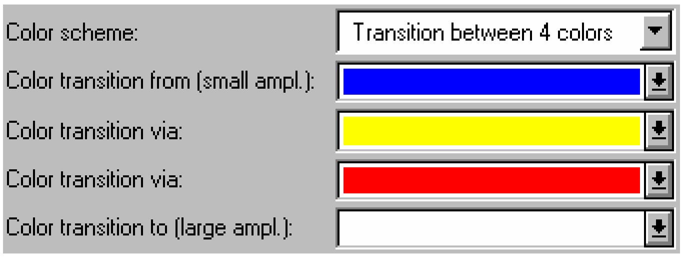
All color schemes (except *auto*) are independent of the capabilities of the output device.

Color scheme	Description
auto	For color output devices, the colors Magenta to Red are used; for b&w printers, the shades from White to Black.

<table>
<tr><th>Color scheme</th><th>Description</th></tr>
<tr><td>Transition between 2, 3 or 4 colors</td><td>
Here you have a choice of using 2, 3 or 4 fixed colors. Then additional controls appear to let you select the particular colors.



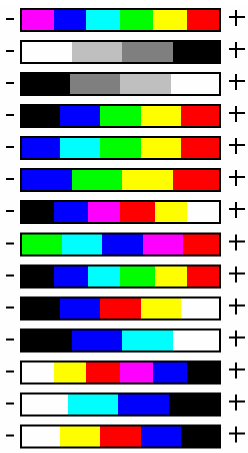
Dialog with 2 colors.



Dialog with 4 colors.

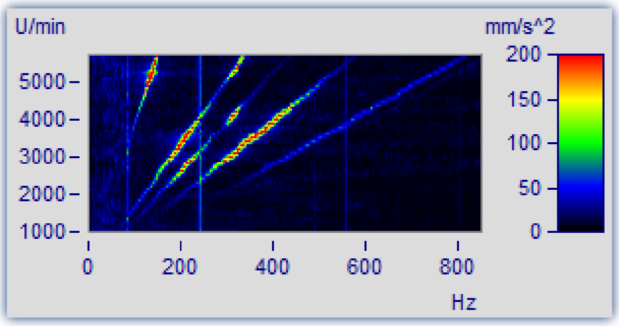
Between the fixed colors, any intermediate colors are generated by linear interpolation of the fixed colors. For instance, if color map display with 5 graduated colors is chosen, and a transition between two fixed colors is also set, the two colors at the ends of the scale are fixed and the other 3 are determined by interpolation.

In the dialog, the color for the smallest amplitude is indicated first (above), and the color for the highest amplitude in the lowest position.
</td></tr>
<tr><td>Fixed color schemes</td><td>
These color schemes are available for direct selection. At left (where "-" appears), the color for the smallest amplitude is shown, at right ("+") the color for the highest.


</td></tr>
</table>

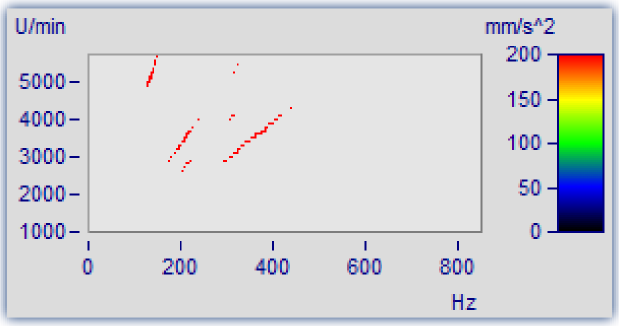
Only take into account values above

The options depend on what display type is selected.

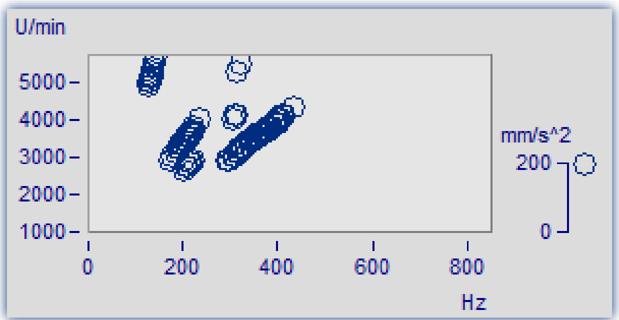


If this option box is not check-marked, all readings are taken into account (default).

If the checkbox is marked, then a lower limit for the amplitudes to be displayed can be specified.



Only relatively large reading values are given consideration. All others merge into the background.

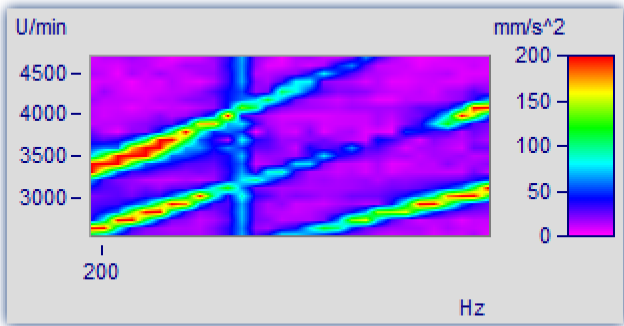
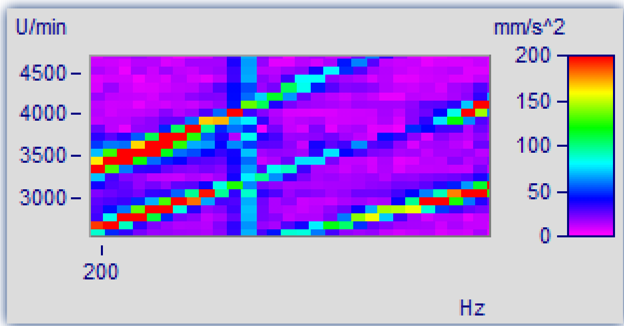


The same graph in the mode *Symbols, size corresponding to amplitude (Campbell)*

Interpolation between measured values

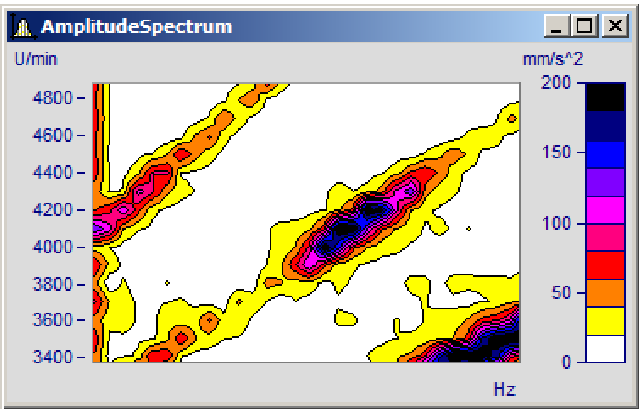
The options depend on what display type is selected.

This refers to interpolation in xy-plane between readings. Not to be confused with interpolation in the z-direction (interpolation of colors).

Interpolation	Description
auto, linear	In the x- and y-directions (horizontal and vertical on-screen, respectively) interpolated values between the specific readings are determined. This corresponds to linear interpolated lines between plotted points. 
Constant extension to upper right	In the x- or respectively, the y-direction, all measured values are extended at constant magnitude until the next measured value. This corresponds to stair-step or bar meter display of measured values. 

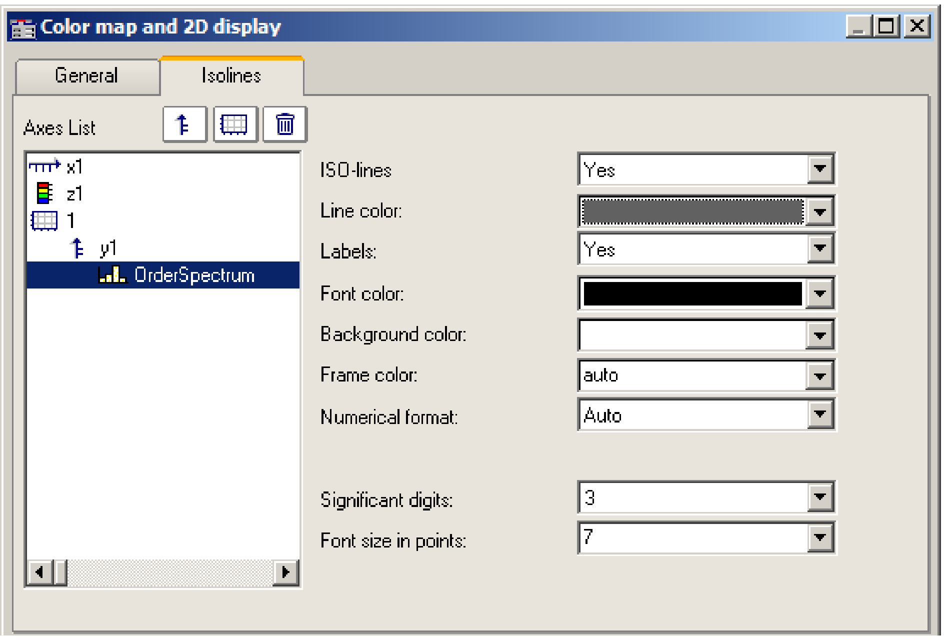
11.6.2.5.2 Color map dialog, ISO-lines

ISO-lines are contours, in other words, lines joining coordinates of equal height. They are used here in the same way as in maps. Since the lines appear in conjunction with graduated colors, they mark the boundaries between the colors.



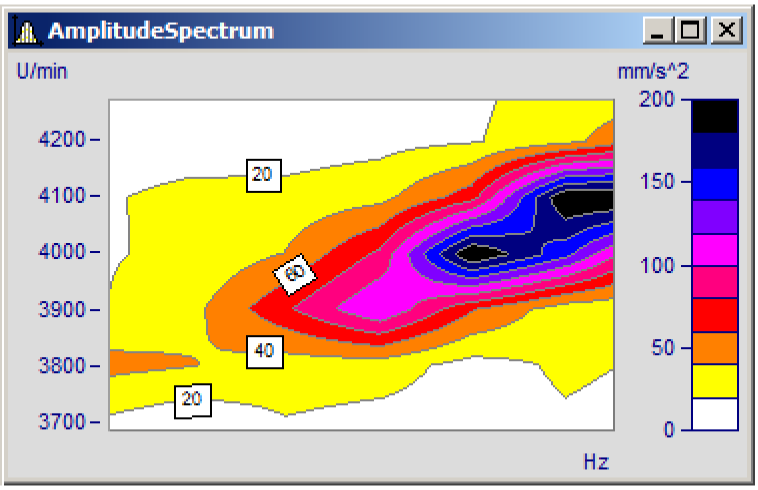
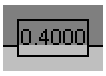
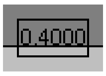
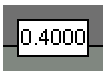
ISO-lines can only be set for *color map display with graduated colors* 1167.

The "*Isolines*" index card of the Color map settings dialog



The following options can be selected:

Options	Description
ISO-Line	Display of the isolines. This option is only available for the display types *Color maps, graduated colors*.
Line color	The color of the isolines is set here.

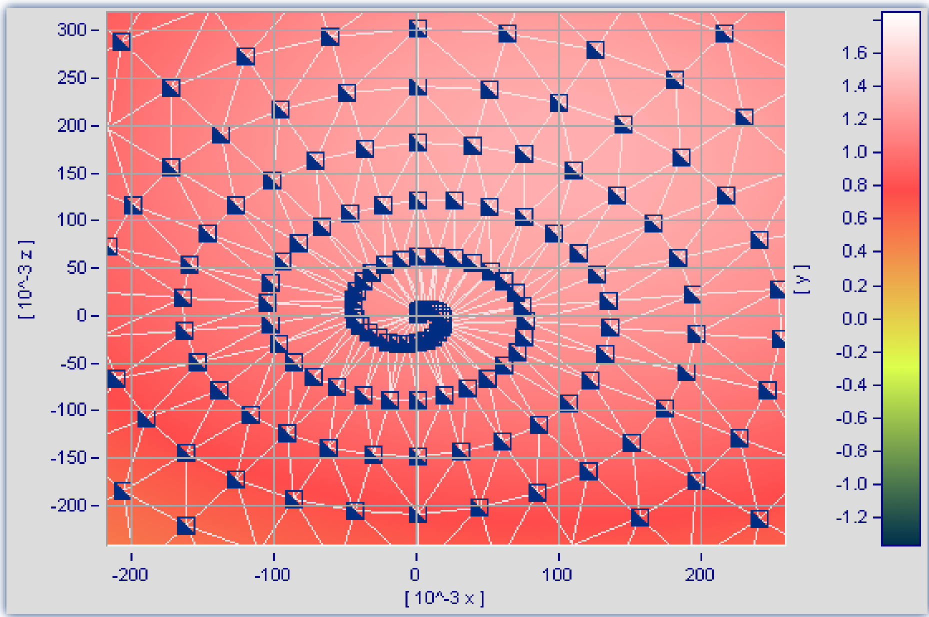
Options	Description
Labels	• *auto*, *no*: The isolines are not labeled. • *yes*: The isolines are labeled; small tags are attached to the lines, as space allows.  All further options only pertain to the labeling of the isolines.
Font color	Determines the color of the label text.
Background color	Determines the color of the label background.  • *auto*: Transparent background, but covering the contour line.  • *transparent*: The label background is totally transparent. The contour line between the colors is visible as well.  • *Fixed color*: The label background is given a fixed color and is thus not transparent.
Numerical format	• *Fixed point*: Fixed point with a fixed number of decimal places to the right of the point e.g. 17, 17.35, -0.0017. • *Floating point*: Floating point with a fixed relative precision and exponent, e.g. -1.28E-7 or 3.4E+0. • *auto*: Automatic selection, partially dependent on the numerical representation of the z-axis.
Unit prefix	This consists of the order of magnitude and, if appropriate, a prefix such as kilo, milli, Mega or even just 1 (default, use of unit without prefix), which appears after the number before the unit. If the reading is 10 and takes the unit V (Volts), then for a selection of "m" (milli), a value of 10000mV is returned. For *automatic numerical format*, the same order of magnitude is set as for the labeling of the z-axis.
Places right of point	Number of decimal places for *Numerical format Fixed point* or *Floating point*: 0 to 15.
Valid digits	For *numerical format auto* the number of decimal places cannot be set, instead, the number of significant digits. Thus, the numbers 3.4, 3.4E-4 and 0.034 each have 2 significant digits.
Font size in points	The font size in points (pt): 4pt to 10pt. Typical values are 6 and 8 points.

Reference — Waterfall Diagrams

See chapter Waterfall Diagrams 1138

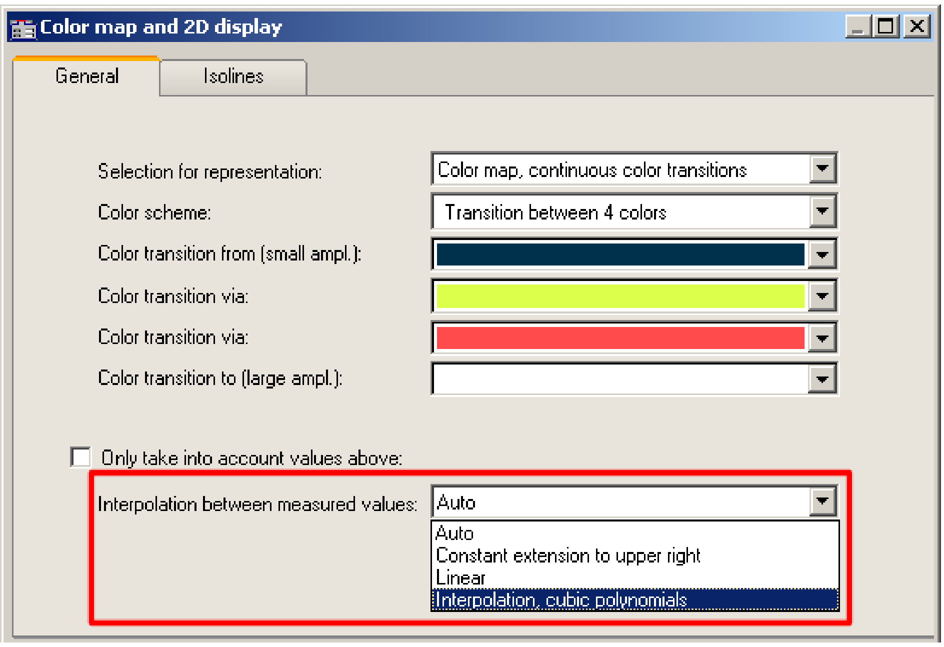
11.6.2.5.3 Waveforms with associated x-,y-,z-variables

A an alternative to 3D-display, waveforms with associated variables can also be displayed in a color map.



Color map display of a data set with multiple dimensions

It is also possible to specify interpolation between measured data points for this display style. To do this, open the color map's Properties dialog and on the *General* page select an interpolation type from the dropdown-list.



Interpolation between measured values in a color map

11.6.2.6 3D Display

Another display style for datasets with associations of x, y, and z variables 1200, for segmented waveforms is *3D* display.

In this display style, the perspective can be freely rotated, and the Axis Navigation Bar 1364 can be used to change the view. It is possible to display more than one dataset with associations of x, y and z variables. This makes **comparison** of multiple superimposed 3D data sets possible.

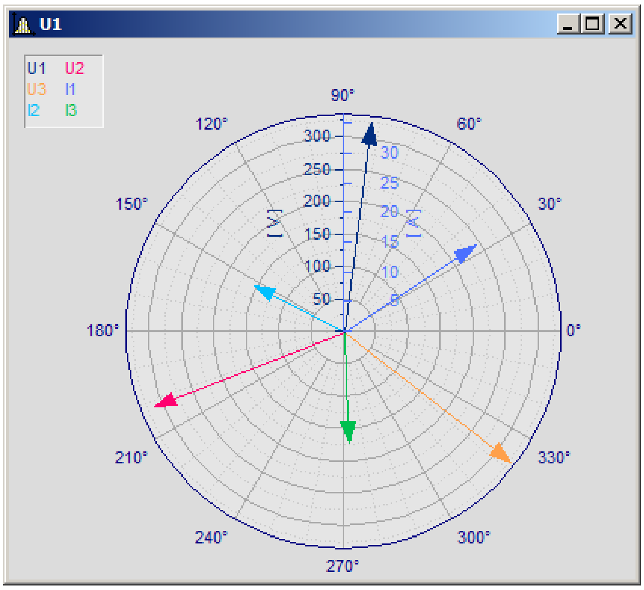
Other curve window functions such as *zooming*, *setting markers* or *line-shifting* are not available here.

For more on using 3D-display, see the section on *Configuration / 3D* 1256.

11.6.2.7 Polar plot

Complex data sets can be displayed as a polar diagram. To do this, select from the menu *Configuration\Display* the the display type *Polar plot*.

Example: Pointer diagram



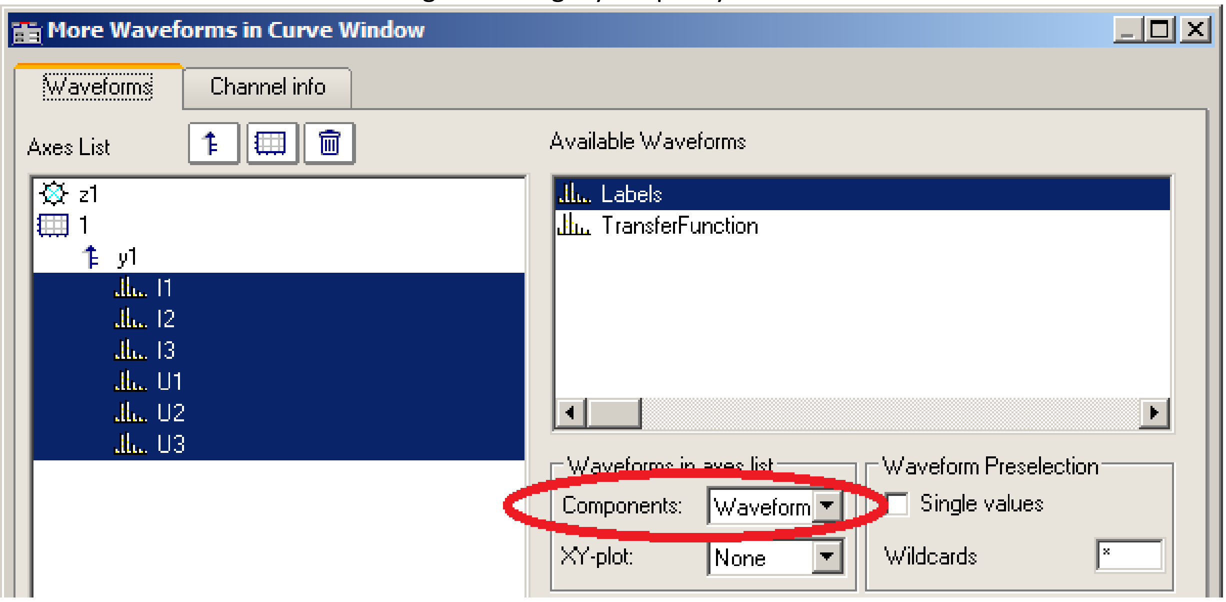
Complex single values as vector diagram

In imc FAMOS you can create a complex single value using the function Cmpl().

The pointer graph above is created as follows:

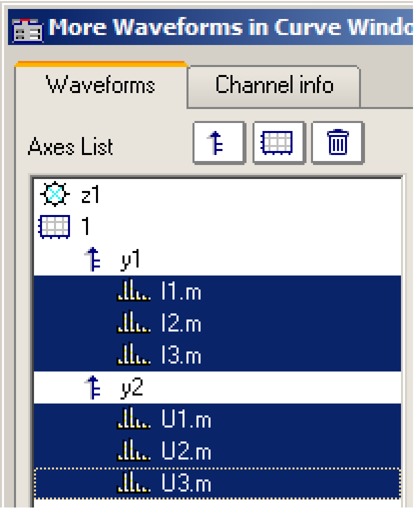
1. Create the desired single values:
   I1= Compl (27'A', 33'Degr')
   I2= Compl (17'A', 153'Degr')
   I3= Compl (19'A', 273'Degr')
   U1= Compl (327'V', 82'Degr')
   U2= Compl (315'V', 202'Degr')
   U3= Compl (331'V', 322'Degr')
2. Display the single values in a curve window and select the display style *Polar diagram* in the menu *Configuration\Display.*

3. By default, the curve window only shows the magnitude component of a variable. For this reason, all arrows point upward. With the right mouse button, open the context menu and there select *More Channels...*. Select the variables and select *Waveforms in axes list\Components: Waveform.* The arrows will then be drawn according to the angle you specify.

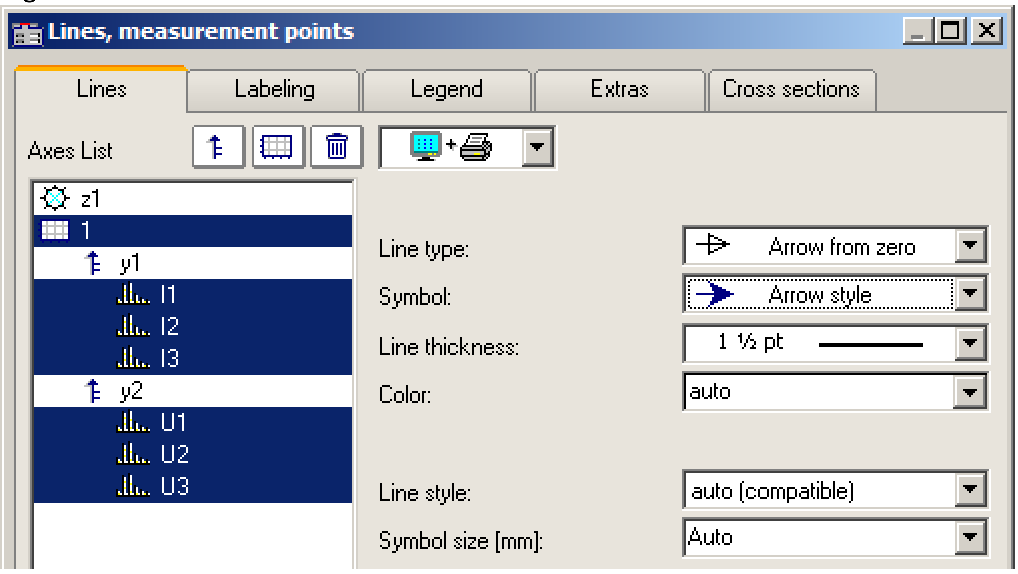


Observing each component of a complex waveform

4. As in a normal curve window, all variables are assigned to an axis. The current which are comparatively low in magnitude therefore appear in the zero point. Create one axis each for current and voltage: right mouse button for context menu -> "*More Channels*"

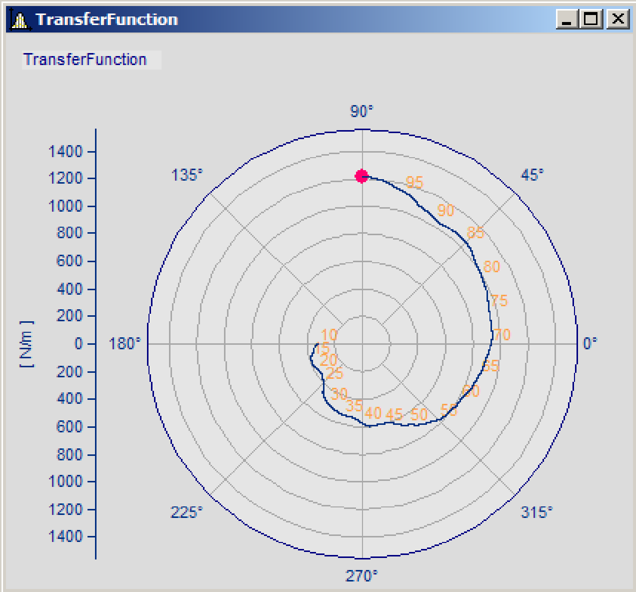


5. Using the Lines dialog, you can now adapt the display of the arrows.
   Right mouse button: "*Lines*"



Dialog lines: Display with arrows

Example: Transfer function



Example transfer function

There are further possibilities for displaying a complex data set:

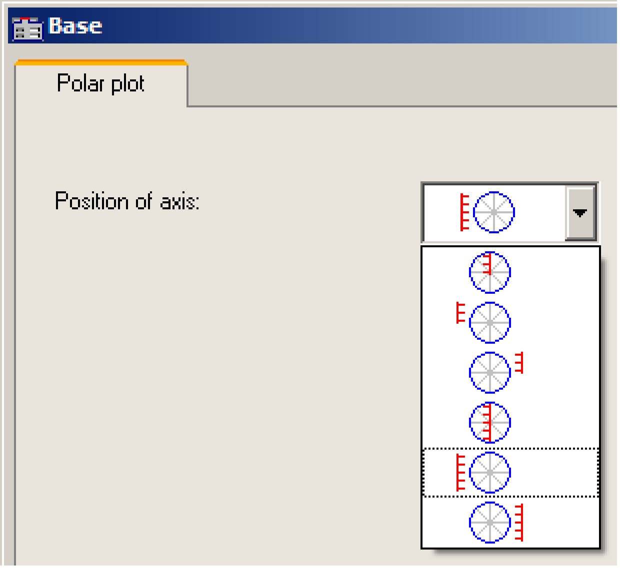
1. Use imc FAMOS to create a complex data set:

```
; transfer function diagram
t = ramp ( 0, 1, 11000 )
m = t * 0.1 + 200 + 1000*smo ( Random(leng?(t), 2, 0, 0, 3), 1000 )
p = t * 0.03 +  150
m = xoff ( xdel ( CutIndex ( m, 1001, 10000 ), 0.01 ), 10 )
p = xoff ( xdel ( CutIndex ( p, 1001, 10000 ), 0.01 ), 10 )
yUnit p Degr
yUnit m N/m
xUnit p Hz
xUnit m Hz
TransferFunction = compl ( m, p )
Labels = red ( TransferFunction, 500 )
```

   Important Note: The angle specification distinguishes between degrees and RAD as the unit. If no unit is specified, then RAD is applied, meaning 2PI instead of 360°. For this reason, it is important to use yUnit to set the unit as Degr, as shown in the example.

2. Display the data set *TransferFunction* in a curve window and select the display style *Polar plot* in the menu*Configuration\Display.*
3. Right-click the mouse to open the context menu and there select *More Channels...*. Select the variable and under *Waveforms in axes list\Components: Waveform.* The angle data is now reflected in the display.

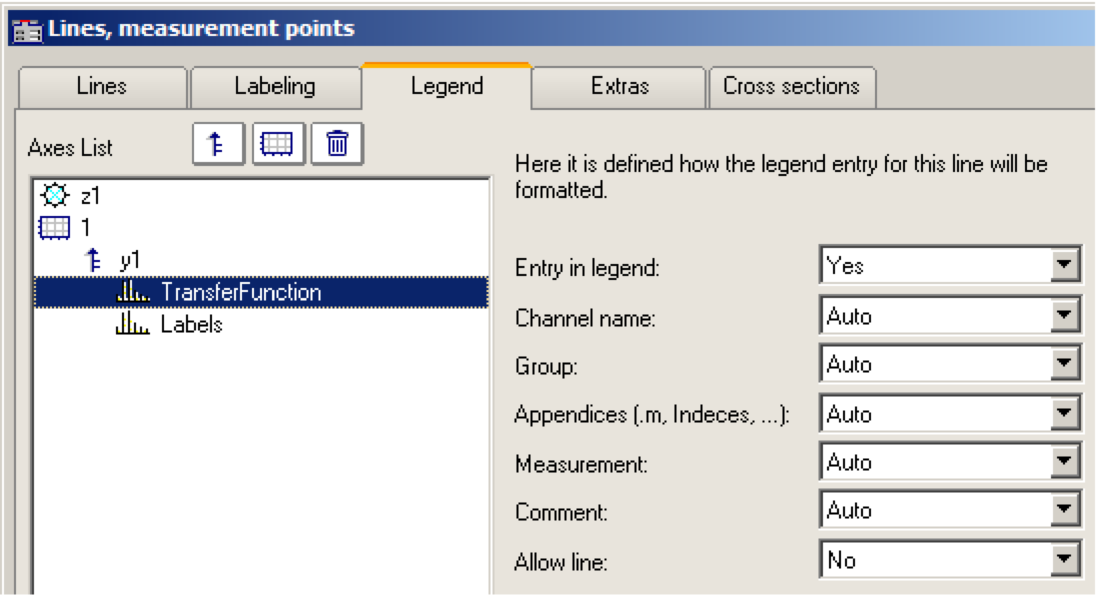
4. **Axes position:** By default, the Y-axis is displayed only in the positive direction. You can change both the axis' position and its range: Right mouse click: *Polar plot*.



Position of axis

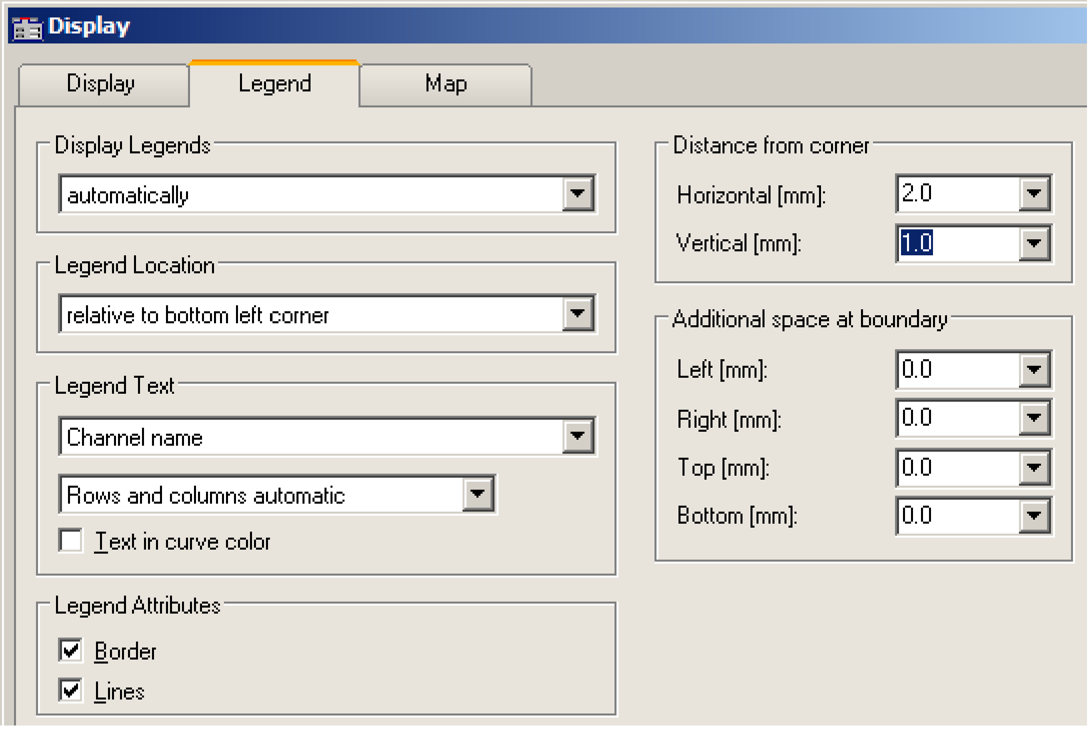
5. **Labeling the values:** The individual values could be labeled in any curve window with their values. However, in this example the amount of data would make that impossible to read. For this reason, the data set *Labels* was created, which is an image of *TransferFunction* reduced by a factor of 500.
Select the right mouse button: *More Channels...* and assign *Labels* to the same axis.
Click the button *Topic* and select *Lines*.
Go to the page *Labeling* and activate it.
By default, *Labeling* displays the magnitude. In our example we wish to display the frequency. For this reason, select for *Value selection* the entry *Parameter*.

6. **Legend:** The legend's position can be moved. First of all, the data set *Labels* is not to appear in the legend. For this reason, in the *Lines dialog* on the page *Legend* we select the data set *Labels* and select *Entry in legend: no.* For the data set *TransferFunction* we select *Allow line: no.* Close the dialog.



Legend display on/off for each channel separately

7. Open the dialog *Configuration \ Legend.* Position the legend in the upper left corner at some distance from the edge.

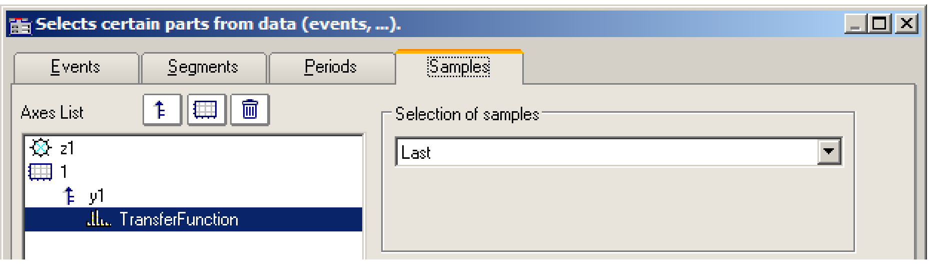


Position of legend

Note — Notes on online display

For measurements with imc CANSAS, the measurement device does not generate complex data sets. For instance, with an online FFT, the magnitude and phase are each transferred as separate channels. These can be combined to form complex data sets in the curve window under *More Channels...* 1200.

If one wishes to display the complex data as a pointer diagram 1175 like above, then besides the procedure outlined above the following step is also necessary: Since only the channel's current value, in other words, the last one, is to be displayed, select *Configuration \ Events, segments periods*...Go to the page *Samples* and select *Last* under *Selection of samples*.



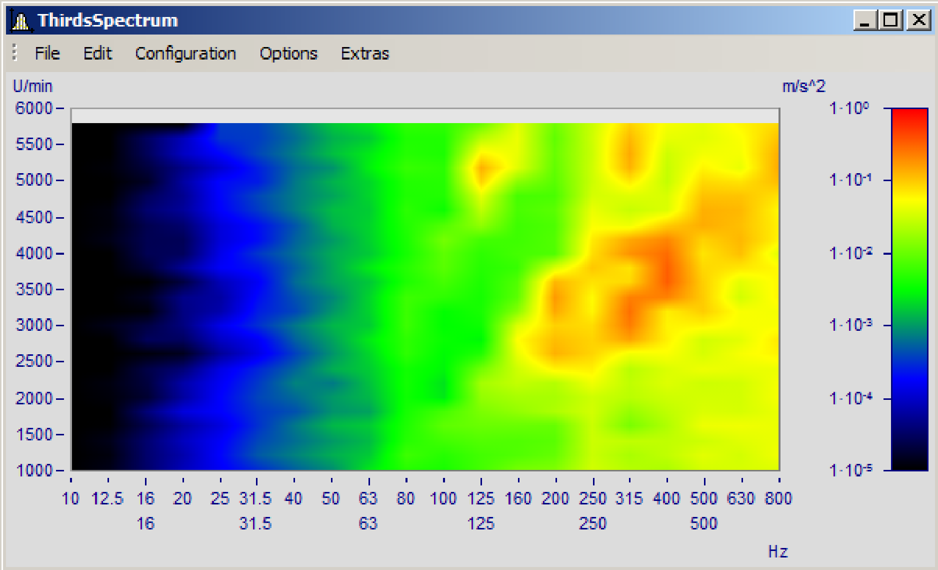
Displaying only the last sample

11.6.2.8 Third-Octave Display

Certain methods and forms of representation in the analysis of sounds and vibrations have gained widespread acceptance in industry. 1/3-octave, octave and narrow-band analysis require mathematical operations to be performed, in which the spectra in question are computed from the time signals of vibration pick-ups. The x-axis of the coordinate system is labeled according to the selected frequency bands; the frequencies themselves are determined by industry standards.

Example

Using the mathematical functions in imc FAMOS, the 1/3-octave spectrum was calculated over time. The following color map diagram displays the result, with the x-axis labeled in 1/3-octaves and octaves.



Description

The following nominal pass ranges apply to octave filters. Higher and lower values can be computed by taking the first ten values from the list and multiplying them by ten-to-the-power-of any multiple of three.

Octaves

Center frequency (Hz)	Lower limit (Hz)	Upper limit (Hz)
16	11.2	22.4
31.5	22.4	45
63	45	90
125	90	180
250	180	355
500	355	710
1000	710	1400
2000	1400	2800
4000	2800	5600
8000	5600	11200
16000	11200	22400

The following frequencies apply to 1/3-octaves. Higher and lower values can be computed by taking the first ten values from the list and multiplying them by ten raised to an integer exponent.

1/3-octaves

Center frequency (Hz)	Lower limit (Hz)	Upper limit (Hz)
1000	900	1120
1250	1120	1400
1600	1400	1800
2000	1800	2240
2500	2240	2800
3150	2800	3550
4000	3550	4500
5000	4500	5600
6300	5600	7100
8000	7100	9000
10000	9000	11200

The center frequencies of 1/12- and 1/24-octave bands are located at the center frequencies of the 1/3-octaves and at the intermediate values located at logarithmically equal distances. Here the edges of the 1/3-octave range are used as additional frequency check points.

1/12 octaves

Center frequency (Hz)	Lower limit (Hz)	Upper limit (Hz)
1000	974	1029
1058	1029	1089
1120	1089	1151
1183	1151	1216
1250	1216	1286
1323	1286	1361
1400	1361	1448
1497	1448	1547
..	..	..

1/24 octaves

Center frequency (Hz)	Lower limit (Hz)	Upper limit (Hz)
1000	987	1014
1029	1014	1043
1058	1043	1073
1089	1073	1104
1120	1104	1135
1151	1135	1167
1183	1167	1200
1216	1200	1233
1250	1233	1268
1286	1268	1304
1323	1304	1342
..	..	..

When waveforms in the frequency range are displayed as the result of a frequency-band analysis, the program expects the x-axis to have a certain kind of scaling. Since the frequency bands are spaced logarithmically, the x-axis is labeled with the logarithm of the frequency to correspond to the mathematical functions. The logarithm is then expanded again for display, and the frequencies are marked along the axis, according to the German industry standard. The following table illustrates by a few examples the relation between the x-scaling of the data and the frequency bands, based on the following rule: the $\log_{10}$ of the center frequency is multiplied by ten and then this value is rounded.

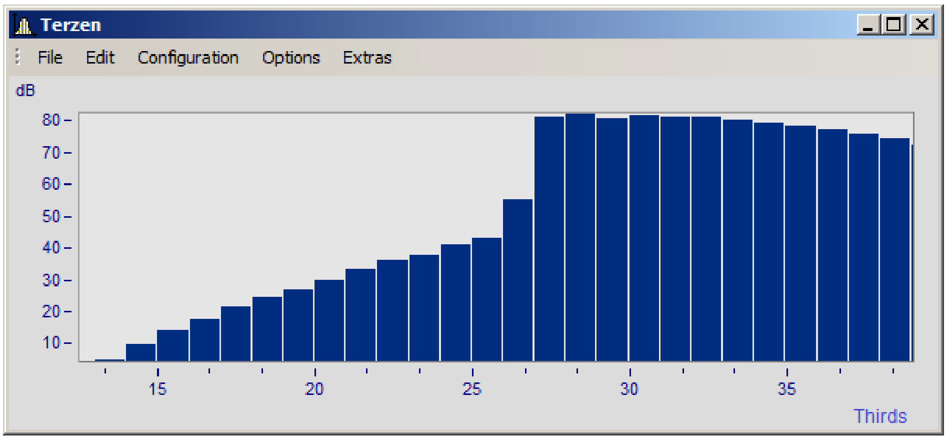
x-scaling	Center frequency (Hz)
..	..
-3	0.5
-2	0.63
-1	0.8
0	1
1	1.25
2	1.6
3	2
4	2.5
5	3.15
6	4
7	5
8	6.3
9	8
10	10
11	12.5
..	..
20	100
30	1000
40	10000
41	12500
43	20000
..	..

The 1/3-octaves are found at the x-positions 0, 1, 2..., the octaves at the positions 0, 3, 6, 9, 12..., 1/12-octaves at the positions 0, 0.25, 0.5, 0.75, 1, 1.25..., and 1/24-octaves are found at all multiples of 1/8.

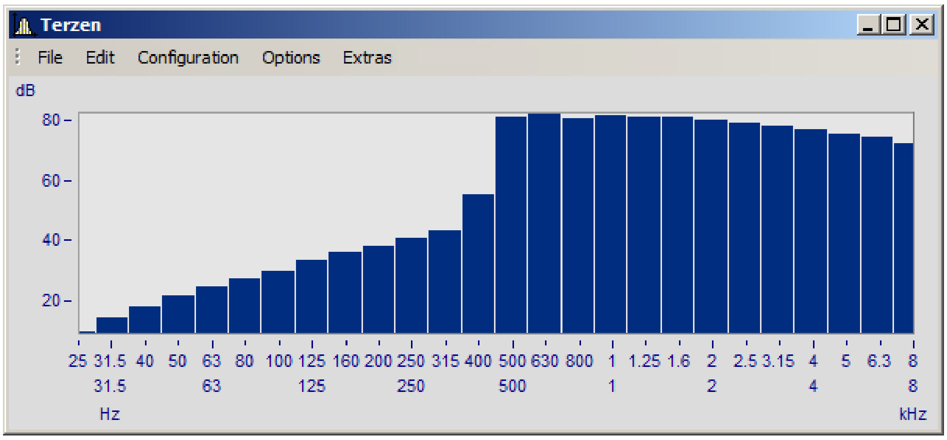
This means that the various bandwidths are expressed as a multiple of a 1/3-octave. Therefore, the delta-x of the x-axis is set to the following values for frequency scaling:

Bandwidth	Delta-X
Octave	3
1/3-octave	1
1/12 octave	0.25
1/24 octave	0.125

Example



A curve window with standard labeling

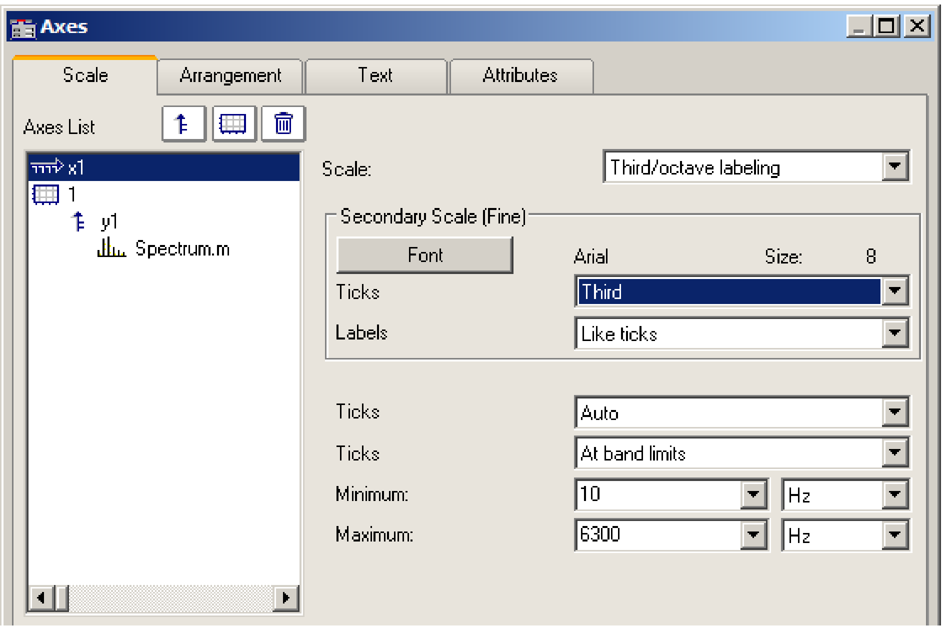


In 1/3-octave / octave labeling

Here, the connection between labeling with the logarithm and the expanded 1/3-octave scaling is apparent.

Mouse Operation

- Set the labeling of the x-axis in 1/3-octave / octaves in the *Axes* dialog called via the menu item *Configuration/ Axes*... menu. Alternatively, you can double-click on the x-axis labeling.



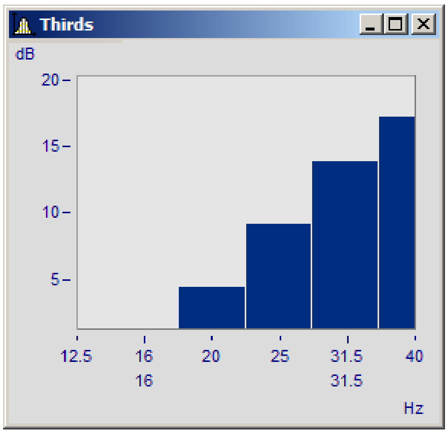
- In the list at left, select the x-axis. Then select under the control *Scale* the option *Third/ octave labeling*

General information

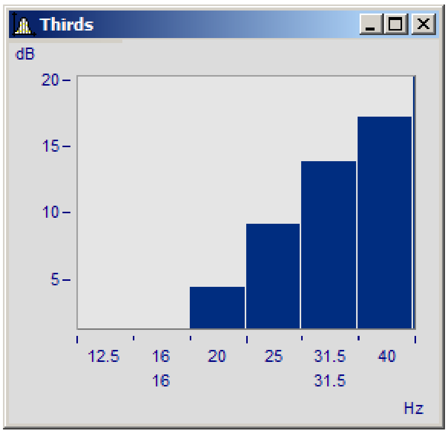
The x-axis scaling is organized into three horizontal layers. The upper layer consists of small ticks and labels (e.g. 1/3-octaves). The middle layer consists of large ticks and the standard font type for the curve window (large labels). The units (Hz, kHz...) are found in the lowest line.

Settings	Description
Secondary Scale (Fine): Font	Establish the font type for the small labels. For true-type fonts, the six-point size is generally quite legible for numbers on the screen.
Ticks	For the small and the large labels, the user can specify the interval between ticks on the axis. Choose from the following options: • Auto: Depending on the domain and the window size, one of the following options can be chosen. • Octaves • 1/3-octaves • 1/12-octaves • 1/24-octaves

<table>
<tr><th>Settings</th><th>Description</th></tr>
<tr><td>Ticks</td><td>Options for centering or aligning ticks. Centered ticks are placed exactly at the center frequency of the corresponding band, with labeling centered under the tick. The edges of the frequency bands are not visible. In the option Ticks to edge, the ticks are located exactly at the edges of the frequency bands, with labels centered between the ticks and at the center frequency.



Ticks centered



At band limits
</td></tr>
<tr><td>Minimum, Maximum</td><td>The limits of the frequency range to be displayed are set using the combobox Minimum and Maximum. The contents of the list with numerical values are based on the previous selection of ticks for small labeling, which the program assumes is the highest resolution.

The entries in the list boxes for Minimum and Maximum are always center frequencies of the band. If numerical values are entered using the keyboard, the precise center frequency will be automatically selected.

The range of selectable numbers extends from 10µHz to 400THz, ensuring that the significant physical ranges are covered. Conventional applications will always lie within the range from 10Hz to 20kHz.</td></tr>
</table>

Remarks

- **Curves:** When a curve is displayed in a stair-step or bar graph display, the curve is <Shift>ed in the x-direction so that the center of the bars or steps are centered over the labels of the center frequency. The curve is moved to the left by one-half of the sampling time. This applies only to data sampled equidistantly, not to XY-displays.
- Note that in a "steps"-representation of a waveform, the sample-points of the conventional linear display would normally coincide with the corners of the steps. This is not the case for an x-axis labeled with frequency bands, where the sample point coincides with the center frequency, i.e. the midpoint of the step!
- When a small window is scaled over several decades, it is generally not possible to label the axis in 1/24 octaves. Select a coarser resolution in labeling, e.g. octaves.

11.6.2.9 XY-Plots

Normally, curve windows display waveforms as time functions. This means the signal's values are indicated as y-coordinates plotted over time represented by the x-axis.

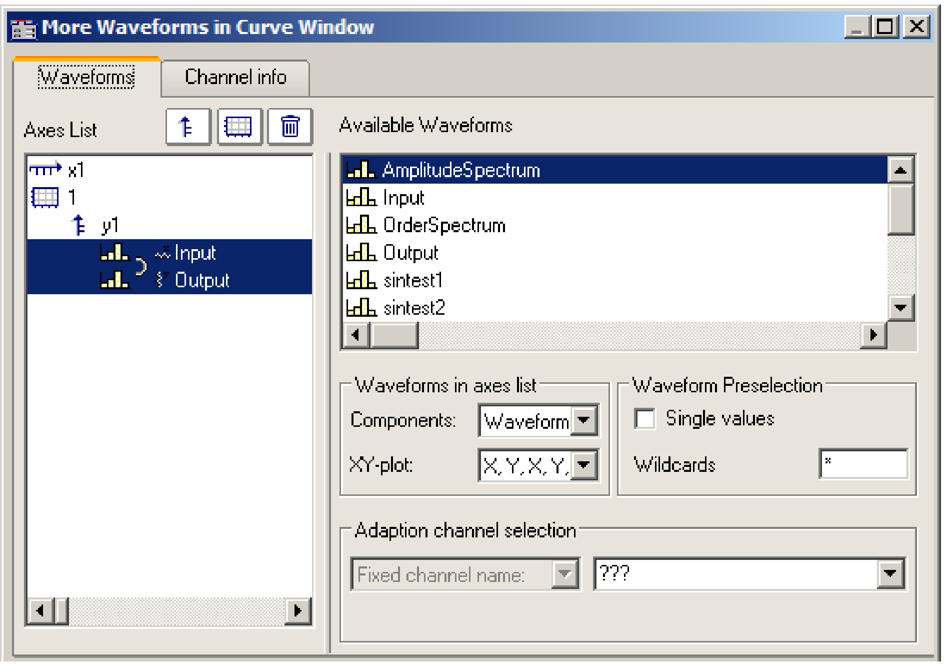
The curve window is also able to display XY-plots, meaning plotting one waveform's values in correlation to another waveform's values.

Examples of XY-plots include **Lissajous figures**, which consist of an XY-plot of sine shaped waveforms of differing frequencies and phases. **Hysteresis curves** for magnetic materials display the correlation between magnetic flux density and magnetic field intensity. **Characteristic curves** enable the assignment of an output variable value to a corresponding input variable value.

Polar plots are another type of XY data. Polar plots are used to display complex waveforms. This type of display can be used for a complex waveform in rectangular coordinates (real and imaginary part) or polar coordinates (magnitude and phase).

Operation

Select "*More Channels in Curve Window* 1193" (by right-clicking the mouse in the curve window). Stack the XY-plots vertically. Select the two waveforms and then in the box *Waveforms in axes list* Select the entry *x,y,x,y* from the drop-down list for *XY-plot:*. If you wish to change the axes, select instead the other order: *y,x,y,x*.



Remarks

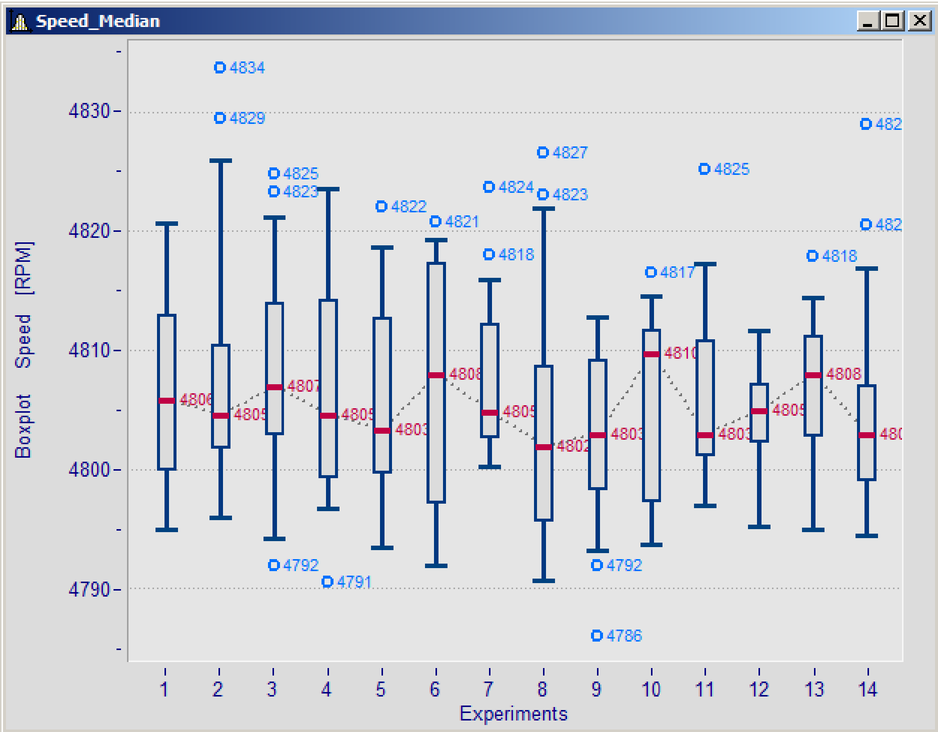
- In all XY-plots, the measurement cursors follow the parameters during operation in "Measure" mode. See chapter section 'Measure 1277'.
- Computing a polar plot requires less computation if the complex waveform is provided in rectangular coordinates. To increase the speed of the graphic display for a waveform in polar coordinates, transfer it into rectangular coordinates.
- The x- and y-values in an XY plot are paired *correctly* with respect to time, *not* point by point! Thus, the two waveforms used for an XY-plot do not have to have the same x-scale! Therefore x-offset and x-delta (sampling rate) are considered, but not the trigger time.
- If a waveform is already defined as complex or of XY-type, simply click on the curve window icon to display it.

11.6.2.10 Boxplot

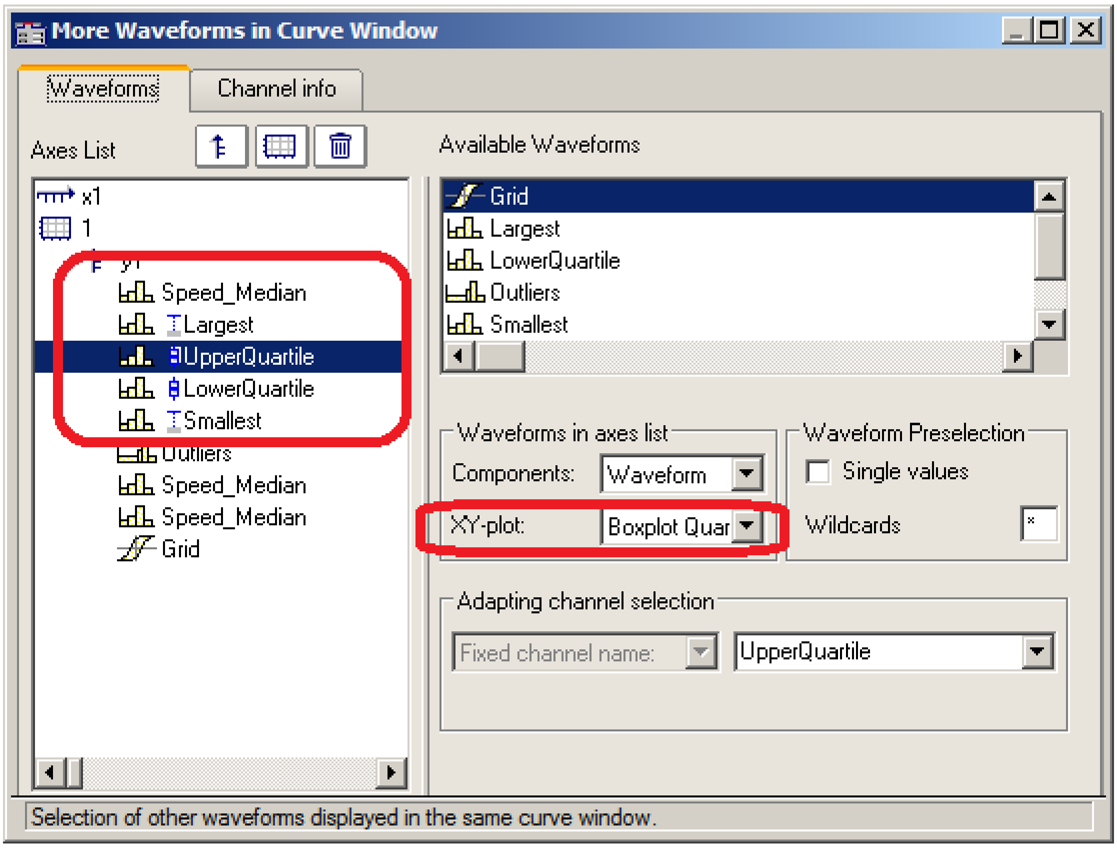
The Boxplot (also called Box Whisker Diagram) depicts a statistical distribution by displaying the minimum value, the maximum value, bottom quartile, top quartile and the median.

In this display, the minimum and maximum values are represented by whiskers, the quartile boundaries as a box, the median as a line.

For a curve window display, each of these statistics is saved in a separate channel, e.g. one channel with the median values, another channel of maximum values...

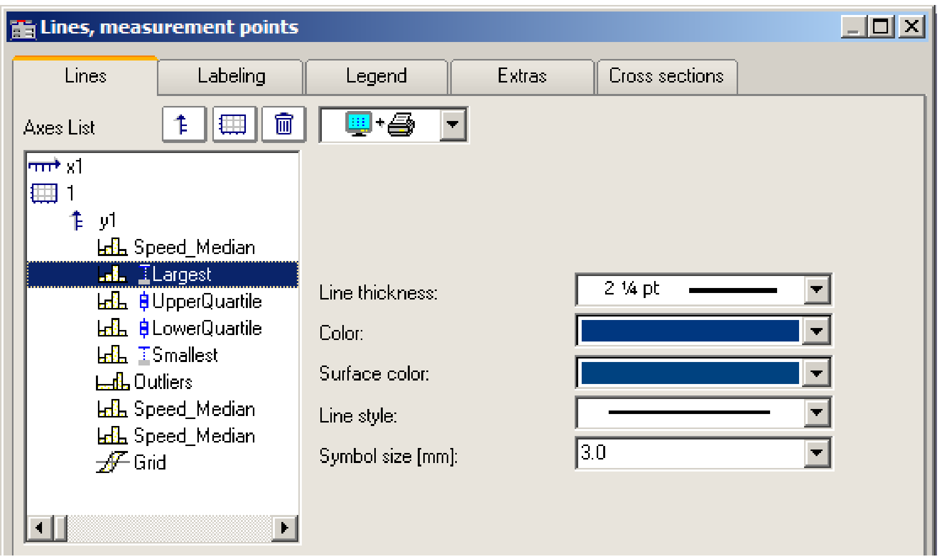


Making the settings:



In the dialog "*More Channels... in Curve Window*", the channel with the median value is initially added. For this channel, no special settings need to be made. Next, the channels for the whiskers and the quartiles are added. For each of these channels, the property *XY-plot* is set to "*Boxplot Whisker*" or "*Boxplot Quartile*", where it does not matter in this case whether a whisker is the top or bottom one; the curve window finds out on the basis of the numerical value. The order of the channels below is arbitrary. They do not even need to be complete, however, the median must always be the first channel.

Subsequently, the line properties are defined:



Depending on the line selected, different properties are available for selection on the right side. The line structure is only applied to the vertical whisker line. The surface color is used for filling the box representing the quartiles and for filling the whiskers' horizontal bar. Automatic color selection for the surface results in transparent fill of the quartiles' box. The color (line color) is used for connecting- and borderlines. Automatic color selection causes this color to be same as the median. Most properties can be set separately, however, for the 2nd quartile defined, only the fill color needs to be selected, since the rest has already been determined by the 1st quartile defined.

The display is performed point by data set point. All data sets must have the same sampling rate. The median itself may be an XY-channel, but all others may only be normal, equidistant data sets (it may be necessary to display the .y-component alone). In the case of an XY-channel, the sampling time of the y-component must match that of the other channels.

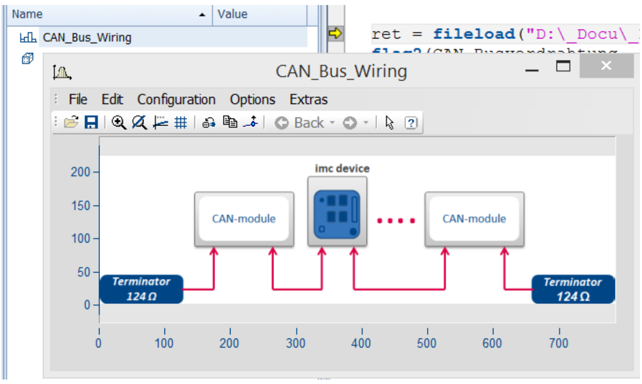
Remarks

- A combination with a color-determining channel is not possible.
- Measurement cursors and other curve window functions have only restricted functionality.
- To display any outliers, supplemental channels are used, for which the legend entry can be suppressed, for instance.

11.6.2.11 RGB-image

An RGB-image variable consists of a segmented data set in which each sample represents a pixel's RGB-code. When loading an image using **FileLoad**(..."#Picture.dll|Picture Format"...), a color-flag is set in the properties of the variable, which can be queried by means of **Flag?**(Variable, 1). If the RGB-flag is set, when the curve window is opened, the property *Image from RGB-values* 1229 is automatically set under *Effect* in the dialog *Lines\Extras*.

The y-axis and x-axis must both have the same scaling so that the image will be displayed without distortion. This is ensured by means of the property *Resolution* in the dialog *Axes\Arrangement* 1215.



The color stages of the pixels are displayed exactly for the Line type setting 1223 "Steps". For the line type "Lines", the color gradients are interpolated.

If a data set has **multiple events** 1266 each having one image, these can also be displayed when the events have appropriate coordinates. With overlapping coordinates, only the last event may be visible.
The **X-offset** determines the offset in the graph, the event's trigger time is not taken into account.

If any settings are made which the system does not support, the image is not displayed. Settings which are not supported include invalid data formats (XY-data, TSA), XY-overlays over the curve window, selections of individual samples, skipping of segments, and period comparisons.

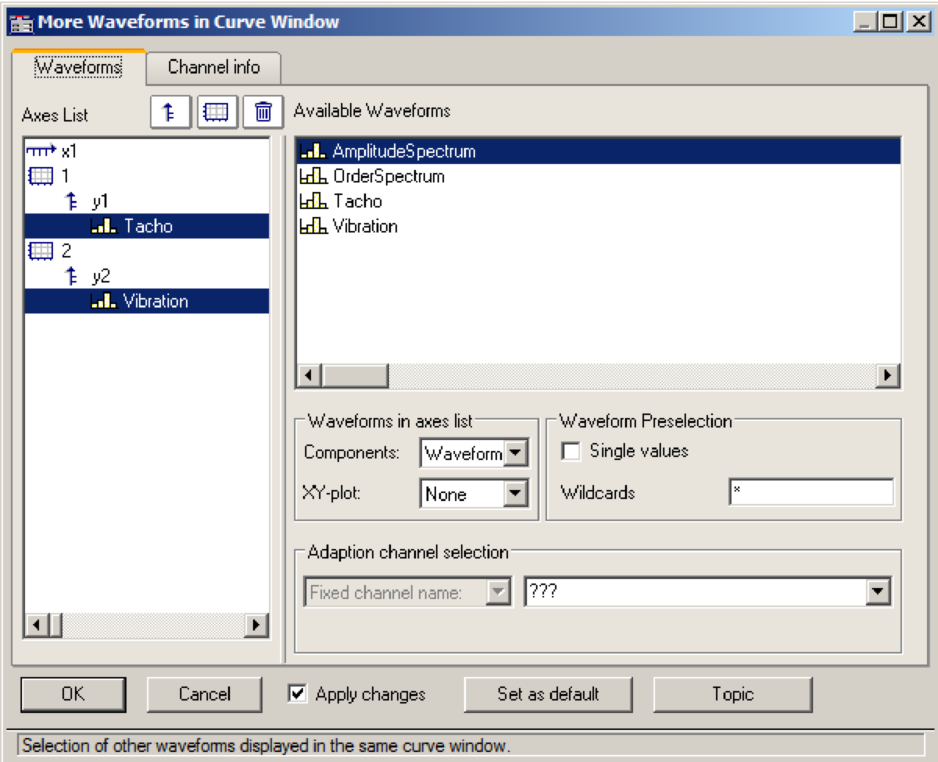
11.6.3 Showing data in curve window

A dialog is available for setting the waveforms to be displayed, the coordinate system and the y-axes in the curve window.

Up to 40 coordinate systems can be represented in a stacked display in the curve window, and each coordinate system can have y- and z-axes with different scaling. A coordinate system and a y-axis (and possibly a z-axis) from this coordinate system must be assigned to each waveform displayed in the window.

Open the dialog by right-clicking the mouse in the curve window and selecting *More Channels*.......

A short help message appears when the mouse pointer is held for a few seconds over a dialog object (provided the curve window help options are enabled).



The space allocated in the layout to the Axes list and the Available Waveforms respectively can be altered by dragging the border between them using the mouse.

The subsections below respectively describe the individual dialog elements.

11.6.3.1 Axes List

This *Axes list* reflects the current structure of the curve window. The symbols for the individual coordinate systems are found in the first column. The y-axes displayed in a coordinate system are indicated underneath, somewhat indented. Waveforms assigned to a y-axis are listed after the y-axis. Each waveform is specified by a symbol and its name.

Waveforms can be **added to *Axes list*** from the list of *Available Waveforms* using Drag and drop.

Drag & Drop applied to one or more selected entries **moves** these. When you hold down the CTRL key, a copy of the respective item is moved.

Buttons for editing the axes list

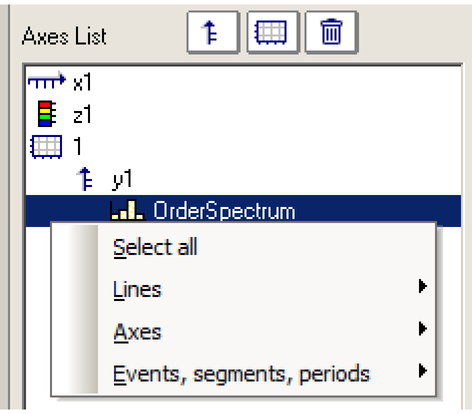
Icon	Description
	A new y-axis is created. To do this, click briefly on this button, which changes the mouse pointer to a suitcase symbol. Click on the target position desired. The new y-axis is inserted above the row over which the mouse pointer is located.
	A new coordinate system is created.
	The lines selected in the axes list (coordinate systems, axes, waveforms) are deleted. Use the <Del> button as an alternative.

Symbols used in the axes list

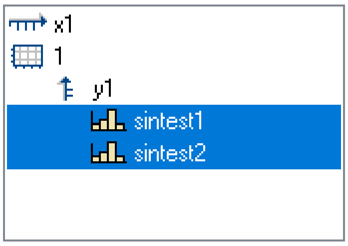
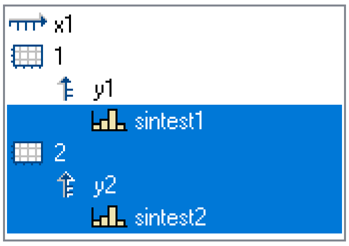
Icon	Description
	x-axis; always at beginning of axes list. All following coordinate systems are scaled on the same x-axis
	z-axis; only in *3D*, *color map and waterfall diagram*. The z-axis can be scaled only with a fixed z0 and delta-z .
	Indicates an independent **coordinate system**. All further axes and waveforms listed until the next such symbol appears or until the end of the list belong to this coordinate system.
	Indicates a **y-axis**. All further waveforms listed until the next y-axis belong to this Y-axis.
	Two consecutive waveforms in the list are superposed
	XY-Display: Two consecutive waveforms in the list are superposed; the data of the waveform denoted by a "y" are plotted over the values of the waveform denoted by a "x"
	3D-Display: Three consecutive waveforms in the list are joined in a multi-dimensional relationship. The data of a waveform designated y and the data of a waveform designated z are associated with the data of a waveform designated as x. This relationship is for the purpose of 3D display, but can also be used for a color map.
	Variable not present: The original waveform at this position has been deleted. Or: a loaded curve configuration expects a waveform at this position
	Second component missing: The waveform is already designated as one component of an XY-waveform, the other component is missing
	A **normal waveform** with equidistant x-scaling
	Empty waveform: A normal waveform with a length of 0
	Single value, normal waveform with a length of 1
	XY-waveform with monotonous x-track (time waveform)

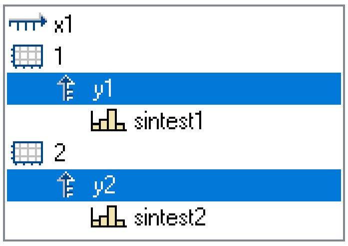
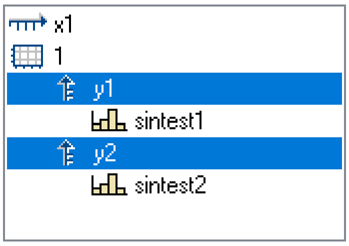
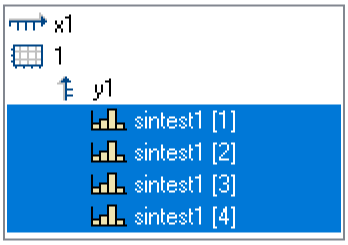
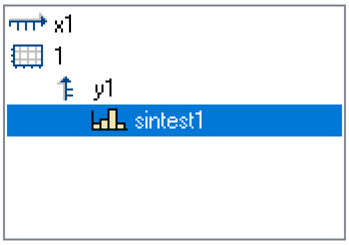
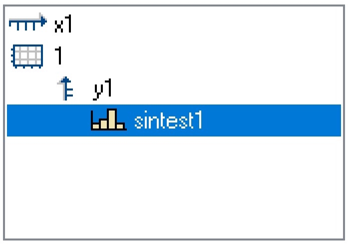
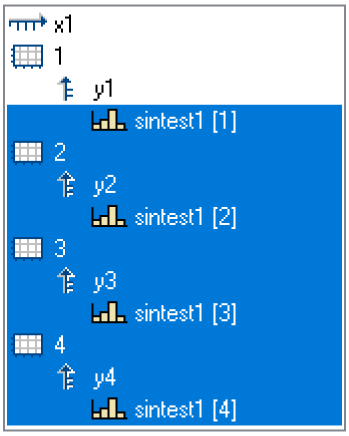
Icon	Description
	**XY-waveform** with **NON-monotonous** x-track (characteristic curve)
	A **digital** waveform
	A **complex waveform** in magnitude/phase- or real/imaginary display

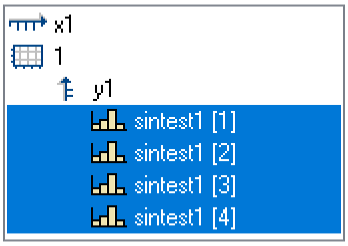
Context menu in Axes List

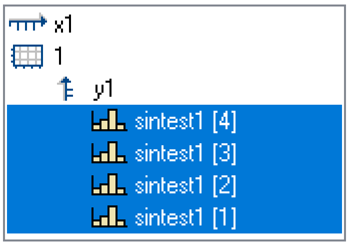


The following menu items are available:

Menu item	Description
Select all	Selects all lines in the list.
Lines	A *line* is the graphical representation of one or more data sets, in other words a *waveform*. Normally an entry in the axes list will indicate the simple representation of one data set as a line. The following items affect the selected lines.
Individual coordinate systems	This produces a *stacked* representation of curves.  **before**  **after**
All on 1 axis	All selected lines are displayed with only one axis. Any obsolete axes and coordinate systems are deleted.
Individual axes	A separate axis is displayed for each line.
Axes	The following items affect the selected axes.

Menu item	Description
All in 1 coordinate system	All axes are incorporated into only one coordinate system. Obsolete coordinate systems are deleted.  **before**  **after**
Individual coordinate systems	A separate coordinate system is displayed for every (y-) axis.
Events, Segments, Periods	The following items are relevant only to special data types (segmented and multi-shot waveforms)
Combine	Various lines are attached to each other, if the numbering permits. The range of possibilities is dictated by the exigencies of the corresponding dialogs for selecting structural elements.  **before**  **after**
Separate with same layout	One line consisting of several structural elements is dissolved into its components. The order of the elements is retained. If the original line was provided with, say, a coordinate system, then all the new lines will each receive one as well.  **before**  **after**
Separate into individual lines	This is the contrary of *Combine*. Multiple lines, which each amount to a structural element, are created.
Separate into individual coord. systems	Each structural element receives its own coordinate system.

<table>
<tr><th>Menu item</th><th>Description</th></tr>
<tr><td>Reverse order</td><td>Reverses the order in which the lines appear.


before


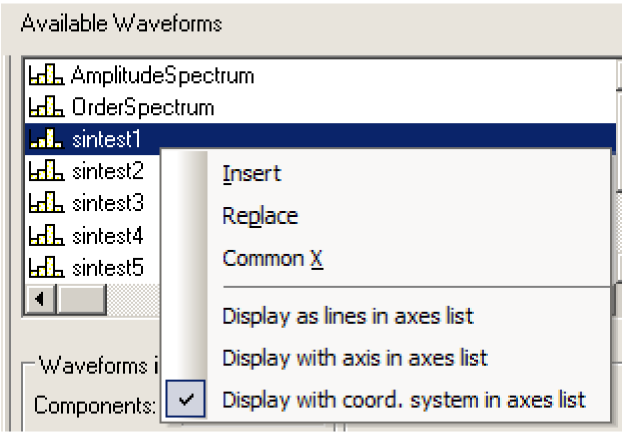
after</td></tr>
</table>

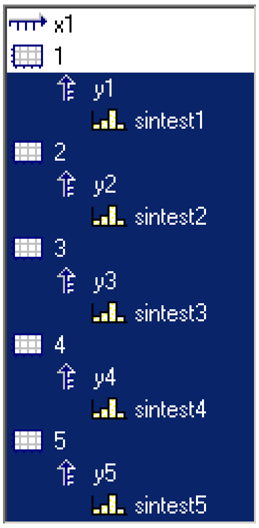
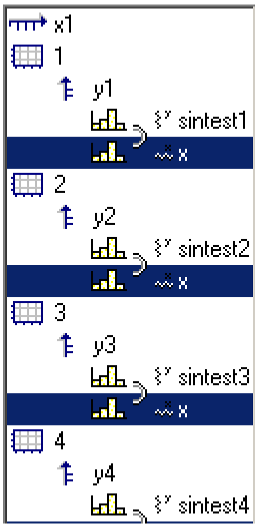
11.6.3.2 Available Waveforms

This list contains the waveforms which can be displayed in the curve window. Waveforms selected from this list can be fetched into the axes list using drag & drop (starting from the left edge of the list, the mouse pointer has the shape of a hand).

Context menu in Available Waveforms

Right-clicking mouse in the *Available Waveforms* list to open the context menu:



Menu item	Description
Insert	The waveform selected is added to the axes list. Depending on how the controls below are set, the waveforms are automatically created along with y-axes or coordinate systems: • Display as lines in axes list, Display as axis in axes list, Display with coord. system in axes list
Replace	The waveforms in the axes list are replaces with the waveform selected under *Available Waveforms*. If more than one waveform is selected under *Available Waveforms*, this menu item is not enabled.
Common X	The waveforms selected in the axes list contain an x-component.  **before**  **after**

11.6.3.3 Waveform Preselection

Waveform Preselection: Single values

Single values are only indicated in the list of available waveforms if this option is selected. Frequently, single values are generated in FRAME programs or imc FAMOS sequences, for example, as control variables, parameters for functions or indexed variables in loops. The single values are not of interest for display in a curve window.

This name only

The user can specify here a filter for the name of the waveforms to be indicated in the list. Only those waveforms whose names match the specified filters are included. The program does **not differentiate** between **upper** and **lower case letters**. Use the wildcards '*' and '?' when specifying the filter.

The wildcard '*' indicates any number of any given characters, '?' indicates any one given character. The wildcard can also be placed at the beginning or end of the filter.

Examples for wildcards

*	All waveforms
a*	All waveforms whose names begin with 'a'
Channel?	All waveforms whose names consist of 'Channel', followed by any character
Channel	All waveforms in whose names the string 'Channel' appears
a*;t*	different filters are separated by ";"

11.6.3.4 Waveforms in axes list

Waveforms in axes list: Components

What components are selected affects the current selection in the axes list. For two-component waveforms, specify whether the complete waveform should be indicated (XY, polar plot) or only a particular component of the waveform.

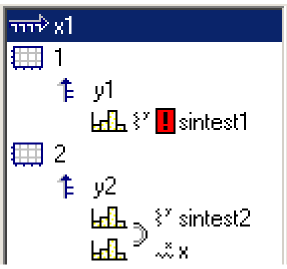
Component	Description
???	The settings for the selected waveforms do not match.
Waveform	Complete display of variables according to type. XY-Waveform: the entire waveform "Y over X" Complex data: polar plot
.x .y	The specified components of XY-waveforms are displayed
.r .i	Real or imaginary part of a complex waveform in real/imaginary display
.m .p	Magnitude or phase of a complex waveform in magnitude/phase or decibel/phase display

Waveforms in axes list: XY-plots

Superposition of normal single-component waveforms.

XY-plots	Description
???	The settings for the selected waveforms do not match
None	No XY-plot has been determined
x of XY	In an XY-plot, this waveform is the x-component
y of XY	In a XY-plot, this waveform is the y-component
x, y, x, y ..	The selected waveforms become x- and y-components in this order
y, x, y, x ..	The selected waveforms become y- and x-components in this order
z	In multi-dimensional displays, this waveform is the z-component.

An XY-plot always involves two or three consecutive waveforms in the axes list, which must both belong to the same y-axis. All must be single-component waveforms (a normal waveform or a specified component of a 2- or 3-component waveform). The two waveforms in an XY-plot are marked by a parenthesis in front of their names.



A small symbol indicates whether a waveform acts as the x-, y- or z-component in an XY-plot.

If a waveform has already been designated as part of an XY-plot, but it's counterpart is missing, this is indicated by a red exclamation mark in front of its name.

Dimensions for 3D displays

If you select the display type *3D*, the available dimensioning options for 3-component waveforms are presented here. Three waveforms as associated spatial dimensions are denoted by a parenthesis in front of the name.

XY-plots	Description
???	this means the waveforms selected have different settings
None	no multi-dimensional relationship defined
x	this waveform is the x-component in a multi-dimensional relationship
y	this waveform is the y-component in a multi-dimensional relationship
z	this waveform is the z-component in a multi-dimensional relationship
y, x, z	The selected waveforms are respectively the x-, y- and z-component of a 3D display

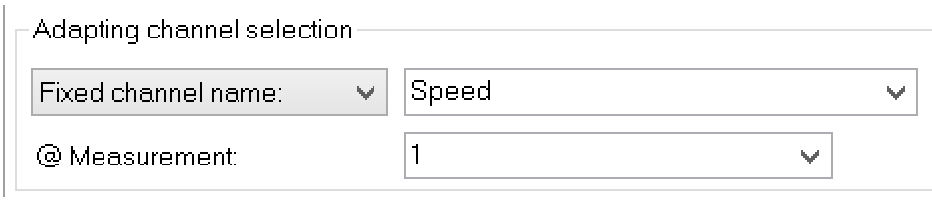
The multi-dimensional relationship always applies to three consecutive waveforms belonging to the same y-axis. All waveforms must be one-dimensional (so either normal waveforms or defined as one component of a 3-component waveform).

Also, there is a small symbol indicating whether a waveform is acting as the x-, y- or z-component. If a waveform is already defined as a dimension in a multi-dimensional relationship, but the complementing dimensions are still missing, a red exclamation mark will appear in front of the waveform's name.

The z component of the display is always the 3rd component. X, y or y, x come first. Please note that the purpose is to display a surface. This is a function y = f (x, z). Compare this with the display of with normal time domain data, where y = f (x). The difference is the same as with waterfall display. Y is the amplitude. X and Z are the independent coordinates. This corresponds to segmented waveforms where you have dx and dz for the two dimensions of the matrix. The values contained are y values. So a segmented waveform is a function as well: y = f (x, z). Thus, a surface will be plotted like with segmented waveforms, but with segmented waveforms all x and z values are equidistant. With xyz display you can chose any pairs of x and z values.

11.6.3.5 Adapting channel selection

The dialog portion *Adapting channel selection* is needed in conjunction with the Data Browser 1069.



Fixed channel name

Lets one specify that only a waveform having the channel name entered in the edit box at the right is displayed. Toward this end, "Unknown channel" from the window *Available Waveforms*: is added to the axes list and configured accordingly.

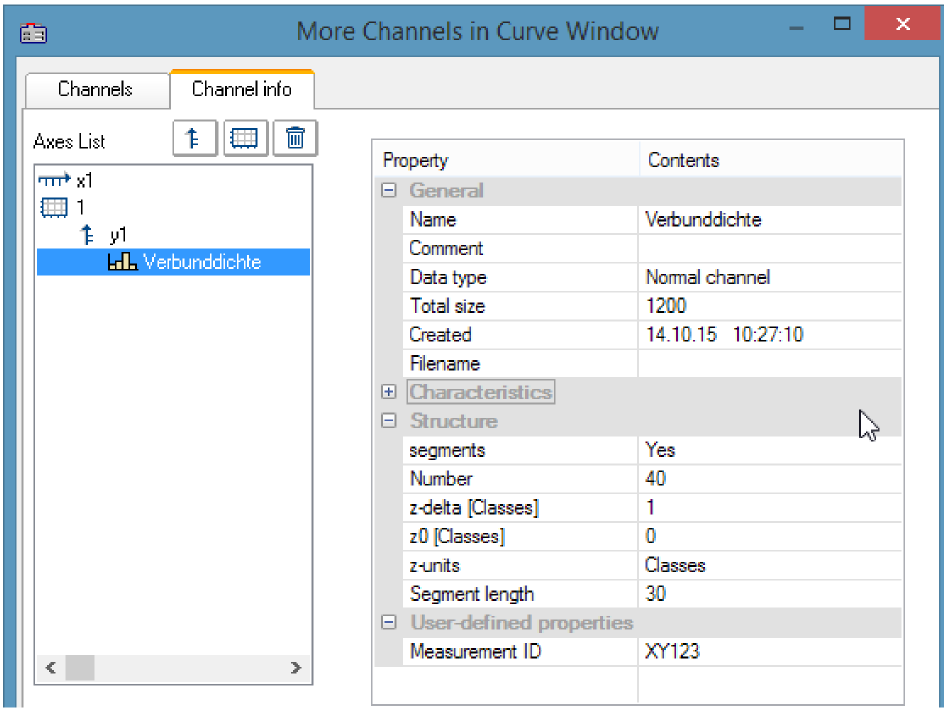
Selected channel

The curve window can be configured so that the waveform having the corresponding number in the Data-Browser is displayed at the this location. The pertinent number for the selected channel can be set in the dropdown list. Toward this end, "Unknown channel" from the window *Available Waveforms*: is added to the axes list and configured accordingly.

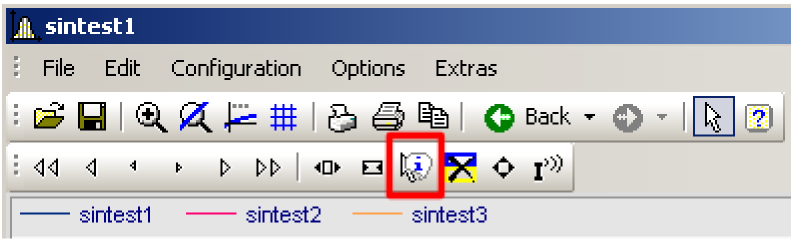
Additionally, the measurement selected in the Data-Browser can be set as a further display criterion in the dropdown-list *@Measurement*.

11.6.3.6 Channel info

The dialog "*More Channels in Curve Window*" contains a second page, *Channel Info*. Here you will find information about the properties or contents of any selected waveforms. The user-defined properties are also listed here.



In Select-mode, the dialog can also be reached via a line's context menu under the heading *Channel properties*, or in the menu ender [Configuration / Arrangement / Channel properties](#) 1272 or via the corresponding symbol in the *Navigation Toolbar*.

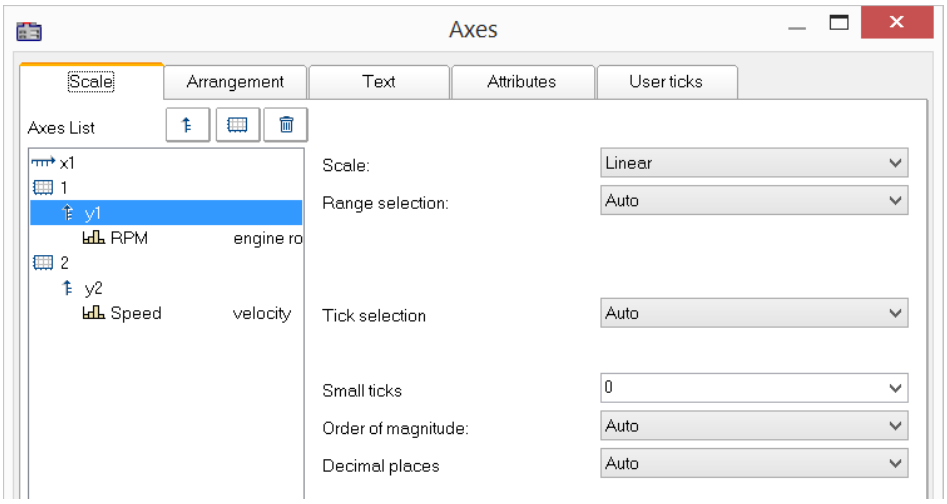


11.6.4 Axis configuration

Each axis (x, y, z) can be scaled manually, with a linear, logarithmic or dB scale. Linear scaling is useful for all time functions, whereas logarithmic scaling is appropriate for spectra. In logarithmic scaling, the waveform is stretched in small coordinate range and compressed at higher x-values.

Mouse Operation

- In the curve window's menu *Configuration*, select the item *Axes*... or to double-click in the region of the axis' scale labels. A dialog for scaling the axes then appears.



The Axes list shows the curve window's structure. Here, select the axis, which you wish to edit on the right side of the dialog. Selecting multiple axes is also possible.

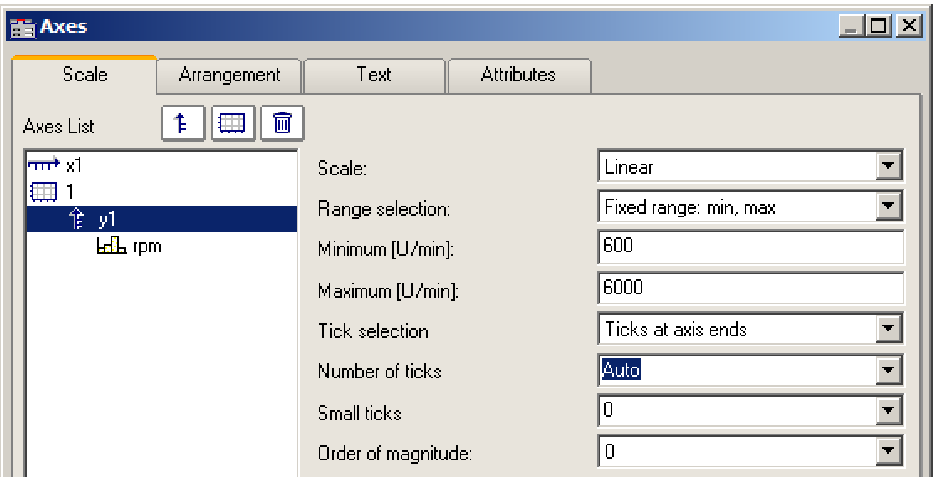
11.6.4.1 Scale

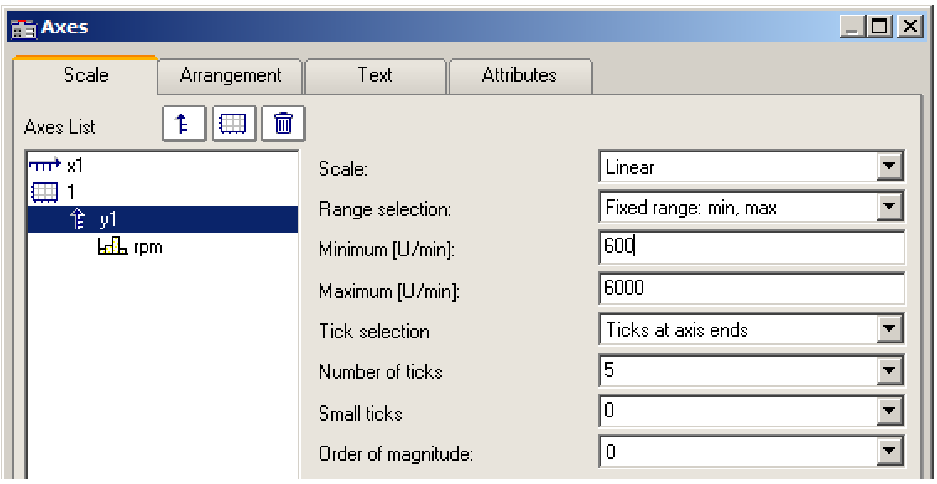
Scaling of the axes. An axis' domain can be defined in a number of ways.

Scale

The axis can be scaled as *linear*, *logarithmic* or in *dB*. In Date/time display, the scaling is always linear. When the mode *Rounding* is selected for logarithmic labeling, powers-of-ten will be written to the axis as long as the range displayed is large enough.

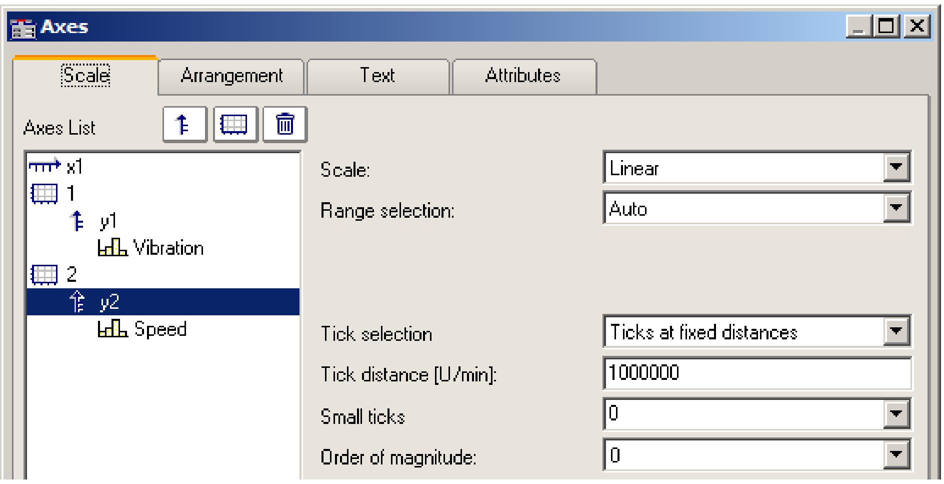
Range selection

Range selection	Description
Rounding: min, max	Specify the axis' domain by specifying the minimum and maximum. The specified values of the waveform are then rounded off in such a way that, taken together with the set number of markings on the x-axis, that axis appears labeled with nice, round numbers. Note that the maximum must always be greater than the minimum.  This menu option is not enabled when the option *Tick selection* is set to *Ticks at fixed distances*.

Range selection	Description
Fixed range: min, max	Here, the range limits and the number of markings are defined. For instance, a minimum specified as 10.0, a maximum of 40.0 and four markings on the axis result in the values 10.0, 20.0, 30 and 40.0 being marked along the axis.  In logarithmic display, the factor with which to multiply the individual tick points must be stated, and it must be more than 1. If you set the first value to 10, the factor to 2 and the number of ticks to 3, then the values 10, 20 and 40 are marked on the axis.
Auto	Determining the range is automatic. The entire curve is displayed in the curve window.
Automatic with zero	With this setting, the zero point is always visible. If the signal values lie within the range 2.0 ... 2.5, the range displayed is 0.0 ... 2.5. This corresponds to an oscilloscope's DC-setting. If the function values are distributed at only a small distance around the mean value, the deviations from the mean value will be interpreted as interference or noise. In that case, a display with visible zero intercept is always set automatically.
Like previous axis	This option is only available if more than one y-axis is displayed in the curve window and an axis other than the first one is selected. If you select this display style, the axis concerned appears in the same style as the preceding axis in the list. In this way you can make multiple curves be displayed with the same axis, and have this one axis state the scaling for all curves correctly.

Tick selection

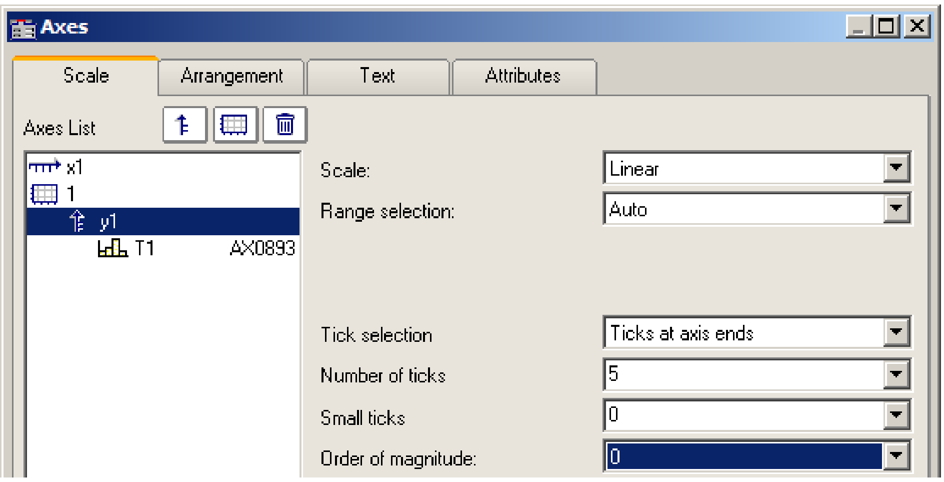
The main ticks, along with which the axes labeling appears in the curve window, can be placed anywhere on the axis. If you select the option *Ticks at fixed distances* in the *Tick selection* control, the additional control *Tick distance* becomes available. Here you have the ability to set the amount of ticks per unit. For instance, when the unit is ms, the ticks appear every 3ms, if 3 was entered in the text box *Ticks distance*.



Select the option *Automatic Labels*, if the ticks should be placed at the ends of the axis. The increment between ticks then depends on the total amount of ticks set.

Automatic tick spacing is recommended; for this, simply select *Auto* under *Tick selection*.

If the option *Automatic Labels* was selected in the *Tick selection* control, the number of ticks can be entered in a text box. The number must be greater than or equal to 2.



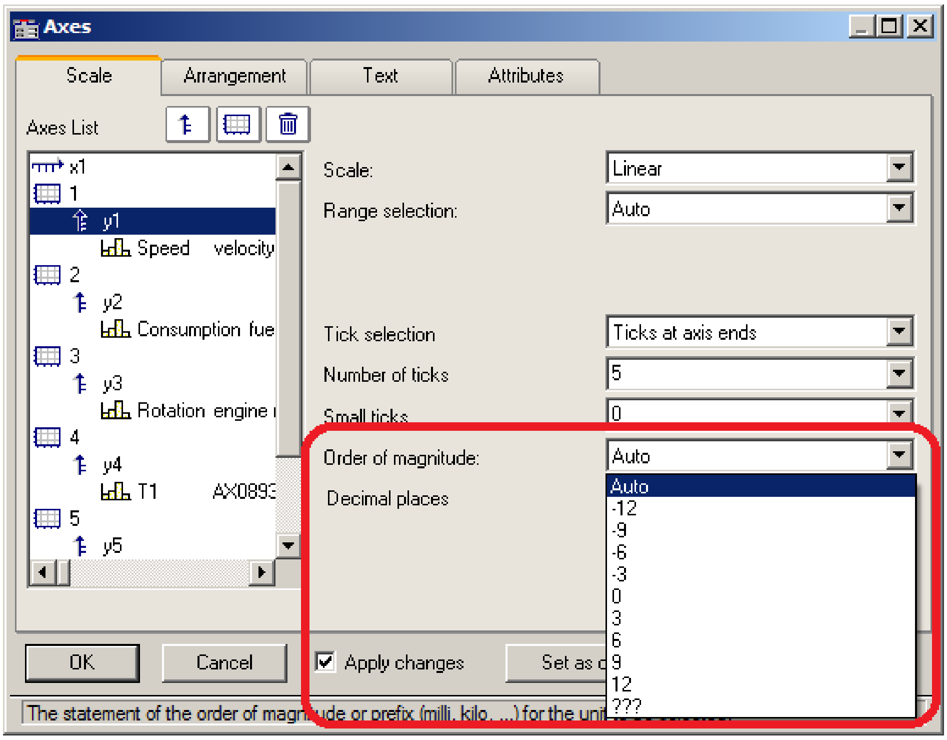
The number of ticks per unit is calculated by subtracting one (1) from the number of markings and dividing the difference by the displayed interval in units. For example, with an interval of 3ms and seven markings specified, two ticks per unit (ms) will be placed on the axis.

Remarks

- An error message is generated when clicking on *OK* if inapplicable values were entered in the text boxes. Error messages occur on account of inapplicable values (too large) or ranges (no positive values in logarithmic display, minimum not smaller than maximum, or inapplicable number of markings). Correct the relevant text boxes and then click on *OK* again.
- The distance (difference) between xmin and xmax may not be too small in relation to the maximum magnitude of xmin and xmax. For example, a range of
  1.0000000000000001 ..... 1.0000000000000002
  CANNOT be displayed. The maximum permissible factor between difference and maximum magnitude is 1E-13.
- When the display mode *1/3-octave/octave* labeling is selected, then the scaling of the x-axis is accomplished as detailed in the appropriate chapter. A different dialog appears for scaling the x-axis.

Order of magnitude

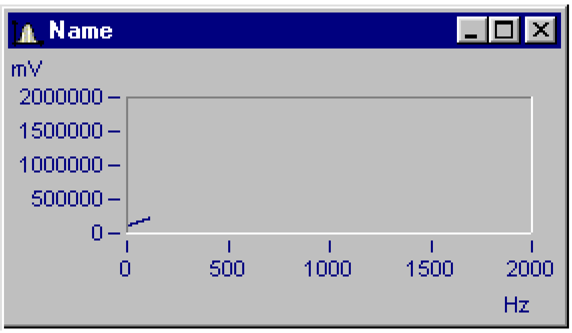
It is possible to arbitrarily determine the power-of-ten of the axis-scaling. If the axis is labeled with a unit, and appropriate prefix will be appended to the unit symbol, if applicable (e.g., mV or MV).



Example x-axis with a fixed

For an x-axis with a fixed scaling range of 0...2000V:

Order of magnitude	Display
Auto:	0..2 kV
+6	0..0.002 MV
0	0..2000 V
-	0..2000000 mV

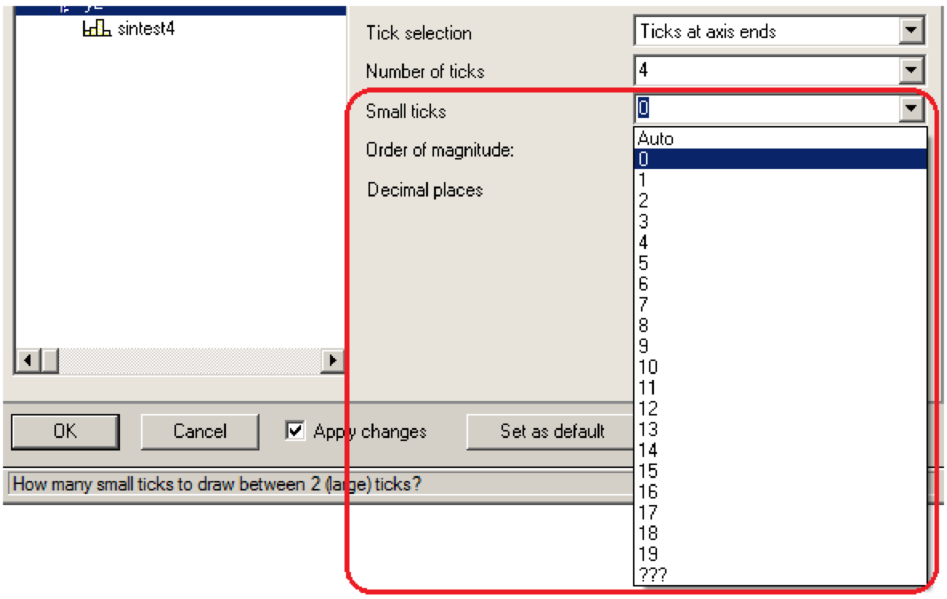


Curve window with inappropriate scaling

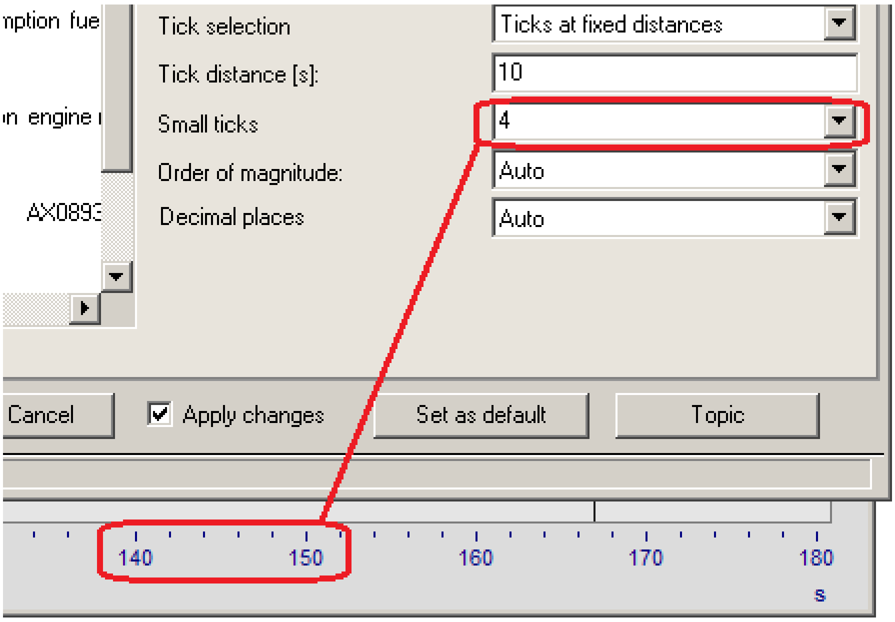
x-axis scaled with exponent 0, y-axis with exponent -3.

Small ticks

Small ticks can be positioned along the axis between the big ticks (main ticks):



To do this, select the amount desired from the pop-down list. If you don't want any, select 0.



The small ticks are not labeled. If the curve window featured a grid, then supplementary grid lines (which may appear thin in a printout) will appear at the small tick coordinates. For details, see the discussion of the menu item *Configuration/ Grid* 1256.

Decimal places

With linear axes, the number of decimal digits can be set here.

Format (for Date/time absolute)

If the scaling of the x-axis is in abs./rel time, the format of the labeling can be specified:

- *Auto ,Auto 1 line, Auto 2 lines*
- *fix 1 line or fix 2 lines.*

The display of time and date makes use of placeholders.

Placeholders in absolute time:

Time: h, hh for hours; m, mm for minutes; s through ss.ssssss for seconds

Date: D, DD for day, M, MM for month; YY, YYYY for year

Names: DDD for abbreviated weekday, DDDD weekday, MMM abbreviated month, MMMM month

A.M., a.m., AM, am for AM/PM format

The placeholders and special characters appear in angle brackets. Furthermore, other characters can be added.

Duplications << or >> for one < or > character in the output

Example

<hh:mm:ss.ss>

<hh:mm a.m.>

<DD.MM.YYYY, hh:mm>

<DDD, DD.MMM.YYYY>

date=<DD>.<MM>.<YY>

Placeholders with relative time:

h, hh for hours; m, mm for minutes; s to ss.ssssss for seconds

D to DDDDDD for days; o to oooooo for hours without days

The placeholders and special characters are expressed in angle brackets. Furthermore, other characters can be added.

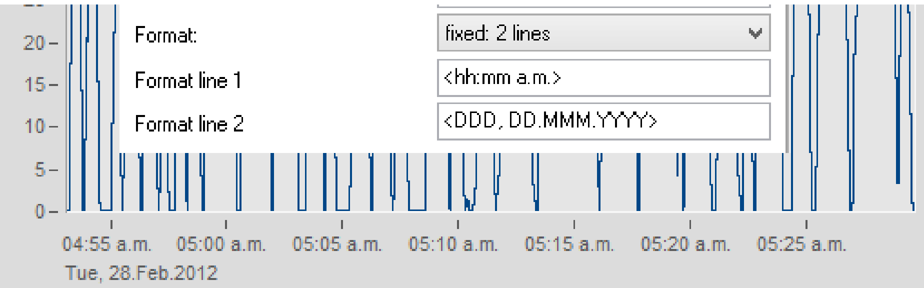
Example

<hh:mm:ss.ss>

<D> Tage

<o:mm:ss>

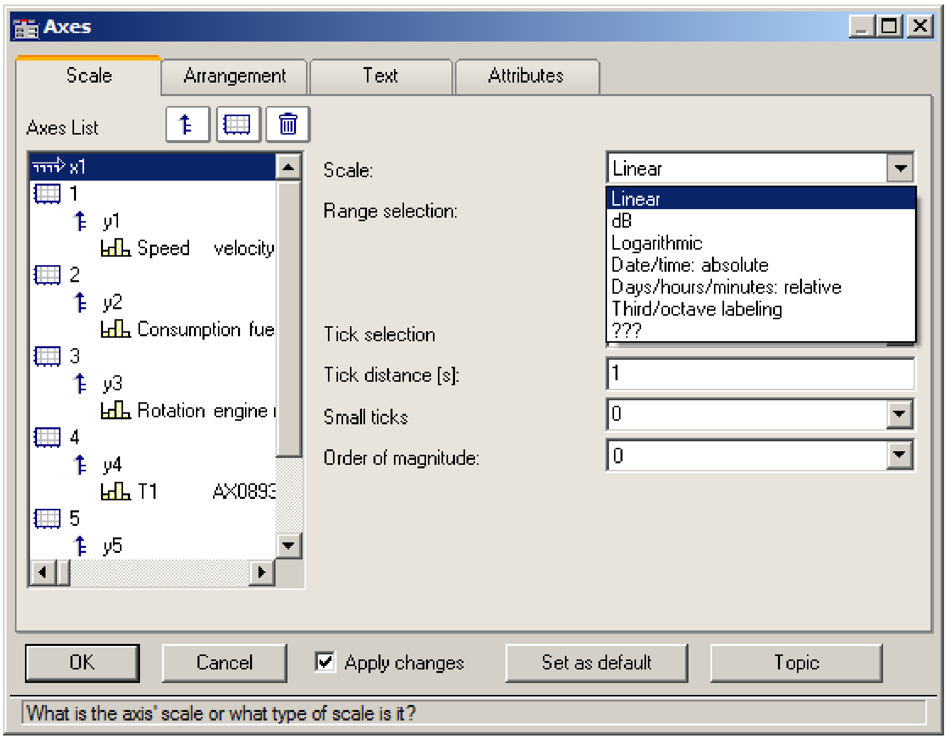
<o> Std, <mm:ss>



Example: line 1: <hh:mm a.m.> line 2: <DDD, DD.MMM.YYYY>

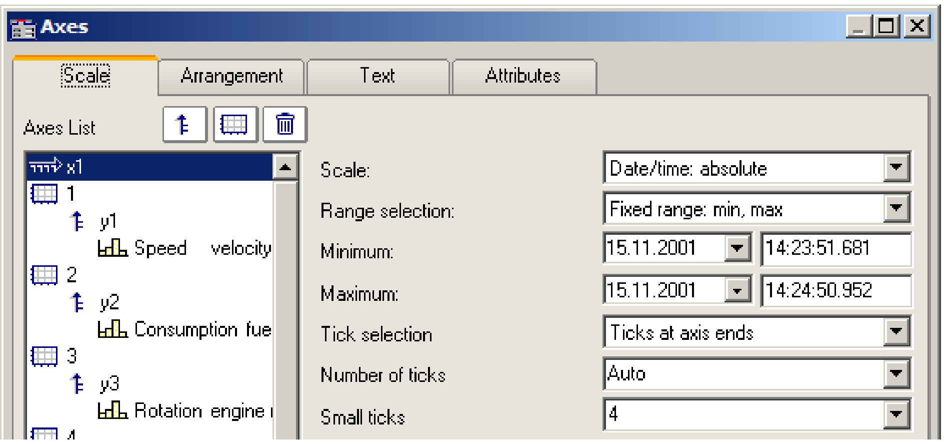
11.6.4.1.1 Particularities of the x-axes

The following concerns special display types only available for x-axes. The x-axis alone must be selected in order for these options to be enabled.



Scale

Absolute date, time: The minimum and maximum are each specified separately in terms of the time and date. Selection of the date is accomplished by means of a calendar. The time is entered into a text box in compact form. The seconds in the time can have decimal places.

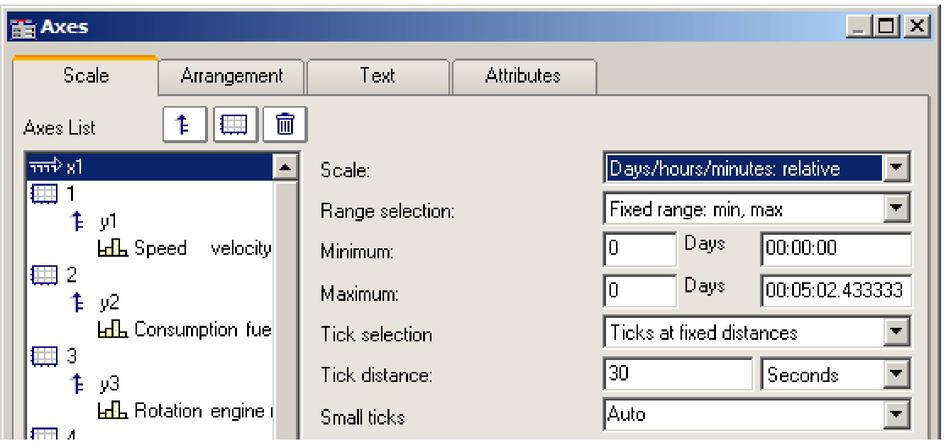


The distance between ticks can be set to be determined automatically or to be fixed. With a fixed setting, the unit can be anything from seconds to days.

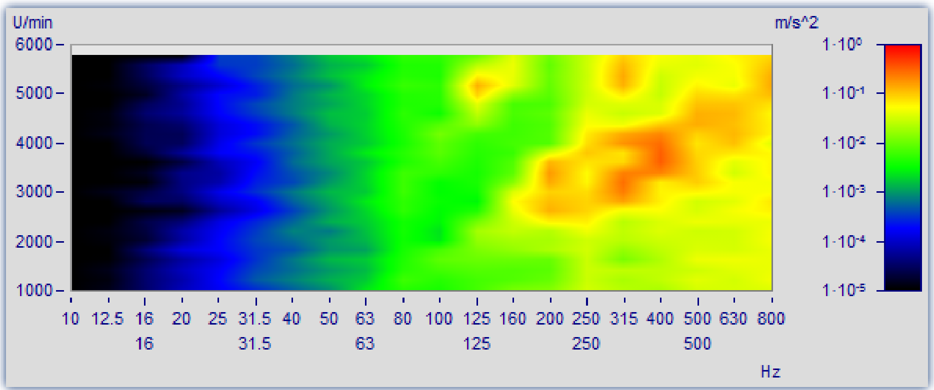
The channels are displayed in reference to absolute time. The absolute time of the measured points is usually derived from the sum of the specified absolute trigger time and the relative time for a point measured after the measurement's start.

Days, hours, minutes: relative: The amount of day and of hours, minutes and seconds (the latter may have decimal places) can be specified. As in linear display mode, the display of the measured data doesn't refer to the absolute triggering time. Thus, only the time intervals between the measured points and the trigger time are indicated.

It is also possible to specify a negative amount of days, in order to indicate points in time preceding the trigger.



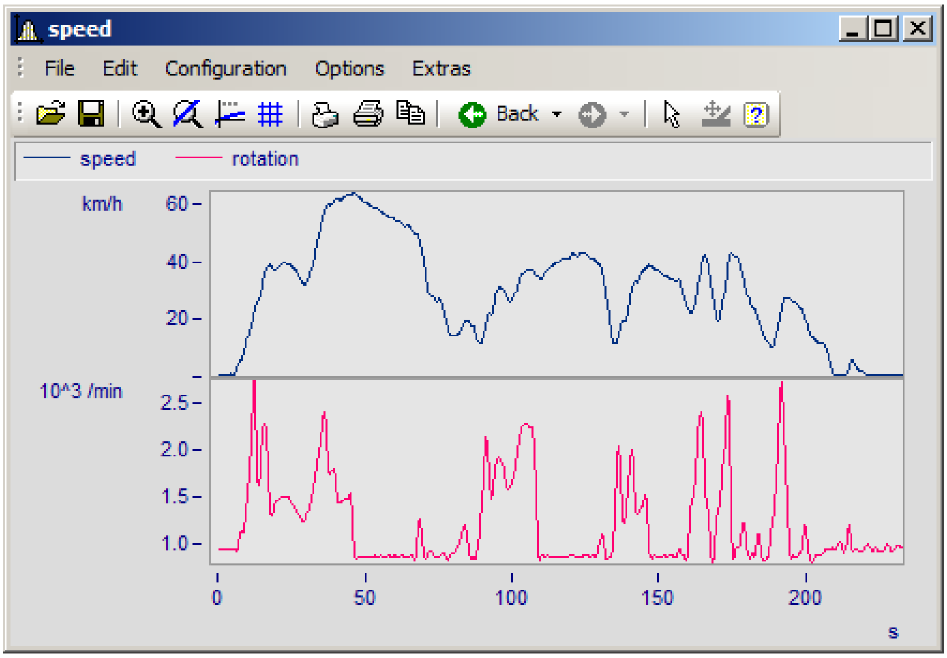
Third/ octave labeling: If a waveform contains a 1/3-octave or octave spectrum and the waveform's x-axis is scaled in 1/3-octaves, then the x-axis can be drawn with numerical values of the 1/3-octaves and octaves, in accordance with DIN.



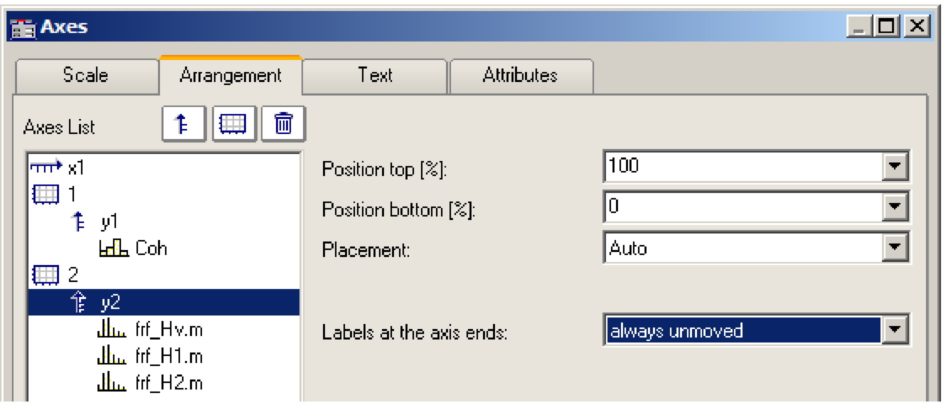
For details, see the dedicated section on "Third / octave labeling 1181".

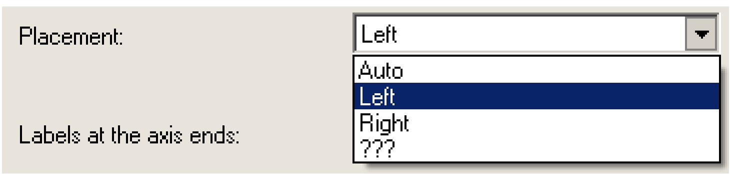
11.6.4.2 Arrangement

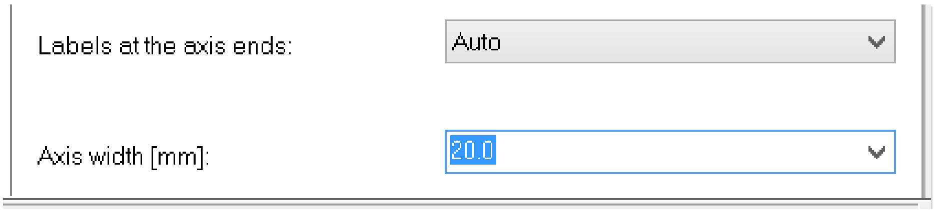
It is possible to stack multiple y-axes in a single coordinate system. It is also possible to set whether to layout the axes a the left or right of the coordinate system.

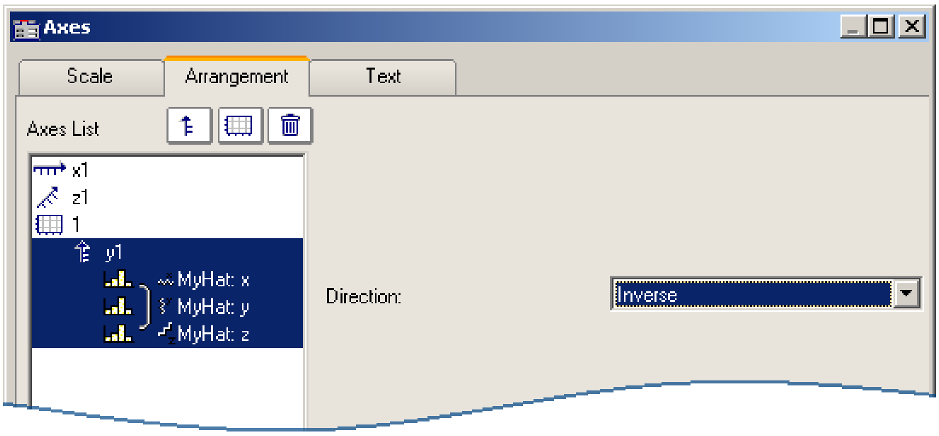
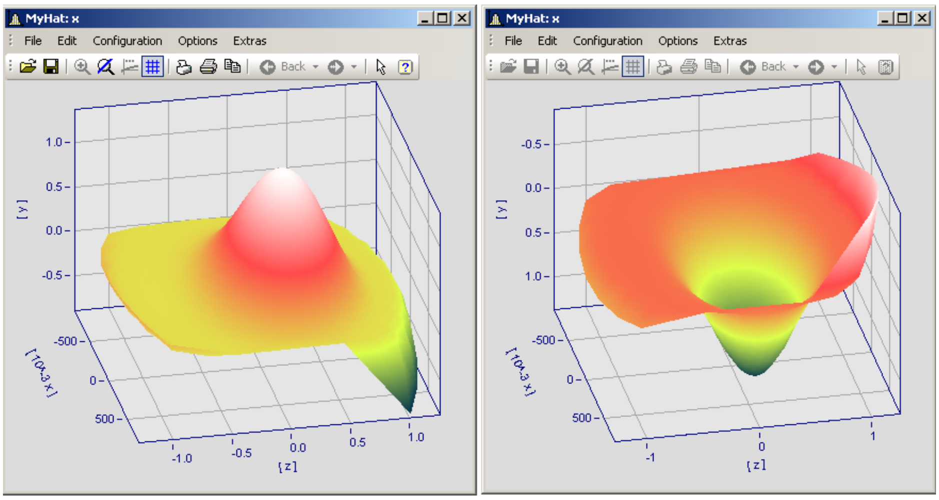


To do this, select the page *Arrangement* in the dialog *Axes*.

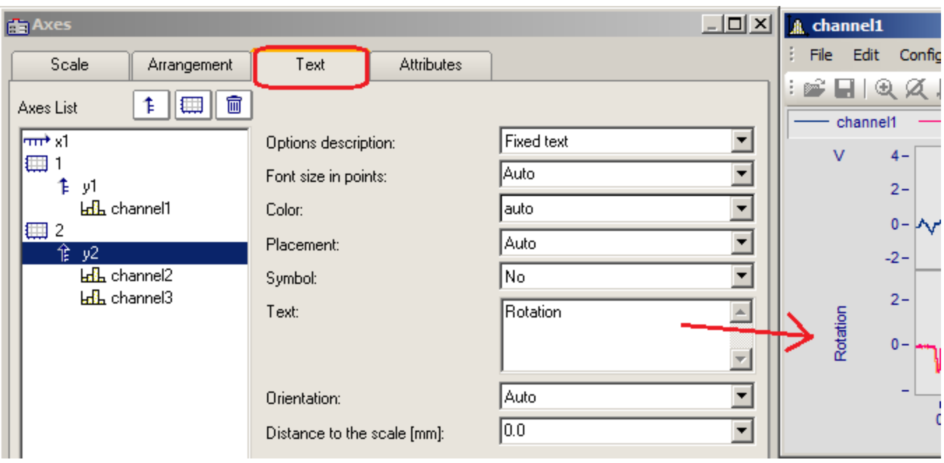


Settings	Description
Position	The relative position along the full height of the coordinate system can be specified for each axis. The setting 100% represents the position all the way at the top, 0% the very bottom. If the axes overlap each other, new "columns" are automatically set up.
Placement	The control *placement* sets whether to position the axis at the left or right of the coordinate system. 

Settings	Description
Labels at the axis ends:	Alongside automatic orientation of the labeling, this control also offers ***always unmoved*** and ***move if necessary***. 
Axis width	The width of the Y- and X-axis can be specified manually. In particular when using "User Ticks 1218", this helps in providing sufficient room for the labeling.
Resolution	Setting the scaling of the y-axis *auto*: individually *same resolution as x-axis*: Generates a constant aspect ratio. In consequence, the ensures among other things that for an RGB-image 1192 the image is displayed without distortion.  This setting only works when the same setting (linear or logarithmic) applies to both the x-axis and y-axis, and only for either standard display or Y-axes stacked. Not available for abs./rel time, and 1/3-octaves.

Settings	Description
Inverting the axis direction	With 3D display, you can invert the direction of the Y-axis. Use the menu: *Configuration\Axes* and select the page *Arrangement*. In the dropdown list you will find the entry *Inverse*.   **Example: Invert the axis direction** **At left the normal orientation, at right the inverted Y-axis**

11.6.4.3 Text



Along with the normal axis labeling in the respective units, there is also the possibility to use the page "Text" to personally define the axis labels and to set their parameters. If there is text for a y-axis, it will be printed in vertical alignment in the curve window. Text for the x-axis is aligned horizontally and placed in the center. The following settings are available for the text:

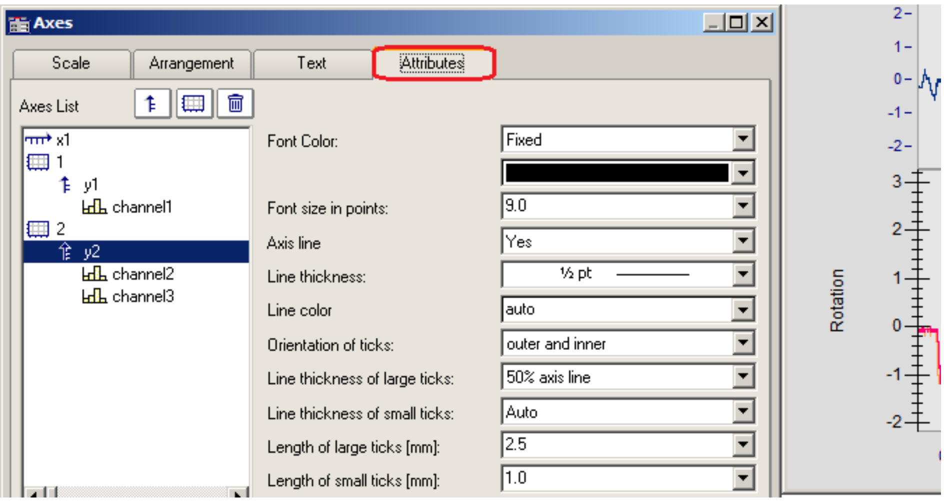
Settings - Options description	Description
No text	The default setting, in which the unit associated with the waveform is displayed horizontally at the upper end of the axis. For "No text", the additional option "*Unit indication*" is shown. This can also be hidden, for instance when using "User Ticks 1218".
Fixed text	Here you can enter any desired text, such as "Length [m]", as a permanent feature. Seed also the notes on Greek letters 1360.
Unit	The unit saved with the waveform is displayed.
[Unit]	The unit saved with the waveform is displayed in angular brackets.
Name, Unit	The channel name is displayed in the first line of the coordinate system and the associated unit saved with the waveform are displayed.
Definable with placeholders and formatting instructions	The text can be given along with fixed components and placeholders. Available placeholders are: • <name> for the channel name • <unit> for the unit • <comment> for a comment on the channel • <e>exponent</e> for an exponent, as an alternative to a^b. • <s>index</s> formats the text as small index. Nesting of the index or exponent is no allowed. • <g*b> for Greek letters. Also in the exponent: A<e>-<g*a>t</e> => $A^{\alpha t.}$ • x<s>i</s><e>e</e> for exponent together with index.

Additionally, it is possible to set the ***font size***, font ***color***, ***placement*** along the axis, and whether the ***symbol*** for the first line appears in front of the signal name, as it does in the legend. The symbol can only be set in the dialog for y-axes. The ***Orientation*** determines whether the text is displayed across the axis or parallel to it. Further, using ***Distance to the scale***, it is possible to specify a minimum distance to the text.

Reference	Further texts

Further texts can be added on the tap *Display/Text* 1254 and in chapter *User ticks* 1218.

11.6.4.4 Attributes



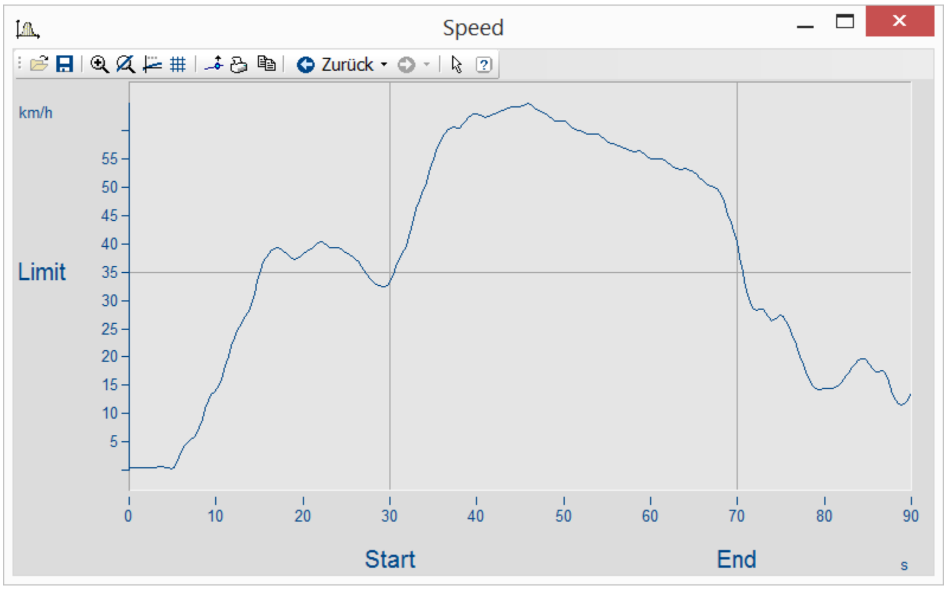
Settings for the axis

The control ***Font Color*** allows the color of the first data set to be applied, or a freely selected color to be set.

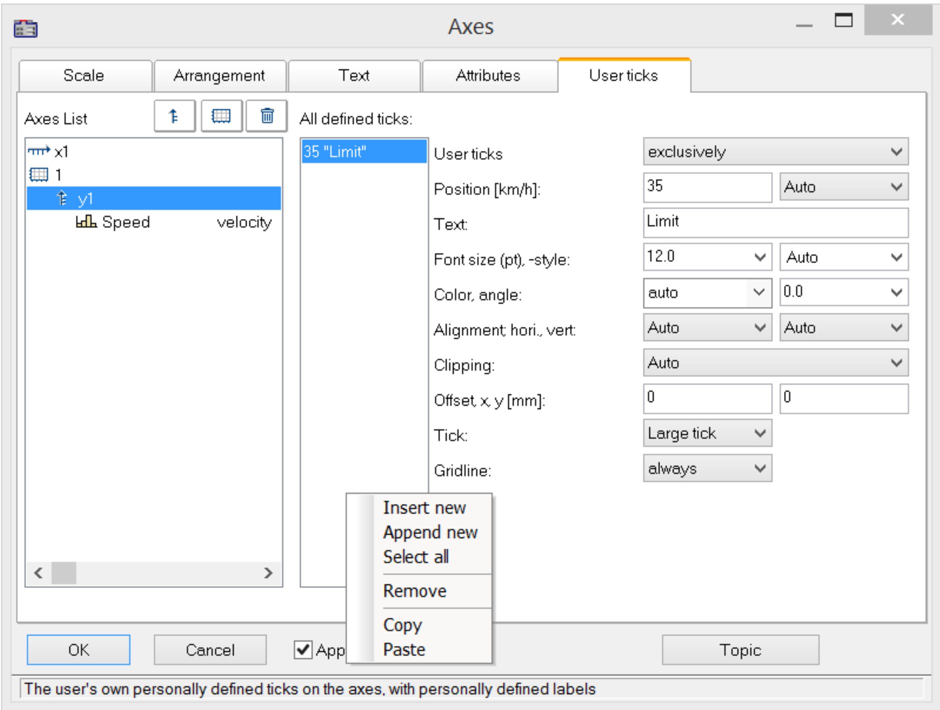
Additionally, it is possible to add an ***Axis line*** while specifying its ***Line thickness*** and individual ***Line color***.

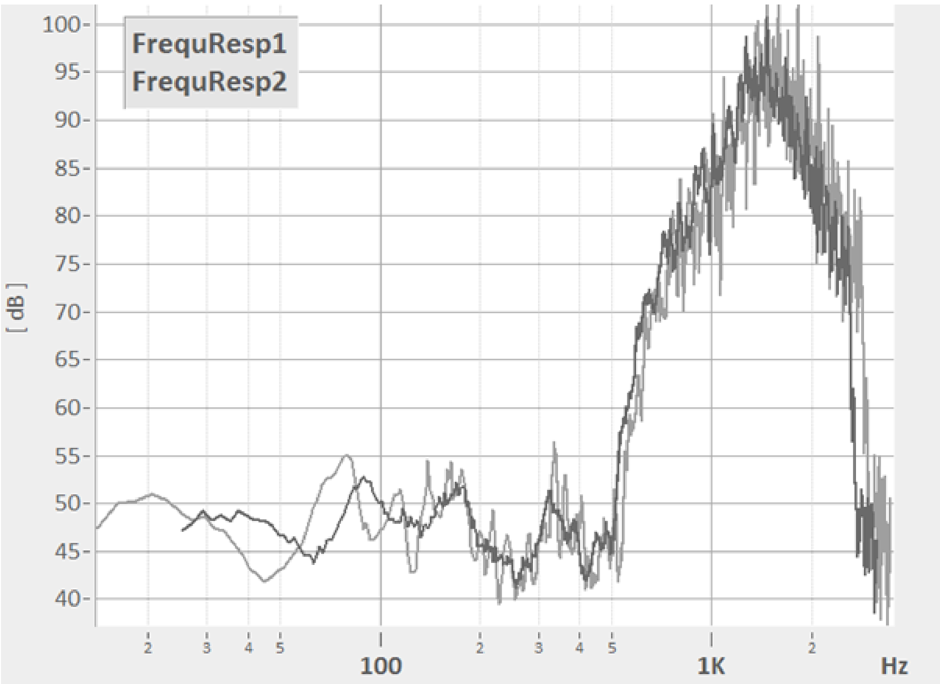
The ***Line thickness*** and ***length*** of the ***ticks*** can be set separately for both the small ticks (between numbers) and large ticks.

11.6.4.5 User Ticks

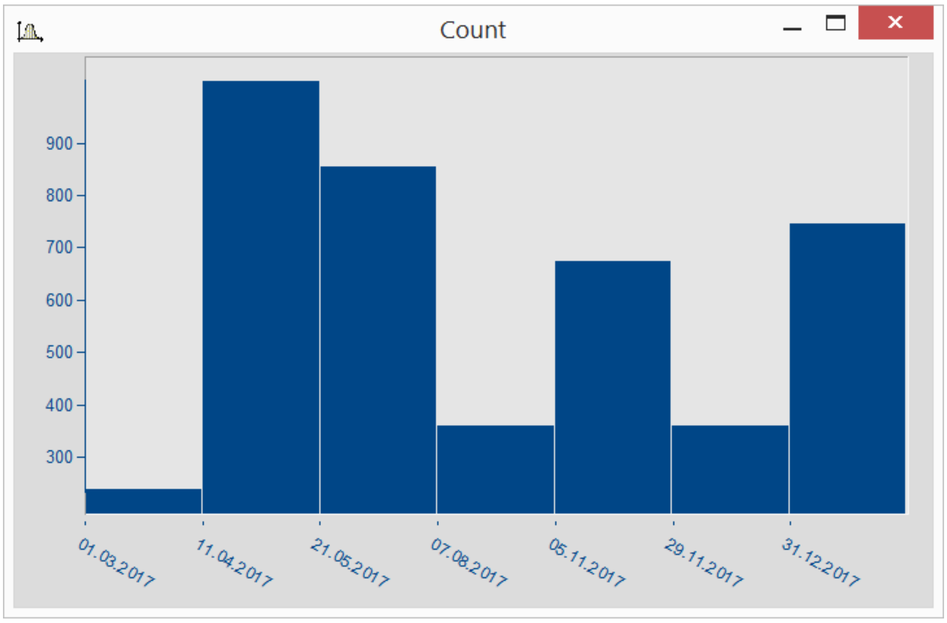


On the page "*User Ticks*", there are controls for inserting extra ticks. Using the context menu for "*All defined ticks*", you can insert, copy and delete ticks.





Any formatting, e.g. for log. Display



Date display independent of x-delta

The properties of the respective ticks assigned are listed according to the axis selected.

Settings	Description
User ticks	Replaces(*exclusively*) or complements(*additionally*) the existing scaling.
Position	Determines the position on the axis.
Font -size, -color, -alignment etc.	determine the appearance of the text. The necessary width can be set on the page "*Arrangement* 1215".
Restriction	With *Restriction* active, the text is no longer displayed if it is moved out of the visible area by scrolling the axis. Without *Restriction* active, the text is still displayed.
Shift	Moves the user ticks to the left (<0) or to the right, for instance in order to avoid overlapping with the scaling in cases of additional ticks.
Tick	Selection of the tick representation, according to the settings on the tab *Attributes* 1218.
Gridline	Shows a line corresponding to the tick. There is a choice of whether or not to make its appearance depend on the presence of a grid.
Exclusively	Custom settings for the selected tick: *Yes*= only the user tick; *No*= in addition to the scaling
From "Label for raw data"	Only visible if *Insert from "Label for raw data*" was activated with the context menu. User-defined properties of the type imc30 are imported automatically.

Reference	Further texts

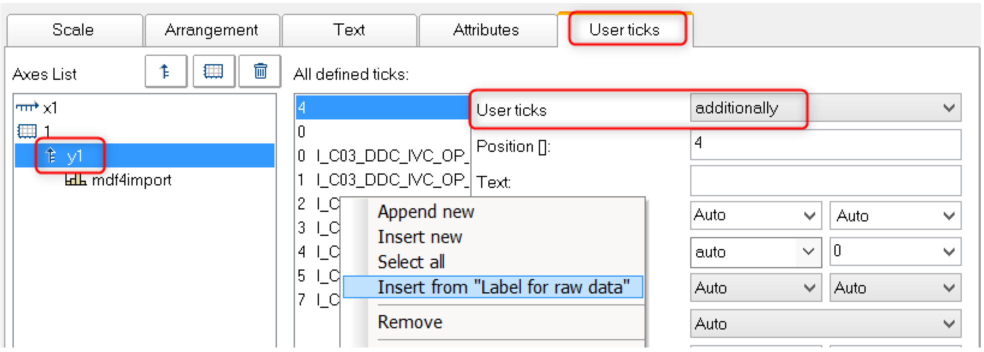
Free texts can be set at *Display/Text* 1254 and on the tab *Axes/Text* 1216.

11.6.4.5.1 Label for raw data

Some signals contain integers representing certain states or error codes. For instance, such a number can denote the gear in an automatic transmission (0=N, 1=D, 2=R, 3=P, etc.). Such information is typically recorded as an integer value.
imc's data format makes it possible to save such supplemental information along with the variable. Once category of these "*user-defined properties*" is called *imc30* and lists texts which are provided by certain sources (MDF, CAN, etc.) as "*Label for raw data[]*".
When a data set contains such imc30-information, the values can be used as User Ticks.

Activating "Label for raw data"

- To import the data, open the dialog *Axes* -> Tab: *User ticks*.
- Select *additionally* or *exclusively* under *User ticks.*
- Select the affected Y-axis and right-click the mouse over the middle list, *All defined ticks.* Only when the signals has properties of the type *imc30*, the entry "*Insert from Label for raw data"* is visible.
- All *"Labels for raw data"* are imported.



Editing the presets for user ticks

As soon as *Insert from "Label for raw Data"* has been activated, the property *"Label for raw data"* is available with the following options:

no: as previously

yes: this tick is derived from a *Label for raw data[integer]*.

Template: Template, if new properties are associated with the channel.

FAMOS generates a tick without a text, at the position 0. This is used as a template. When new positions are added, new ticks are generated in accordance with these settings.

Remarks:

- When positions are discarded, the associated ticks are deleted.
- When you do not desire automatic updates, set the property *From "Label for raw data"* to *"no"*.
- *Label for raw data[integer]*: The value in brackets is a whole number in the channel's raw data, which means unscaled (whole numbers). If there are real numbers, only whole numbers are given consideration.
- *Label for raw data[integer]* always only pertain to a channel's y-values and is only suitable for the y-axis. XY-display is the exception, in which the x-axis represents the y-values of an XY superposition.

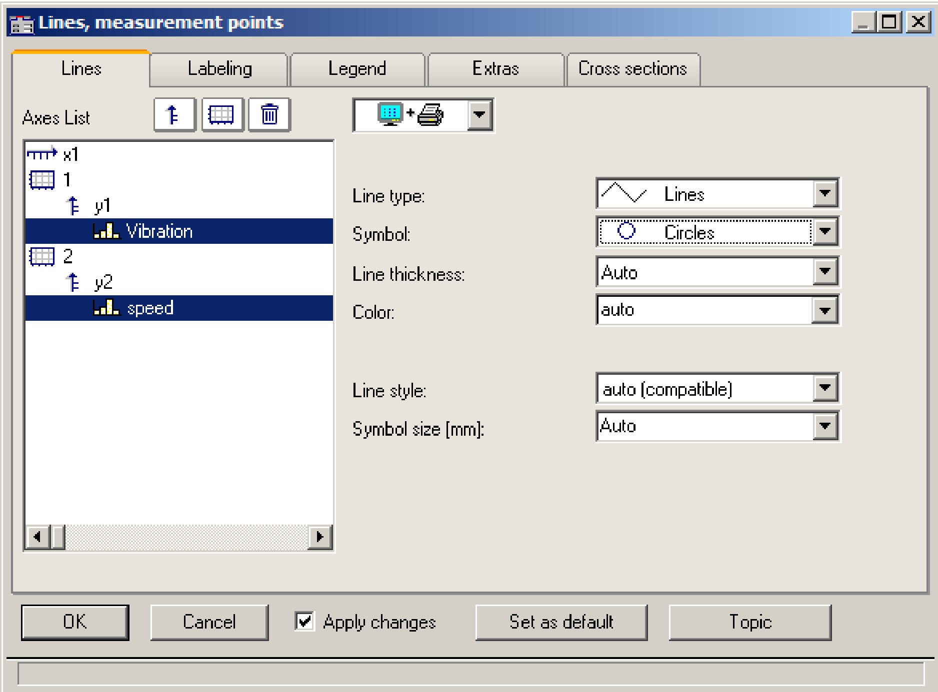
11.6.5 Line configuration

Function

Here, the type of line used to draw the curve and the symbols used to identify the sample values can be specified.

To make the settings for the lines, call the menu item *Configuration / Lines...*. Alternatively, you can switch directly from the dialog *Axes...* to the dialog *Lines* by using the button *Topic*.

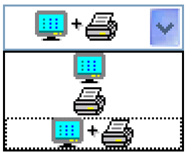
The dialog for setting line properties then appears:



11.6.5.1 Lines

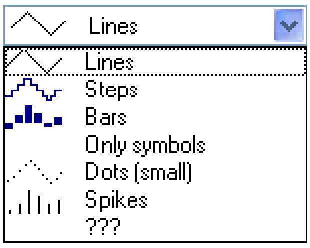
Appearance of lines in the screen display and in printouts

Effect on the printer and/or monitor screen



By making this selection, you determine whether the properties you set apply to the screen view and/or to the printer (or Clipboard). By this means, it is of course possible to make separate settings for the printer and for the screen. Not all properties can be set separately for the printer and the screen each.

Line type



Display of the samples. Normally, the samples are displayed by linearly interpolated solid *lines*. Alternatively you can select other display options from the list appearing further below.

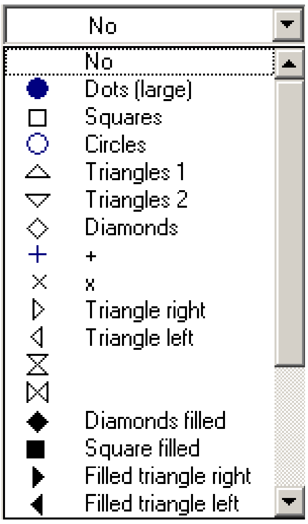
When displaying an RGB-image 1192, there is a distinction between *Lines* and *Steps*. For *Lines*, the pixels are interpolated between the samples (original image points) with color gradients. With *Steps*, the interpolated pixels remain constant. With any RGB-image, all line types other than *Lines* are treated as *Steps*. If multiple samples fall on one and the same pixel on the screen, the system takes an average.

The line type is always the same for the printer and the screen.

Line type	Description
Lines	The "*Lines*" style displays the curve as a polygon, i.e. as straight lines connecting the points of the waveform. In an RGB-image, the pixels are linearly interpolated between the original image points.
Dots	When the option "*Dots*" is selected, only the points of the waveform are displayed as dots of one pixel each.
Bars	The "*Bars*" display shows every point of the waveform as a bar rising from the horizontal axis.
Steps	When "*Steps*" is selected, all points of the waveform are connected with stair-steps, i.e. each sample value of the waveform is held until the next sample ('sample and hold' effect). In an RGB-image, the pixels are interpolated by a constant value between the original image points.
Only symbols	With the setting "*Only symbols*", there is no continuous line. At each measured point, a symbol (e.g. a square) is drawn. The particular symbol desired must then be selected under the *Symbol* control.
Spikes	"*Spikes*" are vertical lines extending from the x-axis to the height of the measured value.

Symbol

Every measured point is indicated with a symbol.



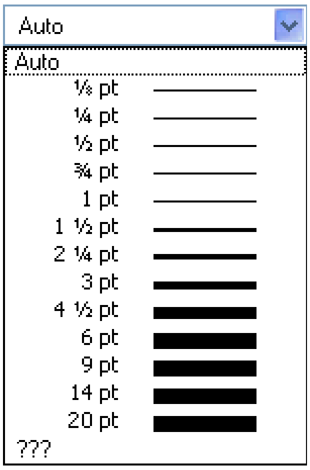
The symbol type desired is selected form this pop-down list. Symbols can be displayed either together with a line or all alone.

In special cases, not every measured point is represented by its own symbol, but rather the symbols are distributed evenly along the plot, for example, in order to differentiate between the plot lines of different channels. See the section on the menu item *Configuration/ Display* 1128, in connection with the property *Number of symbols*.

The symbol always appears the same on screen or printed out.

A fixed number of symbols can be specified on the "*Extras* 1231" tab.

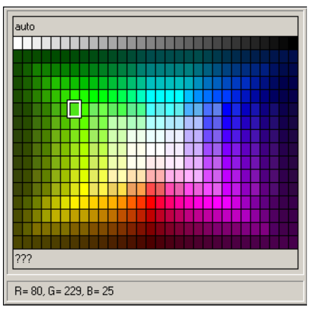
Line thickness



The thickness of lines can also be selected. It pertains no only to continuous plot lines, but also to other line types and certain symbols.

The line thickness can be different for the printout and for the screen display.

Color

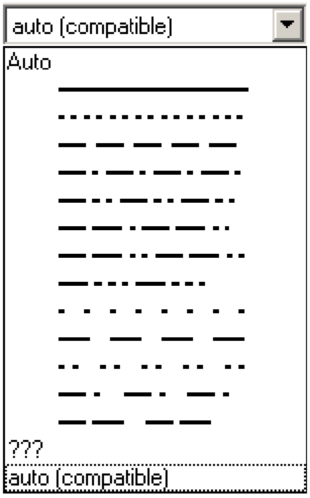


Here, the color of the line or symbol can be specified. If the color is set to *auto*, it is selected automatically by the system. In that case, a line's color depends on its order of appearance among the lines, and on the corresponding global settings for color assignments in the curve window; see the discussion of the menu item "Options / Colors 1341".

It is also possible to select a fixed color from the palette provided, which cancels all automatic settings.

The color can be different for the printout and for the on-screen view.

Line structure



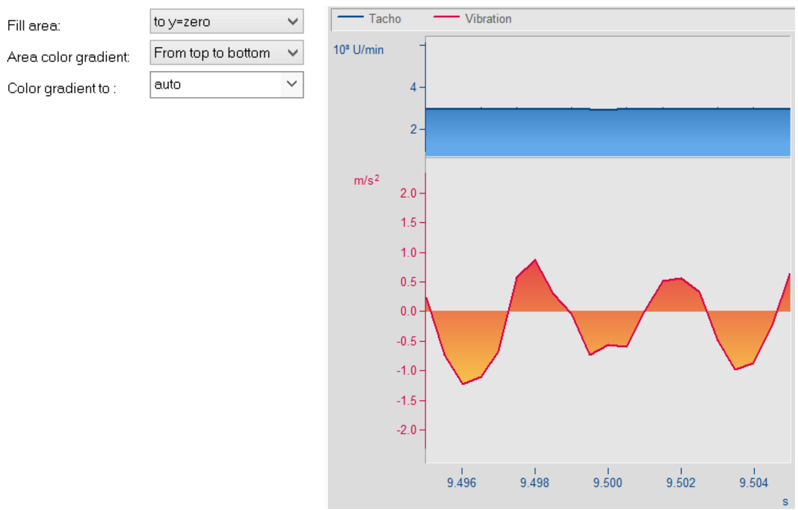
This determines the line's structure. If the structure is set to *auto*, then different line structures are assigned in succession, i.e.the first line is solid, the second dotted, the third dashed etc. For *auto (compatible)*, the global setting *Curves in structure* is observed. This mode is compatible with imc FAMOS 5.0, where the line structure was set globally in the *Colors*-dialog.

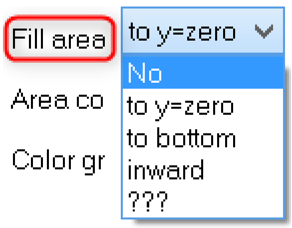
Symbol size [mm]

If symbols were selected for display of the measured points, the diameter in mm can be defined here. For *auto*, the global setting *Symbol diameter* is observed.

Fill area

Fills the area below a line.



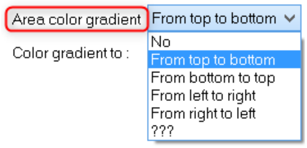


no: as previously

to y=zero: Fills area below the graph up to the zero line.

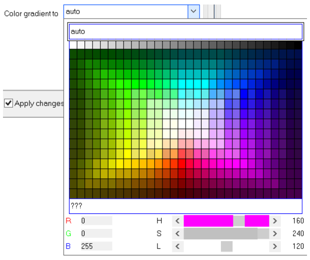
to bottom: Fills area to the bottom edge of coordinate system.

inward: encircled area. The last sample of the data set displayed is connected to the first sample. An closed line results, and the area it encloses is filled.

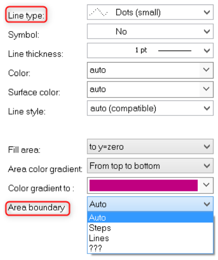


If ***Fill area*** is not ***no***:

Area color gradient: Specifies the color gradient for the filled area. without color gradients, only the one color is applied evenly. Otherwise, the color transitions from one line color to another. The second color is specified under ***Color gradient to***.



Color gradient to: auto (like the line itself) or permanently selected. For ***auto*** and color gradient, a lighter variant of the line color is drawn.



If ***Line type*** = ***Dots*** or ***only symbols***, there is the additional option

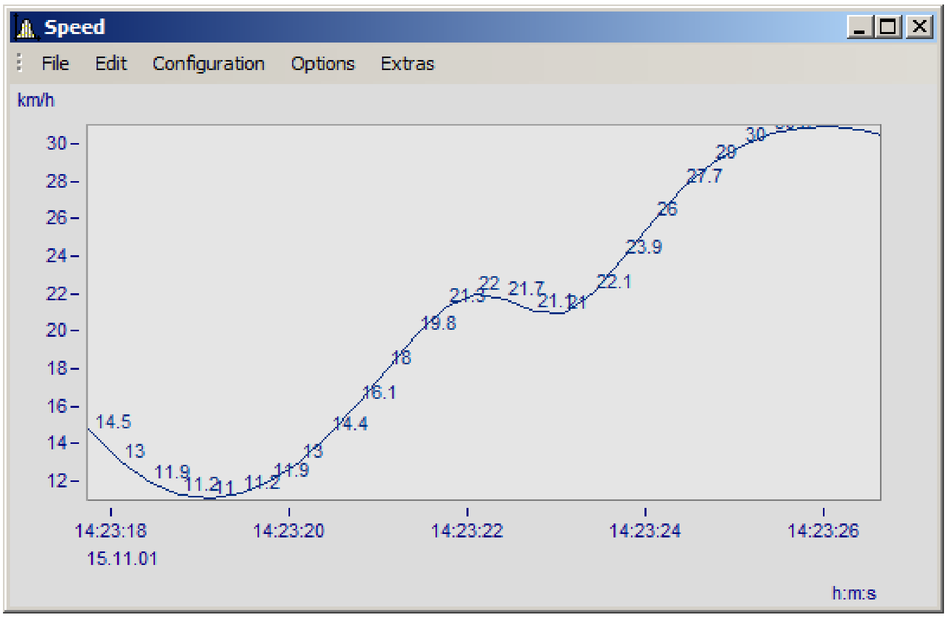
Area boundary: This determines whether the edge of the area is interpolated linearly or appears in discrete steps.

If multiple curves are displayed with overlap, the order for each curve is:

1. first the area
2. then measurement uncertainty
3. then lines

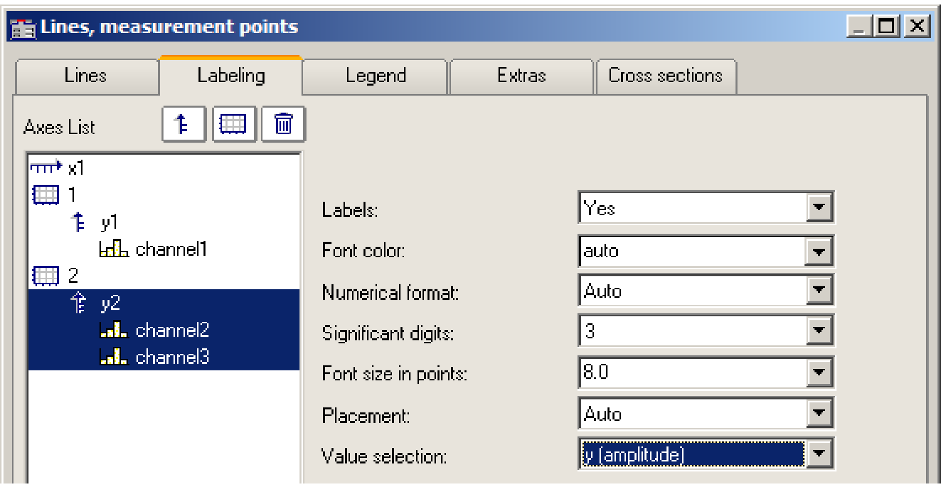
It is possible to generate a **pure** area without any borderline by setting ***Line type*** = ***Only symbols*** and ***Symbol = empty***.

11.6.5.2 Labeling



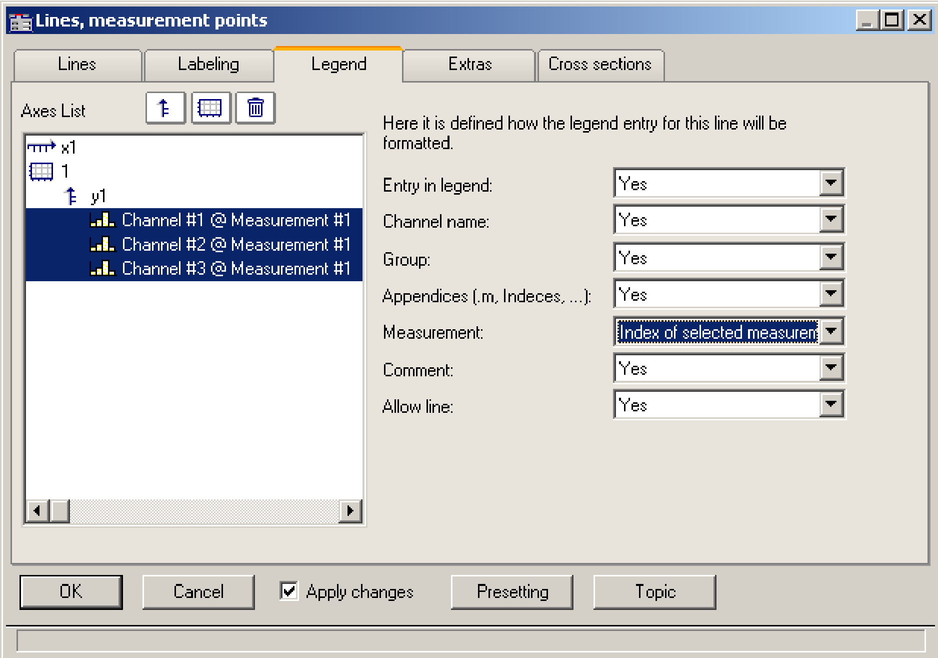
Here you can set whether or not the measurement points are labeled with text stating their numerical values.

For the ***labeling*** of the numerical values, the ***color***, ***format***, ***number of valid digits***, ***font size*** and ***position*** can be set.



Using ***Value selection***, you can set which values are displayed: y, x, parameter, magnitude and phase

11.6.5.3 Legends



Options for displaying the legend

By selecting this tab, you can select various options for displaying the legend pertaining to the line selected.

Note

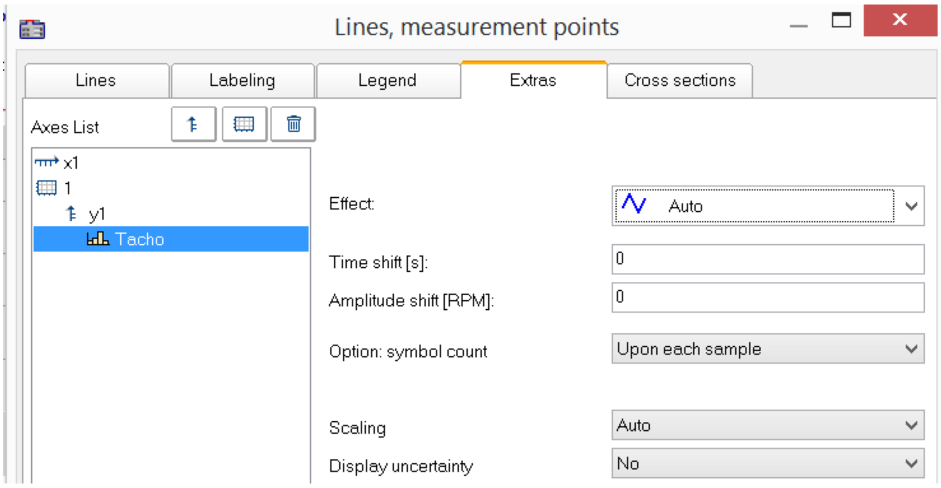
If you display only one data set in the curve window, the legend is only displayed if you have set the control for *Display\Legends\Display Legends* to *always*.

Settings	Description
Entry in legend	The option *No* means that no legend is displayed at all. Selecting *Yes* means all options are shown.
Channel name	Determines whether the channel name is displayed.
Group	Specifies the group for grouped data sets, e.g. Measurement1:Channel_01
Appendices (m, Indices, ..)	Indication of component or event number, e.g. Spectrum.b
Measurement	Here, the option *Number of the selected measurement* is especially interesting, which enables display of the measurement number instead of the measurement name.
Comment	This is the channel comment as described in the imc FAMOS manual, in the chapter Properties/ Charact. Dialog (Waveforms). For channels recorded using imc STUDIO, the comment can be entered as a channel property.
Allow line	This determines whether an example of the line's appearance is displayed to the left of the label.

Additional general legend settings are described here: *Menu Configuration / Legends*.

11.6.5.4 Extras

On the page *Lines\Extras*, special display options are available:

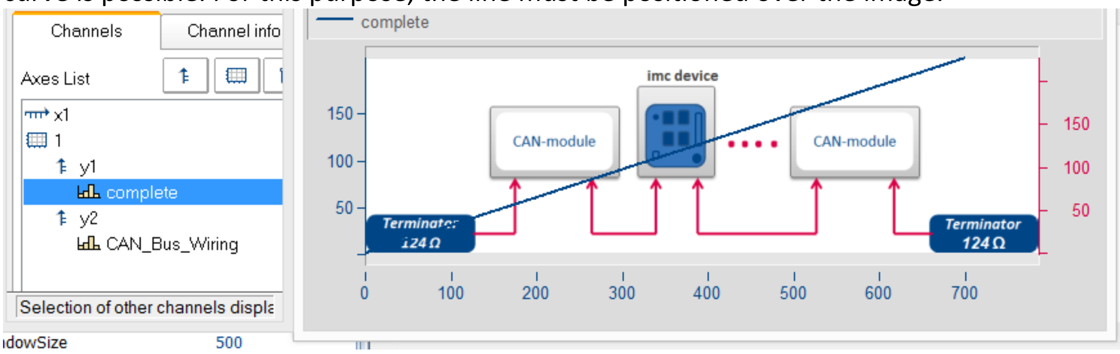


- Time-/Amplitude-Shift 1230: Shifts the line in the curve window without changing the values of the variable.
- RGB-image 1229: Display of an image made of segmented data.
- Special color map display 1230
- Reduction of the symbol display 1231
- Measurement uncertainty 1232

Effect: Image from RGB-values

When the color-flag is set, for RGB variables, the parameter ***Effect*** in the *Extras* dialog is automatically set to "*Image from RGB-values*". Otherwise, it can be set manually here.

The property applies to each line separately, which means that superpositioning of an image with a curve is possible. For this purpose, the line must be positioned over the image.

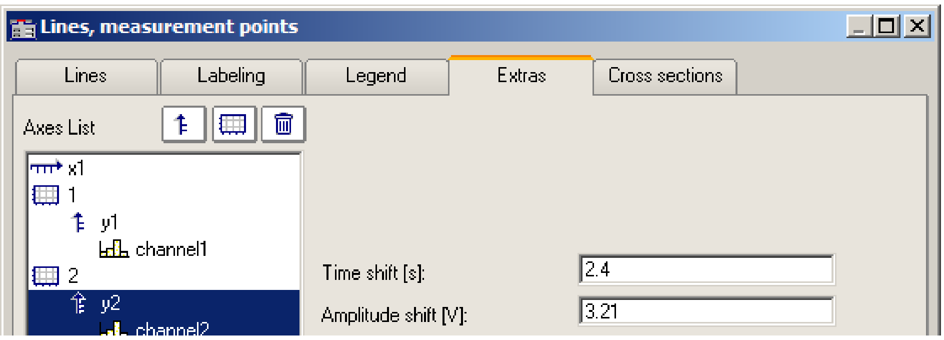


References

General info on RGB-images is presented in the chapter Display variants of the curve window 1192

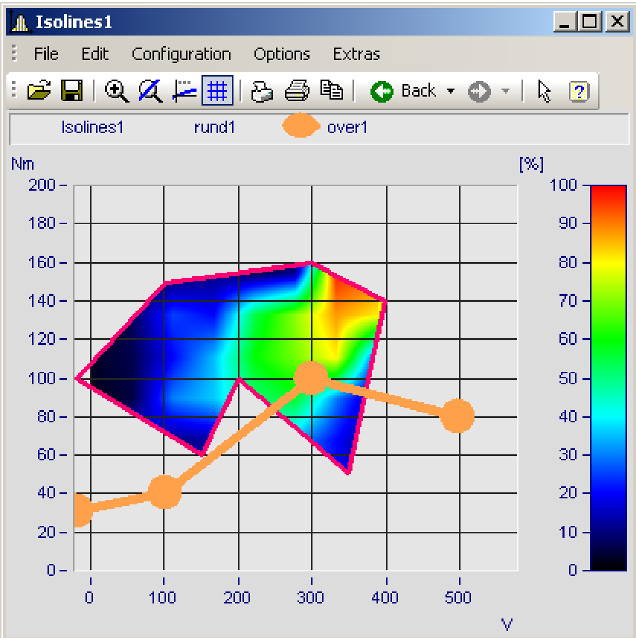
Info on aspect ratio and resolution is in the chapter Axes configuration/Arrangement 1215

In display mode *Default*, you can manually specify the parameters of the Line-Shift function here. For more info, see the section Line-Shift 1323.

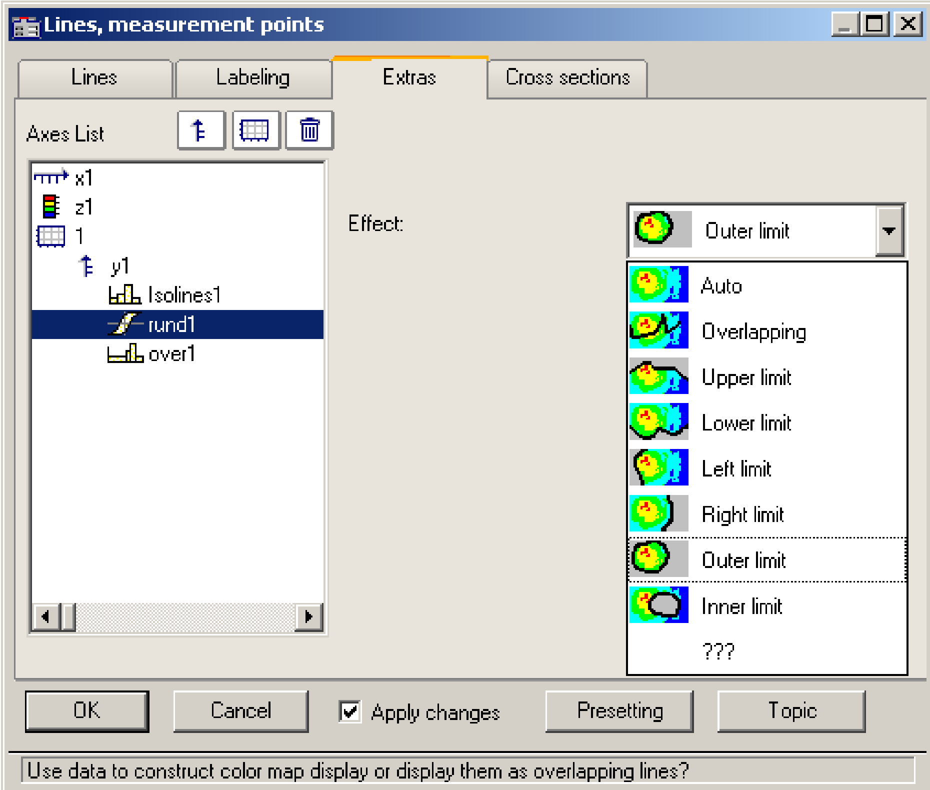


Data are moved in the picture in terms of the X- and Y-coordinates.

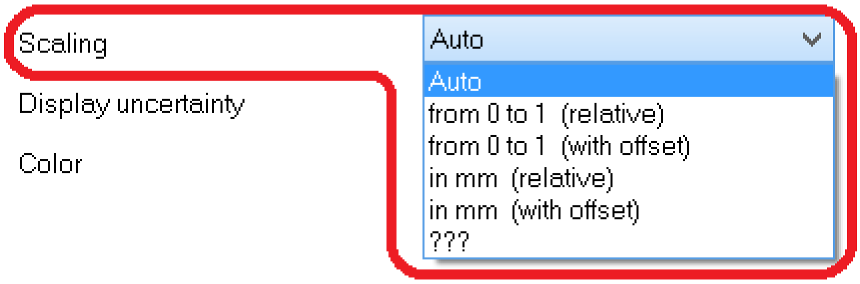
In the display style *Color map*, this menu contains the function *Effect*, with which you can use XY-data to construct the color map, or to superimpose as actual lines on the color map. This makes such displays as shown below possible.



In this picture you see a function for constructing the color map, and a function for superimposing a line over the color map.

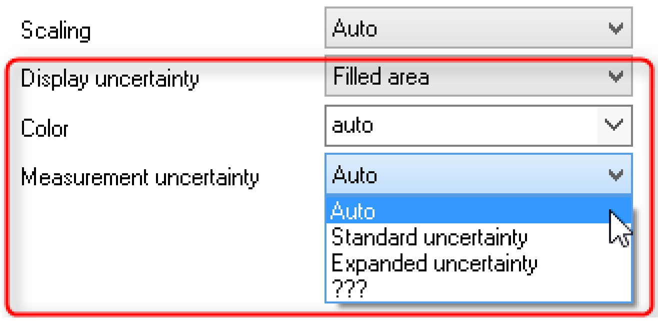
<table>
<tr><th>Settings</th><th>Description</th></tr>
<tr><td>Effect</td><td>The available Effects are 1) Overlapping for superimposing a line over the color map, and 2) various margin functions affecting the construction of the color map.
<table>
<tr><th>Effect</th><th>Description</th></tr>
<tr><td>Overlapping</td><td>An XY-waveform is superimposed as a line over the color map. For the purpose, the usual line properties are available.</td></tr>
<tr><td>... limit</td><td>An XY-waveform is inserted into the color map as a real line and frames the color map view as either the upper, lower, left, right, outer or inner margin, according to the setting for Effect.</td></tr>
</table>


</td></tr>
<tr><td>Symbol</td><td>The number of symbols can be defined with "Option: symbol count" and "Number of symbols". Symbols are activated on the line tab 1224 .</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Description</th></tr>
<tr><td>Scaling</td><td>

Independently of the coordinate system, the data can be scaled in millimeters. By this means, it is possible to use a data set to define a graphical object, which retains a constant size regardless of the current zoom level.

Alternatively, the data can be displayed in a value rage from 0 to 1 across the entire coordinate system.

The position of the data can be set to a particular coordinate by means of an offset. This is accomplished using the user-defined property *Offset X display* or *Offset Y display*</td></tr>
<tr><td>Display uncertainty
(tolerance range)</td><td>

The data set's measurement uncertainty can be indicated either as a *Line* or *Filled area*. The value of the measurement uncertainty is entered as a property of the variable already when the data are captured, and it appears in imc FAMOS as a *user defined channel property*. Alternatively, it can also be set in imc FAMOS as a *user defined property* in the *channel property* dialog, or by means of the function "UserProSet(Data, "Uncertainty"...).

Example: UserPropSet(Data, "imc33", 0.3, 0, 0) or UserPropSet(Data, "Uncertainty", 0.3, 0, 0)

Measurement uncertainty:

- *Expanded uncertainty*: In accordance with GUM, the expanded measurement uncertainty is a symmetrical interval around the measurement value.
- *Standard uncertainty*: Measurement uncertainty expressed as standard deviation.</td></tr>
</table>

11.6.5.5 Cross sections

Here you can set the default appearance of cross-sections for x-, y-, and z-data sets or segmented waveforms or segmented waveforms with the respective position. For more info see the section Connect with 3D 1322.

11.6.6 Additional display options

11.6.6.1 Display

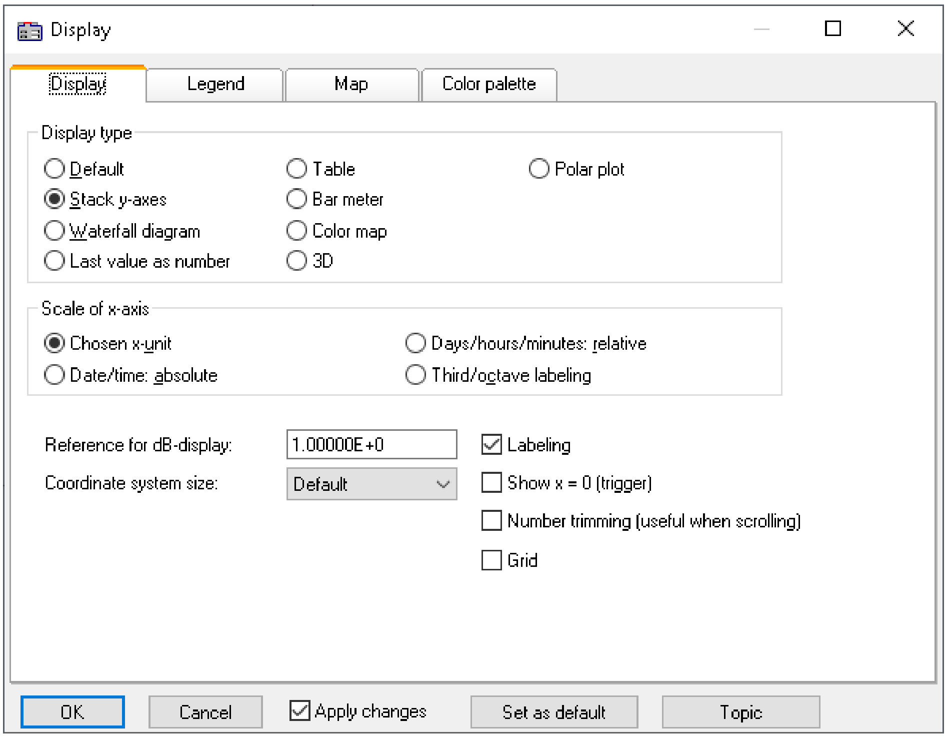
Function

The display mode of a curve window can be defined in a variety of ways.

Calling the dialog

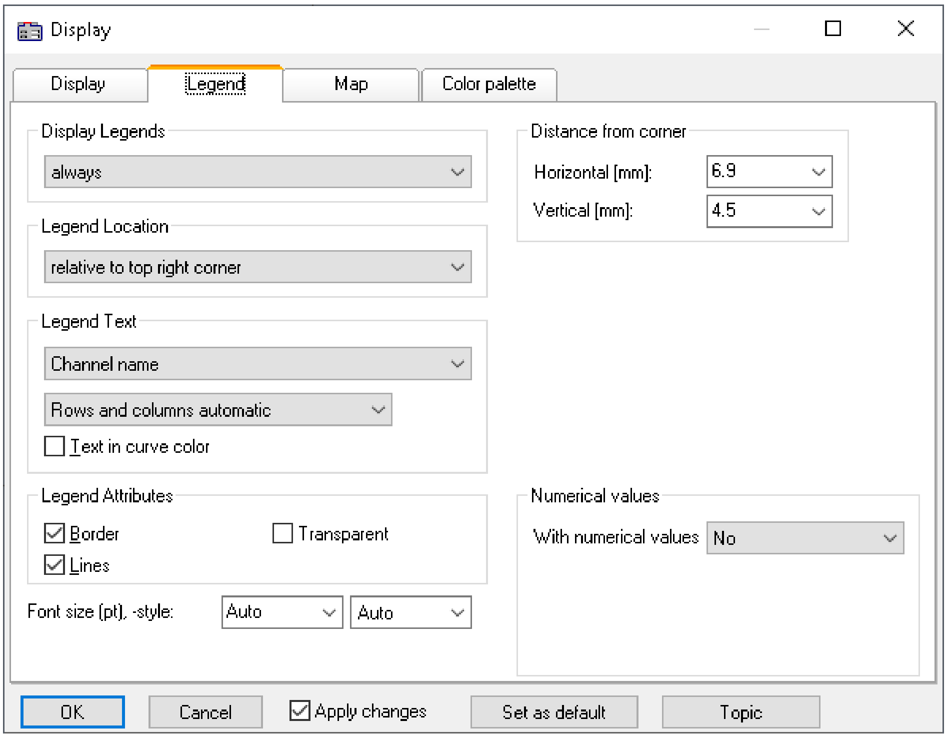
Select menu option "*Configuration*" > "*Display*" in the curve window. A dialog appears in which the curve window display can be defined.

Tap	Description
Display 1128	Display variants of the curve window
Legends 1234	All curve windows can include a legend, with the channel (variable) name, line color etc.
Map 1237	Map lets you place a picture in the background. It is additionally possible to layout the picture in specified coordinates.
Color palette 1250	A channel's color can be governed by a reference signal's amplitude.



11.6.6.1.1 Legends

All curve windows can include a legend, with the channel (variable) name, line color etc. Select "*Configuration*" > "*Legends*" in order to make the desired settings.



Display Legends

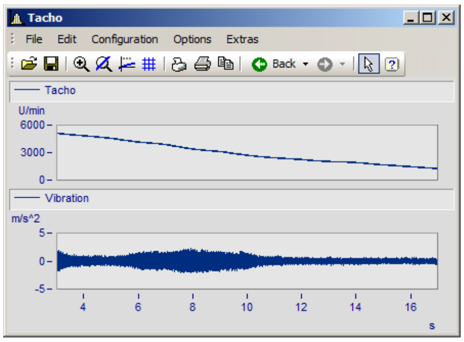
Specify here the conditions under which a legend is to appear. The following options are available:

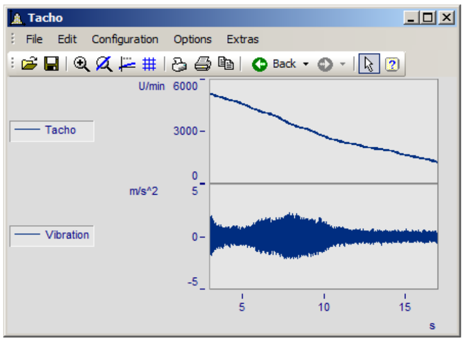
- *Automatically*
- *Always*
- *Never*
- Only if more than one curve is present

Legend Location

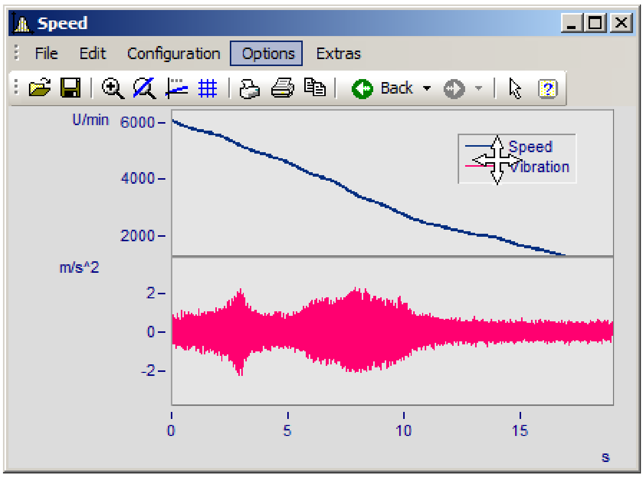
By default, the legend for all variables appears above the curve.

Alternatively, the combobox control *Legend Location* allows the legend to be placed above or to the left next to each coordinate system.





For making placements **within** the coordinate system, additional entries are available. It is possible to move the legend to anywhere within the coordinate system by means of the mouse.



Legend Text

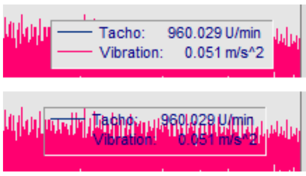
Specify here the text which is to appear in the legend, as well as the format and color of the text. The following options are available:

Settings	Description
Channel name	the variable name, with group name if available, is displayed. In the Data-Browser, affiliation to a membership is indicated by *Channel @ Measurement*; if there is no such affiliation, only the channel name is displayed.
Channel name (without group name)	only the variable name is displayed.
Channel comment	the comment entered for the channel on the "Characteristics"-file card in the imc FAMOS dialog *Variable/Properties* is displayed. See also the notes on Greek letters 1360 .
Channel name and comment	the variable name, with group name and corresponding comment are displayed.
Channel name (without group name) and comment	only the variable name and the corresponding comment are displayed.
Channel name without measurement	only the channel name will be displayed. Even if the channel belongs to a measurement, the name of the measurement will not be displayed. - Only relevant in the Data-Browser.
Channel name with index of selected measurement	if the channel belongs to a measurement and if that measurement is currently selected, then the index (number) of the selected measurement will be displayed instead of the name of the measurement. If no index is available, then the name of the measurement will be used. If no measurement is available, then only the channel name itself will be displayed. - Only relevant in the Data-Browser.

The legend text can be ordered in any of the following ways:

- Rows, columns automatic
- Always row
- Always 1 column
- Fixed number of rows (enter the number)
- Fixed number of columns (enter the number)

Legend Attributes



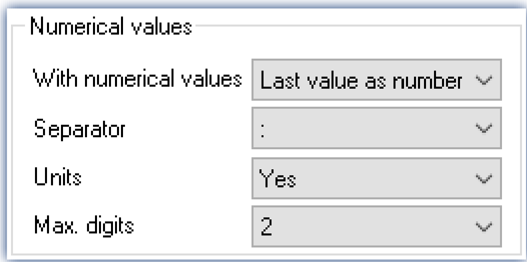
The option *Border* places the legend in a frame, which provides a 3D-effect.

Lines draws a line behind the variable's name in the color of the associated curve.

Transparent makes the curves visible behind the legend.

Numerical values

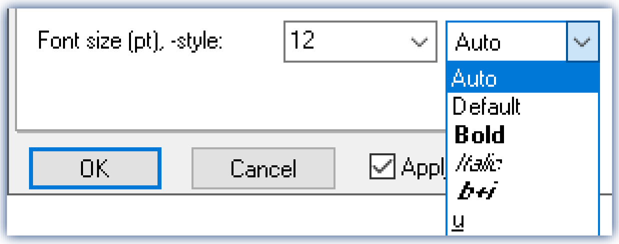
With running measurements, it is possible to display the updated values in the legend. To do this, in the box of controls "*Numerical values*", select the list box entry "*Last value as number*" for the control "*With numerical values*".



Settings	Description
Separator	*Separator* inserts a colon or equal sign.
Units	*Units* controls whether or not the units are indicated: *yes* or *no*
Max. digits	Maximum amount of digits possible. This determines the distance between the variable's name and the numerical value.

Font size (pt), -style

The font size and font style for the legend can be set manually here.



OK, Cancel, Set as default

For details on operation, see the chapter Confirmation bar 1273

11.6.6.1.2 Map

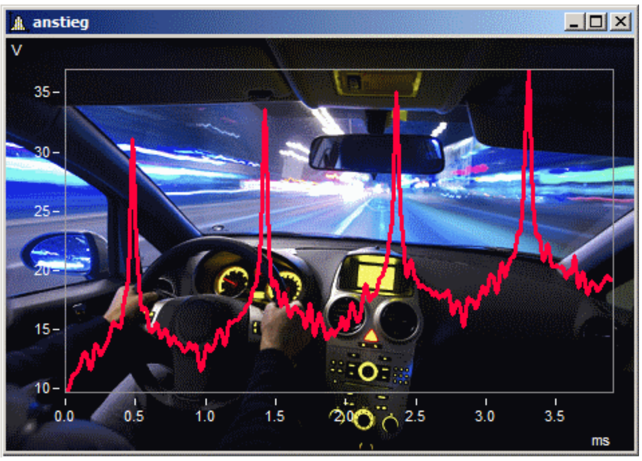
Function

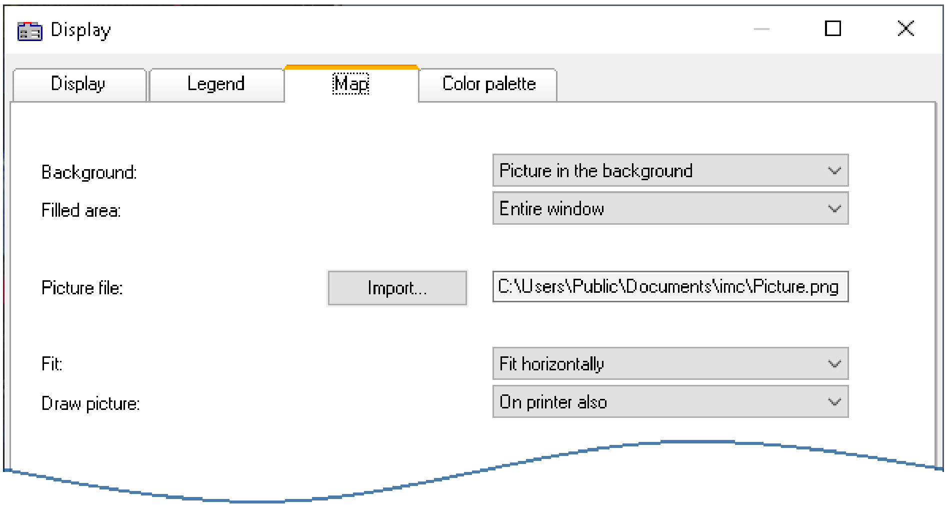
Map lets you place a picture in the background. It is additionally possible to layout the picture in specified coordinates.

Mouse Operation

In the dialog called by the menu item *Configuration / Display*, select the option *Map*.

11.6.6.1.2.1 Background picture





Settings	Description
Background	Select Background to place a picture in the "*Background*"
Filled area	"*Coordinate system*" or "*entire curve window*"
Fit	"*auto*" adjusts both the picture's horizontal and vertical dimensions. "*Retain size*" does not adjust the size but centers the picture. "*Fit horizontally*" and "*Fit vertically*" each adjust the picture's respective dimension.
Draw picture	The option *Only on screen* is used to prevent the printer from printing the picture out.

Constraints

- *Background*: Only for *Default display*, *Stack Y-axes*, *Last value as number*, and *Table*. Applicable with limits to *Color map* and *Bar meter*, since the largest part is hidden. Not possible for *Waterfall* or *3D* display.
- The button *As presetting* is available in either the *Background picture* or *auto* modes. In the presettings, the filename and directory path of the picture are recorded. For any new curve window, the system first looks for this picture there.
- The background picture or the map is saved with a curve configuration file (CCV).
- .BMP files are very large, but can be adapted well to the display. JPG files normally are smaller, but are less capable of being adapted to the display.

11.6.6.1.2.2 Map

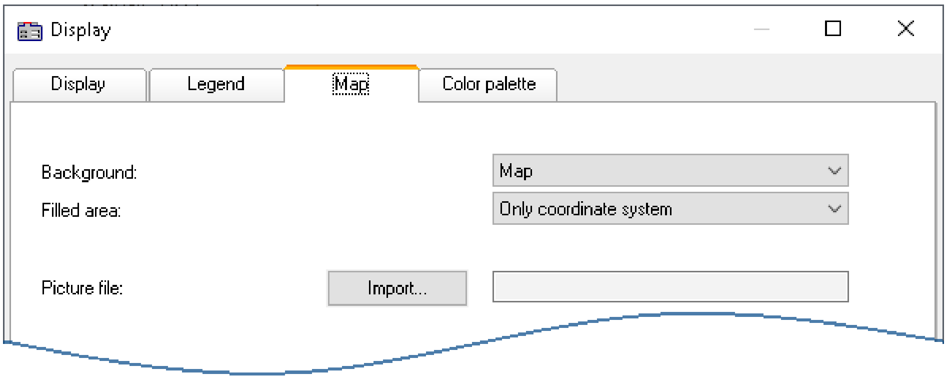
Positioning a map as the background picture

On the following conditions, a picture can be correctly displayed as a map:

- selected curve window configuration: *Display \ Default*
- linear axes
- only one coordinate system

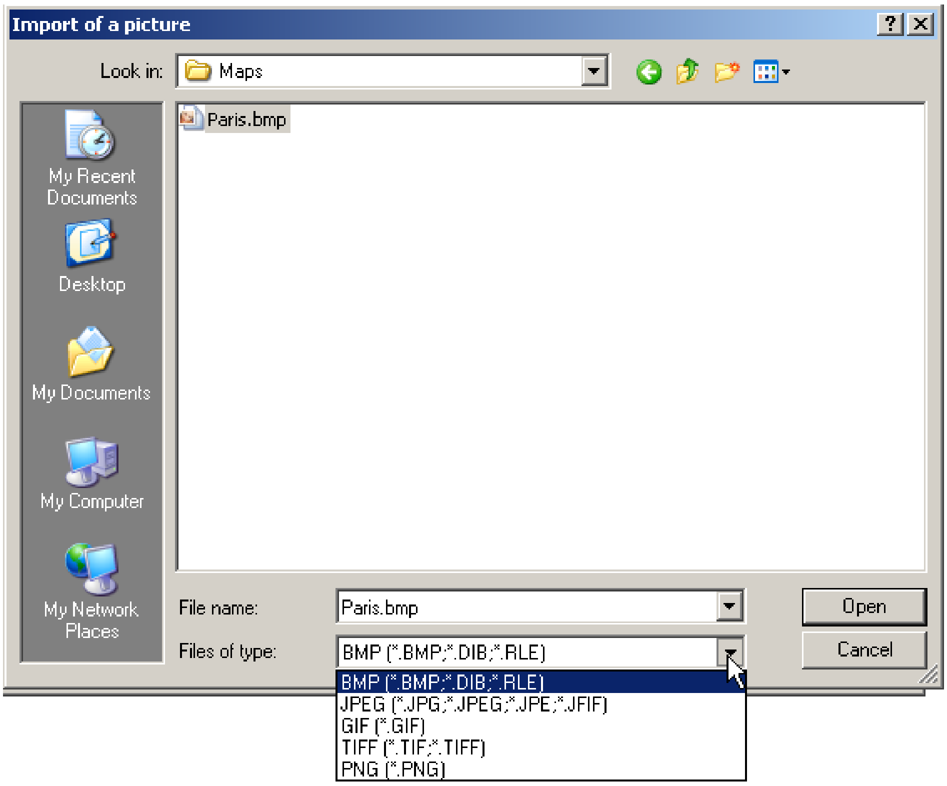
The following example illustrates how GPS data are linked with a map.

Import of a picture



Select the "Map" page and set the background to "Map"

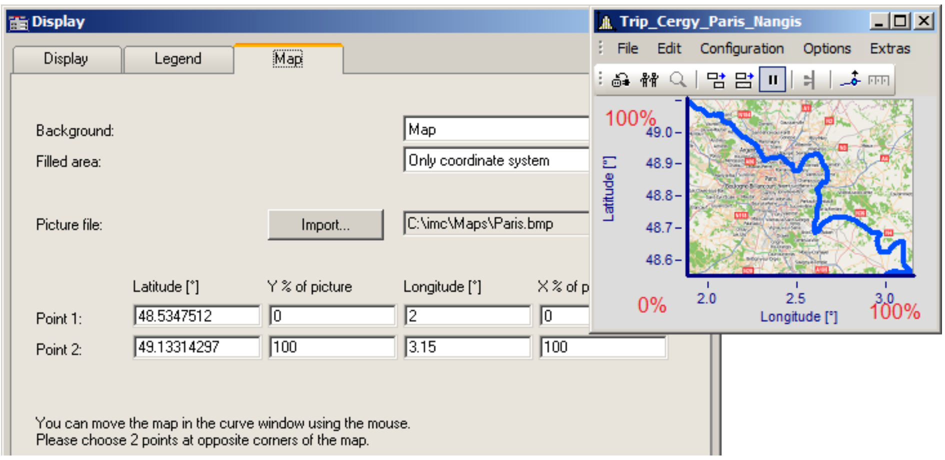
Click on the button *Import* and select a *picture file*. Specify its format.



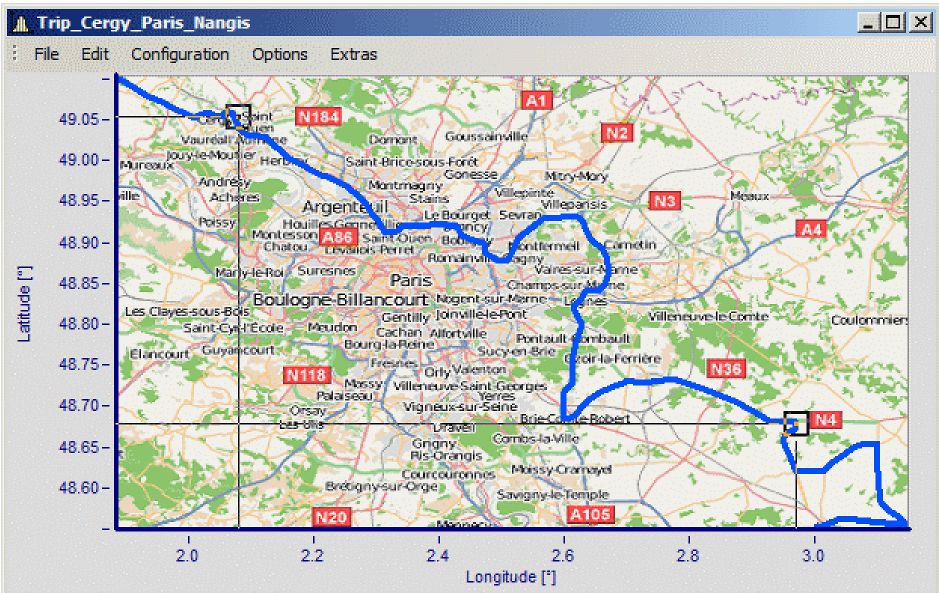
Selecting a picture file. All customary graphics formats are available.

Adapting maps and Map Mode

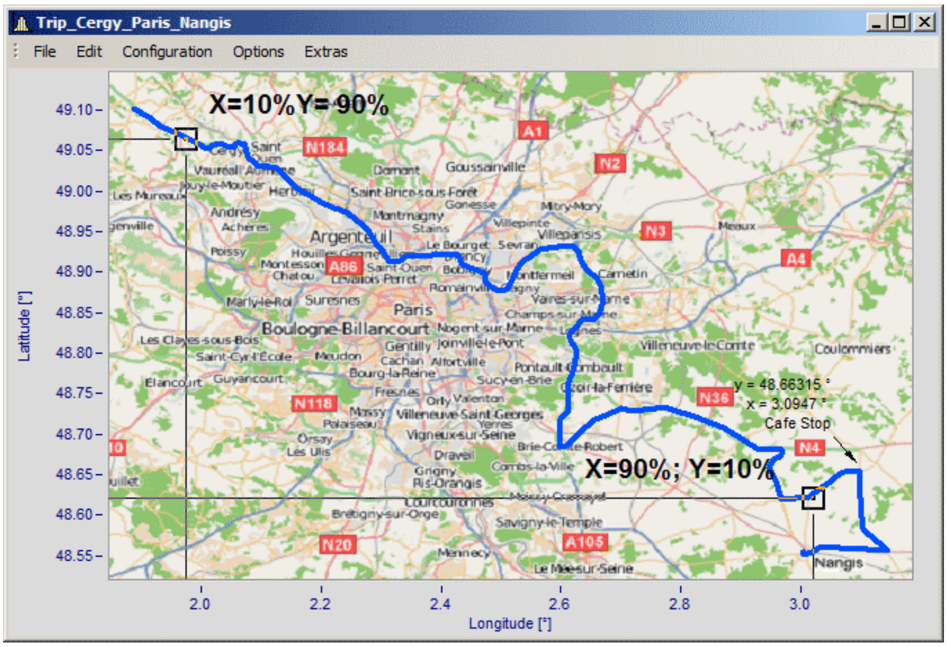
To position a map, you must specify two points. This accomplished by making entries in the input boxes. The curve window is then in Map Mode.



Specifying points: Point 1 at bottom left, Point 2 at top right



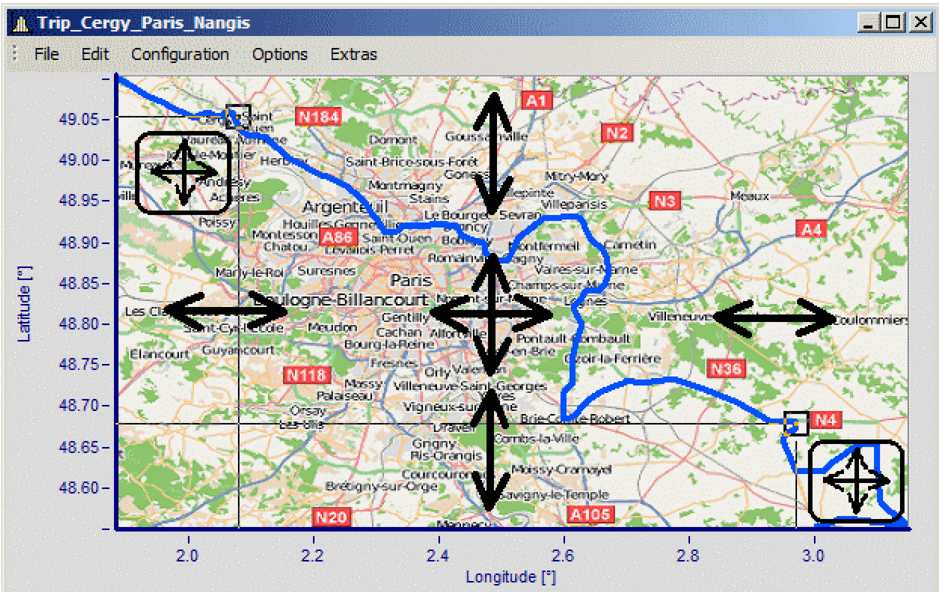
The points are entered into the curve window while the Map dialog is open. Move the points by clicking within the squares and dragging the points using to the mouse to the correct



By moving, the points' X- and Y-positions are updated.

The mouse pointer changes appearance in response to the position in the curve window.

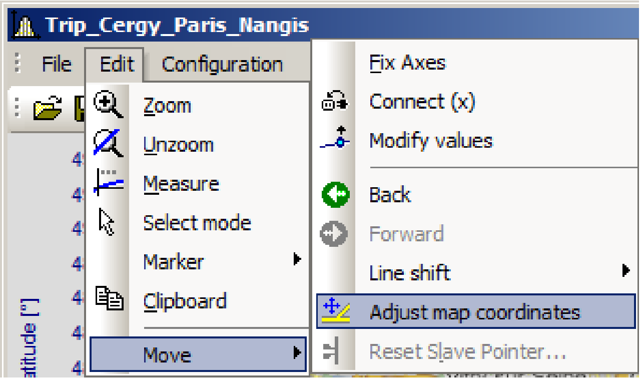
- Drag the entire map by clicking in the center of it.
- Stretch the map by clicking either at the right, left, top or bottom of the map.
- Move the position points by clicking within the squares.



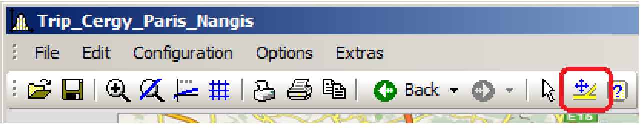
Adjusting the map and points in response to the mouse position

Activating Map mode retroactively

Once the map dialog has been closed, you can use menu commands to adjust the map: *Edit\Move\Map*.



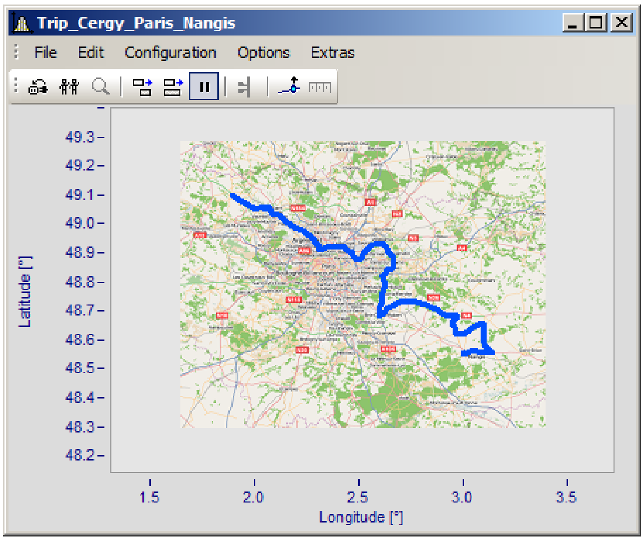
Alternatively, activate the mode by means of the toolbar. To do this, adapt the [Toolbar](1352).



You can also drag this function into the toolbar.

Curve window and map

The map is dependent on the axis' coordinates:



This shows the effects of magnifying the axis width

Not that the picture is magnified, stretched or trimmed. Only the details of the original picture can be displayed. The maps used must have an appropriate projection. Constant latitude and longitude lines must be displayed as straight lines. The distances must be equidistant.

Naturally, a map extending from the north to the south pole cannot meet this requirement. The same applies to map material near the poles and the dateline.

Alternatively, you can use a static picture in the background 1237.

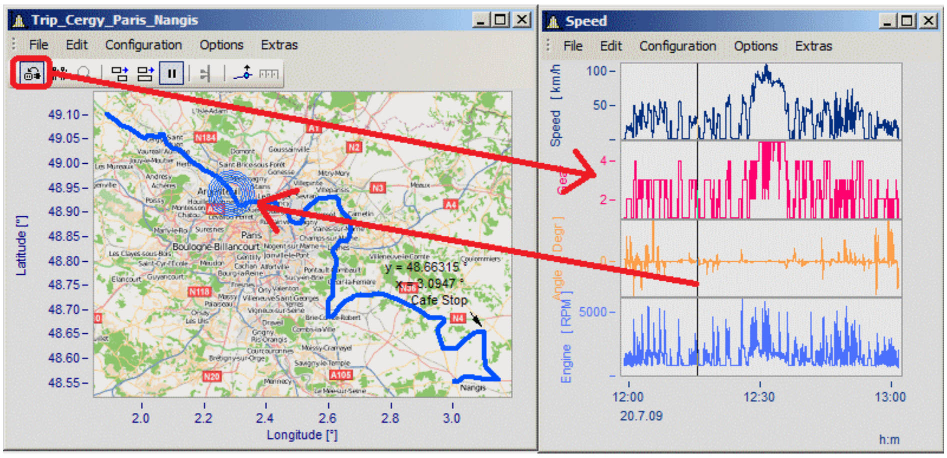
Constraints:

- *Map*: Only for Default display and Stacked Y-axes, but only for the first coordinate system and first Y-axis. All axes must be set to linear (no 1/3-octaves or absolute time).
- The button "*As presetting*" is not available in Map mode.
- The background picture or map is saved with a curve configuration file (CCV).
- .BMP files are very large, but can be adapted well in a display. JPG files are smaller but are not able to be adapted as well.

Linking a map with time data

It is possible to link a curve window displaying time data with a map display.

If the map contains an XY-channel, it is possible to link this channel with time data from a different curve window. To do this, drag the linking tool icon from the Communication toolbar to the desired curve window.



Linking the map with time data from a different curve window

You can move the position on the map in concert with the time marker line in the second curve window.

11.6.6.1.2.3 Map (from Internet)

Automatic loading of a map from the Internet

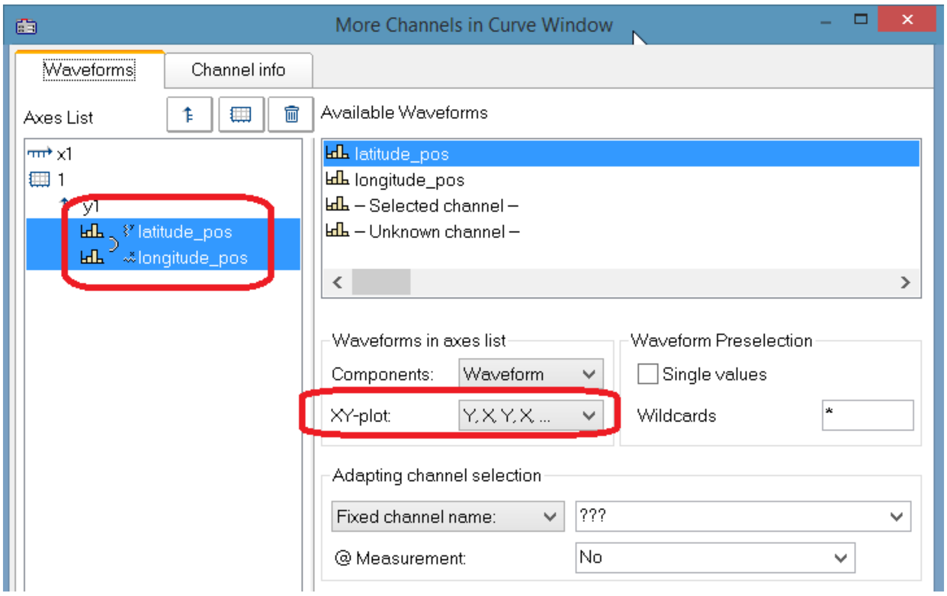
On the following conditions, a picture can be correctly displayed as a map:

- selected curve window configuration: *Display \ Default*
- linear axes
- only one coordinate system
- a data set with plausible position data is displayed.

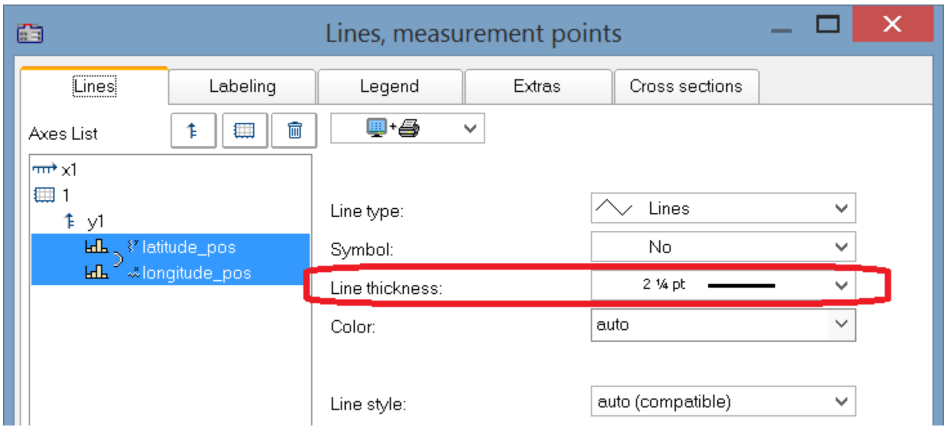
The following example shows how GPS data are automatically superimposed on a map from the Internet.

Selection and display of the GPS data as an XY-plot

Load the data sets for Longitude and Latitude and display them as an XY-plot. To do this, open a curve window with the two components and superimpose them by means of the dialog "*More Channels in Curve Window*":

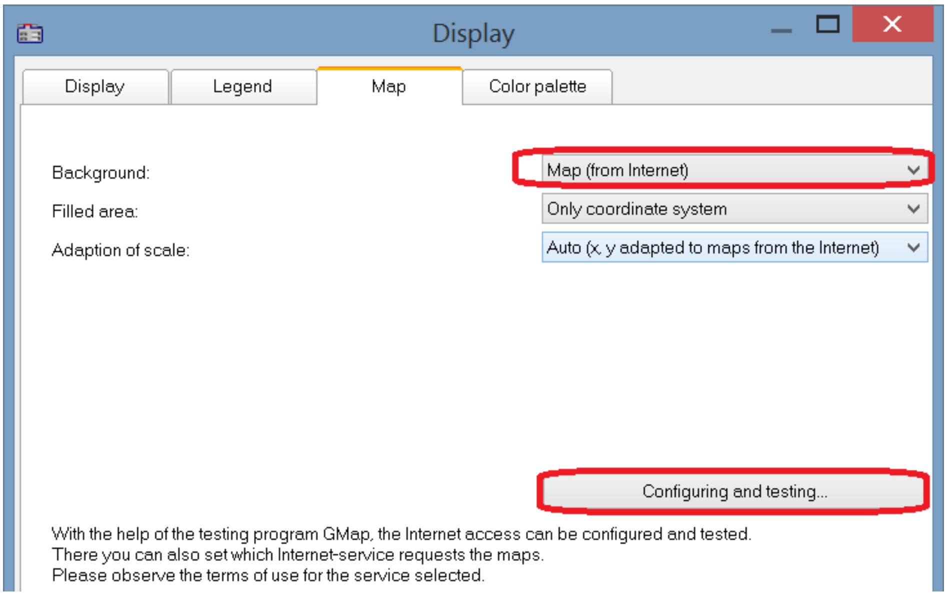


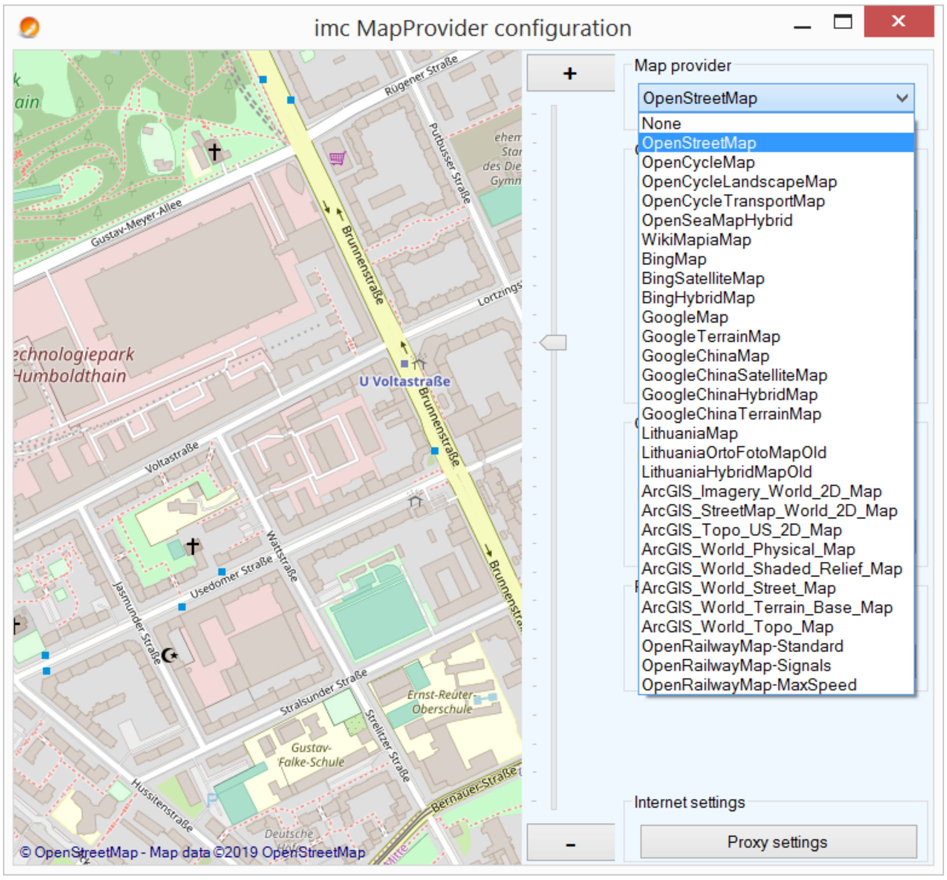
It is advisable to draw the lines more thickly:



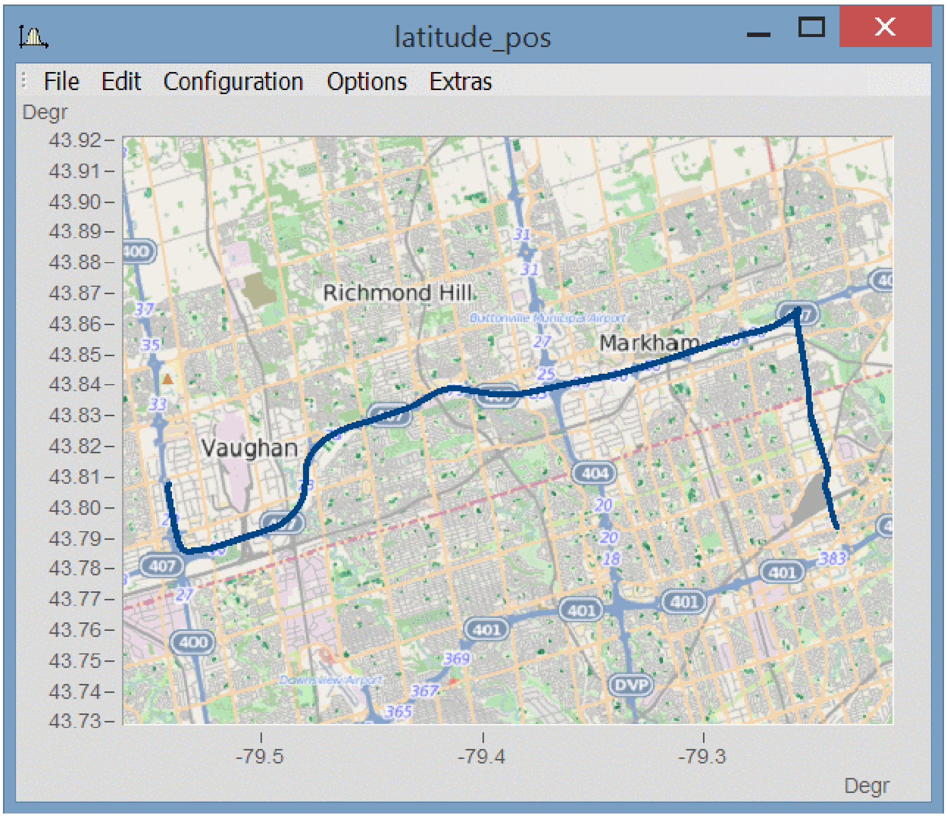
Selecting the map service

Select "*Map (from Internet)*" on the page "*Map*" in the dialog "*Display*". The setting "*Configuring and testing*" selects the Internet-service:





After selecting the map service, the map section loads immediately if an Internet connection already exists. In the curve window, this may appear as shown below, for example:



Note 注意 Changing the map-provider

After changing the map-provider, the provider's maps are not automatically reloaded. To do this, the axes of the curve window must be actively changed, e.g. by changing the zoom factor with the mouse wheel or moving the image section.

Adding a map provider

The selection of map-providers can be supplemented with the file "*AdditionalMapProvider.config*" in the folder "*C:\ProgramData\imc\Common\Settings*". If this file doesn't exist on your system, create a text file having this name.

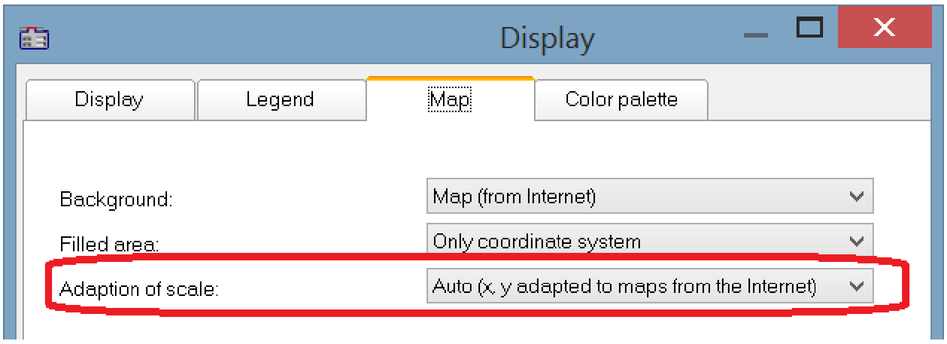
1. Open the folder. By means of *%programdata%*, Windows opens the folder *ProgramData* and then go to *imc\Common\Settings*.
2. The file *AdditionalMapProvider.config* is an XML file with the following structure:

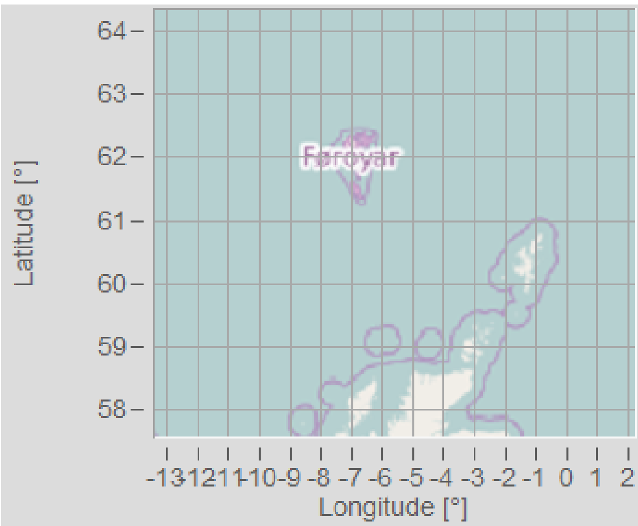
```
<?xml version="1.0" encoding="utf-8"?>
<MapProviders>
  <MapProvider Name="OpenRailwayMap-Standard" Url="http://a.tiles.openrailwaymap.org/standard/{z}/{x}/{y}.png" User="" Pwd=""
TileThreads="2"/>
  <MapProvider Name="OpenRailwayMap-Signals" Url="http://a.tiles.openrailwaymap.org/signals/{z}/{x}/{y}.png" User="" Pwd=""
TileThreads="2"/>
  <MapProvider Name="OpenRailwayMap-MaxSpeed" Url="http://a.tiles.openrailwaymap.org/maxspeed/{z}/{x}/{y}.png" User="" Pwd=""
TileThreads="2"/>
</MapProviders>
```


Replace the lines *<MapProvider Name="... TileThreads="2"/>* with the information pertaining to your map provider.

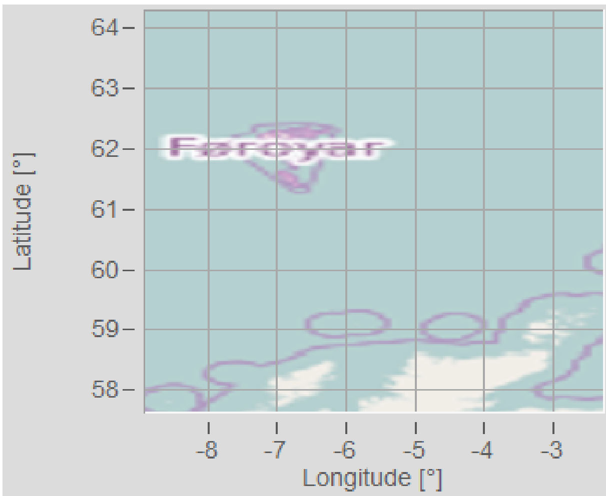
Adaptation of scale

Compensation of distortion due to Mercator projection. Maps typically display the coordinates with a distortion in the direction of the cylinder axis, in order to achieve correct depiction of angles between features on the Earth's surface. In the mode "*Auto (x,y adapted to maps from the Internet)*", the axis are stretched in proportion to the Mercator projection distortion.





Undistorted map accounting for the Mercator projection



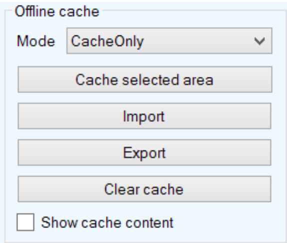
Coordinates equidistantly scaled -> Map distorted

Note

This projection named after Gerhard Mercator (1512-1592) causes imprecision in the curve window, since the coordinates are displayed equidistantly in it. The imprecision increases with the distance from the Equator and the size of the map.

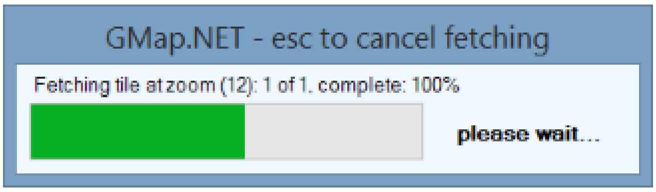
More map service option

Offline cache

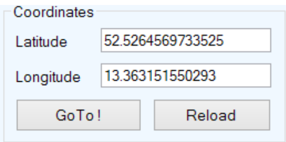


You can export, import, or save a map section locally. To do this, select "*Mode*" *ServerAndCache*" or "*Cache only*".

To make the selection, drag open a rectangular region while holding down the mouse button. When you click on "Cache selected area", the region is downloaded and saved in various zoom levels.

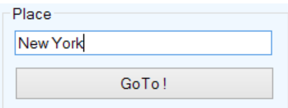


Coordinates



Select the map section by its coordinates and zoom to the desired section.

Place



Select the map section by entering a location.

Internet Settings

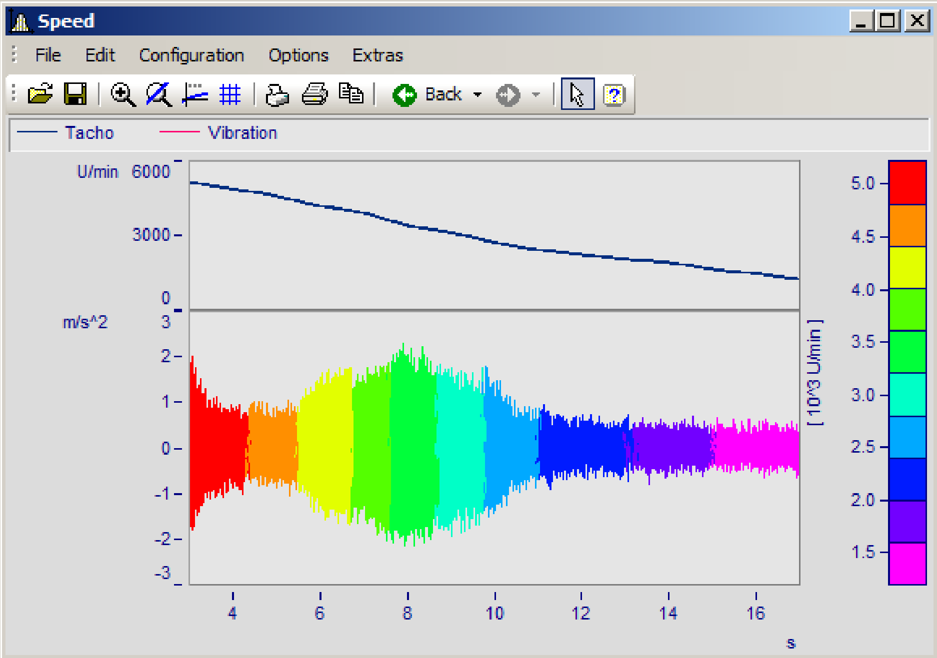
Here you can specify a proxy-server.

11.6.6.1.3 Color palette

A channel's color can be governed by a reference signal's amplitude.

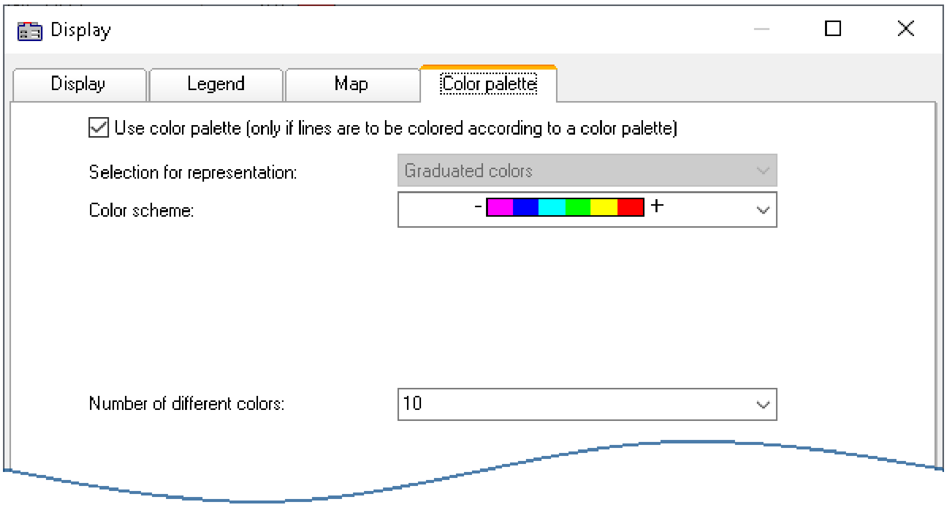
Note

This function is working only for channels using the same sampling rate (x-delta).



Line color of a graph of vibrations as a function of the RPMs

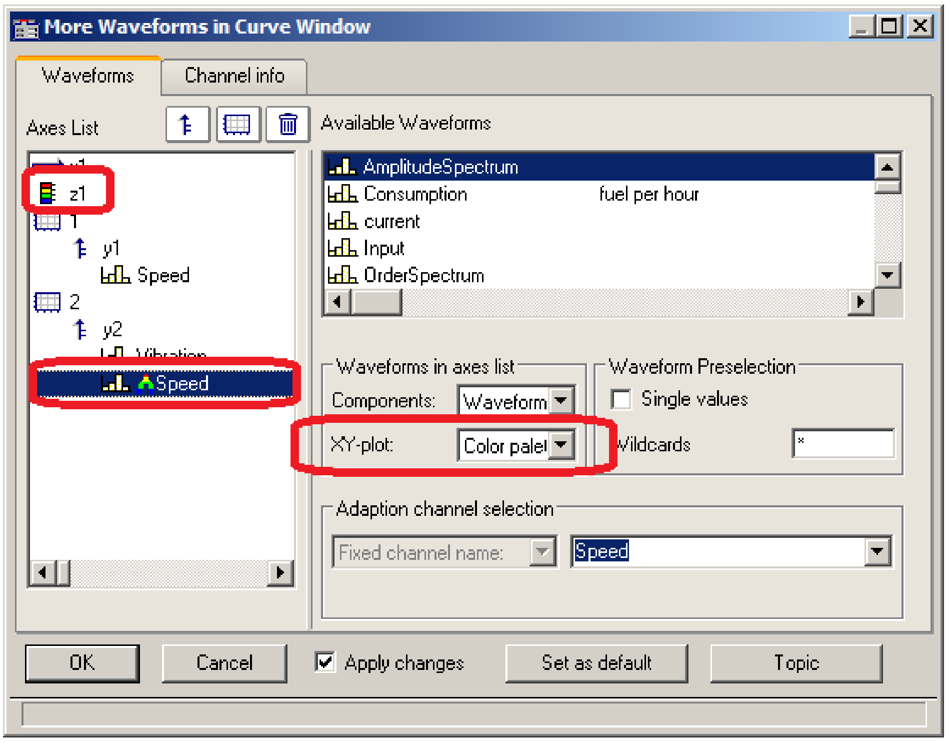
Select the page *Color palette* (not *Display type Color map*) in the dialog called by *Configuration\Display*.



First, activate the color palette by setting a check in its checkbox. In consequence, the controls for *Color scheme* and *Number of different colors*. The control *Selection for representation* is disabled, since at this moment only graduated colors are available.

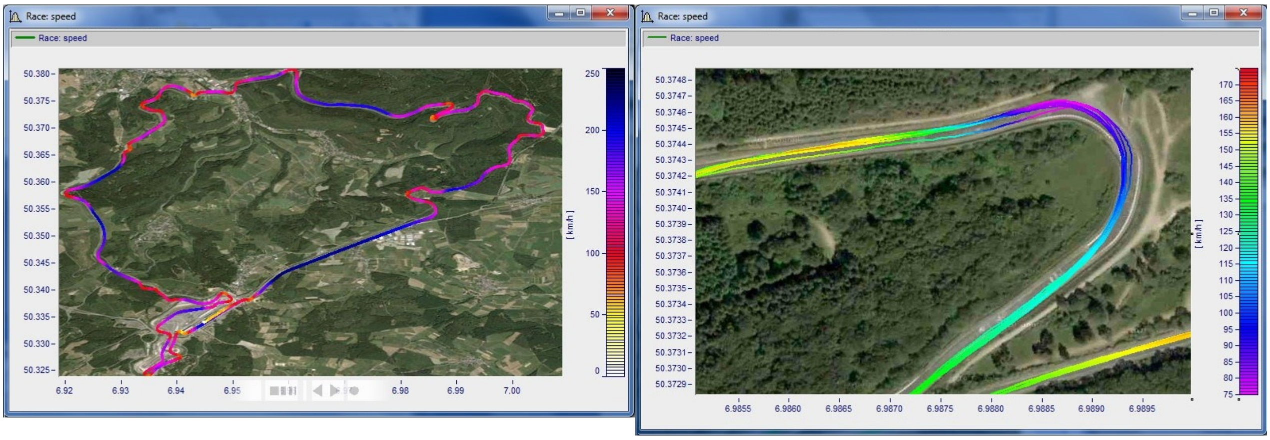
The same settings options for the color scheme and amount of colors are available as for Color map 1166.

The assignment is performed in the dialog *More Channels...,* which is called from the curve window's context menu.



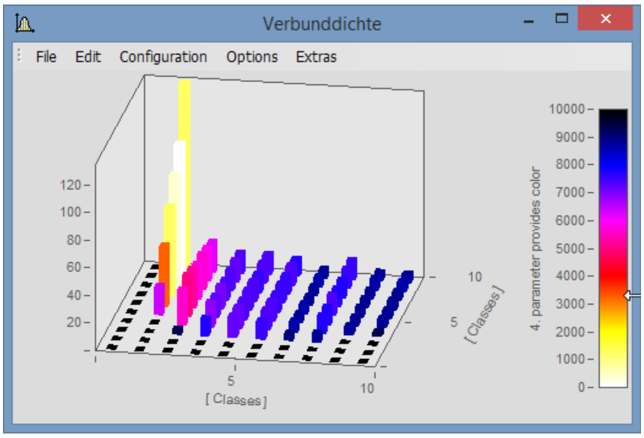
The reference channel is assigned to the same y-axis as the channel to be colored. Select a reference channel and set the *XY-plot* to *Color palette*.

Example:



Color palette as 4th parameter in 3D

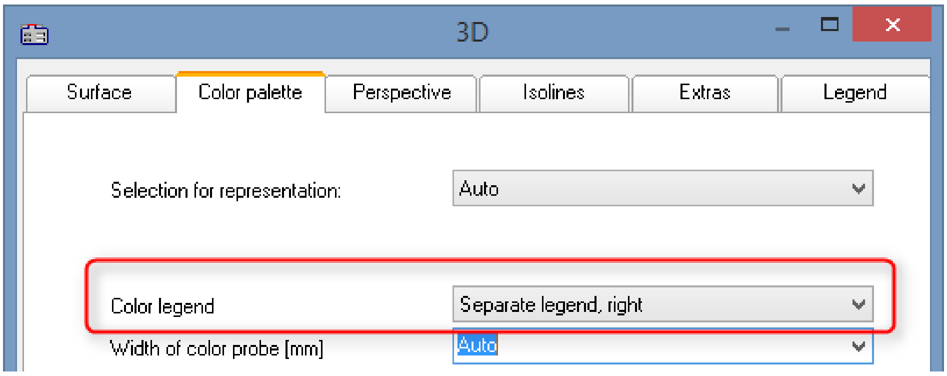
A 3D display can be colored according to a fourth parameter. Thus, 4 dimensions (4D= 3D + color) can be displayed. See also here 1260.



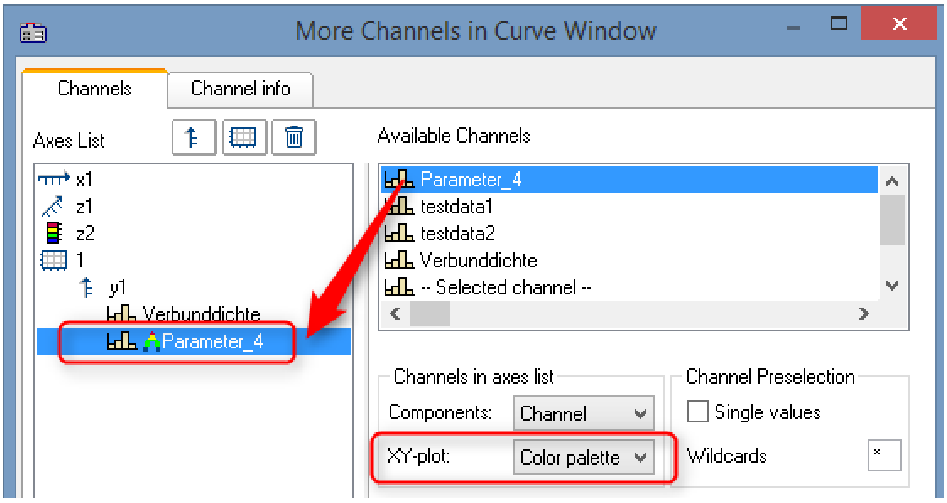
3D display with colors governed by a fourth data set

Procedure:

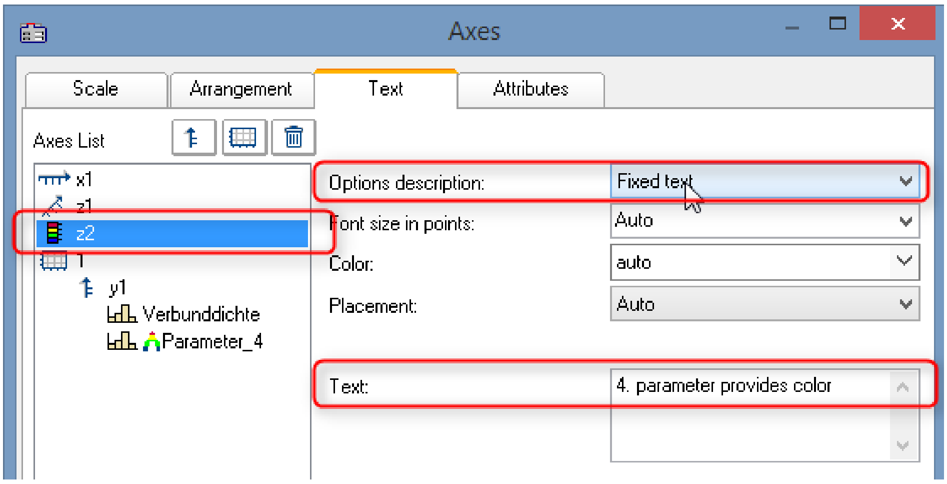
1. Set *3D* display with ***Separate legend right*** or **left** in ***Color plaette*** 1260. With the settings *Auto, No* and *Integrated into y-Axis*, it is not possible to generate a colored overlay.
2. Under *More Channels*..., place the fourth variable directly below the 3D data set.
3. Under *XY-plot*, select *Color palette*.
4. Labeling of the color palette by means of *Axes\Text.* This is necessary since the legend does not provide an indication of the color scale's origin.



Activate Separate color legend at "Configuration\3D\Color palette"



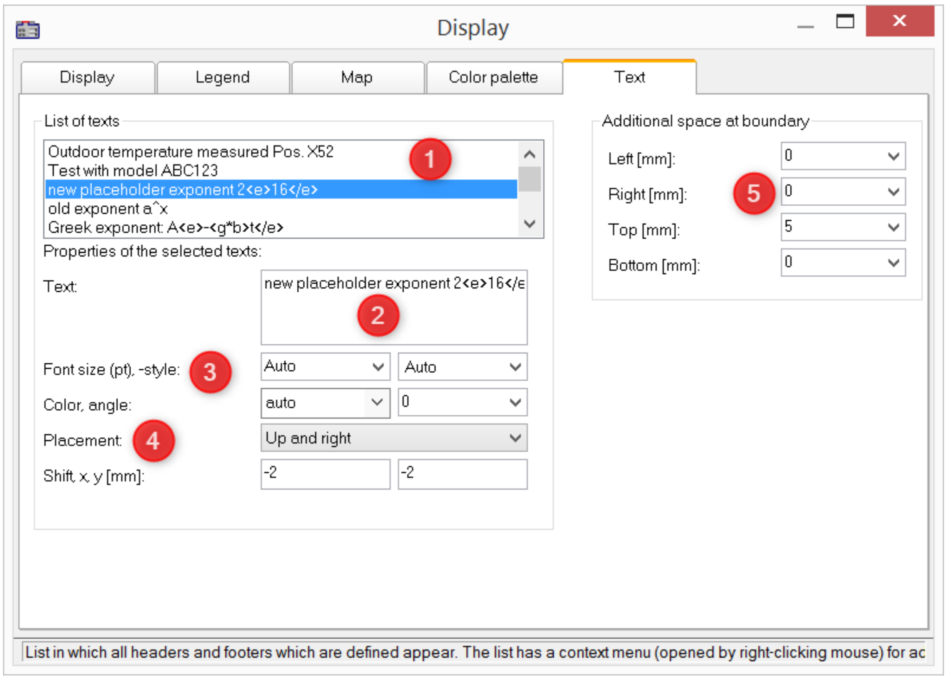
Under "Configuration\More Channels...", assign the color-coded variable

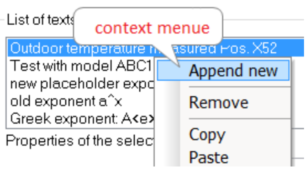


Under "Configuration\Axes\Text" with "Fixed text", state the origin of the coloring.

11.6.6.1.4 Text

The Text page of the Display dialog enables any desired texts to be positioned, for example as titles, headers, footers, or general comments.



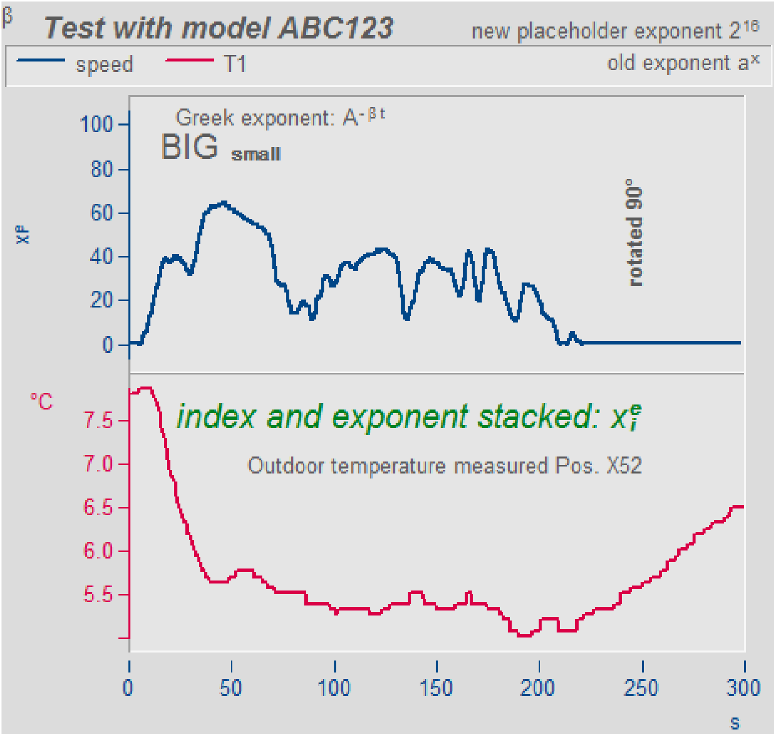


By **right-clicking** in the *List of texts* (1), you open a context menu for managing the entries.

In the *Text box* (2), up to 256 characters are allowed. Line breaks are placed by pressing the CRTL+ENTER keys.

The placeholders supported are described in the chapter *Axes configuration/Text* 1216.

The *Font, font size, -color,* and alignment (3) can be set for each entry.



The *placement* (4) is initially determined from a list and subsequently fine tuned by means of the parameters for *Shifting* in the *x* and *y* directions. When a position is selected which references a **coordinate system**, an additional parameter for specifying the number of the Y-axis appears.

Beyond the space occupied by the actual curve graph, it is possible to make room for additional texts (5).

Remote control via sequences:

The function CwDisplaySet offers some functions "*header.x*" with which to texts can be placed.

```
CwDisplaySet("header.count", 5 )
CwSelectByIndex( "header", 1 )
CwDisplaySet("header.text", "TEXTMITTE" )
CwDisplaySet("header.position", 8 )
CwDisplaySet("header.text.color", 255 )
```

The additional space at the edge is adjusted using the "*legend.x*" functions.

```
CwDisplaySet("legend.space.left", 10.4 )
CwDisplaySet("legend.space.right", 4.7 )
CwDisplaySet("legend.space.top", 10 )
CwDisplaySet("legend.space.bottom", 10 )
```

Reference | Further texts

Further texts can be added via the axis dialog 1216.

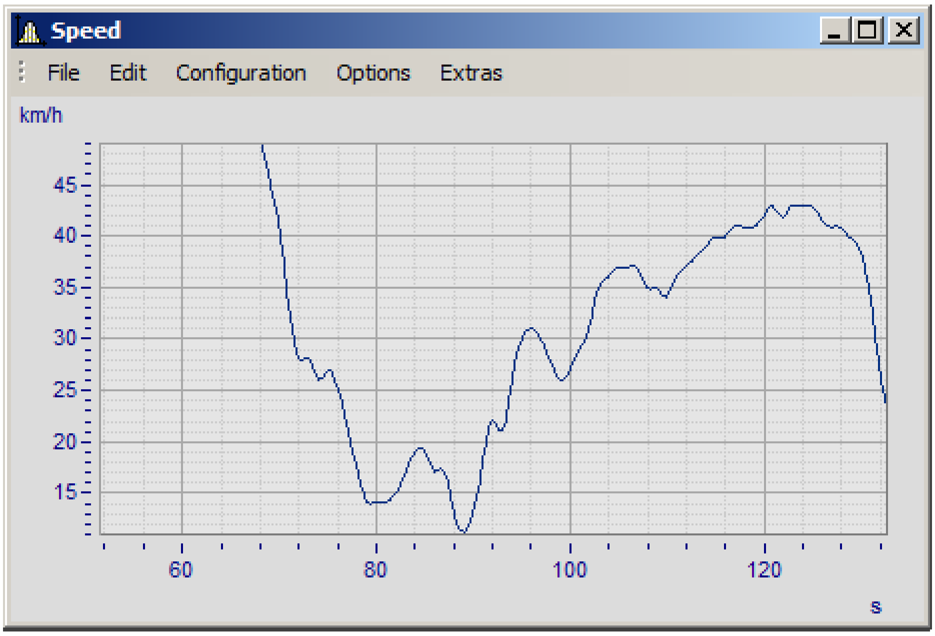
Texts can also be defined as *user ticks* 1218. Here you can also find the function "*Label for raw data* 1221".

11.6.6.2 Grid

Function

A grid may be added to the coordinate system in the curve window. The grid is composed of vertical and horizontal lines running through the ticks on the axis, with additional lines between them.

The grid consists of a main and secondary grid. The main grid lines end at the main ticks of the coordinate system axes, where the axes are labeled. The secondary grid lines end at the secondary ticks, optionally inserted between the main ticks (see menu option Configuration/ Display 1128). Settings for the secondary grid are made in the Axes dialog by means of the control Small ticks 1209.



Various line widths and types can be specified for the clipboard or print-out, see menu Opt./ Clipboard Settings 1336.

A grid is drawn for a logarithmically represented axis (but not in dB) so that eight lines appear between each set of markings on the axis. The eight lines are easy to interpret, since a factor of ten lies between each set of axis markings. The lines designate equidistant points, i.e. between the markings 1 and 10, the points 2, 3, 4, 5, 6, 7, 8, 9 and between the markings 10 and 100, the points 20, 30, 40,... . The lines are then spaced as on logarithmic graph paper.

Mouse Operation

- Select menu option *Grid* from the *Configuration* menu in the curve window.

Remarks

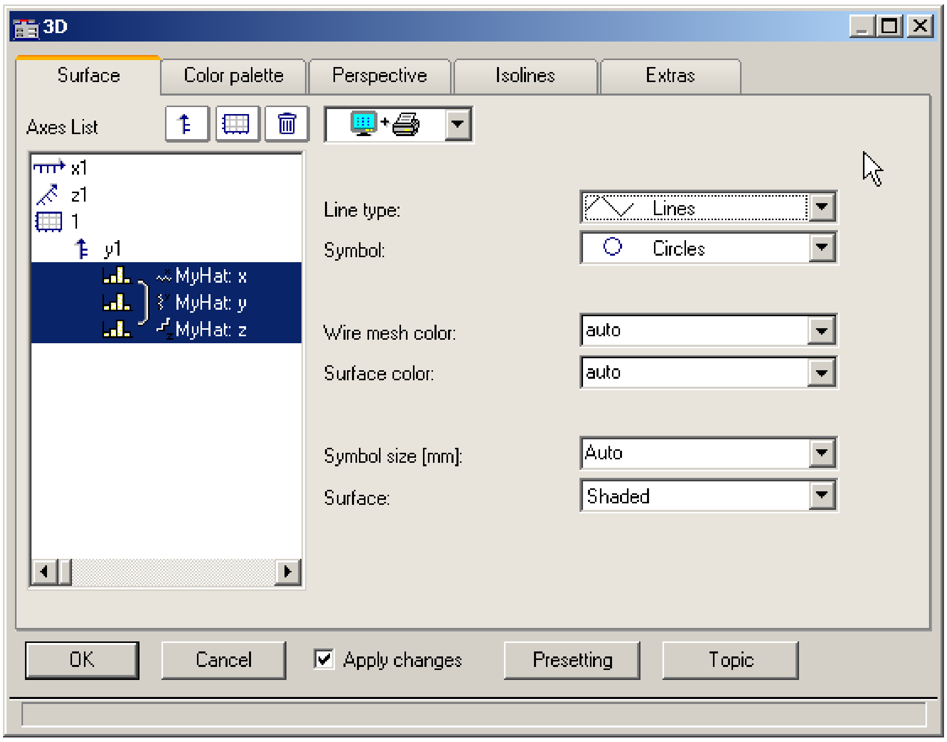
- The color of the grid lines can be determined in the *Colors...* dialog.
- A grid is not drawn if labeling is not visible.
- The menu option *Grid* is marked with a checkmark when grid display is selected.

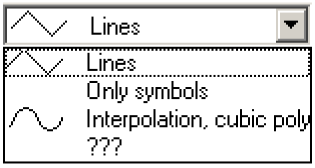
11.6.6.3 3D

You have various options in the *3D* display, to modify and optimize the display of surfaces. If you have selected the *3D* option, you achieve the setting dialog for the 3D design *Configuration / 3D*. You can also achieve this setting dialog with the corresponding button in the toolbar.

11.6.6.3.1 Surface

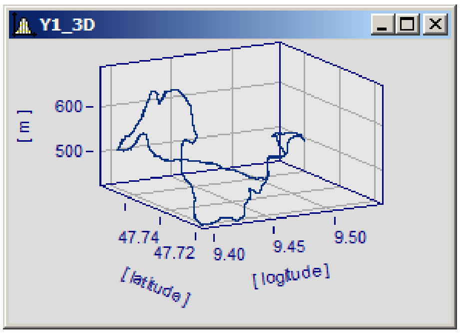
In the dialog page *Surface* there are additional settings for 3D-display besides the settings described under Lines 1223.



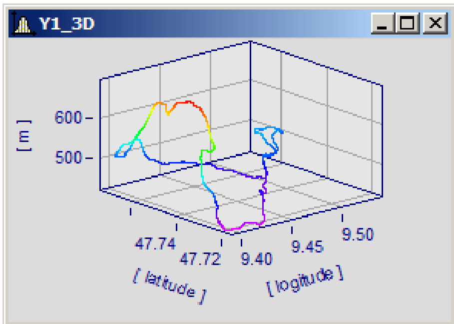
Settings	Description
Line type	In 3D-display, the only available line types are straight lines, no lines, or interpolated lines connecting measured points. For bars, see here 1259. 
Symbol and Symbol size	See the section on lines 1223.
Wire mesh color	Here you can set the color of the grid, or of the connecting lines between measured points. If you set *auto*, then the color will be set according to the global color setting (color palette 1260).
Surface color	Here you can set the color of the surface. If you set *auto*, then the color will be set according to the global color setting (color palette 1260).

Settings	Description
Surface	

Surface	Description
Wire mesh shaded	The individual measured points are connected with lines to a grid and are additionally displayed as a surface with the color/color palette set.
Shaded	The individual measured points are displayed as a surface with the corresponding selected color/color palette.
Wire mesh	The individual measured points are connected to lines in a grid.
Wire grid with color tones	The individual measured points are connected with lines to a grid and this grid is additionally displayed as a surface with the color/color palette set.
Samples	The individual measured points are displayed as points or, if selected, as symbols.
Space curve	The individual measured points are all connected in sequence with lines.
Space curve with color tones	In addition to the space curve, the line can be colored with different colors to correspond to different y-component value ranges.



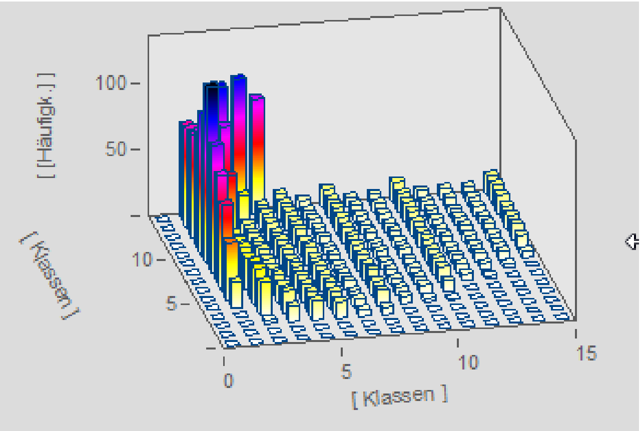
Monocolor space curve



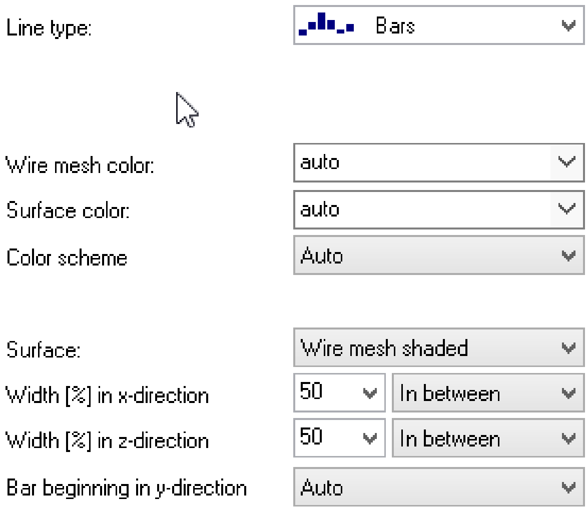
Space curve with color palette

Options for 3D bars

With *Line type: Bars*, three-dimensional bars are displayed, for which additional display parameters are shown.



3D bars



Settings for 3D-bars

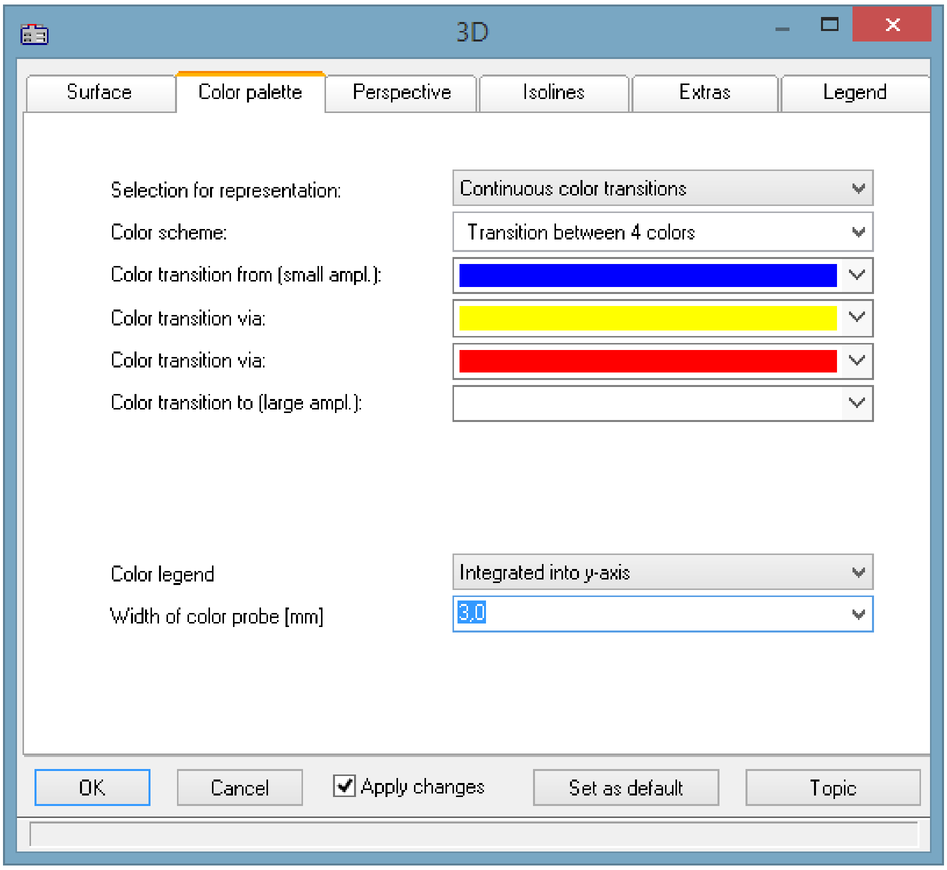
Note

3D-bars can only be set for segmented data. XYZ-plots are not supported.

Settings	Description
Color scheme	The color of the column and the color of the wire mesh (edges) can be given fixed settings. With *Surface color* set to *auto* , a color gradient is drawn if the *Color scheme* is set to *auto* or *With color gradient* is set. With *Color scheme: One color*, the complete column is colored according to its peak value.
Surface	The surfaces of the columns can be displayed in the following ways: • *Wire mesh shaded* or *auto*: colored columns, with edges • *Shaded*: colored columns without edges • *Wire mesh*: only edges • *Wire mesh with color tones*: only colored edges
Width (%) in x/y-direction	The width and depth of the bars can be set in terms of a percentage. The position may be arranged as *In between, Centered* or *Aligned*.
Bar beginning in y-direction	This sets the height of the bottom surface.

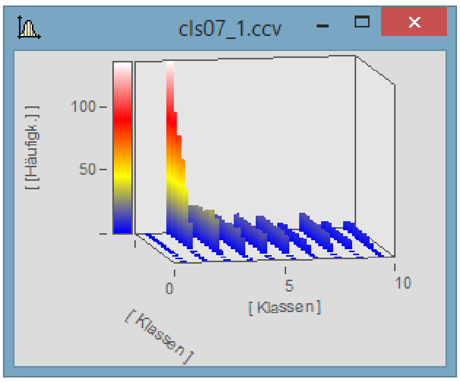
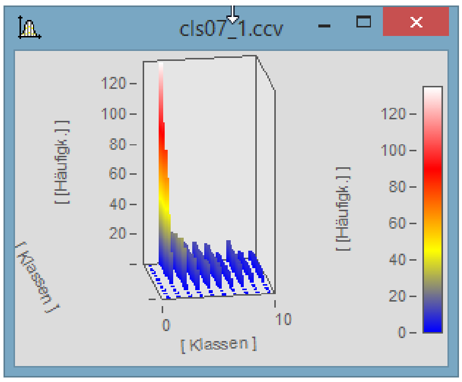
11.6.6.3.2 Color palette

You can make a choice in the *color palette* tab to select a color for the surface. There are two illustration facilities like the continuous color transitions. You can find more information in the chapter Color map dialog, "General" 1166



Color legend

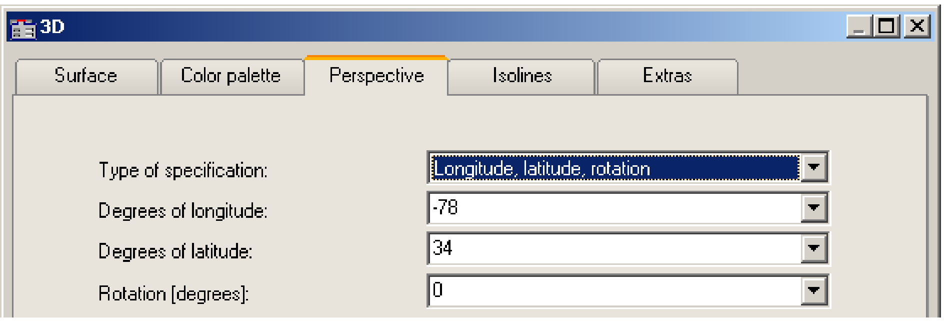
The scaling of the colors can be indicated with a *color legend*. The following options are available:

Settings	Description
Auto, No	No color legend
Integrated into y-axis	The Y-axis is supplemented with color columns. Their width can be set.
Separate legend left, right	Separate color column to left or right of the data.  **Color legend in y-axis**  **Color legend separate right**

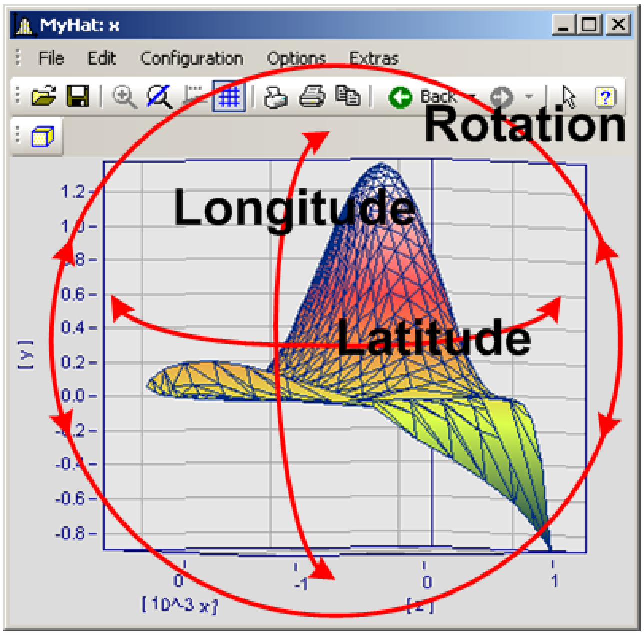
Reference

One way to color the 3D display according to a fourth variable is presented here 1252.

11.6.6.3.3 Perspective



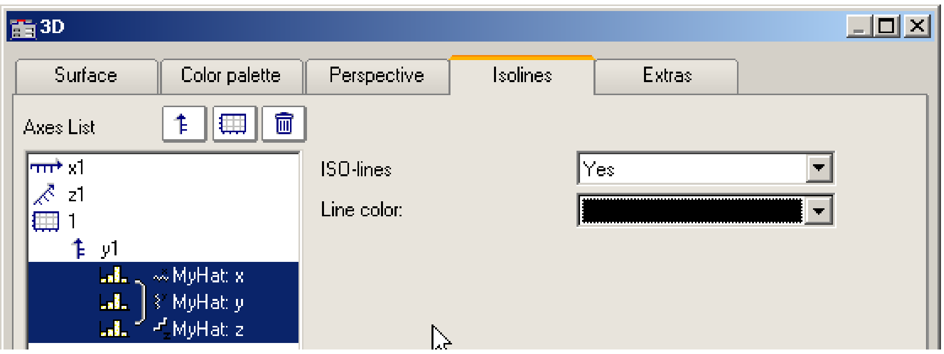
In the dialog page *Perspective*, you can set the viewing perspective as an angle between -180° and +360°. There are three ways to make the specification: *Angle of z-axis*, *Longitude* and *latitude* and *Longitude*, *latitude* and *rotation*.



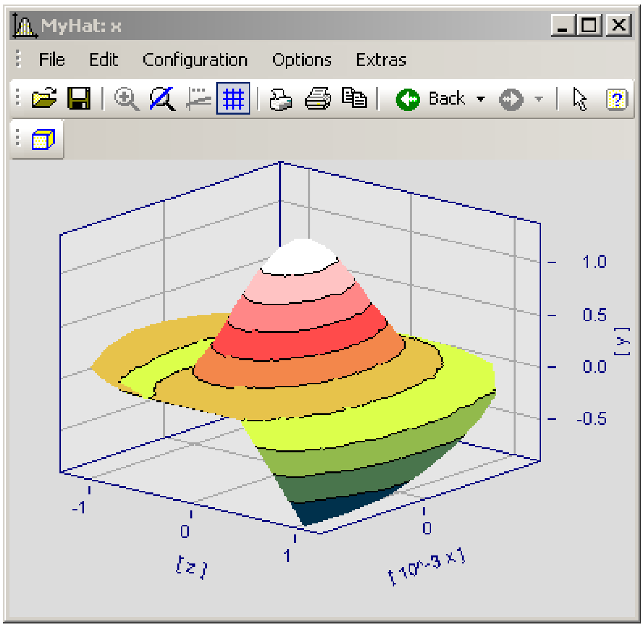
The perspective *Longitude* and *latitude* offers the best mouse control. This view behaves like a survey of the earth from outer space. This is the recommended perspective. If you wish you can additionally specify the rotation.

The three perspective parameters are related as shown below.

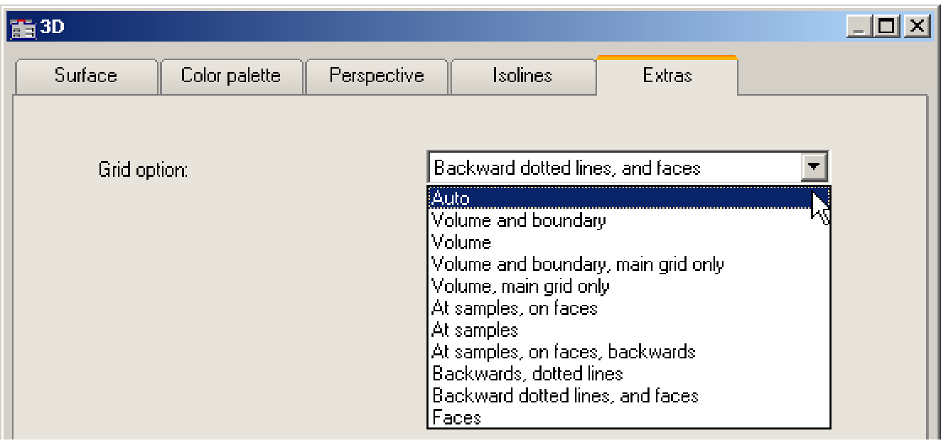
11.6.6.3.4 Isolines



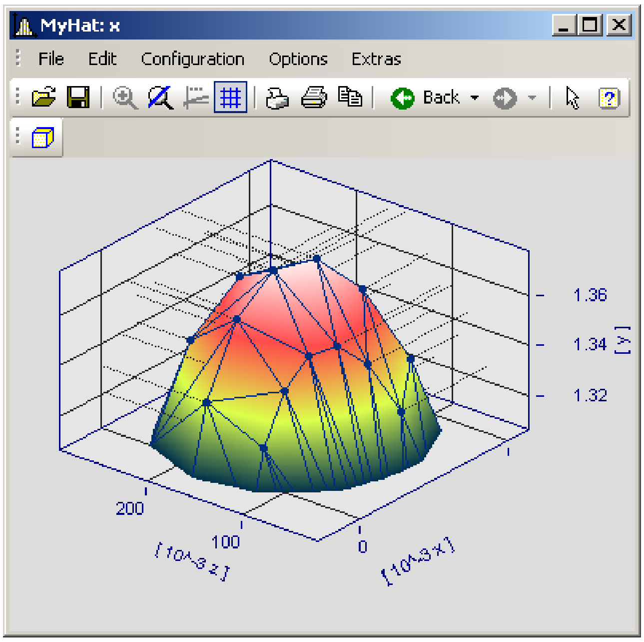
In the dialog page *Isolines* you can select whether to have isolines superimposed on the toned surface, like in color map display. This function can only be activated if graduated colors are set on the *color palette* 1260 page.



11.6.6.3.5 Extras

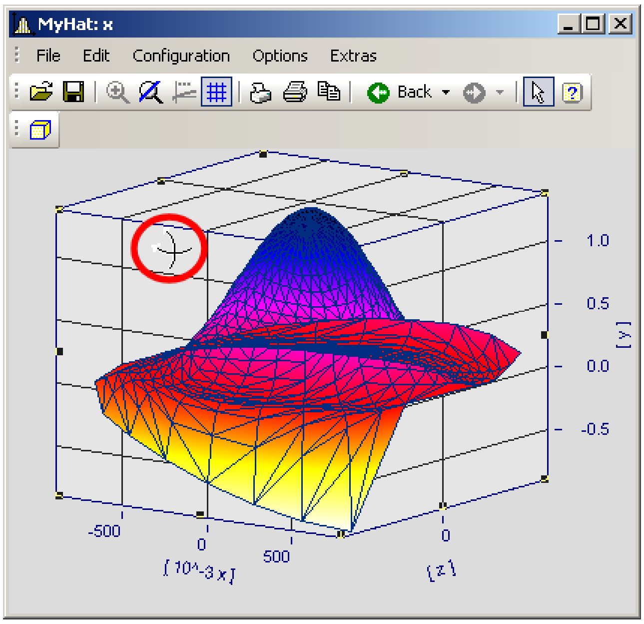


The dialog page *Extras* offers access to various grid options. This grid is then displayed in the space, in addition to the standard coordinate grid, for better legibility of a measurement point's axis values.



11.6.6.3.6 Rotate

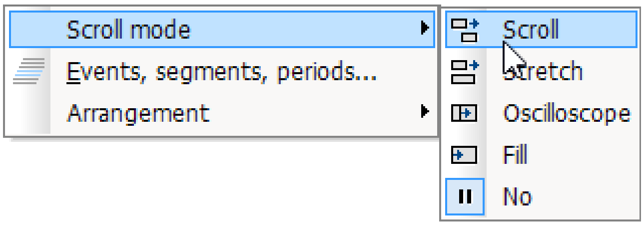
For spatial manipulation of a 3D-display, bring the mouse cursor in the coordinate system, which makes its shape change. If you then click on the mouse and start moving it, the cursor shape changes, as shown in the picture, and the 3D-display can be freely rotated by moving the mouse around.



Cursor for free rotation of a 3D-display

11.6.6.4 Scroll mode

This function is used during a running measurement, when the curve window is continually receiving new measured data to display.



Using the scroll mode, a particular segment of time-domain data can either (*scroll across*) the screen, or the segment itself, beginning from the measurement start, can continually (*grow)* or be stopped for purposes of performing analysis (*No*).

Menu item	Description
Scroll Mode	The *Scroll mode* is set for the curve window for a running measurement. The extent of the displayed x-range remains constant; the offset of the x-axis is shifted with each new measurement value.
Stretch Mode	Click on this button to have the curve window *stretch* during a measurement. The minimum value on the x-axis remains in effect, while the maximum is automatically set to the end of the waveform. Thus, the extent of the domain displayed increases with each new measured value.
Oscilloscope-Mode	During a running measurement, the curve window displays a static image which, like an oscilloscope, is redrawn at intervals. The zoom width remains intact.
Fill	Here, the curve window is filled similarly to Scroll mode. When the right edge is reached, the x-axis skips back by 75%, however. In consequence, the x-axis remains at rest most of the time, giving the user the opportunity to use a measure window 1279 during a running measurement.
No: End Online mode	Click on this button to halt the *Scroll* or *Stretch* mode in a curve window in running measurement; this means the x-axis is frozen in its current state and the signal can then be viewed at rest as long as needed.

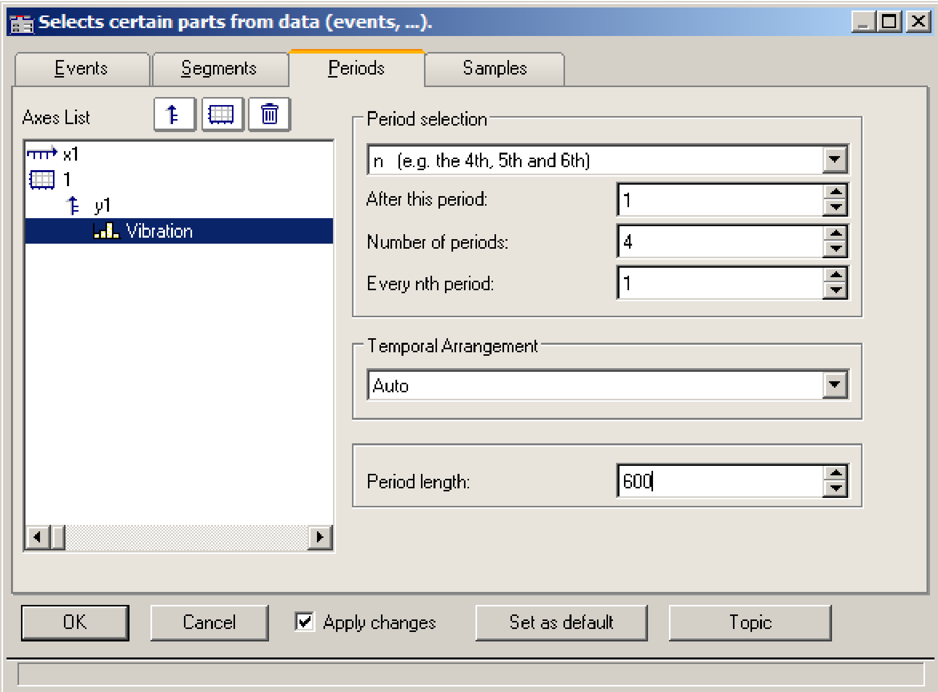
11.6.6.5 Events, Segments, Periods

Function

With normal waveforms, it is possible to perform a comparison of signal periods 1271 in a general way where an individual period is selected and compared with others. With **segmented** and **event-based** data, comparison of any desired portions of the data can also be carried out.

Operation

The dialog is called by selecting the menu item *Configuration / Events, Segments, Periods*.



Periods

First select the file card *Periods* from the stack (of three). Then select the channels, which are to be displayed in the period comparison, from the axes list on the left.

Next enter the *Period length* in the box on the bottom right; it is a amount of measurement values >=1.

Under **Period selection**, you specify in what way the periods are identified. The default entry is *No period comparison*. The option Auto shows all periods. Further options enable targeted display of specific periods. Select "N" periods from the list box, for example, then enter a starting period, an amount of periods, and the increment between successive periods to be compared. The first period in the waveform is denoted by the index 1.

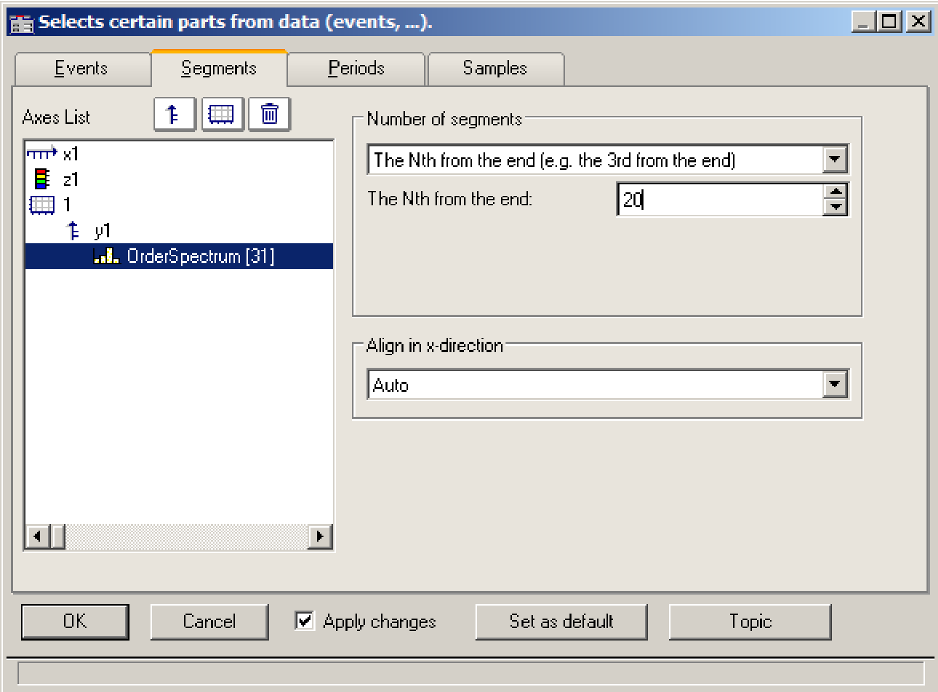
When you have specified the amount, then proceed to the ***Temporal Arrangement***:

Settings	Description
Auto	The curve window determines the temporal arrangement. When in doubt, then, use this option.
x0 set to zero	The waveforms' property x0 (their relative trigger time) is set to 0 for the display.
x0 of the first period	The period comparison representation's initial x-coordinate is defined as the x-coordinate of the first measurement value belonging to the first period in the original data set.
x0 of the last period	The period comparison representation's initial x-coordinate is defined as the x-coordinate of the first measurement value belonging to the last period in the original data set.
Each period contains a unique x0	Each period has its own individual x0, which is identical to the x-coordinate of the first measurement value belonging to that period in the original data set.

Segmente

For the display of segmented data. Segmented waveforms are matrices, as generated, for example, by imc STUDIO spectral calculations or class-counting.

Select the *Segments* file card:



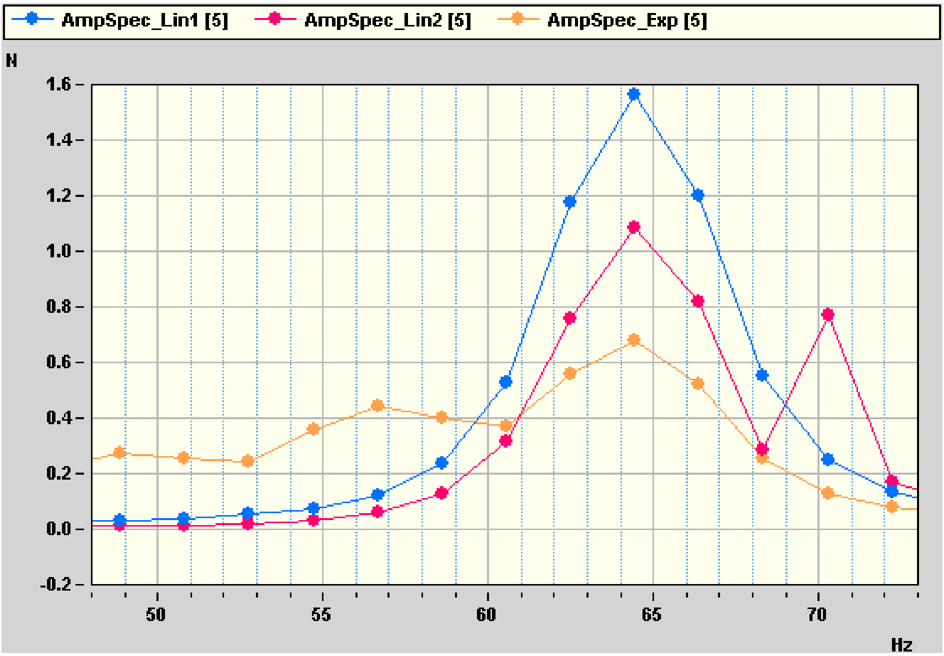
First you must make your selections in the Axes list on the left, as only the selected data indicated there are affected by settings performed with the instruments on the right.

As with *Number of segments*, select the segments to be displayed.

Then select ***Align in x-direction***:

Settings	Description
Auto	When in doubt, choose this option to at least get a view of the segments.
Retain x-coordinate	Each segment receives the same initial x-coordinate, namely, the x0 of the original data set. This is the most appropriate option for handling matrices (Rainflow,...) and multiple FFT's.
Add z to the x-coordinate	Segmented waveforms are provided with z-coordinates, which is determined from z0, dz, and a segment's index. The x-coordinate of a segment's first measurement value is in this mode the sum of x0 and the segment's z-coordinate

Example of segment indices:

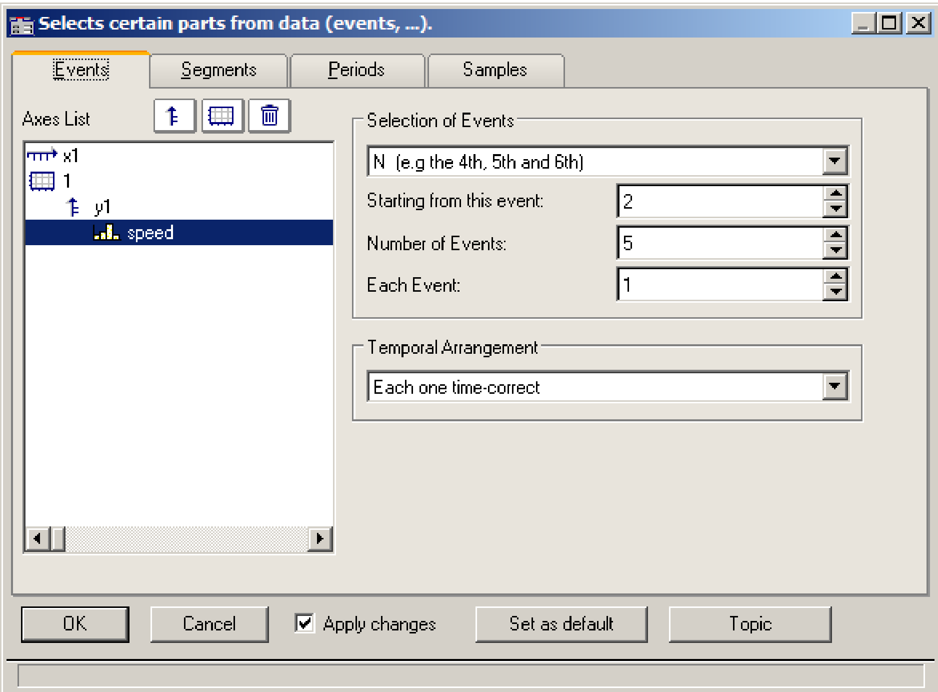


Legend with segment indices

Events

If you have recorded triggered waveforms, make the settings on the Events page. Events are triggered signal segments.

Select the page *Events*:



As before, the desired data sets are to be selected from the *Axes list* at left and the *Selection of Events* from the list box on the upper right.

Select the appropriate ***Temporal Arrangement***:

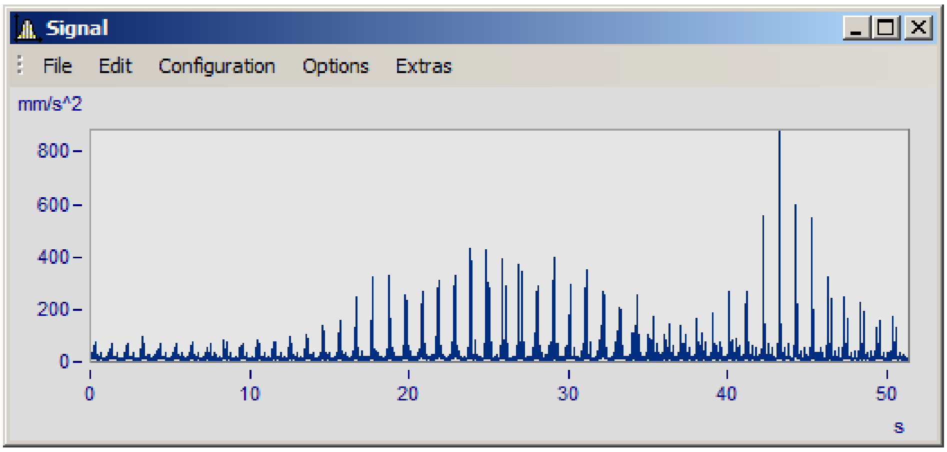
Settings	Description
Auto	This delivers an automatic representation, and is certain to achieve some result. When in doubt, then, use this option.
Each one time-correct	Each event is represented with its genuine time-coordinates. With the curve window's time representation set to "relative", the individual events receive time coordinates which correctly correlate to each other; in the "absolute" time representation the actual trigger instant for each event is indicated in absolute terms. This option is generally the most appropriate for multishot waveforms.
Trigger time of 1^{st} is valid for all	Caution! Options which rearrange the trigger time can lead to an incorrect temporal representation. The representation may, nonetheless, be of interest for purposes of comparison. This option places the initial time coordinate of every shot at the absolute trigger time of the first event. In relative time representation there is no effect (the time-accuracy is retained); but in absolute-time mode all events are <Shift>ed to reflect the first event's trigger instant.
Trigger time of last is valid for all	As above, but based on the last event's trigger instant.
Trigger time of 1^{st} displayed is valid for all	As above, but with reference to the first specifically selected event.
Trigger time of last displayed is valid for all	As above, but with reference to the last specifically selected event.
Trigger time difference to 1^{st} in x0	Caution! Options which rearrange the trigger time can lead to an incorrect temporal representation. The representation may, nonetheless, be of interest for purposes of comparison. This function uses the time difference between the trigger instant of the original data set and the trigger instant of the first selected event as the x0, the initial time coordinate of the period comparison representation. This affects a representation which is made in relative time mode. The event coordinates are <Shift>ed by their genuine trigger times. In absolute time representation no effect is achieved.
Trigger time difference to last in x0	As above, but based on the last event.
Trigger time difference to 1^{st} displayed in x0	As above, but based on the first specifically selected event.
Trigger time difference to last displayed in x0	As above, but based on the last specifically selected event.

11.6.6.5.1 Period Comparison

Periodic signals occur in a variety of applications, such as rotating machinery, where the measured signal almost repeats itself at each revolution.

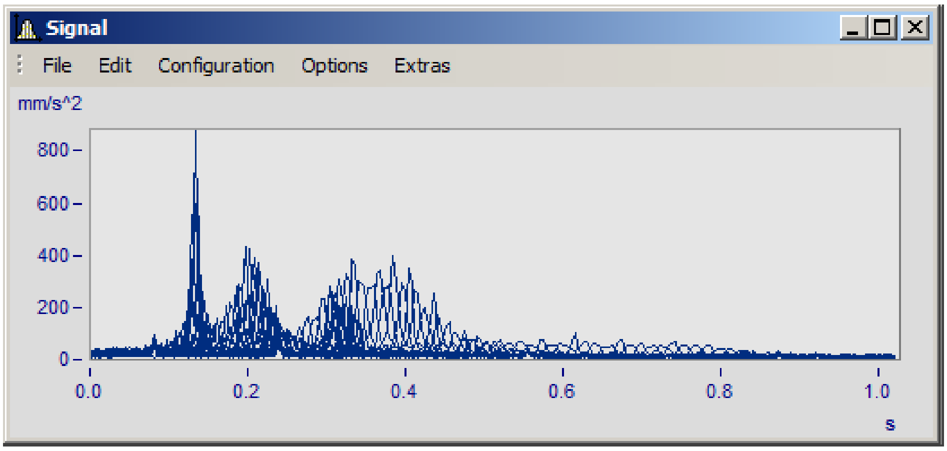
In the curve window's default display mode, entire waveforms appear plotted over time. This means that all periods are drawn in a series. In such a display, it is not always possible to compare individual periods in terms of their maximum values, for instance, or even other properties.

Example:

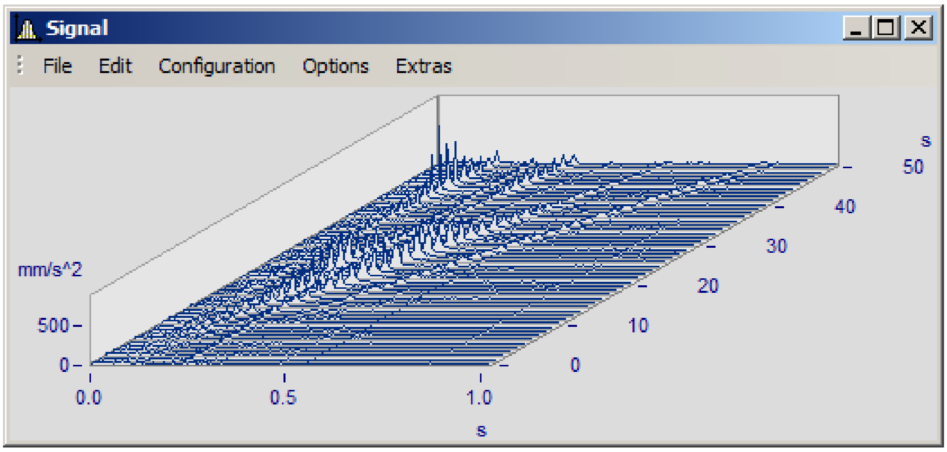


A waveform with 50 periods of 1s duration each is shown

In the period comparison mode, the waveform is divided into its individual periods. The periods are stacked over each other, enabling direct comparison. There are three ways of performing a period comparison:



Default mode. The curve plots of all the periods are drawn superimposed over each other. A dense region of coinciding signal points is visible.

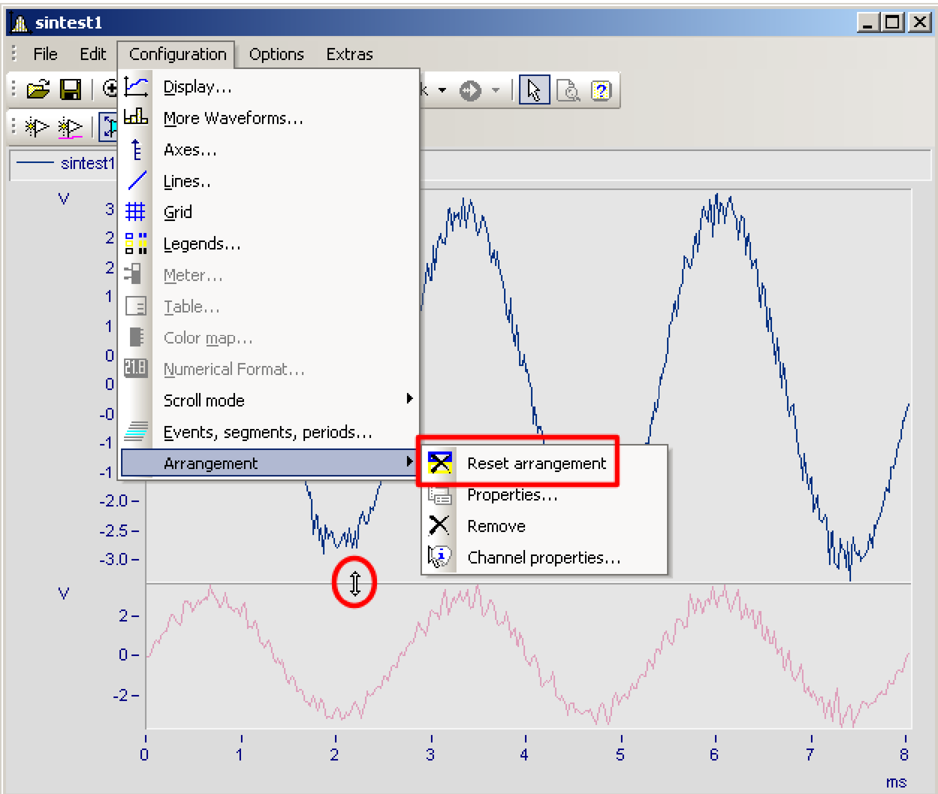


Waterfall diagram: the mountain-range-shaped surfaces clearly illustrate trends emerging across the accumulating signal periods.

In the period comparison mode, the length of a period -in data points- must be known. The amount of points reflect the amount of measured values in each period.

11.6.6.6 Arrangement

This function affects how the coordinate systems are laid out, in terms of the height of the y-axes.



In the menu *Configuration*, you have access to the same items as in the Select-mode's 1291 context menu. Additionally, there is the function *Reset arrangement*, which lets you totally undo any previous changes to the coordinate system arrangement. The relative heights of coordinate systems within a curve window can be changed using the mouse. To do this, move the mouse cursor to the separator between two coordinate systems, so that its shape changes to a vertical double-arrow. Then drag the separator, by holding down the mouse button, up or down as desired to rearrange the coordinate systems' heights.

11.6.6.7 Confirmation bar

Apply changes

When this option is selected, all changes made in the axes list are displayed immediately in the curve window. Thus, the user is always informed about the current appearance of the curve window as resulting from the settings made in the axes list. On the other hand, redrawing the curve window, especially for long waveforms and several curves, can have an adverse effect due to delays.

OK

Click on this button to close the dialog. The current settings are implemented automatically. The same effect can be achieved by closing the window, as is customary in WINDOWS.

Cancel

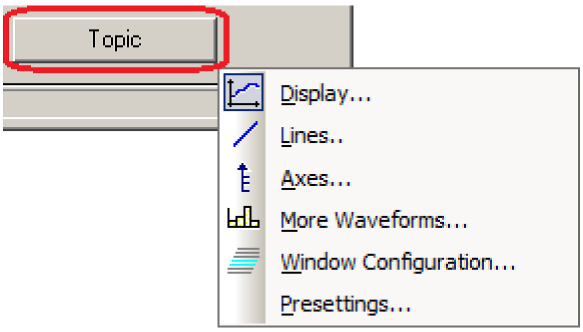
The dialog is closed and any changes made are discarded. This also applies to changes made and displayed in the curve window using the option *Apply changes*.

As presettings or Set as default

This saves the currently effective settings as default settings for future curve windows. The settings are saved to the Windows Registry. If you wish to transfer the default settings to a different computer, use the program XConfig, which is located in imc FAMOS' BIN folder.

Topic

From here, you can go directly to the properties dialogs for other objects.



11.6.7 Working with the curve window

Menu item	Description
Zoom 1275	Enlarges a section of the curve window.
Unzoom 1276	Displays the entire curve.
Measure 1277	A measurement value window and measurement cursors for measuring curves are displayed.
Select-mode 1291	In this mode, it is possible to select and edit legends, coordinate systems, axes, curves and markers.
Marker 1293	Proceeds to the list of marker functions.
Clipboard 1317	Copies the graphics in the curve window into the Windows clipboard.
Graphic-export... 1317	The graphic of the curve window is saved as image or as a PDF file.
Move 1319	Proceeds to a submenu listing various curve viewing functions.

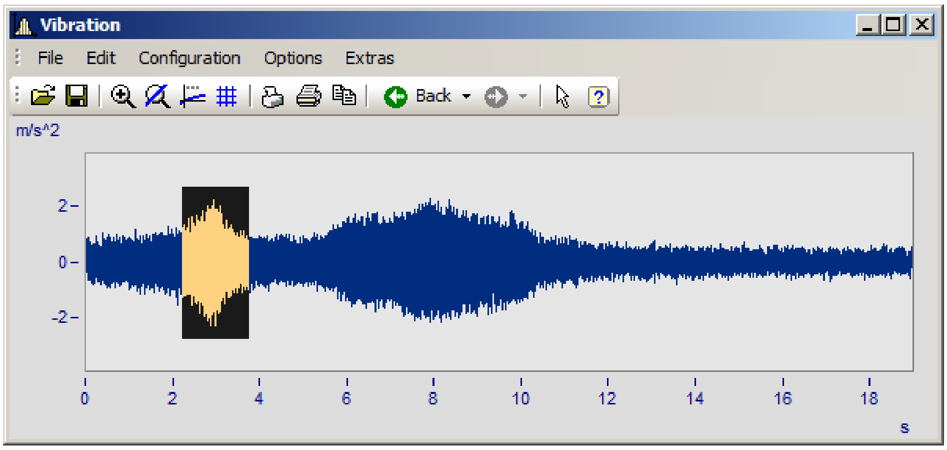
11.6.7.1 Zoom

Function

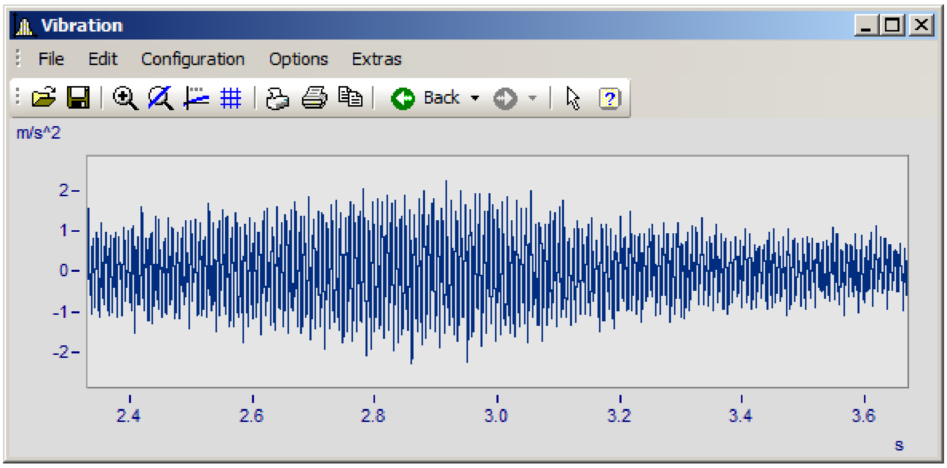
Any region of a displayed curve can be enlarged for viewing (zoomed). Zooming can be done in both x- and y-directions at the same time. The zoomed region is a rectangular area within the coordinate system, with size and position determined by the user.

Mouse Operation

- Select menu option *Edit / Zoom* from the *Scales* menu. The mouse pointer changes its shape to a vertical arrow.
- Draw a rectangle with the mouse around the area you want to see. The selected area is displayed with inverted colors.



- Release the mouse button to enlarge the area displayed in negative and end the zoom mode



Remarks

- The *Zoom* mode can be ended at any time by pressing ESCAPE.
- The mouse pointer must not necessarily be within the coordinate system when selecting the corners of the zoom range.
- A zoomed region can be zoomed further for greater detail.
- Use menu option *Unzoom* to view the entire curve.
- The zoom function can also be used when the *overview* or *measurement value windows* are active.

- After completed zooming, the axes can optionally be labeled with rounded values. In that case, a slightly larger region is usually displayed than was selected.
- Note that the option *use rounding* 1343 can be switched off in the *Presettings* menu.
- The zoom function can be regarded as a short-cut for a series of manual axis scaling operations (see menu option *Axes* 1204). If the result is not satisfactory, scale the axes manually (without rounded values).
- Note that zooming in the x-direction often does not produce the desired results, especially for x-axes displayed logarithmically. In rounding, the values on the x-axis will be shown in powers-of-ten as long as the x-range is large enough. Try zooming even more in the x-direction or scaling the x-axis manually. Then you must give consideration to the presettings for the curve window.
- When several curves are displayed in a window, all are zoomed at the same time.
- The measurement value- and overview windows are updated automatically; the positions of the measurement cursors are kept, if feasible.
- Unlimited zooming is not possible:
  - The relative resolution is 10^{-13}.
  - Note that unlimited zooming doesn't make sense, since the representation of the numbers is only precise to approximately 15 decimal places.
  - The zoom region is determined by the resolution of the monitor screen. Enlarge the curve window to make zooming more precise.
  - When the display mode *y-axes stacked* 1128 is selected, you can spread the color-negative rectangle of the zoom mode onto one single or several curves. If the rectangle covers only one curve, this curve is zoomed in the x- and y-directions; while for the other curves in the window, the y-range remains intact and the x-range is adapted to the zoomed region. If the rectangle extends over more than one curve, only the x-direction is zoomed; the y-range for each curve remains the same.
  - In waterfall diagrams, only the XY-level can be zoomed.

11.6.7.2 Unzoom

Function

Select the *Unzoom* function to return to the display of the entire waveform after having zoomed. If the curve window had customized scaling and parameters before zooming, those settings are lost after unzooming, since the scaling is then performed automatically.

Mouse Operation

Select menu option *Unzoom* in the *Edit* menu to restore the previous curve window settings.

Remarks

All y-axes present when the function *Unzoom* is selected are scaled automatically, except when they are scaled like the next axis to the left. The x-axis is scaled automatically so that the first curve in the window is displayed completely. Additional curves may extend beyond this range due to a different x-scaling.

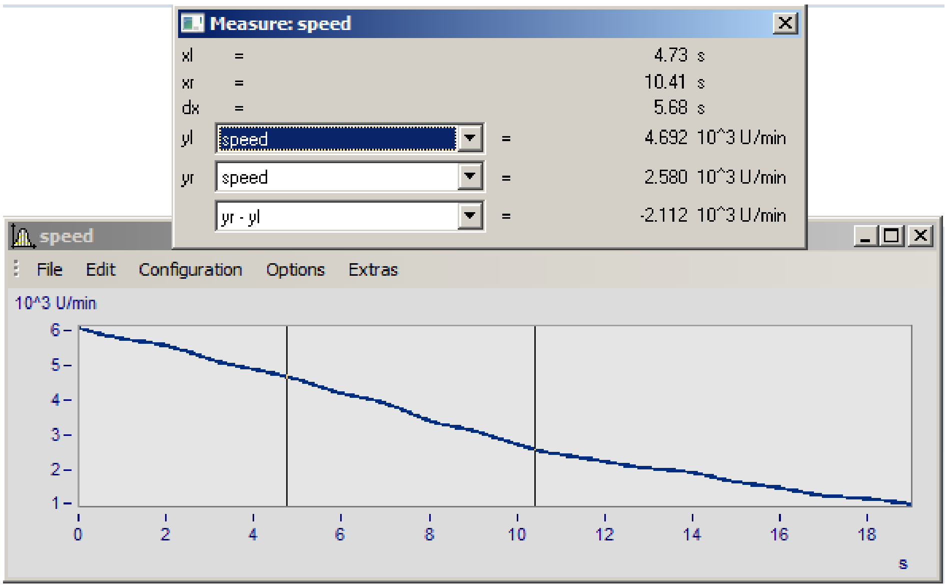
11.6.7.3 Measure

Function

Two independent measurement cursors are available for performing measurements. The x- and y-values of the intersections with the vertical cursor lines are displayed together with the curves in a measurement value window.

Mouse Operation

- Select *Edit/ Measure* and the *Measure* window appears. A measurement value window appears and two measurement cursors are set up in the curve window.
- Move the mouse pointer to over the coordinate system and hold down the left or the right mouse button. The mouse pointer then jumps to the measurement cursor. On the other hand, if you wish to place the measurement cursor at the mouse pointer's position, hold down the keys CTRL or SHIFT while clicking on the mouse button.
- The **left mouse button** controls the **left measurement cursor;** the **right mouse button** the **right measurement cursor**. If you hold down both mouse buttons at the same time, you move both measurement cursors simultaneously.
- When you click in the curve while holding down the SHIFT key, the measurement cursor jumps to the mouse pointer's current x-coordinate.
- In order to place the measurement cursor at any desired location in XY-displays, click one of the mouse buttons while holding down the SHIFT key. The measurement cursor then jumps to the closest point on the curve to the current position.



Remarks

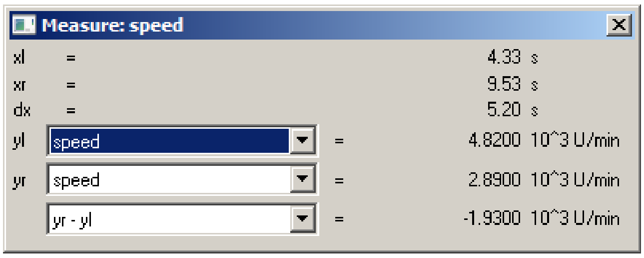
- The crosshairs may cross each other.
- In normal time displays, the horizontal line of a measurement cursor is visible only as long as the curve lies within the coordinate system and is defined for the x-coordinate of the measurement cursor.
- Zooming in XY or locus plots may result in the measurement cursors no longer being visible.
- If linear interpolation between the actual points of a curve is used to draw a graph (points connected by lines), the measurement cursors follow this path.

- To measure the actual points of the curve, select the display mode *Steps* in the *Style* submenu of the *Lines* 1222 menu.
- The horizontal measurement cursor can be switched off in the *Options/ Presettings* 1343 menu. This is sometimes useful when displaying slowly changing data or digital data consisting of steps.
- If no mouse is connected, the mouse pointer only appears whenever the curve window is active at the moment.

11.6.7.3.1 Measure Window

Function

The measurement value window appears once menu option *Measure* has been activated in the curve window. Its position can be changed as desired. However, the measurement value window is always in front of the curve window to which it is assigned. The measurement value window shows the x- and y-values for both measurement points and those values' mutual differences; the display of other characteristic values is optional.

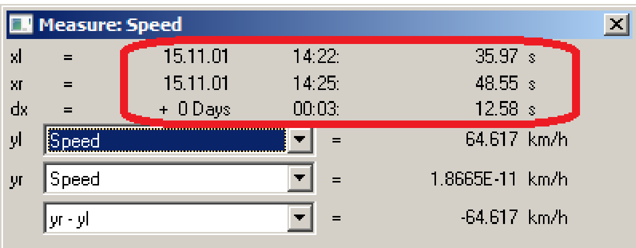


In the selection lists *yl* and *yr*", a waveform displayed in the curve window can be selected for measurement, which is accomplished using the measurement cursors. The list box at the bottom of the dialog contains the following entries as available choices of calculated values:

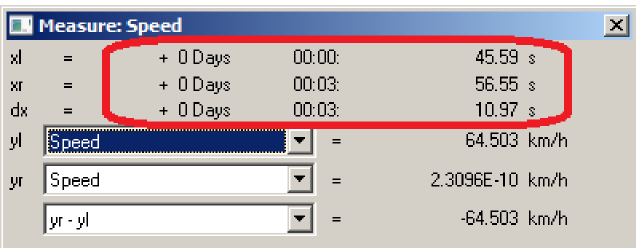
Symbol	Description
xl	x-coordinate of left measurement cursor
xr	x-coordinate of right measurement cursor
dx	Difference between the x-coordinates, xr-xl
xr/xl	Quotient of the x-coordinates of the measurement cursors
yl	y-coordinate of the specified curve at the intersection with the left measurement cursor
yr	y-coordinate of the specified curve at the intersection with the right measurement cursor

Calculations	Description
yr-yl	Difference between the y-coordinates
yr/yl	Quotient of the y-coordinates
Slope	Slope between the two measurement points, dy/dx
Slope per decade	Slope is defined in units per decade, dy/lg(xr/xl); especially useful for logarithmic display. For example, the slope of a filter is often measured in dB/dec.
1/dx (frequency)	Difference between x-coordinates (xr-xl) in frequency units, e.g. 1/ms
Surface	Integral of the data between the measurement cursors = Sum(Yn*xdelta) Available only for equidistantly sample waveforms.
y-Min	Minimum between the measurement cursors. Available only for equidistantly sample waveforms.
y-Max	Maximum between the measurement cursors. Available only for equidistantly sample waveforms.
RMS	The root of the mean value of the squares of each value between the cursors ("root-mean-square") is calculated. Available only for equidistantly sample waveforms.
Standard deviation	For the data between the measurement cursors, the deviation of each value from the arithmetical mean is squared and then all of these squared values are summed. This value is then divided by the number of these values minus 1; finally, the square root is calculated. Available only for equidistantly sample waveforms.
x-coordinate of inflection point	Inflection point according to the following formula: yl > yr -> x-position of **minimum** slope yl < yr -> x-position of **maximum** slope Available only for equidistantly sample waveforms.

When using one of the display modes *Date/ time* or *Days/ hours/ minutes*, the time data appears as follows:



Measure window with date and time view



Measure window with relative time

A negative sign before data in *days/hours/minutes* and *seconds* pertains to the entire time declaration, not only to the days.

Positioning the measurement cursors

The left measurement cursor is positioned while holding down the left mouse button, and the right cursor while holding down the right mouse button.

In normal cases the cursors move along the data line; for this reason, the *line type* 1223 applies to it.

By means of the contextmenu command "*Cursors freely movable* 1281", it is possible to cancel the linkage.

Wen you click in the curve window while holding down the Shift key, the cursor jumps to the selected x-position. Depending on the setting "*Cursors freely movable* 1281",the horizontal measurement line jumps either to the associated amplitude or to the selected position.

11.6.7.3.2 Context Menu in Measure Window

Move the mouse cursor to the measurement value window and right-click the mouse to prompt the following context menu:

Cursors unrestrictedly movable

If you select this function, both measurement cursors can be moved freely in the curve window without any linkage to particular curves.

Send Curve Segment to imc FAMOS!

This option sends the curve section located between the vertical lines of the measurement cursors to imc FAMOS. This new waveform receives a name which appears in the variable list and by which it is designated as per the transfer options set using the menu Options/ Transfer options. 1349.. in the curve window.

When multiple curves are displayed in the window, the section between the measurement cursors of each of them will be transferred to imc FAMOS if the pertinent transfer option is currently activated.

Note that the original data sets are overwritten if you do not specify a new name when using Transfer Options.

Note that this export function duplicates the waveform in the course of the export procedure, unlike other export functions. Shifting the position of the measurement cursors after exporting a curve section will not affect the exported waveform.

Reference

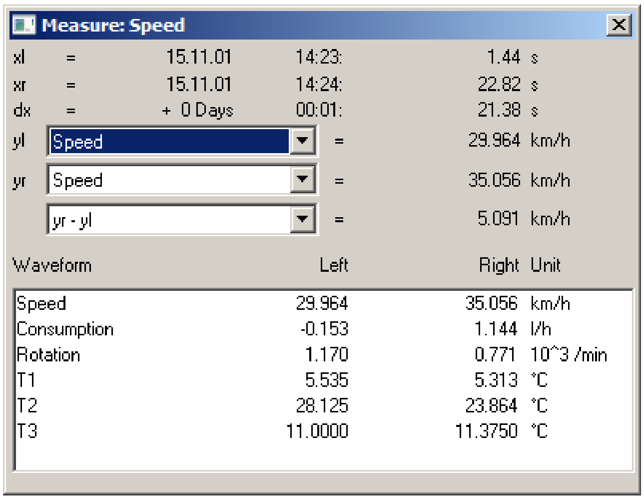
More about Transfer options 1349

Clipboard

All measurement values displayed in the measurement value window are copied to the clipboard in text format. This text is then available for use by other applications.

Channels List

When several curves in one window are compared with each other, it can be helpful to see simultaneously the measurement values of as many curves as possible. Do this by selecting the option Channels List, which displays a list of all channels. The measurement value window is enlarged and a list of all y-coordinates at each of both measurement cursors appears, irrespective of which curve the cursors are currently set to move along.



When *List of all channels* is active, the menu item is marked with a check. If you wish to close the list mode, select the same menu item again. The last state remains in operation the next time the measurement window is opened. The channel list's size can be changed. You can highlight list entries to distinguish then visually.

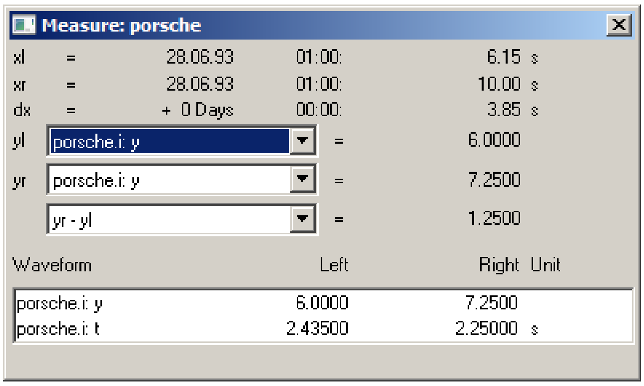
Remarks

The column *right* and *left* above the list is assigned to the measurement cursor which is controlled by the corresponding mouse button.

Expand List

When *List of all channels* is active, the menu item *Expand the list* appears. By selecting this option, separate measurement values for all XY-waveform components -if any such waveforms are present- are displayed in the list. In polar plots, the measurement values of the magnitude and phase are displayed. This option can also be activated by double-clicking on the pertinent entry in the list.

Double-clicking on a component of the waveform also deactivates the option; and only the selected component is retained as a separate entry in the list.



Reprocessing signals...

This menu item allows signals to be reprocessed, for example, to undergo smoothing or peak clipping. For a detailed description, see the separate chapter Reprocessing signals 1285.

Place marker with left click; Place marker with right click

Set a marker at the measurement cursor positions. Subsequently, a dialog for marker settings 1304 appears.

Reference

More about "Markers" 1293 and "Marker Definition" 1304

Append to measurement value file

This menu item appends the measurement values to the file of measurement values as text. The name (along with the directory path) is set in the menu under *Measurement value file name*.

The file is a normal, text file in ASCII without formatting, so that it can be edited by any word processing program. By repeatedly calling this menu item for a variety of cursor positions, it is possible to generate a list of landmark points. If the file doesn't exist, it is first created.

Note that MS-Windows applications misread *umlauts* in these files. The OEM format is used for writing to these files. For this reason, use programs (such as word processors) not running under MS-Windows to analyze these files.

Note

As of imc FAMOS 7.0 / imc STUDIO 5.0R3, this function is no longer shown.

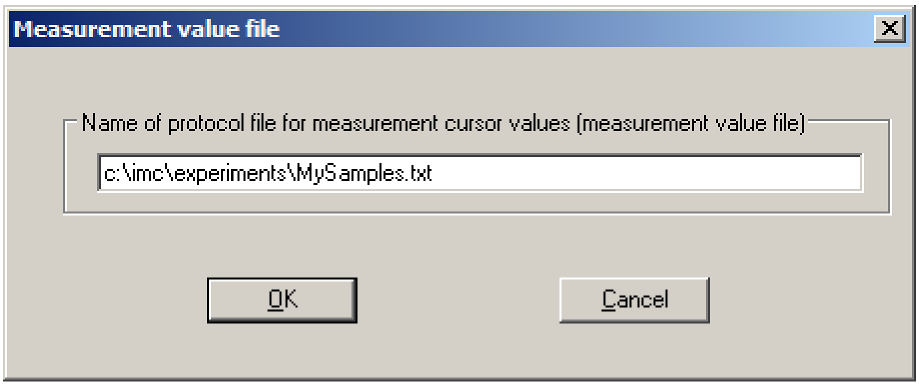
By means of an entry in the Registry, it can be made visible again:

Computer\HKEY_CURRENT_USER\Software\imc Measurement and Control\Default\CurveDataManager\Curves

If it is not already present, enter as a *New String* the text "*EnableMeasFile*". Set its content to *1*.

Measurement value filename

This menu item calls a little dialog in which the name of the measurement data file can be edited. The setting for this filename is valid globally for all measurement value windows.

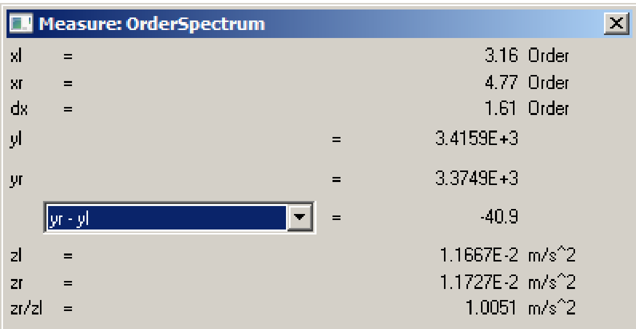


Remarks

- The *Measure* mode (i. e. Measure window is open) is ended whenever a major change in the display of the curve window is made, e.g. when numerical value display mode is selected.
- The menu option *Measure* in the curve window is checkmarked if the curve window is in the *Measure* mode. If the checkmark is removed, the measurement value window is closed.
- Each curve window can be in the *Measure* mode, regardless of the status of all other opened curve windows. It is thus possible to conduct measurements with multiple measurement value windows independently of each other. The title bars in the *Measure* windows contain the names of the corresponding curve windows.
- When measuring in all XY-representations (or polar plot), the measurement cursors move somewhat differently than in normal time-dependent representation. The movement of the measurement cursors always follows the parameter of the XY-display. Moving the mouse to the right or upward moves the corresponding measurement cursor in the direction of the increasing parameter.
- The measurement cursor speed in XY and locus plots caries depending on the point density of the curve. The measurement cursors cannot be moved in arbitrarily fine increments between samples. Zooming too strongly, therefore, can cause the measurement cursors to jump between points.

11.6.7.3.3 Performing Measurements on Color Maps

In this display mode, the measurement cursor can be moved freely over the entire plane of the coordinate system. x- and y-coordinates are arranged horizontally or vertically. The z-coordinate is indicated along the "color axis", which extends outwards from the plane of the monitor.



11.6.7.3.4 Reprocessing signals

Function

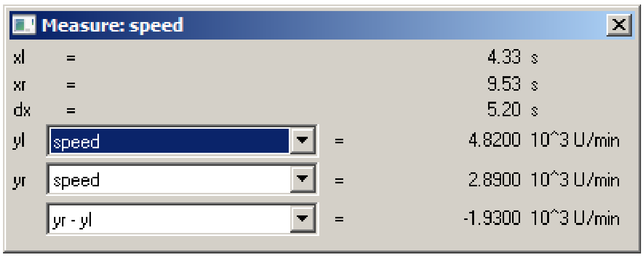
Here it is possible to edit, for instance, to smooth clip peaks from, simple signals. Thus, invalid readings can be removed from a signal and replaced with plausible ones, or distorted readings can be corrected, for example, by eliminating offsets or drifts.

These functionalities are only available off-line (in imc FAMOS).

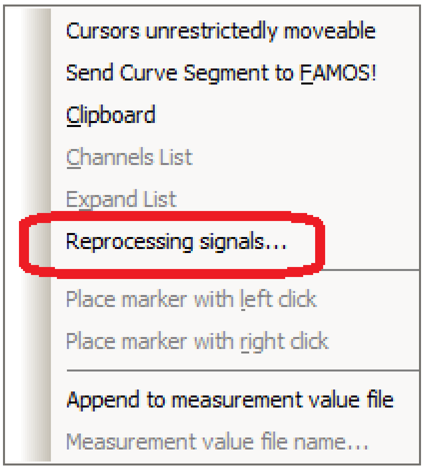
Mouse Operation

A channel is displayed in a curve window. A region is staked out using the measurement cursors, e.g. the region around a signal peak representing interference to be deleted. In the dialog called from the menu item *Reprocessing signals...*, a mathematics function is selected for applying to the staked-out region. When this function is performed, the channel's measured value are replaced by newly calculated values.

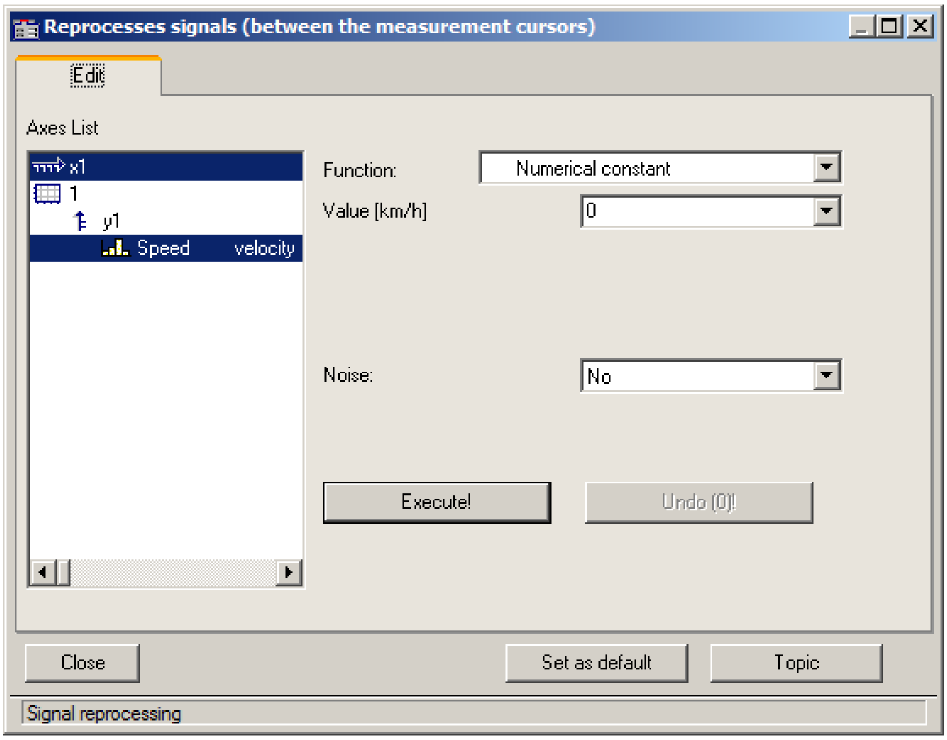
First, the Measurement value window is opened:



Next, this window's context menu is opened: move the mouse pointer over the measurement value window and right-click the mouse; the menu illustrated below then appears:



Select *Reprocessing signals*.... The following dialog is called:



Select in the left portion of the dialog the channels in the curve window to which the function is to be applied. On the right side, select the calculational function and the function parameter.

Use the measurement cursors to carefully delineate the desired signal segment.

When the *Execute!* button is pressed, the function is applied to the respective signal segment of the selected channels, which is delineated by the cursors.

The button *Undo* lets you reverse the last action taken.

Remarks

- Only simple data types can be handled in this way. These are equidistant data (constant sampling time, dx = constant) no having any additional structural pattern. In particular, it is not possible to process segmented waveforms, data with events, XY-data, data already subjected to Transitional Recording, Time-stamp-ASCII data, texts, and complex data.
- The data's original format is retained. This can mean that the value range is limited and stays that way, and that the math function can thus only be performed in approximation. For instance, if a channel's value range is -10V .. +10V with 2 Byte integer format, no value >10V can be displayed. Thus, an overdriven spline can be truncated at 10V. And it isn't possible to set the signal to 11V, instead it stays limited to 10.0V.
- Undo: Up to 30 actions can be reversed (undone).
- If invalid function parameters are specified, the function cannot be carried out. Instead, an error message appears.
- **The interval for determining boundary values may not be less than 0!**
- The dialog for reprocessing signals can only be opened for one curve window at a time. So if you wish to reprocess another curve window's signal also, first close the *Reprocessing signal* dialog in the first window.
- The dialog for reprocessing signals has no *Cancel* button. If the dialog is exited, changes made to the channels are retained. The *Undo* button is the only way to reverse changes that have been made.

- See the discussion of "Confirmation bar 1273" for more information on the operation of the *Set as default* button.
- If data in imc FAMOS are edited by means of the *Reprocessing signals*.. dialog, the display in imc FAMOS' data editor is not updated. The Data Editor should be closed during this time; it can be called again afterwards.

Description of the functions

The following is a description of all functions in the list *Function*. The functions are ordered by subject.

The subjects appear aligned to the left edge, e.g. *Adapts curve*. The functions themselves appear in the list with an indent, e.g. *Constant level based on right boundary*. Only functions can be selected.

Subjects

- *Adapt curve*: A connecting line, either a straight line or a spline, is inserted.
- *Re-define curve*: The curve is re-defined; for instance, as a specified constant level.
- *Smoothing*: e.g. low-pass filtering
- *Edit signal*: e.g. value range limiting
- *Edit trend*: e.g. add offset, eliminate trends, high-pass filtering
- *Noise*: Add noise to produce readings which "look convincing".

Please note also the description of the parameters *Noise* 1289 and *Boundary interval* 1289.

Adapt curve	Description
Constant level based on right boundary	The mean value of the right boundary interval (which see below) is taken. This value replaces all original readings in the delineated region. If desired, noise (which see below) can be added.
Constant level based on left boundary	The mean value of the left boundary interval (which see below) is taken. This value replaces all original readings in the delineated region. If desired, noise (which see below) can be added.
Connecting line	The respective mean values of the right and left boundary intervals are taken. These mean values are used as the boundary values for a straight line replacing the signal curve between the cursors (linear interpolation). If desired, noise (which see below) can be added.
Cubic spline	The respective mean values and average slopes of the right and left boundary intervals are taken. The mean values are used as the boundary values of a replacement curve between the cursors, and the slopes are used to form a cubic spline, which is a polynomial whose slope at the boundaries matches the slope of the original curve.

Re-define curve	Description
Constant numerical value	The delimited region can be replaced with a fixed numerical value to be specified. If desired, noise (which see below) can be added.

Smoothing	Description
Low-pass	Smoothing: A digital filter is applied to the readings within the delimited region, a low-pass filter of Butterworth characteristic. The filter order and cutoff frequency can be specified. The order can be set to between 1 and 10. The pop-down list presents suggestions for the cutoff frequency. The cutoff frequency must be substantially less than half of the sampling frequency for the data. The function works in a manner similar to imc FAMOS' FILTTP() function. Note that the filter has a transient oscillation and always produces a delay.

Edit signal	Description
Clip signal above	All readings in the region delineated are clipped to keep the curve below a specified maximum value.
Clip signal below	All readings in the region delineated are clipped to keep the curve above a specified maximum value.

Edit trend	Description
Add a numerical constant	Adds an offset. A fixed numerical value is added to all readings in the delineated region. This means adding an offset. To subtract, enter a negative value.
Multiplication	A fixed numerical value is multiplied to all the measured values within the staked-out interval.
High-pass	Eliminates offsets and slow drifts: a digital filter is applied to the readings within the delineated region, a high-pass filter of Butterworth-characteristic. The order can be set to between 1 and 10. The pop-down list presents suggestions for the cutoff frequency. The cutoff frequency must be substantially less than half of the sampling frequency for the data. The function works in a manner similar to imc FAMOS' FILTHP() function. Note that the filter has a transient oscillation.
Add a slope	Trend correction: a slope is added to all readings within the delineated region. The slope is a linearly increasing function. To define the slope, and amplitude is specified for the initial point (y-coordinate at left boundary of delineated region) and the amplitude at the end (y-coordinate at right boundary of delineated region). The values specified define the slope, which is then added to the readings.
Subtract linear approximation	Trend correction: a linear approximation is formed from all the readings in the delineated region. The least-squares method is used for this. The approximation The approximation is later subtracted from the curve in the delineated region.
Fade in/out	The signal can be faded in to or out from zero within the delineated region. For this purpose, the signal is multiplied with a ramp. Fading in is the typical case, from 0% to 100%. Fading out from 100% to 0% is another typical action which is possible. Both percentages can be specified. An entry of 100% corresponds to a factor of 1.0. These parameters appear in the dialog as Start, component [%] and End, component [%] as the values at the left and right boundaries, respectively. In between, the values are interpolated linearly. The two percentages supplied may not be either 0.0 or 100.0, but can take any other real value in between.

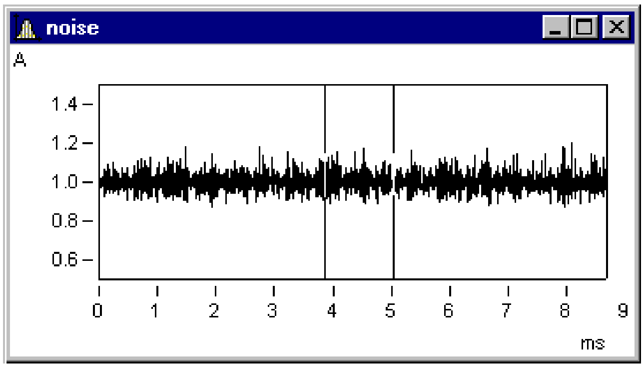
Noise	Description
Add boundary noise	The respective trend is eliminated from each of the boundary interval's signals. This is accomplished by subtracting the linear approximation calculated. What remains is interpreted as noise. This noise, cyclically repeated, is added to the readings in the delineated region. In the process, the noise at both ends merges by means of linear weighting over the width of the delineated region. The values within the boundary interval naturally remain unchanged.
Add equally distributed noise	Equally distributed noise of specified amplitude is added to the readings within the delineated region. If the amplitude is 1.0, random numbers in the range -1.0 ... +1.0 are generated and added.
Add Gaussian-distributed noise	A noise signal with Gaussian distribution (normal distribution), having a specified RMS-value, is added to the readings within the delineated region.

Boundary interval

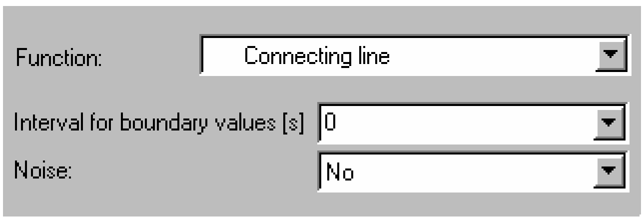
Many functions use the boundary values at the edges of the delineated region; for instance, all values within the delineated region are bridged by a connecting line or spline.

Now, it would be possible to simply use the boundary value itself for this purpose. However, this would not take the noise, which frequently is present, into consideration. The result of the function would be dependent on the noisy value at the region's particular edge, and this is largely a matter of chance. Therefore it would seem reasonable to take the mean of a small interval around the boundary, in order to reduce the influence of random noise. This interval should be, on the one hand, relatively small, but on the other hand still large enough to suppress the noise.

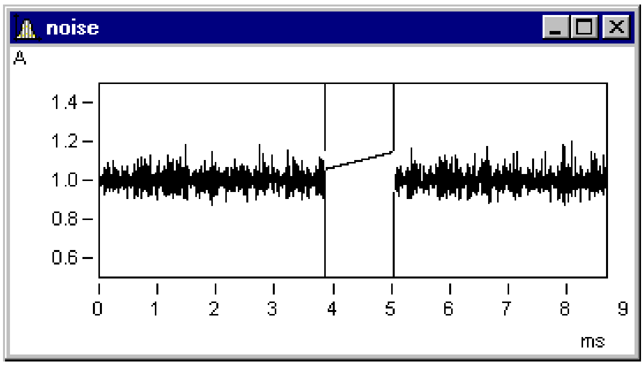
In the example below, the delineated region is to be replace by a straight line (between the boundary values):



In the dialog *Reprocessing signals*..., the following settings are made.

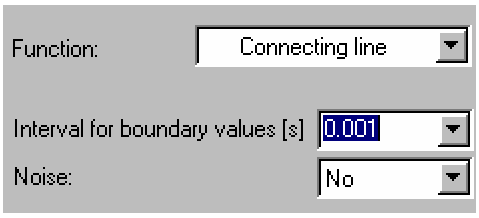


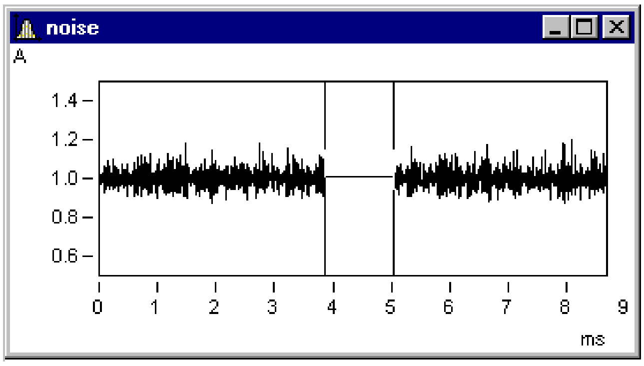
The following connecting line results:



This isn't what one would expect. By chance, the values at the edges (under the cursors) are random peaks.

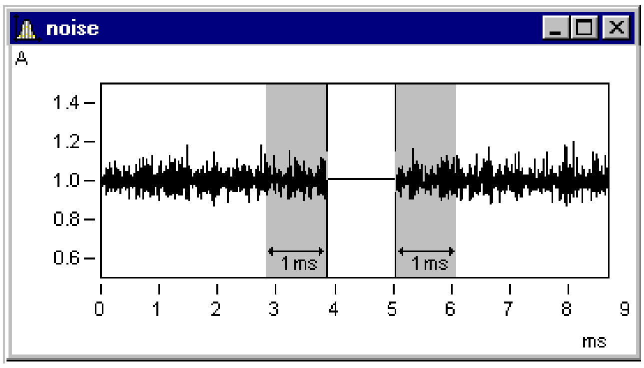
Setting a boundary interval of 1ms (0.001s !) produces proper results:





The boundary interval always is located outside of the delineated region:

Here, the boundary intervals are shaded in grey.



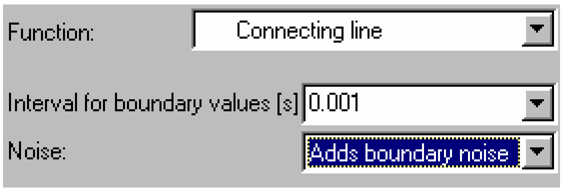
Remarks

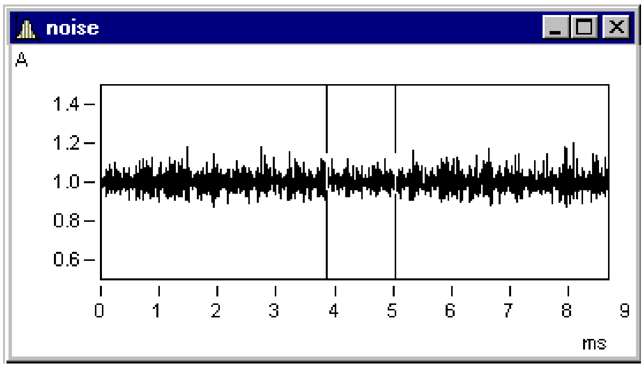
If 0.0 is taken as the boundary interval width, the value at the exact edge is used. Thus, the minimum width of the boundary interval is 1 reading.

Adding noise

To the sample signal above, it is now possible to add noise. Toward this end, the noise in each of the boundary intervals is determined. This noise, cyclically repeated, is then added to the delineated region. Between the noise signal on the left and that on the right side, a smooth transition is accomplished by linearly increasing weighting along the width of the region.

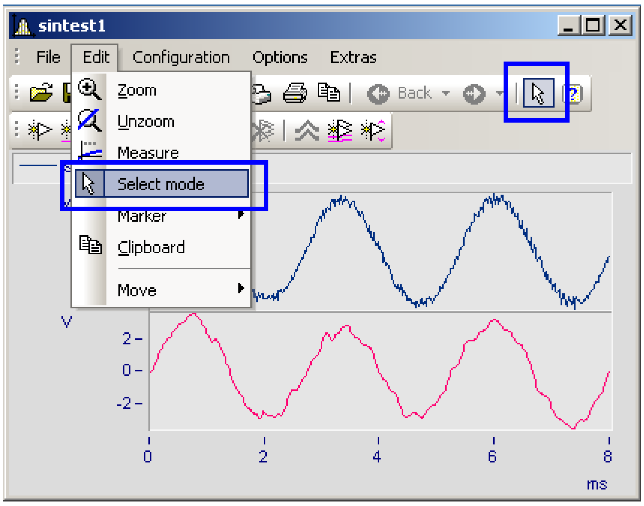
With the following setting, noise from the boundary intervals is added to the delineated region. This produces a realistic signal appearance:





11.6.7.4 Select mode

The *Select mode* enables the user to select legends, coordinate systems, axes, lines and markers by means of the mouse. *Select mode* can be activated/deactivated either via the *Edit* menu or the toolbar. Alternatively, it is possible to activate/deactivate Select mode by double-clicking over a region where there are no objects, for instance in the middle of a coordinate system.



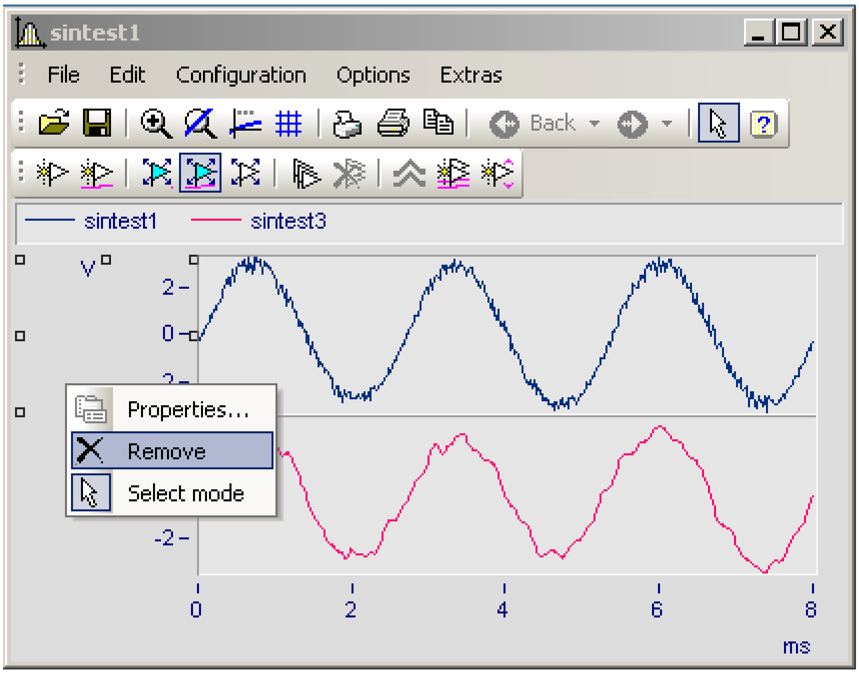
If you are in *Select mode*, the current object is highlighted. This is indicated by the presence of small empty squares at the object's edges. Any lines not selected appear dulled in color.

Multiple selection is possible by making a selection using the left mouse button while holding down the CTRL-key. However it is only possible to join up objects all of the same type (lines or axes) in multiple selection.

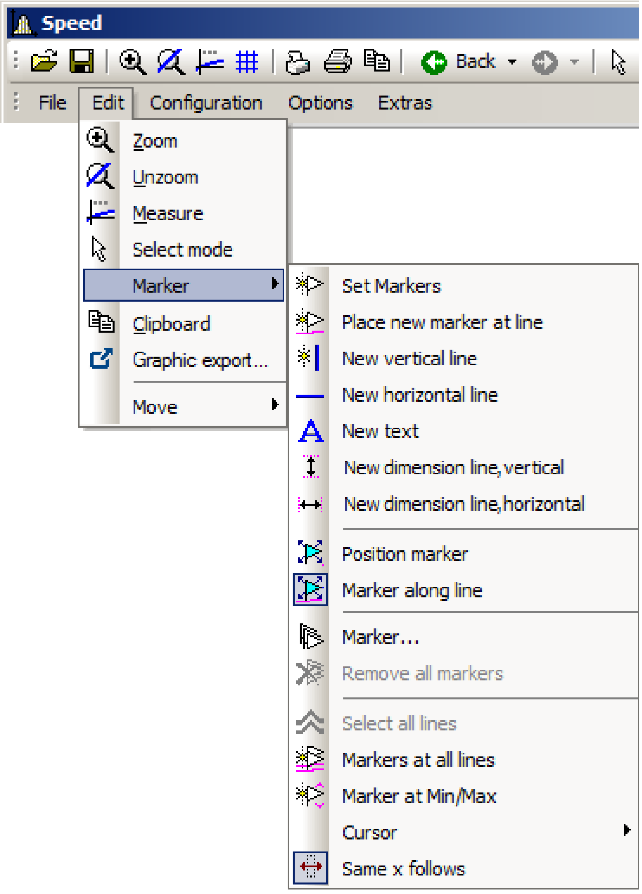
Among other things, the context menu contains the function *Delete*. This is only available if objects which can be deleted are available, such as a second y-axis. If such an object is deleted, any associated objects are also deleted. In the example, the lines in the deleted y-axis would also be deleted.

Example

You select the upper y-axis and deleted it. In the process, the sintest1 lines with which it is associated are also deleted.



11.6.7.5 Markers



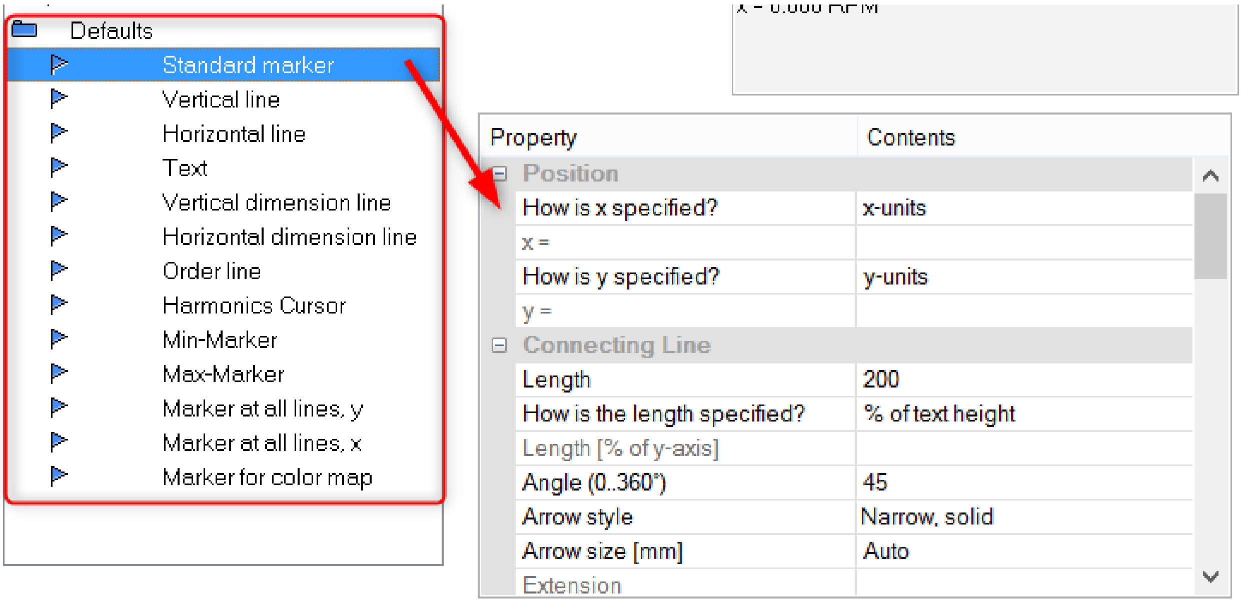
Function

A marker is a designated point in a curve window, to which a text can be assigned. The point itself is not visible, but a line with an arrow may point from the text to the point. The text can be enclosed in a frame; various characteristics can be established for the lines and font for each marker, such as color and size.

Defaults

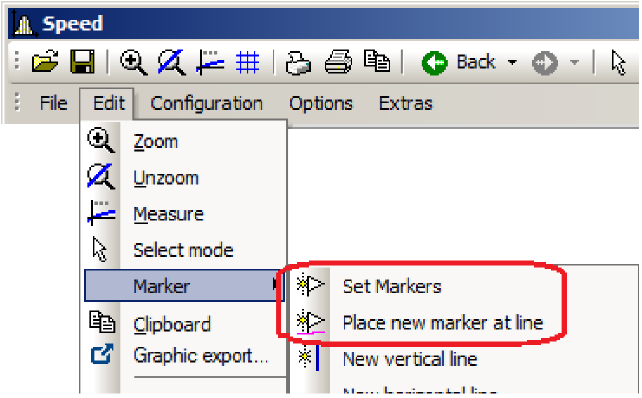
All marker types are described below. Each type has particular default settings which are applied when the marker is inserted.

You can customize these individually by modifying the parameters for the selected marker type.


Defaults
Standard marker
Vertical line
Horizontal line
Text
Vertical dimension line
Horizontal dimension line
Order line
Harmonics Cursor
Min-Marker
Max-Marker
Marker at all lines, y
Marker at all lines, x
Marker for color map
Property
Contents
Position
How is x specified?
x-units
x =
How is y specified?
y-units
y =
Connecting Line
Length
200
How is the length specified?
% of text height
Length [% of y-axis]
Angle (0..360°)
45
Arrow style
Narrow, solid
Arrow size [mm]
Auto
Extension

11.6.7.5.1 Set Markers

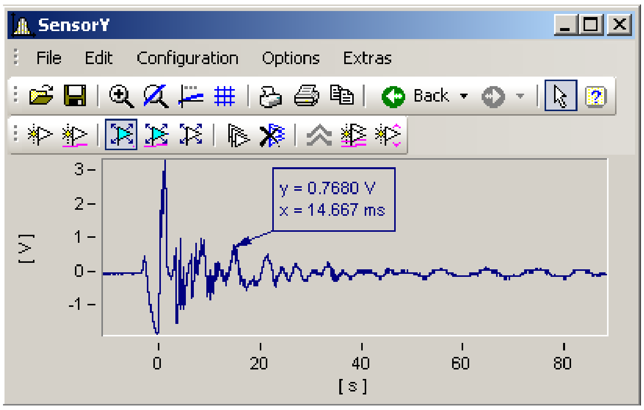
There are two ways of setting a marker, which are accessed either from the Marker toolbar or via the menu item *Edit/ Marker*.



Set Markers ()

This function lets you generate markers at any desired position. If the function is selected, the cursor is represented by this symbol (), which disappears again after the marker is set.

Click to the point in the curve window to be marked. A dialog box is promted in which marker characteristics can be established. If no settings are made and the dialog is ended with <OK>, the x- and y-values of the marked point are used as the marker text. More about Marker Definition 1304.



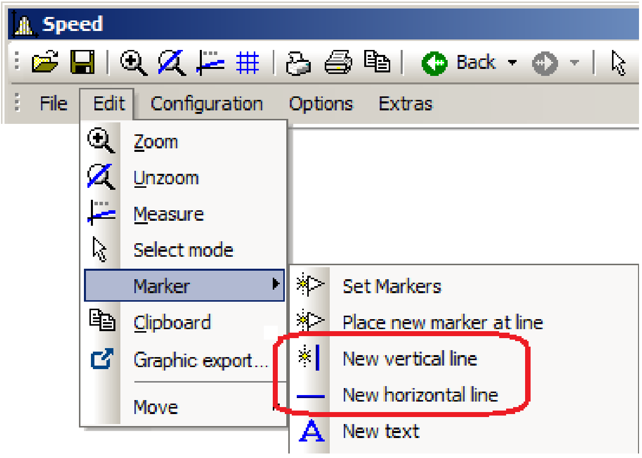
Markers can be placed anywhere in the curve window. Zoom more intensely if a marker should be placed near a line. Accuracy depends on the resolution. To place a marker exactly at a certain point in the curve, select the function *Place new marker at line*.

Place new marker at line ()

This function only helps to generate markers at lines. If the function is selected, the cursor is represented by this symbol (), which disappears again after the marker is set. The marker automatically snaps to the next closest line and then moves in response to cursor movements only along the line, until the cursor approaches another line.

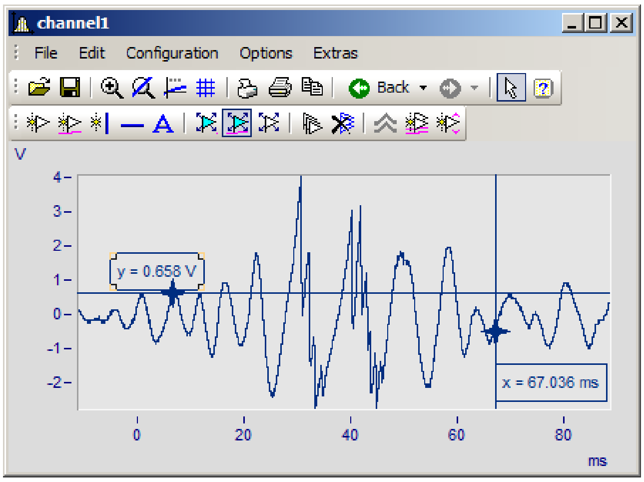
Both modes can be exited by a click of the right mouse button.

11.6.7.5.2 New line

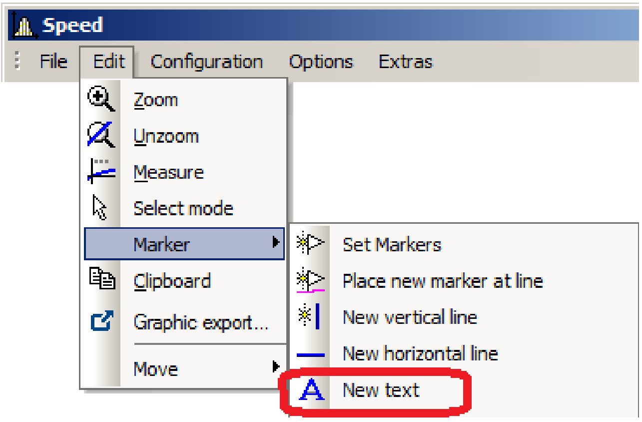


Vertical line new and Horizontal line new

Use these to create vertical or horizontal lines. The location is displayed as an amplitude or x-position in the text box. If the text box attaches directly to the line, it can be moved along the line. Drag the box further away from the line, it can be placed freely at any location.



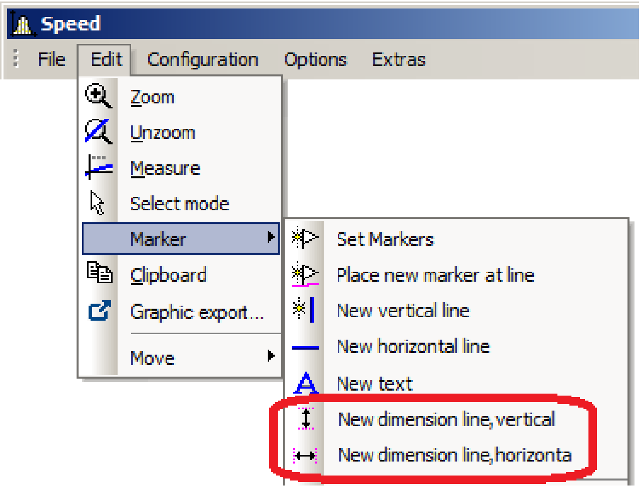
11.6.7.5.3 New text



New text

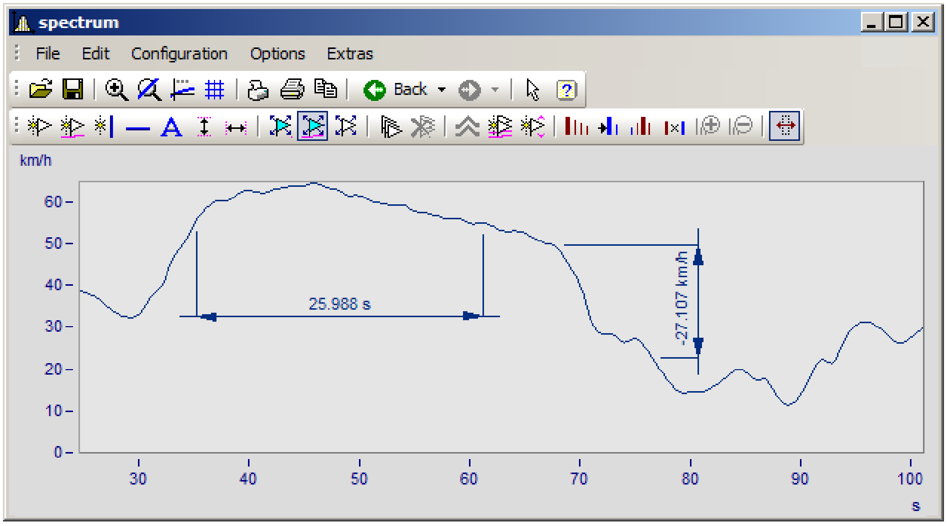
A text box without an arrow can be placed freely. Otherwise, the same settings are available as for markers.

11.6.7.5.4 New Dimension Lines

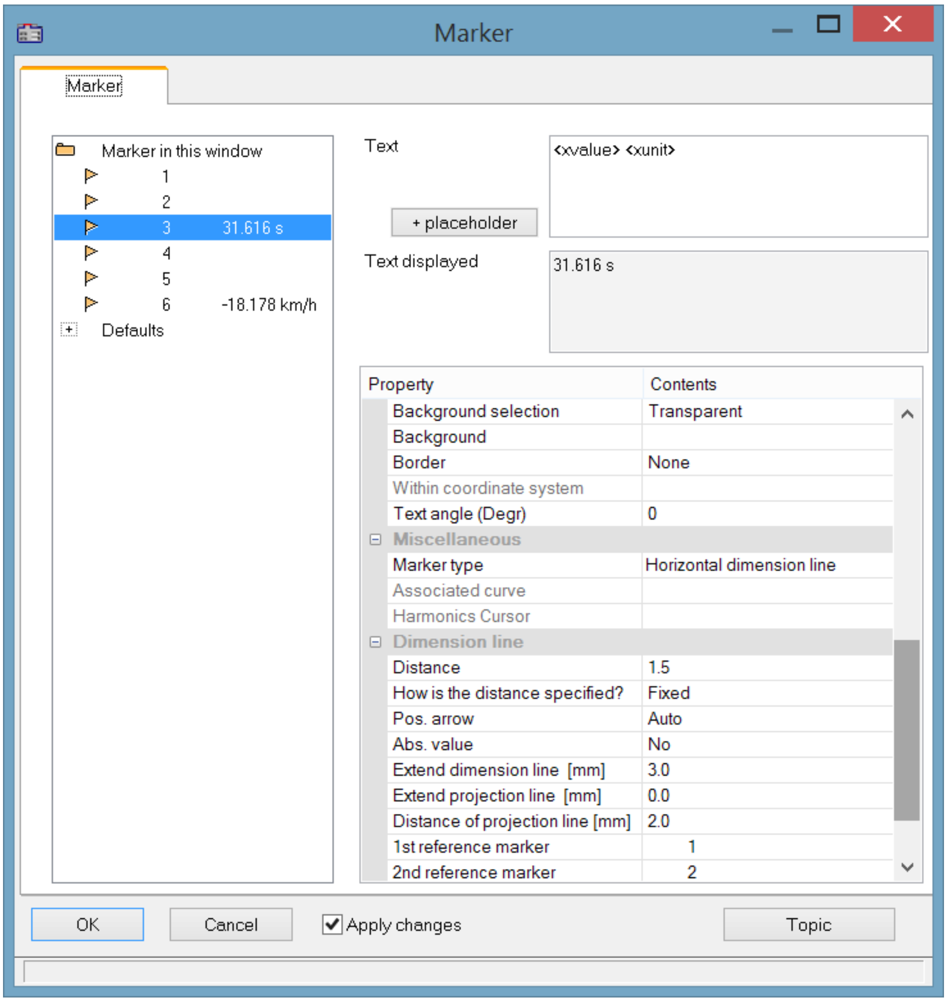


New Dimension Line: vertical and New Dimension Line: horizontal

Select this entry to create a vertical or horizontal dimension line between two points in the curve window where you click the mouse.



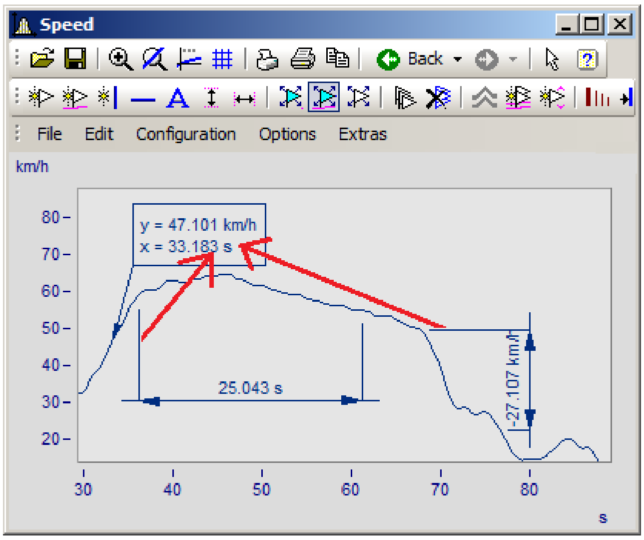
You can change the width of the dimension lines using Drag & Drop. The placement of the legend as well as of the line is positioned by Drag & Drop. Making settings for the markers is done as shown below:



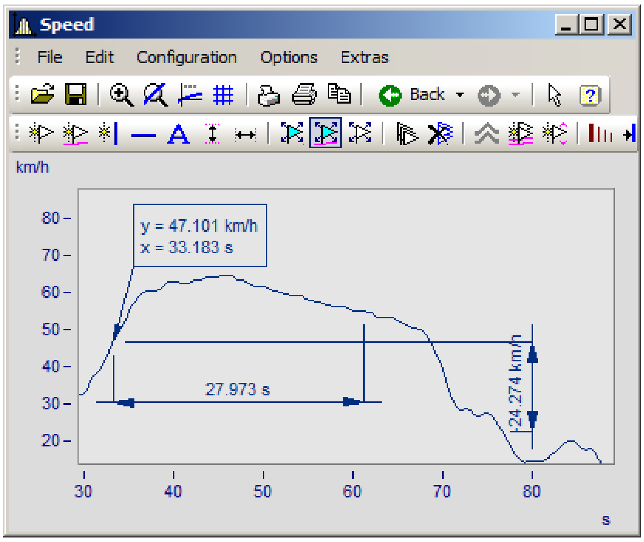
Position

Reference marker: A dimension line is defined by three entries for the marker: two reference markers (1, 2) and the actual line arrow and legend. If other markers are already in the curve window, these can also be used. Assignment of the markers is made by means of the list boxes for the 1st and 2nd reference markers. Alternatively, use Drag & Drop in the curve window to move a dimension line's extension lines to the existing marker.

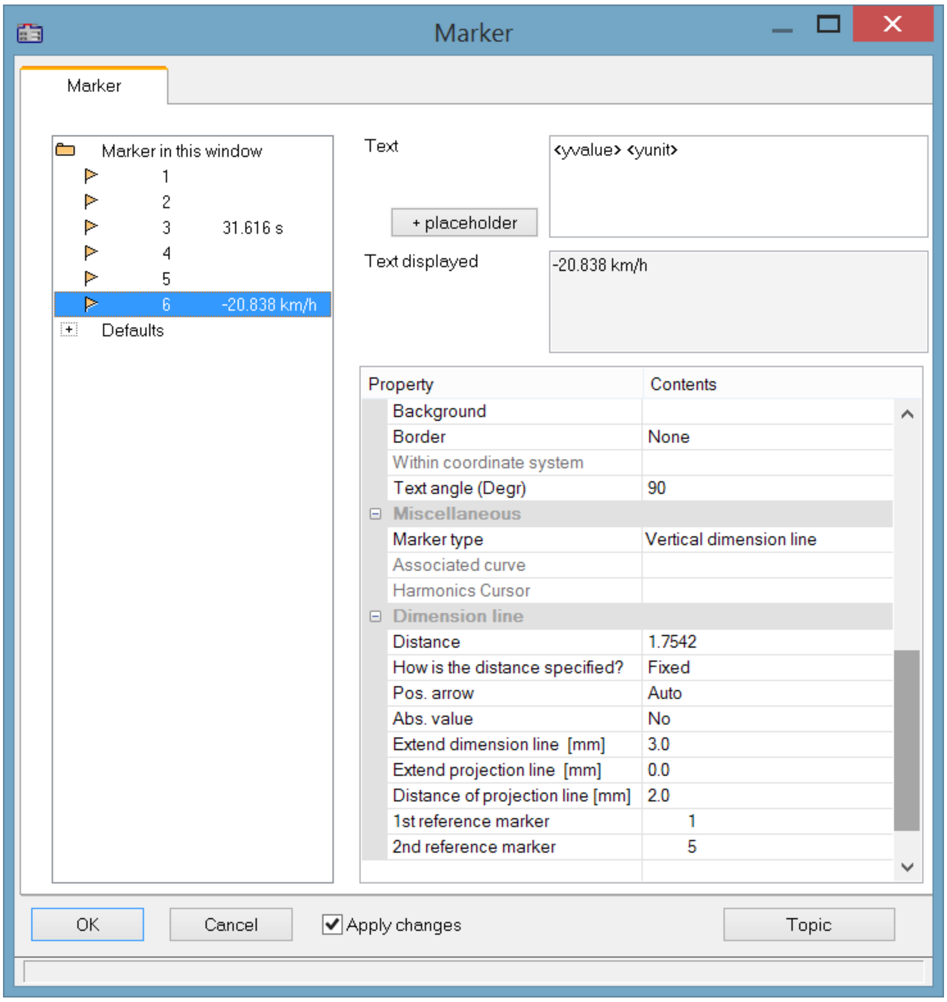
The example below shows how two dimension lines are linked to a marker. When the marker is subsequently moved, the dimension lines are adapted automatically.



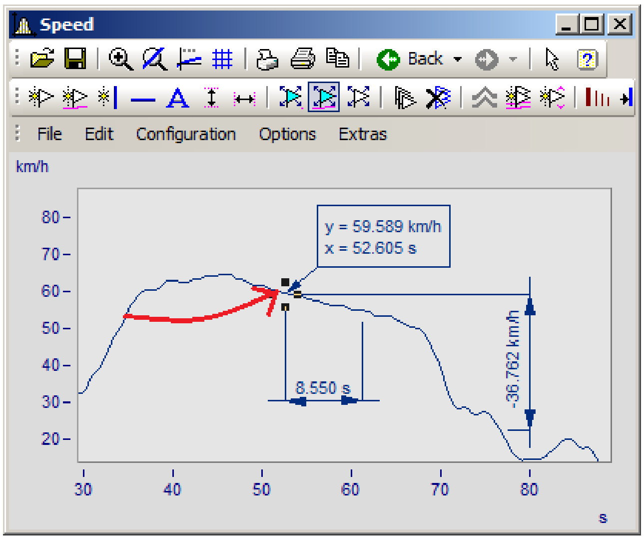
The marker and dimension lines are not yet linked. The extension lines are dragged to the marker.



Now the marker and the dimension lines are linked with the marker.

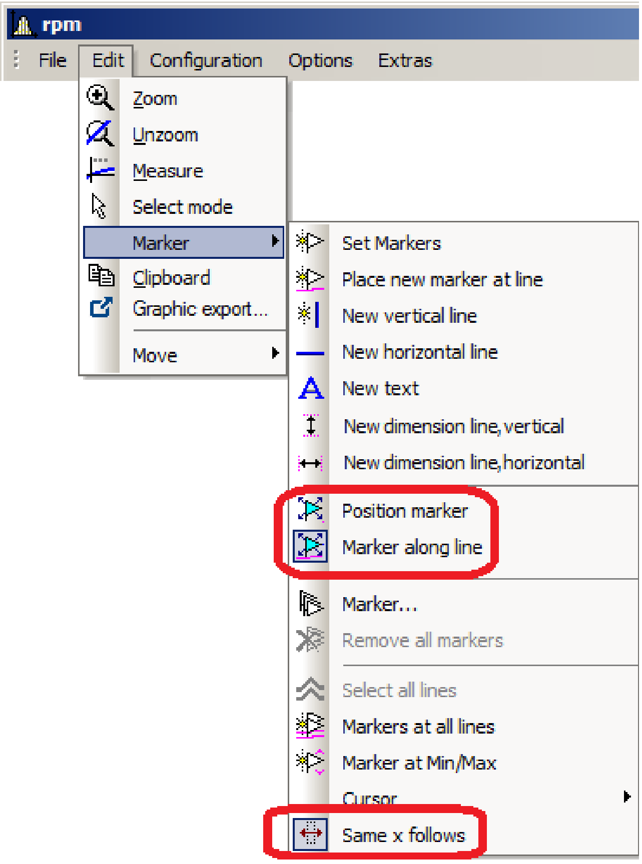


In the definitions dialog, the reference marker for the dimension lines is now linked with the marker.

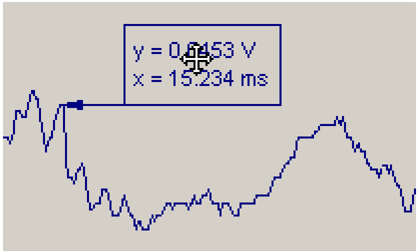
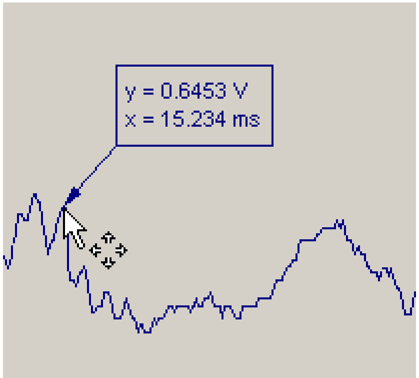


Now, when the marker is moved, the dimension lines are updated.

11.6.7.5.5 Move Markers



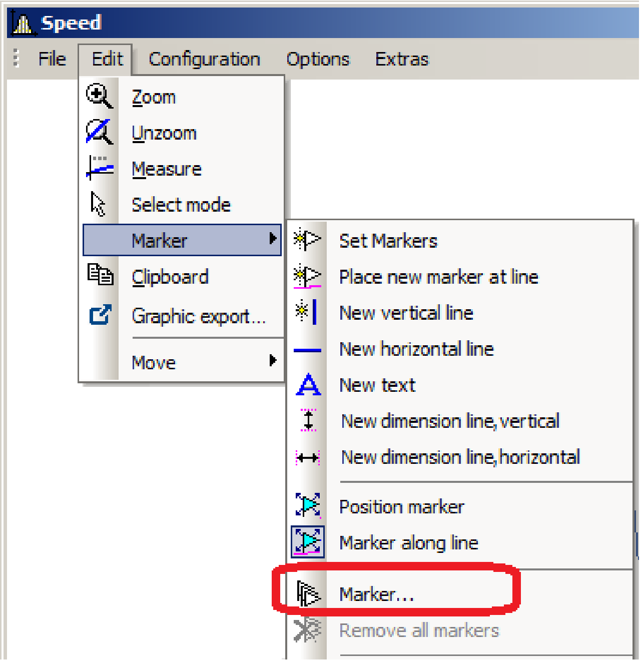
There are different ways to change the marker position:

Action	Description
Position Marker	This function lets you move a marker freely, while the marker text is automatically updated to reflect the respective new position.
Marker along line	This function lets you move a marker along a line, while the marker text is automatically updated to reflect the respective new position. If there are multiple lines in a curve window, the marker snaps to the line closes to the cursor's location.
Move label	In order to move a marker's label, bring the cursor near the label or the arrow, so that the cursor changes shape as shown below. 
Move marker	Existing markers can be moved subsequently. To do this, use Drag&Drop to move the arrowhead point. 
Same x follows	Markers assigned to the same x-position can be moved jointly by means of this function. To do this, move a marker. The markers having the same x-position are moved along with it automatically.

Remarks

- Markers are assigned only to the curve windows, not the waveforms.
- In order to save markers, the curve configuration must be stored as a CCV file.
- Markers already established for a curve window may become meaningless if additional curves are modified or the XY-display is redefined. These markers can be deleted

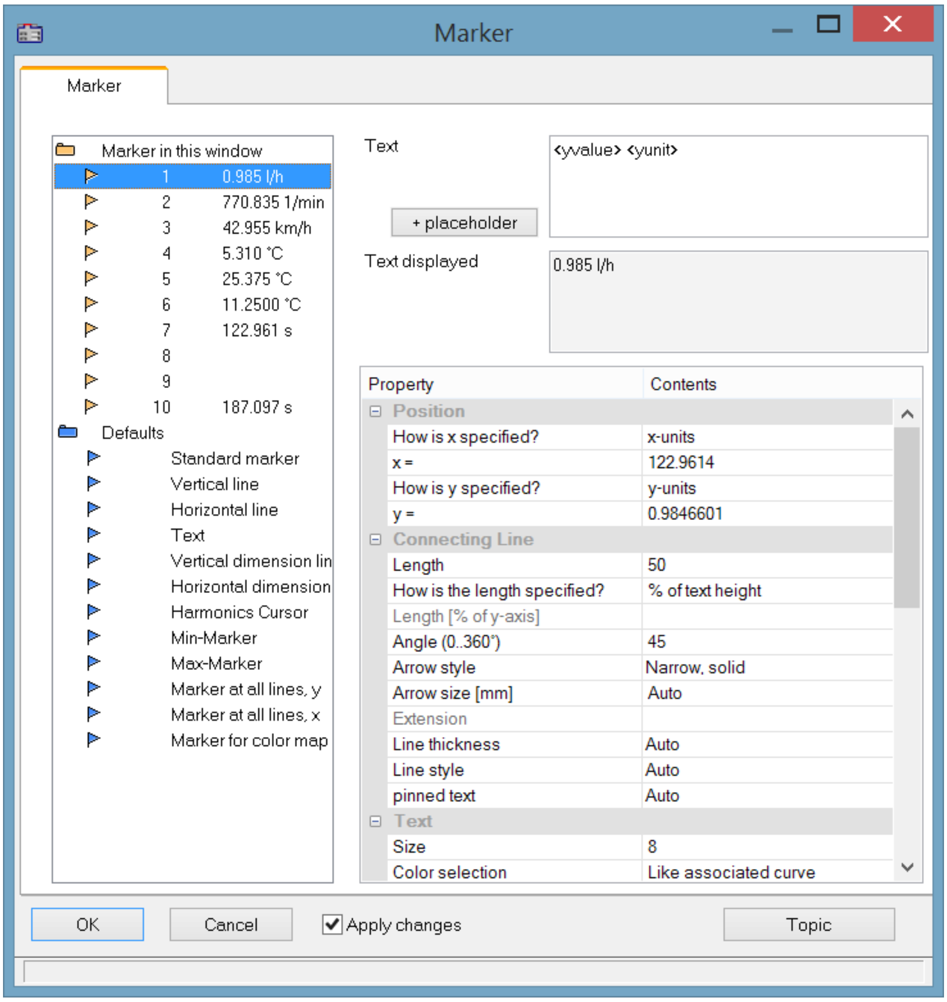
11.6.7.5.6 Marker Definition



Function

Displays the properties of the markers created.

The following dialog appears if a marker was set in a curve window:



The list of markers, in which all markers in the curve window are listed, is found in the upper left box in the dialog.

Select an entry from the list to change the settings for the corresponding marker. Several markers can be selected by dragging the mouse across the entry or clicking several times on the entry while holding down the <CTRL> button.

The Marker-**properties** are listed at right in a table and are set using the column at right.

Marker type

Along with the usual markers having arrows and a text box, the following marker types are available:

- Vertical and horizontal lines
- Text
- Vertical and horizontal dimension lines

Normally, the type is determined already when the marker is set. By means of this combo-box, it can be changed subsequently.

Position

Determines the marker's position. By default, the position is specified in the coordinates of the curve to which the marker is assigned. In addition, the numerical value can also be specified in x- or y- units, or in percentage of the x- or y-axis. Select the corresponding entry in the combo box to the right of the number boxes. When specifying the numerical value in percentage of the axis, 0% is at the lower left, 100% at the upper right of the coordinate system. This allows markers to be defined so they are always visible in the curve window, regardless of the scaling. This is useful for comments, which needn't necessarily be assigned to a certain line in the coordinate system.

When changing from dB display to linear display, the axis coordinates change and the markers slip from their position. The scaling should be determined before the markers are specified.

Connecting line

The connecting line between text and marker is arranged in this group.

Settings	Description
Length	The length of the connecting line between the text and the marker. It is specified either in x-units, y-units, in percent of axis length or in percent of the text height. The last option is recommended. All value specifications should be in scientific notation with units, meaning that the exponent must be indicated. For a length of 0, no line is drawn. If an arrow is set, the length of the line is the entire length for line and arrow. If the line is shorter than the arrow, the arrow is drawn completely.
Angle: (0...360°)	The angle of the connecting line can be set between 0° and 180°. The line is horizontal if an angle of 0° is specified. This means that the line can be set to run in any direction.
Arrow	The line between marker and text may have an arrowhead at the end of the marker. The size and type can be selected: • none • wide • narrow • wide, solid • narrow, solid • large • large, solid • circle • Point • Diagonal dash • Star • Default The size of the arrow is oriented to the size of the symbol, see also "Clipboard settings 1336".
Line thickness, Line style	Settings like for Lines 1223. At printout, the line appears in the thickness of the cursor-line, see Clipboard Settings 1336.
Text corner	Position of the text box (upper right, upper left, lower right, lower left)

Text

The text specified in the text window is assigned to the marker, and can consist of several lines. Press <CTRL> and ENTER to enter a new line. If a marker is created, this text is already defined as the x- and y-measurement values. This text can be overwritten.

Placeholder

The edit box initially contains the placeholder *<auto>*, which by default represents the y and x-value. This entry can be supplemented/replaced with the following placeholders:

Placeholder	Description
<xunit>, <yunit>, <zunit>	Display of the x-, y, or z-unit
<xvalue>, <yvalue>, <zvalue>	Display of the marker's x-, y, or z- component. For xvalue, mostly the time value in the x-axis' formatting.
<name>	Display of the variable's/channel's name
<comment>	Comment on the variable
<xtimeofday>"	Display of the marker's time. For this purpose, the x-axis must represent absolute time.
<xdate>	Display of the marker's date. For this purpose, the x-axis must represent absolute time.

Placeholders for values, with specified precision level

Placeholder	Description
value:**fx** e.g. <yvalue:f2>	Num#ber of digital positions (0..15); in the example 5.34211 -> `5.34`
value:**fxpy** e.g. <yvalue:f2p3> <yunit>	Specified number of decimal places and order of magnitude as exponent of 10. The exponent of 10 is only displayed along with the unit. In this example, 3556.23 becomes `3.55 10^3 RPM`.

Note

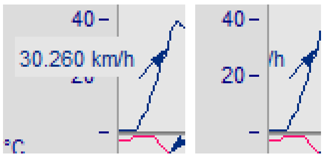
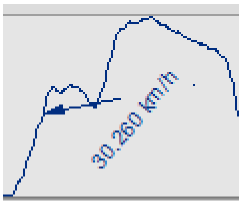
- Greek letters 1360 can also be displayed.
- Numbers without a unit sometimes come to a misleading representation:

Example:

31.000.000 represented with <yvalue: f0p6><yunit> is displayed as 3110^{6}

A multiplication sign or blank space creates clarity:

<yvalue: f0p6>*<yunit> -> $31*10^{6}$

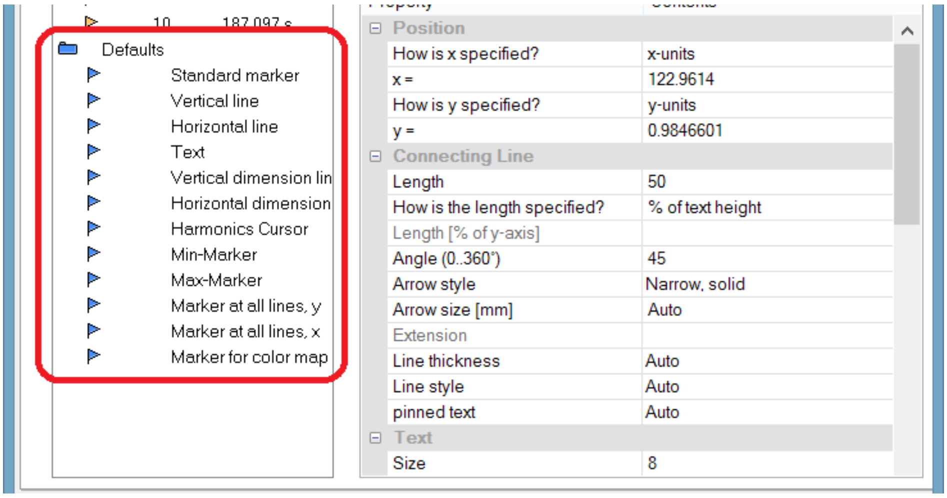
Settings	Description
Size	The size of the text can be defined in points. In general, a 12-point font can be read quite easily. The font specified in "Clipboard settings..." is the font used for printing. A true-type font should be selected. The standard font set for the curve window is also used for the monitor screen (see "Presettings 1343").
Color	The color can be selected as absolute (e.g. red) or relative. A relative color definition refers to a color already defined for the curve window. For example, if the color of the first curve in the window is selected, it is possible to select another color for the printout and the screen.
Background	The background of the text can be in the same manner as the text color. A transparent background is also possible, so that lines behind the background are not completely hidden.
Border	The text may have a border around it. Various options are available for the border joining the connecting line with the marker: • *none, simple, pointed (trapezoid-shaped), double border*
Within coordinate system	When the text box is located at the edge of the coordinate system, you can decide whether it overlaps the edge or whether it is clipped. 
Angle text (Degr)	Angle of the text box up to ±90 degrees. 

Delete

All lines selected in the marker list are deleted.

Edit defaults

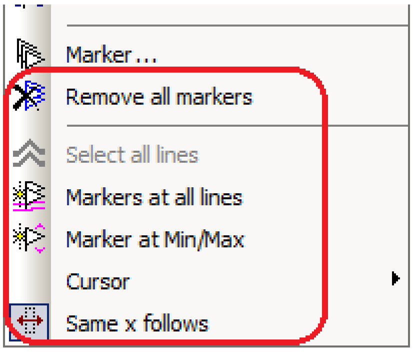
The ***Defaults*** for the *Marker types* are listed at left links and can be edited at any time using the Properties table.



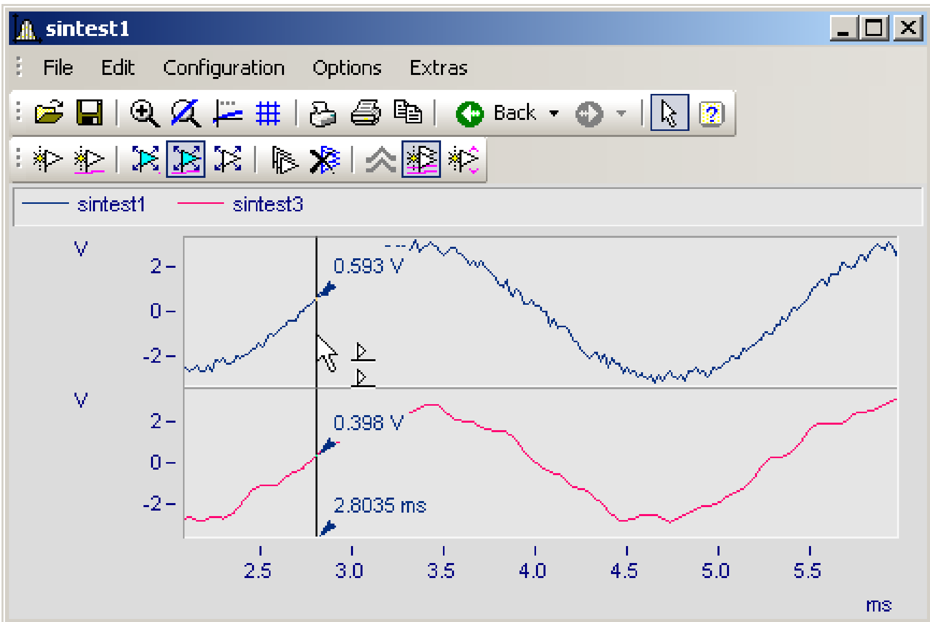
Remarks

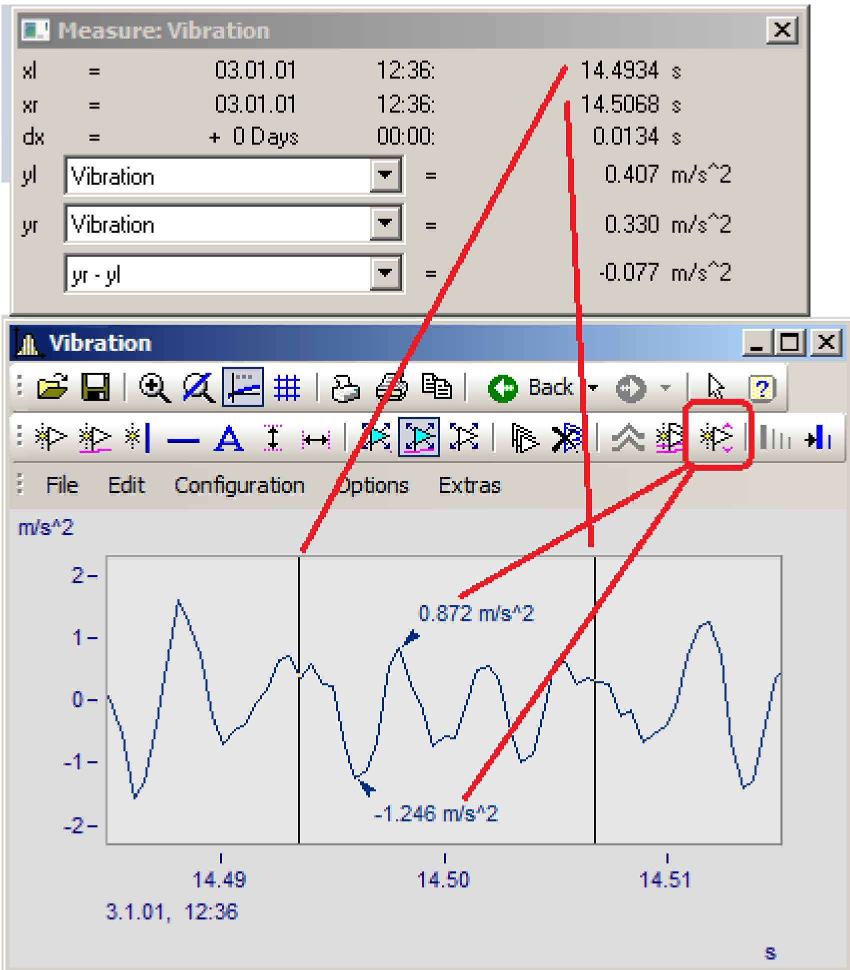
- If several markers are selected in the list, the characteristics for all of the selected markers are indicated. If a characteristic differs among the separate markers, this is indicated by "???" in the corresponding box. If a characteristic is changed, this change is effective for all selected markers.
- An inapplicable entry in a text box is ignored.
- When changes are being made in a dialog, they are implemented immediately and displayed. They can be seen immediately when the dialog is <Shift>ed next to the curve window. If the curves are very long and the on line-update is too slow, the curve window should be placed so that the graphics can no longer be seen when working in the dialog. It is recommended to use a transparent display for the representation in a waterfall diagram.
- Markers already defined for the curve window may lose their meaning if the curves are modified or XY-plots are redefined. These markers should then be deleted.
- The definition of markers is recorded when the curve window configuration is saved. The markers are also reloaded when a configuration is loaded. However, the markers may not be visible in the window because the settings do not fit the window or the curves.
- To design markers which are not device-specific, the colors should not be specified as absolute. Use instead a default or a color in the curve window (e.g. the color of the first curve). The default itself can be dependent on the device. The same is true of the font size and the line characteristics.

11.6.7.5.7 Extra marker functions

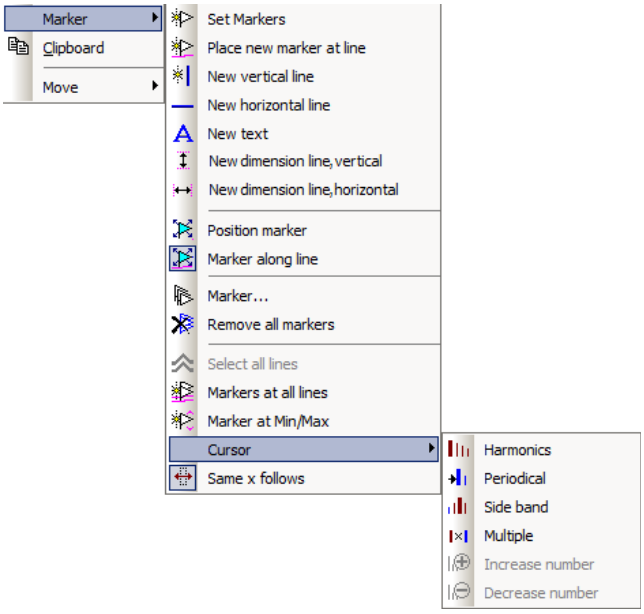


There are four additional marker functions available:

Menu item	Description
Delete all markers	With this function, all markers set in the curve window can be deleted at once.
Select al lines	With the Select mode active, this function selects all lines in the curve window.
Markers on all lines	Set markers at all lines or at all lines selected in the Select-mode. Select the lines desired an click on the symbol in the toolbar. A vertical line appears which extends across the entire curve window, even when multiple y-axes are stacked one above the other. The line denotes the y-value and the x-value on the y-axis. Simply move the line with the mouse and confirm setting of the marker at the desired position by clicking the mouse. The position of the markers as well as their labels can be moved as desired, just as described in the section "Set Markers 1302". 

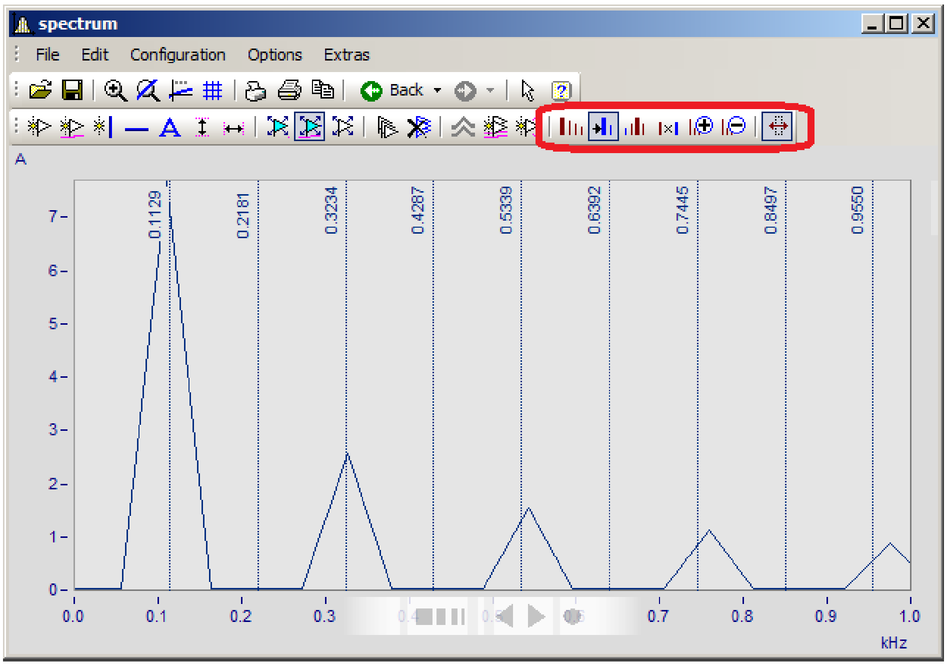
Menu item	Description
Markers at Min/Max	Markers are set for the maximum and the minimum of the line selected. If multiple curves are in a curve window, the function only applies to the line selected. As described in the section "Move Markers 1302", the marker's position and its label can be moved as desired. The function only affects the selected time segment. For this reason, zoom on to the region before setting the marker. If the "*Measure*" function is also active, the system finds and denotes with markers the minimum and maximum just between the two measurement cursors. 

11.6.7.5.8 Harmonics cursor

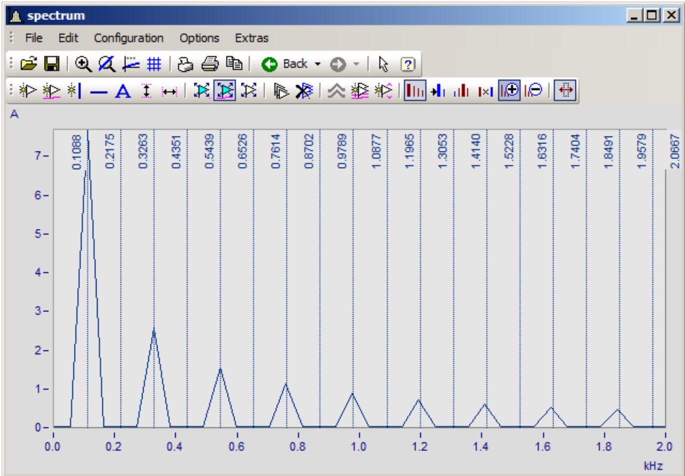
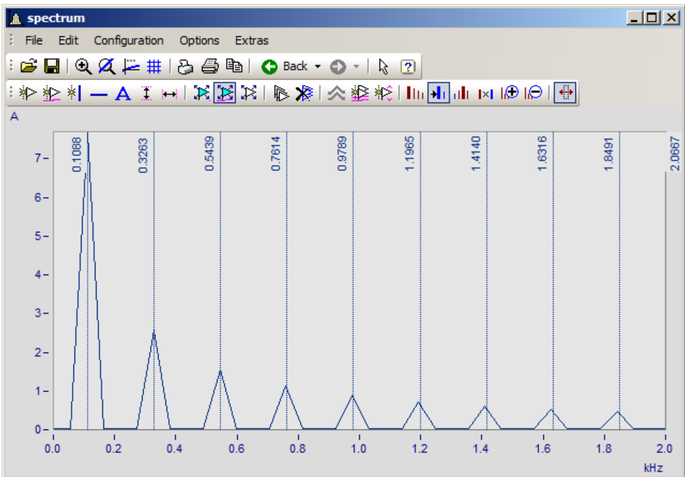


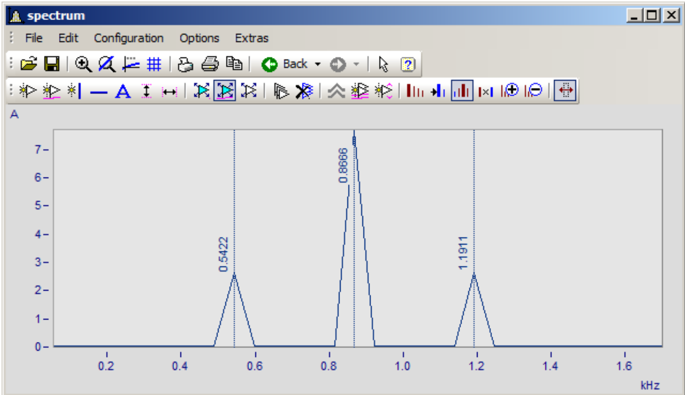
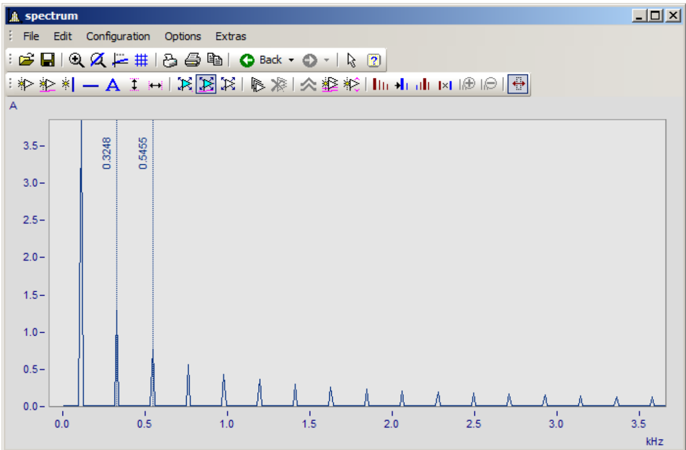
Function

Harmonic cursors indicate periodic multiples of a fundamental frequency. Set the marker at the position of the fundamental oscillation. The position can be readjusted subsequently, if desired.

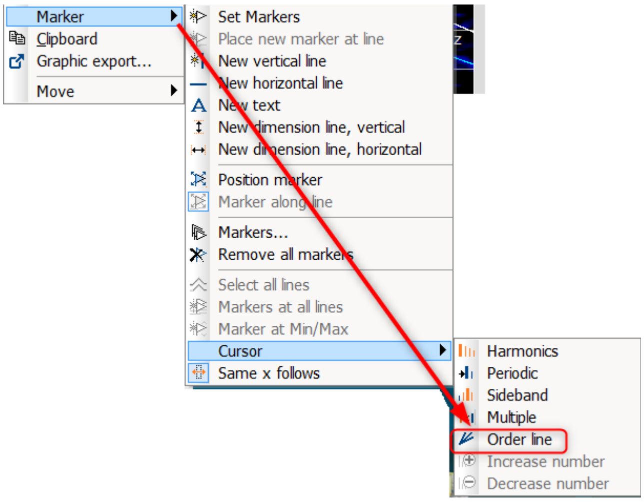


The following types are available:

Menu item	Description
Harmonics	Fundamental oscillations with harmonics. 10 equally spaced markers are inserted. Place the fundamental oscillation. The subsequent harmonics follow the fundamental oscillation by the respective multiple. The fine adjustment is performed by moving the upper harmonics. 
Periodic	Periodic processes with arbitrary start time. The fundamental frequency can be freely placed. The distance between the harmonics is independent of the fundamental oscillation. 

Menu item	Description
Side band	Fundamental oscillation with side bands. 10 equally spaced markers are inserted. Position the fundamental oscillation. The harmonics which follow the fundamental oscillation by the respective multiple. Fine adjustment is performed by moving the upper harmonics. 
Multiple	Distances at a fixed ratio. Two frequency lines which can be freely positioned. 

11.6.7.5.9 Order lines



Calling the Marker dialog for order lines

Function

The amplitudes of RPM-dependent vibrations can be displayed by means of various color diagrams.

When the amplitudes are plotted over the RPMs, the correlation becomes visible as straight **order lines**, which begin in the origin of the coordinate system. Frequencies which are independent of the RPMs appear in this diagram as horizontal lines of constant frequency.

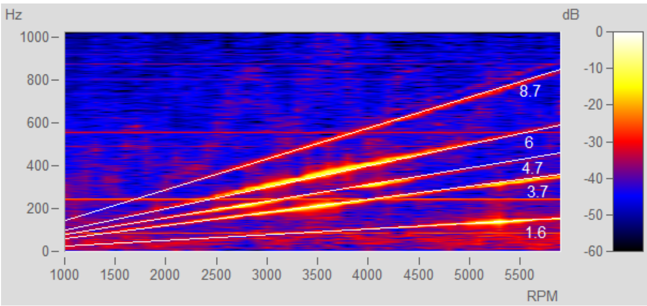
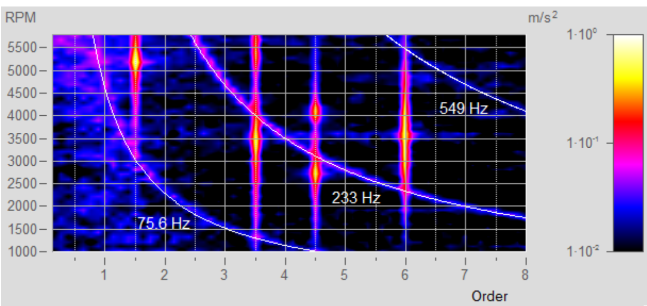


Fig. Amplitude spectrum with frequency over RPMs

In the Markers dialog, these order lines can be highlighted and labeled. Clicking on the marker symbol "*Order line*" creates the first marker, applying the presets for calculating "*Order line in the RPM-spectrum*". Subsequently, you open the marker definition dialog by double-clicking and you can design the display.

Calculating the diagram over these orders, they appear as vertical lines. Fixed frequencies are distorted to **hyperbolas** by these conversions.

For the example shown here, setting for the calculation in the marker definitions must be "*RPM and Order*".



RPM and order with hyperbolas

As with all markers, the text belonging to the line can be designed with placeholders, freely defined texts and custom formatting.

The line's position can be moved manually using the mouse. As a snap grid, the parameter *Multiple of* in the section *Order line* is used.

New hyperbola markers get the value of the highest frequency line x120% as initial frequency - and this to the next grid *Multiple of.*

The most important properties of this *Marker-type: Order line* are:

Property	Contents
⊟ Miscellaneous	
Marker type	Order line
Associated curve	At the first y-axis
Harmonics Cursor	
⊞ Dimension line	
⊟ Order line	
Parameter	6
Calculation	Order line in the RPM-spectrum
Start of the line [%]	0
End of line [%]	100
Labeling position [%]	95.079
Multiple of	0.1

Order line

Calculation with unit over unit

Order line in the RPM-spectrum

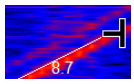
RPM over frequency
Frequency over RPM (=default)
Angular frequency over frequency
Frequency over angular frequency

Hyperbola in the order spectrum

RPM and order (=default)
Angular frequency and frequency

Parameter is the value of the order or of the constant frequency which appears as a hyperbola. This value determines the position and is represented by the placeholder *<yvalue>* and formatted accordingly, e.g. *<yvalue:f1p0> Hz*

Start/End of line [%]: Determines whether the line is to be drawn up to the edge of the coordinate system (0-100%) or should keep some distance from it (e.g. 5-95%). The ends of the line can also be edited graphically using the mouse.



Labeling position [%]: This value specifies the position in percent of the visible order line length. The text can also be positioned manually using the mouse.

Multiple of: When the order line/hyperbola is moved, the position snaps to multiples of this value. When changing *Multiple of*, the parameter in the curve window is updated immediately, but not in the properties table. This allows further editing of the value in the properties. With Ok of the properties or click on the marker list the parameter is accepted.

Additionally, the section *Text* offers the usual formatting properties for texts, and in the section *Connecting Line* there are parameters such as *Line thickness, -style* and *Text angle*.

Note	Order lines

- The first order line applies the presettings for the marker-type Order Line 1293. You are able to format these according to your wishes. If any order lines are added, the settings for the previous order line are applied.
- It is possible for a marker to be inserted in the range which is not visible, e.g. if an order spectrum was calculated only for a range of 2000-4000 RPM. In this case, the marker must be given a parameter value in the visible range by means of the marker definition.

11.6.7.6 Clipboard and Graphic export

Function

The graph displayed in the curve window can be sent to the Windows clipboard. The clipboard is a Windows tool which allows applications to exchange data in any form, e.g. text or graphics.

With the menu item *Edit\Graphic-export..* 1334. the graphic can be saved as a file in an image or PDF format. The default settings 1348 are taken into account here. For example, it is possible not to overwrite an existing PDF file, but to add the new graphic to the document.

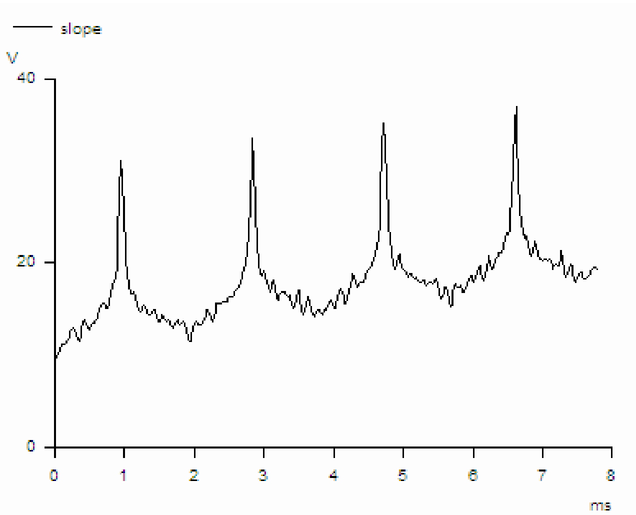
When one application sends graphics to the clipboard, another application can read and retrieve these graphics from the clipboard. In general, data are not damaged when they are read from the clipboard, which means that applications can retrieve the same graph as often as desired. Existing graphics are replaced when an application sends new graphics or text to the clipboard. Only the last information sent to the clipboard can be read.

In the case of curve windows, graphics are sent to the clipboard in the form of a memory-resident metafile. A meta file is a standard format defined in Windows and is supported by many applications. The meta file does not contain screen pixels; instead it describes the graphics using a multitude of vectors. This creates a high-resolution graphic display which can be arbitrarily scaled up or down.

Graphics sent to the clipboard can be read by text processing or desktop publishing programs. In that environment the graphics can be combined with text and other graphics to create documents to be printed by any printer or plotter supported by Windows. Graphics are printed in the best resolution possible for the output device.

Graphics are created in the fashion specified in the menu option "Options/ Clipboard settings...". The specified size, font and line width are used to format the graphics.

Graphics can be output to the clipboard in color or in black and white. Have regard for the color setting possibilities, especially the printer's. The curve window copied to the clipboard can, for example, have the following layout:



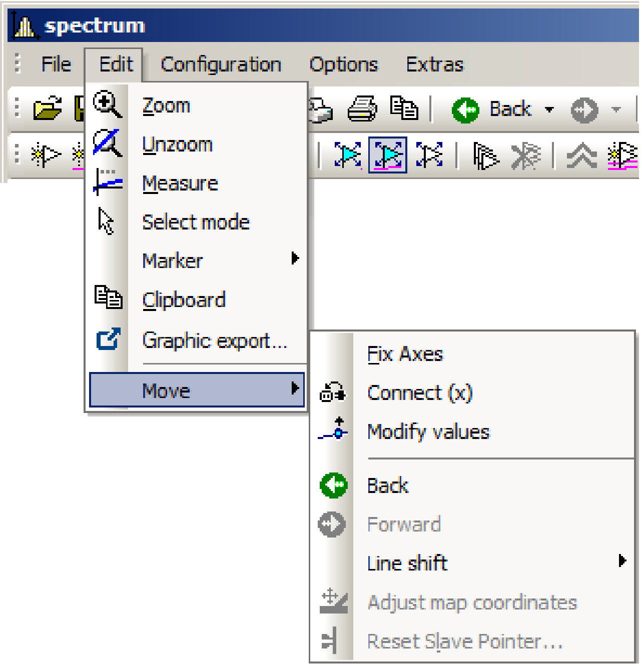
Remarks

- Letters may look distorted, lines may intersect and overlap and details may disappear when a meta file created from the curve when another program is loaded. The image can be improved by enlarging the display on the screen. Meta files are designed to optimize the image output by printers or plotters, and not for ideal display on the monitor.
- The fonts used for the meta files are selected from the available fonts for the printer (see "Printer Setup 1331"). Not all of these fonts are easily legible on the screen or available in the necessary size.
- A meta file can only be created when sufficient memory is available. The clipboard remains empty or is emptied if the available memory is insufficient.
- In some extreme cases, it may not be possible to create a suitable meta file. Such situations can occur when several curves are displayed, or in connection with dotted, bar-graph or XY-representations. It is often helpful to display a smaller section of the waveform, to change the display mode, to cut out a section of the waveform or reduce data using mathematical functions.
- When axes scaling is set to automatic, the axes labeling on the screen and on the printer will be calculated differently for the current dimensions. Specify a set scaling and a set number of markings to achieve clearly defined proportionality.
- In printing, texts may overlap if the selected font is too large.
- If a waveform does not have a "created.."- time, the current time is automatically designated as such.
- Images of curves sent to the clipboard can also be incorporated in reports using the imc Report Generator. However, a direct transfer of the curve window is recommended, whereby objects pose as curves. See chapter 'Report Generator 1329' in this document.
- The time format (time and date) can be changed using menu item "Country settings..." in the Windows Control Panel.
- Even the best and most popular text processing and desktop publishing programs contain minor flaws. Although the graphics in most programs appear to be correct, one of these programs does not correctly interpret the offset of the curves, which is present as a command in the meta file. As a result, when graphics are inserted in this program, the curve lies next to the coordinate system. In another program, the clipping (fading-out) of curve sections extending beyond the coordinate system is ignored. Thus, the curve may extend well into the labeling or generally beyond the coordinate system. It is recommended to transfer the graphics to the Report Generator or to a text processing program directly, without modifying the graphics.

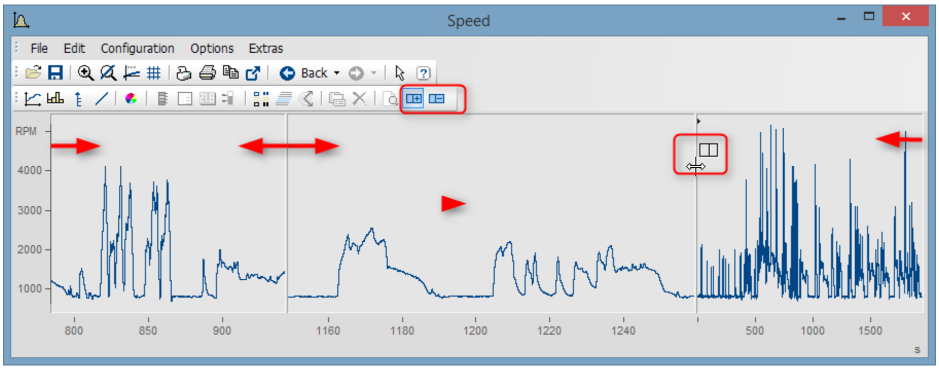
Reference	Clipboard Settings
Section 'Clipboard Settings 1336'	

11.6.7.7 Move

The menu item *Move* contains various curve window functions for working in the curve window:



Menu item	Description
Fix Axes	This lets you fix the current axes so that the curve window does not automatically adapt to any newly added waveform, but rather keeps the previously existing axis scaling.
Connect	For connecting curve windows. For more on this topic, see the section Connect 1320.
Modify values	This function lets individual measured points from a data set be moved in the y-direction, thus changing their values. These changes are applied directly in the data set and stored. Caution: These changes can no longer be reversed by means of the *Back*-function. There will also not be any prompt for confirmation of the changes to the data set.
Back and Forwards	Step-by-step reversal of the most recent changes, or conversely repetition of the most recently reversed changes. With these two functions, changes in the curve window view can be reversed, or reversed changes can be restored. In the toolbar, the *Back*-function is additionally provided with a dropdown history, so that every change to the curve window view can be reversed separately. The exception is the function *Modify values*, since it directly changes the data set and not the curve window view.
Line-Shift	For moving selected lines in horizontal and vertical direction. More on this topic is presented in the section Line-Shift 1323.
Reset Slave Pointer...	For resetting the slave pointer. For more on this topic, see the section Bar meter 1154.
Split-Mode	*Split-Mode* subdivides the curve window's X-axis. This makes it possible to observe the same data at different points in time and at different zoom levels. With *Split-Mode+*, the curve window can be split an arbitrary amount of times. With *Split-Mode-*, the subdivision is canceled.

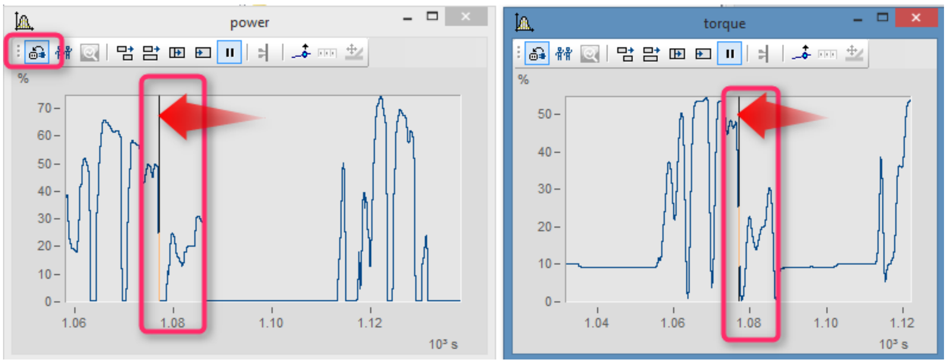


Split-Mode

11.6.7.7.1 Connect (Link)

Use this button to create a link between a curve window and either another curve window or a imc FAMOS table window. The connection is a x- (or scroll-) connection. Two windows connected in this manner have the same x-value at a defined position in their display ranges. Scrolling in one curve window prompts synchronous scrolling in the connected window. Several windows can be connected to form a linkage chain. No matter in which window the displayed x-range is changed, all connected table or curve windows are automatically updated to reflect the change.

To create a connection, click on the designated button and hold down the mouse button. The mouse pointer changes to a "blocked" symbol. If the mouse pointer is now moved over a curve or table window, it changes its shape back to a cursor. As soon as the mouse button is released, the windows are connected. The button appears to remain pressed and thus indicates the connection.



The x-axes of both curve windows are linked.

A vertical (curve window) or horizontal (table window) reference line indicating the x-position of the linkage is shown in the window. The connected windows each have the same scaling value in the x-direction at this line. The behavior desired can be specified using the *Options* dialog opened via Options\Presettings*Settings > What is influenced in the Link and This window follows* 1343.

This reference line first appears in curve windows in the middle of the x-axis, but can be moved to any position desired using the mouse. Move the mouse to this line; when the mouse pointer then changes its shape, hold down the mouse button and the line shifts as you move the mouse.

All connected windows should have the same x-axis mode (relative x-axis or display with absolute time).

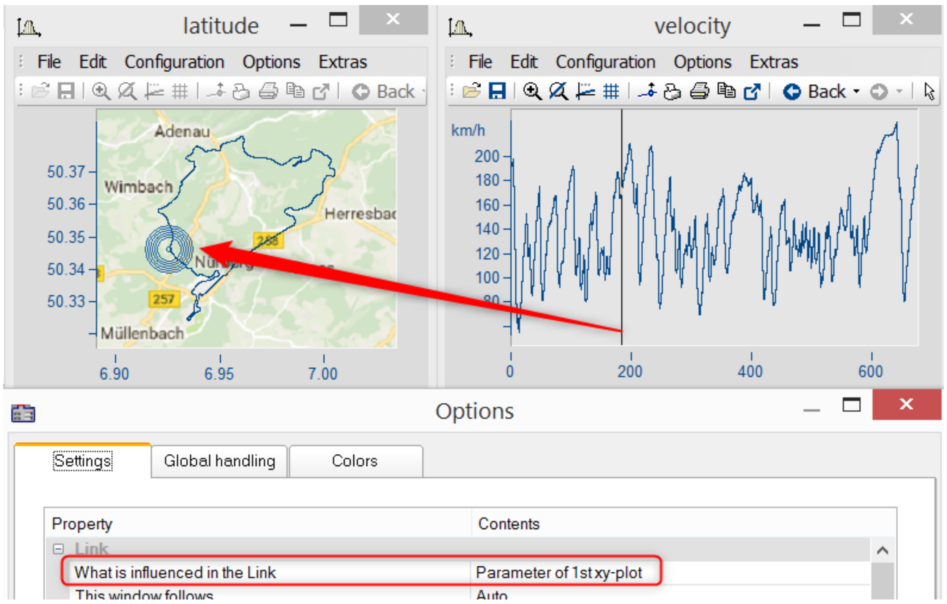
To undo an x-linkage, simply click on the button again.

Connect with XY

When linking XY and normal data sets, it may be necessary to specify which component of the XY data is to be linked.

This is configured under "*Options*"/"*Presettings*"/"*Link*"->"*What is influenced in the link*". In the following example the GPS channels Longitude and Latitude are used to display the speed with the position on a map.

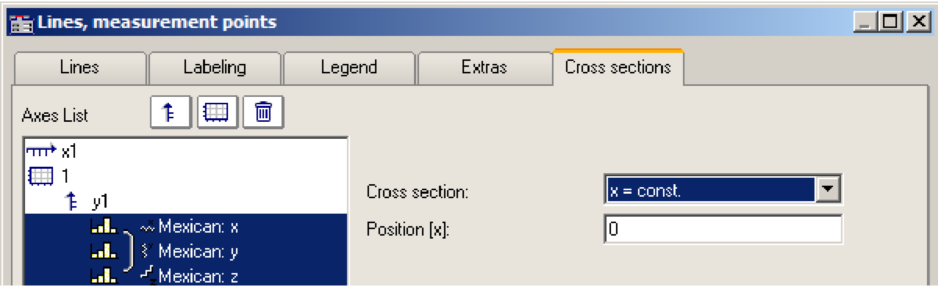
For this you have to set "*What is influenced in the link" -> "Parameter of 1st xy-plot* 1344".



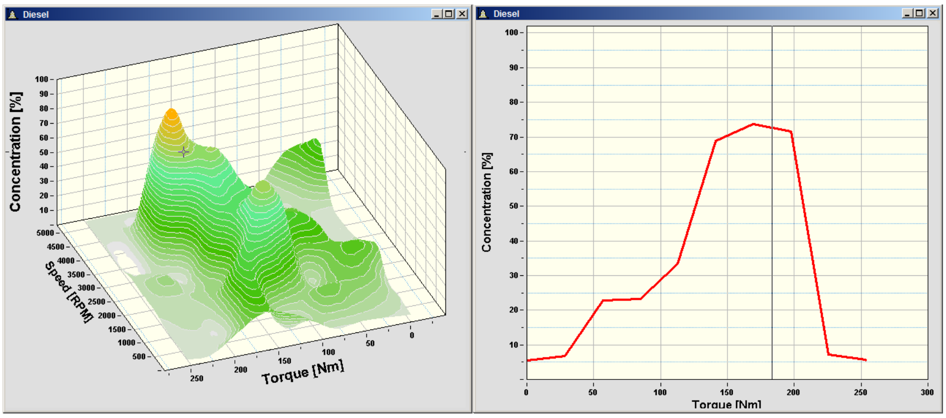
Connect with 3D

The ability to link curve windows together is also provided for 3D-displays. In this case, a 3D data set can be simultaneously displayed in 3D-display and as a cross-section with x or z as the constant, and both curve windows can be linked together.

To do this, load the 3D data set in a curve window with standard display style, parallel to the curve window with the 3D-display, and then open the *Lines*-dialog either from the coordinate system's context menu or as the menu item *Configuration / Lines*. On the page *Cross sections*, you can select from the dropdown-list whether to keep the x- or the z-coordinate constant. Then confirm by clicking *OK*.



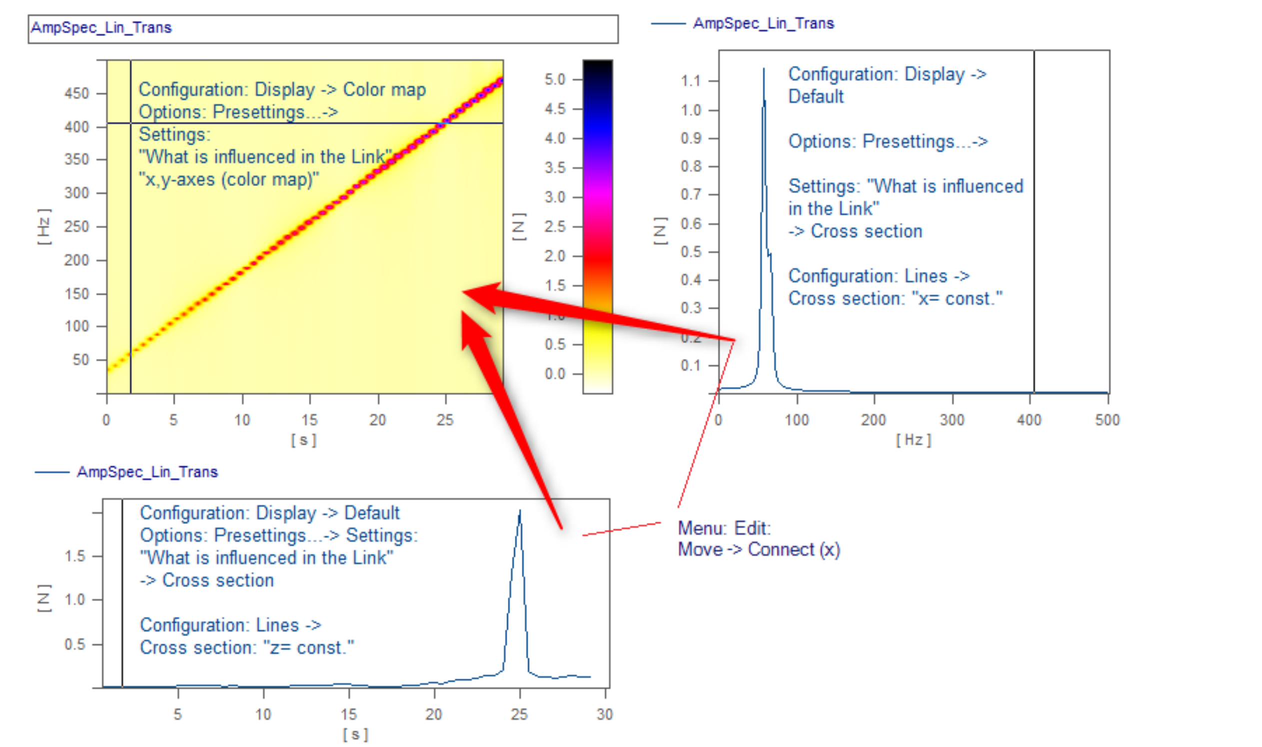
In one of the two curve windows, activate the *Connect*-function, so that the cursor changes shape. Then move the changed cursor into the other curve window's coordinate system and click on the left mouse button. In the curve window with the 3D-display, a crosshairs appears at the upper left edge. Move the cursor to the crosshairs, click the mouse on it and move the mouse while holding down its button. In the curve window with the standard display and the cross section, there is a vertical line. The position of the vertical line changes in response to the position in the 3D-display.



Example | Example with two cross sections

Color maps can also be linked in the y-direction. For this purpose, in the Options for the curve window 1343, under *Settings*, it is necessary to set the *Link*-property "*What is influenced in the Link*" accordingly:

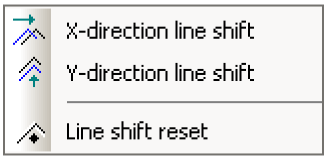
- On the color map: "*x-, y-axis (color map)*"
- On the right and bottom curve window*: "Cross section"*
- All curve windows show the same amplitude spectrum from example project "FA70 Spectral analysis"



The linkage is made by means of Edit> Move> Connect (x)" by using Drag&Drop in succession from the lower right window into the color map.

11.6.7.7.2 Line Shift

Using this function, any lines selected in the Select-mode, or all lines at once can be moved in the either the x- or y-direction.

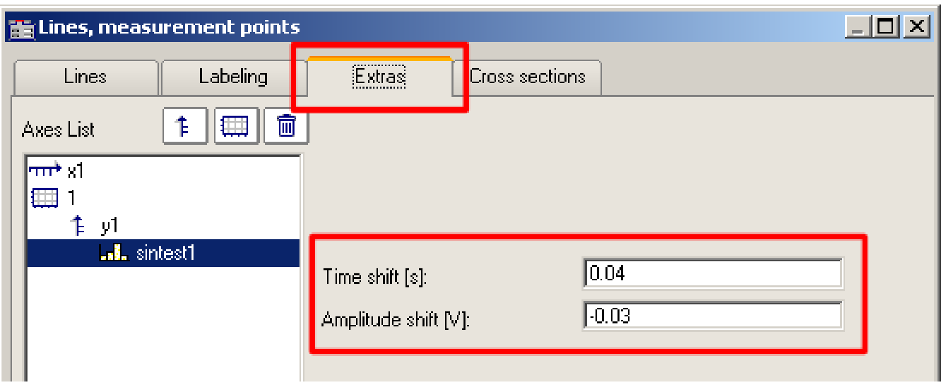


To do this, select one of the two functions either using the menu *Edit/Move/Line-Shift* or from the *Line-Shift toolbar*.´

With the cursor in the pertinent coordinate system, and its shape changed to a double arrow, the lines can be moved either horizontally or vertically, depending on the function, by moving the mouse while holding down its button. With this function, only the view changes, i.e. the data set remains unchanged and any changes made with *Line-Shift* can be changed back either using the *Back* function or using *Line-Shift Reset*. With *Line-Shift Reset*, all changes are reversed at once, while *Back* reverses the actions one step at a time.

Line-Shift of a selected line in x-direction

The parameters for Line-Shift can also be changed directly in the Properties dialog for the lines, under *Extras*. There, too, the changes can apply either to individual lines or to all of them. With linear scaling display, the parameters are simply added. By contrast, with logarithmic scaling display, the parameter's value is interpreted as a factor, where the value 1.0 stands for no shift, a value of 10.0 stands shifting by tenfold, and a value of 0.1 shifts the lines downwards one-tenth.



Changing the Line-Shift parameters

Reference

The Time-Shift settings can be saved with the ccv file, if the curve window option"*Time-Shift in der CCV*" has been set to "*yes*". 1345

11.6.8 Ribbon

11.6.8.1 "File" menu

Menu item	Description
Load 1326	Loads a curve window configuration from a file.
Save as 1328	The curve window configuration (e.g. the axis scaling) is saved in a file.
Transfer to imc FAMOS! 1329	The waveform in the curve window is transferred to imc FAMOS.
Report Generator 1329	Calls the Report Generator. The report's layout can have your own personal, creative design.
Print 1329	Prints out the curve window.
Printer setup 1331	Sets up the printer used for printing out the curve window's contents.
Overview Window 1332	Displays an overview window.
Twin Window 1333	Generates a new curve window with the same appearance.

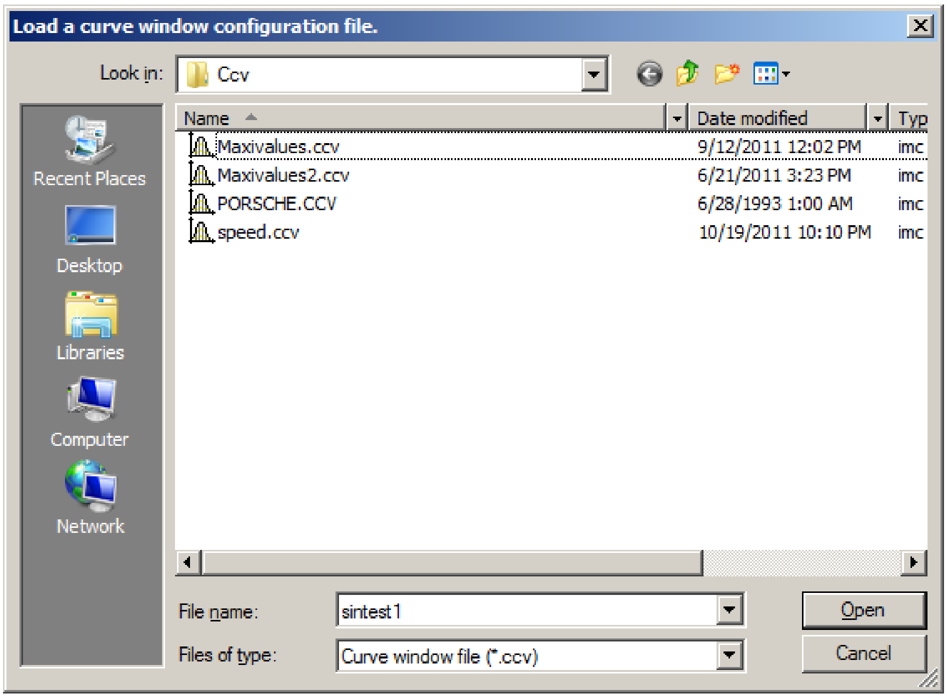
11.6.8.1.1 Load Configuration

Function

You can a curve window configuration directly from a file. A curve window configuration includes various attributes of the window such as size, axes scaling and names of additional curves in the window.

Mouse Operation

- Select *File/ Load*...
- A dialog appears in which the file can be specified whose configuration should be loaded.

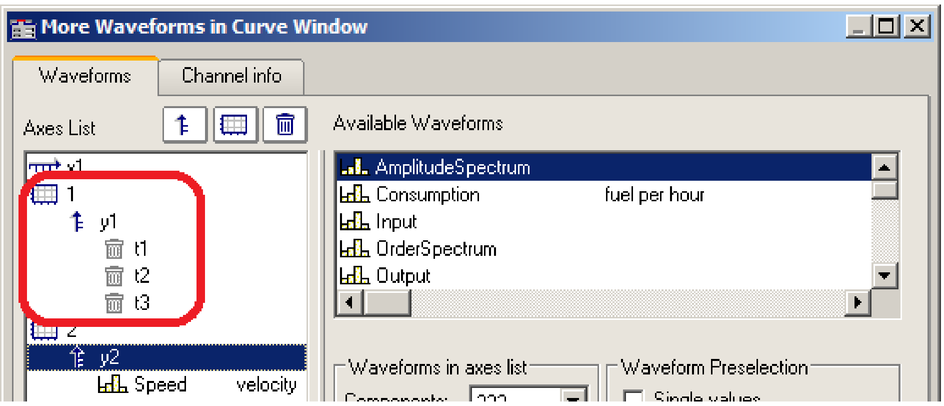


- Select file format "CCV".
- Select the desired file and end the dialog by clicking on *Open*.

Remarks

- The standard file name extension is "CCV".
- The directory used for loading configurations is read from the Windows System Registry when the program is started. In imc FAMOS, the folder can be handled via the menu item Extra / Options... .
- Once a file has been saved or loaded successfully, the directory involved is used for any subsequent loading or saving operation.
- The curves displayed in the window and their corresponding data sets are not contained in the configuration.

- When a curve configuration is loaded, an attempt is made to find all of the waveforms which were saved to the configuration. Any of these which are not found are marked as invalid:



- The names provide an indication of what waveforms are expected for the display. (When loading configurations from imc FAMOS 2.0, the system behavior of that time is reproduced and the waveform is deleted.) Configurations having multiple curves should be used only for stock tasks, where the names of the waveforms stay the same. For making changes, see Chapter 4, kit function *CvReplaceChannel()*.
- The name of the "basis waveform" (i.e. the first data set to be opened in the window) of a configuration is also saved.
- The position of the window does not change when a configuration is loaded manually. In automatic loading using a program or a sequence, the window is moved to the position saved in the configuration file. This does not apply to curve windows in dialogs.

Note

By means of Copy & Paste 1363, you can directly transfer a configuration from one curve window to another.

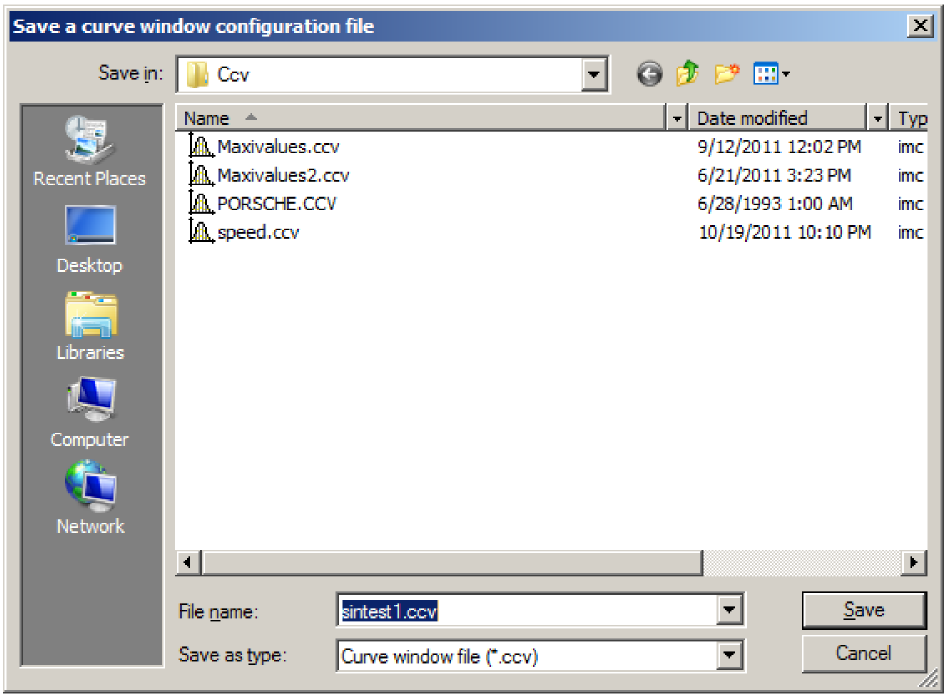
11.6.8.1.2 Save Configuration

Function

The curve window configuration can be saved in a file. This configuration includes curve window attributes such as window size, axes scaling and the names of additional curves in the window.

Mouse Operation

- Select menu item *File / Save as...* in the curve window menu.
- A dialog appears for selecting the file in which the configuration should be saved.



- Enter the name of the file in the input box.
- Select the file format "CCV".
- End the dialog by clicking on *Save*.

Remarks

- If the file into which you wish to save the configuration already exists, the program asks if it should be overwritten.
- When a configuration is saved with automatic axes scaling set, different values may be written to the axes when this configuration is loaded for a new waveform. An appropriate scaling is defined automatically for the new waveform.
- It is useful for some applications to save configurations with automatic axes scaling. This is recommended especially when the expected signals fluctuate strongly in their range of values.
- The standard file name extension is "CCV".
- The directory path for projects is the project folder, or the default CCV folder from imc FAMOS Options.
- Once a file has been saved or loaded successfully, the directory involved is used for any subsequent loading or saving operation.

- The waveforms displayed in the window and their corresponding data sets are not contained in the configuration.
- The name of the "basis curve" of a configuration is also specified.

Note

By means of Copy & Paste 1363 you can directly transfer a configuration from one curve window to another.

11.6.8.1.3 Transfer to FAMOS!

"*Transfer to imc FAMOS*" creates a copy in imc FAMOS of the data sets displayed in this curve window. After the transfer, the data sets appear in the imc FAMOS Variables list, where they are available for working with. The transfer is normally only helpful if the curve window belongs to another imc program than imc FAMOS, such as imc STUDIO.

The settings made in the dialog "*Options*" > "*Transfer options* 1349"for naming variables in imc FAMOS are also valid for this operation. A command can be specified to be executed after the variables have been transferred to imc FAMOS, for example, a command to call a sequence for analyzing the transferred waveform.

Note Variables will be overwritten

Existing variables in the Variable list will be overwritten without notification.

Reference

- Transfer of waveforms or sections of waveforms can be made from a measurement value window. Refer to the section "*Context Menu in Measure Window* 1281" for more information.
- Waveforms can also be transferred to imc FAMOS using Drag and Drop 1363.

11.6.8.1.4 Report Generator

This lets you open the Report Generator, which can be used to assemble your curve windows in a report. For more information, please see the Report Generator documentation.

11.6.8.1.5 Print

Function

Hardcopy of a curve window can be created on any printer or plotter supported by Windows. The hardcopy is always made to an entire page. The graphics are centered on this page.

The graphics are sent to the printer which was specified in the dialog belonging to the curve window's menu item *File/ Printer Setup...* Various printing preferences can be specified in the *Opt./ Clipboard settings....* The size, font, width, etc. correspond to these settings.

Mouse Operation

To print the curve window, choose *File/ Print.*

In consequence, a small info-dialog appears which indicates that the printout is in progress. The process can be canceled by clicking on the *Cancel* button.

Normally, you have to allow for a delay before a print job is actually stopped.

Remarks

- Use the MS-Windows Control Panel to make settings for the printer.
- Additional parameters can also be specified for the printer here, e.g. printer resolution, paper size and format (portrait/landscape), printer memory allotment, etc. To do this, use the curve window's menu item *File / Printer setup*...
- The quality increases with the resolution. Graphics only look good, of course, when they are printed with high resolution. Note however that the higher the resolution, the longer it takes to print. In fact, the time to compute a printer job increases with the square of the resolution.
- Select a low printing resolution if you value speed of printout more than quality.
- The current time is used as the "Created/ Modified" time if the waveform does not have one already.
- To combine text and graphics in a desktop-publishing program, send output to the Windows Clipboard instead of using the Print option. See "Clipboard 1317".
- If the printer is either not correctly defined in the MS-Windows system or switched off, or if it has no paper, an error message will appear.
- If you wish to create a more detailed layout, use the imc Report Generator. See chapter "Report Generator 1329" in this document for more information on this powerful program.
- The time format (date and time) can be changed in the Control Panel under *Regional Settings*.

Reference

See "Clipboard Settings 1336", "Printer Setup 1331"

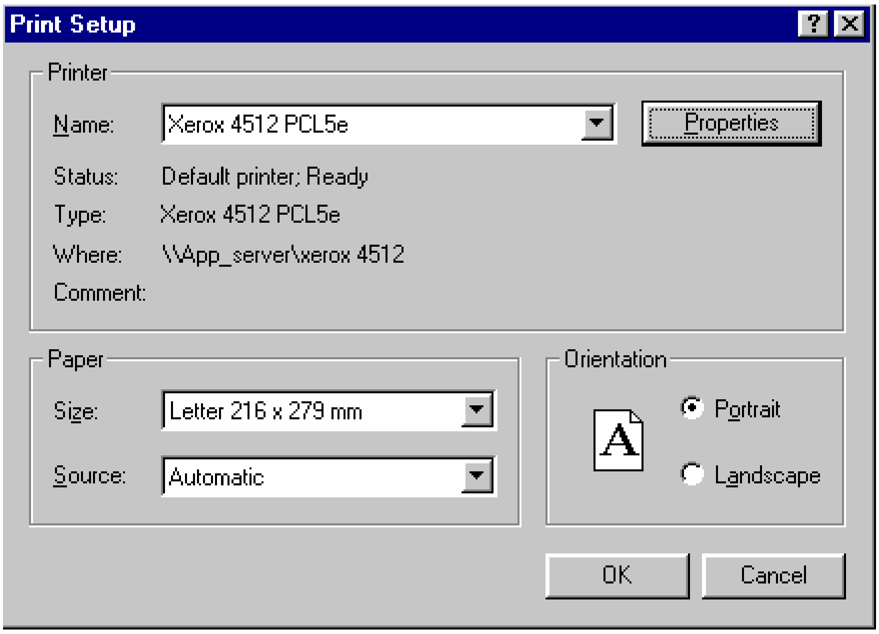
11.6.8.1.6 Printer Setup

Function

This is where the printer is configured, which is used to produce the hard-copy output from the curve window.

Operation

Select menu item *File/ Printer setup*... in any curve window. The standard Windows dialog for selecting and configuring a printer.



This dialog's appearance varies according to what Windows version or printers are involved.

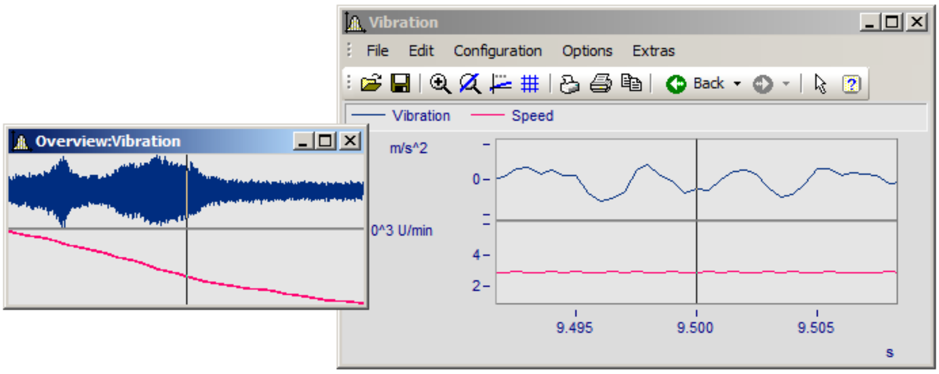
The settings apply to all of the computer's imc curve window's and remains operative upon the program's next start.

11.6.8.1.7 Overview Window

Function

Whereas a curve window can display any portion of a waveform, an overview window, which is shown in conjunction with a curve window, will only display the entirety of any waveforms which are represented at all in the curve window. The curve- and overview window are linked with each other in the x-direction, in that the reference line of each window marks the same x-coordinate. The overview window is especially useful for:

- Keeping track of a position in convoluted or long curves (especially during zooming), or distinguishing between different axes lengths when several waveforms are displayed together.
- correctly associating a displayed section with its entire curve when scrolling in the curve window in the x-direction.



Mouse Operation

- To open an overview window, choose *File/ Overview Window*. A check mark appears beside the selected option.
- Zoom in on one region of the curve window and navigate through the signal using the reference line in the overview window.
- Click again on this option or select *Close* in the system menu of the *overview window* to close it.

Overview windows are independent windows which behave almost like curve windows. However, each overview window is assigned to a curve window and cannot exist without the curve window; the overview window also contains the same menu as the curve window. All settings for configuration and display of waveforms in curve windows can be made for the overview window. It is thus possible to display a curve together with variously strongly zoomed views by opening an additional overview window.

Remarks

- The overview window is only recommended if the range displayed in the curve window can be displayed fully in the overview window.
- When the curve window is reduced to an icon, the overview window is not visible.
- The display style used in the overview window can be changed and zoomed as desired.
- If an overview window and a measurement value window are displayed for the same curve window, the measurement value window should be closed when the zoom range is moved in the overview window. This reduces flickering while the curve window is being updated.
- The title of the overview window is composed of the string "Overview:" followed by the name of the corresponding curve window. This allows easy identification of the windows.

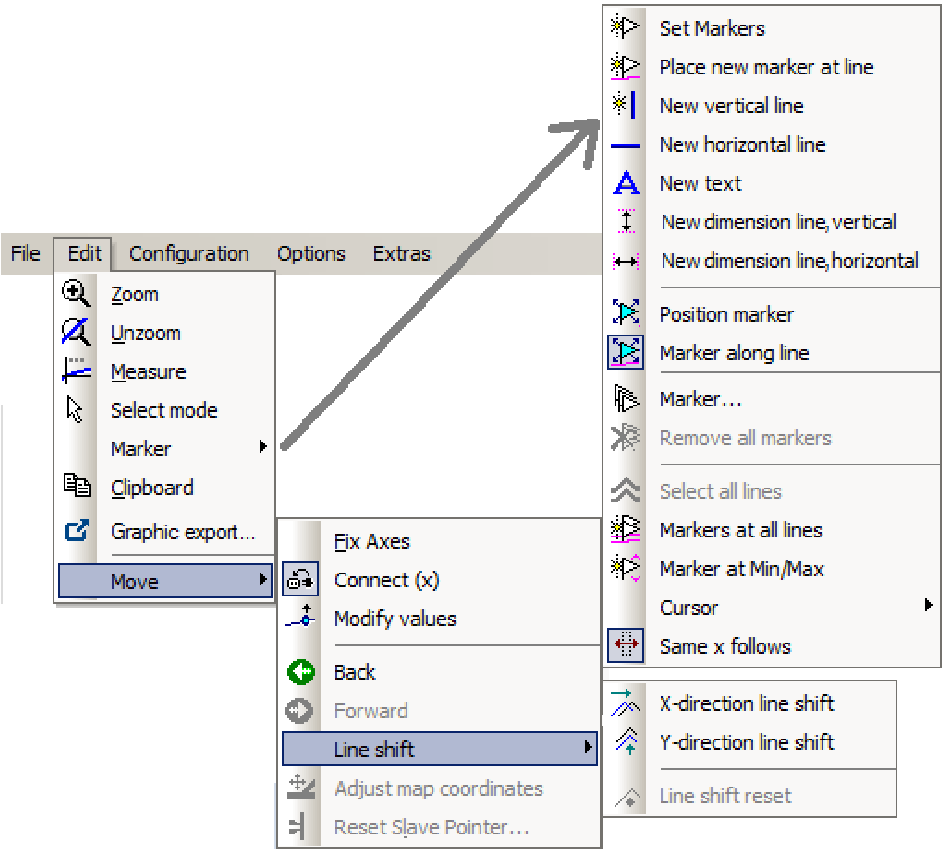
11.6.8.1.8 Twin Window

Using this item you can create an identical copy of the curve window. Subsequently, both windows can be configured independently of each other.

Possible applications:

- During an online measurement, the measured data can be displayed both as a curve plot and as numerical values (Last Value as Number 1144).
- Display of a Waterfall graph in 3D, or a color map.
- Simultaneous display of the exact same data both in an overview and zoomed.

11.6.8.2 "Edit" menu

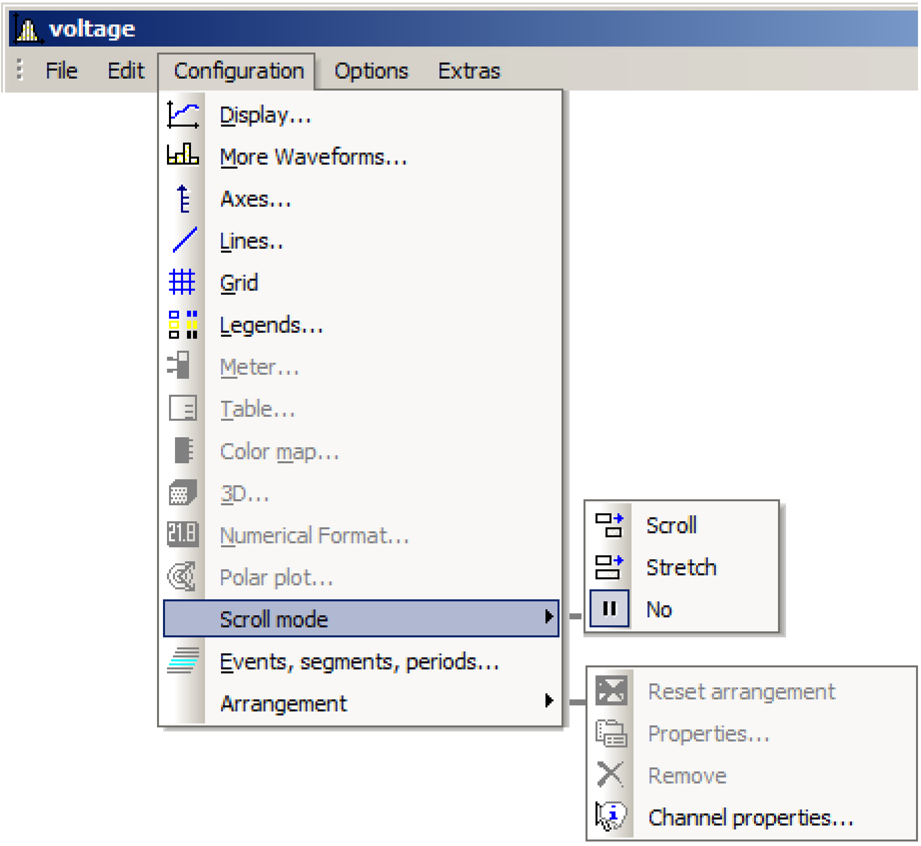


Menu item	Description
Zoom 1275	Enlarges a section of the curve window.
Unzoom 1276	Displays the entire curve.
Measure 1277	A measurement value window and measurement cursors for measuring curves are displayed.
Select-mode 1291	In this mode, it is possible to select and edit legends, coordinate systems, axes, curves and markers.
Marker 1293	Proceeds to the list of marker functions.
Clipboard 1317	Copies the graphics in the curve window into the Windows clipboard.
Graphic-export... 1317	The graphic of the curve window is saved as image or as a PDF file.
Move 1319	Proceeds to a submenu listing various curve viewing functions.

Reference

Another possibility to navigate through the curve window is provided by the 'Axes Navigation Bar' 1364.

11.6.8.3 "Configuration" menu



Menu item	Description
Display 1128	The structure of the curve window and other attributes, such as the "Freeze" mode and time/date display can be selected here.
More Channels 1193	Selects additional waveforms to be displayed in the current curve window.
Axes 1204	Sets x- and y-axis parameters.
Lines 1222	Sets line (measurement cure) parameters.
Grid 1256	A grid can be added to the coordinate system.
Legends 1234	Sets the display of legends in the curve window.
Meter 1154	Sets properties of bar meter display.
Table 1149	Sets properties of tables display.
Color map 1163	Sets properties of color map display.
3D 1175	Sets properties of 3D display.
Numerical format 1144	Sets properties of the display mode "Last value as number".
Polar plot 1175	Sets properties of polar plot.
Scroll mode 1265	In the curve window, a particular section of the data set can either "scroll past" or continuously "grow" from the beginning.
Events, segments, periods 1266	Selects the display of individual events (in imc STUDIO: trigger events), individual segments (e.g. spectra or rows in a matrix) or even periods (period comparison).

Menu item	Description
Arrangement 1272	Restores the curve window arrangement, access to properties and deletion of selected objects.

11.6.8.4 "Options" menu

Menu item	Description
Clipboard settings 1336	Settings for graphics created for output or export with the clipboard are specified here.
Colors 1341	Changes the colors in the curve window.
Presettings 1343	Presettings such as the standard configuration directory and drives for storage of temporary files are made here.
Printer preview 1350	This function makes it possible to switch between the Print Layout view and Normal view. It is used exclusively in curve windows which are embedded in the Data-Browser's Report view.

11.6.8.4.1 Clipboard Settings

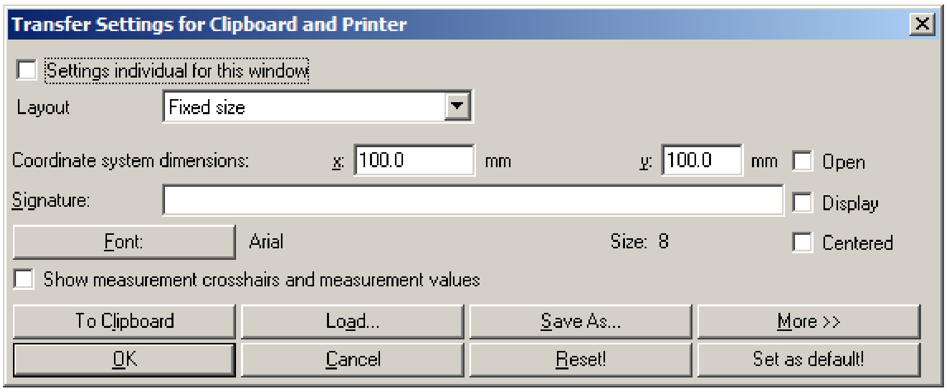
Function

The graphics in the curve window can be documented in professional quality. Graphics can be sent to the clipboard as vector graphics, for further processing by any text processing, graphics- or desktop publishing programs. The graphics can also be sent to the Report Generator for output in a report designed by the user.

The user can specify how graphics are generated by selecting the font and line width in the clipboard settings.

Operation

Call menu option *Options/ Clipboard settings*... in the curve window menu. The following dialog appears:



The settings are applied when the item *Clipboard* 1334 in the *Edit* menu is called.

Settings	Description
Settings individual for this window	Here you can set whether the clipboard settings only apply to the current curve window or for all curve windows.

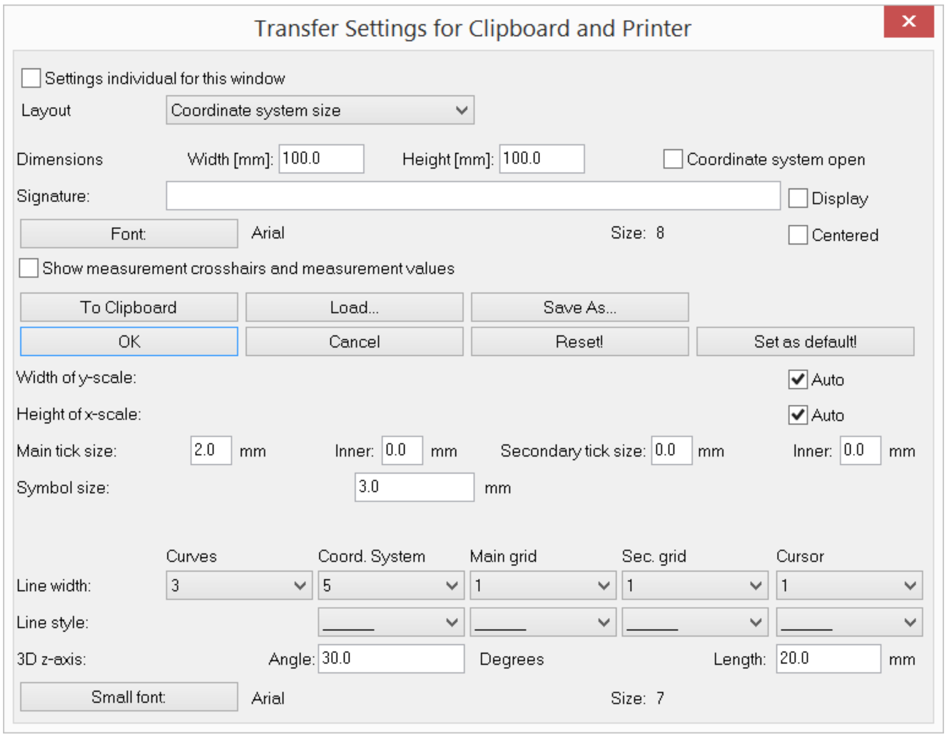
Settings	Description
Layout	***Proportions as on screen*** (the default setting!) saves the curve window to the clipboard with the proportions which accord with the settings currently applied on screen. The layout ***Coordinate system size*** creates a graph in which the **coordinate system** exactly applies the *x* and *y* values specified by the setting *Dimension*. Observe also the notes on the Table 1338. ***Total size*** creates a graphic in which the **outer edge of the curve window** is determined by the x and y values.
Coordinate system	The ***width*** and ***height*** of the coordinate system, stated in mm, are set in the text boxes appearing in the dialog line *dimensions*. If the lines are particularly thick, the size is calculated from the middle of one line to the middle of the next line. Axis labeling of the coordinate system is not included in these dimensions, they are drawn outside of the actual coordinate system. Dimensions should be at least several mm, but no larger than the page.
Open coordinate system	This option causes curves in a standard display (y-axes not stacked) to be drawn in an open coordinate system, with no upper and right-hand borders. The curve is thus less crowded in the display. When this option is not selected, all lines in the coordinate system are drawn.
Caption	The user can specify a text to appear below the x-axis. This text may contain up to 60 characters. It will be displayed, along with the date and time, only when the option *Show* is selected.
Centered	When this option is selected, all labels (as much as possible) are centered under the ticks. The effect is most noticeable for the labels at the edges of the axes, at the far right and left of the x-axis and at the top and bottom edges of the y-axis. When the type is not centered, these labels are often drawn so that they end at the edges of the coordinate system.
Show measurement cursors (crosshairs) and measurement values	When a measurement value window is present when graphics are generated, and this option is active, the measurement cursors are included in the coordinate system display. The measurement values of the cursors are displayed below the x-axis.
Font	Select here the font for the axes scaling. The MS-Windows standard dialog appears when the "*Font*" button is selected. The dialog shows all fonts available for the printer currently set for the curve window. Select a font, the size in points and any other features desired, e.g. bold type. A font size of 10 to 12 points is generally very legible. TRUETYPE fonts are preferred since they can be scaled more easily.
To clipboard	Click on this button to copy the contents of the curve window with the current settings to the clipboard.
Reset!	When the *Reset*! button is selected, the controls of the dialogs are set to default values. Controls accessed with the *More >>* button are also reset.
Save as	A dialog appears for saving the contents of the *Clipboard settings* in a file.
Load	Once the contents of the dialog have been saved in a file, this file can be loaded to initialize the dialog with the settings in the file.

Note

It is possible to achieve an exact scale of units/cm by means of the combination *Layout: **Coordinate system size*** and an appropriate count of *Ticks* 1207 along the X- and Y-axes. Note that due to particular presets in the target program, the size of the graphic may not be equal to 100%. For example, after insertion into a WORD document, it is necessary to specify 100% for the *Size and Position* (in the graphic's context menu).

More >>

The dialog box is enlarged when this button is selected. Additional, less frequently used settings for the graphics configuration are made here. The dialog appears as follows:



Settings	Description
Width of y-scale	The width of the y-scale is set automatically, if the checkbox appearing after *y-scale width* is marked. To specify a different width manually, deactivate the check box *auto*. A text box appears in which the width should be specified in mm. Make sure that the specified width is large enough for the selected font. The width is calculated from the middle of the line enclosing the coordinate system.
Height of x-scale	The height of the x-scale is set automatically, if the checkbox appearing after *x-scale height* is marked. To specify a different height manually, deactivate the check box *auto*. A text box appears in which the height can be specified in mm. Make sure that the specified height is large enough for the selected font. The height is calculated from the middle of the line enclosing the coordinate system.
Size of ticks	Specify here the length of the *main* and *secondary ticks*. The length is composed of sections: length within and outside the coordinate system. Specify the total length and the portion *inside* for the main ticks and the secondary ticks, respectively. The lengths are specified in mm with up to one digit after the decimal; a length of zero is also possible.

Settings	Description
Symbol size	Lines can also be distinguished by accompanying symbols, see the menu items *Configuration/ Axes* 1204 and *Configuration/ Display* 1128. The size of the symbols is specified here. Enter the diameter of the symbols in mm, with up to one place after the decimal.
Line width	The width can be specified for the following lines: • curves, coordinate system, main grid, secondary grid, measurement cursor Any specified line thickness 1223 for an individual waveform overwrite the settings saved in the Clipboard. Specify the line width with a setting between 1 and 100. A very fine line width can be achieved with the lowest settings. Line width depends on the resolution of the output device. Since the width is always entered in pixels (units of resolution), only a whole number of points of the output device can be specified. A line width of 1 may be a practically invisibly fine line on a high-resolution laser printer, but may appear like bold type on a simple matrix printer. Line widths are generally set to between 1 and 5.
Line style	Various line styles can be selected for the following: • coordinate system, main grid, secondary grid, measurement cursor The following line types can be selected: • broken, dense dots, coarse dots, dense dashes, coarse dashes, alternating dots and dashes The various line types help differentiated between main and secondary grids when both are drawn with thin lines, so as to avoid distracting from the displayed curves.
z-axis angle	The angle of the z-axis can be set to between 1 and 89 degrees for the waterfall diagram. The larger the angle, the steeper the z-axis climbs. An angle of 30 degrees is recommended.
Length of z-axis	The length of the z-axis can be specified in mm for the waterfall diagram, with up to one place after the decimal.
Small font	The font for the small print in the 1/3-octave/octave labeling of the x-axis can be specified. Click on the button *Small font* to prompt the MS-Windows standard dialog for selecting the font.

Remarks

- The settings in this dialog apply to all curve windows.
- The fonts available for selection depend on the printer set for the curve window.
- When graphics are transferred to the clipboard, it is important that the printer set for the curve window is also the printer with which the graphics will later be printed. The meta file for the clipboard is created specially for the selected printer; if graphics are outputted on a different device, some fonts may not be available or scaling may change and then the graphics will appear in poor quality. Format settings such as landscape or portrait and the size of the page should also correspond. The metafiles are in some measure adapted to the output device.

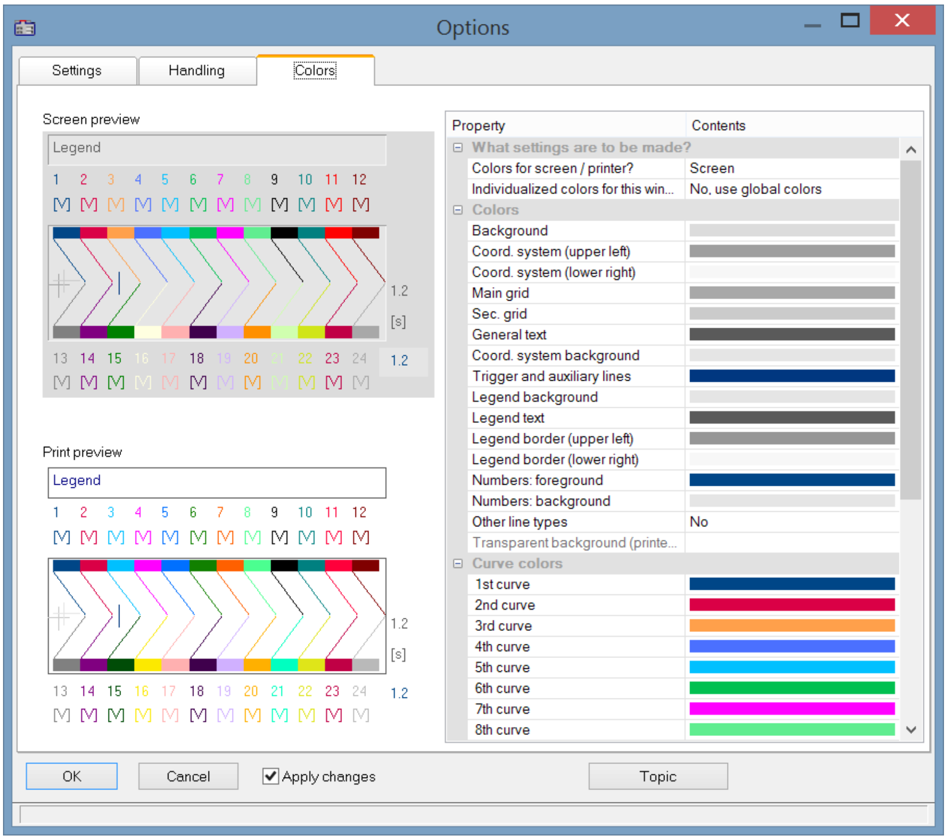
- A metafile is created with the selected fonts and size for the curve window graphics when they are sent to the clipboard. If this metafile is later changed to a different size (e.g. because the graphics were shrunk by the text processing program after they were inserted in the clipboard), the font proportions may no longer be correct. The font may become too wide or too high. Use of truetype fonts may also have this result, since the Curve Manager only dictates the height of the font in points. Always create graphics in the size in which they will later be printed. If this is not possible, at least try to comply with the height-width proportions.

11.6.8.4.2 Colors

Function

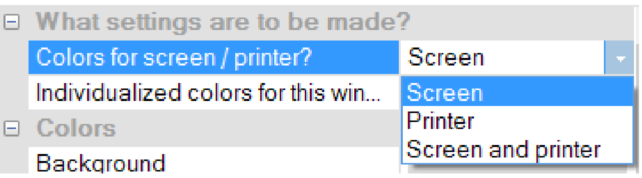
All colors used in the graphic interface of the curve window can be defined as desired in a special dialog. Single windows can use an individual color scheme.

The following dialog is used to define the colors:



Screen/Printer

A combobox is found at the top edge of the dialog, which contains the entries *Screen, Printer* and *Screen and printer*.



The colors can be changed from the default settings. The default colors for the printer are black/white. However, the screen colors can be applied for printouts, see below under ***Copy...***

The printer settings additionally offer the option of leaving the background transparent. Besides saving ink, this has the advantage of keeping graphics objects located behind the curves visible.

Color graphic elements

A curve window contains the following graphic elements:

- background
- coordinate system and grid ...
- coordinate-system background
- general text
- legend...
- numbers...
- trigger line, auxiliary lines
- curves 1 to 12

Operation

Select menu option *Colors*... in the *Options* menu in the curve window.

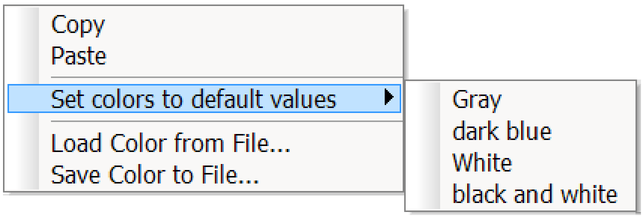
A dialog appears in which the colors can be defined. This dialog contains a list of the graphic elements in the curve window.

A display is found in the center of the dialog showing the colors currently defined for icons of the graphic elements. Colors are defined for one element at a time.

Select a graphical element from the list and set its color.

Context menu

Right-clicking the mouse in the dialog box calls the context menu:



Menüaktion	Beschreibung
Copy	The table including colors is copied to the clipboard.
Paste	The table values are pasted in the selected curve window in order to adjust the screen colors to the printer settings or for an individual window.
Set colors to default values	The colors are reset. There are serveral color schemes to choose from.
Load Color from File	The color settings for the monitor and for the printer are loaded from a file. This file must previously be created by using the menu option *Save Color to File*.
Save Color to File	Stores color settings in a file.

In the sequence, the colors can be loaded using the Curve Kit's function `CwGlobalGet("colors.printer.pattern")` or `CwGlobalGet("colors.screen.pattern")`.

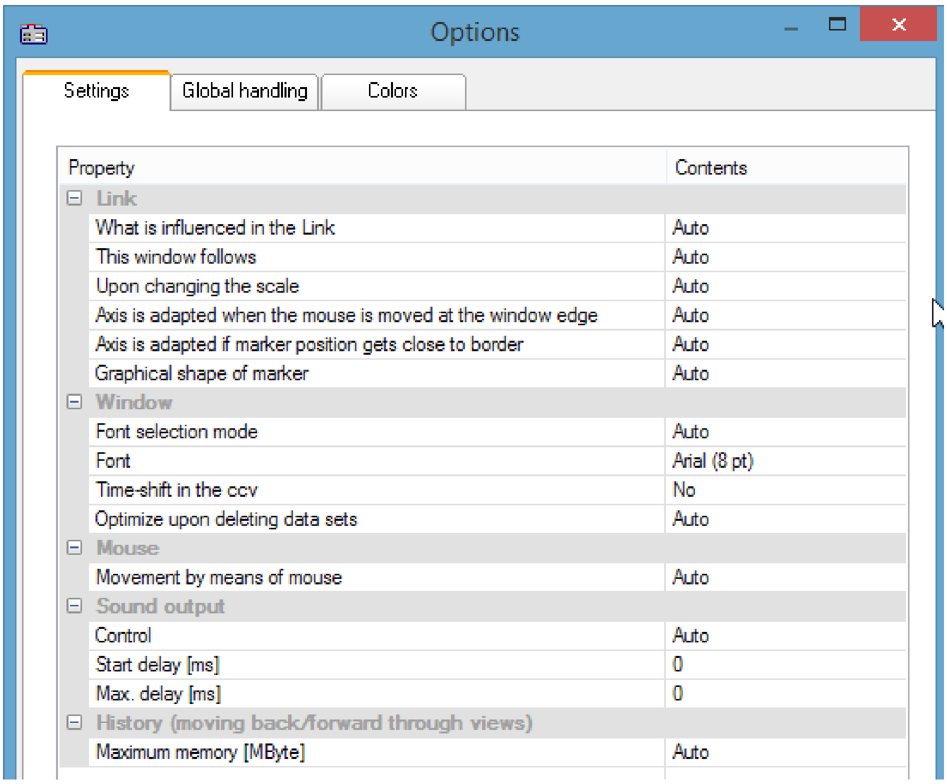
Remarks

- None of the colors produced by mixing and blending may be selected for lines and texts. If other color intensities are selected, the program will use the closest true color. This also applies to the coordinate system background color.
- It is recommended to select always colors which produce a good contrast. Yellow curves on a white background would be a very inappropriate combination.
- Background colors should not contain any noticeable pattern, to guarantee good contrast to the curves and lettering.
- Do not select a dark background color for printing. Laser printers are not designed to print large dark areas. A white background would be appropriate.
- Colors set in this dialog are effective for all curve windows.
- The colors for printing are also used when the graphics are transferred from curve windows to the MS-Windows clipboard, and when curves are sent to the Report Generator.
- The selected colors settings remain intact even after the program has been ended.
- Colors cannot be selected individually if more than twelve curves are displayed in the curve window. The colors are then repeated cyclically.

11.6.8.4.3 Presettings

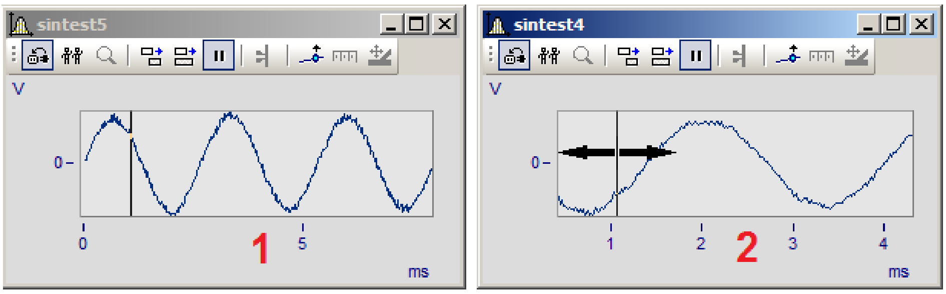
Here you find more controls for the curve window's default settings, such as the font, axes, linkages to the curve window, etc.. By clicking on the column Contents, you can select from the possible options; see the arrow below.

Settings



Presettings - Page: Settings

Link: The settings for the link affect how one curve window is linked to another one, for instance, one curve window's waveform in the time domain could be linked with second curve window showing GPS positions.	
What is influenced by link	**auto:** depending on the display type, one of the following options is used **x-axis:** usually default **Parameter of 1st XY-plot:** e.g. for the position on a *map* **x-, yAxis (color map):** both the x-, and the y-direction are linked 1320. **y-axis:** follows the y-direction in color maps **Cross section:** creates a cross-section referenced to the linked axis on the color map.
This window follows	**auto:** mostly Line follows **Axis follows:** The curve and the axis are moved, but the link pointer remains stationary. **Line follows:** The curve and axis remain stationary while the link pointer moves.
Upon changing the scale	**auto:** Stretching and compression of the x-axis; mostly: line remains at screen position **Line follows:** Line remains at screen position **Line remains at position on screen:** curve moves away behind it.
Axis is adapted when the mouse moved at the window edge	Affects curve windows where the line moves (in picture 2 below) **auto:** mostly "no", except with map 1244 **yes:** the axis of the curve window whose line is moved is compressed. **no:** no changes.
Axis is adapted if marker position gets close to border	Affects curve windows which move due to linkage (in picture 1 below) **yes:** Axis of linked curve window is compressed
Shape of position marker	**auto:** always line, except with map 1244 where a circle is used . **Line:** Vertical line



Link options

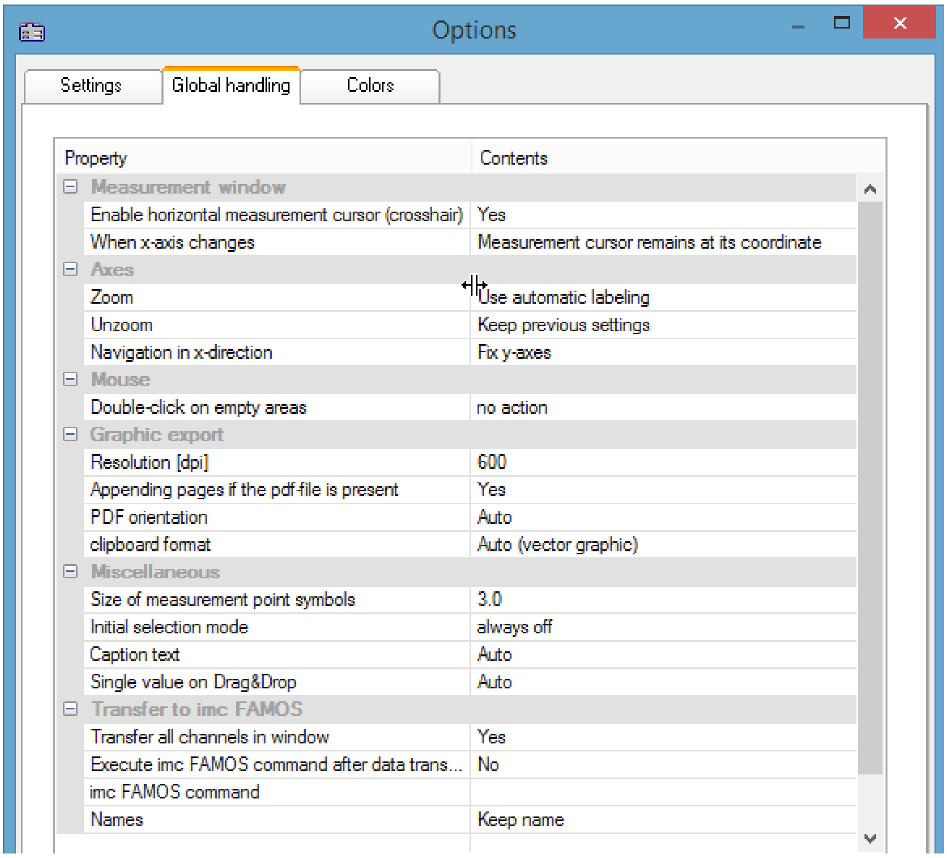
Window: In this section, set the **font**.	
Font selection mode	**Auto:** the font which is principally used whenever the curve window is opened. **Individual for this window:** Only affects the current curve window.
Font	All fonts used by Windows are available here.
Time-Shift in the ccv	**Yes:** Any shift made using the Time-Shift or Line-Shift function will be saved with a curve configuration file (ccv).
Optimize upon deleting data sets	With "*No: Lines and axes remain intact*", only a variable will only be removed from the curve window. The structure remains intact. This parameter can be set by the function `CwDisplaySet("opt.on.delete", 0)` as well. With "*Auto*", the system behaves the same way as before, which means the associated axes are removed. If the deleted data set is the only variable in the curve window, the curve window closes.
Mouse: Behavior of the curve window when dragging the mouse while holding its button	
Movement by means of mouse	**Auto:** Moves the location of the data in the curve window in the X and Y directions, similarly to moving a map. **Only in x-direction:** Like *Auto*, only in the x-direction. **No:** The display is not moved. Instead, the data can be moved into a different coordinate system or curve window by means of Drag&Drop. (Default behavior up to imc FAMOS Version 7.0)
Sound output: Options for playback of a data set by means of the audio output.	
Control	Either the data is played from the player position (*auto*) or the last, currently recorded data is played back(e.g. during the measurement with imc STUDIO).
Start delay [ms] Max. delay [ms]	Options for synchronization of online streaming data with imc STUDIO. More info is presented here 1359.
History: Determines the maximum undo buffer depth for changed made.	
Max. memory [MByte]	Here you can determine the maximum memory allocated to the history of changes, which can be reversed by means of the undo 1320 command.
Scroll mode: Options for automatic scrolling for streaming data with imc STUDIO	
Allow smart scrolling	*Yes/No*
Smart scrolling as of width	Stated in milliseconds. With this setting, you determine the scrolling behavior with streaming data during a running measurement.
Time lag with smart scrolling	In particular with the output of sound, these settings can be used to avoid lapses.
Jitter on the right edge	

<table>
<tr><td colspan="2">Graphic export: Sets the maximum memory depth for the changes made.</td></tr>
<tr><td>Export optimization</td><td>
Bitmap: A bitmap is created containing the interior of the coordinate system, with its curves and graph lines. This bitmap is then exported as a PDF. In consequence, when the graphic is complicated, having very many measurement points, graphics elements are not generated as a vector graphic, but only as a bitmap.
Markers, axis labels and legends are not affected and continue to be processed as text elements as vector graphics.
Vector graphic: The interior of the coordinate system generates a vector graphic.
Auto: Set to either "Bitmap or Vector graphic", depending on the implementation. This setting may change in future versions.

The setting "Export optimization" is only useful if overall a vector graphic is to be generated in Global handling 1348. If the setting there is for export of the curve window as a Bitmap to PDF 1348, this setting provides no benefit.
This option is applied, besides when exporting the curve window as PDF, also when printing out a Panel, exporting the Panel as a PDF and when transferring to the Report Generator.
In a Report Generator printout file, the setting Bitmap can cause very large DRB files, since bitmaps are not compressed there. But subsequently, compact and easily handled PDFs are generated from the DRB.
This option applies individually to each curve window or ccv-file. It can thus be used to provide individualized modification of the behavior for particular curve windows, e.g. ones with complex graphics.
When transferring a graphic to the Report Generator, any printer currently set for the Report Generator is taken into account. Thus, the coordinate system's bitmap is appears in shades of gray when a B/W printer is used. If this is not the desired behavior, because actually only a PDF is to be generated, a color printer (or if not available the XPDS printer) should be selected.

</td></tr>
</table>

Global handling



Presettings - Handling

Measurement window	
Enable horizontal measurement cursor	*yes/no:* display of the horizontal measurement cursor (yes: crosshairs; no: vertical line)
When x-axis changes	*Sets whether the measurement cursor remains at the data set coordinate or at the pixel position when the zoomed region is changed.*

Mouse	
Double-click on empty areas	Enables *Select-mode* 1291 to be activated by double-clicking on an empty space in the curve window.

Axes: Here, settings are made which affect the ticks on and at the ends of the axes, once zooming and or re-zooming has been performed.	
Zoom Rezoom	*Use automatic labeling; Place labels at end, use rounding;Place labels at end, use no rounding; Keep previous settings* *See Axes Scale* 1205
Navigation in x-direction	Determines whether after navigating 1364 the Y-axis is permanent or is scaled automatically.

Graphic export: Settings for exporting the curve window as a graphic to the Clipboard	
Resolution [dpi]	Dots per Inch (150, 300, 600, 1200)
Appending pages if the pdf-file is present	If the PDF document already exists, it can be overwritten or supplemented with the curve window.
PDF orientation	Portrait or landscape
clipboard format	Vector- or pixel graphic
Create PDF files	**Bitmap:** The entire graphic is converted to PDF as a bitmap. Resolution in dpi. (Default before Version imc FAMOS 7.3) **Vector graphic:** All graphics elements which are not available as a bitmap are embedded in the **vector graphic in the PDF**. For color maps and 3D, the resulting bitmaps have 300 dpi, which are retained. However, the text elements in the curve window are processed to vector graphics. The system can do a search through the PDF for these by text search. The vector graphic as significantly better resolution at lower memory requirements for normal curve plots. BUT: for graphics with many vector elements (e.g. 10000 big solid dots), the PDF becomes unwieldy large an export is slowed down by an extreme amount. In this case, it is preferable to use the Bitmap setting. On an individual basis, the interior of the curve window can be generated as bitmap and the text elements as vector graphics. To do this, use vector graphics here and for *Export optimization use "Bitmap" under Settings* 1346. For vector graphics, the **Windows XPS printer** is used. This is installed by the operating system and must be operational. Otherwise, the printer will need to be reinstalled via the PC's control panel settings. Here, a resolution of 600 dpi is always assumed; the stated resolution is ignored! **Auto:** When exporting from the Panel or Report Generator, imc FAMOS checks which method is more advantageous. For specific conditions, always select either Bitmap or Vector Graphic. From directly in the curve window, *auto* is either set to *Bitmap or Vector Graphic*, depending on the implementation. The settings are global and can also be set in imc FAMOS, under the menu item: "*Extra*" > "*Options*" > "*File - Save/Export: PDF*".
Miscellaneous	
Size of measurement point symbol	*0.5 -10* mm. Size of the symbols 1224 representing the measured points, e.g. squares, circles...
Initial selection mode	Default setting for *Select-mode* 1291.
Caption text	**Auto:** Name of first dataset. **Filename:** The filename of the loaded ccv file can be shown in the caption of a free-floating curve window.
Single value on Drag&Drop	With the option "*As horizontal line*", single values are always displayed as a line, e.g. for display of value limits.

Transfer to imc FAMOS: A detailed description is provided here 1349.	
Transfer all channels in window	You can transfer either all of the data sets or only the first one which has the window's title.
Execute imc FAMOS command after data transfer	The function/sequence set under "*imc FAMOS Command*" is executed.
imc FAMOS command	Command which is executed once the data have been transferred if the option "*imc FAMOS command after data transfer*" is activated.
Names	Variables names can be changed in order to avoid overwriting existing variables.

Remark: The presettings remain in effect after the program is closed.

Reference: Colors 1341

Transfer Options

Waveforms displayed in the curve windows can be transferred directly to imc FAMOS. It is often useful to transfer data from imc STUDIO or user-made programs which use the curve window to imc FAMOS for special evaluation.

But even within imc FAMOS, the measurement window 1281 enables signal portions located between measurement cursors to be copied. Note that there is a way (Name 1350) to automatically rename the portions, in order not to overwrite the original data.

Waveforms are transferred one by one to imc FAMOS. Once a waveform has been successfully transferred to imc FAMOS, it appears in the variables list.

For the purpose of transferring to imc FAMOS, it is also possible to select options via the presettings 1349.

Execute imc FAMOS Command after Data Transfer:

Immediately after all selected waveforms have been transferred, a imc FAMOS-command can be optionally executed. Any command which can be executed in imc FAMOS can be transferred. For example, a sequence call can be transferred, which imc FAMOS uses to execute the sequence. When the option "*Execute imc FAMOS command after data transfer"* is not selected, it is irrelevant what the user enters in the input box.

Names

Use this option to decide under which file names the data are stored in imc FAMOS after transfer. The following options are available:

Options	Description
Keep	The name of the waveform is accepted unchanged. This option is useful when data are transferred from another application to imc FAMOS and the same name should be used. **Attention:** Be careful when transferring measurement intervals of imc FAMOS curves!
'_' instead of first character	The first character in the name is replaced by '_' (underline).
'_' precede	A '_' is placed **in front of** the name. If the name is too long, it is truncated at the end.
'_' append	A '_' is added **to the end** of a name. If the name is too long, the last character of the original name is dropped.
Fixed Names	User-defined names can also be specified. This option is useful only when just one waveform is transferred. If the user attempts to transfer multiple waveforms with the same name, each waveform will be overwritten by the next one.

The option most appropriate depends on the application and the particular names. The options *'_' precede* or *'_' append* are recommended for transferring measurement intervals within imc FAMOS. Any significant characters in the name should not be changed. The transferred data should have distinct names.

Mouse Operation

- Select menu item *Options/Transfer options*... to set the options for transferring data. A dialog appears in which settings are made.
- Select menu option *File/ Transfer to imc FAMOS* in the curve window to transfer data to imc FAMOS using the specified options.
- In order to transfer a curve window section defined by the measurement cursors, select the context menu item *Send curve segment to imc FAMOS* 1281.

Remarks

- If the imc FAMOS application hasn't been opened yet, it is automatically started when transfer to imc FAMOS is executed. The imc FAMOS.EXE file is searched for in the same directory as the IM7CUDAM.DLL file.
- If waveforms are to be transferred to imc FAMOS, it is recommended to end any sequences running in imc FAMOS before starting transfer.
- The transfer options remain intact after the program is ended.
- Transfer options are valid for all curve and measurement value windows.

11.6.8.4.4 Printer preview

This item is only enabled in the Data Browser's Report view.

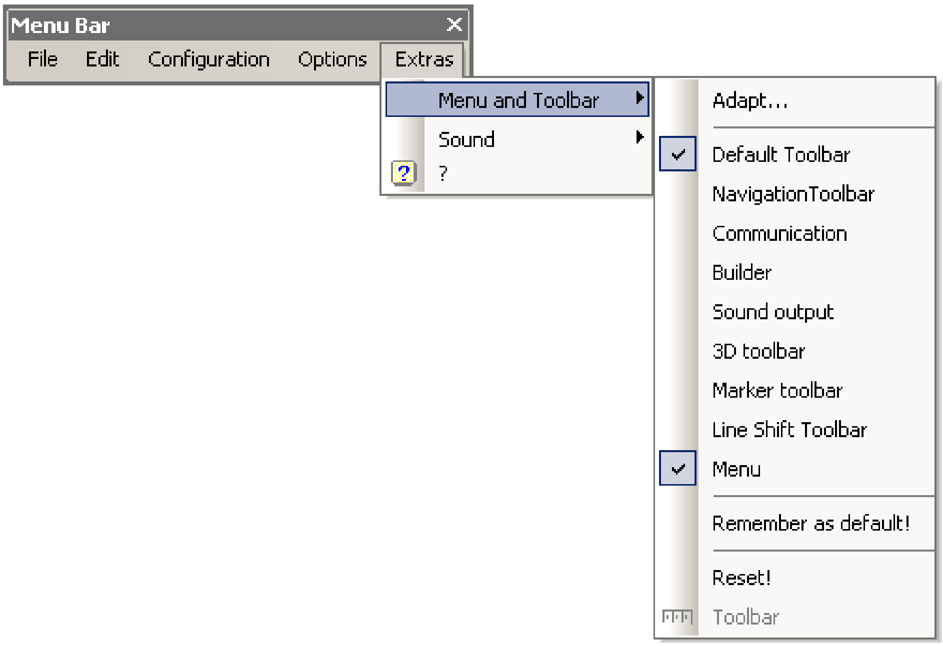
The *Print Preview* is activated by default for curve windows which are incorporated into a report in the Data-Browser. This means that the colors are displayed which the user set in the *Colors* 1341-dialog in the *Options* menu as the color scheme for the printer.

With this option, it is possible to switch to the monitor screen's color scheme.

11.6.8.5 "Extras" menu

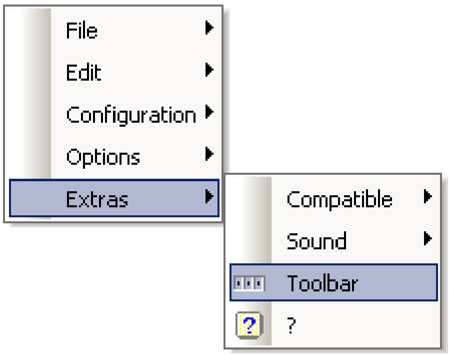
Menu item	Description
Menu and Toolbar 1351	Options pertaining to the menu and toolbar.
Sound 1355	Activates the sound output and access to the functions of the Sound-Toolbar.
?	Displays the curve window's Help.

11.6.8.5.1 Menu and Toolbar



Menu item	Description
Adapt... 1352	Dialog for adapting (making one's own arrangement of and settings for) the curve window's menu and toolbar.
Standard Toolbar, Navigation Toolbar, ...Menu	These toolbars or even the menu bar can each be activated separately.
Remember as default!	The arrangement of the menu and the toolbar is saved as the valid default arrangement. In this way, the same settings are used even for a different, new curve.
Reset!	The menu and toolbar are reset to their initial, factory-set state.

Toolbar

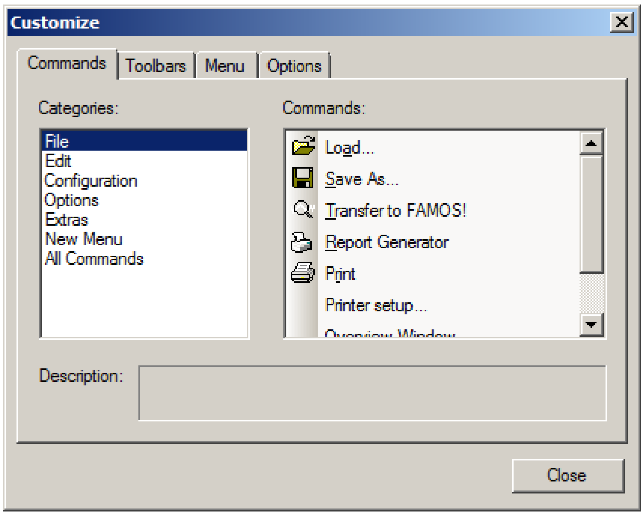


As a curve window integrated in the Data-Browser's Report view, the entire Toolbar only appears when a curve window is selected. To cancel this behavior so that the Toolbar does not appear, the function "Toolbar" can be selected. This is only available from within the Data-Browser. To make the toolbar visible again, select "Toolbar" under "Extras" in the curve window's context menu.

11.6.8.5.1.1 Adapt / Customize

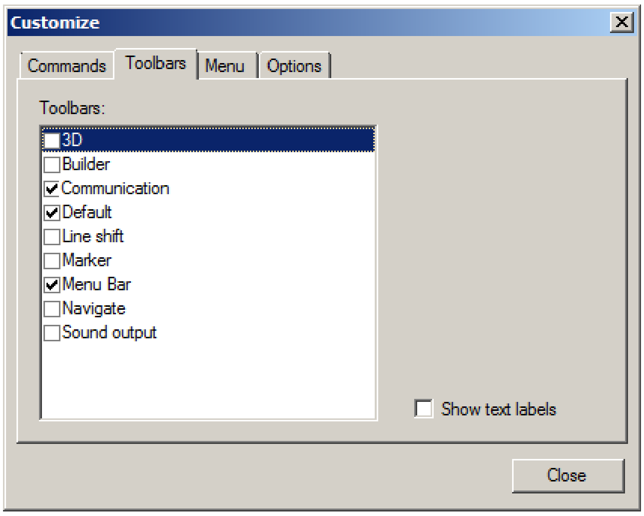
The curve window's menu and toolbar can be adapted. Right-clicking in either the menu or the toolbar opens the context menu. Alternatively, select the menu item *Extras / Menu and Toolbar*.

The menu item *Adapt*... opens the following dialog:

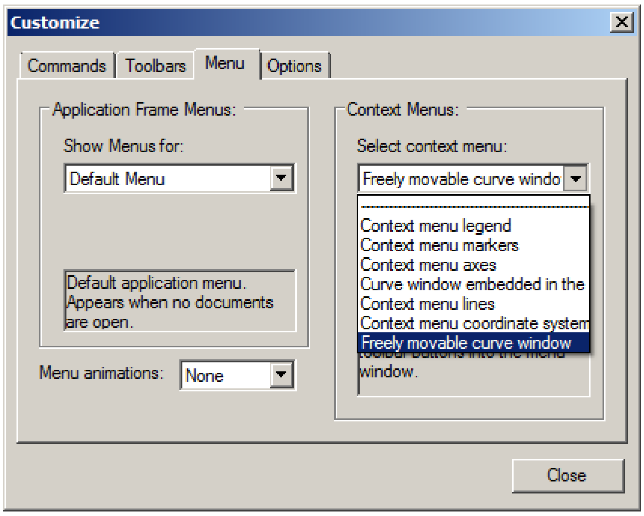


A command can be dragged from thee list at right and dropped on a menu or toolbar. Pop-down menus open by themselves when the mouse is moved over them. The list at left contains the different command topics.

The dialog below offers the additional option of showing or hiding the various toolbars:



The curve window has a context menu. This, too can be edited:



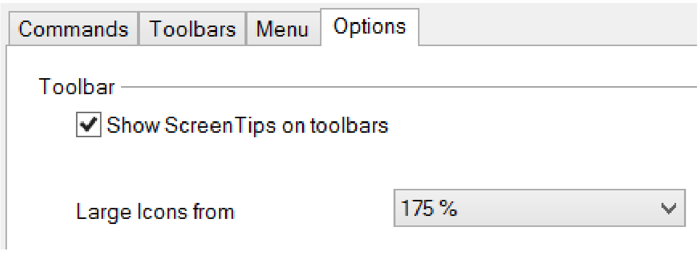
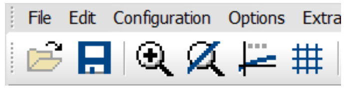
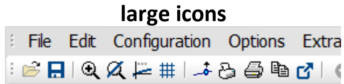
Select the display type which you wish to process.

- normal curve window which is free-floating and freely movable and can also be maximized (popup-window)
- a curve window without title bar (child window) embedded in a dialog.

While editing menus, the curve window can't be operated.

While the dialog *Customize* is open, all menu items as well as toolbar elements can be moved around by the Drag and Drop technique. Note that moving an element to the "outside" means deleting the element.

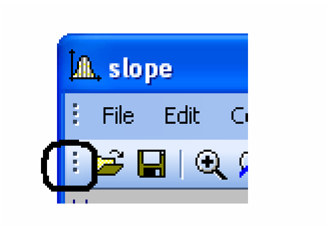
On the page "***Options***", there are two options for the display of the *Toolbars:*

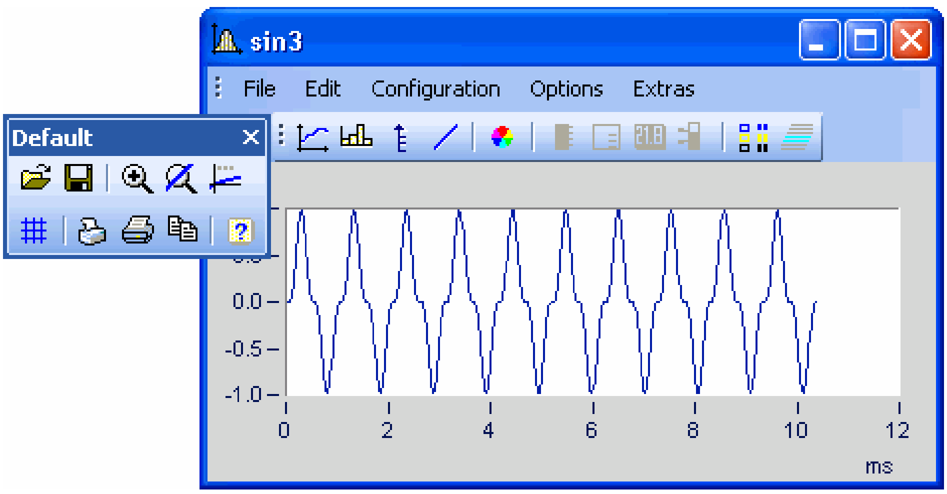
Options	Description
Show tips on toolbars	A description of the icon is displayed when the mouse is moved over the window.
Large buttons	For clearer display at fine screen resolutions such as 4K, the icons can be automatically enlarged from a certain scale.  small icons  large icons  small icons

Changes of the menu are permanently saved when the dialog Customize is closed. The particular toolbar arrangement saved depends on the display type:

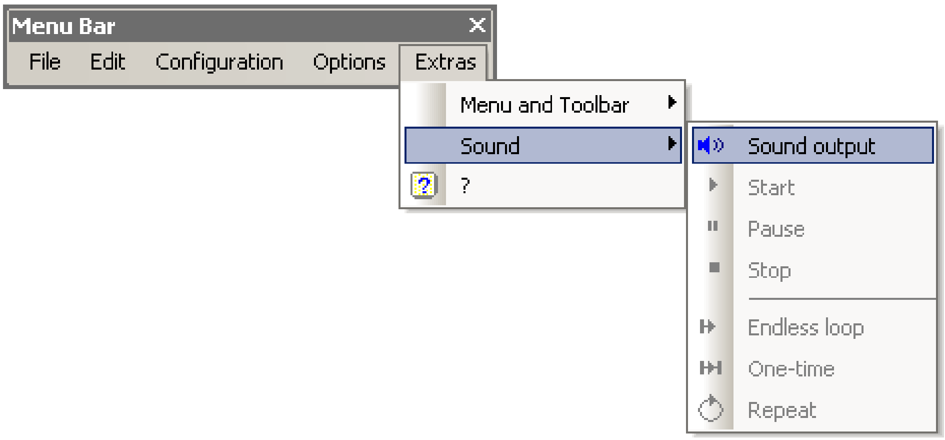
- Default
- Last value as number
- Overview window
- Table

The toolbars can also float freely away from the window. To accomplish this, drag the toolbar away by its left edge:





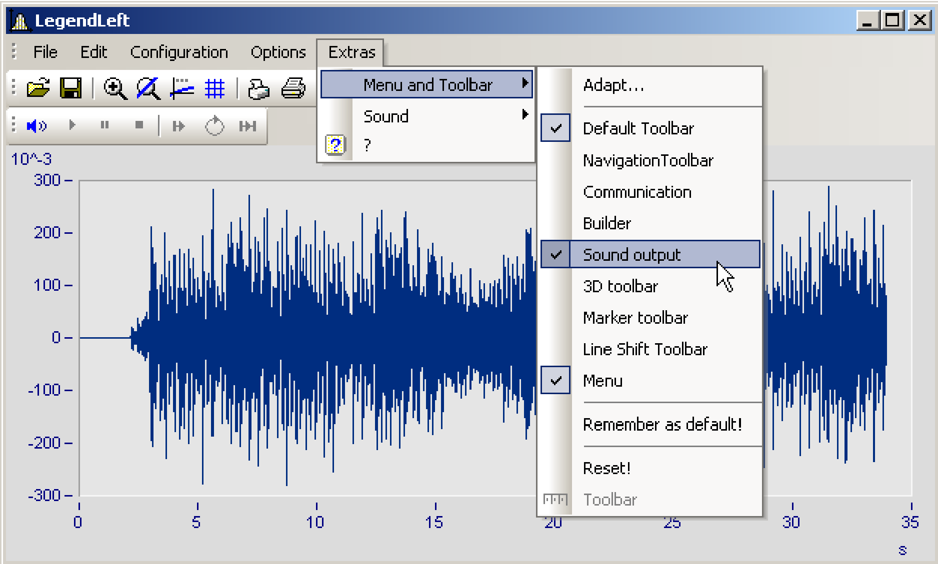
11.6.8.5.2 Sound



The Sound Toolbar lets you make measured data sets audible. For this purpose, a variety of functions such as cutting, endless looping and repeat are available. The sound output always only applies to the first data set in the first coordinate system and is only available in the Standard view, or with multiple y-axes.

11.6.8.5.2.1 Sound Toolbar

For working with the sound output, you should select the associated toolbar from the menu *Extras / Menu and Toolbar / Sound output*.



Sound output toolbar

Under Sound Output, the following functions are available:

Menu item	Description
On/Off	This function lets you switch the sound output on and off. A vertical bar marks the current playback position within the curve window (playback marking), and a horizontal bar denotes the selected playback range.
Start	With this function you start output of the sound, and the selected range of the data set is played back in real time. The playback's starting and ending points can be freely selected and the position of the resulting playback time window can be moved as desired (see Cut Sound 1358).
Stop	This function stops playback of the data set. The playback marking is set back to the start of the selected playback region.
Pause	This button pauses playback of the data set. The playback marking remains at its current position. By clicking on it again, playback can be resumed.
Loop from loop start to end of waveform	When you choose this operation mode, the final position for the playback is automatically set to the end of the waveform; see Cut sound 1358)
Loop (repeat) from loop start to loop end	Repeated playback of loop (so-called Repeat-mode).
Loop (single) from loop start to loop end	One-time playback of the loop

Volume

The volume is set by setting the scaling of the y-axis. The range between y-min and y-max is interpreted as the maximum volume of the sound card. Thus for example, if the signal extends from -5 to 5 (units) and the y-axis extends from -5 to 5, the maximum volume is achieved. If there is an additional signal extending only from -0.5 to + 0.5, and if it is displayed with the same y-axis settings, the amplitudes from the sound card will only be 1/10 as high. I.e. the signal will be played back correspondingly softly.

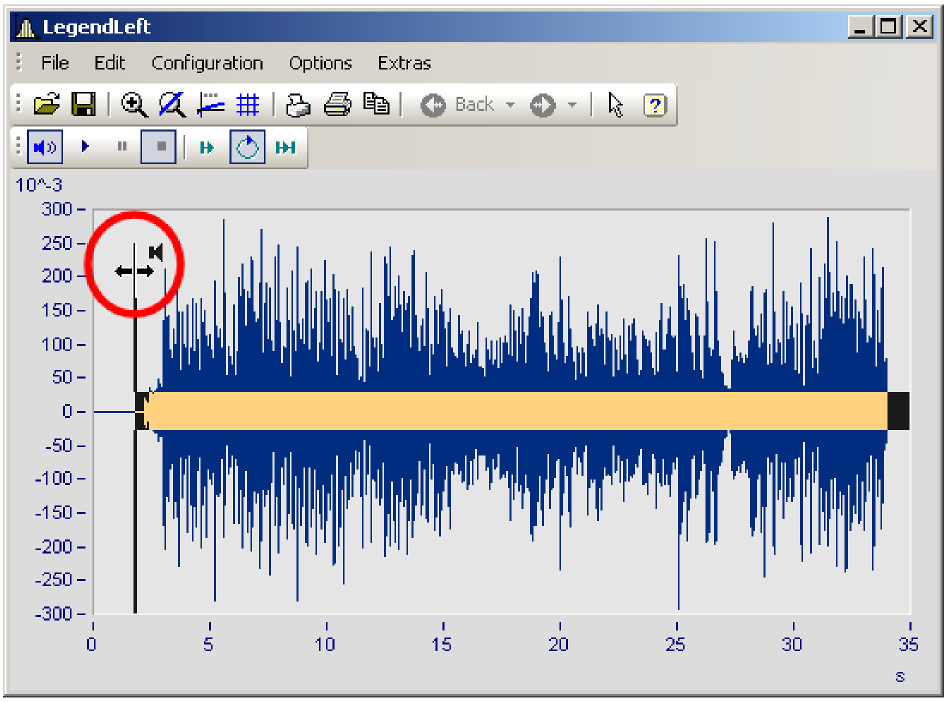
When the volumes of various signals are to be compared, all y-axes must be set to the same scaling. If the y-axes are scaled automatically, all signals have the sound card's maximum level.

The Sound Kit functions have not settings options for volume.

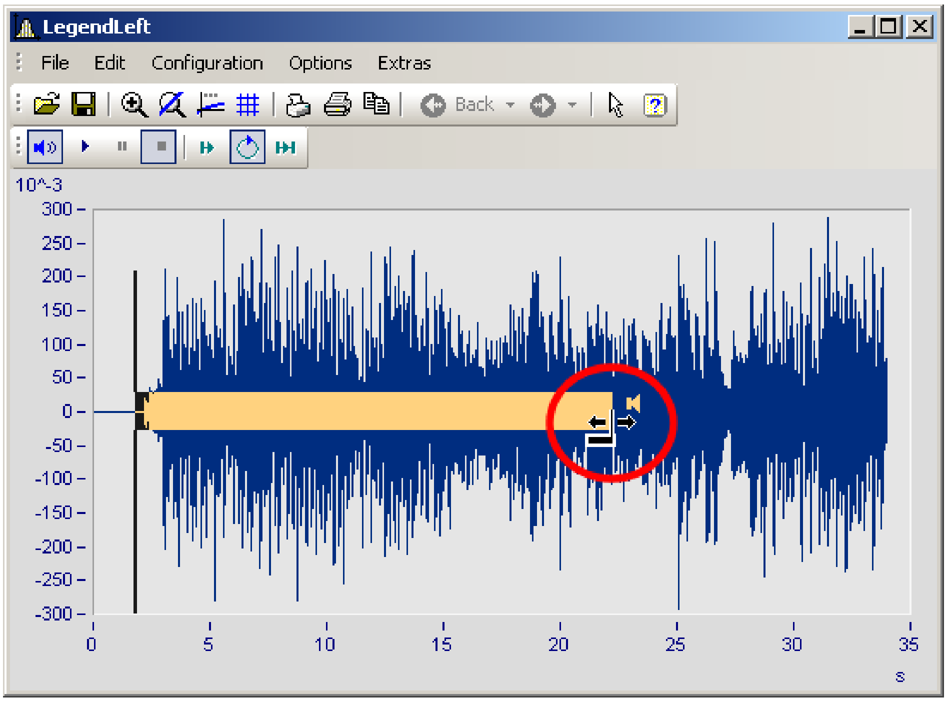
11.6.8.5.2.2 Sound clip

In sound output, it is possible to freely select (take a clip from) the playback region.

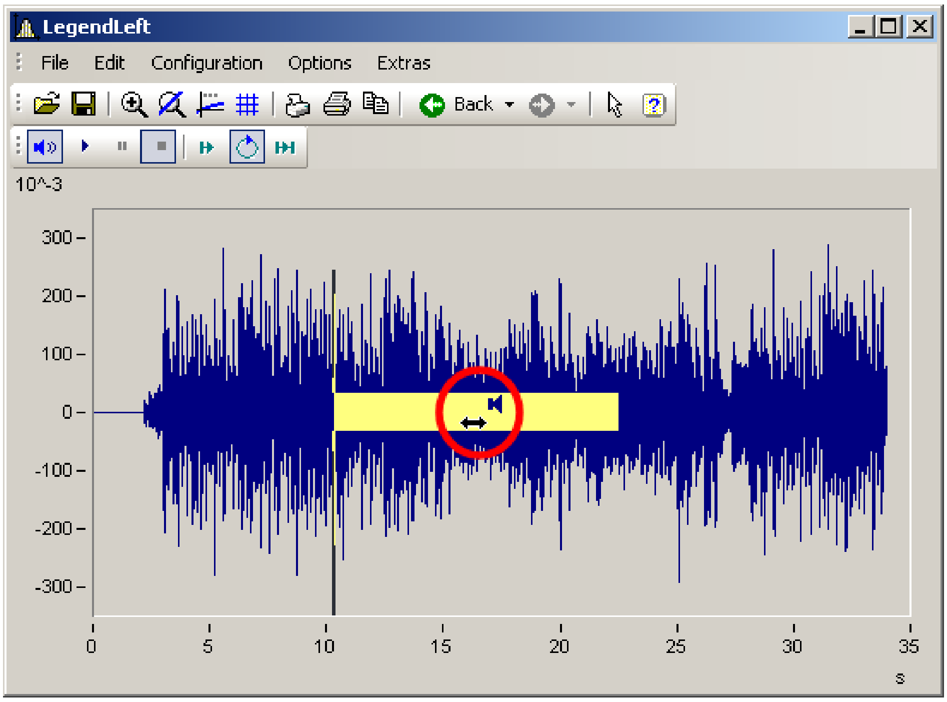
Grab the start position at the beginning of the Playback strip and move it to the position desired.



The final position for playback can also be changed. Grab the end of the playback strip and move it.



You can also move a selected playback region forwards or backwards along the data set. Click on the strip and move the mouse while holding down its button.



11.6.8.5.2.3 Audio output directly during measurement

During a measurement with imc STUDIO /DEVICES, it is possible to use the curve window to listen directly to the streaming data. Since the data are transferred block-by-block and sporadically, the output must be delayed in order for the playback to be seamless.

In the curve window settings 1345, you will find the two entries "*Start delay*" and "*Max. delay*".

At the beginning, as well as after losing synchronization, the *"Start delay"* takes effect. By means of *"Max. delay",* it is possible to compensate for asynchronization between the measurement device and the PC. Both values are stated in milliseconds.

11.6.9 Information and Tips

11.6.9.1 Greek texts in comments, markers and axis labels

Axis labels and comments on the variables can be supplemented with Greek letters.

This is accomplished using the statement <g*Placeholder>.

Example

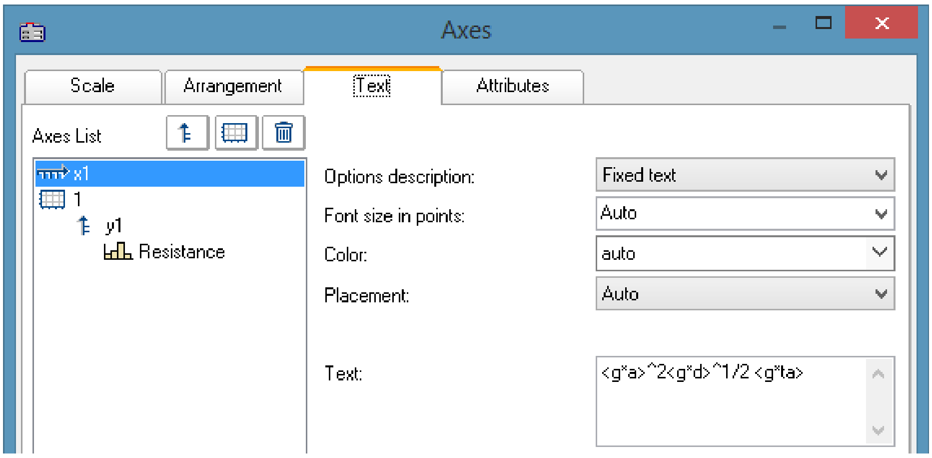
<g*a> ^ <g*a> is displayed as α^{β}.

The following table lists the available Greek letters with their respective placeholders. Here, the Unicode is only provided as a reference; it can't be used in the statement.

Placeholder		Meaning	Placeholder		Meaning
'a'	0x3b1	Alpha	'm'	0x3bc	My
'b'	0x3b2	Beta	'n'	0x3bd	Ny
'g'	0x3b3	Gamma	'x'	0x3be	Xi
'G'	0x393	uppercase Gamma	'X'	0x39e	uppercase Xi
'd'	0x3b4	Delta	'p'	0x3c0	Pi
'D'	0x394	uppercase Delta	'ph'	0x3c6	Phi
'e'	0x3b5	Epsilon	'ps'	0x3c8	Psi
'et'	0x3b7	Eta	'P'	0x3a0	uppercase Pi
'z'	0x3b6	Zeta	'Ph'	0x3a6	uppercase Phi
'th'	0x3b8	theta	'Ps'	0x3a8	uppercase Psi
'ta'	0x3d1	theta, (customary) notation	'r'	0x3c1	Rho
't'	0x3c4	tau	's'	0x3c3	Sigma
'Th'	0x398	uppercase Theta	'S'	0x3a3	uppercase Sigma
'k'	0x3ba	Kappa	'ch'	0x3c7	Chi
'l'	0x3bb	Lambda	'Ch'	0x3a7	uppercase Chi
'L'	0x39b	uppercase Lambda	'o'	0x3c9	Omega
			'O'	0x3a9	uppercase Omega

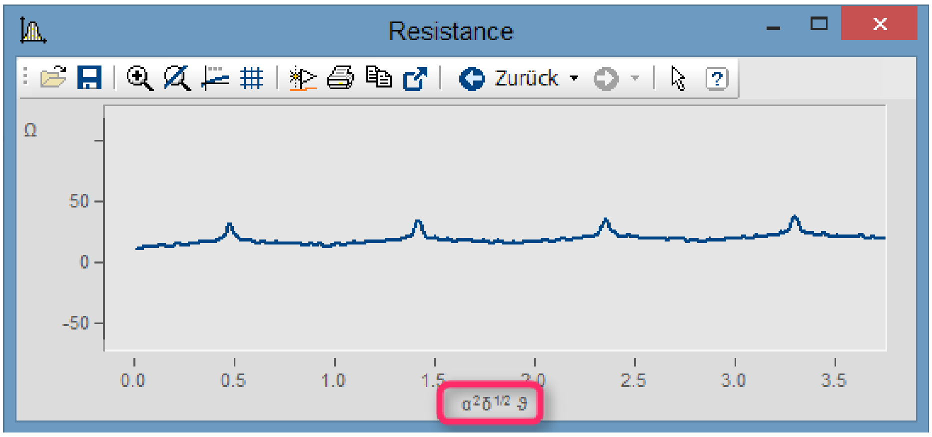
Example curve window

with



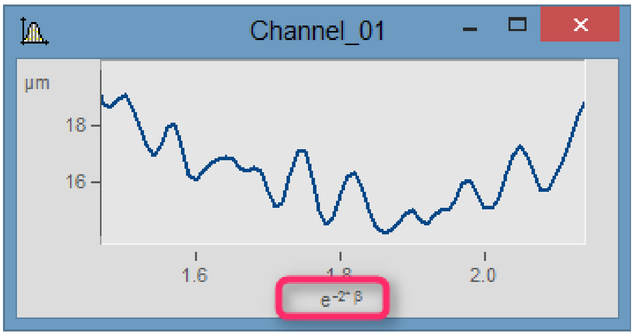
Greek characters in "Axes\Text": <g*a>^2<g*d>^1/2 <g*ta>

the result is:



Greek characters as text at the X-axis

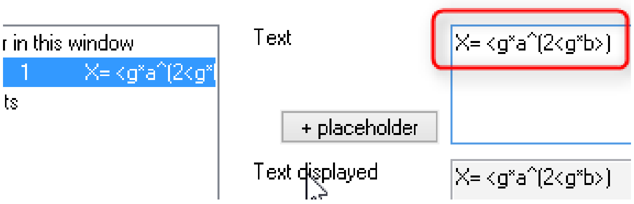
Exponent with multiple characters. From e^(-2*<g*b>) we obtain:



Exponent of placeholder in parentheses: e^(-2*<g*b>)

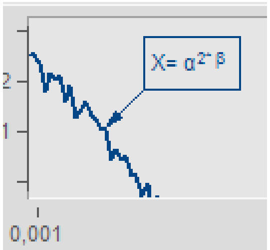
Example markers

with



Greek characters in marker-definition:

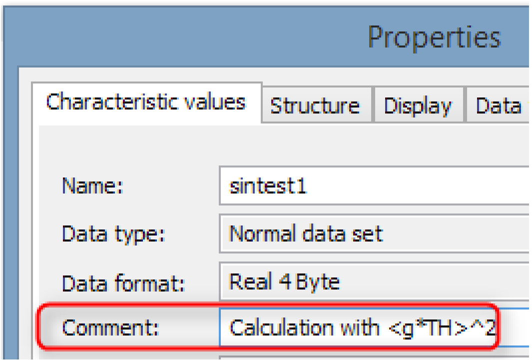
the result is:



Greek characters in markers

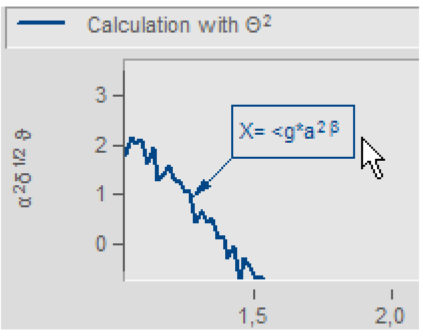
Example comment on variables

with



Greek characters in variable "Properties\Comment"

the result is:



Greek characters in "Axes/Legends"

Orders of magnitude and units

Specified orders of magnitude with units are recognized and displayed appropriately. For example, the unit 'mm' is corrected to the SI unit 'm'. 10.000 'mm' becomes 10 'm', 0.01 'mm' becomes 10 'µm'. The condition is that *"auto"* is set for *"Order of magnitude* 1208*"* under *"Scale"*.

11.6.9.2 Curve Window Context Menu

Function

Click with the right mouse button in the curve window to prompt a context menu, which offers quick access to further functions in the curve window. The context menu depends on the cursor's position and on whether or not you are in Select-mode.

11.6.9.3 Copy&Paste - Transfer configuration

With Copy & Paste, you can transfer once curve window's configuration to another. To do this, copy the configuration of the selected window using ***CTRL-c*** and transfer it to another one using ***CTRL-v***.

With embedded curve windows, it is additionally necessary to hold down the *SHIFT*-key (child-windows/widgets in the Panel).

11.6.9.4 Drag and Drop, mouse wheel

Moving waveforms

Drag and drop allows the user to shift or copy waveforms in curve windows. To apply this technique within a coordinate system, hold down the CTRL-key. Use Drag and drop for the following:

- **Drag** a waveform **from** the **imc FAMOS variable list to** the **curve window**. This allows the waveform to be displayed in the curve window as well as indicated in the list.
- Within a curve window: While the **CTRL-key is pressed**, **all data can be moved to an axis or to a coordinate system**.
  Note: The old behavior without the CTRL-key is made available by means of the Registry entry: `[HKEY_CURRENT_USER\Software\imc Measurement and Control\Default\CurveDataManager\Curves];` String value: `"dd63"="1"`
- Transfer **all data** for an axis, a coordinate system or an entire curve window **to another curve window** for display.
- Move **all data** concerning an axis, a coordinate system or a curve window **to** the **imc FAMOS** variable list. If the data do not belong to imc FAMOS (i.e. are from another application, e.g. imc STUDIO), they are copied to imc FAMOS.
- With maximized curve window display 1137 (coordinate system = outer frame), Drag&Drop also starts when an axis is moved to the bottom. In that case, the mouse pointer symbol changes.

Displayed region

- Using ***Drag and Drop*** within a curve window moves the axes.
- By using the ***mouse wheel***, the region around the mouse cursor's current position is increased/reduced. The increments of size change are smaller/larger when pressing the SHIFT-/CTRL-key, respectively.
- If the **mouse wheel** is located over either the **X-** or the **Y-axis**, then only the respective axis is altered.
- Pressing the **CTRL-key** causes the **effect of the mouse wheel** to be **increased**, while pressing the **SHIFT-key** causes it to be **diminished**.

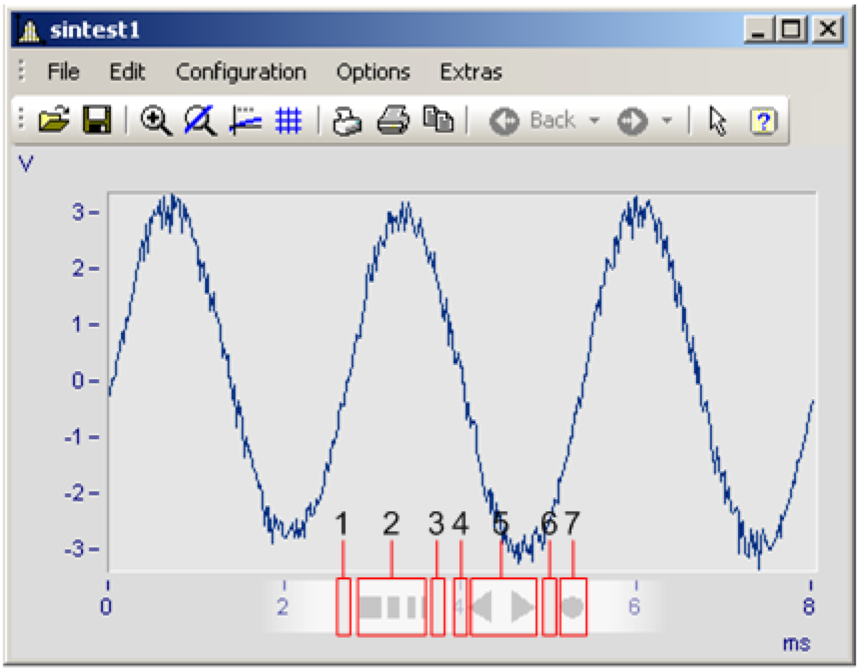
Remarks

- If the mouse is released over a y-axis, the data are displayed on this axis. Release the mouse over a coordinate system, and the data are displayed with a new y-axis for this coordinate system. Otherwise, a new coordinate system is opened.
- When data are moved to the variable list in imc FAMOS, the waveforms are actually copied. In all other cases, the same waveforms are simply relocated.
- The cursor changes its shape during "Drag". If a symbol appears indicating an invalid operation, "Drop" cannot be executed, only Cancel is possible.

11.6.9.5 Axes Navigation Bar

For quick navigation through the curve window, each axis has its own navigation bar. The controls appear when you move the mouse cursor square over the axis labeling. The navigation bar offers three basic functions:

- You can magnify or reduce the displayed region, while leaving the value in the middle of the x- or y-axis, or z-axis remains unchanged. This function is provided by the button denoted as "2" in the picture. Alternatively, you can change the axes' range using the mouse wheel.
- You can shift the region displayed to the right or the left. This function is provided by the button denoted as "5" in the picture.
- Any changes in the magnification, moving or zooming can be reversed and thus return to their original appearance.



Dragging		Description
1 <- [2] 3	Dragging from 2 to 1	Magnification
1 [2] -> 3	Dragging from 2 to 3	Shrinking
4 <- [5] 6	Dragging from 5 to 4	Move left
4 [5] -> 6	Dragging from 5 to 6	Move right
[7]	Click on 7	Rezoom the X-axis. Displays all data

Use of the keyboard arrow keys

While holding down the left mouse button with the pointer in the Navigation pane, you can also move the region by using the keyboards arrow keys.

11.7 Special Widgets

Here, special Widgets are described.

11.7.1 Text input for report channel

This Widget enables you to write pre-defined **texts** to a **report channel**. During the running measurement, it is also possible to add freely defined texts to the channel along with predefined texts.

In order to be able to use this Widget, link it with a report channel. In the chapter "*User-defined variables*1087", there is a description of how to create a report channel. How a channel is linked with the Widget is described in the section "*Variable linkage*1390".

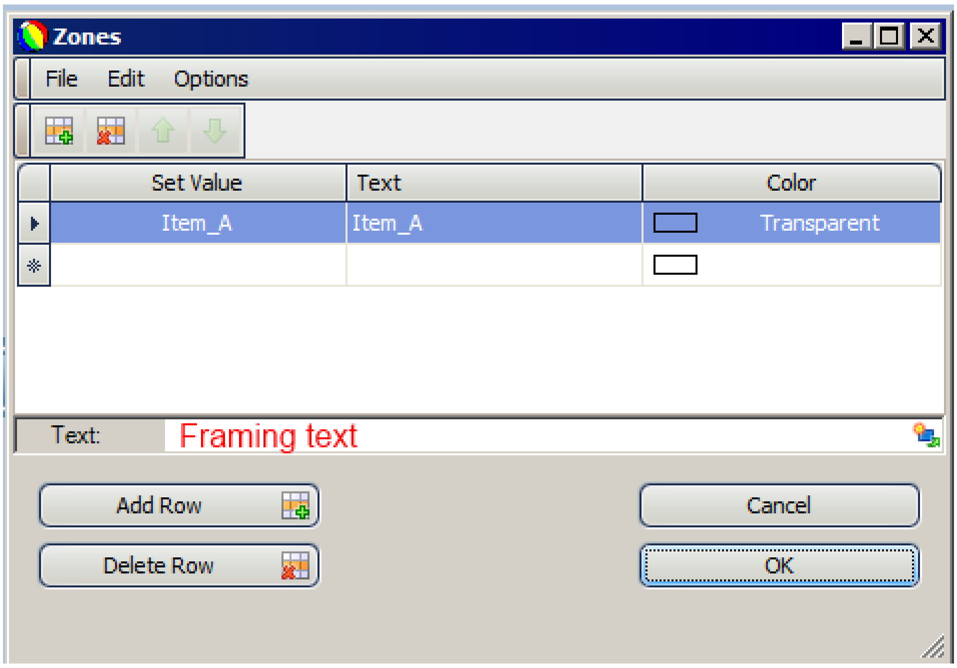
Defining the texts

In order to define the text, open the **Zones-dialog** in the **Properties window**. This dialog contains the columns **Text** and **Set Value**.

- Text: This text is displayed in Widgets selection list

- Set Value: This text is written in the report channel if the Widget is activated

Below the table, a framing text can be entered which is written to the channel each time it is activated, no matter which text is currently set. As soon as something is entered here, the text entered under **Set Value** is no longer written to the channel. However, it is possible to incorporate the value from the table into this text by means of the placeholder **<CONTROL.VALUE>**.



Textinput for report channel, zone dialog

Further information on this dialog is presented in the chapter Zone dialog 1114.

Example

Two entries are created in the table:

- Text: *It is too hot*, Set Value: *Too hot*
- Text: *It is too cold*, Set Value: *Too cold*

Frame text (text below the table): *Error message: <CONTROL.VALUE>*

If one now selects the first entry in the Widget, then the *Error message: Too hot* is written in the channel.

Writing text in the channel

To write the **predefined texts** in the channel, there are a variety of possibilities:

- **Select** the desired entry **from the list**. For this purpose, just selecting is adequate, additionally clicking on the Widget is not necessary.
- If the entry is **already selected**, click on the Widget in order to add the entry to the channel; the Widget works like a button.

In order to add a **freely defined text** to the report channel during the measurement, left-click the mouse once over the value being displayed currently. Then you will be able to edit it. To write the value to the channel, conclude the entry by clicking on Enter. If a **frame text** is set in the Zones dialog, it is **ignored**.

Note — Where are entries inserted

- The entries are added during the measurement at the **current moment**.
- It is possible to add the entries at the position of the Navigation bar's slider; for information on this, see the section "*Post-processing mode* 1404".

Context

Report channels offer the possibility of saving a context along with the text entries. This context is typically the channel (or channels) where the event occurred, about which the comment is to be made.

The context is stated in **curved brackets {}** in the frame text.

In order that the context (channel) can be added during running measurement, use the placeholder **<SELCONTROL.VARS>** here. If you add a text during measurement (release of the Widget), you subsequently have time to click the mouse on the Widget, with which the channel to receive the comment is linked. During this time, the Widget flashes. You can set the time in the Widget's properties (display mode: *All Properties*).

Example

Zones dialog:

- Three entries are created, *Text1*, *Text2* and *Text3*
- Frame test is: *Test: <CONTROL.VALUE>{<SELCONTROL.VARS>}*

Channels:

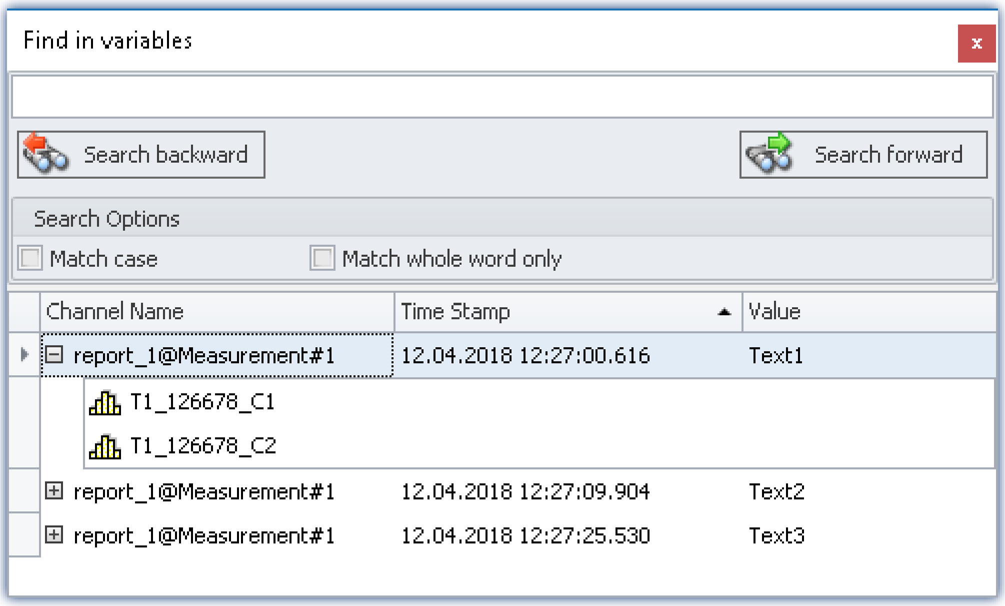
- Two active measurement channels, *T1_126678_C1* and *T1_126678_C2*
- Report channel for Text entries: *report_1*

Panel:

- Widget *Text input for report channels* linked with *report*
- A curve window linked with both measurement channels, curve window linked with Navigation bar
- Report channel *report* linked with the Navigation bar

During measurement, each time after the Widget was released, the curve window with the two channels was clicked on. Thus as the context of the text etries, the two measurement channels were captured, since <SELCONTROL.VARS> always includes all channels/variables, which are linked with the Widget on which you click.

In the Navigation bar's Search box 1403, the context is displayed below the channel:



Display of the context in the Search box

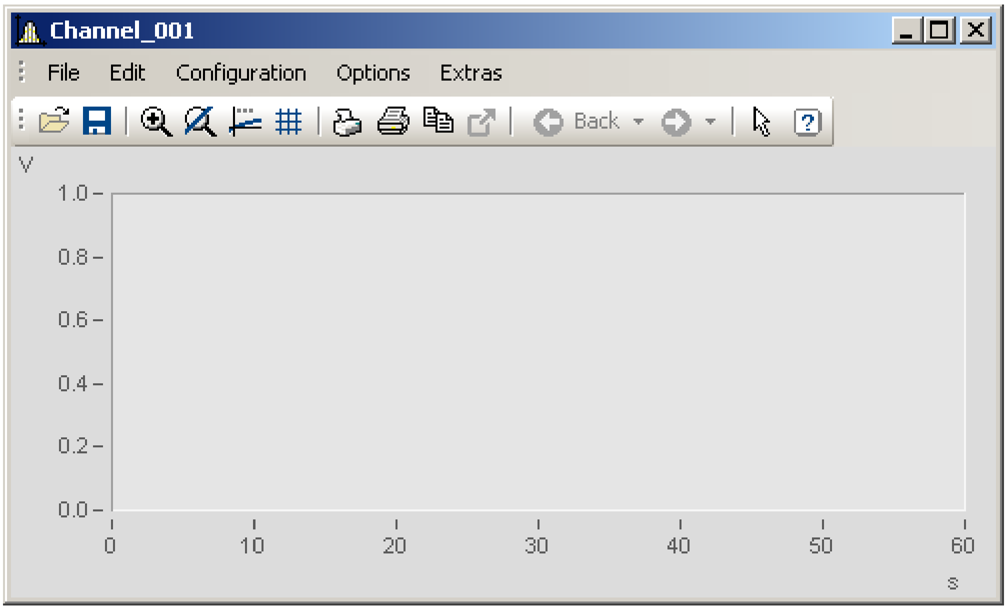
Since the search includes all columns (Channel Name, Time Stamp, Value), it is also possible to search for a specific context. You also have the option of displaying an additional column *Context*.

11.7.2 Curve Window - "Free-floating"

The curve window comes in two varieties:

- "free-floating" and
- embedded on a Panel page

The "free-floating" curve windows are associated with the experiment. They remain open until closed (X) and are displayed even when the Panel is not open.



Example of a "free-floating" curve window

The embedded curve windows are only visible if the associated Panel page is opened.

The configuration of the windows is described here: Curve Window 1126.

Opening a "free-floating" curve window

The curve window can be opened from different plug-ins:

Setup:

- Open the context menu for the desired channel in the Channels table
- Click on: *Show in curve/values window*

Panel:

- Double-click in the tool window Data Browser on the desired channel
- or select the desired channels and click on the *Show* 1077-button (/) in the symbol bar of the tool window Data Browser.

Reference	See also

Setup - Device Configuration > "*Import of an imc DEVICES Experiment* 290": How do I get the free-floating curve windows from imc DEVICES into the imc STUDIO Panel pages?

11.7.3 Clock

With its various design and formatting styles, the clock provides a variety of ways to visually illustrate a report. It can indicate how long a measurement has been running or when a measurement ended. The current time and date can be displayed. For these purposes, a variety of formats are available.

Here are a few examples:

Variants of the clock

Selecting the time display style

A variety of time readouts are available, depending on the linked variable.

Variable linkage	Description
SystemClock - PC time	Current PC clock time - Default option when the Widget is set up.
SystemClock - System time	Current clock time of imc STUDIO ("VRTC 315"). This time is used for all components of imc STUDIO.
Linkage with a channel	Displays the channel's elapsed measurement time, meaning the amount of time which passed since the trigger fired, or the measurement was started. The final time display reflects when the measurement concluded or the triggering event ended. When the trigger fires again, the display time returns to "0 s" and restarts.
Linkage with a trigger-variable's "*Trigger time*"	Displays the moment in time at the last change of the state: Armed, Triggered, Stopped. I.e. when: • the measurement is started, • the trigger fires, • the trigger event ends and • the measurement is stopped. Thus, stopping the measurement also resets the clock after a previously concluded triggered measurement.

Clock properties

<table>
<tr><th>Properties</th><th>Description</th></tr>
<tr><td>Appearance</td><td>Here you specify the appearance of the clock; e.g. with clockhands, or a digital readout.</td></tr>
<tr><td>Mask</td><td>There are various ways to display the time or date. The output format depends on the system and on its setting for the Region (Windows "Clock, Language & Region"). E.g. in the format "Long date" in one region may contain the weekday, while in a different region it does not.
<table>
<tr><th>Mask</th><th>Description</th></tr>
<tr><td>Long time</td><td>Example: 08:11:45</td></tr>
<tr><td>Short time</td><td>Example: 08:11</td></tr>
<tr><td>Long date</td><td>Example: Wednesday. April 17, 2019</td></tr>
<tr><td>Short date</td><td>Example: 17/04/2019</td></tr>
<tr><td>Date and time</td><td>Example: 17/04/2019 08:11</td></tr>
<tr><td>UTC (IRIG Format)</td><td>Example: 107:08:11:45:261
The first position indicates the current day's number within the calendar year. Thus the date 1/5/2019 is day "5" in this system. This format provides no indication of the current year's number.</td></tr>
</table></td></tr>
<tr><td>Time zone</td><td>In imc STUDIO, it is possible for differing time zones and clock readings to coincide.

The external clock (e.g. GPS-mouse) may indicate different time than the PC.
The devices may be located in different countries.
On a business trip, the laptop’s clock time may reflect a different time zone than the device's.

The clock-Widget can be set for different time zones. For this purpose, there is a new selection available: "imc STUDIO-Time zone". With this selection, the clock automatically uses the device's time zone. With the selection: "Local time zone", the PC's time zone is used.</td></tr>
</table>

11.7.4 Image

Using the Widget, you are able to display a logo or a project graphic, or a background which shapes the page. There are various ways to apply the Widget.

Reference	Background image

If you wish to display a background image over the entire page, you can use the page's property: "*Background image* 1379".

Properties

<table>
<tr><th>Properties</th><th>Description</th></tr>
<tr><td>image</td><td>Available file types: png, jpg and bmp

If an image is selected, the text: "(Bitmap)" appears under this property. In order to delete the image, delete the text.

Be aware that large pictures place high demands on the PC's memory and performance capacity. So if possible, first modify the image to the desired size.</td></tr>
<tr><td>Size mode</td><td>The image can be stretched or displayed without any zoom factor:
<table>
<tr><th>Size mode</th><th>Description</th></tr>
<tr><td>Auto and Normal</td><td>The image is displayed in its original size within the Widget. The upper left corner is the reference position. If the Widget is too small, only a section is displayed.</td></tr>
<tr><td>Stretch image</td><td>The image is stretched to completely fill the Widget. The aspect ratio is not retained.</td></tr>
<tr><td>Automatic Widget size</td><td>The image is displayed it its original size. The Widget adjusts itself to the image's size.</td></tr>
<tr><td>Center image</td><td>The image is displayed in its original size within the Widget. The center point is the reference position. If the Widget is too small, only a section is displayed.</td></tr>
<tr><td>Zoom image</td><td>The image is stretched in such a way as to touch the edges of the Widget on at least two (opposing) sides. The aspect ratio is retained. At the other two edges, there are resulting empty strips ("Background color").</td></tr>
</table></td></tr>
<tr><td>Background color</td><td>The color displayed wherever the Widget is not totally filled by the image.</td></tr>
</table>

11.7.5 Execute menu action

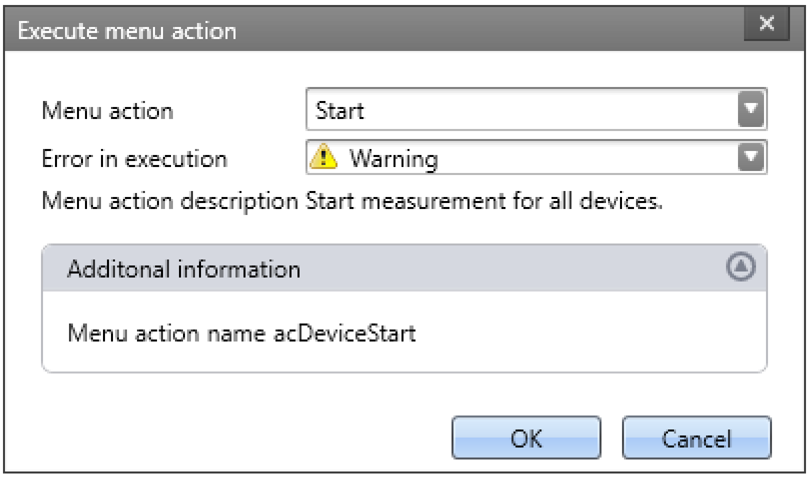
This Widget lets you execute a menu action. A list contains the actions available in the menu ribbon. When this Widget is run, it replicates clicking the mouse over the corresponding button. This widget can be helpful when the Panel is running in fullscreen mode. The menu ribbon is not present then.

This Widget adapts itself to the status of the menu action. E.g. when the action is currently not present, the button can not be clicked. Some menu actions are attached to specific user roles, device components or loaded imc STUDIO-components.

Various menu actions

Reference	Command - Execute menu action

For Sequencer-routines, there is a command of the same name 1557. This command is often linked with switches on the Panel.



Configuration: Execute menu action

Parameter	Description
Menu action	Here, select the desired menu action. Open the drop-down list. The menu actions appear in groups. Scroll to the appropriate group and select the desired action. Filtering: You can enter the first letter of the action's name in the input box. Then the list will be restricted to actions starting with that letter.
Error in execution	If this action returns a fault condition, there are various responses available. • Error: The action returns an error message in the logbook. • Warning: The action returns a warning message in the logbook. • Ignore: No info appears in the logbook.
Menu action description	The action's description text is displayed.
Additional information	The menu action's internal designator is displayed.

11.8 Pages

11.8.1 Insert - Dialog / Report

The following ways to add a page are available:

- via the page title's "*context menu* 1094"
- via the menu ribbon
- via the tool window "*Page templates* 1093" by means of Drag&Drop or double-clicking

Ribbon	View
Panel-Design > Insert Page ()	Complete
Panel-Design > Standard Dialog ()	Complete

Menu item	Description
Insert Page	Selection window for creating a new Dialog- or Report-page is opened.
Standard Dialog	Creates a new Standard dialog page.

Note Replacing a page

When you use Drag&Drop to move a template from the tool window "*Page templates* 1093" to an empty page, it is replaced.

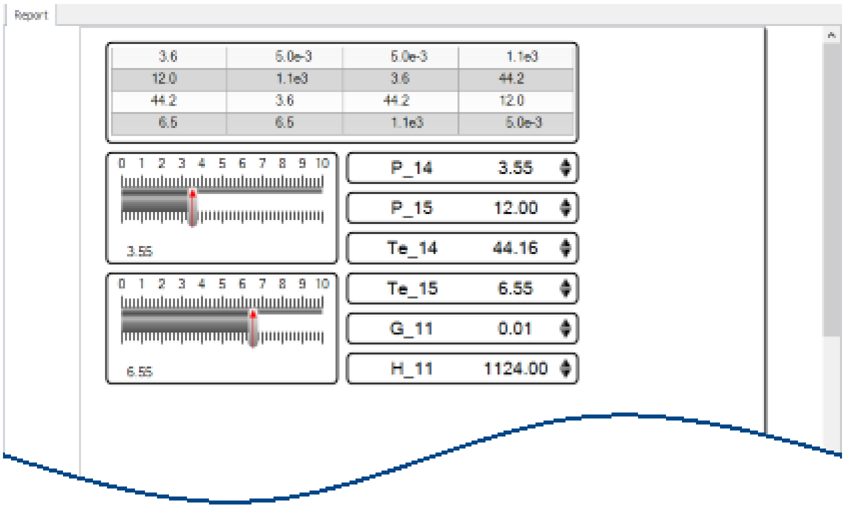
A page can be generated as a "*Dialog-page*" or as a "*Report-page*".

Report-page

The Report-page is optimized for printout. On the screen, one of its distinguishing features is that "margins" are displayed. By default, the pages are displayed in a fixed size.

Change the size and other page settings using the dialog: "*Page setup*" ("*Page Layout for Printing*" via the context menu 1094 of the Panel page's tab).

Menu item	Description
Page Layout for Printing	Opens the dialog: "*Page Setup*" Here, you can change the setup and printout settings for Report-pages (including paper size, source, orientation, margin).



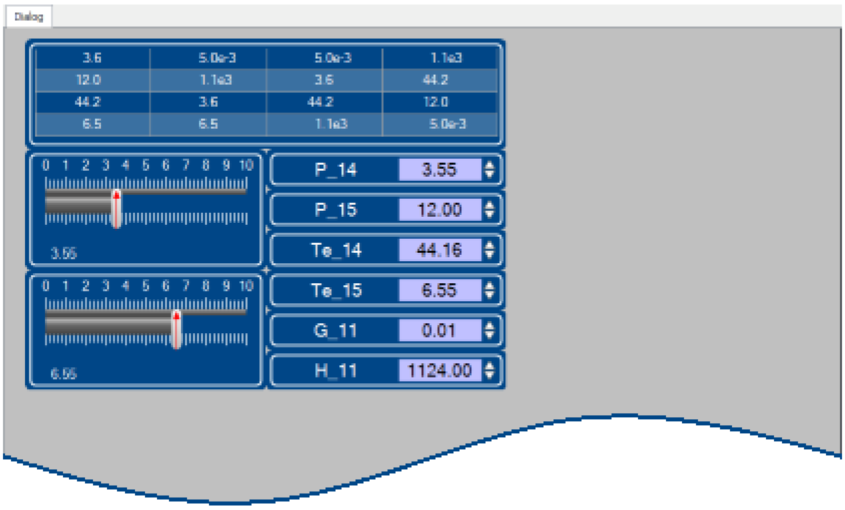
Example of a Report-page

To **print out the page in the page format set**, select the menu item: "*Print* 1059" or the command: "*Print Panel page*". By means of **PDF-export** (in the menu ribbon or the corresponding command), you can generate a corresponding PDF in that format.

Detailed information is presented in the chapter: "*Page printout or print to PDF* 1388".

Dialog-page

The dialog-page is optimized for screen display. By default, the pages are **generated in maximum size**. Change the size via the Page Properties 1379.

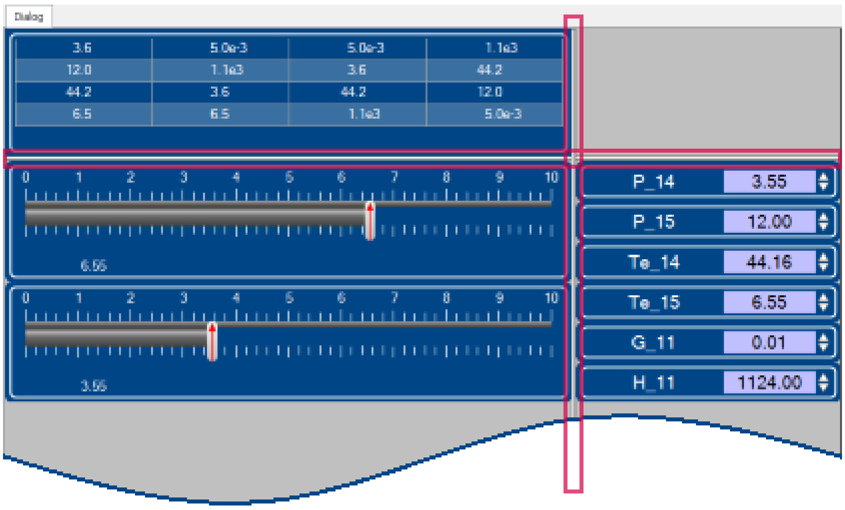


Example of a Dialog-page

After the program is started, the Panel contains a default Dialog-page.

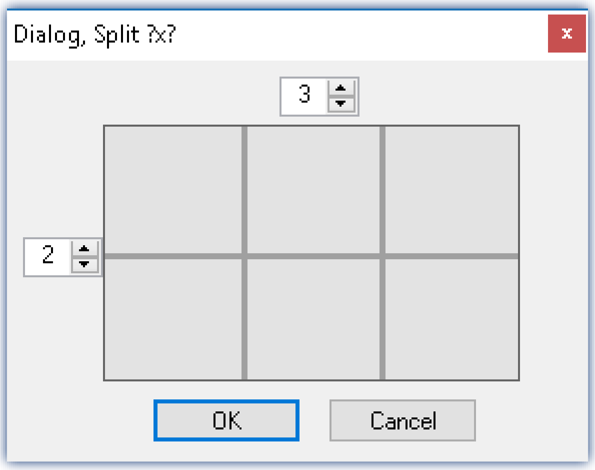
Divided dialogs, e.g. "Dialog 2x2"

These dialogs are partitioned into regions by movable sliders. The size of the docked 1107 Widgets adjusts to the position of the sliders.



Example of a partitioned Dialog-page
Sliders are framed in red

Using the choice "*Dialog, ?x?*", you can personally define the partitioning:

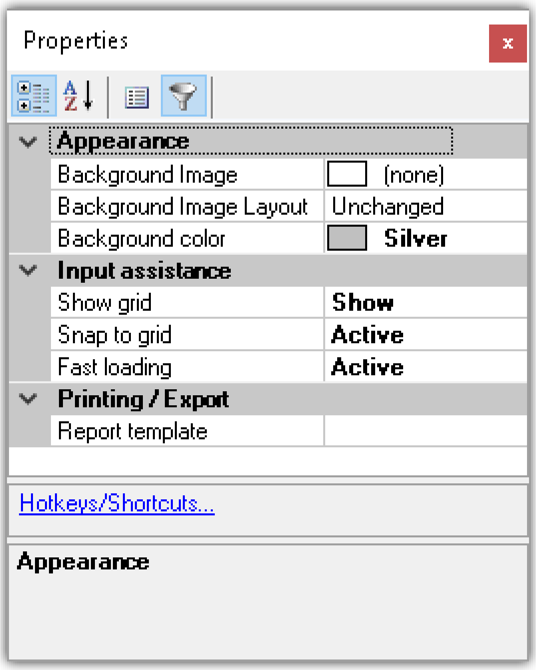


Partitioned format

11.8.2 Properties - Pages

With this tool window, you can set the page's properties. The Panel must be in Design Mode 1097 in order that the properties can be seen/edited.

Right-click on an empty area of the page and select from the context menu the command ***Properties*** (to see all the properties, click on the symbol for "All properties"):



General

Property	Description
Name	Name of the page. Each page has a unique name.
Title	The title displayed in the page's tab. Default: <empty>; in that case, the page name is used. If the title is changed, the page name is no longer used.
Multilingual title	The title can be pre-defined for multiple languages 1405.

Data linkage

Property	Description
Script name	Panel-scripts are associated with Panel pages. This can be defined directly by means of the script-properties. If no Panel page is selected, the script can be associated with the page by means of this property (Script name).

Layout

Property	Description
Page size	Size of the Panel page (<Width>; <Height>)
Width	Width of the Panel page
Height	Height of the Panel page
Page	Pages can be shown or hidden (not hidden in Design mode).

Appearance

Property	Description
Background image	An image can be displayed on the page. In order to select an image, click in the cell and next confirm by clicking on the button `[...]` on the right edge. In order to delete an image, delete the text "`[Bitmap]`".
Background image layout	Placement of the background image in reference to the page size: • Unchanged: The image is placed in the upper left corner in original-size. • Tile: multiple copies of the image are displayed side-by-side. The entire page is filled up. • Centered: The image is displayed centered and in original size. • Stretch: The image is displayed centered over the entire page (stretched) • Zoom: The image is displayed centered in optimum size (zoomed). The aspect ratio remains intact.
Background color	The page's displayed background color.

Property	Description
Background plain colored	Display of the background color: • Solid: The background color is displayed over the entire page. • Color gradient: The background color's shade becomes increasingly pale in the downward direction. The page's upper edge conforms to the background color. This progression is not visible for all colors.
Skin	You can choose among multiple pre-defined color schemes (Skin). The color scheme influences the foreground and background colors of the Widgets and pages.

Printing / Export

Property	Description
Report template	Define a Report-page as a print template. The print template must contain the Widget "*Print Preview*", which is filled in upon executing Print/Export. See: "*Page printout or print to PDF* 1389".

Input assistance

Property	Description
Grid size	The distance between the grid points.
Show grid	Hides/shows grid (see "Aligning to grid 1383")
Snap to grid	Activates/deactivates the alignment of the Widgets to the grid. • Activated: New Widgets or changes to the Widgets (size and position) are aligned automatically to the grid. • Deactivated: Widgets can be positioned freely.
Fast loading	• Activated: Going to pages for which the option "Fast loading" is activated happens quickly since the page's setup is retained in memory (default selection). • Deactivated: Going to pages for which the option "Fast loading" is deactivated happens more slowly since the page's setup needs to be loaded first. This option is recommended for elaborate pages in order to conserve memory resources.

11.8.3 Adapt/automatically adapting the size of pages and Widgets

You can adjust the size of the pages and Widget automatically.

- To do this, open the context menu of the Panel page
- Select *Adapt Page Size*:

Adapt Panel page to window size (or for all pages)	The Panel page takes up the space available.
Adapt Panel page to window size (keep aspect ratio) (or for all pages)	The Panel page retains the aspect ratio, but adjusts its height/width to the available space.
Adapt Widgets to the size of the Panel page (or for all pages)	The Panel page retains its page size. The Widgets take up the space on the page currently available.

Note

Notes on automatically aligning to the grid

- If the Widgets are automatically oriented to the **grid**, this is taken into account when adjusting the size.
- Among other effects, this can lead to the current aspect ratio of the Widgets to no longer persist after the adjustment.
- On every page, there can be a resultant discrepancy of ±1 grid increment. If this is not desired, first deactivate the grid orientation 1383.

all pages

The functions can be applied either to the current page or to all loaded pages simultaneously.

The following pages are not affected by the functions applied to all pages:

- all pages in which the property "fast loading" was deactivated, unless they are already open currently.

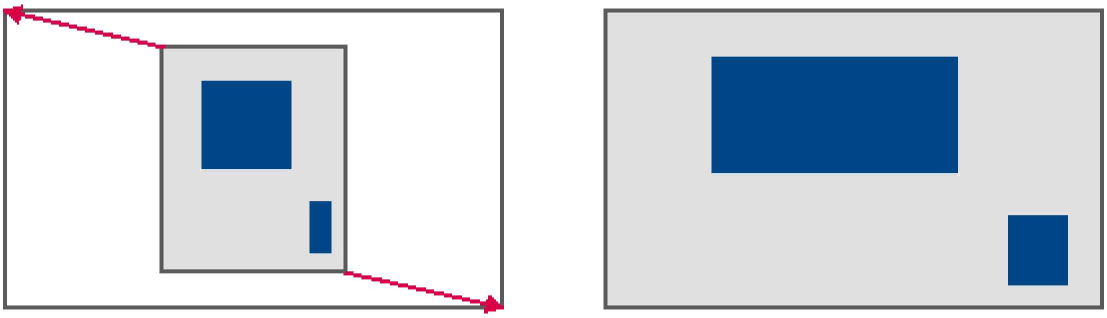
Use of the Zoom function

The Zoom-factor is deactivated whenever the Panel page is adjusted to the window size.

Adapt: Adapt Panel page to window size

The Panel page takes up the space available. This page size remains constant, even if the program window size is changed.

- The aspect ratio of the individual Widgets does not remain intact (observe the note above about the Grid)

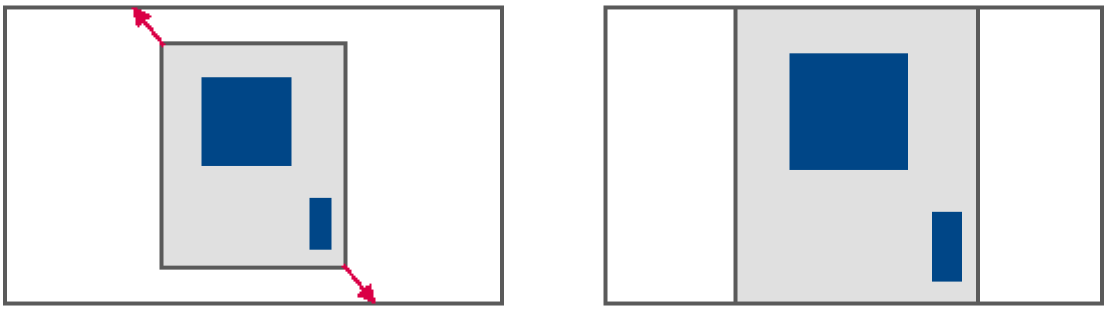


Result

Adapt: Adapt Panel page to window size (keep aspect ratio)

The Panel page retains the aspect ratio, but adjusts its height/width to the available space.

- The aspect ratio of the individual Widgets remains intact (observe the note above about the Grid).

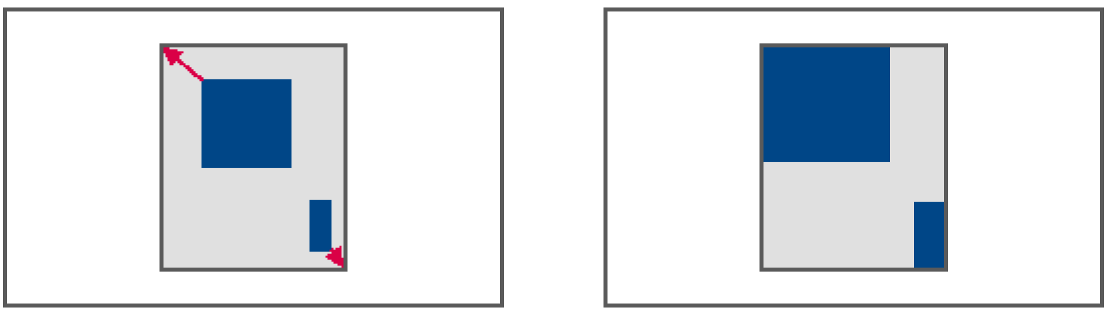


Result

Adapt: Adapt Widgets to the size of the Panel page

The Panel page retains its page size. The Widgets take up the space on the page currently available.

- The aspect ratio of the individual Widgets is not retained (observe the note above about the Grid).



Result

11.8.4 Locking/unlocking a page

You are able to completely protect a page from being changed (also in "Design Mode"). Lock/Unlock the page via the associated menu item or via the context men of the Page-tab.

Ribbon	View
Panel-Design > Lock/Unlock Page ( )	Complete

The associated symbol appears next to the page-name.

The locking/unlocking **applies only to the current page**.

In contrast to the deactivated "*Design Mode* 1097", not even Widgets can be placed on a locked page by means of Drag&Drop.

Note — No protection against deletion of the page

Locked pages can also be deleted. All that is protected against changes is the content.

11.8.5 Aligning to grid

To simplify the positioning and moving of Widgets on the page, the grid can be used. The Widgets can be aligned to the grid. The distance between grid points can be adjusted in the page's Properties (*Page Properties > Grid size*).

To activate/deactivate the grid or to align all Widgets to the grid, open the Panel page's context menu .

- Select *Grid* ( ):

Action	Description
Show Grid	Hides/shows grid (also adjustable via the page's settings)
Snap to Grid	Activates/deactivates the alignment of the Widgets to the grid (also possible via the page's settings). • Activated: New Widgets or changes to the Widgets (size and position) are aligned automatically to the grid. • Deactivated: Widgets can be positioned freely.
Realign to Grid	All Widgets are aligned to the grid (even when *Align at Grid* is not activated)

11.8.6 Zooming Panel pages

For better visibility of Panel pages, for instance, you can zoom in on the display.

- To do this, open the context menu of the Panel page's tab.
- Select *Zoom* ( ) or *Zoom (all Pages)* ( ):

Action	Description
50%	Panel page is zoomed to 50%. Image ratio: 1:2
100%	Panel page is displayed in original size. Image ratio: 1:1
>100%	Panel page is zoomed to 200% or 400%. Image ratio: 2:1 or 4:1
Zoom	Arbitrary zoom-factor

Note all pages

The zoom can be applied either to the current page (*Zoom*), or to all loaded pages (*Zoom (all Pages)*) simultaneously.

The following pages are not zoomed with the function "*Zoom (all Pages)*":

- all pages in which the property "Fast loading" was deactivated, unless they are already open currently.

11.8.7 Fullscreen

Panel pages can be displayed on a monitor in a full-screen mode. The Fullscreen-mode offers certain advantages:

- **larger display area**, since the menu and tool windows are covered over
- **more protection** against unintended changes, since the fullscreen mode must be exited explicitly

Folgende Vollbild-Arten bietet imc STUDIO

- Display of a page on a monitor (no "genuine" fullscreen, without protection)
- Panel in fullscreen mode, so that the imc STUDIO user interface is no longer accessible (imc STUDIO Professional and higher)

Display of a page on a monitor (no "genuine" fullscreen, without protection)

Panel pages can be displayed in **fullscreen on individual monitors**. The imc STUDIO user interface can still be operated. However, the Panel page is in the foreground (so if there is only one monitor, it covers the user interface). Thus, you could **observe the Sequencer on the main monitor**, while the **second monitor shows measurement readings** on a Panel page in fullscreen mode.

When a Panel page is displayed on a **second monitor**, this page layout is **saved in the experiment** and restored upon subsequent loading. If the monitor is no longer present upon loading, the page appears again, embedded in the Panel.

- To do this, open the context menu of the Panel page tab.
- Select "*Show Page on Monitor*" ( ):

Action	Description
Page on monitor	• embedded: The page is displayed in the plug-in's Panel main window (default selection) • <Monitor name>: The page is displayed in fullscreen mode on the monitor selected. Independent of the opened main window.

Uses	Description
Automatic assignment by command: Browse in workspace	When the command "*Browse in workspace* 1551" is executed, imc STUDIO jumps to the selected page. When a **Panel page is defined as a target**, then it can also be **displayed in fullscreen mode** on any desired monitor. In this case, imc STUDIO does not change the main window.

Note — No comprehensive protection

This mode **offers no protection against changes** to the imc STUDIO user interface. The button for exiting the fullscreen can be hidden. However, it is possible to exit Panel by typing the key combination `alt+F4`. Or when using multiple screens, the program can be relocated to the second monitor.

Hiding the Exit-button in this fullscreen view

The button is hidden when the following conditions apply:

- The user who is logged on does not possess the right to close the fullscreen view.
- The Panel is already in fullscreen view (see the possibility 2).
- No tabs are shown in the fullscreen mode.

Panel in fullscreen mode (imc STUDIO Professional and higher)

The Panel is displayed in fullscreen mode. The imc STUDIO **user interface is hidden** and can thus no longer be operated or accessed (excepting the Panel pages) .

Ribbon	View
Start > Panel Fullscreen ( )	Standard, Compact
Panel-Control > Panel Fullscreen ( )	Complete
Panel-Design > Panel Fullscreen ( )	Complete

Note

Protection against changes

This mode **offers protection from changes** to the imc STUDIO user interface. The button for exiting the fullscreen mode can be hidden if one possesses the pertinent access rights. Without such rights, it is not possible to exit the fullscreen mode.

By means of the User administration, you can **prohibit exiting Fullscreen mode**.

Right: Panel fullscreen: Button "Exit fullscreen mode"

Navigation through the pages

In this case, show the tabs for the individual pages. Or use buttons and action, in order to navigate to the Panel pages. E.g., you can skip between the individual pages using the commando: "*Browse in workspace* 1551".

Uses	Description
Automatic launch in Fullscreen mode	Using the command-line parameters 36, you can start an experiment directly in Fullscreen mode. Thus, you can **start the desired experiment immediately**. And you can **prevent unauthorized modifications**.
Automatic Fullscreen mode by means of the command: Browse in Workspace	When the command "*Browse in Workspace* 1551" is executed, imc STUDIO jumps to the selected page. If the **Panel is defined as the target**, it can be **displayed in fullscreen mode**.
Combination of the Fullscreen variants	If the Panel is in Fullscreen mode, you can additionally display more Panel pages on other monitors.

Title Bar - Overview of functions

The fullscreen window has its own title bar (menu). A **variety of functions** can be called from this menu (most of the functions are only available in the actual fullscreen mode).

	The menu includes various buttons. It can be **expanded and moved**.
	By means of this button, you can expand the menu to reach **additional functions**.
	Using this button, you can **move the menu**, in order to access **elements located behind** it. When you move the mouse pointer over this button, you obtain a special cursor. While holding down the mouse button, you can change the menu's position within the top edge.
	By means of this button, you can exit **Fullscreen mode**. When the menu is expanded, this function is located at this button: Exit Fullscreen Mode.
	This button **minimizes the program**.
	Thus button **closes the program**.
Show Tabs	These checkboxes control whether the tabs for the Panel-pages are hidden or shown.
Data Browser	This button Show Data Browser causes the free-floating Data Browser 1069 to be shown.

Additional functions can be accessed via the context menu or via the button in the expanded menu.

Menu item	Description
Login 131	Logs in a user
Logout 131	Logs a user out
Design Mode	• Activated: the Panel page can be edited, the Widgets can not be operated. • Deactivated: The Panel page can not be edited. The Widgets can be operated.
Info	Opens the dialog with version information
Product Configurator	Opens the dialog for product configuration

Note — Notes on modifying the fullscreen size

The full screen has **mode available space**, for which reason you can **increase the page size**. If you already have finished pages and you wish to **magnify these pages**, then in Fullscreen mode use the function: "Adapt Panel page to window size".

You may need to first deactivate the grid alignment, since there may otherwise be unintended displacements. For more information, please see the chapter: "*Adapt/automatically adapting the size of pages and Widgets* 1381".

11.8.8 Page printout or print to PDF

Panel pages can be printout out as hard copy or to a PDF-file. imc STUDIO offers a variety of possibilities for this purpose: via the menu ribbon or via the commands ("*Print Panel page* 1582" / "*Export Panel page* 1582").

Ribbon	View
Panel-Control/Navigation > Print/Print Preview (/)	Complete
Edit > Print/Print Preview (/)	Complete
Panel-Control/Navigation > As PDF (Export) ()	Complete
Home > Print ()	Standard, Compact
Home > As PDF (Export) ()	Standard, Compact

The respective menu item allows you to **print/export only one page at a time**.

If you wish to keep **multiple pages** together, then it is best to use **the respective command**. You can, for example, place this on the Panel page and execute it from there. You can hide its button when printing the page out.

Note — Font in the printout

"Font in the printout" is a topic which we can only improve step-by-step. imc STUDIO passes the information about your page to the default printer set up for your system. This then produces either the PDF or the printout. For this reason, it is hard for us to influence the results, which strongly depend on the printer driver.

If you experience problems, please send the imc Hotline the exact identification of your system's default printer. Switching the default printer temporarily may be helpful.

PDF with vector-elements

In response to the menu item "*As PDF (export)*", a PDF is generated on which graphics are displayed. If the graphics quality is not sufficient, it is possible in some cases to generate vector elements in the PDF by means of a PDF-printer. This, too, depends on the printer driver and not necessarily every PDF-printer is able to do it. Additionally, not all Widget support this function. Some will still embed the image as a graphic.

Therefore, please test this technique with your printer driver before choosing it.

Report-pages - Adjusting the size

The Report-page is optimized for printout. You can make changes to the size and other page settings by means of the dialog: "*Page Setup*" ("*Page Layout for Printing*" via the context menu 1094 over the tab for the respective Panel page)

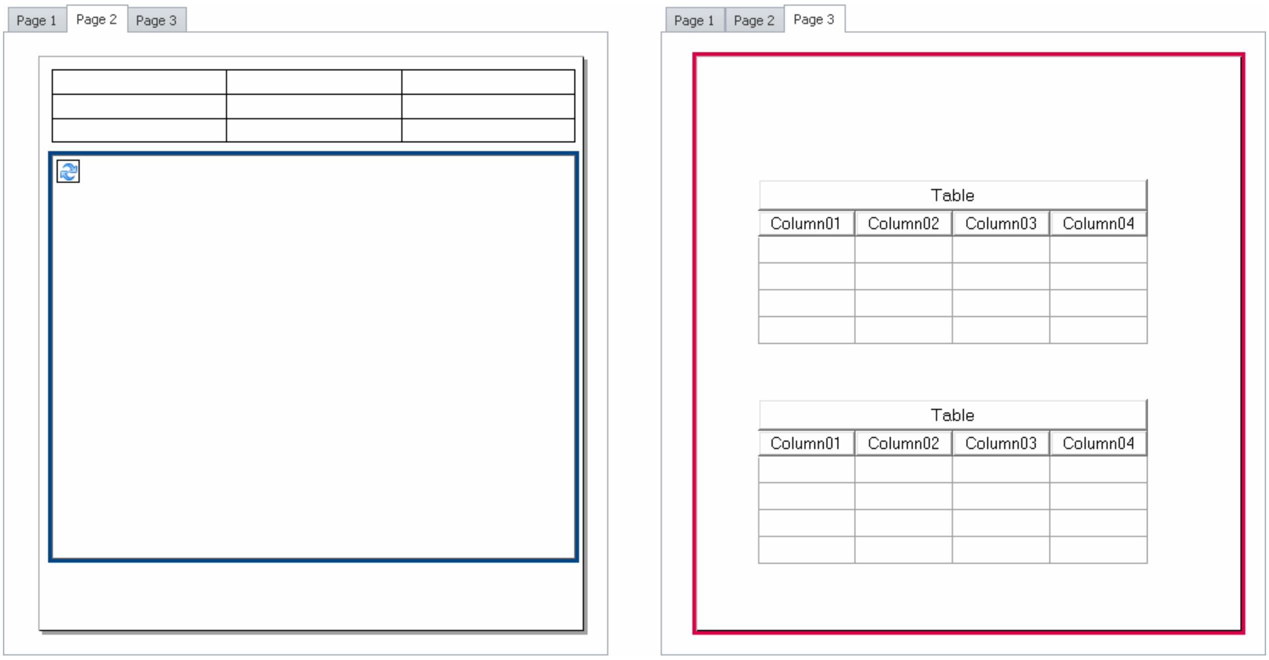
Menu item	Description
Page Layout for Printing	Opens the dialog: "*Page Setup*" Here, you can change the setup and printout settings for Report-pages (including paper size, source, orientation, margin).

Reportseitenvorlage - Seiten-Kopf

For purposes of export or printing, it is possible to define another page as the template. This "template page" can be set up as a kind of "page header" and be filled with multiple report pages upon printout. E.g. texts and logos which are to appear on every page.

On this page the Widget: "*Print Preview*" appears.

If a page is printed on which the "template page" is set as the "*Report template*", the Widget is filled with the page to be printed.



Example: When it is printed out, the Panel page on the right side will appear inside of the frame appearing within the page shown on the left side.

11.9 Variable Linkage

To link a Widget with a variable, there are two methods:

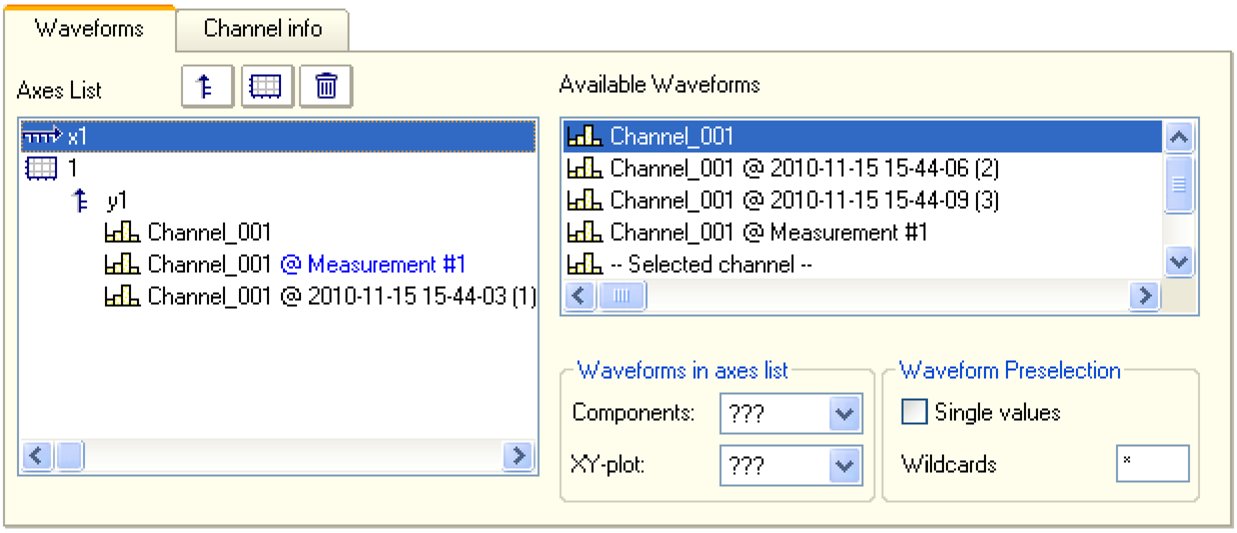
Variable linkage by Drag&Drop 1391	**Move the variable** using Drag&Drop from the Data Browser 1069 **to the Widget** or the Panel page.
Variable linkage by Widget Properties 1391	Open the "**Properties** 1108" window of the Widget and there click on "***Variable***".

Even **without existing variables**, it is possible to set up a linkage (see: "*Variable linkage to not yet existing variables* 1393").

Directly connecting with a measurement, or changing measurements at the click of the mouse (measurement number)

You can link a variable either by its **fixed name** or its **symbolic name** with a Widget.

Fixed name	**<VariableName>@<Measurement Name>** e.g. **Channel_001** or **Channel_001@Current measurement** In this way, the Widget always indicates the current measurement. or **Channel_001@2010-11-15 15-44-03 (1)** in this way, the Widget is always linked with this concrete measurement
Symbolic name	**<VariableName>@Measurement#<Measurement number>** e.g. **Channel_001@Measurement#1** Contains the name of the variable followed by a measurement number. The measurement number can be assigned variably with the Data Browser. This enables you to **compare measurements**. After measurement, you can select the saved measurement (it is then assigned the the number "1"). Subsequently, **all Widgets** show the variables belonging to the saved measurement. You can now compose the report.



Properties of the curve window
Example: three times the Channel_001.
1. Current measurement
2. Selected measurement (Measuremnt number 1)
3. Saved measurement with the defined name

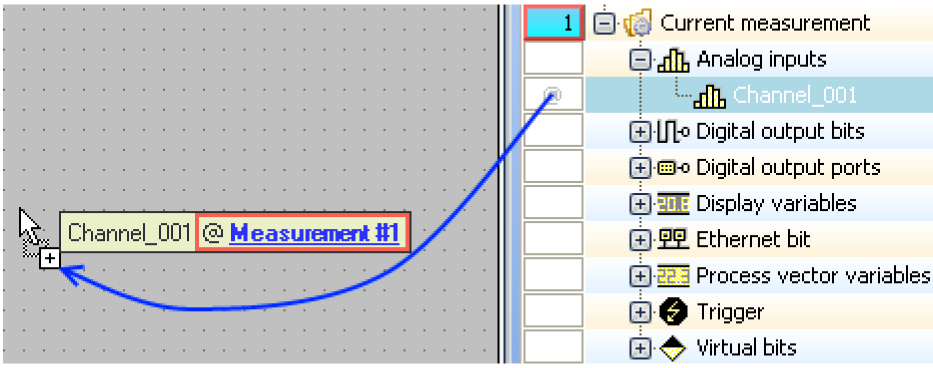
Browsing data

Once you have linked a Widget with a **symbolic name**, you can view the various measurements by simply clicking in the Data Browser (see: "*assigning a measurement number* 1075").

Variable linkage by Drag&Drop

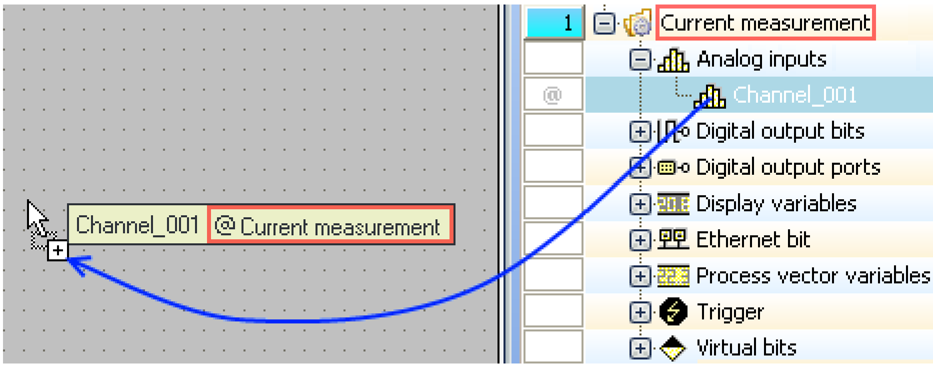
If you have opened a measurement in the Data Browser, the **"@" Symbol** (@) appears in the **Numbering column**.

- To link a variable with a Widget **via a measurement number** (symbolic name), **use Drag&Drop** to move the variable **from the "@"-symbol** to the page.



Variable linkage with symbolic name.
Example: "Channel_001@Measurement#1"

- To link a variable with a Widget by its **fixed name**, move the variable to the page **from the name column using Drag&Drop**.



Variable linkage with fixed name.
Example: "Channel_001@Current measurement"

- Release the mouse button over the Panel page and select the Widget with which the variable is to be displayed,
- or release the mouse button over a Widget. The Widget is linked to the variable.

Variable linkage by Widget Properties

Note

Only for Widgets having the property "*Variable*". For the curve window, please see the separate documentation 1126.

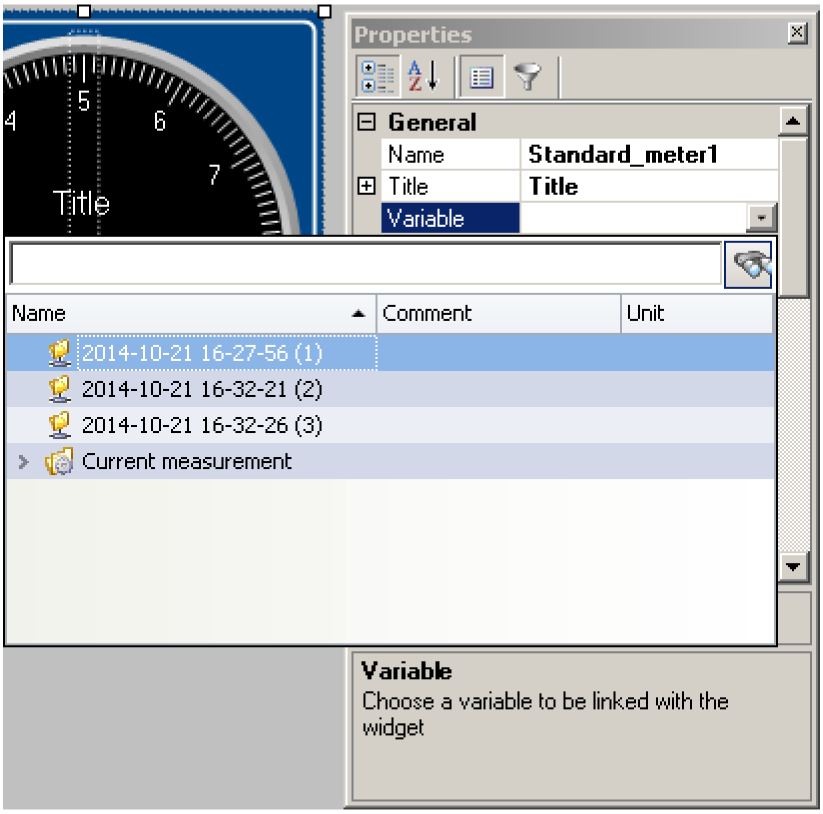
You can establish the link with the variable by means of the Widgets's properties.

- Open the properties of the Widget
- There, click on the entry ***Variable***

You can use the dropdown list or enter a name for the variable.

Variable linkage by dropdown list

- Click on the dropdown button ( )
- A Data Browser opens

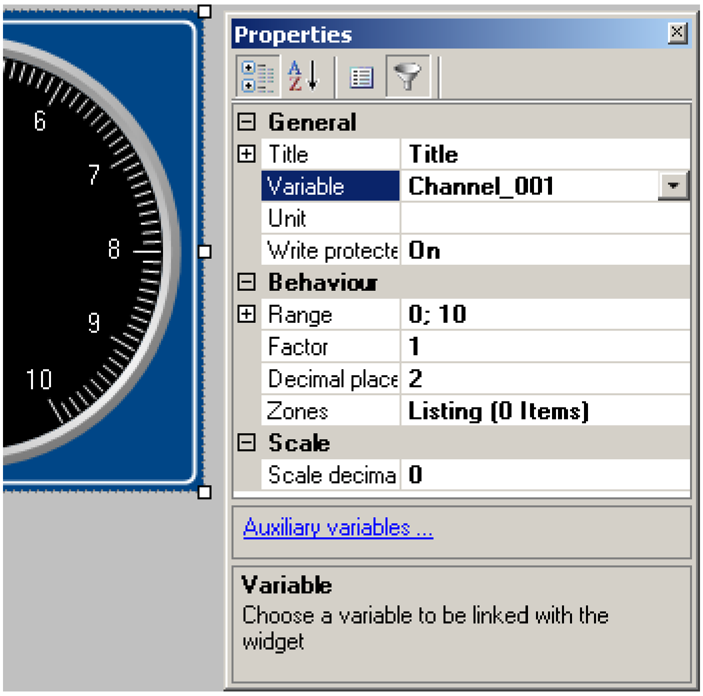


- Select the desired variable

The Widget is now linked with the variable.

Entry of the variable's name

- Enter the variable's name in the text box.



The Widget is now linked with the variable.

By means of the property "*Variable*", you can also set up a link using a **fixed name** or a **symbolic name**:

Fixed name Current measurement	e.g. **Channel_001**
Fixed name	e.g. **Channel_001@2010-11-15 15-44-03 (1)**
Symbolic name Measurement#x	e.g. **Channel_001@Measurement#1**

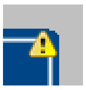
Variable linkage to not yet existing variables

You can even design a Panel page before any variables exist.

Using the property "*Variable*", you can establish a future variable linkage. *

- Enter the variable's name in the text box

The Widget is linked with the non-existing variable.



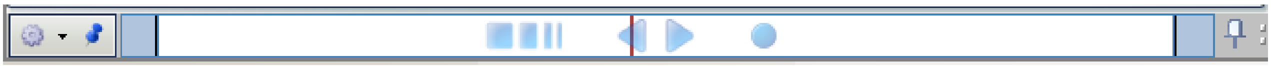
Since the variable doesn't exist, a yellow warning triangle appears on the Widget.

As soon as the variable is created, the Widget displays the variable's value and the warning triangle disappears.

* (Only for Widgets having the property "*Variable*". See Variable linkage by Widget Properties 1391)

11.10 Navigation Bar

The Navigation bar **facilitates navigation across time** in one or more Widgets. You can link various Widgets with the Navigation bar. **Linked curve windows** display the **desired time frame** in accordance with the navigation. If you have linked other Widgets with the bar, these can also display a time-referenced value of a time-referenced channel, according to the setting for the option "*Panel*" > "*Navigation*" > "*Widgets navigation mode*"112".



Navigation bar: Navigation view

While "*Design Mode*" is activated, you can show/hide the Navigation bar:

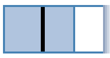
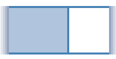
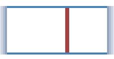
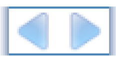
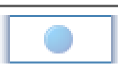
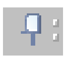
Ribbon	View
Panel-Navigation > Navigation Bar ( )	Complete
Panel-Design > Navigation Bar ( )	Complete

Linking the Widgets with the Navigation bar

By means of the die thumbtack symbol, select the Widgets to be linked with the bar. (See also "*Linking a Widget* 1400")

Ribbon	View
Panel-Navigation > Selection ( )	Complete
Panel-Design > Selection ( )	Complete

Quick overview of user interface

Element	Description
	Opens the Navigation bar menu 1397
	Tool for linking Widgets with the Navigation bar 1400
	The **black lines** at left and right indicate the **boundaries of the visible area** of all linked curve windows.
	The **white bar** (which serves as a sort of sighting gauge) shows the **visible range**. If varying zooming levels for the linked curve windows are used, this bar is **shaded grey** and indicates the maximum visible range.
	**Changes the zoom level** of the linked curve windows: Move the mouse over the icon, click on its left button and while holding it down, move the mouse pointer left in order to zoom out, or right to zoom in. With the <CTRL>-key held down: large change; with the <SHIFT>-key held down: small change.
	Slider 1401
	Navigation left/right: Panning along the x-axis. Click the mouse over the arrow buttons, or hold the mouse button while moving the mouse. With the <CTRL>-key held down: large change; with the <SHIFT>-key held down: small change. The movement depends on the curve window mode: • curve window in either **Stretch or Scroll mode**: the **position slider changes position**. • curve window in **Pause mode**: The x-axis **(time axis) moves**. In consequence the measured data are moved. The position slider remains at the same location in the curve window.
	**Rezoom** of X-axis: Displays all data in the linked curve windows
	Pins the Navigation bar down or loosens it again

Note Difference between curve window and Navigation bar

The functions used here ("Rezoom", "Zoom" and "Navigation left/right") do not fully match the full scope of the ones available for navigation in the curve window.

Differences:

- **Zoom:** The Zoom always has the position slider in the center. The Zoom in the curve window uses the window's center point. Thus, the Zoom can be applied to a defined point in time by means of the bar. During the measurement, this has no effect on the modes "Scroll" and "Stretch". Here, the display automatically skips to the newest measurement value. In this case, there is no difference between the curve window and the Navigation bar.
- **Rezoom:** Performs Rezoom over all measured data which are associated with the linked curve windows. As a result, empty spaces may emerge at the edges, if the data were recorded at differing times.
- **Navigation left/right:** Depending on the mode, moves the slider and not the x-axis. The curve window always moves the x-axis.

11.10.1 Menu

In order to open the Navigation bar menu, click on the cogwheel symbol ( ) at the far left of the Navigation bar. You can also find these actions in the menu ribbon "*Panel-Navigation*".

Menu item	Description
Scroll	All curve windows linked with the Navigation bar change their mode to: "Scroll" In Scroll mode, the **time window** displayed always **has the same width**. Thus, the plot of the data set progresses through the time window in the manner of a digital readout scrolling across a marquee screen.
Stretch	All curve windows linked with the Navigation bar change their mode to: "Stretch" In Stretch mode, the complete data set is displayed **starting from a defined x-value up to the last value**. As long as the measurement is running, the time axis range continues to extend, so that the signal plot appears increasingly compressed. For the setting "Stretch", the right edge of the window does not automatically jump to the last value. Only once new data arrive, the displayed range "stretches" (e.g. during a running measurement, or when other measured data are loaded which are to be displayed in the same curve window).
Pause	All curve windows linked with the Navigation bar change their mode to: "Pause" (in the curve window, this corresponds to the Scroll mode: "No") In Pause mode, all curve window's linked with the Navigation bar are frozen. Measurement continues in the background without being displayed. **Exception:** In the curve window, the **time axis is set to "automatic"**. This causes a similar situation as the "Stretch" mode. The difference is that then the complete data set is always shown (the left side also adjusts accordingly.) This mode is **suitable for reports** when measured data are to be loaded in succession and **displayed completely in a curve window**.
Absolute Time	Sets the X-axis of all linked curve windows to absolute time. The channels are displayed with a **date and time**.
Relative Time	Sets the X-axis of all linked curve windows to relative time. The **time elapsed** since the **start of channel's data acquisition** is displayed (in days, hours, minutes and seconds). Thus, what is displayed is the time locations of measured points in reference to the triggering time. The time may also be specified as negative numbers to indicate points in time prior to the trigger ("pretrigger").
Zoom	Specify here which **time window** (in seconds) you wish to **display**. All linked curve windows automatically display the time set (starting from the right edge).
Find in Variables	**Search for** (Report channel) **variables** which are linked with the Navigation bar. Using this function, you can **perform a targeted search for entries** and **skip** to them. See also the segment "*Find in Variables* 1403".
Auxiliary Variables	It is possible to **link variables with the Navigation bar**. This is needed in particular for report channels in order to be able to navigate through entries in the report channel. See section "*Linking variables* 1401".
Properties	Opens the Navigation bar's "**Options**".

11.10.2 Useful options

In the Options, you can activate additional useful functions: "*Panel*" > "*Navigation*".

Navigate through all Panel pages

Option	Description
Navigate through all Panel pages 112	Activates the mode in which the Navigation bar navigates through all Panel pages, including invisible pages.

This option provides the following settings possibilities:

The Zoom settings as well as changes of the position by means of the Navigation bar and also of the position slider

- apply to all Panel pages simultaneously or
- apply only to the current page.

Widgets Navigation Mode

Option	Description
Widgets Navigation Mode 112	One can choose which value the Widgets will show. The following possibilities are available: • **Automatic:** While the measurement is running or while working on the current measurement, the Widgets show the **current value**. They show the value at the **slider's position**, whenever one is working on saved measurement data. • **Always show navigation value:** The Widgets always show the value at the **slider's position**. • **Always show current value:** The Widgets always show the **current value**.

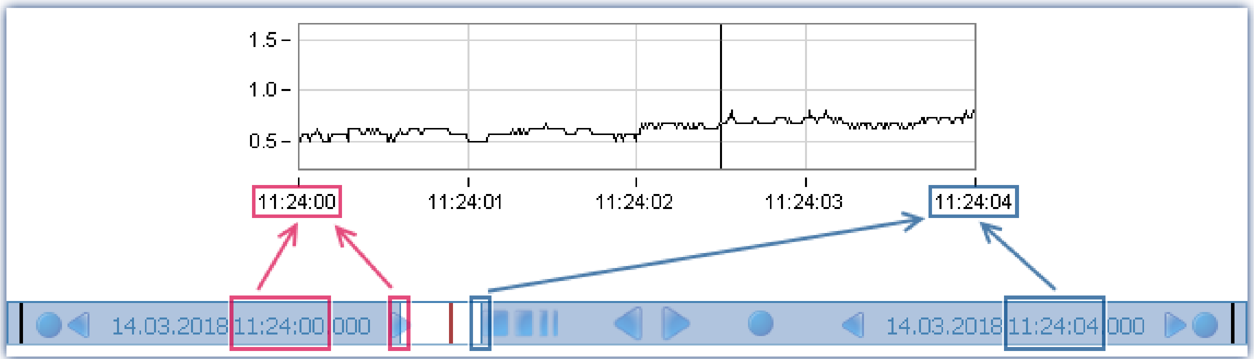
This option is useful when you associate Widgets with a variable according to the measurement number.

- For "*auto*", the Widget **always shows** the channel's **current value in the measurement** ("*Current Measurement*").
  After the measurement, you can select the saved measurement in the Data Browser. The Widget now shows the **saved measurement**. Using the position slider, you are now able to navigate through all connected Widgets. In consequence, the **standard meter indicates** a channel's **time-referenced value**.
- "*Always show navigation value*" has the advantage that a former **navigation value** can be **displayed even during the measurement**. However, this means that **linked** Widgets **never show the current value**. You can thus use **Widgets to display the measurement** (without navigation) and **Widgets to display former values** (with navigation).

Time controls

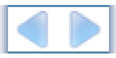
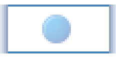
Option	Description
Time controls 112	Shows advanced time controls on the Navigation Bar. The visible range of the linked curve windows is displayed and can be set for each of the two sides separately.

This option is helpful for the purpose of precisely adjusting the side boundaries.



Navigation bar with time controls

The times displayed are the **time points representing the left/right boundaries** of the white (or sometimes grey; see below) bar, which is like a sighting gauge. Using the Navigation bar, you can adjust the side boundaries exactly. For this purpose, the following controls are available:

Element	Description
	**Moving** the respective **X-axis end left/right**: Shifting along the x-axis. Click the mouse over the symbol or on the time readout. Hold the mouse button down while moving the mouse, or click the mouse over the time readout and enter numerical values by means of the keyboard.
	**Rezoom** of the respective **X-axis end**. The respective end of the curve window skips to the last/first time point of all linked data.

When **different zoom levels** are used for the linked curve windows, the **time readout is replaced by a horizontal line**. In that case the sighting gauge is also grey. When navigating by means of the mouse, the ends move in parallel. The time ranges of the curve windows remain in the same ratio to each other.

Example: Two curve windows are linked with each other. One of them shows the first 10 seconds, the other the first 20 seconds. When the right edge is moved so that the first one now shows 30 seconds, the other shows 60 seconds.

Performing Rezoom or making a numerical entry (in the time readout) sets the times of the respective X-axis ends of all curve windows back to being the same.

Always link new Widgets to Navigation bar

You can link newly positioned Widgets with the Navigation bar automatically.

Option	Description
Always link new Widgets to Navigation bar 112	If this option is activated, newly positioned Widgets are automatically linked with the Navigation bar.

Postprocessing

See part Post-processing mode 1404

11.10.3 Linking a Widget

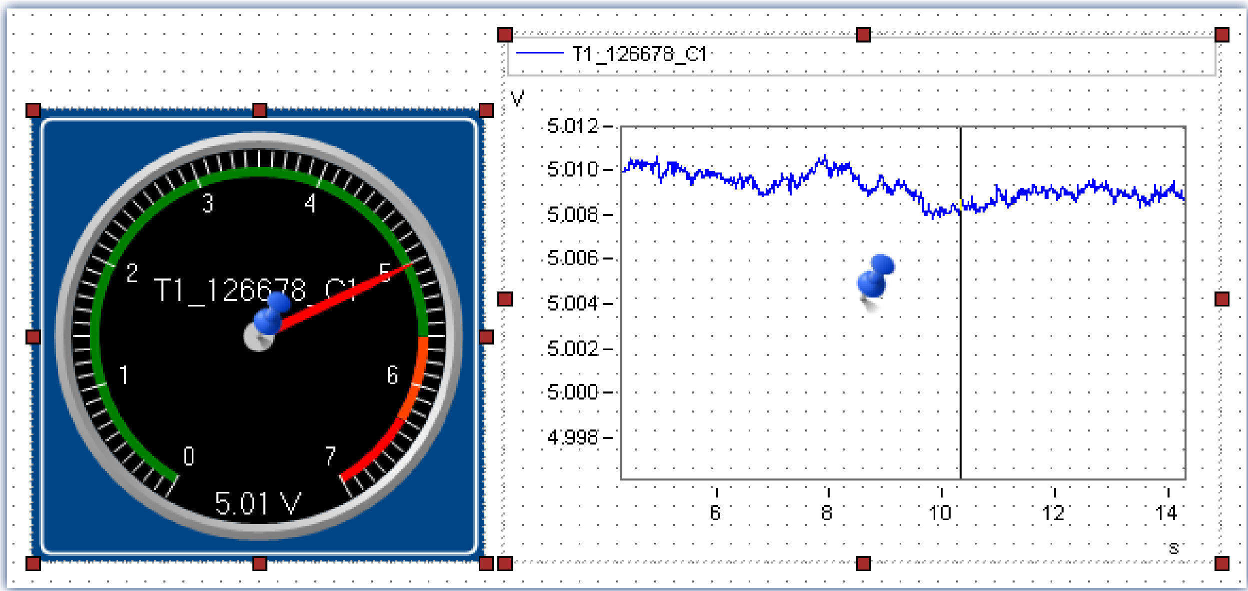
By means of the die thumbtack symbol, select the Widgets to be linked with the bar:

Ribbon	View
Panel-Navigation > Selection ( )	Complete
Panel-Design > Selection ( )	Complete

Creating a link

- In order to link a Widget with the Navigation bar, click on the Selection-icon ( ). Note that for this purpose, the Design Mode must be activated. The mouse pointer changes into a thumbtack symbol.
- Next, click on the Widget which you wish to link with the Navigation bar.

All linked Widgets are indicated by a blue thumbtack symbol in the center:



Widgets linked with the Navigation bar

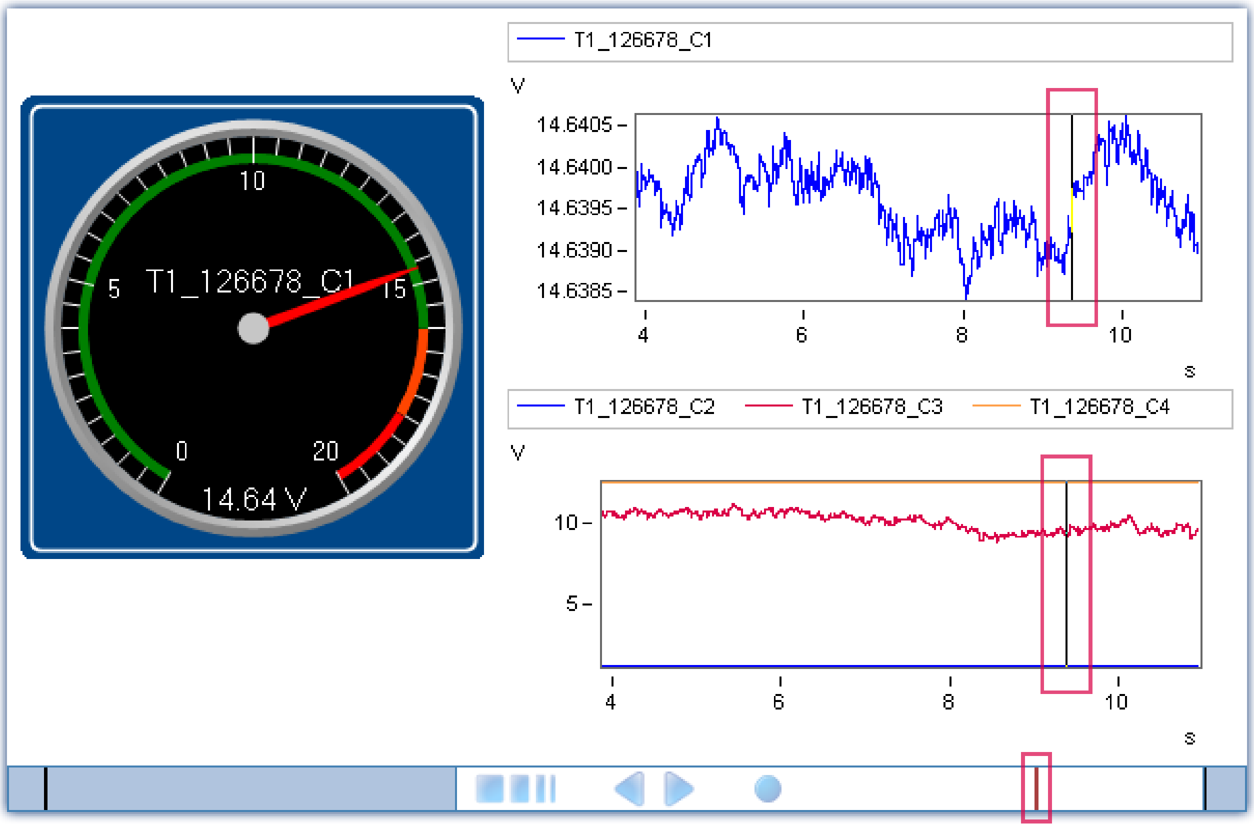
You can link newly positioned Widgets with the Navigation bar automatically. See options: "*Panel*" > "*Navigation*" > "*Always link new Widgets to Navigation bar* 112".

Dissolving a link

- To cancel the link, click on the Selection-icon ( ), so that the mouse pointer is again displayed as a thumbtack symbol.
- Then click again on the linked Widget whose linkage you wish to cancel. The pin on the Widget disappears and the linkage is canceled.

11.10.4 Slider

If a curve window is linked with the Navigation bar, a sighting line is displayed in the curve window: a "slider". This line corresponds to the red position sighting line in the Navigation bar. The illustration below shows both slider lines.



Position indicator in the curve window and the Navigation bar

If **multiple curve windows** are linked with the Navigation bar, each one is assigned a position indicator slider.

The position can be changed by moving the mouse while holding down its **mouse button**. Or by clicking on the mouse while holding down the <SHIFT>-key. Using the Navigation bar itself, you can change the position by means of the Navigation buttons: . The slider's position adjusts accordingly in all linked curve windows. In this way, you can **sight and compare a position in different windows**. The slider is independent of the zoom setting of individual curve windows.

If the slider's location is outside of the measured data, a red arrow appears on the corresponding side: . To retrieve the position slider back into the curve window, click the mouse while holding down the <SHIFT>-key.

Other **Widgets** can also **display the navigation value**. See the option: "*Widgets Navigation Mode* 1398".

11.10.5 Linking variables

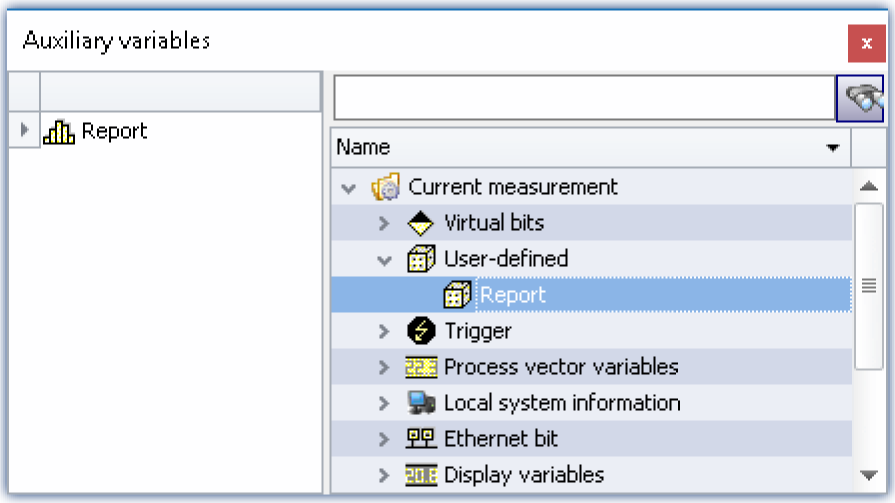
It is possible to link variables with the Navigation bar. This is needed in particular for report channels in order to be able to navigate through entries in the report channel.

Note

The variables belonging to linked Widgets are not automatically linked with the Navigation bar.

Link the Navigation bar with a variable by means of Drag&Drop from the Data Browser, or by means of the menu item: "*Variables*".

Ribbon	View
Panel-Navigation > Variables ()	Complete
Panel-Design > Variables ()	Complete



"Auxiliary Variables" dialog

In this dialog window, variables which have already been linked are shown in the left column. On the right side, available variables in the experiment are shown. In order to link the desired variable with the Navigation bar, use the Drag&Drop technique to move it from the right side to the left side.

In order to cancel the link, highlight the desired variable in the left column and select the context menu (called by clicking the right mouse button) item "*Delete*".

11.10.6 Navigation by marker

If a variable (e.g. a report channel) is linked with the Navigation bar, the Navigation bar displays "*markers*" on its top edge. Markers are set at the following positions:

- Text entry (day)
- Trigger time (+ offset) of all linked measurement channels

By means of these markers (circled in red in the image below), it is possible to navigate.

If the Navigation bar has the focus (or if the mouse is over the Navigation bar), the navigation mode can be switched by using the <ALT>-key.

Navigation bar, navigating by means of markers

Now you can navigate using the keyboard (left/right arrow keys) or using the mouse over the buttons shown . Upon each click of the mouse, the position slider skips to the next marker line. Any linked curve windows in "Pause"-mode also skip to the desired position.

In addition to this navigation method, you can also make a targeted search for specific markers and jump to these (see "*Find in Variables*" 1403").

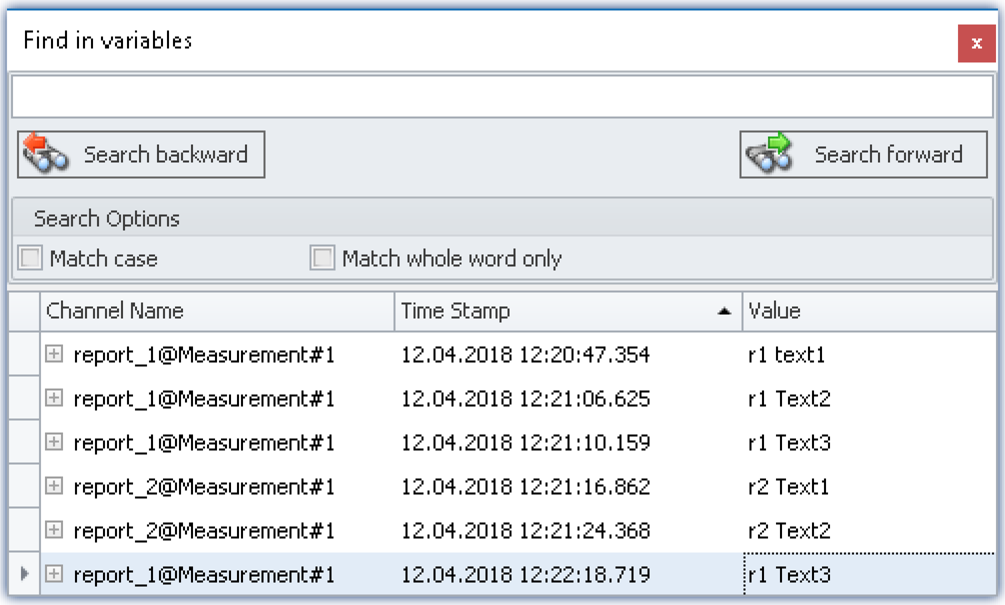
11.10.7 Find in Variables

Using this function, you can conduct a targeted **search for specific markers** and **jump** to them.

If the Navigation bar has the focus (or if the mouse is over the Navigation bar), the search box can be opened by using the keyboard combination <CTRL>+F. Or using the menu item: "*Find in Variables*".

Ribbon	View
Panel-Navigation > Find in Variables ( )	Complete

A dialog window opens in which all markers with time stamps and the associated channel are listed.



"Find in Variables" dialog, here with two report channels

In the image, two report channels which contain text inputs are linked with the Navigation bar.

Navigating: By double-clicking on an entry or making a selection using the Enter key, the position slider is moved to the position to be located. Any linked curve windows in "Pause"-mode also skip to the desired position.

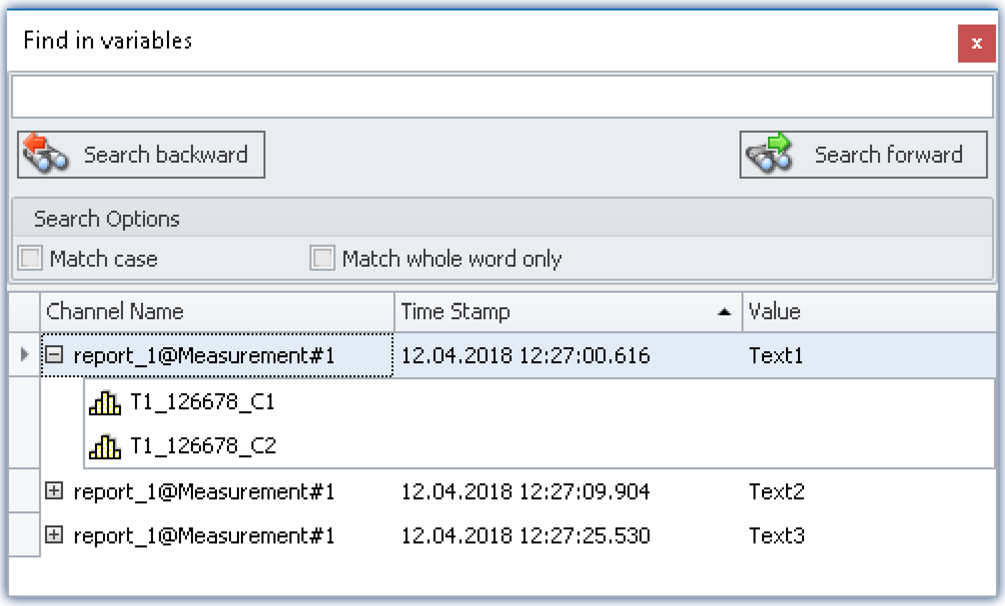
Adapting the layout

You can add extra columns using the "*Column Chooser*" (accessed via the context menu in the upper left corner of the table). For more info, see the description of the Setup-Layout: "*Showing and moving columns* 254".

Column	Description
Channel Name	name of the report channel
Time Stamp	time stamp of the marking on the channel
Value	entered value/text about the marking
Channel Type	the channel's type
Context	more information on the marking (see further below)

Context

If a context was specified with an entry to a report channel, it is displayed below the channel name. Since all entries in the columns are taken into account, it is also possible to enter a context in the search box. Additionally, the column Context can be displayed; for information on this, see the section "*Adapting the layout*". Use of the context is described in more detail in the section "*Text input for report channels* 1365".



Displaying the context in the Search window

11.10.8 Post-processing mode

As a rule, **entries** to report channels **are written** to the channel **at the current point in time** (the current point in time = the "virtual clock/VRTC 315"'s time).

After the end of the measurement, no more entries can be added. Detailed information on this topic is presented under "*Special Widgets* 1365" as well as in the chapter "*user-defined variables* 1087" in the section "*Report Channels*".

The Post-processing mode offers the ability to write **comments** to the channel at the **position of the slider** even during a running measurement, and after the measurement in the case of **saved measurement data**.

For this purpose, the **curve window** in which the slider is to be moved to a certain position must be **linked to navigation bar**. For greater ease of operation, **it should be in "Pause mode"**. Further, the report channel's Widget must also be linked to the navigation bar (see also part "*Linking a Widget* 1400").

Using the following options, you can pre-configure the post-processing mode: "*Panel*" > "*Navigation*":

Options	Description
Post-processing tool 112	Shows the post-processing tool for activating Postprocessing Mode, which enables you to insert tags in the Report channel at navigation time.
Post-processing mode as default 112	Automatically activates the Post-processing mode.

When the **tool is displayed**, you can **activate/deactivate the mode** via the menu item: "*Post-processing mode*".

Ribbon	View
Panel-Navigation > Post-Processing ( )	Complete

Menu item	Description
Post-Processing	Activates/deactivates the Post-processing mode. • **Activates:** In the Post-processing mode, entries into the Report channel are inserted at the navigation time point (time point corresponding to the Position slider 1401). In the case of saved measured data, also after the measurement. • **Deactivated:** The Report channel entries are written to the channel at the current point in time (current time point = time stated by the "Virtual clock/VRTC 315").

Note — Comments on saved measurements

Post-processing mode is useful for **assigning comments to saved results** after the measurement.

In order to be able to access the saved measurement, be sure to **link** all affected **elements with the channels associated with the saved measurement** (e.g. the curve window channels and the Navigation bar channels). Use the variable linkage via the "Measurement Number" 1390.

Thus you can use the Data Browser as a convenient way to choose which measurement you see and wish to make a comment on (either a saved one or the current measurement). You can use this mode both during or after the measurement.

11.11 Information and Tips

11.11.1 Multi-lingual text input

In many cases you can pre-define titles and zone-texts for a variety of languages. Depending on what the operating system's language is, the respective language variant is displayed. If any text is not defined for any language, the respective English text is displayed (fallback-language). The English text is always automatically filled first.

Example

You define the title of the Panel page in German, English and French. If you start the experiment on a German system, the German text is displayed; on an English-language system the English text, etc.

When you start the experiment on a system not set to any of the three languages, the English text is displayed.

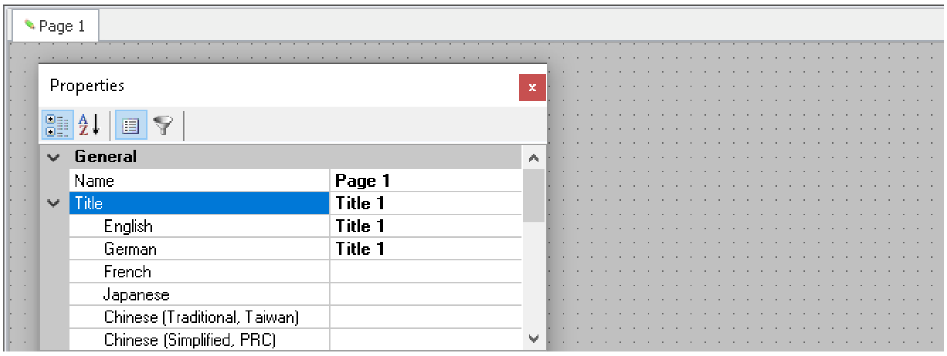
Option: Deactivating multi-language text input

You can, if desired, deactivate multi-language input: "*Panel*" > "*General Options*".

Option	Description
Multi-lingual text input	Enables textual input for computers with other language settings. For example, in this way, Panel pages can be pre-configured for different language settings. If the language set is configured for the respective text, it is displayed. Otherwise, the default language: "English" is displayed.

Defining titles and automatic adaptation

The various languages are usually only shown once the **Properties-filter** is deactivated. Display all of the properties ( ). Expand the Title-property. In the main branch, you see the **currently displayed title**. Below that are all available **languages and the content**.



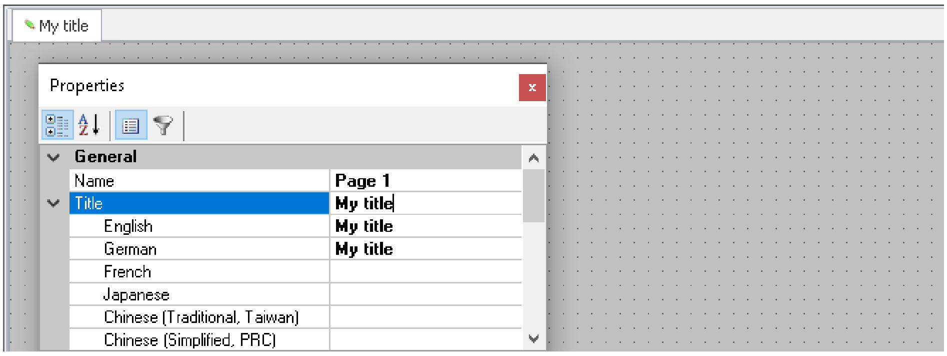
Example - Title of the Panel page

In most cases, the operating system's language and English are defined, unless English is already the operating system's language.

For the following example cases, the operating system language is (1): "*English*" (2): "*German*".

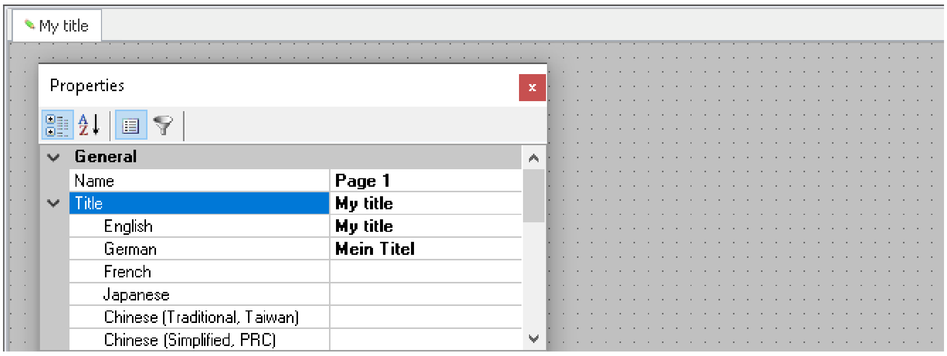
Case 1: You change the title in the main branch (all existing titles are the same):

The following is implemented: (1) the English entry is set to the new title | (2) English and German entries are set to the new title.



Case 2: You change the title in one language (e.g. German):

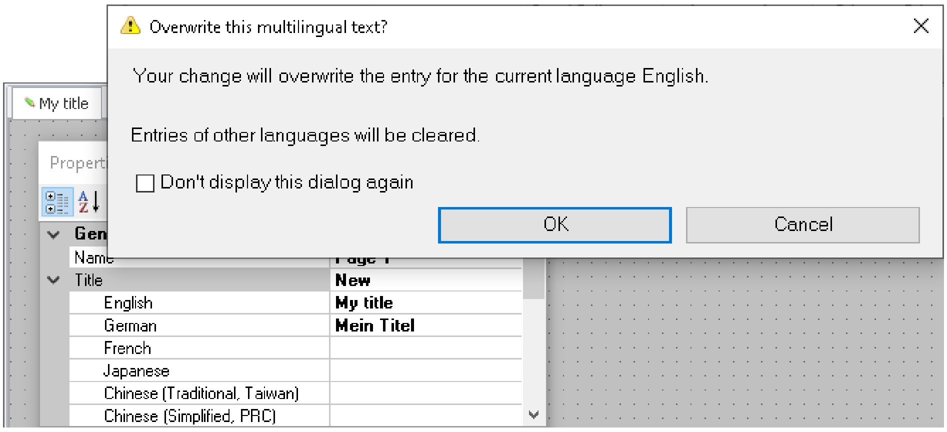
The following is implemented: German systems now display the new title.



Fall 3: You change the title in the main branch while the titles in the other languages are all different:

The following is implemented: An error message is posted.
(1): "*Your change will overwrite the entry for the current language English. Entries of other languages will be deleted.*"
(2): "*Your change will overwrite the entry for the current language German and the entry of the default language English. Entries of other languages will be deleted.*"

The languages stated are assigned the new title; all others are deleted.



12 Automation

This chapter describes the use and operation of "imc STUDIO Automation".

Automation enables **implementation of test stand automation** meeting real-time capability requirements. This implementation is achieved by uniting imc Online FAMOS with PC-based design- and visualization components. Internally, the visualized elements are automatically converted to imc Online FAMOS-code. The code is not accessible for viewing.

Automation is an aid in **defining and implementing state-based processes**. Toward this end, **logical states** are named and **associated with an action** by means of Drag&Drop. Examples include setting a digital output, browsing to a certain Panel page, running a signal plot output etc.. You generate states which then govern how your system runs.

A **variety of control structures** (For, Do, While, If) are available for your use. For the purpose of evaluating measured data, you can insert imc FAMOS sequences (see "*System requirements*"). In order to be able to **observe results at the PC**, or to be able to intervene in the procedure, you can use the Panel.

The Automation runs independently of the PC, like any normal measurement. **Connection** between the PC and the imc device **is not required**. The connection is only needed for configuration purposes. Interfaces with the PC as well as imc FAMOS-sequences always require a connection with the PC.

System requirements

Measurement device requirements
The same hardware prerequisites apply as for imc STUDIO Setup.
An extra device option is required: imc Online FAMOS Professional

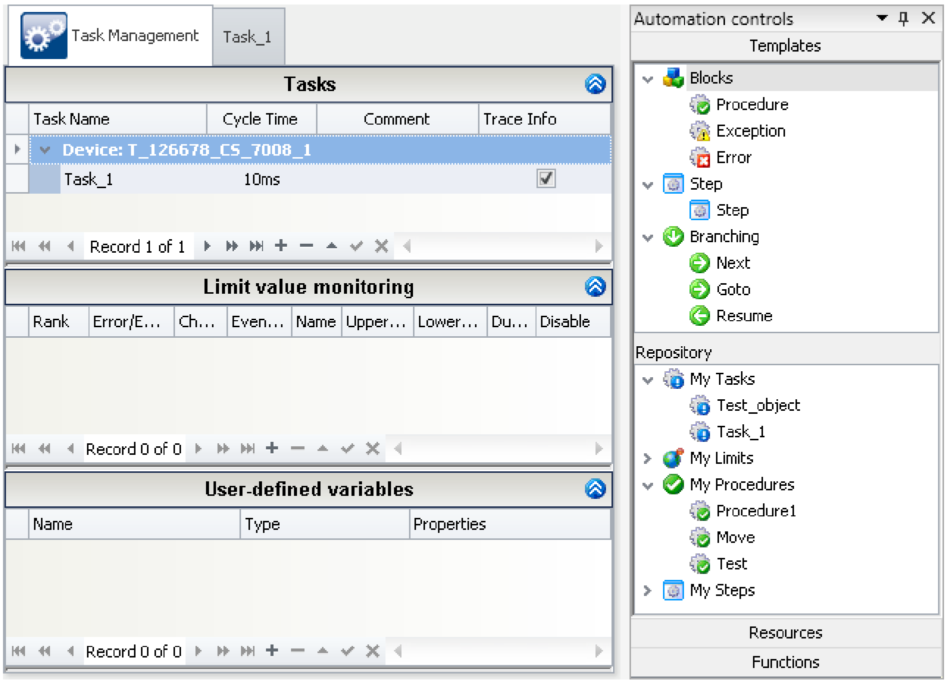
Optional products
imc FAMOS: The product is sold separately. The prerequisite is installation of an imc FAMOS version of 6.1 or higher, as a **Runtime**, **Professional** or **Enterprise** Edition (see TD: "*Additional imc Software Products*").

Chapter overview

Synopsis	Chapter
What should I do first? How does the task begin? What components are there?	Getting started 1409
Creating a "*Task*". What is a cycle time? Monitoring of signals. What kinds of variable types can be created?	Task Management 1424
What can this be used to make? The various kinds of "*Blocks*" available and their purposes.	Task Editor 1437
Creating the "*Steps*". Things to keep in mind. What elements can be incorporated into the "*Blocks*"? How the procedure responds to parallel structures/tracks?	Block Editor 1444
The properties of the elements. Blocks, steps, states, loops and branching. Interaction with the PC: commands and imc FAMOS-analysis.	Templates - Elements for the Editors 1446
Functions for special applications. Signals, tolerances, timers, ...	Functions 1477
Various sample applications for practice purposes.	Tutorial 1493

12.1 Getting started

Structure of the user interface



Components of the Automation

In the picture at left, you see the "*Automation Editor* 1423" in which the **tasks** (flow controls) **are created**. In the tool window "*Automation controls* 1420" at right, process elements, functions and access to the input/output parameters (resources) are available.

Definition of terms

Term	Description
Tasks 1424	A task refers to the **complete processing** of a variety of commands in real time. Within a task, it is exactly **defined what actions are to be performed**. You may generate up to **five Tasks 1424 for a device**.
Initialization 1440	Required in order to bring the testing system into a **defined initial position upon starting**.
Terminate 1440	Used to bring the testing system into a **defined end position** and to conclude the measurement.
Procedures 1441	Procedures define the **actual course of the automation run**. A procedure may contain a variety of elements. In contrast to the initialization and the termination, there can be **multiple procedures**. At the end of one procedure it is possible to use a "branching" to switch over to a different procedure, or to repeat the same procedure.
Exception 1442	An exception is used in order to, for instance, **remedy minor errors** occurring during the automation **without canceling the automation**. If an exception occurs, the automation is interrupted and "exception handling" is performed in order to resolve the error. Afterward, the automation can be resumed.
Error 1442	An error is a **major error**, causing **canceling of the automation**. The "error handling" is used in order to bring the testing system into a **defined end position** and to stop the measurement. The **termination is not performed**.

12.1.1 How to create a operating plan?

In order to create a complete routine for an assignment, it is necessary to first **compose the outline of an operating plan**. Only then is it advisable to focus on individual items of the plan and to specify more exact conditions and steps.

For this purpose, the Automation uses a structure which allows the **larger blocks** of steps to be planned **first** and for the **details** to be designed later **step-by-step**.

Creating a plan

First create the complete tasks using the blocks and then proceed in more detail step-by-step.

Structure	Description
Task 1424	A Task represents a complete routine. Within a task it is possible to create multiple "*blocks*".
Block 1448	A Block represents a portion of a routine. A block comprises multiple "*steps*".
Step 1452	A Step represents one concrete action to be taken. This is filled with the actual action elements: "*states* 1453", "*loops* 1457" and "*branches* 1460".

Example with multiple blocks and steps

In the image above, **three blocks** are seen, which are **to be executed in sequence**.

- Within the first block: "*Move Up*", a test object is to be moved to the correct position.
- Within the second block: "*Test*", the various tests are to be performed.
- Within the third block: "*Move down*" a test object is to be moved to the initial position.

Next, the individual steps are defined. And these can be filled with the corresponding action elements. E.g., in the step "*Movement to perform*", the exact states are specified, which move the object from its present position to the correct height:

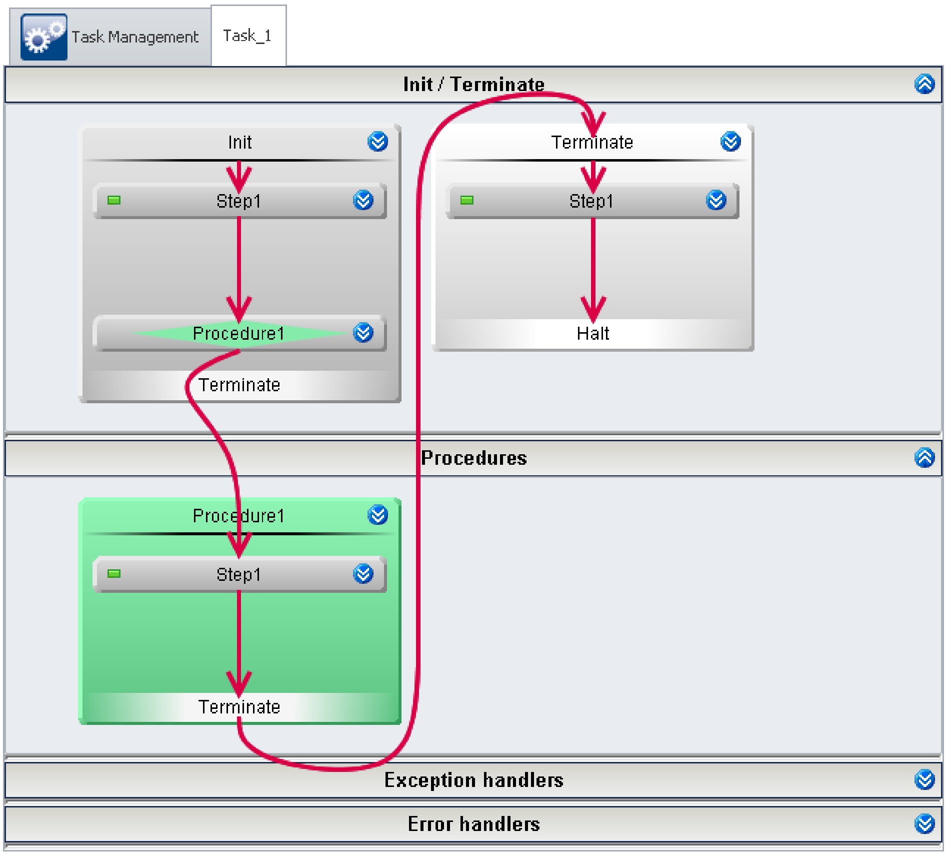
- Start movement
- End movement once height reached

12.1.2 How does the measurement work?

A task **begins at the start of the measurement**.

After the start, the "***Initialization (Init)***" 1440 " **is called**. You must specify how matters proceed next. By default, the initialization contains a "*Next branching*" 1449 ". There, the task **skips back to the first** "***procedure***" 1441 ". **At the end** of the task, the block "***Terminate***" 1440 " is performed (as long as no error has occurred). This concludes the task with "*Halt*".

Below is a simple example:



Minimal task without any funtion

The relationship between the measurement and the "task"

A task is always associated with a running measurement.

Note	1-Trigger

The Automation can only be performed if the device has at least one active channel with a "1-Trigger" (e.g. the "Trigger_48"). "1-Triggers" are triggers which fire upon starting the measurement, and have no other associated sources.

The **task is concluded** when the routine arrives at a "*Halt*" (e.g. at the end of the "*Terminate*"-block). The conclusion of a task has no effect on the measurement's state; the measurement continues. Using the "*Automation Task* 1491" Widget, you can repeat concluded tasks without needing to re-start the measurement. Or stop them, if desired.

If the **measurement ends** before the task is finished, the "*Terminate*"-block is called automatically (if the task is not in an "*Error handling*" stage). The task continues to run until the "*Terminate-block*" or the "*Error handling*" has been concluded. One way to observe this is in the "*Trace Info* 1490".

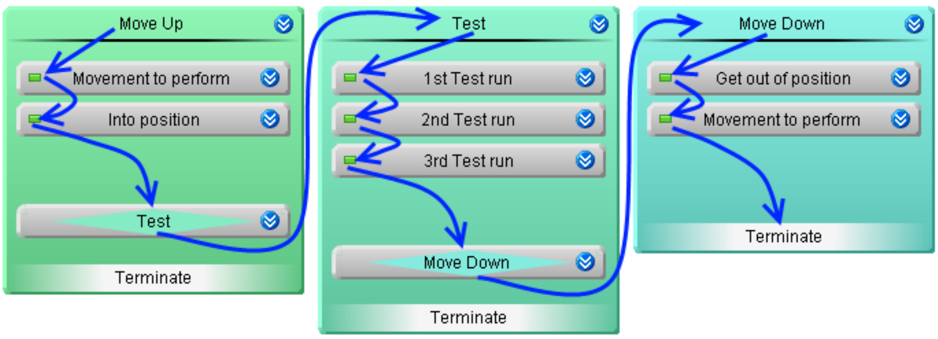
If the user attempts to re-start the measurement while the task is in this state, or if imc STUDIO is disconnected from the device while the task is running, a dialog appears, which offers the choice of ending the task.

Action	Description
Stop	Ends the task without running any further actions. No conclusion phase is run. Even any running error handling processes are interrupted.

Use of multiple blocks and steps

- The task jumps from block to block.
- Once a block has been processed, the next one is started.
- If a block starts, the first step within this block starts and is processed.
- Once a step has been processed, the next one is started.
- This continues until the block has no further steps.

Below, an example with three steps is shown:

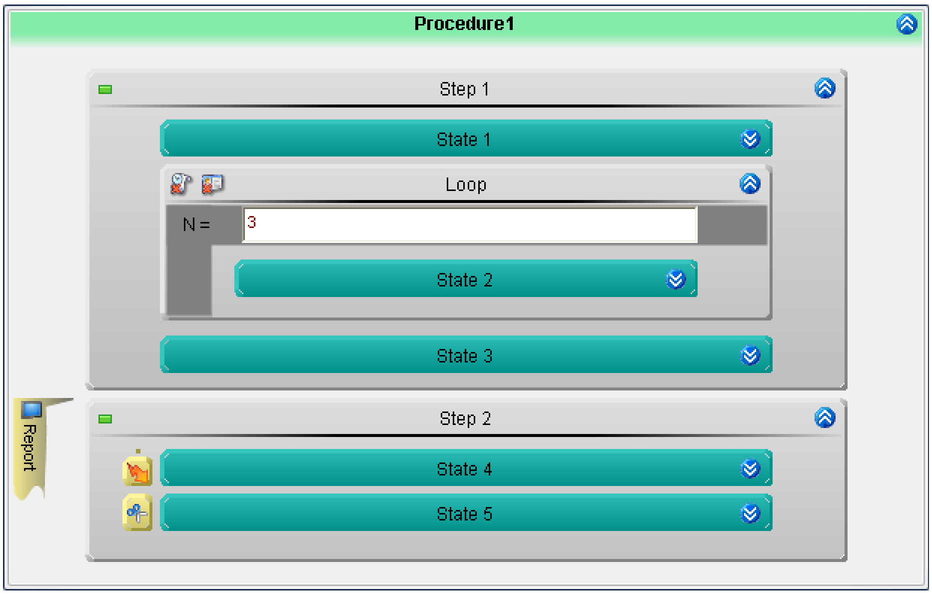


After the block "*Move Down*", the block "*Terminate*" starts.

Jumping from state to state

If a step starts, its contents are carried out. Here, the task comes to its **actual actions**: To the "**States**". The measurement device only knows this layer. The actual procedure jumps from state to state.

Example



It is assumed that all states in the example have the cancel condition {immediately}.

- If the block "*Procedure 1*" is started, the state: "*State 1*" is carried out (see the chapter: "State 1453 ").
- After conclusion of the cycle time set, the state: "*State 2*" is carried out.
- In accord with the For-loop, this is carried out three times in succession. Evaluation of the **For-loop** does **not affect the speed**.
- After "*State 2*" comes "*State 3*", then "*State 4*" and "*State 5*". The fact that these are in **different steps** does **not affect the speed**.

Thus, the block "*Procedure 1*" is processed within seven cycle times. Subsequently, the system jumps to the next block's state.

Note

Evaluation of the For-loop and of the jump to the next step or block does not affect the speed.

12.2 Operation

The plug-in Automation offers a variety of operation possibilities.

Opening and closing windows

In the plug-in ***Automation***, it is common for windows to be used which must be displayed either open or in minimized ("closed") mode.

There are different ways to open or close windows.

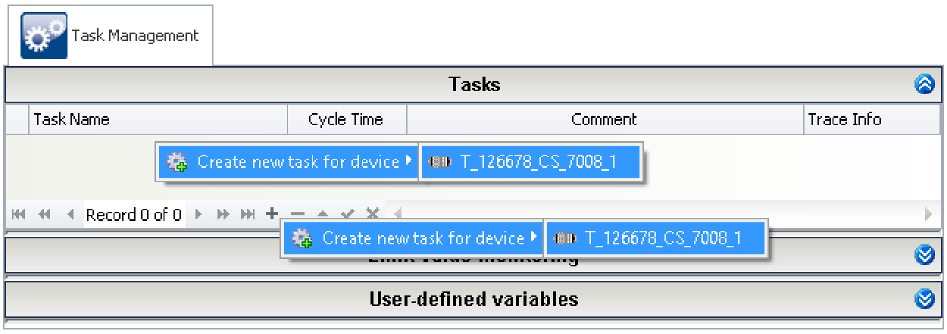
- Double-click on the area title
- Click on the double-arrow (or), or:
- select either the item "*Open*" or "*Close*" from the context menu.

12.2.1 Operation in the Task Management

Creating elements

To add an element at the desired position, there are two possibilities:

- Click on the plus-symbol ( ) and follow the menu guidance, or
- open the context menu over the empty areas and follow the menu guidance.



Example: Creating a task by means of the context menu or "+" symbol

Deleting elements

To delete an element, there are two possibilities:

- Select it and left-click the mouse on the minus-symbol ( ), or
- open the context menu over the empty areas and follow the menu guidance.

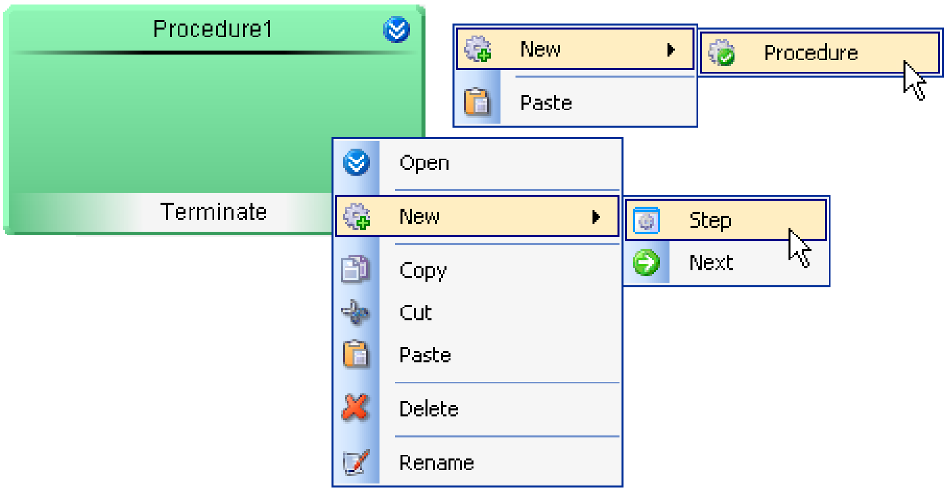
Exporting an element to a different device

You can export tasks from one device to another.

- Right-click the mouse over the task, select "*Export selected task to device*".
- Select the desired device.

12.2.2 Operation in the Task and Block Editor

Creating elements



New element in an example with the Task Editor

There are two ways to add an element at the desired position:

- by means of Drag&Drop
- by a context menu command

Creating elements by means of Drag&Drop

- Use Drag&Drop to move the desired element from the tool window **Automation Elements** to the desired position.
- Release the mouse button.

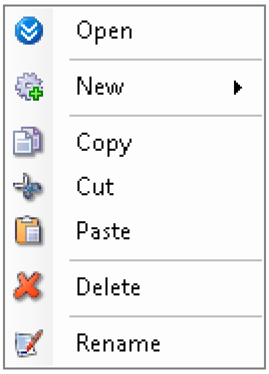
The element is created at the selected location.

Creating elements by context menu

- Open the context menu of the desired free space.
- Select *New*.
- Select the desired element.

The element is created at the selected location.

Copying, cutting, pasting and deleting elements



Context menu of a block

To perform these actions, there are several possibilities:

- via the Edit menu
- via the context menu
- via shortcut (Ctrl + c/x/v and Del)

Element added by means of the context menu appear at the position where the menu was opened. Elements added by means of the *Edit* menu appear at the back of the stack.

Added elements are renamed to be identifiable as a copy.

Renaming an element

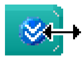
The name of most elements can be chosen freely (with the constraint that every block name must be unique).

- To do this, open the element's context menu and select *Rename*.
- Or select the element with the left mouse button and then click again with the left button on the element.

Stretching elements

Some elements in the Task Editor can change in size and thus also change their association with other elements. This is a way of synchronizing "tracks" 1445 or extending imc FAMOS-analyses across multiple element.

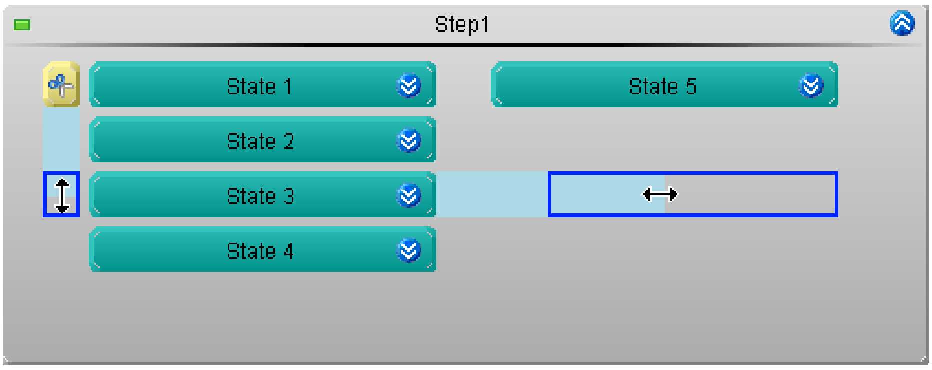
To change the stretching, proceed as follows:

- move the mouse over the element's edge. An arrow symbol appears 
- click on the left mouse button and hold it down
- drag the mouse to the desired position  and release the mouse button

Example

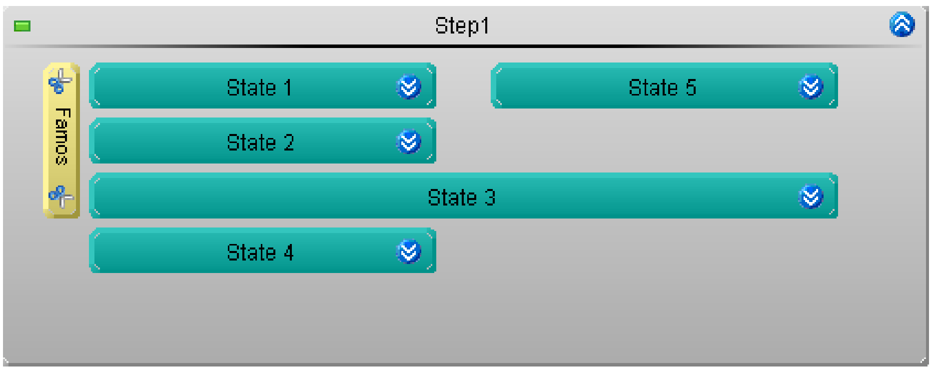
"*State 3*" is intended to synchronize across two tracks, and a imc FAMOS evaluation is intended to "cut" three states.

- Grab the edges of the element and release then within the marked space.



Example: Changing the extent of the elements

The elements are extended.



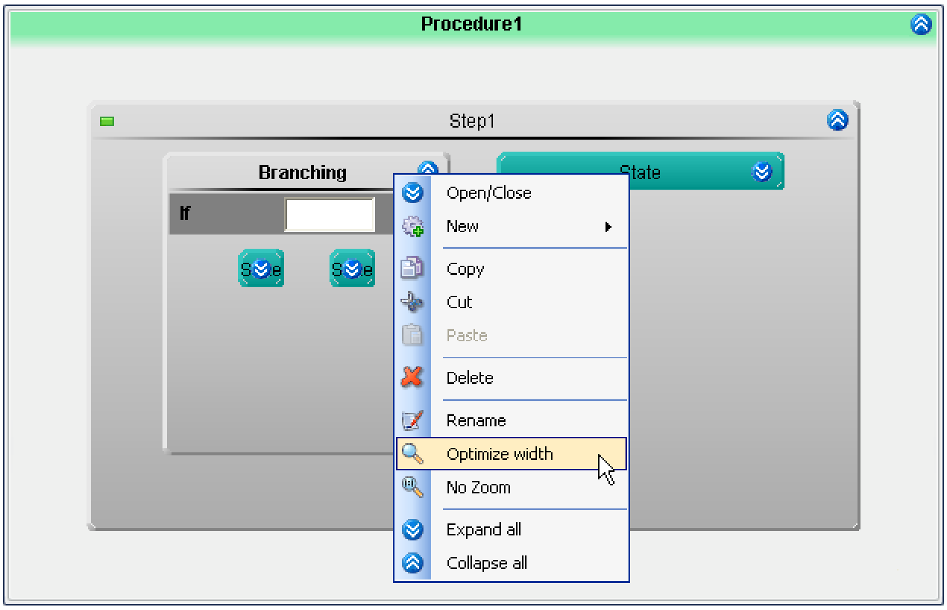
Example: The elements were extended

12.2.3 Zoom - Adapting an element's size

When elements are used in parallel or if multiple nested loops are used, the elements become to small. in consequence, it is no longer possible to read the texts and no more settings can be made in the elements.

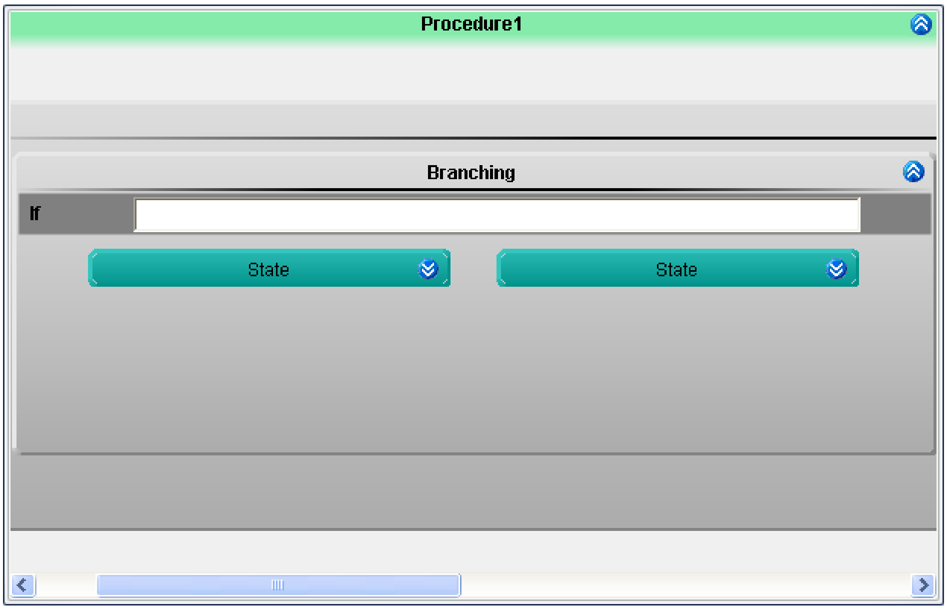
For this reason, in order to keep a clear overview, it helps to assign descriptive names to the nested loops, which reflect what they do.

In order to be able to edit the elements, you must **zoom it out**.



Toward this end, there are multiple possibilities:

- open the element's context menu and select the item "*Optimize width*", or
- open the procedure's context menu and select one of the specified Zoom sizes.



Example:
Zooming in a branch

Reversing the zoom

To reverse the zoom, there are two ways:

- open the element's context menu and select the item "*No Zoom*", or
- open the procedure's context menu and select "*Zoom*" > "*Adapt to page size*"

12.3 Tool window Automation Elements

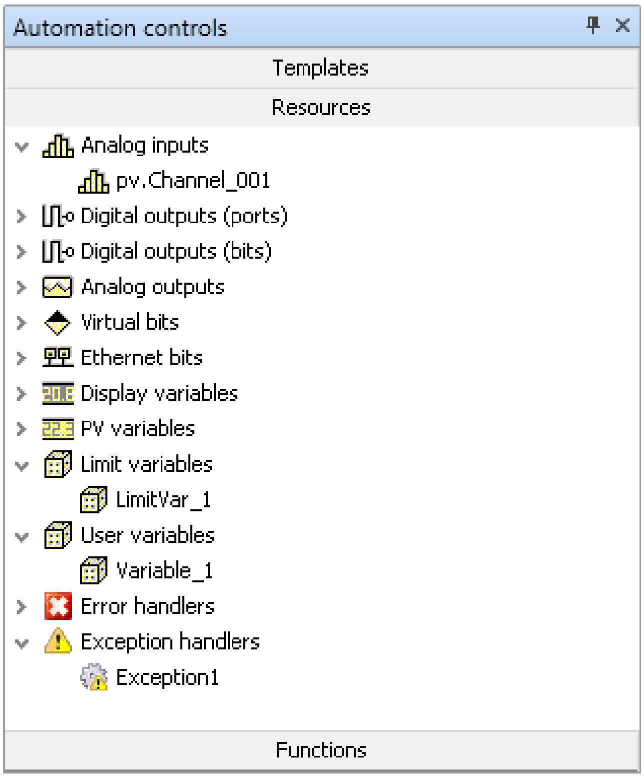
The component Automation includes the tool window "*Automation Elements*".

The tool window is divided into four fields:

Fields	Description
Templates 1446	This region contains the element which you can insert into the current main window.
Repository 1422	You can copy such elements as "*Steps*" and "*Procedures*", "*Limit value monitoring*" and whole "*Tasks*" to the repository, or use ones which are already there.
Resources 1421	This region contains the variables which can be used in a Automation-task.
Functions 1477	You can use functions in "*States*", "*Loops*" and "*If-branches*". This region contains functions which allow special applications in a Automation-task, as well as imc Online FAMOS functions which can be used in the control command "`OnSyncTask`".

12.3.1 Resources - Variables

This region contains variables which can be used in a Automation-task.



Resources

Operation

Inserting a variable into the active element (e.g. into a state description):

- double-click on the variable (the input box must be selected), or
- using Drag & Drop, or
- enter the variable (keyboard combination <CTRL>+<SPACE> helps in making the entry).

Variables

All single-value device variables are available. Channel data streams can not be subjected to calculations in a task. Instead, use the channels' pv-variables. Also CAN-bits and DI-bits (in the mode: "*Sampling*") can be used, for example.

A task's user-defined variables only appear in the list if the associated task is opened/selected. Variables belonging to other tasks can not be used. The only exception are the pv-variables; these can be used across the boundaries of different tasks.

Exception handling and error handling, as well as value limit monitoring processes, have their own dedicated variables. With those of value limit monitoring as with user-defined variables, they can be used as pv-variables in other tasks.

12.3.2 Repository

Such elements as "*States*" "*Steps*" and "*Procedures*", "*Limit value monitoring*" and whole "*Tasks*" can be copied to the Repository, or retrieved from there for use.

Note States in the repository

It is possible to record states in the repository. Events and their associated commands are included along with the state.

imc FAMOS-data cutting is discarded, since it is not necessarily associated with only one state.

Operation

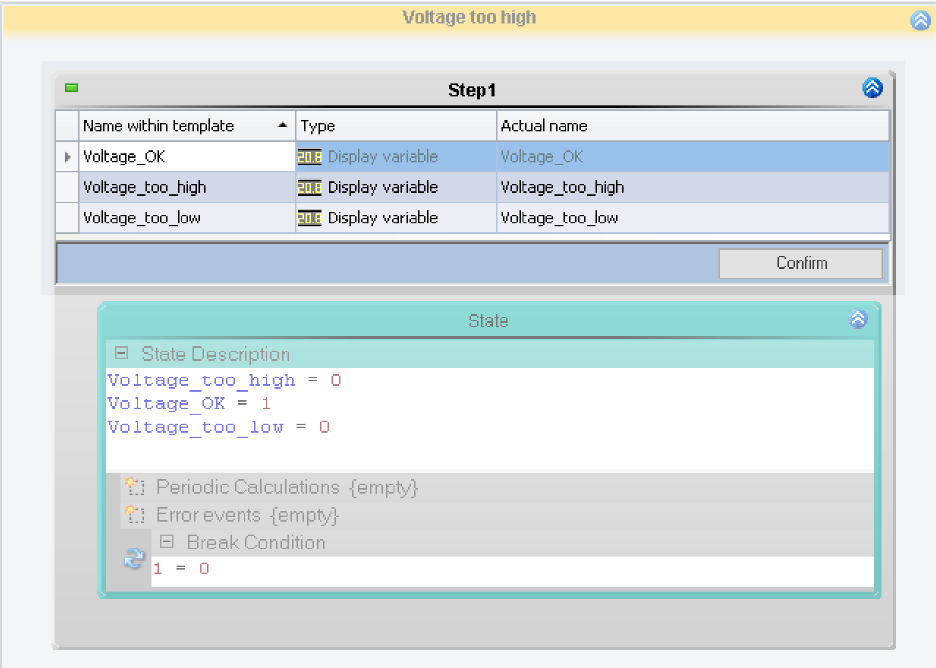
Copying an element into the repository or retrieving one from there for use:

- by means of Drag & Drop.

Unconfirmed template variables

In some cases you can automatically rename variables.

When you use a "*Step*" from the template, then at the upper edge of the step there is an additional window (you may need to open the step). Here, you can set new names for the variables ("*Actual Name*"). When you click on the "*Confirm*"-button, all variables in the step are renamed accordingly.



When a "*Task*" from the template is used, an additional grouping appears above the grouping "*Init/Terminate*", where you can change the names.

Note Replace variables in imc FAMOS sequences

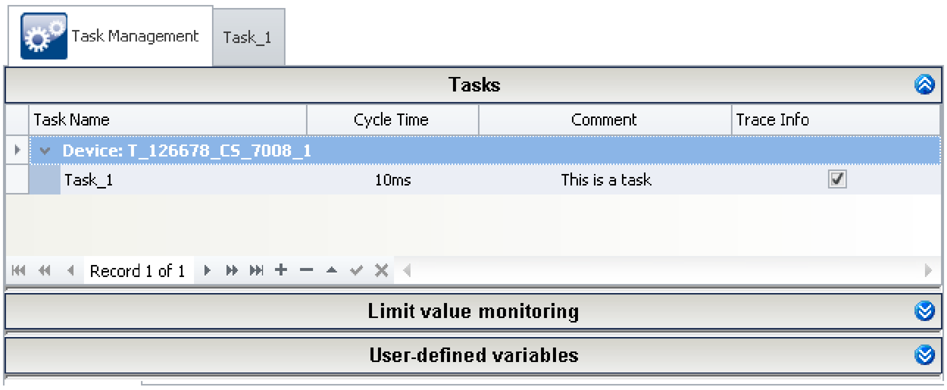
imc FAMOS Sequences (data cutting): **The In/Out variables** can also be replaced. The sequence and the imc FAMOS-variables are not taken into account.

12.4 Automation Editor

"*Automation Editor*" contains three different fields. All views are needed in order to program your tasks.

Fields	Description
Task Management 1424	Here you **define the tasks** and their environment
Task Editor 1437	Here you create the **outlines of your tasks' flow**.
Block Editor 1444	Here you set the **exact procedures of your tasks' individual Steps** 1452.

Only after you have added a task you can open the Task Editor and the Block Editor.



Automation Editor with Task Management opened

In the image above, you see the "*Task Management*" with the task: "*Task_1*".

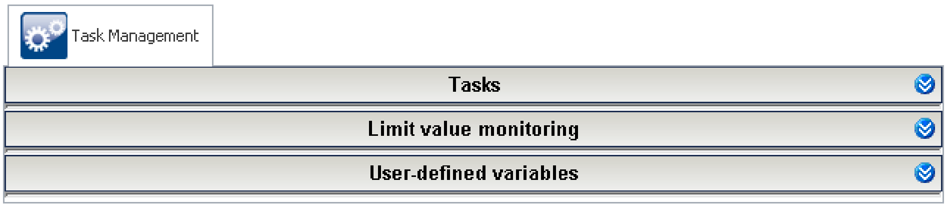
For each task, a new tab appears next to the "*Task Management*".

Tab list

By clicking on the corresponding tabs, you can switch between the "*Task Management*" and "*Task_1*" (which opens an editor).

If you have opened an editor (e.g. "*Task_1*"), you can switch between the editors "*Task Editor*" or "*Block Editor*".

12.4.1 Task Management



Task Management (Fields minimized)

"*Task Management*" consists of three fields:

Fields	Description
Tasks 1424	Here you **define** the **tasks**.
Limit value monitoring 1427	Here you can define **events for every task**, **catch any exceptions or errors** that occur, and have them handled in a controlled manner.
User-defined variables 1432	Here you define the **variables for every task**, which are used in the Task Editor 1437, among other places.

Each task has its own combination of "*Limit value monitoring*" and "*User-defined variables*".

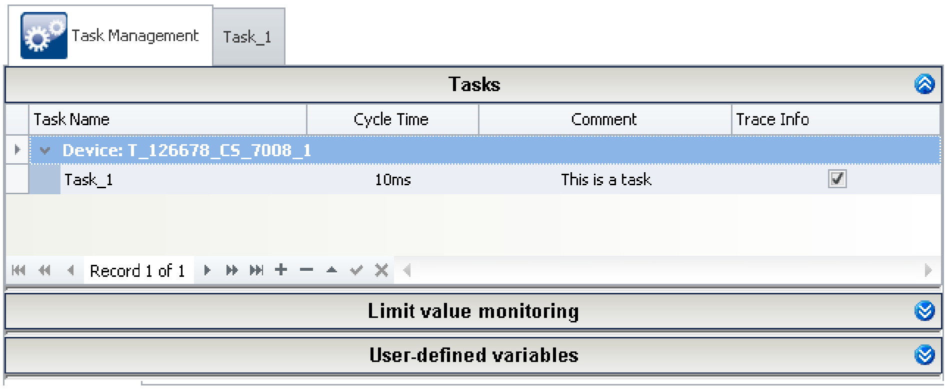
12.4.1.1 Tasks

A Task is a **complete routine of various commands** performed in real-time. Functions to be performed in the task are defined exactly. For this purpose, various elements are available to the task:

Element	Description
Value limit monitoring	See chapter "*Task Management* 1424"
User-defined variables	
Blocks	See chapter "*Task Editor* 1424"

For each device, up to five tasks can be created.

- Tasks are created for a particular device. In order to be able to create a task, a device must be selected.
- Tasks run on the device independently in real-time as an imc Online FAMOS program, in parallel with and mutually independent of each other.
- Tasks can be created for and performed by one or multiple imc measurement systems independently.



Example of a new task

Parameter	Description
Device	Device to which the task is assigned. The tasks are grouped according to the device to which they belong.
Task Name	Name of the task. The name must be unique.
Cycle Time	(processing speeds) Cycle time for the task. Selectable from 100 µs to 1 s. Default value: 10 ms.
Comment	User-defined comment
Trace Info 1490	Activation/deactivation of monitoring of the tasks' current status.

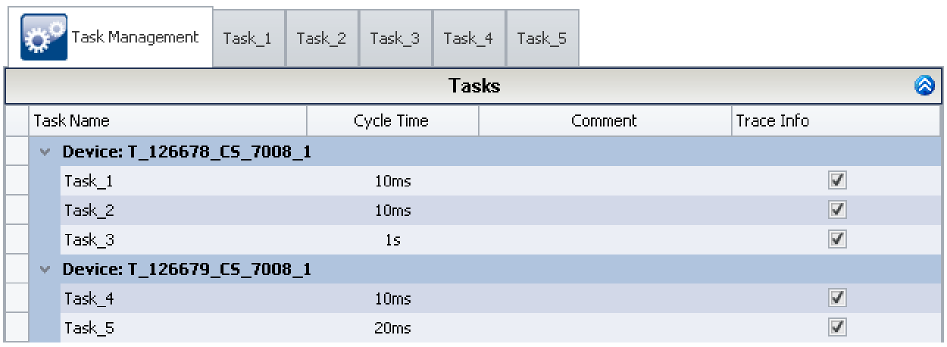
For each task, a new tab appears next to the "*Task Management* 1424": (here) "Task_1". When you **click** on this, **you come to the "Task Editor 1437"** with which you can **create the flow of the selected task**.

Tab-list

Cycle time and parallel tasks

Tasks are processed in real time. For this purpose, **assign the task a cycle time** (input range from 100µs to 1s). The cycle time represents the **duration of a state**, and thus reflects the task's speed. For more information, see the chapter "*State* 1453".

Up to five tasks per device can be set up. These are performed in parallel. For each device, **you can assign a different cycle time to each task**.



Synchronous task

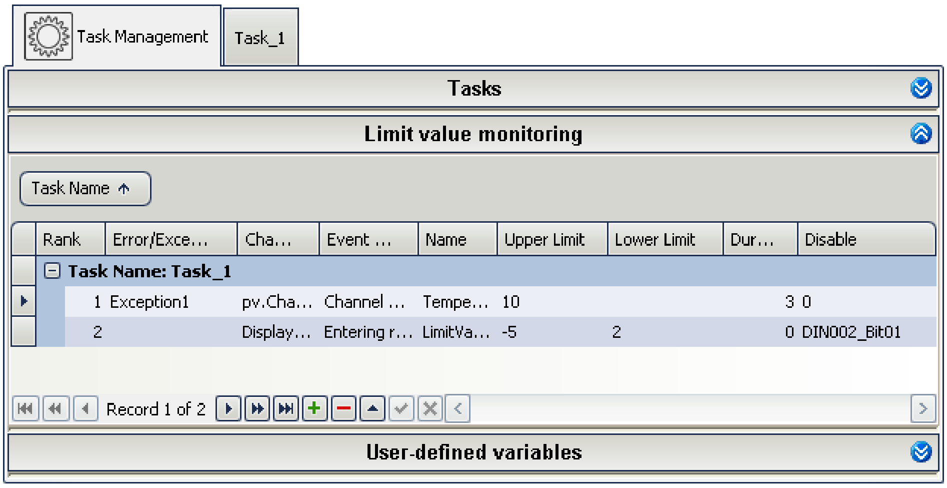
Trace Info

While the Automation is running, you can **observe** which "*block*" and which "*Step*" 1452 **are currently being processed**. For more information, see the chapter "*Trace Info*" 1490.

12.4.1.2 Limit value monitoring

In the field Limit value monitoring you can **define events**. Events can be assigned directly to an "*Exception handler* 1442" or an "*Error handler* 1442". If one of these events occurs while the task is running, the **procedure which is under way is automatically interrupted** and the appropriate error handling is performed.

Minor errors can be dealt with in a controlled way by means of an exception handler. In the case of a serious error, the running task can be concluded in a controlled way by means of error handling. More information on the error treatment procedures is presented in the chapter "*Exception handler and Error handler* 1442".



New limit value monitoring

Parameter	Description
Task-Name	Task to which the limit value monitoring is assigned.
Rank	Priority of the limit value monitoring. If multiple events occur, the limit value monitoring having the lowest number is run.
Error/Exception	Name of the exception handler 1442 or error handler 1442 to be performed, if the event occurs.
Channel	Channel to be monitored.
Event Type	Event type to be monitored
Name	Name of the variable set by the limit value monitoring. Value of the variable: • 0: if not all conditions are met • 1: if all conditions are met
Upper Limit	For the respecting event type the upper limit is entered here. Either a constant or a variable can be used.
Lower Limit	For the respecting event type the lower limit is entered here. Either a constant or a variable can be used.
Duration	This time amount determines how long the condition formulated must be met before triggering the Limit value monitoring routine. Stated in s. (See "*Sample calculation* 1431")
Disable	Here you can deactivate the "*Limit value monitoring*".

Note — Clock rate of the monitoring

Every limit value monitoring procedure is assigned to a task and is evaluated at its clock rate.

The monitoring always occurs at the beginning of a cycle time. When a violation of the value limit is detected, the routine immediately branches off to the linked exception-/error-block. (See "*Sample calculation* 1431")

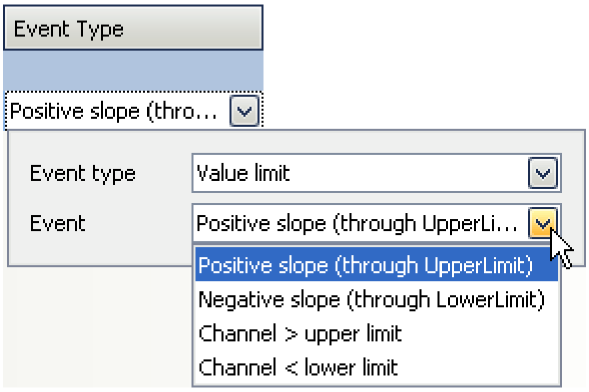
Events

For the limit value monitoring, an event must be selected. The event is one of the conditions which must be met in order for one of the handling processes to start.

To set the event, there are two selection boxes:

- Event type
- Event

As the **event type** can select between "*Value limit*", "*Range*" and "*Bit*". The event can then be set accordingly.



Possible events

Event type: Value limit

Event	Description
Positive slope (through upper limit)	If the monitored channel passes through the **upper limit** from below upward, this condition is met.
Negative slope (through lower limit)	If the monitored channel passes through the **lower limit** from below downward, this condition is met.
Channel > upper limit	As long as the monitored channel's signal is above the **upper limit**, this condition is met.
Channel < lower limit	As long as the monitored channel's signal is below the **lower limit**, this condition is met.

Event type: Range

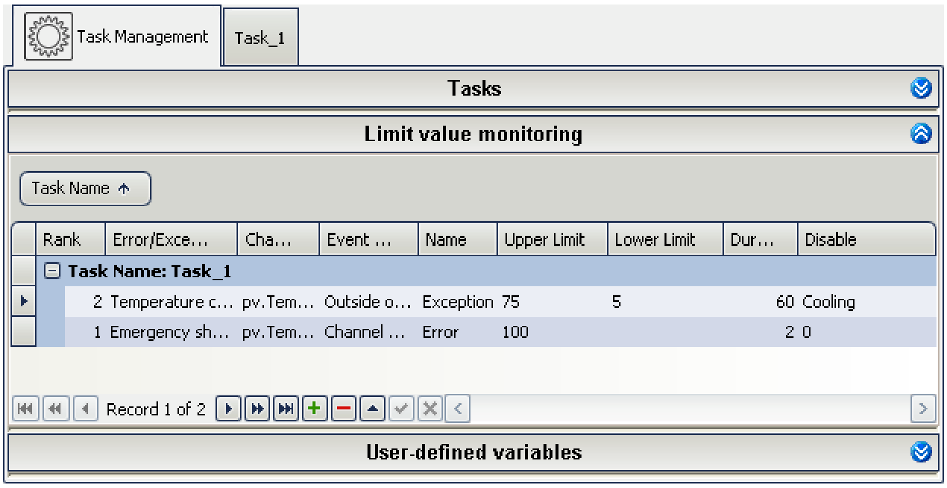
Event	Description
Entering range	If the monitored channel enters a range from either above or below, the condition is met.
Exiting range	If the monitored channel exits a range from either above or below, the condition is met.
Inside of range	As long as the monitored channel is within the range, the condition is met.
Outside of range	As long as the monitored channel is outside the range, the condition is met.

Event type: Bit

Event	Description
Transition from 0 to 1	If the monitored channel transitions from 0 to 1, the condition is met.
Transition from 1 to 0	If the monitored channel transitions from 1 to 0, the condition is met.
Signal = 1	As long as the monitored channel's value is 1, the condition is met.
Signal = 0	As long as the monitored channel's value is 0, the condition is met.

Limits

If you have specified an associated event type, you must assign a value for the "*upper limit*" and/or "*lower limit*". This can be accomplished by means of either a fixed number or a variable (also possible: "*user-defined variables* 1432").



Example of temperature monitoring

Activation/Deactivation

You can activate and deactivate Limit value monitoring functions. To do this, select a variable in the cell "*Disable*" (also possible: "*user-defined variables* 1432").

- If this variable has a value **other than "0"**, the **Limit value monitoring is deactivated**.
- If its value **is "0"**, the **Limit value monitoring is activated**.
- If the "0" is selected in the cell instead of a variable, the Limit value monitoring is always activated.

Name: Variable for the limit value monitoring

The value **limit monitoring's name** becomes a **variable**, which can also be processed in the tasks. Thus, for example, it is possible to check whether all of a value limit monitoring's conditions are still met.

Value of the variable:

0: if not all conditions are met

1: if all conditions are met

Note Making monitored variables globally available

Normally, it is only possible to access the variable within the task. By defining the variable as a pv-variable, you can also access it in other tasks or in imc Online FAMOS. Additionally, you also display the value on the Panel.

Set the string "pv." at the beginning of the name. If you have already used the variable in the blocks, you must rename it in all of its occurrences there ("*Find and replace* 1488").

The conditions

If all of a value limit monitoring's conditions are met

- its variable is set to 1 and
- a handling process is started if one was selected.

Note

- If no handling process was selected, it is only possible to detect that all conditions are met by the variable. The task continues to work without interruption.
- If a handling process starts, the running procedure is interrupted, for example.

The following three conditions must be met:

- the "***event***" must occur,
- the "***minimum duration***" must be reached and
- the value limit monitoring may **not be deactivated**.

Order and priority of the limit value monitoring

The order specifies the relative priorities for monitoring functions. The following rules apply:

- Error handling always has higher priority than exception handling,
- lower numbers have higher priority.

Example	Priority

1. The conditions for multiple monitoring functions of the *same type* are fulfilled:
   - the handling with the *lowest number* is started
2. The conditions of multiple monitoring functions of *different types* are fulfilled:
   - the error handler with the *lowest number* is started
3. If an error handling function is already running and the conditions of a limit value monitoring function of *higher priority* are fulfilled:
   - the running error handling function is interrupted
   - the limit value monitoring function with higher priority is started

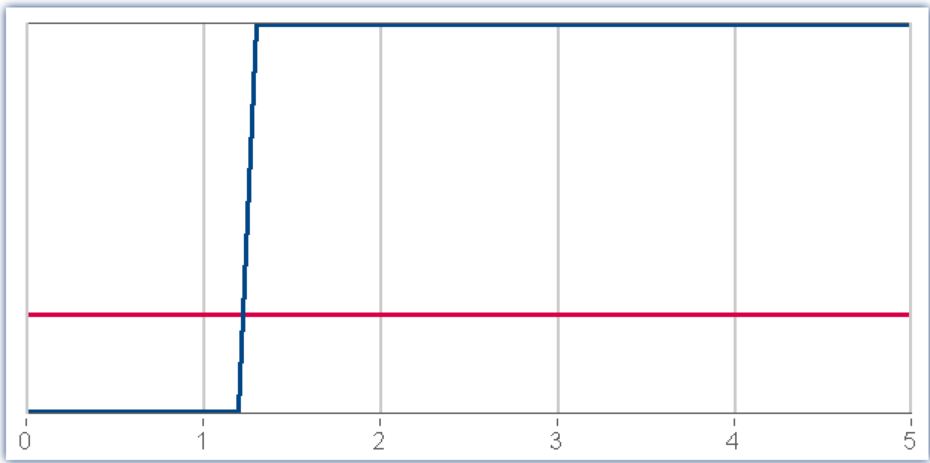
Note	Occurrence of the value limit monitoring's event while the Terminate block is in process

If all of a value limit monitoring's conditions for starting an error handling are met during the Terminate block, the subsequent error handling is performed.

This does not apply for an exception handling. The termination has higher priority 1439 than the exception handling and is carried out the conclusion.

Sample calculation - At which cycle-steps is handling started?

In this example, a signal is monitored. Whenever a threshold has been violated, a handling procedure is to be started.



blue: monitored channel signal
red: threshold
grid: cycle steps

Question: At what point in time is the limit violation captured and the exception handling started?

At the point in time #1 the value is below the threshold. The limit violation is only registered as of the point in time #2. The handling process begins immediately. At time point #3, the second state of the handling process is already being performed.

Question: As of what time does the clock start if a minimum duration is specified? And when does the handling process start?

The time is counted as of time point #2. The number of cycle steps is determined as follows:

Cycle-steps = Duration / SyncTime.

Sample data: Minimum duration: 2.5s; with a cycle time = 1s

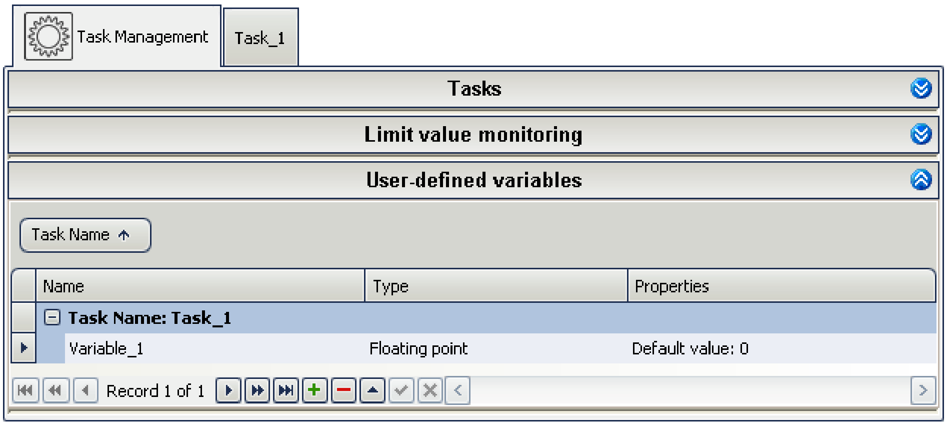
Thus in this example:

Cycle-steps= 2.5 (rounded to 2).

The handling process is thus launched at time point #4.

12.4.1.3 User-defined variables

In the field User-defined variables, you can **declare variables for the automation for each task**. Each task has its own set of user-defined variables. The variables can be defined in such a way that they can only be edited or accessed by their respective associated task. Or alternatively, (as a pv-variable) by all tasks.



New user-defined variable

Parameter	Description
Task-Name	Task to which the user-defined variable is assigned.
Name	Name of the variable
Type	The variable's data type. More information presented below.
Default Value	Here you can assign an initial value to the variables. The recorded value is written to the variable upon reconfiguration 171 (or when the configuration downloading is performed). This is the same as what you see happening in imc Online FAMOS in the block: `OnInitAll`. The exception here are persistent variables; on this topic, see the description of "Default values and persistent values 1435".
Persistent	The variable can save the current value in the device so that it is available for use upon the next activation of the device. As soon as "persistent" is set, the variable is converted to a PV-variable.

Variable-type

<table>
<tr><th>Variable-type</th><th>Description</th></tr>
<tr><td>Floating point</td><td>Single value as Float

Syntax example: `Variable = 12.345`

Possible numbers: ±1.0E35 (exponent: 8 bits, mantissa: 23 bits)</td></tr>
<tr><td>Integer</td><td>Single value as 32-bit Integer

Syntax example: `Variable = 12`</td></tr>
<tr><td>Virtual channel from single value</td><td>This lets you generate a channel which is sequentially filled with single values. The imc Online FAMOS-function "SingleValueChannel" generates the same variable type.

In the curve window, the variable is displayed as a virtual channel. However, in the Automation it is treated as a single value. Whenever a value is assigned to the variable, this value is entered as a value in the virtual channel. By default, the distance between points is given by xd="1" (Auto). You can modify this in the settings for the variable.

Syntax example: `Variable = 12.345`

The following settings choices are available:
• **Y-unit:** unit of the values entered. Auto = no unit
• **X-unit:** unit of the actual "*time axis*". Auto = no unit
• **X Offset:** Offset of the first point. Auto = 0
• **X Delta:** Distance from the next point. Auto = 1

More information is presented in the description of the function "SingleValueChannel 1003"

The circular buffer memory set also applies to this variable type. With the preset "*1 min*" and a value of "*X Delta*" of "*1*", exactly 60 values are displayed.

This variable is missing any reference to time. For this reason, displaying it in a curve window along with other channels will not be meaningful in most cases.

Conversely, the variable can very well be displayed in a table, since the individual values are often significant.

Use this channel type as a results-variable, for instance. Whenever the result of a calculation is generated, it can be appended to the variable.</td></tr>
</table>

Variable-type	Description

Vector from datapool	The vector must be present in the Data Browser. In the Prepare-process, the vector's content is written to the device. Thus it is available for the task with the current values.
	
	Please be aware that the Prepare-process is only carried out if a change has been made to the device configuration. If necessary, perform "*Reconfiguration* 171".
	
	It is possible to access the elements of the vector with the help of variable. The first element is addressed with the value "1". The second with "2", etc.
	
	In the following example, the value is written to the vector by means of the "pointer"-variable: "DisplayVar_01":
	
	"Vector" is a user-defined variable of the type: "Vector from datapool".
	`; writing to a vector at a variable position`
	`Vector[DisplayVar_01] = DisplayVar_02+10`
	In the following example, the value is read from the vector by means of the "pointer"-variable: "DisplayVar_01":
	`; reading from the vector at a variable position`
	`DisplayVar_03 = Vector[DisplayVar_01]`
	
	There are a variety of ways you can create the variable in the Data Browser. E.g. as a user-defined variable in the Data Browser 1087 or by means of imc FAMOS 1607. You can also create and fill the variable by means of the commands: "*Load/Import variable* 1620", for instance.

Static vector	This lets you generate a channel whose elements can be changed during the measurement. The imc Online FAMOS-function "`VectorStatic`" generates the same variable type. All elements are initialized at "0". It is possible to access the elements of the vector with the help of variable. The first element is addressed with the value "1". The second with "2", etc. Example: See "*Vector from datapool*". Accessing the individual elements works in the same way. You can make the following settings: • **Elements:** Count of elements in the vector. Once the measurement has been started, the count can no longer be changed. • **Y-unit:** Unit of the values entered. Auto = no unit • **X-unit:** Unit of the actual "*Time axis*". Auto = no unit • **X Offset:** Offset of the first point. Auto = 0 • **X Delta:** Distance to the next point. Auto = 1 More information is presented in the description of the function "`VectorStatic` 1026" Note the vector's refresh rate on the Panel. With the default setting, the vector is only updated every 10 seconds. If appropriate, modify the setting if higher-speed refreshing is needed: Setup-page "*Analog Channels*"; "*Histogram / Rainflow*" > "*Histogram display update interval* 383".

Process vector variables

You can assign a prefix "pv" to the variable created. For instance, "pv.Variable_1". By this means, this variable can also be used in other plug-ins, such as in the Panel. For more information on process vector variables, see the chapter "*Process Vector Variables*" 355".

Default values and persistent values

Default value of non-PV-variables:

The default value is "0" and can be modified in accordance with the respective variable type. The value is written to the variable when the imc Online FAMOS-block: `OnInitAll` is executed (e.g. when reconfiguring).

Default value for PV-variables:

The default value is "Keep current value". This can be modified in accordance with the respective variable type.

- Keep current value: The variable has no default value. It is not modified upon reconfiguration and keeps the value it already has.
  When the device is deactivated and reactivated, the variable retains its current value which is displayed for the variable in the Data Browser.
- a number: matches the behavior as for non-PV-variables.

Default value for persistent PV-variables:

The default-value is "Keep current value". It can be modified in accordance with the respective variable type.

- Keep current value: matches the behavior of non-persistent variables. Persistent has no effect.
- a number: matches the behavior of non-PV-variables only upon the first reconfiguration.
  In this case the variable is "persistent" (see also the description of the imc Online FAMOS-syntax "`restore`").
  The value of the variable is saved in the device upon deactivation and before the download. When the experiment is first downloaded once the device has started, the value is written to the variable again (immediately following the `OnInitAll`-block). The assignment is performed after a plausibility check of whether the values can be assigned to the existing PV-variables (e.g. whether they belong to the experiment and to the Automation-task).
  The default value entered has no longer has any significance for the rest of the process. It is set only in case no value is saved in the device.

What is saved are the current experiment's values. Values from previous experiments can not be restored.

Examples:

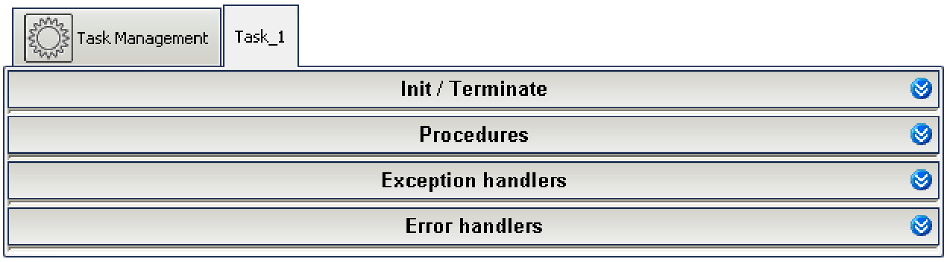
<table>
<tr><th colspan="3">Parameter</th><th colspan="3">Action</th></tr>
<tr><th>Persistent</th><th>Process-vector variable</th><th>Default value</th><th>Reconfiguration</th><th>Measurement start (after reconfiguration)</th><th>Switch device off and back on
Start measurement</th></tr>
<tr><td>no</td><td>no</td><td>5</td><td>5</td><td rowspan="8">Keeps the current value</td><td>5</td></tr>
<tr><td>no</td><td>no</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>no</td><td>yes</td><td>5</td><td>5</td><td>5</td></tr>
<tr><td>no</td><td>yes</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>no</td><td>yes</td><td>Keep current value</td><td rowspan="2">Keeps the current value</td><td rowspan="2">Keeps the current value</td></tr>
<tr><td>yes</td><td>yes</td><td>Keep current value</td></tr>
<tr><td>yes</td><td>yes</td><td>5</td><td>Keeps the current value
Except upon first reconfiguration: 5</td><td rowspan="2">Loads the value present in the device when the device was deactivated</td></tr>
<tr><td>yes</td><td>yes</td><td>0</td><td>Keeps the current value
Except upon first reconfiguration: 0</td></tr>
</table>

Deleting saved values

For certain applications, the persistent values must be deleted in time for the next start. To delete the values, click on the button "*Delete*" which is in the column "*Process vector backup file*" on the Setup page: "*Devices*". You may need to first show the column 254.

When the function is selected, all persistent values are deleted upon the next start and the device is prepared with the "*Default values*".

12.4.2 Task Editor - Structure of the blocks



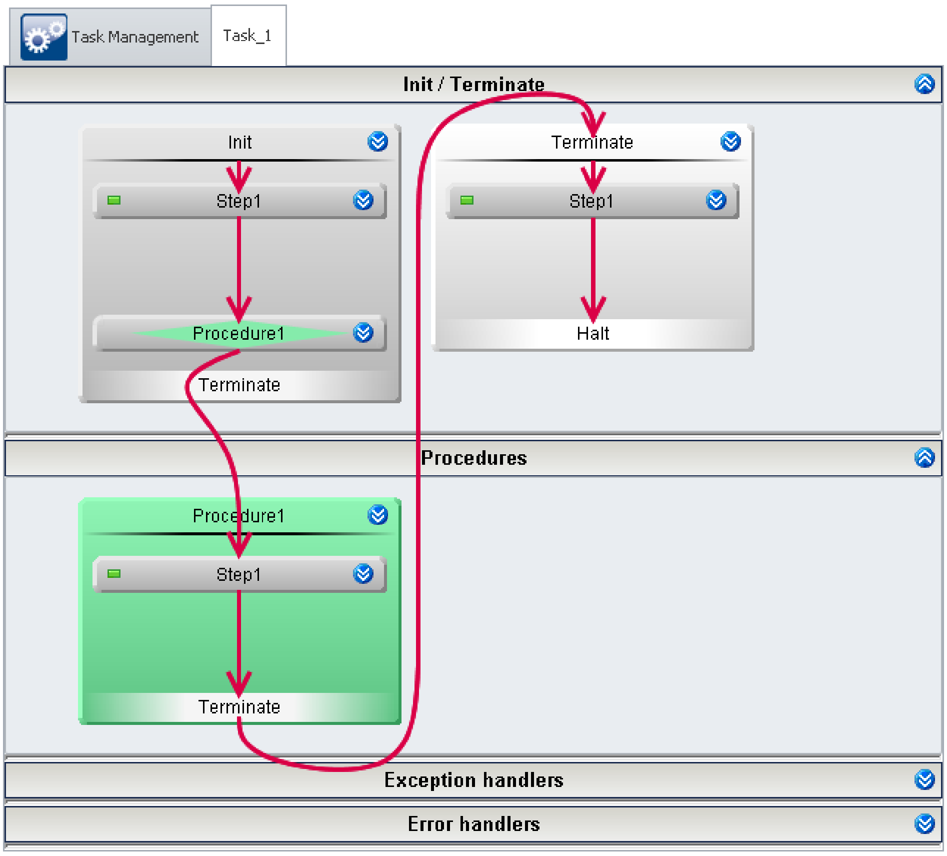
Task Editor

The "*Task Editor*" normally consists of four sectors:

Fields	Description
Init / Terminate 1440	Here, the beginning and end of the Task are defined.
Procedures 1441	Here is where the actual flow is created.
Exception handlers 1442	Here, possible exceptions are defined in order to be able to remedy them.
Error handlers 1442	Here, processes are created which enable controlled closure of the test in case of major errors.
Unconfirmed template variables	This sector only appears when you import a task from the repository. See: "*Repository* 1422".

Blocks

Each of these fields contains individual blocks. A task consists of at least three blocks: an Init 1440, a Procedure 1441 and a Terminate 1440. A block **comprises multiple steps**, which in turn are collections of multiple other elements.



Minimaler Task without function

You can add **any amount of blocks** consisting of procedures 1441, exception handlers 1442 and error handlers 1442.

Execution

- **After** the task **starts**, "***initialization***" is called. You specify the subsequent process.
- By default, the initialization contains a Next-branching. There, the task jumps to the first Procedure.
- **At the end** of the task, the **block "*Terminate*"** is run (as long as no error has occurred). This **concludes the task with "*Halt*"**.

If the measurement concludes with the stop button ( ), then the block ***Terminate*** is called automatically, as long as no handling is running.

The Terminate-branch is not an obligatory branch. You can insert a branch beforehand to any desired procedure (not in Terminate or Error Handling).

Priorities of the blocks - Branching across block types

The routine is always running within one of the blocks. The priority is given as follows:

1) Error handlers
2) Terminate
3) Exception handlers
4) Procedure/Init

The following branching situations are possible:

If the program run is at the stage of "*Error handling*" (1), then once this stage is concluded, the routine stops. The "*Termination*" (2) is no longer performed.

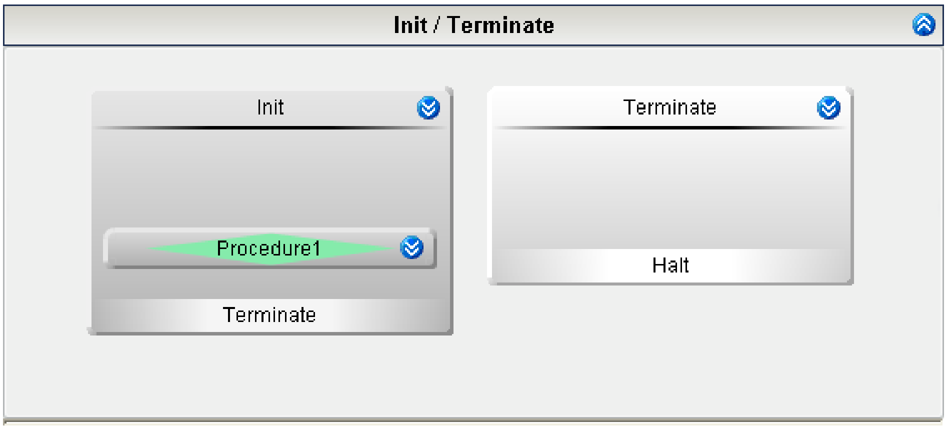
If the program run is at the stage of "*Termination*" (2), then upon conclusion of the Termination, the program is finished. It is possible to branch off to an "*Error handler*" (1), but not to an "*Exception handler*" (3).

If the program run is at the stage of an "*Exception handling*" (3) process, it is possible for it to skip back to any "*Procedure*" (4).

12.4.2.1 Init / Terminate

The field **contains the beginning** ("*Init*") and **the end of the Automation** ("*Terminate*"), if no error occurs.

There is only one Init block and one Terminate block. The names can not be edited.



Initialization and termination

Init

With the help of the Init, **the measurement system is placed in a defined initial state**. For this purpose, you are provided with

- "*Steps*" and
- "*Next-branchings*".

End of the Init

At the end of the Init, there are two possibilities:

- Next-branching: The task skips to the procedure defined in the branch.
- No branching: the Terminate block is started.

By default, the Init contains a Next-branch. From here the Task, skips to the first procedure.

Reference	Branchings

For more information on the branchings, see the chapter "*Branching (Task Editor)*" 1449".

Terminate

"*Terminate*" brings the measurement system to a **defined conclusive state**. For this purpose, you are provided with

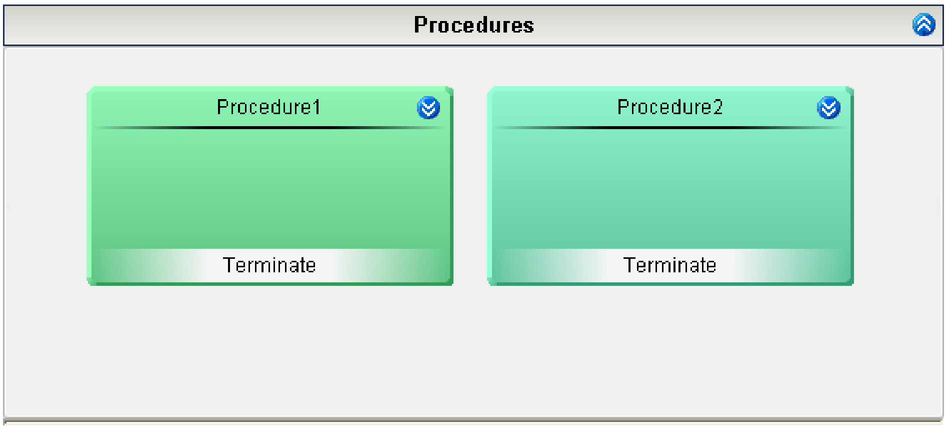
- "*Steps*".

Halt

At the end of Terminate, the **task is concluded with "*Halt*"**. Skipping back to a procedure is not possible.

12.4.2.2 Procedures

The field Procedures **contains the actual algorithm**.



Procedures

The procedures are used to create the outlines of the algorithm. For this purpose you are provided with

- "*Steps*" and
- "*Next-branchings*".

End of a procedure

At the end of a procedure there are two possibilities:

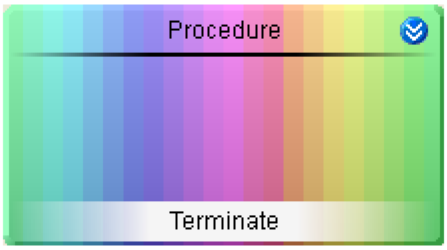
- Next-branch: the Task skips to the procedure specified in the branch.
- No branch: the Terminate block is started.

Reference	Branchings

For more information on the branchings, see the chapter "*Branching (Task Editor)*" 1449.

Colors

Each procedure is distinguished by its name and a color. When a new procedure is created, it is assigned a new color. There are 22 pre-defined colors.



The 22 colors for the procedures

To change the colors later, proceed as follows:

- Open the procedure
- Open the context menu of the procedure
- Select the item "*Select procedure's color*"

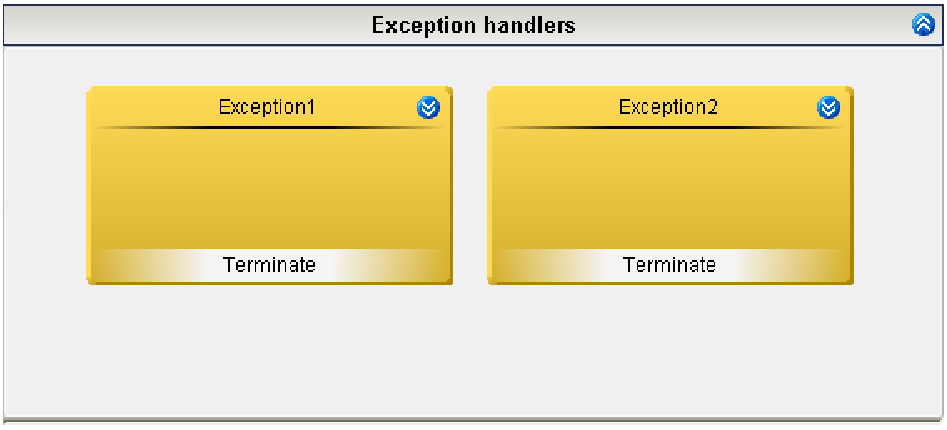
Subsequently, the color selection window appears. Select the desired color and click on the "*OK*"-button.

12.4.2.3 Exception handler and Error handler

Handlers are blocks for **treating any disturbances or errors**. If a disturbance occurs, the **current "*procedure*" is stopped** and **the handler is run**.

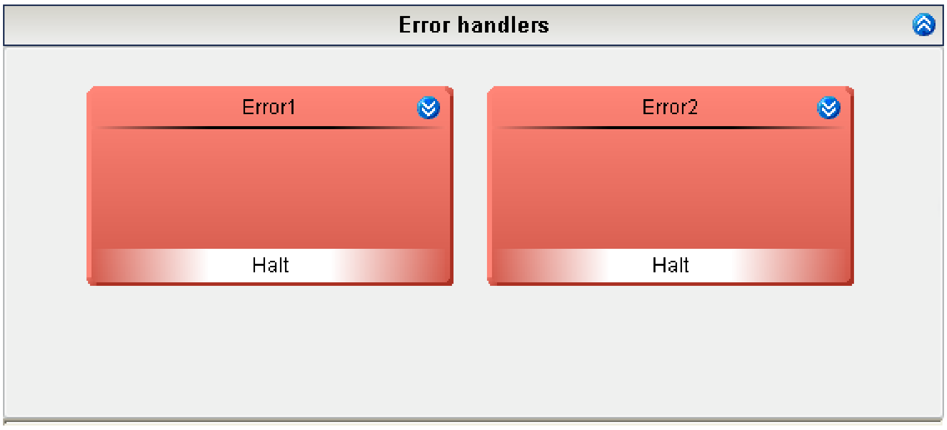
There are two types of handlers:

Exception handler



Exception handlers

Error handler



Error handlers

A **minor error** can be **remedied in a controlled manner using an exception handler**. In the case of **major errors**, you can **end** the running task **in a controlled manner** with an error handler. For this purpose, the following elements were available.

- "*Steps*" and
- for the Exception handler additional "*Resume-branchings*" and "*Go to-branchings*".

Starting a handler

It is possible to start a handler routine either from within a ***limit value monitoring*** process or from a ***state***.

Defined in the Limit value monitoring:

This **applies to the entire task**. **It is started if all conditions** of a limit value monitoring routine. The handling which is defined in the "*Exception/Error*" box of the Limit value monitoring is started.

Reference	Limit value monitoring
For more information on defining the limit monitoring, see the chapter "*Limit value monitoring* 1427".	

Defined in a State:

This **only applies to the state**. The handling routine is started if a disturbance occurs during the state. The **procedure** running **is interrupted** in such a case.

End of a handling routine

At the **end of an error handler**, the "*Halt*"-state is set and the task is concluded.

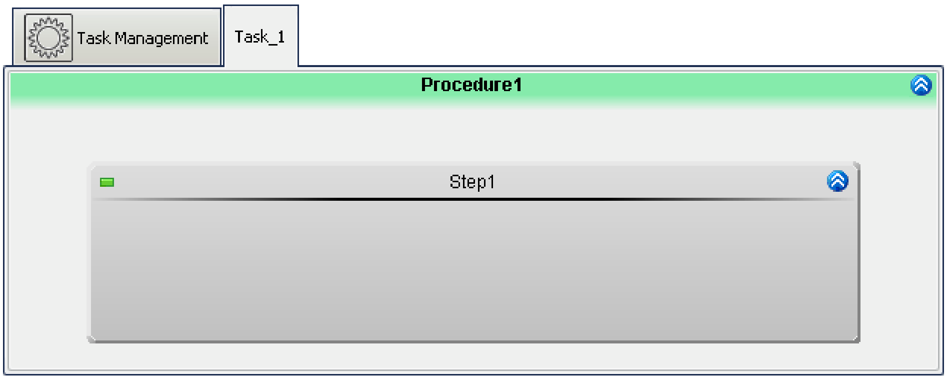
At the **end of an exception handler** routine there are multiple possibilities:

- Resume-branching: the Task resumes from the point at which the first exception handler was started. The state is then re-implemented completely (also the "State description").
- Go to-branching: the Task skips to the step specified in the branch.
- No branch: the Terminate block is started.

Reference	Branchings
For more information on the branchings, see the chapter "*Branching (Task Editor)* 1449".	

12.4.3 Block Editor

In the "*Block Editor*", **the detailed behavior** in the individual "*Steps* 1452" of a block are specified.



Block Editor with a procedure step created

In the Block Editor, all of the opened block's "*steps* 1452" are displayed. Here, steps can be created or existing steps can be edited. In a step any desired amount of the following elements can be combined in order to provide a better overview:

Elements	Description
States 1453	The element State puts the measurement system in a certain "state" or "condition. For this purpose, a variety of "functions" are available.
Loops 1457	Within a loop it is possible to perform various elements repeatedly.
If-branches 1460	The If-branch element enables other elements to be performed or skipped in dependence upon a condition.

Interaction between the devices and the PC can be set up by means of the following elements:

Elements	Description
General Event 1461	Some elements can be linked with a command sequence, which is executed upon the start or end of the element (called an event).
imc FAMOS Automation (data cutting) 1464	From within imc STUDIO it is possible to transfer variable currently being measured to imc FAMOS and to process them with a imc FAMOS sequence there. The results of the imc FAMOS sequence can be transferred back to imc STUDIO and displayed in a Panel page, for instance.
Page through Panel 1476	Steps can be linked with a Panel page, which is displayed with the step starts.

Execution

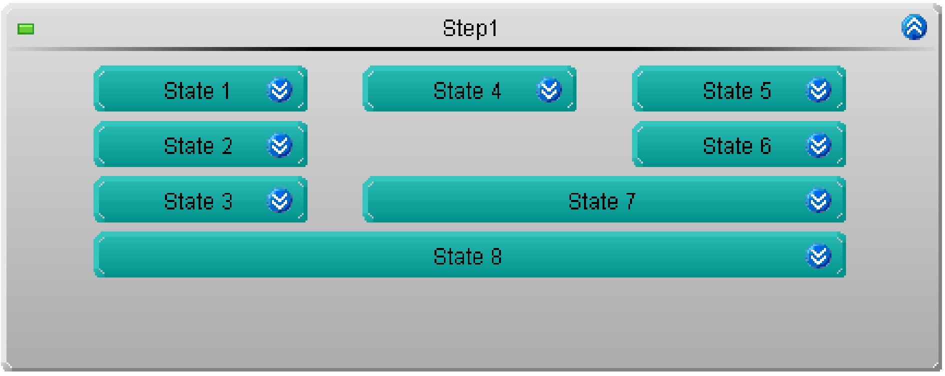
- When a block is executed, all active steps which it contains are executed from top to bottom in succession.
- When a step is executed, all its elements are executed from top to bottom in succession.

Reference

More information on execution of the block is presented in the chapter: "*How does it work?* 1412".
Or, in reference to the individual elements, in the chapter: "*Templates* 1446".

Example of a procedure

12.4.3.1 Track: Parallel elements



Tracks: Parallel arrangements of multiple states

Within one step, it is possible **to process multiple elements in parallel**.

- This results in so-called "*tracks*"

In order to create a track, an additional element must be set up to the right or left of an element.

Tracks can be composed of states, loops and If-branches.

Synchronization

Parallel tracks do not need to have the same processing duration.

In order to achieve synchronization between tracks, they are concluded with the same element.

Example featuring states:

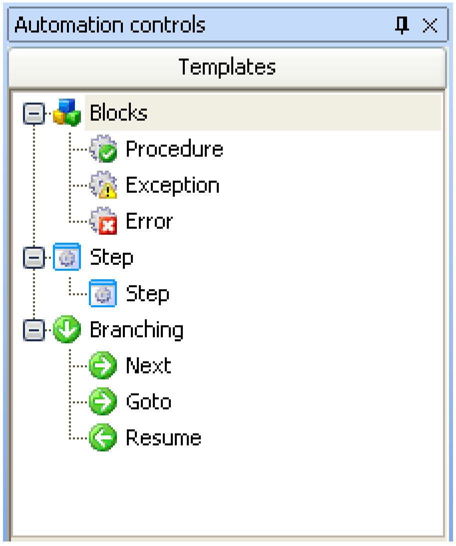
- "*State 7*" synchronizes Tracks 2 and 3
- "*State 7*" is only started, when "*State 4*" and "*State 6*" have finished.

This also works with loops and branchings.

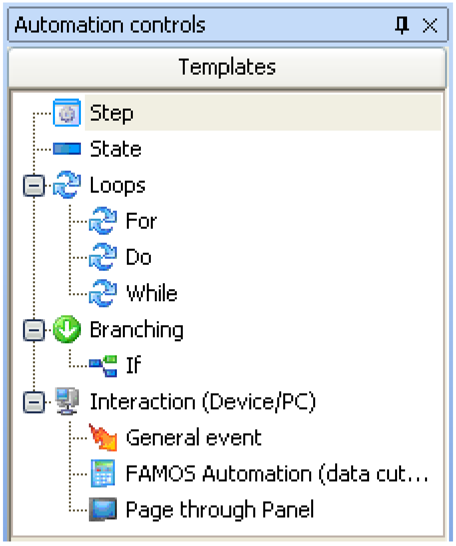
Reference	Stretching elements

Descriptions of how to operate the elements are provided in the chapter: "*Operation in the Task and Block Editor* 1418"

12.5 Templates - Elements for the Editors



Templates (Task Editor)



Templates (Block Editor)

This area presents the elements available for use in the current main window. The elements can be positioned where desired by means of the mouse and the Drag&Drop technique. Or, by using the context menu (see chapter "*Operation in the Task and Block Editor* 1416").

The templates adapt to the main window, i.e. in the "*Task Editor*" and "*Block Editor*" only such templates are visible which can be used.

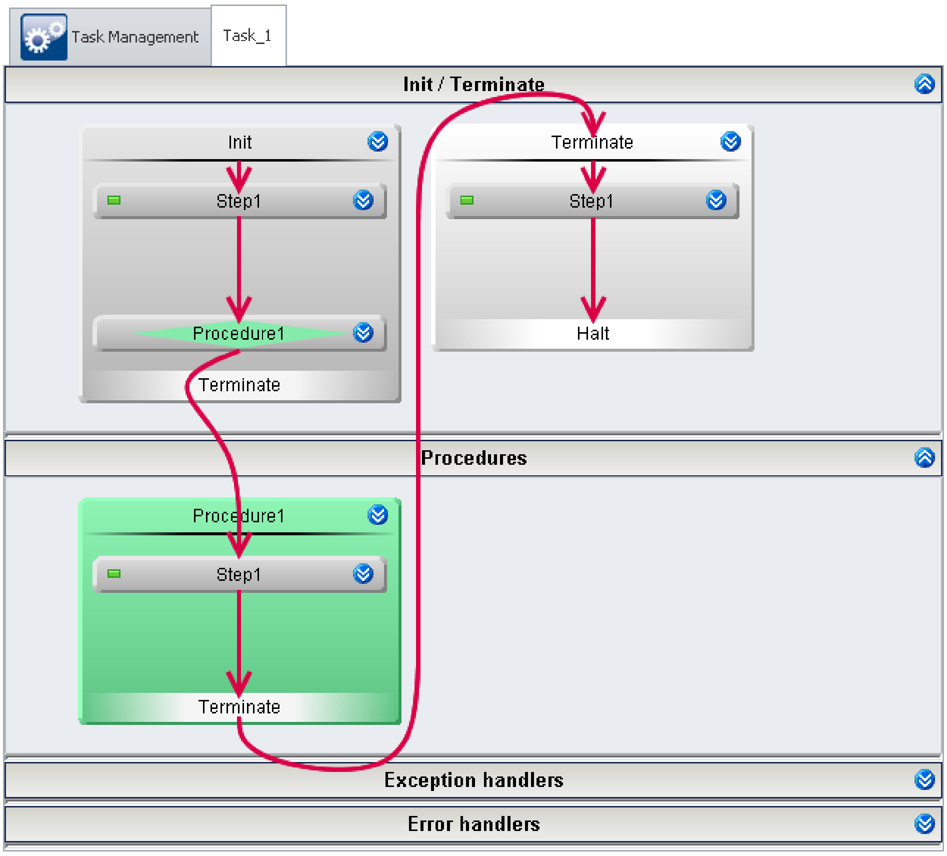
A variety of elements are available:

Task Editor templates	Description
Blocks 1448	A block combines multiple steps, which in turn are a combination of multiple other elements.
Steps 1452	A step comprises multiple states, loops and If-branches.
Branchings 1449	By means of a branching, it is possible to switch from a block to a procedure. This makes it possible to jump from one task to another.

Block Editor templates	Description
Steps 1452	A step comprises multiple states, loops and If-branches.
States 1453	The element State puts the measurement system in a certain "state" or "condition. For this purpose, a variety of "functions" are available.
Loops 1457	Within a loop it is possible to perform various elements repeatedly.
If-branches 1460	The If-branch element enables other elements to be performed or skipped in dependence upon a condition.
Interaction (Device/PC)	• Some elements can be linked with a command sequence, which is executed upon the start or end of the element (called an event). • From within imc STUDIO it is possible to transfer variable currently being measured to imc FAMOS and to process them with a imc FAMOS sequence there. The results of the imc FAMOS sequence can be transferred back to imc STUDIO and displayed in a Panel page, for instance. • Steps can be linked with a Panel page, which is displayed with the step starts.

12.5.1 Block

A task consists of at least three blocks: an Init 1440, a Procedure 1441 and a Terminate 1440. A block **combines multiple steps**, which in turn are a combination of multiple other elements.



Minimal task without functions

Five different blocks are available (see also the detailed material under "*Definition of terms* 1410"):

Block	Description
Init 1440	Here, the beginning of the Task is defined.
Terminate 1440	Here, the end of the Task ist defined.
Procedures 1441	Here is where the actual flow is created.
Exception handlers 1442	Here, possible exceptions are defined in order to be able to remedy them.
Error handlers 1442	Here, processes are created which enable controlled closure of the test in case of major errors.

You may add **any desired amount** of blocks of "*Procedures*", "*Exception handlers*" and "*Error handlers*".

Structure of a block

Each block has **a name** and a **fixed End-branch**.

In each **block**, it is possible to add a variety of elements:

- "*Steps*" and
- "*Branches*" (not in Terminate or error handling blocks).

Execution

When the block starts, it is executed from top to bottom.

The Terminate-branch is not an obligatory branch. You can insert a branch beforehand to any desired procedure (not in Terminate or Error Handling).

12.5.2 Branching (Task Editor)

Next-, Goto- and Resume- branches can only be created in the Task Editor. By means of a branching, it is possible **to switch from a block to a procedure**. This makes it possible to jump from one task to another.

Structure

In the **respective blocks**, **only certain branchings** are permitted.

Branches are set up on the bottom edge of the block. They form the conclusion of the block and they determine what procedure follows next.

There are three types of branches

Branch	Location of use	Description
Next	Init and procedures	The selected "*Procedure*" is next to start.
Resume	Exception handlers	The task is resumed at the "*State*" where the first exception handler was started. The state is then re-implemented completely (also the "*State description*").
Goto	Exception handlers	Next, the selected "*Step*" in the selected "*Procedure*" starts.

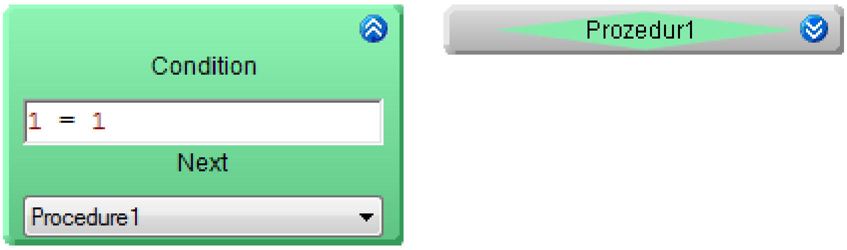
Conditions

Each of these branches **is linked to a condition**. This condition is an "If"-query. If it is **fulfilled**, the **branch is run**.

In the condition's box, any single-value variables and values can be used, **plus functions**. If the condition is intended to be met always, it is possible to use a "1" or "1 = 1".

Branching: Next

This branch is used in the Init and in procedures.



Next-branch open and closed

When the branch is called, there is a test of whether the condition is met.

- **If** it **is met**, the procedure selected is performed.
- **If** it **is not met**, the next item in this block is run. This can either be a further branch or the conclusion of the block.

The branch's **color** adapts to the target.

Branching: Resume

This branch is used in exception handlers.

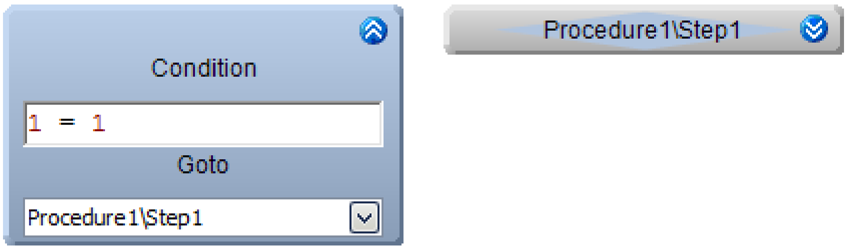
Resume-branch open and closed

When calling the branch, a test is made of whether the condition is met.

- **If** it **is met**, then the Task is resumed **from the point at which the first exception handler** was started. The **state is then re-implemented completely** (also the "*State description*").
- **If** it **is not met**, the block's next item is run. This can either be another branch or the block's termination.

Branching: Goto

This branch is used in **exception handlers**.



Goto-branch open and closed

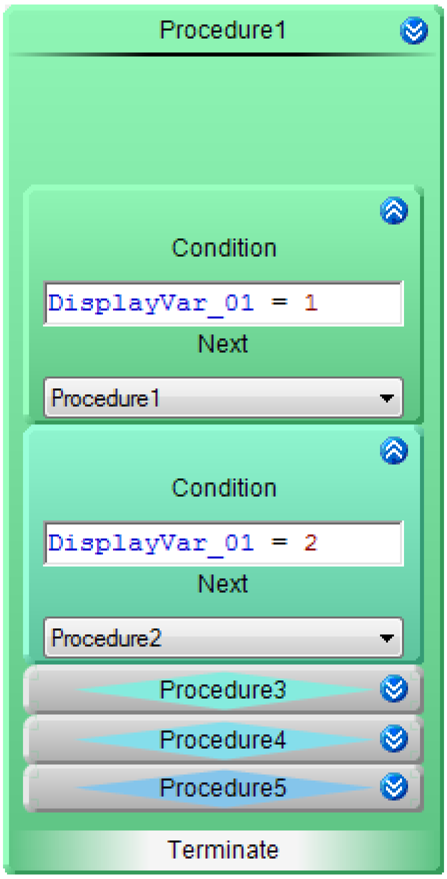
When calling the branch there is a test of whether the condition is met.

- **If** it **is met**, then the Task is resumed **at the selected step** in the selected procedure.
- **If** it **is not met**, then the next item in the block is run. This can either be another branch or the block's termination.

The branch's **color** adapts to the target.

Multiple branches

Multiple branches can be placed in succession. If the conditions of the first branch are met, then the next one is tested.



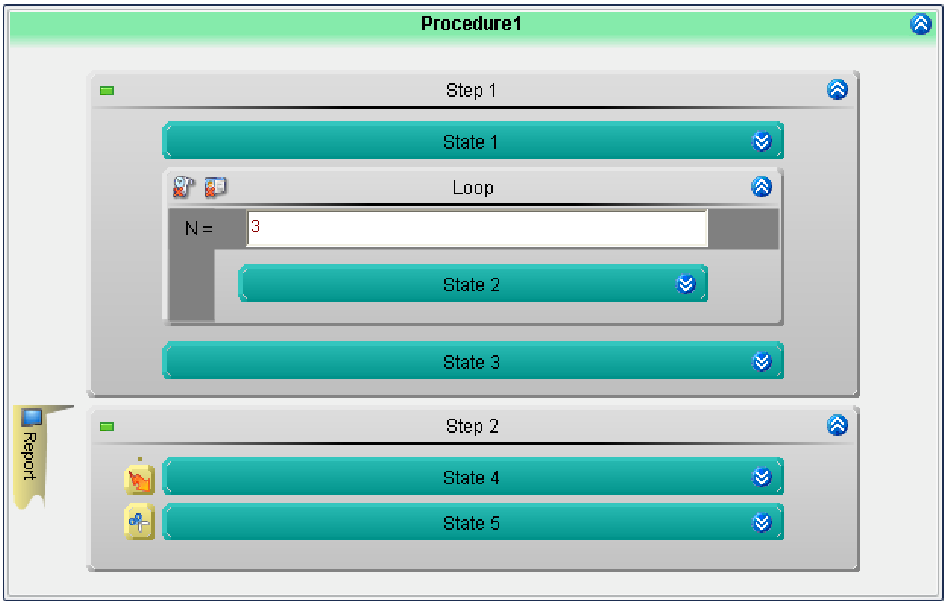
Multiple branches in succession

12.5.3 Steps

Empty step

Each block can contain a number of steps. Steps can be created in the Task Editor or in the Block Editor.

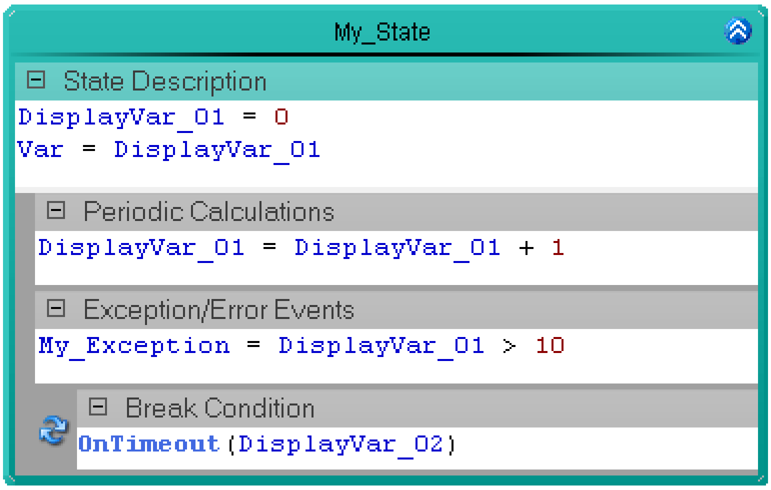
A step comprises multiple states, loops and If-branches.



Example: Two steps
A step can contain various elements

12.5.4 State

The element "*State*" puts the measurement system in a certain "state" or "condition. For this purpose, a variety of "*functions* 1477" are available.



State

Positioning

A state can be located within a step, loop or If-branch.

Structure

A state consists of multiple input boxes:

Input box	Description
State description	In executing the state, the measurement system is brought into a defined state. Here, it is possible to perform a calculation.
Cyclical calculations	Similar to state descriptions, a calculation can be performed here
Exception and error handling 1456	This input box serves the purpose of monitoring measurements. If a condition defined here occurs, the respective handling begins.
Break condition 1456	The "*cyclical calculations*" and "*exception and error handling*" are performed until the "*break condition*" is met or an error occurs.

Execution

Once the state is started, all commands are executed from top to bottom.

- **All commands in the state description** are executed
- **All commands of the cyclical calculation** are executed
- A **check is performed** of whether a **condition in the exception- or error handling** is true. If this is the case, execution of the state is interrupted and the handling starts.
- If there was no error, the system **checks** whether the **break condition** is true. If it is, the state is exited, and in it is false, the program **skips back to the cyclical calculation**.

Timing

One iteration of the state lasts one cycle.

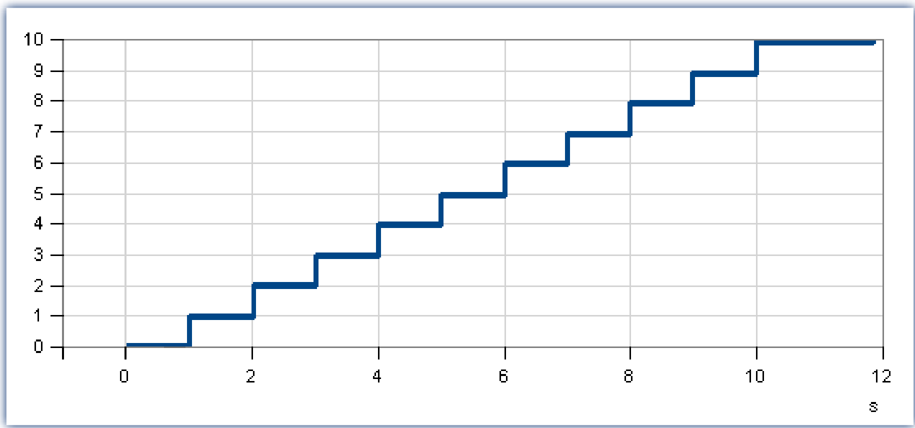
- If the **break condition is true**, then in consequence the **next state starts after exactly one cycle**.
- If the **break condition is not true**, the state is processed again (**Cyclical calculations** without the State description) within one cycle.

Example — A counter

- Cycle time: 1s
- State description: DisplayVar_01 = 0
  (setting the Display variable to 0 when starting the state is needed for initializing the counter. In the counter, the value is immediately afterwards increased in the cyclical calculations.)
- Cyclical calculations: DisplayVar_01 = DisplayVar_01 + 1
- Break condition: DisplayVar_01 = 10

Assuming that when the state starts, t = 0s

State	Description
t = 0s	The state is started: • State description: DisplayVar_01 is set to 0 • Cyclical calculation DisplayVar_01 is set from 0 to 1 • Break condition is not true (1 =! 10)
t = 1s	After exactly one second, the cyclical calculation is performed again • Cyclical calculation DisplayVar_01 is set from 1 to 2 • Break condition is not true (2 =! 10)
...	This continues until DisplayVar_01 = 10
t = 9s	• Cyclical calculation DisplayVar_01 is set from 9 to 10 • Break condition is true (10 = 10) • The state is concluded
t = 10s	The next state starts



Example: Counter
Plot of the variable: DisplayVar_01

Exception handling and error handling

This input box is for monitoring purposes. If the condition defined here occurs within this state, an (exception/error) handler is started 1442. The entry must follow this pattern:

<**Name** of the handler to be started > = <Condition>

e.g.

```
My_Exception = DisplayVar_01 > 10
```

or

```
My_Error = Virt_Bit01 = 1
```

Multiple monitoring mechanisms can be entered, e.g.:

```
Exception1 = Cycles_1 % 5 = 0 or Calibration_Act = 1
Exception2 = Cycles_1 % 100 = 0
```

The following branching types are possible:

States in "*Initialization*" and "*Procedures*" may branch to "*Exceptions*" and "*Errors*".

States in "*Exceptions*" and "*Termination*" may branch to "*Errors*".

States in "*Errors*" may not branch.

When the handler is concluded

If the handler concludes with a "*Resume-branching*", processing of the routine continues from the point at which the first exception handler had been started. The state is re-run again in its entirety (including the "*State description*").

Additional possibilities are presented in the chapter: "*Exception handler and Error handler* 1443"

Break condition

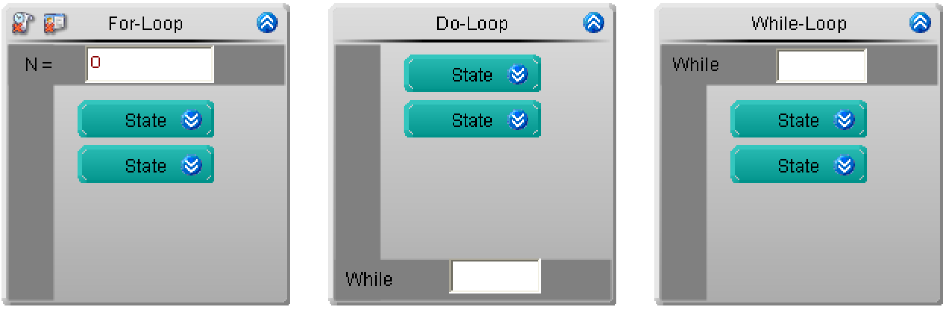
If any break condition is defined, processing of the routine remains in the same state until the condition is met or a handler is started. If the break condition is not true, then upon the next cycle, the "*Cyclical calculation*" is executed again, but not the "*State description*".

Examples are presented with the documentation for the functions:

- OnRampEnd 1481
- OnTimeout 1483
- OnStable 1487

12.5.5 Loops

Within a loop it is possible to perform various elements repeatedly. As the repetition's condition, there are a number of commands available.



Loops

There are three loop types in the Block Editor:

Loop types	Description
For-Loop	Counting loop (for additional properties, see chapter: "*For-loop* 1458") With the For-loop, the header specifies how often the loop is to be performed. The specified value exactly corresponds to the number of runs. Here, it is not necessary to set up a counter by hand.
Do-Loop	Post-test loop The Do-loop is run at least once. The test of the condition is performed only at the end of the loop. The loop is performed as long as the condition is true.
While-Loop	Pre-test loop The While-loop checks the specified condition before entering the loop. Then the loop is performed as long as the condition remains true. By specifying the condition 1=1, i is easy to create a permanent loop.

Positioning

A loop can be located within steps, loops, and If-branches. In loops, it is possible to insert all elements which could also be inserted into steps.

Timing

The **test** of the condition does **not use up any cycle time**. I.e., after the last state in the loop, either the loop's first state or the first state outside of the loop is started next.

Condition

A test box is available for the loops, in which a condition can be entered. This box can contain numbers, variables or other commands. E.g., for the For-loop it is possible either to enter a 10, or a variable can be used which represents a number. Note that the variable's values could change, for which reason the loop might end prematurely.

12.5.5.1 Properties of the For-loop

Loop counters as variables - Named/Unnamed loop counters

The element **For-loop** can write the current counter reading to a variable. Thus, it is possible for other elements to access the current counter.

To write the current counter reading to a variable, click on the button ( ).

Loop counter with name

The counter reading is written to a variable.
A variable with the name of the For-loop is created in the group: "*User-defined variable*" in the "*Resources* 1421".

No variable is created.

Note Unique association with the task

The variable created is only visible within the task.

Process vector variables

You can assign a prefix "pv" to the variable created. For instance, "pv.Loop".

- It is possible **to access** the variable **globally throughout the task**.
- It can be displayed on a Panel page.

Persistent/Non-persistent loop counter

If the element **For-loop** is run through multiple times in succession, the loop counter always starts counting from "1". In some cases, however, it is important for the loop counter to save the last value and to start counting from that value upon the next run.

To save the loop counter's last value, click on the button *Persistent* ( )

Persistent loop counter

The loop counter is persistent. Upon the next iteration of the loop, counting starts from the last value.

The counter always starts at "1".

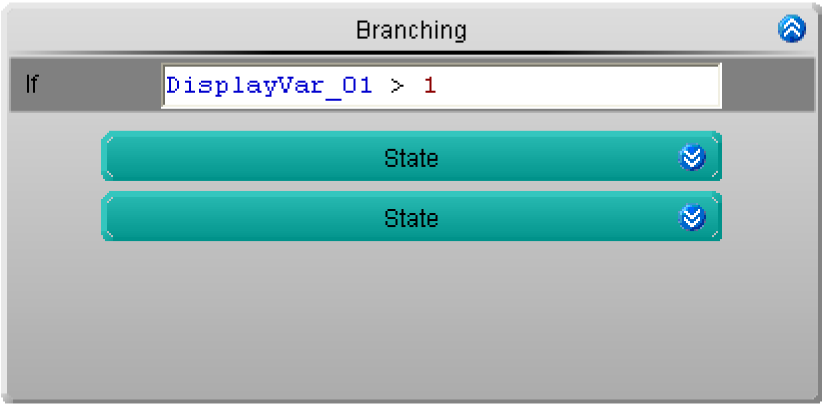
Note — If both properties are activated

If both properties are **active simultaneously**, the variable becomes a **process vector variable**.

- It is possible **to access** the variable **globally throughout the task**.
- It can be displayed on a Panel page.

12.5.6 Branching (Block Editor)

The If-branch element enables other elements to be performed or skipped in dependence upon a condition. A variety of commands are available for the condition.



If-branch

Positioning

An If-branch can be located within a step, loop, or other If-branch. It is possible to insert If-branches in any elements into which it is also possible to insert steps.

Execution

With a If-branch, a condition is specified in the header. Before the If-branch starts, the specified condition is checked.

- If the condition is true, the contents are carried out.
- If the condition is not true, the contents are skipped.

Timing

The **test** of the condition does **not use up any cycle time**. I.e., after the last state in the loop, either the loop's first state or the first state outside of the loop is started next.

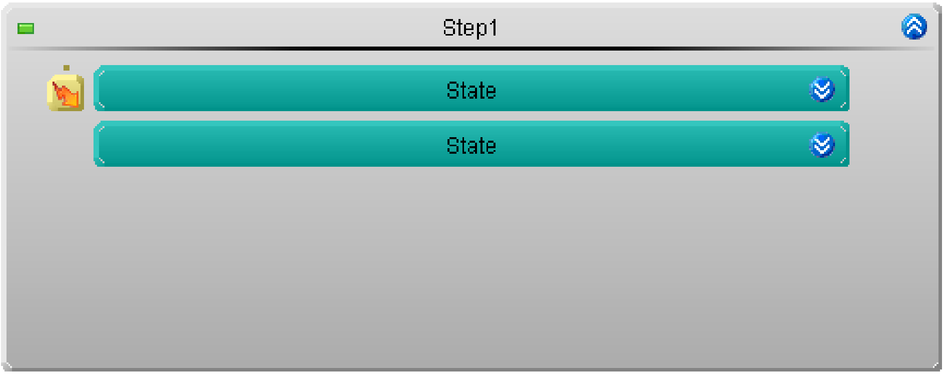
Condition

A test box is available for the loops, in which a condition can be entered. This box can contain numbers, variables or other commands. E.g., as the condition, one could specify Display_Var_01>1. Only if the value of Display_Var_01 is greater than 1, the content of the If-branch is executed.

12.5.7 Interaction (Device/PC)

12.5.7.1 General event

Some elements can be linked with a "*command sequence*", which is executed upon the start or end of the element (called an "*event*").



Example: Starts a command sequence after the state is concluded

Positioning

The element "*General event*" can be located to the **left beside states, loops and If-branches**. **Only one device/PC interaction** can be to the left of these elements.

Parallel General events are possible by means of separate "*tracks*" 1445".

Execution

When the specified event occurs (beginning or end), the command sequence is started.

Timing

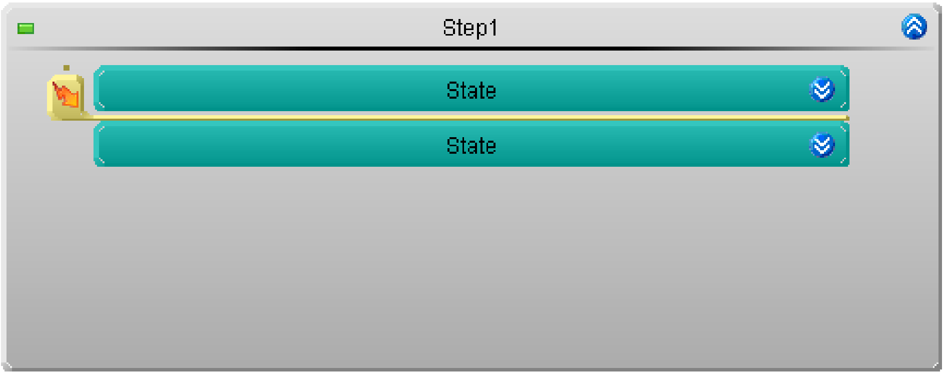
The element "*General event*" **does not use up any of the devices cycle time**. The command sequence runs on the PC. Thus, the command sequence starts and **the task proceeds without restrictions**, although the command sequence is still running.

Synchronization

However, in some cases it is necessary for the **command sequence to be concluded before the next state** can be performed. In order to prevent the next state from starting before the command sequence is concluded, there is one possibility:

- open the element's context menu and select "*Synchronize*"

Now the next state only starts once the command sequence is finished. This is indicated graphically by a **synchronization line below the element**.



Example: A synchronized command sequence starts once the state is finished

Note

The duration of the command sequence depends on the computer. In this case, it is not possible to say when the next state starts.

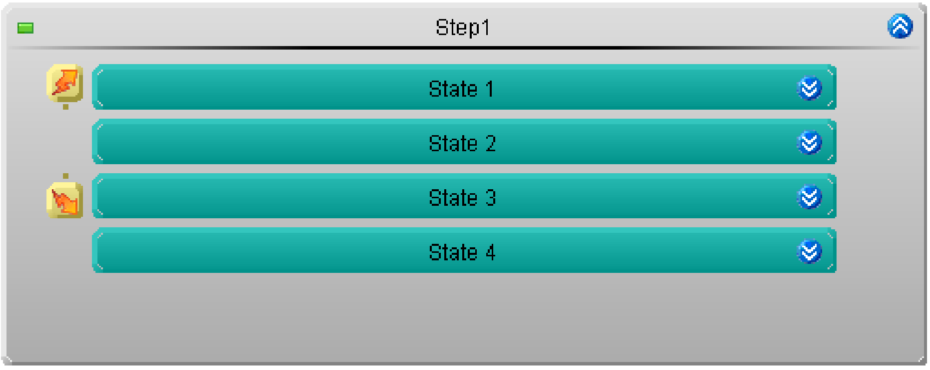
Execution at the beginning or at the end

The command sequence can start either when the element starts or when it is concluded.

To set when the command sequence is to start, open the context menu of the "*General event*" element and select the corresponding entry from the drop-down list:

General event	Description
Before	Execute at beginning
After	Execute at end

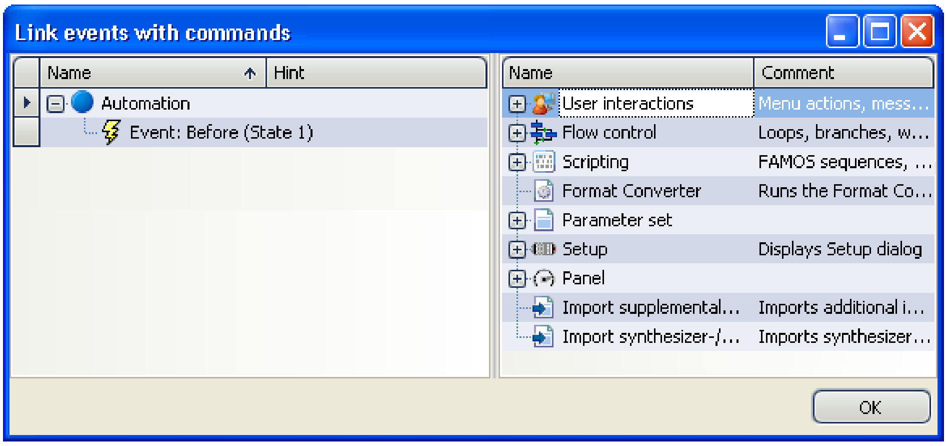
Example Execute



- When starting "*State 1*", a command sequence is started
- When starting "*State 3*", a command sequence is started

Opening the Event Dialog and making settings

To open the Event Dialog, double-click the left mouse button over the element.



Example: Event Dialog
Event "Before" of the element State 1

Reference Command Reference and Command Sequence

- The workings of the individual commands is described in the chapter "*Command Reference* 1545" beschrieben.
- A **sequence of commands** can be set up in a variety of imc STUDIO plug-ins and is described separately (see chapter "*Sequencer, Events and Commands* 1524").

12.5.7.2 imc FAMOS automation (data cutting)

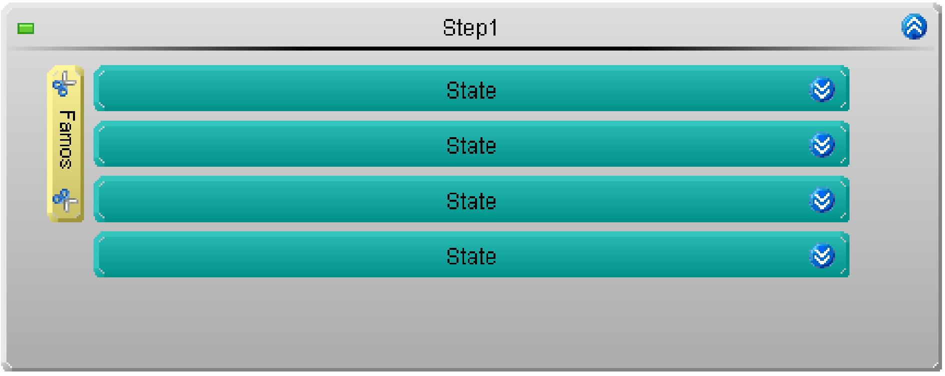
From within imc STUDIO it is possible to transfer variable currently being measured to imc FAMOS and to process them with a imc FAMOS sequence there. The results of the imc FAMOS sequence can be transferred back to imc STUDIO and displayed in a Panel page, for instance.

Note	Prerequisite

The prerequisite is installation of imc FAMOS on the same (see "*Technical data sheet*" > "*Additional imc Software Products*").

Reference	Functions

Information on imc FAMOS' scope of functions is presented in the separate imc FAMOS manual



Analysis with imc FAMOS

Positioning

The element imc FAMOS Automation can be located to the **left beside states, loops and If-branches**. **Only one device/PC interaction** can be to the left of these elements.

imc FAMOS Automation can perform analysis over the space of one element's time frame, or across multiple elements.

Parallel analyses by means of separate "*tracks* 1445" are possible.

Execution

"*imc FAMOS Automation*" starts the automation **after** the last element, with which "*imc FAMOS Automation*" is connected, has finished. Only then are all the data available.

What data are transferred?

In contrast to the other plug-ins, **not all data measured ate transferred to imc FAMOS**.

The **data measured which accrued within the connected elements** are transferred to imc FAMOS. The data are cut out: referred to below as "***Cutting***".

Example

imc FAMOS Automation is waiting for two states. Channel_001 is transferred to imc FAMOS.

- *State 1* lasts 5 seconds
- *State 2* lasts 2 seconds
- Once *State 2* has been concluded, **the last 7 seconds** before Channel_001 are cut and transferred to imc FAMOS for analysis.

Note Data types

Only single values and equidistantly sampled channels can be transferred; these include the "*Analog channels*", for example.

Timing

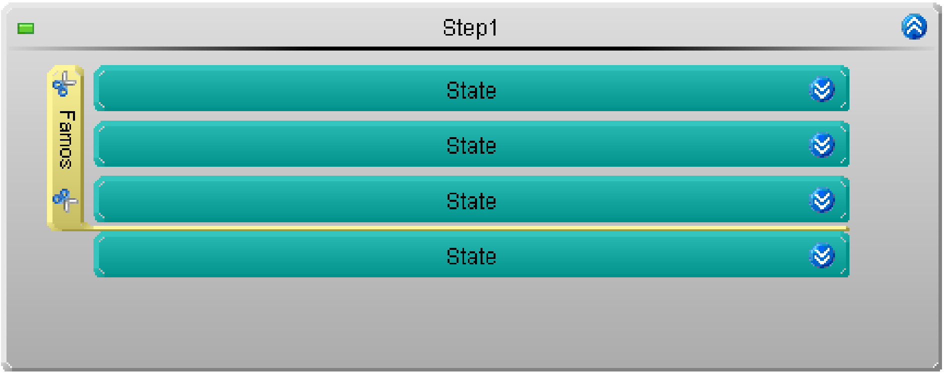
The element "*imc FAMOS Automation*" **does not take up any of the device's cycle times**. The analysis is performed by the PC. Thus, the analysis starts and **the next state is carried out immediately** although the analysis is still running.

Synchronization

However, in some cases it is necessary for the **results to be available before the next state** can be performed. In order to prevent the next state from starting before the imc FAMOS analysis has finished, there are two possibilities:

- open the element's context menu and select "*Synchronization*", or
- open the imc FAMOS dialog and select "*Synchronized event*"

Now the next state only starts once the imc FAMOS analysis is finished. This is indicated graphically by a **synchronization line below the element**.



Synchronized analysis with imc FAMOS

Note

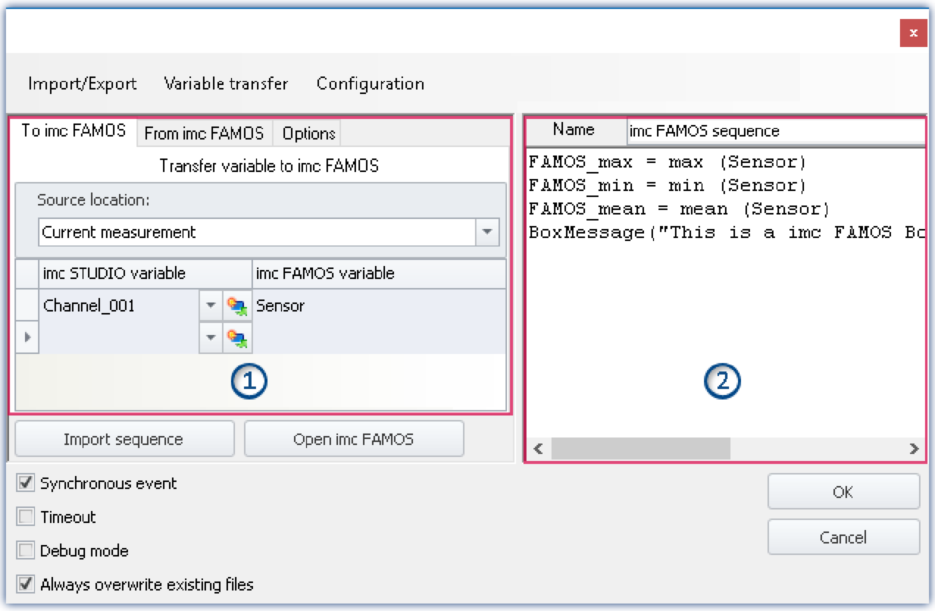
The duration of the analysis depends on the sequence and the computer. In this case, it is not possible to say when the next state will start.

Opening the imc FAMOS dialog and making settings

To open the imc FAMOS Dialog 1467, double-click the left mouse button over the element.

12.5.7.2.1 imc FAMOS Dialog

The dialog consists of multiple areas:



imc FAMOS Sequence Editor and transfer table of imc STUDIO variables to imc FAMOS

- Transfer table 1470 (1): **Transfer of the imc STUDIO-variables** is accomplished by means of this table.
- imc FAMOS Sequence Editor (2): Here, the **imc FAMOS sequence in use** is displayed and can be edited.

Procedure

- The **measured variables** set in the Transfer Table 1470 under "*To imc FAMOS*" **are transferred to imc FAMOS**.
- The **calculations** belonging to the sequence are **performed**.
- The **result variables** set in the Transfer Table 1470 under "*From imc FAMOS*" **are transferred to imc STUDIO**.

Editing the imc FAMOS sequence

In order to create a imc FAMOS sequence, there are a variety of techniques:

- By editing in the imc FAMOS **Sequence-Editor**.
- Using the **Start command for imc FAMOS** via the button "*Open imc FAMOS*". (Preferable when not knowing the imc FAMOS functions and their parameters)
- By **importing** an existing **sequence file** using the button "*Import Sequence*".

To edit or test a sequence in imc FAMOS, use the button "*Open imc FAMOS*".

Dialog interface

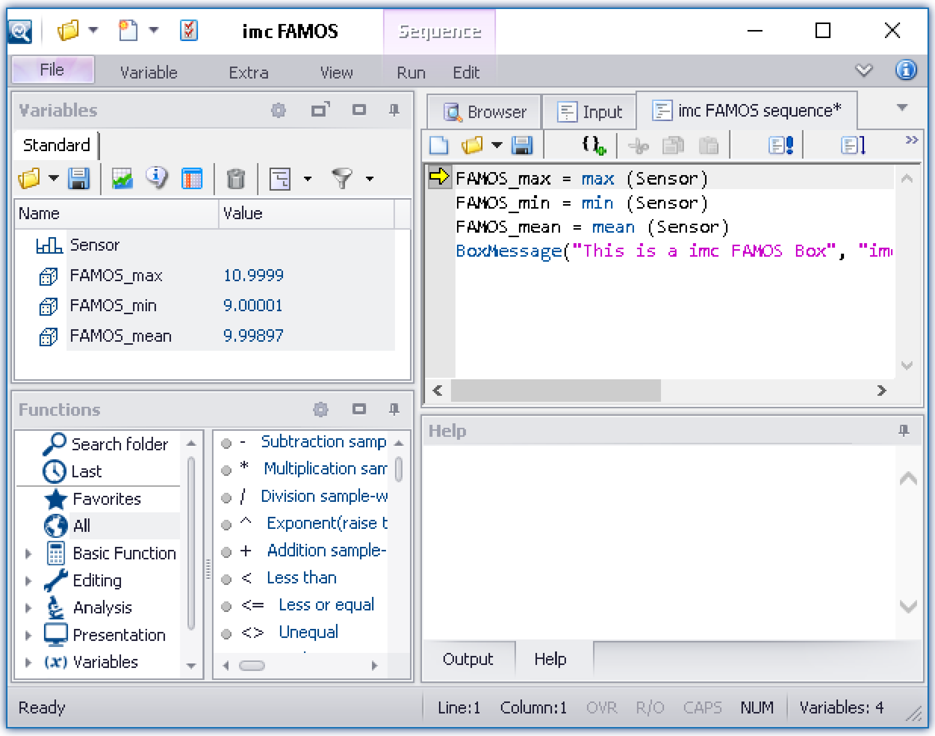
Checkbox	Description
Synchronous event	"*Synchronous event*" means that the **source waits until** imc FAMOS has concluded the sequence. This means: • Sequencer: The next command line is only started when imc FAMOS has concluded the sequence. • Automation: The next step only starts when imc FAMOS has concluded the sequence.
Timeout	The option "*Timeout*" (only available if the dialog is called from a command) only appears if "*Synchronous Event*" is activated. • At the latest, after a specified timeout time, the Sequencer runs the next line.
Debug Mode	If the command is executed while the option "*Debug Mode*" is activated, then imc FAMOS is opened. In this case, the sequence is not run automatically. In Debug Mode, you can **run the sequence step-by-step**, and make changes which are saved in the command. If imc FAMOS is closed, the results are transferred to imc STUDIO, if they are available in the table "*From imc FAMOS*". The command is only concluded as of this moment in time. Please note that in Debug Mode, the command needs longer to execute: • With **the option: "*Synchronized event*" active**: The subsequent commands wait until the imc FAMOS-command has concluded. • With **the option: "*Synchronized event*" deactivated**: Required results may not exist in time since the command is still working. As well, the **option: "*Timeout*"** should not be activated, since it can cause premature closing of the command, although imc FAMOS has not yet been ended.
Always overwrite existing files	If this option is activated, files having the same name in the destination folder will be overwritten without a confirmation prompt. This option is useful for automated routines.

Open imc FAMOS

Alternatively, **imc FAMOS** can be started using the button "*Open imc FAMOS*". In this case, the imc FAMOS Editor is used for making entries. You have the entire scope of the Function Assistant's functionality, help texts, etc., at your disposal.

In imc FAMOS, you can run the sequence directly for testing purposes. To this end, the variables in the table: "*To imc FAMOS*" are automatically set up with the current values. They appear in imc FAMOS's Variables list. If the variables do not yet exist in imc STUDIO at that moment, an empty variable is used in substitute (see note 1470 below).

The results of the test evaluation are not transferred back to imc STUDIO.



imc FAMOS as editor

Save the sequence if you wish to use the changes in imc STUDIO.

Reference

An example of Sequencer working in conjunction with imc FAMOS is found in the Sequencer-Tutorial 1636.

Note

Variable not present

If a variable does not exist in imc STUDIO when it is to be transferred to imc FAMOS, an "empty" variable is created in imc FAMOS as a substitute.

- Data type: Normal data set
- X-Delta: 1
- Total size: 0

Using the imc FAMOS-paths

The default paths set in imc FAMOS also apply to the command.

E.g. "`SEQ MySequence`" is premised on "MySequence.seq" being located in the default sequence folder of the installed imc FAMOS program. Alternatively, it is possible to specify the absolute path, e.g. "`SEQ "D:\SEQ\MySequence.seq"`".

Transferring the files used when exporting to other computers

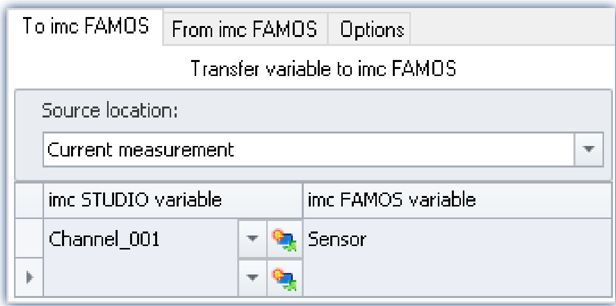
When exporting an experiment, the external files called in the sequence are not automatically included! Copy these files separately.

The exception is the files located in the experiment's subfolder "Meta". There, you are able to save your own files about the experiment, such as your own metadata, imc FAMOS-sequences, info-files, ... (for more information, see the chapter "*Experiments, Projects and the Database* 94").

12.5.7.2.2 Transfer Table

Transfer of the imc STUDIO variables or the imc FAMOS variables is accomplished by means of the transfer table. It is possible to rename the variables. In this way, existing sequences can be adopted directly.

Passing variables to the sequence ("To imc FAMOS")



The variables entered in the column: "*imc STUDIO variable*" are passed to the imc FAMOS sequence. There, they are assigned the name of the associated cell in the column: "*imc FAMOS variable*".

The variable does not need to be already registered in imc STUDIO. In this case, it is created as an "empty" variable in imc FAMOS (see note 1470).

In the example shown, the measured variable "*Channel_001*" is passed to the imc FAMOS sequence as the variable "*Sensor*".

You are able to transfer placeholders

Where is the measurement "x" saved? Which test object is used? Such information can be transferred directly to imc FAMOS by means of placeholders ( ). When the command is run, the placeholder is resolved and transferred.

Source: Selecting the source (measurement)

All variables defined are transferred from the source selected.

Source	Description
Current measurement	The current measured data are transferred. Note that in this case, only the amount of circular buffer memory set for the curve window display is available for use. This may be only a fraction of the entire measurement.
Last concluded measurement	If the measured data are saved, the last measurement saved is loaded automatically. The associated variables are passed to the imc FAMOS sequence.
Measurement number Measurement#<No>	The variables belonging to the measurement with the respective measurement number are passed.

Note — Variables from varying measurements

In some cases, variables from varying measurements need to be transferred to imc FAMOS. Independent of what "Source" is set, you can define in the Variables list whether a variable is to be transferred from a different measurement.

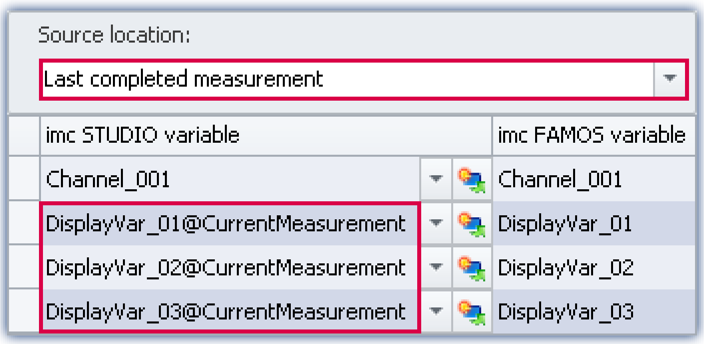
In this case, use the following syntax for the imc STUDIO variable:

Syntax	**Example**
@<MeasurementName>	<VariableName>@<MeasurementName> e.g. Channel_001@2010-11-15 15-44-03 (1)
@Measurement#<MeasurementNumber>	<VariableName>@Measurement#<MeasurementNumber> e.g. Channel_001@Measurement#1
@LastMeasurement	corresponds to: "*Last completed measurement*"
@CurrentMeasurement	corresponds to: "*Current Measurement*"

For measurement names, an **input support tool** is available: in the input box behind the channel name, click on the keyboard combination: <CTRL> + <SPACE>. You are then provided with a list of various input options. Select one and modify the results if appropriate.

Sample application: Variables from a saved measurement in combination with variables from "*Current Measurement*"

The analysis of measured data often requires the use of additional parameters which are saved with variables under "*Current Measurement*". With this imc FAMOS command, you are able to transfer variables both from a saved measurement and from "*Current Measurement*".

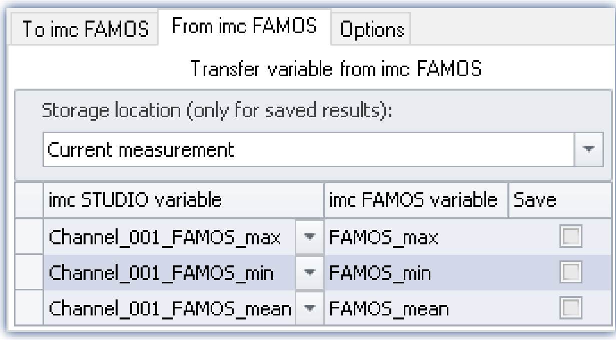


In this example, a particular measurement is selected. Additionally, variables from "*Current Measurement*" are also transferred. In this case, use the following syntax for the imc STUDIO variable:

<VariableName>@CurrentMeasurement

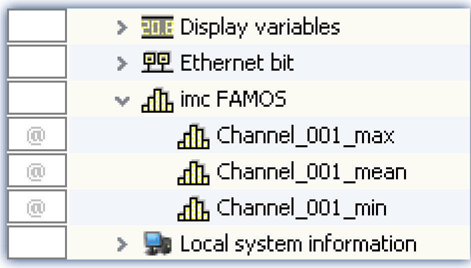
Example: *DisplayVar_01@CurrentMeasurement*

Receiving the sequence's results ("From imc FAMOS")



The variables calculated by imc FAMOS are transferred to imc STUDIO along with the transfer table.

The results appear in the Data Browser:



Storage location without saving: Selection of the target (measurement)

The result appears in the Data Browser, but is not saved.

<table>
<tr><th>Storage location</th><th>Description</th></tr>
<tr><td>Current measurement</td><td>If the target variable already exists (e.g.: a user-defined variable), the result is copied to the existing variable, provided that the variable's type is correct.
If the target variable does not yet exist, the result is created under the category "imc FAMOS" and is assigned the scope (Validity range): "Temporary". The variable's type is selected on the basis of the content.</td></tr>
<tr><td>Last concluded measurement</td><td rowspan="2">The result appears temporarily in the Data Browser along with the last/selected measurement. The result is not saved and is deleted as soon as the measurement is closed (un-loaded).</td></tr>
<tr><td>Measurement#<No></td></tr>
</table>

Storage location with saving: Selection of the target (measurement)

(Not possible with "*imc FAMOS automation (data cutting)*1464")

The result appears in the Data Browser and is stored as a.dat-file.

Speicherort	Beschreibung
Last concluded measurement Measurement#<No>	(recommended) If the option **Save** is selected, use **Last concluded measurement** or **Measurement#<No>**. The result is saved to the folder with the last concluded measurement respectively to the folder of measurement with selected number #<No.>. After loading the measurement, the result is always available. **Please note that at least one channel must be saved on PC. Otherwise the measurement folder does not exist.** If in Data Browser the selected measurement number is assigned to "Current measurement" , the system acts as if "*Current Measurement*" is selected.
Current measurement	(not recommended) If **Current measurement** is selected as target, no saved measurement is selected. A subfolder reflecting the current time stamp (e.g. "*imcFAMOSResult_2014-07-31 12-50-43*") is set up in the experiment folder for the results.

"Options"

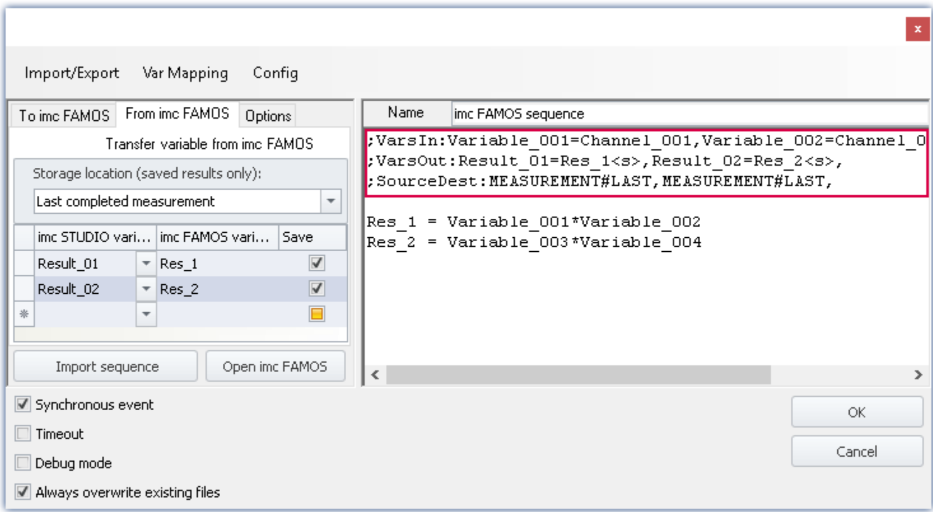
On this page, you can define fixed parameters which are used in the sequence.

Passing (assignment in the Transfer table) of variables can be incorporated in the sequence

Passing (assignment in the Transfer table) of variables can be incorporated in the sequence. Once the assignment is in a sequence, it can easily be passed (copied) to other imc FAMOS-commands.

The assignment is expected/entered as a "Header" in the first three lines of the sequence.

By means of the menu, the assignment can be passed from the transfer table into the sequence, or conversely from the sequence to the table.



Below, the header is set up (with sample names as per the picture):

Example

Variables: To imc FAMOS:

```
;VarsIn:Variable_001=Channel_001,Variable_002=Channel_002,Variable_003=Chan
nel_003,
```

Variables: From imc FAMOS:

```
;VarsOut:Result_01=Res_1<s>,Result_02=Res_2<s>,
```

Source and data storage location:

```
;SourceDest:MEASUREMENT#LAST,MEASUREMENT#LAST,
```

Variables

Description	Variables: To imc FAMOS:	Variables: From imc FAMOS:
Start	;VarsIn:	;VarsOut:
First variable name	Name in imc FAMOS	Name in imc STUDIO
Assignment character	=	=
Second variable name	Name in imc STUDIO	Name in imc FAMOS
Activation of data storage (optional)		<s>
Separator from next assignment	,	,

Source and data storage location:

Description	Syntax
Start	;SourceDest:
First name	Source of the page "To imc FAMOS"
Second name	Storage location of the page "From imc FAMOS"
Separator	,

Possible syntax:

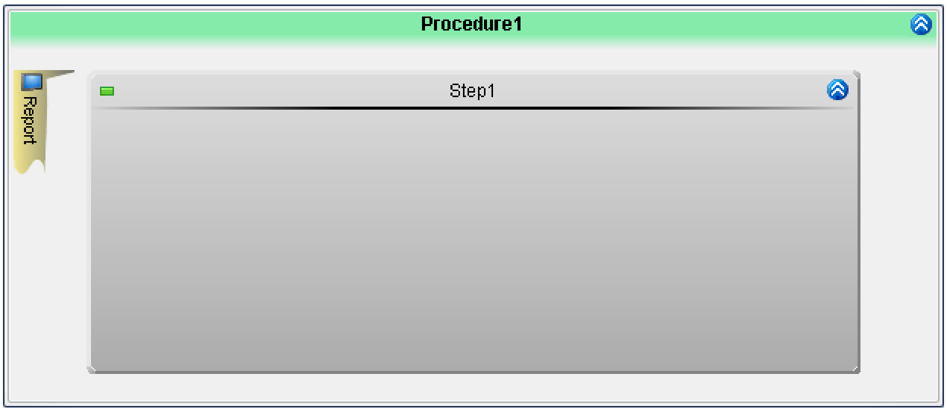
Source or data storage location	Syntax
Last concluded measurement	MEASUREMENT#LAST
Measurement number 3	Measurement#3
Current measurement	empty, so only ","
Fixed measurement name (as in the Data Browser)	2017-02-08 16-42-41 (1)

Example

Examples	Description
;SourceDest:MEASUREMENT#LAST,Measurement#1,	Source: Last concluded measurement Data storage location: Measurement number 1
;SourceDest:MEASUREMENT#LAST,2017-02-08 16-42-41 (1),	Source: Last concluded measurement Data storage location: Measurement with the name 2017-02-08 16-42-41 (1)
;SourceDest:,MEASUREMENT#LAST,	Source: Current measurement Data storage location: Last concluded measurement

12.5.7.3 Page through Panel

Steps can be linked with a Panel page, which is displayed with the step starts.



Example: The view switches to the Panel-page "Report" when the step starts

Positioning

The element "*Page through Panel*" can be positioned to the **left of a step**. **Only one device/PC interaction** can be to the left of these elements.

Execution

When starting the step, the view switches to the Panel page set.

Timing

The element "*Page through Panel*" **does not use up any of the device's cycle times**. The view switching is on the PC. Thus, the page is turned and **the task continues without any limitations**.

Selecting a Panel page

If the element is added, it is not linked with any Panel page. For linking the element with a Panel page, there are multiple possibilities:

- open the element's context menu and select an already existing page by selecting the item "*Page through Panel*", or
- open the element's context menu and select "*Create a new Panel page*". A "*standard dialog*" is created in the Panel.
- double-click on the element. A "*standard dialog*" is created in the Panel.

The element is now linked with the Panel page.

By means of the context menu, you can now

- select another Panel page, or
- open the selected Panel page

Reference	Panel

The description of the Panel pages is presented in the description of the plug-in "*Panel* 1058".

12.6 Functions

You can use functions in "*States*", "*Loops*" and "*If-branches*".

This includes functions which enable special applications to be performed in a Automation-task, as well as imc Online FAMOS functions which can be used in the control command "`OnSyncTask`".

Operation

Adding a function into the active element (e.g. to a state description):

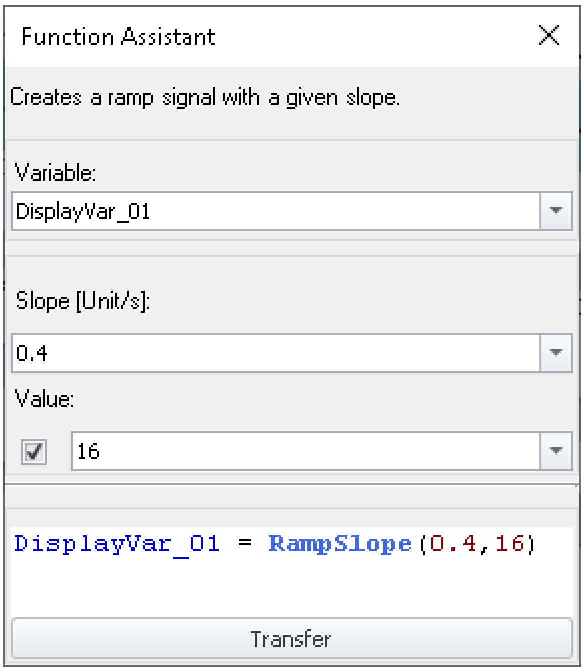
- Double-click on the function (the input box must be selected), or
- use Drag & Drop, or
- use the "*Functions Assistant*" (the input box must be selected), or
- enter the function (the keyboard combination <CTRL>+<SPACE> helps in making the entry).

Functions Assistant

The Functions Assistant helps you make entries.

- Select the target location in which to insert the function
- Select the function and click on "*Assistant*"
- In the Assistant, configure the function and subsequently transfer it by means of "*Transfer*"

The function is inserted at the location selected.



Functions Assistant
In the bottom line, the result is presented

Function description

The next chapters provide descriptions of the groups: "*Signals*", "*Timers*" and "*Tolerances*". The explanations of the other functions are provided in the Help-window below the Assistant, or in the functions reference of the imc Online FAMOS-functions.

Function group	Description
Signals	You can generate ramp signals which depend on the signal slope or the target time.
Timer	Use timers, for example, in order to prolong certain states.
Tolerances	You can test whether signals have adhered to limits or have achieved a stable level.

12.6.1 Signals

Note Notes on using ramps

A ramp function only needs to be launched once; the task itself does not need to remain in the associated state until the ramp is finished.

Instead the **ramp continues running until it reaches its final value** or it is stopped/interrupted. **The ramp function is not automatically stopped**, either by the end of the task or the **end of the measurement**. To be on the safe side, ensure that all ramps are finished at the latest in the Terminate-block, in case these functions affect any external elements.

Internally, the ramp is calculated in a "`OnSyncTask`" at a cycle time of 1 ms. The individual steps of the ramp are derived from the results. Please note that only five tasks can be created in the Automation. If there are already five tasks present, the cycle time of one of those tasks is applied as the ramp's cycle time. In order to preserve the precision level, the next shorter cycle time available is selected. But if the cycle times of all five tasks are longer, the next longer one available is applied, which results in larger ramp steps.

The slope or time periods can be calculated as follows:

RampTime

Slope = (Final value - Initial value) / Time
Example: Slope = (20 V - 10 V) / 100 s = 0.1 V/s

Slope per cycle step = (Final value - Initial value) * cycle time / Time
Example: Slope per cycle step = (20 V - 10 V) * 1 ms / 100 s = 0.0001 V

RampSlope

Slope per cycle step = Slope * Cycle time
Example: Slope per cycle step = 0.1 V/s * 1ms = 0.0001 V

Time = (Final value - Initial value) / Slope
Example: Time = (20 V - 10 V) / 0.1 V/s = 100s

RampSlope: Generating a ramp of defined slope

Variable = RampSlope (Slope, Final value)

Variable: Variable whose values are to be outputted in a ramp shape **Slope**: the ramp's slope [unit/s]	Optional parameter: **Final value**: Final value which is held

Generates a ramp from the variable's current value and having a defined "*Slope*". The ramp signal shape is imposed on the variable assigned.

If no final value is defined for the ramp, the value increases until the ramp is stopped ("`StopSignal`") or paused ("`PauseSignal`").

The function "`OnRampEnd`" is used to query whether the end of the ramp has been reached yet.

RampTime: Generating a ramp which reaches its end after a defined amount of time

Variable = RampTime (Final value, Time [s])

Variable: Variable whose values are to be outputted in a ramp shape	**Final value**: Final value of signal ramp **Time**: Time in seconds

Generates a ramp from the variable's current value up to the specified "*Final value*". The slope is calculated such that the final value is reached after elapse of the parameter "*Time*". Then the "*Final value*" is held.

The ramp signal shape is imposed on the variable assigned.

The function "`OnRampEnd`" is used to query whether the end of the ramp has been reached yet.

Note Ramp with high slope

Be aware that ramps generated by this function can have varying slopes.

If the initial and the final values lie far apart, the ramp's slope may become very high. If the signal is outputted by a DAC, please make sure that any mechanical equipment which moves in response is able to handle this slope rate.

OnRampEnd: Has the end of the ramp been reached?

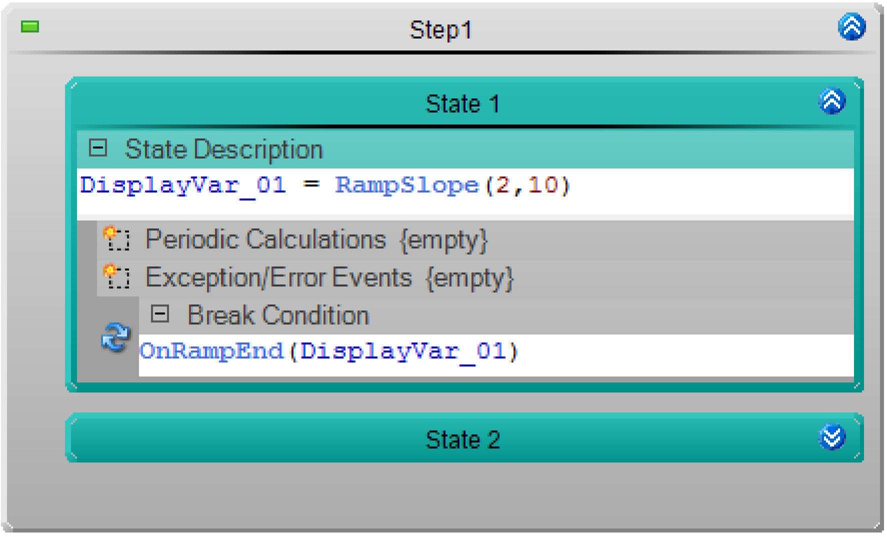
Result = OnRampEnd (Variable)

Result: 1, if the "*Final value*" is already reached, else 0	**Variable**: Variable assigned as the signal

The function tests whether a ramp has reached its "*Final value*". The ramp is previously started with either of the functions "`RampTime`" or "`RampSlope`".

Example | Holding a state until the ramp is concluded

The state is only ended once the ramp has concluded.



The ramp is started with "*State 1*": Slope 2; Final value 10. According to the break condition, the state is only ended when the function "`OnRampEnd`" returns a 1, which means when the ramp has concluded.

PauseSignal: Pausing the signal

Variable = PauseSignal (Value)

Variable: Variable assigned as the signal	Optional parameter: **Value**: Instead of the last value, this value is held

Interrupts the process of generating a ramp/signal in the variable. The last value is held, or optionally a substitute value can be outputted.

By means of the function "`ResumeSignal`", it is possible to resume generating the signal.

ResumeSignal: Resuming the signal

Variable = ResumeSignal ()

Variable: Variable assigned as the signal

Resumes the process of generating a ramp/signal in the variable, which had been interrupted by the function "`PauseSignal`".

StopSignal: Stopping the signal

Variable = StopSignal (Value)

Variable: Variable assigned as the signal	Optional parameter:
	Value: Instead of the last value, this value is held

Stops the process of generating a ramp/signal in the variable. The last value is held, or optionally a substitute value can be outputted.

12.6.2 Timer

InitTimout: Starting a local timer

InitTimout (Duration [s])

Duration: A local timer clocks the duration specified, in seconds.

The function "`OnTimeout`" is used to query the timer's state.

Example illustrating a "*State*":

In the state description, you start the timer with: `InitTimout (DisplayVar_01)`

In the break condition, you wait until the timer is finished by using: "`OnTimeout`"

Recommendation: To start the timer, use the function "`OnTimeout`".

OnTimeout: Starting and/or checking a local timer

Result = OnTimeout (Duration [s])

Result: 1, if clocked duration elapsed, else 0	Optional parameter: **Duration**: Local timer clocks the duration specified, in seconds.

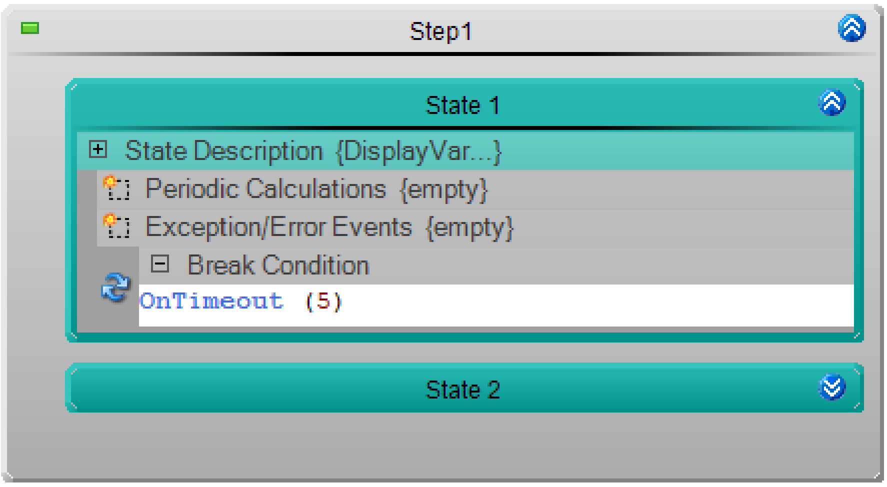
The function tests whether the local timer has already clocked the specified duration.

The timer had previously been started using the function "`InitTimeout`".

Recommendation: Optionally, a "*Duration*" can be defined. Thus the function itself starts a local timer. The function "`InitTimeout`" is not required.

Example — Retaining a state until a defined time has elapsed

The state is only ended after 5 seconds.



InitTimer: Starting a global timer

Result = InitTimer ("Name", Duration [s])

Result: 1, if clocked duration elapsed; else 0	**Duration**: Clocked duration in seconds

A global timer is started. It can be addressed by means of its "*Name*".

Once the timer's clocked duration is elapsed, it can be restarted by means of the function "`RestartTimer`".

OnTimer: Testing the global timer

Result = OnTimer ("Name")

Result: 1, if clocked duration elapsed; else 0	**Name**: Designation of the timer

The function tests whether the duration which the global timer "*Name*" clocks has already lapsed.

The timer is previously started by the function "`InitTimer`".

RestartTimer: Restarting the global timer

RestartTimer ("Name", Duration [s])

Name: Designation of the timer	Optional parameter: **Duration**: Global timer clocks the new duration specified, in seconds.

The global timer "*Name*" is re-started. Optionally, a new duration can also be specified.

The timer must previously have already been run at least once by means of the function "`InitTimer`".

StopTimer: Stopping the global timer

StopTimer ("Name")

Name: Designation of the timer

The global timer "*Name*" is stopped.

12.6.3 Tolerances

Note	Tolerances

Tolerances can only be checked if the functions are called at regular intervals; e.g in a break condition. A one-time call of the function returns a "0". The function must then be called at least a second time after elapse of the minimum dwell time. In order to be able to use the function effectively, it should be called very often within the dwell time.

Only the current value is evaluated. If the input variable violates the condition between the test steps, this is not captured. Optimally, the test would be repeated in accordance with the sampling rate of the input variable.

The maximum dwell time (*t2*) should not lie below the test's repetition interval.

OnAboveLevel: Is the boundary value exceeded?

Result = OnAboveLevel (Channel, Level, t1, t2, t3)

Result: 1, if the condition is met; else 0 **Channel**: Input-variable **Level**: Boundary value for the test	Optional parameters: **t1**: The minimum dwell time [s] above the boundary to meet the condition **t2**: The maximum dwell time [s] below the boundary which the test against the condition tolerates **t3**: Duration in [s] before the function begins testing against the condition

The function checks whether the current value of "*Channel*" exceeds the "*Level*".

OnBelowLevel: Has the boundary value been violated?

Result = OnBelowLevel (Channel, Level, t1, t2, t3)

Result: 1, if the condition is met; else 0 **Channel**: Input-variable **Level**: Boundary value for the test	Optional parameters: **t1**: The minimum dwell time [s] below the boundary to meet the condition **t2**: The maximum dwell time [s] above the boundary which the test against the condition tolerates **t3**: Duration in [s] before the function begins testing against the condition

The function checks whether the current value of "*Channel*" falls below the "*Level*".

OnInsideRange: Does the value lie within a range?

Result = OnInsideRange (Channel, Reference, Delta1, Delta2, t1, t2, t3)

Result: 1, if the condition is met; else 0 **Channel**: Input-variable **Reference**: Reference value within the boundaries **Delta1**: Defines the upper boundary: Positive distance from the reference value	Optional parameters: **Delta2**: defines the lower boundary: Negative distance from the reference value **t1**: minimum dwell time [s] within the boundaries to meet the condition **t2**: maximum dwell time [s] outside of the boundaries which the test against the condition tolerates **t3**: duration in [s] before the function begins testing against the condition

The function checks whether the current value of "*Channel*" lies within the boundaries.

The boundaries are defined as follows:

upper boundary = Reference + Delta1

lower boundary = Reference - Delta2

If "*Delta2*" is not defined, "*Reference*" is the lower boundary.

OnOutsideRange: Does the value lie outside of a range?

Result = OnOutsideRange (Channel, Reference, Delta1, Delta2, t1, t2, t3)

Result: 1, if the condition is met; else 0 **Channel**: Input-variable **Reference**: Reference value within the boundaries **Delta1**: Defines the upper boundary: Positive distance from the reference value	Optional parameters: **Delta2**: defines the lower boundary: Negative distance from the reference value **t1**: minimum dwell time [s] outside of the boundaries to meet the condition **t2**: maximum dwell time [s] within the boundaries which the test against the condition tolerates **t3**: duration in [s] before the function begins testing against the condition

The function checks whether the current value of "*Channel*" falls outside of the boundaries.

The boundaries are defined as follows:

upper boundary = Reference + Delta1

lower boundary = Reference - Delta2

If "*Delta2*" is not defined, "*Reference*" is the lower boundary.

OnStable: Has the value stabilized?

Result = OnStable (Channel, Delta, t1, t2, t3)

Result: 1, if the condition is met; else 0	Optional parameters:
Channel: Input-variable	**t2**: maximum dwell time [s] outside of the boundaries which the test against the condition tolerates
Delta: defines the upper and lower boundaries	
t1: The minimum dwell time [s] within the boundaries to meet the condition	**t3**: duration in [s] before the function begins testing against the condition

The function checks whether the current value of "*Channel*" lies within the boundaries.

The boundaries are defined as follows:

upper boundary = Channel + Delta

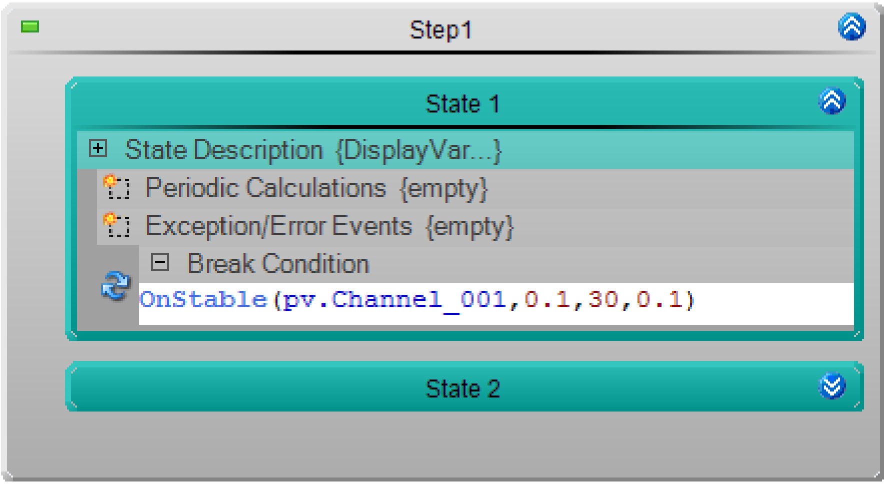
lower boundary = Channel - Delta

The boundaries are determined upon the first call of the function.

If a boundary value violation is detected, new boundaries are determined. If a time value is specified for "*t3*", the function waits again before performing the test.

Example — Holding a state until the input signal stabilizes

The state only ends once the input signal has stopped fluctuating for a relatively long time period.



When the function is run the first time, the boundaries are determined. The current value of the channel ± a Delta value of "0.1".

12.7 Information and Tips

12.7.1 Source Code - Find and Replace

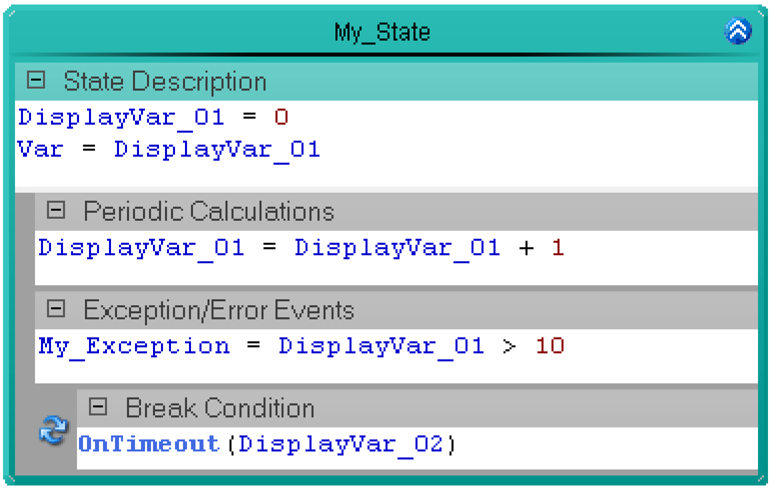
The Automation has a text search enabling texts to be found and replaced. The source code is searched within all of the elements: e.g. the description of a state or a loop's condition.

To find a text, open the dialog "*Find and Replace*".

Menu item	View
Edit > Find and Replace ()	Complete

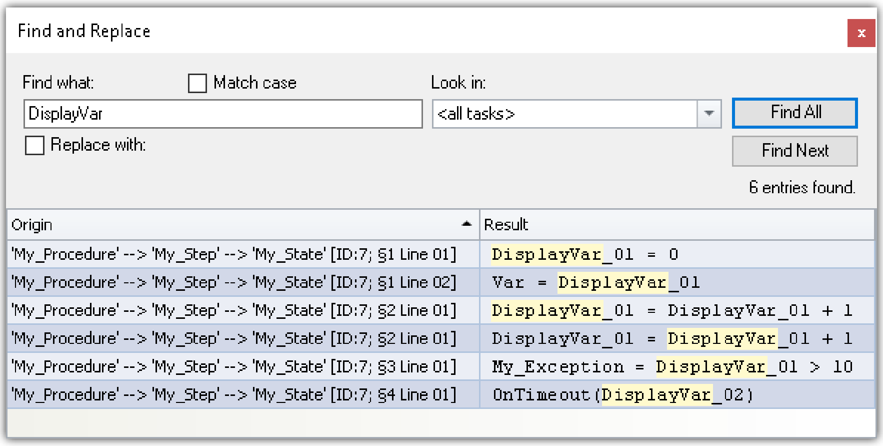
Example

The state "*My_State*" is located within "*My_Step*" and "*My_Procedure*".



State

The search is for the text: "*DisplayVar*". This text exists six times within the state.



Example of a text search

Note — Find/Replace variables in imc FAMOS sequences

imc FAMOS Sequences (data cutting): The **In/Out variables** can also be detected or replaced. The sequence and the imc FAMOS-variables are not taken into account.

Search

To find a text:

- enter a text to find in the box under "*Find what*".
- click the button "*Find all*".

Search option	Description
Match case	Takes the exact spelling in regard to capitalization into account in the search.
Task-limited search	Either all tasks or individual tasks can be searched. Select the appropriate entry in the selection list below "**Find in:**" <all tasks> — Search is performed in all tasks Name of task — Search is performed in selected task

Replacing text

The text search enables simultaneous replacement of the words.

To replace texts

- Click in the checkbox "*Replace with*"
- Enter a text in the box below "*Replace with*"
- Click on the button "*Find all*".
- Select any entry found and click on the button "*Replace*", or click on the button "*Replace all*".

Navigate - Find next

To navigate to the entries found, there are several possibilities:

- Double-click the mouse button over an entry
- Click on the button "*Find next*". In this case, the system navigates to the next entry.

The view switches to the position of the selected entry and the entry is selected.

Column: Origin

In the column Origin, the location where the entry was found is indicated.

Example: The text was found in the text box: Cyclical calculation of a state.

- 'Procedure-Name' --> 'Step-Name' --> 'State-Name' [ID: 11; §2 Line 07]

In this case, the first three names specify the element's position.

The content in brackets [] states the position within the element:

ID	Internal number of the element (depends on the setting)
$	Cell position: • 1: state description • 2: cyclical calculation • 3: exception- and error handling • 4: break condition
Line	line within the cell

12.7.2 Trace Info

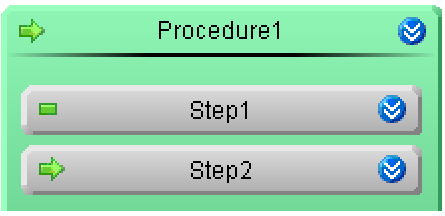
The trace info **displays during a task's execution** which "*procedure*" and which "*step*" is **currently being processed**. To activate/deactivate the trace info for the task, click on the corresponding checkbox in the Task Management's area Tasks. By default, this option is active.

While the task is running, an arrow symbol () appears at left next to the name at the current position.

There are always two arrow-symbols:

- one at the current procedure and
- one at the current step in the procedure.

If a **step** is not currently running, it has a bar symbol ( )



Arrow symbol for the Trace Info

Displaying the current status on the Panel page

You can extract a task's current state from a variable.

Variable: <Task-Name>.Trace

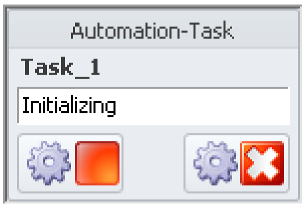
This returns a multi-line text indicating where the task is currently located.

Structure:

Task-name:
 Procedure-name
  Step-name
  State-name

12.7.3 Widget - Automation Task

Using the Widget "*Automation Task*" gives you the ability to intervene in a running program. To do this, link the Widget with the task (variable: "*<Task-Name>*").



The Widget represents the current state; e.g. "*Initializing*", "*Running*", "*Terminating*", "*Done*", ...

Additionally, you can use buttons to start, close or halt the task:

Action	Description
Start	Re-starts the task once it has finished.
Finish (Close)	Interrupts the current procedure/exception handling. The block Terminate is run unless an error handler is currently running.
Stop (Halt)	Ends execution of the task without executing any more actions. ⚠ No Terminate-phase is run. Any running error handlers are also interrupted.

12.7.4 Report of Automation-configuration

You can **create a report** of the **current Automation-configuration**. The report is opened in the Browser and can be **saved or printed** there. Start the report via the menu ribbon if Automation is open.

Menu item	View
Edit > Print ( )	Complete
Edit > Print Preview ( )	Complete
Home > Print ( )	Compact, Standard

There are three varieties available extending from a broadly outlined structure to the contents with the source text of all elements. Two examples are presented below.

Init / Terminate

Block	Init	
	Step	Step 1
	Next	Terminate

Block	Terminate	
	Next	Halt

Procedures

Block	Prozedure 1	
	Step	Step 2
	Step	Step 3
	Next	Terminate

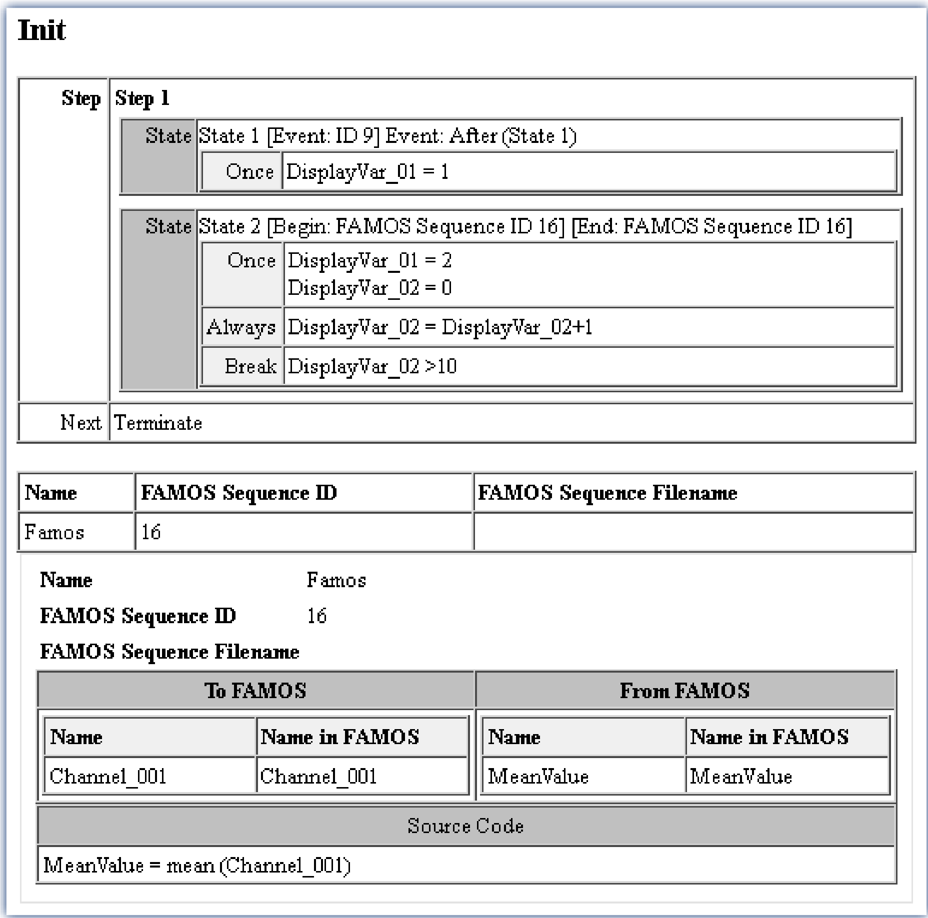
User-defined variables

Name	Type	Default Value	Persitent
Variable_1	Float	NaN	false
pv.Variable_2	Float	NaN	true

Limit value monitoring

Name	Processing Order	Channel	Exception	Event Type	Lower Limit	Upper Limit	Duration	Disable
Limit_1	1	pv.Channel_001	true	EXCESS_LIMIT		12	0	0

Example of a report
Overview of structure, without contents



Init

Step	Step 1		
	State	State 1 [Event: ID 9] Event: After (State 1)	
		Once	DisplayVar_01 = 1
	State	State 2 [Begin: FAMOS Sequence ID 16] [End: FAMOS Sequence ID 16]	
		Once	DisplayVar_01 = 2 DisplayVar_02 = 0
		Always	DisplayVar_02 = DisplayVar_02+1
		Break	DisplayVar_02 >10
Next	Terminate		

Name	FAMOS Sequence ID	FAMOS Sequence Filename
Famos	16	

Name Famos

FAMOS Sequence ID 16

FAMOS Sequence Filename

To FAMOS		From FAMOS	
Name	**Name in FAMOS**	**Name**	**Name in FAMOS**
Channel_001	Channel_001	MeanValue	MeanValue

Source Code
MeanValue = mean (Channel_001)

Example of a report (showing small excerpt)
A more exact listing of all elements and their contents

12.8 Tutorial

Below we present some examples of the plug-in **Automation**. The examples assume that the plug-ins **Setup** 164 and **Panel** 1058 are installed.

A prerequisite for operation of the plug-in **Automation** is an imc measurement device with imc Online FAMOS Professional installed.

12.8.1 Blinking LED using timer

Assignment:

Set up two LEDs on the Panel page and have them flash in alternation. The flash duration should be adjustable by means of a potentiometer.

Create for this purpose a **Task** and use an appropriate **timer function** from among the **automation controls functions**.

Learning goals:

- Creation of a **task**
- Use of **timer functions**
- Use of **status descriptions** and **break conditions**

Elements used:

- Init / Terminate
- Procedures
- Steps
- States (State description and Break conditions)
- Next branching
- While loops

Additional plug-ins used:

- Setup
- Panel

Procedure:

Start **imc STUDIO** as described in the chapter Start 31.

12.8.1.1 Setup - Settings

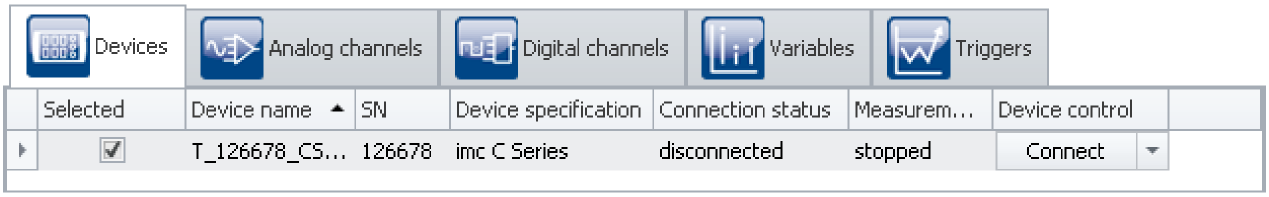
To begin, the measurement device is selected and configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Here you will find any devices which are known to the system due to having been used before. Following the first installation of imc STUDIO, the list is empty.

Select your device:

- If the device desired does not appear in the list, then perform a **device search** 222 () (Ribbon *Home* (or *Setup-Control*) > *Search for Devices*). Subsequently, the list will display all devices found.
- Click on the Checkbox-symbol () in order to **select** the device.



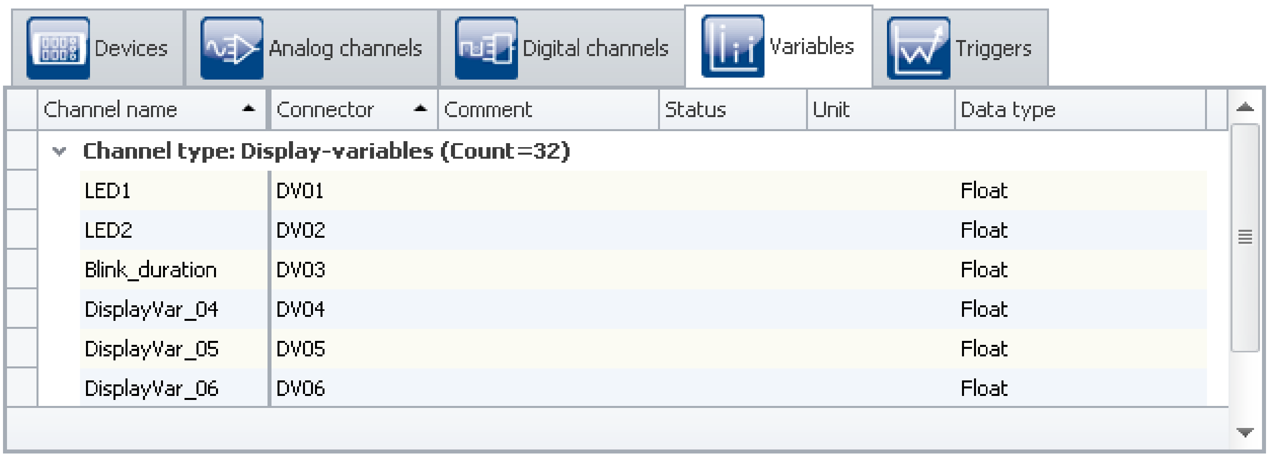
Selecting a device

The device is now known and selected, and is available each time **imc STUDIO** is started.

Configuring the variables

Now we assign appropriate names to the variables used.

- Go to the tab: **Variables** .
- Change the name of the **Display-Variables** 01, 02 and 03 to *LED1*, *LED2* and *Blink_duration.*



Assigning a name

Note

In order to prevent the **automation** from ending prematurely, make sure that the first channel's (***Channel_001***) **measurement duration** is set to *undefined* (=infinite).

- To apply the changes, click on the button **Process configuration** 222 () (Ribbon *Home* (or *Setup-Control*) > *Process*).

By this means, the device settings are available to other plug-ins.

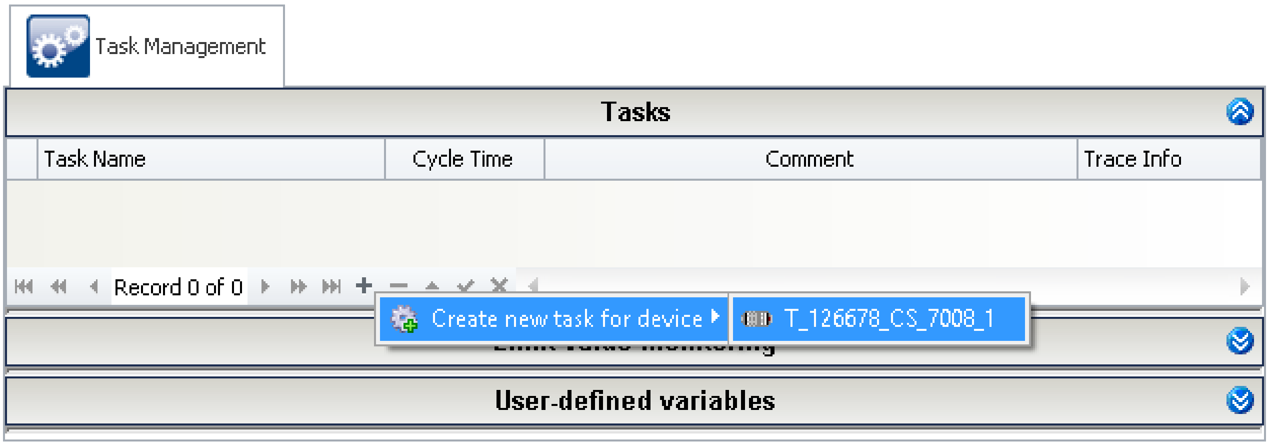
12.8.1.2 Automation - Settings

Now it is possible to set up the **Task**.

- Open the plug-in **Automation**.

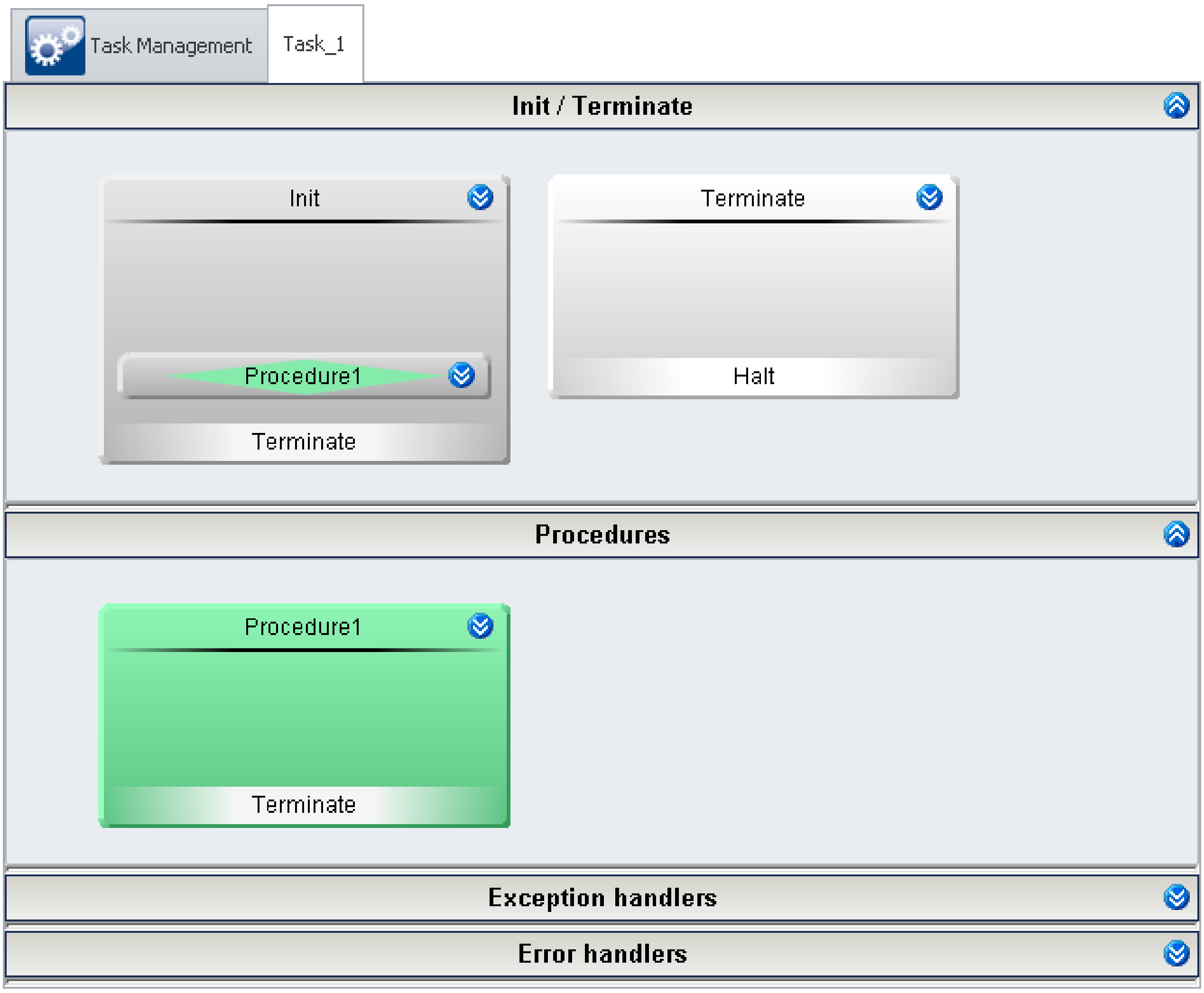
You are now in the **Task Management** interface. Proceed with creating a **Task**.

- Click on the plus-sign (+) and select the **Measurement device**.



Task Management: Creating a task for the measurement device

Along with the **Task Management**, a new tab for the **Task** created appears. This takes you to the **Task Editor**. Open it next.



The Task Editor for "Task_1"

Init

In **Init**, create the initial values for the *LEDs* and the *Blink duration*.

Create a **Step**:

- Drag from the **Templates** a **Step** in the **Initialization** or open the context menu of the **Initialization** and select *New, Step*.

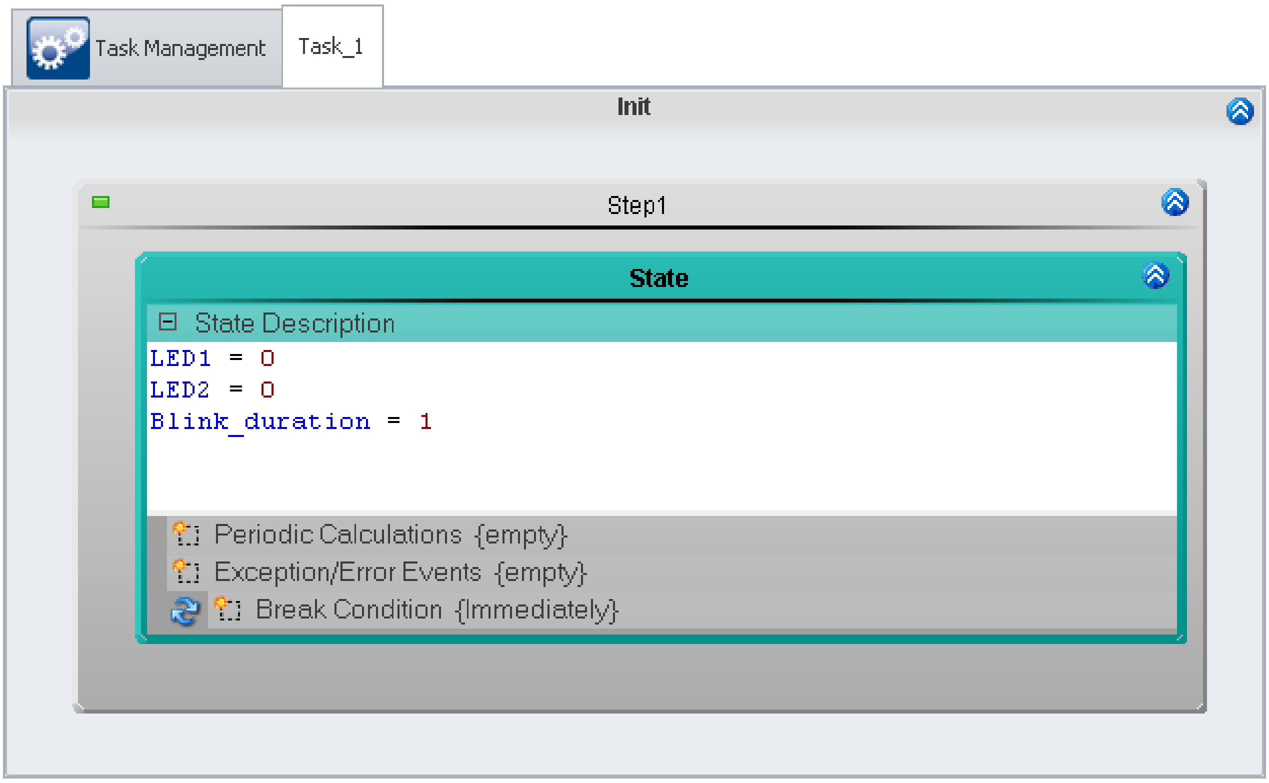
Open this **Step** by clicking on the double arrow (). You arrive at the **Block Editor**.

In the **Step**, add a **State**.

- Drag a **State** from the **Templates** to the **Step** or open the **Step's** context menu and select *New, State*.
- Open this **State** by clicking on the double-arrow ().

In the **State description** enter the initial values.

```
LED1 = 0
LED2 = 0
Blink_duration = 1
```



Setting the initial values

Close the **Block Editor** by clicking on the double-arrow ( ) in the Init dialog.

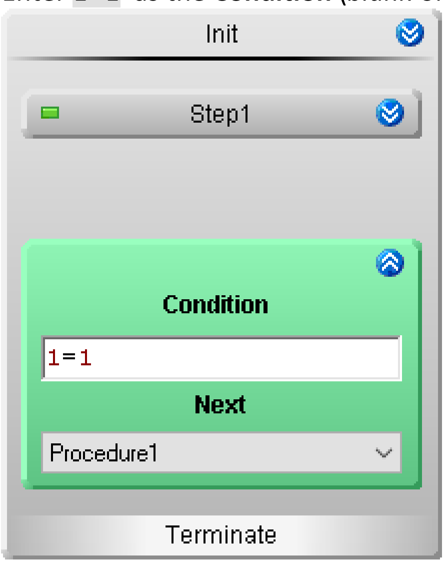
Once having concluded the **Init(ialization)**, next run *Procedure1*. In order to make this skip, a **Next-branch** is used, which is already provided.

Branching to Procedure1

Open the **Branch** by clicking on the double-arrow ( ).

In the **Branch's** upper input box, the **Condition** for skipping (e.g.: `1=1` is true, in which case the skip is always made) is stated. In the lower box, the target procedure is stated.

- Enter `1=1` as the **Condition** (*blank* or just `1` is are also interpreted as true).



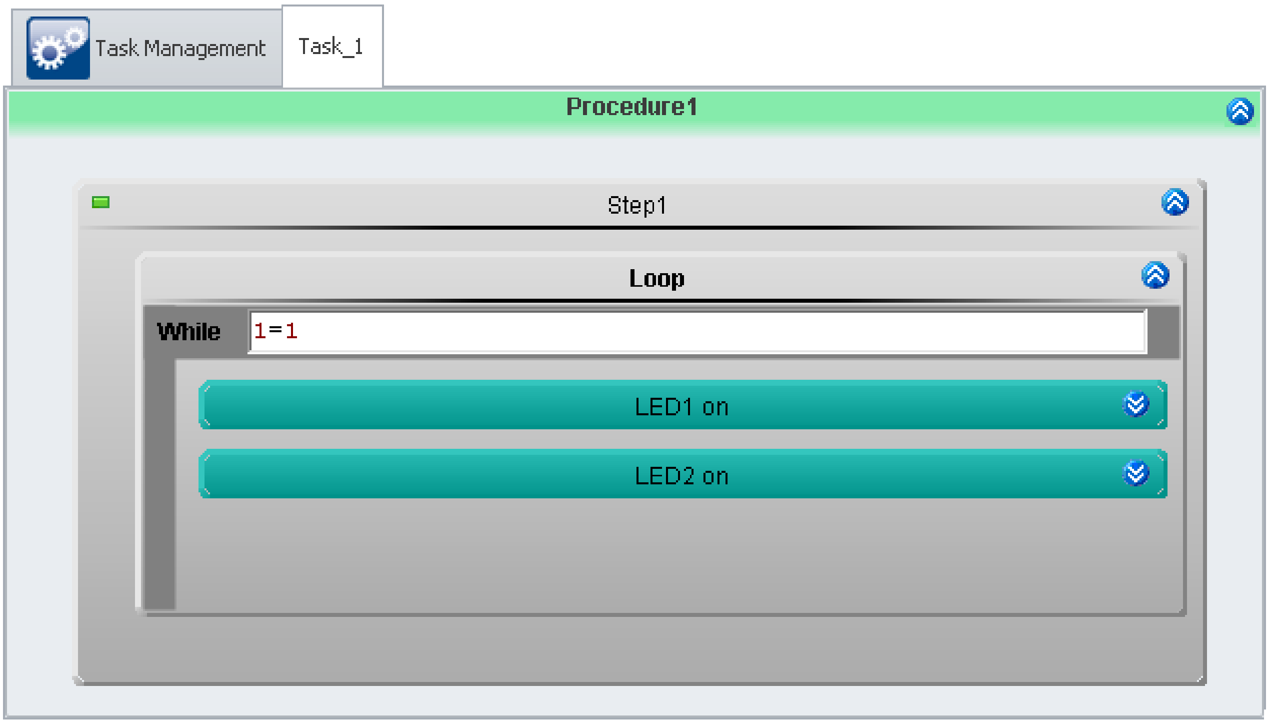
Skip from block "Init"
to the block "Procedure1"

Procedure

Open *Procedure1* by clicking on the double-arrow (). This takes you to the **Block Editor** of this **Procedure**.

Here is where the actual routine is programmed.

- Add a **Step**
- Open the **Step**
- Inside this step, add a **While-loop**
- Open the **loop**
- Set the loop's **condition** to `1=1` (this means the condition is always fulfilled and thus that the loop's instructions are always carried out).
- Add two **states** to the loop
- The first **state** is called *LED1 on* and the second is *LED2 on*. To do this, open the **state's** context menu and select *Rename*.



Sequence, while loop and two states

Open the **State** *LED1 on*. In this **State**, what should happen is:

- the *LED1* should go on and
- the *LED2* should go off.

The **State** should be exited once the *Blink duration* set has elapsed.

Enter in the box **State description** the following instructions:

```
LED1 = 1
LED2 = 0
```

The box **Break condition** contains the condition for when the **State** is to be exited. Here, enter the following condition:

```
OnTimeout(Blink_duration)
```

The function `OnTimeout` starts a local timer. The timer has as its parameter the **Running time**. If the time has elapsed, the function returns `1`, otherwise `0`. The **Condition** is thus true when the timer period elapses and the **State** is exited.

Open the **State** *LED2 on*. In this **State**, what should happen is:

- *LED1* should go off and
- *LED2* should go on.

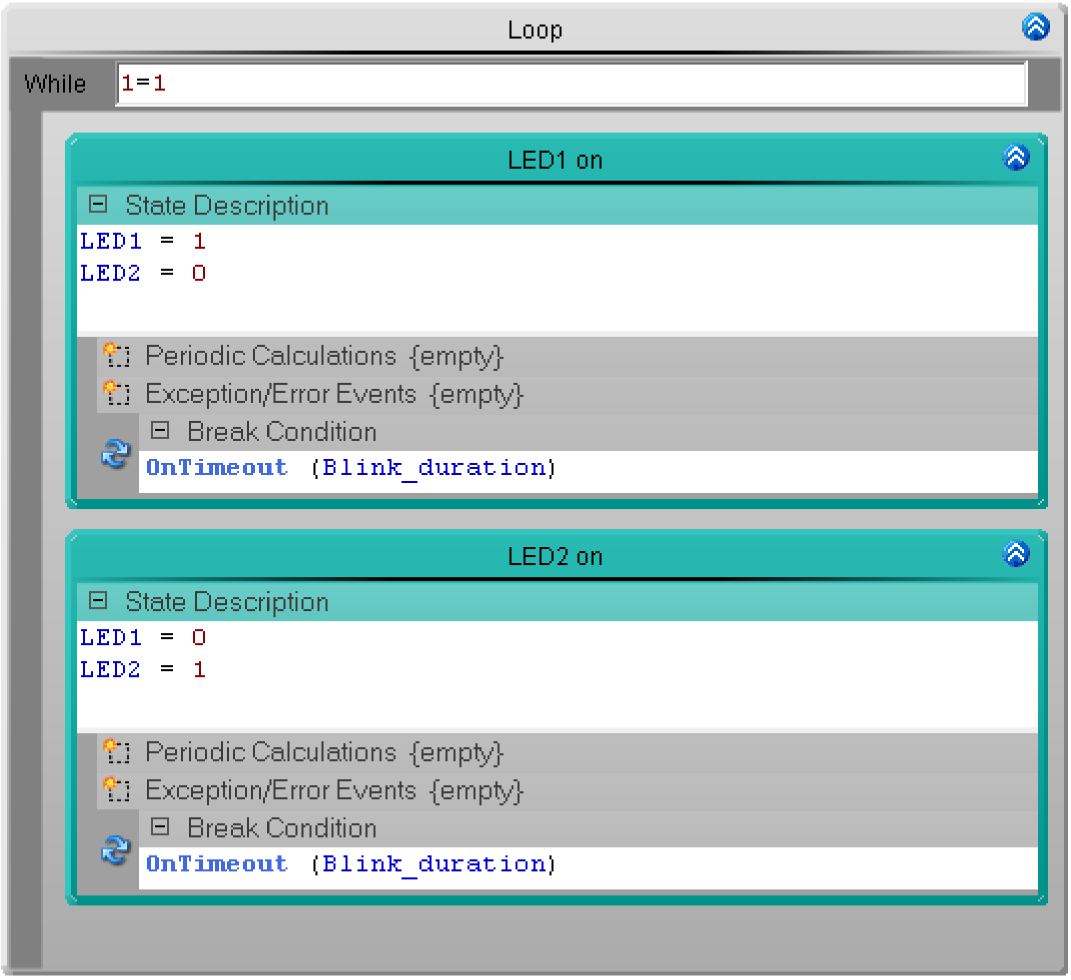
The **State** should be exited once the *Blink duration* set has elapsed.

Enter in the box **State description** the following instructions:

```
LED1 = 0
LED2 = 1
```

The **Break condition** is the same as for the **State** *LED1 on*.

```
OnTimeout(Blink_duration)
```



Source code in the states

The **State** *LED2 on* is below the **State** *LED1 on*. The **States** are processed in the order from top to bottom (unless otherwise programmed, e.g. in a **Branch**).

Check and Apply

Once the entire **Task** has been set up, the syntax of the program should be checked.

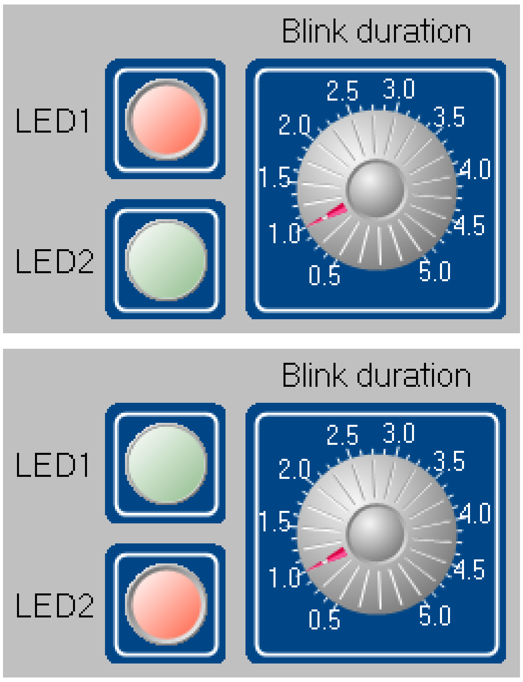
- Check and apply the changes (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

12.8.1.3 Panel - Settings / Start measurement

Now the Panel page can be set up.

- Open the plug-in **Panel**.
- Use the Drag&Drop technique to move the **Display-Variables** *LED1* and *LED2* to the Panel page and display them as LEDs.
- Represent the **Display-Variable** *Blink_duration* as a potentiometer.
- In the potentiometer's **Properties**, an appropriate **Range** must be set, e.g. 0.5-5
- The scale **Dividors** must be set next. In this example, there are 9 scale divisions.
- For all controls, display the **Title**.
- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).

Test the blinking behavior for various settings of the *Blink duration*.



Panel- Blinking LED using timer (example)

12.8.2 Blinking LED using Cycle Time

Assignment:

Set up the flashing LED from the previous example Blinking LED using timer 1494 using **Cycle Time** and **User-defined variables**.

To do this, create a **Task** with an appropriate cycle time and **User-defined variables** and create **counters** which work with the **Cycle Time**.

Learning goals:

- Creation of a **task**
- Use of **Cycle Time**
- Use of **User-defined variables**
- Use of **Periodic calculations**

Elements used:

- Init / Terminate
- Procedures
- Steps
- States (State description, Periodic calculations and Break conditions)
- Next branching
- User-defined variables

Additionally used plug-ins:

- Setup
- Panel

Procedure:

Begin by starting **imc STUDIO**.

12.8.2.1 Setup - Settings

First, the measurement device is parameterized and an appropriate name is assigned to the variables used.

- Open the plug-in **Setup**.

Proceed as described in the previous example Blinking LED using timer 1494.

12.8.2.2 Automation - Settings

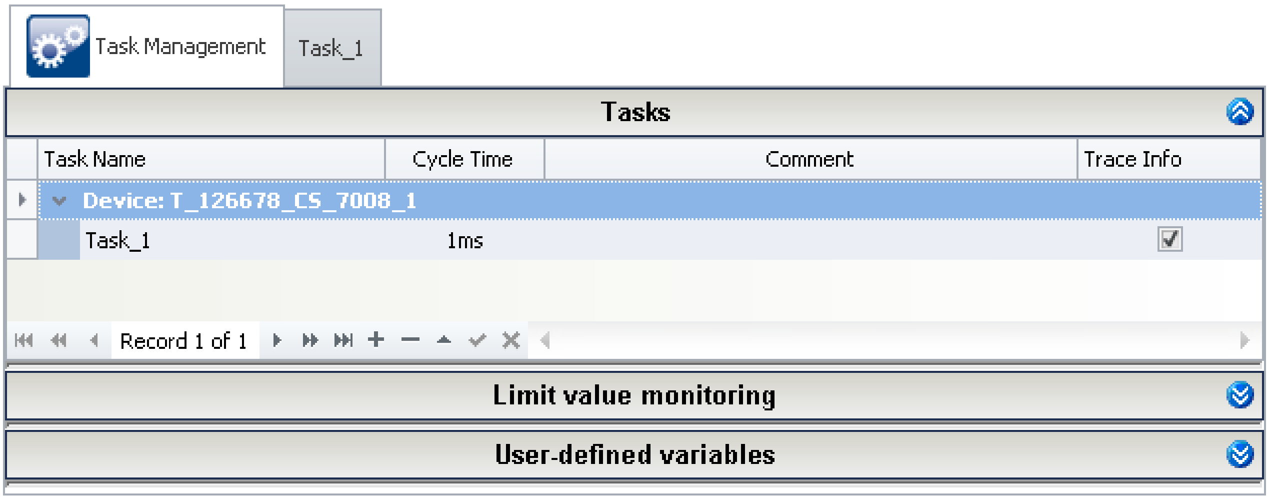
Now it is possible to set up the **Task**.

- Open the plug-in **Automation**.

You are now in the **Task Management** interface. Proceed with creating a **Task**.

Tasks are performed in real-time. For this purpose, assign the **task** a **Cycle Time** (adjustment range: *100µs* through *1s*). The **Cycle Time** stands for the duration of a **state**.

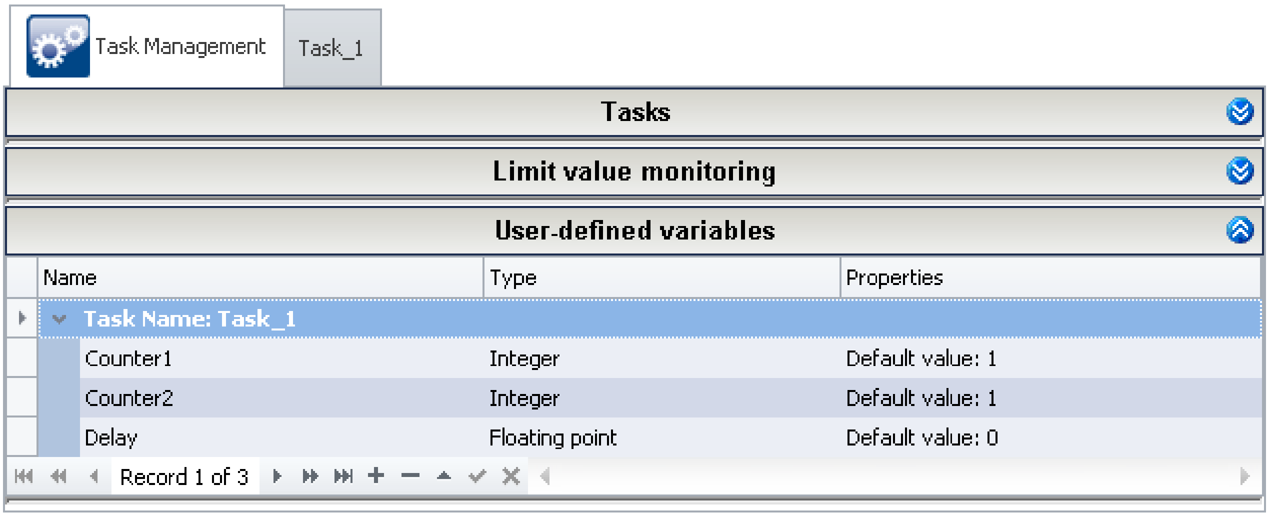
- Enter 1ms as the **Cycle Time**.



Task with a 1 ms Cycle Time

- Create three **User-defined variables**.

Name	Type	Properties
Counter1	Integer	Default value: 1
Counter2	Integer	Default value: 1
Delay	Floating point	Default value: 0



User-defined variables

Now go to the **Task Editor** (*Task_1*).

Init

In the **initialization**, set the initial values for the *LEDs* and the *Blink duration*.

Open this block by clicking on the double-arrow ( ). This takes you to the **Block Editor**.

- There, create a **step**
- In this **step**, add a **state**.
- Add the initial values in the **state description**.

```
LED1 = 0
LED2 = 0
Blink_duration = 1
```

Close the **Block Editor** by clicking the initialization's double-arrow ( ).

Open the existing **Next-branch** by clicking on the double-arrow ( ).

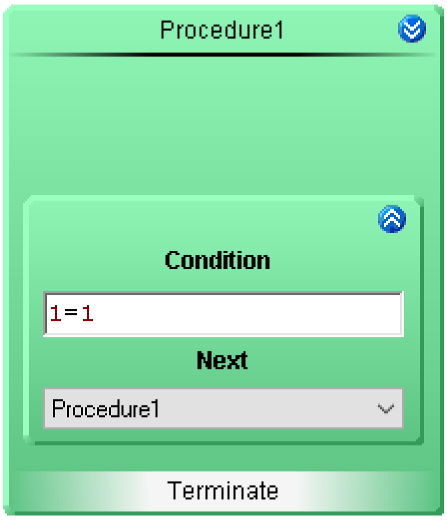
- Enter `1=1` for the **condition**.

Once the **initialization** has been run, *Procedure1* is performed automatically.

Procedure

In the example Blinking LED using timer 1494, a continual repetition is carried out by means of a **While-loop**. This can also be achieved by a **Next-branch**.

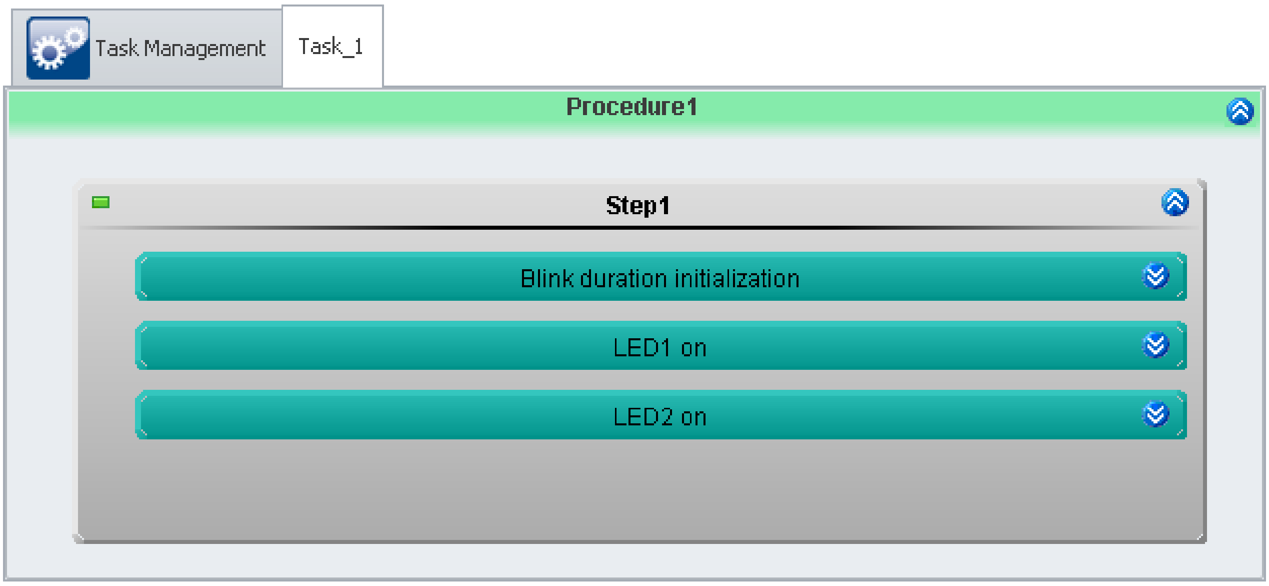
- Add a **Next-branch** into *Procedure1.*
- Open the **Next-branch**
- Set the **condition** to `1=1`
- The procedure is is own target (**Next**).



Now the **procedure** calls itself again when it finishes. But using the **Next-branch**, it is also possible to call any other **procedure**.

Open *Procedure1* by clicking on the double-arrow ( ). This takes you to the **Block Editor** of this **procedure**.

- Add a **step**
- Open the **step**
- Add three **steps**: *Blink duration initialization, LED1 on* and *LED2 on*.



Procedure1 with one step and three states

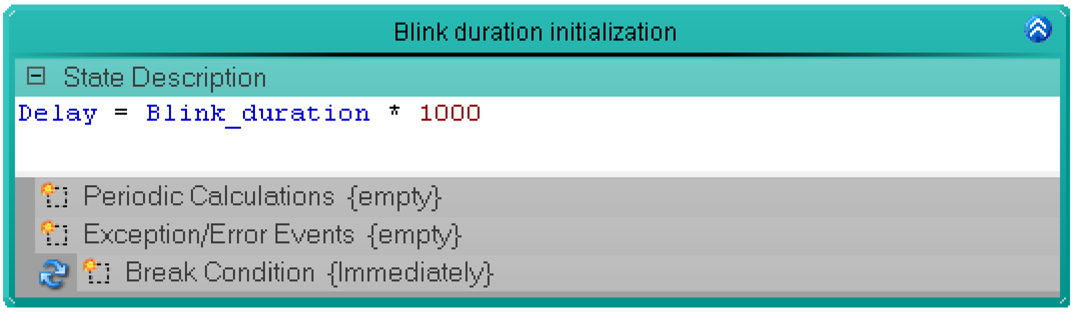
Each **state** is processed with a *1ms* cycle time.

The **states** *LED1 on* and *LED2 on* should end only after the *Blink duration* set. For this purpose, the following boxes are used:

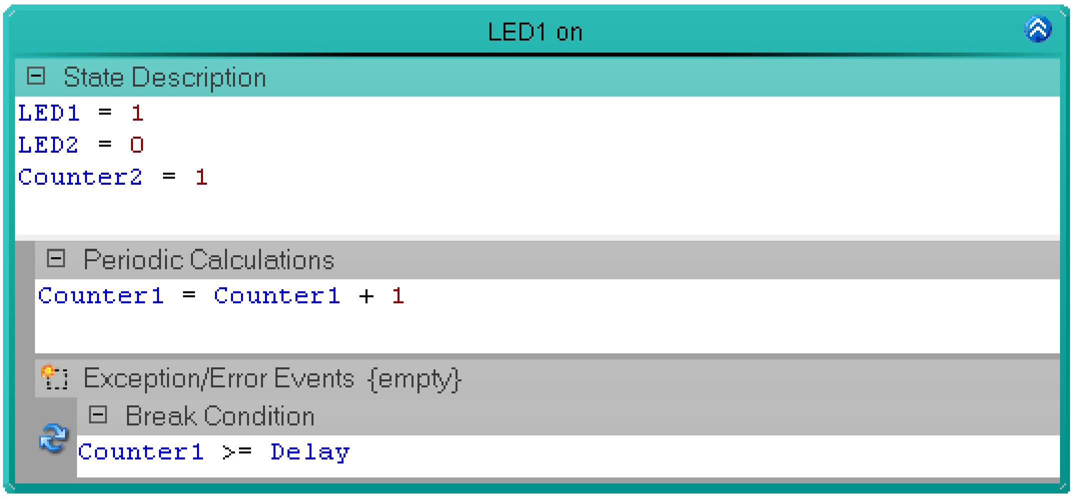
- **Cyclical Calculation**: Incrementation of a counter
- **Break Condition**: `Counter >= Delay` (= Blink_duration/Cycle Time)

The instructions in the box **Periodic Calculations** are repeated at the period duration set in the **Task Management** under **Cycle Time**. Afterwards, the **break condition** continually re-assessed. If it is met, then the **state** is exited.

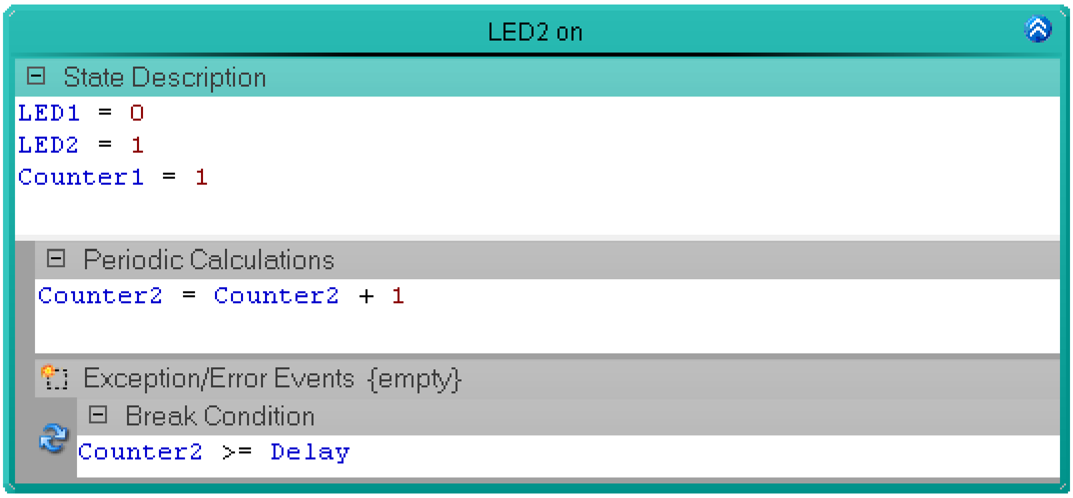
Now create the source code for the **states**:



Initializing the Blinkduration - calculating the delay

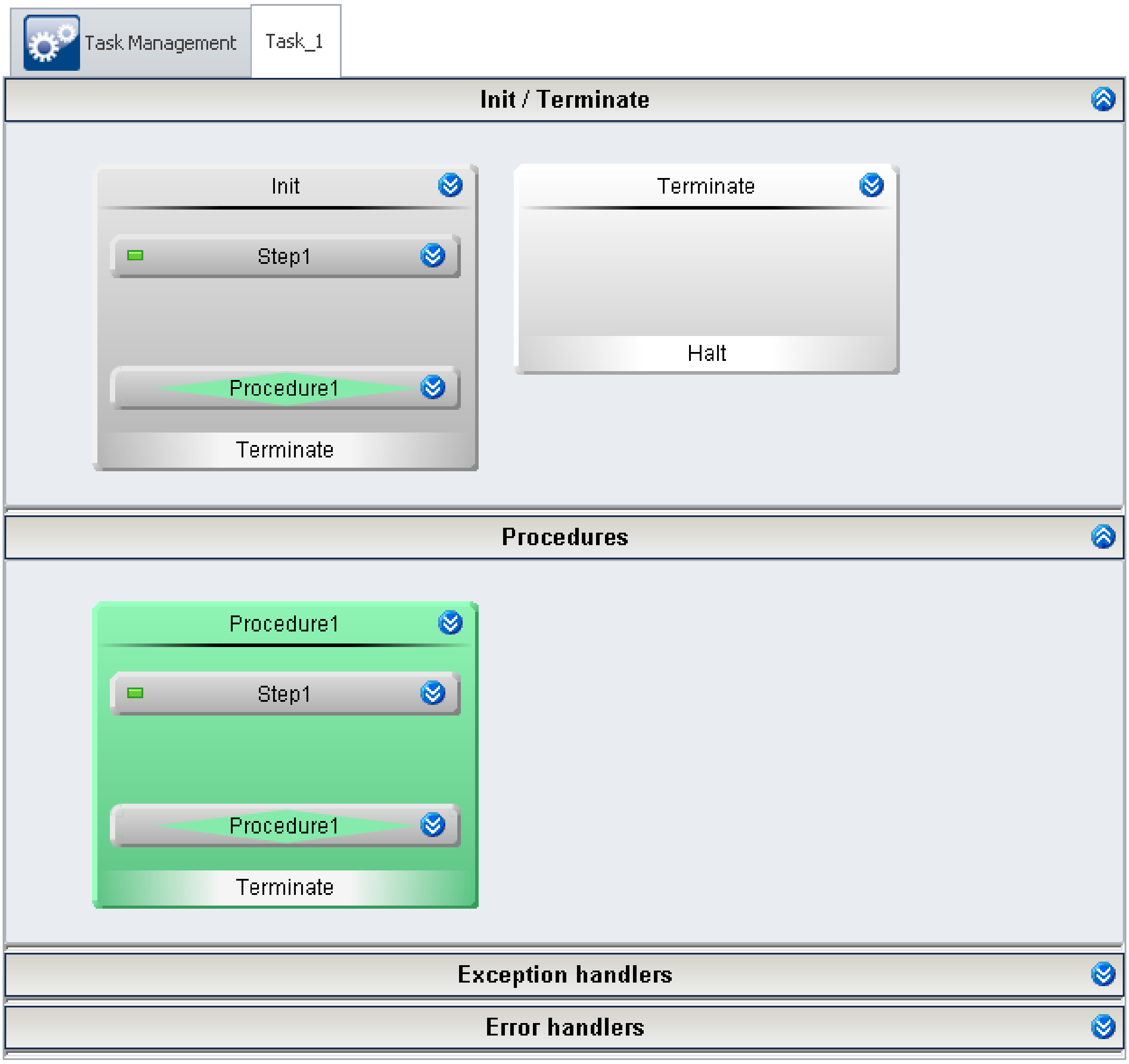


Source code for LED1 on



Source code for LED2 on

Every **state** is now described exactly and the **procedure** is thus completed. When you exit the **procedure**, you return to the **Task Editor** and see the outline of the procedure.



Check and Apply

Once the entire **Task** has been set up, the syntax of the program should be checked.

- Check and apply the changes (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

12.8.2.3 Panel - Settings / Start measurement

Now the Panel page can be set up.

- Open the plug-in **Panel**.

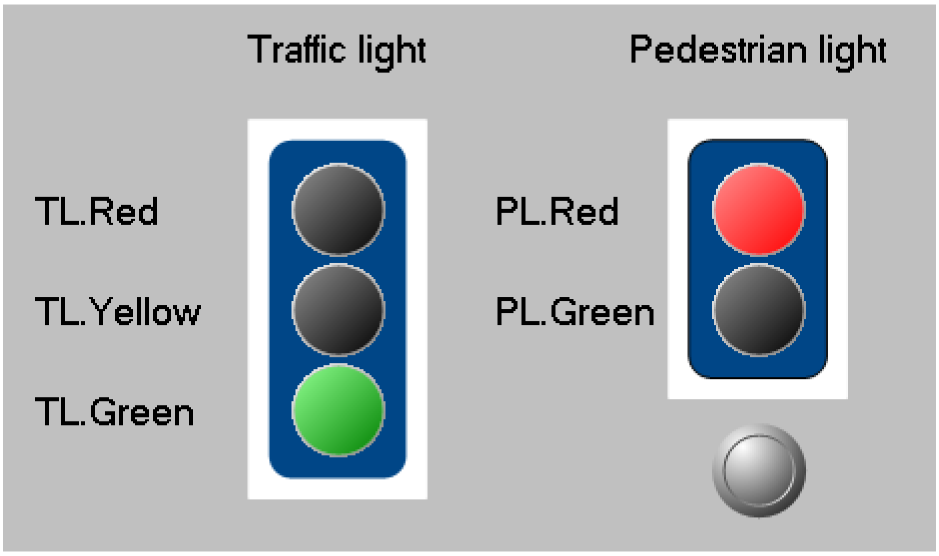
Proceed as described in the previous example Blinking LED using timer 1494.

12.8.3 Traffic light

Assignment:

Make a pedestrian intersection crossing light.

A stoplight for vehicles (TL = traffic light) has the colors red, yellow and green. But the light for pedestrians (PL = pedestrian light) is either red or green and has a button for requesting.



Panel - Traffic light (example)

Learning goals:

- Creation of a **task**
- Use of **timer functions**
- Use of **State description** and **Break conditions**

Elements used:

- Init / Terminate
- Procedures
- Steps
- States (State description and Break conditions)
- Next branching

Additionally used plug-ins:

- Setup
- Panel

Procedure:

Begin by starting **imc STUDIO**.

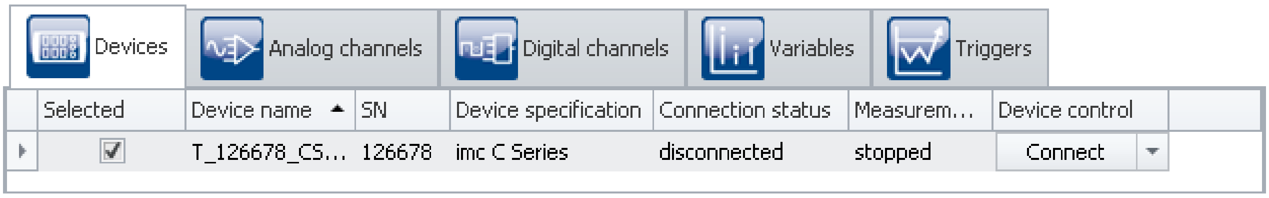
12.8.3.1 Setup - Settings

To begin, the measurement device is selected and configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device:

- If the device desired does not appear in the list, then perform a **device search** 222 () (Ribbon *Home* (or *Setup-Control*) > *Search for Devices*). Subsequently, the list will display all devices found.
- Click on the Checkbox-symbol () in order to **select** the device.



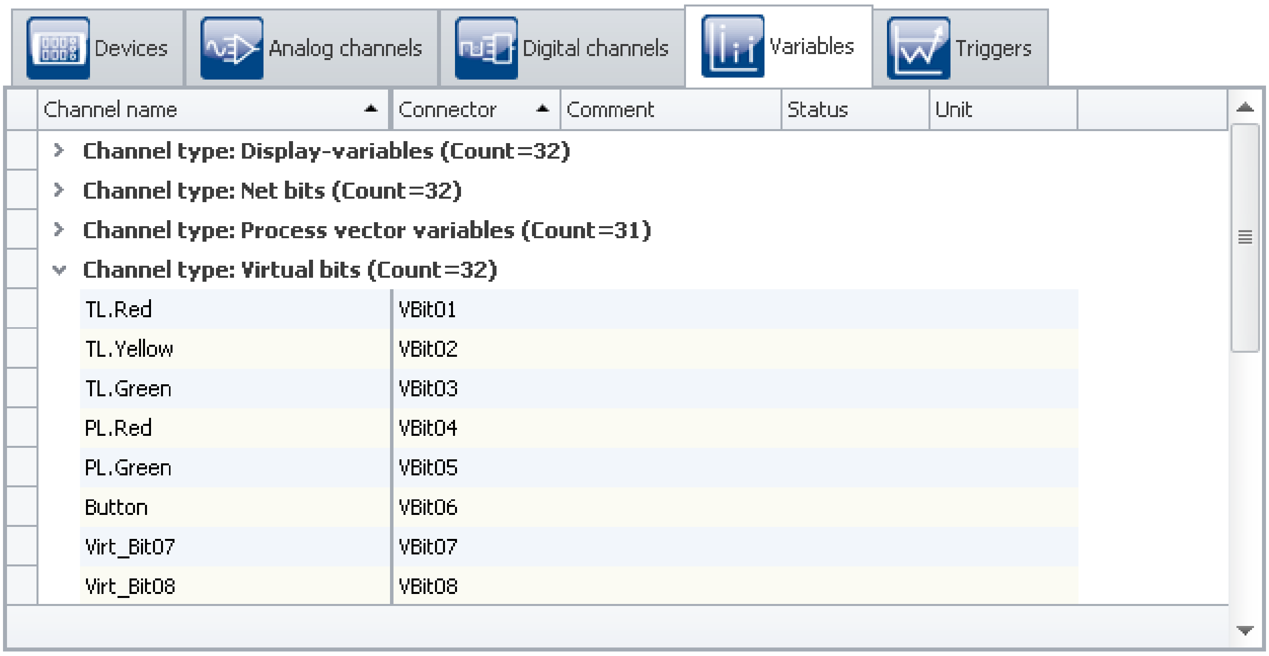
Selecting a device

The device is now known and selected, and is available each time **imc STUDIO** is started.

Configuring the variables

Now we assign appropriate names to the variables used.

- Go to the tab: **Variables** .
- Change the name of six **Virtual bits**:
  TL.Red, TL.Yellow, TL.Green,
  PL.Red, PL.Green,
  Button.



Assigning names

Note

In order to prevent the **automation** from ending prematurely, make sure that the first channel's (***Channel_001***) **measurement duration** is set to *undefined* (=infinite).

- To apply the changes, click on the button **Process configuration** 222 (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

By this means, the device settings are available to other plug-ins.

12.8.3.2 Automation - Settings

Now it is possible to set up the **Task**.

- Open the plug-in **Automation**.

You are now in the **Task Management** interface. Proceed with creating a **Task**.

The following table presents the **states** and their dwell times, which the stoplight is to run through after the button is pressed.

	TL.Red	TL.Yellow	TL.Green	PL.Red	PL.Green	Dwell time in sec.
A	0	0	1	1	0	until button pressed
B	0	1	0	1	0	3
C	1	0	0	1	0	3
D	1	0	0	0	1	5
E	1	0	0	1	0	3
F	1	1	0	1	0	1
back to A	0	0	1	1	0	until button pressed

Init

In the **Init** block, set the initial values.

Open this block by clicking on the double-arrow ( ). This takes you to the **Block Editor**.

- There, create a **step**
- In this **step**, add a **state**.
- Add the initial values in the **state description**.

```
TL.RED = 0
TL.YELLOW = 0
TL.GREN = 1
PL.RED = 1
PL.GREEN = 0
Button = 0
```

Close the **Block Editor** by clicking on the double-arrow ( ) for the initialization.

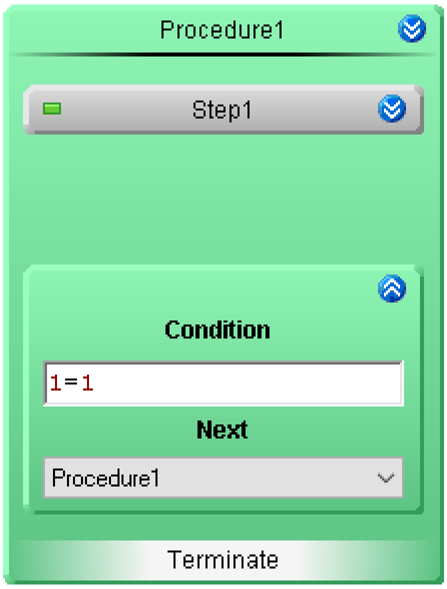
Open the existing **Next-branch** by clicking on the double-arrow ( ).

- Enter `1=1` for the **condition**.

Once **Initi** has been run, *Procedure1* is performed automatically.

Procedure

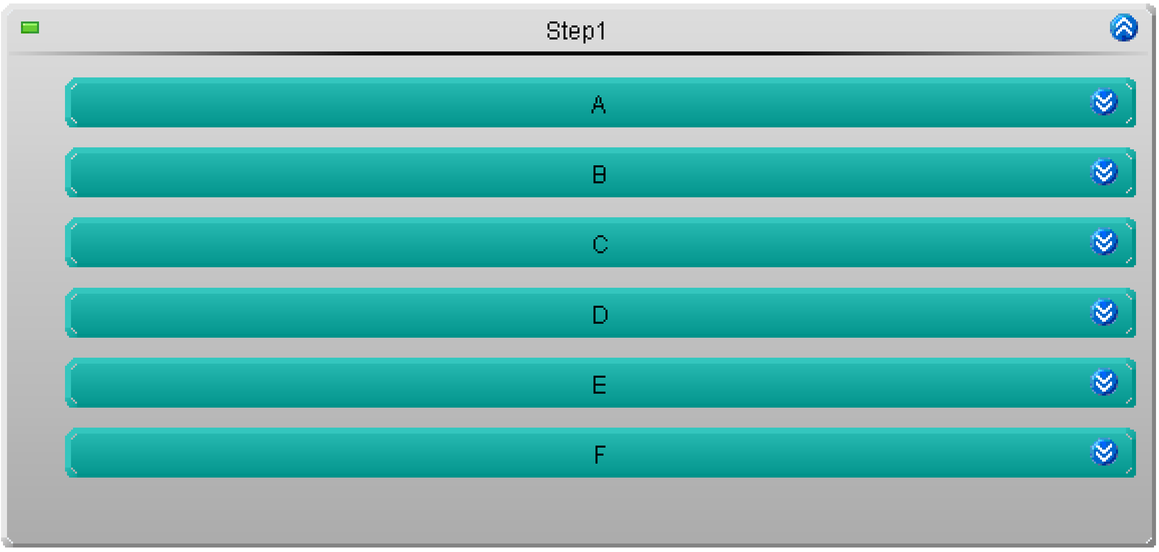
- Add a **Next-branch** into *Procedure1.*
- Open the **Next-branch**
- Set the **condition** to `1=1`
- The procedure is is own target (**Next**).



Procedure1

Open *Procedure1* by clicking on the double-arrow (). This takes you to the **Block Editor** of this **procedure**.

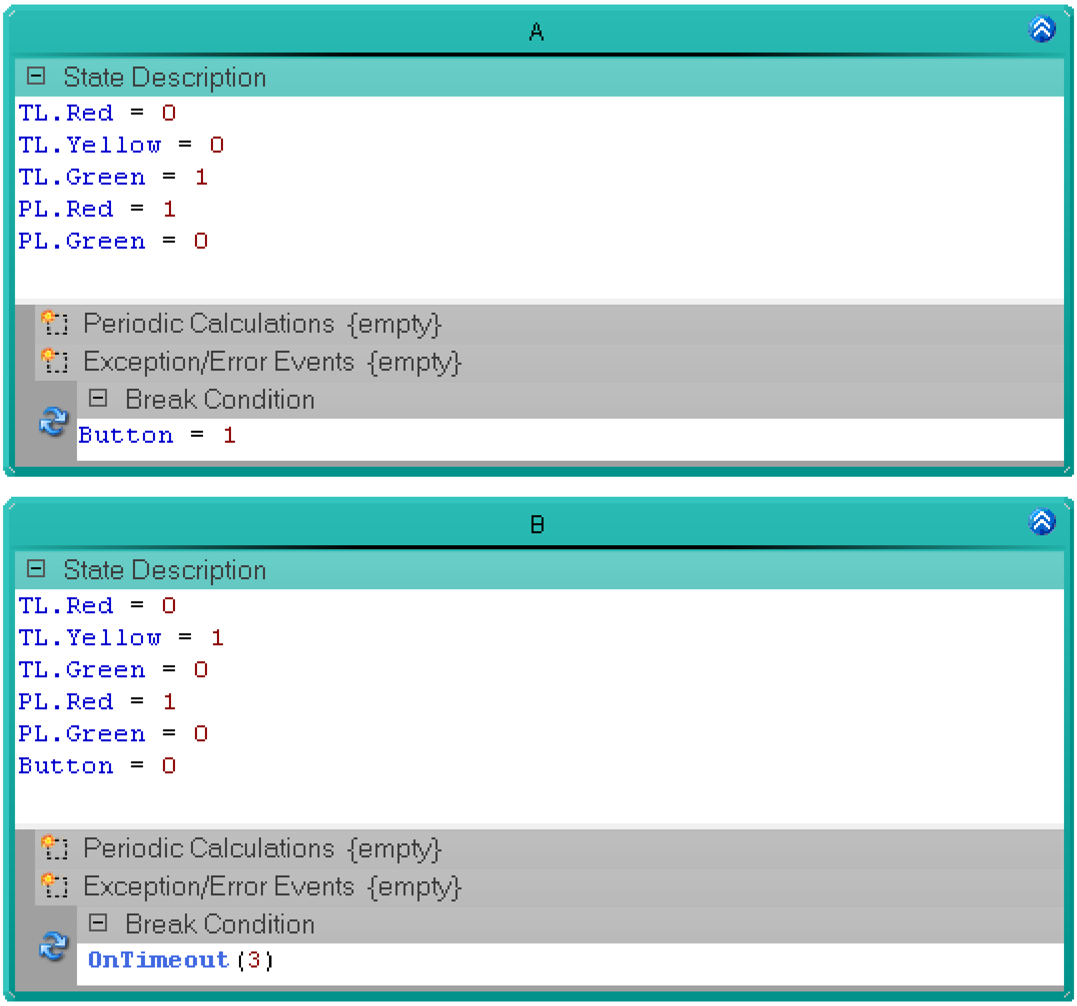
- Open **Step1**
- Create six **states**: ***A*** through ***F***.



Individual states of the stoplight control

- In the individual **states** you determine which LED are to blink and which ones are not.
- Also supply an appropriate B**reak condition** (press button or `OnTimeout`)

As an example: the **states** *A* and *B*.



Source code for the first two states

Note

By deleting the **virtual bit**: *Button* in **state** *B*, it is specified to behave like a **pushbutton**. However, in the Panel you can also assign the **switch** to have *Switching behavior*, then you don't need to reset *Button* here. This happens upon releasing the **pushbutton**.

Check and Apply

Once the entire **Task** has been set up, the syntax of the program should be checked.

- Check and apply the changes (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

12.8.3.3 Panel - Settings / Start measurement

Now the Panel page can be set up.

- Open the plug-in **Panel**.
- Use the Drag&Drop technique to move the stoplight's virtual bits to the Panel page and display them as LEDs.
- Drag the virtual bit: ***Button*** from the Data Browser to the Panel page and display it as a switch or as a pushbutton (depending on the widgets that have been installed with your product).

You can also set the **Switching behavior** of the two models as desired. To do this, open the **properties** of the respective **Widgets** and change the property **Switching behavior**.

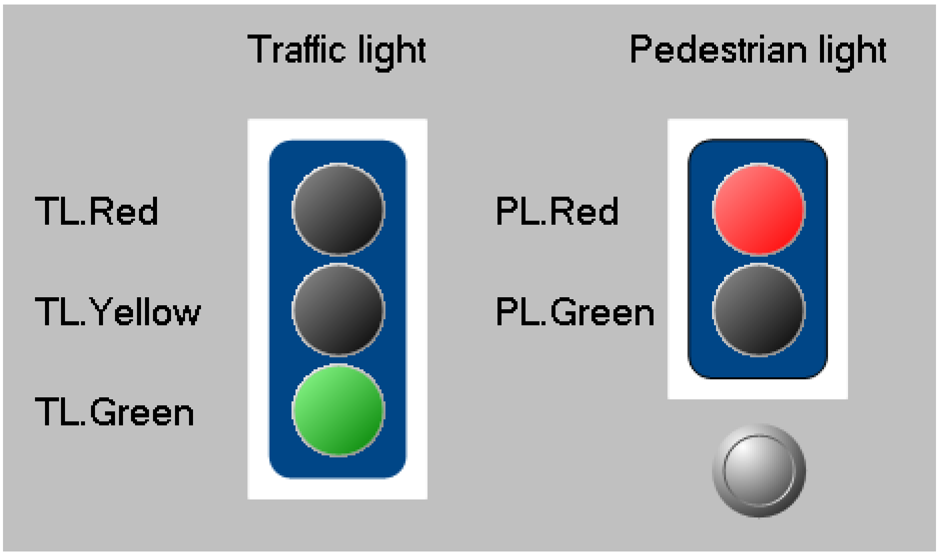
- If you have not reset *Button* with the **state** *B* in the **task**, then select the *Push-button behavior*
- If you reset it by program control, the switch does not need *Push-button behavior*

Adjust the zone colors of the LEDs:

- 0->0.5: Black
- 0.5->1: Red, Yellow or Green

You can also insert a background image and adapt the LED Color Control to it.

- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).



Panel - Traffic light (example)

12.8.4 Limit value monitoring

Assignment:

Set up **Limit value monitoring** for a voltage value.

The voltage value is to be set using a **potentiometer**. By means of two **input boxes**, an upper and a lower value limit can be set. Three **LEDs** indicates whether the current voltage value is too high, within the limits, or too low.

Learning goals:

- Creating a **task**
- Setting up **Limit value monitoring**
- Use of **timer functions**
- Use of **State description** and **Break conditions**
- Use of the **Repository**

Elements used:

- Init / Terminate
- Procedure
- Exception
- Step
- State (State description and Break conditions)
- Resume branching

Additionally used plug-ins:

- Setup
- Panel

Procedure:

Begin by starting **imc STUDIO**.

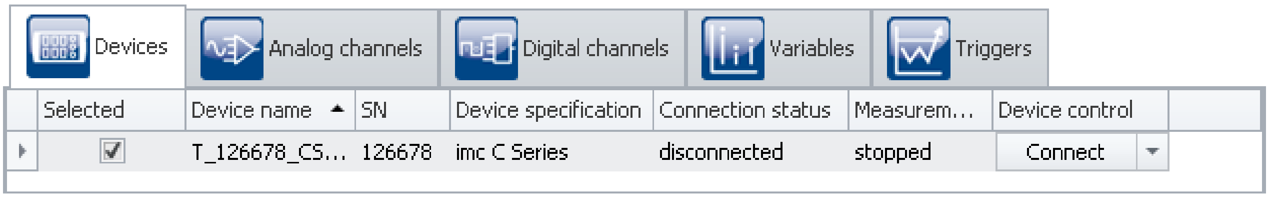
12.8.4.1 Setup - Settings

To begin, the measurement device is selected and configured.

- Open the plug-in **Setup**.
- Go to the tab: **Devices** .

Select your device:

- If the device desired does not appear in the list, then perform a **device search** 222 ( ) (Ribbon *Home* (or *Setup-Control*) > *Search for Devices*). Subsequently, the list will display all devices found.
- Click on the Checkbox-symbol ( ) in order to **select** the device.



Selecting a device

The device is now known and selected, and is available each time **imc STUDIO** is started.

Configuring the variables

Now we assign appropriate names to the variables used.

- Go to the tab: **Variables** .
- Change the name of six **Display-Variables**: *Voltage*, *Upper_limit*, *Lower_limit*, *Voltage_too_high*, *Voltage_too_low*, and *Voltage_OK*

Note

In order to prevent the **automation** from ending prematurely, make sure that the first channel's (***Channel_001***) **measurement duration** is set to *undefined* (=infinite).

- To apply the changes, click on the button **Process configuration** 222 ( ) (Ribbon *Home* (or *Setup-Control*) > *Process*).

By this means, the device settings are available to other plug-ins.

12.8.4.2 Automation - Settings

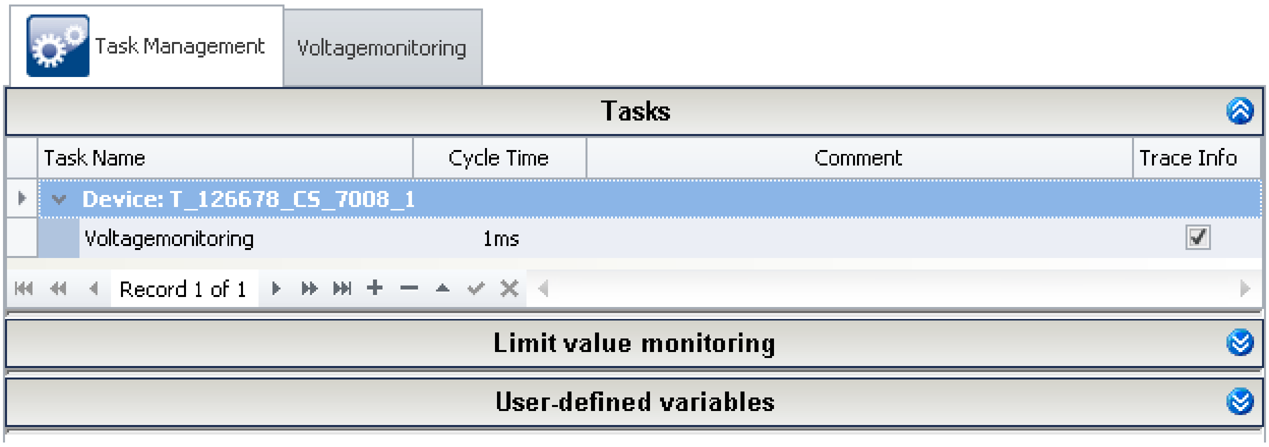
Now it is possible to set up the **Task**.

- Open the plug-in **Automation**.

You are now in the **Task Management** interface.

Create a **task** with the name *Voltagemonitoring*

- Change the **Cycle time** to "1 ms", so that the voltage monitoring can respond more quickly.



Task for a voltage monitoring function

Open the **task**.

Procedure

- Change the name from *Procedure1* to *Monitoring*

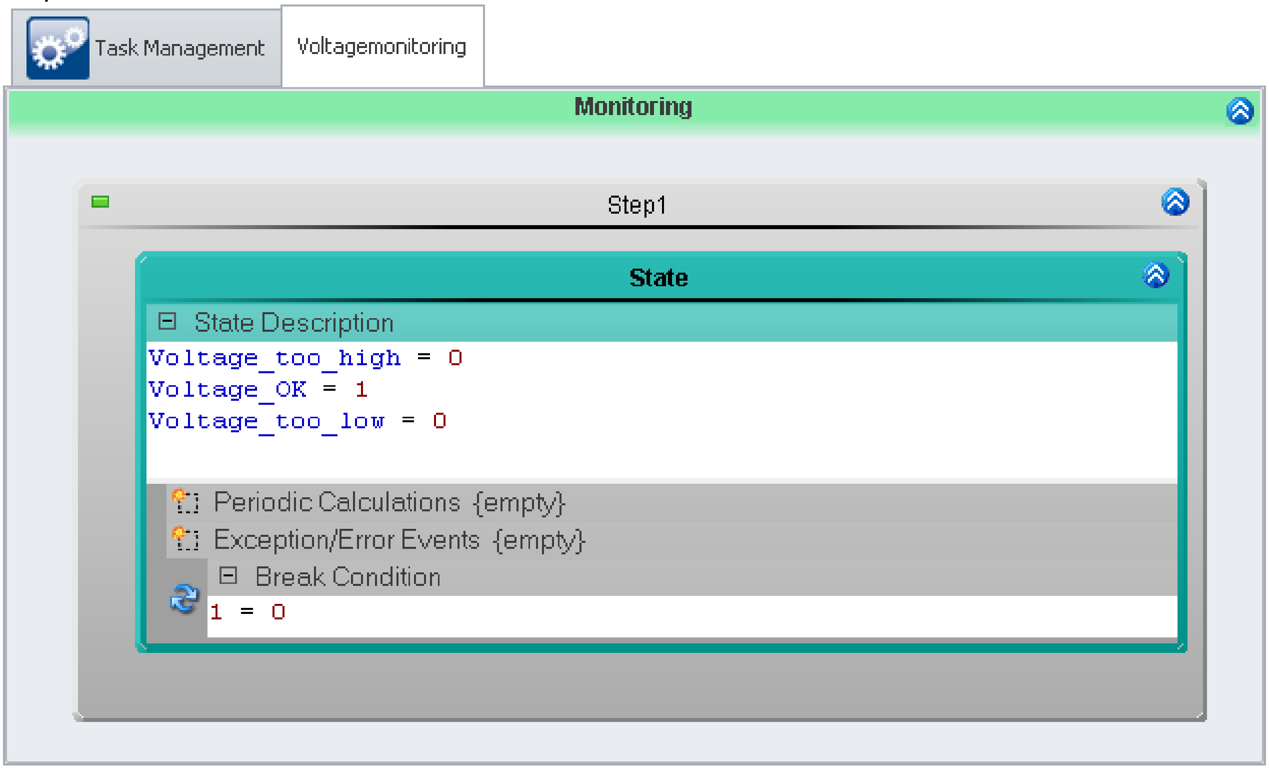
Open this **block** by clicking on the double-arrow (). This takes you to the **Block Editor**.

- There, create a **step**
- In this **step**, add a **state**.

In the **State description**, enter the following instructions:

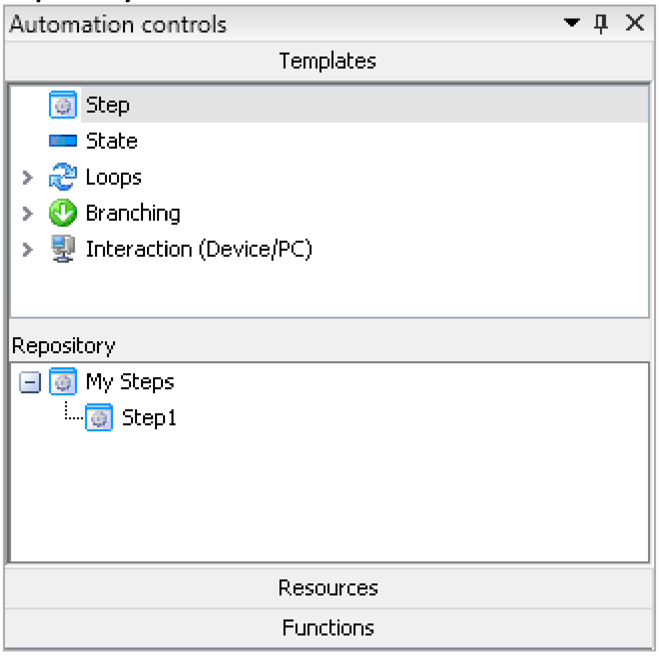
```
Voltage_too_high = 0
Voltage_OK = 1
Voltage_too_low = 0
```

This should always be the current **state**. For this reason, enter `1=0` for the **Break condition**. The **state** is only exited when a handler is started.



Source code: Voltage within the specified interval

Minimize the *Step1* by clicking on the step's double-arrow (). Copy it by means of Drag&Drop into the **Repository** of the **Automation controls**.



Repository

Close the **block**.

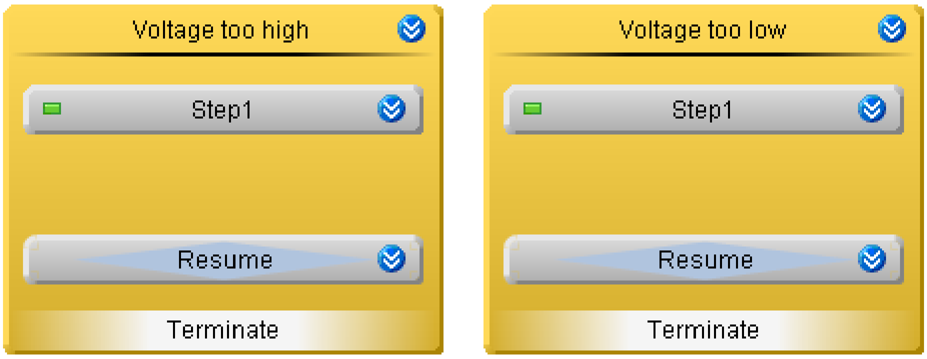
Exception handling

Create two **exception blocks** in the **Exception handling**.

- *Voltage too high*
- *Voltage too low*

These can be used in the **Limit value monitoring**.

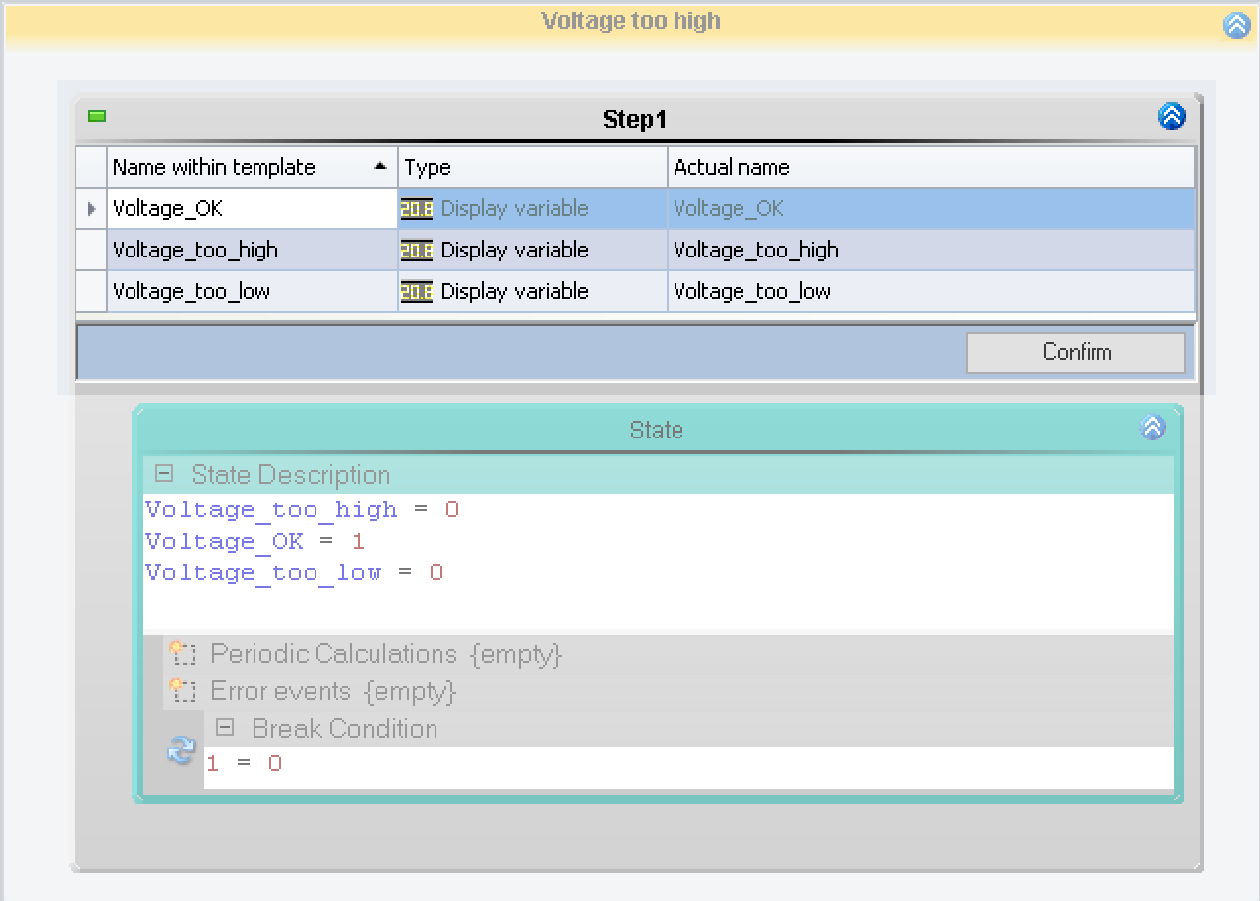
- Use Drag&Drop to copy the previously added **step** *Step1* to both **blocks**
- Add to each **block** one **Resume-branching** having the **condition**: `1=1`



Exception handling

Voltage too high

Open the **block** *Voltage too high* and in it open *Step1*. A **confirmation prompt** appears.



Confirmation prompt

- The variables used are the same as before. Click on *Confirm*.

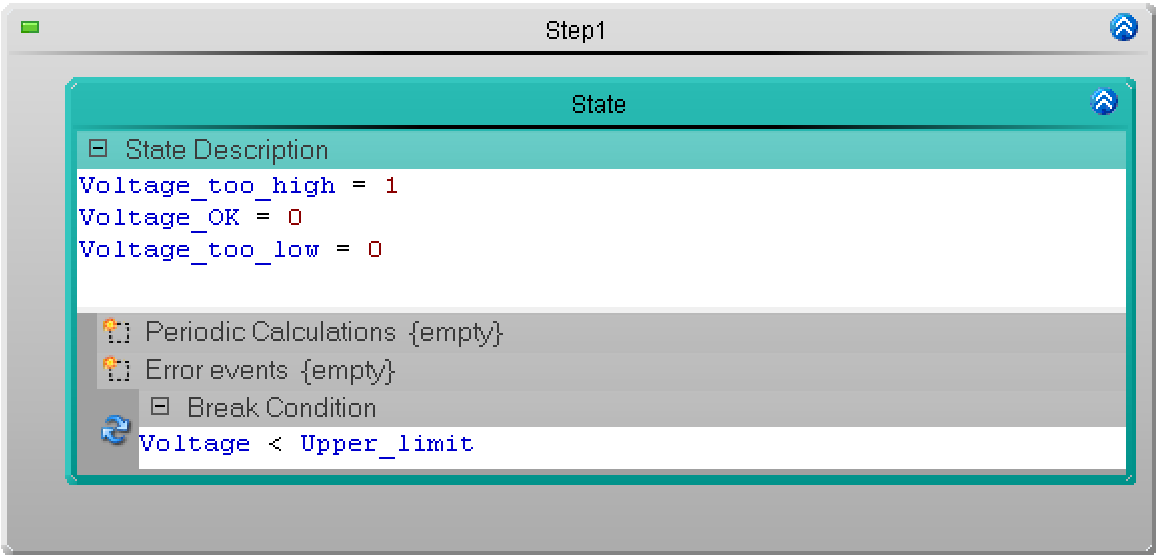
Change the values in the **State description**:

```
Voltage_too_high = 1
Voltage_OK = 0
Voltage_too_low = 0
```

Replace the existing **Break Conditions**:

```
Voltage < Upper_limit
```

The **state** is exited once the *Voltage value* is back below the *upper limit*.



Source code: Voltage over the specified interval

Close the **block**.

Voltage too low

Open the **block** *Voltage too low* and in it *Step1*. Another **confirmation prompt** appears.

- The variables used are the same here, too. Click on *Confirm*.

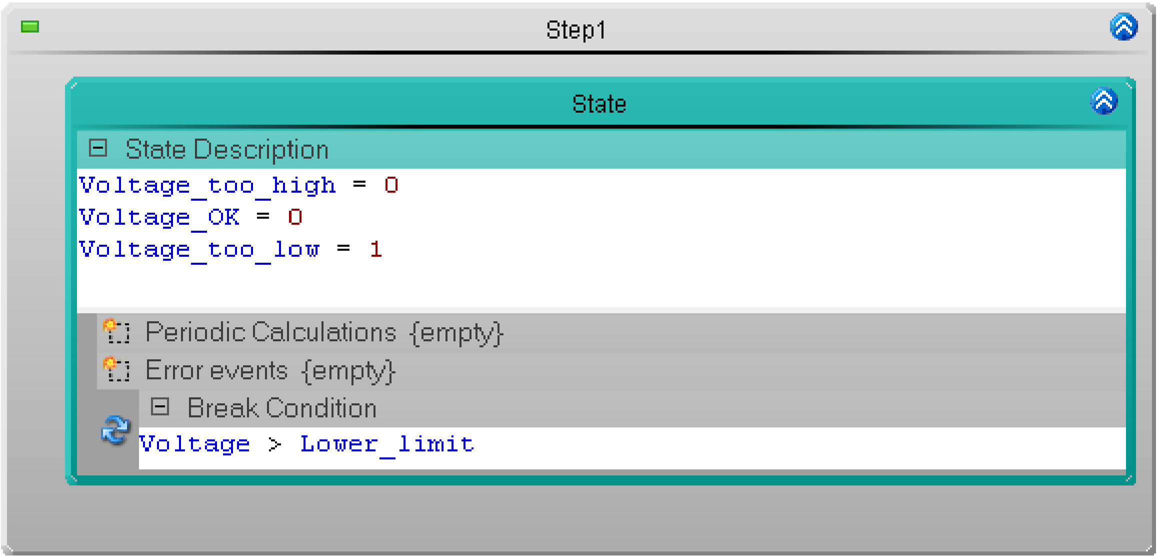
Change the values in the **State description** as follows:

```
Voltage_too_high = 0
Voltage_OK = 0
Voltage_too_low = 1
```

Replace the existing **Break Condition** as follows:

```
Voltage > Lower_limit
```

The **state** is exited once the *Voltage value* is back above the *lower limit*.



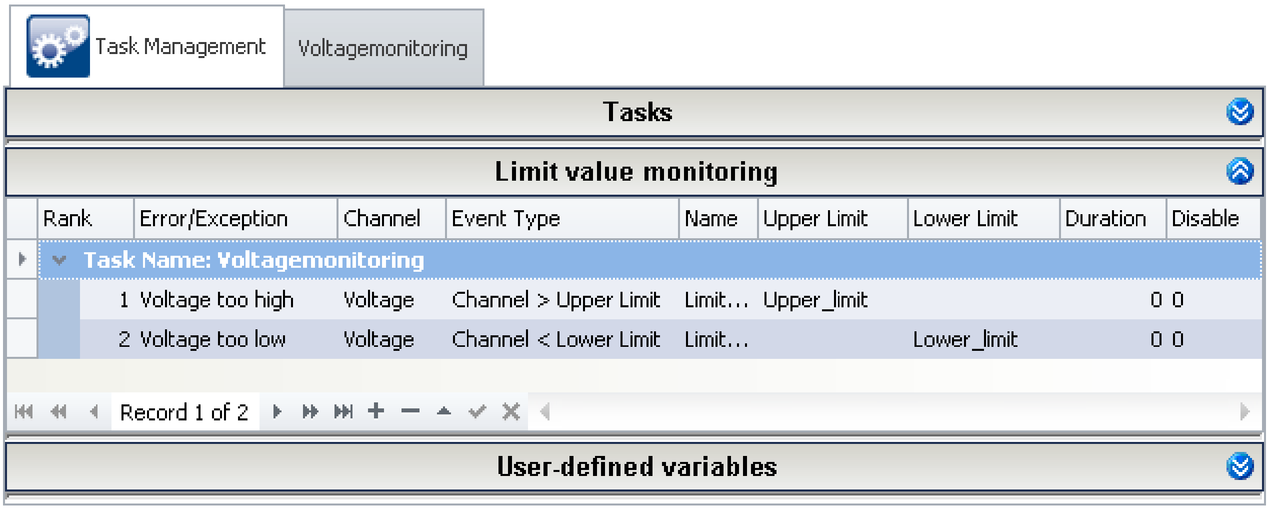
Source code: Voltage below the specified interval

Limit value monitoring

Go to the **Task Management**.

Create two **Limit value monitoring** functions and parameterize them:

	Error/Exception	Channel	Event Type	Upper Limit	Lower Limit
1	Voltage too high	Voltage	Channel > Upper Limit	Upper_limit	
2	Voltage too low	Voltage	Channel < Lower Limit		Lower_limit



Setting the value limit monitoring

If one of the two monitored events occurs, the corresponding **handling** is performed automatically.

Check and Apply

Once the entire **Task** has been set up, the syntax of the program should be checked.

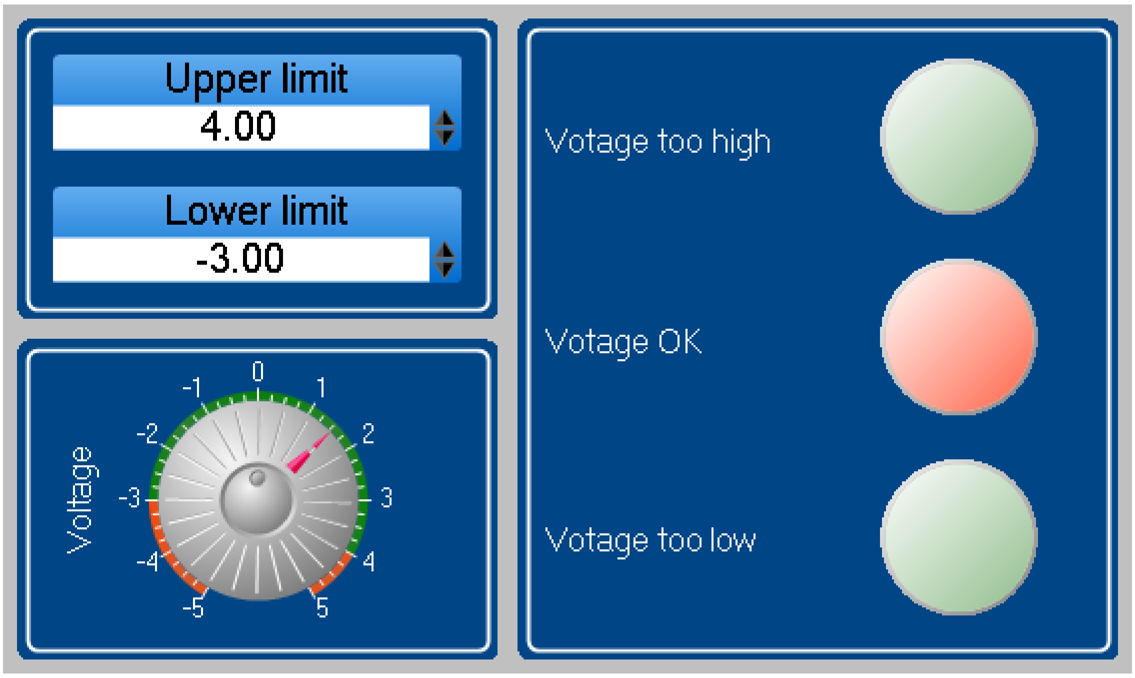
- Check and apply the changes (✔) (Ribbon *Home* (or *Setup-Control*) > *Process*).

12.8.4.3 Panel - Settings / Start measurement

Now the Panel page can be set up.

- Open the plug-in **Panel**.

Drag the **Display-variables** used to the Panel page and display them with the appropriate elements.



Panel - Limit value monitoring (example)

- Set the limits.
- Start the measurement 222 ( ) (Ribbon *Home* (or *Setup/Panel-Control*) > *Start*).

Test the monitoring function by adjusting the *voltage* to higher than one of the *limits* by means of the **potentiometer**.

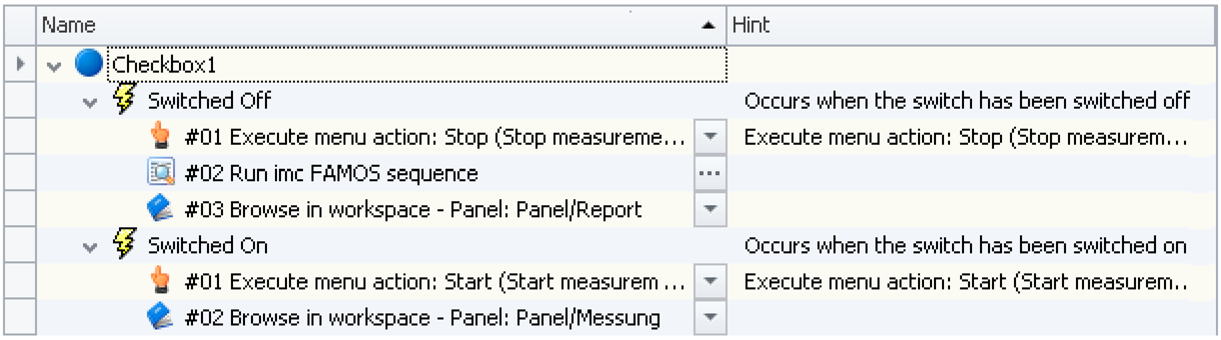
13 Sequencer, Events and Commands

Using imc STUDIO, you are able to create sequences, which carry out various commands in sequence either manually or automatically.

Sequences can be created in a variety of imc STUDIO and imc WAVE components:

Component	Description
Sequencer	On the Sequencer-page, you can **create automated routines**. In the "*Sequence table* 1527", you can **use all commands**.
Panel Automation	You can **link events with commands** by means of the "*Event Dialog* 1529". The commands are executed when the event occurs. Here, you can use selected commands.
Events	On the Sequencer-page, you see an overview of all events 1537 and can configure these here. Additionally, you can create your own events 1540. Here, you can use selected commands.

The sequence



Sequence table: Example having multiple commands

A sequence consists of a table (referred to below as the "*Sequence table*"). The commands appear there in a tree diagram. The structure and complexity of the Sequence table depends on the component used.

Chapter overview

Synopsis	Chapter
Creation and configuration of a sequence of commands. Adding, moving and making settings for commands.	Creating a sequence of commands 1533
An overview of the Sequencer-page's user interface.	Sequencer 1525 Sequence table 1527
What to pay attention to when starting/stopping the sequence.	Running Sequencer 1528 Stoppen der Sequenz 1531
Events relating to Panel-switches or Automation.	Event Dialog - Panel and Automation 1529
Creating one's own events.	User-defined events 1540
Description of all commands.	Command Reference 1545

13.1 Sequencer

On the Sequencer-page, you can **create automated routines**. The routines consist of "*commands*", such as "*Load*" and "*Start*" for experiments, "*configuration dialogs*" and "*imc FAMOS sequences*" to be carried out while Sequencer runs.

The sequence is created in a **table** 1527. The commands appear there in a tree diagram. The available commands can be found, among other places, in the "*Commands* 1526" tool window.

Further, you can **link the commands to "*events* 1537"**.

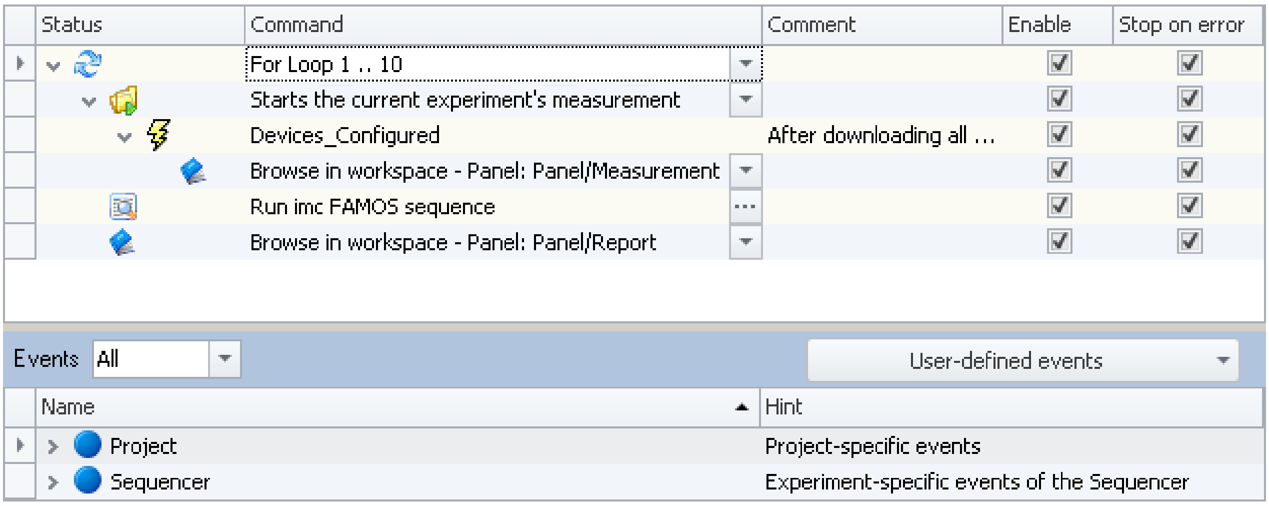
Reference	Command Reference

How the individual commands operate is described in the chapter **Command Reference** 1545.

Opening and configuring Sequencer

In order to open the Sequencer-page, click in the Navigator 119 ( ) on the title having its name.

The image below shows an example of a sequence table 1527 with multiple commands and the event handling 1537.



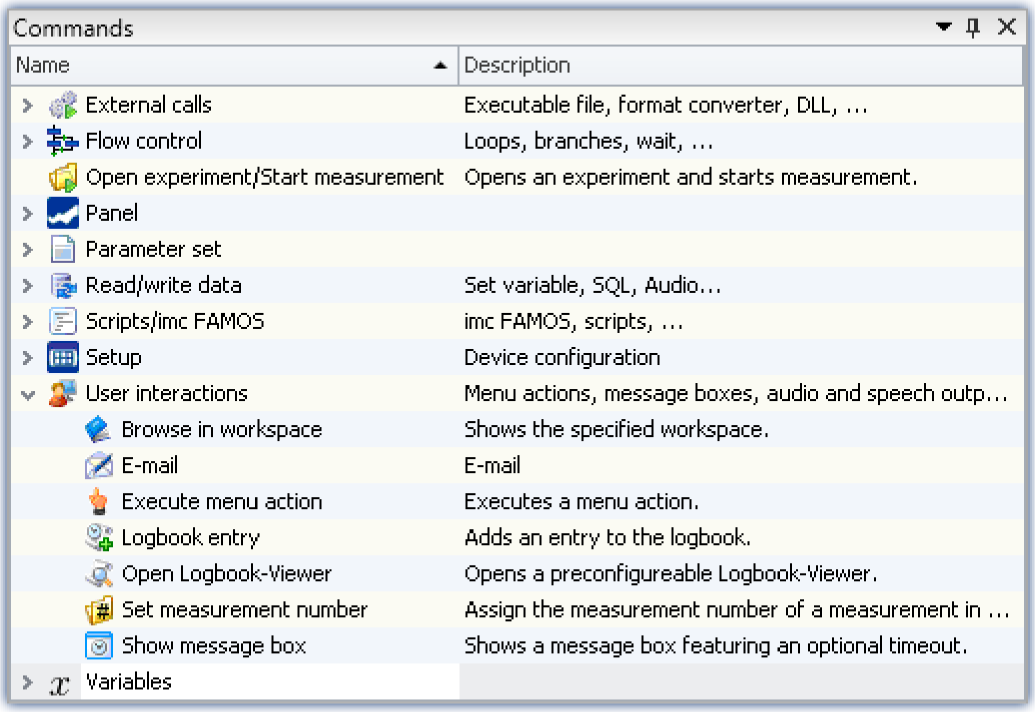
Sequence table with routine of the plug-in "Sequencer"'s commands

Note	Saving the Sequence Table

The **content of the Sequence Table** is **saved** 92 **along with the experiment**.

13.1.1 Tool window Commands

The component Sequencer has a tool window called "*Commands*". This comprises commands with which the sequence is created.



Commands tool window in Sequencer plug-in

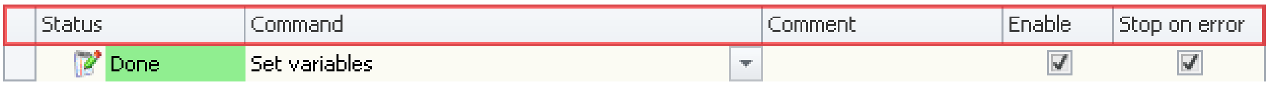
It is possible to access the commands from various locations in imc STUDIO. For this reason, they are described separately.

Reference	Command Reference

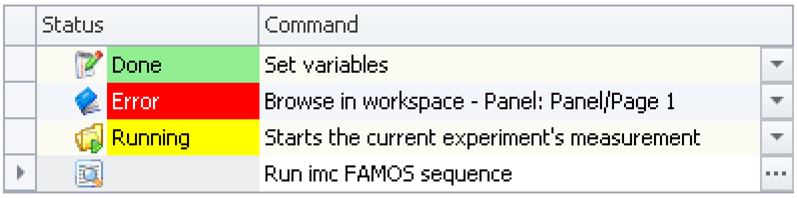
How the individual commands operate is described in the chapter "*Command Reference*" 1545".

13.1.2 Sequence table

The sequence table contains multiple columns.



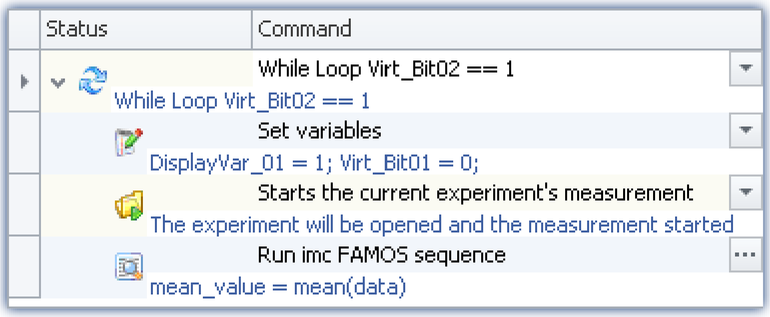
Columns - Command sequence table

<table>
<tr><th>Column</th><th>Description</th></tr>
<tr><td>Status</td><td>In this column, the commands' status is indicated.


Status in the sequence table
Empty: The initial state before the sequence's first start.
Running: The command is still running and has not been concluded.
Done: The commando was concluded successfully.
Error: The command was concluded by an error.</td></tr>
<tr><td>Command</td><td>The command's name. The text entry can not be changed. The command's settings are accessible via the button at the cell's right edge.</td></tr>
<tr><td>Comment</td><td>Click in this cell and enter a comment.</td></tr>
<tr><td>Activated</td><td>Indicates whether a command is run or ignored. By default, this checkbox has a mark in it, which means that the respective command will be performed during runtime. However, you can also deactivate a command by de-selecting this option.</td></tr>
<tr><td>Stop on error</td><td>With this option, the sequence is halted 1532 when an error occurs while the command is running.</td></tr>
</table>

Options - Display in the sequence table

Some command offer additional information which you can have displayed in the Sequence table. The following items belonging to the group "*Options*" ( ) are available via the table's context menu:

Option	Description
Show all events	All events which the current command ("*Open experiment/Start measurement* 1568") comprises are shown. Events used are shown even if the option is not activated. Just as there events for each measurement, there are also events which can only be configured for a measurement.
Show property preview	The Sequence table sows important information from the commands.  **Properties preview**

Groups - Loop, IF, Switch

By placing an **command under a loop** (Loop) or a conditional branch (If, Switch), you create a so-called "*Group*". This means the sequence has groups and levels and branches, which can be represented by a tree diagram.

The commands within a group are executed when the group as a whole is activated.

By means of Drag & Drop, you can move or copy an entire group.

13.1.3 Running Sequencer

The sequence is read, analyzed and implemented step by step. Analysis of the commands occurs at runtime. The top command in the sequence table is the first to be run. Start/Stop the Sequencer via either the menu ribbon or the context menu 1535.

Menu item	View
Extra > Start ( )	Complete
Home > Start ( )	Complete
Extra > Stop ( )	Complete
Home > Stop ( )	Complete

Targeted running of commands via the context menu

Action	Description
Start	Starts the sequence from the beginning of the table.
From selected command to end of group	Starts the sequence from the location where the context menu had been opened. The process flow remains in the current level/group 1528. This means, for example, that if the action is started from within a loop, the process flow ends at the end of the loop.
Only selected command	Only the command selected is run.

Note — Behavior upon stopping

If the Sequencer is stopped while a command is running, that command is halted and not executed all the way to its conclusion.

Special note concerning the command "*Open Experiment /Start Measurement* 1568": In this case, the measurement itself is additionally halted.

13.1.4 Useful options

In the Options, you can activate additional useful functions: "*Sequencer*".

Reduce logbook entries

When you run the Sequencer, many commands generate entries for the logbook. By means of these entries you can analyze the signals‘ background situations. For instance, what commands started right before a problem, or in what loop the routine was currently located at the relevant point in time.

Option	Description
Reduce logbook entries 114	Reduces the number of logbook entries produced by the Sequencer. The following messages will be suppressed and not be reported to the logbook window or the logbook file: • Starting/Stopping command • Messages regarding loops (for/while) • Messages regarding if and switch

The advantage of this is that more important entries in the logbook may be noticed more quickly.

13.2 Event Dialog - Panel and Automation

Certain **events** can be **linked with commands**. The commands are performed **upon occurrence of the event**. The sequence is read, analyzed and implemented step by step. Analysis of the commands occurs at runtime. The top command in the sequence table is the first to be run.

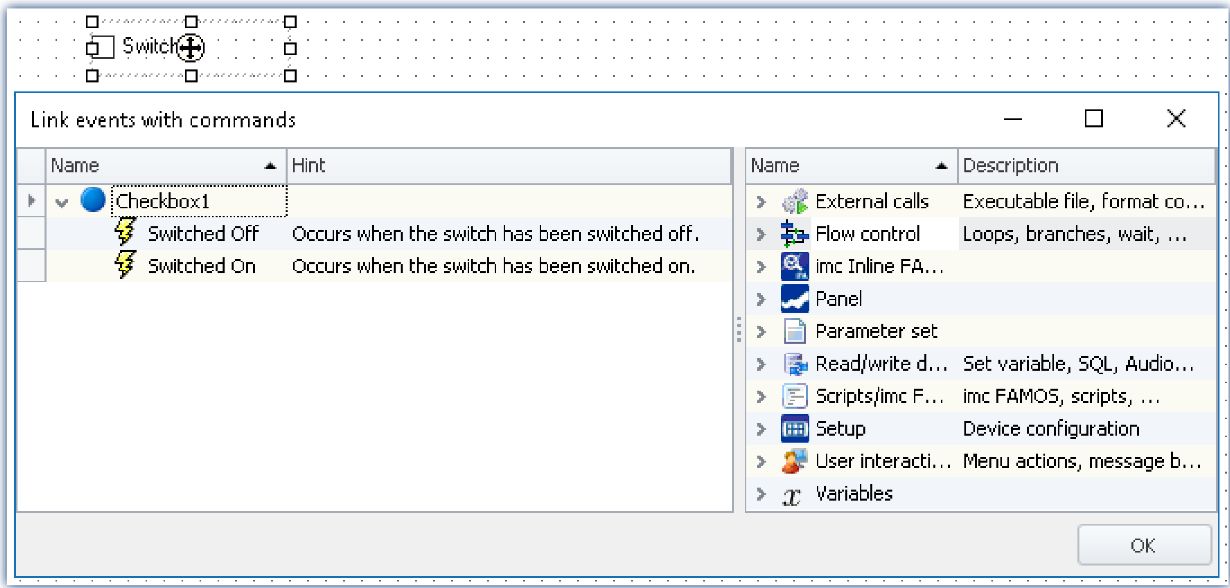
For configuring the event, the "*event dialog*".

Events can, for example, occur in the Panel when a switch is activated or in the Automation upon entering or exiting a signal state.

Example

As an example, the two events ( ) belonging to a "*Switch*" from the group "*Standard*":

Event	Description
Switched off	from On to Off
Switched on	from Off to On



"Event Dialog":
Events belonging to a switch from the group Standard

Targeted running of commands via the context menu

Action	Description
Start	Starts the event.
From selected command to end of group	Starts the event from the location where the context menu had been opened.
Only selected command	Only the command selected is run.

Note Behavior upon stopping

If the sequence is stopped while a command is running, that command is halted and not executed all the way to its conclusion.

13.3 Stopping the sequence

Except in cases of intentional intervention, a **running sequence only stops** when the **last command** has been run.

Note	Behavior upon stopping

If the sequence is stopped while a command is running, that command is halted and not executed all the way to its conclusion.

Special note concerning the command "*Open Experiment /Start Measurement* 1568": In this case, the measurement itself is additionally halted.

Stopping Sequencer manually

You can stop the running Sequencer either via the context menu or using the menu item "*Stop*".

Menu item	View
Extra > Stop ( )	Complete
Home > Stop ( )	Complete

Menu item	Beschreibung
Abort	Stops the Sequencer and exits the current command.

This method **only stops the Sequencer**. Running commands belonging to events are not affected.

Stopping Sequencer by command

You can stop the Sequencer by a command 1548.

This method **only stops the Sequencer**. Running commands belonging to events are not affected.

Stopping due to an "*Error*"

When there is an **error notification**, it usually means that something is interfering with the processing of the sequence. For this reason, **all sequences are immediately stopped** (including events). The current command posts "*Error*" in the status bar (see for instance "*Sequence table* 1527"). This is independent of the error notification's source. The notification may not have anything to do with the sequence.

Note

Deactivating "*Stop on error*"

If you wish that a **command is not stopped by an error notification**, then remove the check mark from the "*Stop on error*" box for the respective command. If an error is reported while the command is running, the sequence is not interrupted. This can be necessary in cases where, at certain points in the sequence, errors are possible but should not interrupt the sequence because they are handled in a different way.

Treat error as warning

Some commands offer the ability to **convert "personal" error messages to warnings**. E.g. the "*Load/Import variable* 1622" command with the option "*Treat error as warning*".

The command can return an error if, for instance, a variable can not be loaded because it is already present. So if you wish to load multiple variables from a file, of which one of these might already be present, you can put a checkmark in this option's box. Then the message indicating that the variable can not be loaded will be outputted as a warning.

13.4 Creating a sequence of commands

The following examples are illustrated in the sequence table. However they also apply to the "*Event dialog* 1529".

To add a command to the sequence table, there are two options:

by Drag&Drop	• Use Drag&Drop to move the command from the "Commands" tool window to the desired position. • Release the mouse button.
by the context menu 1535	• Open the context menu of the desired position and select a command.

You can place a command at different positions.

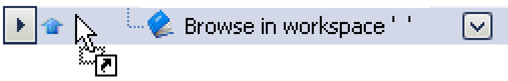
⬆	Before the current position
↳	Below or within the current position: groups 1528 (Sequencer) or events 1537 (following also called group)
⬇	After the current position

Examples of Drag&Drop

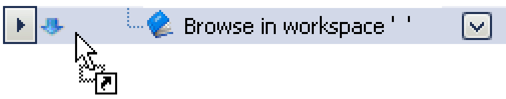
Use Drag&Drop to move the command from the "*Commands*" tool window to the desired position (in the "*event dialog*" from the right side of the dialog.).

Adding commands before or after existing commands

Commands can be added either **before** or **after** an existing command. To do this, move the mouse either a little upward/downward.



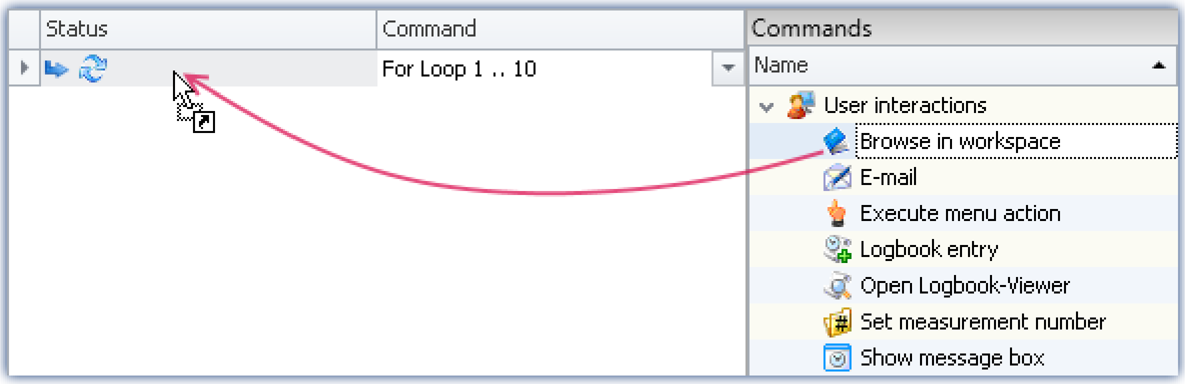
Inserting before the command: "Browse in workspace"



Inserting after the command: "Browse in workspace"

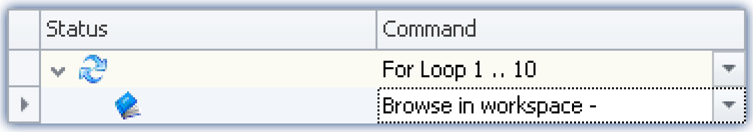
Adding commands to a group

Use Drag&Drop to place the command in a group, as seen below:

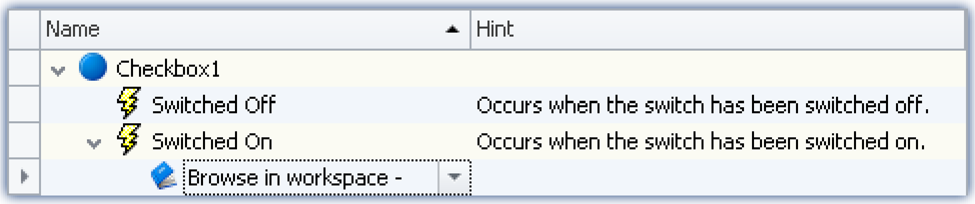


Example: Using Drag&Drop to add the command: "Browse in workspace" to the loop

To the left of the even the position is specified ( ). Release the mouse button. The command is added to the group:



Result: sequence table



Result: Event dialog

Deleting a command

To delete selected commands, highlight them and select the context menu item "*Delete*".

Action	Description
Delete	Deletes the selection
Delete all	Deletes all commands in the Sequence table or in the events. ⚠ If all commands in the events are deleted (via the Sequencer), then the commands associated with the events of the Panel pages are also deleted.

Configuring a command

Most commands need to first be configured appropriately before they will work. E.g., for "*Load experiment*", it is necessary to define what is to be loaded. Or when using "*Export*", a setting must be made to specify what to export and to where, etc.

To make the configuration, select the command in the sequence table. **Click on the button** to the right of the command's name. In most case, a configuration dialog will open.

The **various configuration possibilities** are presented in the description of the commands: "*Command Reference* 1545".

13.5 Context menu

With the context menu, you can control all of the Sequencer's functions. In order to open the context menu, click on the right mouse button in the free area of the sequence table.

			Description
	Add or New 1533 before/after/into		Sets up the selected command at the specified location.
	Cut		Clips out the selection and moves them to the Clipboard.
	Copy		Copies the selection to the Clipboard.
	Paste		Inserts the content of the Clipboard at the selected position.
	Delete		Deletes the selection
	Delete all		Deletes all commands in the Sequence table or in the events. If all commands in the events are deleted (via the Sequencer), then the commands associated with the events of the Panel pages are also deleted.
	Start 1528		
		Start	Starts the sequence from the beginning of the table.
		From selected command to end of group	Starts the sequence from the location where the context menu had been opened. The process flow remains in the current level/group 1528. This means, for example, that if the action is started from within a loop, the process flow ends at the end of the loop.
		Only selected command	Only the command selected is run.
	Abort		Stops the Sequencer and exits the current command.
	Options 1528		Some commands offer additional information which you can show. (Does not apply to commands associated with events)
		Show all events	All events which the current command ("*Open experiment/Start measurement* 1568") comprises are shown.
		Show property preview	The Sequence table sows important information from the commands.
	Expand/ Collapse		Expands/collapses either all groups 1528 or the selected group.

	Description
Element one level up	The selected commands are extracted from the current group 1528 (e.g. For-Loop, If, ...) and moved one level upward.
Move into for-loop	The selected commands are moved to a For-Loop (group 1528). You can modify the For-Loop at a later time (loop type: For/While, Start and End, ...).

13.6 Events

The bottom region of the Sequencer contains the event handling. Here, you can **link commands with events**. The linked commands are performed when the event occurs.

- Use Drag&Drop to move the command to the event. To do this, follow the same procedure as when creating a sequence 1533 in the Sequence table.

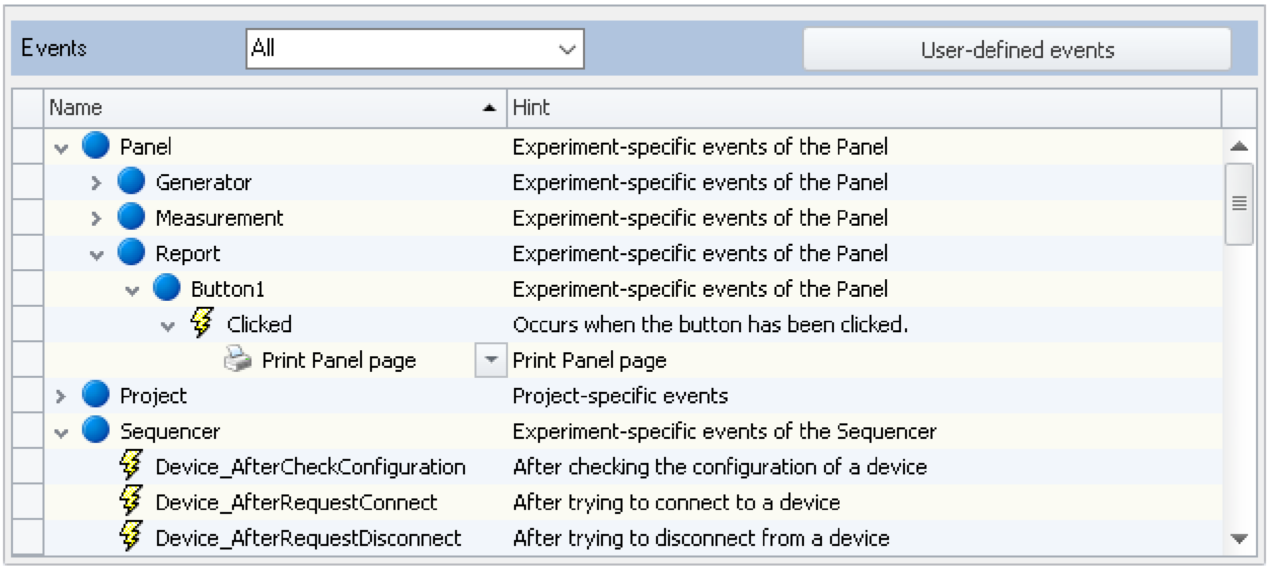
There are a variety of event types:

Type	Description
Panel	Events which are assigned to specific Widgets. E.g. a switch is actuated by a user.
User-defined events 1540	Events defined by the user such as "a variable exceeding a value limit".
(Standard) events	e.g. device actions such as "the measurement was stopped"

There are events specific to various scopes of applicability (with which they are respectively saved):

Scope	Description
Panel	Panel-events which are assigned to certain Widgets
Experiment	User-defined events which only apply within the current experiment
Sequencer	(Standard) events and user-defined events which only apply within the current experiment. These are also applicable when other experiments are loaded using the command: "Open experiment 1567".
Project	(Standard) events and user-defined events which apply to all of a project's experiments.
Command	(Standard) events which only apply within the current command ("*Open experiment/Start measurement* 1568").

The illustration below shows some events in the various applicability scopes. The event list consists of the **event/command name** and a **brief description** (column: "*Hint*").



Events on the Sequencer page

Most events affect device actions. In the column "Hint", there is an exact description of when which event occurs. For some actions, the particular moment in time is important. For instance, before the measurement is started, a Panel page is to be opened. Or after the measurement has concluded, the results and the report are to be exported.

Differing points in time

For the device actions, there is often a point in time "beforehand" and one "afterward". For instance:

Device_BeforeCheckConfiguration	Before preparation of a device configuration. The vent occurs before the preparation. The preparation is only performed once all of the event's commands have been concluded.
Device_AfterCheckConfiguration	After preparation of a device configuration.

Differing numbers of devices

Some events are triggered for each device. Others are only triggered once all devices have concluded the action.

Devices_Started	After the measurement start for all devices. The event occurs once all devices have started the measurement.
Device_Started	After the measurement start for one device. The event occurs when one device has started measurement. This means that if you have two devices, the event occurs twice when measurement starts, as long as both devices actually start this measurement.

What is noteworthy here is that both events occur upon starting of a measurement. Thus with two devices, there are three events: two times "Device_Started" and one "Devices_Started".

Attempted and successful performance

For some cases there is a distinction between whether an action is attempted and whether it is started successfully.

Devices_BeforeRequestConnect	Before the attempt to connect with all devices.
Devices_Connected	Once connection with all devices has been established.

Note Avoiding time-sensitive combinations

Once events have been concluded, other actions are initiated. However, you need to plan for a certain delay time before these actions generate results.

Example: Once the measurement has been started, the configuration is to be saved along with the measured data as a parameter set.

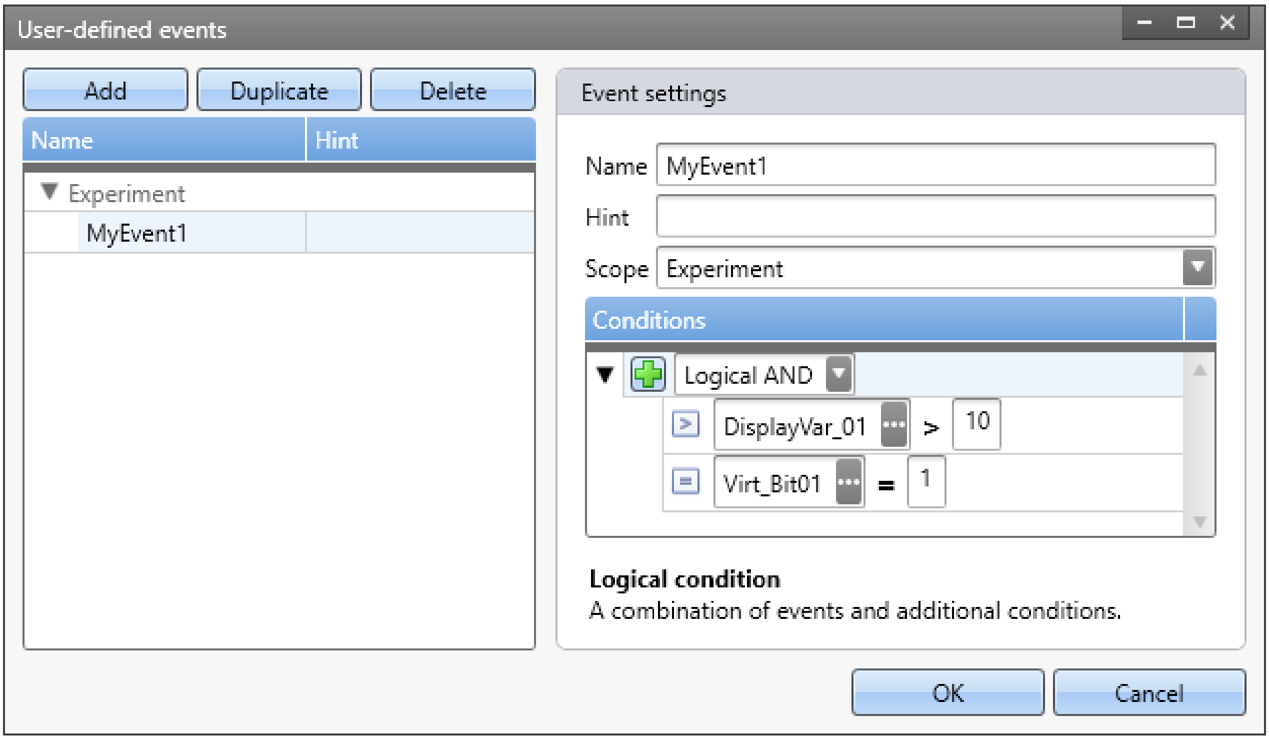
Possible implementation: Set up the command "*Export Parameter Set*" to be associated with the event "*Devices_Started*". Use "*<VARS["Channel_001"].PATH>**Parameter.csv*", for example, as the target folder.

Problem: Once the measurement starts, it takes a (very short) moment before the first measured data arrive at the PC. Next, the target folder in which the data of "*Channel_001*" is defined. The command: "*Export parameter set*" gets working faster and causes an error to occur in this case since the folder is not defined.

Solution: Avoid such time-sensitive combinations whenever possible. In this case, export could be performed at a different point in time, such as after conclusion of the measurement, for example. However, if it is not possible to change the procedure, insert the "Wait"-command (for 2 seconds, for example) at such locations.

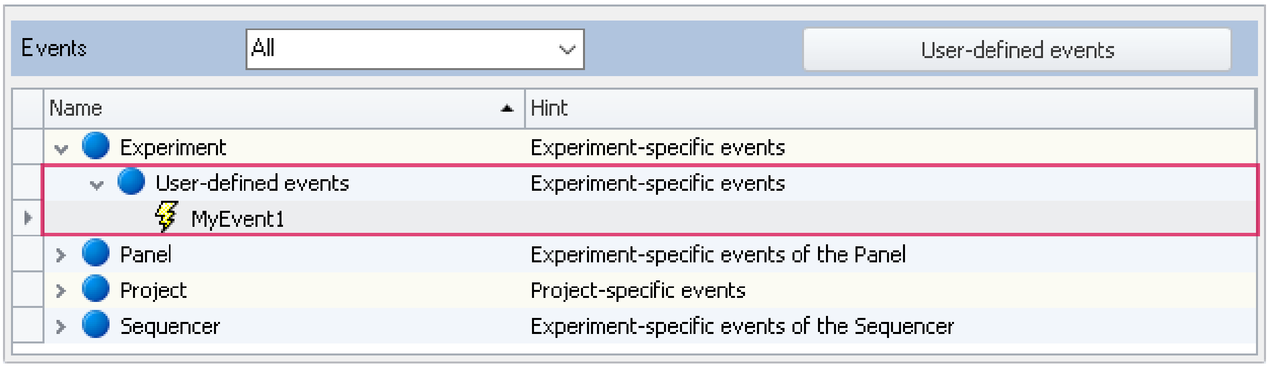
13.6.1 User-defined events

Using the button "*User-defined events*" you can create your own events. Here you can for instance, monitor variables and thus trigger actions in response.



Example: The event has occurred if:
- the Display-variable is greater than 10
and
- the virtual bit equals 1

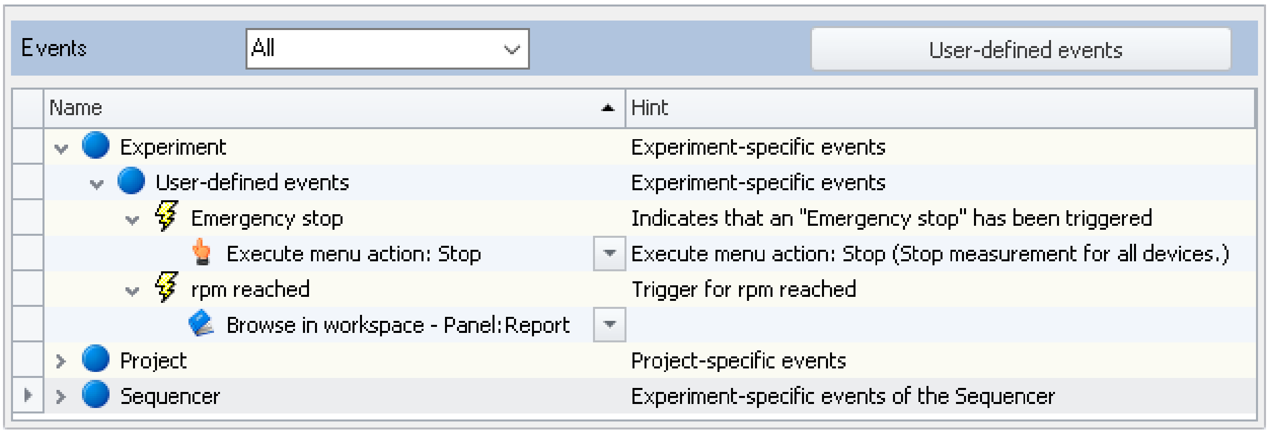
The event is found in the Events-list under the respective scope in the category "*User-defined events*".



New event, without command

Procedure illustrated by two examples

As the result of this example, you will have generated two events. Both events can cause commands to be performed.

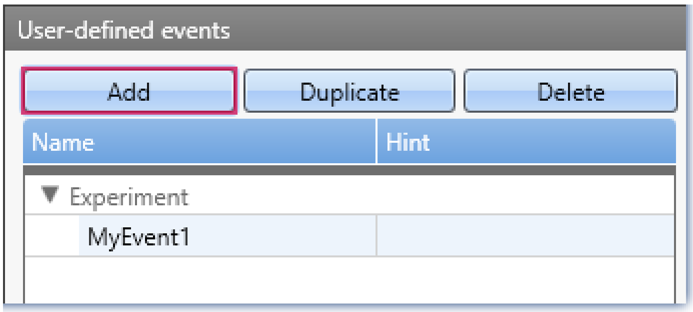


User-defined events with commands

Example **Monitoring variables**

Click on the button "*User-defined events*" in order to open the dialog.

Create an event by means of the button "*Add*". An event appears in the list:



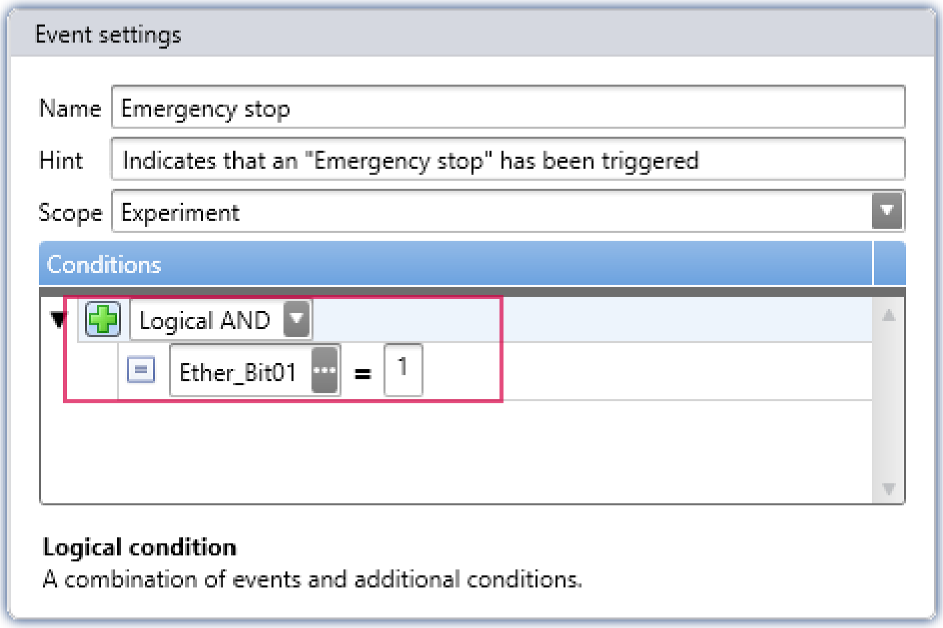
An event is created

Select the condition type via the button "+" () at right.

E.g. "Equals"

In the condition which has now been created, enter **the variable to monitor at left** and **the value at right**.

Modify the **name and the note (hint)**. These two texts are displayed in the Events-table and help keep a clear overview.



Event settings - Example of an event.
This event occurs if an "Emergency OFF" is displayed via the Ether_Bit01.

Example — Trigger event

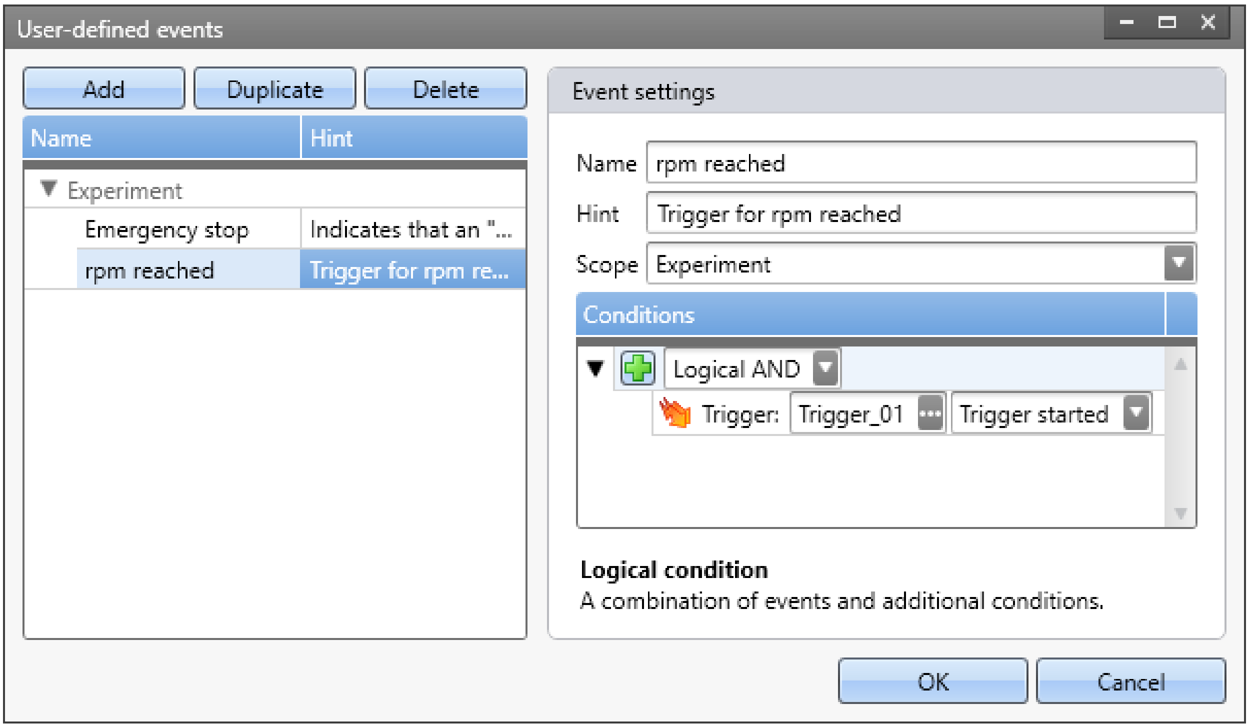
Create an event by means of the button "*Add*". A second event appears in the list.

Select a condition type by means of the "+"-button () at right.

E.g. "Trigger"

In the examination which has now been set up, enter **the trigger to be monitored at left** and **the trigger state at right**.

Modify the **name and the note (hint)**.



In the dialog you will find at left two configured events. After confirming by clicking on the "OK" button, both events can be found in the table.

Next, link commands with the two events.

Condition types

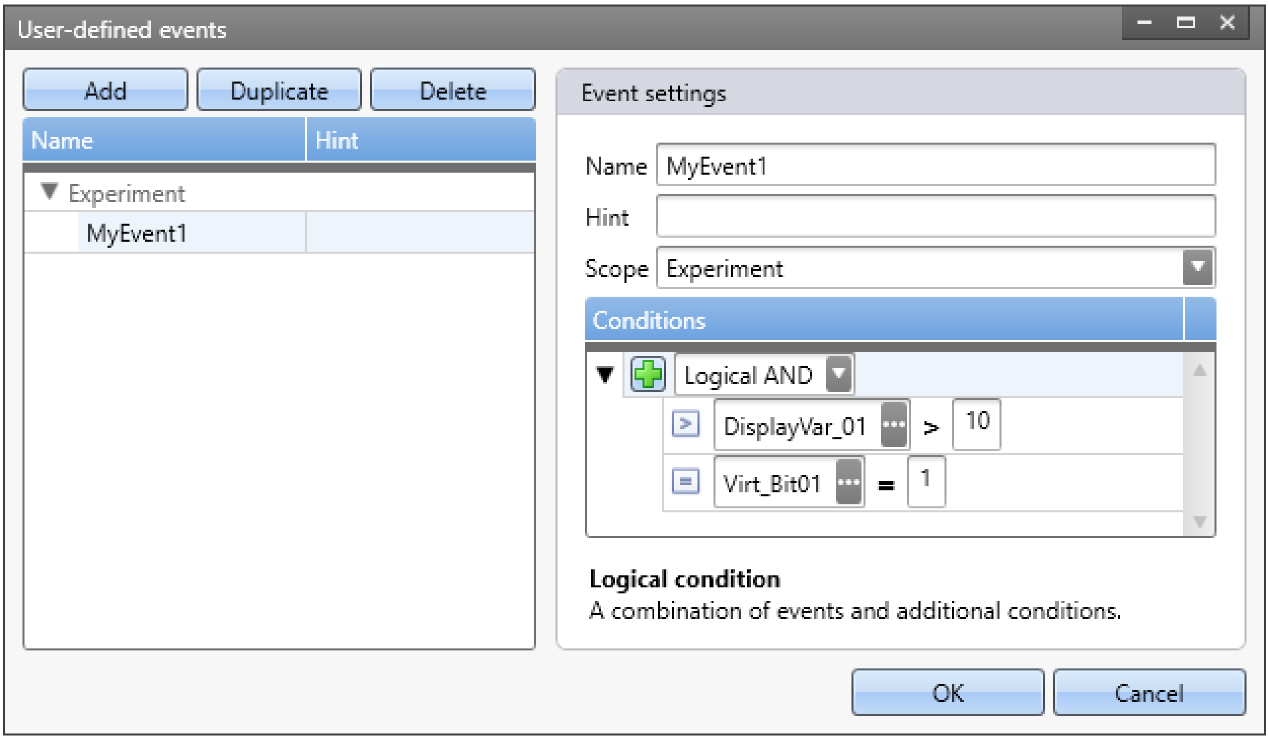
Select a condition type via the "+"-button () at right.

Here you find a variety of conditions. Among others, value comparisons such as "*greater*", "*lesser*", "..." which need no explanation at this moment. Below, additional special conditions are presented:

Condition	Description
Logical condition	Inserts a subordinate logical operation. This may in turn contain its own conditions.
User-defined event	This condition is met when another user-defined event occurs.
Trigger	Reacts to trigger states; the available options are "Trigger started", "Trigger stopped" and "Trigger changed"
Timer	Enables the commands to be run cyclically - *Attention: starts immediately upon setting the event (when the OK-button is clicked).*
Value change	This condition is met when the variable's value changes.

Linking with conditions - Logical condition

It is possible to link multiple conditions with an event.



Example: The event has occurred if:
- the Display-variable is greater than 10
and
- the virtual bit equals 1

Operator	Description
Logical and (AND)	When all conditions are simultaneously "*true*", the result is "*true*"
Logical or (OR)	When one of the conditions is "*true*", the result is "*true*".
Exactly one condition	When exactly one condition is "*true*" (and no more), the result is "*true*".
Logical NAND	Unless all conditions are simultaneously "*true*", the result is "*true*". Or stated another way: If all conditions are simultaneously "*true*", the result is "*false*".
Logical NOR	Unless one of the conditions is "*true*", the result is "*true*". Or stated another way: If one of the conditions is "*true*", the result is "*false*".

Example

Condition: Within a range, but not including the range boundaries: x>a AND x<b

Condition: Within a range, including the range boundaries: x≥a AND x≤b

Scope

By means of the scope, you define where the event is to be saved and for what it is to apply. See "Scope 1537" of events.

Notes and tips

Tip: Suppressing the timer

The timer is to be tripped only once a certain point in time is reached.

Solution: Use an AND-operator with a second condition (e.g. Virtual Bit=1).

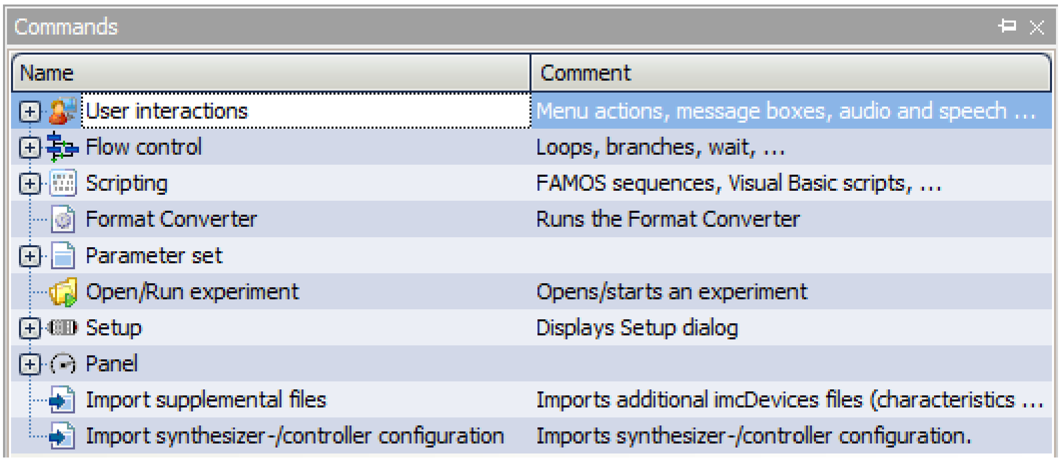
Disadvantage: the timer continues to run in the background the whole time. The timer's actual start time can not be chosen.

Note: When the same event occurs too soon

The linked commands are all run in succession. Only once one has been concluded can the event be triggered again. If the event occurs again during processing, a warning appears in the logbook.

13.7 Command Reference

Commands allow the execution of targeted actions such as jumping to a Panel page, running a imc FAMOS sequence, or printing out a Panel page as a report.


Commands

Name	Comment
User interactions	Menu actions, message boxes, audio and speech ...
Flow control	Loops, branches, wait, ...
Scripting	FAMOS sequences, Visual Basic scripts, ...
Format Converter	Runs the Format Converter
Parameter set	
Open/Run experiment	Opens/starts an experiment
Setup	Displays Setup dialog
Panel	
Import supplemental files	Imports additional imcDevices files (characteristics ...
Import synthesizer-/controller configuration	Imports synthesizer-/controller configuration.

Tool window Commands

Commands are available in various areas of imc STUDIO and imc WAVE:

- imc STUDIO Sequencer
- imc STUDIO Panel
- imc STUDIO Automation

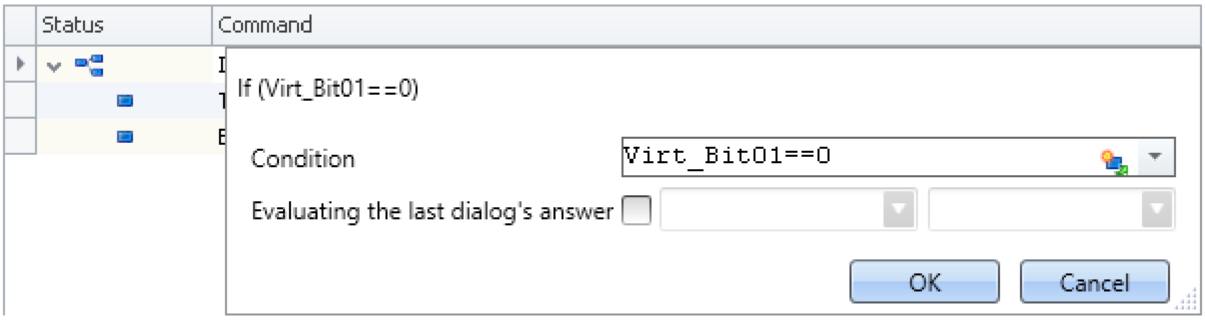
Note

Not all commands described here are available in all areas mentioned, since not all of them are relevant to every area. The commands respectively available are displayed in the associated command list.

13.7.1 Flow control

13.7.1.1 If

"*If*" enables the routine to branch off in response to "*If*" and "*Else*" instructions.

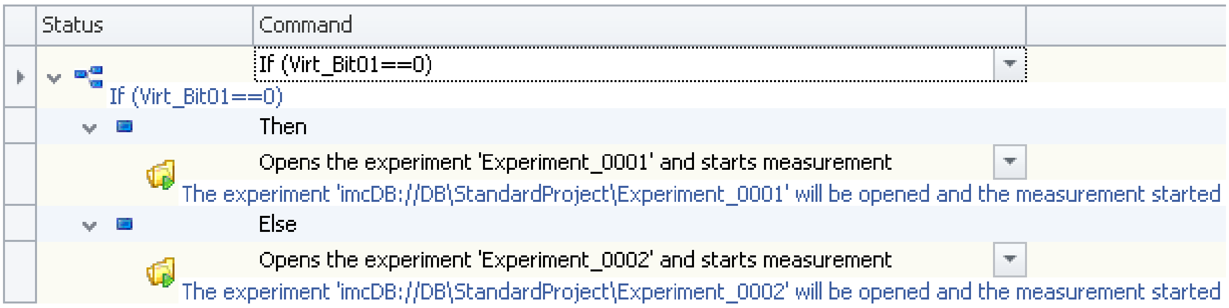


Note that a comparison is performed using the operator "==".

Note — **Evaluating the last dialog's answer**

Using this command it is possible to react to dialog responses. For more on this topic, see: "*Evaluating the last dialog's answer* 1550".

Beispiel Example 例 — **Loading different experiments according to a variable's value**



Example: Depending on the variable Virt_Bit01 an experiment is loaded and started.

In the example, an experiment is loaded and started, depending on the variable "*Virt_Bit01*". If the variable's value is "0", then "*Experiment_0001*" is loaded and started. For any other value, "*Experiment_0002*" is loaded and started.

Note — **Note on loading an experiment from the Sequencer**

Note that the command "*Open Experiment/Start measurement* 1567" does not overwrite the Sequencer. The Sequencer is ignored when the command "*Open Experiment/Start measurement* 1567" is selected.

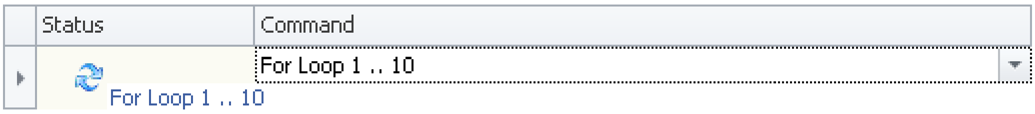
13.7.1.2 Loop

Repeatedly run sections of code are placed inside of loops. There is a distinction between the For Loop and the While Loop.

- A *For Loop* is repeated until a specific number of loops is reached.
- A *While Loop* is run until a specifically defined condition is met.

As the counter variable, a PV variable or Display variable can be used, which can be displayed, for instance, in the Panel.

From the *commands* belonging to the group *Flow control*, drag the command *Loop* to the sequence table.

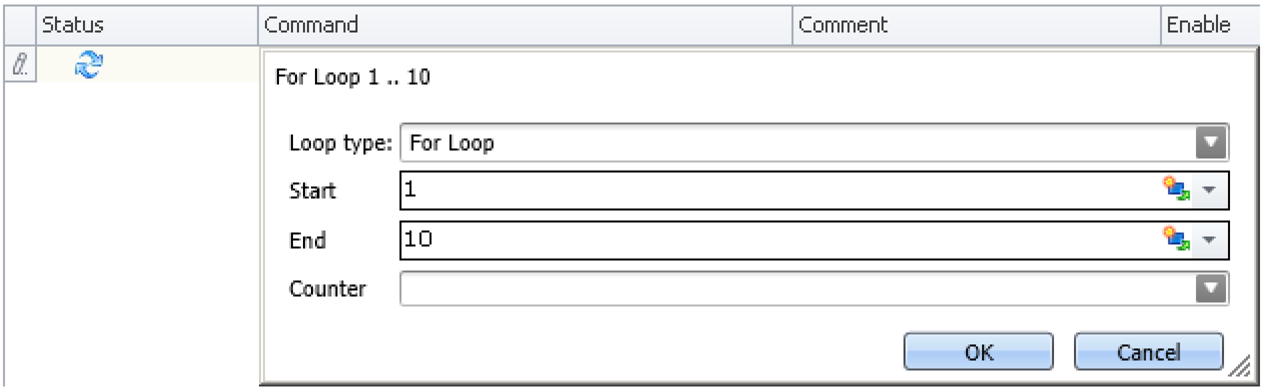


Flow control: Loop

Right-click next to the *For Loop* entry to open its Properties dialog:

- Select the *Loop type: For Loop* or *While Loop*.

For Loop

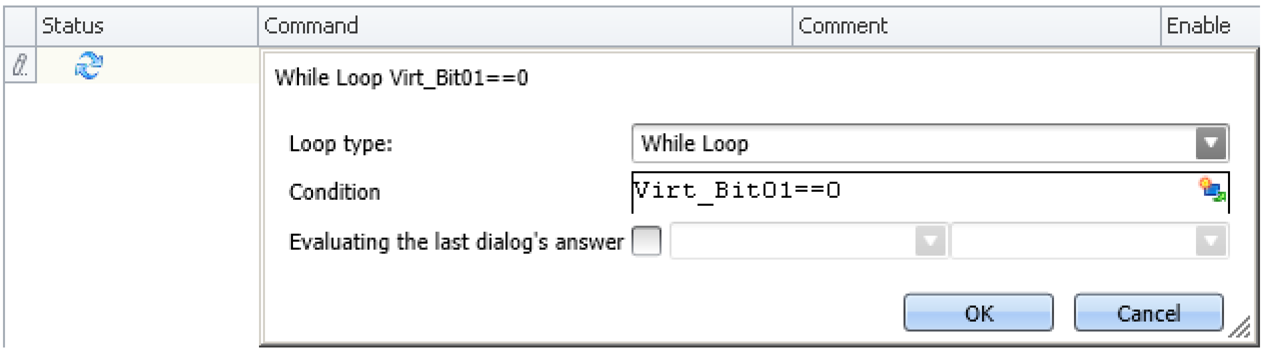


Flow control: For Loop

A *For Loop* has a *Start*- and an *End*- number. These can be constant numbers or variables (PVV or Display variables).

The current number of runs is specified under *Counter* as a Variable.

While Loop



Flow control: While Loop

A *While Loop* is repeated until the *Condition* is no longer fulfilled.

In the example, by means of the symbol under *Variable* the virtual Bit01 was used. As long as this is not set, the Sequencer stays in the loop.

Note that a comparison is performed using the operator "==".

Reference

An example of a For Loop 1639 and While Loop 1641 is found in the examples for the plug-in Sequencer.

Note Evaluating the last dialog's answer

Using this command it is possible to react to dialog responses. For more on this topic, see: "*Evaluating the last dialog's answer* 1550".

13.7.1.3 Stop Sequencer

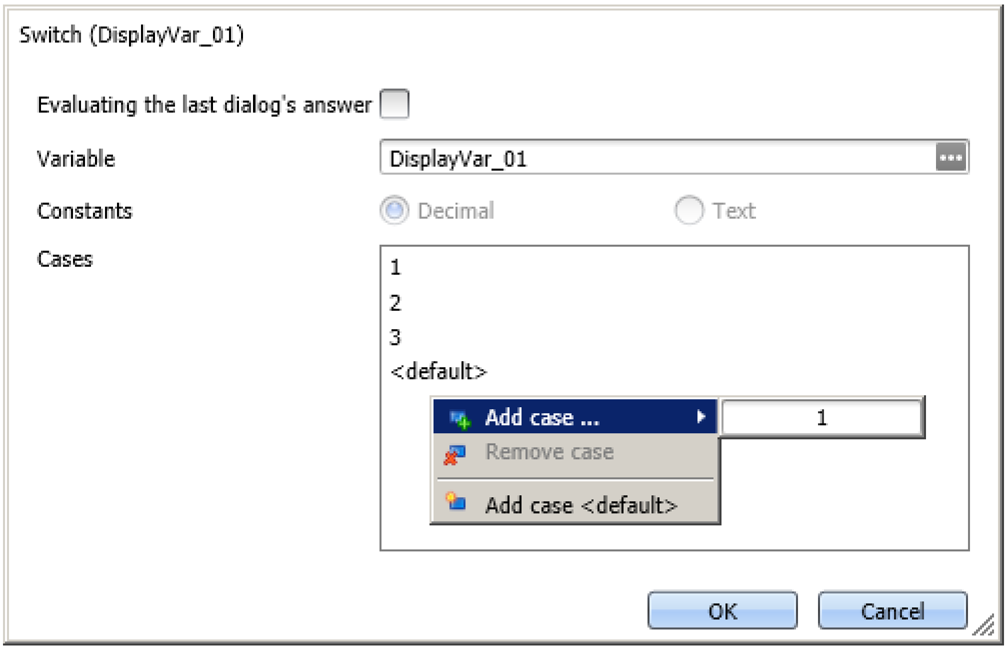
When this command is run, the Sequencer is stopped. The command only takes effect on the Sequencer running. Other command-lists, such as ones which are started by means of a Panel-button, are not stopped in that way.

13.7.1.4 Switch - Case

The command Switch enables multiple branching (Case) depending on a variable's value.

The *Variable* must be a single value (Display- or PV-variable) or a text variable.

The *Cases* are defined as concrete numbers (*decimal*) or texts (*Text*).



Flow control: Switch

Expressions such as "2<x<5" are not allowed here.

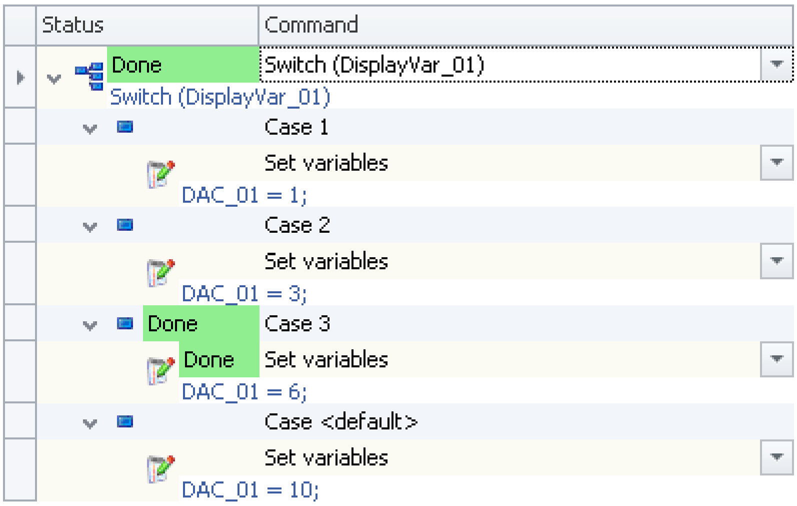
Additional *cases* are added using the right mouse button.

Note Evaluating the last dialog's answer

Using this command it is possible to react to dialog responses. For more on this topic, see: "*Evaluating the last dialog's answer* 1550".

Example

In the example, the Displayvariable DisplayVar_01 is linked to a pop-down list in the Panel.

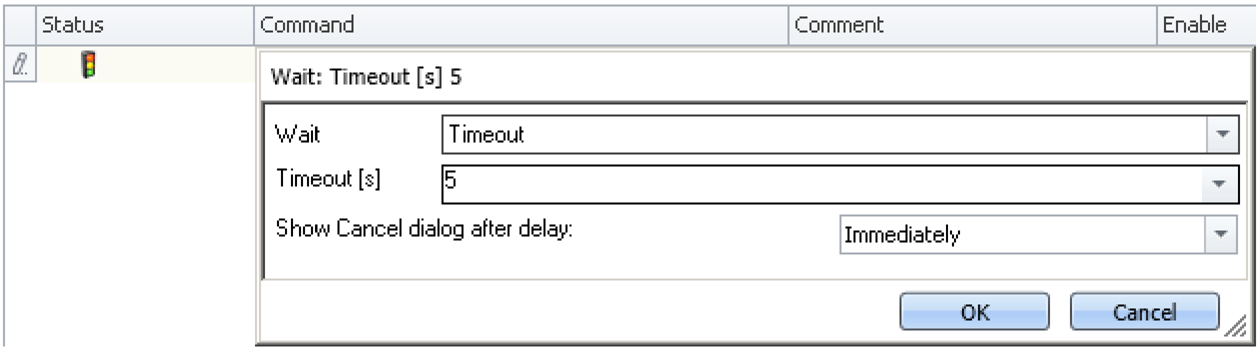


Example of a Switch - Case structure

The selected line determines the value of the Display variable. The analog channel DAC_01 is set in response to the value.

13.7.1.5 Wait

Using the command *Wait* you can halt the Sequencer. The waiting time can be set in the mode *Timeout* or be made to depend on a *Condition*.



Flow control: Wait

Parameter	Description
Wait	Sets the mode to either **Timeout** or **Condition**.
Timeout [s]	In the *Timeout* mode, enter the waiting time here, in seconds. This can be achieved by use of a variable, or it can be a fixed value.
Show Cancel dialog after delay	If you wish to cancel the timeout early, you can have a "Cancel dialog" after a specified time.
Condition	In the mode *Condition*, set the condition here, e.g. `Virt_Bit01==1`

Note that a comparison is performed using the operator "==".

13.7.1.6 Evaluating the last dialog's answer

By means of this property, some commands can react to dialog responses. This property is available for the following commands:

- If 1546
- Loop as While Loop 1546
- Switch 1548

For the evaluation, always the response to the last dialog is used. This includes *Show message box* 1554 and *Show Panel page as dialog* 1579.

The last dialog-response is reset when the Sequencer is re-started. In consequence, at every start of Sequencer, the same state is available: "No response provided yet".

Is no response available yet?

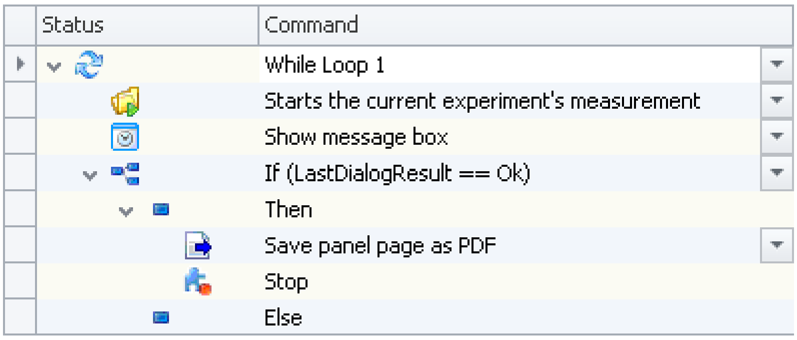
If no dialog has received a response yet by the time a response must be evaluated, the response: "*OK*" is assumed. For example, a question is posed at the end of a While-loop, which decides whether the While-loop is repeated or concluded. In this case, no response is available upon entering the While-loop, so "*OK*" is assumed.

Example

Example for the If-command:
Loading different experiments depending on variable's value

In a message box (command: *Show message box*), the user is asked whether the measurement was processed properly and the procedure can thus be concluded.

- For `Yes`, a report-page is to be exported and the Sequencer is stopped.
- For `No`, the measurement is to be repeated.



Example: Depending on a dialog result, the Sequencer is either stopped or run one more time

Note

Notes regarding the evaluation

- **Only such dialogs are evaluated which are called in the course of executing the Sequencer.** Any dialogs called by means of a Panel-button or by a another event are not evaluated.
- Please note that there is no assignment for what dialog to evaluate. Always the last dialog called by Sequencer is evaluated. For this reason, either evaluate dialogs immediately or ensure that between the dialog and its evaluation, no other dialog can be called by means of the Sequencer.

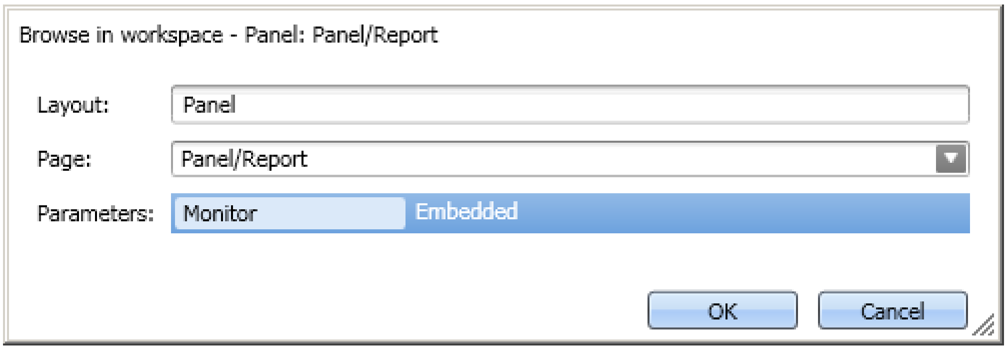
13.7.2 User interacion

13.7.2.1 Browse in workspace

If the command **Browse in workspace** is executed, imc STUDIO jumps to the selected page. Every main window can be selected as the target. With main windows which have their own pages, it is also possible to jump directly to a special page (e.g. Panel or Setup).

If a Panel page is defined as the target, the page can also be displayed on a monitor of the user's choice in fullscreen mode. In this case, imc STUDIO does not change the main window. Thus, for instance, the Sequencer can be viewed on the main monitor, while on the second monitor, the measured data can be viewed on a Panel page in fullscreen mode.

Using this command, it is always possible to open the appropriate window via the Sequencer, or to jump to, for example, the balancing dialog, by means of a button on a Panel page.



Selection of a specific page

Parameter	Description
Layout	Display of the main page's name. Adjusts itself according to the target page. Can not be edited.
Page	Here, you define the target page.
Parameters	If target page: Panel • **View: Panel Embedded Mode:** Jumps to the Panel. If necessary, exits fullscreen view. • **View: Panel Fullscreen Mode:** Jumps to the Panel in fullscreen mode (see Panel menu ribbon: *Control* > *Panel fullscreen view* 1059). If target page: Panel page • **Monitor: Embedded:** Jumps to the Panel and opens the selected page • **Monitor: <Monitor name>:** The page is displayed in fullscreen mode on the monitor selected. Independent of the opened main window (see Panel Context menu: The Panel page's tab: *Show Page on Monitor* 1094).

Reference

An example of the command: "*Browse in workspace*" is presented in the user’s manual: Sequencer > Tutorial 1625.

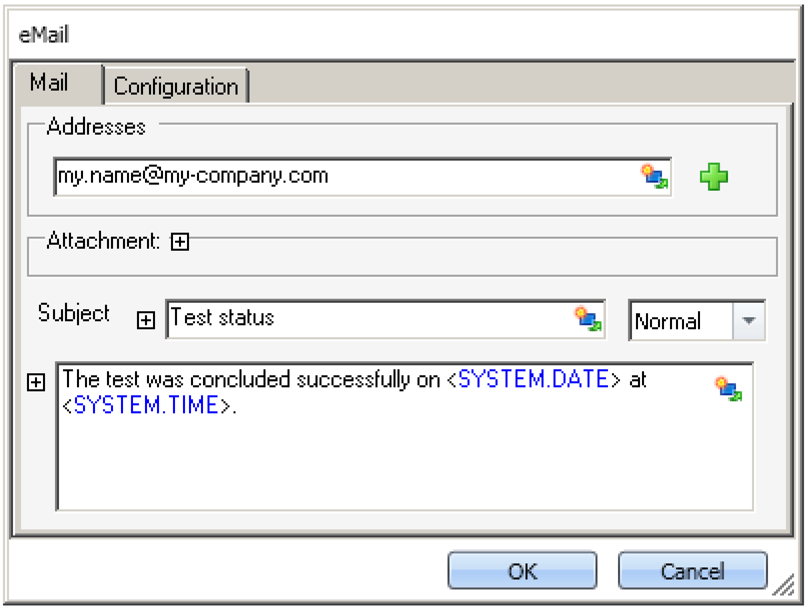
13.7.2.2 E-mail

The command **E-mail** enables automated sending of an email in important situations. For this purpose, no external E-mail program is required.

The E-Mail-provider requires the login data of the sender's address.

Mail

The typical dialog boxes for an e-mail program are found on the page *Mail*.



Defining an E-Mail

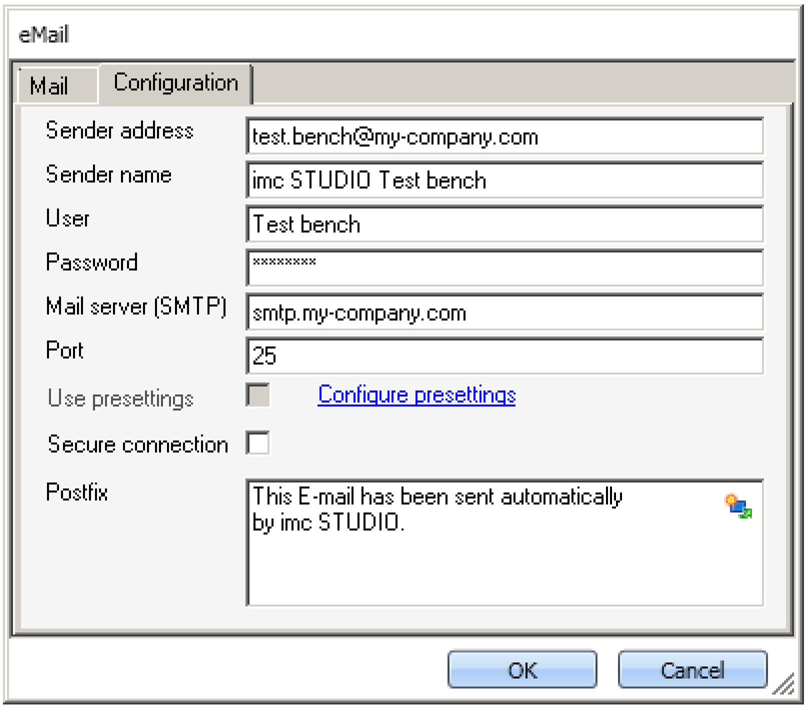
By right-clicking, or by clicking on the placeholder symbol (), you can apply a variety of placeholders.

Under *Addresses*, you can define one or more recipients. Additionally, an *Attachment* can be added and the *Priority* of your message specified.

The box *Subject* and the text to be sent can be defined in various languages.

Configuration

On the page *Configuration* you set the access data for the E-Mail provider.



Defining the E-Mail configuration

Parameter	Description
Sender address	Sender address (your email address).
Sender name	The name of the sender of the email (your name).
User	User name for logging in.
Password	Password for authentication.
Mail server (SMTP)	Outgoing mail server of the E-Mail provider used.
Port	SMTP server port used.
Use presettings	In the imc STUDIO option, it is possible to define a presetting for the E-Mail command (Ribbon *Extra > Options*). If "Use presettings" is activated, these settings are applied. This means that the setting can be defined a single time in the Options and does not need to be entered again for each E-Mail command.
Encoded connection	Encryption protocol for secure data transmission via Internet.
Postfix	This postfix will be appended to every email.

FAQ

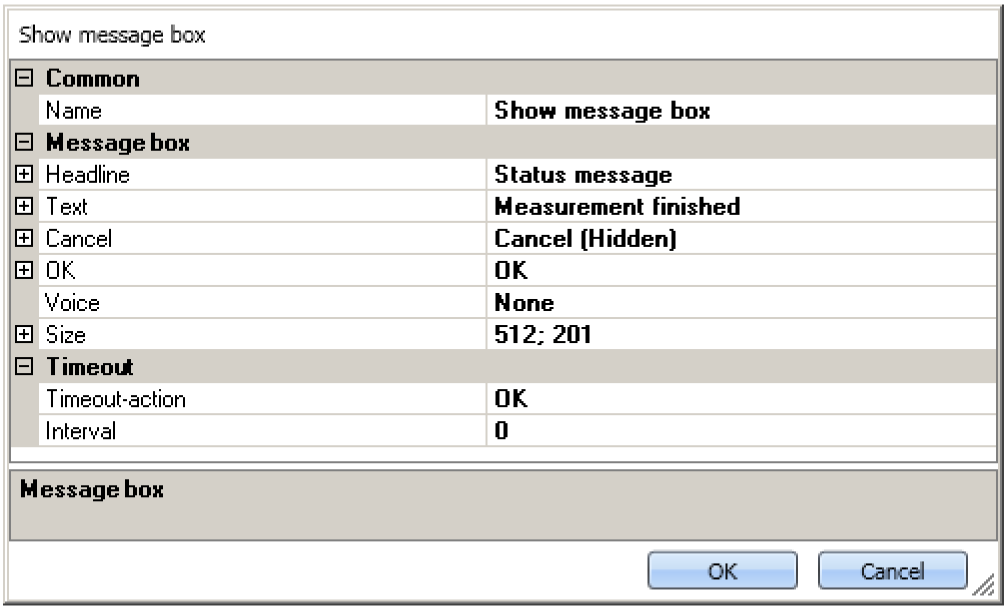
Why do E-mails not get sent, even though the settings are correct?

Answer: For reasons of security, some firewall programs prohibit the sending of E-mails when the firewall is not familiar with the program. Please check your firewall and configure it if necessary. **The process "imc.studio.exe" must be permitted to send E-mails if imc STUDIO is intended to send mails.**

13.7.2.3 Show message box

When the command *Show message box* was executed, a user-defined dialog was displayed. This can be used to display information, or to ask the user what to do next.

Along with a header and the information text, the dialog can also be displayed with a voice output.



Show message box

Parameter	Description
Name	Display text in the sequence table (without effect on the dialog).
Headline	The dialog’s header.
Text	Text displayed in the dialog. With "\r\n", it is possible to force a line break.
Cancel OK	Settings for the buttons: "OK" and "Cancel" **Text:** Button caption **Visible:** The button can be either shown or hidden. • **Show:** The button is shown. In this way, the dialog can be closed with the corresponding dialog response. • **Hide:** The button is hidden In this way, the dialog can not be closed with the corresponding dialog response.
Voice	Character of the voice output. The available selection depends on the Windows system and usually only offers English voices.
Size	Size of the dialog.
Timeout-action	The selected action is performed upon elapse of the timeout time. The dialog is closed with "OK"/"Cancel".
Interval	Duration in seconds [s] until the timeout occurs. "0" switches the timeout off.

Note Evaluating the dialog’s answer

Note that it is possible to have the dialog’s response evaluated automatically.
See: Evaluating the last dialog's answer 1550.

Reference Tutorial

An example of the command: "*Show message box*" is presented in the user’s manual:
Sequencer > Tutorial 1625.

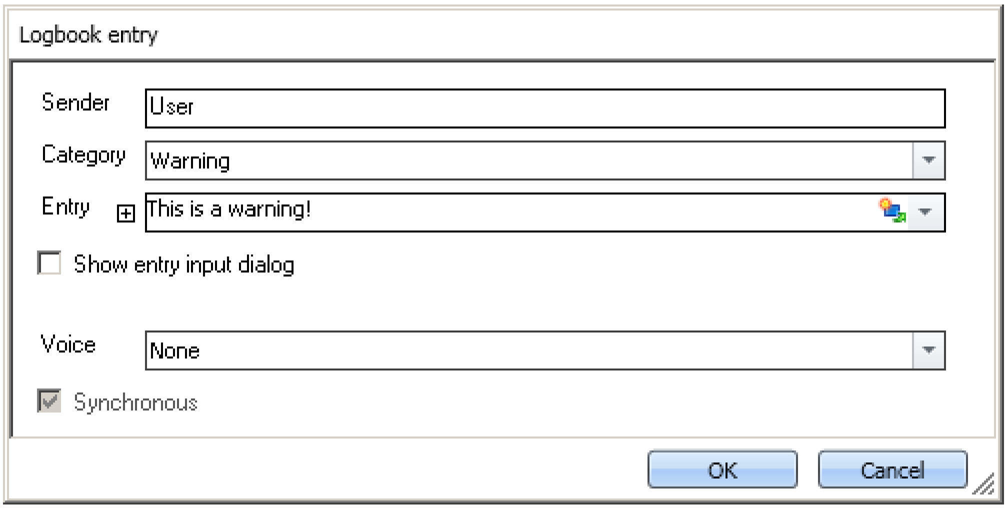
13.7.2.4 Open Logbook-Viewer

If the command is executed, the Logbook-Viewer is opened. How to operate the Logbook-Viewer is described in context of the tool window: Logbook 122.

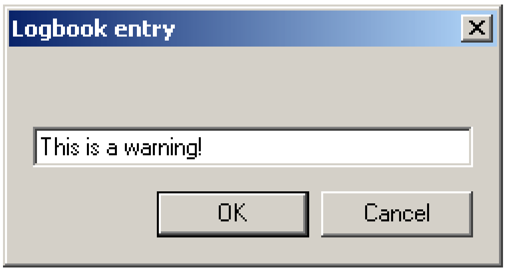
The Logbook-Viewer can be started with defined filter settings. For example, messages of the category: *Information* 123 and all Duplicates 123 can be hidden.

13.7.2.5 Logbook entry

Using this command, you can create an entry in the logbook and stop the Sequencer if appropriate.



Properties of the log book entry

Parameter	Description
Sender	Entry of information on the message's origin.
Category	There are four different categories: • **Information:** Informative messages • **Warning:** Warning text entry in the log book, otherwise no other effects. • **Error:** Error message, which interrupts the running Sequencer if appropriate. • **Fatal:** Fatal error message, which interrupts the running Sequencer if appropriate.
Entry	Text entered as message in the log book.
Shows entry input dialog	Enables a text input during runtime.  **With the option: "Show entry input dialog"**
Voice	The message text can be spoken by the computer voice.
Synchronous	When activated, the Sequencer remains on this command until audio output (Voice) was completed.

Output in the Logbook:

The output is logged to the logbook.

	Time	Code	Message	Sender
	13.02.2015 16:42:48	0	Sequencer ...done	imc STUDIO
	13.02.2015 16:42:48	0	This is a fatal error!	User
	13.02.2015 16:42:48	0	This is an error!	User
	13.02.2015 16:42:47	0	This is a warning!	User
	13.02.2015 16:42:47	0	This is some information	User
	13.02.2015 16:42:47	0	Sequencer ...starting	imc STUDIO

Logbook with generated entries

13.7.2.6 Execute menu action

This command lets you execute a menu action. A list contains the actions available in the menu ribbon. When this command is run, it replicates clicking the mouse over the corresponding button.

This command is often linked with switches on the Panel. In particular when the Panel is run in fullscreen. The menu ribbon is not present then.

Reference Widget: "Execute menu action"

The action can be directly linked with the synonymous Widget: "*Execute menu action* 1373". This Widget adapts itself to the status of the menu action. E.g. when the action is currently not present, the button can not be clicked.

Note When is the command "Done"

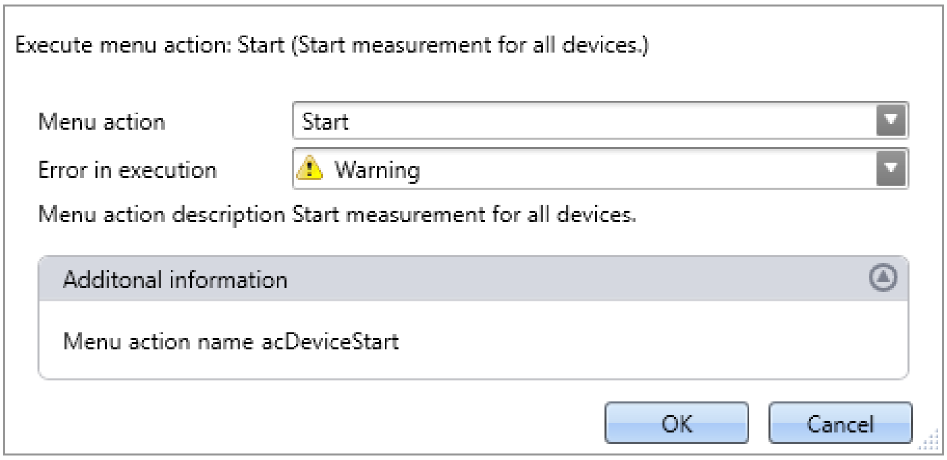
The sequence does not wait for the function behind the action to be concluded. For the sequence, the action is "done" when the action is acknowledged.

Examples:

- Menu action: Connect
  The command does not wait until the connection can be established.
  The command does not care whether the connection even can be established.
- Menu action: Start Measurement
  The command does not wait until the measurement has been started.
  The command does not care whether the measurement even can be started.

Once the action has been initiated, the command is "done". Even if error messages are posted afterward.

The menu action can not be executed if it is not available or not enabled. Some menu actions are attached to specific user roles, device components or loaded imc STUDIO-components. When such actions are initiated, a corresponding error message is posted.



Configuration: Execute menu action

Parameter	Description
Menu action	Here, select the desired menu action. Open the drop-down list. The menu actions appear in groups. Scroll to the appropriate group and select the desired action. Filtering: You can enter the first letter of the action's name in the input box. Then the list will be restricted to actions starting with that letter.
Error in execution	If the action is not enabled or not available, the command may respond in various ways. • Error: The command returns an error message in the logbook. If "Stop on error" is activated, the sequence is stopped. • Warning: The command returns a warning message in the logbook. The sequence continues to run. • Ignore: The command is concluded with "Done". No info appears in the logbook.
Menu action description	The action's description text is displayed.
Additional information	The menu action's internal designator is displayed.

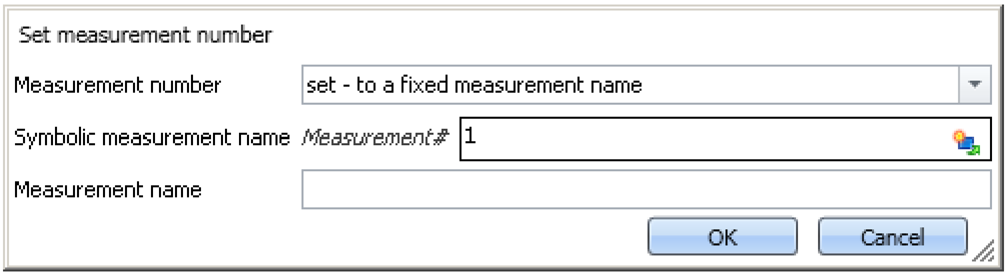
13.7.2.7 Set measurement number

The command *Set measurement number* assigns a measurement number to a measurement.

The available settings are:

- Set measurement number **to a fixed measurement name**
- Set measurement number **to a fixed index**
- Set measurement number **to the last completed measurement**
- Set measurement number **to a fixed offset before the last completed measurement**
- Remove measurement number

The numbers **1 through 99** can be used for assigning measurement numbers.**set - to a fixed measurement name**

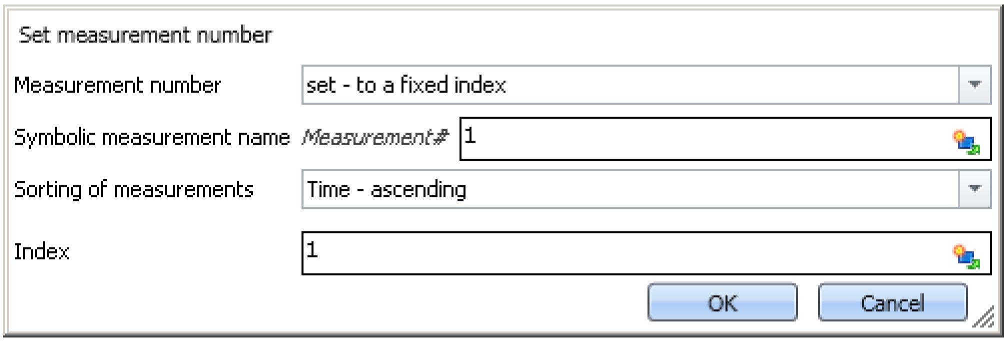


Command "Set measurement number to a fixed measurement name"

With this command, you can assign a number to a measurement which has a **particular measurement name** at the time the command is run.

In the box *Symbolic measurement name*, you specify the measurement number to be assigned. In the box *Measurement name* you can assign a name to the measurement receiving that number.

set - to a fixed index

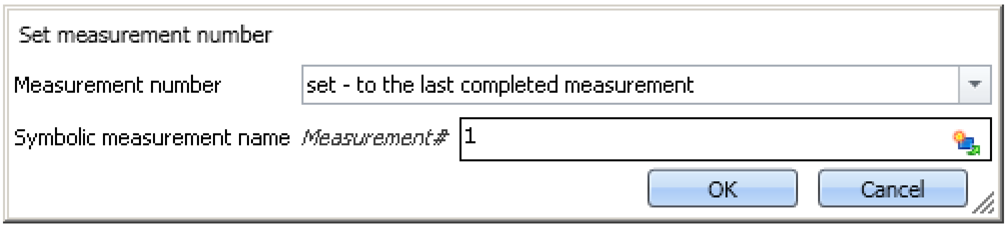


Command "Set measurement number to a fixed index"

With this command, you can assign a number to a measurement which has a **particular index** at the time the command is run.

In the box *Symbolic measurement name*, you specify the measurement number to be assigned. In the box *Sorting of measurements*, you can specify what kind of sorting to apply to the value entered in the box *Index*.

set - to the last completed measurement

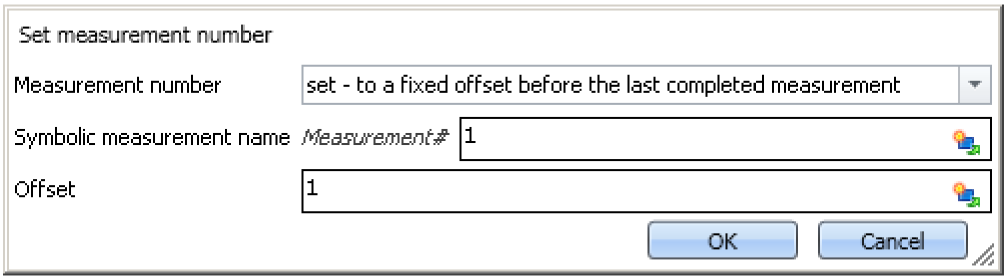


Command "Set measurement number to the last completed measurement"

With this command, you can assign a number to a measurement which is the **last completed measurement** at the time the command is run.

In the box *Symbolic measurement name*, you specify the measurement number to be assigned.

set - to fixed offset before the last completed measurement

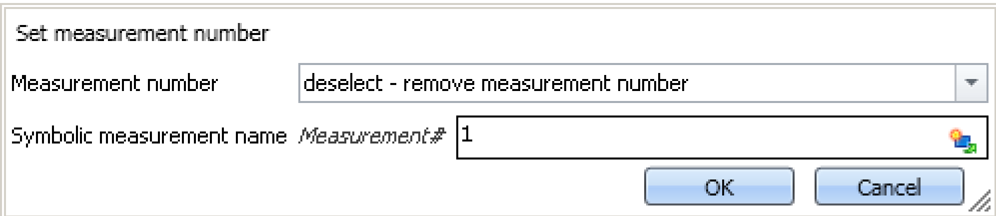


Command "Set measurement number to a fixed offset before the last measurement"

With this command, you can assign a number to a measurement which has a certain **offset to the last completed measurement** at the time the command is run.

In the box *Symbolic measurement name*, you specify the measurement number to be assigned. In the box *Offset*, you can specify how many completed measurements going back the measurement to be numbered is. For instance, an offset of 1 means that the next-to-last completed measurement is assigned the number.

deselect - remove measurement number



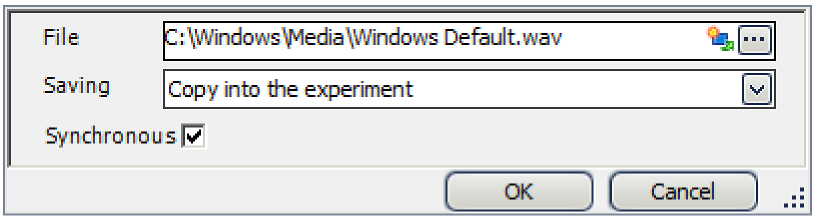
Command "Set measurement number - remove measurement number from a measurement"

With this command, you can delete an assigned measurement number from any measurement.

In the box *Symbolic measurement name*, you specify which number to delete. It does not matter to which measurement this number is assigned.

13.7.3 Read/Write data

13.7.3.1 Play soundfile



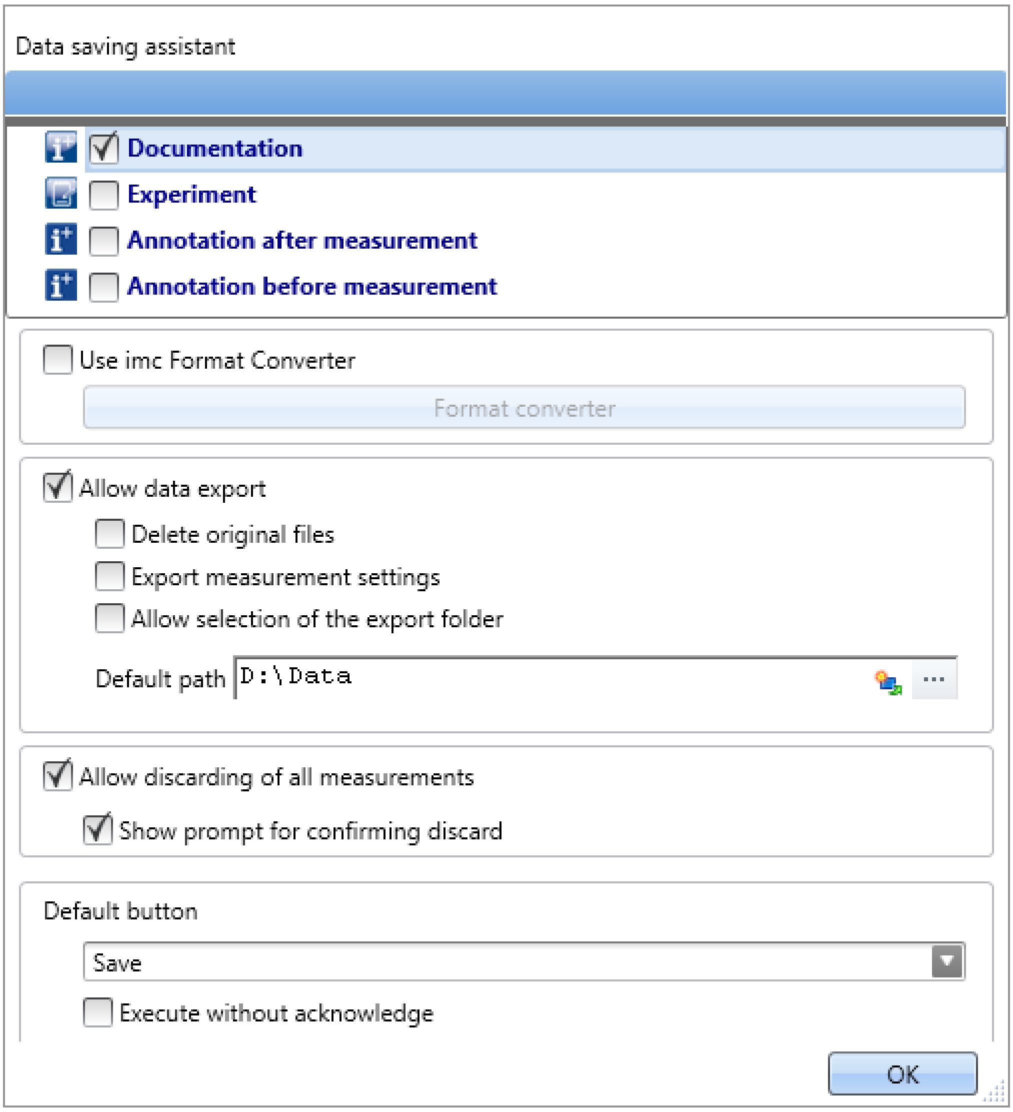
Properties of Play soundfile

Parameter	Description
File	Select an audio file in WAV format.
Saving	Sets whether the audio file is permanently saved in the experiment file *(As copy in the experiment)* or only the path to the file is saved *(Only as link).*
Synchronous	When activated, the Sequencer remains on this command until audio output was completed.

13.7.3.2 Data saving assistant

If data saving to the PC was selected for at least one active channel, then in the default case, the measurement results are saved in the database. With the help of the **Data Saving Assistant** command, one can continue to specifically process these measurements. This command must be started either through a Panel event (Widget) or by means of a sequencer event.

The Data Saving Assistant lists all new measurement folders which were created since the start of the last measurement. The number of folders depends on for instance the interval data saving or the interrupt/resume of data storage. Thus, these measurements, for example, can then be exported with or without deleting the original files.



Data Saving Assistant

Setup pages

It is possible to save **measurement comments** (metadata) which pertain to the measurement. In the list at the top, the Setup pages are listed. When you select one of the pages, this page's parameter set as saved with the measured data as a *.csv* file.

If the assistant is running, a new window appears. For each page selected, a tab is added at the top. There, you can fill the fields.

imc Format Converter

In addition to the saved or exported measurement results, you can transfer the results to other formats. In the options for the imc Format Converter, you can additionally specify the format, e.g. ASCII or EXCEL.

Data export

This settings allows you to export saved measurements.

Allow data export

When this option is active, the measurement results can be exported to a different location. When the command is executed, an additional button appears, by means of which the export is initiated. I.e. in that case the buttons *Export* and *Save* become available.

- If you click on *Save*, the measurement result only goes to the database.
- If you click on *Export*, the data are exported according to the settings for the other options.

Delete original files

The original files in the database can be deleted upon exporting. This means that the database only contains the explicitly saved measurements which were not exported. The exported measurements are only located in the export path.

Example: Supposing you don't need the measurement results to be in the database. If the measurements were performed correctly, the results are exported and the original files are deleted right away. In all other cases, you can delete the measurements right away by means of the button "*Discard measurement* 1563" (described further below).

Export measurement settings

For purposes of traceability, the measurement settings (in force for the current experiment) are saved along with the corresponding measurement results in the database (unless a different setting applies 113). If this option is active, the current experiment's settings are exported in parallel with the data export.

Allow selection of the export folder

- If a default path is specified, you can allow/forbid changes by the user.
- If this option is activated, a folder selection dialog always appears. If a default path is specified, it is the suggested target folder in the dialog.
- If this option is deactivated, export is always to the specified default path.

Default path

Here you set the target folder for export.

Discard measurement

You have the choice of discarding measurement results.

Allow discarding of all measurements

If this option is activated, it is possible to delete the measured results. When the command is executed, an additional button by means of which the results can be deleted appears. I.e., the buttons *Discard measurement* and *Save measurement* become available. If you click on *Save*, the measurement results remain in the database. If you click on *Discard measurement*, the measurement results are deleted.

Prompt to confirm discard

Here you set whether to post a confirmation prompt when *Discard measurement* is clicked.

Default button

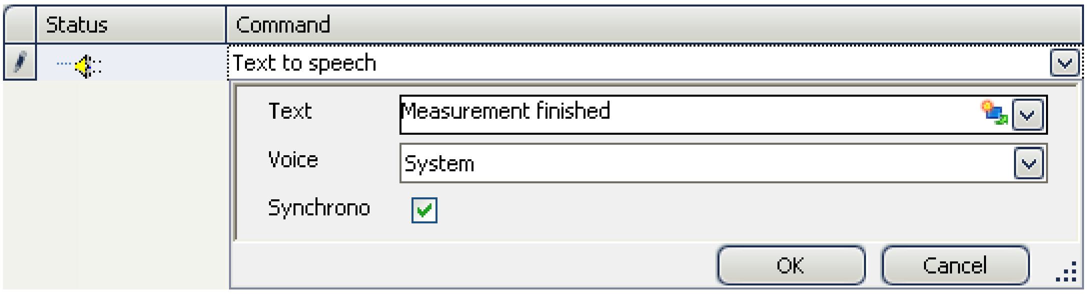
Here you set which button is "pre-selected". If the commando is executed, the selected action can be run by clicking on the Enter-key.

Execute without acknowledge

If the box "Execute without acknowledge" is checkmarked, the selected default action is executed automatically, without a delay for the purpose of confirmation. In this case, it is not possible to change the action if the command is executed.

You can only checkmark this box if the other settings do not require any acknowledgement. For instance, there would have to be a pre-set path for exporting, and no confirmation prompt would be required for deleting.

13.7.3.3 Text to speech



Properties of Text to speech

Parameter	Description
Text	Enter here the text to be spoken, e.g. "*Measurement finished*".
Saving	Character of the voice output. The available selection depends on the Windows system and usually only offers English voices.
Synchronous	When activated, the Sequencer remains on this command until audio output was completed.

13.7.3.4 SQL command

The SQL command offers the ability to communicate with relational databases from within imc STUDIO by means of the database language SQL. It is possible to process data from a database within imc STUDIO using one of the supported adapters, as well as to save other data and values to a database.

Supported database systems

Previously, SQL commands supported three database adapters:

- OleDB (MS Access databases *.mdb)
- MS SQL (Microsoft SQL Server as of Version 7)
- Oracle (Oracle Server as of Version 8)

Note — Notes on the use of Oracle databases

On the PC on which the SQL command is run, a version of the Oracle client software which match the database server. Otherwise, it is not possible to set up a connection with the Oracle server.

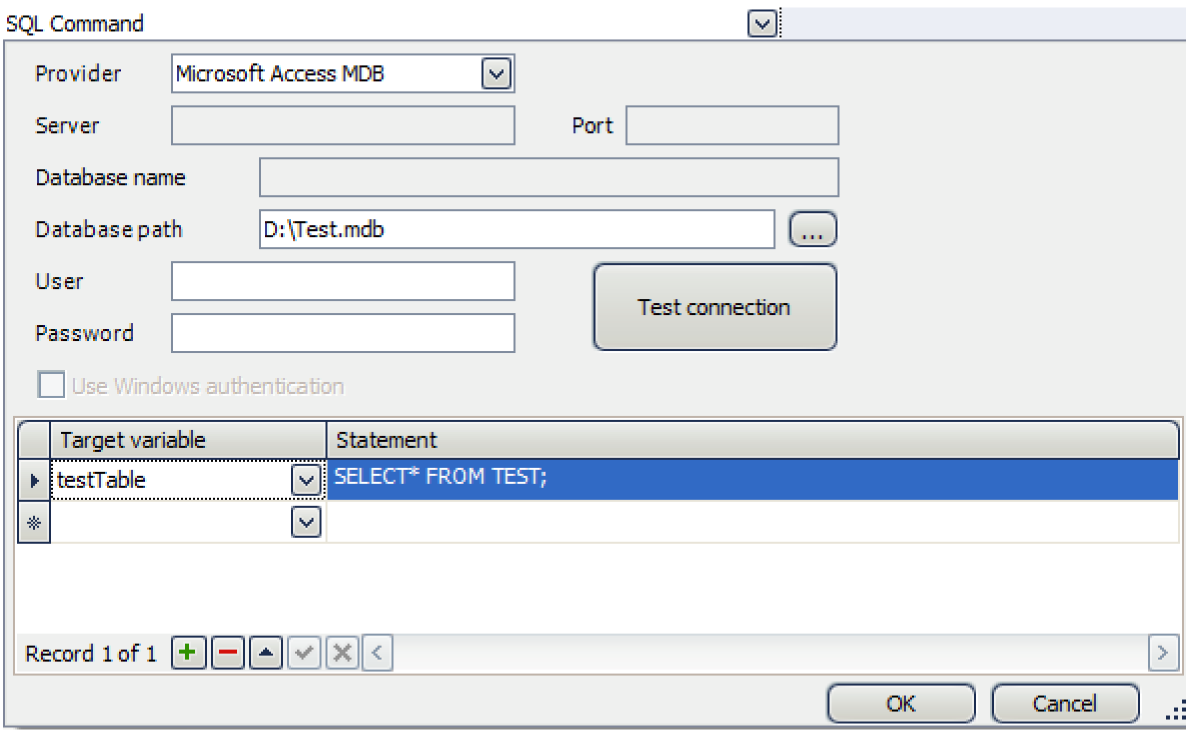
Supported SQL-commands

Except for a few limitations (see note below), all SQL commands which the respective adapter supports can be used on the database by means of the command.

Note

It is not possible to use SQL commands, e.g. selections, on data tables which were **created in the imc STUDIO**. Data selection, deletion and other changes can only be used on tables **within** the database.

Configuration



Command "SQL Command"

Parameter	Description
Provider	Provider of the database accessed: • Microsoft Access MDB • Microsoft SQL Server • Oracle Server
Server	IP address and name of the server instance; instead of the IP address, it is also possible to state the server's name: <Server Address>\<Instance Name>. Providing this specification is only possible with Microsoft SQL Server and Oracle Server.
Port	If the database system's port on the server differs from the respective default, it must be specified separately here. Providing this specification is only possible with Microsoft SQL Server and Oracle Server.
Database name	Name of the database to be accessed. Providing this specification is only possible with Microsoft SQL Server and Oracle Server.
Database path	Absolute path of the access database; it is also possible to specify a UNC-path, e.g. \\Computer\test\data.mdb; by means of ..., it is also possible to select the database by means of the file selection dialog. Providing this specification is only possible with Microsoft Access MDB.
User	User name for registering with the database (if necessary); the user name is saved with the experiment, with secure encoding, and is only visible in plain text in the configuration dialog.
Password	Password for registering with the database (if necessary); the password is saved with the experiment, with secure encoding, and is only visible in plain text in the configuration dialog.
Use Windows authentication	Some database systems support the usage of the current Microsoft Windows user's data (name and password) for log-in on the database server. It is required that the current account is enabled for log-in on the database server. It is unnecessary to explicitly specify the user name and associated password. The Windows user logged in is always determined at runtime (time at which the command is called) and refers to the current Windows user, not the current imc STUDIO user. None of these data (name and password) are saved with the experiment.
Test connection	Uses the data supplied to verify whether a connection can be made to the database.
Target variable	see the section *Target variable*
Statement	see the section *Statement*

Target variable

All values returned by SQL-commands at the time they are called can be saved in user-defined variable 1087. The following types of user-defined variables can be used for this purpose:

- Data tables
- Text
- Numerical

Which variable type to select depends on what the particular SQL command returns, and on how many values you wish to save. For instance, if you with to save only a single value even though the SQL-command returns multiple values or a table, select the data type **Text** or **Numeric**. If the data type **Data Table** is selected, then the SQL command must actually return a table. With the data type **Data Table** k, it is **not possible to save single values**.

If the target variable is a single value (numerical or text) and the SQL-command does not return a data table, then the value in the first row in the first column is always assigned.

Note

- The specified **target variable** must **exist** at the time of the call.
- If the SQL-command's return value is **not required**, then the box *Target variable* must also be left **empty**.
- It is also possible to select variable of types other than the above mentioned ones, but these can **not** be used for **saving the return values**.

Command

Here, the SQL-command is entered. This can consist of a single but arbitrarily extensively nested command which is valid for the selected database system-provider. The validity and required syntax can vary with the provider as presented in the respective database system documentation.

Any arbitrary amount of commands can be entered. All these commands use the configured connection and are processed successively.

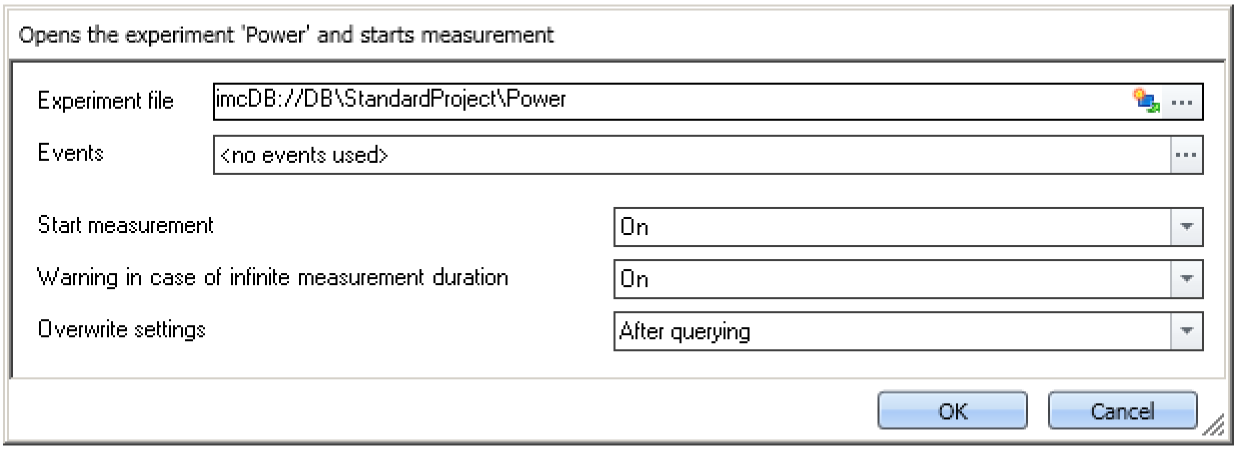
Commands can contain placeholders 145, allowing values to be inserted dynamically at runtime. Thus, it is possible to transfer data at runtime from imc STUDIO to databases.

Note

If a certain SQL-command is not valid for the adapter selected, or cannot be run for other reasons, a corresponding error message is posted in the log book and the running of commands is interrupted.

13.7.4 Open experiment/Start measurement

The command **Open Experiment/Start measurement** enables starting of the measurement from the Sequencer.



Properties of the command Open Experiment/Start measurement

Parameter	Description
Experiment file	Leave this entry empty if you wish to start the measurement with the current device settings. To load a different experiment's **experiment settings** to the **current experiment**, enter the experiment here. What is important to know is that the experiment is not loaded (like when using the ribbon *Home > Open*). Further, the current experiment remains loaded. All experiment settings are **replaced** with the settings of the experiment to be loaded. • **All current experiment settings are deleted**, such as the device configuration (Setup), Panel, user-defined variables with the validity range: Experiment, in accordance with saved scripts. • **All experiment settings are loaded from the selected experiment.** • All Sequencer-settings of the experiment to be loaded are ignored.
Events	Enables insertion of a command within the starting procedure.
Start measurement	For *On*, the measurement starts upon being opened. For Off, the experiment is only loaded. You can also enter a user-defined variable here.
Warning in case of infinite measurement duration	If a channel was configured so that its duration would be infinite, the Sequencer stays on this line until the measurement is stopped. With this option, you can notify the user that the measurement will have to be stopped manually.
Overwrite settings	Confirmation prompt for whether to overwrite settings. Alternatively, besides *After prompt* and *Without prompt*, you can use a *Variable*.

Note — What happens if variables also exist in the experiment loaded?

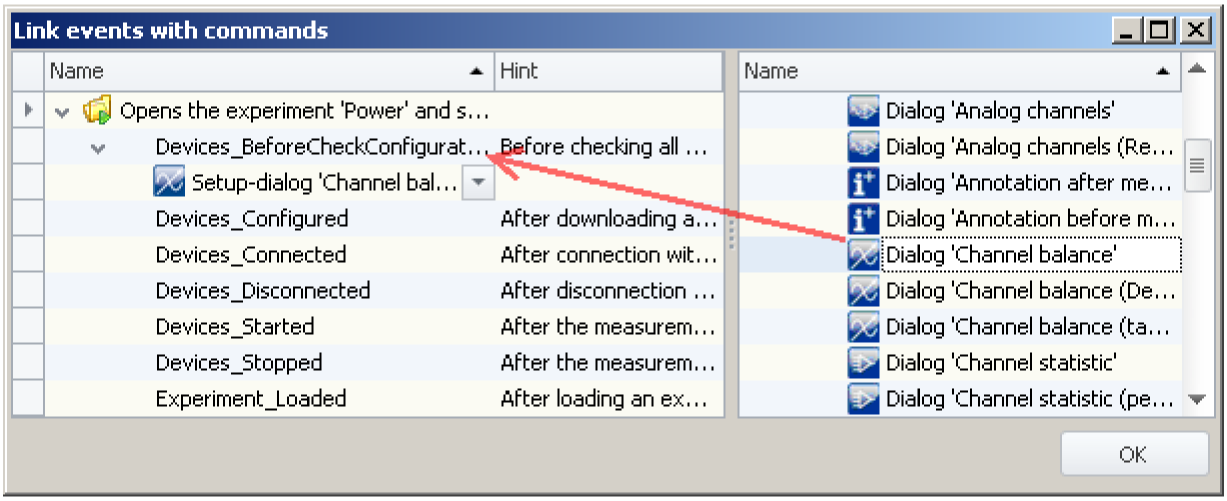
Any "higher-level" variables are not overwritten if a variable of the same name but from a different validity range is loaded.

Example: Suppose a variable exists with the validity range "*Project*" or "*Sequencer*". An experiment is loaded by means of the command: "*Open experiment*". A variable having the same name exists in this experiment and has the validity range "*Experiment*". This variable is not loaded from the experiment when the command is run.

Events

Just as there **events** for each measurement, there are also events which can only be configured for this measurement.

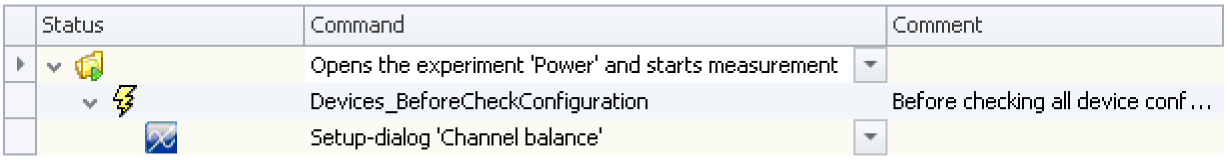
Using the parameter: *Events* opens an additional window:



In the example, the channel balancing dialog is called prior to processing the configuration

Here, you can attach commands to events of this measurement.

If events are used, they also appear in the Sequence table:

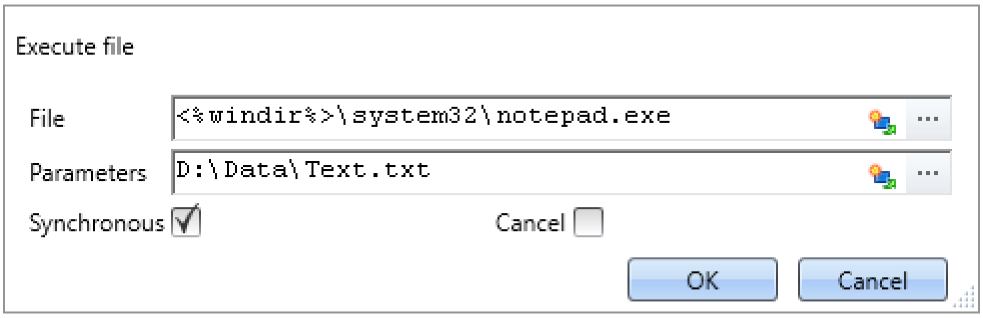


Example: Command associated with an event in the Sequence table

13.7.5 External calls

13.7.5.1 Execute file

The command starts a Windows program.



Execute: In the example, Notepad is started

Parameter	Description
File	Display text in the sequence table (without effect on the dialog).
Parameters	The dialog’s header.
Synchronous	When activated, the Sequencer remains on this command until either the program or the file is closed.

Parameter	Description
Cancel	Activates the Timeout function. At the latest, after a specified timeout time, the Sequencer runs the next line.
Timeout	Duration in seconds [s] until the timeout occurs.

13.7.5.2 Format converter

The imc Format Converter provides the ability to convert measured data to a different format, e.g. to EXCEL data format. For instance, the imc Format Converter can operate as a command performed automatically at the end of a measurement for the purpose of converting the data to the desired format.

Reference

You can also use the imc Format Converter without imc STUDIO as a **standalone** program; see the chapter "*imc Format Converter* 1921"

Export formats

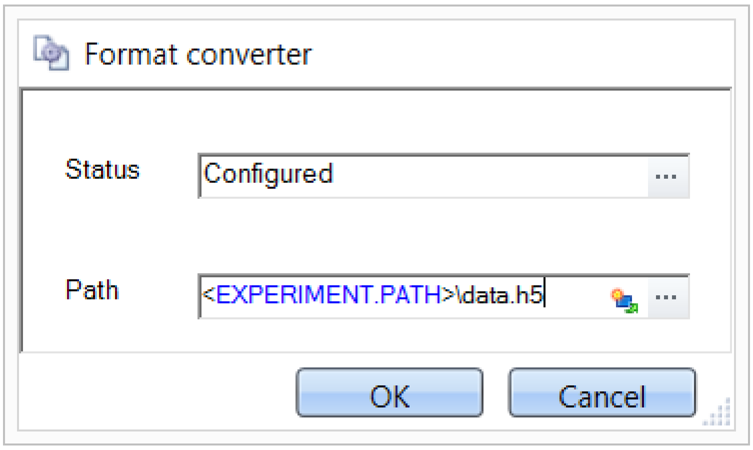
The same export formats are supported which are also offered by imc FAMOS. These include:

- user-defined ASCII export-formats
- user-defined EXCEL export-formats
- MDF2.0, MDF3.0, MDF4, ASAM ATFX, ASAM ATFX NVH, Catman 5.0
- Google Earth Export, HEAD acoustics (also 4.5 compatible)
- Matlab 4 and 5, nSoft-DAC, RPC-3, Somat SIF (nCode output)
- TEAC TAFFmat and TEDAM, DIAdem TDM and TDMS
- Binary Universal File Format
- Universal File Format (UFF)

13.7.5.2.1 Format Converter as command

Calling

Via the Sequencer: "*External calls*" > "*Format converter*":



Configuration of the command: Format Converter

Status

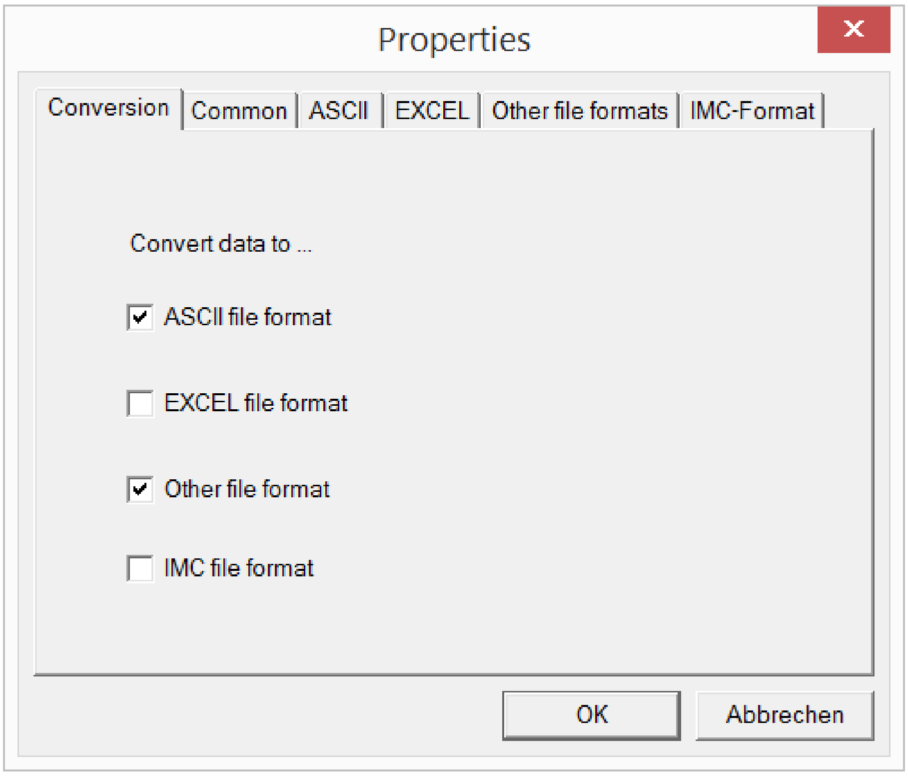
Immediately upon opening the command's configuration, the status is set to "*not configured*".

Path

- If just **one** file (*.dat, *.raw) of measured data is specified here, you can select whether to **convert either only the single file, or all files of measured data** which the **folder** contains.
- If a **folder** is specified here, then **all files of measured data in the folder** are converted:
  - If the option "*Save all files of a folder in one file*" among the settings on the tab page "*Common*" (see the segment on "*Status*") is selected, then **all files of measured data** present in the specified folder are converted to **a single target file**.
  - If the option is **not selected**, then each file of measured data which the folder contains, the data are converted to **a separate file**.

Using the button [...] in the box "*Status*" you can open a dialog via which you can make all the settings for the conversion:

- Conversion: Target format. It is also possible to select multiple formats.
- Common: Storage location and whether individual files or a multi-file is to be created.
- ASCII: Selection of the export template and specifying of the file extension.
- EXCEL: Selection of the export template and specifying of the file extension xls or xlsx.
- Other file format: Selection of the format and if necessary its formatting options.
- IMC-file format: Save the data to a file in the imc format, or as a copy to a different memory location.



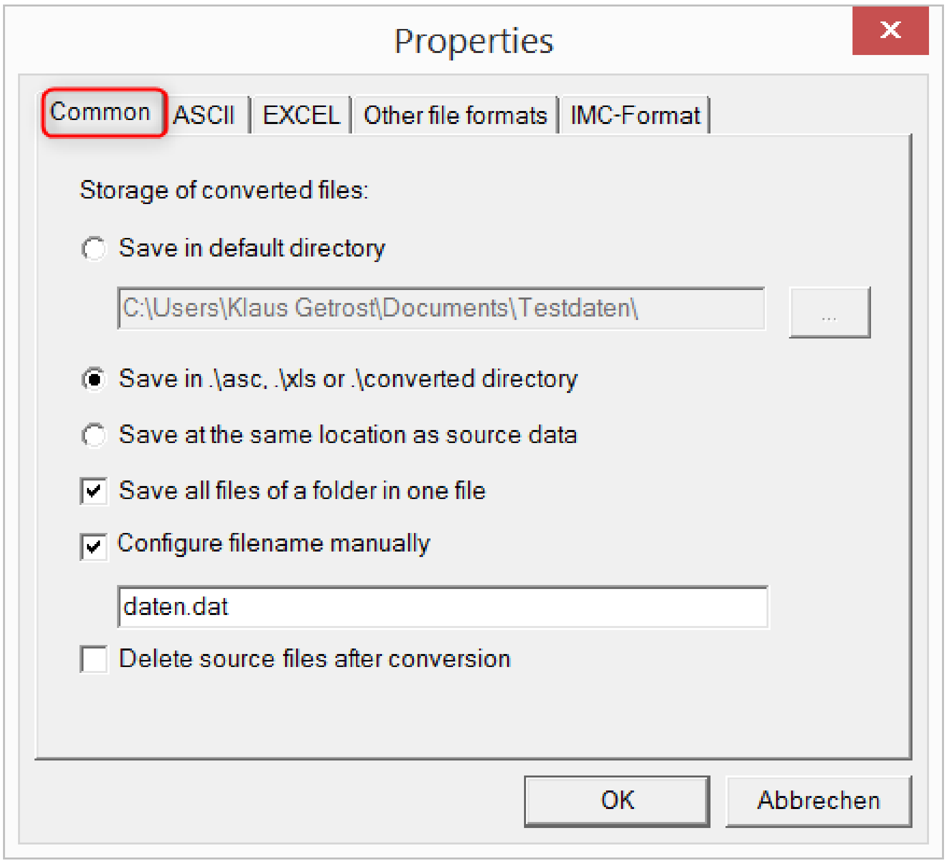
Setting the Format Converter

13.7.5.2.2 Settings

In the settings you specify whether the data are saved either individually or together, which templates are used for ASCII and EXCEL, or what other formats are used.

The settings remain intact, so that under normal circumstances you can immediately select data and convert them.

Data saving



Storage location for converted files:

Save in default directory: Free choice of a **target folder**. Even network drives are possible.

Save in .\asc, .\xls oder .\converted directory: The data are saved in their source folder but additionally in a **subfolder**. For ASCII in the *asc* folder, *xls* for EXCEL and *converted* for any other export formats.

Save at same location as source data: The data re saved on the same **level of the tree diagram as the source data, without subfolders**.

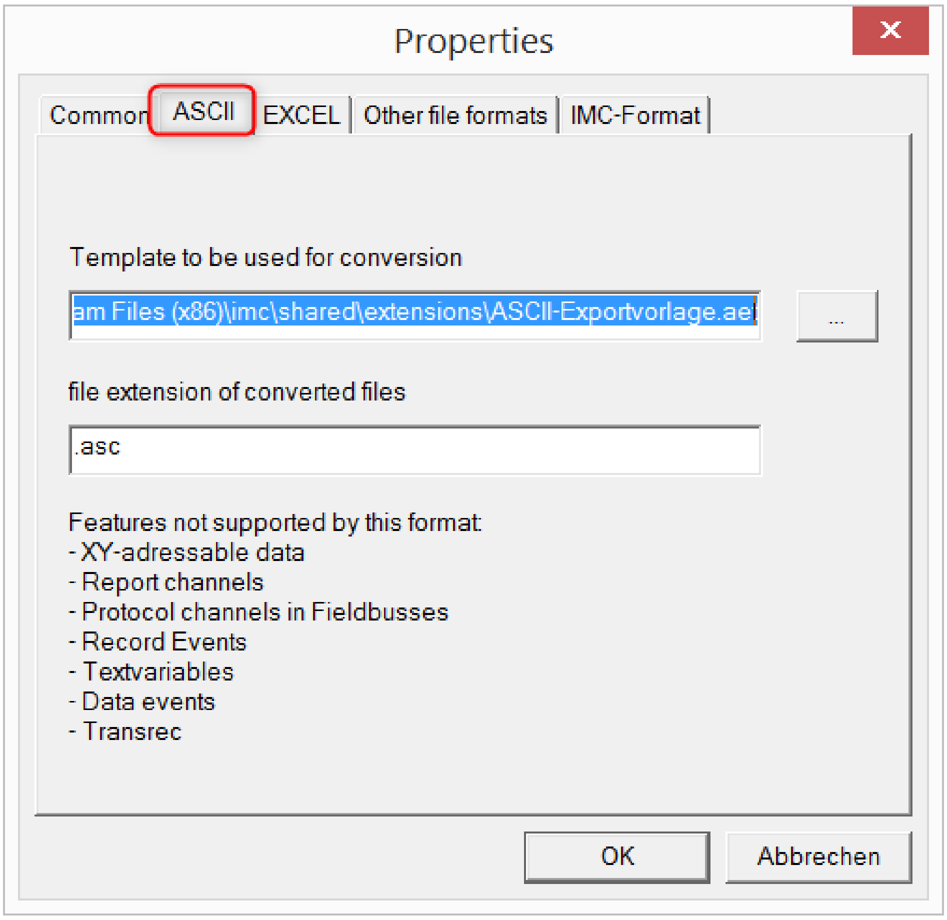
Manner of data saving:

Save all files of a folder in one file: All of a channel's files are saved **together in one file**.

Configure file name manually: **Name of the target file** in which all channel files are saved together.

Delete source files after conversion: Once the data have been converted, the **source files can be deleted automatically**, in order to make memory space free. This setting can make sense when all data are saved together in the imc format.

ASCII



Format template to be used for conversion:

By default, ASCII export templates are located in the folder *"C:\Program Files (x86)\imc\Shared\Extensions"* and use the file extension ***.aet**. Owners of imc FAMOS are also able to personally create or modify these templates. In this case, the aet-files are saved in the folder *"C:\ProgramData\imc\Common\Def"*.

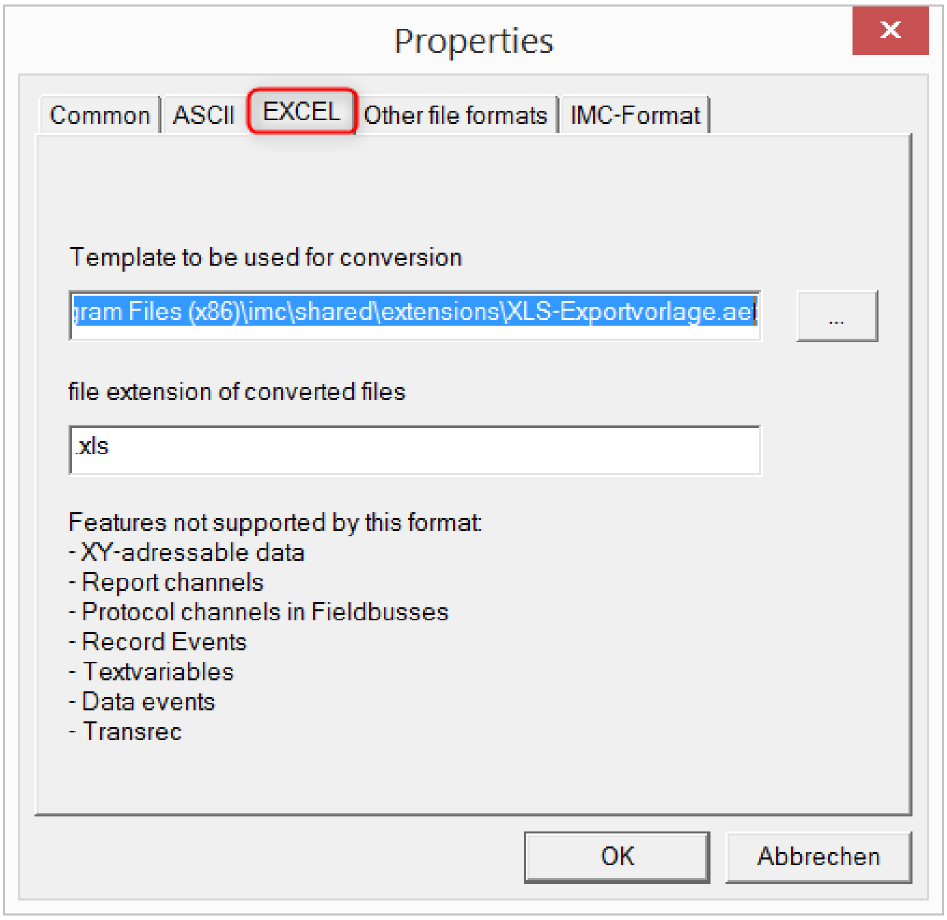
By default, the file extension is *"asc"*, but any arbitrary one can be specified here.

Special variable types which can **not** be exported as ASCII data are listed on this tab page.

Notes File extensions

In imc FAMOS the file extension is specified with the ASCII template. Within imc FAMOS this file extension is added to the ASCII file. With imc Format Converter the file extension specified here is used instead.

EXCEL



Format template to be used for conversion:

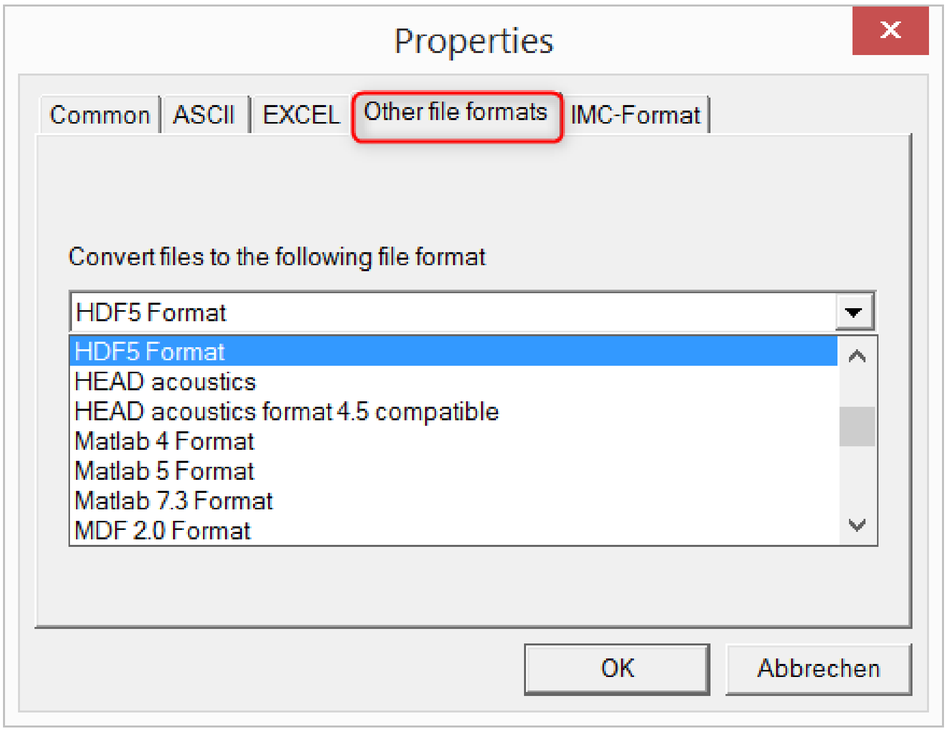
For EXCEL files, a similar technique is used as for ASCII 1573. By default, the file extension is *"XLS"*, but can be arbitrarily specified here.

Variable types which are **not** exported correspond to those for ASCII-export 1573.

Notes	File extensions

If the XLS**x** format was selected as the export template, it must be here as the file extension. The imc Format Converter does not import the specified file extension from the AET file.

Other file formats



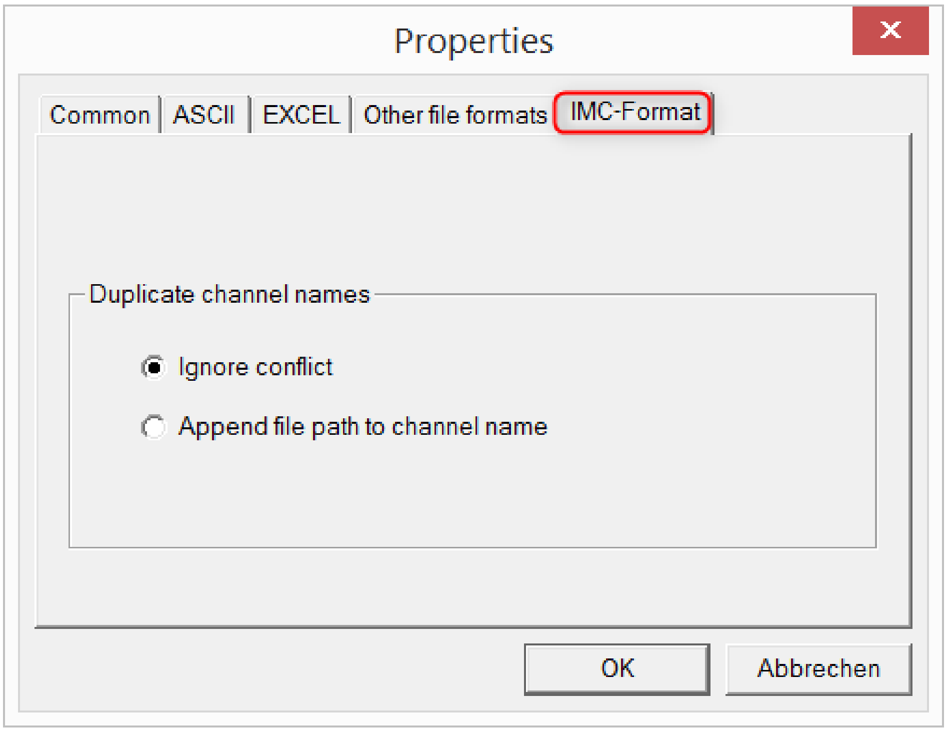
Convert files to the following file format:

Selection of the format in which the data are to be saved. Installation of the imc Format Converter makes certain export formats available. Otherwise, what selections are available depends on what version of imc FAMOS is installed in the 32-bit variant.

Options

If the format selected comes with additional export options, these can be set by means of the dialog opened by clicking on the button "*Options*". Descriptions of the options appear in the document ***ImportExportFilter.pdf***, of which a copy is imported along with the imc FAMOS installation. Alternatively, the document is available from the imc homepage.

imc-Format



Handling duplicate channel names

Ignore conflict: If files are overwritten due to duplicate channel names, the conflict is not reported.

Append file path to channel name: A unique channel name is generated from the file path.

Notes Whay save in the imc-format?

The imc Format Converter is designed for imc data, so why is there an imc-Format option? imc devices allow complex data structures in which channels can be recorded at different moments in time (using triggers). For this reason, the channels are saved as individual files. Using the imc Format Converter, you are able to join the data sets accumulated into one single file after the measurement. One appropriate group of settings on the page "*Common*1572" to accomplish this would be:

Save at same location as source data = active

Save all files of a folder in one file = active

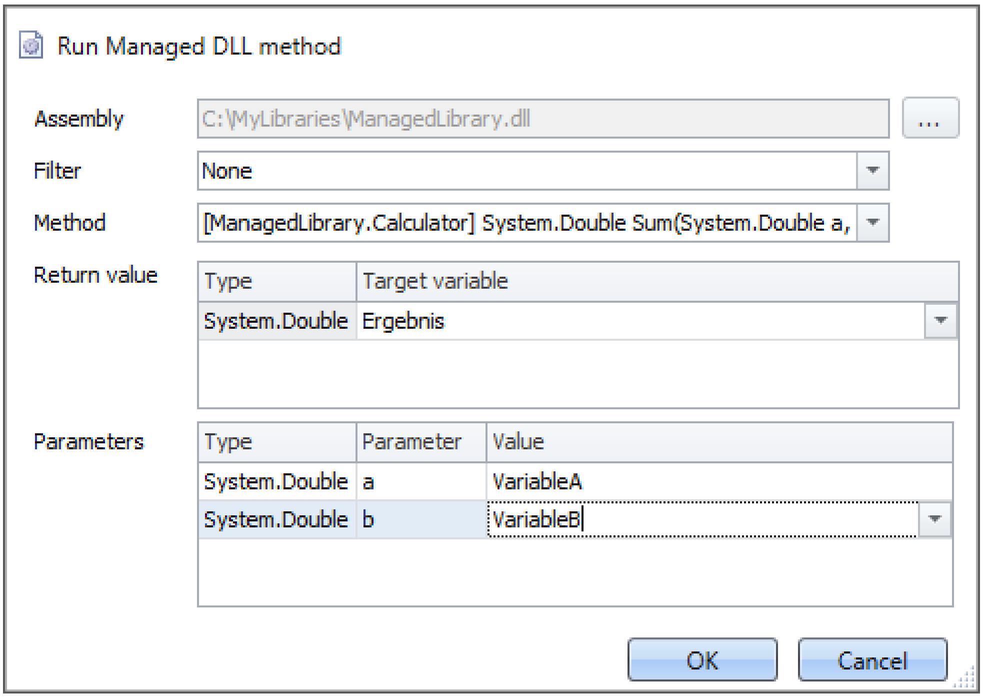
Delete source files after conversion = active

13.7.5.3 Run Managed DLL method

This command enables you to to use methods from external **managed** DLLs in imc STUDIO.

Note	Notes on using this command

- Whether external DLLS and their methods **work correctly** or on the other hand even cause damage **can not be ascertained by** imc STUDIO, and thus also **not be prevented**!
- For the purpose of obtaining a good understanding of error messages and the necessary settings, skill in distinguishing between **unmanaged** and **.NET DLLs**, as well as basic programming experience, are **recommended**.
- Only primitive data types can be used.
- If you wish to use only one **WinAPI-DLL**, be **absolutely certain** that the **parameter signature** is correct. Otherwise, the imc STUDIO functionality could be affected.



Example of a configured command

Parameter	Description
Assembly	Clicking on the button causes a .NET Framework Assembly to be selected which usually is of the type .dll.
Filter	You can set up a filter which hides any unnecessary method names from a list of available ones. The filters listed here are permanently programmed and cannot be changed.
Method	Here, methods offered in the assembly are listed, naturally only the ones designated as public.

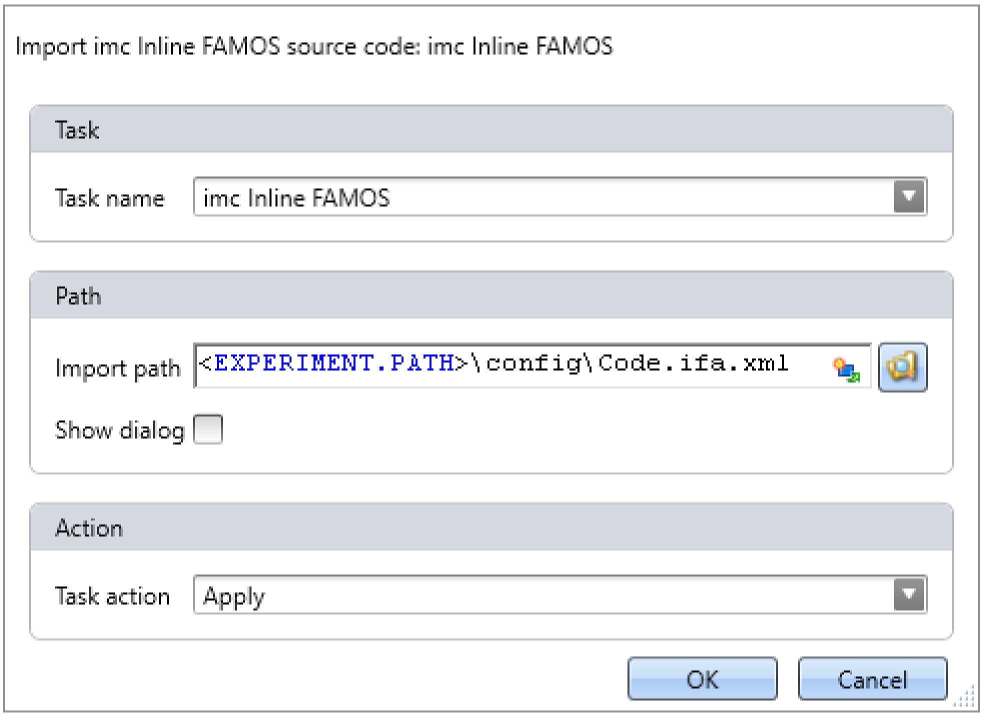
Parameter - Return value	Description
Type	The data type's **complete .NET name**, which is returned by the method. This name must be outputted in its entirety in order to distinguish between any multiple declarations in different locations (in the example shown: "System").
Return value	The name of the imc STUDIO variable in which the value is to be saved; this box can also remain empty, if the return value is not needed.

Parameter - Parameters	Description
Type	The data type's **complete .NET name**, which is expected by the method. This name must also be specified completely in order to distinguish between any multiple declarations.
Parameter	The parameter's name in the method declaration.
Value	The value of the parameter to be transferred; this box comes with the same functions as Set Variables. If a variable from imc STUDIO is used here, it must necessarily be **convertible** to the **target data types**. If this rule is violated, then an error message appears in the log book at the moment the command is run.

13.7.6 imc Inline FAMOS

13.7.6.1 Import imc Inline FAMOS source code

Using this command, you can import imc Inline FAMOS source texts. You can choose whether a text is to be immediately applied and run after the import, or initially only imported.



Configuration: Import imc Inline FAMOS source code

Parameter	Description
Task name	Target name of the Task. If a Task of that name exists already, it is overwritten without confirmation prompt. If no Task of that name is present, a new Task of that name is created.

Parameter	Description
Import path	Specification of the file to import, including the pathname.
Show dialog	If this option is activated, the file selection dialog appears when the command is executed. Select the file desired. If a path has been defined, the selection dialog starts there. The selection does not take effect on the configuration of the command in the command list, but only on the import currently performed.
Task action	The imported Task can either be applied and run immediately, or initially only imported. • **Apply**: The Task is applied and the calculation started immediately (see also the information on the "Apply 1666" Ribbon in the Data Processing) • **Edit**: The source text is imported, but the Task is not applied immediately. Thus, this does not cause the running calculation to be concluded. If the measurement is re-started, the Task is applied automatically.

13.7.7 Panel

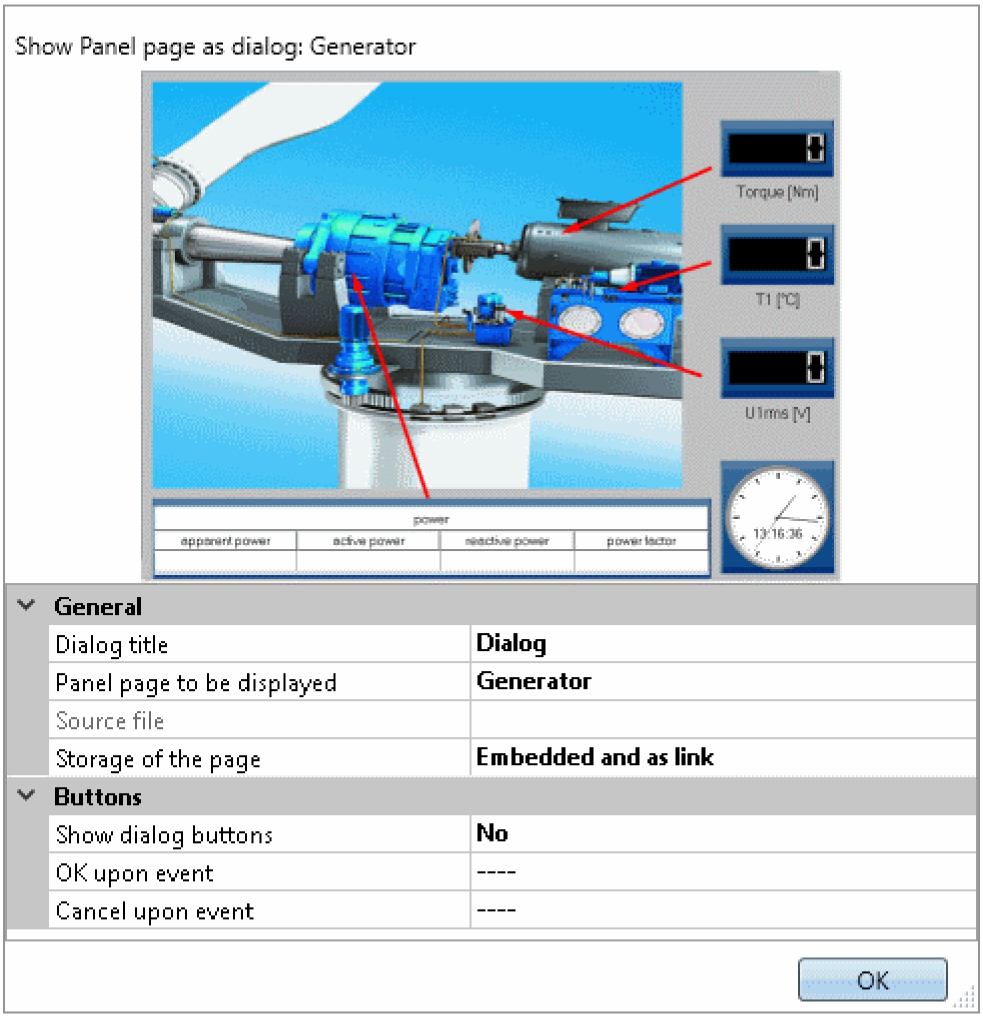
13.7.7.1 Show Panel page as a dialog

A Panel page can be displayed as a dialog.

The ways to close the dialog are:

- use existing buttons on the Panel page, or
- actuate the dialog's separate "OK" and "Cancel"-buttons.

If Setup pages are displayed on the Panel, the buttons can be hidden until all important boxes are filled.



Properties of the command "Panel-page as dialog"

Parameter: General	Description
Dialog title	Title of the dialog to be displayed
Panel page	Select the page to be displayed. The possible selections are existing pages and exported pages in the dbv format. Using "..." it is possible to select any arbitrary *.dbv file.
Source file	If this box is **empty**, the Panel pages of the current experiment are used. If you have selected a *.dbv-file in the box "*Panel page*", its name including its path is displayed here.

Parameter: General	Description
Storage of the page	Here you can define to which changes to the Panel pages the system responds. **Embedded:** This page is embedded into the command. There is no connection to the page in the Panel. • If this page is deleted, the command continues to function. • Changes to the page are not applied for the command. **As link:** Only a reference to the existing Panel page is saved. • If the page is deleted, the command no longer functions. If it is run, an empty page is displayed. • Changes to the page are applied for the command. **Embedded and as link:** The page is embedded into the command. Additionally, there is a linkage to the existing Panel page. As long as a page having this name is present, it is displayed. If the page is not present, the last state is displayed. • If the page is deleted, the command continues to function. • Changes to the page are applied for the command. • If a new page having the same name is created, then it is used.

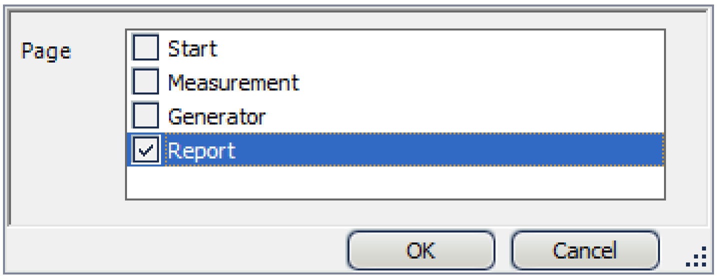
Parameter: Buttons	Description
Show dialog buttons	Separate "OK" and "Cancel"-buttons in the dialog can be shown or hidden. **Yes:** The buttons are displayed upon execution. The parameters for the OK- and Cancel-buttons are shown for the purpose of configuring the button. **No:** The buttons are not displayed. Instead, use certain buttons on the Panel page ("OK and Cancel upon event"). If neither of the two actions is defined upon event occurrence, the Close-button (X) is displayed. Then it is only possible to close the window using the "X". Closing this way is interpreted as "Cancel".
OK upon event	Select an event on the page, which closes the dialog with "OK". E.g. pushing on a switch. Some switches have two events, while others have only one. For this purpose, the switch must be present on the page.
Cancel upon event	Analogous to "OK upon Event". In this case, the dialog is closed with "Cancel".
OK button	This field is only enabled if "Show dialog buttons" is set to "Yes".
Visible	Shows/hides the button.
Active	The button can be deactivated in particular situations. **Always:** The button can be actuated at all times. **If all inputs are valid:** The button can only be actuated if all inputs are valid. For this purpose, embedded Setup pages are required. For details on this topic, see the chapter: "*Setup-Layout*" > "*Using Mandatory Boxes* 277".
Label	The button's caption.
Cancel button	This field is only available if "Show dialog buttons" is set to "Yes". For the Cancel-button, the same parameters are available as for the OK-button (Visible, Active, Label).

Note | **Evaluating the dialog’s answer**

Note that it is possible to have the dialog’s response evaluated automatically.
See: Evaluating the last dialog's answer 1550.

13.7.7.2 Print Panel page

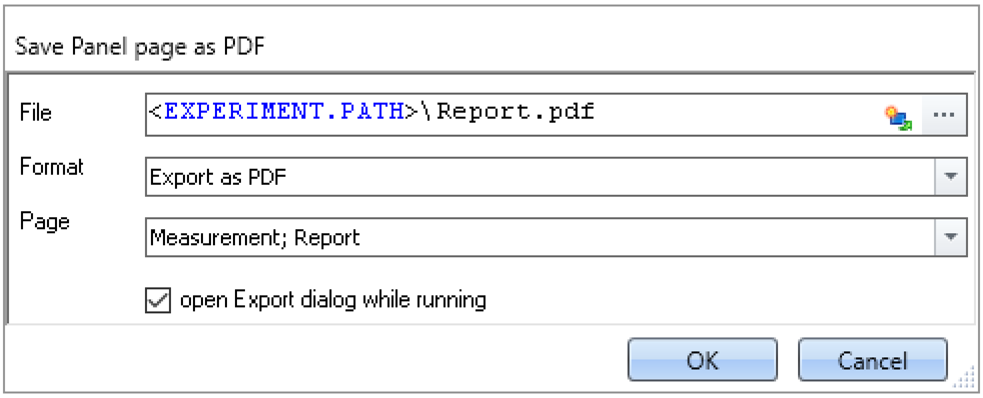
You can print out Panel pages. By this means, it is easy to compose reports. To do this, create Panel pages which are displayed as a report.



Example for printing out a Panel page

13.7.7.3 Export Panel page

Export Panel pages to a specified folder. As a graphic, PDF or in the form of Panel export.



Example of exporting Panel page

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>File</td><td>Specification of target file including the path.</td></tr>
<tr><td>Format</td><td>Target format for export. Please always select the appropriate format! Possible options:
<table>
<tr><th>Format</th><th>Description</th></tr>
<tr><td>Export Panel page</td><td>Exports the page in dbv-format. The file can be imported back into the Panel at another position as a page.

For each page, a separate page is generated.</td></tr>
<tr><td>Export as PDF</td><td>Exports the pages in PDF.

All pages are exported to one file.</td></tr>
<tr><td>Export as graphic</td><td>Exports the page as a graphics file in png-format.

For each page, a separate page is generated.</td></tr>
</table></td></tr>
</table>

Parameter	Description
Page	Selection of the pages to be exported. Depending on the parameter "File" and "Format", either one or more pages can be selected.
Open Export dialog while running	If this option is activated, then when the command is run the "Save as" dialog appears. The change has no effect on the configuration of the command in the commands list, but only affects the current export.

Note Name of the results file depending on the setting

For varying formats, there are different respective results unless there are clear specifications available for the parameter "File".

Panel page:

Parameter	Description
C:\tmp\Report.dbv	Generates the file: Report.dbv in the path C:\tmp Only possible when an individual page is selected.
C:\tmp\Report C:\tmp\Report\	Generates a separate dbv-file in the path C:\tmp\Report for each selected page The files are named for their respective page.

PDF:

Parameter	Description
C:\tmp\Report.pdf C:\tmp\Report	Generates the file: Report.pdf in the path C:\tmp.
C:\tmp\Report\	Generates the file .pdf in the path C:\tmp\Report (<-- *not recommended!*)

Graphic:

Parameter	Description
C:\tmp\Report.png	Generates the file Report.png in the path C:\tmp Only possible when an individual page is selected.
C:\tmp\Report C:\tmp\Report\	Generates a separate png-file for each selected page in the path C:\tmp\Report The files are named for their respective page.

13.7.7.4 Import Panel page

You can import a Panel page which was previously exported in DBV format.

13.7.7.5 Delete page

If the command is executed, a defined Panel page is deleted, without waiting for confirmation.

By means of the command's settings, you determine which Panel page is to be deleted. To do this, select an existing page, or enter the page name, if the page does not yet exist.

It is possible to use the list to select multiple pages. To select multiple pages by making an input, use the following syntax:

```
Site 1; Site 2; Site 3.
```

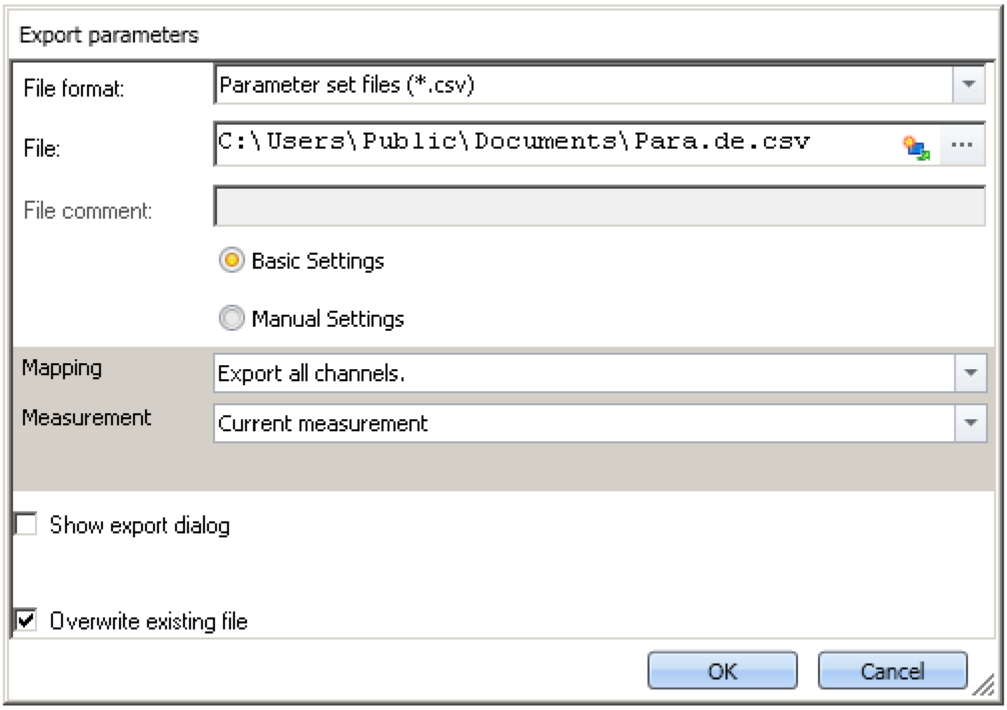
13.7.8 Parameter set

13.7.8.1 Export parameters

A parameter set is a group of parameters which can be used for various purposes. For instance, parameters may be **settings for the device and channel configuration**. They can also be **metadata** and **variables values**.

The command: "**Export parameters**" allows automated export of the parameters at desired times and according to previously adjusted settings.

There are pre-made export-configurations available such as "Export all channels" (the values of the active channels' variables) or "Export all channels and settings" (the values of the active channels' variables, and channel settings of all analog channels). Or you can manually select which variable values and settings to export.



Command: Export parameters

Reference — Description of the parameter set

Basic information on working with a parameter set, as well as about its content and structure, is presented in the chapter: "*Parameter set* 226".

Practical examples appear in the chapter: "*Parameter set in the application* 233"

Option	Description
File format	Selection of the export format. For more information, see the description of the parameter set (File formats 228).
File	Specifies the target file including the pathname.
Basic/Manual Settings	In order to configure the export, you can choose between **basic** and **manual** settings. • **Basic Settings** 1585**:** Here you find prepared export settings, for instance, one where only all values of the analog channels are exported. • **Manual Settings** 1586**:** Here you can define exactly what to export.
Measurement	You can export either parameters belonging to the current measurement, or those of a different measurement (identified by the measurement name or the measurement number).
Overwrite existing file	If this option is activated, files having the same name in the destination folder will be overwritten without a confirmation prompt. This option is useful for automated routines.
Show export dialog and Show element list	If one of the two options is activated, then when executing the commands the dialog appears in which to make settings in these two areas: • **Show export dialog:** File options (Save as dialog) • **Show element list:** Datapool (variables) and device configuration. All settings can be inspected and edited. Any changes have no effect on the configuration of the command in the command list, but only on the current export.

Basic Settings

Option	Description
Mapping	Here you can select what to export. • **Export all channels:** All variables having the channel type: "**analog inputs**" are exported. • **Export all channels and settings:** All content of the table description: "**analog channels**" are exported and all variables of the channel type: "**analog inputs**" are exported. • **...:** Select a user-defined assignment. For more information, see the description of the parameter set (Mapping for import and export 231).

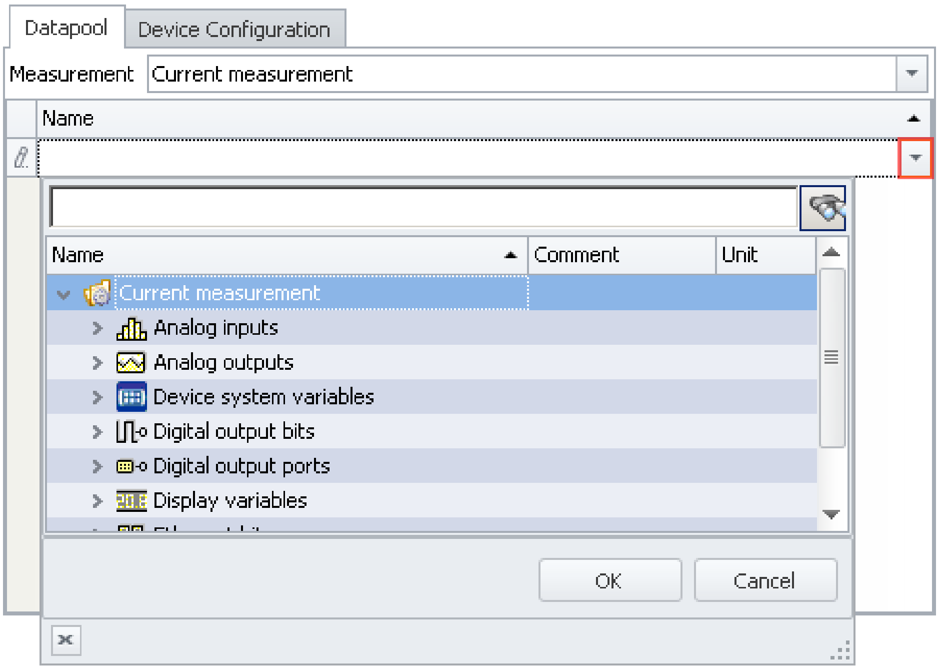
Manual Settings

<table>
<tr><th>Tab</th><th>Description</th></tr>
<tr><td>Datapool</td><td>Selection of the variables to be saved.

Here you create a list of the variables to be exported. At runtime, these are exported automatically. The list is not dynamic, it does not adapt when variables are added or deleted. In some cases, the variables do not exist yet when the list needs to be filled.

In order to add a variable to the next empty line:
• enter the corresponding name, or
• click on the button ( ) to the right of the line.

When you click on the button, a strip-down Data Browser with a list of all available variables appears. If needed, run a Process configuration 222 ( ) to update the list of variables it contains.

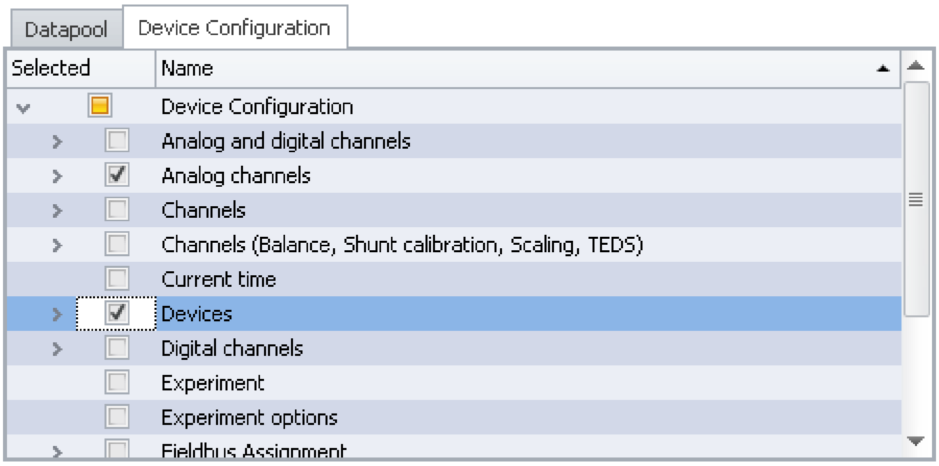


List of the variables to export

Select all desired variables (multi-selection is also allowed) and click on the button OK. All selected variables are added to the list of variables to export.</td></tr>
</table>

<table>
<tr><th>Tab</th><th>Description</th></tr>
<tr><td>Device Configuration</td><td>
Selection of the device and channel configurations to be saved.

Here, select the settings to be exported.

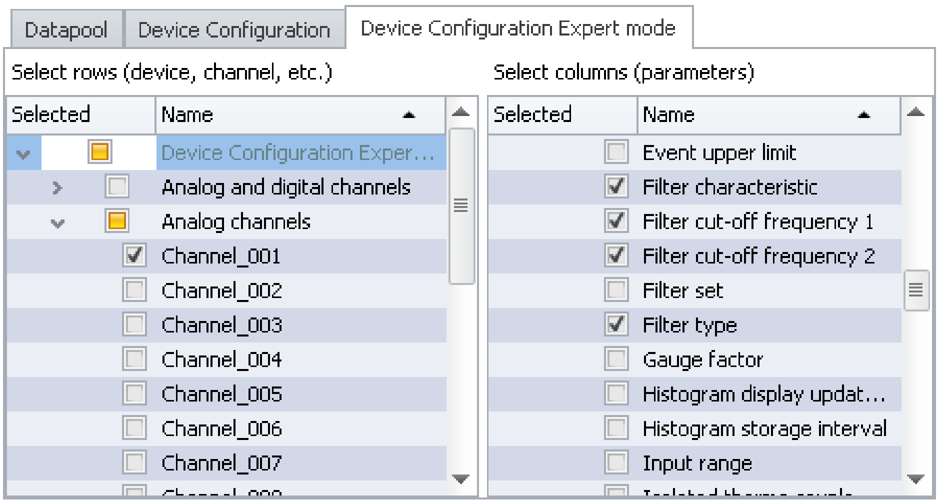


List of device settings

The individual table descriptions are available for selection. These define which parameters are exported. To limit the export to individual variables, devices or other elements, you can expand the table descriptions and select the desired elements.
</td></tr>
<tr><td>Device Configuration Expert mode</td><td>
This tab is only visible if expert mode for export of parameter sets 115 was activated in the options.

Here, you can select individual parameters for export.

In the region on the left, select the rows of a table description:
the element (e.g. variable or device) whose parameters are to be exported.
In the region at right, select the columns of the associated table description:
the parameters which are to be exported.



Left: List of the rows in a table description (devices and variables)
Right: List of the columns of a table description (parameters)

In the example, the parameters "Filter characteristic", "Filter cut-off frequency 1", "Filter cut-off frequency 2" and "Filter type" belonging to the variable: "Channel_001" are exported.
</td></tr>
</table>

Note

Keeping variables' values and the device configuration separate

You are able to export variables' values and device configurations together to one file. You are also able to combine the selection in the individual tabs. You can also combine "Device configuration" and the expert mode.

But please note: You will have greater clarity if you keep these things separate. To minimize error sources and to find errors more easily, we recommend exporting them separately.

Important parameters are always exported

Certain important parameters, which are necessary for assignment purposes when importing, are always included in the export process. Even if they are not selected, the following parameters are always included in the export of channel parameter:

Device name, Device identifier, Channel name, Name.

Trigger-settings and imc HiL/Application module assignments

Trigger-settings and imc HiL/Application module assignments can not be exported as parameter sets in a useful way.

Exporting balance values (taring, scaling, bridge, ...)

The balancing process is dependent on various parameters such as the measurement range and measurement mode. In order for it to be possible to re-import the balance value, these values need to be compatible. For this reason, when exporting balance values, many additional parameters are exported along with them.

Note

All necessary balance values are recorded in the file in xml-notation, even if the export is not in xml format.

The balance values are associated with certain channel settings and only apply if these settings are previously restored when importing. E.g., when changing the measurement range, a new balancing procedure must be performed.

The record of the experiment includes the respective balance values saved for the various settings. For this reason, the balance values for each measurement range, for example, are exported to the same file.

Example

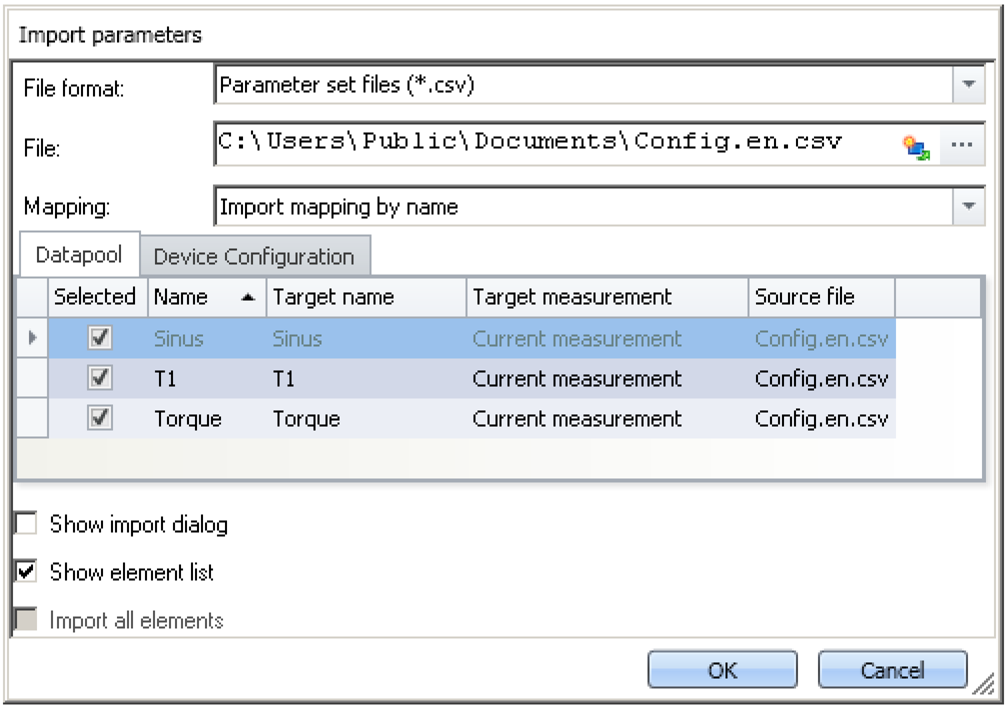
You perform balancing for Channel_001 with the measurement range 10 V. Next, you perform another balancing for the 5 V measurement range and export the result also to the file Balance.en.csv; the file contains both balancing values.

Upon importing, the appropriate balancing settings are imported in accordance with the measurement range set.

13.7.8.2 Import parameters

A parameter set is a group of parameters which can be used for various purposes. For instance, parameters may be **settings for the device and channel configuration**. They can also be **metadata** and **variables values**.

The command: "**Import parameters**" allows automated import of the parameters at desired times and according to previously adjusted settings. You can also select from which file to import which variable's values and/or settings.



Command: Import parameters

Reference — Description of the parameter set

Basic information on working with a parameter set, as well as about its content and structure, is presented in the chapter: "*Parameter set* 226".

Practical examples appear in the chapter: "*Parameter set in the application* 233"

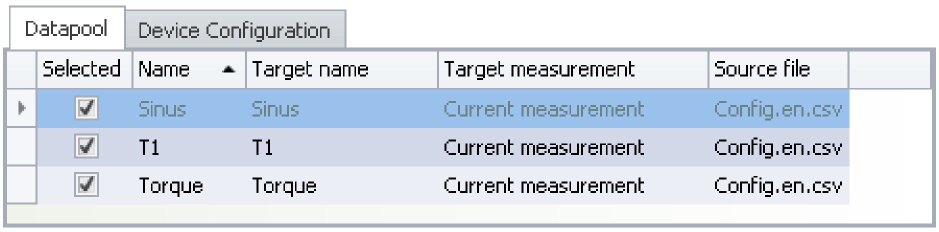
Option	Description
File format	Selection of the file format. For more information, see the description of the parameter set (File formats 228).
File	Specification of the file to import, including the pathname.
Mapping	Here you can select according to which parameters to perform the import. At least one parameter must be used for assignment purposes in order to ensure that the parameters are also assigned to the desired channel. **An unsuitable assignment can cause either no parameters or incorrect ones to be imported!** For more information, see further below under: *Mapping for import* 1594.

Option	Description
Show export dialog and Show element list	If one of the two options is activated, then when executing the commands the dialog appears in which to make settings in these two areas: • **Show export dialog:** File options (open-dialog) • **Show element list:** Datapool (variables) and device configuration. All settings can be inspected and edited. Any changes have no effect on the configuration of the command in the command list, but only on the current import.
Import all elements	This option is only available if Show element list is not selected. When it is activated, then the complete parameter set, meaning the datapool and the device configuration is always imported according to the assignment instruction. The advantage is that at the moment you create the command, you don't need to know what elements the parameter set contains. **Note:** If the box is checked, then the system no longer distinguishes between the device configuration and the datapool. If only the datapool is exported (e.g. for Channel_001), then when importing, the channel configuration is also imported. E.g. in this case, the unit is also set.

<table>
<tr><th>Tab</th><th>Description</th></tr>
<tr><td>Datapool</td><td>

Selection of the variables to be saved.

Here you create a list of the variables to be imported. At runtime, these are imported automatically. The list is not dynamic, it does not adapt when variables are added or deleted.

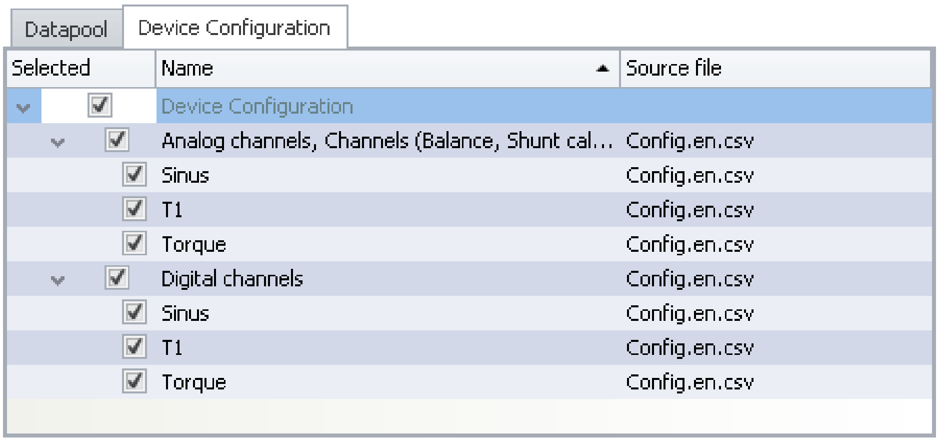


List of variables to import

</td></tr>
</table>

<table>
<tr><th>Tab</th><th>Description</th></tr>
<tr><td>Device Configuration</td><td>
Selection of the device- and channel configurations to be imported.

Here you select which configurations are to be imported from the file.



List of device settings

Some table descriptions are already available for selection.

If the file format xml was selected for the export, the source table description is located in the file. The parameter set import derived from this, via which table description it is possible to import.

As long as the file does not state from which table description the export came, there is a choice of possible table descriptions. The table descriptions displayed may not match the original table description.

Example: In the picture above, you see the table descriptions: "*Analog channels, Channels (Balance, Shunt calibration, Scaling, TEDS)*", and "*Digital channels*". These were determined from the parameters which the file contained.

However, the parameter set was generated from the table description "*Analog channels*".

Since the table descriptions mostly contain the same parameters, these two are the first ones found which cover the import. If you ensure that all parameters are present on the target computer, then a correct table description will always be selected for import.

To limit import to individual variables, devices or other elements, you can expand the table descriptions and select the desired elements.
</td></tr>
</table>

Note	Importing a configuration

Make certain that the configuration can be imported.

Often certain settings depend on other parameters. For example, the measurement range depends on the offset/factor. When the measurement range is imported, then either the appropriate offset/factor-values must also be imported with it, or be set already.

Many other such interdependencies exist.

If a parameter can not be imported, a corresponding message appears in the logbook.

Note — Importing to the Datapool / Variables

- It is not possible to import to the **device channels** belonging to the current measurement (Data Browser: *Current measurement*). This applies to analog channels, incremental counters, ... This does not apply to single value variables, such as Display-variables, DACs, ... It is possible to import to these.
- For importing variables' values, instead of the command: "*Import parameter*", the command "***Import variables***" should be used. This command is specially designed for variable values. Using the command: "*Import parameter*" can cause unintended alteration of the device control.

Imprecisions in importing

Import of the measurement range

Due to imprecision from rounding, the measurement is not adopted correctly in some cases.

When there is no match, the next larger measurement range is selected which completely covers the range required. To handle rounding problems, a tolerance of 1% is provided. If a smaller measurement range is below the desired range by only 1%, it is selected.

Example

Possible measurement ranges	0.1 and 0.25	0.75 .. 1.25 and 0.5 .. 1.5
Measurement range in the import file	0.12	0.75 .. 1.263
Import generated	0.25	0.5 .. 1.5
	because it is the next larger range	because it is the next larger range

In case of rounding problems

Possible measurement ranges	0.1 and 0.25	0.75 .. 1.25 and 0.5 .. 1.5
Measurement range in the import file	0.10000001 to 0.101	0.75 .. 1.2500001 bis 0.75 .. 1.262
Import generated	0.1	0.75 .. 1.25
	because this deviates from a measurement range by 1% or less	because this deviates from a measurement range by 1% or less

Importing balance values (taring, scaling, bridge, ...)

The balancing process is dependent on various parameters such as the measurement range and measurement mode. In order for it to be possible to re-import the balance value, these values need to be compatible. For this reason, when exporting balance values, many additional parameters are exported along with them.

Warning Bridge balance

When you import bridge balancing values for a channel whose amplifier type or device model is different (e.g. CRONOScompact with 16-bit Integer resolution to CRONOSflex with 24-bit Float resolution), the resulting measurement values are implausible! By contrast, balancing values from taring only correct the measured value and for this reason they can be imported without any problems.

Mapping for import

Here you can select according to which parameters to perform the import. At least one parameter must be used for assignment purposes, in order to ensure that the parameters are actually assigned to the desired channel.

Selection	Description
Import mapping by name	For all parameters (all table descriptions), the settings are imported. The assignment is made on the according to the **name**. This means: All parameters belonging to a source-row (from the parameter set) are imported to a row in the target, if the parameter **Name** is identical in both the source and the target. **Special case:** If the parameter set contains the columns: **Name** and **Channel name** with different names: In this case, the column **Name** is still used for the assignment, but the column **Channel name** for setting the new name! Then it is possible to adapt the name by means of the name assignment. But this means that the parameter set can no longer be used since the previous name then no longer exists. By this method it would be possible, for example, to initialize the channel names. Then assign the new names of the parameters using a second parameter set.
Import of channels according to connector and device serial number	For all channels/variables (parameters of the table description: **Channels**), the settings are imported. The assignment is made according to the **connector designation** and **the device serial number**. **Note:** When using multiple devices, this selection is preferable to "*Import of channels according to connector*", since each connector designation is unique within a device. Disadvantage: it is not possible to assign parameters to other devices this way. If necessary, edit the parameters beforehand, in order to adapt the serial number to the target device.
Import of channels according to connector	For all channels/variables (parameters of the table description: **Channels**), the settings are imported. The assignment is made according to the **connector designation**. **Note:** When using multiple devices, the connector designation is not always unique; the same one could appear in every device. Use this setting only when using only one device.
...	Select a user-defined mapping. See "*Mapping - Modifications of the default behavior* 236".

FAQ

Question: Why do my changes to the parameter set have no effect following the import?

Answer: There are multiple possible reasons:

- An unsuitable assignment is used.
  For example, the name assignment is used, but the names in the parameter set file do not match the names in the channel list. This can be the case if the name is to be modified by via the parameter set.
  Solution: Use instead, for instance, import according to the connector designation, or observe the notes on the mapping by name (see: *Mapping for import* 1594).
- The settings are reset by other parameters.
  For instance, if you export the parameter set of the page: *Analog channels*, you obtain among others the parameters for the analog channels and analog Monitor-channels. The parameters of these two channel types are interrelated. For example, if you change the coupling of the analog channel in the parameter set file from "Full bridge" to "DC", but leave the Monitor channel unchanged, the importing the Monitor channel will overwrite the analog channel.
  Solution: Always minimize the parameter set to the most important parameters. Delete everything which is not needed.

13.7.9 Setup

13.7.9.1 Execute device action

By means of this command, you can perform a variety of device actions which are also available via the action buttons on the Setup pages. For instance, you can perform bridge balancing or a shunt calibration.

The list of available actions is unfiltered. For this reason, you also find actions here which have no effect unless you make additional settings on the Setup pages, or which have no effect as they are located in the list.

Parameter	Description
Enumerator Class	In an enumerator-class, the association with "object-groups" is defined (e.g. analog channels, Display-variables, devices, ...). See also: "Enumeration Classes 245".
Action column	List of possible actions to be performed (corresponding to the buttons on the Setup pages)
Action	Some action columns contain various possible actions to be performed. For instance, with the action column: "Balance action", it is possible to perform a taring or bridge balancing.

Parameter	Description
Filter type	Here you define the target for which the action is to be performed. In many cases, multiple targets are available, e.g. all analog channels in the case of a balancing action. **All rows:** The action is performed for all targets possible. In some cases this can lead to error messages being posted if the particular action cannot be performed for certain targets. **Selection:** Here, select particular targets on which the action is to be performed. If any new targets are added, they are not already automatically selected. **Filter:** Create a filter according to whose criteria the targets are selected. Here are some examples:

Summary	Filter formulation	Interne designation
all active channels	[Channel status] Equals Active	`([eStatus] = 1)`
Only one balancing type	[Balance action] Equals Bridge	`([eBalanceAction] = 2012)`
Only one particular module type	[Module type] Equals Bridge, current and voltage amplifier and temperature measurement unit "UNI2-8"	`([eModuleType] = 47)`
Only channels belonging to a defined coupling	Coupling Is any of (Full bridge, Half bridge, Quarter bridge)	`[eCoupling] in (5,3,6))`

As an illustration, the following examples from practical applications

Example Balancing 1

Perform a balancing action: for all channels currently selected

Parameter	Setting
Enumerator Class	Channel
Action column	Balance action
Action	Currently selected
Filter type	All rows (here the use of a filter is recommended: see further below)

For all analog channels, whichever of the balancing types "Bridge", "Taring" or "Manufacturer's calibration" which is set on the Setup page: "Balancing" is performed.

Note: Since passive channels will report an error in consequence of this action, it is advisable to define a filter for all "Active" channels:

[Channel status]] Equals Active

`([eStatus] = 1)`

Example Balancing 2

Perform bridge balancing: for all active channels of the module type: "Bridge, current and voltage amplifier and temperature measurement unit "UNI2-8""

Parameter	Setting
Enumerator Class	Channel
Action column	Balance action
Action	Bridge
Filter type	Filter: Only active channels and only channels belonging to the amplifier: "UNI2-8" (([eModuleType] = 47) And ([eStatus] = 1)) (here, it is recommended to use an additional filter: Only channels for which a suitable coupling is set: see further below),

For all analog channels having the appropriate amplifier, a bridge balancing operation is performed.

Note: Since not all channel settings allow bridge balancing, it makes sense to modify the filter even more. Depending on the amplifier used, the coupling may need to be set to full bridge, half-, or quarter-bridge:

```
(([eModuleType] = 47) And ([eStatus] = 1) And [eCoupling] in (5,3,6))
```

Example Shunt calibration

Perform a shunt calibration: for all channels selected

Parameter	Setting
Enumerator Class	Channel
Action column	Shunt calibration
Action	--
Filter type	Selection

Example Starting measurement

Start a measurement: for all devices

Parameter	Setting
Enumerator Class	Device
Action column	Device control
Action	Start
Filter type	All rows (starting a specified device is also possible)

All devices are started.

Note: The difference from the menu action is that correct preparation (reconfiguration) is always performed previously.

Instead of starting measurement this way, please use the command: "*Execute menu action* 1557".

13.7.9.2 Transfer device settings

When the command is run, the device configuration can be transferred to other devices automatically. The transfer can be run either always or only when no connection can be established.

Here is a common application: When the command is run, the software connects with the selected devices. If the connection can not be established, it is possible to specify an appropriate reaction. The configuration can, for example, be transferred to a substitute device.

Note — **The module assignment can not be modified**

When transferring to other devices and when updating the hardware configuration, it is important to observe certain points. In contrast to manual transfer, in this case here, the assignment of modules can not be modified! See the section: "*Setup - Device Configuration*" > "*Information and Tips*": "*Transferring an experiment to other devices*" 288".

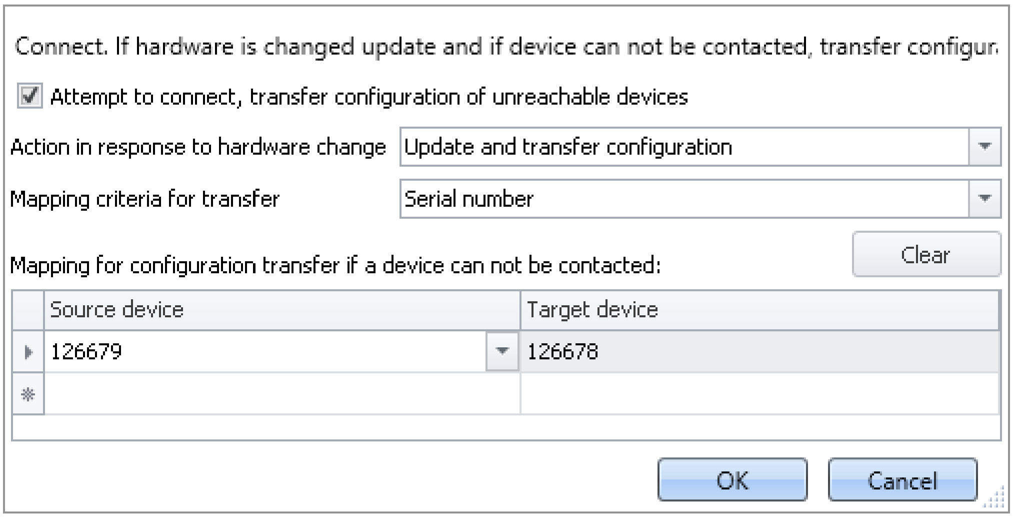
For purposes of transferring, the suggested configuration is always used here.

Recommended:

- If possible, always only use devices/modules of the same model.
- In modular systems, be sure to assign the module connection numbers correctly.

If appropriate, perform a one-time manual transfer of the configuration. Thus you ensure that the suggested module transfer is applicable to their case.

With modular system, there is always the possibility of modifying the module addresses. Before starting the experiment, ensure that the correct addresses are assigned to the modules.



Configuration example:
When the command is run, the software connects with the device "126679". If the connection can not be established, the configuration is automatically transferred to the device 126678 and the connection is established.

Parameter	Description
Attempt to connect	Attempt to connect, transfer configuration of unreachable devices: • **activated:** A connection is established to all devices. If connection to a device can't be established or if the device hardware setup has been changed, consequent responses can be specified by means of the subsequent parameters. • **deactivated:** With this command, no connection is established to the devices. The configuration is always transferred to the target devices as per the assignment table.

Parameter	Description
Action in response to hardware change	• **Update and transfer configuration:** The hardware changes are applied. The existing configuration is transferred to the new hardware setup. • **Reject and update configuration:** The hardware changes are applied. The existing configuration is discarded. This means that the entire device configuration is deleted. (**not recommended!**) • **Cancel:** The connection is not established and the configuration is not transferred. The command is halted with the status "Error".
Mapping criteria for transfer	No adaptations possible. The assignment is always made according to the serial number.
Mapping for configuration transfer	• **Behavior when no attempt to connect is made:** The configuration of all listed "source devices" is transferred to the respective device. • **Behavior when an attempt to connect is made:** Configuration of the source devices which are not found is transferred to the respective target device. If the target device can also not be found, the configuration is not transferred.

13.7.9.3 Import MFB configuration

The command enables the **import** of Fieldbus-configurations. The following Fieldbusses are supported:

- **CAN:** *.cba; *.dbc
- **ARINC:** *.idb
- **ECAT-IF:** *.imcecatif.xml
- **AFDX:** *.xml

Reference	Description of the configuration files

The files are generated using the Fieldbus-Assistant. For a detailed description, please refer to the associated chapters of the manual.

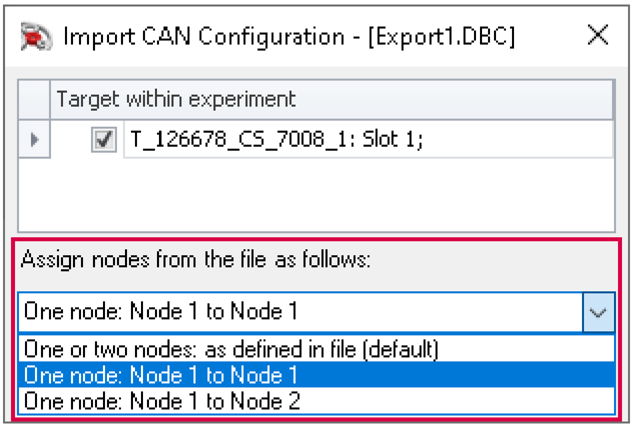
Parameter	Description
Import file	Specification of the file to import, including the pathname.
Mapping	Either specify the device so that no additional prompt will appear upon execution of the command, or wait to select the device until when you run the command. **Show mapping table:** Upon **execution**, a **prompt** appears which requests you to specify the device to use as the target. You can predefine the mapping table. **Use mapping table:** Specify the desired device by means of the additional parameter "*Mapping table*".
Mapping table	Here, select the desired device. The target is a device having an appropriate module.

Menu item: "Import/Export":

By means of this menu item, you can also import MFB-configurations. Here, the same options are available for your use.

CAN-import - Node selection

If the configuration only contains information on one node, you can select to which node to perform the import.



Selection	Description
One or two nodes: as defined in file	The file's content is processed sequentially. The first node (belonging to the file) is placed on the first node (in the Assistant). If there is any second node in the file (only cba), then this is set on the second. If there is no second node in the file, the configuration of the **second node** is **deleted** from the Assistant.
One node: Node 1 to Node 1	The file contains only one node - The content of the file is imported **to the first node** in the Assistant. The configuration of the **second node remains intact**.
One node: Node 1 to Node 2	The file contains only one node - The content of the file is imported **to the second node** in the Assistant. The configuration of the **first node remains intact**.

13.7.9.4 Reassignment of module positions

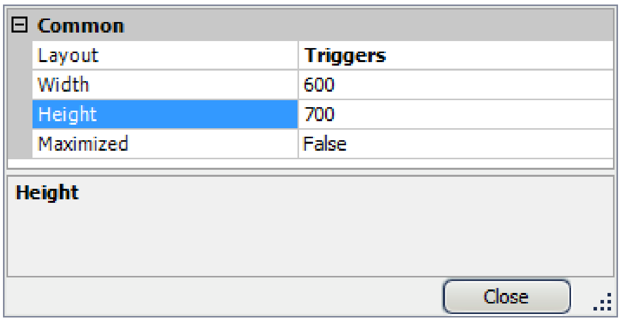
The module addresses are re-assigned. This matches the working of the function "*Reassign*" in the dialog "*Module Properties*". The existing module numbers are overwritten according to a gapless re-numbering process.

Reference

For more information on the module position and re-assignment, see the chapter: "*Module Properties* 199".

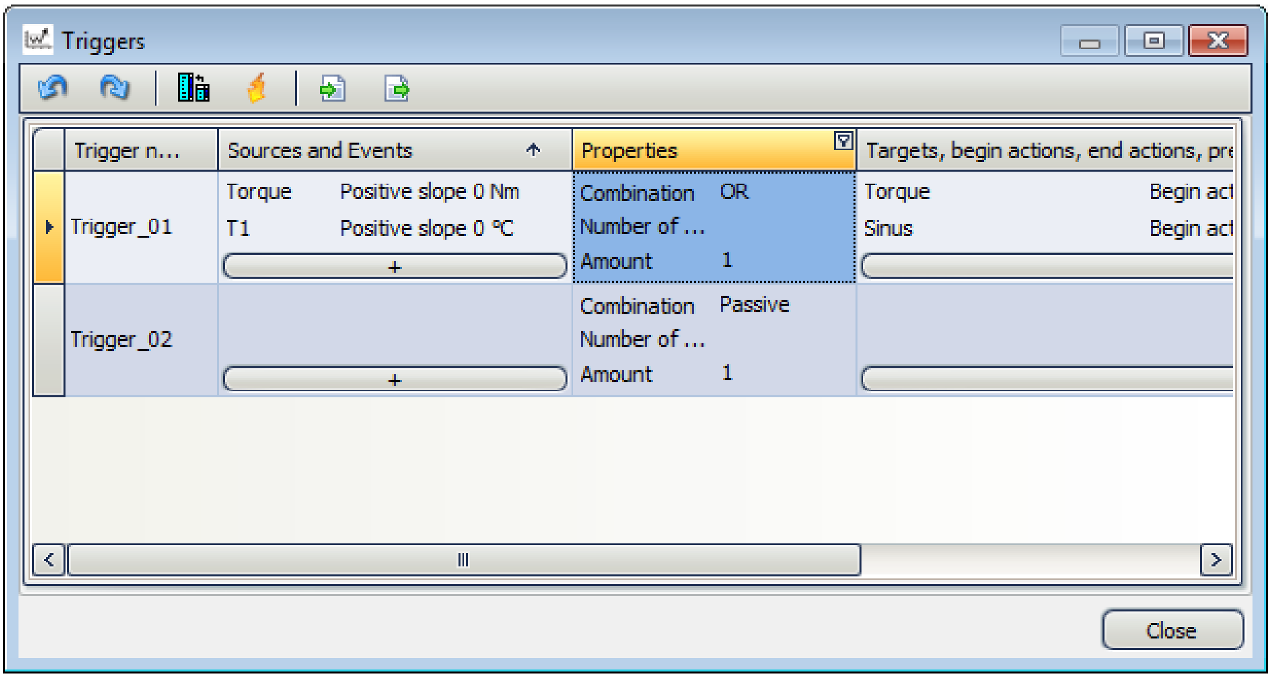
13.7.9.5 Display Setup dialog

The command group *Setup* offers all setup settings in dialog form.



Setup properties

Select *Layout* and set the *Width* and *Height*. Alternatively, the dialog's display can be *maximized*.



Example Trigger dialog, started by means of the command Setup

13.7.9.6 Import synthesizer-/controller configuaration

This command enables **import** of synthesizer and controller configurations for the **Synthesizer-module**.

Reference	Description of the configuration files

The files are generated by means of the Synthesizer-Assistant. A detailed description is presented in the Synthesizer user’s manual.

Parameter	Description
Import file	Specification of the file to import, including the pathname.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Mapping</td><td>Either specify the device so that no additional prompt will appear upon execution of the command, or wait to select the device until when you run the command.

Show mapping table: Upon execution, a prompt appears which requests you to specify the device to use as the target.

Use mapping table: Specify the desired device by means of the additional parameter "Mapping table".

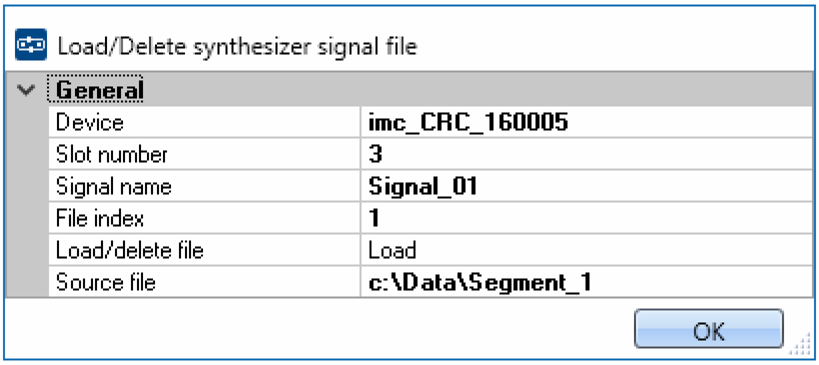
auto: The system searches for an appropriate target for the import. Only devices having a suitable module can be the target.
The import file contains a statement of the source device. If this device is selected, it is used.
If that device is not selected, the system uses a device among the ones which are selected which has the same number of slots.
If no such device is available either, the system selects the next best one.
Assignment of the slot is performed in a similar way. If the same numbers are available, they are used. Otherwise the assignment procedure uses other numbers in numerical succession.</td></tr>
<tr><td>Mapping table</td><td>Here, select the desired device. The target is a device having an appropriate module.</td></tr>
</table>

13.7.9.7 Load/Delete synthesizer signal file

Using imc STUDIO you can load files for the Synthesizer module into the device, or delete them from the device. By means of an index you can import various segment-files. With an appropriate device, you can play back these segments in succession.

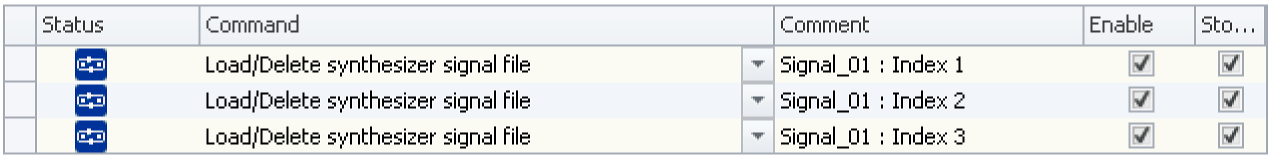
In the Properties you select the Synthesizer output. The outputs are distinguished by their respective slot numbers and signal names.

Parameter	Description
Device	Here, select the target device. The device requires a Synthesizer-module
Slot number	Synthesizer slot in the device
Signal name	See the Synthesizer-configuration for the signal name.
File index	A signal’s segments can be changed during the measurement. By means of the parameter, the segment is assigned an index in reference to which it is accessed. The index indicates the number of the segment which is selected by means of the pv-variable <SignalName>_Slot<Number>_NextFile. For an detailed description, see the section "*Managing the segment files*" in the "*Synthesizer Manual*".
Load/delete file	• **Load:** Transfers the source file to the device • **Delete:** Deletes the file having the index specified from the device
Source file	Here, select the file you wish to import.



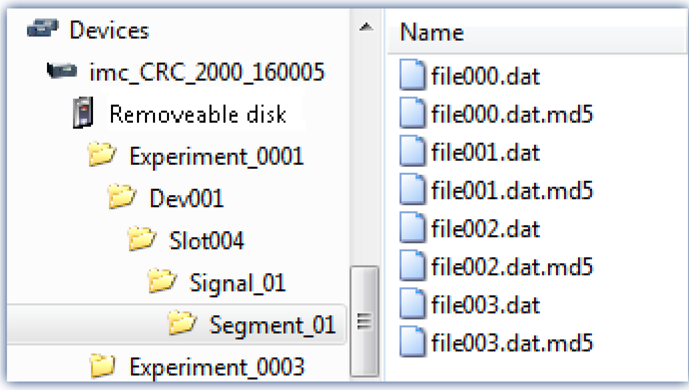
Assignment of the segment to the synthesizer output

It is thus possible to transfer multiple segments in succession:



Transfer of three segments

The segments are set up in the device's data carrier as follows:



File structure of segments on the device disk

Note

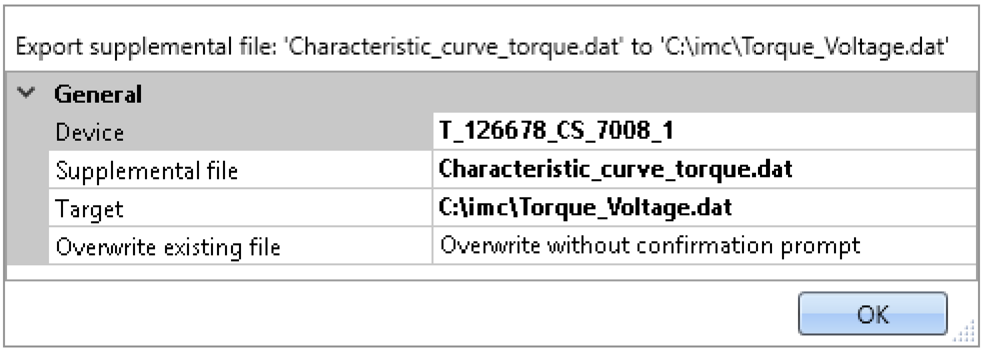
The data are saved on the device drive in a special format. It is **not** possible to copy the data manually!

13.7.9.8 Export supplemental file

This command enables export of a supplemental file. The files can, for example, be exported from the device.

Reference Description of the supplemental files

Supplemental files exist in various file types. For an exact description of the supplemental files, see the section: "*Setup - Device Configuration*" > *Ribbon:* "*Supplemental Files* 185".



Configuration: Export supplemental file

Parameter	Description
Device	Here, select the source where the file is located. The source may be a device. It is always only possible to make one selection.
Supplemental file	Specifies the file to be exported.
Target	Target file including the path.

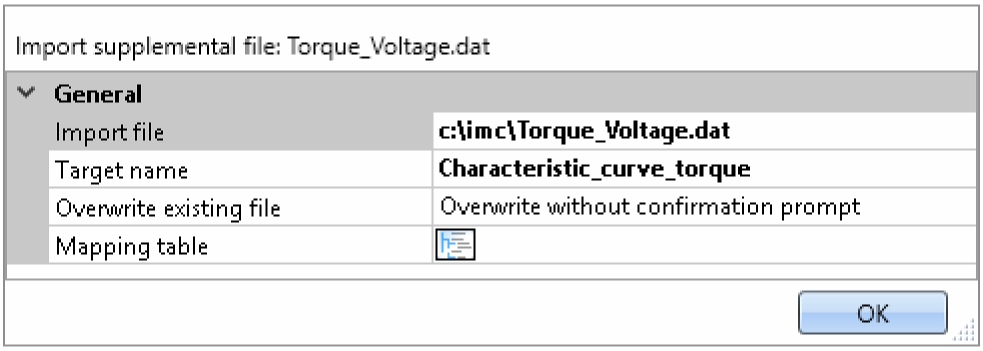
Parameter	Description
Overwrite existing file	Here, define the system's behavior for handling the files if the target file already exists. • **Overwrite without confirmation prompt:** Files in the target location which have the same name are overwritten without any confirmation prompt. • **Do not overwrite:** Files in the target location which have the same name are retained. The file is not exported and no notification is posted. • **Prompt for action:** A dialog concerning the subsequent proceedings is displayed. Available options are: "Overwrite", "Cancel". Each of these actions concludes the command with "Finished". This option is relevant for automated routines.

13.7.9.9 Import supplemental file

This command enables import of one supplemental file. The files can be used by imc Online FAMOS, for example.

Reference Description of the supplemental files

Supplemental files exist in various file types. For an exact description of the supplemental files, see the section: "*Setup - Device Configuration*" > *Ribbon:* "*Supplemental Files*" 185".



Example of a characteristic curve used in imc Online FAMOS with the Charact() function

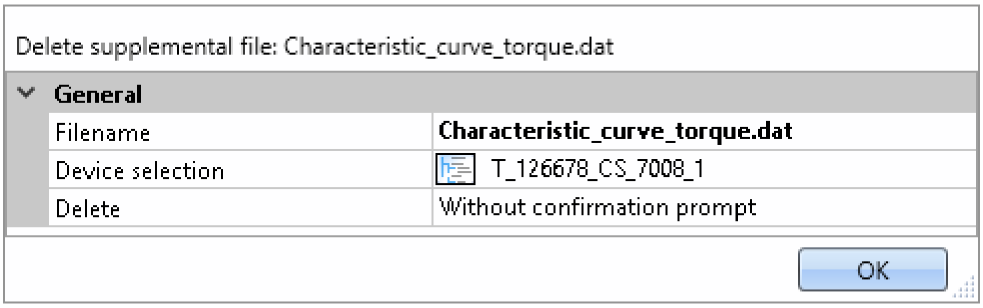
Parameter	Description
Import file	Specification of the file to import, including the pathname.
Target name	Optional entry. Here, specify a deviating name if the filename in the device is not supposed to match the original filename.
Overwrite existing file	Here, define the system's behavior for handling the files if the target file already exists. • **Overwrite without confirmation prompt:** Files in the target location which have the same name are overwritten without any confirmation prompt. • **Do not overwrite:** Files in the target location which have the same name are retained. The file is not imported and no notification is posted. • **Prompt for action:** A dialog concerning the subsequent proceedings is displayed. Available options are: "Overwrite", "Rename", "Cancel". Each of these actions concludes the command with "Finished". This option is relevant for automated routines.
Mapping table	Here, select the import target. The target may be a device . it is always only possible to make one selection.

13.7.9.10 Delete supplemental file

This command enables deletion of a supplemental file. The files can be deleted from the device, for example.

Reference Description of the supplemental files

Supplemental files exist in various file types. For an exact description of the supplemental files, see the section: "*Setup - Device Configuration*" > *Ribbon:* "*Supplemental Files* 185".



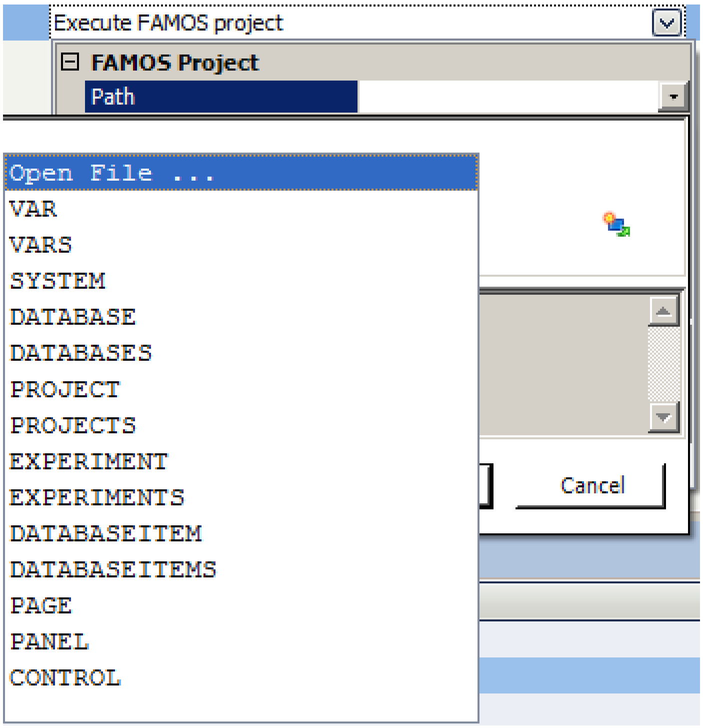
Configuration: Delete supplemental file

Parameter	Description
Filename	Specifies the file to be deleted.
Device selection	Here, select the source where the file is located. The source can be a device. It is always only possible to make one selection.
Delete	Define here whether a confirmation prompt is to appear. • **Without confirmation prompt:** The supplemental file is deleted without any confirmation. • **With confirmation prompt:** A dialog concerning the subsequent proceedings is displayed. Available options are: "Delete", "Don't delete". Each of these actions concludes the command with "Finished". This option is relevant for automated routines.

13.7.10 Scripts/imc FAMOS

13.7.10.1 Execute imc FAMOS project

A imc FAMOS project is selected and started:

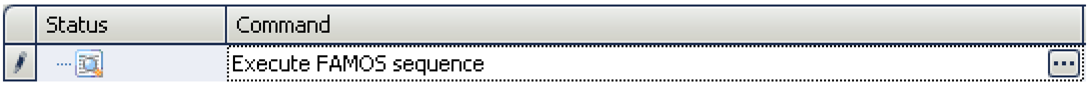


Command: Execute imc FAMOS project

Click on the symbol and select *Open File...*

In the project folder, select the file *Default.FamosPrj*.

13.7.10.2 Run imc FAMOS sequence



From within imc STUDIO it is possible to transfer variable currently being measured to imc FAMOS and to process them with a imc FAMOS sequence there. The results of the imc FAMOS sequence can be transferred back to imc STUDIO and displayed in a Panel page, for instance.

Note	Prerequisite

The prerequisite is installation of imc FAMOS on the same (see "*Technical data sheet*" > "*Additional imc Software Products*").

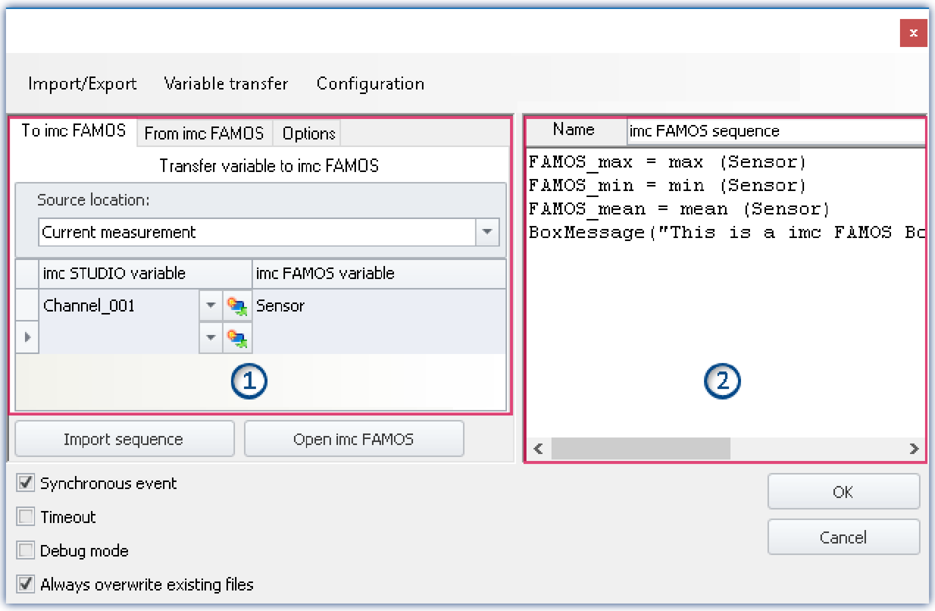
Reference	Functions

Information on imc FAMOS' scope of functions is presented in the separate imc FAMOS manual

To open the imc FAMOS Dialog, click on the button (symbol with three dots) in the sequence table.

13.7.10.2.1 imc FAMOS Dialog

The dialog consists of multiple areas:



imc FAMOS Sequence Editor and transfer table of imc STUDIO variables to imc FAMOS

- Transfer table 1470 (1): **Transfer of the imc STUDIO-variables** is accomplished by means of this table.
- imc FAMOS Sequence Editor (2): Here, the **imc FAMOS sequence in use** is displayed and can be edited.

Procedure

- The **measured variables** set in the Transfer Table 1470 under "*To imc FAMOS*" **are transferred to imc FAMOS**.
- The **calculations** belonging to the sequence are **performed**.
- The **result variables** set in the Transfer Table 1470 under "*From imc FAMOS*" **are transferred to imc STUDIO**.

Editing the imc FAMOS sequence

In order to create a imc FAMOS sequence, there are a variety of techniques:

- By editing in the imc FAMOS **Sequence-Editor**.
- Using the **Start command for imc FAMOS** via the button "*Open imc FAMOS*". (Preferable when not knowing the imc FAMOS functions and their parameters)
- By **importing** an existing **sequence file** using the button "*Import Sequence*".

To edit or test a sequence in imc FAMOS, use the button "*Open imc FAMOS*".

Dialog interface

<table>
<tr><th>Checkbox</th><th>Description</th></tr>
<tr><td>Synchronous event</td><td>"Synchronous event" means that the source waits until imc FAMOS has concluded the sequence. This means:
Sequencer: The next command line is only started when imc FAMOS has concluded the sequence.
Automation: The next step only starts when imc FAMOS has concluded the sequence.</td></tr>
<tr><td>Timeout</td><td>The option "Timeout" (only available if the dialog is called from a command) only appears if "Synchronous Event" is activated.
At the latest, after a specified timeout time, the Sequencer runs the next line.</td></tr>
<tr><td>Debug Mode</td><td>If the command is executed while the option "Debug Mode" is activated, then imc FAMOS is opened. In this case, the sequence is not run automatically. In Debug Mode, you can run the sequence step-by-step, and make changes which are saved in the command.

If imc FAMOS is closed, the results are transferred to imc STUDIO, if they are available in the table "From imc FAMOS". The command is only concluded as of this moment in time.

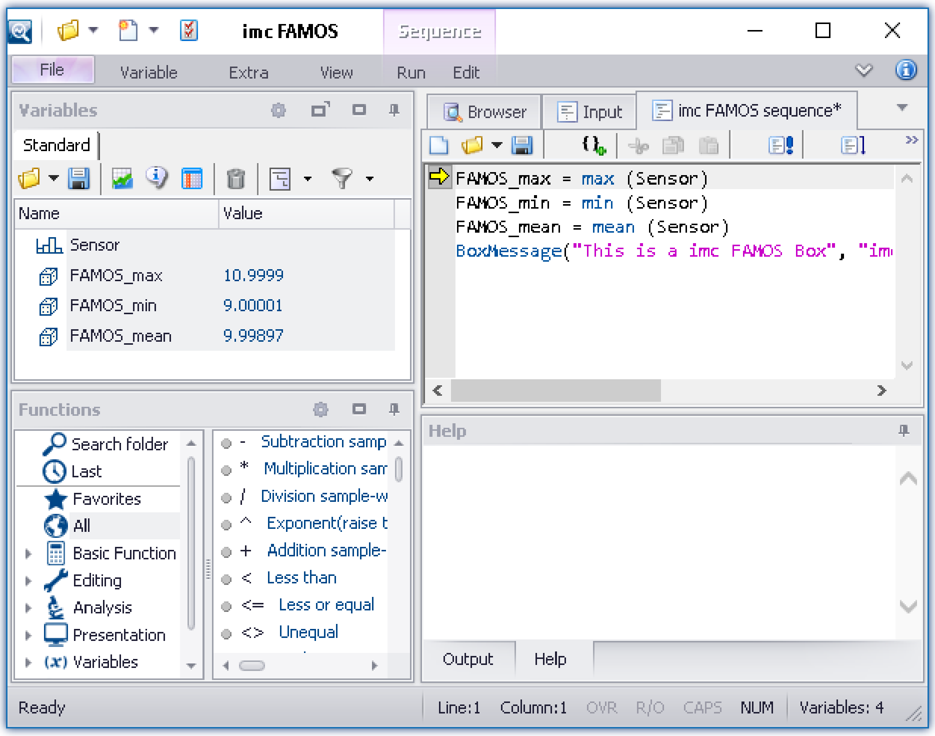
Please note that in Debug Mode, the command needs longer to execute:
With the option: "Synchronized event" active: The subsequent commands wait until the imc FAMOS-command has concluded.
With the option: "Synchronized event" deactivated: Required results may not exist in time since the command is still working.
As well, the option: "Timeout" should not be activated, since it can cause premature closing of the command, although imc FAMOS has not yet been ended.</td></tr>
<tr><td>Always overwrite existing files</td><td>If this option is activated, files having the same name in the destination folder will be overwritten without a confirmation prompt. This option is useful for automated routines.</td></tr>
</table>

Open imc FAMOS

Alternatively, **imc FAMOS** can be started using the button "*Open imc FAMOS*". In this case, the imc FAMOS Editor is used for making entries. You have the entire scope of the Function Assistant's functionality, help texts, etc., at your disposal.

In imc FAMOS, you can run the sequence directly for testing purposes. To this end, the variables in the table: "*To imc FAMOS*" are automatically set up with the current values. They appear in imc FAMOS's Variables list. If the variables do not yet exist in imc STUDIO at that moment, an empty variable is used in substitute (see note 1470 below).

The results of the test evaluation are not transferred back to imc STUDIO.



imc FAMOS as editor

Save the sequence if you wish to use the changes in imc STUDIO.

Reference

An example of Sequencer working in conjunction with imc FAMOS is found in the Sequencer-Tutorial 1636.

Note

Variable not present

If a variable does not exist in imc STUDIO when it is to be transferred to imc FAMOS, an "empty" variable is created in imc FAMOS as a substitute.

- Data type: Normal data set
- X-Delta: 1
- Total size: 0

Using the imc FAMOS-paths

The default paths set in imc FAMOS also apply to the command.

E.g. "`SEQ MySequence`" is premised on "MySequence.seq" being located in the default sequence folder of the installed imc FAMOS program. Alternatively, it is possible to specify the absolute path, e.g. "`SEQ "D:\SEQ\MySequence.seq"`".

Transferring the files used when exporting to other computers

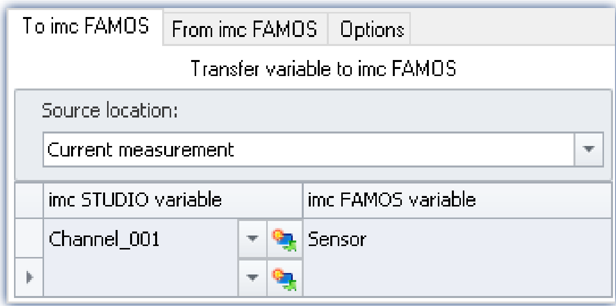
When exporting an experiment, the external files called in the sequence are not automatically included! Copy these files separately.

The exception is the files located in the experiment's subfolder "Meta". There, you are able to save your own files about the experiment, such as your own metadata, imc FAMOS-sequences, info-files, ... (for more information, see the chapter "*Experiments, Projects and the Database* 94").

13.7.10.2.2 Transfer Table

Transfer of the imc STUDIO variables or the imc FAMOS variables is accomplished by means of the transfer table. It is possible to rename the variables. In this way, existing sequences can be adopted directly.

Passing variables to the sequence ("To imc FAMOS")



The variables entered in the column: "*imc STUDIO variable*" are passed to the imc FAMOS sequence. There, they are assigned the name of the associated cell in the column: "*imc FAMOS variable*".

The variable does not need to be already registered in imc STUDIO. In this case, it is created as an "empty" variable in imc FAMOS (see note 1470).

In the example shown, the measured variable "*Channel_001*" is passed to the imc FAMOS sequence as the variable "*Sensor*".

You are able to transfer placeholders

Where is the measurement "x" saved? Which test object is used? Such information can be transferred directly to imc FAMOS by means of placeholders ( ). When the command is run, the placeholder is resolved and transferred.

Source: Selecting the source (measurement)

All variables defined are transferred from the source selected.

Source	Description
Current measurement	The current measured data are transferred. Note that in this case, only the amount of circular buffer memory set for the curve window display is available for use. This may be only a fraction of the entire measurement.
Last concluded measurement	If the measured data are saved, the last measurement saved is loaded automatically. The associated variables are passed to the imc FAMOS sequence.
Measurement number Measurement#<No>	The variables belonging to the measurement with the respective measurement number are passed.

Note — Variables from varying measurements

In some cases, variables from varying measurements need to be transferred to imc FAMOS. Independent of what "Source" is set, you can define in the Variables list whether a variable is to be transferred from a different measurement.

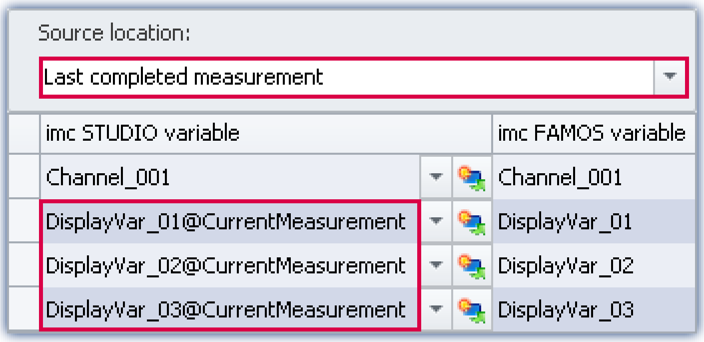
In this case, use the following syntax for the imc STUDIO variable:

Syntax	Example
@<MeasurementName>	<VariableName>@<MeasurementName> e.g. Channel_001@2010-11-15 15-44-03 (1)
@Measurement#<MeasurementNumber>	<VariableName>@Measurement#<MeasurementNumber> e.g. Channel_001@Measurement#1
@LastMeasurement	corresponds to: "*Last completed measurement*"
@CurrentMeasurement	corresponds to: "*Current Measurement*"

For measurement names, an **input support tool** is available: in the input box behind the channel name, click on the keyboard combination: <CTRL> + <SPACE>. You are then provided with a list of various input options. Select one and modify the results if appropriate.

Sample application: Variables from a saved measurement in combination with variables from "*Current Measurement*"

The analysis of measured data often requires the use of additional parameters which are saved with variables under "*Current Measurement*". With this imc FAMOS command, you are able to transfer variables both from a saved measurement and from "*Current Measurement*".

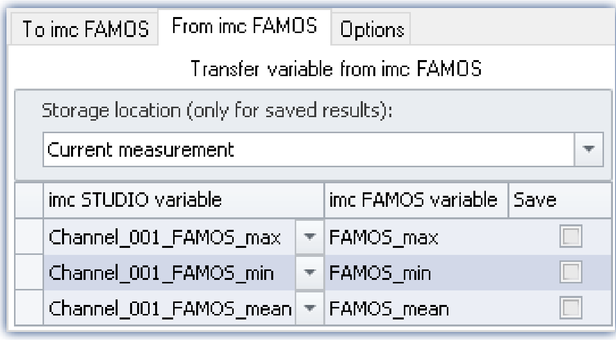


In this example, a particular measurement is selected. Additionally, variables from "*Current Measurement*" are also transferred. In this case, use the following syntax for the imc STUDIO variable:

<VariableName>@CurrentMeasurement

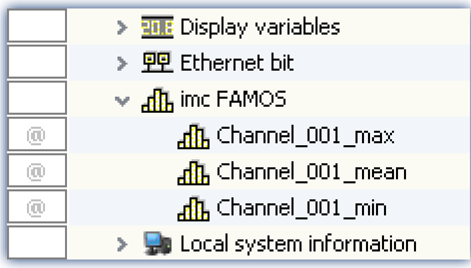
Example: *DisplayVar_01@CurrentMeasurement*

Receiving the sequence’s results ("From imc FAMOS")



The variables calculated by imc FAMOS are transferred to imc STUDIO along with the transfer table.

The results appear in the Data Browser:



Storage location without saving: Selection of the target (measurement)

The result appears in the Data Browser, but is not saved.

Storage location	Description
Current measurement	If the target variable already exists (e.g.: a user-defined variable), the result is copied to the existing variable, provided that the variable’s type is correct. If the target variable does not yet exist, the result is created under the category "*imc FAMOS*" and is assigned the scope (Validity range): "*Temporary*". The variable’s type is selected on the basis of the content.
Last concluded measurement	The result appears temporarily in the Data Browser along with the last/selected measurement. The result is not saved and is deleted as soon as the measurement is closed (un-loaded).
Measurement#<No>	

Storage location with saving: Selection of the target (measurement)

(Not possible with "*imc FAMOS automation (data cutting)*1464")

The result appears in the Data Browser and is stored as a.dat-file.

Speicherort	Beschreibung
Last concluded measurement	(recommended) If the option **Save** is selected, use **Last concluded measurement** or **Measurement#<No>**. The result is saved to the folder with the last concluded measurement respectively to the folder of measurement with selected number #<No.>. After loading the measurement, the result is always available. **Please note that at least one channel must be saved on PC. Otherwise the measurement folder does not exist.** If in Data Browser the selected measurement number is assigned to "Current measurement" , the system acts as if "*Current Measurement*" is selected.
Measurement#<No>	
Current measurement	(not recommended) If **Current measurement** is selected as target, no saved measurement is selected. A subfolder reflecting the current time stamp (e.g. "*imcFAMOSResult_2014-07-31 12-50-43*") is set up in the experiment folder for the results.

"Options"

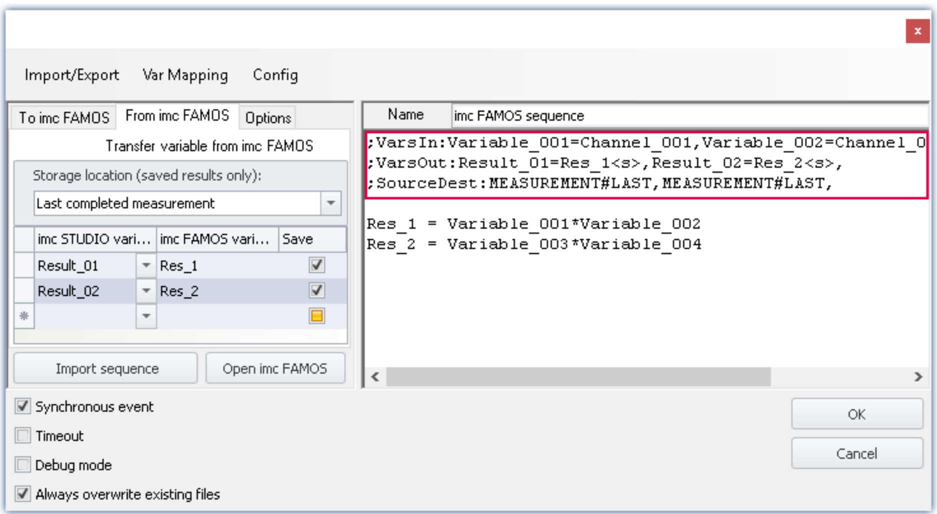
On this page, you can define fixed parameters which are used in the sequence.

Passing (assignment in the Transfer table) of variables can be incorporated in the sequence

Passing (assignment in the Transfer table) of variables can be incorporated in the sequence. Once the assignment is in a sequence, it can easily be passed (copied) to other imc FAMOS-commands.

The assignment is expected/entered as a "Header" in the first three lines of the sequence.

By means of the menu, the assignment can be passed from the transfer table into the sequence, or conversely from the sequence to the table.



Below, the header is set up (with sample names as per the picture):

Example

Variables: To imc FAMOS:

```
;VarsIn:Variable_001=Channel_001,Variable_002=Channel_002,Variable_003=Channel_003,
```

Variables: From imc FAMOS:

```
;VarsOut:Result_01=Res_1<s>,Result_02=Res_2<s>,
```

Source and data storage location:

```
;SourceDest:MEASUREMENT#LAST,MEASUREMENT#LAST,
```

Variables

Description	Variables: To imc FAMOS:	Variables: From imc FAMOS:
Start	;VarsIn:	;VarsOut:
First variable name	Name in imc FAMOS	Name in imc STUDIO
Assignment character	=	=
Second variable name	Name in imc STUDIO	Name in imc FAMOS
Activation of data storage (optional)		<s>
Separator from next assignment	,	,

Source and data storage location:

Description	Syntax
Start	;SourceDest:
First name	Source of the page "To imc FAMOS"
Second name	Storage location of the page "From imc FAMOS"
Separator	,

Possible syntax:

Source or data storage location	Syntax
Last concluded measurement	MEASUREMENT#LAST
Measurement number 3	Measurement#3
Current measurement	empty, so only ","
Fixed measurement name (as in the Data Browser)	2017-02-08 16-42-41 (1)

Example

Examples	Description
;SourceDest:MEASUREMENT#LAST,Measurement#1,	Source: Last concluded measurement Data storage location: Measurement number 1
;SourceDest:MEASUREMENT#LAST,2017-02-08 16-42-41 (1),	Source: Last concluded measurement Data storage location: Measurement with the name 2017-02-08 16-42-41 (1)
;SourceDest:,MEASUREMENT#LAST,	Source: Current measurement Data storage location: Last concluded measurement

13.7.10.3 Run script

Using the command **Run Script**, available scripts of type *Script* can be executed. When running the script, the script's method Run() is called. The programming language is C# (.NET 4.0).

Script selection

Parameter	Description
Name	Here, the script to be run is selected.
Add new Script	Using this button, a new script can be created. The Create Script dialog will subsequently open.

Reference Scripting

For further information see Scripting-manual:

- Create script 1733
- Run script 1738

Note When is the command "Done"

The command is **Done** when the `Run()`-method has concluded.

13.7.11 Variables

13.7.11.1 Export variable

Description of the command "*Export variables*" and of the corresponding function accessed via the Data Browser 1078.

The function **enables variables** and their respective values **to be saved** at any desired location. It is possible to select one or more variables to be exported.

The following applies to the command: All options can be either specified, or selected manually while the Sequencer is running.

Parameter - File options	Description
Folder	Specifies the target folder. If no target folder is specified and the option: "*Show Dialog*" (only applicable to command) is not activated, a folder selection dialog appears when the function is executed.
Save to one file per file format (Save all in a single file)	If this option is activated, all variables are saved to a single (multi-channel) file. The filename can be specified. The file format for the file does not need to be specified. However, if no filename is specified, all variables are automatically saved to the file *data.dat*. Furthermore, for each file format a separate file is created. If the option is not activated, each variable is saved in a separate file. In that case, the filename can be specified separately for each variable.

Parameter - Mapping instruction	Description
Mapping instruction	Here you can select pre-defined export settings. • **No selection:** The user-defined settings are used (e.g. selection of variables) • **Default Export Mapping:** It is not possible to select variables. Instead, all variables (but not single-value variables) are exported. Thus, the same functionality is implement as for the menu action: **Save Current Measurement Data**. Additionally, it is possible to select a measurement whose variables are to be exported.
Measurement	Here you specify which measurement's variables to export. The option can only be used in conjunction with a mapping instruction. • **No selection:** Variables from the current measurement are exported. • **Selection or entry possibilities:** Measurement name or Symbolic measurement name (with measurement number)

Parameter - Variables	Description
Add variables	Here, the variables to be exported are selected and entered in the Variables list. • If the variables exist in the Data Browser, they can be selected by means of the button . • If a variable does not yet exist, it is still possible to add it. Enter its future name and confirm by clicking on Enter. Selected and entered variables appear in the Variables List.

Parameter - Variables list	Description
By means of the checkbox, it is possible to de-select for export a variable already entered. This means that it still exists in the list, but is not exported. It can later be activated for export again at any time.	
Variable name	Name of the variable as it is shown in the Data Browser
Measurement name	Measurement from which the variable is to be exported • **No selection:** The variable is selected from the current measurement • **Selection or entry possibilities:** Measurement name or Symbolic measurement name (with measurement number)
File format	Target format of the file to export. The system selects the file format automatically on the basis of the variable type. Alternatively, you can specify the file format in the settings under Options 117.
Filename	(not for: "*Save all in a single file*") By default, the file name is formed from the variable's name. You can change this here.

Parameter - Other options	Description
Treat error as warning	If the function is executed even though not all selected variables exist, error messages are posted. In normal cases, the function and the Sequencer is exited when an error message appears. This also causes not all variables to be exported. The variables in the list are exported in succession and all variables below the non-existent variable are thus not exported. In order that always exports all existing variables, it is possible to activate this option. In this case, no error messages appear in the logbook, but warnings instead. Warnings do not cause the function or the Sequencer to close.
Show file options and Show variables options (Only applicable to command)	If one of the two options is activated, then when the command is executed, the settings dialog opens for the respective scope: • **Show file options:** File options • **Show variable options:** Mapping instruction, Variables and Variables list. All settings can be checked and edited. Any changes do not take effect on the configuration of the command in the command list, but only on the export currently performed.
Always overwrite existing files	If this option is activated, files having the same name in the destination folder will be overwritten without a confirmation prompt. This option is useful for automated routines.

File comment	A file comment can be added.
	In imc FAMOS, the file comment is called as shown below:
	`path = FileName?(Channel_001)`
	`id = FileOpenDSF(path, 0)`
	`comment = FileComm?(id)`
	`FileClose(id)`
	Supported:
	• Export in RAW/DAT-format, as |NO Key
	• Export to *.aet files for the placeholder %FILECOMMENT%

13.7.11.2 Load/Import variable

Load Variable: The command enables **creation of user-defined variables with pre-defined values** from saved files. The variable may not exist before the command is run.

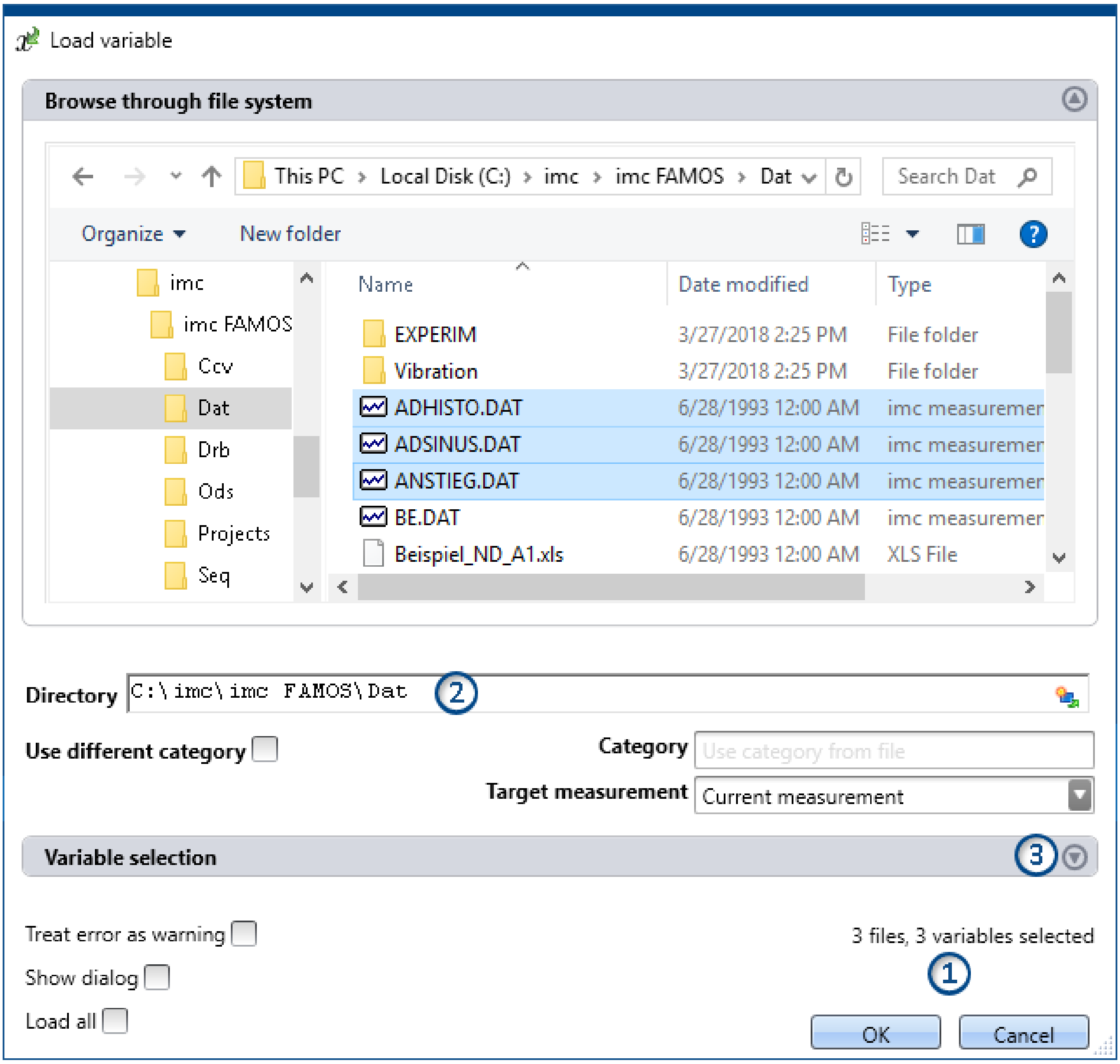
Import Variable: The command enables **setting the values of an existing variable** from saved files. The variable must already exist before the command is run.

The values must be saved in a suitable file, for example one which was created using the commando: "*Export Variable* 1618". It is possible to select one or more variables to be imported or loaded. If you wish to use multiple files, they must all be located in one folder.

All options can be either specified, or selected manually while the Sequencer is running.

Brief description:

In the upper region, there is an Explorer for selecting files:



Here you can use the "Explorer"-functions to **navigate to the files and select them**. After making a selection, you can close the dialog by clicking "OK". **All file selected are loaded** or alternatively selected for the Import command.

Exception: If you don't select any file in the Explorer, all importable files belonging to the current folder are automatically selected.

Note	Adding variables subsequently

Please be aware that the **variables are no longer in the selected state** in the Explorer once the command has been concluded by clicking "*OK*". If you open the configuration again and **select an additional file**, then **only this file is selected**; all others are de-selected.

Add more files by means of either the <CTRL>- or <SHIFT>-key. In this case, the files are added to the list.

Remove the variables via the "Variable selection" area.

File count (1): At the bottom right there is a readout of how many files are selected and how many variables belonging to these files are selected.

Directory (2): Below the file selection window, there is an input box for the folder path, which can be used as an alternative for specifying the file(s) desired. Here, you can enter placeholders ( ) or paths which only exist once the command is run.

Note	Utilizing a placeholder

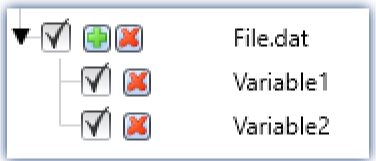
The placeholder can be used at all positions (start, middle, end). E.g. "`<EXPERIMENT.PATH>\Data\`"

When possible, the path is resolved in the "Explorer". There, you can also select files.

However, if you open a subfolder or a different folder in the Explorer, the field "Directory" is filled with the current value. The placeholder is no longer present.

Variables-box (Variable selection) (3): Using the buttons ( ) near the right edge, you can, for example, expand the Variables area. You can also make additional settings such as

- **de-/selecting** specific files or **variables** using the checkbox ( ) , for cases where not all variables belonging to a file are to be loaded. This means that the are present in the list but will not be imported. They can be activated for import again at any time.
- **adding more elements**, for the case where the variable only exists once at the command's runtime. Use the "+"-symbol ( ) to add files and variables. Be aware that a file must always contain at least one variable.



Example: a file having two variables

Variables list	Description
Variable name	Name of the file/variable as found in the file.
Target variable name	Name of the variable as it is to be found in the Data Browser following import.

The element-specific configuration is discarded once the file/variable is deleted from the list.

Other options

Category	Description
(Only for the command: Load Variable)	
Use different category	Put a checkmark in the box if you wish to create the variables in a deviating category. An input box for the new category appears. This category is applicable for all variables loaded. • **deactivated:** The variable is displayed **in the variable's category, or without any category** under "no category". • **activated:** The variable is displayed **in the specified category or without any specification under "User-defined variable"**.

Target measurement	Description
Current measurement	**Load:** The variable appears in the Data Browser under "*Current measurement*". **Import:** The variable overwrites any variable existing under "*Current measurement*".
Last completed measurement	**Load:** The variable appears temporarily in the Data Browser. The variable is not saved along with the measurement. **Import:** The variable temporarily overwrites any existing variable in the measurement. You are able to write any changes back into the file. See the section: "*Data Browser*" > "*Operation - Checkout and Check-in* 1077".
Measurement number Measurement#<No>	
Fixed measurement name	

Other options	Description
Treat error as warning	If the command is executed even though not all selected variables exist, error messages are posted. In normal cases, the Sequencer is exited when an error message appears. Das führt auch dazu, dass keine Variable importiert wird. In order that the command always imports all variables, it is possible to activate this option. In this case, no error messages appear in the logbook, but warnings instead. Warnings do not cause the Sequencer to close.
Show dialog	If this option is activated, the settings dialog appears when the command is executed. All settings can be checked and edited. Any changes do not take effect on the configuration of the command in the command list, but only on the import currently performed.
Load/Import all	When this option is activated, then when the command is run, all variables are imported in accordance with the file selection: • **if files are selected**, then all variables belonging to those files are imported at runtime. • **if no file is selected**, then all files and their variables are imported at runtime.

Note — Changes to files are not applied

If configuration of the command is completed, the Variable list's configuration is permanent.

This means that if the file is subsequently changed, the changes will be ignored.

Example: A file contains two variables: Var_1 and Var_2.

The command is configured in such a way that the file is selected. When the command is run, both variables are imported.

Later the file is replaced. The two variables still exist in it, but now with an additional variable: Var_3. If the command is executed, only Var_1 and Var_2 are imported. The new variable is not imported.

If you wish to make changes to the files actually applicable, please activate the setting: "*Import/Load all*".

13.7.11.3 Delete variable

The command ***Delete Variable*** enables existing variables to be deleted. When the command is executed, all selected variables are deleted. It is possible to select one or more variables to be deleted. All options can be either specified, or selected manually while the Sequencer is running.

Variables list

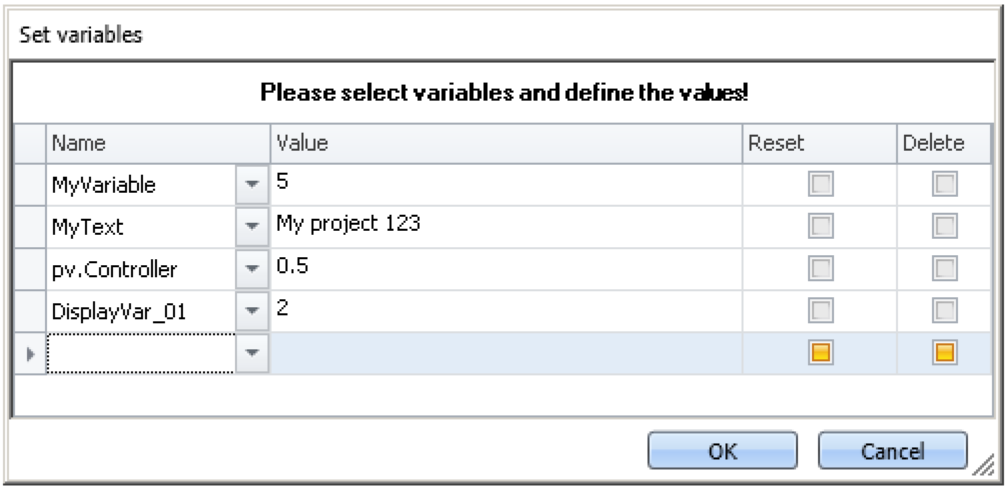
To add a variable to the list, first click in the empty box and then

- enter a variable's name or
- click on the button ... and select an already existing variable from the Data Browser.

Parameter - Other options	Description
Treat error as warning	If the command is executed even though not all selected variables exist, error messages are posted. In normal cases, the Sequencer is exited when an error message appears. This also causes not all variables to be deleted. The variables in the list are deleted in succession and all variables below the non-existent variable are thus not deleted. In order that the command always deletes all existing variables, it is possible to activate this option. In this case, no error messages appear in the logbook, but warnings instead. Warnings do not cause the Sequencer to close.
Show dialog	If this option is activated, the settings dialog appears when the command is executed. All settings can be checked and edited. Any changes do not take effect on the configuration of the command in the command list, but only on the deletion currently performed.

13.7.11.4 Set variables

The command **Set variables** assigns values to variables.



Command: Set variables

It is possible to set pv-variables, Display variables, virtual bits, or user-defined variables. You can also set triggers to 0 or 1, as well as write text entries to "*report channels* 1091" and assign data to whole channels.

To select an **existing** variable, click on ⌄, the Data Browser opens. All variables used in this command must be present at the time the command is run.

In the column *Value*, you can use placeholders; see the chapter for more Placeholders 145 information.

Note — Automatic resolution

As described below, this command automatically resolves a number of expressions. To prevent this automatic resolution, place the assigned value in quotations marks.

It is recommended to write texts in the box *Value* in quotation marks, as a rule, in order to prevent unintended resolution.

The quotation marks are automatically deleted before the assignment, so that they do not appear during subsequent processing and display of the variables.

If you wish to include quotation marks in a variable, use \".

Resolving existing variables

If the name of an existing variable is used in the *Value* box, then at runtime it is replaced by its current value. In order to prevent a new name being replaced by a value, place the text in quotation marks. If you wish to resolve a targeted variable within a text which is in quotation marks, please use the following placeholder: <VARS["My_Variable"].VALUE>.

Mathematical operators

In the *Value* box, it is possible to use mathematical operators such as +, -, / and *. Thus, you could set the variable `a`, for instance, to the value `a+1`.

Logical operators

In the *Value* box, it is possible to use logical operators such as && and ||.

Comparisons

It is possible to perform comparisons in the *Value* box such as <, >, <=, >=, ==. In order for the comparison operators to be recognized as comparison operators, there must be numerical values (either a number or a resolved variable) to their right and left.

Reset

If the checkmark: *Reset* is set, the variable is set to the initialization value. The value entered in the box *Value* is ignored.

User-defined variables have an initialization value which is set when the variable is created.

Device variables have no initialization value. Here, the value is set to "0".

Delete (should not be used)

If the checkmark: *Delete* is set, the variable is deleted. The value entered in the box *Value* is ignored.

No device variables are deleted, nor is any error message posted, when an attempt is made to delete a device variable.

Note

To delete variables, please use the command: **Delete Variable** 1623. Using this command, it is possible to preclude special cases such as the deletion of illegal variable types.

13.8 Tutorial

The following are examples involving the plug-in **Sequencer**. The examples use **Widgets** 1098 from the plug-in **Panel** 1058, which may not come with your installation (depending on the product configuration).

13.8.1 Starting the Sequencer

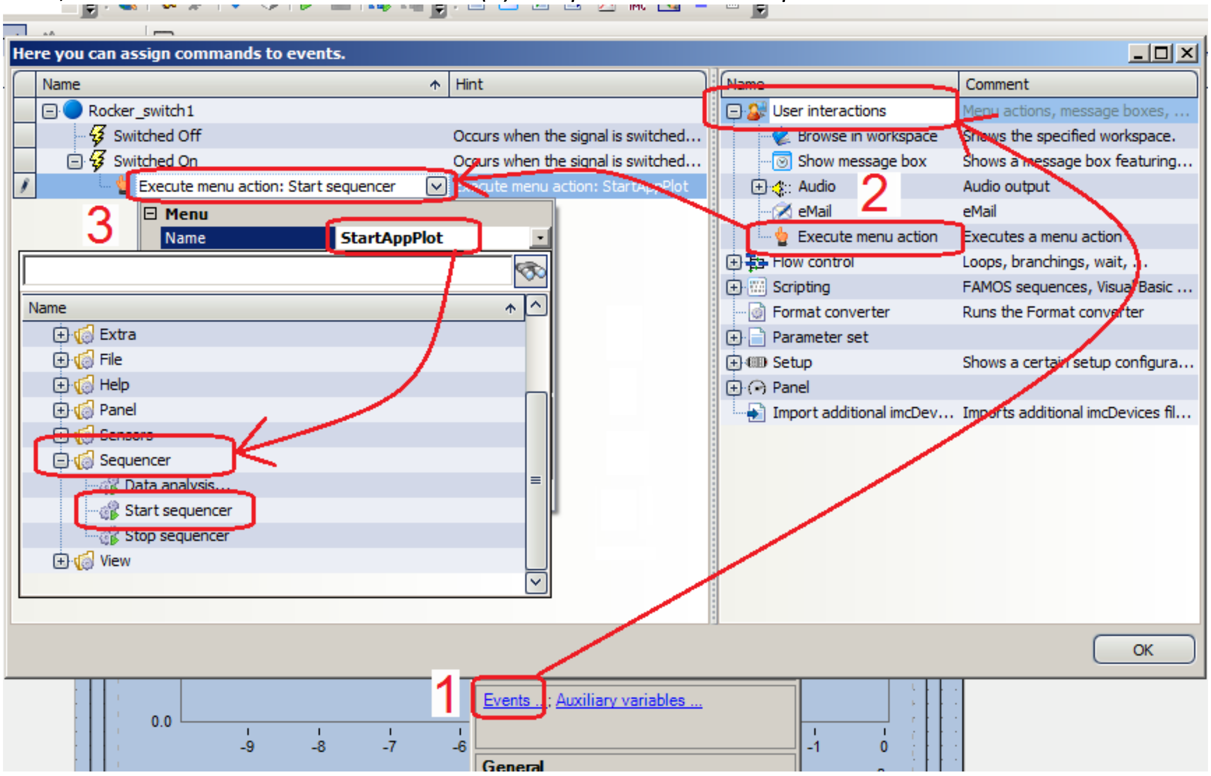
This exercise shows how to start a measurement by means of the Sequencer. At the end, an audible announcement of the measurement's conclusion is emitted by the computer's sound card.

Assignment: Create a **curve window** in the Panel page with one channel. The measurement is started by the Sequencer and automatically ends after 10s. The computer announces the measurement's conclusion via the sound card.

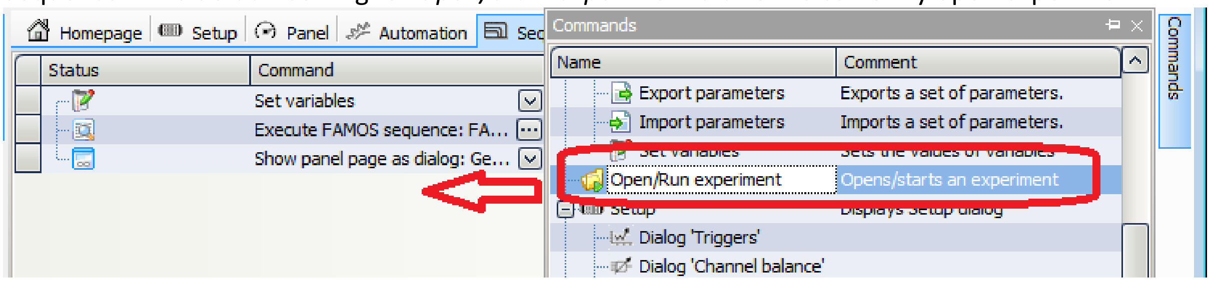
Procedure:

1. Go to the page Setup. Select the desired measurement device and activate a channel. Set the channel's measurement duration to 10s.
2. Go to the Panel page.
3. Open the tool window *Widgets* and select from the group Curve window the Widget Standard. Drag the object to the Panel page. Move the curve window to its center, using the curve window's move handle. Change the shape by dragging the sizing handles, which are the white squares at the corners and sides of the object.
4. Click on Prepare Measurement . The channel then appears in the Data Browser. Drag the channel to the curve window.
5. From *Widgets - Automotive*, drag a *Rocker switch* to the Panel page. Set its *Switching behavior* to *Hold-to-run*.
6. Open the *Rocker switch* properties dialog. The switch is to be labeled with the word *Start*.
7. Click on the link *Events...* in the lower portion of *Properties (1)*. Select the event *Switched On* and assign to it the *User interactions - Execute menu action (2)*.

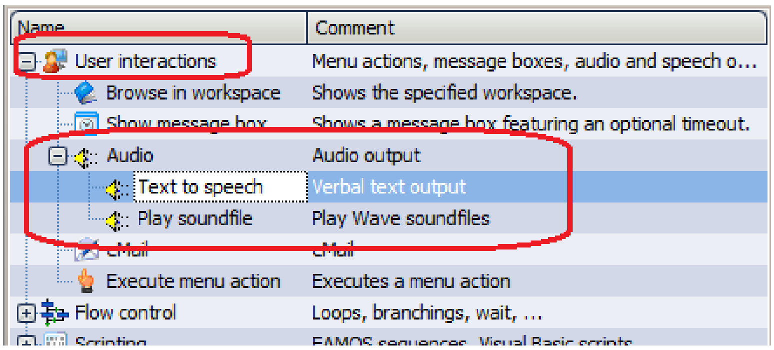
8. Next, select as the menu action *Actions (3) - Sequencer - Start Sequencer*.



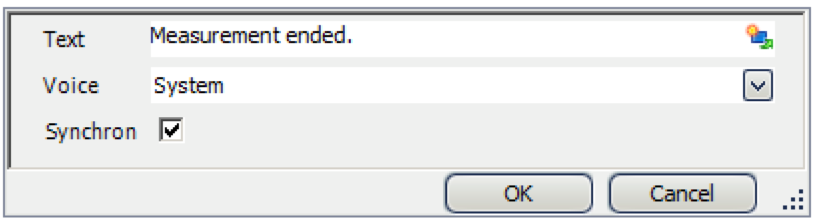
9. Go to the Sequencer and select from *Commands* the item *Open/Start experiment.* Drag it into the Sequencer. The default setting for *Open/Start experiment* starts the currently open experiment.



10. From the commands in the branch *User interactions*, drag the entry *Audio - Text to speech* to the Sequencer.



Enter a text, e.g. "Conclude measurement". Try a different voice as well. The defaults depend on the Windows system. There are usually only English voices, so that any German inputs are pronounced as English words.



11. Next, select instead of voice output the entry *Play soundfile*. Enter as the WAV file a sound from the folder C:\Windows\Media.
12. Go back to the Panel and switch off the Design mode. Make sure that the sound volume is set to high. Click on the Start button which you previously created: The measurement starts and finally the synthetically produced voice output is emitted, followed by the sound you selected.
13. Save the experiment under the name "Start Sequencer"

Result: The measurement is started via the Panel. By means of the Sequencer, you can have the user notified when the measurement ends.

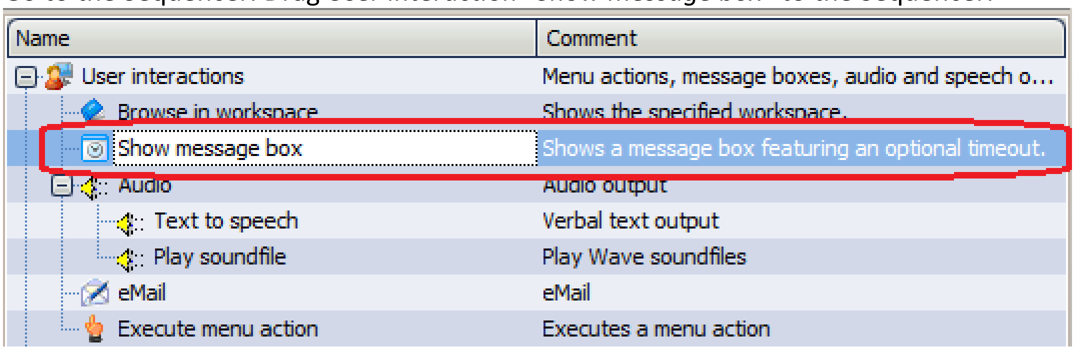
Remark: It is still possible to start the measurement independently of the Sequencer. (Green Start button in the Studio toolbar). In this case, however, the Sequencer does not start with it.

13.8.2 Output box

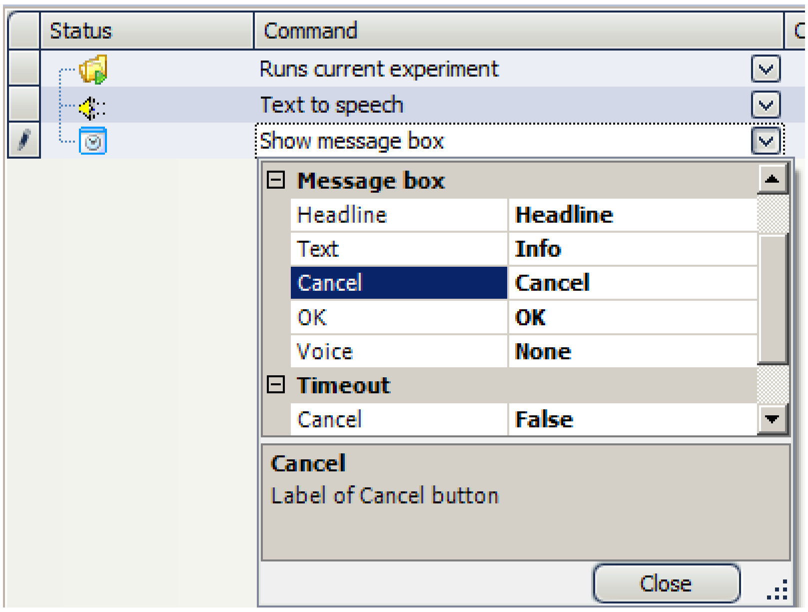
The preceding exercise is expanded to include a message box at the end of the measurement. Subsequently, an additional message box with sound output is displayed.

Assignment: Create a message to be displayed at the end of the measurement. Also, have the text spoken by voice output.

1. Load the experiment "Start Sequencer" if it is not open yet and **save** the experiment under the name "**Output box**".
2. Go to the Sequencer. Drag *User interaction "Show message box"* to the Sequencer.



3. Enter in the properties:



4. **Save** the changes made under the experiment name "**Output box**"
5. Go back to the Panel and switch off the Design mode. Make sure that the sound volume is set to high. Click on the Start button you previously made.

Result: At the end of the measurement, an output box appears, whose text is additionally outputted acoustically.

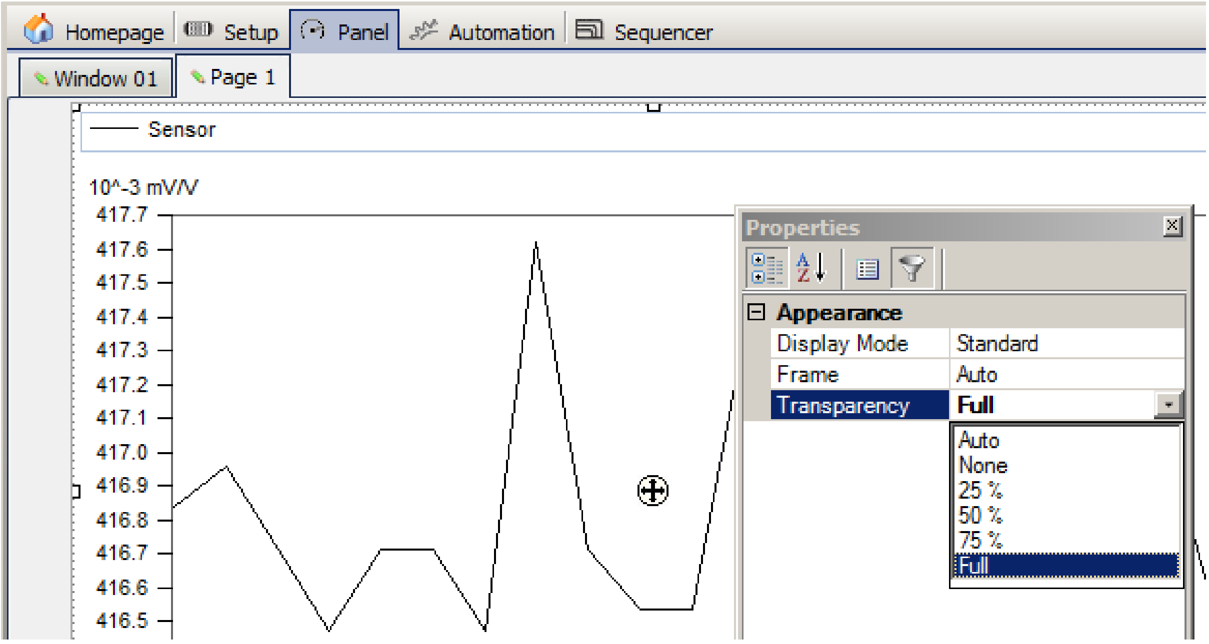
Remark: The voice output can be switched off by the entry Voice: none.

13.8.3 Scrolling through the Panel pages

A new Panel page is create. At the end of the measurement, the system automatically goes to this Panel page.

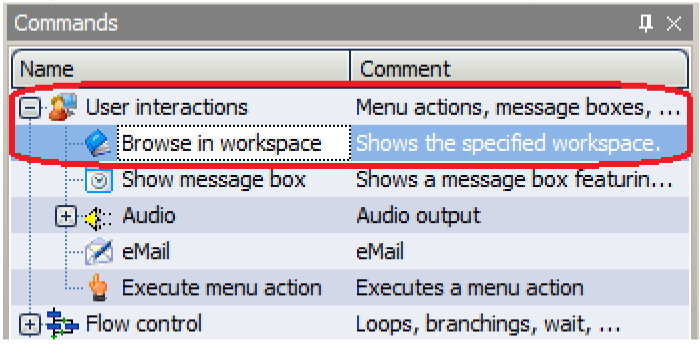
Assignment: Change the example "Start Sequencer" so that at the end of the measurement, a second Panel page is displayed instead of the sound output.

1. Load the experiment "**Start Sequencer**" and **save** the experiment under the name "Scroll".
2. Go to the Panel. Create a **new Page** as a ***Report (Portrait format)***. To do this, right-click the mouse over the Panel and select *Add Page...* Name it "*Report*".
3. Create a **Standard curve window** and set the property *Transparency* to *Full*.

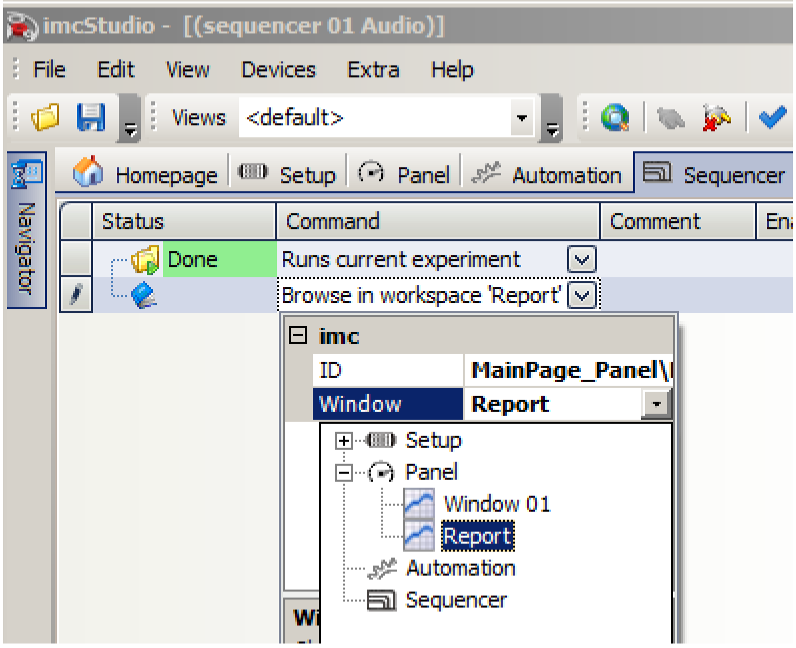


4. Go to the Sequencer. **Delete all Sequencer steps** except the first step, which starts the measurements. To do this, highlight the steps and right-click the mouse to open the context menu. Select the context menu item *X Delete*.

5. Drag the ***User interaction*** "***Browse in workspace***" to the Sequencer steps.



6. As the **Target**, select the new Panel page **"Report**".



7. **Save** the changes made under the experiment name "**Scroll**".
8. Go to the Panel and switch off the Design mode. Click on the Start button you previously created.

Result:	At the end of the measurement, imc Studio automatically pages through to the Report page.
Remark:	Using the command *Browse in workspace*, you can scroll to any pages which can also be reached manually, e.g. even the analog channel settings on the Setup page.

13.8.4 Dialog

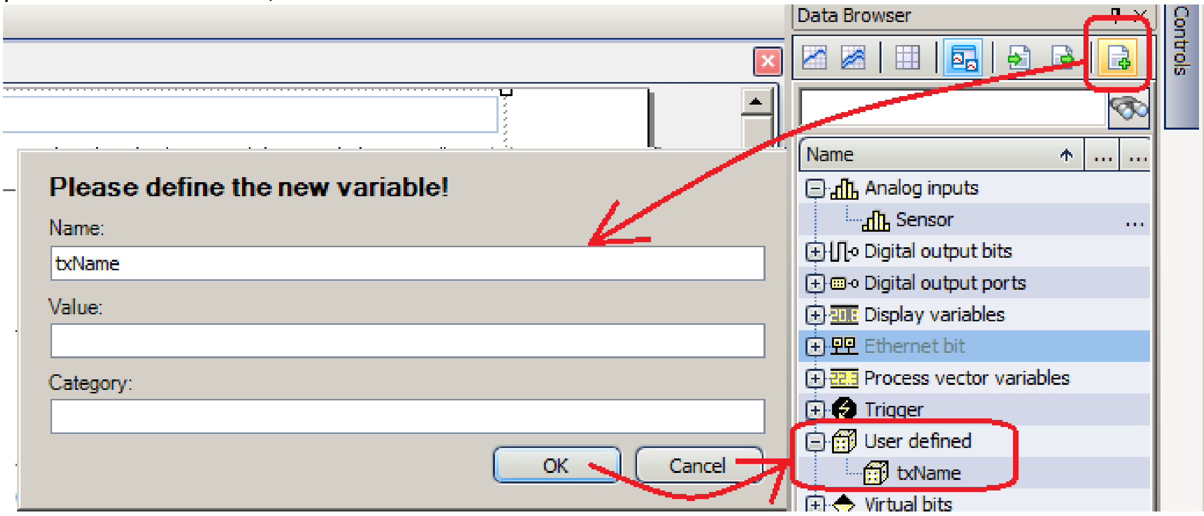
An additional Panel page is displayed as a dialog.

Assignment: Expand the experiment "Scroll". Create a dialog by entering your name and test object number before the measurement.

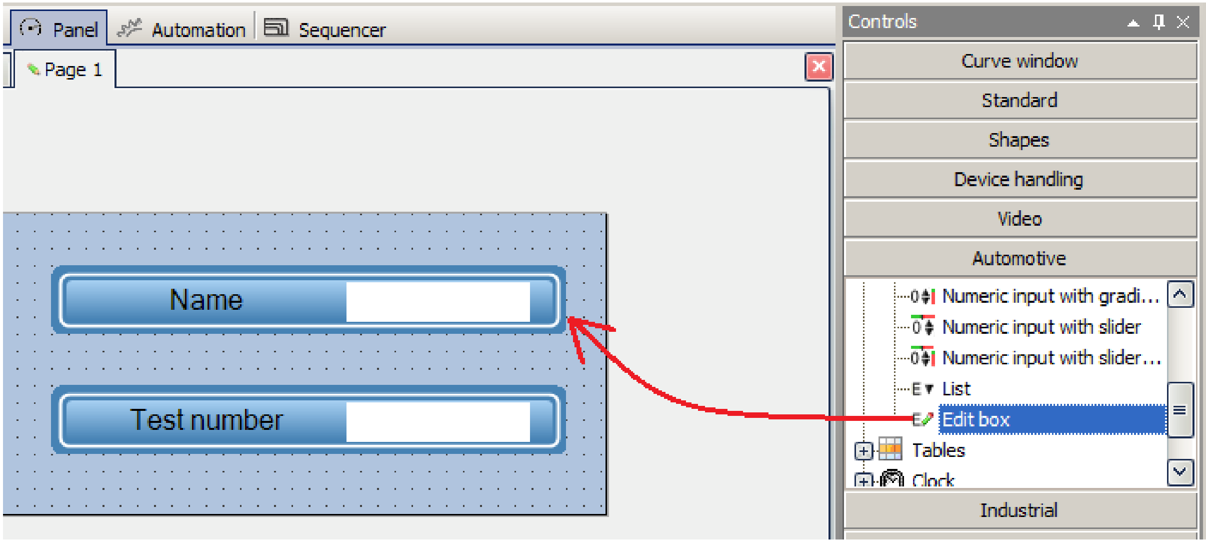
1. Load the experiment "**Scroll**" if it isn't open yet and **save** the experiment under the name "Dialog"

2. Go to the Panel and create a **new page as *Standard Dialog***. Name the dialog *"Input"*

3. In the Data Browser, add the *user-defined* variables TxName and TxTestObject. If you wish to provide default values, enter them in the box "*Value*".



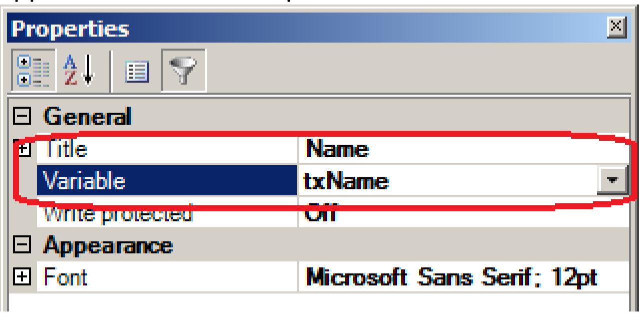
4. Drag the Widget *Automotive - Input, Output - Edit box* to the Panel



Input dialog with two text boxes

5. Set the Widget's properties to :
   Title= Name
   Variable= txName (this is under the 3rd variable created)

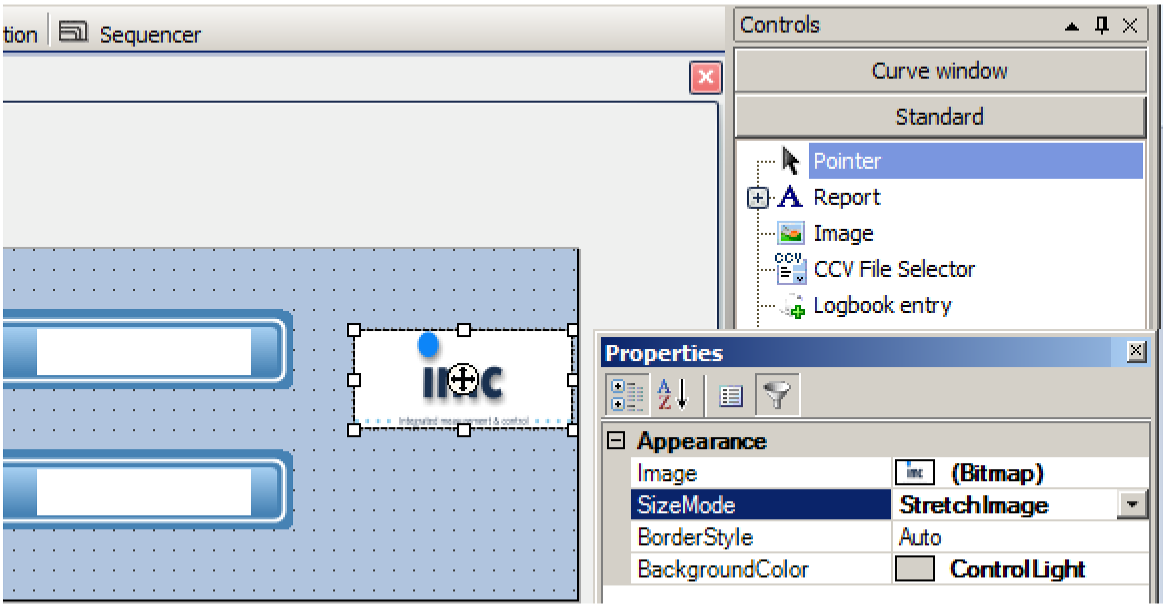
   Click on the small triangle next to the title entry and select the left arrow. Then the name will appear in front of the input box.



6. Repeat the last step with
   Title= Test Object
   Variable= txTestObject

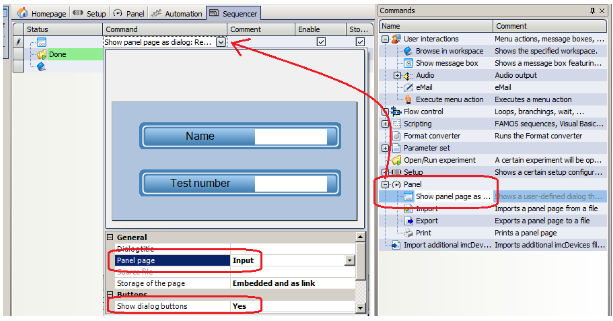
7. Make the Panel page smaller using the sizing handle at the lower right corner.

8. Drag the Widget *Image* from the group *Standard* to the dialog. Select the imc logo in the property *Image* and set the property *SizeMode* to *Stretch Image*.

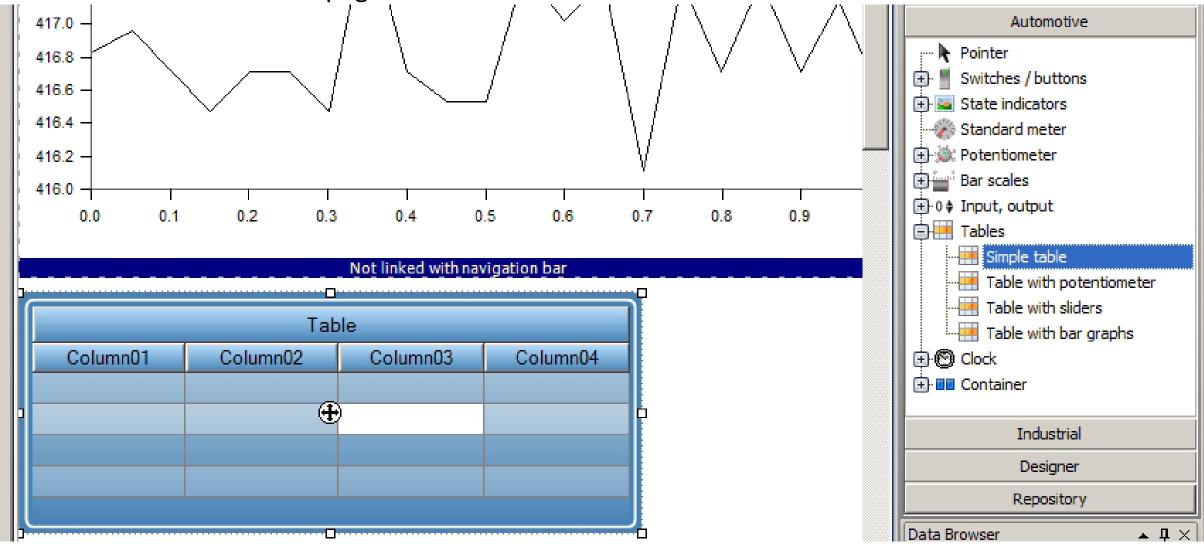


9. Go to the Sequencer

10. In the next step, the Panel page "Input" is entered into *Show panel page as dialog*. Select the Panel page "Input" as the *Panel page*. Activate the setting *Show dialog buttons* by entering *Yes*. Then in the branch *OK-button* activate the property V*isible* by entering *Yes*.

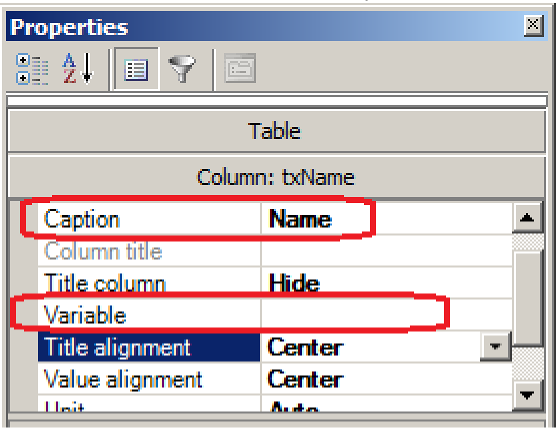


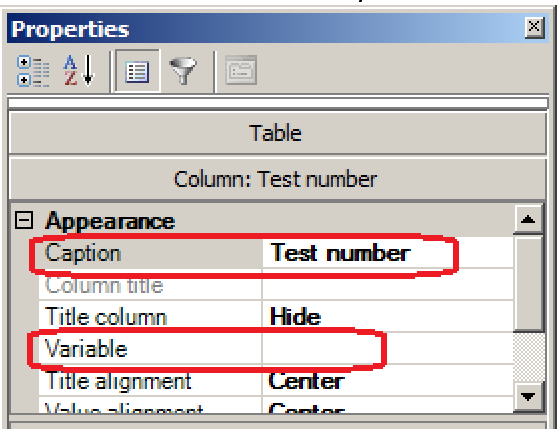
11. Go to the Panel page "Report". From the group *Automotive*, drag the table object *Table* from the branch *Tables* to the Panel page.

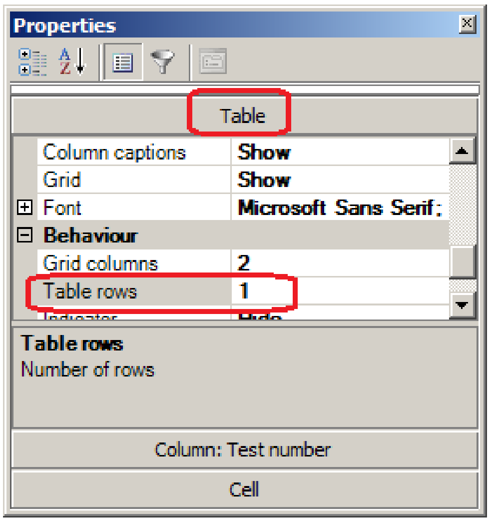


12. Remove *Column03* and *Column04* by pulling them down.
From the Data-Browser, drag the user-defined variable txName to the first cell in the column (not the column header). Drag the variable txTestObject to the cell in the second column.

Open the *properties* and click on the title cell Column01. Select as *Caption* 'Name'.
Do the same for Column02: *Caption*: "Test number". Leave the column's entry for *Variable* empty.







Set the number of *Table rows* to 1. This entry is visible when you select *Table* in the Properties.

13. Remove the table's title cell by clicking on the cell *Table*. In the Properties, expand the branch *Title* ad select for *Position* "-".
Make the table's size small enough that only the column header and the input box are visible.
Adapt the table's colors to your wishes. The best way to get white is by selecting *Background color: Transparent*, visible only, if the properties of *Table* has been selected.

Name	Test number
	123456

14. **Save** the changes made under the experiment name **"Dialog"**.
15. Go back to the Panel and turn off the Design mode. Click on the Start button which you had made.

Result: Before the beginning of the measurement, an input template appears for extra information displayed at the end of the Report page.

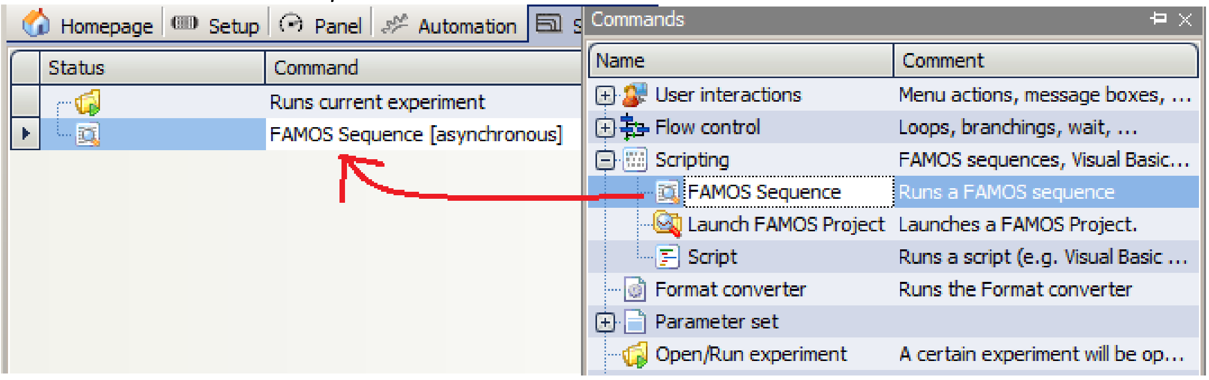
13.8.5 Use of imc FAMOS

Following the measurement, the data are automatically transferred to imc FAMOS for statistical analysis. The results are displayed on a Panel page and saved together with the measured data.

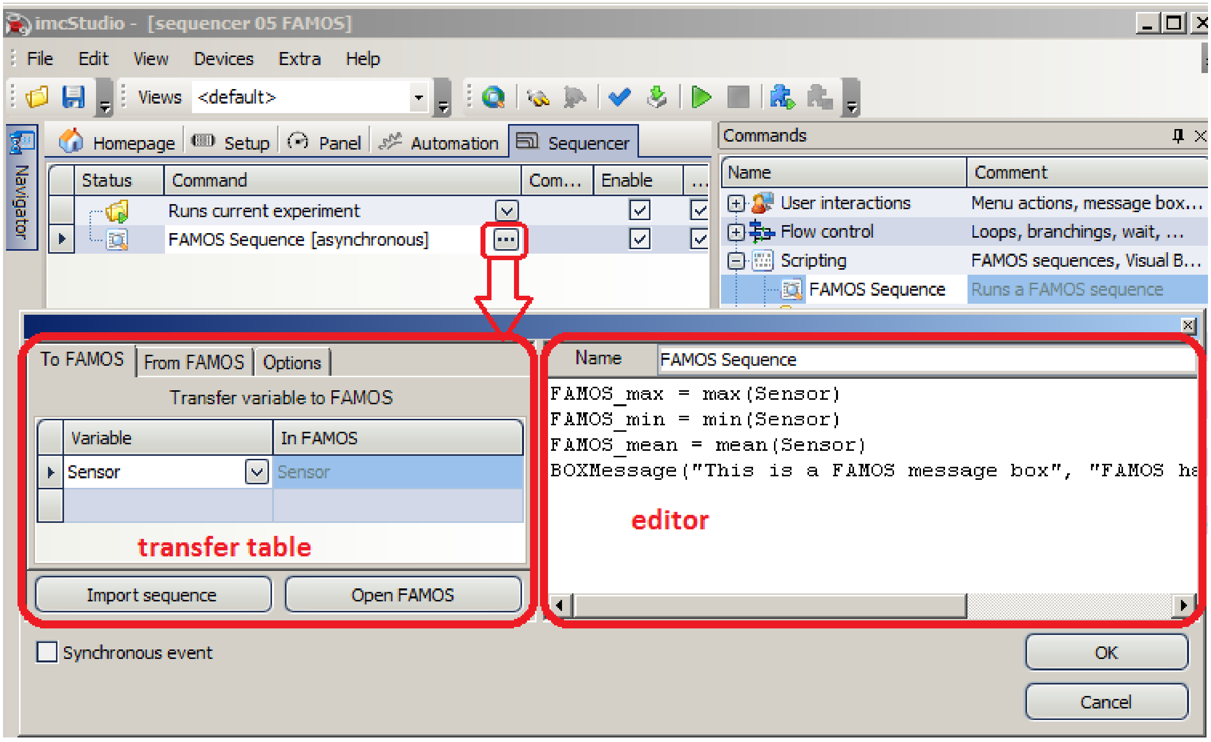
ATTENTION: For this exercise, an installed version of imc FAMOS is required.

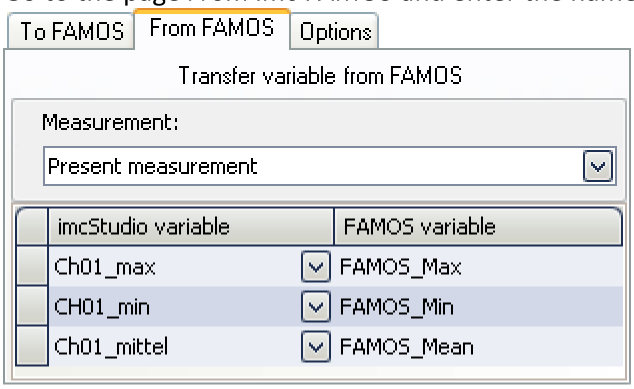
Assignment: The previously created experiment "Start Sequencer" is to be enhanced with an automated analysis by imc FAMOS. imc FAMOS determines the maximum, minimum and mean values. The results are to be displayed in the report. The report is to be printed out at the push of one button.

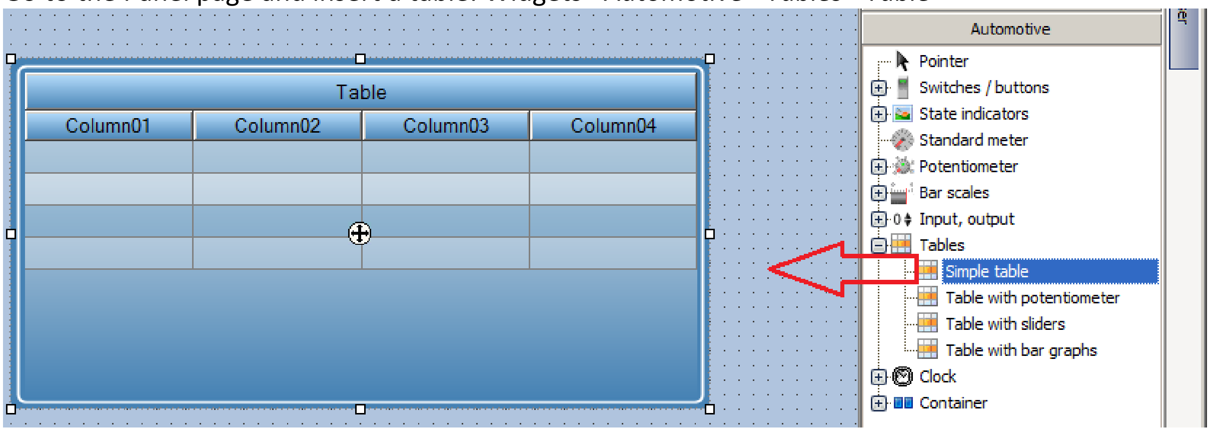
1. Load the experiment "**Start Sequencer**" if it isn't open already and save it under the name "**FAMOS_Analysis**".
2. Go to the Sequencer page and select from the commands *Scripting - imc FAMOS Sequence*, and drag it to under "*Runs current experiment*"



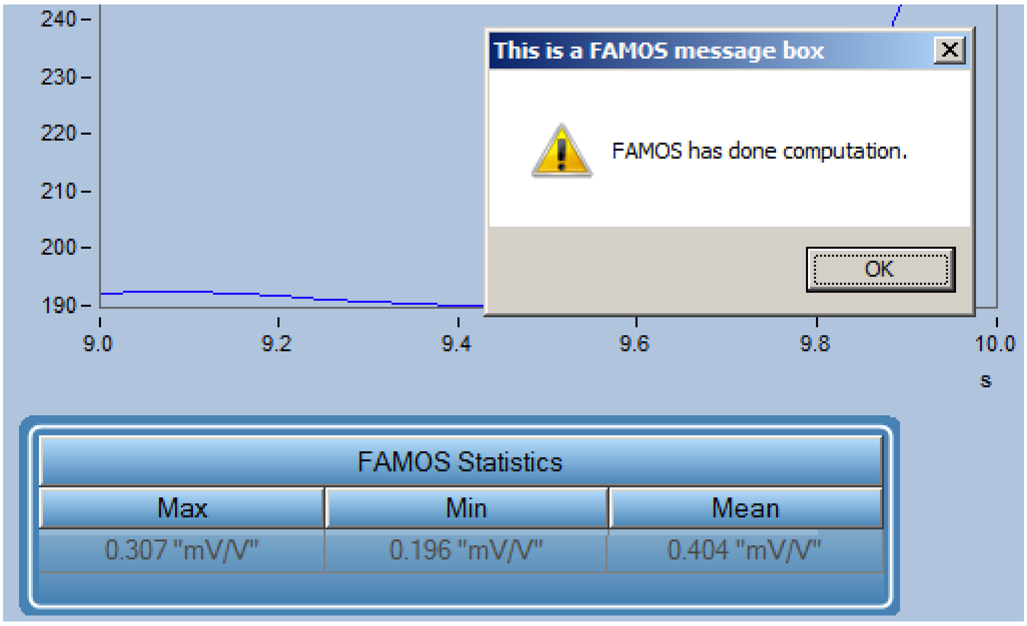
3. Click on the symbol with the three periods "...". An input dialog for the imc FAMOS sequence appears. You can enter the sequence to be run directly in the input dialog, if you already know the functions.



4. Enter the command lines as shown in the picture. As of imc FAMOS 6.1, the language in which the function names are expressed no longer matters.
```
FAMOSMax = Max(Sensor)
FAMOSMin = Min(Sensor)
FAMOSMean = Mean(Sensor)
BOXMessage("This is a imc FAMOS Box","imc FAMOS has done
calculation.","!1")
```
5. Transfer to and from imc FAMOS is accomplished using the tables at left. On the page *To imc FAMOS* , enter the channel *Sensor* for Variable and give it the same name under imc FAMOS.
Go to the page *From imc FAMOS* and enter the names of the variables:


These variable name were already used in the Results table. After the calculations by imc FAMOS, they are automatically applied.
6. Go to the Panel page and insert a table: Widgets - *Automotive - Tables - Table*


7. Delete Column04 by dragging it downward. Set the property *Table rows* to 1.
8. Click in the gray property Table and change the title column "*Table*" to "*Results*".
9. Drag and Drop the results from the Data browser\ branch imc FAMOS into the table.
10. **Save** the changes made under the experiment name "**FAMOS_Evaluation**".
11. Go back to the Panel and deactivate the Design mode. Click on the Start button you earlier created.



Result: At the end of the measurement, an output box appears which was created using imc FAMOS. The results are subsequently displayed in the table.

Remark: Instead of simple using the Sequence Editor (see point 8), you can start imc FAMOS by means of the button "Open imc FAMOS" and there create the sequence using the imc FAMOStools. When you close it, the sequence is adopted.

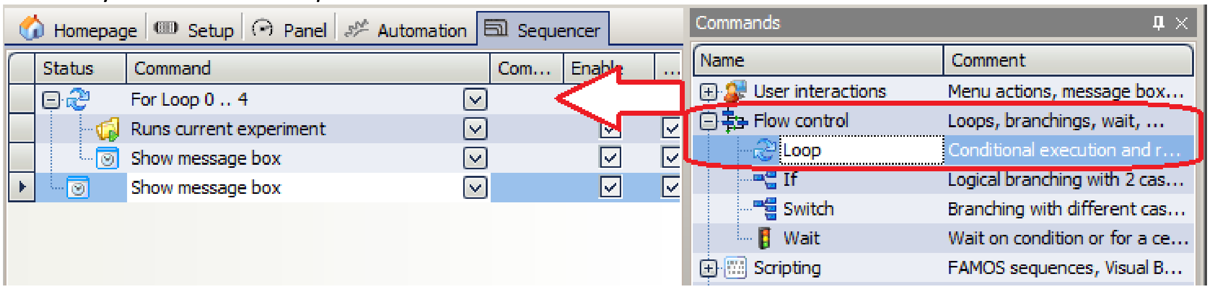
13.8.6 Conditional branches

This exercise shows how the conditional branches (For, While, Switch, If, Else etc.) are used in the Sequencer.

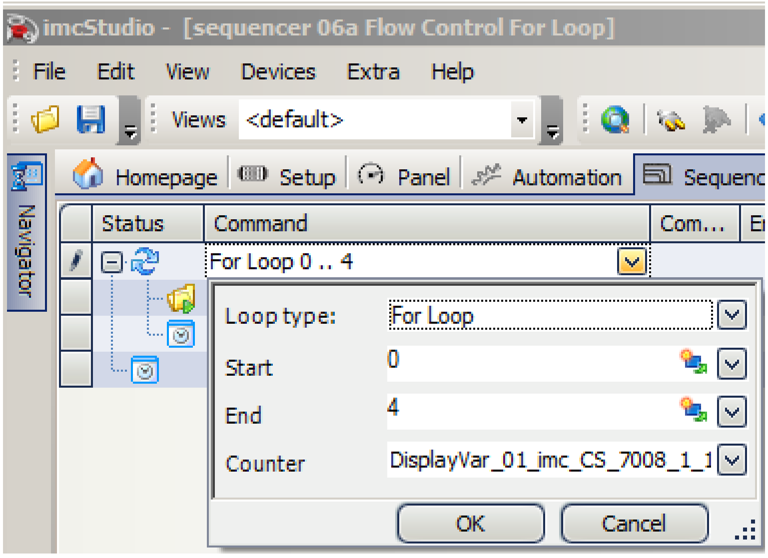
13.8.6.1 For Loop

Assignment: Run the current experiment 4 times in succession. A Seven-segment-displaydisplays the number of runs on a Panel page.

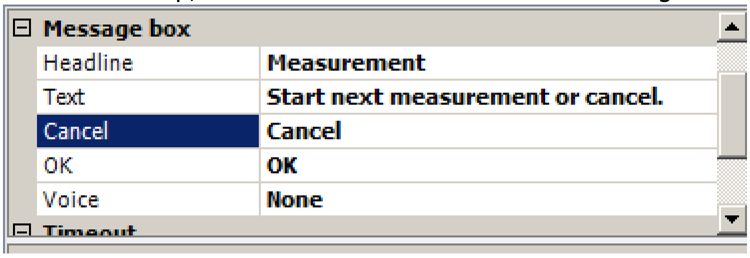
1. Load the experiment "**Start Sequencer**" and save it under the name "**Sequencer_For**".
2. Reduce the channel's measurement duration to 3s.
3. Go to the Sequencer and drag from the command group *Flow control* the command *Loop* to before the entry "*Runs current experiment*"



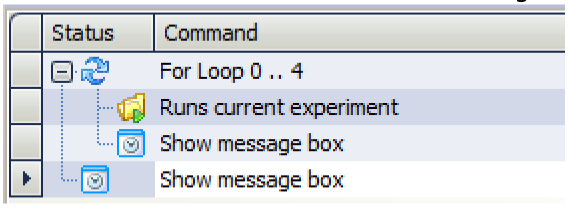
4. Right-click the mouse next to the *For Loop* entry and make specifications for the loop stages 0 through 4. Link the counter with a display variable.



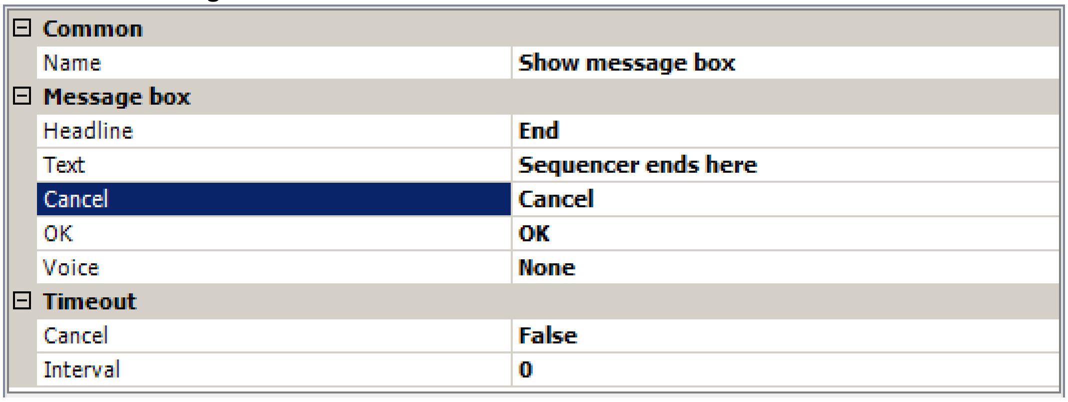
5. Within the loop, add the *User interaction* "*Show message box*". Make the following entries:



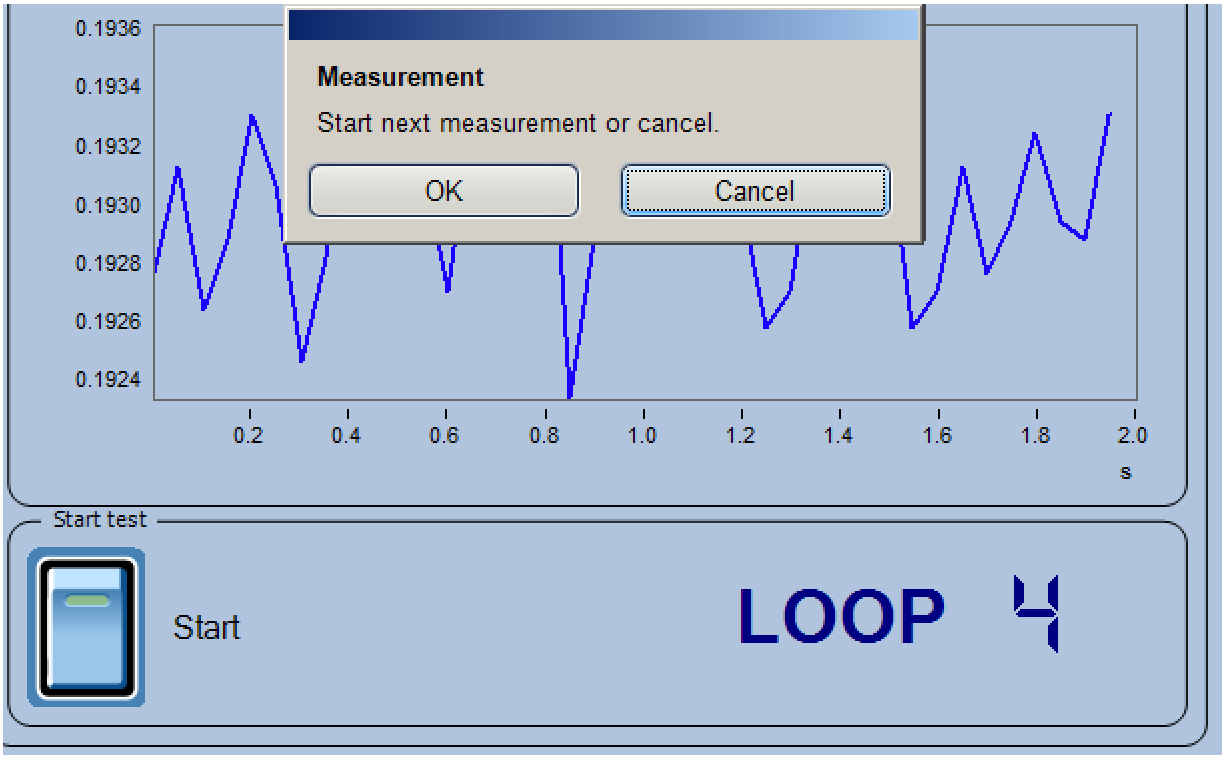
6. Add another *User interaction* "*Show message box*", but after the loop



with the following contents:



7. Go to the Panel and place a *Seven-segment-display* there from Widgets - *Automotive - Status display*. Link it to the Display variable previously linked in the *For Loop*.
8. **Save** the changes you made under the experiment name "**Sequencer_For**".
9. Go back to the Panel and switch off the Design mode. Click on the Start button you made.



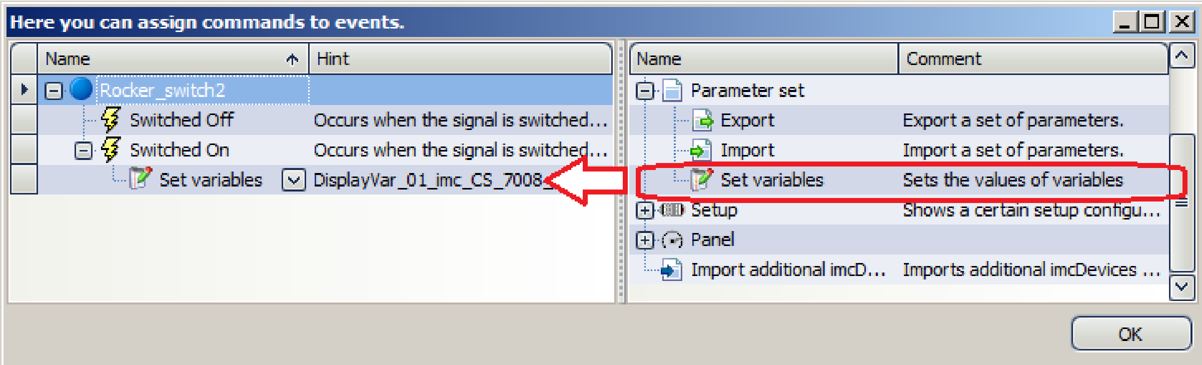
Result: A message appears after each run. The seven-segment-display indicates how many runs have been performed.

13.8.6.2 While Loop

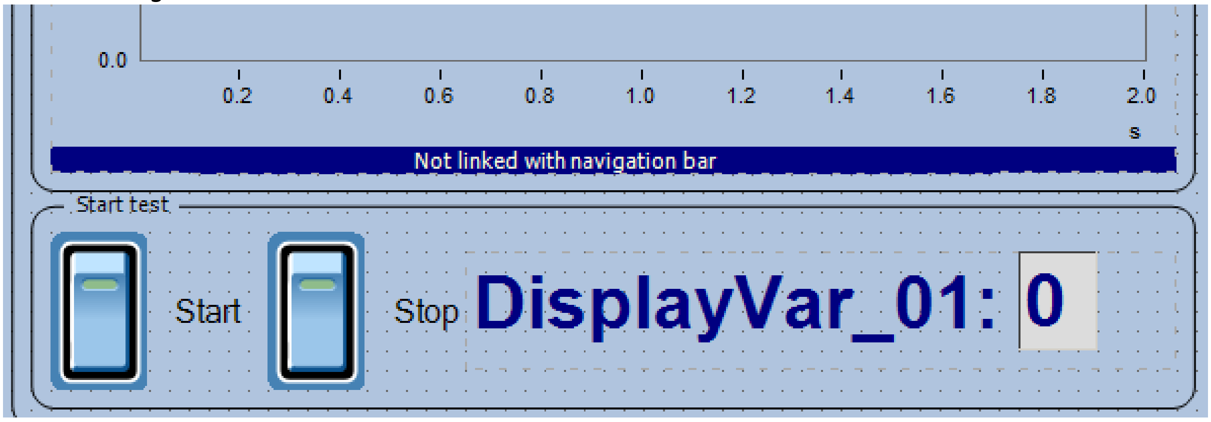
Assignment: Run the current experiment repeatedly until a Display variable contains a nonzero value. Use a pushbutton which assigns a value of 1 to the Display variable when pressed. The Display variable value is displayed on a Panel page.

Based on the experiment "Sequencer_For", an experiment "Sequencer_While" is created.

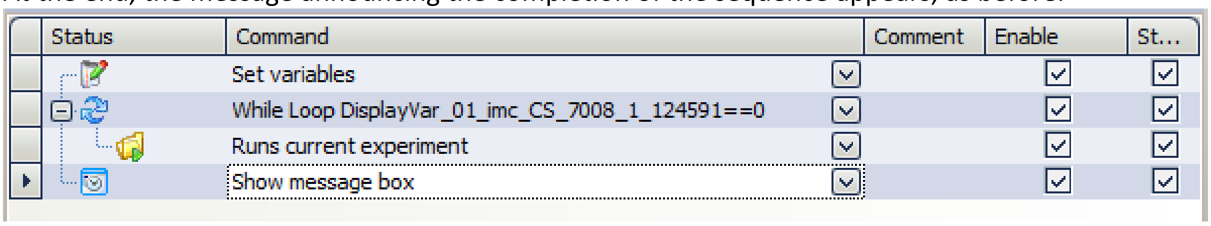
1. Load the experiment "**Sequencer_For**" and save it under the name "**Sequencer_While**".
2. Go to the Panel and create a pushbutton. Give it the caption "Stop". Select "Events" and in the branch Switched On, add the entry Set Variables from the branch Parameter set.



3. Create an input box (*Standard* - *Report* - *Editbox*) and link it to a Display variable. Select as the format "*Integer*"



4. Go to the Sequencer and drag from the command group *Flow control* the command *Loop* to in front of the entry "*Runs current experiment*". In the *Properties*, switch the *Loop type* to *While Loop*. For the condition, enter "DisplayVar_01==0". The Display variable name may be supplemented with the device name.
5. So that the loop isn't interrupted at the beginning, you must ensure that the Display variables are set to zero.
This is accomplished using the entry *Set variables* from the branch *Parameter set.* Insert this and there, set the Display variable = 0
6. The experiment is called within the loop.
7. At the end, the message announcing the completion of the sequence appears, as before.



8. **Save** the changes made under the experiment name "**Sequencer_While"**.
9. Go back to the Panel and switch off the Design mode. Click on the Start button you created earlier. Check whether the measurement starts multiple times and the click on the Stop button.

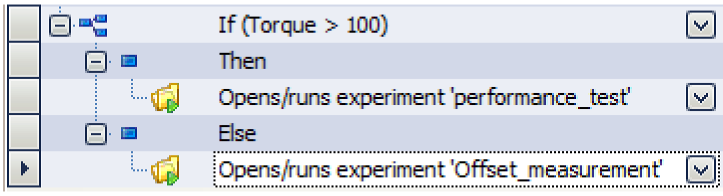
Result: When you click on the Stop button, the Display variable is set to 1 and the measurement does not start again.

13.8.6.3 If - Else

Assignment: The exercise Sequencer_While 1641 is expanded. At the end of every measurement, the system checks whether the **mean value is positive or negative**. The result is indicated in a text message.

You can enhance the sequence yourself. To do this, you need the knowledge presented in the exercise Use of imc FAMOS 1636.

One solution could appear as shown below:



13.8.6.4 Switch-Case

Assignment: The exercise Sequencer_While 1641 is enhanced. At the end of each measurement, the mean value is calculated. Depending on this statistic, one of four different messages is to be displayed.

To do this, use the Switch Case operator. For the lowest value, the message "All OK" appears. For the next higher value, the message "Pressure slightly elevated", then "Pressure too high" and finally "Danger: Pressure Out Of Control"

You can enhance the sequence yourself. To do this, you need the knowledge presented in the exercise Use of imc FAMOS 1636.

13.8.7 Example: Wind Power

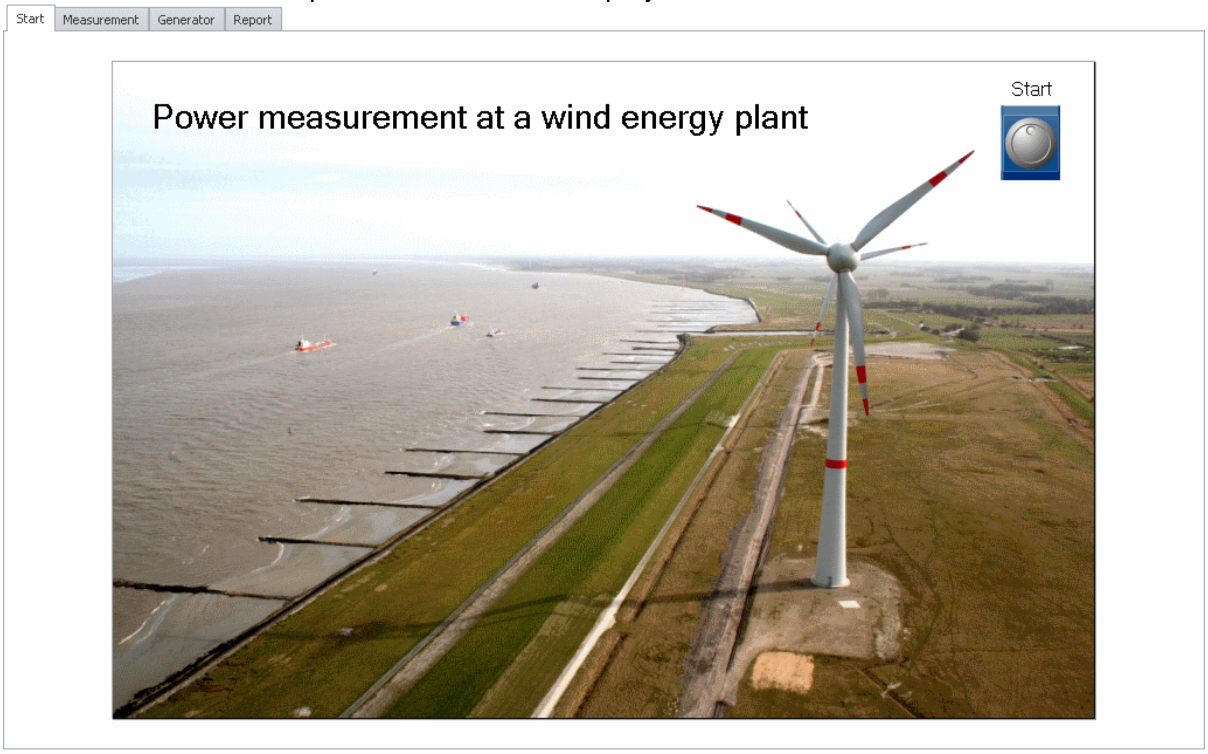
Assignment: Based on the project WEP, an example of skills presented in all the previous exercises working in concert is shown.

The measurement variables for 3x U and 3x I are simulated using imc Online FAMOS. All variables relevant to the power are computed with the function Power3.

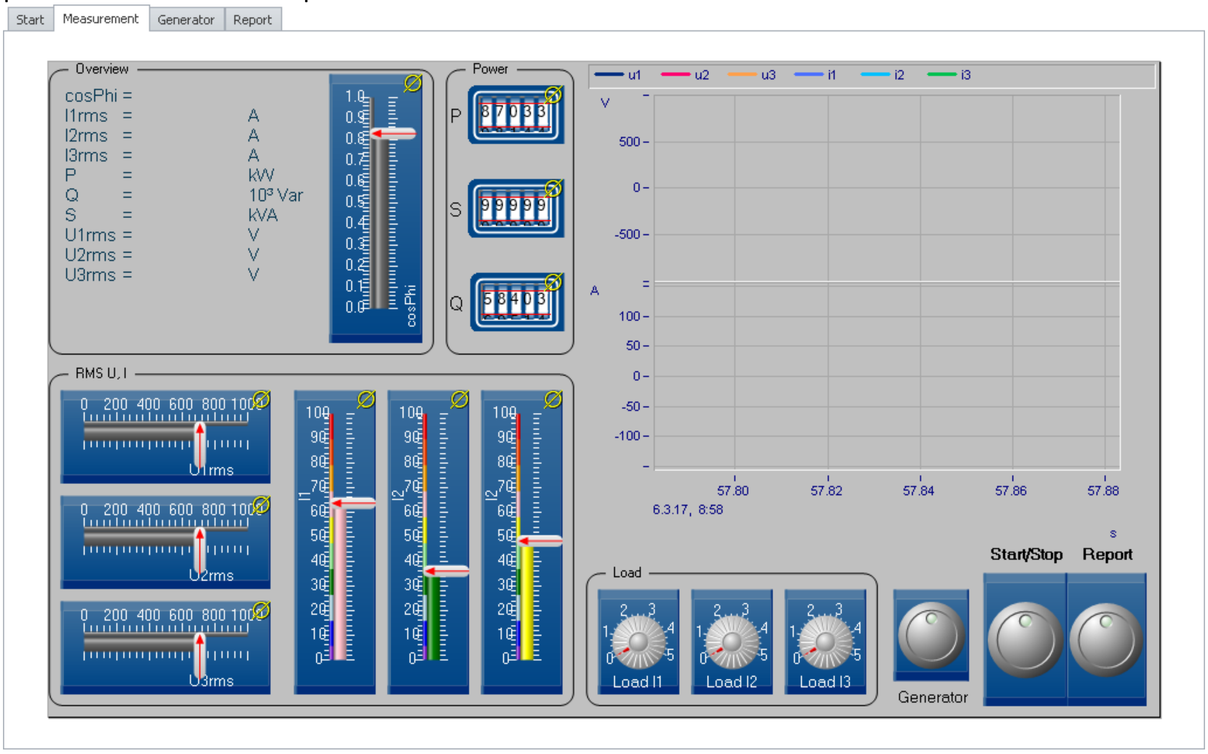
Additionally, a torque (simulated by a tuning fork) is measured, and a temperature.

The following steps are performed:

1. A welcome screen with a picture commences the project.

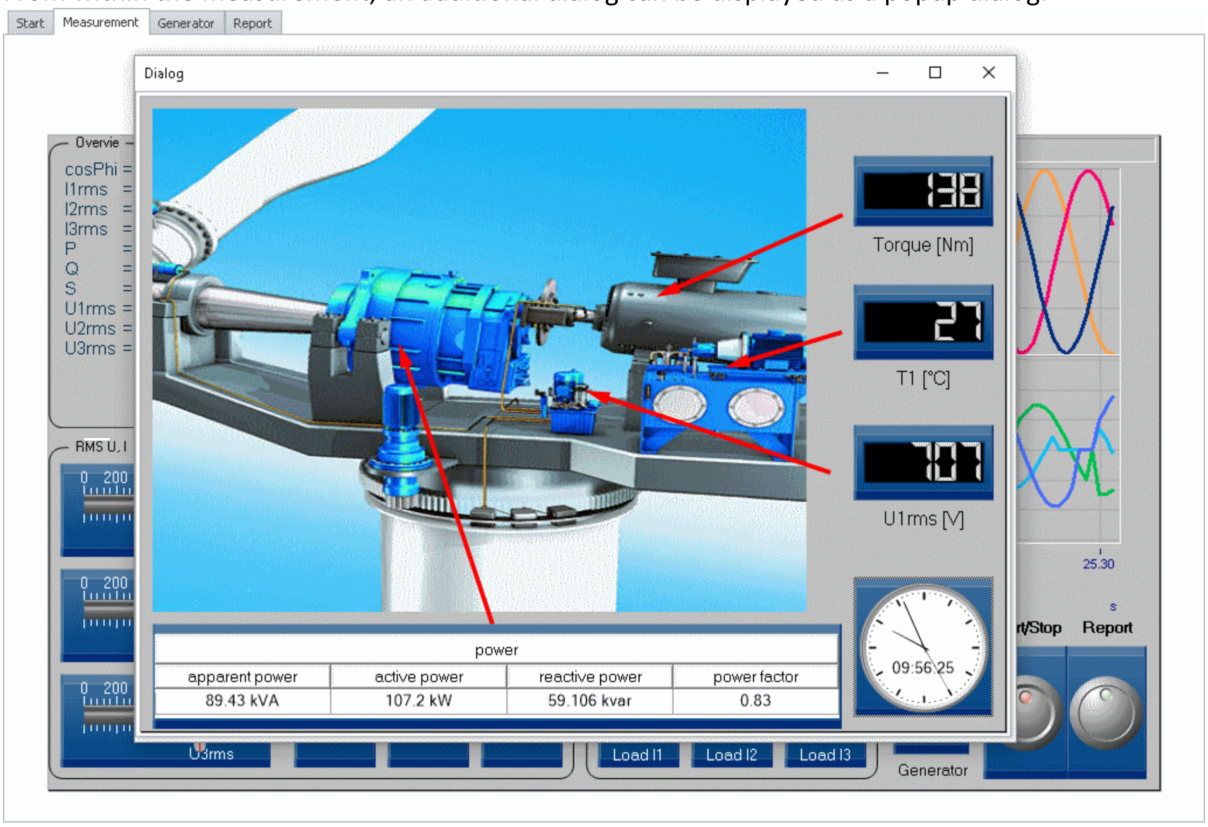


2. On a measurement page, both time and power data are displayed. The load can be set using potentiometers for each phase conductor.

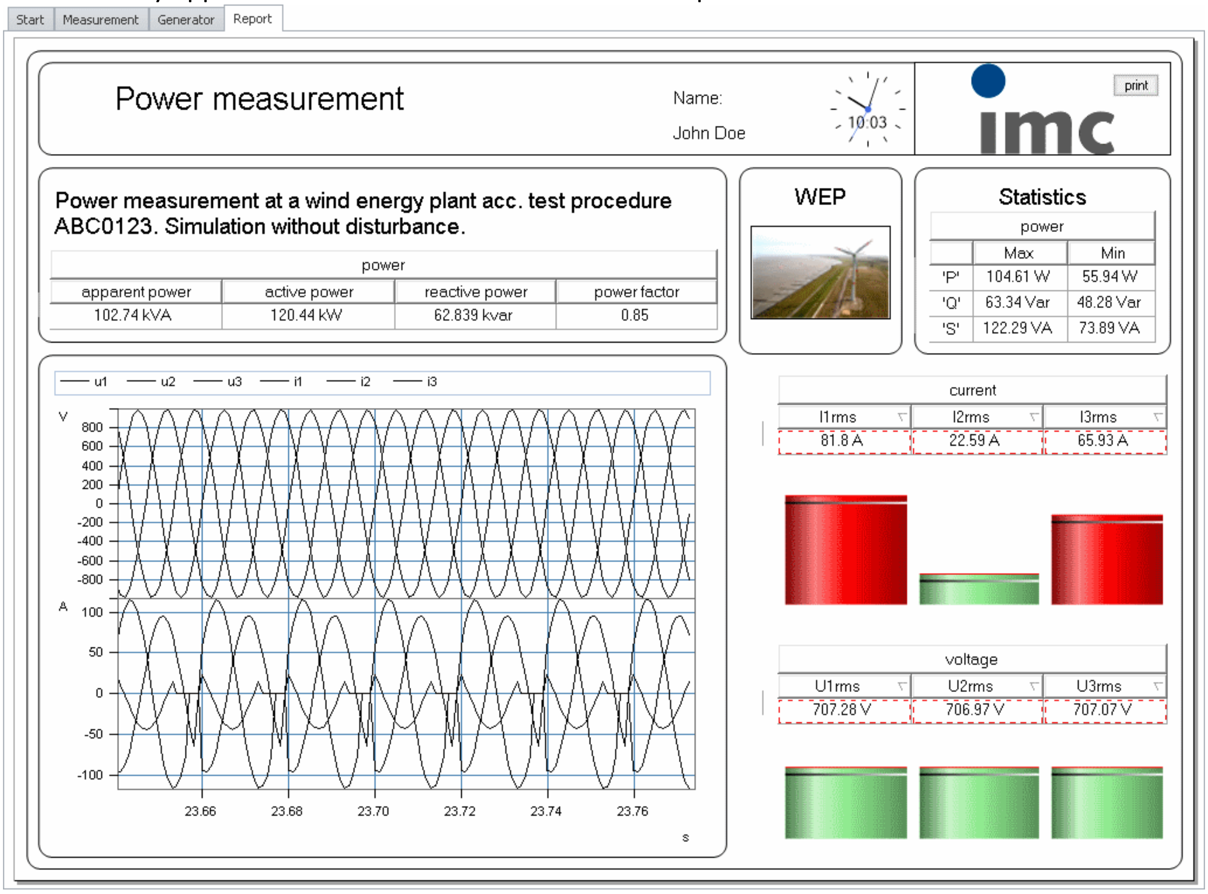


Measurement is started and stopped by a switch. At the end of the measurement, additional results are calculated by imc FAMOS: P max/min, Q max/min and S max/min.

3. From within the measurement, an additional dialog can be displayed as a popup dialog:



4. The results are displayed with the associated data in a Report page and as a PDF, which automatically appear once imc FAMOS has calculated the power statistics.



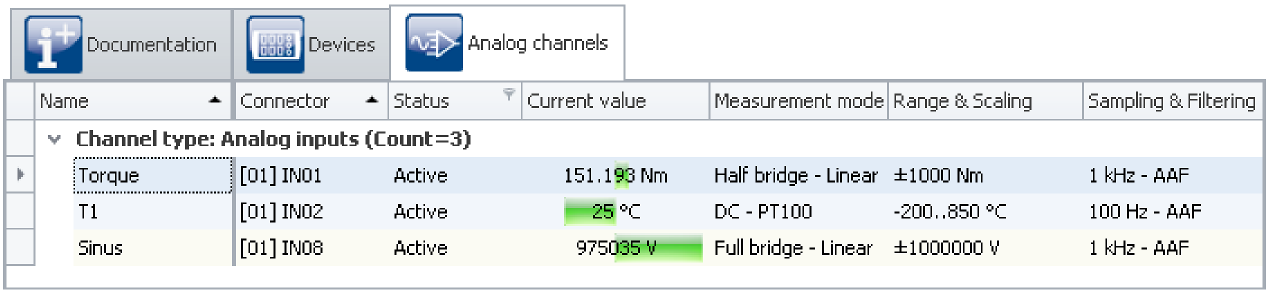
imc Online FAMOS Code: This code is based on the existence of a channel "Sine" which is recorded at a rate of 1kHz.

```
; Three phase simulator
_r =  6.28*SawTooth(Sinus, 0, 0.05, 20) ; Ramp
_r2=  6.28*SawTooth(Sinus, 0, 0.0005, 2000) ; Ramp
u1= 1000 * Sin(_r) ; three phases with 120° offset
u2= 1000 * Sin(_r+ 2.0941)
u3= 1000 * Sin(_r+ 4.18)

; the currents with different phases
; the unit A must be set by means of the Properties (toolbar "i").
i1= DspV_i1 * 20 * Sin( less(_r, 5.3) * (_r+ 0.53))      *  (2  + Sin(_r2))
i2= DspV_i2 * 20 * Sin( less(_r, 4.2) * (_r+ 0.47+2.09))*  (2  -  Sin(_r2))
i3= DspV_i3 * 20 * Sin( less(_r, 5.7) * (_r+ 0.32+4.18))*  (1.5+Sin(_r2))

Power3(p_t, P, S, Q, cosPhi, U1eff, I1eff, U2eff, I2eff, U3eff, I3eff, 0.02, u1, i1,
u2, i2, u3, i3)
properties
yUnit( i1, "A" )
yUnit( i2, "A" )
yUnit( i3, "A" )
yUnit( p_t, "W" )
yUnit( P, "W" )
yUnit( S, "VA" )
yUnit( Q, "Var" )
yUnit( cosPhi, "" )
yUnit( I1eff, "A" )
yUnit( I2eff, "A" )
yUnit( I3eff, "A" )
```

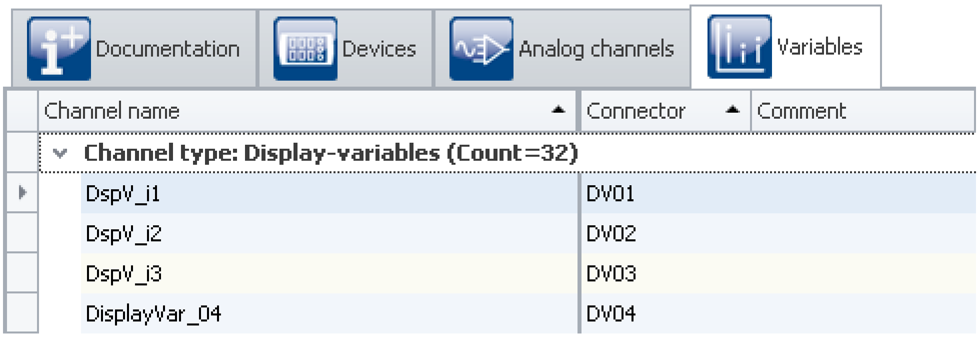
One possible solution is illustrated on the following pages.

13.8.7.1 Setup

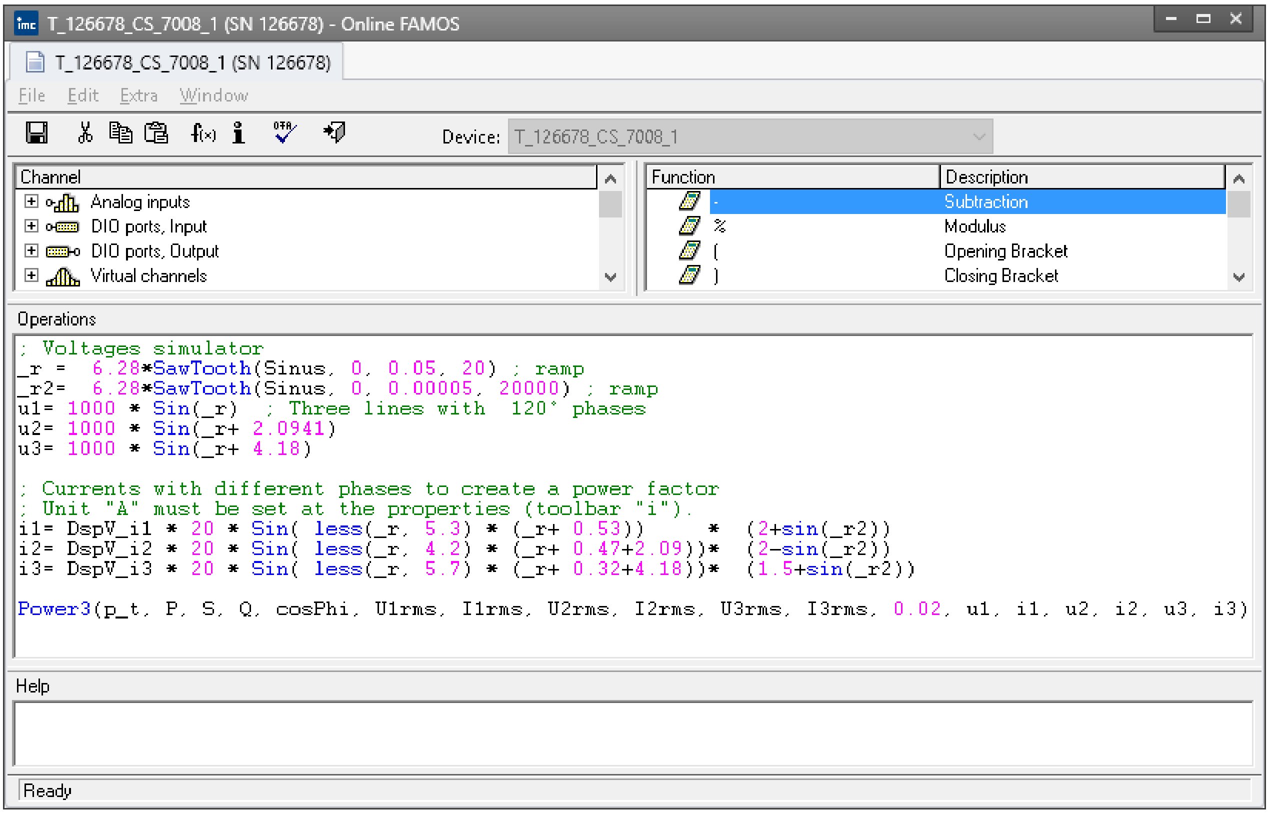
1. Go to *Setup \ Analog channels*
2. First activate three channels. Name one of the channels, which does not need to have an applied signal, **"Sine"**, with a sampling rate of 1kHz.
3. Connect the tuning fork to Channels 1 and 2. Name Channel 1 "Torque" and Channel 2 "T1". Settings:
   Torque: Half-bridge, scaling: 1 "Nm"/"mV/V", range: 1000 Nm, sampling rate: 1kHz
   T1: coupling: DC, correction: Pt100, sampling rate: 100Hz



4. Go to the Setup / Variabes
5. Name the three Display variables: DspV_i1, DspV_i2 and DspV_i3



6. From the Device menu, open imc Online FAMOS and enter the imc Online FAMOS source text. From this text it is possible to copy script and paste it into imc Online FAMOS. If the imc Online FAMOS source text is available as a file, you can import it directly to imc Online FAMOS.



7. Click on the blue checkmark button to prepare the configuration, which sets up the channels in the Data Browser.

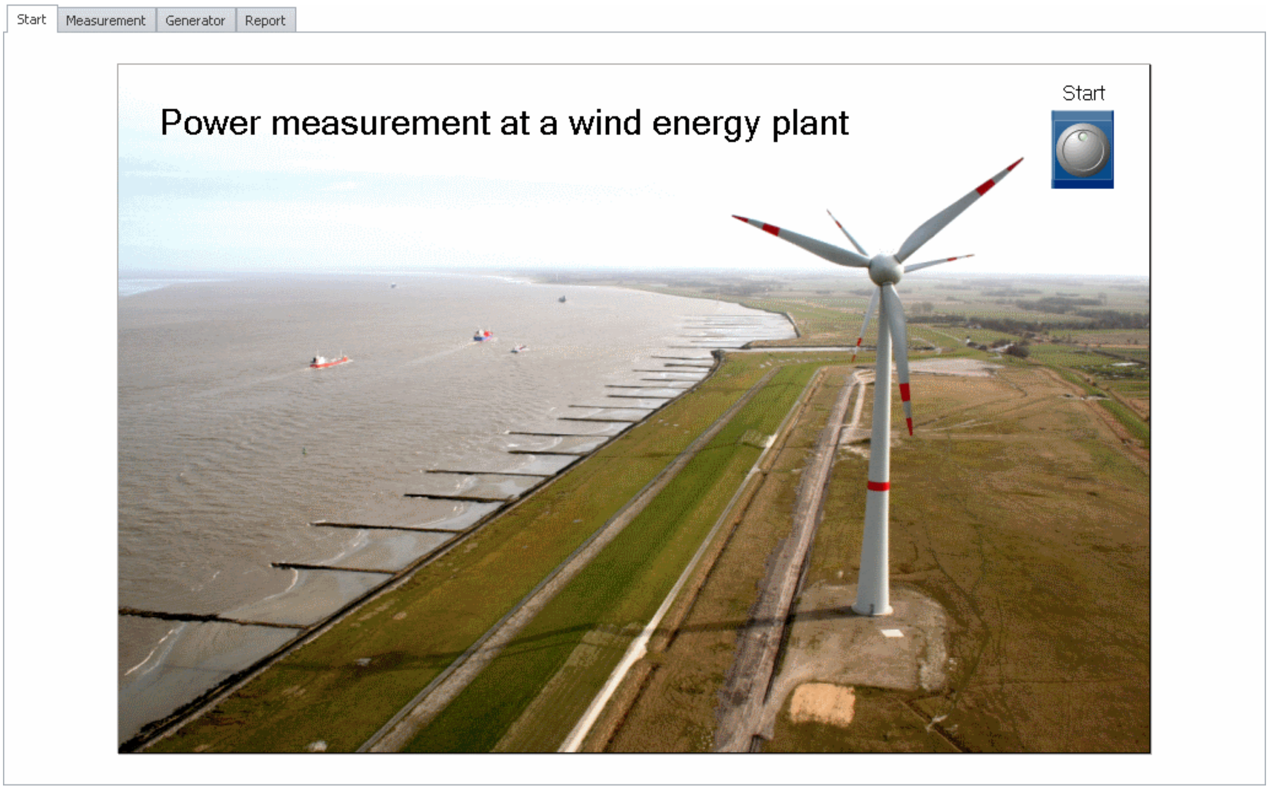
13.8.7.2 Panel pages

All Panel pages in the example were created with the **Skin** "*Gray color scheme*". To do this, right-click the mouse over the page and use the appropriate context menu items.

First create **four Panel pages**: "*Start*", "*Measurement*", "*Generator*" as standard dialogs and "*Report*" as a report in landscape format. These will be configured in the next steps.

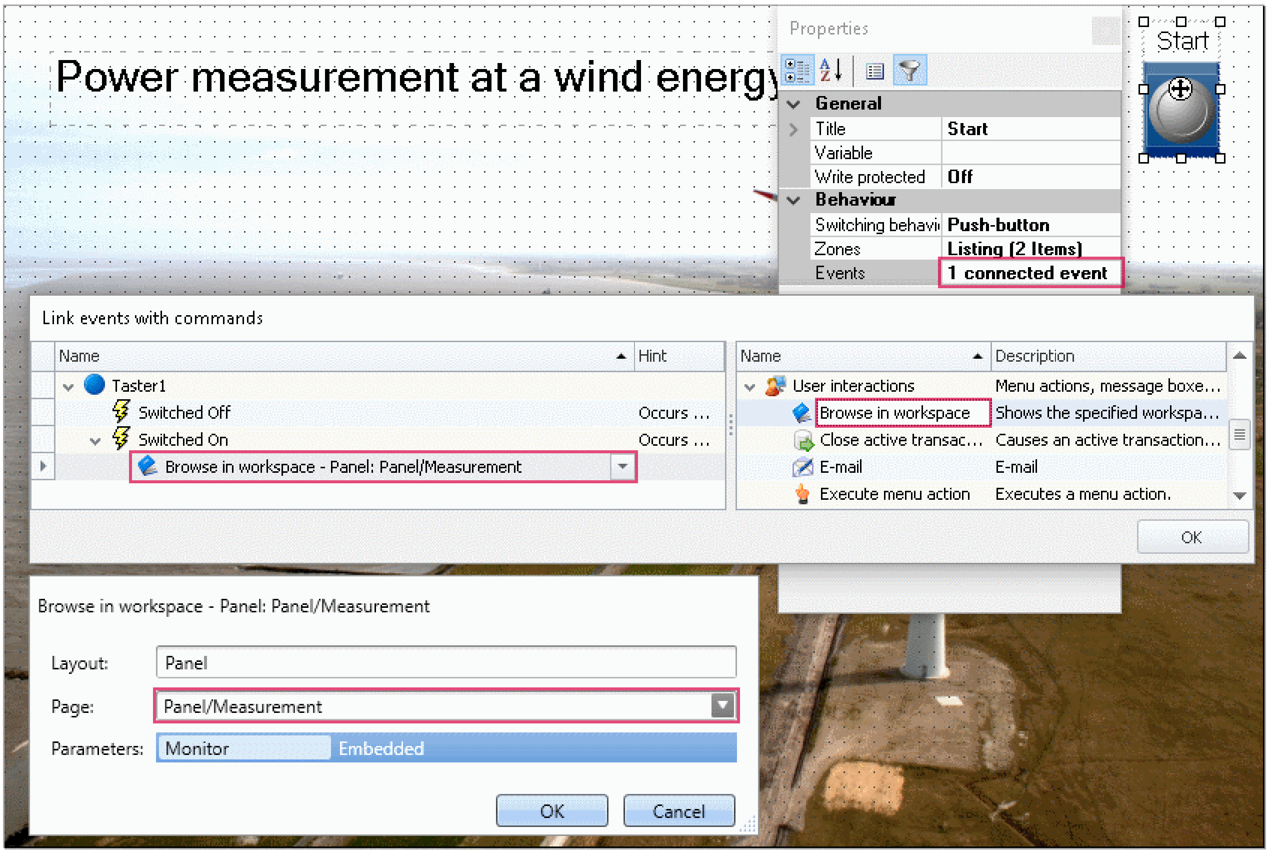
13.8.7.2.1 Panel - Start

The Panel page initially contains only a start button and the picture "Windanlage.jpg".

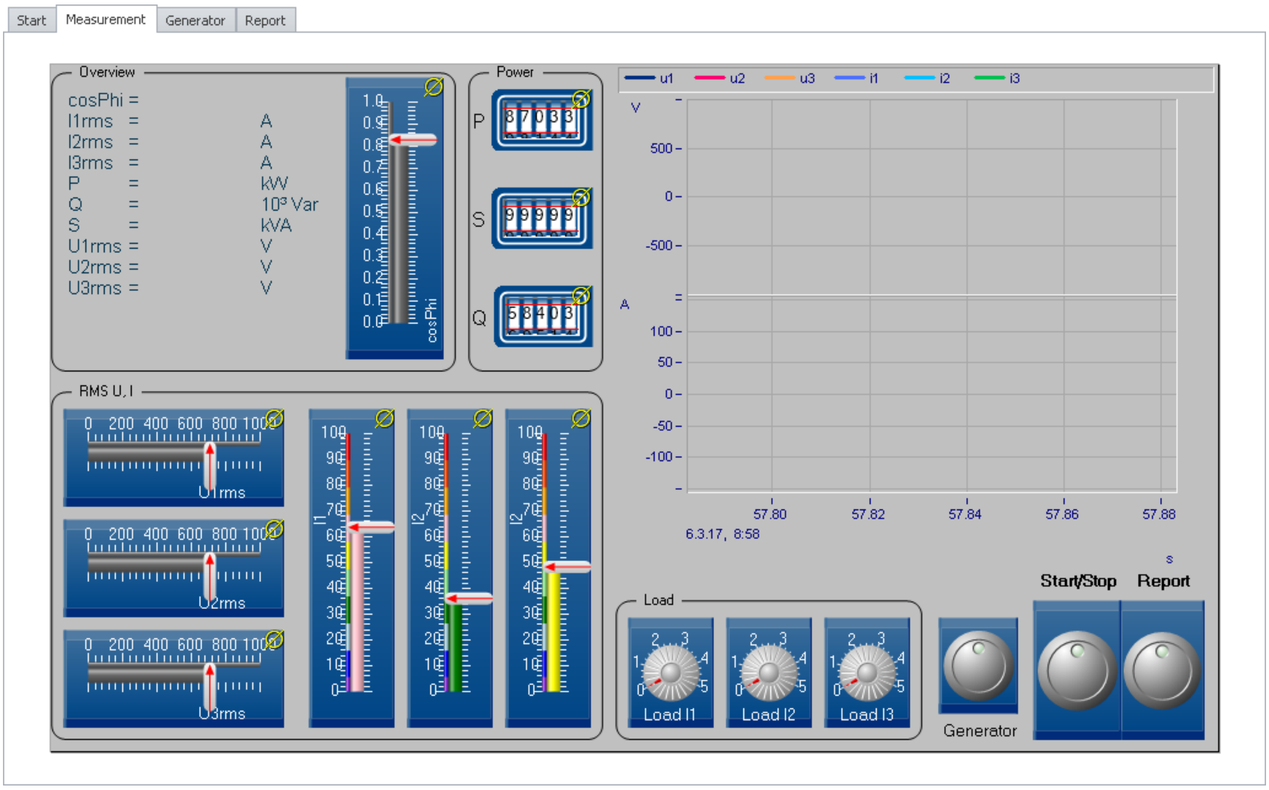


In the example, the Widget "*Industrial - Switch/buttons- Push-button*" is used. Give the *push-button* the caption "Start".

The *push-button* when pressed is to page to the Panel page *Measurement*. This is arranged by setting the *Events* in the button's Properties:



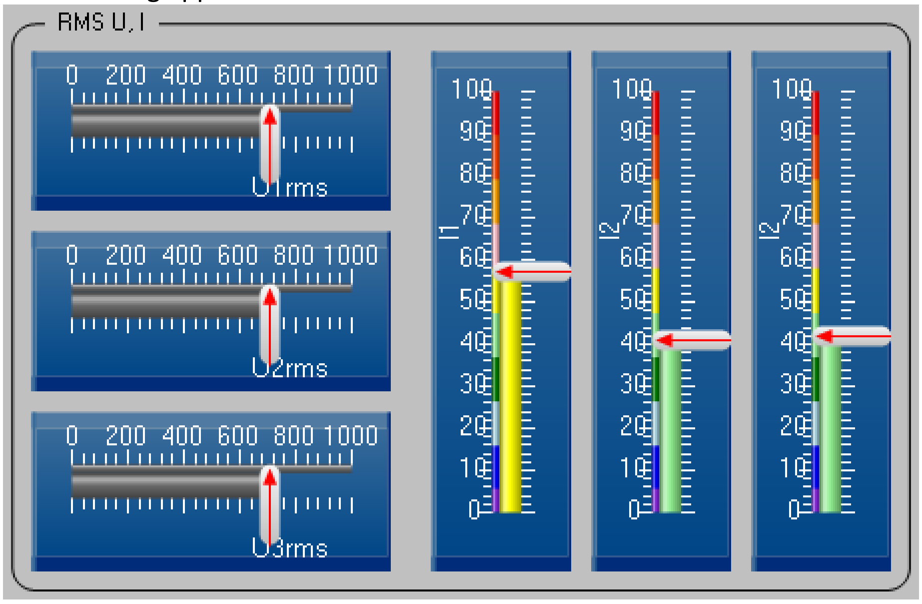
13.8.7.2.2 Panel - Measurement



This page has multiple bar meters for U and I as well as cosPhi, gauges for the power readings, potentiometers for setting the load, pushbuttons and two curve windows.

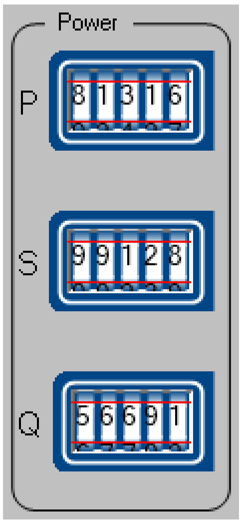
1. Begin with the **curve windows**. The window at right shows the instantaneous U and I values. Determine the variable. Create two Y-axes by first dragging thre voltages to the Y-axis. Then drag the three currents to under the X-axis. Add a grid.
2. Set up the left curve window. Drag the power signals, cosPhi and RMS-values from the Data Browser to the curve window, as illustrated in the picture. Set the curve window to "*Last value as number*" (right-click to open context menu: *Configuration\Display*). Format the numbers as desired: *Double-click\Numerical format*).

3. Next create the bar meters. In the example, the Widgets *Bar meters* from *Automotive - Bar scales* have been used. Also, their design was switched to *Industrial*. Set the input range as shown in the picture. The currents were supplemented with zones. Simply by adding the zones, you should obtain the following appearance.



Tip: First create a bar meter and make all desired settings. Next, make two copies of the Widget. From the Data Browser, drag the other channels to the copies.

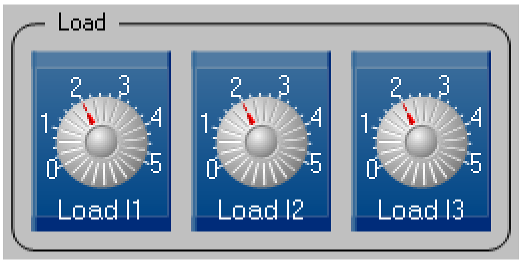
4. The power signals are represented by the Widget *Odometer* from the group *Industrial - Potentiometer*.



A *GroupBox* is dragged from the group *Shapes* to a position around the power signals.

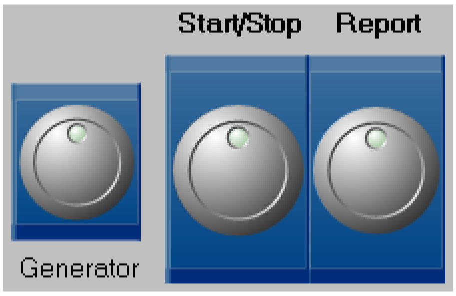
Ensure that the variable name is visible to the left of the readout.

5. The loads are simulated by having one Display variable in the imc Online FAMOS programs govern each current amplitude. *(DspV_i1* through *DspV_i3*).
   In the Panel, the Display variables are linked with potentiometers. For this example, the potentiometers from the *Industrial* group are used.



The range extends from 0 to 5. Name the potentiometers *Load I1* through *Last I3*

6. Finally, create the *push-buttons*; in this example, also using the Widgets from the *Industrial* group.



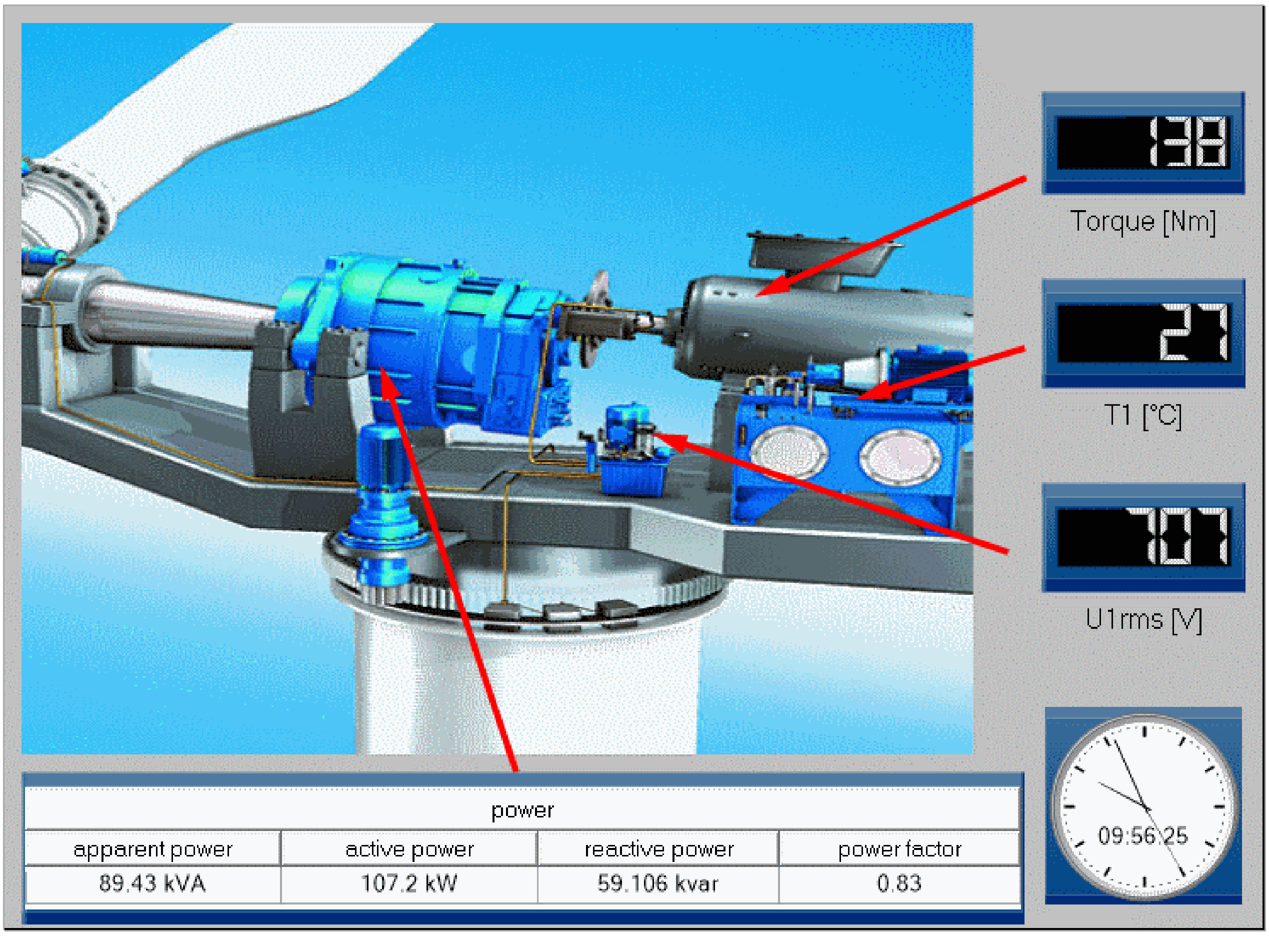
The **Generator-push-button** displays the dialog "*Generator*" as a popup dialog. If you have not yet created one, do so now. Ensure that the title "Generator" is visible. The push-button's events for the branch *Activated* are set as "Panel" - "Panel *page as dialog*". Click on the arrow next to "Panel *page as dialog*" and select the Panel "Generator" as the Panel page to be displayed.

The **Report-push-button** takes you to the Panel page *Report*. To do this, the *User interaction "Browse in workspace*" under Events is needed.

The **Start/Stop** switch Widgets the Sequencer. To do this, the property Switching behavior must be set to *Switch*. What is essential is that the Sequencer is now governed by the switch. This is accomplished by means of the *Events*:
Switched On: *Execute menu action: Sequencer - Start Sequencer;*
Switched Off: *Execute menu action: **Device** - Stop.*
The Sequencer is now started. The measurement is concluded for the device. In the Sequencer, we will later wait for the end of the measurement and then run the imc FAMOS evaluation.

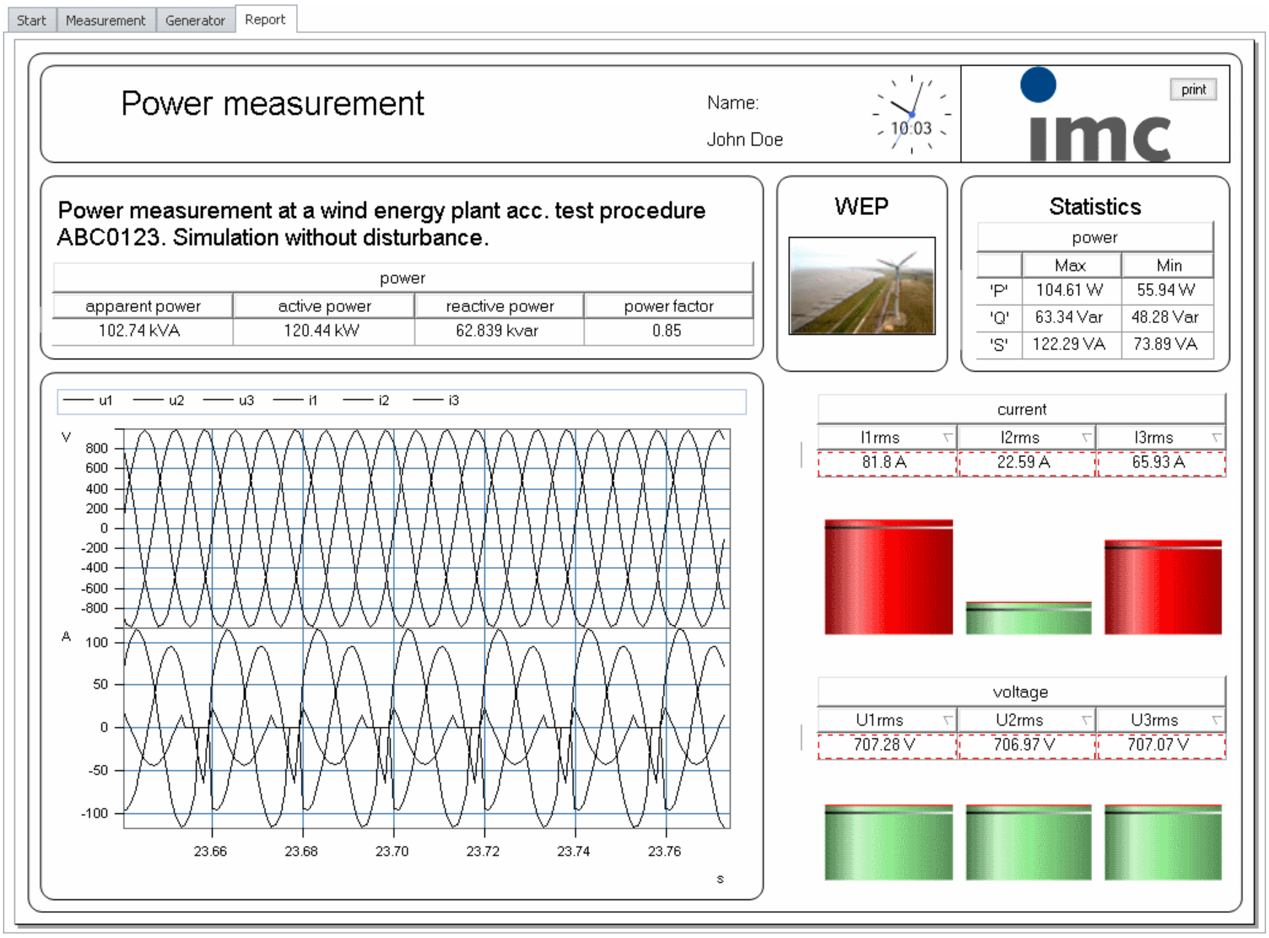
13.8.7.2.3 Panel - Generator

The Generator page is displayed as a popup dialog from the Panel page Measurement.



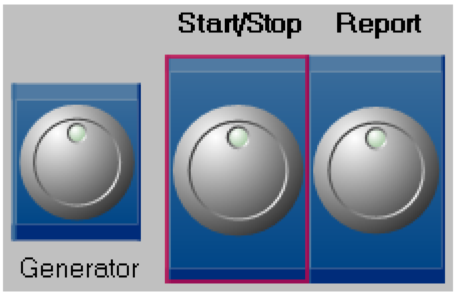
1. This page shows an additional picture "Generator.jpg".
2. From the group Industrial, **table** for the power signals is inserted. The row count is reduced to 1. By means of Drag&Drop, the cells are filled from the Data Browser with power values. Also, enter headers for the column and table.
3. Add three "*Seven-segment-displays*" from the group *Industrial\Status indicators*. Change the property *Background* to *Industrial*.
   Link the *Torque* and the temperature *T1*, as well as an RMS voltage value, with the displays, and display their titles as well.
4. Drag the clock Widget to the Panel page.

13.8.7.2.4 Panel - Report



1. Copy the **curve window** from the Panel page Measurement to the report. Set the curve window's Transparency to *Full*.
2. Copy the **power table** from the Panel page Generator to the report. There, too, switch the Transparency to *Full*.
3. For the "Statistics", create an additional table with 3 rows and 3 columns. Give a name to the table caption and column headers as shown in the picture. The cells are linked with variables which have not yet been created. Nevertheless, enter for the property *Variable* of the number entries "P_max", "P_min", "Q_max", "Q_min" and "S_max", "S_min".
4. For the Properties under *Cell*, select the appropriate *Unit* (W, Var, VA) and the *Factor Kilo*.
5. Create additional *Tables with Bar meter* for the RMS-values of the current and voltage.
6. As finishing touches for the report, add pictures and the remaining texts.

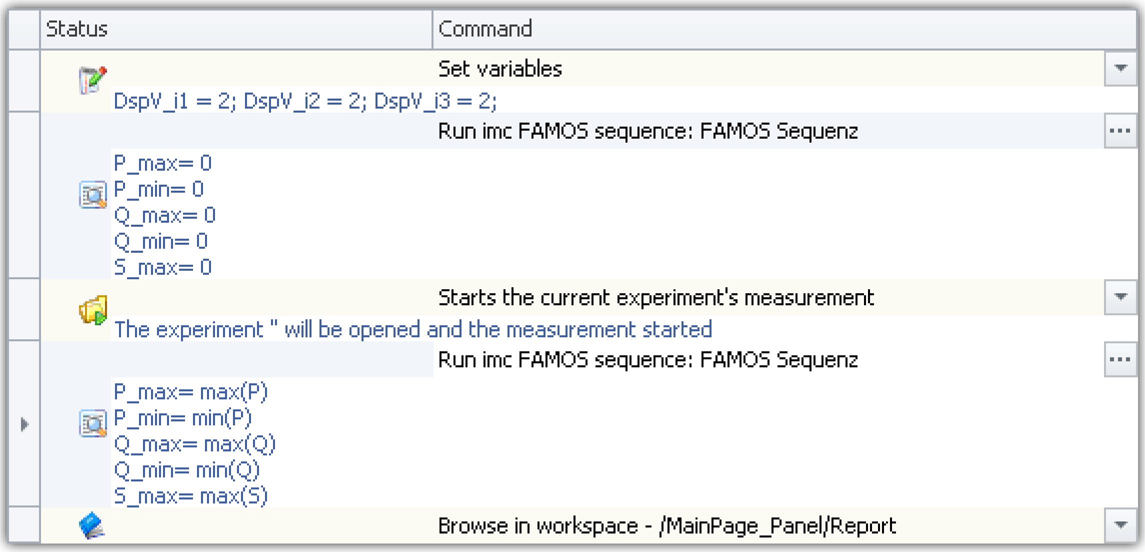
13.8.7.3 Sequencer



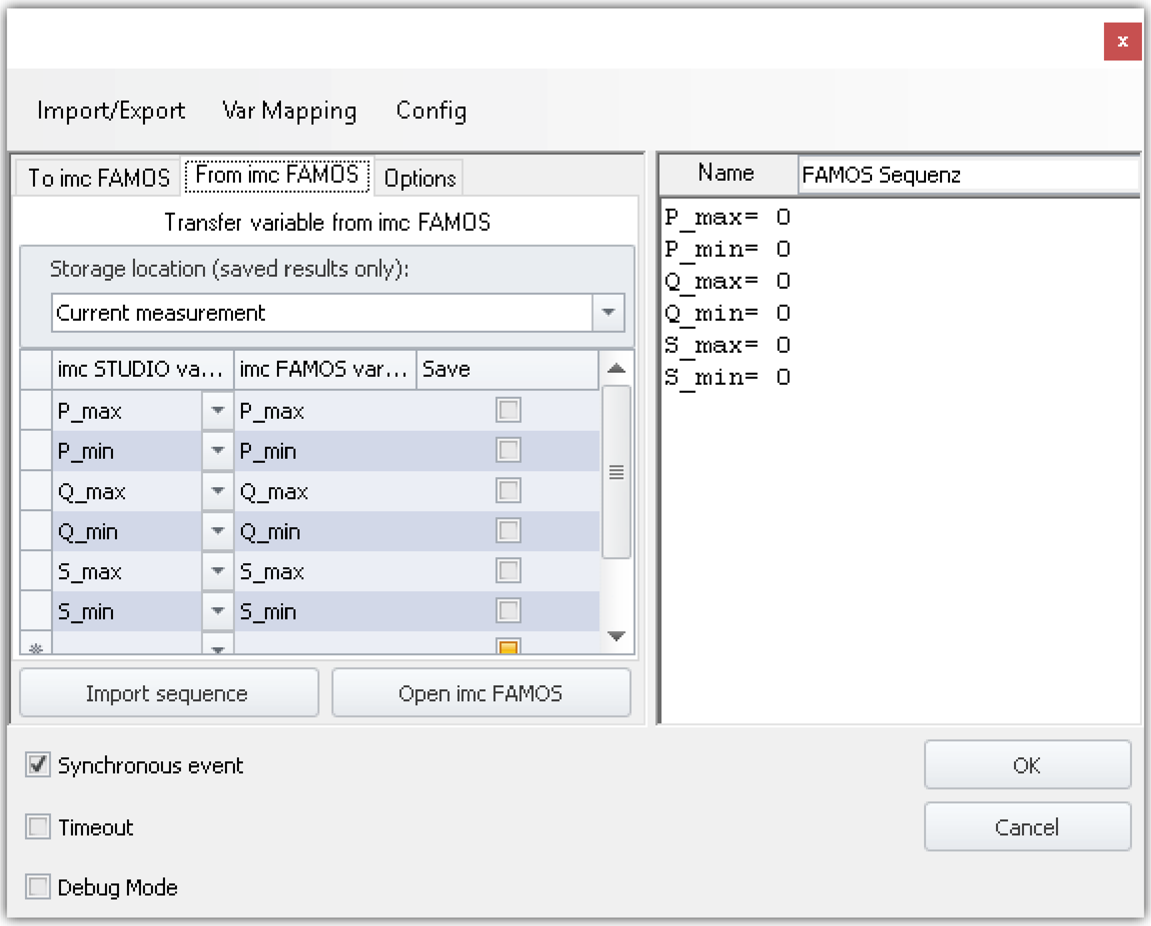
To start the Sequencer push the *Start/Stop* button in the Measurement Panel (see in fig.).

The following steps are now carried out automatically:

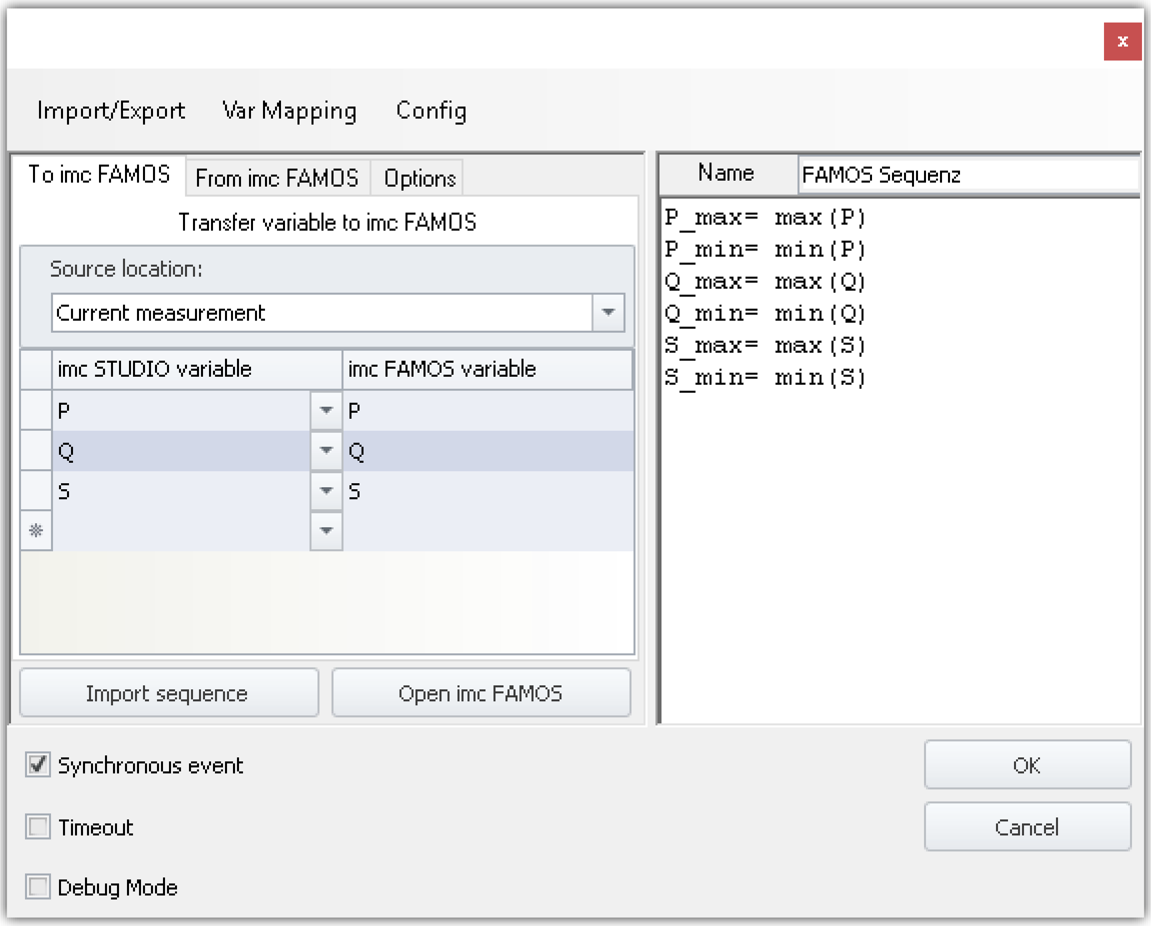
- initializing the variables to be transferred to Famos directly after the measurement
- measurement starts
- measurement stops (*Start/Stop* switch in panel)
- Famos sequence runs. This computes P_max, P_min, Q_max, Q_min ..... etc.
- report page pops-up, showing the calculated results.



First sequence, for initialization:



Second sequence, for calculating the power values.



Remark: The measurement can also be started using the normal Start button (green triangle), however, in that case the Sequencer steps will not be carried out.

14 Monitor

imc STUDIO Monitor makes it possible to connect with one or more measurement devices during a running measurement, particularly for the purpose of observing the current measurement data. Data can be viewed and edited live on multiple workstations.

imc STUDIO Monitor is an independent installation variety of imc STUDIO. This means it is installed and started as a separate application. For Monitor, separate licensing is required accordingly (an edition of imc STUDIO + imc STUDIO Monitor).

The fundamental elements are imc STUDIO's Panel 1058, as well as the tool window Devices/Channels 1660.

14.1 Ribbon

Home

Menu item	Description
Device Search (imc STUDIO Monitor)	The system searches for all imc devices in the network. The amount of time this takes depends on how many devices are connected and on the network type. Upon conclusion, the devices found are listed under the tab: **Devices** in the tool window: **Devices / Channels**. For more information on the correct configuration of all network settings, see the manual: Setting Up - Connect the device 43.

Other unassigned menu items

Menu item	Description
Activate saving (imc STUDIO Monitor)	Activates the saving of all channels selected. (See also the description of the respective symbol in the tool window Devices / Channels 1660 ())
Deactivate saving (imc STUDIO Monitor)	Deactivates the saving of all channels selected. (See also the description of the respective symbol in the tool window Devices / Channels 1660 ())

14.2 System Prerequisites and Limitations

Measurement device requirements
The same hardware prerequisite apply as for imc STUDIO Setup.
For the purpose of connecting with imc STUDIO Monitor, the devices must additionally have at least **32 MB of internal device memory** available.
Accessing the device: at most, • three imc STUDIO Monitor PCs can be directly connected with one device (SN 12xxx), or • four imc STUDIO Monitor PCs can be directly connected with one device (as of SN 13xxx).

Without imc STUDIO Project Management

In imc STUDIO Monitor , the component "imc STUDIO Project Management" is deactivated. For this reason, there is no database as in imc STUDIO. The dialogs for saving and loading experiments correspond to the standardized "Saved As"-/”Open”-dialogs.

Experiments can be saved at any desired location. The saved measurement data are stored in the associated experiment folder.

Summary of the limitations:

- No use of one’s own database
- No compilation in projects having settings in common
- No display of saved measurements in the Data Browser

14.3 Tool Window

14.3.1 Devices / Channels

In this tool window, you can search for and select devices, as well as select channels which you wish to view using Monitor. Also, you can set the circular buffer time for each channel separately and activate/deactivate the data saving.

The window contains a toolbar and three tabs, which contain the respective views for the device/channel selection and additional options.

Toolbar

Menu item	Description
Device Search (imc STUDIO Monitor) Network search	The system searches for all imc devices in the network. The amount of time this takes depends on how many devices are connected and on the network type. Upon conclusion, the devices found are listed under the tab: **Devices** in the tool window: **Devices / Channels**. For more information on the correct configuration of all network settings, see the manual: Setting Up - Connect the device 43.
User-defined Device	Using either the IP-address or the domain name (DNS-name), it is possible to establish a connection to a device without a device search. This is necessary with some structured networks (with routers, Internet, ...), when imc devices can not be integrated by means of a network search.
Refresh	Removes all channels belonging to de-selected devices from the Channels list.
Save	Activates/deactivates the saving of all selected channels (corresponds to the menu actions Activate/Deactivate saving (imc STUDIO Monitor) 1658). When data saving is activated, a measurement folder is created having the current time stamp (or according to the data saving options set). All selected channels are saved. If data saving is deactivated again, the measurement folder is closed. Upon each new activation, a new folder is created.

Tab: Devices - Select device

Parameter	Description
Monitor	By clicking on the desired devices *Monitor* box, a connection to the device is established. You can also select multiple devices. Only such devices can be selected which have been initialized for a measurement or on which a measurement is already running. If this condition is not met, the selection is automatically deleted.
Name	Name of the device.
Device status	Indicates the connection status and the device status. E.g. "connected; running"; This means Monitor is connected with the device and the measurement is running.
Serial number	The device's serial number.

Tab: Channels - Selecting channels

Parameter	Description
Monitor	Clicking on the box *Monitor* causes the variable to be selected. Data transfer for the variable begins immediately.
Name	Name of the variable.
Comment	Comment on the variable.
Unit	The variable's unit.
Circular buffer time	All accruing data are held in a circular buffer memory are. This parameters lets you determine how long the maximum time period for this circular buffer memory is. **Note:** The circular buffer memory only applies to the display in the curve window and does not affect the storage of the measured data!

Tab: Options

Storage options

Parameter	Description
Folder designation	Using this parameter, you set the folder structure for the measured data. • Timestamp - date time (measurement number) The path name is formed from the start time • Continuously numbers
Data folder	Current storage area for measured data.
Saving interval / Amount of saving interval	With these two parameters, you can limit the amount of data and number of files. In this way, it is possible to prevent complete exhaustion of available memory even during long-term measurements. Multiplying the count and the interval determines which measurement duration is available after the measurement has been run. **Example:** Storage interval = 5 min, Storage interval count = 12. The measurement duration is set to 24 h. This ensures that after one day (24 h) **at least** the last 60 min of the measurement are available in intervals of **a maximum of** 5 min.

In order to apply changes to the options, press the button "*Apply*".

14.4 Information and Tips

Placeholder EXPERIMENT.PATH

The placeholder EXPERIMENT.PATH can now also be used in imc STUDIO Monitor, in order to find the path to the experiment file.

Note Deviating System Behavior

Deviating system behavior in absence of the component: imc STUDIO Project Management:

If the component imc STUDIO Project Management is deactivated, no database is used to manage the experiments jointly. For this reason, the placeholder returns different results.

Name	Context menu	Description
CFG	-	*Not supported.*
NAME	-	*Not supported.*
PATH	Experiment - Path	Path to the storage directory of the configuration file ".imcStudio"/".imcExp"
SETTINGS	-	*Not supported.*

14.5 Tutorial

Below we present some examples of the plug-in Monitor.

14.5.1 Monitor - First Steps

imc STUDIO Monitor can connect with imc devices as soon they were **initialized** ("Download") or a **measurement is running**.

Proceed as follows:

- Run a device search to obtain a list of all available devices.
- Select the device to obtain the list of all device variables.
- Select the channels you wish to observe.
- Configure a Panel page, in order to view the measured data (no further explanation presented here).

Device Search

To search for devices available in the network, click on the device search symbol ( )

- in the tool window: **Devices / Channels** or
- in the ribbon: **Home** (or **Panel-Control**) **> Device Search (imc STUDIO Monitor)**.

Note Connecting with the device

The same conditions for a successful search apply as for imc STUDIO. If a device is not found, there are a variety of possible causes.

For more information on correct configuration of all network settings, see the manual: **Setting Up - Connect the device** 43.

Tab: Devices - Device selection

Once the device search has concluded, you can connect with the desired device.

- Go to the main window **Panel**
- In the tool window **Devices / Channels**, open the tab **Devices**

Here you will find the list of all devices found.

- Select the desired device by setting a checkmark in the column **Monitor** ( ).

Note Firmware

In order to be able to connect with a device, the firmware version (imc DEVICES) must be installed which matches the device.

The firmware must not only be present on the imc STUDIO computer for configuring the device, but also on the imc STUDIO Monitor computer, in order for it to read from the device.

Transfer of measured data begins with the selection of a device, as long as at least one channel is selected on the tab *Channels*.

If the device is de-selected, transfer of the measured data stops.

Tab: Channels - Channel selection

To select the channels you wish to see, open the tab **Channels** in the tool window **Devices / Channels**.

In the default setting, the channels are grouped according to the devices selected.

- Activate the channel desired by selecting it in the column **Monitor** (☑).

Note

If no channel is selected here, none of this channel's data are transferred.

If a **comment** was assigned to the channel in imc STUDIO, it is also displayed, in the *Comment* column. As well, the column *Unit* displays the **unit** of the measured data.

Circular buffer time

All incoming data are kept in a circular buffer memory. The volume of this buffer memory can be set for each channel separately in the column *Circular buffer time*.

Note Circular buffer time

The circular buffer memory only applies to the display in the curve widow and does not affect storage of the measured data!

Activating data storage

By default, data storage is deactivated. You can activate the data storage for all channels selected.

Note Saving the experiment is necessary

Since the measured data are saved with the experiment, a defined storage location is needed.

Save the experiment, otherwise the button for activating the data storage is deactivated.

To activate the data storage,

- click on the button: **Save** 1660 () in the tool window: **Devices / Channels** or
- the menu action: **Activate saving (imc STUDIO Monitor)** 1658 ().

To deactivate the data storage,

- click again on the button: **Save** 1660 () in the tool window: **Devices / Channels** or
- the menu action: **Deactivate saving (imc STUDIO Monitor)** 1658 ().

A variety of options is available for the data storage. The description of all storage options is found in the description of the tool window: Devices / Channels 1661.

15 Data Processing

imc STUDIO DataProcessing is a imc STUDIO plug-in by means of which it is possible during a running measurement to outsource various data processing and computational tasks, which previously were performed by the measurement device, to the PC. This means that the measurement device's computational resources are freed up, and the high computing power of the PC is exploited.

A number of functions packages for Data Processing are available:

Functions package	Description
imc Inline FAMOS 1667	Processing and analysis of measured data during running measurement
imc WAVE 1667	NVH analysis of measured data during running measurement
Power Quality 1668	Expansion package for power quality analysis as per EN 50160 (IEC 61000-4-30 Class A)
imc STUDIO BusDecoder 1683	Expansion package for decoding Field-bus log channels
Powertrain Monitoring 1687	The component imc STUDIO Powertrain Monitoring is developed for the diagnosis of powertrains. The powertrains can consist of motors, shift gearboxes and engines as well as devices for braking. The diagnosis can be used in field scenarios, test plants or end of line tests in a production.

Opening Data Processing

The plug-in can be opened via the Navigation Pane: .

Tasks

For each activated functions package, a **Task**, represented by a card tab, is opened. In consequence, you can jump from one functions package to another. All Tasks are processed in parallel. How many tasks can be performed depends on the demands made by the functions used and on the PC's capacities.

For each functions package, you can set up additional tasks. Here again, the amount possible depends on the capacities of the PC used.

Configuring results channels in the Setup

For quick and clearly organized configuration of the results channels belonging to Data Processing-tasks, all results channels appear in the channel table in the main window: Setup. Here, the channels can be configured like the virtual channels belonging to imc Online FAMOS

Note

Wherever the documentation refers to a device, the statements also apply analogously for multiple devices.

15.1 Ribbon

Task

Menu item	Description
New	Adds a new Task. Select from which **Functions Package** the new Task is to be generated and enter an appropriate name for the task.
Edit	Opens a dialog in which, for example, the selected task's name can be changed.
Delete	Deletes the selected Task. The configuration is discarded and can no longer be restored.

Configuration

Menu item	Description
Restore	Restores the most recently **applied** state of the selected task's configuration. The current configuration is discarded and can no longer be restored.
Check	Checks the configuration of the selected Task. If an error occurs, a notification will appear in the status bar! Special feature of imc Inline FAMOS: The faulty portion will appear highlighted in the Editor. If the syntax-check concludes without an error, all newly defined virtual channels and variables will be adopted in the Channels list.
Apply	Applies the configuration of the selected Task. As soon as the configuration has been **applied**, the Task starts and the calculations are performed. In the table of channels in the Setup, the newly defined channels appear as additional **virtual channels**.

Clipboard

Menu item	Description
Cut	Removes the selection (the highlighted portion in the Editor) to the Clipboard.
Copy	Copies the selection (the highlighted portion in the Editor) to the Clipboard.
Paste	Inserts the Clipboard contents at the position highlighted.

Edit

Menu item	Description
Undo	Reverses the effect of the last change (in the Editor).
Redo	Restores the previously reversed change.

Search

Menu item	Description
Find	Find specific text
Find and Replace	Find and replace specific text

Im-/Export

Menu item	Description
Import	Imports Data Processing Task configurations.
Export	Exports the configuration of the selected Data Processing Task.

15.2 Inline FAMOS

Processing and analysis of measured data during a running measurement

imc Inline FAMOS is a functions package for Data Processing.

imc Inline FAMOS enables calculations to be performed on data streams from the measurement currently runnning. The calculations are performed on the PC, taking advantage of the PC's processing power. By contrast, with imc Online FAMOS, the calculations are performed by the device.

Reference	Reference: Documentation on imc Inline FAMOS

For a detailed description, see the chapter: "*imc Online FAMOS and imc Inline FAMOS*" 835

15.3 imc WAVE

NVH analysis of measured data during running measurement

imc WAVE is a functions package for Data Processing.

imc WAVE enables calculations to be performed on data streams from the measurement currently runnning. The calculations are performed on the PC, taking advantage of the PC's processing power.

Reference	Reference: Documentation on imc WAVE

For a detailed description, see the chapter: "*imc WAVE*"

Note	Licenses

Internally, imc WAVE uses imc Inline FAMOS-functions. Nevertheless, you do not require any imc Inline FAMOS license in order to use them. However it is necessary for imc Inline FAMOS to be activated in the Product Configurator. This occurs automatically when you activate an imc WAVE Analyzer. The imc Inline FAMOS-Editor is also only displayed once you have activated an imc Inline FAMOS-license.

15.4 Power Quality

Expansion package for power quality analysis conforming to EN 50160 (IEC 61000-4-30 Class A)

Power Quality allows the calculation of power quality indicators according to EN 50160 (IEC 61000-4-30 Class A). The calculations are performed by the PC on the basis of the currently measured data while measurement proceeds. This utilizes the PCs computation resources.

When using the Power Quality for the first time, you should first get to know the user interface 1668 and then work through the example 1671.

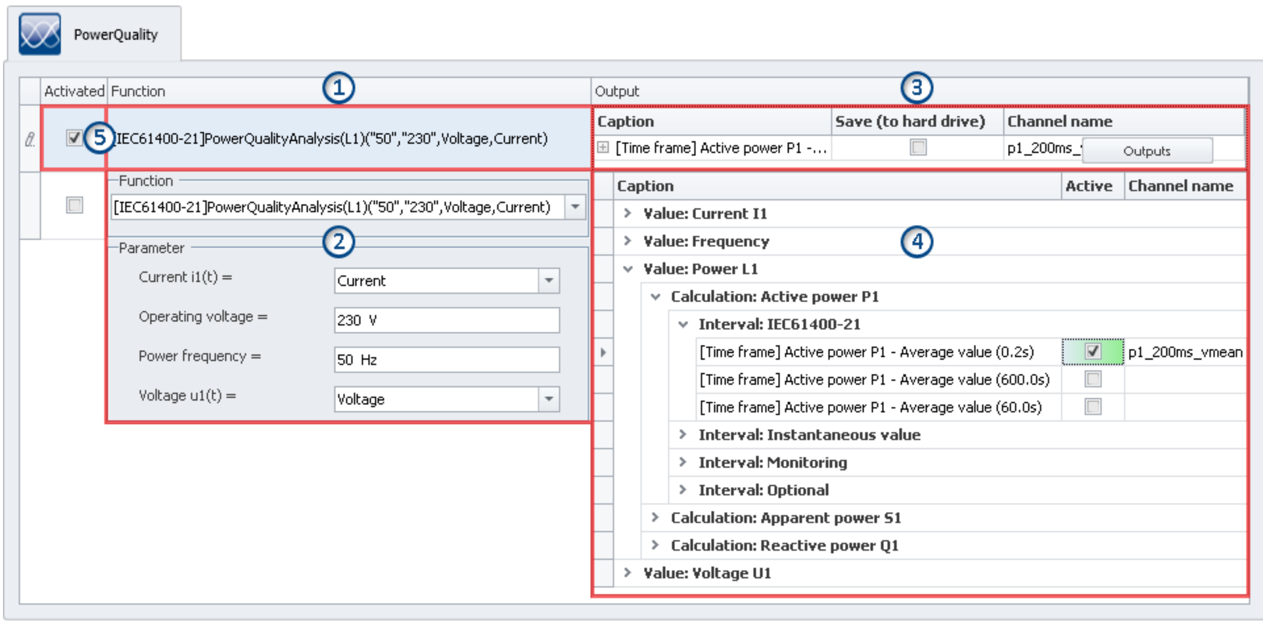
System Requirements and Limitations

To ensure valid results, all the channels subjected to calculations (voltage and amperage) must be sampled at frequencies of at least 10 kHz.

15.4.1 Opening Power Quality

Open the plug-in Data Processing via the Navigation pane. In the plug-in's main window, there will be a tab (Task: ) for the functions package Power Quality. If it is not selected already, left-click the mouse on the Task name. The Power Quality Editor will appear in the main window.

15.4.2 User Interface



The window is subdivided into five regions:

1. Function: Lists any functions whose parameters have already been set.
2. Function: Window for selecting a function and setting its parameters
3. Output: Displays the activated outputs
4. Output: Window for parameterizing and activating the calculations
5. Activate/deactivate functions

Region 1: Display of parameterized functions

Until the settings have been made for any function, this line appears empty.

Once the settings for any functions have been made, these functions along with their parameters are displayed here.

- Each function has its own group of input parameters, which must be set after selecting the particular function in Region 2.
- Additionally, each function has various output quantities which must be activated/parameterized in Regions 3 and 4.

Three functions are available:

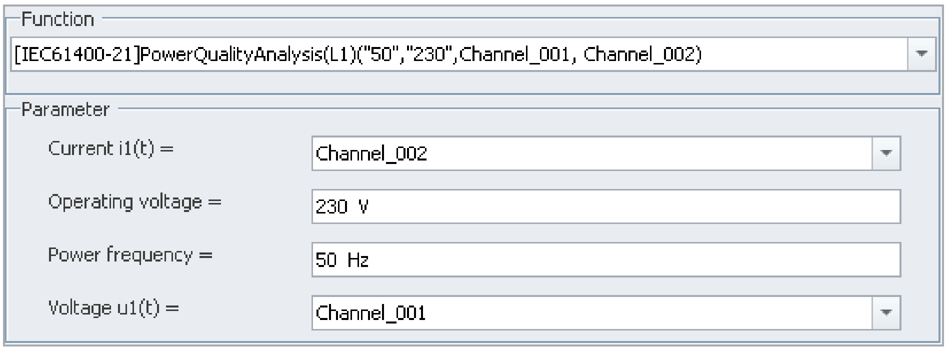
- PowerQualityAnalysis(L1): single-phase power calculation
- PowerQualityAnalysis(L1,L2,L3): three-phase power calculation (delta configuration)
- PowerQualityAnalysis(L1,L2,L3,N): three-phase power calculation (star configuration)

Actions	Description
Setting up a function	To select the function desired, click in the column "*Function*" in the first empty row. In consequence, Region 2 (the parameterization window) opens; there you can select and configure your function.
Changing a function	To alter a function which has already been set up, click on it corresponding cell.
Deleting a function	To delete a function which has already been set up, open the context menu 1679 in the corresponding cell and select "*Delete function*".

Region 2: Function parameterization window

Here you select the **function** and configure the **input parameters**.

Clicking on the arrow button in the top row opens a list of named functions from which to select. Based on what you select (single- or three-phase), the respective input parameters must be set subsequently.



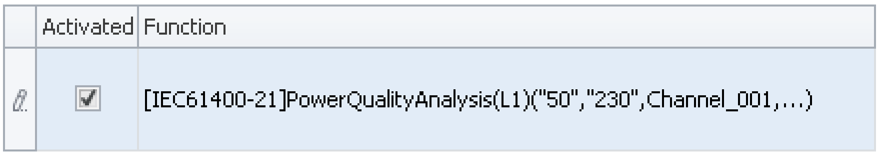
Parameters for the single-phase power calculation

With single-phase systems, the following parameters can be set:

- Power frequency
- Operating voltage
- The voltage u1(t), to be measured
- The current i1(t), also to be measured

The channels specified for u1(t) and i1(t) need not be active nor even exist at the time the settings are made. However, for the sake of simplicity a selection list of active channels is provided.

When you click the mouse anywhere outside of the dialog, the parameter settings are concluded. In consequence the selected function is displayed along with the parameters set.



Function after setting the parameters

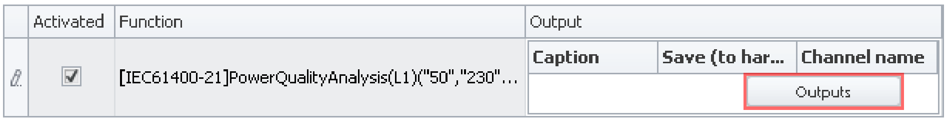
With three-phase power calculations, there would be two additional voltage and two more amperage signals to set.

Region 3: Display of activated outputs

An "Output" in this context is the calculated result quantity returned, e.g. average frequency, maximum active power, etc. Each calculated output quantity generates a channel (virtual channel), which is available in the **Data Browser** and can be linked with a Widget, such as a curve window.

Activating and making settings for outputs

To activate and make settings for the currently selected function, click in the column "*Output*" on the button "**Outputs**". Immediately, the parameterizing window (Region 4) opens; there, select and configure the output quantities.



Setting the calculation's outputs

For each function, the selected output quantities are set separately, for which reason there is an "*Outputs*" button for each function. For each function, any number of outputs can be activated. Here, too, as with the functions, the amount is limited only by the performance power of your PC.

Region 4: Window for parameterizing and activating the calculations

Here, you can activate and parameterize the output quantities. The quantities available are listed in a table. One section of this table is shown below:

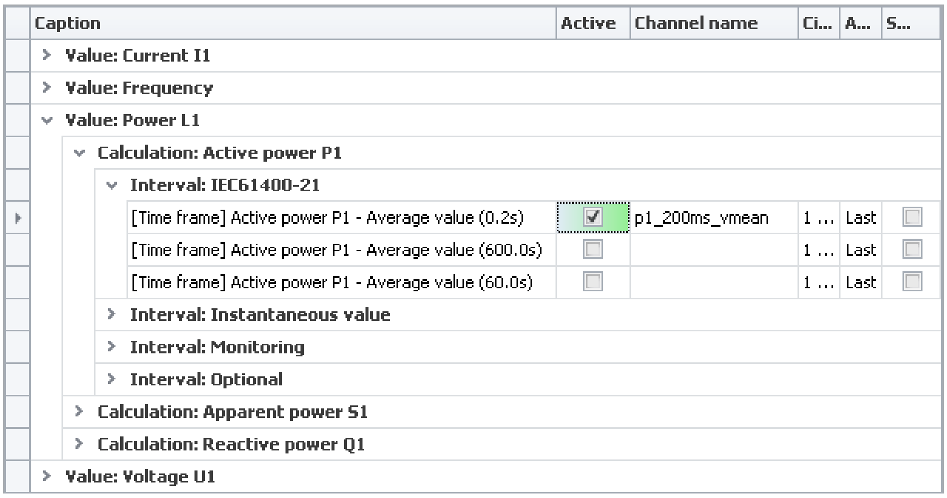


Table of available outputs for a single-phase power calculation

The figure above is based on a single-phase power calculation. If a three-phase power calculation were selected, there would correspondingly be more selection options.

Activating a calculation

Navigate to the desired output quantity and put a checkmark in the column "**Active**".

Checking this box activates the calculation. The channel name is set automatically, but can be edited as desired subsequently. Activated calculations appear as "**Virtual channels**" in the Channels table (Setup) and in the Data Browser (Panel).

Parameterizing calculations

Each output quantity has parameters which can be adapted to the respective requirements.

E.g., storage of channels on the PC can be activated. To do this, put a checkmark in the box for the column "*Save (HD)*". If necessary, adjust the other settings as well, by editing the inputs.

In the channel table (Setup), the outputs defined appear as "**Virtual channels**". Here, the channel can be parameterized like any other virtual channels (e.g. the data storage). The changes made in the Setup have a direct effect on the Power Quality settings, since the same settings, in part, can be made here.

For more information on the individual parameters, see the section: "Output Parameters 1676".

Region 5: Activating/deactivating functions

Here, the calculation of a complete function can be activated/deactivated.

Only such calculations are performed which have a checkmark in the column "**Activated**". All newly added functions are activated by default.

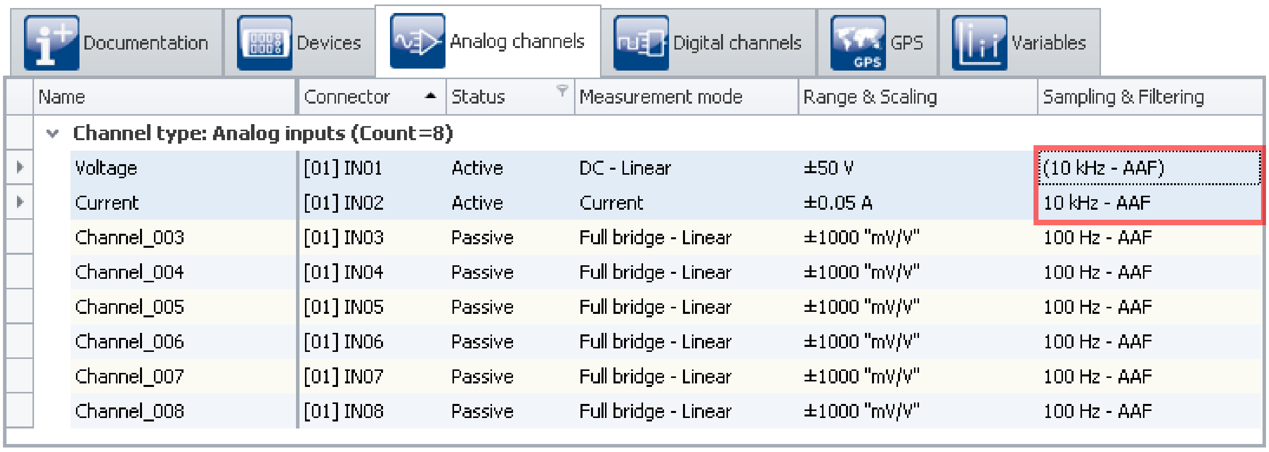
15.4.3 Introductory Example

As our introductory example, Power Quality is used to determine the active power in a 50 Hz power network having 230 V service voltage.

Setup - Setting channels

Make the appropriate settings for the measurement devices in the plug-in Setup's main window. For this example, two measurement channels are required: one measures the amperage and one the voltage.

The sampling rate of both channels must be at least 10 kHz. Meeting this requirement is necessary in order to correctly determine all network analysis results.



Name	Connector	Status	Measurement mode	Range & Scaling	Sampling & Filtering
Channel type: Analog inputs (Count=8)					
Voltage	[01] IN01	Active	DC - Linear	±50 V	(10 kHz - AAF)
Current	[01] IN02	Active	Current	±0.05 A	10 kHz - AAF
Channel_003	[01] IN03	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF
Channel_004	[01] IN04	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF
Channel_005	[01] IN05	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF
Channel_006	[01] IN06	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF
Channel_007	[01] IN07	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF
Channel_008	[01] IN08	Passive	Full bridge - Linear	±1000 "mV/V"	100 Hz - AAF

Setting the channels

To apply the changes, click on the button Process configuraton 222 (✔). In consequence, the device configuration is available to the other plug-ins. This means that the channels can be subject to operations by the functions package: Power Quality.

Configuring the Power Quality-function

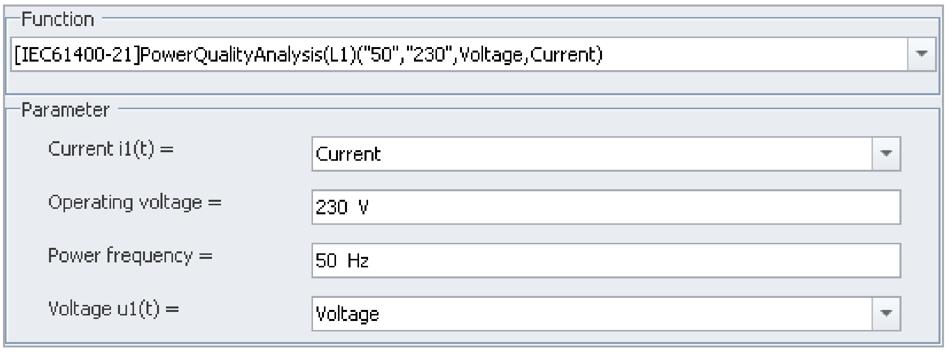
Open the plug-in Data Processing via the Navigation pane. In the plug-in's main window, you will see a tab (Task:) for the functions package Power Quality. If it is not yet selected, left-click the mouse on the task name. The Power Quality Editor will then be displayed in the main window.

Selecting and parameterizing a function

In this example, a single-phase power measurement is to be conducted, in order to calculate the actual power from its result.

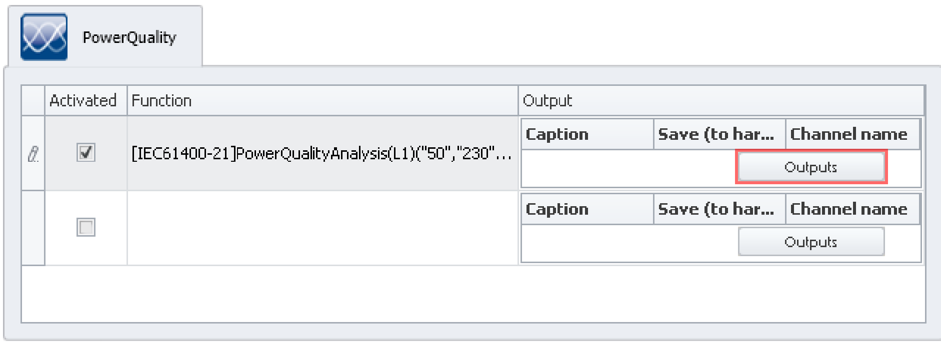
- Click on the top empty line under the column: **Function**
- In the drop-down list, select the following function: **[IEC61400-21]PowerQualityAnalysis(L1)("50","230",,)**
- Next, a list of all parameters of the function appears. Parameterize it as follows:

Parameter	Value
Power frequency	50 Hz (already given)
Operating voltage	230 V (already given)
Voltage u1(t)	Voltage (usually an analog channel which measures the voltage)
Current i1(t)	Current (usually an analog channel which measures the amperage)



Configuring Power Quality-result (output) quantities

To set the actual power as the result quantity, click in the column **Output** on the button **Outputs**:

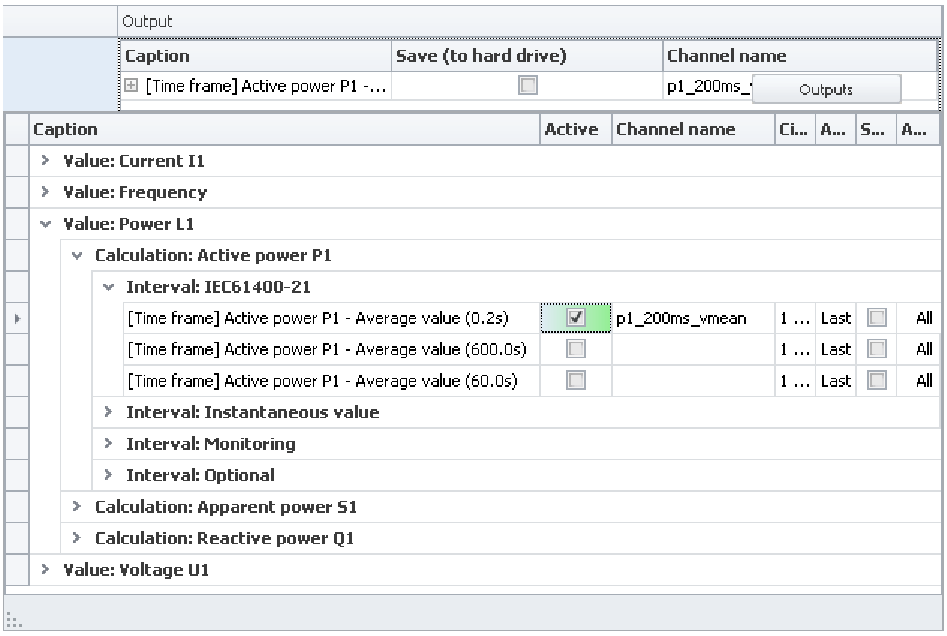


In consequence, a list of various calculations available for selection appears. The desired calculations can be activated/parameterized here.

- The active power is found under *Value: Power L1 > Calculation: Active power P1*.

Here, various intervals are available. In this example, the mean value over 200 ms is to be determined as per the standard IEC 61400-21.

- Open *Interval: IEC61400-21*
- Put a check mark in the column **Active** for the calculation: *[Time frame] Active power P1 - Average value (0.2s)*



By checking the box, the calculation is activated. The channel name is set to *p1_200ms_vmean*, but can be changed as desired.

Here, make the following settings:

Parameter	Value
Active	☑
Channel name	p1_200ms_vmean
Circular buffer duration (curve window)	1 min
Available events (curve window)	Last (no other options available)
Save (to hard drive)	☐
Available events (hard drive)	all (not relevant since there is no data saving)
Circular buffer duration (hard drive)	undefined (not relevant since there is no data saving)
Averaging time	0.2 s (permanent setting)

Inspecting the Power Quality-configuration and starting calculation

Check / Syntax-Check

Click on this button to perform a *Syntax-Check*. If any errors occur, you will be notified via the logbook!

Applying the Power Quality-configuration

Even if the Syntax-Check concluded without any errors, the task still will not start. As soon as the configuration is **applied**, the task starts and the calculations are performed. To do this, click on the button *Apply* ( ).

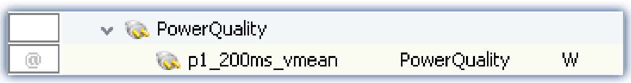
More information on *Check* and *Apply* is presented under: Performing Calculations 1678.

Configuring a results channel in the Setup

In the table of channels in the Setup, the newly defined channel appears as an additional **virtual channel**. Here, the channel can be parameterized (e.g. the data storage) just like any other virtual channel. The changes made in the Setup directly affect the Power Quality settings, since some of the same settings are made there, too.

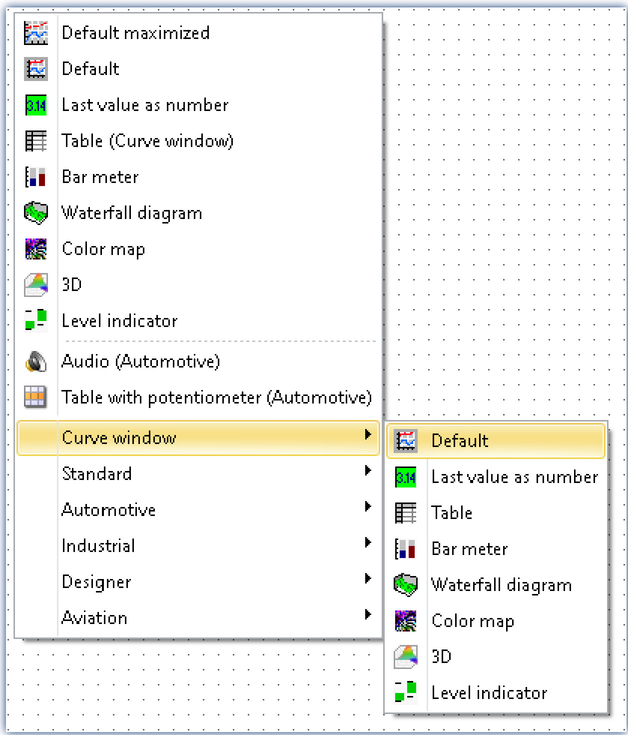
Displaying the results channel in the Panel

Once the configuration has been applied, the results channel appears in the **Data Browser** with the name *p1_200ms_vmean*. It is found under its own category *Power-Quality-Analysis*:



From there you are able to link the channel to a Panel page with Widgets, e.g. a standard curve window.

To do this, use Drag&Drop to take the Variable *p1_200ms_vmean* to the Panel page. In the menu which then opens, select *Curve window - Standard:*



Now have a curve window on the Panel page, in which *p1_200ms_vmean* is displayed.

Start the measurement now using the Start-Button ( ).

A tip on producing a simulation, without actual signals

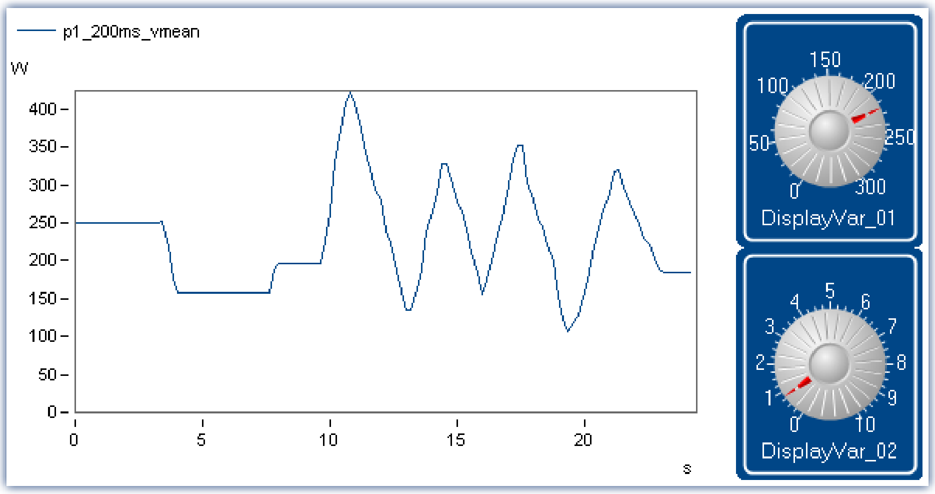
If appropriate voltage and current signals are not available, you can simulate some for the purpose of getting an introduction. To do this, use imc Online FAMOS and generate corresponding virtual channels.

For this simple exercise, generate the virtual channels consisting of a Display-variable's instantaneous values. The value of the Display-variable is edited by means of the Panel for simulation.

imc Online FAMOS-Code:

```
Voltage = Channel_001 * 0 + DisplayVar_01
Current = Channel_001 * 0 + DisplayVar_02
```

In this case, the analog inputs may no longer be called *Current* and *Voltage*, since the virtual channels now have these names for purposes of the calculation.



By means of a potentiometer, the Display-variable's value is adjusted. In the curve window, the calculated values appear.

15.4.4 Output Parameters

Every output can be parameterized. The parameters affect the results returned. The table contains the following columns, in which settings can be made:

	Parameter [1]	Description
-	Caption	Name of the output quantity (permanently assigned)
-	Active	Activates/deactivates calculation of the output quantity • Deactivated: the output quantity is not calculated • Activated: the output quantity is calculated
-	Channel name	Name of the virtual channel on which the output quantity is to be outputted. This name appears in the channel table (Setup) and in the Data Browser (Panel).
•	Circular buffer duration (curve window)	For the time period specified, the data are retained on the PC for the purpose of display in the Panel. The Widgets (e.g. the curve window) only contain data for the duration of the buffer period set by the user.
•	Available events (curve window)	With this setting, you determine whether all events triggered in the Panel are to be available, or only the last one. If *Circular buffer duration (curve window)* is set, then only *Last* is available. For a detailed explanation, see "Storage options 711".
•	Save (to hard drive)	Saves the output quantities to the PC
•	Available events (hard drive)	With this setting, you determine whether all events triggered in the Panel are to be available, or only the last one. If *Circular buffer duration (HD)* is set, then only *Last* is available. For a detailed explanation, see "Storage options 712".
•	Circular buffer duration (hard drive)	For the time period specified, the data are retained on the PC for data storage purposes. The saved measurements only contain data for the duration of the buffer time set.

Parameter [1]	Description
- Averaging time	Averaging time in seconds

1 Parameters denoted by ● can also be set in the channel table in the Setup.

If certain parameters are already determined by the nature of the quantity being calculated, such as the averaging duration for *Active power - Instantaneous value* or *Voltage - Flicker - Interval 10 minutes*, these boxes are not editable.

A detailed listing of result quantities is presented under Basics 1679.

Interval Monitoring/Optional

For many result quantities, there is a distinction between: *Interval: Monitoring* and *Interval: Optional*. This distinction simply provides the ability to calculate the same result quantity using two different averaging intervals.

Thus, for instance, it is possible, on the one hand, to calculate the active power with a long averaging interval (e.g. 15 min), and on the other hand to obtain quick preliminary results using a short interval (e.g. 1 s).

Flicker: With the flicker calculation, the algorithm following *Interval: 10 minutes* and *Interval: Optional* is the same; *Interval: Monitoring* offers the ability to determine the arithmetic mean of the instantaneous flicker within a specified time window. *Interval: 10 minutes* calculates the flicker over the 10-minute averaging interval specified in the standard IEC 61000-4-15; *Interval: Optional* calculates according to the same algorithm, but at any arbitrary averaging interval.

10/12 Period

If a result quantity is calculated over 10/12 periods and a specific averaging duration is calculated, the following apply:

- per 10 periods (with 50 Hz rated network frequency; 12 periods at 60 Hz), one value is determined.
- As many values are determined as possible until the averaging interval has elapsed.
- From these values, the minimum, maximum or arithmetic mean is determined depending on the result quantity specified
- The result quantity is only updated after the averaging interval (e.g. in the curve window)

With a network frequency of exactly 50 Hz (non-existent in practice) and an averaging interval of 1 s, this would mean: per 10 periods = 0.2 s one value is determined, i.e. per averaging interval 5 values.

The principle behind this arrangement is described in the standard IEC 61000-4-30.

15.4.5 Performing Calculations

The plug-in Data Processing continually performs calculations, even when no measurement is running. The instantaneous values are used for the measurement.T

In order that the calculation can be performed, the parameters (network voltage, network frequency, voltages and currents) must be complete. Specified channels (which are already present) must be sampled at a minimum of 10 kHz. Also, the network frequency must be 50 Hz or 60 Hz.

Check

When you click on the button: **Check** (), the current configuration is examined to verify that all conditions are met. If any condition is not met, an error message appears in the logbook.

Note

At this point, there is no check of whether the specified channels exist, since they could still be created later (e.g. by imc Online FAMOS).

Apply

After the settings have been checked, clicking on the button: **Apply** ()

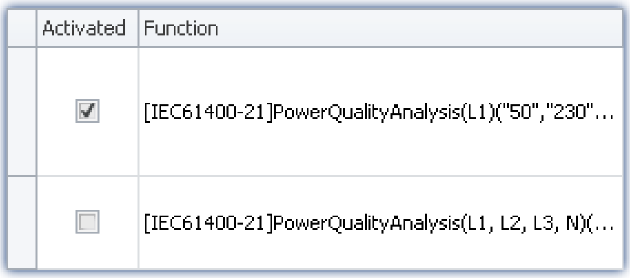
- stops the running calculations,
- adopts the updated functions with their parameters and desired result quantities,
- and re-starts calculations.

Note

For Apply, the verification process described above is repeated. If any of the calculations can not be performed, for instance because the sampling rate of some channel is less than 10 kHz, none of the calculations are performed! The new specifications (function, parameter, outputs) are not transferred in this case, and the calculation is not re-started.

Activating/deactivating functions

Only such calculations are performed which are selected in the column *Active*. All newly added lines are selected by default as soon as one function is assigned. Deactivated calculations are not performed.



Calculation activated/deactivated

15.4.6 Context Menu

Context menu in the table

Right-clicking in the table the calls following context menu:

Menu item	Description
Delete function	Deletes the function. Is only enabled if the context menu is opened via a row.
Delete all functions	Deletes all function.

Context menu at the outputs

Right-clicking the mouse over the opened Outputs list opens the following context menu:

Menu item	Description
Expand	Expands all or individual groups located under *Caption*.
Collapse	Collapses all or individual groups located under *Caption*.
Select all groups	Expands all groups and highlights them; can be used, for example, to set all outputs to active.
Deselect selection	De-selects all selected outputs/groups

15.4.7 Basics

In this chapter, the result quantities which can be set under *Outputs* 1676 are described.

The result quantities are each discussed separately the following sections:

- Frequency 1680
- Power 1680
- Voltage 1681
- Current 1682

In the tables below, the possible result quantities are briefly discussed. The order of presentation is the same as they appear in the user interface.

Since the possible result quantities fall under the categories *Power*, *Voltage*, *Current* and *Frequency* (on with three-phase power calculations, also *Network frequency*), both for single- and for three-phase power calculations, the breakdown of the next chapters is based only on these categories.

The distinction between *Interval: Monitoring* and *Interval: Optional* is not given consideration since these options do not result in different kinds of result quantities, but are simply based on different respective averaging intervals (see Ausgangsparameter 1676).

Reference	Calculation of power

A good overview of the topic Power measurement is provided in the documentation on imc Online FAMOS 835 in the chapter *Information and Tips*.

15.4.7.1 Frequency

The following result quantity can be selected for the frequency:

Quantity	Interval	Explanation
Frequency	time frame	The frequency is calculated over an interval set as the averaging interval. The available outputs are the minimum, maximum and the arithmetical mean.

15.4.7.2 Power

The following result quantities can be determined for the power:

Quantity	Interval	Explanation	Definition
Reactive power	10/12 periods	Calculates the reactive power over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *reactive power* denotes the component of the apparent power which is not used by the load.
Apparent power	10/12 periods	Calculates the apparent power over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *apparent power* is the product of the voltage times the current, disregarding phase offset.
Active power	time frame	Calculates the active power over a specified time window in accordance with the standard IEC 61400-21. The available choices are 0.2 s, 60.0 s and 600.0 s.	The *active power* denotes the component of the apparent power actually used by the load.
Active power	instantaneous value	Calculates the instantaneous value of the active power.	
Active power	10/12 periods	Calculates the active power over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean	
Active power(mean value)	time frame	Computes the arithmetical mean of the actual power over a time window specified as the averaging interval.	

15.4.7.3 Voltage

The following result quantities can be selected for the voltage:

Quantity	Interval	Explanation	Definition
Harmonic distortion	10/12 periods	Calculates the total harmonic distortion of the voltage over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *Total Harmonic Distortion* is the ratio of the sum of all voltages of all upper harmonics (here, 2nd through 50th) to the fundamental oscillation.
Root mean square	10/12 periods	Calculates the RMS of the voltage over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *RMS* is the quadratic mean of the input signal.
(Mean) Root mean square	time frame	Calculates the arithmetical mean of the RMS values within a time window specified as the averaging interval.	
Flicker	time frame	Calculates the voltage's flicker according to the standard IEC 6100-4-15 in a fixed 10-minute time window. Also, the arithmetical mean of instantaneous flicker values within a time window specified as the averaging interval can be calculated. **Observe notes on** ***Interval Monitoring/Optional*** 1676**!**	*Flicker* refers to voltage fluctuations which can cause a perceptible flickering of light bulbs. The prevalence, strength and duration of these fluctuations are used as indicators of the network quality.
Harmonics	time frame	Calculates the harmonics of the voltage according to the standard IEC 61400-4-7 (upper harmonics subgroup) over a time window specified as the averaging interval. The choices of output are minimum, maximum and arithmetical mean.	Harmonics are the amplitudes of all integer multiples of the network frequency (fundamental oscillation = 50/60Hz); these are determined up to the 50th harmonic (2.5kHz/3kHz).
Higher frequency contents **2 kHz - 9 kHz**	time frame	Calculates the voltage's higher frequency components according to the standard IEC 61400-4-7 over a time window specified as the averaging interval. The choices of output are minimum, maximum and arithmetical mean.	Higher frequency components (2kHz - 9kHz) indicate the amplitudes in the higher frequency range (from 2kHz on in 200Hz steps).
Interharmonics	time frame	Calculates the voltage's interharmonics according to the standard 61400-4-7 (centered interharmonic subgroup) over a time window specified as the averaging interval. The choices of output are minimum, maximum and arithmetical mean.	Interharmonics are sinusoidal oscillations whose frequency is not an integer multiple of the network frequency (determined here up to the 50th interharmonics).

15.4.7.4 Current

The following result quantities can be selected for the current:

Quantity	Interval	Explanation	Definition
Harmonic distortion	10/12 periods	Calculates the total harmonic distortion of the current over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *Total Harmonic Distortion* is the ratio of the sum of all currents of all upper harmonics (here, 2nd through 50th) to the current of the fundamental oscillation.
Root mean square	10/12 periods	Calculates the RMS of the voltage over either 10 (50 Hz network frequency) or 12 periods (60 Hz network frequency).The choices of output are minimum, maximum and arithmetical mean.	The *RMS* is the quadratic mean of the input signal.
(Mean) Root mean square	time frame	Calculates the arithmetical mean of the RMS values within a time window specified as the averaging interval.	
Flicker	time frame	Calculates the current's flicker according to the standard IEC 6100-4-15 in a fixed 10-minute time window. Also, the arithmetical mean of instantaneous flicker values within a time window specified as the averaging interval can be calculated. **Observe notes on *Interval Monitoring/Optional* 1676!**	Analog to the definition in the section Voltage 1681 .
Harmonics	time frame	Calculates the harmonics of the current according to the standard IEC 61400-4-7 (upper harmonics subgroup) over a time window specified as the averaging interval. The choices of output are minimum, maximum.	Harmonics are the amplitudes of all integer multiples of the network frequency (fundamental oscillation = 50/60Hz); these are determined up to the 50th harmonic (2.5kHz/3kHz).
Higher frequency contents **2 kHz - 9 kHz**	time frame	Calculates the current's higher frequency components according to the standard IEC 61400-4-7 over a time window specified as the averaging interval. The choices of output are minimum, maximum and arithmetical mean.	Higher frequency components (2kHz - 9kHz) indicate the amplitudes in the higher frequency range (from 2kHz on in 200Hz steps).
Interharmonics	time frame	Calculates the current's interharmonics according to the standard 61400-4-7 (centered interharmonic subgroup) over a time window specified as the averaging interval. The choices of output are minimum, maximum and arithmetical mean.	Interharmonics are sinusoidal oscillations whose frequency is not an integer multiple of the network frequency (determined here up to the 50th interharmonics)

15.5 Bus Decoder

Expansion package for decoding Field-bus log channels

imc STUDIO BusDecoder is a package of functions for Data Processing.

This plug-in allows either all or individual measurement channels belonging to a log-channel to be decoded/extracted. A log-channel can be a logged Field-bus communication ("Logfile").

The decoding information which is usually located in separate configuration files (e.g. with CAN in *.dcb) is instead in embedded in the log channel. Thus, the log channel contains all information necessary for decoding. This provides more flexibility and dynamic capability for deciding on targeted extraction of individual channels from the compressed logfile.

The decoding is performed on the basis of the data streams of the measurement currently running on the PC. This utilizes the PC's computation resources.

The following functions are available:

- Decoding of either all or individual channels from a log-channel
- Resampling of the channels
- Saving of the result channels

The results generated can be displayed on Panel pages and saved with the associated measurement data. Subsequent processing by means of imc Inline FAMOS is also possible.

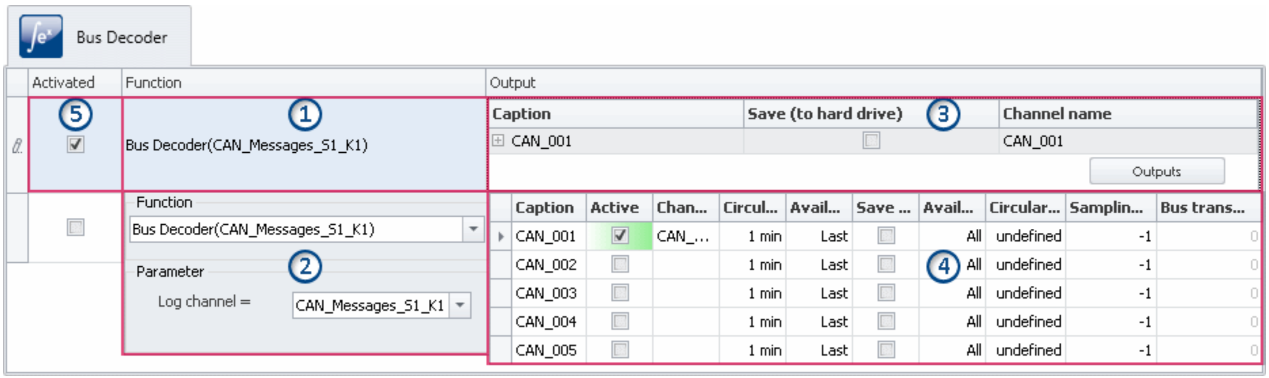
Note	Notes on activing

Activate the Bus Decoder and the "imc STUDIO DataProcessing Editor" using the Product Configurator 29, so that it will appear in the software. You will find the Bus Decoder in the group: "imc STUDIO DataProcessing".

15.5.1 Opening Bus Decoder

Open the plug-in Data Processing via the Navigation pane. In the plug-in's main window, there will be a tab (Task:) for the functions package Bus Decoder. If it is not selected already, left-click the mouse on the Task name. The Bus Decoder Editor will appear in the main window.

15.5.2 User Interface



The window is subdivided into five regions:

1. Function: Lists any functions whose parameters have already been set (decoding of a log channel)
2. Function: Selection of the log channel
3. Output: Displays the activated outputs (the decoded channels)
4. Output: Activate and parameterize the outputs here (the decoded channels)
5. Activate/deactivate functions

Region 1: Display of parameterized functions

Until the settings have been made for any function, this line appears empty. Once the settings for any functions have been made, these functions are displayed here.

Decoding a log channel (setting up a function)

In order to decode a desired log channel, click in the column "**Function**" in the first empty row. In consequence, Region 2 opens. There, select the log channel.

Changing a function

To alter a function which has already been set up, click on it corresponding cell.

Deleting a function

To delete a function which has already been set up, open the context menu 1679 in the corresponding cell and select "*Delete function*".

Region 2: Selecting the log channel

Here you select the "**Log channel**".

In the bottom input box having the arrow button ( ), select the desired log channel.

When you click the mouse anywhere outside of the dialog, the settings are concluded.

Region 3: Displaying the activated outputs (the decoded channels)

Under "**Output**", all channels belonging to the log channel, for which decoding is configured in the Bus Decoder, are listed. Each output quantity generates a channel (virtual channel), which is available in the Setup and in the Panel and can be linked with a Widget.

Activating (decoding) and making settings for outputs

In order to activate and parameterize outputs (channels), click in the column "*Output*" on the button "**Outputs**". Immediately, the parameterizing window (Region 4) opens. There, select and configure the channels.

Activated	Function	Output		
		Caption	Save (to hard drive)	Channel name
☑	Bus Decoder(CAN_Messages_S1_K1)	CAN_001	☐	CAN_001
				Outputs

For each function, the selected channels are set separately, for which reason there is an "*Outputs*" button for each function. For each function, any number of channels can be activated. Here, too, as with the functions, the amount is limited only by the performance power of your PC.

Region 4: Window for parameterizing and activating the channels

Here, you can activate and parameterize the channels. The channels available are listed in a table.

Caption	Active	Chan...	Circul...	Avail...	Save ...	Avail...	Circular...	Samplin...	Bus trans...
CAN_001	☑	CAN_...	1 min	Last	☐	All	undefined	-1	0
CAN_002	☐		1 min	Last	☐	All	undefined	-1	0
CAN_003	☐		1 min	Last	☐	All	undefined	-1	0
CAN_004	☐		1 min	Last	☐	All	undefined	-1	0
CAN_005	☐		1 min	Last	☐	All	undefined	-1	0

Activating channels

Put a check mark in the column "**Active**" for the channel desired.

Checking this box activates the decoding for the channel. The channel name is set automatically, but can be edited as desired subsequently. Activated channels appear as "**Virtual channels**" in the Channels table (Setup) and in the Data Browser (Panel).

Parameterizing channels

Each channel has parameters which can be adapted to the respective requirements.

E.g., storage of channels on the PC can be activated. To do this, put a checkmark in the box for the column "*Save (HD)*". If necessary, adjust the other settings as well, by editing the inputs.

In the channel table (Setup), the outputs defined appear as "**Virtual channels**". Here, the channel can be parameterized like any other virtual channels (e.g. the data storage). The changes made in the Setup have a direct effect on the Power Quality settings, since the same settings, in part, can be made here.

For more information on the individual parameters, see the section: "Output Parameters 1686".

Region 5: Activating/deactivating functions

Here, the function can be activated/deactivated.

Only such log channels are decoded which have a checkmark in the column "**Activated**". All newly added functions are activated by default.

15.5.3 Output Parameters

Every output can be parameterized. The parameters affect the results returned. The table contains the following columns, in which settings can be made:

- Parameters denoted by ● can also be set in the channel table in the Setup.

	Parameter	Description
-	**Caption**	Name of the output quantity (permanently assigned)
-	**Active**	Activates/deactivates decoding of the channel • **Deactivated:** the channel is not decoded • **Activated:** the channel is decoded
-	**Channel name**	Name of the virtual channel on which the output quantity is to be outputted. This name appears in the channel table (Setup) and in the Data Browser (Panel).
●	**Circular buffer duration (curve window)**	For the time period specified, the data are retained on the PC for the purpose of display in the Panel. The Widgets (e.g. the curve window) only contain data for the duration of the buffer period set by the user.
●	**Available events (curve window)**	With this setting, you determine whether all events triggered in the Panel are to be available, or only the last one. If "*Circular buffer duration (curve window)*" is set, then only "*Last*" is available. For a detailed explanation, see "Storage options 711".
●	**Save (to hard drive)**	Saves the output quantities to the PC
●	**Available events (hard drive)**	With this setting, you determine whether all events triggered in the Panel are to be available, or only the last one. If "*Circular buffer duration (HD)*" is set, then only "*Last*" is available. For a detailed explanation, see "Storage options 712".
●	**Circular buffer duration (hard drive)**	For the time period specified, the data are retained on the PC for data storage purposes. The saved measurements only contain data for the duration of the buffer time set.
-	**Averaging time**	>0 Sampling of the decoded channel at a defined sampling time -1 The original channel's setting (Feldbus-Assistenten) is applied. 0 Recorded with a time stamp
	Bus transmission cycle [s]	Defined by the Assistant >0 Sampling interval/transfer cycle of the channel 0 Recorded with a time stamp

15.5.4 Preparing the Field-bus

Decoding of the log channels is possible for multiple Field-busses. Some Field-busses need to be configured separately for this purpose.

Field-bus type	Link
CAN 522	A description of the necessary settings is provided here: "Blob - Decoding with the Bus Decoder 549"
SPI 695	Channel settings: All channels are recorded in the blob and can thus be decoded. No selection is possible.
MVB 655	Channel settings: All channels are recorded in the blob and can thus be decoded. No selection is possible. Logging of the data must be activated.
FlexRay 612	Channel settings: See "Properties of Signals 623" Logging of the data must be activated.

15.6 Powertrain Monitoring

General

The component imc STUDIO Powertrain Monitoring has been developed in close cooperation with the company **GfM** (**Gesellschaft für Maschinendiagnose mbH**), experts in machine and bearing diagnostics.

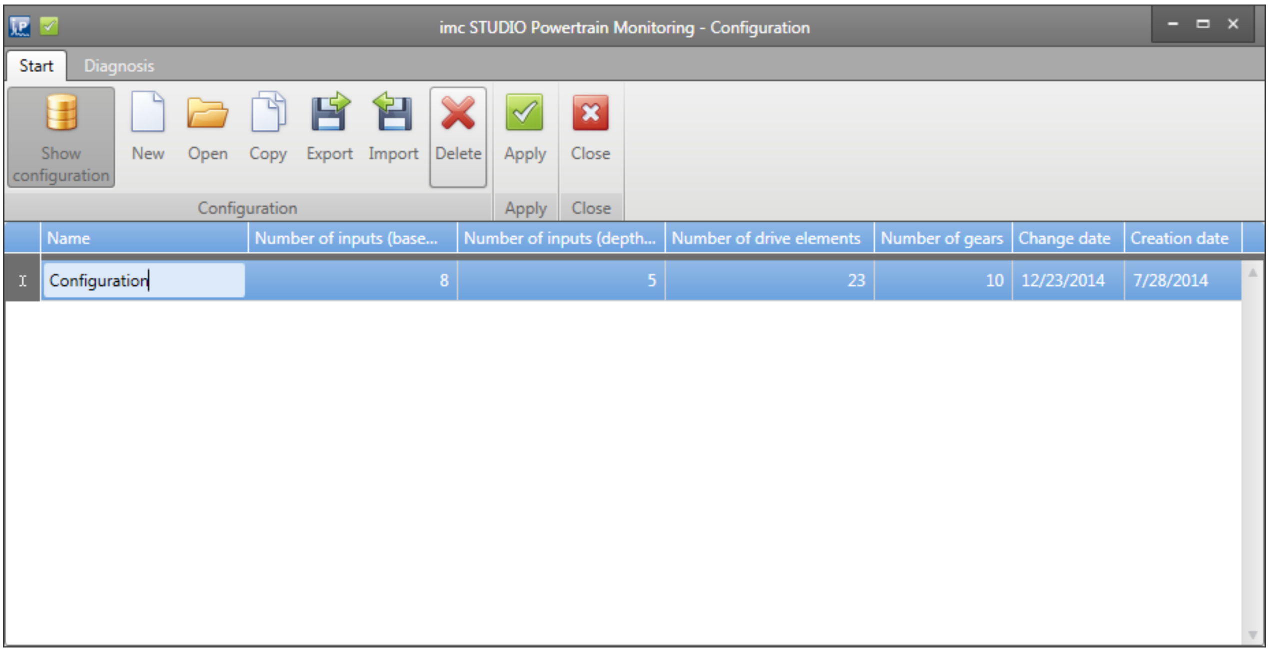
It is dedicated to diagnosis of powertrains. The powertrains can consist of motors, shift gearboxes and engines as well as devices for braking. The diagnosis can be used in field scenarios, test rigs or end of line tests in production.

Powertrain Monitoring offers two different kinds of diagnosis of vibrations: a **Base diagnosis** 1691 on the basis of characteristic values and a **Advanced Diagnosis** 1698 on the basis of a frequency selective search of kinematic pattern. A configuration for a specific gear type will be created via the **Powertrain Monitoring Assistant**. This configuration will be saved in the project of imc STUDIO and can be distributed via this project on different test locations. The configuration is used by the **Editor** by applying configured inputs to physical measurement channels. This system allows to use the same configuration on different measurement systems if multiple test locations are driven with the same powertrain type.

For using the component Powertrain Monitoring the product imc STUDIO in the version 5.0 R3 or higher as well as a license of the imc STUDIO Powertrain Monitoring is required. Both can be obtained at imc Test & Measurement GmbH. The license can be activated via the imc LICENSE Manager.

15.6.1 Assistant

15.6.1.1 Configuration

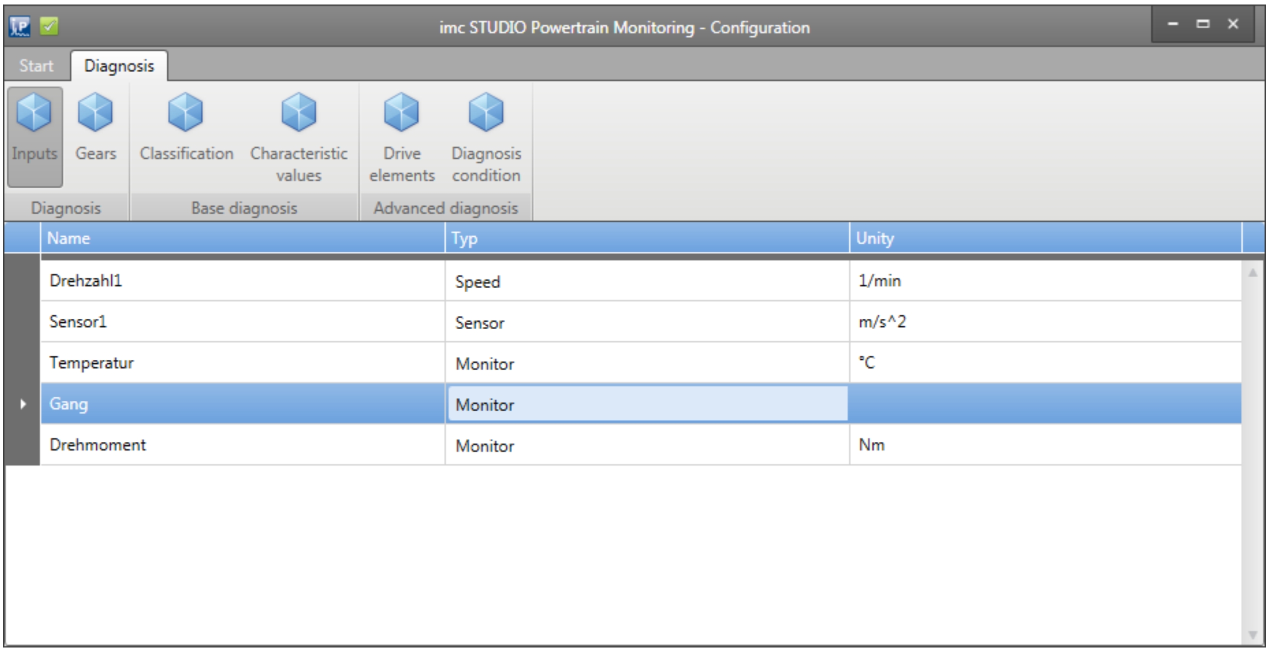


Picture 27: Manage Configurations

Via the menu point show configurations, all configurations that are saved in the active imc STUDIO project can be managed. That means creating new, open, copy, export, import and delete configurations.

One configuration can be applied to the active project by the menu point apply. **To have this persistent the imc STUDIO project have to be saved**.

15.6.1.2 Inputs



Picture 28: Assistant Inputs

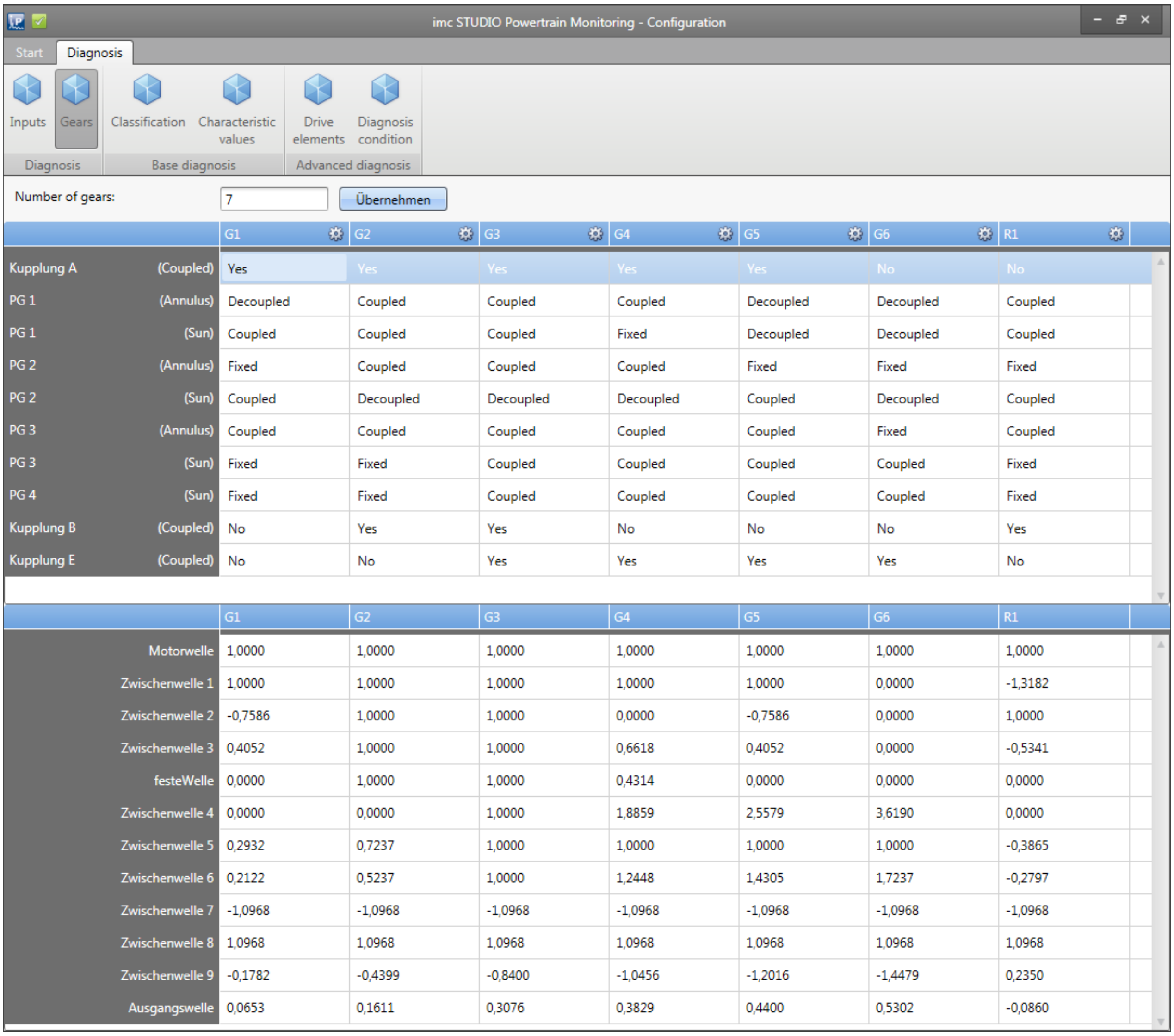
An essential part of both diagnosis procedures are the measurement of structure-borne sound of the test item via accelerometers. These will be added as sensors in the assistant.

Particularly for the advanced analysis the accurate measurement of the speed is required. This speed input will be assigned to sensors as reference speed.

Furthermore up to 12 process information can be measured with the Powertrain Monitoring. These serve for the classification of the operational state in the base diagnosis and thus a description of steady states of the system. In the advanced diagnosis the process information can be used to limit the analysis to certain operational states.

In the menu point inputs, the accelerometer, speed and process inputs can be configured. For a speed input the maximum occurring speed must be set in the properties. For a sensor the reference speed must be chosen from the already configured speed channels. For the advanced analysis 1698 the measurement time for this sensor must also be set.

15.6.1.3 Gears



	G1	G2	G3	G4	G5	G6	R1
Kupplung A (Coupled)	Yes	Yes	Yes	Yes	Yes	No	No
PG 1 (Annulus)	Decoupled	Coupled	Coupled	Coupled	Decoupled	Decoupled	Coupled
PG 1 (Sun)	Coupled	Coupled	Coupled	Fixed	Decoupled	Decoupled	Coupled
PG 2 (Annulus)	Fixed	Coupled	Coupled	Coupled	Fixed	Fixed	Fixed
PG 2 (Sun)	Coupled	Decoupled	Decoupled	Decoupled	Coupled	Decoupled	Coupled
PG 3 (Annulus)	Coupled	Coupled	Coupled	Coupled	Coupled	Fixed	Coupled
PG 3 (Sun)	Fixed	Fixed	Coupled	Coupled	Coupled	Coupled	Fixed
PG 4 (Sun)	Fixed	Fixed	Coupled	Coupled	Coupled	Coupled	Fixed
Kupplung B (Coupled)	No	Yes	Yes	No	No	No	Yes
Kupplung E (Coupled)	No	No	Yes	Yes	Yes	Yes	No

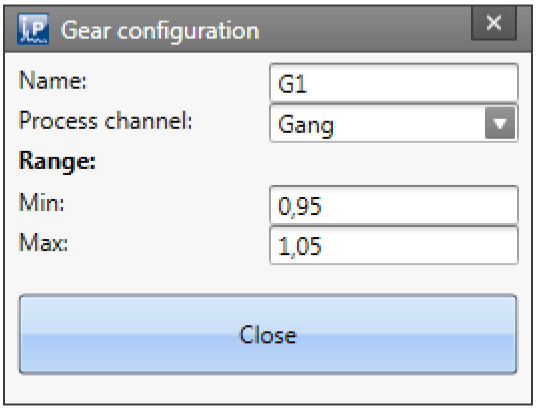
	G1	G2	G3	G4	G5	G6	R1
Motorwelle	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Zwischenwelle 1	1,0000	1,0000	1,0000	1,0000	1,0000	0,0000	-1,3182
Zwischenwelle 2	-0,7586	1,0000	1,0000	0,0000	-0,7586	0,0000	1,0000
Zwischenwelle 3	0,4052	1,0000	1,0000	0,6618	0,4052	0,0000	-0,5341
festeWelle	0,0000	1,0000	1,0000	0,4314	0,0000	0,0000	0,0000
Zwischenwelle 4	0,0000	0,0000	1,0000	1,8859	2,5579	3,6190	0,0000
Zwischenwelle 5	0,2932	0,7237	1,0000	1,0000	1,0000	1,0000	-0,3865
Zwischenwelle 6	0,2122	0,5237	1,0000	1,2448	1,4305	1,7237	-0,2797
Zwischenwelle 7	-1,0968	-1,0968	-1,0968	-1,0968	-1,0968	-1,0968	-1,0968
Zwischenwelle 8	1,0968	1,0968	1,0968	1,0968	1,0968	1,0968	1,0968
Zwischenwelle 9	-0,1782	-0,4399	-0,8400	-1,0456	-1,2016	-1,4479	0,2350
Ausgangswelle	0,0653	0,1611	0,3076	0,3829	0,4400	0,5302	-0,0860

Picture 29: Assistant Gears

A special process information, always required by Powertrain Monitoring, is the gear information. This process information is also used in the classification like all other process information. It also serves as output of status information for the base diagnosis. Thus a status information is written whether a certain characteristic value is exceeded in a certain gear. This allows to control the test procedure for example skipping a certain gear.

For the advanced analysis the gear information serves as information for calculating the transmission of the individual drive elements correctly and therefore allows a frequency selective search of kinematic patterns.

The gears can be configured in the menu point gears (see Picture 29).



Picture 30: Gear configuration

To identify the current gear in the analysis, a unique range of one process information must be defined. The same process input must be used for all gears. This can be configured by clicking the button besides the gear name (see Picture 30).

15.6.2 Editor

To apply the configuration built with the assistant to the current experiment, the Powertrain Monitoring Editor [1695] has to be used.

One of the configurations that are saved in the current project must be chosen in the **configuration selection box**. The executing function should be set depending on the chosen configuration to base or advanced diagnosis. Thus all sensor, speed and process inputs are read from the configuration and are provided as inputs. These must be assigned to measurement channels that are available in the current experiment.

The measurement channels must met the following requirements:

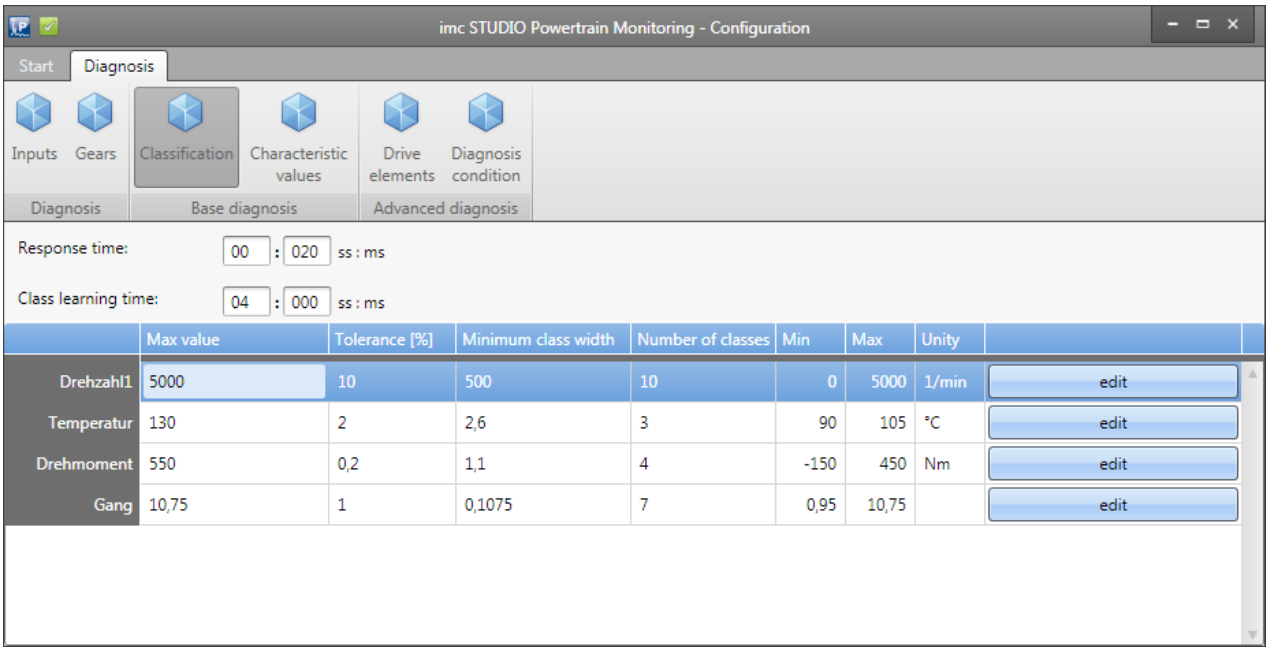
- Accelerometers and speed channels must be measured with 50 kHz.
- Sampling frequencies of process channels must be an integer divider of 50 kHz (e.g. 100 Hz, 1 kHz, ...)
- All channels must be set to undefined measurement time.

15.6.3 Base Diagnosis

The base diagnosis consists of a characteristic value calculation with self-learning thresholds. For the learning phase a classification is used where an individual warn- and alarm threshold is learned for each class. The classification [1692] can be configured with the Powertrain Monitoring Assistant.

15.6.3.1 Assistant

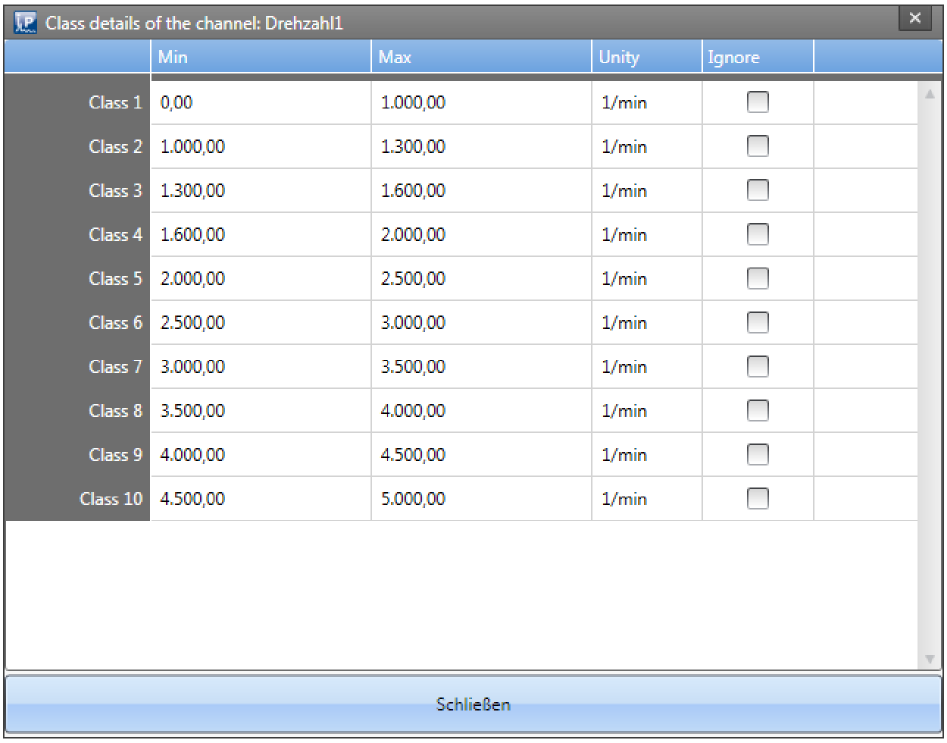
15.6.3.1.1 Classification



Picture 31: Assistant Classification

The following general settings must be configured in the menu point **Classification**:

Settings	Description
Reaction Time	If a certain class is active continuously over this time it counts as stable. The learning time for unlearned classes starts counting from this time point. For already learned classes, the learned warn- and alarm threshold will be used from this time point. The user defined threshold will be used between the actual class change and the reaching of the reaction time.
Class Learning Time	A class will be considered as learned if the system was in this state over the defined class learning time. The class learning time can also be reached by multiple time parts that sum up to the class learning time. During the learning phase the maximum occurred characteristic values will be saved. At the end of the learning phase warn- and alarm thresholds are calculated by multiplying the occurred maximum with a percent factor.

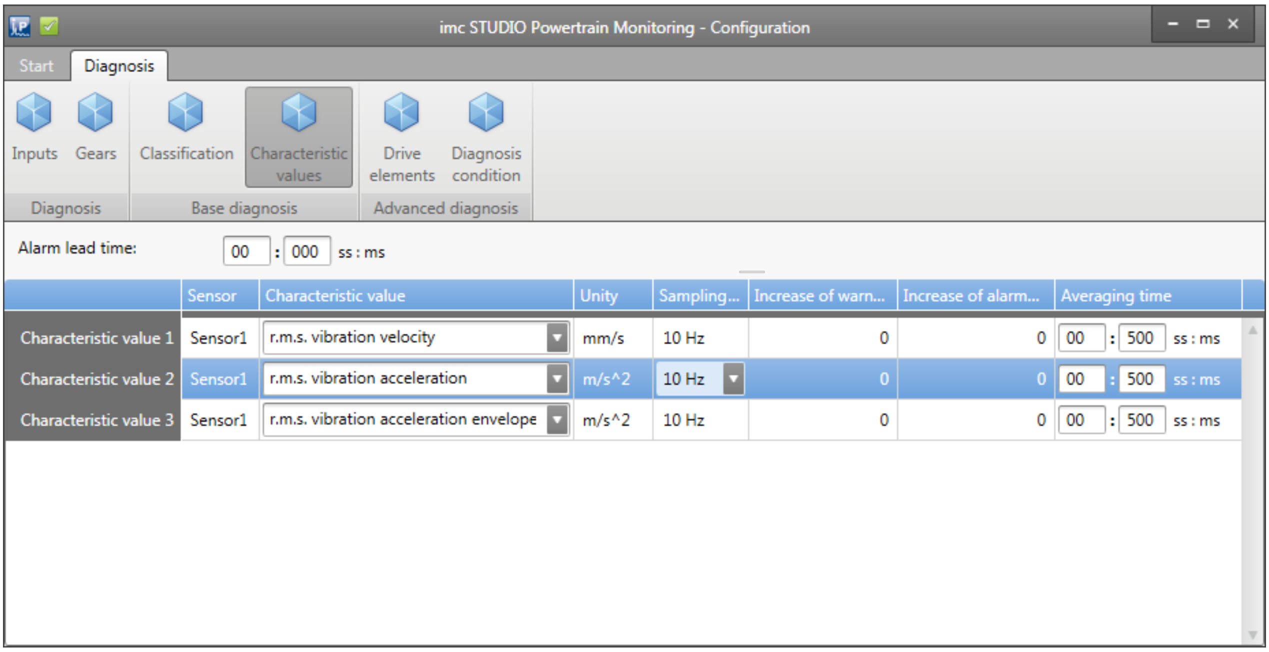


Picture 32: Assistant Classification Details

For the classification each process information is used that were defined (see chapter "*Configuration* 1688"). Each process information can be divided in up to 1000 classes. Thus the class borders can also be learned automatically by only configuring the class width of each process information. Furthermore the classes can be configured individually by clicking the Edit button (see Picture 32).

An exception is the **gear** information. This process information can be configured as described in chapter "*Gears* 1690" and is not modifiable in this section.

15.6.3.1.2 Characteristic Values



Picture 33: Assistant Characteristic Values

The characteristic values can be configured in the corresponding menu point (see Picture 33).

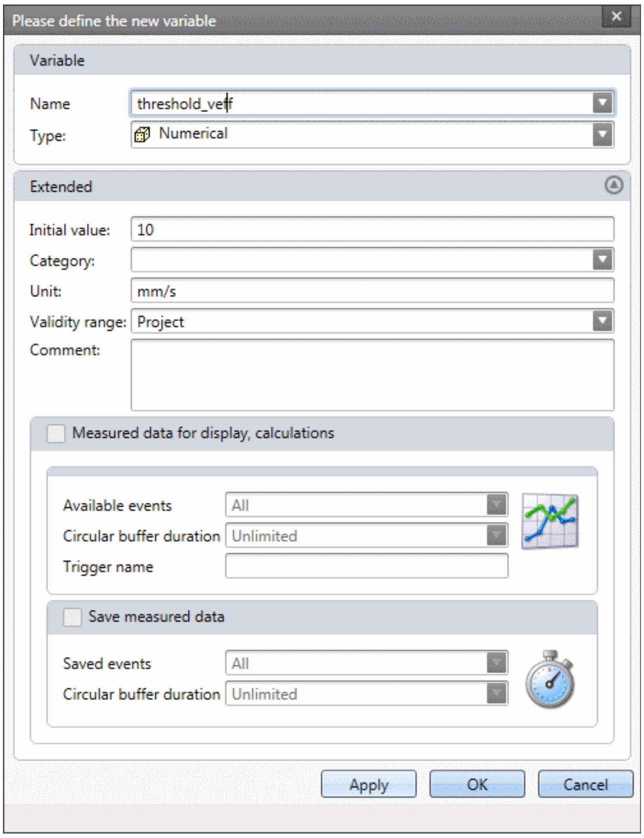
The following characteristic values are available for the base diagnosis for each configured accelerometer:

- R.M.S. of vibration velocity based on DIN-ISO 10816-3 in the frequency range 10 Hz - 1 kHz
- R.M.S. of vibration acceleration in the frequency range 0 Hz - 25 kHz
- R.M.S. of vibration acceleration of the envelope in the frequency range 0 Hz - 25 kHz

The characteristic value will be calculated from the measured signal of the accelerometer with the given average time. A prerequisite is a configured Anti-Aliasing filter for the sampling frequency of 50 kHz for the accelerometers in imc STUDIO.

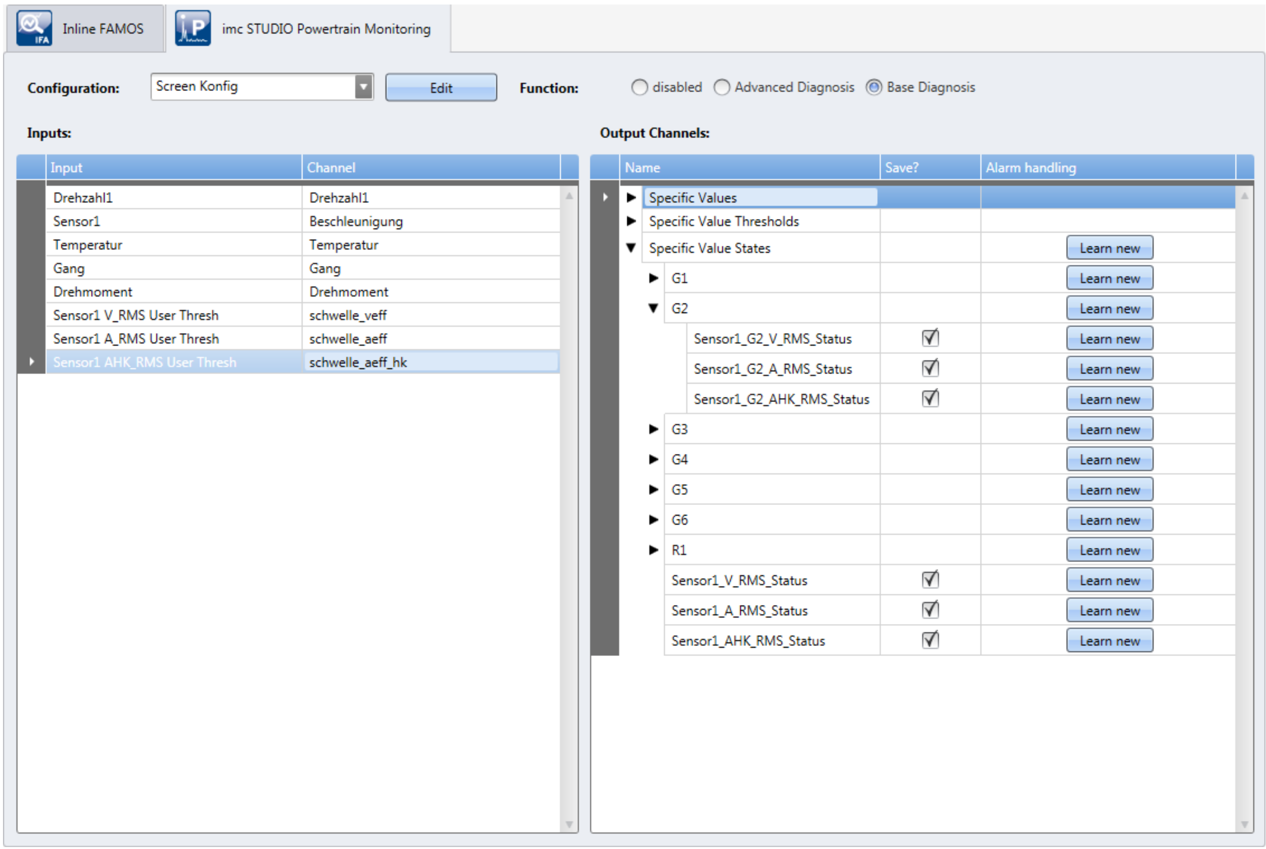
The configured percent increase of warn- and alarm thresholds are multiplied to the maximum characteristic value at the end of the learning phase of the class.

15.6.3.2 Editor



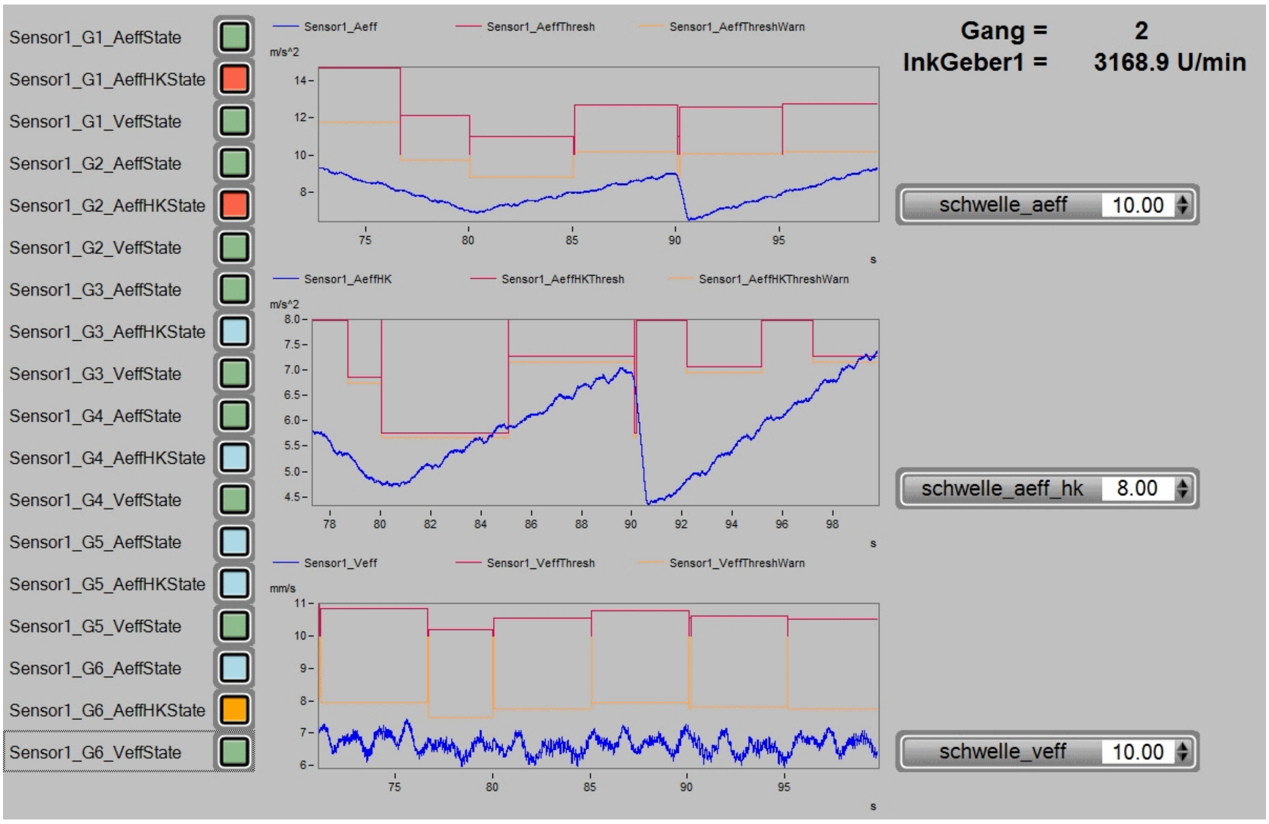
Picture 34: Create User defined variables

The inputs of the configuration must be assigned to the physical measurement channels for the base diagnosis (see also general description of the editor 1691). Furthermore each characteristic value has a user defined threshold that must be assigned. These are assigned to user defined variables that can be configured in the Data Browser by right clicking in the Data Browser (see Picture 34).



Picture 35: Base Diagnosis Editor

15.6.3.3 Measurement Data



Picture 36: Example: Base Diagnosis

For each configured characteristic value a warn- and alarm threshold channel is provided.

If a certain class is learned, the corresponding warn- and alarm threshold is put out to the channel. If the class is not yet learned or the reaction time is not yet elapsed, the user defined threshold will be put out.

Additionally to the characteristic value, warn threshold and alarm threshold, state information are provided. These signalize an exceedance of a threshold in the following manner:

- No Exceedance of any threshold = 0
- Exceedance of the user defined threshold = 1
- Exceedance of the warn threshold = 2
- Exceedance of the alarm threshold = 3

The state information are written for each characteristic value and for each individual gear.

By using existing visualization tools the state information can be visualized for example as traffic light.

If the user defined threshold is changed during the measurement, the user defined thresholds will be reevaluated and reset if the new threshold does not exceed the characteristic value. The warn- and alarm thresholds are based on learned classes and will not be reset due to a change of the user defined threshold. They must be reinitialized by resetting and relearning the classes. This can be achieved in the Powertrain Monitoring Editor 1695 on the right side at the various state channels.

Picture 36 shows a possible way of visualizing the data of the base diagnosis. On the left side the state information are shown for each characteristic value and each gear. The curve windows contain the characteristic values and corresponding warn- and alarm thresholds. The user defined thresholds are placed on the right side.

15.6.3.4 Summary of Function

- Calculating the characteristic value of one accelerometer with the configured average time and bandwidth.
- Determining the current class
  - A class counts as stable if it is active the whole reaction time.
  - A class is learned if the learning time is reached. This can also be reached in multiple time parts.
  - At the end of the learning phase the maximum characteristic value during the learning phase is used to calculate the warn- and alarm thresholds.
- If the class is not yet learned or not stable the user defined threshold will be written to the threshold channels.
- If the class is learned and stable the learned warn- and alarm threshold will be written to the corresponding threshold channels.
- Depending on the exceedance of a threshold the state is written to the state channels for the characteristic value.

15.6.4 Advanced Diagnosis

The advanced diagnosis of machine monitoring evaluates abnormal states in spectra and envelope spectra. It provides early evidence of evolving damages. The methods are well known and accepted. They are partly described in the VDI 3832. If an abnormal state of a drive element is recognized it is possible to view the damage evolution long before an actual failure. So it is possible to evolve knowledge about approaches of improvement.

Basis for the advanced diagnosis are the order and envelope order spectra. These spectra are calculated from the vibration signal and the speed signal if defined conditions are fulfilled for a certain measurement time. Possible conditions are speed or process ranges to allow an analysis in well-defined states.

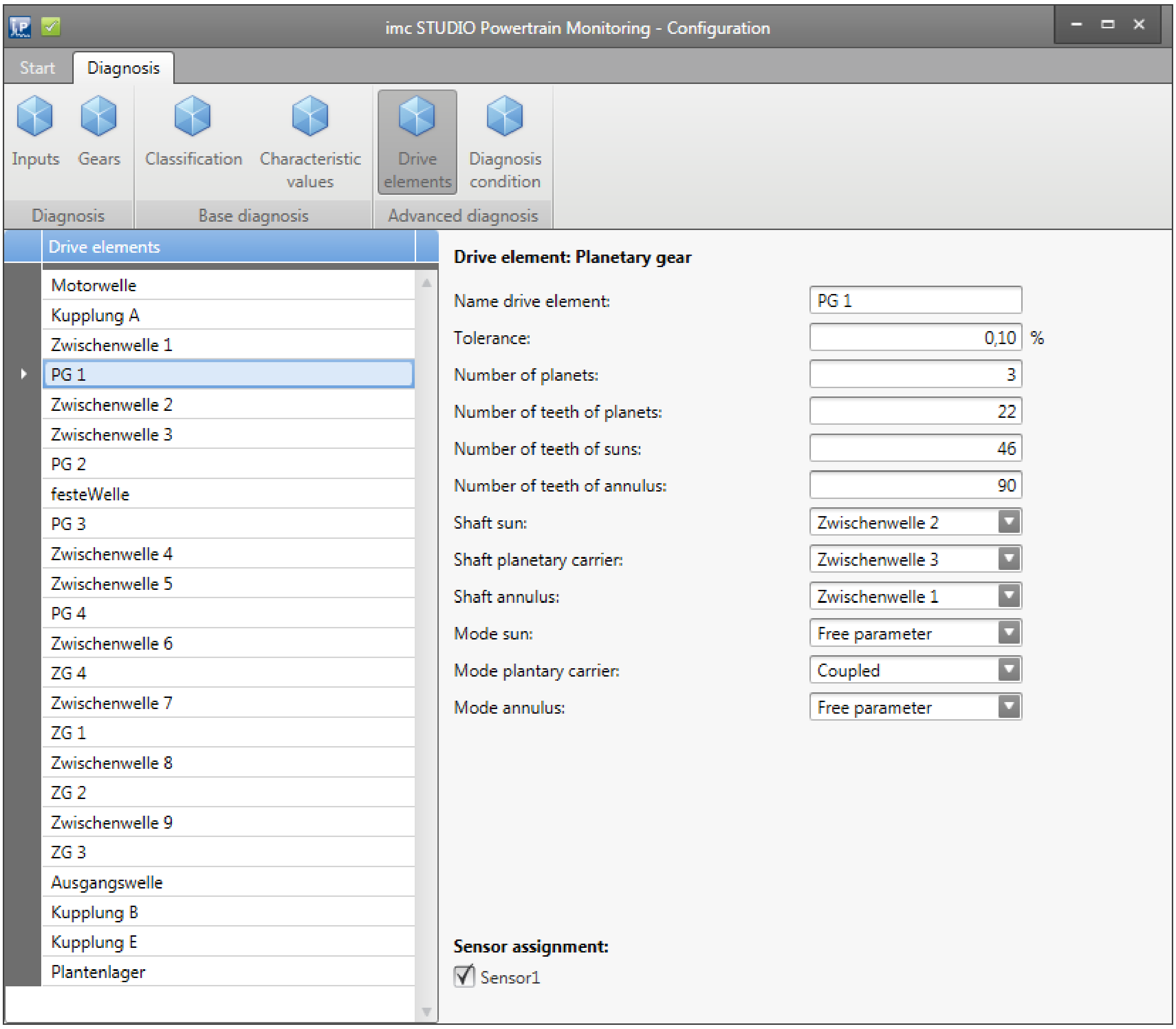
The calculated spectra are then analyzed according to a significance analysis. This is done by first calculating a moving significance threshold that represents the average amplitude over the abscissa. The spectrum is then divided by this threshold and all values below one are set to zero. The remaining peaks are significant and thus with high possibility a consequence of a deterministic mechanic cause, in contrast to random excitations. If this significant spectral components fit to kinematic pattern of a drive element, they are called diagnostic attributes below.

For further diagnosis the spectra can be visualized as single spectrum, color map or waterfall diagram.

15.6.4.1 Assistant

The advanced diagnosis is based on a cyclic evaluation of the measured vibration signal. In order that an analysis can take place, the predefined diagnosis conditions 1703 must be fulfilled over a configured measurement time. The measurement time is configured in the menu point **inputs**, as described in chapter "*Configuration* 1688". The longer the measurement time the better the resolution of the calculated spectra. This increases the diagnosis quality. However the maximum order or frequency is lower. This can possibly lead to not examining all kinematic patterns.

15.6.4.1.1 Drive Elements



Picture 37: Assistant Drive Elements

The monitoring gear has to be configured in the Powertrain Monitoring Assistant. Thus the complete power train must be represented under the menu point Drive Elements (see Picture 37). Thereby at some drive elements free parameter can be chosen. These free parameters must then be set in the menu point Gears. This allows an individual configuration for each gear. For example a clutch can coupled in one gear and decoupled in another and thus influencing the transmission of the shafts. That a certain drive element can be monitored by the advanced diagnosis, it has to be assigned to one ore more sensors.

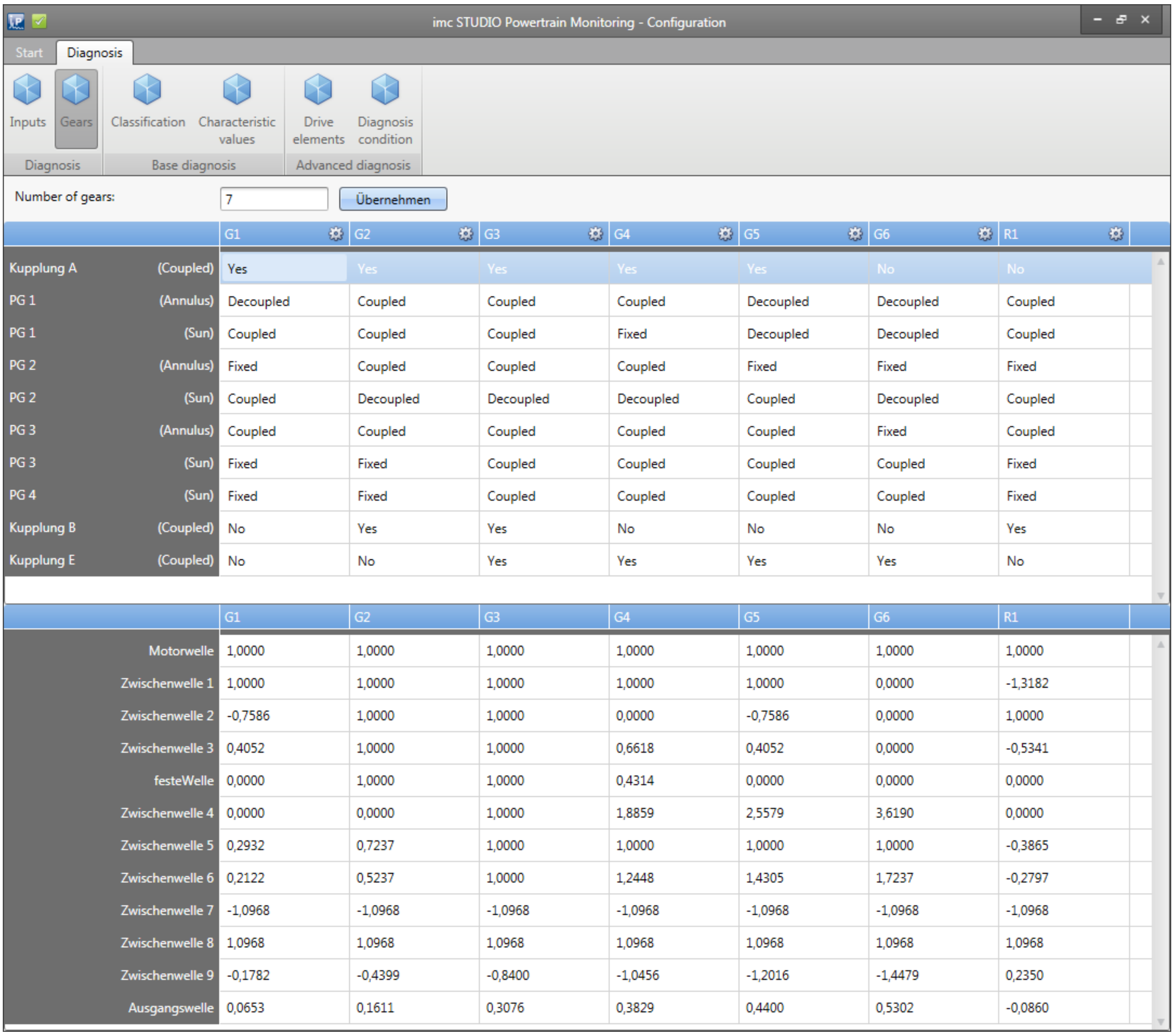
The following drive elements can be configured:

Drive elements	Description
Shaft	Exactly one shaft in the system must be configured as reference shaft. This is also the shaft where the speed is measured. It has always the transmission of 1. The transmission of all other shafts in the machine are in relation to this reference shaft. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for loose particles and unbalance on the configured shafts.

Drive elements	Description
Drive Shaft	The drive shaft can be used as in the configuration like a normal shaft. This can also be used as reference shaft for speed measurement. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for loose particles, unbalance and link damage or misalignment on the configured drive shafts.
Clutch	A clutch can be configured as fixed connection or as shifting clutch between two shafts. Therefore the input and output shaft must be set to one shaft of the already configured shafts. If this clutch is fixed the option coupled has to be set to yes. If the clutch is decoupled due to gear switching the option must be set as free parameter. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for misalignment on the configured clutches.
Gear Drive	The gear drive describes a spur gear and bevel gear. It must be chosen a shaft for the pinion and wheel respectively. It has to be set whether the pinion and wheel are coupled with the shaft or whether the coupling between pinion and shaft or wheel and shaft is decoupled due to gear switching. Furthermore the number of tooth for the pinion and wheel has to be entered. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for revolving deviation of flank shapes and local deviation of flank shapes at the pinion and wheel on the configured gear drives.
Belt Gearing	For the belt gearing the shaft of the driven and driving wheel. It has to be configured whether the driven and driving wheel is fixed coupled with the shaft or whether the connection is modified due to gear switching. Furthermore the diameter of the driven and driving wheel as well as the length of the belt must be defined. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for local irregularities of the belt on the configured belt gearings.
Planetary Gear	The planetary gear covers planetary gears with single planets (in contrast to stage planets). The number of planets, number of tooth of the planets, sun and annulus must be configured. Furthermore the shafts must be selected for the annulus, sun and planetary carrier. The mode of the planetary gear must be configured. One of the following combinations can be used: • sun and planetary carrier rotate and annulus is fixed • sun and annulus rotate and planetary carrier is fixed • planetary carrier and annulus rotate and sun is fixed • all shafts rotate The modes can also be set as free parameter if the state changes due to gear shifting. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for local irregularities of the sun, annulus and planets as well as for revolving deviation of flank shapes on the configured planetary gears.

Drive elements	Description
Rolling Bearing	For the rolling bearing the kinematic parameters must be configured. These are the rotational cage order, the ball spin order, the double ball spin order and the ball pass order of the outer and inner ring. These data can be obtained from the manufacturer of the rolling bearing. The input of the rotational orders can be done with respect to order 1 or with respect to the relative speed of the rolling bearing. Furthermore the shafts for the outer and inner ring must be chosen. If one of these is fixed the shaft can be left empty. If the rolling bearing is configured as planetary rolling bearing no shafts must be set. Normally a tolerance of 1 % is suitable to compensate slippage of the rolling bearing. In the analysis it is searched for outer and inner ring damage, cage damage and rolling element damage on the configured rolling bearings.
Three-Phase Motor	For the three-phase motor the net frequency must be configured. Normally a tolerance of 0.1 % is suitable. In the analysis it is searched for magnetic imbalance on the configured three-phase motors.
Steady Frequency	The elements steady frequency and steady frequency envelope can be used to monitor individual frequencies in the frequency spectrum and envelope frequency spectrum respectively. The frequency must be configured.
Steady Order	The elements steady order and steady order envelope can be used to monitor individual orders in the order spectrum and envelope order spectrum respectively. The order must be configured.

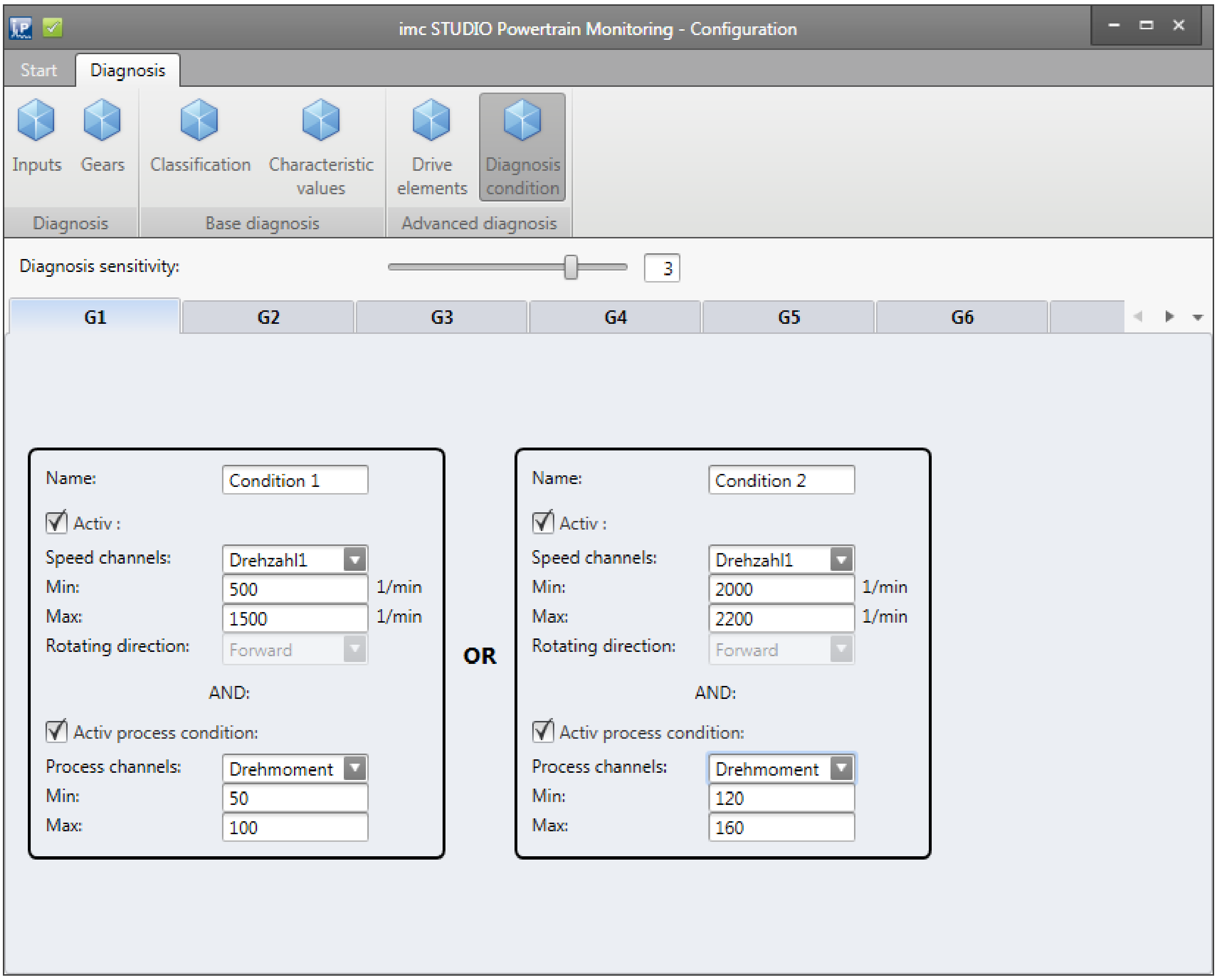
15.6.4.1.2 Gears



Picture 38: Assistant Gear configuration

In the menu point Gears the free parameter can be set for each configured gear as described in chapter "Gears 1690". The resulting transmission of each shaft is shown in the table below as an overview. Thus it can be traced whether the complete power train was entered correctly. Picture 38 shows an example configuration of a power train with 10 gears.

15.6.4.1.3 Diagnosis Conditions

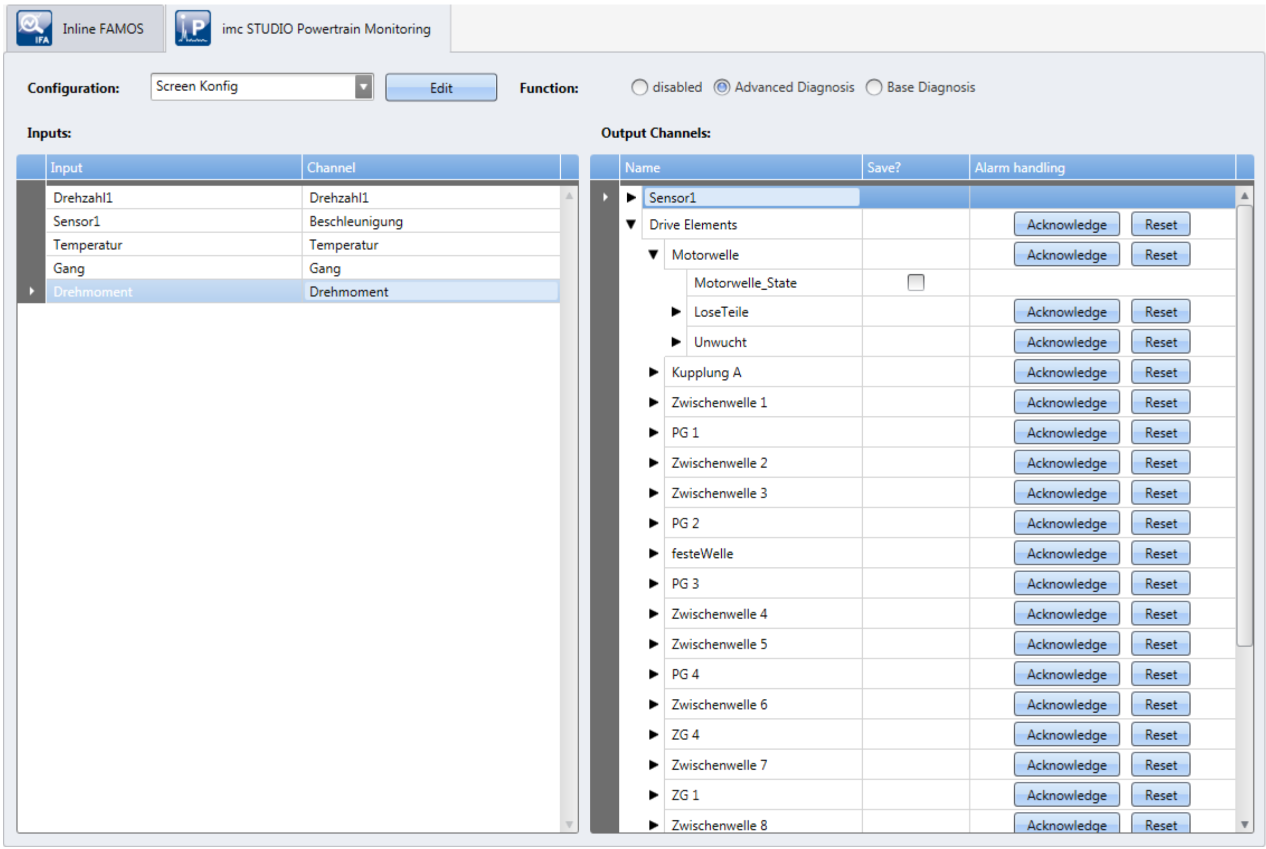


Picture 39: Assistant Diagnosis Conditions

In the menu point diagnosis condition the sensitivity of the advanced analysis must be set. This parameter corresponds to the number of detections before an irregularity is signalized.

Furthermore 5 different diagnosis conditions can be set for each gear individually. One diagnosis condition can consist of a speed range and one process range (see Picture 39). If one of the conditions are fulfilled over the complete measurement time, the analysis of kinematic patterns will be started.

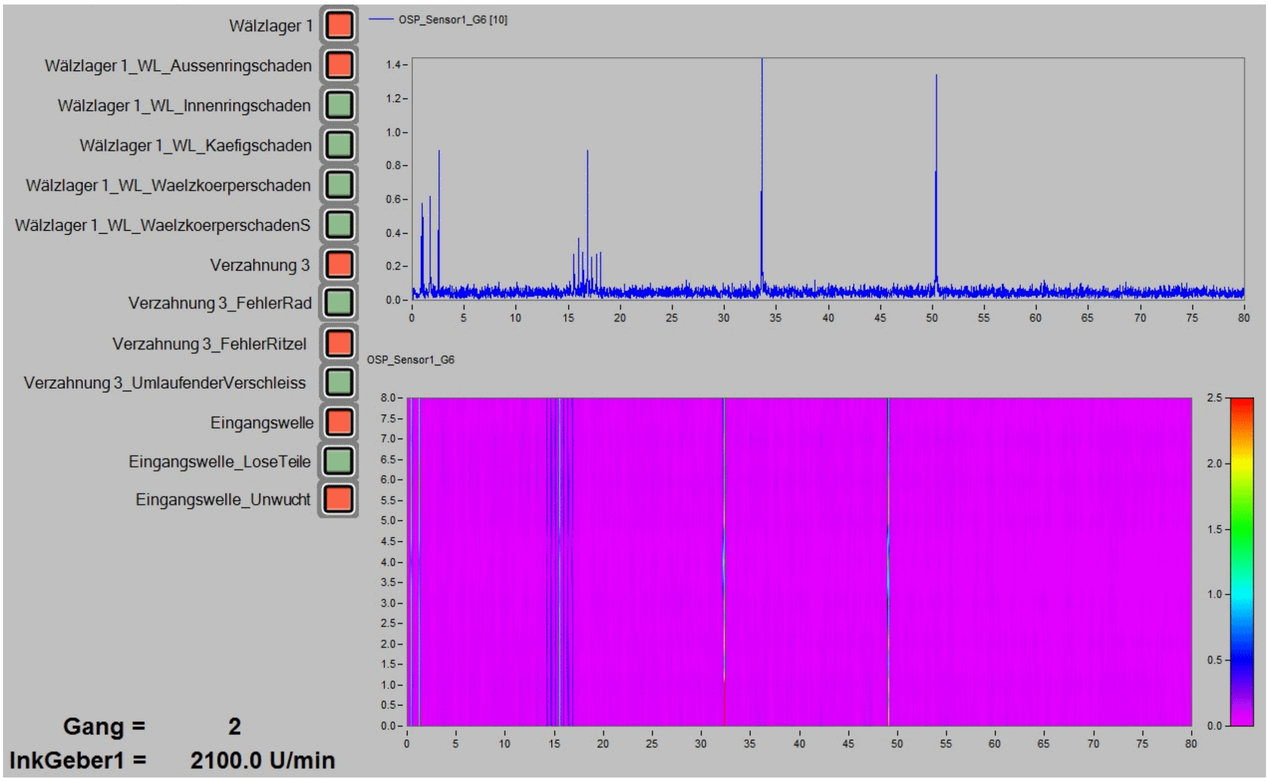
15.6.4.2 Editor



Picture 40: Editor Advanced Diagnosis

For the configuration of the advanced analysis the inputs of the configuration must be assigned to the physical measurement channels (see also general description of the editor 1691).

15.6.4.3 Measurement Data



Picture 41: Example: Advanced Diagnosis

The following output channels are provided for each configured sensor in the advanced analysis:

- Order spectra for each configured gear
- Envelope order spectra for each configured gear
- Frequency spectra for each configured gear
- Envelope frequency spectra for each configured gear

Furthermore the following output channels are provided for each configured drive element:

- For each possible irregularity of one drive element 1699 **a state channel** whether this irregularity is detected (0 or 1)
- **One state channel** for each drive element whether one or multiple irregularities are detected (0 or 1)
- For each diagnostic attribute **three channels** with the **order**, **amplitude** and **significance** of the kinematic pattern

All these channels are triggered channels. Thus the time point of the measurement is saved in the channel.

The signalized irregularities can be acknowledged or reset in the Powertrain Monitoring Editor (see picture Editor 1704). An Acknowledgement increases the significance threshold for the searched orders by the given percent value and resets the alarm state. Thus in the following analysis this irregularity is signalized only if the new threshold is exceeded. A reset of an alarm resets the significance threshold to its origin value.

Panel pages offer various possibilities to visualize the input and processed data. Picture 41 shows one Panel page exemplary. The last calculated order spectrum of Sensor1 in the 6th gear is visualized. Furthermore all events of the same order spectrum are visualized in a color map. Irregularities of the drive elements are visualized on the left part of the Panel page with Widgets. On the left bottom corner the current gear and the current speed is shown.

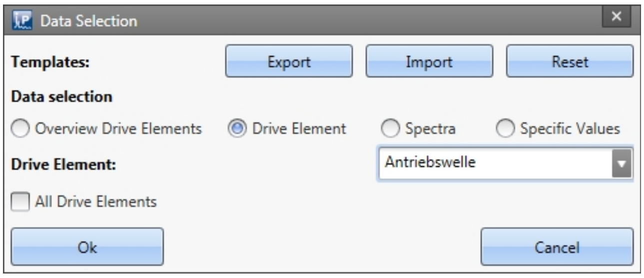
15.6.4.4 Summary of Function

- Evaluating whether one of the diagnosis condition is fulfilled over the configured measurement time.
- If one diagnosis condition is fulfilled an evaluation of the vibration signal is done.
  - Calculation of all frequency, envelope frequency, order and envelope order spectra of all vibration signals.
  - Calculation of diagnostic attributes of all kinematic frequencies or orders.
  - Determining whether an irregularity is detected with respect to the preceding analysis.
- Output of the spectra, diagnostic attributes and alarm states in the corresponding channels.

15.6.5 Visualization

15.6.5.1 Create Panel Pages via Menu Action

In imc STUDIO an additional action "Powertrain Monitoring Panel" can be added to a Ribbon via the function "Customize". If this new action is executed, Panel pages with selected data from the Powertrain Monitoring can be generated automatically (Picture 42).



Picture 42: Powertrain Monitoring Panel

The dialogue directly accesses the tasks of the Powertrain Monitoring of the current experiment. Thus all data of the configured tasks are available in the selected category. It can be chosen between the following categories:

- **Overview Drive Elements:** Generates an overview page with the alarm state of all configured drive elements.
- **Drive Element:** A Panel page fort he selected drive element is generated with state information for each damage pattern.
  - If the option "All Drive Elements" is chosen, this Panel page is created for each drive element in the list. This can lead to lot of Panel pages, depending on the configuration.
- **Spectra:** For the selected sensor and gear one Panel page with order spectrum, envelope order spectrum, frequency spectrum and envelope frequency spectrum is generated. These are visualized as color map.
- **Specific Values:** A Panel page with all configured specific values at the chosen sensor is created. For each specific value the alarm state for each gear, an aggregated alarm state as well as a curve window with the specific value and the corresponding warn and alarm thresholds are visualized.

In order that the channel assignment is working properly, the default channel names in the Powertrain Monitoring Tasks must be used. These are automatically generated when a task is applied. Additionally the used Panel pages can be exported, imported and reset via the "Powertrain Monitoring Panel". Further information can be found in chapter Manage Panel Templates 1707.

15.6.5.2 Create Panel Pages via Scripting

The described functionality in "Create Panel Pages via Menu Action 1706" is also accessible via the imc STUDIO Scripting Editor. Thus the generated Panel pages can be individualist e.g. by adding further channels that do not come from the Powertrain Monitoring tasks.

To have the Powertrain Monitoring accessible from one Script, a reference to the .NET Assembly imc.Studio.PlugIns.GfM.PowertrainMonitoring.Scripting.dll must be added to the project. This can be done via the menu Project > AddReference > GAC.

A short example for creating a Panel page for the first drive element that can be found in the Powertrain Monitoring configuration follows.

```
using System.Linq;
using System.Collections.Generic;
using imc.Studio.Interfaces.V2.Core;
using imc.Studio.PlugIns.GfM.PowertrainMonitoring.Scripting;
```

```
// get reference to PowertrainMonitoring component
ISharedComponentBase shared_comp;
SharedComponents.TryGetValue("PowertrainMonitoring", out shared_comp);
var pm_ref = shared_comp as IPowertrainMonitoringBase;

if (pm_ref == null)
{
    //no reference to Powertrain Monitoring found
    return;
}

//use template directory of current project
string template_dir = pm_ref.GetTemplateDir();
//get first element of DriveElement List
var element = pm_ref.GetDriveElementList().FirstOrDefault();

if (element != null)
{
    //get Panel template file and insert Panel
    string panel_file = template_dir + pm_ref.GetDriveElementType(element) + ".dbv";
    string page_name = Panel.InsertPageBefore(0, panel_file, "", element);

    //get reference to Panel and apply Powertrain Monitoring variables
    PanelPage pp = Panel.Pages.FirstOrDefault(p=>p.Name == page_name);
    pm_ref.ApplyVariablesDriveElement(pp.Base, element);

    //e.g. add additional channels to Panel page
}
```

15.6.5.3 Manage Panel Templates

With the installation of the Powertrain Monitoring there are also Panel templates for the different data types and their visualization installed. These can be redesigned as needed. In the menu action "Powertrain Monitoring Panel" there is a function available to export all templates to a directory. The exported Panel pages can be loaded in imc STUDIO like normal Panel pages. After redesigning the pages the new Panel pages can be activated via the import function of the menu action.

These are then saved with the current project. Thus they are also exported if the imc STUDIO project is exported. If the project is changed the templates may be imported again by the user. Via the function reset the user designed templates are overwritten with the default ones.

When designing the Panel templates it is crucial to maintain the exact file names.

Table 1: Panel templates

Template File	Description
AntriebOverview.dbv	Overview Drive Elements
Welle.dbv	Diagnosis Data Shaft
KardanWelle.dbv	Diagnosis Data Drive Shaft
Kupplung.dbv	Diagnosis Data Clutch
Waelzlager.dbv	Diagnosis Data Rolling Bearing
Zahnradgetriebe.dbv	Diagnosis Data Gear drive
Planetengetriebe.dbv	Diagnosis Data Planetary gearing
Riemengetriebe.dbv	Diagnosis Data Belt gearing
Drehstrommotor.dbv	Diagnosis Data Three-phase motor
FesteFrequenz.dbv	Diagnosis Data Steady Frequency
FesteFrequenzHK.dbv	Diagnosis Data Steady Frequency Envelope
FesteOrdnung.dbv	Diagnosis Data Steady Order
FesteOrdnungHK.dbv	Diagnosis Data Steady Order Envelope
Spektren.dbv	Frequency und order spectra of one sensor in one gear
Grunddiagnose.dbv	R.M.S. of Base diagnosis of one sensor

The Panel templates contain Widgets with specific names. On the basis of these names it will be determined which channels are assigned to the Widgets. Furthermore there are placeholder that are replaced with the instantiated data types. Generally it is crucial to take care of the exact spelling of the placeholders and Widget names. Otherwise a correct assignment of the channels to the Widgets is not possible.

In the following tables an overview of all names and their channel assignment is shown.

Table 2: Used placeholders

Placeholder	Description	Usage
{Sensor}	Name of the sensor in the configuration	Specific values
{Antrieb}	Name of the drive element in the configuration	Diagnosis data of one drive element
{Antrieb1} .. {Antrieb30}	Name of the chosen drive element	Overview of drive elements

Table 3: Widget names for spectra

Widget name	Channel assignment	Example Channel name
Signal_OSP	Order spectrum of one sensor in one gear	OSP#Sensor1#G1
Signal_HKOSP	Envelope order spectrum of one sensor in one gear	HKOSP#Sensor1#G2
Signal_FSP	Frequency spectrum of one sensor in one gear	FSP#Sensor1#G3
Signal_HKFSP	Envelope frequency spectrum of one sensor in one gear	HKFSP#Sensor1#G4

Table 4: Widget names for Base Diagnosis

Widget name	Channel assignment	Example Channel name
Status_VEff	Gear dependent status channel of r.m.s. of vibration velocity	Sensor1#G1#VEff#Status
Signal_VEff	r.m.s. of vibration velocity and corresponding warn and alarm thresholds	Sensor1#VEff#Alarmschwelle
Status_AEff	Gear dependent status channel of r.m.s. of vibration acceleration	Sensor1#G2#AEff#Status
Signal_AEff	r.m.s. of vibration acceleration and corresponding warn and alarm thresholds	Sensor1#AEff#Warnschwelle
Status_AEffHK	Gear dependent status channel of r.m.s. of vibration acceleration envelope	Sensor1#G3#AEffHK#Status
Signal_AEffHK	r.m.s. of vibration acceleration envelope and corresponding warn and alarm thresholds	Sensor1#AEffHK

Table 5: Widget names for Diagnosis data

Widget name	Channel assignment	Example Channel name
Signifikanz_{Damage}	All significance values of the chosen drive element at the current damage pattern	Antriebswelle#LoseTeile#S2#Grundordnung_OSP#Signifikanz
Amplitude_{Damage}	All amplitude values of the chosen drive element at the current damage pattern	Antriebswelle#LoseTeile#S2#Grundordnung_OSP#Amplitude
Ordnung_{Damage}	All order values of the chosen drive element at the current damage pattern	Antriebswelle#LoseTeile#S2#Grundordnung_OSP#Ordnung

The following listing shows all drive elements and their available damage pattern that are used in the diagnosis data. It must be used the exact given spelling of the name for these damage pattern.

Table 6: Names for damage pattern

Drive Element	Damage Pattern	Name
Shaft	Imbalance	Unwucht
	Loose particles	LoseTeile
Drive shaft	Imbalance	Unwucht
	Loose particles	LoseTeile
	Link damage or misalignment	Gelenkfehler
Clutch	Misalignment	Ausrichtfehler
Rolling Bearing	Cage damage	WL_Kaefigschaden
	Rolling element damage	WL_Waelzkoerperschaden
	Rolling element damage spin	WL_WaelzkoerperschadenS
	Outer ring damage	WL_Aussenringschaden
	Inner ring damage	WL_Innenringschaden
Gear Drive	Revolving tooth damage	UmlaufenderVerschleiss
	Local irregularity wheel	FehlerRad
	Local irregularity pinion	FehlerRitzel
Planteray Gear	Revolving tooth damage	UmlaufenderSchaden
	Local irregularity planet	FehlerPlanet
	Local irregularity sun	FehlerSonne
	Local irregularity annulus	FehlerHohlrad
Belt Gear	Local irregularity belt	FehlerRiemen
Three-Phase Motor	Magnetical imbalance	MagnetischeUnwucht
Steady Frequency	Steady frequency	FesteFrequenzSchaden
Steady Frequency Envelope	Steady frequency envelope	FesteFrequenzHKSchaden
Steady Order	Steady order	FesteOrdnungSchaden
Steady Order Envelope	Steady order envelope	FesteOrdnungHKSchaden

16 Video

imc STUDIO Video enables the acquisition of video data.

The cameras must be connected to the operating PC on which imc STUDIO is running.You can record and save data from imc measurement devices and Video-data simultaneously.

Note — Notes on the camera drivers

- The configuration possibilities regarding camera settings depend on the driver and the camera. For this reason, there may be a variety of available options in imc STUDIO.
- imc STUDIO has no influence on the effects of camera settings. For example, positive values for the brightness control may make the picture either brighter or darker, depending (on the driver, camera...).
  To allow you to adjust the settings as desired, a picture preview appears next to the options.
- Please ensure that the most up-to-date driver for the camera used is installed.

Warning — Warning about changing the driver

- Remove the camera from the imc STUDIO configuration, if you make a change of the driver manufacturer.
- All experiments with the old camera settings become inoperative.
- This note is also valid for the frame grabber and the compression.

Note — Note on the PC performance

The achievable data rate of image data from the camera depends on multiple factors, including the computation power of the PC used, the hard drive's writing speed, the data throughput of the camera interface, as well as the camera's frame rate. Only the use of high-performance components can ensure a high data rate of image data.

imc STUDIO Product Configuration 29

In order to use cameras, activate the option **imc STUDIO Video Adapter** in the product configuration.

Note — Recommended: Use of the codec "LAV Filters"

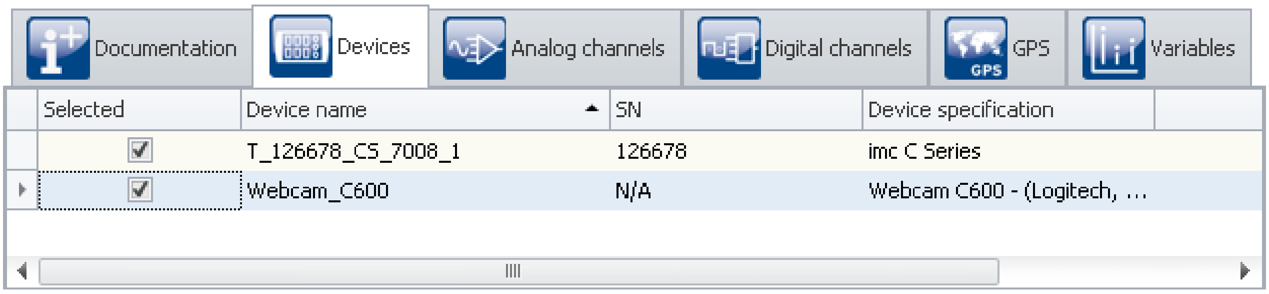
For the playback of MPEG 4 video formats, the use of "LAV-Filters" is recommended. This package includes all necessary codecs.

You can obtain the software from the Internet or from our Hotline 10.

16.1 Setup Configuration

You can configure and manage cameras in the same way as imc measurement devices. In order to use connected cameras, start a **Search for Devices**.

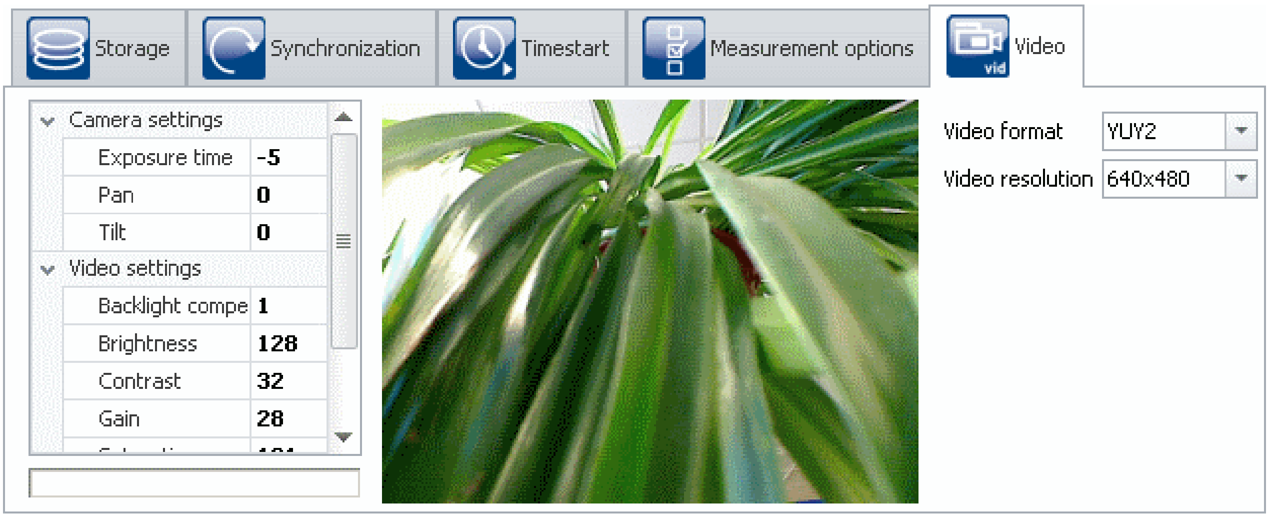
Following a device search, the cameras located are displayed in the Devices list.



Device list with a camera selected and a device selected

Setup: Devices - Settings and Video Preview

Once you have selected the camera from the Devices list, a new dialog appears: **Video**. Here you can change all settings.



Dialog: "Video"
On the Setup page: "Devices"

The video properties' values can be adjusted using a slider control, or by entering the desired value in the input box. By means of the Video Preview, you can test and correct the image reproduction. You can adjust the video format and the desired resolution. These settings determine the quality and volume of the video data saved.

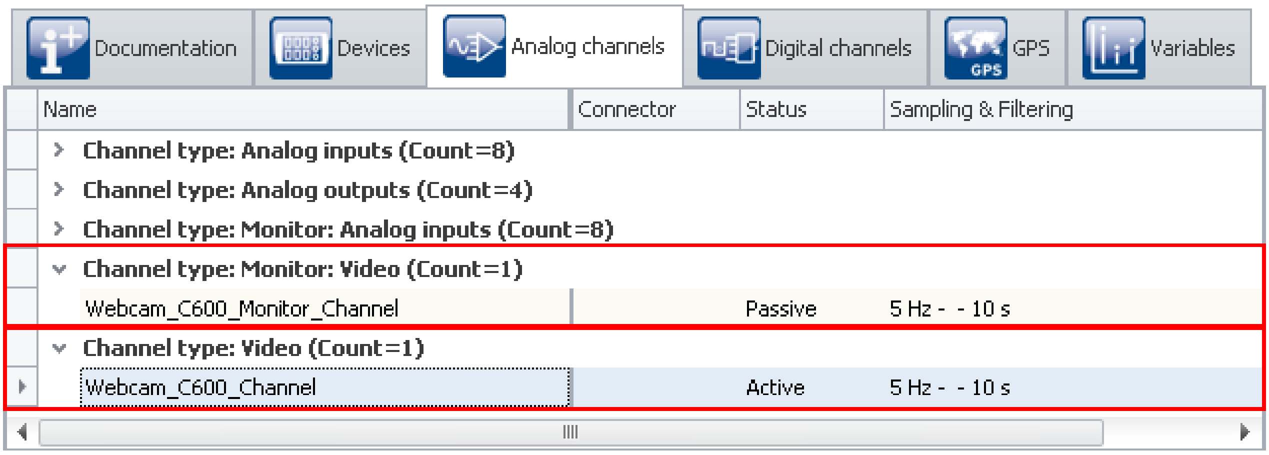
Warning — Warning about the use of high resolution and a high sampling rate

When the video resolution is high, you should avoid a high setting for the sampling rate. Otherwise, you may experience problems with the system's capacities. Some camera-types no longer receive commands from the PC when the demands on the PC resources becomes very high. In consequence, it may be possible in some cases to stop the video-recording, for example.

Setup: Channels - Configuring "Video Channel"

The video channels are configured in the same way as the device channels. To do this, open the Setup page: **Analog channels**.

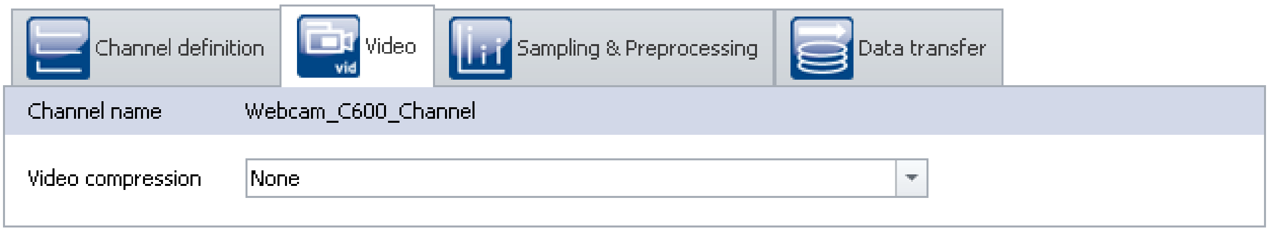
Each camera has a Video- and a Monitor-channel.



Channel list with a camera's two video channels

The main channel serves the purposes of high-speed data capture and storage, e.g. for Snapshots. The monitor channel, having slower sampling rates, serves other purposes such as long-term measurements or observation, without recording the video data.

A new dialog: **Video** is displayed if you select a video channel. Here, you can set the data compression.



Dialog: "Video"
On the Setup page: "Analog channels"

16.1.1 Saving

Warning Video files are not save automatically!

- Activate data storage for the respective video channel, if you wish to save the video data associated with the measurement.
- Otherwise, the video data are only present until you re-start the measurement or close imc STUDIO, or load a different experiment.

Video channels can be configured just like the measurement channels belonging to imc measurement devices.

In order to activate data storage, put a check in the box at: **Save (PC)**

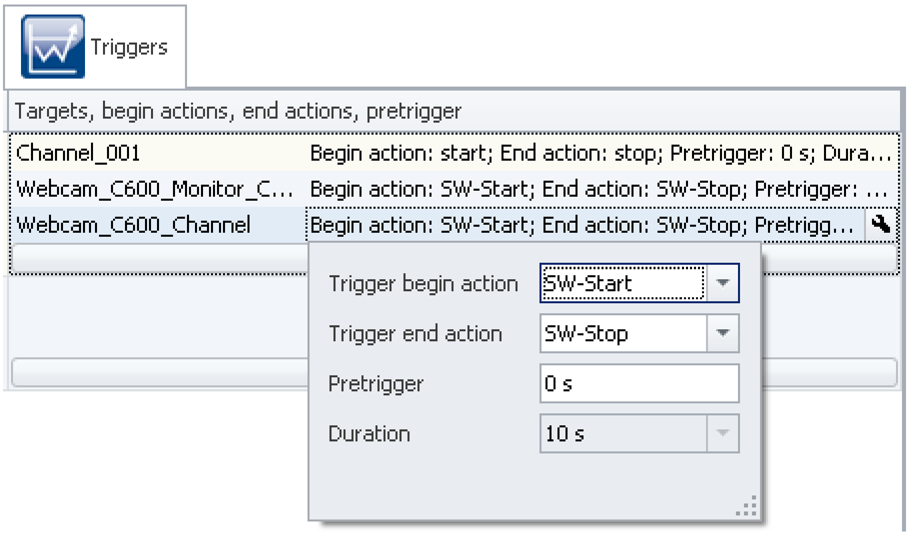
- The video files are saved on the PC’s hard drive in the same folder as the stored data for the measurement.
- The size of the video files is limited by the hard drive.

Reference Introduction to data storage

You can find an introduction to data storage in the manual:
Setup - Device (general) - Dialog: Data transfer 381.

16.1.2 Video measurement with triggering

The video channel can be triggered like measurement channels. To do this, open the Setup page: **Triggers**. Here, you can set the triggers for the video channels.



Note

Triggering

- Please be aware that you can only use a video channel as the trigger target in conjunction with active measurement channels.
- The main channel and the monitor channel can each be assigned to different triggers belonging to the imc measurement device.

The achievable frame rate decreases in consequence of video-triggering

With triggered data capture, the frame rate achievable decreases by half, since the circular buffer memory used makes greater demands on the system.

- This applies to all video channels which are not assigned to a 1-Trigger.

Save trigger events in individual files

The video channel's trigger events can also be saved in individual files (Setup page: *Devices > Storage > Save trigger events in individual files (PC)*).

Pretrigger

- With video channels, you can configure a pretrigger just like for channels belonging to a imc measurement device. This means that the pictures preceding the trigger event are recorded along with the data subsequent to the trigger event.
- The pretrigger duration can be set to values from **0 seconds to 10 minutes**.

16.1.3 Synchronicity

For the time stamp, Video devices use the "Virtual clock" (VRTC).

Reference	VRTC - Virtual clock

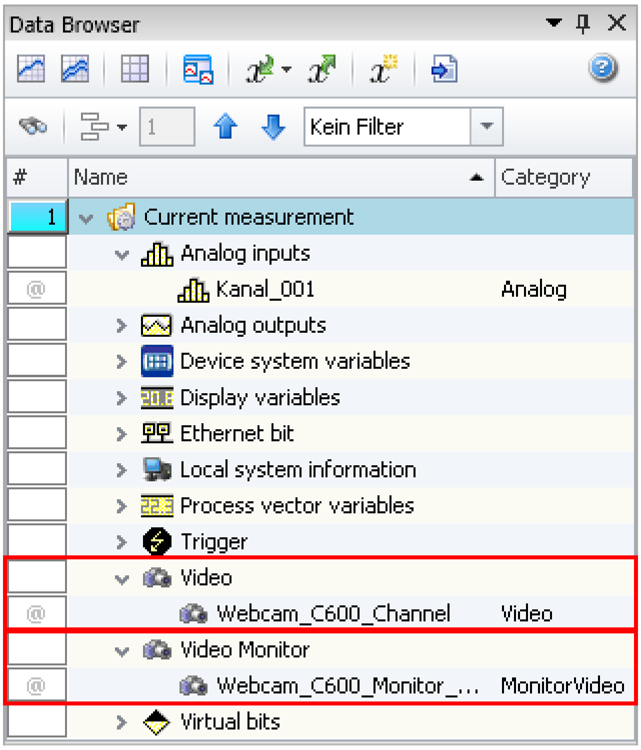
For more information on the VRTC, see the chapter:
"*Setup pages - Configuring Device*" > "*Synchronization*" > "*Clock types*" > "*VRTC - Virtual clock on the PC*" 315"

Time shift

The recorded Video signal is always offset from the saved measured data. The amount of this offset depends on the network quality/network speed. In consequence, it also depends on the quality of the Video signal. High resolutions make high demands on the network.

16.2 Displaying Video-Channels on a Panel Page

Click on **Process configuration** or **Download**. Then you are able to display the Video-channels on a Panel page.



Data Browser with video channels

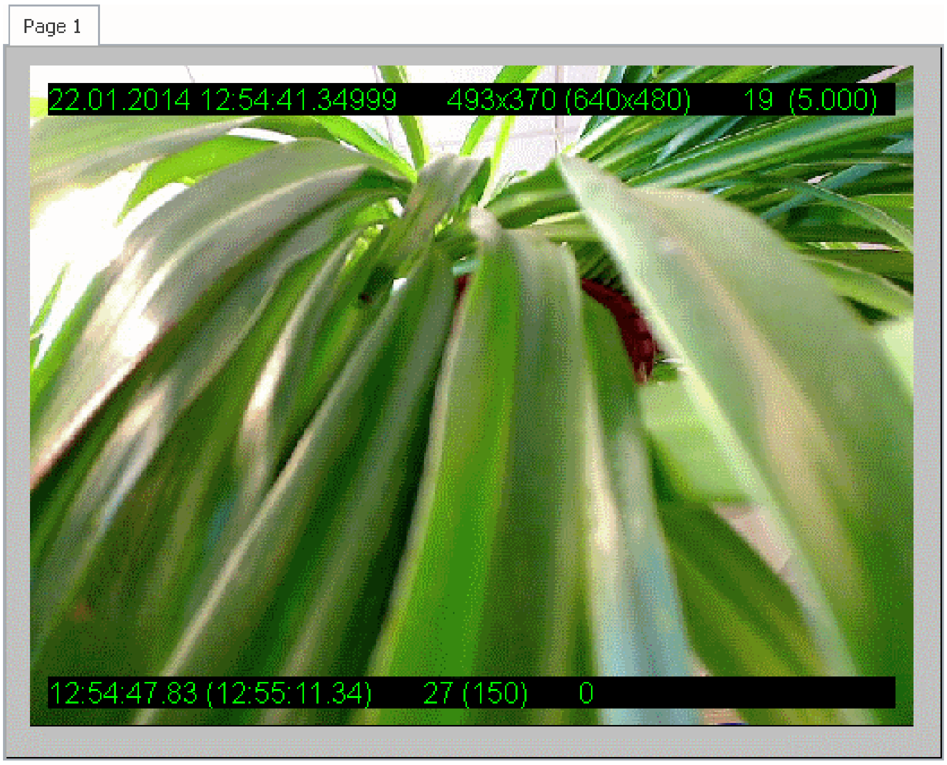
Treat the Video-channels on the Panel just like the other channels.

All active channels and thus also the video channels appear in the Data Browser.

Displaying videos on the Panel page

You can display videos on Panel pages.

Use Drag & Drop to move the video channel to the Panel page. The video-Widget appears along with the image reproduction. To configure the display, open the Properties.



Video-Widget with activated screen display

To each video-Widget, either a main channel or monitor channel, or a saved video can be assigned. You can position multiple videos on a single Panel page.

Note	Notes on display

The Widget shows the current image prior to triggering of the measurement/release of the trigger.

On Screen Display (OSD)

By means of the screen display (OSD), you can observe the sate of the video recording process. For example, with trigger measurements, the display will reflect whether recording is in process or has stopped.

Interpretation of the screen display

1. Date of recording
2. Time (start time)
3. Displayed resolution
4. Video resolution
5. Displayed frame rate
6. Set frame rate
7. Start time of most recent video recording, or time of current playback
8. End time of most recent video recording
9. During recording:

   Count of already recorded images

   During playback:

   Count of images already played back
10. During recording:

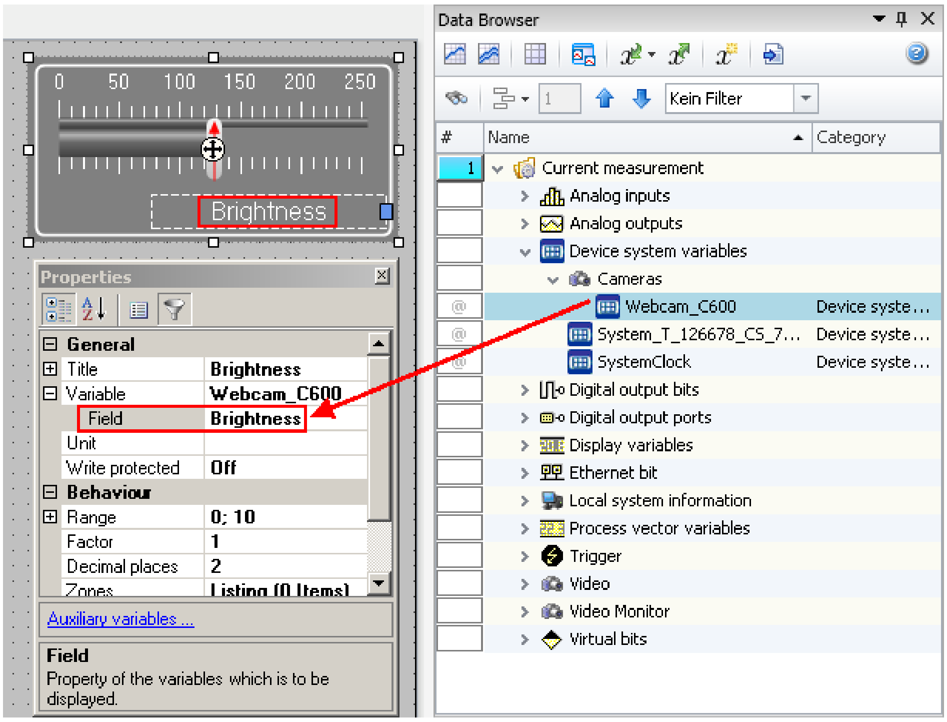
    Count of images to be recorded (depends on the measurement duration and the frame rate set)

    During playback:

    Number of recorded images
11. Event number of the current playback (for triggered measurement)
12. Event count

Changing video settings by means of the Panel page

Some camera settings can be changed directly via the Panel. To do this, drag an appropriate Widget (e.g. Automotive: Bar Meter) to the Panel page. Link it to the camera's *Device system variable*.



Camera properties on a Panel page

In order to be able to adjust a different camera property by means of the Widget, select the desired camera property as your choice for: *Field*, which is an extension of the property: *Variable*. It only appears when particular variables are linked with the widget.

The Widget now has direct influence on the future recordings and on the current video output.

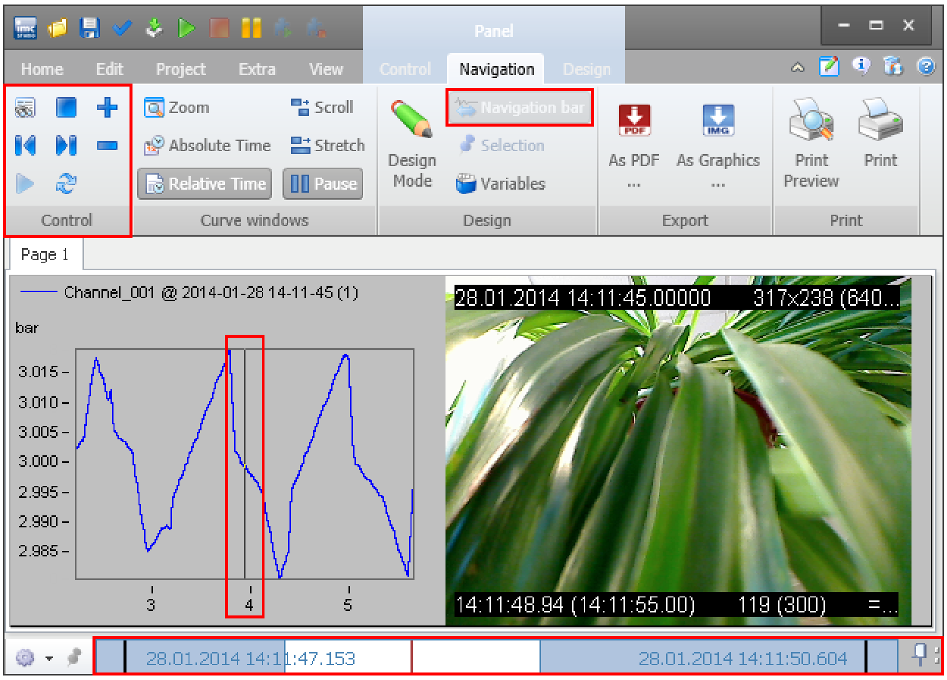
Video measurement - Recording and Playback

On a Panel page, you can view the measurement channels and video data during a running measurement. After conclusion of the measurement, you can play back the measurement channels and the video file jointly.

To do this, connect the corresponding curve window and the video-Widget with the Navigation bar.

By means of the menu item *Panel-Navigation > Control*, it is possible to skip to the recording's start time and **play it back**. You can also navigate to the desired position by means of either the Navigation bar or the curve window.

To learn about the many navigation capabilities, see the documentation on the Navigation bar.



Navigating through the time domain by means of the Navigation bar
Video-Widget and curve window

Playback of saved video files

If data storage is activated both for the measurement channel and the video channel, the measurement results are displayed in the Data Browser as a measurement.

In order to be able to play back various measurements on the same Panel page, do not associate the Widgets with the measurement's *Fixed name*, but rather with its symbolic measurement number 1390.

In this way, you can play back the current measurement and the saved measurements in succession on the same Panel page.

16.3 Export/Import of video files

Video channels can be exported/imported just like measurement channels. This can be done either via the Data Browser or by means of commands.

To do this, use the function:

Function	Description
Export Variable	Exports variables' values to a file. In this case, the video recording (values) belonging to the video channel (variable) are saved in a folder (file) chosen by the user.
Load Variable	Creates variables using values from a file. In this case, a video channel (variable) is created. This contains the selected video (values) and can be played back.
Import Variable	Imports the values from a file to existing variables. In this case, data is imported into an existing video channel (variable). This contains the selected video (values) and can be played back.

The available file format is *Windows Video File (AVI)*.

Note — Long waiting times may occur

When importing/exporting large video files, long waiting times may occur.

Additional information on exporting 1618 and importing 1620 is presented in the descriptions in the reference of commands .

16.4 Information and tips

16.4.1 Specifications and Notes

	Description
Data capture	• Two measurement channels per camera are available simultaneously: the main channel and the monitor channel. Among other things, this means that you may apply different settings for the sampling rate and triggering. • Main channel for high-speed capture and storage, e.g. for triggered snapshots. • Duplicated monitor channel at low-speed sampling rates, e.g. for untriggered, continuous long-term measurements.
Visualization	• A video-Widget (Window) is provided to display video data on Panel pages. • Multiple such video windows can be placed on the pages of the Panel. • Each video window can be assigned to either a camera's main or monitor channel. • In the video window, data are displayed even before release of the trigger.

	Description
Trigger	• The main- and monitor channels can each be assigned to different imc measurement device triggers. • The imc measurement device's triggers are also the triggers for the camera. This means that video channels are triggered at the same time as the associated imc measurement device channels. • Pre-trigger: As for the imc measurement device channels, it is also possible to configure pretriggers for video channels. This means that the data recorded can also include images relating to situations prior to the trigger events. • Pre-trigger duration: 0 sec to 10 minutes.
Synchronization	• Automatic synchronization of the video- and measurement data. • The achievable accuracy depends on the workload of the entire system. Up to dt = [1 frame duration + 20 ms] is achievable. • The device must be connected with the PC by an Ethernet line of at least a 100 MBit/s , with a maximum of 1 hub or switch in between. The connection must remain intact for the duration of the entire measurement.
Advisory notes	• For stable and reliable operation we recommend the use of tested and approved camera models and selected software drivers according to the tables in the "*Technical data sheet*": "*Supported Cameras*". imc can only grant support for these combinations listed. • Systems with cameras from different manufacturers are not recommended, since the drivers could also interact uncontrollably. • For maximum cable length between the control PC and camera, please refer to the respective technical specs for the camera.
Data throughput / frame rate	• The data transfer rate is specified as the frame rate (typically 60 fps) • The frame rate is based on pictures of the size 640 * 480 pixels with 1 Byte per Pixel in Bayer encoding, meaning 300 kByte per frame. This results in 17.5 MByte per second being continually written to the data storage medium. • With the computer equipped accordingly, in Bayer format up to 100 fps can be achieved for 640 * 480 pixels or 200 fps for 320 * 240 pixels. • The data transfer rate stated is aggregate. When multiple cameras are used, they split the transfer rate. Thus, a camera with 60 fps has about the same transfer volume as two cameras with 30 fps apiece. One camera at full resolution of 640 x 480 generates about the same data volume as four cameras with 320 x 240 resolution. • With other encoding (such as RGB instead of Bayer), the data volume is increased threefold. This means the achievable frame rate is reduced to one third. • With triggered data recording (all video channels not assigned to any 1-Trigger), the achievable frame rate is cut in half due to higher demands on the system made by the circular buffer memory used.

	Description
Prerequisites for achieving maximum frame rate	• Hard drives: Solid State Disk (SSD) or 3.5” SATA hard drives (at least 5400 revolutions per minute) configured as Raid 0[1]. Please note that 2.5” hard drives are much slower. Particularly in notebooks, slower hard drives are often installed. • The data carrier may only be filled to a maximum of 70%. Note that writing to a harddisk that is almost full results in significantly reduced writing speed. • The data carrier may not be fragmented. Note that high writing speed is only achieved if the write head is not forced to excessive displacements. • Hard drive controller: This must allow data throughput in write mode. Please note that during measurement operation mode, not only video files have to be written, but other data as well! • Processor: Quadcore with 2.4 GHz (or in case of using Intel I7, two processor cores should be sufficient). • Interface to camera: 1 GBit Ethernet, Firewire A or B or USB as of Version 2.0. • No virus scanner for video files. • No backup tool (or synchronization tool) in use during the measurement. • No additional programs running on the computer. Also services such as hard drive defragmentation or file indexing may not be running during measurement. [1] A RAID system consists of multiple hard drives connected together in Stripe-Mode (RAID 0). This increases the capacity as well as the data throughput. It is also possible to connect more than two hard drives, but eventually the hard drive controller imposes limits on the data throughput.
Crucial parameters for optimum frame rate performance	• The maximum frame rate is determined by the camera’s properties • The performance capacity of the interface to the camera, e.g. 400 MBit/s for Firewire A • The hard drive controller's and its PC interface and driver • Processor and mainboard chip set • The hard drive's maximum writing speed • Compression

16.4.2 Video Compression

Dated: 2018

For the purpose of compressing the Video files, the use of "LEADTOOLS" is recommended. You can obtain a customized version (recommended) from our Hotline 10. This customized version contains only the components required.

Copy the tool to your local hard drive and perform the installation as an Administrator (via the context menu "Run as administrator")

In the Installation dialog, click on: "Install". Subsequently, the text: "INSTALL READY" should appear in the text box.

Subsequent to restarting imc STUDIO and re-integrating the camera, you can select the new Video-compression on the page "Analog Channels" > "Video".

Note	Re-integrating Video devices

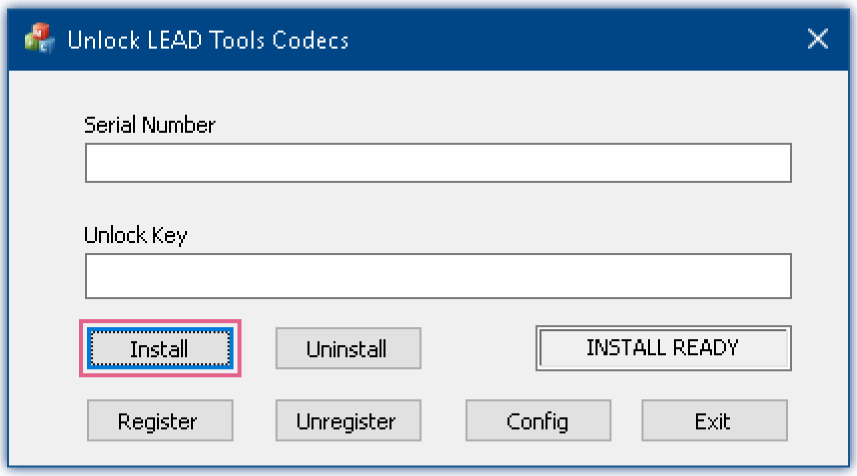
In order to be able to use the compression in imc STUDIO, perform a device search and repeat the process of integrating the Video devices. Beforehand, remove any known Video devices.

Note	Registration

Please also purchase a license for the codec via the imc Hotline. This license can be entered and registered here.

You can now use the version for evaluation purposes. Until you register the tool, the **picture** in Video-files created with it will **be partially obscured by a black bar** with the text "LEAD H264 Eval Encoder" displayed at the margin. This notification is omitted for newly created videos once the tool has been registered.

By means of "Config", you can adapt the compression to your application.



16.4.3 Camera: GoPro Hero 4

Installation:

To operate the GoPro in imc STUDIO, two additional program packages are required. You can obtain both packages from the imc Hotline.

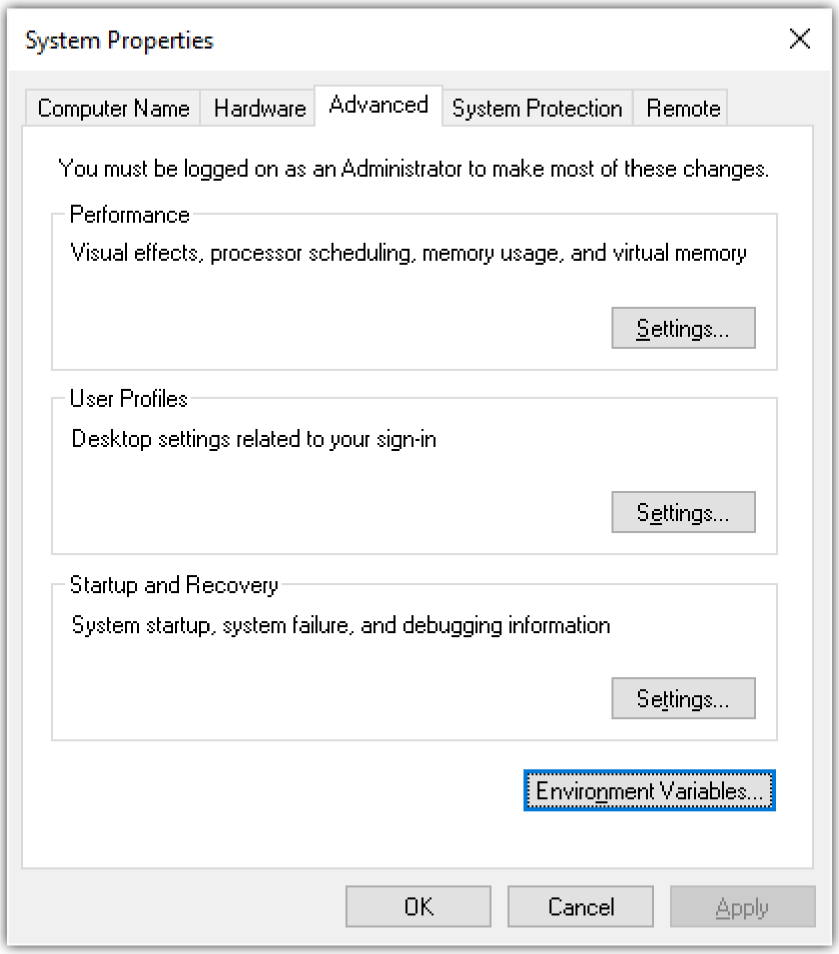
- DatasteadRTSPFilter and
- FFMPEG

RTSPFilter: Run the installer: "DatasteadRTSPFilterInstaller.exe" and follow the instructions.

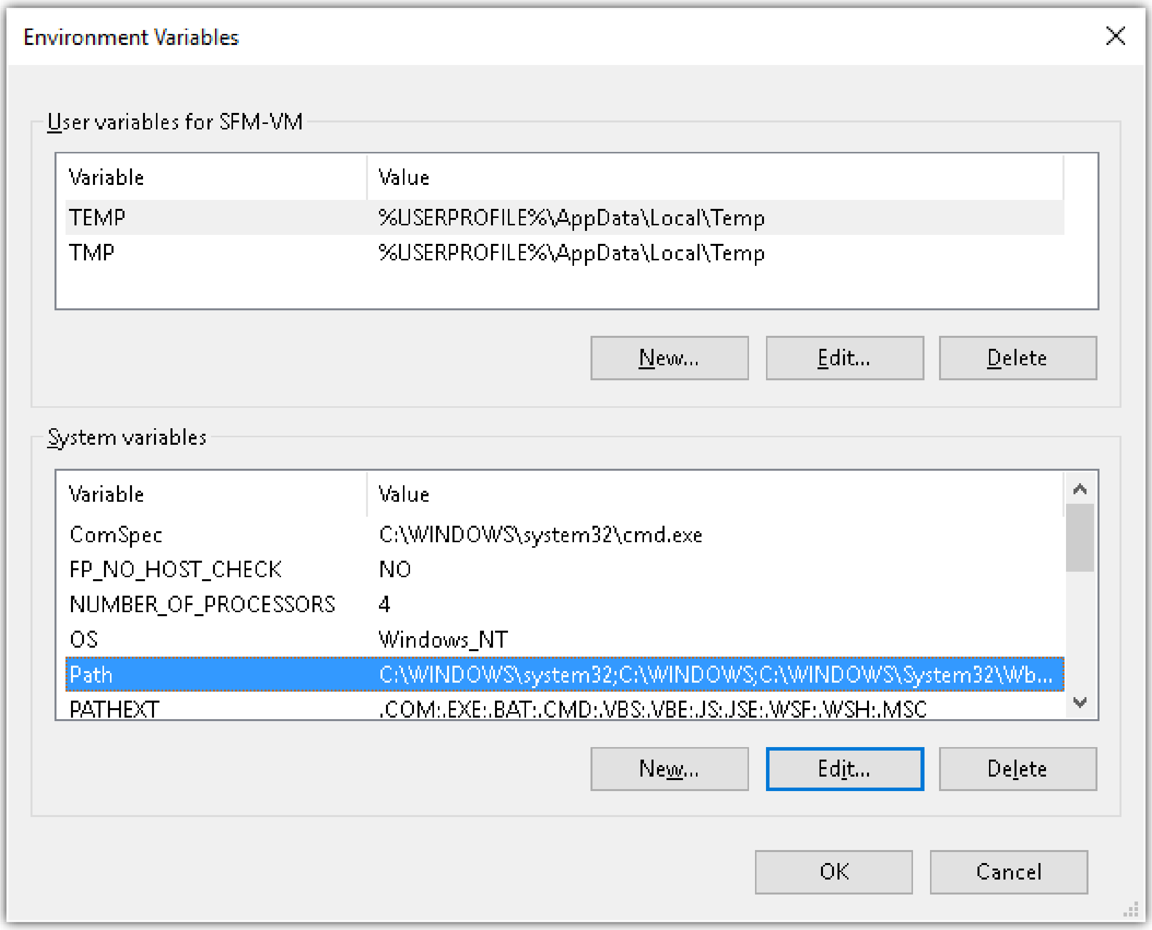
FFMPEG:

- Unpack the archive "ffmpeg-20160404-git-54c9146-win64-static.7z" in the desired installation folder (e.g. "C:\Program Files\ffmpeg-20160404-git-54c9146-win64-static").

  It may not be possible to unpack directly to "C:\Program Files" if Administrator privileges are required. In this case, extract the archive to any other arbitrary location and move it subsequently to the desired location.
- Next, the Windows "Path"-variable is modified accordingly.
- To do this, open the Control Panel and find "Environment variables". Select either "Edit environment variables for your account" or "Edit the system environment variables", depending on you operating system.
- The dialog "System Properties" then appears. There, click on the button: "Environment variables".



- In the new dialog, under "System variables" select the variable "Path". Edit these.



- In the example above, the path "C:\Program Files\ffmpeg-20160404-git-54c9146-win64-static\bin" must be added.

Note

- In order for the firewall used not interfere with communication between imc STUDIO and the camera, the UDP Port: 8554 must be enabled.
- GoPro itself provides a Wireless Access Point. The IP address of the GoPro is 10.5.5.9 and can not be changed. In order to avoid an IP-address conflict, it makes sense to select a different, non-routed IP-address range, e.g. 172.16.0.0 - 172.16.0.255.

Commissioning:

First, the GoPro must be connected with the WLAN; to do this follow the manufacturer's instructions. Next start imc STUDIO and run a device search.

Special features:

The GoPro saves its recordings on a removable memory card (micro-SD). In the imc STUDIO database, only an info file with the extension "ivi" is saved. In this file, information such as the triggering time, offset, filename (on the GoPro) ... are saved.

The .ivi-file thus contains information about importing the video to imc FAMOS.

Under the entry "*GoPro Video File Name*", you find the actual name of the video file located on the SD card.

You can copy the appropriate file to the measurement and rename it to the name stated under the entry "*Video File Name*". Next, you are able to import the video file to imc FAMOS and use it there.

Note

The resolution displayed in imc STUDIO and framerate of the GoPro camera is only the same as those of the preview. The recordings are always made according to the values (manually) set on the camera.

Warning Only use one GoPro camera

In imc STUDIO, only one GoPro camera at a time can be used in an experiment.

Note Some settings are not supported

Display of videos during a running measurement is not supported in conjunction with the following settings, and thus may not be selected:

- Hero 4 black : 2,7K 60, 1440 80, 1080p120/90, 960p120, 720p240, WVGA
- Hero 4 silver : 960 100, 720 120, 720pSV 100, WVGA

If you wish to use one of these configurations anyway, switch off video display during the measurement!

To do this, create a file named "ImcCameraSettings.ini" in the following folder:

C:\Users\<User Name>\AppData\Roaming\imc\Default\Video\

Fill the ini file with the following text:

GoProNoPreviewOnRecord = "true"

Display of videos is thus deactivated during measurement for all GoPro devices. (With the value "false", it is activated again).

16.4.4 Camera: Basler

Installation:

To operate this camera in imc STUDIO, an additional driver package is required: "*Basler Pylon Version 5.1*". This package can be obtained from either the Basler homepage: www.baslerweb.com.

16.4.5 Integrated imc STUDIO-PC with video

A video-PC is a PC unit integrated in the **imc CRONOS*compact*** rack.

Reference	Reference to the device documentation

Details and specifications are available in the device manuals.

Note	Note on the Windows version

This description applies to Windows 7. The information pertaining to other Windows versions may vary.

Windows remote connection to the video-PC

Prerequisite: two computers having an Internet connection, in this case the video-PC and a Client computer.

Prerequisites for a remote desktop connection

It is not possible to establish a remote connection with every edition of Windows. The remote computer (video-PC) must run one of the following Windows 7 editions as its operating system:

- Windows 7 Professional
- Windows 7 Ultimate or
- Windows 7 Enterprise.

On the client computer, what Windows 7 edition is running does not matter. It is possible to establish a remote connection to the video-PC with any edition.

The video-PC must be switched on and may not be either in Standby mode or hibernation. If necessary, check and adjust the PC's energy saving setting beforehand.

Check the video-PC's firewall configuration and ensure that the port for the remote desktop (normally port 3389) is open.

Configuring the remote computers (video-PC)

Open the Remote settings:

- Open *Control Panel > System and Security > System*.
- Select *Remote settings* at left. You may need to enter an Administrator password.
  - Under *Remote Assistance*, activate the option *Allow Remote Assistance connections to this computer*.
  - Under *Remote Desktop* select and configure one of the two alternatives for allowing the connection.
- Confirm by clicking in *OK*.

Establishing a remote connection from the client computer to the video-PC

- Open the Start Menu.
- Type the word *Remote* in the search box.
- Click on the result: *Remote Desktop Connection* to start it. The *Remote Desktop Connection* dialog appears.
- In the input box *Computer*, enter the name or the IP-address of the video-PC. To configure the connection, click on the button *Show Options* to open the corresponding dialog.
- Start the process of establishing the connection by clicking on *Connect*.
  - If necessary, enter a user name and password.
- if it was possible to establish the connection, the video-PC's login dialog appears.
  - Enter the user name and password here, too, if required.

VNC connection to the video-PC

Prerequisite: two computers, in this case the server (video-PC) and a client computer.

Installation of the VNC software (UltraVNC)

- On the **client-PC**, install only the component selection: *UltraVNC Viewer*.
- On the **video-PC**, install only the component selection: *UltraVNC Server*.

Server configuration (video-PC)

Specify a password

- Open the context menu belonging to the VNC-Task bar symbol: blue eye.
- Select Admin Properties.
- Under *Authentication > VNC Password*, enter a password to apply to the connection.
  ATTENTION: The connection is not encrypted. Do not use any important passwords associated with other programs!

Check the Firewall settings

Check the firewall configuration and ensure that the program winvnc.exe is present in the list of exceptions.

Establishing the VNC connection from the client computer to the video-PC

- On the client computer, start the *VNC Viewer*.
- Enter the video-PC's (the Server's) IP-address.
- Start the setup for the connection and enter the password, if required.

17 Programming Interface

Chapter	Description
Scripting 1730	Interface for using Scripts in imc STUDIO.
Third Party Device Interface 1860	Interface for using third party devices in imc STUDIO.
API 1900	Interface for developing custom application with access to imc STUDIO functions.

17.1 Scripting

The **imc STUDIO Scripting** is an **imc STUDIO** plug-in providing a programming interface (C#, .NET) to imc STUDIO. The development environment *SharpDevelop* (Editor) is included.

Besides user-defined programming, **fundamental functions** of imc STUDIO are available, e.g.

- read and write device and channel settings/parameters (Setup),
- access to the Panel and the Widgets,
- access to the Data Browser: create, read and write variables,
- application of imc FAMOS-functions to channel data,
- execution of menu actions (ribbon),
- execution of Sequencer commands,
- respond to events.

The following **script types** are available:

- Script
- Panel Script
- Context script
- Type library script
- Event script
- Third Party Device script.

It is possible to export and import the scripts, also as DLL.

To **run a script**, the following mechanism are available depending on the script type:

- as command
    - in the Sequencer
    - at Widget
    - on events
- in the background
    - linked to a Panel page
    - linked to the experiment or project

This manual illustrates entry points into **Scripting**.

Note

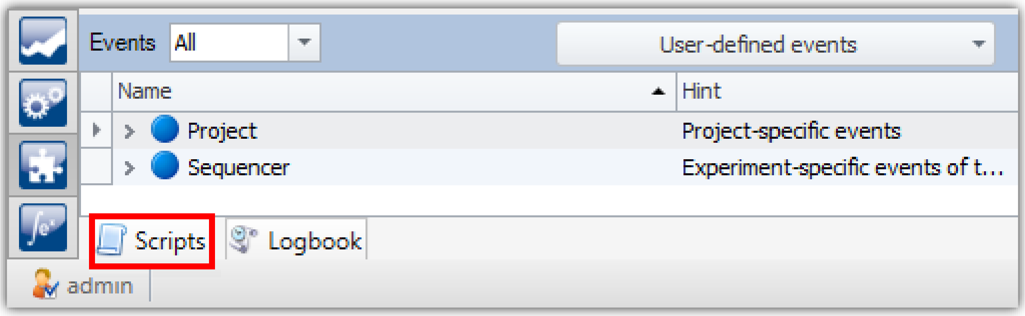
- For **creating** and **editing** a script an imc STUDIO *Developer* license is needed.
- Scripts[1] can be **run** in all editions without a special license.
- The programming language is C#.

[1] with the exception of Third-Party-Device scripts

17.1.1 Menu bar and context menu

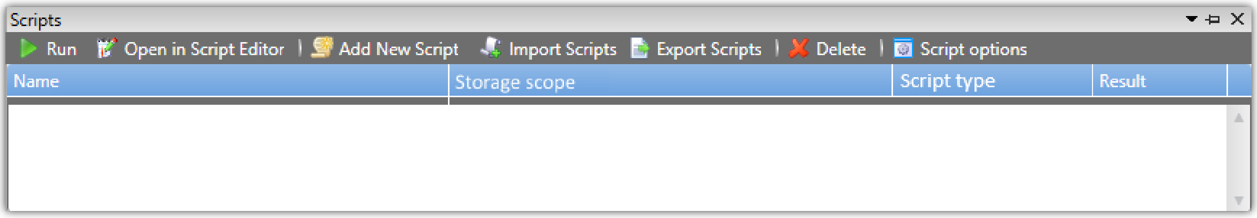
Tool window

To use **Scripting**, go to the Sequencer page. There is a tab on the bottom called **Scripts**.



Sequencer: Tool window "Scripts"

In the tool window the scripts can be sorted by clicking on the column names.



Tool window "Scripts"

Note

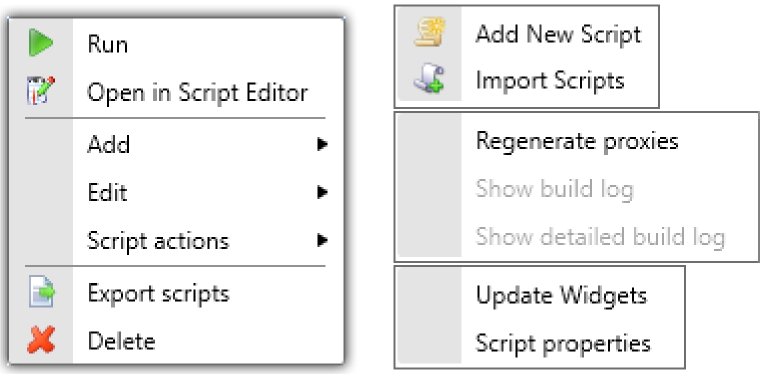
If the *imc STUDIO Scripting Editor* (Developer-Edition) is activated and the tool window *Scripts* is not available, please check in the ribbon *View > Choose Tool Windows* if the tool window *Scripts* is activated.

Menu

Menu action	Description
Run	Runs 1738 the selected script.
Open in Script Editor	Opens 1738 the selected script in the editor.
Add New Script	Opens the dialog for creating 1733 a script.
Import Scripts	Opens the Import-Dialog 1740.
Export Scripts	Opens the Export-Dialog 1739.
Delete	Deletes the selected script.
Script options	Opens 1844 the script options in the imc STUDIO options dialog.

To edit a script, select the menu item *Open in Script Editor* Open in Script Editor.

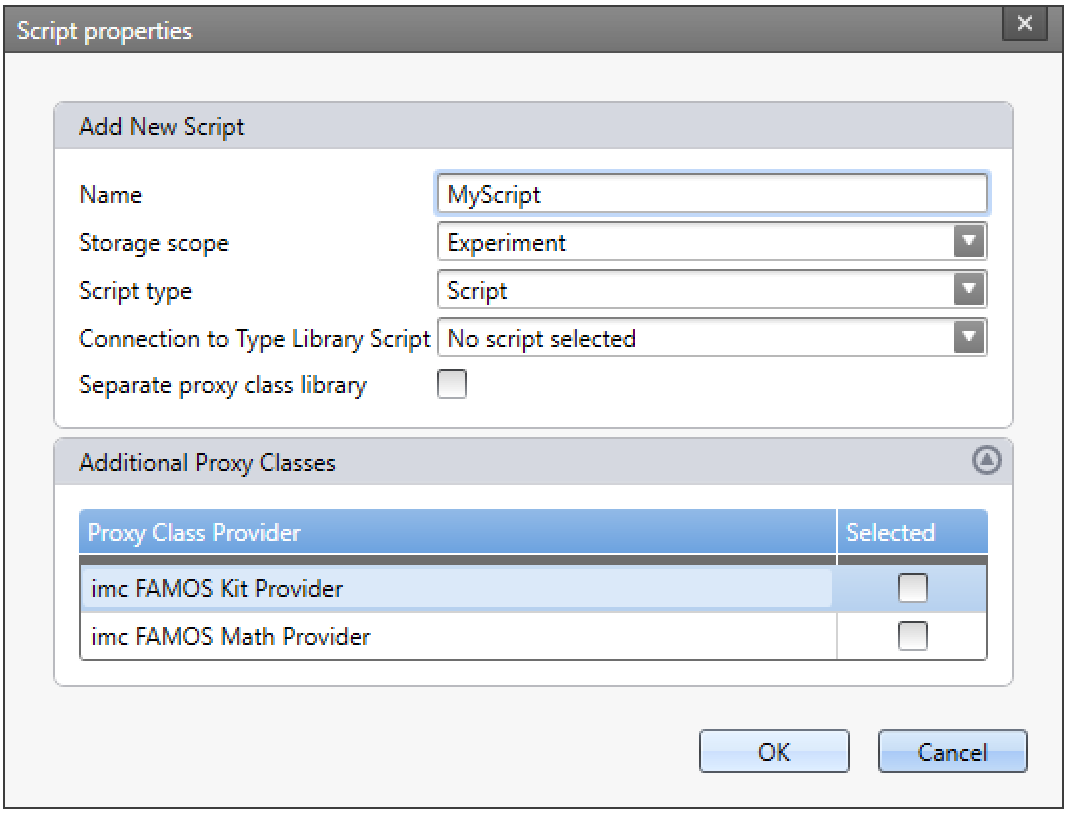
Context menu



Menu actions	Action/Sub-menu
Run	Runs 1738 the selected script. (Script types: Script, Context script, Event script)
Open in Script Editor	Opens 1738 the selected script in the editor.
Add	• Add new Script 1733 • Import Scripts 1740
Edit	• Regenerate proxies 1740 • Show build log • Show detailed build log
Script actions	• Script Properties: New Storage scope 1737 • Regenerate Script Widgets 1812 (Panel script)
Export scripts	Opens the Export-Dialog 1739.
Delete	Deletes the selected script.

17.1.1.1 Create scripts

To create a new script (C#), switch to the Sequencer and open the tool window **Scripts.**
Click on *Add new script* Add New Script. The **Script Editor** has to be closed before adding a new script.

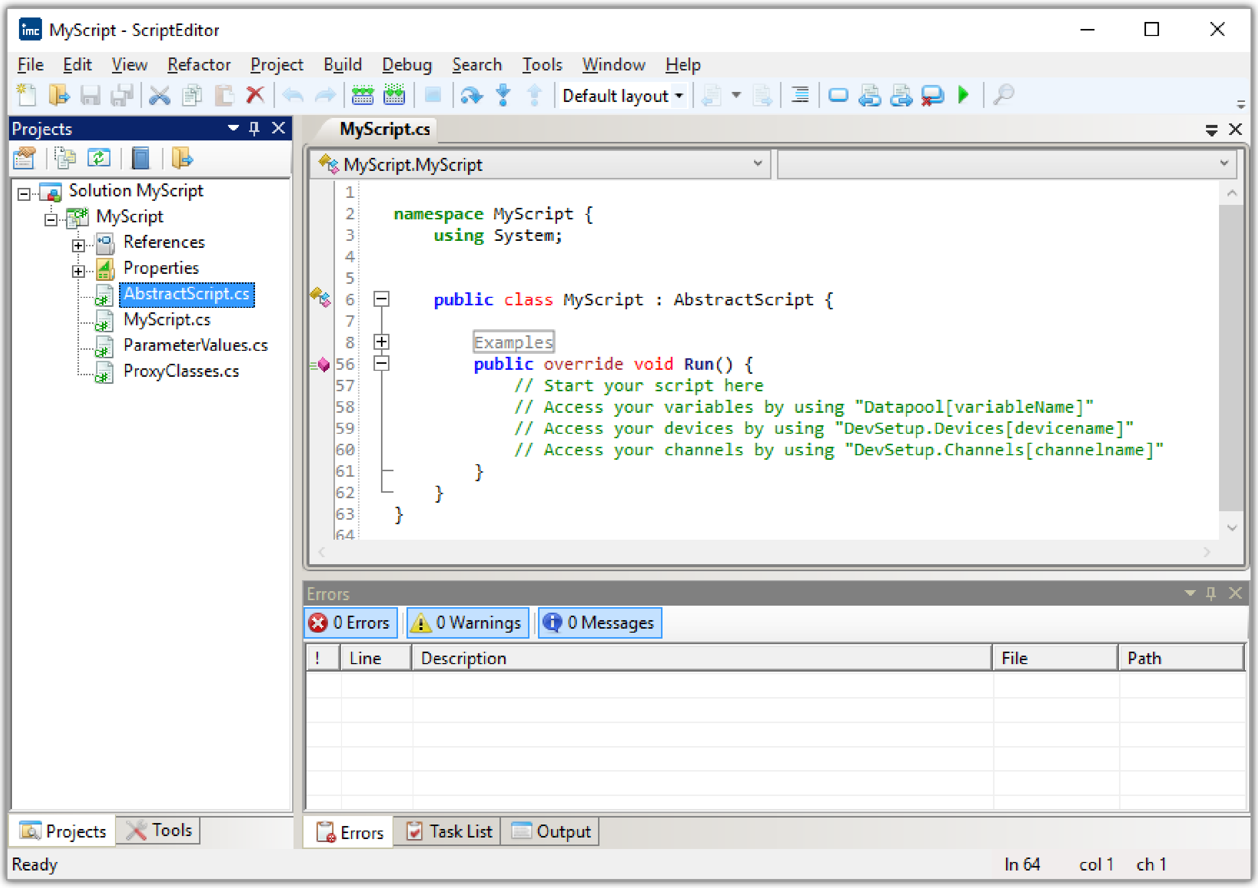


Dialog: Script properties

For the other script types 1735, this dialog and the editor template looks different. See also the corresponding sections: Panel-script 1812, Context-script 1819, Type-Library-script 1823, Event-script 1826.

If the dialog is exited with *OK*, the **Script Editor** opens. The programming language is C#.

Helpful examples are provided in the *Examples* portion of the source text . Before a script can be used, it must be compiled (*Build > Build Solution*).



ScriptEditor

Note — **Changing the language of the editor**

The **language** of the editor can be changed via *Tools > Options > General > UI Language.*

17.1.1.1.1 Script type

The following **script types** are available. The **script type** should be selected which accords with the intended application.

Script Type	Description
Script 1810	• A **Script** is called and run by means of a *command*.
Panel Script 1812	• When creating a **Panel Script** an according *Panel page* has to be selected. • A **Panel Script** is linked to the corresponding Panel page. • The `Run()` method in the script is called when **browsing to** the corresponding page or when the page is already opened and the *Design mode* is deactivated. This is also the case when loading an experiment. • The `Stop()`-method is called when **browsing to other** pages or when the experiment is closed, or the *Design mode* is activated.
Context Script 1819	• A **Context Script** is linked to a *scope* (Experiment, Project, ...), • The `Run()`-method is called when **opening** an experiment (Scope *Experiment*). • The `Stop()`-method is called when **exiting** the experiments or when imc STUDIO is closed or another experiment is opened. (Scope *Experiment*). • Here, some of the possible actions are to register ("*hook*") actions with *events* and to de-register ("*unhook*") them from the events.
Type Library Script 1823	• The **Type Library Script** is a way to provide one's *own classes* and *methods* for the other script types as a *DLL*.
Event Script 1826	• The **Event Script** is appended to the associated events as a *command*. • In the script, there is the possibility to access *arguments* of the events triggered, e.g. the measurement's name or its path for interval storage.
Third Party Device Script 1860	• With the help of the **Third Party Device Script**, it is possible to integrate and use Third Party Devices in imc STUDIO.

When registering actions to, or de-registering them from events, it is preferable to use a **Context Script** (or for Widget-actions, a **Panel-script**) instead of a **normal script**.

For further information, see the corresponding sections: Panel-script 1812, Context-script 1819, Type-Library-script 1823, Event-script 1826 or rather Third Party Device Script 1860

17.1.1.1.2 Script Properties

Script Properties	Description
Name	The script's name must not start with a *number*. No *spaces* or *special characters* are allowed, except for the underline. It also may not be the designation of any C# command (for, foreach, if, else, class, private, public, int, double, string ...).
Storage Scope	The script's *availability*, e.g. Experiment, Project, Application or Sequencer. To change this setting, click on *Script actions > Script properties > New Storage Scope* 1737.
Type	The selected *script type* 1735.
Connected Type-Library-Script	Selection from a list of created *Type-Library-Scripts* 1823. The Type-Library-Script is available within the script as a library.
Separate proxy class library	The Proxy class is added as separate reference (DLL) and can be also used in other scripts, e.g. for global use of objects from the script's namespace, using the Script clipboard 1808.
Additional Proxy Classes	Selection of *imc FAMOS functions* Math-Library and Kits. These classes can be regenerated, see Regenerate proxies 1740
Activity Scope	*for Context scripts only:* Scope (Experiment, Project, Application), in which the script is active.

Note Name assignment

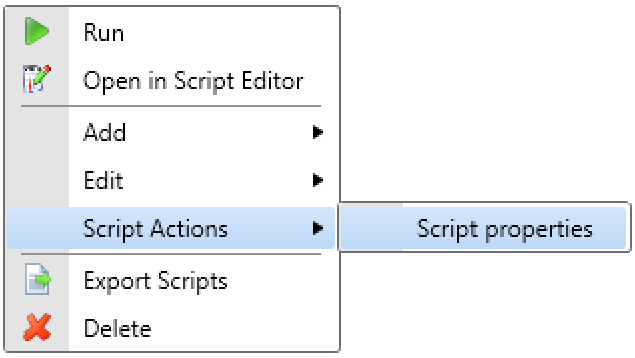
- Note that the same script **name** may not be used multiple times, even when using different **Script Storage Scopes.**
- **Example:**
  - In the **Experiment** *Exp_001*, a **script** "*Test*" is created with the **Storage Scope** *Experiment*.
  - In another **experiment**, *Exp_002*, a **script** "*Test*" is created with the **Storage Scope** *Project.*
  - The **experiment** *Exp_001* is loaded, and a warning appears in the logbook, indicating that the **script** "*Test*" cannot be loaded since it already exists (in the project).

17.1.1.1.3 Storage scope

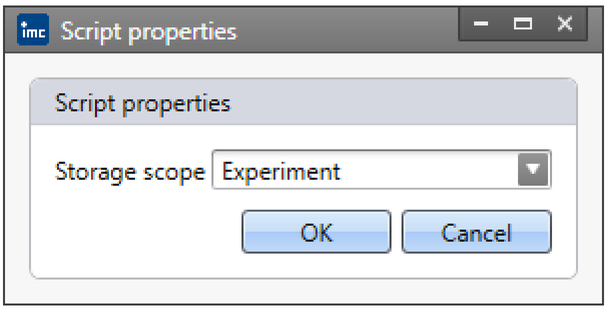
The option **Storage Scope** (*Save With / Script storage)* specifies the script's location in memory.
In order to use scripts in other experiments belonging to the same project, the script is created with the setting *Save with > Project.*

Storage Scope	Description
Experiment	The script is saved in the *experiment folder* and is also only available within the experiment.
Project	The script is saved to the *project folder* and is listed and available to all experiments belonging to the project. If you wish to transfer the experiment to another system, the project-script must also be exported and transferred along with it.
Application	The script is saved to the *applications-folder* (e.g. C:\ProgramData\imc\imc STUDIO\Applications_1\Scripts) and is available for all projects and all experiments. Here, too, for the purpose of transferring the experiment to a different system, the script must be exported and transferred along with it.
Sequencer	If a (different) experiment is loaded by means of a command, then this script remains available. This script is saved in the applications folder and only be listed in the main experiment.

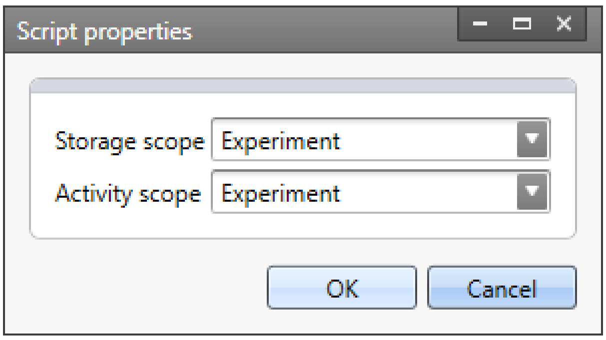
This option can be changed in the **context menu** *Script Actions > Script properties.*



Script Actions: Script properties



Dialog: Script properties



Dialog: Script properties (for Context-Scripts)

Warning Save Project and Experiment

Please **save** your **project** and **experiment** after **changing** the *Storage Scope*, otherwise changes might be lost.

17.1.1.2 Edit scripts

To edit a script, please open the tool window **Scripts** and click on *Open in Script Editor* 

. You can also double-click on a script to edit the script. Before editing another script, the Script Editor must be closed.

Note

The scripts are deposited beyond imc STUDIO.

The save state of the scripts is only transfered, if the corresponding *storage scope* (Experiment, Project) is **saved**.

17.1.1.3 Run scripts

To run a script, the following mechanism are available depending on the script type:

Script type	Mechanism

Script 1810	• Command in theSequencer
	• Command on an event.
	• Tool window scripts
	  ▪ Menu
	  ▪ Context menu

Panel script 1812	• Browsing to a page (`Run` method) • Leaving the page (`Stop` method)
Context script 1819	• Loading/opening the corresponding context (`Run` method) • Leaving/closing the context (`Dispose` method)
Type library script 1823	• Cannot be executed. • Is used in other scripts.
Event script 1826	• Command on an event.
Third Party Device Script 1860	• Cannot be executed • Refresh of the Third Party Device after closing the editor.

After running the script using **Run**, you can display the Build-Log by selecting *Edit > Show Build log* in the context menu.

If the script runs successfully, it will be indicated by a green dot symbol in the tool window.

Otherwise, if there is any error, a red dot symbol will be displayed.

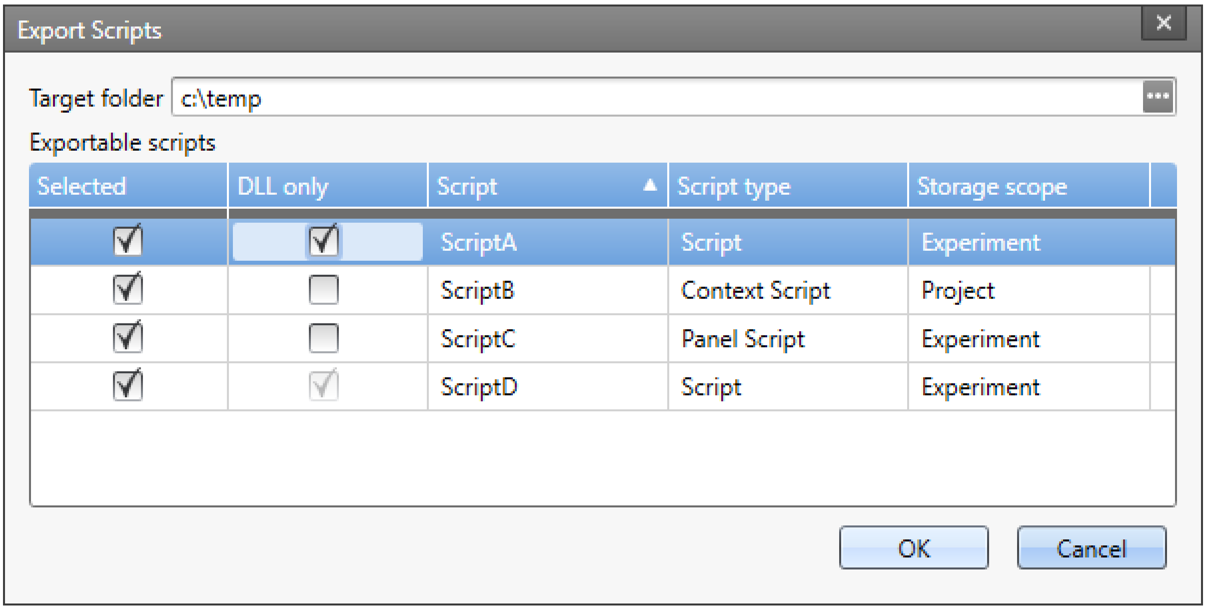
17.1.1.4 Export and Import

Note

If **Resources** are used in the *C#-Project*, please get sure, that they the property "Build action" is set to "*Resource*" or "*Embedded Resource*" and/or "Copy to output directory" is set to "*true*".
With these settings the Resources folder is considered when using **DLL-Expor**t.

Export

To export scripts, click in the **Scripts** tool window on *Export scripts* Export Scripts . Subsequently, a dialog showing all scripts opens.



Dialog: Export scripts

Here, select the scripts to export and enter a target path.
if only the library (DLL) of a script is to be exported, then make the corresponding selection in the column "only DLL".
The scripts are exported as an archive (*.zip). Along with the script-files, some information is also recorded on the type and storage type of the ZIP-file. This also applies to the DLL-exports.

Warning

If a script is exported as DLL, there might be a dependency to assemblies of the current version.

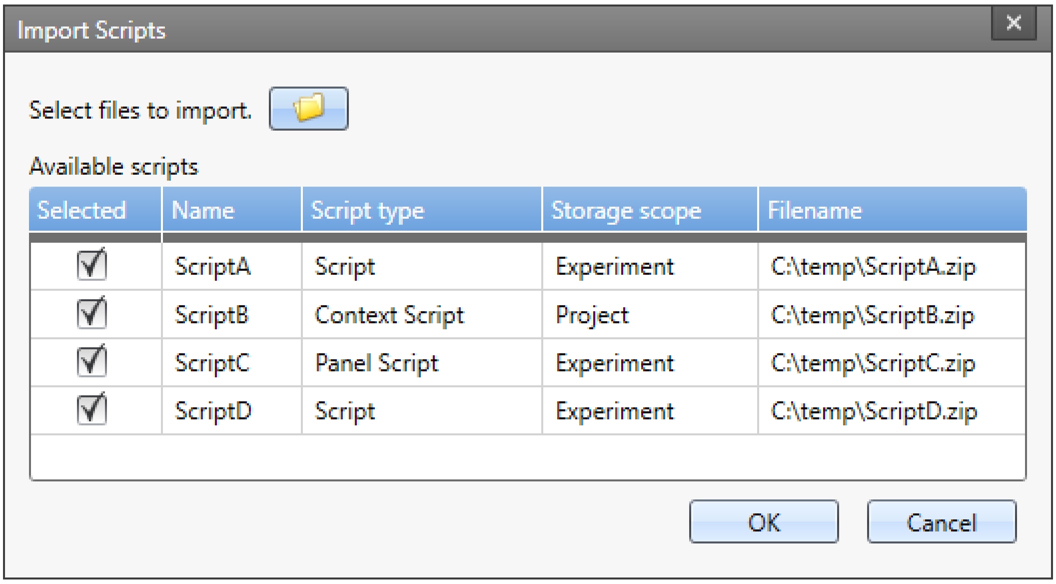
If an experiment with DLL-scripts is used in a newer version, there might be an FileNotFoundException error.

The developer of the script must recompile it in the newer version. See also, Important Information 1857.

Import

Click in the tool window **Scripts** on *Import Scripts* 

. The following dialog will appear:



Dialog: Add existing scripts

Choose the file at *Name.* Depending on the script type, the dialog will change and further settings can be changed, e.g. Name and Storage Scope. Click on *OK* to add the script to the list. When scripts are imported which contain only a library (DLL), then of course these can not be edited but only executed.

Also, single script files (*.cs) can be added in the **ScriptEditor** to the C# project via *Add > Existing item.* Former *s*cript files with the extension *.csscript has to be renamed with the extension *.cs.

Warning

If you import a Panel script, you have to link the script to the corresponding Panel page in the page properties.

Note Add "Import Scripts" to the ribbon

You can customize the ribbon and add the menu action "Import Scripts".

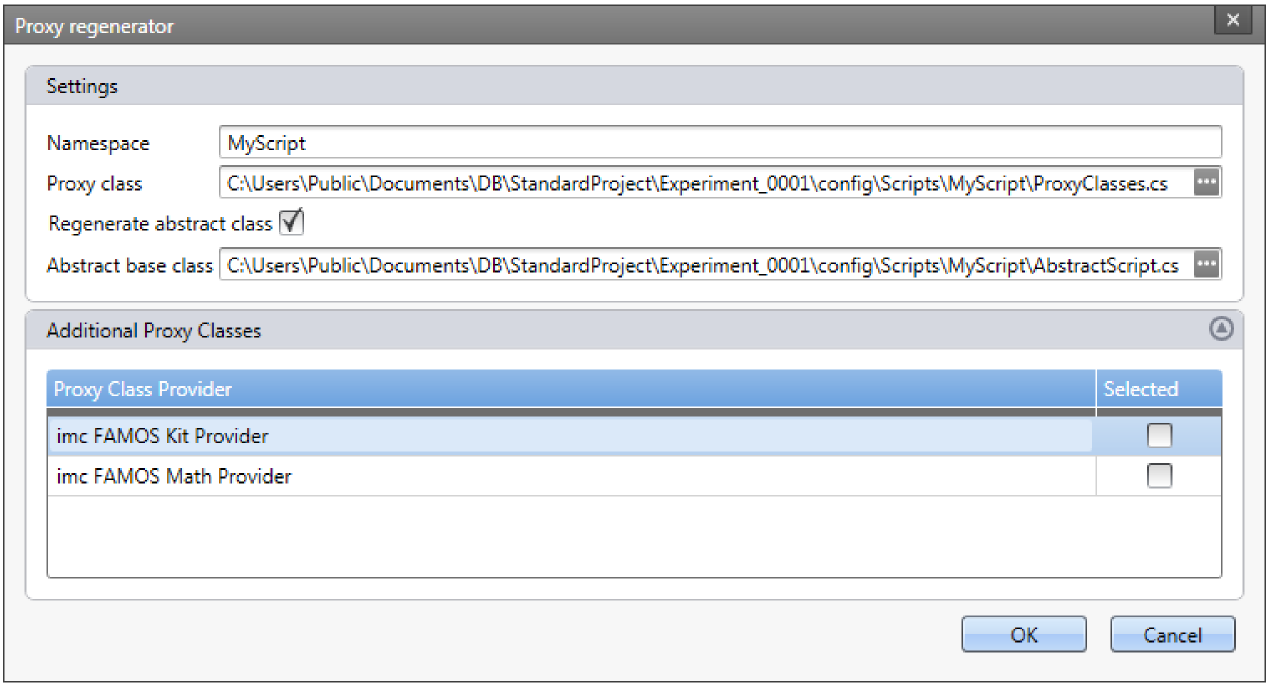
After adding the menu action the view needs to be saved.

17.1.1.5 Regenerate proxies

If a script of an old imc STUDIO version is imported and new functions are needed in this script, the proxy classes have to be regenerated. Also, if you wish to use imc FAMOS functions and haven't selected the provider when creating the script. Select the script in the tool window **Scripts** and click in the **context menu** on *Edit > Regenerate proxies.*

The following dialog opens.

If no new imc FAMOS functions should be added, keep the current settings and click on *OK* button. Otherwise choose **Kit** and/or **Math** and then click on *OK*.



Dialog: Proxy regenerator

Warning

Due to new functions, internal structures may have changed. Therefore after regenerating proxies, you have to check and change the source code to fix the compiler errors.

You will find hints in the chapter Important Information 1857.

17.1.1.6 Debugging

To **debug** a script, the following steps must be performed after compiling.

Step 1 : Add breakpoint

Press **<F7>** or use the menu item *Debug > Toggle Breakpoint* to add a breakpoint. The program counter will stop in this line, when reaching this statement.

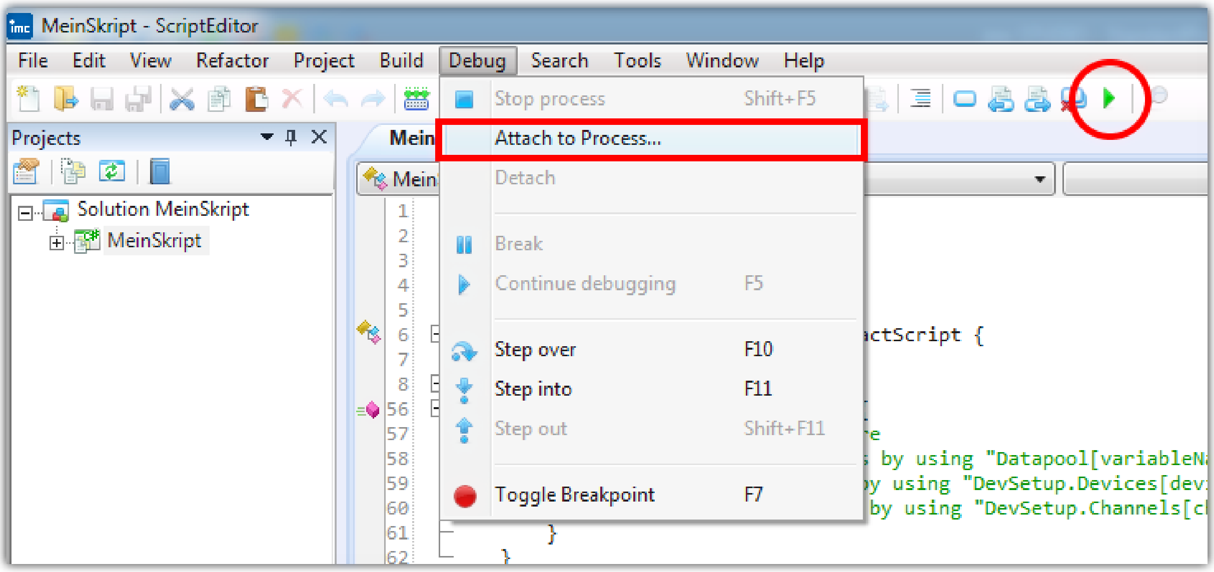
Afterward there is a red point left to the line number.

Editor: set Breakpoint

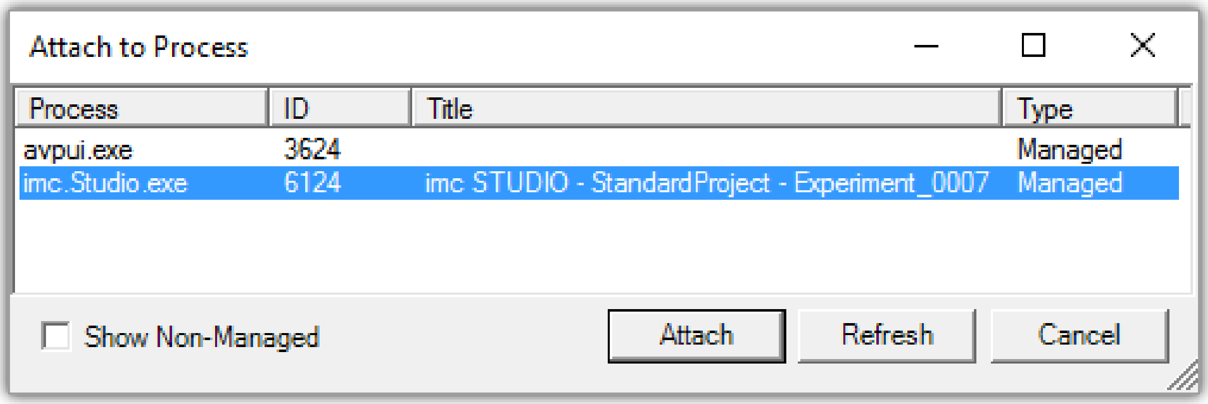
Step 2 : Attach to imc STUDIO process

Attach the Debugger to the running imc STUDIO process by using the menu item *Debug > Attach to Process* In the dialog, select *imc.Studio.exe* (if multiple processes are listed, select the task whose name matches the experiment's name).

The Play button (green triangle) in the menu bar can be used instead to attach the debugger directly to *imc.STUDIO.exe*.
Subsequently, the breakpoint's color is yellow .



Editor: attach to process



Process selection

Editor: Debugging is attached to process

Step 3 : Run the script

Run the script in imc STUDIO according to the script type.
Perform the actions needed to reach the breakpoint.

Step 4 : Program counter

The *Program Counter* (yellow arrow ➡) stops at the breakpoint, if this line is reached.

Editor: Program Counter

Step 5 : Navigate

Navigate through the script by using the keys **<F10>** and **<F11>**, or **<SHIFT>+<F11>**, continue debugging by using **<F5>**.

Icon	Key	Description (englisch)
	F5	Continue debugging
	Shift+ F5	Stop process
	F7	Toggle breakpoint
	F10	Step over
	F11	Step into
	Shift + F11	Step out

Warning

Warning Always use 'Continue Debugging' before detaching

Do not *detach* from the process while debugging. Depending on the user's programming, imc STUDIO might be in an undefined or non-operable state. Do always use *Continue Debugging* (blue "Play" symbol) to end debugging before detaching.

17.1.1.7 Classes

Class name	Description
Actions	Access to the menu actions: Commands 1803
Commands	Access to the Commands 1803
Core	Access to classes (needed in other script types) *also see table on the below*
Datapool	Access to variables: Datapool functions 1769
DataProcessing	* Access to Data Processing
DevSetup	Device and channel settings (parameters): Device functions 1745, Channel functions 1752
Documents	Informationen about the project and the experiment.
Environment	Informationen about the software environment.
Events	Access to events.
InlineFamos	Access to InlineFamos: Inline FAMOS functions 1802
Logbook	Access to the logbook: Logbook 1778
Notifications	Access to the notification system.
Panel	Access to the Panel and the Widgets: Panel and Widget functions 1761
ScriptClipboard	Script Clipboard 1808
Scripts	Access to the scripts
SharedComponents	*
StorageManager	Used in an Event Script 1826
UserRequest	Default dialog response 1807
VariableViewer	* Current values window
Windows	Access to tool windows. Show and hide.

* Access not possible or restricted.

Core

Some of the classes above can also be accessed via the Core class. In Addition there are the following classes.

Class name	Description
Accessibility	* Access to the user administration
Options	*
Services	*

* Access not possible or restricted.

17.1.2 Script (general)

17.1.2.1 Device functions

Note

- For setting the parameters, class *EClassID* is used. Setting values of the parameter are available in the *ParameterValues*-Class. See also Device Parameters 1828.
- The method `ExecuteActions()` is only needed for device and channel actions. For parameters the method `SetValue()` is used.

To use needed constants/classes the following **libraries** have to be added:

```
using imc.Studio.Tools.DevSetupGraphGenerator; // EClassID
using imc.Studio.Interfaces.V2.DevSetup;  // DeviceAdapters
using imc.Studio.Interfaces.DevSetup; // EDeviceCoreType_V2
```

The following line is needed for the following examples. The device *imcDev__17123456* is used. The device name is case sensitive.

```
var device = DevSetup.Devices["imcDev__17123456"];
```

The parameters are used as follows:

```
// EClassID_Parameter as string or from EClassID-Class
//var parameter = channel.Parameters["eMyParameter"];
var parameter = device.Parameters[EClassID.eDeviceName]; // Example
```

```
// set parameter value
parameter.SetValue("SetValue");
// get parameter value
string parameterValueAsText = parameter.GetValue().ToString();
// get printout of the parameter value
string parameterText = parameter.Text;
// select list of parameter values, if available
string [] paraTextArray = parameter.TextList;
```

For further information, please read the following chapters:

- Devices control and parameters 1746
- Storage 1749
- Diskstart 1749
- Misc 1751

17.1.2.1.1 Devices control and parameters

Search for devices

The device search is performed by the following command:

```
DevSetup.SearchDevices();
```

Add Device by DNS-Name or IP

Add a device by DNS-Name or IP by the following command:

```
using imc.Studio.Interfaces.V2.DevSetup; // add Library
```

```
// IP
DevSetup.SearchDevice("192.168.0.2", DeviceAdapters.imcDevcies2x);
```

```
 // DNS
DevSetup.SearchDevice("imcDev__17123456", DeviceAdapters.imcDevcies2x);
```

```
// The return value of type "EnumItem" is the according device.
EnumItem device = DevSetup.SearchDevice("0.0.0.0", DeviceAdapters.imcDevcies2x);
```

Add Device via SecureAccess

Please replace the text `<entry>` by the corresponding value.

The order of the entries is not relevant. You can also omit entries. In this case the default value is used.

The entries are separated by semicolons.

SecureAccess is applied as soon as a equal sign is used in the text for the `SearchDevice` method.

```
using System.Text;
using imc.Studio.Interfaces.V2.DevSetup;
```

```
var secureAccessCode = new StringBuilder();
secureAccessCode.Append("AllowFTP=<entry>;"); // true or false
secureAccessCode.Append("RemoteAddr=<entry>;");
secureAccessCode.Append("DevicePwd=<entry>;");
secureAccessCode.Append("LocalAddr=<entry>;");
secureAccessCode.Append("ProxyAddr=<entry>;");
secureAccessCode.Append("ProxyUser=<entry>;");
secureAccessCode.Append("ProxyPwd=<entry>;");
secureAccessCode.Append("ProxyPort=<entry>;");
DevSetup.SearchDevice(secureAccessCode.ToString(), DeviceAdapters.imcDevices2x);
```

Select a device

If the device name is unknown, the name can be determined by using the device's serial number.

```
// getting the device object via serial number
string serialNumber = "123456";
EnumItem device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);
```

```
// getting the device identifier
string deviceName = device.Parameters[EClassID.eDeviceName].GetValue().ToString();
```

```
// getting the device name
string deviceNickName = device.Parameters[EClassID.eDeviceNickname].GetValue().ToString();
```

Actual selection of the device is based on the device name (*EClassID.eDeviceNickname*) or the device identifier (*EClassID.eDeviceName*).

```
using imc.Studio.Interfaces.DevSetup;
```

```
// selecting device via nickname
DevSetup.SelectDevice(deviceNickName, true, EDeviceCoreType_V2.Measurement);
```

```
// selecting device via name
DevSetup.SelectDevice(deviceName, false, EDeviceCoreType_V2.Measurement);
```

The device name can also be obtained by using the device list.

New parameters for the device are available, therefore the device object has to be assigned afterwards.

```
// via device name
EnumItem device = DevSetup.Devices[deviceName];
```

```
// via serial number
EnumItem device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);
```

Deselect a device

```
DevSetup.DeselectDevice("DeviceNickName", true, EDeviceCoreType_V2.Measurement);
```

```
DevSetup.DeselectDevice("imcDev__17123456", false, EDeviceCoreType_V2.Measurement);
```

Remove device from List

```
DevSetup.RemoveDevice("DeviceNickName", true);
```

```
DevSetup.RemoveDevice("imcDev__17123456", false);
```

Device control actions

To connect to the device or start and stop the device, the following functions have to be executed.

```
var status = device.Parameters[EClassID.eDeviceControlAction];
// for action values see ParameterValues.eDeviceControlAction
```

```
// connect to device
status.SetValue(ParameterValues.eDeviceControlAction.Connect);
status.ExecuteAction();
```

```
// start measurement
status.SetValue(ParameterValues.eDeviceControlAction.Start);
status.ExecuteAction();
```

```
// stop measurement
status.SetValue(ParameterValues.eDeviceControlAction.Stop);
status.ExecuteAction();
```

```
// disconnect from device
status.SetValue(ParameterValues.eDeviceControlAction.Disconnect);
status.ExecuteAction();
```

For starting/stopping all selected devices:

```
DevSetup.ExecuteAction(ParameterValues.eDeviceControlAction.Start);
```

```
DevSetup.ExecuteAction(ParameterValues.eDeviceControlAction.Stop);
```

or

```
Actions.FireAction(this, "acDeviceConnect"); // connecting
```

```
Actions.FireAction(this, "acDeviceStart"); // starting
```

```
Actions.FireAction(this, "acDeviceStop"); // stopping
```

```
Actions.FireAction(this, "acDeviceDisconnect"); // disconnect
```

Query, if device is selected

```
bool isSelected = device.Parameters[EClassID.eConnectionStatus] != null;
```

List of selected devices (serial number)

```
using System.Collection.Generic;
using System.Linq; // may needs to be added to the references
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
List<string> serialNumbers = DevSetup.Devices
    .Where(device => device.Parameters[EClassID.eConnectionStatus] != null &&
device.Parameters[EClassID.eDeviceSN] != null)
    .Select(device => device.Parameters[EClassID.eDeviceSN].Text)
    .ToList();
```

Measurement state

```
int mState = (int)device.Parameters[EClassID.eMeasurementStatus].GetValue();
```

```
string stateText = device.Parameters[EClassID.eMeasurementStatus].Text;
```

Manufacturer

```
string manufacturer = device.Parameters[EClassID.eManufacturer].Text;
```

Warning

If *ExecuteAction* is used the according parameter/device should be read/assigned again due to internal changing instances. The consequence is a *NullReference* Exception. This could happen when selecting a device or reading TEDs, for instance.

Note

If several actions should be executed, e.g. multi-selection of devices, the methods `DevSetup.BeginTransaction()` and `DevSetup.EndTransaction()` can be used.

Example Use the first device in the list

```
IEnumerator<EnumItem> deviceList = DevSetup.Devices.GetEnumerator();
deviceList.Reset();
deviceList.MoveNext(); // get next element in the list
EnumItem device = deviceList.Current;
if (device != null)
   string deviceName = device.Parameters[EClassID.eDeviceName].GetValue().ToString();
}else{
   // do something, e.g.
    deviceName = String.Empty;
}
```

```
// Alternative
using System.Linq;
// ...
EnumItem device = DevSetup.Devices.First(); // first known device in the list
```

17.1.2.1.2 Storage

Device specific options - Device

```
// Storage interval ; 0 = End of measurement
device.Parameters[EClassID.eUMIntervalTime].SetValue(60d); // 60 seconds
// Storage interval count
device.Parameters[EClassID.eUMIntervalCount].SetValue(128); // all = 0
// Storage locaction: 0: Removable medium, 1: Hard disk (HD); 2: Network drive
device.Parameters[EClassID.eUMDrive].SetValue(0);
```

```
// Save trigger events in individual files (valid for ALL devices!)
device.Parameters[EClassID.eExtraTriggerDirUMHD].SetValue(1);
```

Delete files on selected disk

All data on the selected storage devices are **deleted**.

Please assure, that the device storage location is set correctly, e.g. to the *removable medium*.

```
device.Parameters[EClassID.eUMDrive].SetValue(0); // Removable medium
device.Parameters[EClassID.eDeleteFilesOnSelectedDisk].ExecuteAction();
```

Experiment options (applies to all devices) - PC

These options can be set by setting the parameter of a device, but it will be applied for **all** devices in the experiment.

```
// Storage interval ; 0 = End of measurement
device.Parameters[EClassID.ePCIntervalTime].SetValue(60d); // 60 seconds
// Storage interval count
device.Parameters[EClassID.ePCIntervalCount].SetValue(128); // all = 0
// Save trigger events in individual files
device.Parameters[EClassID.eExtraTriggerDirPCHD].SetValue(true);
device.Parameters[EClassID.eExtraTriggerDirUMHD].SetValue(true);
```

17.1.2.1.3 Diskstart

Write Diskstart to destination

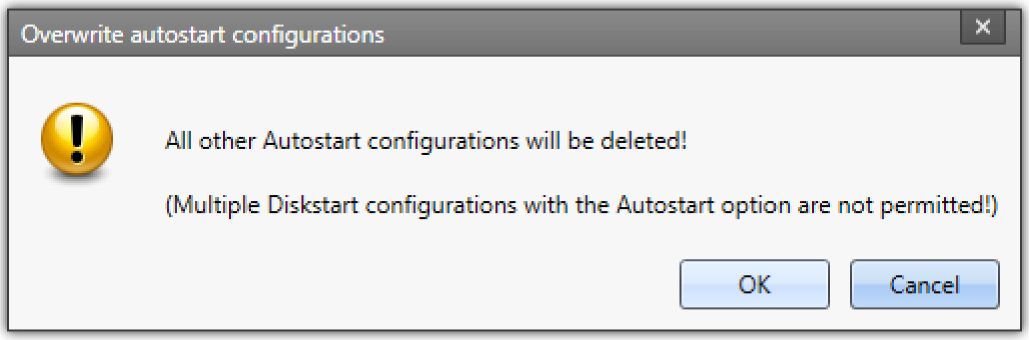
```
device.Parameters[EClassID.eDiskStartSelfStartOption].SetValue(true); // Self-start
```

```
var status = device.Parameters[EClassID.eDiskStartAction];
// See ParameterValues.eDiskStartAction for setting values, e.g.
// 2503: Device HD; 2505: Device intern;
```

```
// saving to removable device
status.SetValue(ParameterValues.eDiskStartAction.Device_PCMCIA);
status.ExecuteAction();
```

```
// saving to PC-HD
status.SetValue(ParameterValues.eDiskStartAction.Device_PC_HD);
status.ExecuteAction();
```

When writing an self-start experiment to the device, a dialog which has to be confirmed **manually** appears.



Dialog: Autostart

If you want to suppress this dialog, open the *Options-Dialog* and go to *General Options > Default dialog response > Overwrite autostart configurations* and choose **OK** from the selection.

This can also be done with Scripting (see chapter Default dialog response 1807):

```
using imc.Studio.Interfaces.V2.Gui;
UserRequest.SetDefaultResultValue("Dev2x_OverwriteSelfStart", EMessageBoxResult.OK);
```

Deletes Diskstart in every selected device

```
foreach(var config in DevSetup.Items[EClassID.eConfig])
{
   var deleteAction = config.Parameters[EClassID.eDiskStarDeleteConfig];
   if((deleteAction != null) && (deleteAction.Base != null))
   {
       // deleteAction.SetValue(ParameterValues.eDiskStarDeleteConfig.Delete);
       deleteAction.ExecuteAction();
    }
}
```

Get Diskstart information

```
// Experiment-Name
var names = DevSetup.Items[EClassID.eConfig]
   .ToList()
   .Where(config => config.Parameters[EClassID.eDiskStartConfigName] != null)
   .Select(config => config.Parameters[EClassID.eDiskStartConfigName].Text);
// Storage location
var location = DevSetup.Items[EClassID.eConfig]
   .ToList()
   .Where(config => config.Parameters[EClassID.eDiskStartLocation] != null)
   .Select(config => config.Parameters[EClassID.eDiskStartLocation].Text);
// Show information
if (names.Any() && location.Any())
{
   MessageBox.Show(names.First() + "\n" + location.First());
}
```

17.1.2.1.4 Misc

Clock type and clock state

```
// Clock type
var clockType = device.Parameters[EClassID.eDeviceClockType].Text;
// Clock state
var clockState = device.Parameters[EClassID.eDeviceClockState].Text;
```

Synchronization

Parameter	ID
Signal input	eSynchSignalInput
Signal output	eSynchSignalOutput
Synchronization master (device)	eSynchMaster
Clock type	eDeviceClockType
Clock state	eDeviceClockState
External synchronization sources	eExternalSynchSignal

You will find the setting values for signal input and output, clock type and state in the ParameterValues class.

Timed start

Parameter	ID
Start option	eStartOption
Start date	eStartDate
Start time	eStartTime
Time offset	eStartTimeOffset
Synchronous start	eSynchStartFlag

You will find the setting values for the start option in the ParameterValues class.

NTP parametes

Parameter	ID	Type
Synchronization NTP Server (1)	eSyncNTPServer1	string
Synchronization NTP Server (2)	eSyncNTPServer2	string
Synchronization waiting time on self start max. [s]	eSyncMaxWaitingTimeOnSelfStart	int
Synchronization NTP deviation time max. [ms]	eSyncNTPMaxDeviation	int
NTP synchronization interval [s] (min;max)	eSyncNTPSyncInterval	string

Example Code:

```
device.Parameters[EClassID.eSyncNTPServer1].SetValue("99.99.99.999");
device.Parameters[EClassID.eSyncNTPServer2].SetValue("11.11.11.111");
device.Parameters[EClassID.eSyncMaxWaitingTimeOnSelfstart].SetValue(1); // int
device.Parameters[EClassID.eSyncNTPMaxDeviation].SetValue(1); // int
device.Parameters[EClassID.eSyncNTPSyncInterval].SetValue("128;1024"); // string
```

Get the fieldbus slot number

Alternative 1 (LINQ):

```
using System;
using System.Linq;
using System.Windows.Forms;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
var serialNumber = "123456";
var device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);
var moduleType = ParameterValues.eModuleType.MT_MFB_CANBUS;

var slotID = device.ChildItems
   .Where(child => child.Parameters[EClassID.eModuleType] != null &&
      (int)child.Parameters[EClassID.eModuleType].GetValue() == moduleType)
   .Select(child => child.Parameters[EClassID.eMFBSlotId].Text);

// Gets the first fieldbus slot number
if (slotID != null && slotID.Any()){
   MessageBox.Show("LINQ: " + slotID.First());
}
```

Alternative 2 (foreach):

```
using System;
using System.Linq;
using System.Windows.Forms;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
var serialNumber = "123456";
var module Type = ParameterValues.eModuleType.MT_MFB_CANBUS;
var slot= GetSlotID(moduleType, serialNumber );
System.Windows.Forms.MessageBox.Show("(): " + slot);
```

```
private string GetSlotID(int eClassID, string serialNumber){
  string slot ="unkown Slot ID";
  var device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);

  foreach (var para in device.ChildItems ) {

      var paraModuleType = para.Parameters[EClassID.eModuleType];

      if (paraModuleType != null){
         int moduleType = (int)paraModuleType.GetValue();
         if ( eClassID == moduleType) {
             slot = para.Parameters[EClassID.eMFBSlotId].Text;
             return slot;
         }

      } // ChannelTypeVal
  } // end of foreach
  return slot;
}
```

17.1.2.2 Channel functions

Note

- For setting the parameters, class *EClassID* is used. Setting values of the parameter are available in the *ParameterValues*-Class. See also Channel Parameters 1830.
- The method `ExecuteActions()` is only needed for device and channel actions. For parameters the method `SetValue()` is used.

The following line is needed for the following examples. The channel *Channel_001* is used. The channel name is case sensitive.

```
var channel = DevSetup.Channels["Channel_001"];
```

Setting parameters of bits (e.g. comment):

```
var port = DevSetup.Channels["DIN001"];
var bit = port.ChildItems["DIN001_Bit01"];
bit.Parameters[EClassID.eChannelComment].SetValue("MyComment");
```

To use the class *EClassID* the following **library** has to be added:

```
using imc.Studio.Tools.DevSetupGraphGenerator;
```

The parameters are used as follows

```
// EClassID_Parameter as string or from EClassID-Class
//var parameter = channel.Parameters["eMyParameter"];
var parameter = channel.Parameters[EClassID.eSampleTime]; // Example
```

Set parameter value

```
parameter.SetValue("SetValue");
```

Get parameter value

```
string parameterValue = parameter.GetValue().ToString();
```

Get printout of the parameter value

```
string parameterText = parameter.Text;
```

Select list of parameter values, if available

```
string [] paraTextArray = parameter.TextList;
```

Metadata columns can be edited via the identifier (here: *MyIdentifier*).

```
var parameter = channel.Parameters["MyIdentifier"];
```

```
// get or set a parameter value
parameter.SetValue("MySettingValue");
string parameterText = parameter.GetValue().ToString();
```

For further information, please see the following chapters:

- Parameter 1754
- Data transfer 1759
- Curve window 1760

17.1.2.2.1 Parameter

Channel name

```
var deviceParameter = DevSetup.Devices["DeviceName"].Parameters;
var channelParameter = DevSetup.Channels["ChannelName"].Parameters;
```

```
// Change Channel name
channelParameter[EClassID.eChannelName].SetValue("Channel_001_new");
```

Balance actions

```
var paraBalanceAction = channel.Parameters[EClassID.eBalanceAction];
```

```
// set offset
paraBalanceAction.SetValue(ParameterValues.eBalanceAction.Offset);
paraBalanceAction.ExecuteAction();
```

```
// set bridge
paraBalanceAction.SetValue(ParameterValues.eBalanceAction.Bridge);
paraBalanceAction.ExecuteAction();
```

```
// set tare
paraBalanceAction.SetValue(ParameterValues.eBalanceAction.Tare);
paraBalanceAction.ExecuteAction();
```

```
// set manufacture's calibration
paraBalanceAction.SetValue(ParameterValues.eBalanceAction.Reset);
paraBalanceAction.ExecuteAction();
```

Balance state

```
string balanceState = channel.Parameters[EClassID.eBalanceStatus].Text;
```

Cable compensation

```
var paraCalibAction = channel.Parameters[EClassID.eCalibrationAction];
```

```
paraCalibAction.SetValue(ParameterValues.eCalibrationAction.CableCompensation); // Cable
channel.Parameters[EClassID.eCalibrationAction].ExecuteAction();
```

```
double cableResistance = (double)channel.Parameters[EClassID.eCableResistor].GetValue();
```

Channel comment

```
channel.Parameters[EClassID.eChannelComment].SetValue("My Channel");
```

Channel name via connector

The channel name of connector "[01] IN01" is queried here. The channel-object with its parameters is In the variable *query.*

```
using System.Linq;
```

```
string plugInName = "[01] IN01";
var channels = DevSetup.Channels
   .Where(channel => channel.Parameters[EClassID.ePlugInName] != null &&
channel.Parameters[EClassID.ePlugInName].Text == pluginName);
```

```
// read channel name
string name = string.Empty;
if (channels != null){
   name = channels.First().Parameters[EClassID.eChannelName].Text;
}
```

```
// write channel name
string name = "MyChannel";
if ( channels != null ){
   channels.First().Parameters[EClassID.eChannelName].SetValue(name);
}
```

If there is a problem with the *where*-query, please use *foreach* instead.

Channel status

The channel name must exist and the value to be set must be valid for this type of channel.

```
// setting status of channel "Channel_1" to "active"
channel.Parameters[EClassID.eStatus].SetValue(ParameterValues.eStatus.Active);
// setting status to "passive"
channel.Parameters[EClassID.eStatus].SetValue(ParameterValues.eStatus.Passive);
// setting status to "write"
channel.Parameters[EClassID.eStatus].SetValue(ParameterValues.eStatus.Write);
// setting status to "read/write"
channel.Parameters[EClassID.eStatus].SetValue(ParameterValues.eStatus.Read_Write);
```

Connector / Enumerated channel number

```
// Connector name
string connectorName = channel.Parameters[EClassID.ePlugInName].Text;
// Enumerated channel number
string channelNumber = channel.Parameters[EClassID.eEnumeratedChannelNumber].Text;
```

Coupling

```
channel.Parameters[EClassID.eCoupling].SetValue(ParameterValues.eCoupling.AC);
channel.Parameters[EClassID.eCoupling].SetValue(ParameterValues.eCoupling.DC);
// See ParameterValue.eCoupling for more setting values
```

Duration

Duration of measurement can be set by the following code whereas the argument is time in seconds.

```
double duration = 60d;
channel.Parameters[EClassID.eDuration].SetValue(0); // undefined
channel.Parameters[EClassID.eDuration].SetValue(duration); // 60 seconds
```

Filtering

The filtering is set to a Butterworth-Bandpass with cutoff-frequencies 10 Hz and 50 Hz.

```
var paraFilterChar = channel.Parameters[EClassID.eFilterCharacteristic];
paraFilterChar.SetValue(ParameterValues.eFilterCharacteristic.Butterworth);

var paraFilterType = channel.Parameters[EClassID.eFilterType];
paraFilterType.SetValue(ParameterValues.eFilterType.Bandpass);

channel.Parameters[EClassID.eFiltCutoff1].SetValue(10); // 10 Hz
channel.Parameters[EClassID.eFiltCutoff2].SetValue(50); // 50 Hz
```

Input range

Input range is set to ±2.5V.

```
string str = "\u00b1" + "2.5 V"; // \u00b1 = PlusMinus-Symbol
channel.Parameters[EClassID.eRange].SetValue(str);
```

Input range of channel *Channel_001* is set to a text variable.

```
using imc.Studio.PlugIns.DevSetup.Common;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
var paraRange = DevSetup.Channels["Channel_001"].Parameters[EClassID.eRange];
string sRange = paraRange.Text; // Display value of range, e.g. "±5 V"
```

Remarks: The only values which can be set are available in the selection list on the Setup page.

A list of possible ranges can be obtained by the following code:

```
var pRange = DevSetup.Channels["Channel_001"].Parameters[EClassID.eRange];
string [] sRange = pRange.TextList;
```

Module type: UNI2-8
Input range
±50 V
±25 V
±10 V
±5 V
±2.5 V
±1 V
±0.5 V
±0.25 V
±0.1 V
±0.05 V
±0.025 V
±0.01 V
±0.005 V

Values for other module types are listed in the corresponding data sheets.

Module type

```
// Return value is language dependent
string sModuleType = channel.Parameters[EClassID.eModuleType].Text;
// -> Bridge, current and voltage amplifier and temperature measurement unit "UNI2-8"
```

Preprocessing

In the following code an arithmetic mean value over 5 sample points is set as preprocessing.

```
var paraProcess = channel.Parameters[EClassID.eProcessing];
paraProcess.SetValue(ParameterValues.eProcessing.ArithMean);
channel.Parameters[EClassID.eProcessingPoints].SetValue(5);
```

Sample time / sample rate

Sample Time is set to 1 ms:

```
// setting Sample Time to 0.001s = 1ms = 1000 Hz
channel.Parameters[EClassID.eSampleTime].SetValue(0.001);
```

Remarks: The only values which can be set are available in the selection list on the Setup page.

A **module-specific** list of possible sample times can be obtained by the following code:

```
var pSampleTime = DevSetup.Channels["Channel_001"].Parameters[EClassID.eSampleTime];
string [] sSampleTimeList = pSampleTime.TextList;
```

Module type: UNI2-8	
Sample rate	**Sample time**
100 kHz	10 µs
50 kHz	20 µs
10 kHz	100 µs
5 kHz	200 µs
1 kHz	1 ms
500 Hz	2 ms
200 Hz	5 ms
100 Hz	10 ms
50 Hz	20 ms
20 Hz	50 ms
10 Hz	100 ms
5 Hz	200 ms
2 Hz	500 ms
1 Hz	1 s
0.5 Hz	2 s
0.2 Hz	5 s
0.1 Hz	10 s
0.05 Hz	20 s
0.0333333 Hz	30 s
0.0166666 Hz	60 s

Values for other module types are listed in the corresponding data sheets.

Sensitivity/Scale and Offset

The scaling and offset of an channel are set in the following code.

```
channel.Parameters[EClassID.eUserUnit].SetValue("Pa"); // Pascal
channel.Parameters[EClassID.eUserOffset].SetValue(1); // 1 Pa
channel.Parameters[EClassID.eUserScalingFactor].SetValue(5); // = 1/Sensitivity
```

Strain gauge

```
Coupling
channel.Parameters[EClassID.eCoupling].SetValue(ParameterValues.Coupling.HalfBridge;
```

```
Bridge resistor
channel.Parameters[EClassID.eBridgeResistor].SetValue(120);
```

```
Bridge mode
channel.Parameters[EClassID.eBridgeBridgeMode].SetValue(1);
// 1=>strain; 2=>stress
```

```
Bridge factor N
channel.Parameters[EClassID.eBridgeN].SetValue(1);
// 1=>1; 2=>2; 4=>3; (1-v)=>4; (1+v)=>5; 2*(1-v)=>6; 2*(1+v)=>7
```

```
Gauge factor k
channel.Parameters[EClassID.eBridgeFactor].SetValue(1);
```

```
Bridge unit
channel.Parameters[EClassID.eBridgeUnit].SetValue(1);
```

```
Transverse strain coefficient v
channel.Parameters[EClassID.eBridgeEps].SetValue(0.3);
```

```
Modolus of elasicity
channel.Parameters[EClassID.eBridgeEModule].SetValue(1);
```

TEDs: Read/Write sensor information

Warning

If *ExecuteAction* is used the according parameter/device should be read/assigned again due to internal changing instances. The consequence is a *NullReference* Exception. This could happen when selecting a device or reading TEDs, for instance.

```
// read
var paraReadSensor = channel.Parameters[EClassID.eSensorAction];
paraReadSensor.SetValue(ParameterValues.eSensorAction.ReadSensorFlash);
paraReadSensor.ExecuteAction();
```

```
// write
var paraReadSensor = channel.Parameters[EClassID.eSensorAction];
paraReadSensor.SetValue(ParameterValues.eSensorAction.WriteSensorFlash);
paraReadSensor.ExecuteAction();
```

```
// delete
var paraReadSensor = channel.Parameters[EClassID.eSensorAction];
paraReadSensor.SetValue(ParameterValues.eSensorAction.ResetChanWithSensorh);
paraReadSensor.ExecuteAction();
```

Two-Point scaling

Set the two-point values as `string`. If they are set as `double`, the scaling factor and offset is considered.

```
channel.Parameters[EClassID.ePoint1SetValue].SetValue("20");
channel.Parameters[EClassID.ePoint1BalanceAction].ExecuteAction();
```

```
channel.Parameters[EClassID.ePoint2SetValue].SetValue("50");
channel.Parameters[EClassID.ePoint2BalanceAction].ExecuteAction();
```

```
var paraCalibAct = channel.Parameters[EClassID.eCalibrationAction];
paraCalibAct.SetValue(ParameterValues.eCalibrationAction.TwoPoint); // Two Point
channel.Parameters[EClassID.eCalibrationAction].ExecuteAction();
```

Unit

To use the types CValueArray the following reference must be added: imc.Studio.PlugIns.DevSetup.Common

Also add the following using-Directive to the script file: `using imc.Studio.PlugIns.DevSetup.Common`

Escaping of quotation marks (") by using backslash (\).

```
// setting User Unit to N/m
channel.Parameters[EClassID.eUserUnit].SetValue("\"N/m\"");
```

```
// reading unit
var paraUnit = DevSetup.Channels["Channel_001"].Parameters[EClassID.eUserUnit];
object oUnit = paraUnit.GetValue();
CValueArray cUnit = oUnit as CValueArray;
string sUnit = cUnit[0].ToString(); // unit is the element with index 0
```

Balance at Device start

Set the following parameter to perform a balance action at the device start (Diskstart/Self-start):

```
channel.Parameters[EClassID.eBalanceAtDeviceStart].SetValue(true);
```

17.1.2.2.2 Data transfer

Save data (PC)

```
// activate saving to Hard Disk
channel.Parameters[EClassID.ePCTransferToHD].SetValue(true);
// deactivate
channel.Parameters[EClassID.ePCTransferToHD].SetValue(false);
```

```
// Saved events (PC) ; 0 = all; 1 = last
channel.Parameters[EClassID.eAvailableEvents].SetValue(0);
```

```
// Circular buffer time (PC)
channel.Parameters[EClassID.ePCRingTime].SetValue(60d); // 60 seconds
```

Save data (Device)

```
channel.Parameters[EClassID.eUMTransferToHD].SetValue(true);
```

Transfer to PC

```
// activate
channel.Parameters[EClassID.eTransferToPC].SetValue(true);
// deactivate
channel.Parameters[EClassID.eTransferToPC].SetValue(false);
```

Display, calculations of measured data

```
// Available Events (Display) ; 0 = all; 1 = last
channel.Parameters[EClassID.eDisplayAvailableEvents].SetValue(0);
```

```
// Circular buffer time (Display)
channel.Parameters[EClassID.eDisplayRingTime].SetValue(60d);
```

Buffer time (RAM)

```
channel.Parameters[EClassID.eBufferTime].SetValue(60d); // 60 seconds; auto = 0
```

17.1.2.2.3 Curve window

Display Time / Circular Buffer Time (Curve Window)

```
channel.Parameters[EClassID.eDisplayRingTime].SetValue(60d);
```

Graph Color

Does not change during measurement.

```
// preset Color
int color = Color.Tomato.ToArgb();
// via RGB
int color = Color.FromArgb(0,255,255).ToArgb();
// set
channel.Parameters[EClassID.eCurveColor].SetValue(color);
```

y-Axis (Scale)

```
channel.Parameters[EClassID.eCurveYAxisOption].SetValue(2);
// Input-Range (1), user-defined (2), auto (3)
channel.Parameters[EClassID.eCurveYAxisMax].SetValue(20d);
channel.Parameters[EClassID.eCurveYAxisMin].SetValue(-20d);
```

17.1.2.2.4 Examples

Example — Saving all active analog channels to hard disk drive

```
using System.Linq;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
public override void Run()
{
   DevSetup.Channels
      .Where(channel => IsAnalogChannel(channel) && IsActive(channel))
      .ToList()
      .ForEach(channel => SaveToHardDiskDrive(channel));
}
```

```
private bool IsAnalogChannel(EnumItem channel)
{
   bool isAnalog = false;
   var channelTypeParameter = channel.Parameters[EClassID.eChannelType];
   if (channelTypeParameter != null)
   {
      var channelTypeValue = channelTypeParameter.GetValue();
      isAnalog = (int)channelTypeValue == ParameterValues.eChannelType.AnalogInput;
   }

   return isAnalog;
}
```

```
private bool IsActive(EnumItem channel)
{
   bool isActive = false;
   var statusParameter = channel.Parameters[EClassID.eStatus];
   if (statusParameter != null)
   {
      var statusValue = statusParameter.GetValue();
      isActive = (int)statusValue == ParameterValues.eStatus.Active;
   }

   return isActive;
}
```

```
private void SaveToHardDiskDrive(EnumItem channel)
{
   var saveParameter = channel.Parameters[EClassID.ePCTransferToHD];
   if (saveParameter != null)
   {
      saveParameter.SetValue(true);
   }
}
```

17.1.2.3 Panel and Widget functions

Here you find the function to access the Panel and the Widget:

- Panel 1762
- Widget 1764
- Tables 1765
- Curve window 1766

17.1.2.3.1 Panel

Get the active Panel page

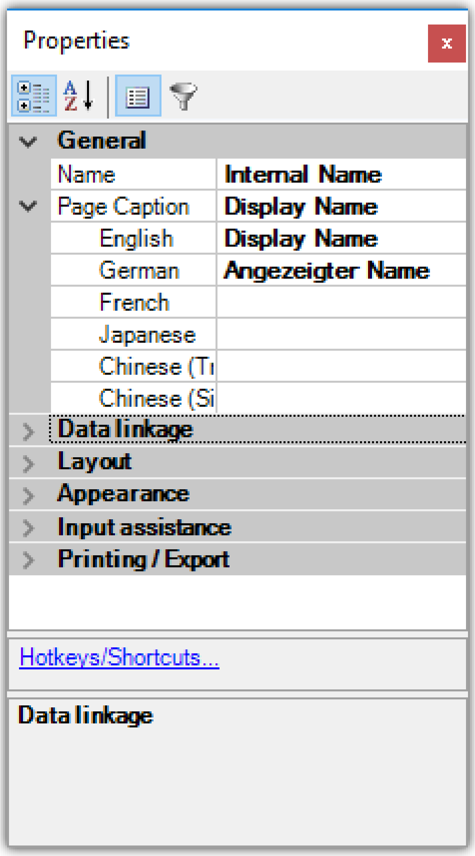
```
PanelPage page = Panel.GetActivePage();
```

Set Panel page with name "Page 1" as active

```
string pageName = "Internal Name";
Panel.SetActivePage(Panel.GetIndexOf(pageName)); // index is needed
```

Note

- For the page name `pageName` the internal name (*Name*) is used and not the displayed name (*Page Caption*) is not used.
- When renaming the *Page Caption* of a side, the *Name* property should also be adapted.



Page properties

Export Panel page

```
using imc.Common.Interfaces.Panel.Scripting;
```

```
Panel["Page 1"].Export(eFileFormat.PDF, @"c:\temp\myPage.pdf");
Panel["Page 1"].Export(eFileFormat.BMP, @"c:\temp\myPage.png");
Panel["Page 1"].Export(eFileFormat.DBV, @"c:\temp\myPage.dbv");
```

Import Panel page

```
string filename = @"c:\temp\myPage.dbv";
int pageIndex = 0; // page index, after the page has to be imported
Panel.InsertPageAfter(pageIndex, filename, "Page 1", "Page 1");
```

```
string filename = @"c:\temp\myPage.dbv";
int pageIndex = 0; // page index, before the page has to be imported
Panel.InsertPageBefore(pageIndex, filename, "Page 1", "Page 1");
```

Delete Panel page

```
Panel["Page 1"].DeletePage();
```

Rename Panel page

```
string error = string.Empty;
Panel["Page 1"].SetPageName("Page renamed", out error);
```

Create a Windows.Forms on the Panel page

It is recommended to create this form in a Panel script in the Initialize-method.

```
using System.Windows.Forms;
```

```
Control MyForm = new Control();
// ... configure form
Panel["Page 1"].Controls.Add(MyForm); // add form
```

The Windows.Forms are deleted when entering the design-mode. It is recommended to use a **Panel Script**.

Events for "Page added" and "Page deleted"

The Events "PageCreated" and "PageDeleted" can be used to react on adding or deleting a Panel page

These can be used in a **Context script**.

```
// Run
Panel.PageCreated += new Action<object, PanelPageEventArgs>(OnPageCreated);
Panel.PageDeleted += new Action<object, PanelPageEventArgs>(OnPageDeleted);
```

```
void OnPageDeleted(object arg1, PanelPageEventArgs arg2)
{
   string text = "New page: " + arg2.PageCaption + " (" + arg2.PageName + ") was delete from
position " + arg2.Position.ToString() + ".";
   Core.Logbook.LogEntry("CheckPanel", text, 0 , ELogbookEntryCategory.Information);
}

void OnPageCreated(object arg1, PanelPageEventArgs arg2)
{
   string text = "New page: " + arg2.PageCaption + " (" + arg2.PageName + ") was added at
position " + arg2.Position.ToString() + ".";
   Core.Logbook.LogEntry("CheckPanel", text, 0 , ELogbookEntryCategory.Information);
}
```

```
// Dispose
protected override void CheckPanelDispose() {
   // Release all your resources and event hooks here.
   Panel.PageCreated -= OnPageCreated;
   Panel.PageDeleted -= OnPageDeleted
}
```

Example — Adding a button to a Panel page

A button with the text "MyText" is added to a page at a specific position with a given size. An action can be added, when clicking on the button.

```
using System.Windows.Forms;
```

```
Button cButton = new Button();
cButton.Text = "MyText";
cButton.Bounds = new Rectangle(100, 50, 100, 50);
// cButton.Click += new EventHandler(eventFunction);
Panel["Page 1"].Controls.Add(cButton as Control);
```

Subsequently, the Windows-control can be copied to the script clipboard.

17.1.2.3.2 Widget

The properties of a Widget can be changed by using `Panel["Page name"]["Widget name"]`. The page name and Widget are case sensitive.

Be sure, that the property is available for the Widget.

Position and size

```
int x = 10; // x-position
int y = 50; // y-position
int h = 100; // height
int w = 200; // width
Panel["Page 1"]["Standard_meter1"].Bounds = new Rectangle(x,y,h,w);
```

Several properties

```
Widget w = Panel["Page 1"]["Standard_meter1"];
//Panel["PageName"]["WidgetName"].PROPERTY = VALUE;
```

```
// Range
w.Max = 30;
w.Min = 10;
w.Interval = 10;
```

```
// Active
Panel["Page 1"]["Rocker_switch1"].Enabled = true;
// Visibility
w.Visible = true
```

```
// Texte setzen
w.Text.SetText("en", "MyText");
```

```
// Connect variable to widget
Panel["Page 1"]["Standard_meter1"].Variable.Name = "MyVariable";
```

The first parameter of `SetText()` is a country code for setting texts in different languages.

Standard Widget

To set the text of a Standard Widget the property `StandardText` has to be set. `SetText()` is not available for Standard Widget.

```
Panel["Page 1"]["CheckBox1"].StandardText = "MyText";
Panel["Page 1"]["CheckBox1"].StandardVariable = "MyVariable";
Panel["Page 1"]["Label"].StandardText = "Hello World!";
```

Setting zones of lists

```
using System.Linq;
```

```
// Automotive, Designer, Industrial
Panel["Page 1"]["List1"].Zones.ElementAt(0).Text.SetText("en", "Entry_1");
Panel["Page 1"]["List1"].Zones.ElementAt(0).SetValue = 0.1;
Panel["Page 1"]["List1"].Zones.ElementAt(0).UpperLevel = 0.1; // sets the upper level
Panel["Page 1"]["List1"].Zones.ElementAt(0).LowerLevel = 0.1; // sets the lower level
```

Note

It is not possible to add Zones via Scripting. If a select list is needed, a **ComboBox** from the `Windows.Forms`-Class can be used. Entries can be added to this control.

Curve window: add Signal

```
// add signal to a new y-axis
Panel["Page 1"]["Curve1"].AddSignal("Channel_001",eAppendConstants.AppendNewAxis);
// add Signal to a new coordinate system
Panel["Page 1"]["Curve1"].AddSignal("Channel_001",eAppendConstants.AppendNewCosy);
// add signal to existing y-axis
Panel["Page 1"]["Curve1"].AddSignal("Channel_001",eAppendConstants.AppendNewLine);
```

Properties of signals can be set via `Panel["Page 1"]["Curve1"].Signals`.

Zones changed (e.g. list)

The event handling methods are run **asynchronously**.

```
public class MyPanel : AbstractMyPanel {

   /// List1 : GaugeWidget
   public override void Run() {
         List1.ZoneChanged += new Action<object, EventArgs>(List1_ZoneChanged);
   } // run

   void List1_ZoneChanged(object arg1, EventArgs arg2) {
         MessageBox.Show("Hello World!");
   } // List1_ZoneChanged

   public override void Stop() {
         List1.ZoneChanged -= List1_ZoneChanged;
   } // stop
} // class
```

17.1.2.3.3 Tables

Link variables to a table cell

The following code links the 1st cell in the 1st column to the variable *Var_01.*

```
using System.Linq;
```

```
var table = Panel["Page 1"]["Table1"];
var cell = table.Columns.ElementAt(0).Cells.ElementAt(0); // 1st col, 1st element
cell.Variable.Name = "Var_01";
```

Access to table cells

The folling example sets the text of the first column in the first row to "Hello World".

```
using System.Linq;
```

```
var cell = Panel["Page 1"]["Table1"].Columns.ElementAt(0).Cells.ElementAt(0)
cell.Text.SetText("en", "Hello World");
```

Table events

Syntax	Description
OnCellClick	Invoked, when a cell is clicked.
OnCellDisplayValueChangedByUser	Invoked, when the user changes the value of a cell.
OnCellDoubleClick	Invoked, when a cell is double-clicked.
OnColumnHeaderClick	Invoked, when the head of a column is clicked.
OnColoumnHeaderDoubleClick	Invoked, when the head of a column is double-clicked.
OnRowIndicatorClick	Invoked, when the indicator is clicked.
OnRowIndicatorDoubleClick	Invoked, when the indicator is double clicked.
OnSelectionChanged	Invoked, when the selection of the cells has changed.

Table functions

Syntax	Description
Region: Tabelle	
CellClick()	Performs a mouse click to the given cell.
CellDisplayValue()	Gets the display value of the cell.
CellDoubleClick()	Performs a double-click to the given cell.
GetCell()	Gets the cell as an CellWidget object.
GetColumn()	Gets the column as an ColumnWidget object.
SelectionClear()	Clears the current selection.

Table properties

Syntax	Description
Region: Table (TableWidget)	
SelectedCells	Gets the selected cells.
RowCount	Gets the amount of rows.
ColumnCount	Gets the amound of columns.
Region: Columns (ColumnWidget)	
Selected	Returns true, if the column is selected.
Region: Cells (CellWidget)	
Selected	Returns true, if the cell is selected.

17.1.2.3.4 Curve window

The following line is needed for the following examples.

```
Widget w = Panel["Page 1"]["Curve1"];
```

The following **libraries** are needed for constants and colors:

```
using imc.Common.Interfaces.Panel.Scripting;
using System.Drawing;
```

Add signals

In the constant *eAppendConstants*, the options for adding as a new y-axis or new coordinate system are included.

```
w.AddSignal("Channel_001",eAppendConstants.AppendNewAxis);
w.AddSignal("Channel_002", eAppendConstants.AppendNewLine);
w.AddSignal("Channel_003", eAppendConstants.AppendNewCosy);
```

Display mode

```
w.DisplayMode = eDisplayMode.Stacked;
```

```
// Display mode
public enum eDisplayMode {
   Default = 1,Stacked, Waterfall, ColorMap, LastValue, Barmeter, Table, ThreeD
}
```

Loading and saving curve window configurations

```
w.Save(@"c:\Test\MyCurve"); // ccv is appended automatically
w.Load(@"c:\Test\MyCurve"); // ccv is appended automatically
```

Axis settings

```
CurveAxis xAxis = w.xAxis;
CurveAxis yAxis = w.yAxis;
```

```
// Scale
xAxis.ScaleType = eAxisScaleConstants.ccwAbsTime; // ccwUnit
// Display range
xAxis.MinMaxType = eAxisMinMaxConstants.ccwFix;
// Minimum / Maximum
xAxis.SetMinMax(-10;10);
double max = xAxis.CurrentMax;
double min = xAxis.CurrentMin;
```

Signal settings

```
CurveSignalLine line = w.Signals[0];
```

```
// Color
line.Color = Color.Blue;
// Line shape
line.Shape = eLineShape.Line; // Bar, Bar3D, Dots, LineCubic, None, Steps, VertLine
//
line.ShowInLegend = eAutoBool.Auto; // Yes , No
//
string name = line.SignalName;
//
line.width = 3;
// Delete a signal from the curve window
line.Delete();
```

Delete all signals

```
foreach (var signal in w.Signals)
{
   signal.Delete();
}
```

Delete all coordinate systems

Please add the reference *imc.Comman.Controls.ImcPanel* to the script project.

`if null`-checks are omitted here.

Afterward only one coordinate system is remaining which cannot be deleted.

```
using imc.Common.Controls.ImcCurves.Interfaces;
using imc.Common.Controls.ImcPanel.Widgets;
```

```
var imcCurve = w.Base as CimcCurveWidget;
var imcCurveCtrl = imcCurve.CurveCtrl;
for (int i = imcCurveCtrl.CoSystems.Count - 1; i>= 1; i--)
{
   imcCurveCtrl.CoSystems.Delete(i, CwIncludeConstants.IncludeRelated);
}
```

For further information also see the **tutorial** Curve Window and channel selection 1852.

17.1.2.3.5 Curve window with imc FAMOS

Libraries

The class *Curve_Window* contains the imc FAMOS functions for the curve window. Using this class, it is possible to control curve windows in imc STUDIO.

```
using imc.Famos.Kits;
```

Load curve window configuration

```
Curve_Window.General.CwLoadCCV("Curve1",strFilename);
```

Add channel to an existing curve window

The corresponding Panel page must be visible and the Design mode must not be activated.

```
Curve_Window.General.CwSelectWindow("Curve1"); // Widget name
```

```
DmChannel channel = new DmChannel();
channel.Name = "MyChannel";
Curve_Window.Elements.CwNewChannel("append last axis", channel);
channel.Dispose();
```

Changing the curve window measurement cursor's position

```
// Run method of Panel script
w.CursorMove += CursorMoveEvent;
```

```
public void CursorMoveEvent(object sender,EventArgs e){
   Curve_Window.General.CwSelectWindow("Curve1");
   double xleft = Curve_Window.Properties.CwDisplayGet("measure.x.left");
   Datapool["xleft"].SetContent<double>(xleft);
   // ...
}
```

```
// Stop method
w.CursorMove -= CursorMoveEvent;
```

Scroll mode

```
Curve_Window.General.CwSelectWindow("Curve1");
Curve_Window.Properties.CwDisplaySet("scroll",0);
```

Several actions

```
Curve_Window.General.CwAction("");   // see editor's tool-tip for more information
```

Set y-Axis color to color of first line

```
Curve_Window.General.CwSelectWindow("Curve1");
Curve_Window.Elements.CwSelectByIndex("y-axis", 1);
Curve_Window.Properties.CwAxisSet("font.color", -3);
// -1 automatic; RGB-Color (as int) for fixed
```

17.1.2.4 Datapool functions

Note

- Be sure, that the variables are available in the Data Browser or are created in the script.
- Check if variable is available in the script.
- For other Script types (Panel, Event, ...) the Datapool is called with Core.Datapool.

```
var variable = Datapool["MyVariable"];
if (variable != null)
{
   //... do something
}
else
{
   // ... throw error
}
```

The following **libraries** are needed:

```
using imc.Common.Interfaces.DataPool;
using imc.Common.Components.DataManager.Interfaces;
```

The different variable types can be found in the corresponding chapter:

- Variablen 1770
- Channels 1771
- Report channels 1773
- Complex Variables 1774
- DataTables 1776
- Examples 1776

17.1.2.4.1 Variables

Create variables

```
// create numeric and text variable
bool isSuccessNumeric = Datapool.CreateVariable<double>("NumericVariable", 0d);
bool isSuccessText = Datapool.CreateVariable<string>("TextVariable", "MyText");
```

In the Data Browser the variables are created in the category *Scripting* with default scope *temporary*.

Create variables with scope

```
// create variables with scope
Datapool.CreateVariable<double>("TemporaryNumber", 0d, EVariableScope.Volatile);
Datapool.CreateVariable<double>("ExperimentNumber", 0d, EVariableScope.Experiment);
Datapool.CreateVariable<double>("ProjectNumber", 0d, EVariableScope.Project);
Datapool.CreateVariable<double>("GlobalNumber", 0d, EVariableScope.Persistent);
```

Create variables in a group

```
// Sub-group / folder
bool isSuccessGroup = Datapool.CreateVariable<double>("Group.Name", 0d);
```

Delete variables

```
// delete variable
bool isSuccessDelete = Datapool.DeleteVariable("NumericVariable");
```

Set content of variables

```
// sets a text to the variable "TextVariable" in the Data Browser
string text = "Hello World!";
Datapool["TextVariable"].SetContent<string>(text);
```

```
// sets a number to the variable "NumericVariable" in the Data Browser
double number = 42.21;
Datapool["NumericVariable"].SetContent<double>(number);
```

Get content of variables

```
// gets the content of the text variable "TextVariable" in the Data Browser
string strVariable = Datapool["TextVariable"].GetContent<string>();
```

```
// gets the content of the numerical variable "NumericVariable" in the Data Browser
double dVariable = Datapool["NumericVariable"].GetContent<double>();
```

Properties of variables

Variables Properties can be read and set via "VariableProperties"

```
DataPoolVariable variable = Datapool["VariableName"];
string unit = variable.VariableProperties.Unit; // gets the unit
unit.VariableProperties.Scope = EVariableScope.Experiment; // set scope
```

```
variable.VariableProperties.Set<string>(EVariableProperty.eCategory, "__USER__"); // set property
var category = variable.VariableProperties.Get<string>(EVariableProperty.eCategory); // get
property
```

EVariableScope	
Selection	**Description**
Volatile	Variable only exist in the current instance of imc STUDIO.
Experiment	Variable only exist in the Experiment context.
Sequencer	Variable only exist in the Sequencer context.
Project	Variable only exist in the Project context.
Presistent	Variable exist in the Application.

EVariableProperty (digest)	
Selection	**Description**
eCategory	Category of the variable.
eDisplayColor	Display color in the curve window.
eYUnit	y-Unit
eYOffset	y-Offset
eXUnit	x-Unit
eXOffset	x-Offset
eSampleTime	Sample time
eComment	Comment

Changing the category

Show variable in the "*user-defined variables*" category:

```
DataPoolVariable variable = Datapool["VariablenName"];
variable.VariableProperties.Set<string>(EVariableProperty.eCategory, "__USER__");
```

17.1.2.4.2 Channels

Get channel

```
// Channel from Current Measurement
string channelName = "Channel_001";
```

```
// from specific time stamp
string channelName = "Channel_001@2013-01-01 09-00-00 (1)";
```

```
// from measurement number 1
string channelName = "Channel_001@Measurement#1";
```

```
// from last measurement
string channelName = "Channel_001@Measurement#LAST"
```

```
var dpChannel = Datapool[channelName];
IDmChannel dataChannel = null;
if (dpChannel != null){
   dataChannel = dpChannel.GetContent<IDmChannel>();
}
```

The measurements must be loaded in the Data Browser.

Get channel data

```
double[] data = null;
if (dataChannel != null){
   if (dataChannel.Length > 0){
      data = dataChannel.Data; // access to channel data. if available
      // Do something
   }
}
```

Get channel data (event triggered)

The circular buffer time (Transfer to PC) has to be set to *unlimited*.

```
double[] data1 = dataChannel.Events[0].Data;
double[] data2 = dataChannel.Events[1].Data;
```

Set channel

```
DmChannel channelOut = new DmChannel(); // create new Channel
channelOut = DmChannel.CloneOf(dataChannel); // creates a copy of "myIChannel"
channelOut.Name = "Channel_output"; // rename
// ... calculations ...
DatapoolVariable dpOut = Datapool[ChannelOut.Name];
// if variable does not exist, create
if (dpOut == null){
   Datapool.CreateVariable<DmChannel>(channelOut.Name, channelOut);
}else{
   Datapool[channelOut.Name].SetContent<DmChannel>(channelOut);
}
channelOut.Dispose(); // DmChannel has to be disposed
```

Note

Objects of type **DmChannel** must be *diposed* after using (e.g. writing to Datapool).

Transfer channel to imc FAMOS

```
dataChannel.TransferToFamos();
```

Save channel to file

```
dataChannel.Save("C:\\Users\\myName\\Desktop\\myChannel.raw");
```

Load channel from file

```
channelOut.Load("C:\\Users\\myName\\Desktop\\myChannel.raw");
```

Show channel in a separate curve window

```
channelOut.Show();
```

Create XY channel

```
using imc.Common.Components.DataManager;
using imc.Common.Components.DataManager.Interfaces;
```

```
double[] xData = {2, 3, 5, 7, 11, 13, 17, 19}; // 8 elements
double[] yData = {4, 9, 25, 49, 121, 169, 289, 361};

DmChannel channel = new DmChannel("xyChannel", IDmChannel.DmChannelType.XY);
channel.Length = xData.Length;
channel.Cmp.X.SetData<double>(xData);
channel.Cmp.Y.SetData<double>(yData);

if (Datapool[channel.Name] == null){
   Datapool.CreateVariable<DmChannel>(channel.Name, channel);
}else{
   Datapool[channel.Name].SetContent<DmChannel>(channel);
}

channel.Dispose();
```

Note

When using **DmChannel** objects, it is important that the object is *disposed*.

```
DmChannel channel = new DmChannel();
// ...
channel.Dispose();
```

17.1.2.4.3 Report channels

Report Channels

```
var reportVariable = Datapool["ReportChannel"];
IDmChannel reportChannel = reportVariable.GetContent<IDmChannel>();
```

Write to an existing Report Channel

Current Time is used as time stamp.

```
reportVariable.SetContent<string>("This is a Report-Channel.");
```

Get the last entry

```
string lastEntry = reportVariable.GetContent<string>();
```

Get Report Channel entries

```
int ind = reportChannel.Tsa.FindFirst();
ind = reportChannel.Tsa.FindNext(ind); // do as long as you got yours
byte [] data = reportChannel.Tsa.GetData(ind);
// convert data to string needed, e.g.
// string t = Encoding.UTF8.GetString(data);
```

Save Report Channel to file

```
reportChannel.Tsa.SaveAscii("C:\\Users\\myName\\myReportText.txt",(byte)';',0,1,0,1);
```

17.1.2.4.4 Complex Variables

Warning

- The access to the complex variable has changed since version 5.2. All scripts must be adapted.
- The assembly **imc.Common.Components** needs to be added to the references.

General

To order to use complex variables, the reference **imc.Common.Components** must be added.

Please add the following line in the using section.

```
using imc.Common.Components.DataSourceTools;
```

Computer

```
var computer = new DataSourceVariable(Datapool.Base, "Computer");
var children = computer.GetAllChildVars();
// children.ForEach(child => MessageBox.Show(child.Name + ": " + child.Content));
```

Computer\\Drives\\C\\		
Variable name	**Internal identifier**	**Data type**
Available free space	AvailableFreeSpace	System.Int64
Total free space	TotalFreeSpace	System.Int64
Total size	TotalSize	System.Int64

Computer\\Process\\		
Variable name	**Internal identifier**	**Data type**
Process: GDI handle consumption	GDIHandleConsumption	System.Double
Process: handle count	GDIHandleCount	System.Int32
Process: physical memory consumption	GDIPhysicalMemoryConsumption	System.Int64
Process: private memory consumption	GDIPrivateMemoryConsumption	System.Int64
Process: virtual memory consumption	GDIVirtualMemoryConsumption	System.Int64

```
// Available space
var internalName = @"Computer\Drives\C\AvailableFreeSpace";
var availableSpace = new DataSourceVariable(Datapool.Base, internalName);
var content = availableSpace.GetContent<System.Int64>();
```

SystemClock

```
var dataSourceSystemClock = new DataSourceVariable(Datapool.Base, "SystemClock");
var children = dataSourceSystemClock.GetAllChildVars();
// children.ForEach(child => MessageBox.Show(child.Name + ": " + child.Content));
```

```
string dateFormat = "yyyy-MM-dd HH-mm-ss";
var internalName = @"SystemClock\SYSTEMTIME";
var dataSourceSystemTime = new DataSourceVariable(Datapool.Base, internalName);
var systemClock = dataSourceSystemTime.GetContent<DateTime>();
// MessageBox.Show(systemClock.ToString(dateFormat));
```

SystemClock		
Variable name	**Internal identifier**	**Data type**
PC time	PCTIME	System.DateTime
System time	SYSTEMTIME	System.DateTime

Trigger

```
var triggerName = "Trigger_48";
var trigger = new DataSourceVariable(Datapool.Base, triggerName);
var children = trigger.GetAllChildVars();
// children.ForEach(child => MessageBox.Show(child.Name + ": " + child.Content));
```

```
string dateFormat = "yyyy-MM-dd HH-mm-ss";
var internalName = triggerName + "\\TriggerTime";
var timeVariable = new DataSourceVariable(Datapool.Base, internalName);
var dateTime = timeVariable.GetContent<DateTime>();
MessageBox.Show(dateTime.ToString(dateFormat));
```

Trigger_NUMBER Trigger_48		
Variable name	**Internal identifier**	**Data type**
State	State	System.Double
Event number	EventNumber	System.Double
Trigger time	TriggerTime	System.DateTime

Device system variable

```
var variableName = "System_MyDevice_123456"; //
var systemDevice = new DataSourceVariable(Datapool.Base, variableName);
var children = systemDevice.GetAllChildVars();
// children.ForEach(child => MessageBox.Show(child.Name + ": " + child.Content));
```

SYSTEM_DEVICENAME SYSTEM_MyDevice_123456		
Variable name	**Internal identifier**	**Data type**
Connection 1: Critical channel fill level	WorstFifoLevel	System.Double
Connection 1: Critical channel name	WorstFifoLevelName	System.String
Connection 1: Data rate	DataRate	System.Double
Device: Client count	ClientCount	System.Double
Device: Disk size	DiskSize	System.Double
Device: Free memory	FreeSpace	System.String

SYSTEM_DEVICENAME\Monitor\1 SYSTEM_MyDevice_123456\Monitor\1		
Variable name	**Internal identifier**	**Data type**
Connection 2 Monitor 1: Critical channel fill level	WorstFifoLevel	System.Double
Connection 2 Monitor 1: Critical channel name	WorstFifoLevelName	System.String
Connection 2 Monitor 1: Data rate	DataRate	System.Double

Similar for further Monitor variables.

```
var internalName = @"System_MyDevice_123456\FreeSpace";
var freeSpace = new DataSourceVariable(Datapool.Base, internalName);
var content = freeSpace.Content;
MessageBox.Show("Free space: " + content);
```

17.1.2.4.5 DataTables

By the means of a DataTable Tables can be set easily.

user-defined variable of type "DataTable"

```
using System.Data;
```

```
var variable = Datapool["Table"]; // variable name
if (variable != null){
   DataTable dataTable = variable.GetContent<DataTable>();
}
```

Add column

```
string columnName = "Name";
if (!dataTable.Columns.Contains(columnName)){
   dataTable.Columns.Add(columnName);
}
```

Add row

```
dataTable.Rows.Add("MyName");
```

Reference

For further information, please search the internet for the type **System.Data.DataTable**.

17.1.2.4.6 Examples

Example Copy active Panel page name to an user-defined variable.

Gets the active Panel page and sets the name to the Datapool text variable "**myText**".

```
PanelPage page = Panel.GetActivePage();
string pagename = page.Name.ToString();
DatapoolVariable text = Datapool["myText"];
if (text == null){
   Datapool.CreateVariable<string>("myText",pagename);
}else{
 text.SetContent<string>(pagename);
}
```

Example — Create an user-defined channel and set channel data

In the [Script options](1844) the *advanced code completion* must be enabled.

```
using imc.Common.Components.DataManager;
using imc.Common.Interfaces.DataPool;
```

```
DmChannel channel = new DmChannel();
channel.Name = "Channel";

channel.Data = new double[]{1, 1, 2, 3, 5, 8, 13};

var variable = Datapool[channel.Name];

if (variable == null){
   Datapool.CreateVariable<DmChannel>(channel.Name, channel, EVariableScope.Experiment);
}else{
   variable.SetContent<DmChannel>(channel);
}
```

17.1.2.5 Logbook

Library

```
using imc.Common.Interfaces.Logbook;
// for ElogbookEntryCategory, ILogbookEntryBase, ...
```

Set Logbook entry

Note

For other Script types (Panel, Event, ...) the Logbook is called with `Core.Logbook`.

```
try{
   // ...
}catch (Exeption exception){
   Logbook.LogEntry("MyScript.cs", exception);
}
```

```
string errorSender = "MyScript.cs";
string errorText = "My Error";
int errorCode = 0;
ELogbookEntryCategory category = ELogbookEntryCategory.Error;
Logbook.LogEntry(errorSender,errorText,errorCode,category);
```

```
/*
ELogbookEntryCategory: Error, Fatal, Information, Warning
*/
```

```
/*
public void LogEntry(string sender, System.Exception x) ;
public void LogEntry(string sender, System.Exception x,ELogbookEntryCategory category);
public void LogEntry(string sender, string message, int code, ELogbookEntryCategory category) ;
public void LogEntry(ILogbookEntryBase entry) ;
public void LogEntry(ILogbookEntryBase entry, ELogbookEntryCategory category) ;
*/
```

Export Logbook entries since a given date

```
DateTime dateTime = new DateTime(2018, 1, 1);
Logbook.Export(@"c:\temp\logbook.xml", dateTime);
```

Show Logbook window

```
Core.Windows.ShowWindow("Logbook")
```

Clear view of the logbook / delete logbook entries in the tool window

```
Logbook.ClearViews();
```

OnError/ OnWarning Event

Use a **Context script** to react to logbook changes.

```
using System.Collections.Specialized;
using System.Windows.Forms;
using imc.Common.Interfaces.Logbook;
```

```
// Run()
Core.Logbook.Base.CollectionChanged += new
NotifyCollectionChangedEventHandler(Core_Logbook_Base_CollectionChanged);
```

```
// Dispose()
Core.Logbook.Base.CollectionChanged -= Core_Logbook_Base_CollectionChanged;
```

```
void Core_Logbook_Base_CollectionChanged(object sender, NotifyCollectionChangedEventArgs e)
{
   foreach (ILogbookEntryBase entry in e.NewItems)
   {
       var log = entry.GetAPI<API_LogbookEntry_V1>();
       if (log.Category == ELogbookEntryCategory.Warning)
       {
           // do something
       }

       if (log.Category == ELogbookEntryCategory.Error)
       {
           // do something
       }
   }
}
```

17.1.2.5.1 Examples

Example Save Logbook entries since start of the script

In this example, all logbook entries which have occurred in the course of the script are written to a text file. For this purpose, at the beginning of the script the time is noted, which is used at the end of the script in order to query the corresponding logbook entries.

```
using System.IO;
using imc.Common.Interfaces.Logbook;

namespace SaveEntries {
   using System;

   public class SaveEntries : AbstractScript {

      public override void Run() {

         DateTime startDate = DateTime.Now; // save Time
         string filename = @"x:\myLogbook.txt";

         // ... body of the script, do something here
         Logbook.LogEntry("MyScript", "My Info", 0, ELogbookEntryCategory.Information);
         Logbook.LogEntry("MyScript", "My Warning", 0, ELogbookEntryCategory.Warning);
         Logbook.LogEntry("MyScript", "My Error", 0, ELogbookEntryCategory.Error);
         // ...

         // entries since the beginning of the script
         ILogbookEntryBase[] entries = Logbook.GetEntries(startDate);

         // save entries to text-file
         using (StreamWriter file = new StreamWriter(filename, true))
         {
            for (int k = 0; k < entries.Length; ++k){
               file.WriteLine(entries[k].ToString());
            }
         }

      } // of void run
   } // of class
} // of namespace
```

Example List of messages with sender "Sequencer"

In this example all messages of the logbook entries with sender "Sequencer" are listed.

In the Script options 1844 the *advanced code completion* must be enabled.

```
using System.Linq;
using System.Windows.Forms;
using imc.Common.Interfaces.Logbook;
```

```
string str = string.Empty;

foreach (var entry in Logbook){
    API_LogbookEntry_V1 e = entry.GetAPI<API_LogbookEntry_V1>();

    if (string.Compare(e.Sender, "Sequencer") == 0){
        str += e.Message + "\n";
    }
}

MessageBox.Show(str);
```

```
// Alternative
var query = from entry in Logbook
      where entry.GetAPI<API_LogbookEntry_V1>().Sender == "Sequencer"
      select entry.GetAPI<API_LogbookEntry_V1>();

API_LogbookEntry_V1[] entries =  query.ToArray();
```

```
// Alternative 2
var entries = Logbook
            .Select(logEntry => logEntry.GetAPI<API_LogbookEntry_V1>())
            .Where(logEntry => logEntry.Sender == "Sequencer")
            .ToArray();
```

17.1.2.6 Events

The following describes how to access events.

The use of a Context script is recommended because the methods must be registered and unregistered.

Access to user-defined events is currently not possible.

Libraries

```
using imc.Studio.Interfaces.V2.Core;
using imc.Studio.Tools.DevSetupGraphGenerator;
using System.Windows.Forms;
```

Event names

These must be defined within the class.

```
private const string deviceStartedEventName = "Device_Started";
private const string devicesStartedEventName = "Devices_Started";
// further names, see Sequencer
```

Register

Register in Run method

```
Events[deviceStartedEventName].Execute += OnDeviceStarted;
Events[deviceStartedEventName].Execute += OnDevicesStarted;
```

Unregister

Unregister in Dispose method

```
Events[deviceStartedEventName].Execute -= OnDeviceStarted;
Events[deviceStartedEventName].Execute -= OnDevicesStarted;
```

Event handler

```
private void OnDeviceStarted(object sender, ICoreEventEventArgsBase e)
{
   // for every single device
   var api = e.GetAPI<API_CoreEventEventArgs_V1>();
   var parameters = api.Parameters as string[];

   if (parameters != null)
   {
       var hardwareId = parameters[0];
       var device = DevSetup.Devices.GetItemByHWID(hardwareId);
       if (device == null) { return; }
       var serialNumber = device?.Parameters[EClassID.eDeviceSN].Text;
       MessageBox.Show("Device '" + serialNumber + "' started...");
   }
}
```

```
private static void OnDevicesStarted(object sender, ICoreEventEventArgsBase e)
{
   // global start
   var apiCancel = e.GetAPI<API_CancelEventArgs_V1>();
   MessageBox.Show("Devices started...");
}
```

17.1.2.7 imc FAMOS functions

In the Script options 1844 the *advanced code completion* must be enabled.

Note

- For using **imc FAMOS functions** a **imc FAMOS Runtime** license must be activated.
- For using **imc FAMOS Kits functions** the corresponding license must be activated.
- To use **imc FAMOS functions**, select *imc FAMOS Math Provider* and/or *imc FAMOS Kit Provider* as the Additional Proxy-Classes when creating a script. These can also be updated subsequently using the **context menu** *Edit > Regenerate proxies*.
- If only a imc FAMOS **64-bit** installation is present, only the CurveWindow- and the Time-Stamp-Ascii-Kit are available. To access to the other Kits (SpectralAnalysis, OrderTracking and ClassCounting) there must be a **32-bit** installation of imc FAMOS,

Warning — Using scripts in the Professional, Standard or Runtime edition

Older Scripts containing imc FAMOS-Kits cannot be used in a newer version. The following error message will be opened in the logbook:

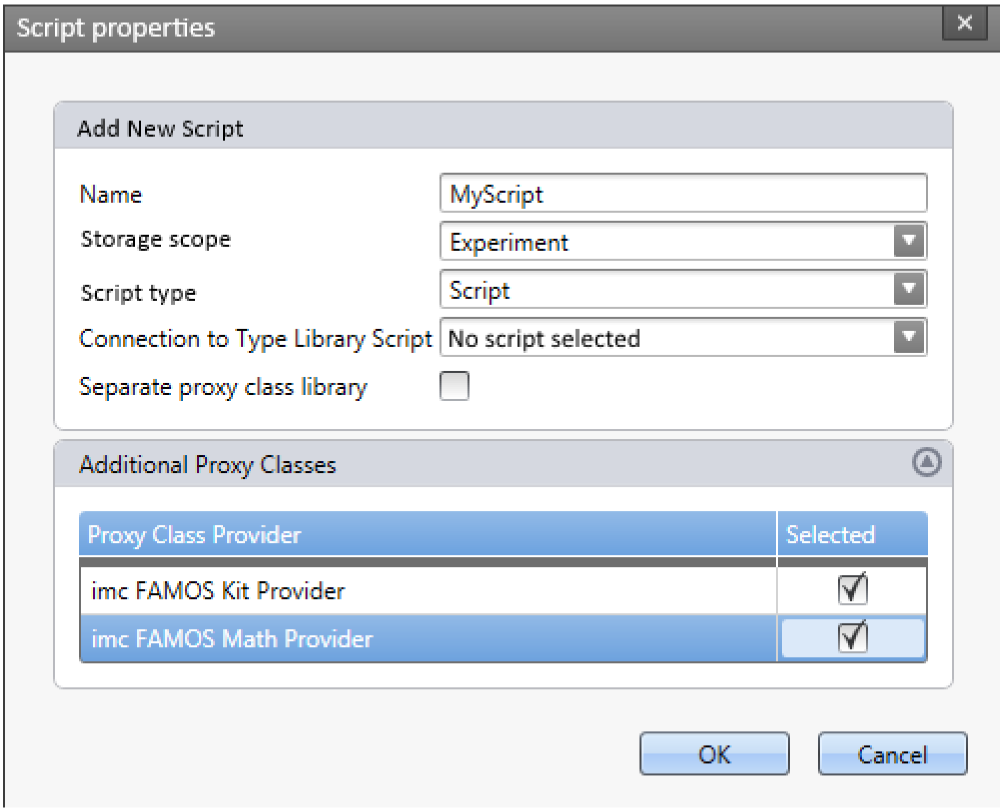
The Script "ScriptName" could not be built. [...]
Could not locate the assembly "imc.Common.Components.FamosKitLibWrapper, Version=5.0.9.6375, Culture=neutral, PublicKeyToken=9350ef35614b8d14".[...]

The experiment/project must be opened with the Developer edition to fix this problem.

For further information, please contact the Customer Support 10.

Note

- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.



Sequencer: Script options

If the following line is used, the prefix *imc.Common.Components.Famos.Math / imc.Famos.Kits* is not needed in order to use the imc FAMOS functions:

```
using imc.Common.Components.Famos.Math;
using imc.Famos.Kits;
```

Initialization of channels

The following channels must exist.

```
// get the channel named 'Channel_001'
IDmChannel channelA = Datapool["Channel_001"].GetContent<IDmChannel>();
IDmChannel channelCMP = Datapool["Channel_compare"].GetContent<IDmChannel>();
// init Result channel
DmChannel channelB = null;
```

Calculation of channels

Addition and Multiplication: +, *, Add, Mul

```
// Add 42 to the channel
Famos.Add(channelA, 0,null, 42, out channelB);
// multiply channel by 42
Famos.Mult(channelA, 0, null, 42, out channelB);
```

Integral and Derivation: int, diff

```
// Integration
imc.Common.Components.Famos.Math.FnBasic.Int(channelA, out channelB);
// Derivation
FnBasic.Diff(channalA, out channelB); // if library integrated by means of "using"
```

Filter: FiltLP, smo

```
// Butterworth Filter, 10th Order, Cut-off frequency 50 Hz
FnFilter.LowPass(channelA, 0, 0, 10, 50, out channelB);
// smoothing over 10ms
FnFilter.Smooth(channelA,0.01,out channelB);
```

Edit: cut, cutIndex

```
// Cut data (use time in [s]) ; [0.1s,0.2s]
FnEdit.CopyPartX(channelA, 0.1, 0.2, out channelB);
// Cut data (use index) ; [5,10]
FnEdit.CopyPartI(channelB, 5, 10, out channelB);
```

Approximation: Regr, PTast

```
// linear Regression
FnMisc.FitLin(channelA, out channelB);
// Resample
FnMisc.ResampleRef(channelA, channelCMP, out channelB);
```

Statistics: mean, StDev, SearchLevel, xMax, All0

```
// Mean value
FnStat.Mean(channelA, out channelB);
// Standard deviation
FnStat.StDev(channelA, out channelB);
// find XY-Points in the interval [-5;5] with gain  [-1000,1000]
FnStat.SearchLevel(channelA, 3, -5, 5, 3, -1000, 1000, 0, out channelB);
// find relative maxima over threshold 10
FnStat.XPostofMaxima(channelA, 10, out channelB);
// Zero crossings
FnStat.XPosOfZeros(channelA, out channelB);
```

The return value of a imc FAMOS-function is of the type *bool* and indicates whether the function was run successfully.

Additional functions are available in chapter Math provider 1785

as well as

- Class_Counting_Kit.* (32-Bit),
- Curve_Window.*, 1792
- Order_Tracking_Kit.* 1795 (32-Bit),
- Spectrum_Analysis_Kit.* 1797 (32-Bit),
- Timestamp_Ascii_Kit.* 1801.

Return to Datapool

The **channel name** must be set accordingly, since it has been altered by the imc FAMOS function.

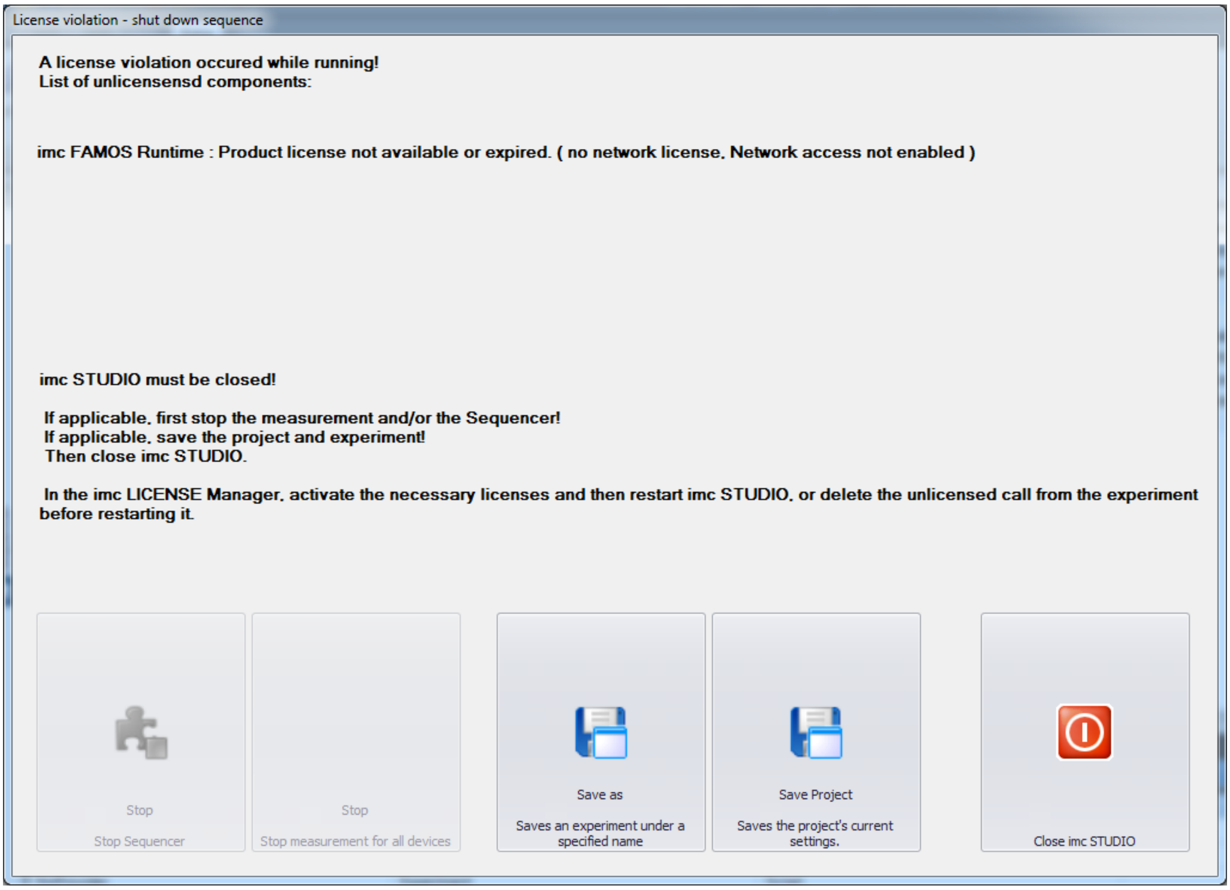
The result is written to the existing user-defined variable "UDvar_Return" of type "Channel".

```
if (channelB != null) {
  channelB.Name = "UDvar_Return"; // Name must be set to Datapool-variable
  Datapool[channelB.Name].SetContent<DmChannel>(channelB);
  channelB.Dispose();
}
```

License violation

If no imc FAMOS Runtime license is activated, the following dialog will appear when executing scripts using imc FAMOS functions.

In this dialog, you have the possibility to stop the Sequencer and the measurement, as well as saving the experiment and the project.



Dialog: License violation

17.1.2.7.1 Math provider

In the Script options 1844 the *advanced code completion* must be enabled.

When adding the following line you can use the *imc FAMOS Math* without the prefix *imc.Common.Components.Famos.Math:*

```
using imc.Common.Components.Famos.Math;
```

Famos

C# method	FAMOS function	Description
Add	+	Point-by-point addition / sample-wise
AddEx	Add	Time- or x-correct addition
Div	/	Point-by-point division / sample-wise
DivEx	Div	Time-correct or x-correct division.
Mult	*	Point-by-point multiplication / sample-wise
MultEx	Mult	Time-/x-correct multiplication
Neg	-	
Power	^	Power operator (exponentiation)
Sub	-	Point-by-point subtraction / sample-wise
SubEx	Sub	Time-/x-correct subtraction

FnBasic

C# method	FAMOS function	Description
Abs	Abs	Absolute magnitude
ACos	acos	Arccosine; inversion of cos
ASin	asin	Arccosine; inversion of cos
ATan	atan	Arctangens; inversion of tan
Cos	cos	Cosine, trigometric function
DB	DB	Conversino to decibels; i.e. 20 * lg...
DegreeToRad	InRad	Degrees-to-radians conversion factor = 0.01745...
Diff	diff	Differentiation, derivatives
Exp	exp	
Floor	floor	Next lower or equal integer
Round		Exponential function (exponent of base e)
IdB	iDB	Inverse function to dB
Int	int	Formation of the integral
Ln	ln	Natural base e (Euler number) logarithm
Log	log	Base 10 logarithm

C# method	FAMOS function	Description
Mod	mod	Modulo (division remainder)
RadToDegree	InGrad	Radians-to-degrees conversion factor = 57,297...
Recip	Rez	Reciprocal
Sin	sin	Sine, trigometric function
Sqr	sqr	Square
Sqrt	sqrt	Square root
Tan	tan	Tangent, trigometric function

FnCompare

C# method	FAMOS function	Description
UpperValue	UpperValue	Returns the greater value of the two parameters.
LowerValue	LowerValue	Returns the lower value of the two parameters.
CmpLesser	<	Comparison operator, "less than"
CmpGreater	>	Comparison operator, "greater than"
CmpLesserEqual	<=	Comparison operator, "less than or equal to"
CmpNotEqual	<>	Comparison operator, "unequal"
CmpEqual	=	Comparison operator, "equal"
CmpGreaterEqual	>=	Comparison operator, "greater or equal"
LogicAND	AND	Logical "AND"-operator
LogicOR	OR	Logical "OR"-operator
LogicXOR	XOR	Logical "Exclusive-OR"-operator
LogicNOT	NOT	Logical inversion

FnEdit

C# method	FAMOS function	Description
ClipYRange	Clip	Imposes a boundary on the Y-value range to a specified band.
CopyPartI	CutIndex	Cuts a section of a data set. Borders of the section are to be specified by indices of the data set's data points.

C# method	FAMOS function	Description
CopyPartX	Gren/Cut	Cuts a section of a data set at specified X-boundaries.
GetSamplesI	ValueIndex	Determines the y-values of a data set at positions specified by indices.
GetSamplesX	Wert/Value	Returns a data set's y-values at specified x-position.
GetSamplesX2		
Join	Binde/Join	Joins 2 data sets together
JoinEx	Append	Time- or x-correct merging of data set values
Mirror	Mirror	Mirroring of a data set's values
Ramp	Rampe/ramp	Generates a ramp (straight line with slope 1) with specifiable initial value, point interval and length
RampEx		
ReplacePartI	ReplIndex	Replaces a part of a data set with new data.
ReplacePartX	Repl	Replaces a part of a data set with new data.
Scale	Scale	Scales a data set by means of linear transformation to a specified new value range.
SchmittTrigger	STri	Schmitt-trigger with specified upper and lower threshold values
SetSamplesI	SetIndex	Sets points in a data set to new y-values at specified indices.
SetSamplesX	Setze/Set	Sets points of a data set at a specified x-position to specified new y-values.
Sort	sort	Sorting of a data set's y-values

FnFilter

C# method	FAMOS function	Description
ABCRating	ABCRating	A, B or C frequency rating in accordance with DIN IEC 651
BandPass	FiltBP	Band-pass filter
BandStop	FiltBS	Band-stop filter
DigitalFilter	Dfilt	Digital filter
HighPass	filtHP	High-pass filter
Hysteresis	hyst	Applies a hysteres to a data set

C# method	FAMOS function	Description
KBRating	KBT	KB-weighting and maximum-rate values
LowPass	FiltLP	Low-pass filter
OctaveAnalysis	OctA	1/3-octaveanalysis
SlopeClip	SlClip	Slope limiting for a data set
Smooth	smo	Smoothing with a specified averaging time.
Smooth3	Smo3	Smoothing over 3 points
Smooth5	smo5	Smoothing over 5 points
MedianFilter	.	

FnMisc

C# method	FAMOS function	Description
ApproFunc	Appro	Approximation of a data set's values using the user's choice of functions
ApproPoly	Poly	Polynomial approximation of a data set's values
Characteristic	Chrct	Correction by characteristic curve
Complex	Compl	Combines two real number data sets to one complex data set.
Envelope1	Envelope1	Constructs the upper and lower envelope curve according to the interval-secant-method.
Envelope2	Envelope2	Constructs the upper and lower envelope curve according to the interval-secant-method using specified nodes.
FitExp	eFit	Exponential regression; fits data set to an exponential function
FitLin	Lfit	Linear regression; fitting to line
IPol1	Lip	Linear interpolation
IPol3	Ipol	Interpolation with cubic splines
Pol	Pol	Transformation of a complex data set to polar coordinates (Magnitude/Phase).
Rect	Rect	Transformation of a complex data set to cartesian (rectangular) coordinates (Real/Imaginary part).
Resample2	Red2	Subsequent resampling in order to produce a power of two.

C# method	FAMOS function	Description
ResampleRed	Red	Subsequent resampling with user-specified reduciton factor
ResampleRef	RSamp	Prototype-resampling; sampling of a data set at the sampling times of a reference, with linear interpolation
ResampleRefEx		
TransRec	TransRec	Data reduction according to the Transitional-Recording procedure
XYdt	XYdt	A data set given by its (X,Y)-coordinates is resampled at a fixed sampling rate.
XYdt2		
XYof	XYof	From the X- and Y-components, an XY-data set is formed.
MatrixTranspose	MatrixTranspose	A matrix (segmented waveform) is transposed (rows are switched with columns).
MatrixCut	MatrixCut	straight cut is made through a matrix. The line of the cut is determined by 2 points.
MatrixSumLines	MatrixSumLines	The function finds the vector of the matrix row or column sums (segmented waveform).

FSpec

C# method	FAMOS function	Description
ACF	AKF /ACF	Autocorrelation function
CCF	KKF / CCF	Cross correlation of a data set with a reference data set
FFT	FFT	Spectrum according to the FFT algorithm
iFFT	iFFT	Inverse FFT, transformation of a spectrum into a time function
Spec	Spek / Spec	Calculates a meaningful spectrum (Spectral lines as amplitudes)

FnStat

C# method	FAMOS function	Description
ExpoRMS	ExpoRMS	Moving RMS with exponential averaging

C# method	FAMOS function	Description
Histo	Histo	Histogram with definable number of bars and bar width
Max	Max	Finds a data set's maximum value
Mean	Mitte/Mean	A data set's arithmetic mean
Min	Min	Finds a data set's minimum value.
MvInt	GInt/MvInt	Gleitendes Integral über vorgebbare Integrationsintervallbreite
MvMax	MvMax	Moving maximum with resampling
MvMean	MvMean	Moving mean value with resampling
MvMin	MvMin	Moving minimum with resampling
MvRMS	MvRMS	Moving RMS-value with equally weighted averaging
MvStDev	MvStDev	Moving standard deviation with resampling
MvSum	MvSum	Moving additive totalling with resampling
Peaks	Pulse Peaks	Returns the number of peaks (oscillations) in the data set.
Perio	Perio	This is a versatile function which can be used to compute any of the following properties in a periodic data set: mean values, standard deviation, upper/ lower envelope curve across all the periods; or a particular period in the data set is outputted.
RMS	Eff/RMS	The RMS value (root-mean-square) of a data set's numerical values is determined.
SearchLevel	SuchePegel / SearchLevel	Finds selectable level and slope conditions in a data set.
StDev	Streu/StDev	The standard deviation of a data set's numericval values is determined.
Sum	Sum	Sums all of a data set's values
XPosAboveLevel	Oben / Top	Returns the x-positions of all data points where the y-value exceeds a threshold value.
XPosOfMaxima	xMaxi / xMax	Returns the x-positions of all relative maxima which lie above a specified threshold
XPosOfValue	posi /pos	Returns the first position (X-coordinate) of a specified Y-value.
XPosOfValueEx		

C# method	FAMOS function	Description
XPosOfZeroes	Alle0/All0	Returns the x-positions of all of a data set's zzero-crossings

17.1.2.7.2 Curve Window Kit

In the Script options 1844 the *advanced code completion* must be enabled.

When adding the following line the *imc FAMOS Curve Window Kits* can be used without the prefix *imc.Famos.Kits:*

For the parameters of the functions please read the *imc FAMOS* user's manual-
You can find the functions in the `Curve_Window`:

```
using imc.Famos.Kits;
```

Elements

C# method	Description
CwDeleteElement	Deletes the selected element
CwNewChannel	Displays a channel in the curve window
CwNewChannel_xy	Two channels are displayed as an xy-display in the curve window.
CwNewChannel_xyz	Three channels are displayed in xyz-representation in the curve window.
CwNewElement	A new element is createdin the curve window.
CwSelectByChannel	Selects an element (e.g. axis) of the selected curve window by means of a channel.
CwSelectByIndex	Selects an element (e.g. axis) within a selected curve window

General

C# method	Description
CwAction	Performs an action on the selected curve window.
CwActionP	Performs an action (with additional parameter) on the selected curve window.
CwLoadCCV	Opens the curve configuration from a *.ccv-file.
CwNewWindow	Generates an empty curve window
CwSaveCCV	Saves the configuration of the selected curve window in a *.ccv-file.
CwSelectWindow	Selects a curve window on the basis of a variable used as reference, or on the basis of its title.

Miscellaneous

C# method	Description
CwGlobalGet	Get global property
CwGlobalGetText	Get global text property
CwGlobalSet	Set general global property for all curve windows
CwIsWindow	Determines whether the specified curve window exists.
CwLoadSettings	This function loads a global setting from the file specified in TxFileName into the Curve Manager.
CwPosition	Adjustment of the position and size of the selected curve window
CwReplace	In a curve window, a channel designated "OldDesignation" is displayed. This channel is now to be replaced with ChannelReplacement in this curve window. Next, ChannelReplacement is to be displayed instead of the channel with the name OldDesignation.
CwSelectMode	Determines how the curve window is later identified

Properties

C# method	Description
CwAxisGet	Get axis property
CwAxisGetText	Get axis text property
CwAxisSet	Set axis properties
CwColorGet	Get curve window colors.
CwColorSet	Set curve window colors.
CwCosysGet	Get property of a coordinate system
CwCosysSet	Sets a coordinate system's property
CwDataGet	Get data element property
CwDataGetText	Get text property of a data element
CwDataSet	Set property of a data element
CwDisplayGet	Get curve window property
CwDisplayGetText	Get general curve window text property
CwDisplaySet	Set general curve window properties
CwLineGet	Get line property
CwLineSet	Set line property

C# method	Description
CwMarkerGet	Get marker property
CwMarkerGetText	Get text property of a marker
CwMarkerSet	Set marker property

Cv_compatible_

This function is only included for the purpose of compatibility with imc FAMOS 6.0 and predecessors!

C# method	Description
CvAppendMarker	This function sets a marker in a curve window.
CvAskTitle	Get title
CvAttrib	Specifies a display attribute for the curve window.
CvConfig	Shows channel using configuration file specified in TxFilename.
CvCursor	Returns the measurement crosshair position in a measurement window.
CvLoadGlobalSetting	This function loads a global setting from the file specified in TxFileName into the Curve Manager.
CvPosi	Settings for the position and size of a curve window
CvRefDB	Defines the reference value for decibel (dB) values.
CvReplaceChannel	Replace channel
CvSave	A measurement cursor (crosshair) is set to a specific position in a previously opened measurement window.
CvSetCursor	A measurement cursor (crosshair) is set to a specific position in a previously opened measurement window.
CvTitle	Set title
CvVar	Swap variables
CvWin	Opens or closes measurement or overview windows affiliated with a given curve window.
CvXAxis	Defines the range of the x-axis to be displayed.
CvYAxis	Defines the range of the y-axis to be displayed.

17.1.2.7.3 Order Tracking Kit

In the [Script options](1844) the *advanced code completion* must be enabled.

When adding the following line the *imc FAMOS Order Tracking Kits* can be used without the prefix *imc.Famos.Kits:*

For the parameters of the functions please read the *imc FAMOS* user's manual-
You can find the functions in the `Order_Tracking_Kit`:

```
using imc.Famos.Kits;
```

FFT_Analysis

C# method	Description
OtrOrderSpecFromFFT	The order spectrum, referenced to the rotation speed, is calculated from the FFT-spectrum referenced to the rotation speed. The FFT-spectrum is given as a root mean square (RMS)-value spectrum.
OtrRpmSpectrum	The FFT spectrum (RMS-values!) referenced to a rotation speed is determined from the time-histories of the vibration and the rotation speed. The desired RPM-range is divided into equally spaced classes.
OtrRpmSpectrumFast	The FFT-spectrum (root mean square values!), referenced to rotation speed, is determined from the time-histories of a vibration and rotation speed. Especially suited to fast run-ups and run-downs. The result is generally not equally distributed along the RPM-axis.
OtrRpmThirds	From the time-histories of a vibration and rotation speed, the 1/3 octave spectrum referenced to the rotation speed is determined. The desired RPM-range is divided into equally spaced classes.

Filters_for_order_tracking_analysis

C# method	Description
OtrTrackingBandPass	Tracking band-pass filter. A vibration signal is band-pass filtered, and the filter's center frequency depends on the rotation speed. The time-history of an order is determined.
OtrTrackingBandPassZ	Tracking band-pass filter without phase shift. A vibration signal is band-pass filtered, and the filter's center frequency depends on the rotation speed.
OtrTrackingBandStop	Tracking band-stop filter. A vibration signal is band-stop filtered, and the filter's center frequency depends on the rotation speed.
OtrTrackingBandStopZ	Tracking band-stop filter without phase shift. A vibration signal is band-stop filtered, and the filter's center frequency depends on the rotation speed.
OtrTrackingExpoRms	Calculation of the moving RMS value with exponentially weighted averaging, where the time constant depends on the rotation speed.

C# method	Description
OtrTrackingHighPass	Tracking high-pass filter. A vibration signal is high-pass filtered, where the filter's cutoff frequency depends on the rotation speed.
OtrTrackingHighPassZ	Tracking high-pass filter without phase shift. A vibration signal is low-pass filtered, where the filter's cutoff frequency depends on the rotation speed.
OtrTrackingLowPass	Tracking low-pass filter. A vibration signal is low-pass filtered, where the filter's cutoff frequency depends on the rotation speed.
OtrTrackingLowPassZ	Tracking low-pass filter without phase shift. A vibration signal is low-pass filtered, where the filter's cutoff frequency depends on the rotation speed.

Order_analysis

C# method	Description
OtrOrderSpectrum	Order spectrum related to the instantaneous rotation speed is determined from the time-history of vibration and tachometer signals. The desired rotation speed range is divided into classes of equal width.
OtrRpmOrder	Finds the RMS (root mean square) value of an order line related to the rotation speed. The desired rotation speed range is divided into classes of equal width. Calculation is preformed with the help of a tracking band-pass filter.

Rotation_speed_and_angle_representation

C# method	Description
OtrResample	Sampling of a vibration signal over the rotation angle, given the tacho signal.
OtrResampleAAF	Sampling of a vibration signal over the rotation angle, given the tacho signal and using a tracking anti-aliasing filter.
OtrRpmPresentation	From the time-histories of a signal and the rotation speed, the signal referenced to the rotation speed is constructed. The desired RPM-range is divided into evenly spaced classes.
OtrRpmPresentFast	From the time-histories of a spectrum and the rotation speed, the spectrum is referenced to the rotation speed. Especially for fast run-ups and run-downs. The result is generally not evenly distributed along the RPM-axis.
OtrRpmPresentVector	From the time-histories of a spectrum and the rotation speed, the spectrum referenced to the rotation speed is constructed. The desired RPM-range is divided into evenly spaced classes.

Tools

C# method	Description
OtrEncoderRevs01	A rectangular signal sampled by an incremental encoder is used to find the rotation speed. The signal consists of the sampled rectangle signal which consist of only ones and zeroes.
OtrFrequLine	Frequency line calculation: The magnitude or phase of a periodic sinusoidal signal is determined.
OtrTachoMode	Is the tacho signal a rotation speed or impulses from an encoder? The interpretation of the signal is specified for the purposes of other Kit functions which use the tacho signal.
OtrTachoToDist	From a tacho signal, provided as encoder pulses, for example, a data set recording the number of revolutions is calculated. Beforehand, the function OtrTachoMode () must be used to set the tacho signal type.
OtrTachoToSpeed	From a tacho signal which may be available as encoder pulses, a rotation speed signal scaled in RPM is calculated. Before calling this function, the function OtrTachoMode() must be used to state the tacho signal type.
OtrTachoToSpeedX	The rotation speed signal is calculated from the tacho signal. The result gets the data type XY and is scaled in RPM. Before calling this function, the function OtrTachoMode() must be used to state the tacho signal type.

17.1.2.7.4 Spectrum Kit

In the Script options 1844 the *advanced code completion* must be enabled.

When adding the following line the *imc FAMOS Spectrum Analysis Kits* can be used without the prefix *imc.Famos.Kits:*

For the parameters of the functions please read the *imc FAMOS* user's manual-
You can find the functions in the `Spectrum_Analysis_Kit`:

```
using imc.Famos.Kits;
// Spectrum_Analysis_Kit._1_Channel.AmpSpectrumRMS(...);
```

_1_Channel

C# method	Description
AmpSpectrumPeak	Magnitude spectrum (harmonics determined as peak values or magnitudes) with a moving window and linear averaging. The result is a segmented waveform, where each segment represents a spectrum.
AmpSpectrumPeak_1	An averaged magnitude spectrum is computed (harmonics determined as peak values or magnitudes). The averaging is taken of as many spectra as there are windows within the waveform.

C# method	Description
AmpSpectrumPeak_exp	Magnitude spectrum (harmonics determined as peak values or magnitudes) with a moving window and exponential averaging. The result is a segmented waveform, where each segment represents a spectrum.
AmpSpectrumRMS	Magnitude spectrum (harmonics determined as RMS (root-mean-square) values) with a moving window and linear averaging. Computed using FFT. The result is a segmented waveform, where each segment represents a spectrum.
AmpSpectrumRMS_1	An averaged magnitude spectrum is returned (harmonics determined as RMS (root-mean-square) values). The averaging is taken of as many spectra as there are windows within the waveform. Calculated by means of FFT.
AmpSpectrumRMS_exp	Magnitude spectrum (harmonics determined as RMS (root-mean-square) values) with a moving window and exponential averaging. The result is a segmented waveform, where each segment represents a spectrum.
ComplexSpectrum	Complex spectrum (harmonics determined as RMS (root-mean-square) values) using a moving window and linear averaging. Calculated by means of FFT.
ComplexSpectrum_1	An averaged complex spectrum is calculated (harmonics determined as RMS (root-mean-square) values). The averaging is taken of as many cepstra as there are windows within the waveform. Calculated by means of FFT.
ComplexSpectrum_exp	Complex spectrum (harmonics determined as RMS (root-mean-square) values) using a moving window and exponential averaging. Calculated by means of FFT.
PowerCepstrum	Power Cepstrum. The cepstrum is calculated using a moving window and linear averaging.
PowerCepstrum_1	Power Cepstrum. Calculates a mean cepstrum. The averaging is taken of as many cepstra as there are windows within the waveform.
PowerCepstrum_exp	Power Cepstrum, exponential averaging
PowerDS	Power Density Spectrum with a moving window and linear averaging. Square of the RMS-spectrum, divided by the frequency line distance. The result is a segmented waveform, where each segment represents a spectrum.
PowerDS_1	An averaged power density spectrum is determined. Square of the RMS-spectrum, divided by the frequency line distance. The averaging is taken of as many spectra as there are windows within the waveform
PowerDS_exp	Power Density Spectrum with a moving window and exponential averaging. Square of the RMS-spectrum, divided by the frequency line distance. The result is a segmented waveform, where each segment represents a spectrum.
PowerSpectrum	Power spectrum with a moving window and linear averaging. The square of the RMS-spectrum. The result is a segmented waveform, where each segment represents a spectrum.

C# method	Description
PowerSpectrum_1	An averaged power spectrum is computed. the square of the RMS-spectrum. The averaging is taken of as many spectra as there are windows within the waveform.
PowerSpectrum_exp	Power spectrum with a moving window and exponential averaging. The square of the RMS-spectrum. The result is a segmented waveform, where each segment represents a spectrum.

_2_Channel

C# method	Description
CrossPowerDS	Cross Power Density spectrum, using a moving window and linear averaging. Calculated by means of FFT.
CrossPowerDS_exp	Cross Power Density using a moving window and exponential averaging. Calculated by means of FFT.
CrossPowerDS_1	A mean cross power density is calculated. The averaging is taken of as many spectra as there are windows within the waveform.
CrossPowerNorm	Normalized cross power density spectrum using a moving window and linear averaging. Calculated by means of FFT. Arithmetical (linear) averaging is performed.
CrossPowerNorm_1	Normalized cross power spectrum, using a moving window and linear averaging. Calculated by means of FFT.
FrequencyResponse	FRF, Frequency response function. Calculated by means of FFT.
Coherence	The coherence is determined through linear averaging of power spectra. It is calculated by means of FFT.

Acoustics

C# method	Description
LoudnessLevel	Either the loudness or the loudness level, as desired, is calculated for a specified spectrum of one-third octave bands as per DIN 45631/A1:2010-03 or ISO 532-1:2017. The method introduced by E. Zwicker is used.
LoudnessSpectrum	A spectrum of one-third octaves is used to plot the specific loudness over Barks as per DIN 45631/A1:2010-03 or ISO 532-1:2017. The specific loudness is designated N' and the abscissa values z are scaled in Barks. The method introduced by E. Zwicker is used.
SoundIndex	Articulation index and others characteristics of a sound signal. Calculation over the entire sound signal.
SpecThirds	From the time-histories of a vibration, the 1/3 octave spectrum referenced to time is determined.

C# method	Description
SpecThirds_1	From the time-histories of a vibration, the averaged 1/3 octave spectrum determined.

Filter

C# method	Description
CFCFilter	Calculation of a CFC-filters as per SAE J211/1.
FiltBpZ	Band-pass filter without phase shift
FiltBsZ	Band-stop filter without phase shift
FiltHpZ	High-pass filter without phase shift
FiltLpZ	Low-pass filter without phase shift
PhaseContinuous	The course of a signal phase is made continuous. This function eliminates all jumps of 360 degrees.
SavitzkyGolay	Savitzky-Golay filter for smoothing data sets
VibrationFilter	Filtering for the evaluation of vibration. The filtering is performed in accordance with a specified frequency-weighting. Subsequently, calculation of the moving exponential RMS value (time weighting) is performed on the results. Finally, resampling is performed, reducing the data volume by a certain factor.

Miscellaneous

C# method	Description
DFTSpectrum	The DFT (discrete Fourier transformation) is applied to the time-based signal. For this purpose, the time signal's rms-spectrum is determined. The time signal's length need not be a power of two.
ShockResponseSpectrum	Shock Response Spectrum, SRS
TransposeMatrix	A matrix (a segmented waveform) is transposed. In other words, the rows and columns exchange places. The matrix' rows correspond to the waveform's segments. Input data and result are segmented. The input data have a single component.
ZoomSpectrumChirpZ	The Chirp-z transformation is applied to the time-based signal. For this purpose, the signal's RMS-spectrum is determined in a selected frequency range. The time signal's length need not be a power of two. The spectrum can be determined with any resolution from 0 Hz up to half of the sampling frequency.

17.1.2.7.5 Time Stamp ASCII Kit

In the [Script options] 1844 the *advanced code completion* must be enabled.

When adding the following line the *imc FAMOS Time Stamp Ascii Kits* can be used without the prefix *imc.Famos.Kits:*

For the parameters of the functions please read the *imc FAMOS* user's manual-
You can find the functions in the `Timestamp_Ascii_Kit`:

```
using imc.Famos.Kits;
```

General

C# method	Description
TsaAppend	A new element is appended to the end of a time-stamp-ASCII channel.
TsaAppendText	A new element is appended to the end of a time-stamp-ASCII channel.
TsaCreateEmpty	Creates an empty channel in time-stamp-ASCII format.
TsaDataToText	At a specified position in a time-stamp-ASCII channel, next equal or larger valid position of an element is determined.
TsaDelete	For a specified position in a time-stamp-ASCII channel, the corresponding element is deleted from the channel.
TsaFindFirst	The position of the 1st channel element is determined.
TsaFindNext	This function is called to continue the enumeration of time-stamp-ASCII channels.
TsaFindTime	At a specified time, the position of the first time-stamp-ASCII element whose time is greater than or equal to the specified time, is returned.
TsaFindValidPos	At a specified position in a time-stamp-ASCII channel, next equal or larger valid position of an element is determined.
TsaGetCount	For a time-stamp-ASCII channel, the number of constituent elements is determined.
TsaGetData	For a specified position in a time-stamp-ASCII channel, the corresponding element's contents are returned as a waveform.
TsaGetText	For a specified position in a time-stamp-ASCII channel, the corresponding element's contents are returned as text.
TsaGetTime	For a specified position in a time-stamp-ASCII channel, the corresponding element's time is returned.
TsaInsert	At a specified position in a time-stamp-ASCII channel, a new element is inserted.
TsaInsertText	a specified position in a time-stamp-ASCII channel, a new element is inserted.
TsaJoin	A second time-stamp ASCII channel is appended to one time-stamp ASCII channel.

C# method	Description
TsaSaveAscii	A time-stamp-ASCII channel is saved to a file in ASCII format.
TsaSetData	For a specified position in a time-stamp-ASCII channel, the corresponding element's contents are reset. The contents are represented as a waveform.
TsaSetText	For a specified position in a time-stamp-ASCII channel, the corresponding element's contents are reset. The contents are represented as text.
TsaSetTime	For a specified position in a time-stamp-ASCII channel, the corresponding element's time is reset.
TsaTextToData	A text is converted byte by byte into a waveform. This waveform will take the Byte numerical format.

17.1.2.8 Inline FAMOS functions

Below, the Inline FAMOS functions in Scripting are described. For this purpose, the appropriate license for imc STUDIO Inline FAMOS is required.

Note

Please use the return value **Result** of the methods to check, if the action was successful, because you do not get any information in the GUI of imc STUDIO, when configuring IFA-Tasks with Scripting.

Library

```
using imc.Studio.Interfaces.V2.DataProcessing;
```

Get or create IFA-Task

```
InlineFamosTask task = InlineFamos.CreateTask(); // Display name will be generated
```

```
// If task available, get it, otherwise create
InlineFamosTask task2 = InlineFamos.GetOrCreateTask("InternalName");
InlineFamosTask task3 = InlineFamos.GetOrCreateTaskByDisplayName("DisplayName");
```

```
InlineFamosTask task4 = InlineFamos.GetTaskByName("InternalName");
InlineFamosTask task5 = InlineFamos.GetTaskByDisplayName("DiaplayName");
```

```
// Create Task with Owner
InlineFamosTask task5 = InlineFamos.GetOrCreateTask("MyPrivateTask", "Owner", ETaskAccess.Public,
 "MyDisplayName");
```

A task created with an *owner* is not saved in the experiment. This allows a dynamically generation of IFA-code. For using the task, the script creating the task needs to be run first.

Create a private task

A **private** task is not shown in the GUI.

```
InlineFamosTask privateTask;
privateTask = InlineFamos.GetOrCreateTask("MyPrivateTask", "Owner", ETaskAccess.Private);
```

Get all public tasks

```
IInlineFamosTaskBase[] tasks = InlineFamos.Tasks;
```

Get all task of an owner.

```
IInlineFamosTaskBase[] tasks = InlineFamos.GetTasks("Owner");
```

Delete IFA-Task

```
Result isSuccessful = InlineFamos.DeleteTask(task.Name); // delete
```

```
Result isSuccessful = task.Delete();
```

Apply Task

```
Result isSuccessful = task.Apply(); // check result for "IsSuccessful"
```

Task Name

```
string name = task.Name;
Result isSuccessful = task.Setup.SetDisplayName("NewName");
```

Source code

The source text can be passed directly as a text variable, or a path for the associated IFA-file is specified.

```
// Get the source code
string sourceCode = task.Setup.SourceCode;
```

```
// Set source code: Path
Result isSuccessful = null;
string filename = @"c:\temp\MyTask.ifa.xml";
using (StreamReader stream = new StreamReader(filename))
{
   string content = stream.ReadToEnd();
   isSuccessful = task.Setup.SetSourceCode(content);
}
```

```
// Set source code: text
task.Setup.SetSourceCode(@"Virt_Chn = Channel_001 * 2");
```

Serialization/deserialization of a task

```
task.Setup.GetXml();
task.Setup.ReadXml(stream);
task.Setup.SetXml(xml);
task.Setup.WriteXml(stream);
```

Example Create task and calculate a channel

A new public task with display name "My IFA Task" is created, which creates the double of an analog channel.

```
InlineFamosTask task = InlineFamos.GetOrCreateTask("MyTask");
task.Setup.SetDisplayName("My IFA Task");
Result resultSource = task.Setup.SetSourceCode("Channel_out = 2 * Channel_001");
Result resultApply = task.Apply();
```

17.1.2.9 Commands

Note

Every command can be used via `Commands.Invoke` in Scripting. While typing this command, press **CTRL+Space** and choose *Command Invoke* to open a dialog. In this dialog the according command can be chosen. The parametrization is done in the same dialog and is converted an XML-string.

Example Delete Panel page *Page 1*

```
Commands.Invoke("Delete page  Page: Page 1",
   "<AppPlotFactoryCmd version=\"1\">" +
      "<common version=\"1\" cuid=\"PanelPageDelete\" caption=\"Delete page\">" +
      "<command version=\"1\">" +
      "<properties version=\"1\">" +
      "<DeletePageCommandTemplate>" +
      "<Version>1.0</Version>" +
         "<Page1>Page 1</Page1>" +
      "<Kind>Delete</Kind>" +
      "<ShowExportDialog>False</ShowExportDialog>" +
      "<ShowPrinterDialog>False</ShowPrinterDialog>" +
      "</DeletePageCommandTemplate>" +
      "</properties>" +
      "</command>" +
      "</common>" +
   "</AppPlotFactoryCmd>");
```

Execute a menu action

```
Actions.FireAction(this, "COMMANDONAME"); // for commandos, see table below
```

React to a menu action

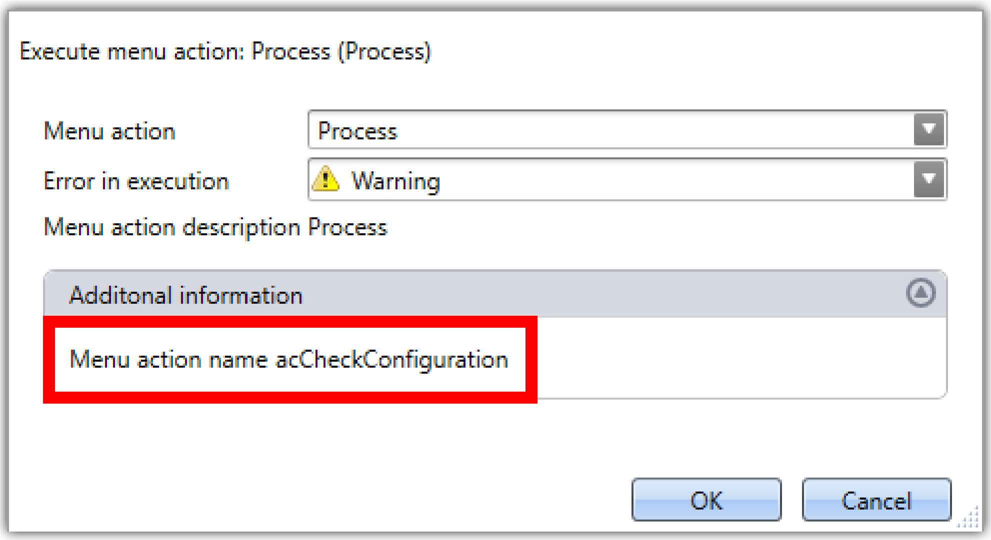
With a Context script you can react to the manually execution of a menu action.

```
using imc.Studio.Interfaces.V2.Core;
```

```
public override void Run() {
   Actions["COMMANDAME"].Execute += new
CommonEventHandler<ICoreActionExecutionEventArgsBase>(Test_Execute);
}

void MyContextScript_Execute(object sender, ICoreActionExecutionEventArgsBase e){
   // do something
}

protected override void MyContextScriptDispose() {
   Actions["COMMANDNAME"].Execute -= MyContextScript_Execute;
}
```

Menu action name (Command name)

The commands are listed in the following table. The menu action names can be shown in the configuration dialog of the command "Execute menu action" under "Additional information".



Example of a menu action name

Sequencer

Action	Command name
start	StartSequencer
stop	StopSequencer

Device actions

Action	Command name
Device configuration (Dialog)	acImcDev30ShowDeviceConfigDlg
open imc Online FAMOS Editor	acImcDev30ShowOFADialog
open Diskstart-Dialog	acDevSetupShowLayout_Diskstart
Device search	acSearchNetwork
connect to selected devices	acDeviceConnect
start selected devices	acDeviceStart
stop selected devices	acDeviceStop
disconnect from selected devices	acDeviceDisconnect
Prepare	acCheckConfiguration
Download	acDeviceDownload
Suspend data storage	acSuspendDiscRecording
Resume data storage	acResumeDiscRecording
Reconfigure	acImcDev30ForceDownload
release all triggers	acReleaseAllTriggers

Panel

Action	Command name
toggle Design mode	cmd_Panel_ToggleDesignMode
toggle Navigation bar	m_biNavBarShow
show Panel	ShowPanel
Panel page in Full-Screen mode	acPanelFullScreen
insert a Standard Panel page	cmd_Panel_InsertPageStandard
toggle lock on Panel page	cmd_Panel_Toggle_Lock
show last Panel page	m_biNavLastPage
show next Panel page	m_biNavNextPage
show previous Panel page	m_biNavPrevPage
show first Panel page	m_biNavHome

Navigation

Action	Command name
absolute time	NavigationActions.SetAbsTime
relative time	NavigationActions.SetRelTime
scroll	NavigationActions.SetXScroll
stretch	NavigationActions.SetXStretch
no scroll	NavigationActions.SetNoScroll

User administration

Action	Command name
log out user	UserLogOut
change user	ChangeUser

File actions

Action	Command name
new experiment (Dialog)	NEW
load experiment (Dialog)	LOAD
save experiment	SAVE
save experiment as	SAVEAS
Import/Export Dialog	IMPORTEXPORTDIALOG

Miscellaneous

Action	Command name
open Help	imcStudioHelpContent
save Current Measurement	imcStudioSaveMeasurement
open Options	imcStudioSharedOptionsDlg
exit imc STUDIO	EXIT
Data (PC)	acImcDev30ShowDataInDevice
Data (Device)	acSetup_ShowDataInPC

17.1.2.10 Additional functions

17.1.2.10.1 Default dialog response

In Scripting the options for the default dialog response can be set as follows:

```
using imc.Studio.Interfaces.V2.Gui;
```

```
public static class DialogConstants
{
   // Measurement running - reconnect not possible
   public const string StopAndConnect = "DevSetup_StopAndConnect";
   // Overwrite autostart configurations
   public const string OverwriteSelfStart = "Dev2x_OverwriteSelfStart";
   // Overwrite existing file
   public const string OverwriteFile = "VariablesOverwriteFileDialog";
   // Project has changed
   public const string SaveProject = "SaveProjectDocumentUserRequest";
   // Connection failed - transfer configuration
   public const string ConnectionFailed = "DevSetup_ConnectionFailed";
   // Disconnect from running measurement
   public const string DisconnectFromRunningMeasurement =
"DevSetup_DisconnectFromRunningMeasurement";
   // No new devices found
   public const string NoNewDevicesFound = "DevSetup_NoNewDevicesFound";
   // Measurement running
   public const string Reconnect = "DevSetup_Reconnect";
   // Devices deselected
   public const string DeselectDevices = "DevSetup_DeselectDevices";
   // Experiment has changed
   public const string SaveExperiment = "SaveExperimentDocumentUserRequest";
   // Channel settings will be reset
   public const string ResetChannelSettingsWarning = "imcDevices2xResetSettingsWarning";
   // Changed supply settings
   public const string ModuleSupplyChangedWarning =
"imcDevices2xModuleSupplyChangedWarningDialog";
}
```

```
UserRequest.SetDefaultResultValue(DialogConstants.StopAndConnect, EMessageBoxResult.OK); // Ok:
Stop and Connect - reconnect not possible

UserRequest.SetDefaultResultValue(DialogConstants.DisconnectFromRunningMeasurement,
EMessageBoxResult.Yes); // Yes: Disconnect, No: Stop and Disconnect

UserRequest.SetDefaultResultValue(DialogConstants.Reconnect, EMessageBoxResult.Yes); // Yes:
Reconnect, No: Stop and Connect

UserRequest.SetDefaultResultValue(DialogConstants.DeselectDevices, EMessageBoxResult.Yes); //
Yes: Discard, No: Transfer

UserRequest.SetDefaultResultValue(ModuleSupplyChangedWarning, EMessageBoxResult.OK);

UserRequest.SetDefaultResultValue(ResetChannelSettingsWarning, EMessageBoxResult.Yes);
```

```
// read setting for Overwrite autostart configuration
EMessageBoxResult result = UserRequest.GetDefaultResultValue(OverwriteSelfStart);
// None = Show Dialog
```

EMessageBoxResult	Description
Yes	The dialog will be automatically answered with "Yes".
No	The dialog will be automatically answered with "No".
OK	The dialog will be automatically confirmed with "OK".
Cancel	The dialog will be automatically canceled ("Cancel").
None	The dialog will be displayed
Button1, ..., Button 5	The dialog will be automatically answered with the corresponding button.

Futher information, see chapter Options: Default dialog response 111.

17.1.2.10.2 Script Clipboard

If objects are to be exchanged between two scripts, the **ScriptClipboard** is available for this purpose.

Objects can be written to the Clipboard for subsequent import to a different script.

The lifetime of the clipboard is linked to the imc STUDIO process.

Copying a new object to the Clipboard (Script A)

```
string text = "My Object";
ScriptClipboard.Add("MyKey", text);
```

Querying an object from the Clipboard (Script B)

```
object o = ScriptClipboad["MyKey"];
string s = o as string;
```

Deleting an object from the Clipboard

```
ScriptClipboard.Remove("MyKey");
```

Testing for existence

```
if (ScriptClipboard.ContainsKey("MyKey")) {
  var value = ScriptClipboard["MyKey"];
}
```

If a device object is to be copied, the corresponding instance must be copied to the Clipboard.

Copying a device object to the Clipboard (Script A)

```
using imc.Studio.Interfaces.V2.DevSetup;
```

```
EnumItem dev = DevSetup.Devices.GetItemBySerialNumber("123456");
IEnumItemBase deviceInstance = dev.Base.GetAPI<IEnumItemBase>();
ScriptClipboard.Add("MyDeviceInstance", deviceInstance);
```

Getting a device object from the Clipboard (Script B)

```
using imc.Studio.Interfaces.V2.DevSetup;
```

```
object o = ScriptClipboard["MyDeviceInstance"] ;
IEnumItemBase item = o as IEnumItemBase;
EnumItem device = EnumItem.GetInstance(item);
```

Note

- When adding an object to the **script clipboard**, it is necessary to note that this object has a **namespace**. In the case of a Widget, this would be the script's name, e.g. *TestScript.Widget,* due to the proxy-classes.
- When retrieving the object from the script clipboard, *Casting-Exceptions* can occur, since the object type belongs to a different namespace than the script.
- To avoid this, create the script which writes the object to the script clipboard with option "**Separate proxy class library**".
- the script is created with the resource **ProxyClasses**.
- Incorporate the file **ProxyClasses.dll** from this script project into the script project which is to import the object from the clipboard, as a **Resource**.
- When using the type, be sure to specify the namespace correctly.

Reference

For details, see Using the script clipboard 1855

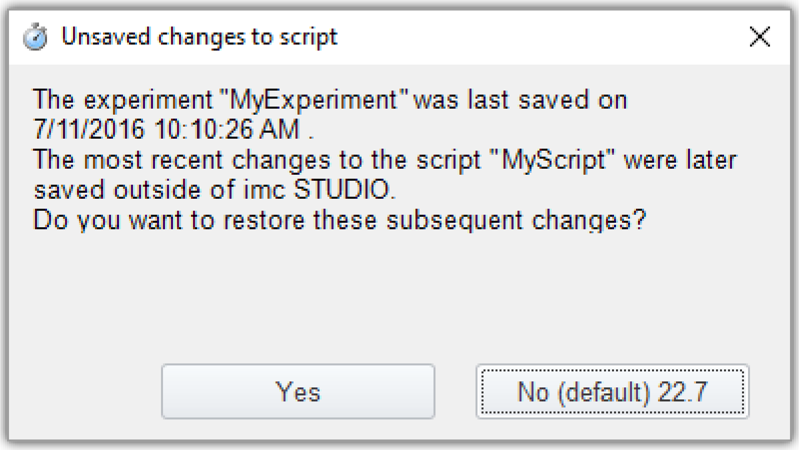
17.1.2.10.3 Restore script changes

Note

The scripts are not only saved in the **Storage scope** (Experiment, Project, ...), but also in a separate folder. Therefore the saving states can be different.

If modifications are made with the script and the corresponding **Storage scope** is not saved, these **changes** to the script are not saved with the experiment/project.

When reloading, the following dialog will open:



Dialog: Unsaved changes to Script

You have the possibility to restore the changes of the script or to load the current state of the Storage scope (*here: Experiment*).

Yes The last changes of the **Script** are used.

No The current state of the **Storage scope** (*here: Experiment*) is used.

In the Script options 1844 a default answer can be set for this dialog.

17.1.2.10.4 File access (imc-Format)

Read channel from imc file

```
using imc.Common.Components.DataManager;
```

```
string filename = @"c:\imc\imc FAMOS\dat\slope.dat";
DmFile file = new DmFile();
file.Open(filename, DmFileFlags.Read);
DmChannel channel = file.ReadChannel("Slope");
```

```
file.Close();
file.Dispose();
channel.Dispose();
```

Save channel in imc file

```
using imc.Common.Components.DataManager;
```

```
string channelName = "Channel";
DmChannel channel = new DmChannel();
channel.Name = channelName;
channel.Data = new double[]{1, 1, 2, 3, 5, 8, 13};

string filename = @"c:\temp\channel.dat";
DmFile file = new DmFile();
file.Open(filename, DmFileFlags.Write);
file.AddObject(channel.DmHandle);
```

```
file.Close();
file.Dispose();
channel.Dispose();
```

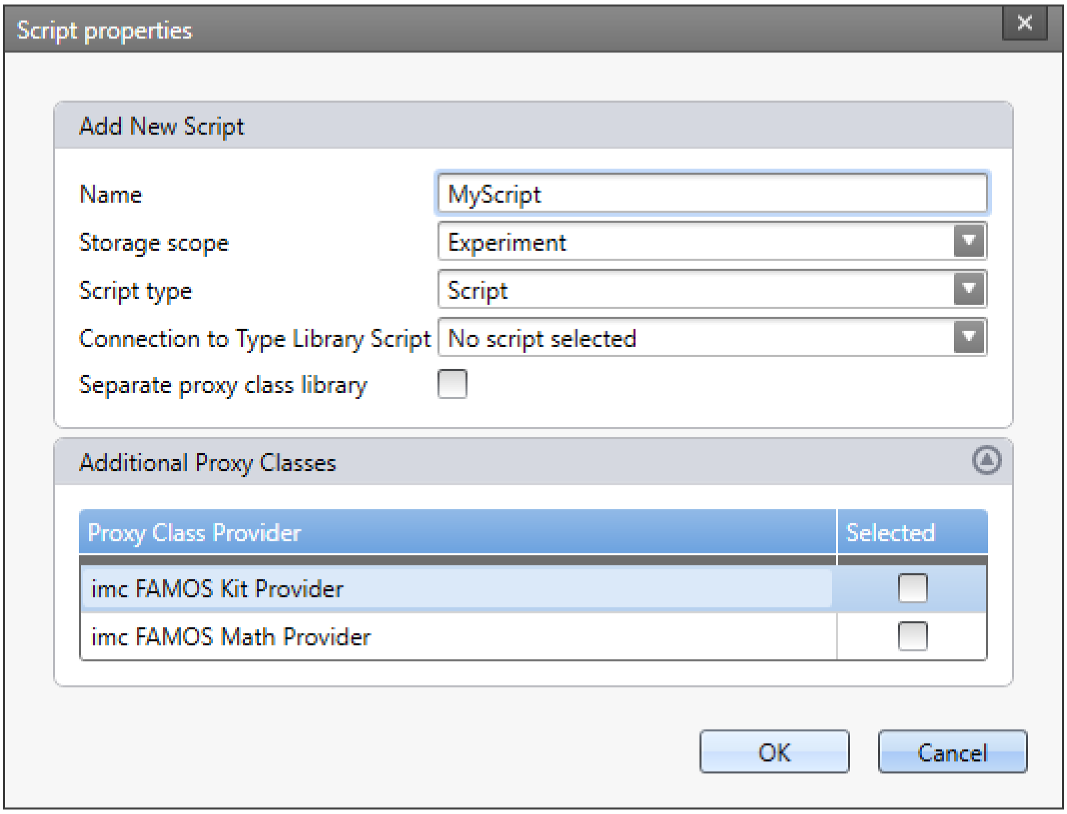
17.1.3 Script types

17.1.3.1 Script

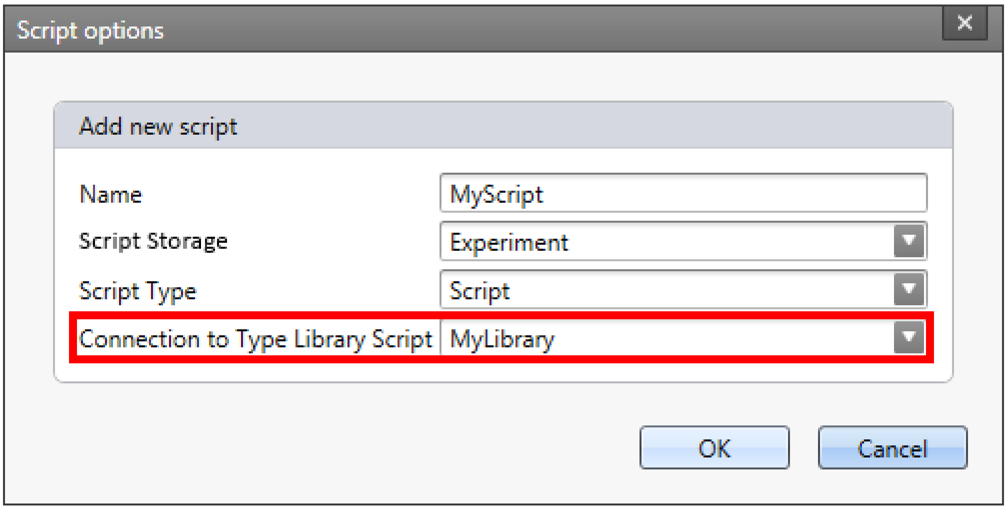
Scripts are run in response to:

- the command *Scripts > Run script* in the Sequencer,
- the command *Scripts > Run script* as button events on a Panel page,
- click on *Edit > Run* in the tool window *Scripts*.

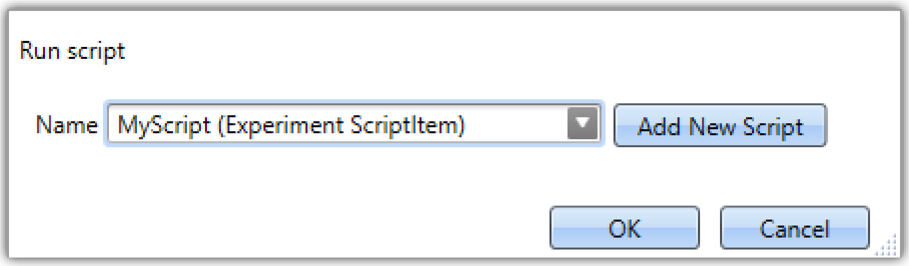
The **Storage Scope** option can be set to Experiment, Project, Application or Sequencer in which the **script** is available.



Dialog: create Script without Type Library Script



Dialog: create Script with Type Library Script



Command: Run script

Editor

When a new Script is added, the **ScriptEditor** will open with the following code:

```
namespace MyScript {
   using System;

   public class MyScript : AbstractScript {

      public override void Run() {
         // Start your script here
         // Access your variables by using "Datapool[variableName]"
         // Access your devices by using "DevSetup.Devices[devicename]"
         // Access your channels by using "DevSetup.Channels[channelname]"
      }
   }
}
```

The code has to be inserted into the method `public override void Run()`.

The entry points for accessing variables, devices and channels are stated in comments.

Helpful **examples** are given in the region *Examples*.

Note

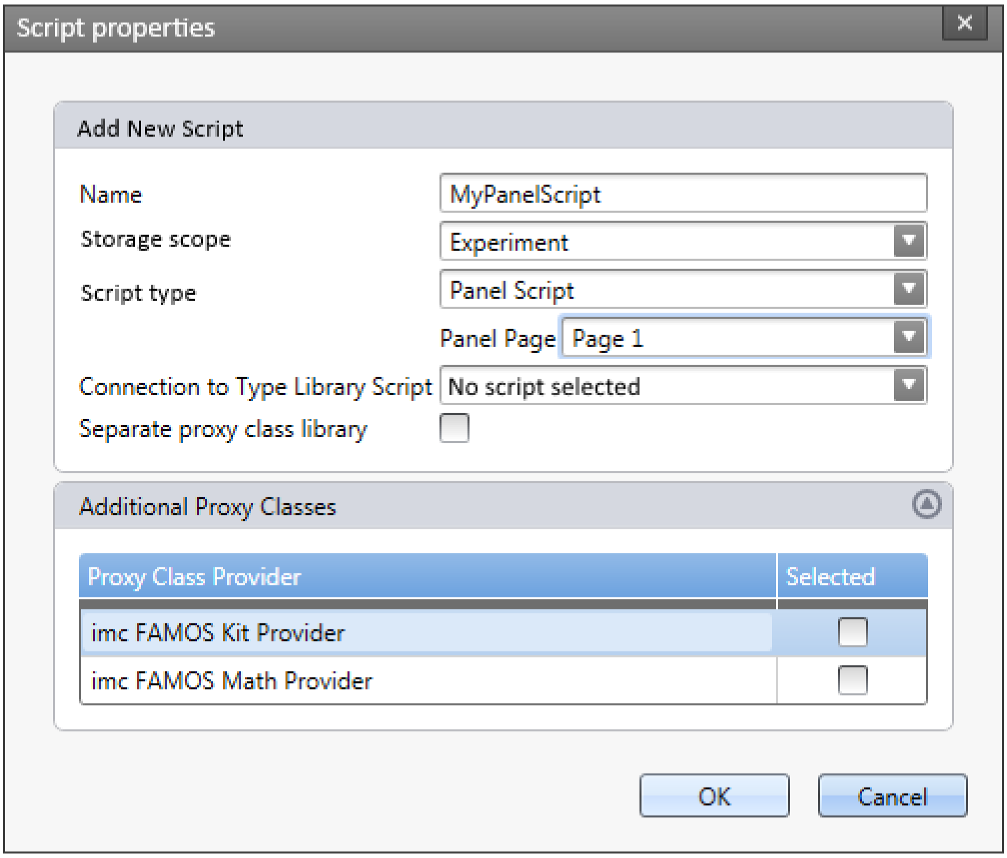
- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.

17.1.3.2 Panel Script

Panel Scripts can not be run in response to commands. They are linked with the corresponding **Panel page**.

When creating a **Panel script** , the corresponding Panel page must be selected.

If no page is selected, the script can be linked to a page via its properties.



Dialog: Creating a Panel-script

Note

- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.

If a new **Panel Script** is added, the **ScriptEditor** will open with the following code:

```
namespace myScript {
   using System;

   public class myPanel : AbstractmyPanel {

      // Custom ComboBox Example (in Region)
      // Custom ListBox Example (in Region)

      // public override bool PanelScriptInitialize() {}
      // public override bool PanelScriptDispose() {}

      /// Rocker_switch1 : ButtonWidget
      /// Standard_meter1 : PotentiometerWidget
      public override void Run() {
         // Add your initialization code here
      }

      public override void Stop() {
         // Add your cleanup code here
      }
   }
}
```

The Widgets on the Panel page are listed in comments above the function `Run()`. In this example a rocker switch (`Rocker_switch1`) and a gauge Widget (`Standard_meter1`) are on the Panel page.

The finished **Panel Script** must be compiled before being run.

The `Run()` and `Stop()` method are executed, when opening or leaving the corresponding Panel-page.

Method	is executed, when ...	Requirement / Characteristics
`Run()`	when changing to the corresponding Panel page	an other Panel page is opened
	when loading the experiment	all Panel scripts are executed, which are linked to a Panel page
	when leaving the Design mode	the corresponding Panel page must be opened
`Stop()`	when changing to an other Panel page	the corresponding Panel page must be opened
	when closing the experiment	the corresponding Panel page must be opened
	when entering the Design mode	the corresponding Panel page must be opened
When changing the main window, **none** of the methods are executed.		

Optionally, there are the following override methods available:

Methode	is executed, when	Application
`PanelScript Initialize()`	changing the script[1] [1] if necessary, the page must be changed or the Design mode must be toggled.	To initialize and register events on Widgets or Windows-Forms.
	loading the experiment and browsing to the Panel page.	
`PanelScript Dispose()`	closing the experiment	To dispose and unregister Events on Widgets or Windows-Forms.
	before the re-initialization.	

Note

- If events are added on a button action, these events have to be unhooked in the `Stop()` method. Otherwise this action would be performed twice/many times when starting the script again.
- With `this.PanelPage.Name` the current Panel page name can be used.

Widget

The properties of a Widget can be changed by the following line. Be sure, that the property is available for the Widget.

Using class object

```
Standard_meter1.Max = 30;
Standard_meter1.Min = 10;
Standard_meter1.Interval = 10;
```

Access via Panel page

```
Panel["Page 1"]["Standard_meter1"].Max = 30;
Panel["Page 1"]["Standard_meter1"].Min = 10;
Panel["Page 1"]["Standard_meter1"].Interval = 10;
```

Standard-Widget

```
// Change text from Standard-Widgets
Label1.StandardText = "Hello World!";
Label1.TextColor = Color.Aquamarine; // System.Drawing
Button1.StandardText = "Hello World!";
```

For futher information, please see chapter Panel and Widget functions 1761.

Add new Widgets

If new Widgets are added on the Panel page, the following steps are needed in order to use these Widgets in the script:

1. Close the **Editor**
2. Highlight the **Panel Script**
3. Regenerate the *Script Widgets* using the script action in the tool window **Scripts**
4. Edit the **Panel Script**
5. Compile

When deleting Widgets, it is necessary to ensure that the script no longer accesses the widget.

Datapool and Logbook

Use class `Core` to access to the datapool or logbook.

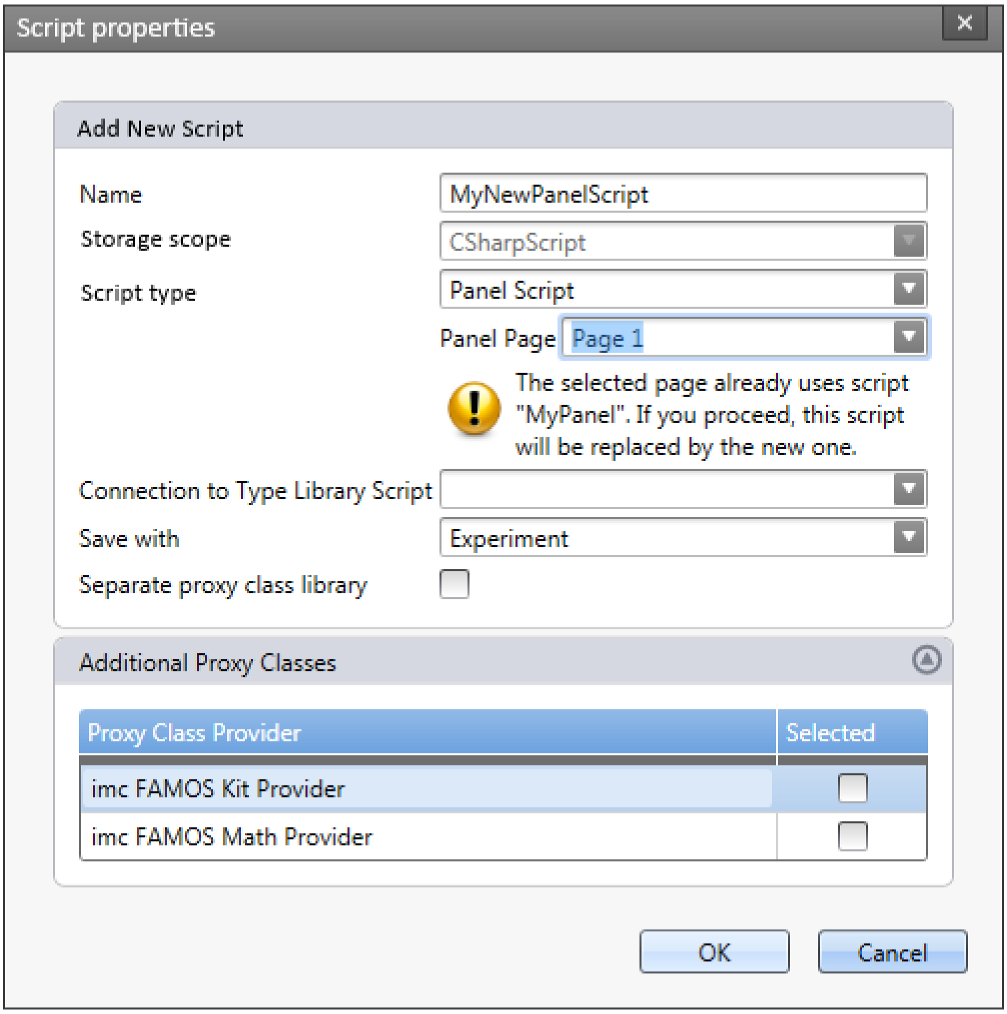
```
double myVariable = Core.Datapool["VariableName"].GetContent<double>();
```

```
Core.Logbook.LogEntry("MySender", "MyMessage", 0, ELogbookEntryCategory.Warning);
```

Link to Panel page

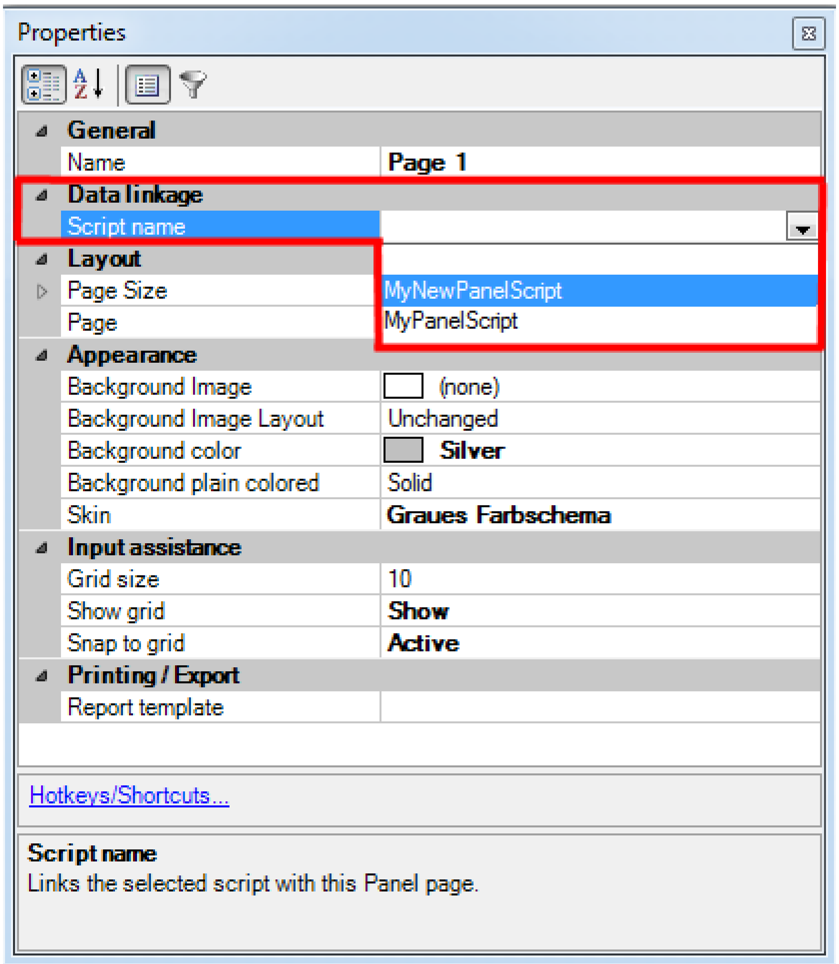
Warning

- If a Panel page is already linked with a Panel script, then the linkage is replaced with the new Panel script. The old Panel script is then no longer linked with any Panel page.
- If you import a Panel script, you have to link the script to the corresponding Panel page in the page properties.



Dialog: Panel Script - choose already linked page

In the properties of a Panel page the linked script can be changed.



Page properties: Script name

See Examples 1818

17.1.3.2.1 Examples

Example Switching visibility of a standard meter by a rocker switch

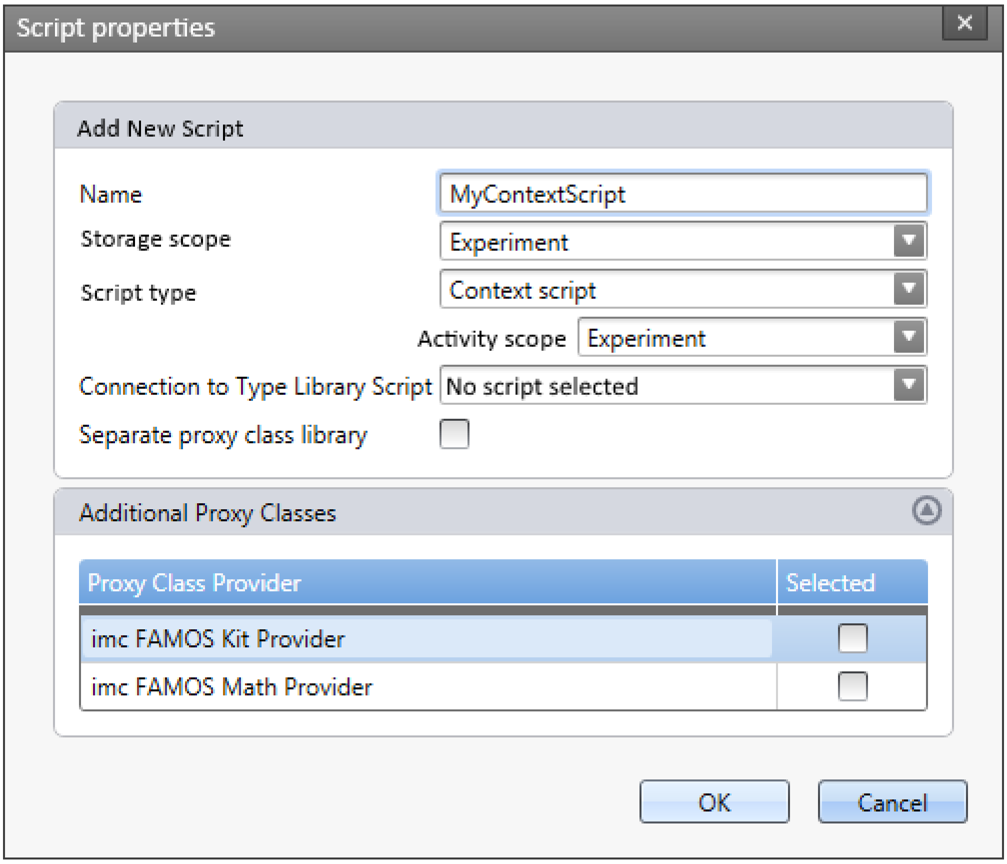
Via Data Browser-Class

```
bool isHooked = false;

public override void Run() {
   if (!isHooked){
      isHooked = true; // State -> hooked
      Rocker_switch1.SwitchOn += new Action<object, EventArgs>(turnon);
      Rocker_switch1.SwitchOff += new Action<object, EventArgs>(turnoff);
   }
}

public void turnon(object myObject,EventArgs args){
   if (isHooked){
      Standard_meter1.Visible = false;
   }
}

public void turnoff(object myObject,EventArgs args){
   if (isHooked){
      Standard_meter1.Visible = true;
   }
}

public override void Stop() {
   if (isHooked){
      isHooked = false; // State -> unhooked
      Rocker_switch1.SwitchOn -= turnon;
      Rocker_switch1.SwitchOff -= turnoff;
   }
}
```

Via Panel-Class

```
bool isHooked = false;

public override void Run() {
   if (!isHooked){
      isHooked = true; // State -> hooked
      Widget w = Panel["Page 1"]["Rocker_switch1"];
      w.SwitchOn += new Action<object, EventArgs>(turnon);
      w.SwitchOff += new Action<object, EventArgs>(turnoff);
   }
}

public void turnon(object mySender, EventArgs ev){
   if (isHooked){
      Panel["Page 1"]["Standard_meter1"].Visible = false;
   }
}

public void turnoff(object mySender, EventArgs ev){
   if (isHooked){
      Panel["Page 1"]["Standard_meter1"].Visible = true;
   }
}

public override void Stop() {
   if (isHooked){
      isHooked = false; // State -> unhooked
      Panel["Page 1"]["Rocker_switch1"].SwitchOn -= turnon;
      Panel["Page 1"]["Rocker_switch1"].SwitchOff -= turnoff;
   }
}
```

17.1.3.3 Context Script



Dialog: create Context Script

To add a **Context Script**, the appropriate **Activity Scope** (Experiment, Project, Application, Sequencer) has to be chosen.

The script calls the `Run()` method, when **opening** the corresponding scope. When **leaving** the scope the `Dispose()` method is called.

For example, when opening an experiment containing a **Context Script** with **Activity Scope** *Experiment*, the method `Run()` is called.

Opening other experiments or closing imc STUDIO calls the method `MyContextDispose()`. It is also called, when the script is deleted. The prefix *MyContext* is derived from the script name.

```
namespace MyContext {
   using System;

   public class MyContext : AbstractScript {

      public override void Run() {
         // Start your script here
      }

      protected override void MyContextDispose() {
         // Release all your resources and event hooks here.
      }
   }
}
```

Note

- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.

Warning

Since these methods are called while the experiment (or project, ...) is being loaded/closed, it is not permitted to implement any **blocking** functionalities within them.

For example, the display of a message-box would interrupt the loading process. In this case, the system is waiting for the user to provide confirmation to the dialog, and only subsequently can loading of the experiment be completed.

This can cause errors and other unintended effects to occur.

React to events

With a Context script you can react to device events. The event names are listed on the Sequencer page.

```
using imc.Studio.Interfaces.V2.Core;
public override void Run() {
   Events["Devices_Connected"].Execute += new
CommonEventHandler<ICoreEventEventArgsBase>(MyContextScript_Execute);
}

void MyContextScript_Execute(object sender, ICoreEventEventArgsBase e){
   // do something
}

protected override void MyContextScriptDispose() {
   Events["Devices_Connected"].Execute -= MyContextScript_Execute;
}
```

Text

With a Context script you can react to the manually execution of a menu action.

```
using imc.Studio.Interfaces.V2.Core;
public override void Run() {
   Actions["COMMANDAME"].Execute += new
CommonEventHandler<ICoreActionExecutionEventArgsBase>(Test_Execute);
}

void MyContextScript_Execute(object sender, ICoreActionExecutionEventArgsBase e){
   // do something
}

protected override void MyContextScriptDispose() {
   Actions["COMMANDNAME"].Execute -= MyContextScript_Execute;
}
```

For further information, please read chapter Commands 1803.

See Examples 1821

17.1.3.3.1 Examples

In the following example, a dialog is shown, if the state of a channels has changed. In the method `Run()` the action-method `ValChanged` is assigned to the event `DevSetup.ValueChanged`. The parameters can be derived from the `DevSetupValueChangedArgs` and be processed.

Within the method *ValChanged* a `try-finally` and a `if`-condition due to *InValueChanged* should be added.

The script starts, when the experiment is opend (Activity Scope *Experiment*).

Example — Show Dialog, if channel parameter "Status" has changed

```
using System.Windows.Forms;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

```
// namespace: ParameterChanged
// class: ParameterChanged
private bool isHooked = false;
private bool InValueChanged = false;

public override void Run()
{
   if (!isHooked)
   {
      isHooked = true;
      DevSetup.ValueChanged += new Action<object, DevSetupValueChangedArgs>(ValChanged);
   }     // of if
} // of void Run
```

```
private void ValChanged(object arg1,DevSetupValueChangedArgs arg2)
{
   // try{
   // if(!InValueChanged){
   foreach (var item in arg2.Changes.Keys){
      if (item.ClassID == EClassID.eStatus.ToString()){
         var channel = DevSetup.Channels.GetItemByHWID(item.HWID);
         if (channel != null && channel.Base != null) {
            var channelNameItem = channel.Parameters[EClassID.eChannelName];
            if (channelNameItem != null) {
               string strChannelName = channelNameItem.GetValue() as string;
               MessageBox.Show(strChannelName + "=" + item.Text, "State Changed");
            }
         }
      }
   } // for each
//   } // of if InValueChanged
//   } finally {
//      InValueChanged = false;
//   } // of try catch
} // of void
```

```
// Class name "ParameterChanged" -> "ParameterChangedDispose"
protected override void ParameterChangedDispose()
{
   // Release all your resources and event hooks here.
   if (isHooked)
   {
      DevSetup.ValueChanged -= ValChanged;
      isHooked = false;
   } // of if
} // of void Dispose
```

Example | If channel state is set to active, activate saving to PC

```
using imc.Studio.Tools.DevSetupGraphGenerator;
```

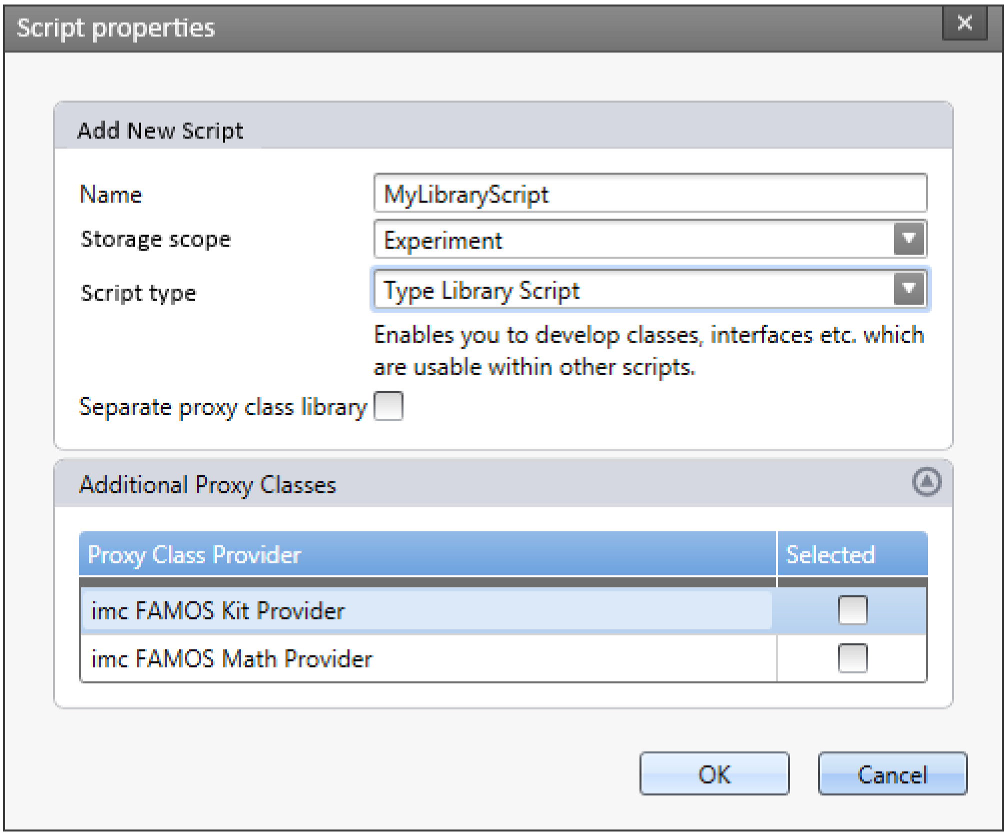
```
// namespace: ParameterChanged
// class: ParameterChanged
bool isHooked = false;

public override void Run()
{
   if (!isHooked)
   {
      isHooked = true;
      DevSetup.ValueChanged += new Action<object,
DevSetupValueChangedArgs>(DevSetup_ValueChanged);
   }
}
```

```
void DevSetup_ValueChanged(object arg1, DevSetupValueChangedArgs arg2)
{
   if (isHooked)
   {
      foreach (var item in arg2.Changes.Keys)
      {
         // when state is not passive, save channel
         if (item.ClassID == EClassID.eStatus.ToString())
         {
            var channel = DevSetup.Channels.GetItemByHWID(item.HWID);
            if (channel != null && channel.Base != null)
            {
               SaveChannelActive(channel);
            }
         } // if eStatus

         // when selecting device, all non-passive channels are saved
         if (item.ClassID == "Dev_SelForMeasurement")
         {
            foreach (var channel in DevSetup.Channels)
            {
               SaveChannelActive(channel);
            }
         } // if Dev_Sel
      } // foreach keys
   } // hooked
}
```

```
protected void SaveChannelActive(EnumItem channel)
{
   var paraSave = channel.Parameters[EClassID.ePCTransferToHD];
   var paraState = channel.Parameters[EClassID.eStatus];

   if (paraSave != null)
   {
      if (paraState != null)
      {
         if ((int)paraState.GetValue() != ParameterValues.eStatus.Passive)
         {
            paraSave.SetValue(1); // set saving on, if active
         }
          else
         {
            paraSave.SetValue(0); // set saving off, if passive
         }
      } // if state
   } // if save
} // SaveChannel
```

```
protected override void SaveActiveChannelDispose()
{
   if (isHooked)
   {
      isHooked = false;
      DevSetup.ValueChanged -= DevSetup_ValueChanged;
   }
}
```

17.1.3.4 Type Library Script



Dialog: create Type Library Script

In the **Type-Library-Script**, it is possible to enter one's own classes and methods which can then be embedded into the other script types where they are subsequently available for use. A **Type-Library-Script** can also be used in multiple other scripts. For this reason, this kind of script is especially useful when certain classes and methods are to be used repeatedly. Thus, the process of embedding these into each script separately is not necessary.

You can implement your own classes and methods in a **Type Library Script**.

A **Type Library Script** can be connected to other script types in the *Script options* dialog, when creating scripts.

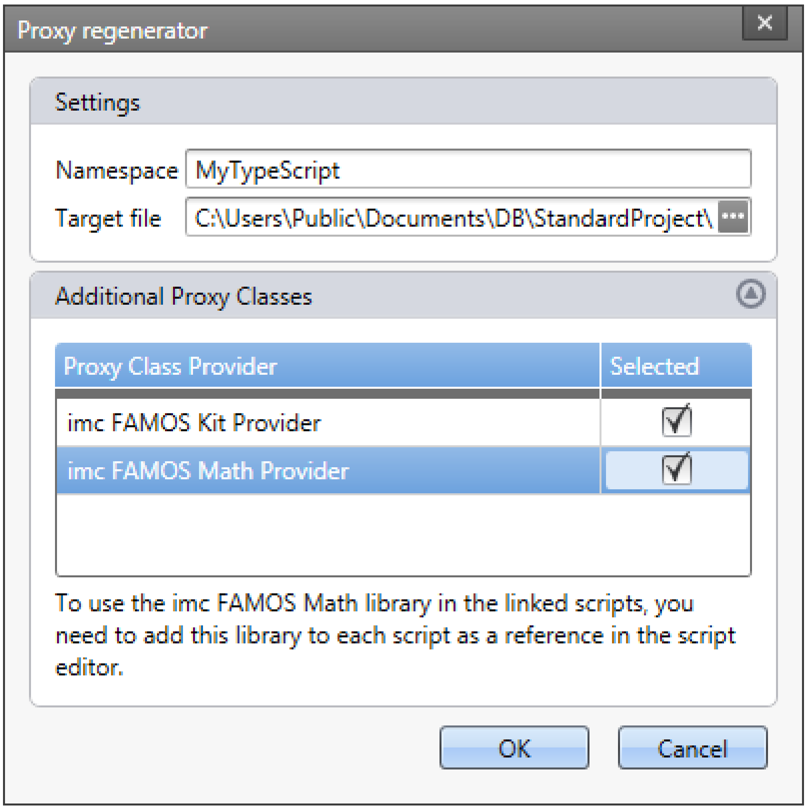
```
using System;
namespace MyLibrary {
    // Insert your TypeLibrary code here
}
```

Warning

- Please make sure when using **Type Library Script**s, that the *Storage Scope* is chosen so that the **Type Library Script** is accessible from the linked scripts, even if you change the *Storage Scope*.
- After making changes to a type-library-script to which there is any link, it is necessary to restart imc STUDIO for the changes to take effect.

Note

- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.



Dialog: Proxy rengenerator

Note

It is recommended to set the **Assembly Version** (see file *AssemblyInfo.cs*):

```
[assembly: AssemblyVersion("1.0.1.0")]
```

See Examples 1825

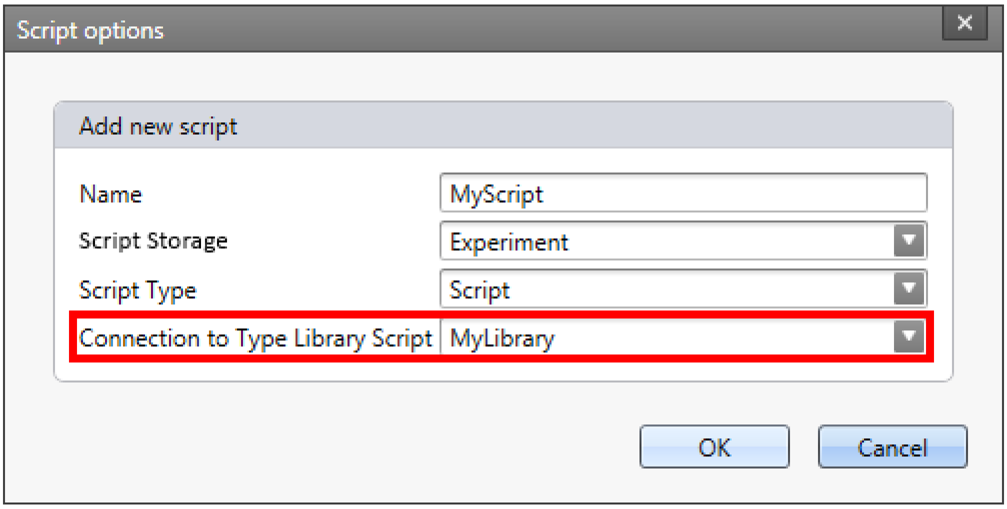
17.1.3.4.1 Examples

Type Library Script

```
using System;
namespace MyLibrary {
   // Insert your TypeLibrary code here
   public class MyClass
   {
      private double dNumber = 12;
      public string ClassName = "MyClass";

      public void SetNumber(double d){
         this.dNumber = d;
      }

      public double GetNumber(){
         return this.dNumber;
      }

   } // end of class MyClass
}
```

Script

The actual script is created with the connection to the Type Library Script *MyLibrary*.

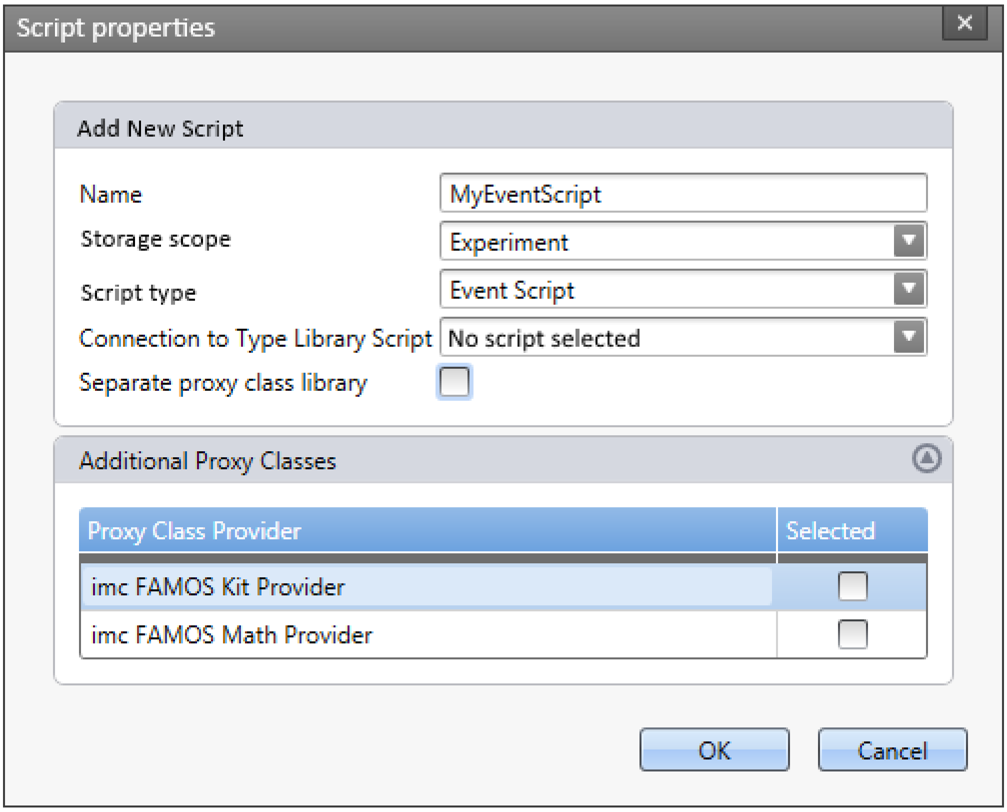


Script with Type Library Script

The class and methods of the library can be used in the script.

```
namespace MyScript {
   using System;
   using MyLibrary;


   public class MyScript : AbstractScript
   {
      public override void Run()
      {
         MyClass a = new MyClass();
         a.SetNumber(8);
         double dNum = a.GetNumber();
         string name = a.ClassName;
      }
   }
}
```

17.1.3.5 Event Script



Dialog: create Event Script

To use an **Event Script**, go to the Sequencer and the Event tool windows and add the command *Run Script* to an event.

In an **Event Script** the event arguments / parameters are available.

```
namespace MyEvent {

   public class MyEvent : AbstractScript {

      public override void Run() {
         // Access event arguments by using e.g. this.DevSetupValueChangedArgs
      }
   }
}
```

Note

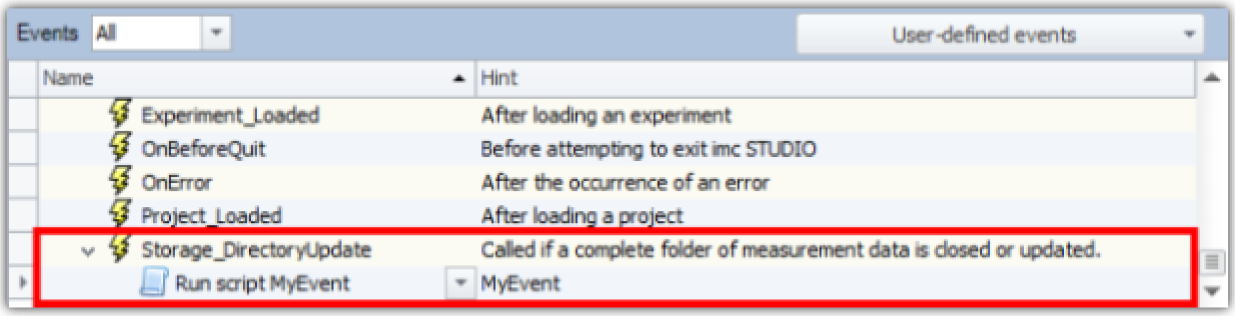
- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.

See Examples 1827

17.1.3.5.1 Examples

In the Sequencer the event *Storage_DirectoryUpdate* is available.

This event is called, when the measurement data in the measurement folder (e.g. interval folder) is completed or updated.



Sequencer: Event Storage_DirectoryUpdate

If an **Event Script** is run by releasing this event, the data storage parameters are given in `this.QuickStorageInfoEventArgs`.

this.QuickStorageInfoEventArgs	
Directory	Full path to the measurement folder
EventNumber	If using trigger/events, event count and saving in individual files is activated.
MeasureID	Hash code
MeasurementName	Name of the folder
RootPath	Experiment path/folder, where the measurements are saved
StartTime	Start time code
StopTime	Stop time code
Trigger	Trigger name; is empty when only using Trigger_48

```
using System.Windows.Forms;
using System.IO;

namespace MyEvent
{
   public class MyEvent : AbstractScript
   {
      public override void Run()
      {
       var MyInfo = this.QuickStorageInfoEventArgs;
       if ( MyInfo != null){
             double startTime    = MyInfo.StartTime;
             double stopTime     = MyInfo.StopTime;
             string measureID    = MyInfo.MeasureID;
             string rootPath     = MyInfo.RootPath;
             string directory    = MyInfo.Directory;
             string trigger      = MyInfo.Trigger;
             int eventNumber     = MyInfo.EventNumber;
         // do something with these parameters

       }
         else
       {
         // do something
       } // if
     } // run
   }
}
```

```
// do something with these parameters
string fullPath = Path.Combine(rootPath, directory);
double duration = dStopTime - dStartTime;
string message = "Your measurement " + measureID.ToString() + " triggered by  \"" +
      trigger + "\" last " + duration.ToString("#.###") +
      "s and was saved in " + @fullPath  + " .\n" +
      "This is the Event #" + eventNumber.ToString();
MessageBox.Show(message);
```

Additionally, the following settings must be made on the **Setup**-page:

- Channel_001: Saving (PC) on
- Trigger_01: Event - Virt_Bit01; Action - Channel_001 start/stop
- Devices: Saving Trigger Events to different files (PC)

17.1.3.6 Third Party Device Script

Reference

For more information see chapter Third Party Device Script 1860.

17.1.4 EClassID - Parameters

17.1.4.1 Device Parameters

Note

For setting the parameters, class *EClassID* is used. Setting values of the parameter are available in the *ParameterValues*-Class. The `EClassID` device parameters are listed below.

To use the class *EClassID* the following **library** has to be added:

```
using imc.Studio.Tools.DevSetupGraphGenerator;
```

Please click on the parameters to see the corresponding tables.

Device Control (Action)

eDeviceControlAction	
Connect	1000
Download	2000
Start	3000
Stop	5000
Disconnect	7000

`ExecuteAction()` has to be run after setting the value.

Diskstart (Action)

eDiskStartAction	
PC + Device HD*	2501
PC HD	2502
Device HD	2503
Removable Device	2504
Device intern	2505
Device intern RAM*	2506
All Device mem space*	2507

`ExecuteAction()` has to be run after setting the value.

* Functions not implemented.

eDiskStartOption	
immediately	1
defined time	2
next second	3
next minute	4
next hour	5
next day	6
automatically	7
next 10th minute	8

Synch Signal: Input/Output

eSynchSignalInput eSynchSignalOutput	
no signal	1
DCF	2
GPS	3
SYNC + GPS	4
Synch. signal NTP	5
Synch. Ethercat	6
PTP	7
IRIG B002W	8

Start option

eStartOption	
immediately	1
defined time	2
next second	3
next minute	4
next hour	5
next day	6
automatically	7
next 10th minute	8

Connection state

eConnectionStatus	
disconnected	0
connected	1

Measurement state

eMeasurementStatus	
stopped	1
running	2
reconfigured	3

17.1.4.2 Channel Parameters

Note

For setting the parameters, class *EClassID* is used. Setting values of the parameter are available in the *ParameterValues*-Class. The `EClassID` channel parameters are listed below.

To use the class *EClassID* the following **library** has to be added:

```
using imc.Studio.Tools.DevSetupGraphGenerator;
```

Please click on the parameters to see the corresponding tables.

Status

eStatus	
active	1
passive	2
write	1001
read/write	1002

Channel Type

eChannelType	
Analog Input	1
DAC-Output	2
Digital inputs/outputs (ports)	3
Trigger	4
Virtual Channels	5
Digial inputs/outputs (bits)	6
Virtual bits	7
Net Bits	8
Counter inputs	9
Temperature reference Channel	10

eChannelType	
Monitor: Analog inputs	11
Monitor: Digital inputs / outputs (ports)	12
Monitor: Counter inputs	13
Monitor: Digital inputs / outputs (bits)	14
Display Variables	15

eChannelType	
Field bus: Analog inputs	17
Field bus: Digital input / output (ports)	18
Field bus: Digital input / output (bits)	19
Field bus: Sum event	20
Field bus: Sending Channels	21

eChannelType	
Synthesizer	22
Communication Object	23
Process-Vector Variables	24
Video	1001
Monitor: Video	1002
Digital inputs/*outputs* (ports)	4099
Digital *inputs*/outputs (ports)	8195

Balance (Action)

eBalanceAction	
Offset	2011
Bridge	2012
Tare	2013
Manufacture's calibration	2014

`ExecuteAction()` has to be run, after setting the value.

Balance Status

eBalanceStatus	
balance state undefined	0
not balanced	1
bridge balance run	2
bridge balance ok	3
tare run	4
tare ok	5
offset run	6
offset ok	7
manufacture run	8
manufacture ok	9

Cable Calibration (Action)

eCalibrationAction	
Two-Point Scaling	2021
Invalid	2022
Cable Compensation	2023
Reset Cable	2024
Reset Two-Point	2025

`ExecuteAction()` has to be run, after setting the value.

Calibration status

eCalibrationStatus	
undefined	0
not balanced	1
Point 1 running	10
Point 1 ok	11
Point 2 running	12
Point 2 ok	13
Point 1 and 2 ok	14
Two-Point scaling running	15
Two-Point scaling ok	16
Two-Point reset running	17
Two-Point reset ok	18
Cable compensation running	19
Cable compensation ok	20
Cable compensation reset running	21
Cable compensation reset ok	22

Filter Type

eFilterType	
Low Pass	1
High Pass	2
Band Pass	3
without	4
AAF	5
Slow	6
Fast	7
Impulse	8
Peak	9

Filter Characteristics

eFilterCharacteristic	
Butterworth	1
Bessel	2
Tschebbychew	3
Cauer	4
A-weighting	5
B-weighting	6
C-weighting	7
D-weighting	8
without weighting	9

Event

eEvent	
Signal = 1	381
Signal = 0	384
Signal change 1 -> 0	383
Signal change 0 -> 1	384
Positive slope	391
Negative slope	392
Signal > Threshold	393
Signal < Threshold	394
Signal entering range	401
Signal exiting range	402
Inside of range	403
Outside of range	404

Event-Type

eEventType	
Threshold	1
Range	2
Ratio	3

Coupling

eCoupling	
AC	1
DC	2
Half-Bridge	3
IEPE	4
Full-Bridge	5
Quarter-Bridge	6
Microphone	7
DC charge	8
AC charge	9
TTL	10

eCoupling	
Strain gauge - quarter-bridge	1001
Poisson half bridge	1002
Half bridge with 2 active strain gauges in uniaxial direction	1003
Half bridge with one active and one passive strain gauge	1004
Full bridge with Poisson strain gauges in opposed branches	1005
Full bridge with Poisson strain gauges in adjacent branches	1006
Full bridge with 4 active arms	1007
General strain gauge - full-bridge	1008
General strain gauge - half-bridge	1009

Channel mode

eChannelMode	
Sampling / Distance (diff.)	1
Bit Output / Angle (diff.)	2
Bit Input / Speed	3
RPM	4
Events	5
Frequency	6
Time	7
Pulse time	8
Angle(abs)	9
Distance (abs)	10
Voltage	1000
Current	1001
Strain gauge	1002
Charge	1003

Preprocessing

ePprocessing	
none	1
Arithmetic mean value	2
Minimum	3
Maximum	4
RMS	5
MinMax	6
Reduction	7

17.1.4.3 Experiment Parameters

Note

The *EClassID* parameters for the **experiment** are set as *string* listed in the following table.

Example

```
DevSetup.Experiment["CompanyName"].SetValue("imc");
DevSetup.Experiment["TestEngineer"].SetValue("Average Joe");
```

Project

Description	EClassID parameter
Company name	CompanyName
Hint	Hint
Project document	ProjectDoc
Linked project document	LinkedProjectDoc
Project documentation path	ProjectDocPath
Project officer	ProjectOfficer
E-mail address project officer	EMailProjectOfficer

Test engineer, test setup, test object, test operator

Description	EClassID parameter
Test engineer	TestEngineer
Test engineer e-mail	EMailTestEngineer
Test setup description	TestObjectDesc
Test station photo	TestObjPic
Test setup document	TestObjectDoc
Test object description	TestSetupDesc
Test object picture	TestStationPhoto
Test object document	TestSetupDoc
User	User
E-mail address user	EMailUser

Annotation

Start: before measurement

End: after measurement

Description	EClassID parameter
Comment (start)	AnnotationStart
Environmental conditions (start)	ConditionsStart
Conditions parameter name (start)	ConditionsParamNameStart
Conditions parameter value (start)	ConditionsParamValueStart
Picture (start)	PicStart
Location	Location
Date	Date
Time	Time
Comment (end)	AnnotationEnd
Environmental conditions (end)	ConditionsEnd
Conditions parameter name (end)	ConditionsParamNameEnd
Conditions parameter value (end)	ConditionsParamValueEnd
Picture (end)	PicEnd

Result

Description	EClassID parameter
Result status (name)	ResultStatusName
Result status (value)	ResultStatusValue
Result characteristic name	ResultCharacName
Result characteristic	ResultCharac
Result description	ResultDesc
Result document	ResultDoc
Result picture	ResultPic

Misc

Description	EClassID parameter
Test part number	TestPartNo
Test object number	TestObjNo
Short Description	DescriptionShort
Description	DescriptionLong

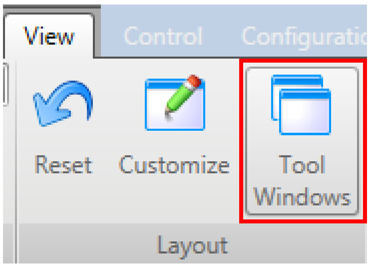
17.1.4.4 Finding parameters and setting values

Finding parameters and their values

The following describes a way to find the **EClassID** parameters on the basis of the table description. Another way is described in Finding setting values 1839.

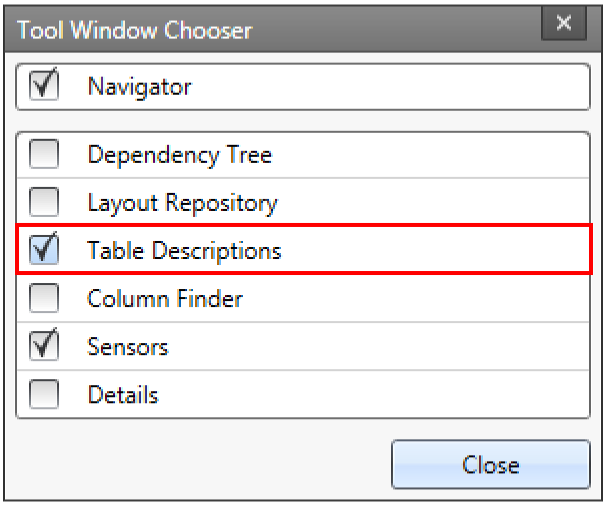
Activating the Table Description tool window

Start by activating the tool window *Table description* on the **Setup** page. Once you are on the Setup page, click in the menu ribbon on *View > Layout > Tool Windows*.



View > Layout > Tool Windows

A new dialog will open. Put a check in the box for *Table Descriptions* and close the window. A new tab is added at the right edge of the screen.

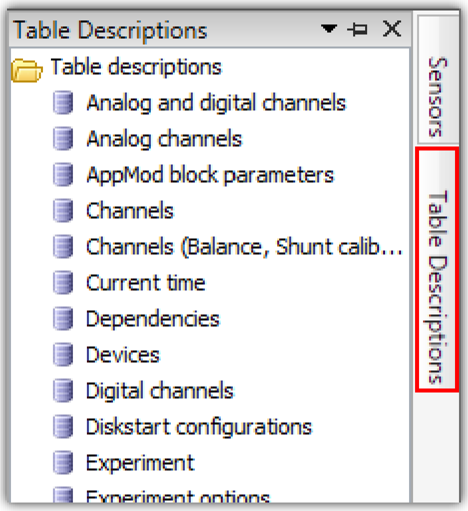


Dialog: Tool Window Chooser

The view can also be saved, so that the tool window is available once again the next time imc STUDIO is started.

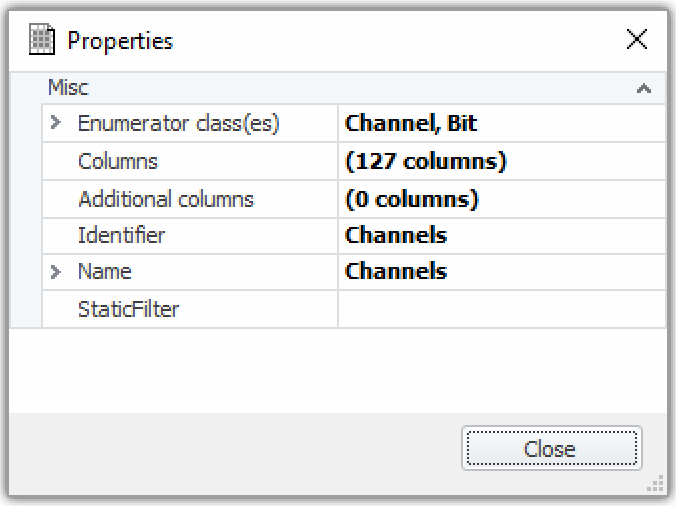
Viewing a table description

Click on the tab *Table description* on the right edge to open the description.



Tool window: Table description

Click in the context menu of the table in which the desired parameter is located, for example on the item *Properties* in the context menu for *Analog Channels*.



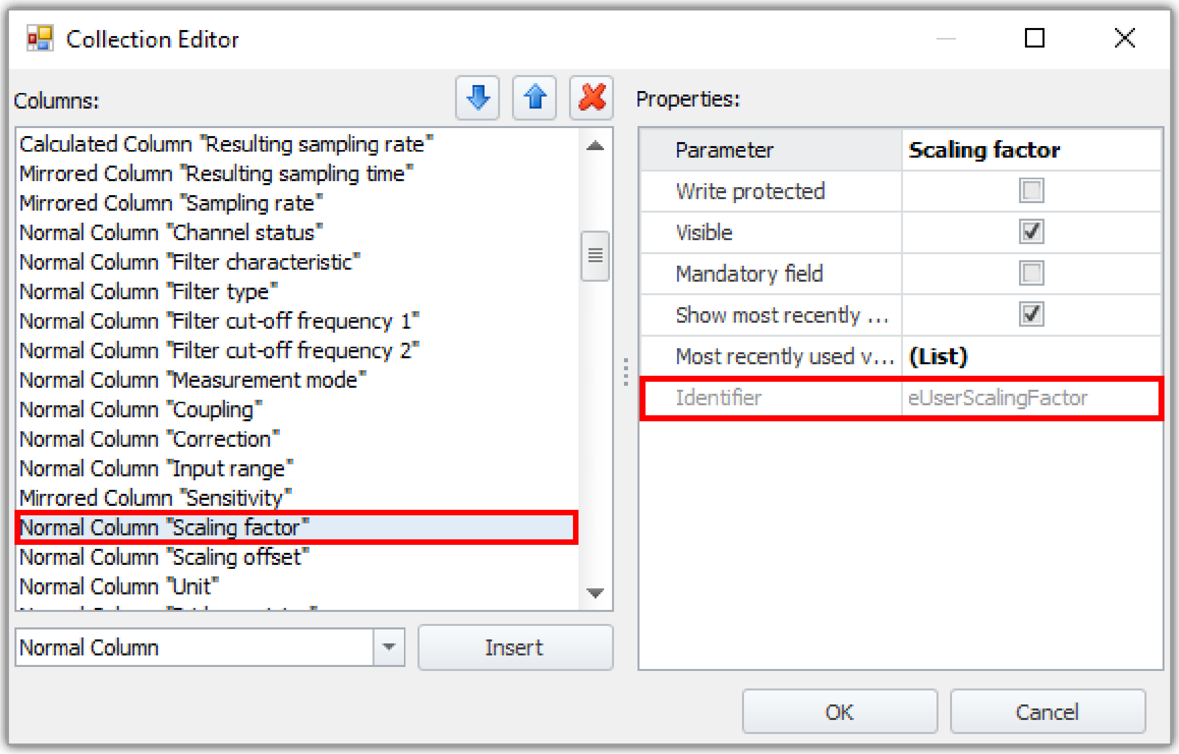
Properties: Analog channels

Click on the button with three dots "..." at the entry for Columns.

Parameter Identifier

After opening the column descriptions, select the pertinent parameter on the left side. On the right side, the associated identifier is stated.

In this example, the *Scaling factor* has been selected and is the identifier indicated is *eUserScalingFactor*.



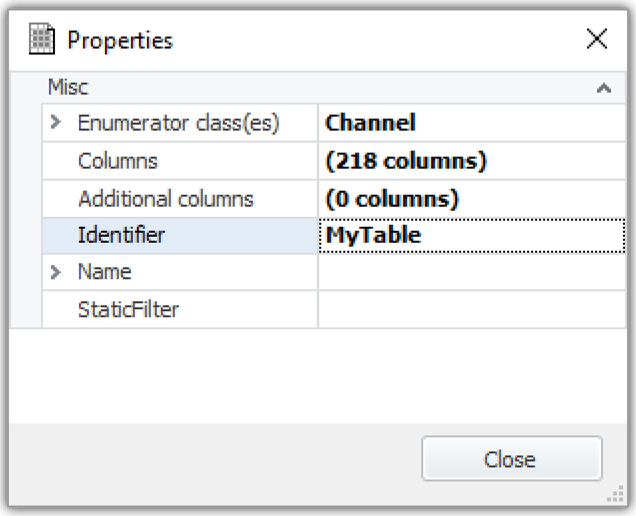
Collection Editor

Finding setting values

Another way to get the parameters and the respective values to which they are set is described in the section below.

Creating one's own table description

The easiest way is to create one's own table description. To do this, right-click in the *Table Descriptions* tool window on the folder icon (also titled *Table Descriptions*) to open the context menu, where you then select the item *Add*. Enter a name for the table description.

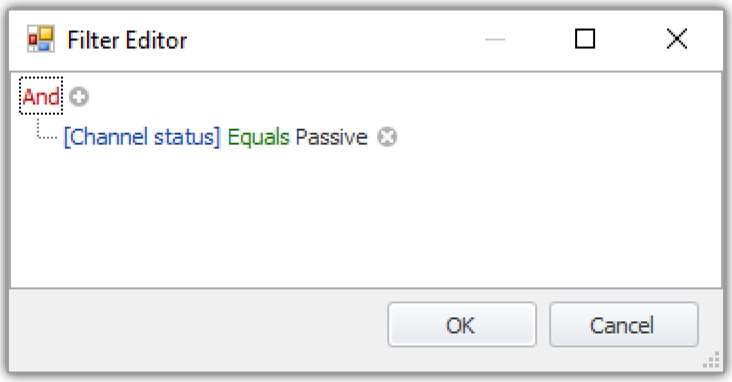


Properties of a user-defined table description

As the Enumerator class, select the desired class containing the parameter, e.g. *Channel*.

Filter Editor

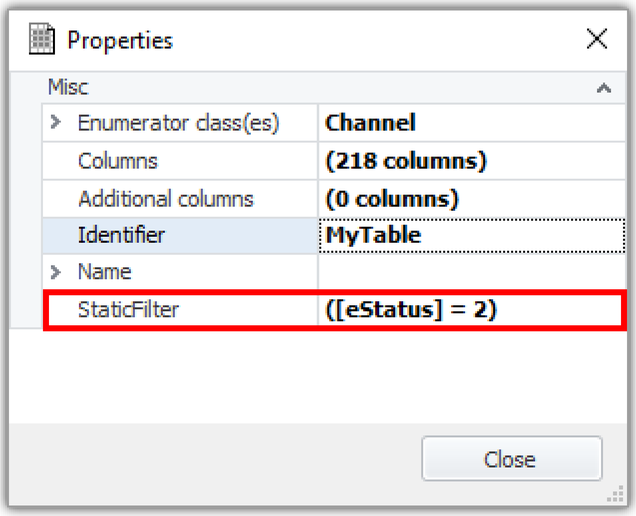
Under *StaticFilter*, select the parameter of which you wish to know what value is set for it, e.g. *Channel status*. For the value, either enter the value desired or select it from the drop-down list. Close the window.



Filter Editor

Viewing

Subsequently, you can view the **EClassID**-name and the value to which it is set under *StaticFilter* in the Properties window, e.g. ([eStatus] = 2). In this case, it means that the channel status is passive.

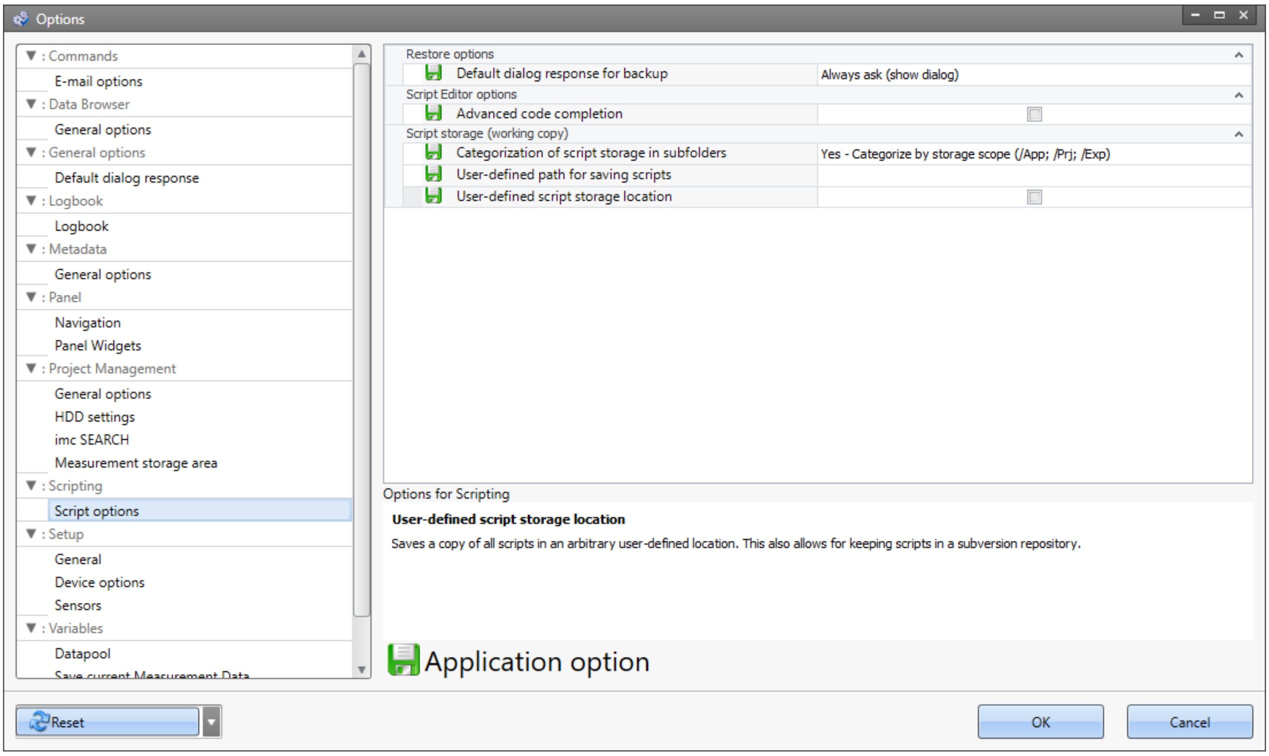


Properties: StaticFilter

17.1.5 Script options

The options can be reached by using the ribbon or by clicking on the button *Script options* in the tool window *Scripts*.

Ribbon	View
Extra > Options ()	All



Script options

Script storage (working copy)

Option	Description
Categorization of script storage in subfolders	The categorization specifies if different subfolders depending on the Script storage should be used or one common folder.
User-defined path for saving scripts	Folder in which a working copy of all scripts is saved, if user-defined script storage location is activated.
User-defined script storage location	The scripts are stored at a different location as the experiment or project. This can be helpful when using subversion tools (SVN). Stores a copy of all scripts in an arbitrary user-defined location. All scripts can be found in the given folder.

Script Editor options

Option	Description
Advanced code completion	If the advanced code completion is enabled, internal interfaces will be shown in the code completion of the editor. These interfaces are only needed for special functions and should only be used by advanced users. When enabling/disabling this option, the editor must be reopened.

Restore options

Option	Description
Default dialog response for backup	The scripts will be stored outside of imc STUDIO. The current state of the scripts is only applied when the associated storage scope is saved. If any changes where made to the script in the Script Editor after the last saving of the storage scope, this option can be used to automatically restore scripts to the last saved state of the script. • **Always ask (show dialog):** A *dialog* appears with the options to restore the last saved state. • **Always restore (use last script saving state):** Changes are always restored. The last saved state from the *Script Editor* is used. • **Never restore (use latest backup in the respective storage scope):** Changes are never restored. The last saved state of the scripts from the *Experiment* or *Project* is used. For more information, see chapter Restore script changes 1809.

17.1.6 Tutorial

Here you will find a list of tutorials:

Tutorial	Description
Device and channel settings 1846	A device is added to the device list. After selection of the device, the analog channels are configured.
Channel calculation 1850	Different methods to calculate channels are shown.
Curve Window and channel selection 1852	A channel selection list is created to select, which channel should be shown in the curve window.
List linked Variables 1853	Shows a list of Widgets and their connection to variables.
RS232-Interface 1854	A example how to control a serial device.
Using the script clipboard 1855	The script clipboard is explained in a little example.

17.1.6.1 Device and channel settings

Channel settings

In this tutorial, a device is to added to the device list on the basis of its serial number (here: 123456) and then selected. Furthermore, all analog channels are to be set as follows:

Parameter	Value
State	active
Save to HDD	on
Sample rate	1000 Hz
Duration:	10 s
Measurement mode	Voltage
Coupling	DC
Input Range	±5 V

The following **libraries** are needed:

```
using imc.Common.Interfaces.Logbook;
using imc.Studio.Interfaces.DevSetup;
using imc.Studio.Tools.DevSetupGraphGenerator;
```

Once imc STUDIO has been started, a scripted named *DeviceSettings* is created by means of the Sequencer-page.

In the first step, the data above are recorded.

```
string errorSender  = "DeviceSettings Script"; // Sender for Logbook
string serialNumber = "123456";

double sampleTime = 0.001; // 1 ms = 1000 Hz
double duration   = 10.0; //  10 s
double range      = 5;  //  +/- 5 V
string rangeText    = "\u00b1" +  range.ToString() + " V"; // +/- Symbol and Unit
```

If the device still does not appear in the Devices list, a device search is performed. Subsequently, the device is selected, if it is present.

```
// Get Device via serial number
EnumItem device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);

// if device is not in list, do device search
if (device == null) {
   DevSetup.SearchDevices();
   device = DevSetup.Devices.GetItemBySerialNumber(serialNumber);

   // if device is not still in the list -> Warning
   if (device == null) {
      Logbook.LogEntry(errorSender, "Device with S/N " + serialNumber + " could not be found.",
0, ELogbookEntryCategory.Warning);
      return; // end script
   } // if
} // if

// get device name
string nickName = device.Parameters[EClassID.eDeviceNickname].GetValue().ToString();
string name = device.Parameters[EClassID.eDeviceName].GetValue().ToString();

// select device for measurement
DevSetup.SelectDevice(nickName,true, EDeviceCoreType_V2.Measurement);
```

For all analog channels, the above **parameters** are to be set as follows:

```
foreach( var channel in DevSetup.Channels){
   var paraType = channel.Parameters[EClassID.eChannelType];    //
   if (paraType != null){
      int chnType = (int)paraType.GetValue();
      // for analog channels
      if ( chnType == ParameterValues.eChannelType.AnalogInput) {

         // ... next block

      } // chnType
   } // paraType
} // foreach

// Download
Action.FireAction(this, "acCheckConfiguration");
```

Setting of the **parameters** is performed as follows:

```
var paraStatus      = channel.Parameters[EClassID.eStatus];
var paraSaveHD      = channel.Parameters[EClassID.ePCTransferToHD];
var paraSampleTime  = channel.Parameters[EClassID.eSampleTime];
var paraDuration    = channel.Parameters[EClassID.eDuration];
var paraRange       = channel.Parameters[EClassID.eRange];
var paraMode        = channel.Parameters[EClassID.eChannelMode];
var paraCoupling    = channel.Parameters[EClassID.eCoupling];
```

```
// set state to active
if (paraStatus != null){
   paraStatus.SetValue(ParameterValues.eStatus.Active);
} // paraStatus
// enable saving to PC
if (paraSaveHD != null){
   paraSaveHD.SetValue(true);
} // paraSaveHD
// set sample rate
if (paraSampleTime != null){
   paraSampleTime.SetValue(sampleTime);
} // paraSampleTime
// set duration
if (paraDuration != null){
   paraDuration.SetValue(duration);
} // paraDuration
// set mode to "Voltage"
if (paraMode != null){
   paraMode.SetValue(ParameterValues.eChannelMode.DAQ_Voltage);
} // paraMode
// set coupling to DC
if (paraCoupling != null){
   paraCoupling.SetValue(ParameterValues.eCoupling.DC);
} // para Coupling
// set Range
if (paraRange != null){
   paraRange.SetValue(rangeText);
} // paraRange
```

After the script has been successfully complied, the Editor can be closed. Subsequently, the script can be run by means of a command, for example.

If the device does not yet appear in the Devices list, a device search is performed and the device is added to the list. The channel settings are performed and can be reviewed on the page *Analog Channels*. If the device is not found at all, a warning is recorded in the Logbook.

Extension: Input via Widgets

Supposing we want to expand on the example above. The goal is to be able to enter the sampling interval, the input range, and the measurement duration by means of Widgets.

First, to represent these parameters, create the user-defined variables *SampleTime*, *Range* and *Duration* in the Data-Browser. These variables are dragged from the Data Browser to a Panel page and displayed as a numerical display widget. It is also helpful the display the Setup-page *Analog channels* (Widget: Device Control Setup).

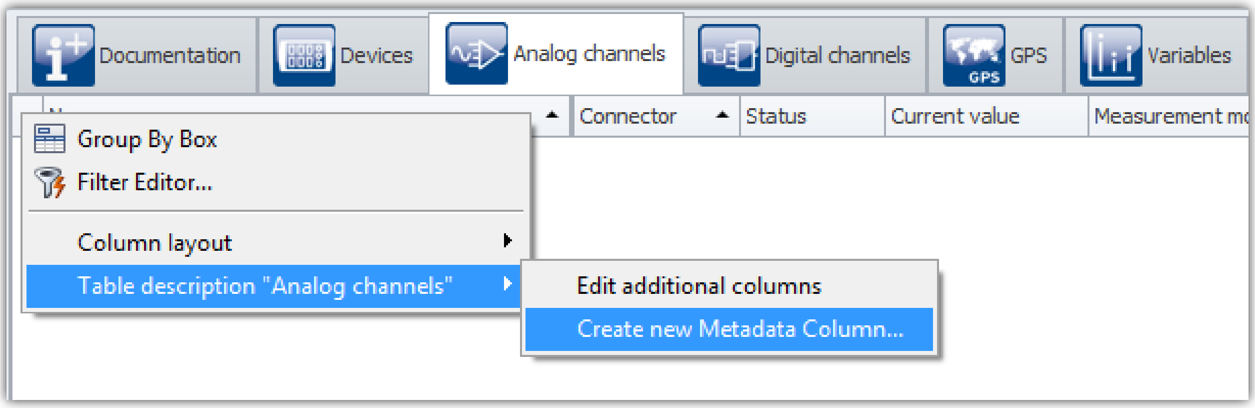
The value of each of these variables is queried in the script and assigned to the corresponding variable.

```
string errorSender  = "DeviceSettings Script"; // Sender for logbook
string serialNumber = "123456";

double sampleTime = Datapool["SampleTime"].GetContent<double>(); //
double duration   = Datapool["Duration"].GetContent<double>(); //
double range      = Datapool["Range"].GetContent<double>();  //
string rangeAsText    = "\u00b1" + range.ToString() + " V"; // +/- Symbol and Unit
```

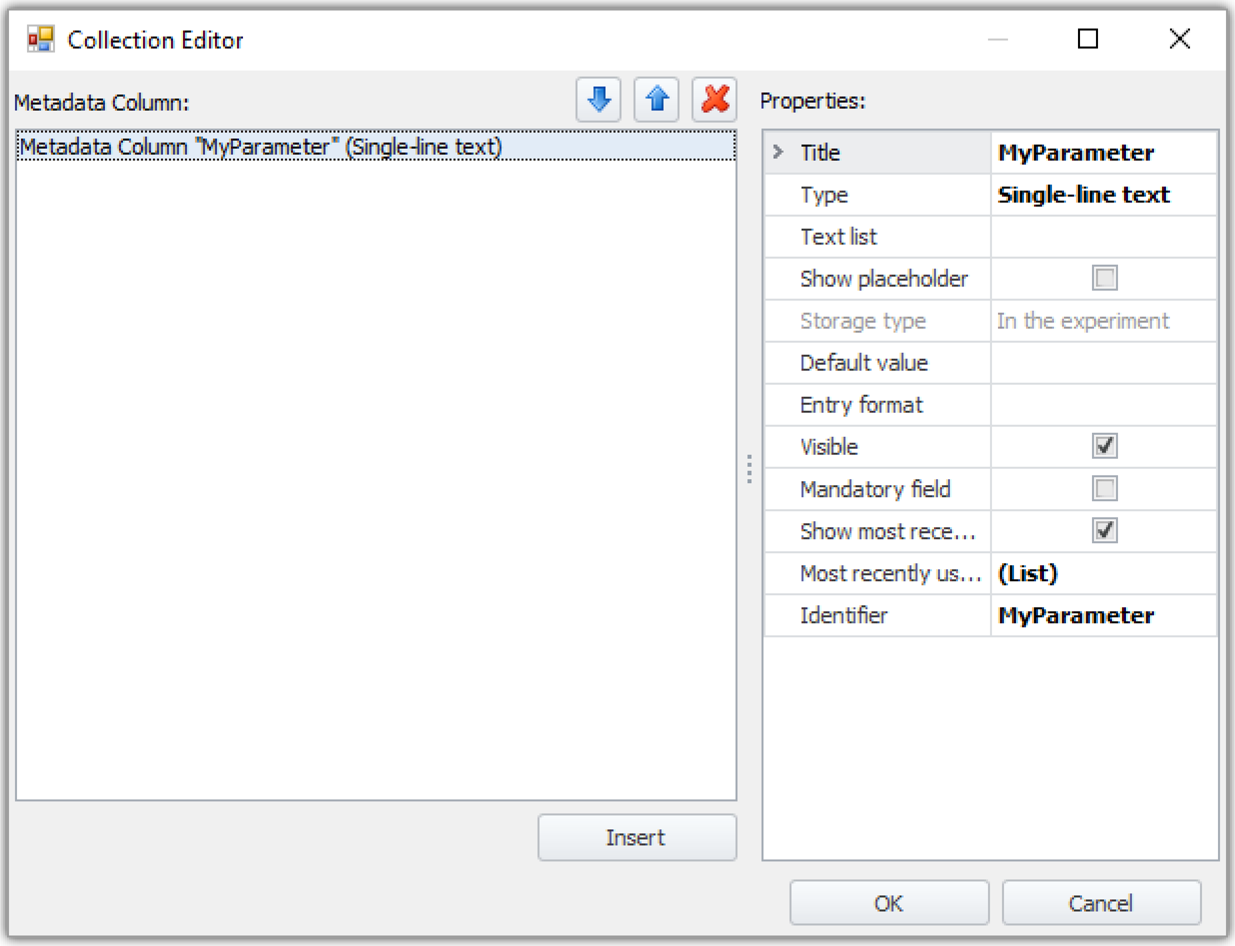
After the script has been compiled, it is possible to set the parameters by means of the widgets while the Design-mode is deactivated. A button which causes the script to run when pressed (command: *Run Script*) is added to the Panel page. When the button is activated, the values are updated to the *Analog channels* page.

Extension: Metadata columns

On the Setup-page *Analog channels*, create your own metadata column 258 *MyParameter by* opening the context menu of **the upper left corner** and clicking on *Table description "Analog channels" > Create new Metadata Column...* **.**



Analog Channels: Add Metadata column



Collection Editor: Metadata column "MyParameter"

This column is to be filled by the script with progressively higher numbers. Toward this end, a counting variable is generated. Save this view.

```
int count = 1;
foreach( var channel in DevSetup.Channels){
  // ...
} // foreach
```

The parameter setting process is supplemented with the following code:

```
var paraCustom = channel.Parameters["MyParameter"]; // Identifier
// ...
if (paraCustom != null){
   paraCustom.SetValue("#" + count.ToString());
   count++;
}
```

After running the script, the newly added table column of the analog channels fills itself.

17.1.6.2 Channel calculation

Calculation without imc FAMOS

In this tutorial, analog channels can be subjected to operations using imc FAMOS. The following settings are to be made for two analog channels:

Parameter	Value
State	active
Save to HDD	on
Sample rate	1000 Hz
Duration	10 s
Measurement mode	Voltage
Coupling	DC
Input Range	±5 V

The script is to begin following a measurement, and the current channels are to be added and outputted on an output channel.

The following **libraries** are needed:

```
using imc.Common.Components.DataManager;
using imc.Common.Components.DataManager.Interfaces;
```

First, the channels are retrieved from the datapool, and the output channel is created.

```
IDmChannel channel1 = Datapool["Channel_001"].GetContent<IDmChannel>();
IDmChannel channel2 = Datapool["Channel_002"].GetContent<IDmChannel>();
DmChannel channelOut = DmChannel.CloneOf(channel1);
channelOut.Name = "Channel_Out";
```

Subsequently, the data can be jointly subjected to calculation operations.

```
double[] data = new double[channel1.Data.Length];

for (int k = 0; k < channel1.Data.Length; k++){
   data[k] = channel1.Data[k] + channel2.Data[k];
}

channelOut.SetData<double>(data);
```

The output channel is then written to the datpool.

```
DataPoolVariable cOut = Datapool["Channel_Out"];
if (cOut == null){
   Datapool.CreateVariable<DmChannel>(channelOut.Name, channelOut);
}else{
   cOut.SetContent<DmChannel>(channelOut);
}
```

Subsequently, the measurement is started. At te end of the measurement, the script is run. A user-defined variable *Channel_Out* is created in case it does not exist already.

The two analog channels and the results channel can now be displayed in the curve window.

Extension: Weight and offset

In the example above, the channel values are added together. The weighting depends on the user-defined variables which were previously created.

To do this, create in the Data Browser the user-defined numerical variables *w1* and *w2*, as well as *offset*, and display them as numerical widgets.

To the script above, the following lines are added, which retrieve the values of the weighting and of the offset from the datapool.

```
double w1 = Datapool["w1"].GetContent<double>();
double w2 = Datapool["w2"].GetContent<double>();
double offset = Datapool["offset"].GetContent<double>();
```

The calculation is then performed as follows:

```
double[] data = new double[channel1.Data.Length];

for (int k = 0; k < channel1.Data.Length; k++){
   data[k] = w1 * channel1.Data[k] + w2 * channel2.Data[k] + offset;
}

channelOut.SetData<double>(data);
```

Change the values for the weighting and for the offset and then run the script. The results channel should reflect the weighting and offset accordingly.

Extension: imc FAMOS functions

Note

When creating the script, the imc FAMOS Providers *Kit* and *Math* must be selected.

Next, add the following library to the beginning of the script:

```
using imc.Common.Components.Famos.Math;
```

The calculation is now performed by means of an imc FAMOS-command, which applies math operations to the two channels while taking the weighting into account.

What is important is for the channel name to be reset, since it is overwritten within the function.

```
bool isSuccessful = Famos.Add(channel1, w1, channel2, w2, out channelOut);
channelOut.Name = "Channel_Out";
```

It is also possible to use additional imc FAMOS functions.

17.1.6.3 Curve Window and channel selection

In this tutorial, a widget is to be used to select an analog channel, which is then displayed in the curve window.

To do this, switch all analog channels to active and perform a *Prepare*. Add a standard curve window to the Panel page and assign it the name "MyCurve".

Create a new **Panel Script** with the name *ChannelChooser*.

The following **libraries** are needed:

```
using System.Windows.Forms; // ComboBox
using imc.Common.Interfaces.Panel.Scripting; // eAppendConstant
using imc.Common.Interfaces.Logbook; // Logbook Category
using imc.Studio.Tools.DevSetupGraphGenerator; // EClassID
```

The corresponding widget is created as an attribute in the class.

```
public class ChannelChooser : AbstractScript {
   string controlName    = "ChannelChooser" //
   string indexVariable = "ChannelIndex";

   public override void Run() {
      // ...
   }

]
```

Widget Zones cannot be added via Scripting yet. Thus, a ComboBox of the Windows.Forms class is used instead.

The combo-box is now to be filled with the list of analog channels and displayed on the Panel page. This is done in the **PanelScriptInitialize()** method.

```
public override bool PanelScriptInitialize()
{
   // create ComboBox
   ComboBox cb = new ComboBox();
   cb.Name = controlName;
   cb.Location = new System.Drawing.Point(100, 200);
   cb.Items.Clear();

   // Add channels to list
   foreach (var chn in DevSetup.Channels){

      var paraState = chn.Parameters[EClassID.eStatus];
      var paraType = chn.Parameters[EClassID.eChannelType];
      var paraName = chn.Parameters[EClassID.eChannelName];

      if (paraState != null && paraType != null && paraName != null){

         if ( ((int)paraState.GetValue() == ParameterValues.eStatus.Active) &&
           ( (int)paraType.GetValue() == ParameterValues.eChannelType.AnalogInput) ){
           cb.Items.Add(paraName.GetValue());
         }
      }
   } // foreach

   if (Core.Datapool[indexVariable] != null) {
      cb.SelectedIndex = Core.Datapool[indexVariable].GetContent<int>();
   }

   // Hook an event listener
   cb.SelectedIndexChanged += MyCombo_SelectedIndexChanged;
   PanelPage.Controls.Add(cb);
   return true;//Return true if everything is initialized, otherwise return false
}
```

If the selection changes, the signal is to be changed in the curve window.

```
private void MyCombo_SelectedIndexChanged(object sender, System.EventArgs e)
{
   ComboBox cb = sender as ComboBox;
   if (cb != null)
   {
      if (cb.Name == controlName)
      {
         if (!Core.Datapool.CreateVariable<int>(indexVariable, cb.SelectedIndex))
         {
            Core.Datapool[indexVariable].SetContent<int>(cb.SelectedIndex);
         }

         // delete every signal in curve window
         foreach (var s in MyCurve.Signals){
               s.Delete();
         }

         MyCurve.AddSignal(cb.SelectedItem.ToString(),     eAppendConstants.AppendNewLine);

      }
   }
}
```

The event has to be unhooked and the old ComboBox has to be deleted:

```
public override bool PanelScriptDispose()
{
   try
   {
      if (PanelPage != null)
      {
         foreach (System.Windows.Forms.Control el in PanelPage.Controls)
         {
            ComboBox cb = el as ComboBox;

            // Unhook events from the ComboBox named "MyCombo"
            if (el.Name == controlName && cb != null)
            {
               cb.SelectedIndexChanged -= MyCombo_SelectedIndexChanged;
            }
         }
         PanelPage.Controls.Clear();
      }
      return true;// Return true if everything is disposed, otherwise return false
   }
   catch (Exception e)
   {
      // Write to the logbook if anything went wrong
      this.Core.Logbook.LogEntry(this.ToString(), e, ELogbookEntryCategory.Warning);
   }
   return false;
}
```

The methods **Run()** and **Stop()** are empty.

With this combination, it is now possible to select a curve window's channel directly by means of a combo-box.

17.1.6.4 List linked Variables

In this tutorial all Widgets on all Panel pages should be listed including the variable link.

The following **Libraries** are used:

```
using System.Linq;
using System.Text;
using System.Windows.Forms;
```

In the `Run()` method you need to add the following lines.

```
StringBuilder text = new StringBuilder();

// for special Widgets
Panel.Pages.ToList()
   .ForEach(page => page.Widgets.ToList()
            .Where(widget => widget.Variable != null)
            .ToList()
            .ForEach(widget => text.Append(page.DisplayedCaption + " | " + widget.Name + " | " +
widget.Variable.Name + "\n")));

// for Standard-Widgets
Panel.Pages.ToList()
   .ForEach(page => page.Widgets.ToList()
            .Where(widget => widget.Variable == null)
          .ToList()
            .ForEach(widget => text.Append(page.DisplayedCaption + " | " + widget.Name + " | " +
widget.StandardVariable.Name + "\n")));

MessageBox.Show(text.ToString());
```

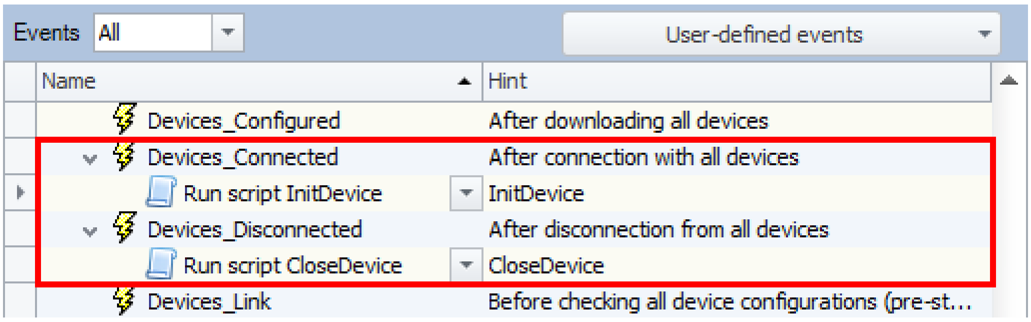
In the message box a list of all Widgets on all Panel pages and their variable connection are shown.

You can also write the results to a file.

17.1.6.5 RS232-Interface

The following **libraries** are needed:

```
using System.IO.Ports;
```



Events

Initialisation / Connect

Add the command *Run script* with the following code to the event *Devices_connected*. The event is released, when connected to devices.

InitDevice.cs

```
try{
   // Create a COM port object and define the port's settings
   SerialPort serialPort = new SerialPort("COM1", 9600, Parity.None, 8, StopBits.One );
   // Open the port
   serialPort.Open();
   // Store the COM port in the clipboard
   ScriptClipboard.Add("COM1", serialPort);
}catch(Exception x){
   // error handling
}
```

Close / Disconnect

Add the command *Run script* with the following code to the event *Devices_disconnected*. The event is released, when disconnected from devices.

CloseDevice.cs

```
try{
   // Get the COM port from clipboard
   SerialPort serialPort = ScriptClipboard["COM1"] as SerialPort;
   // Close the COM port
   serialPort.Close();
   // Remove the COM port from clipboard
   ScriptClipboard.Remove("COM1");
}catch(Exception x){
   // error handling
}
```

Read data

ReadData.cs

```
try{
   // Get the COM port from clipboard
   SerialPort serialPort = ScriptClipboard["COM1"] as SerialPort;
   // Read a message from the device
   string dataAsText = serialPort.ReadLine();
}catch(Exception x){
   // error handling
}
```

Write data

WriteData.cs

```
try{
   // Get the COM port from clipboard
   SerialPort serialPort = ScriptClipboard["COM1"] as SerialPort;
   // Send a message to the device
   serialPort.WriteLine("*IDN?");
}catch(Exception x){
   // error handling
}
```

17.1.6.6 Using the script clipboard

In this tutorial, the script clipboard is to be used to make a Widget belonging to a Panel-page available to a different script.

ScriptA.cs

When adding an object into the script clipboard, it is necessary to be aware that the object has a namespace. In the case of a Widget, this would be the script's name due to the proxy-classes.

For this reason, the script must be created with the option "*Separate Proxy class library*". Then the proxy-class will be integrated into the script as a resource.

```
Widget myWidget = Panel["Page 1"]["MyWidget"]; // Type: ScriptA.Widget
ScriptClipboard.Add("MyWidget", myWidget);
```

ScriptB.cs

The script can be created without the option "Separate proxy class library".

Under *References > Add Reference,* the **ProxyClasses.dll** is added from the **ScriptA-Project**. The file is located in the **ScriptA-project's bin**-folder.

```
object o;
bool b = ScriptClipboard.TryGetValue("MyWidget", out o);

if ( (b) && (o != null) ){
   ScriptA.Widget myWidget = o as ScriptA.Widget;
}
```

17.1.7 Important Information

(older) Experiment import: System.IO.FileNotFoundException

When importing experiment from former versions, there might be error messages, when running the scripts.

Esp. when the scripts were imported as DLL (assembly). In this case the script cannot be compiled automatically.

If the source code is available and you have a Developer-Edition, the error can be fixed by compiling the code again and may correct the references. You might need to Regenerate proxies 1740.

In the case of a DLL-script the developer of the script needs to compile the script in the corresponding version. Please contact the developer of the script.

Close Script Editor before "Experiment > Save as"

Note

When executing *Experiment > Save As..*, the **Script editor** must be closed, otherwise it will still have the script belonging to the original experiment open, and will not automatically alter the path.

imc FAMOS functions and Type Library Script

Note

- If a script is linked with a **Type Library Script** and imc FAMOS functions intended to be used, the imc FAMOS Proxy Classes must be activated in the **Type Library Script**.
- If the imc FAMOS Math Provider is later uploaded into the **Type Library Script** using *Edit > Regenerate proxies*, then a reference to *imc FAMOS M*ath Provider must be added manually in any script which is linked with the **Type Library Script**.

Use of an 4.0R1 experiment including scripts

Warning Import of an imc STUDIO 4.0R1 Experiment with scripts

Due to changes on the interface and provision of new functions, the following steps are needed for using script from an imc STUDIO 4.0R1 experiment.

Before committing any changes, it is recommended to export the scripts as backup.

Error: The script cannot be run.	Solution
Compiler error CS0535 `..\AbstractScript.cs(6,24) : Error CS0535: 'ScriptName.AbstractScript' does not implement interface member 'System.IDisposable.Dispose()'`	Please insert the method `Dispose()` to AbstractScript.cs: `public virtual void Dispose() {}`
Compiler error CS1729 `..\AbstractScript.cs(163,23) : Error CS1729: 'ScriptName.DataPool' does not contain a constructor that takes 1 arguments`	Please replace every instantiation with `new` by the method `GetInstance(), e.g.` `MyClass myObject = new MyClass(*)` by `MyClass myObject = MyClass.GetInstance(*)`

Compiler error CS0234
`..\ProxyClasses.cs(6754,53) : Error CS0234: The type or namespace name 'EVariableProperty' does not exist in the namespace 'imc.Common.Interfaces.DataPool' (are you missing an assembly reference?)`
	Affected methods:
	`public bool Set<T>(*)`
	`public T Get<T>(*)`
	Please add the reference *imc.Common.Interfaces.UnManaged* to your script project (*Project > Add Reference)* and compile again.

Compiler error CS0029 `Error CS0029: Cannot implicitly convert type 'System.EventHandler' to 'System.Action<object,System.EventArgs>'`	Please replace `EventHandler(*)` by `Action<object,EventArgs>(*).`

Parallel installation of multiple imc STUDIO versions

Warning Necessary adaptations to make scripts executable in the older version

When a newer imc STUDIO version is installed **in parallel**, it can happen that the scripts in the **older** version can no longer be run.

To make the scripts in the older version executable, take the following steps:

- Open the experiment affected
- Use the Explorer to open the script project file (*.csscriptproj) in an editor program
- Edit the command lines according to the table below and save the file
- Save the experiment and restart the script. It should now run correctly.

Table: Altering the *.csscriptproj - file of a script belonging to imc STUDIO 4.0R1

Original Text	Changes
<Reference Include="imc.Studio.Interfaces.V2"> <Private>False</Private> <SpecificVersion>False</SpecificVersion> </Reference>	<Reference Include="imc.Studio.Interfaces.V2, Version=4.0.1.0, Culture=neutral, PublicKeyToken=68a4b1d388e6c0b6"> <Private>False</Private> <SpecificVersion>True</SpecificVersion> </Reference>
<Reference Include="imc.Common.Interfaces> <Private>False</Private> <SpecificVersion>False</SpecificVersion> </Reference>	<Reference Include="imc.Common.Interfaces, Version=4.0.1.0, Culture=neutral, PublicKeyToken=9350ef35614b8d14"> <Private>False</Private> <SpecificVersion>True</SpecificVersion> </Reference>
<Reference Include="imc.Studio.Interfaces"> <Private>False</Private> <SpecificVersion>False</SpecificVersion> </Reference>	<Reference Include="imc.Studio.Interfaces, Version=4.0.1.0, Culture=neutral, PublicKeyToken=68a4b1d388e6c0b6"> <Private>False</Private> <SpecificVersion>True</SpecificVersion> </Reference>

The scripts are then only executable for this particular version. Adaptation of the reference version for subsequent versions (5.0R1 -> 5.0.1.xxxx) must be performed correspondingly.

imc STUDIO GUI can not be operated

Note

While the script's `Run()` method is in progress, the imc STUDIO user interface can not be operated. For this reason, the script may not contain any blocking functions.

Renaming elements

Note

If devices, channels or Widgets which are accessed by imc STUDIO Scripting are renamed or deleted in imc STUDIO, then the script must be adapted accordingly.

Do not detach while debugging

Warning

Do not *detach* from the process while debugging. Depending on the user's programming, imc STUDIO might be in an undefined or non-operable state. Do always use *Continue Debugging* (blue "Play" symbol) to end debugging before detaching.

Event handling is asynchronous

Note

The event handling methods are run **asynchronously**.

17.2 Third Party Device Interface

Documentation on the **imc STUDIO** plug-in **imc STUDIO Third Party Device Interface**.

17.2.1 Getting started

17.2.1.1 Introduction

Note

- A **imc STUDIO ThirdPartyDevice License** (inclusive/exclusive) is needed to run a Third Party Device script.[1]
- A imc STUDIO **Developer**-Edition is needed to edit a Third Party Device script.
- The 3rd Party Device Management a available in all editions except Runtime.

[1]The Third Party Device *AudioDevice* and *ChannelLoader* can be used without any 3PDI license.

With the plugin **imc STUDIO Third Party Device Interface** devices from other manufacturers (Third Party Devices) can be added to the Setup page in imc STUDIO easily.

Therefore a C#-Script has to be implemented containing properties of the Third Party Device. A template code and fundamental functions are given by imc STUDIO. In this script the interface to the Third Party Device has to be implemented. After finishing the script, the Third Party Device will appear in the device list on the Setup page. The Third Party Device can now be configured in imc STUDIO and can also be combined with devices manufactured by imc. For example an oscilloscope or a multimeter can be added.

The advantages of Third Party Device Script are:

- consistent measurement format
- synchronous visualization of the measurement data
- common data saving
- common project management
- common management of the device configuration
- no GUI Programming needed, integration of the device in imc STUDIO
- existing device and channel parameters can be used for the Third Party Device
- new parameters can be created

Needs:

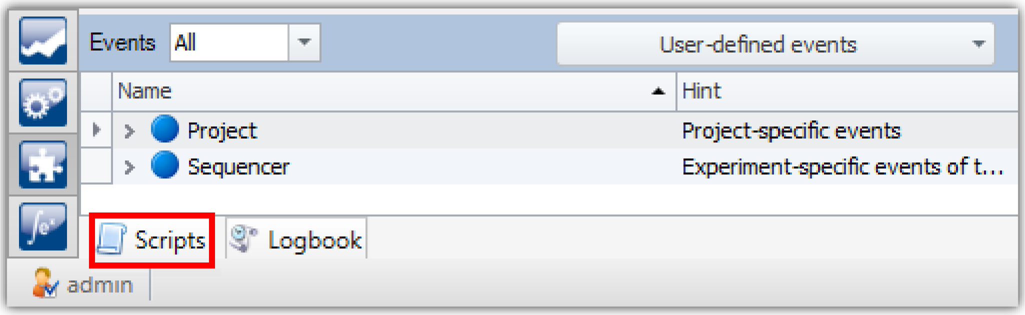
- Experience in C# programming is necessary (C++ for an *unmanaged* data transfer)
- The interface of the Third Party Device has to be known.

17.2.1.2 Add a new script

Reference

For more information about **Scripting**, see here 1733.

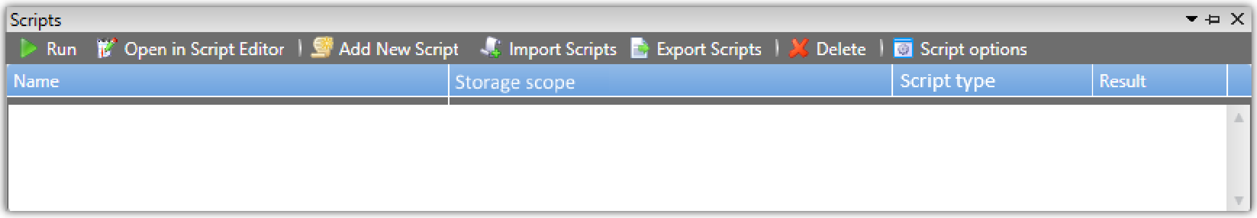
Scripts are created on the Sequencer page by clicking on the tab *Scripts* at the bottom of the page.



Sequencer: Tool window "Scripts"

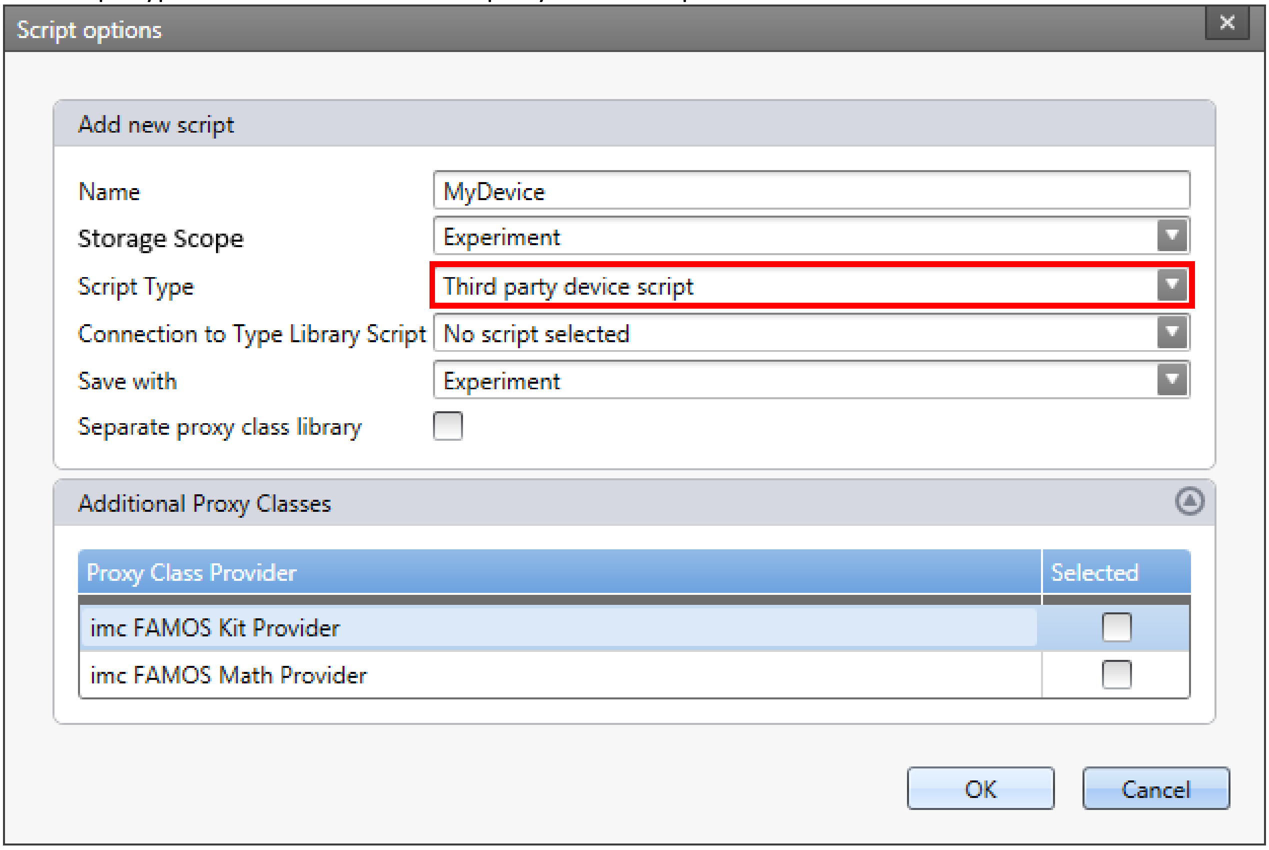
The tool window *Scripts* will open. Click on *Add new script* 

to add a new Script



Sequencer: Tool window "Scripts"

The Script Type has to be chosen: Third party device script.



The editor will open automatically after adding a script containing a template of C#-Code.

Note

To use another template, please use the 3rd Party Device Management 1872.

17.2.2 Serial interface

17.2.2.1 Device control

If an integration to the setup page is not needed, and data should be *polled* from the device by an event or clicking on a button, a normal script can be used.

For example a climate cabinet controlled by RS232 which sends single values of the temperature on command.

Here scripts for opening and closing the connection and for reading and writing data are described.

These code snippets can be bound to the Sequencer events, e.g. "Device connected/disconnected".

Open COM Port/ connect to the device

```
try{
   // Create a COM port object and define the port's settings
   System.IO.Ports.SerialPort serialPort = new System.IO.Ports.SerialPort("COM1", 9600,
Parity.None, 8, StopBits.One);
   // Open the port
   serialPort.Open();
   // Store the COM port in the clipboard
   ScriptClipboard.Add("COM1", serialPort);
}catch(Exception x){
   // error handling
}
```

Close COM Port / disconnect from device

```
try{
   // Get the COM port from clipboard
   System.IO.Ports.SerialPort serialPort = ScriptClipboard["COM1"] as System.IO.Ports.SerialPort;
   // Close the COM port
   serialPort.Close();
   // Remove the COM port from clipboard
   ScriptClipboard.Remove("COM1");
}catch(Exception x){
   // error handling
}
```

Write data

```
try{
   // Get the COM port from clipboard
   SerialPort serialPort = ScriptClipboard["COM1"] as SerialPort;
   // Send a message to the device
   serialPort.WriteLine("*IDN?");
}catch(Exception x){
   // error handling
}
```

Read data

```
try{
   // Get the COM port from clipboard
   SerialPort serialPort = ScriptClipboard["COM1"] as SerialPort;
   // Read a message from the device
   string strData = serialPort.ReadLine();
}catch(Exception x){
   // error handling
}
```

17.2.3 Third Party Device script

17.2.3.1 Methods

void GetAvailableDevices(SetupNodeList deviceList)

Description:	Gets all the currently available devices which could be selected for measurement later on.
Is called when:	search for devcies is performed.
To implement:	Search for the 3rd-party devices, as well as for device parameters of the devices found

void GetDeviceDescription(SetupNode device)

Description:	Gets the complete definition of the device with all modules and channels.
Is called when:	the device is selected for a measurement.
To implement:	Additional parameters for the selected devices and add channels and their properties.

void DeselectDevice(SetupNode device)

Description:	Is called when the device is deselected by the user. Here it is possible to do some cleanup.
Is called when:	the device is deselected from a measurement.
To implement:	Take all actions necessary for de-selecting the device.

void PrepareMeasurement(SetupNode device)

Description:	Prepares the specified device for measurement, downloads the configuration from the PC to the device. Can throw an exception if an error occurred.
Is called when:	Performing a *Process* action.
To implement:	Actions necessary when performing a Process action. E.g. processing user inputs.

void ProcessConfiguration(SetupNode device)

Description:	Processes the device configuration and checks if the the configurations have errors. If an error is detected throws an exception.
Is called when:	Performing a *Download* action.
To implement:	Actions necessary when performing a Download action. E.g. processing user inputs.

void ConnectDevice(SetupNode device)

Description:	If necessary establishes the connection to the specified device. If the connection can not be established an exception is thrown.
Is called when:	the user connects to the devices.
To implement:	stablishment of a connection to the device.

void DisconnectDevice(SetupNode device)

Description:	If the implementation of the method ConnectDevice() established the connection, closes the connection to the specified device. If there was an error an exception is thrown.
Is called when:	the user disconnects from the device.
To implement:	Disconnection from the device.

void StartMeasurement(SetupNode device)

Description:	Starts the measurement for the specified device. If there was an error an exception is thrown.
Is called when:	Measurement is started.
To implement:	Start the device. Access to the device driver can also be done in the *DataTransferDriver*.

void StopMeasurement(SetupNode device)

Description:	Stops the measurement for the specified device.
Is called when:	Measurement is stopped.
To implement:	Stop the device. Access to the device driver can also be done in the *DataTransferDriver*.

void GetParameterConstraints(SetupNode node, SetupParameter parameter, ParameterConstraint constraint)

Description:	Gets the constraints for a parameter. The constraints can be defined with calls to the constraint instance. Constraints can be upper and/or lower value borders for numeric parameters, value lists for combo boxes, enabled or disabled states according to other parameters.
Is called when:	the device and channel configuration is loaded.
To implement:	Selection options for parameters, e.g. the sampling interval.

Please use the correct numeric format as parameter, e.g.:

```
if (parameter.Name == EClassID.eSampleTime.ToString()) {
   constraint.ValueList.Add(0.1);
   constraint.ValueList.Add(1d); // for double
// constraint.ValueList.Add(1); // for double -> error
// ...
```

void ExecuteParameter(SetupNode node, int actionStepID)

Description:	Is executed if a non standard action should be executed. If there was an error an exception is thrown.
Is called when:	Device action (e.g. balancing, eAction, ...) is invoked.
To implement:	Regarding to the ActionID further actions can be performed.

string GetParameterDisplayText(SetupNode node, SetupParameter parameter, object value, bool reciprocal, bool useRoundTripFormat)

Description:	Gets the display text of the parameter's value.
Is called when:	the device and channel configuration is loaded.
To implement:	Display texts for (numerical) parameter presets.

```
if (parameter.Name == EClassID.eAction.ToString()) {
   if (object.Equals(value, 1)) {
      return "Some action";
// ...
```

object ConvertParameterTextToValue(SetupNode node, SetupParameter parameter, string inputText, bool reciprocal)

Description:	Converts the input text of a parameter to the value type of the parameter. If the input text contains an error, throws an exception.
Is called when:	the user enters a value to a parameter.
To implement:	Conversion of inputs to parameter values.

bool? ValidateParameter(SetupNode node, SetupParameter parameter, object oldValue)

Description:	Validates the parameter. Here it is possible to change a parameter value according to the values of other parameters or to prohibit the change.
Is called when:	the user enters a value to a parameter.
To implement:	Parameter validation with respect to certain boundaries, such as limiting the measurement time to a maximum value.

void LoadDeviceConfiguration(SetupNode device, string configurationVersion)

Description:	Informs the device provider about a configuration that was loaded by the device Setup. Here it is possible to convert the device configuration to the current version, i.e. by adding new parameters.

17.2.3.2 Add a device

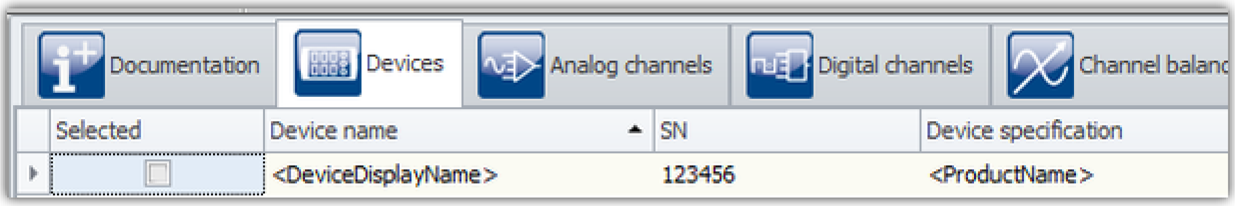
First of all the device (or the devices) has to be configured. In the method `GetAvailableDevices()` the properties of the devices is programmed.

In this example a device is added with the serial number "123456". Further device parameter can be added, too. Therefore the according **EClassID** parameters have to be added.

GetAvailableDevices

```
protected override void GetAvailableDevices(SetupNodeList deviceList) {
// Add the currently available devices here! Example:
   var device = deviceList.GetOrAdd(ESetupNodeType.Device, "<DeviceName>");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceNickname, value: "<DeviceDisplayName>");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceSN, value: "123456");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceProduct, value: "<ProductName>");
}
```

After closing the editor, the Third Party Device is shown on the Setup in the device list.



Setup: Device list

If the device is selected, the device configuration (channels and variables) is loaded. The next step is to add channels and variables 1867 to the device.

17.2.3.3 Add a channel

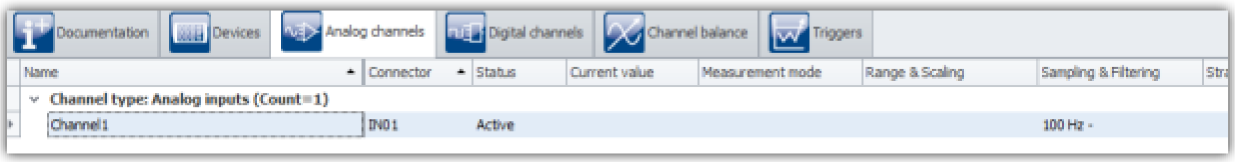
The channel configuration of the parameters is set in the following procedure. This method is run when the device is selected. In this example the configuration is made for only one channel. To configure more channels 1897, use a loop or create a method. Here, the channel type is set to analog input, but also Display variables or other types are possible. For all possibilities see `ParameterValues.eStatus`.

GetDeviceDescription

```
protected override void GetDeviceDescription(SetupNode device) {
   // Add the full device description here! Channels, modules... Example:
   var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "<DeviceName>.Channel1");
   channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Channel1");
   channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "IN01");
   channel.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.AnalogInput);
       channel.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: "V"); // The original
(electrical) measurement unit
       channel.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: "V");
       channel.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEFLOAT);
       channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.01); // 100 Hz - set also
the selectable values in the method
}
```

```
// ParameterValues.cs
public sealed class eChannelType {
    public const int AnalogInput = 1;
    public const int DAC = 2;
    public const int DIOPort = 3;
    public const int VirtChannel = 5;
    public const int DIOBit = 6;
    public const int VirtBit = 7;
    public const int NetBit = 8;
    public const int EncoderInput = 9;
    // ...
    public const int DisplayVar = 15;
    // ...
    public const int PVVar = 24;
    public const int VideoChannel = 1001;
    // ...
    public const int DIO_In = 4099;
    public const int DIO_Out = 8195;
}
```

After selecting the device, the channel is available in the analog channel list.



Setup: analog channels

To add a Display Variable 1899 to the device, the channel type has to be set to "DisplayVar".

You have to `Remove` some parameters for DisplayVariables and pv-Variables:

```
variable.Parameters.Remove(EClassID.eSampleTime);
variable.Parameters.Remove(EClassID.eDuration);
variable.Parameters.Remove(EClassID.ePCTransferToHD);
```

17.2.3.3.1 FFT

In order to create a FFT-channel, the `eXFormat` must be set to FFT. Additionally, various segment parameters must be set:

```
var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "<DeviceName>.Channel1");
channel.Parameters.UpdateOrAdd(EClassID.eXFormat, value: ParameterValues.eXFormat.FFT);
channel.Parameters.UpdateOrAdd(EClassID.eDataType, value: ParameterValues.eDataType.IEEEFLOAT);
channel.Parameters.UpdateOrAdd(EClassID.eSamplesPerSegment, value: 512);
channel.Parameters.UpdateOrAdd(EClassID.eSegmentOffset, value: 0);
channel.Parameters.UpdateOrAdd(EClassID.eSegmentDelta, value: 5);
channel.Parameters.UpdateOrAdd(EClassID.eSegmentUnit, value: "Hz");
channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.1, editorType:
EEditorType.ReadOnlyEdit);
```

The section above belongs to the source text in the collapsed region "Example for FFT channel parameters (streaming vector / segmented channel)"-

17.2.3.3.2 Time stamped

The use of time-stamped channels is explained using the *SimplePollDevice* template.

The example code is not generally valid and must be adapted according to the third-party device.

GetDeviceDescription

For a time-stamped channel, in the `GetDeviceDescription` method the channel parameter `eXFormat` is set to "Timestamp".

```
var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "Channel1");
channel.Parameters.UpdateOrAdd(EClassID.eXFormat, value: ParameterValues.eXFormat.Timestamp);
channel.Parameters.UpdateOrAdd(EClassID.eDataType, value: ParameterValues.eDataType.IEEEFLOAT);
channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.001, editorType:
EEditorType.Hidden);
```

```
// for TimeStamped-ASCII (protocol channel) set DataType to ASCII
channel.Parameters.UpdateOrAdd(EClassID.eDataType, value: ParameterValues.eDataType.ASCII);
```

DataTransferDriver

A TimeStampedSample array must be passed to the `WriteData`-Method in the data transfer driver.

In this example, the *SimplePollDevice* template is used.

```
// OnProcess-Method
// ...
if (dataWriter != null)
{
   var timeStampedData = GetTimeStampedData(dataTransferNode); // get time stamped data from the
device

   if (timeStampedData != null)
   {
      EResult result = dataWriter.WriteData(timeStampedData, 0); // write time stamped data to
imc STUDIO
      // ...
   }
}
// ...
```

```
private TimeStampedSample<double>[] GetTimeStampedData(DataTransferNode dataTransferNode)
{
   // get time stamped data from the device
   // use simulated data from the DeviceDriver
   double[] data = m_deviceDriver.ReadData(dataTransferNode.Name); // simulated data
   var sampleTime = m_deviceDriver.GetSampleTime(dataTransferNode.Name); // method was added in
DeviceDriver
   var timeStampedData = ConvertToTimeStamped(data, sampleTime); // convertion needed to get time
stamped data
   return timeStampedData;
}
```

```
private double lastArgument = 0;
private DataTransferDateTime deviceStartTime;

private TimeStampedSample<double>[] ConvertToTimeStamped(double[] data, double sampleTime)
{
   if (data == null)
   {
      return null;
   }

   var timeStampedData = new TimeStampedSample<double>[data.Length];
   var delayedTime = m_deviceDriver.CurrentTime - deviceStartTime;

   for (int i = 0; i < timeStampedData.Length; i++)
   {
      lastArgument = delayedTime.Ticks / (sampleTime * DataTransferTimeSpan.TicksPerSecond);
      var argument = lastArgument + i;
      var argumentAsLong = Convert.ToInt64(argument);

      timeStampedData[i].Offset = argumentAsLong;
      timeStampedData[i].Value = data[i];
   }

   return timeStampedData;
}
```

DeviceDriver

A method `GetSampleTime` is added to the device driver.

```
public double GetSampleTime(string channelName)
{
   var sampleTime = 0d;

   Channel channel;
   if (m_channels.TryGetValue(channelName, out channel))
   {
      sampleTime = channel.SampleTime;
   }

   return sampleTime;
}
```

17.2.3.3.3 eRange Parameter

The following instructions are needed to add the eRange parameter to a channel.

GetDeviceDescription

The parameter *eRange* needs to be added to the devices description. The values can be selected in a combo box.

```
// var channel = ...
// ...
channel.Parameters.UpdateOrAdd(EClassID.eRange, value: 10, editorType: EEditorType.ComboBox);
```

GetParameterConstraints

In the methode **GetParameterConstraints** (in the region "Optional methods") the items of the selection are set.

```
if (parameter.Name == EClassID.eRange.ToString()) {
   constraint.ValueList.Add(20);
   constraint.ValueList.Add(10);
   constraint.ValueList.Add(5);
   constraint.ValueList.Add(2.5);
   constraint.ValueList.Add(1);
}
```

GetParameterDisplayText

If a different text should be shown in the list, you need to add the following code to the method **GetParameterDisplayText** (in the region "Display text handling").

```
if (parameter.Name == EClassID.eRange.ToString()) {
//   if (object.Equals(value, 20)  ) {
      return "\u00b1" + value + " V";
//   }
}
```

If you need to distinguish between the values, you can use an if- or switch-case statement.

The methods also needs to return a value, e.g. `null`.

DataTransferDrivcer.cs : Prepare()

To use the parameter, you need to iterate over the SetupNode-Children:

```
foreach (SetupNode child in configuration.Children) {
   if (child.NodeType == EClassID.eChannel.ToString()) {
      SetupParameter range = child.Parameters.GetByName(EClassID.eRange);
      // do something with      range.Value;
   }
}
```

17.2.3.4 Action column (eAction)

It is possible to add an action-column for the device/channels. This may be desirable when intending to have a configuration re-imported from the device at the push of a button. In order for this column to appear in the user interface, it must also be added to the associated table by means of the Table description tool window.

The source code already contains examples pertaining to the parameter **eAction,** which are commented-out

GetDeviceDescription

```
device.Parameters.UpdateOrAdd(EClassID.eAction, value: 1, editorType: EEditorType.ListButton);
```

Subsequently, values must be written to this selection list:

GetParameterConstraints

Add new elements with corresponding ID:

```
if (parameter.Name == EClassID.eAction.ToString()) {
   constraint.ValueList.Add(1);
   constraint.ValueList.Add(2);
   constraint.ValueList.Add(3);
}
```

GetParameterDisplayText

In the selection list, the corresponding texts are listed according to their ID.

```
if (parameter.Name == EClassID.eAction.ToString()) {
   if ((int)value == 1) {
         return "Edit configuration";
      } else if ((int)value == 2) {
         return "Import configuration";
      } else if ((int)value == 3) {
         return "Export configuration";
      }
}
```

ExecuteParameter

Here you determine which actions are to be performed in response to a particular selection.

```
switch (actionStepID) {
   case 1:
      MessageBox.Show("Edit Configuration");
      // do something
      break;
   case 2:
      MessageBox.Show("Import Configuration");
      // do something
      break;
   case 3:
      MessageBox.Show("Export Configuration");
      // do something
      break;
}
```

Once the column has been successfully added to the table in the user interface, it is operational when the corresponding device is selected. The associated action is executed upon pushing the button.

17.2.3.5 Data transfer

When creating a third-party script, you are also provided with a data transfer template in the DataTransferDriver.cs.

The next issue to address is whether the target device is polled (see SimplePollDevice 1891), or whether it causes a function call (*callback*) when it has data (see SimplePushDevice 1894).

The SimplePollDevice and the SimplePushDevice are good examples of such Third Party Device.

For further information, please read DeviceDriver and PushDeviceDriver 1885.

Access to the logbook

In the DataTransferDriver you can access to the logbook via the `Environment` class.

```
Environment.Logbook.LogEntry("MySender", "MyMessage", 0, ELogbookEntryCategory.Warning);
```

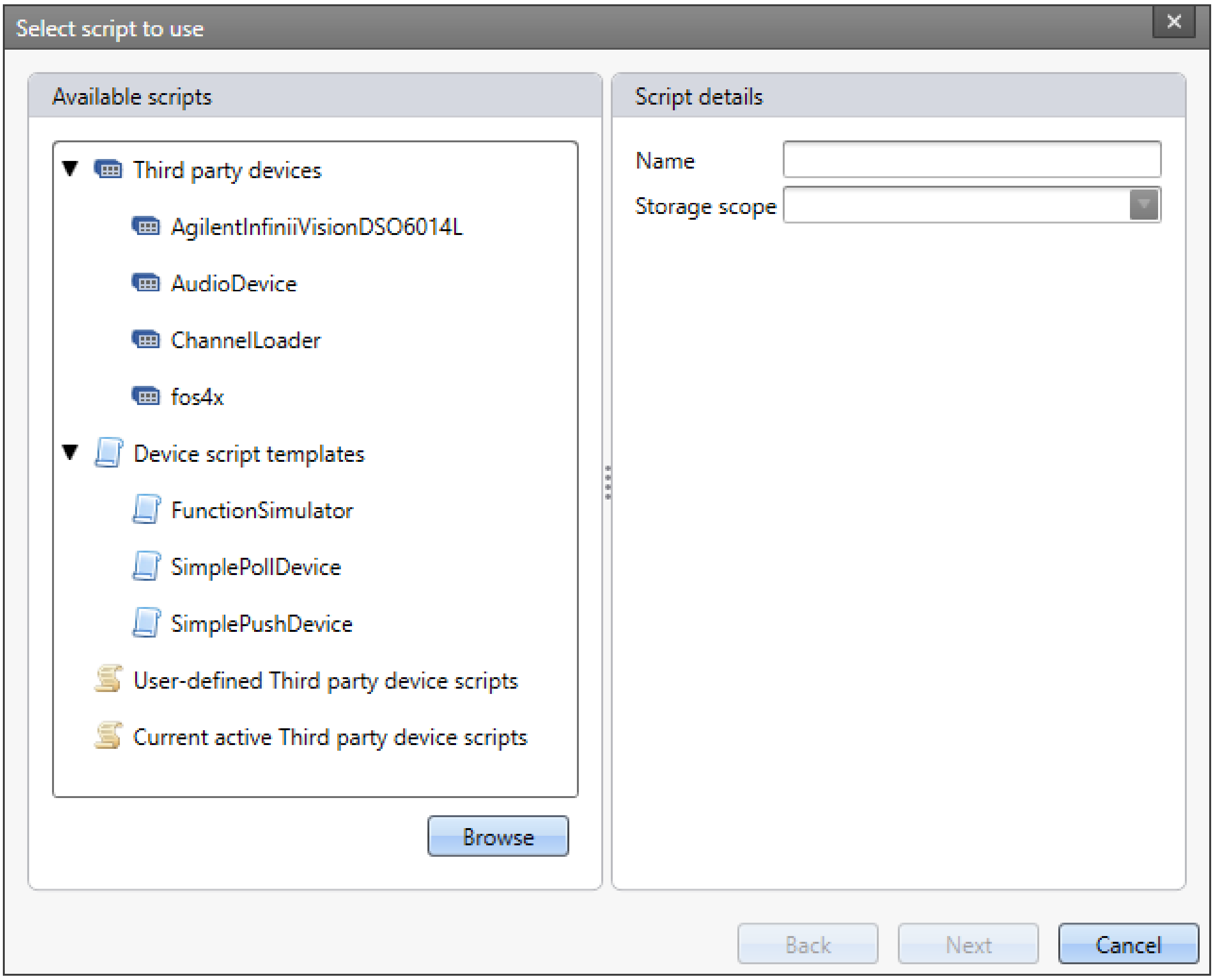
17.2.4 3rd Party Device Management

Using the **3rd-Party Device Management**, it is possible to select executable 3rd-party device script templates, e.g. the Function-Simulator, the SimplePollDevice or the SimplePushDevice. Likewise, there are already pre-made 3rd-party devices. Along with the AudioDevice and the ChannelLoader, the Agilent Scope and the fos4x are also available. The last of the two device require an extra license.

Note

- The 3rd-Party Device Management is available in the editions *Developer*, *Professional* and *Standard*.
- For the use of 3rd-party devices, an activated **imc STUDIO 3PDI-Inclusive** or **imc STUDIO 3PDI-Exclusive** license is required.
- The **AudioDevice** and the **ChannelLoader** can be used without any **3PDI license**.
- For the **AgilentInfinniVisionDSO6014L** an **imc STUDIO 3PDI-Digital Scope** license is required.
- For the fos4x device an **imc STUDIO 3PDI-fos4x** license is required**.**

Ribbon	View
Setup-Control > 3rd Party Device Management ()	Complete



3rd Party Device Management Dialog

When selecting a script-template, there is an option for subsequently opening the Script-Editor.

User-defined scripts can be added by clicking on *Browse*.

In *Current active Third party device scripts* all Third Party Device Scripts are listed and can be deleted by selecting and clicking on *Next*.

AudioDevice

In order to use connected Audio-devices, select the device-script *AudioDevice* and click on *Next*. Subsequently, all Audio-devices appear in the device list. When one of the Audio-devices is selected, the computer's Audio-input channels appear on the page *Analog Channels*. In this way, when a measurement starts, the computer's Audio-inputs can be graphed and recorded.

For more information on this subject, see the chapter AudioDevice 1873.

ChannelLoader

The *ChannelLoader* serves to play back data already recorded. To do this, select the *ChannelLoader* and click on *Next*. Subsequently, the device *ChannelLoader* appears in the device list. When *ChannelLoader* is selected, a file selection dialog with multi-selection appears. Here, multiple already-recorded data or imc FAMOS-data sets can be selected. On the page *Analog Channels*, the corresponding channels appear. When a measurement starts, then the selected data are played back cyclically at their respective sampling rates.

For more information on this subject, see the chapter ChannelLoader 1875.

Device script templates

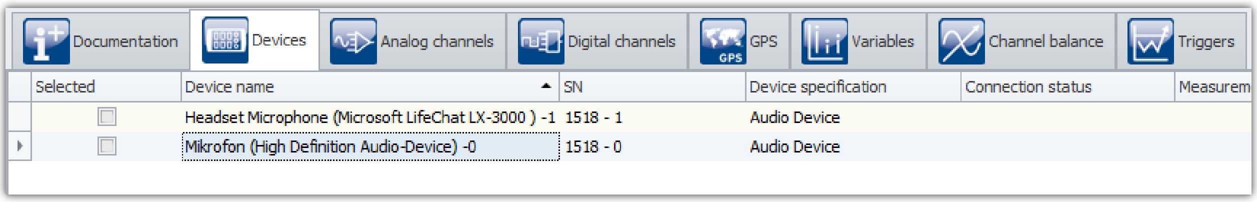
The devices from the script-templates simulate a sine-signal, or in the case of the *FunctionSimulator*, a number of different signals (trapezoid, sawtooth, rectangle, ...).

17.2.5 Third Party Devices

Chapter	Description
AudioDevice 1873	Access to input channels of audio devices (sound card, microphone, ...)
ChannelLoader 1875	Playback device for replay measurement data.
Agilent InfiniiVision DSCO6014L 1875	Agilent/Keysight Oscilloscope
fos4x 1883	Fos4x devices

17.2.5.1 AudioDevice

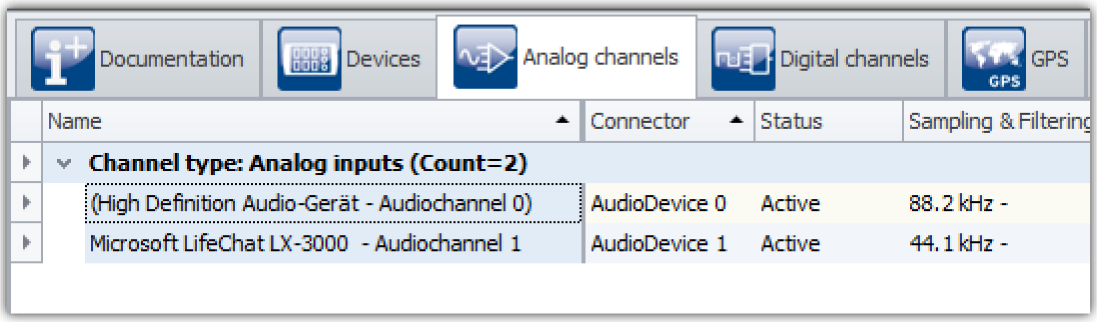
It is possible to add the audio devices of your computer to imc STUDIO. Therefore open the 3rd Party Device Management and add the AudioDevice. Afterward all audio devices are listed in the device list.



Device list: AudioDevice (Example)

On the **analog channel** page the audio channels are listed and also can be saved to the PC.

If multiple channels are available for a device, it is only possible to set one sample frequency for each channel of the device.



Channel list: AudioDevice (Example)

Note

- If the audio device is disconnected during the measurement, a error for each audio channel will appear in the logbook, showing that the data transfer is interrupted for this channel. To continue the measurement of this channel, start the audio device by the device control action in the Device table on the Setup page.
- If the experiment is opened on another computer, the corresponding hardware (USB device, sound card) must be available.
- If necessary, check your firewall for settings or rules: the process "imc.Studio.exe" (Program folder) needs the rights to access to the audio device.

Note — Remarks to certain devices

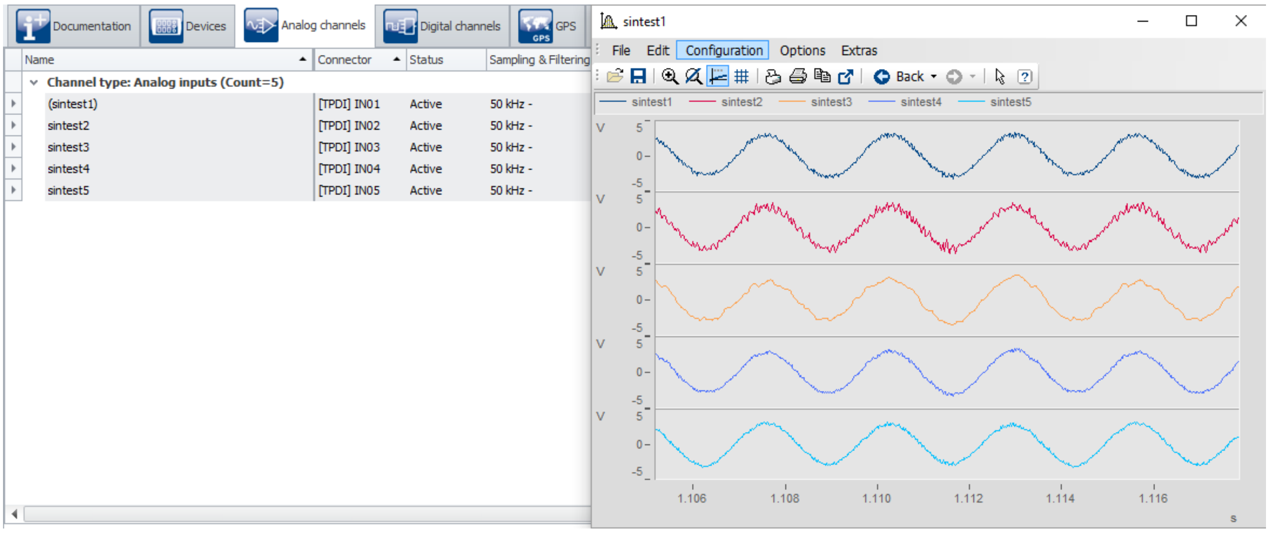
- With the webcam **Logitech HD Pro C920**, it was noticed that it was only delivering one audio channel, although according to the Windows settings there should be two channels.
  This may also apply to other audio devices.
- With the Headset **Microsoft LifeChat LX-3000**, it was noticed that after disconnecting and reconnecting the USB cable, a new measurement is only possible after the *second* start.

17.2.5.2 ChannelLoader

The ChannelLoader is for simulating or replaying data (e.g. recorded measurement data or imc FAMOS files. It can be added using the 3rd Party Device Management.

After selecting the ChannelLoader a file-open-dialog appears where one or more files can be selected. After performing a *Download* the files are listed as channels on the analog channels pages.

After starting the device the signals are played periodically as input signal.



ChannelLoader: sintest1 - sintest5

17.2.5.3 Agilent Scope

17.2.5.3.1 Getting started

It is possible to use the device **Agilent InfiniiiVision DSCO6014L** in imc STUDIO as a 3rd-party device. This device can be configured and controlled via the imc STUDIO interface. Capture of measurement data as individual snapshots is implemented as an event-based data set. Furthermore, synchronized measurement along with imc measurement devices (e.g. imc CRONOS*flex*) is possible. In this documentation, the device is referred to as **Agilent Scope**.

Preparations

Before the Agilent Scope can be used, certain preparations must be made.

As of 2014, the electronic measurement device branch of **Agilent Technologies** has been spun off to the company **Keysight Technologies**. For this reason, this documentation will refer to the company name "Keysight".

Activating the Keysight software

Note	Installing the IO Library Suite

If you haven't already, install the *IO Library Suite*. This software is provided on the imc STUDIO data carrier under the folder:

..\Products\Agilent InfiniiVision DSO6000L

Version auf der DVD: 18.1.22603

Otherwise, it is also possible to download a newer version from Keysight Technologies.

After installation, use the program *Keysight Connection Expert* to add Agilent Scope to the Instruments list by means of a device-scan. For more information, you can also refer to Keysight's help info.

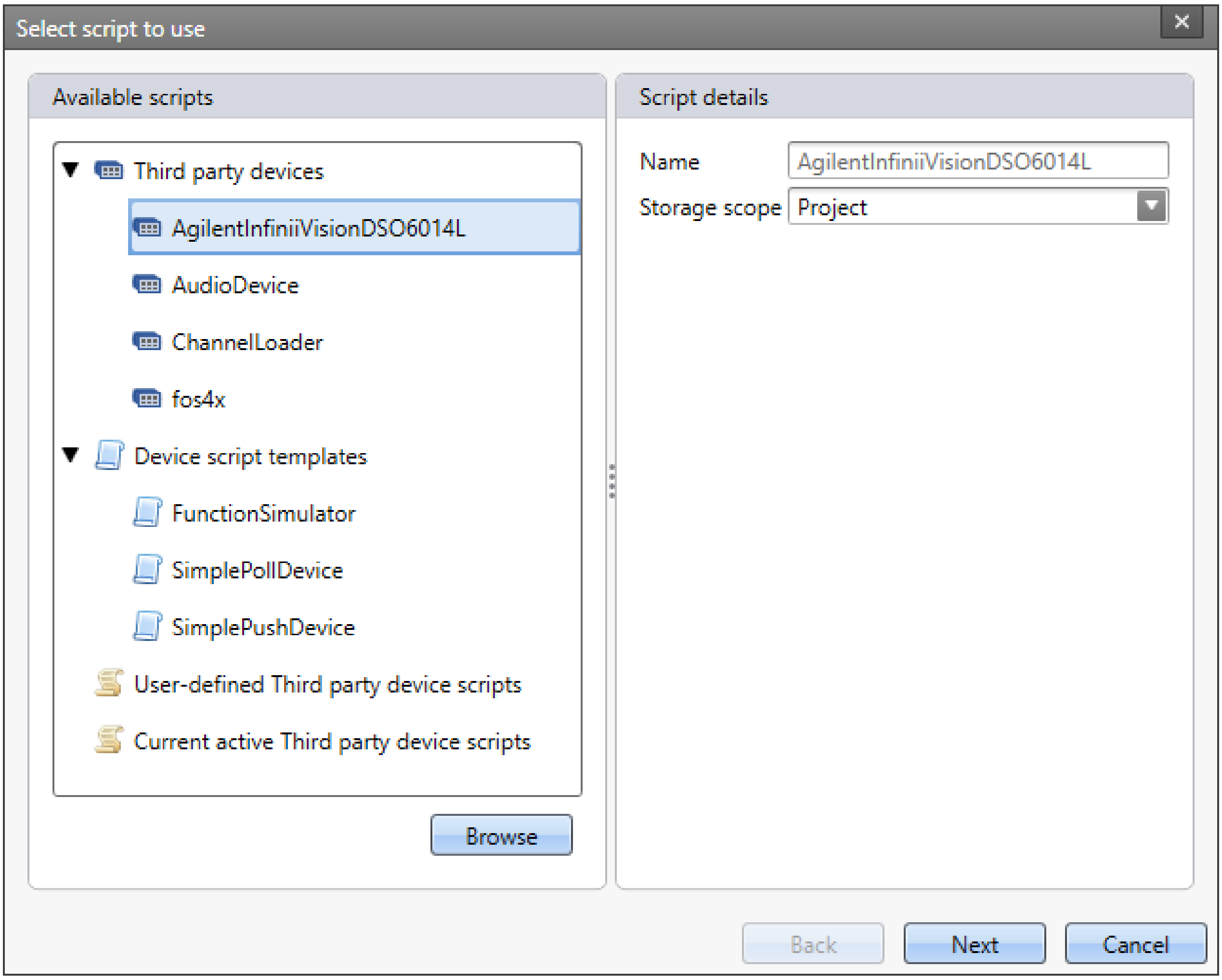
License activation

To use the Agilent Scope, the license **imc STUDIO 3PDI-Digital Scope** is required.

Adding a device

Integrating the Agilent Scope

Go to the Setup–page. In the menu ribbon, click on *Setup Control > 3rd Party Device Management* and select *AgilentIntiniiVisionDSO6014L*.

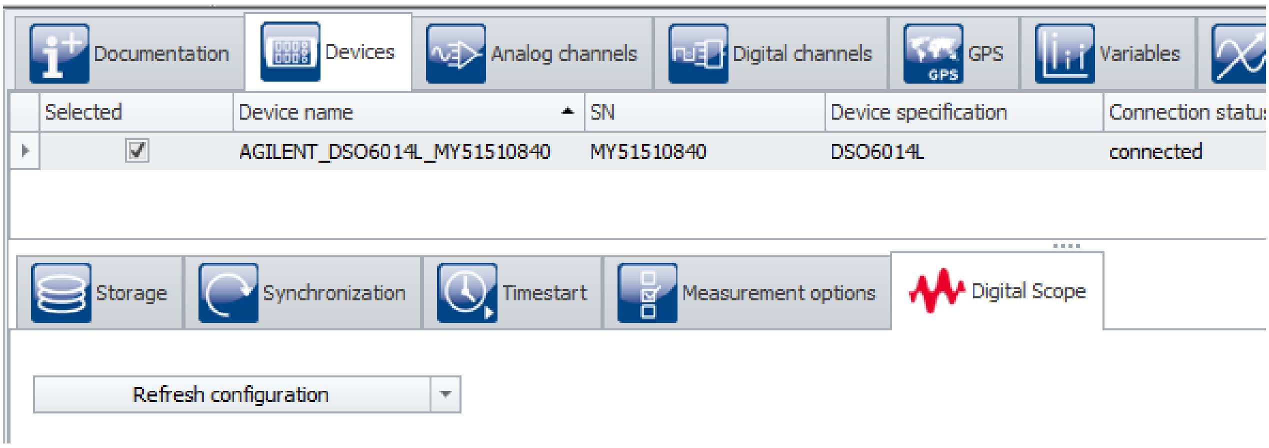


Integrating Agilent Scope

17.2.5.3.2 Device settings

After the device has been added to the Devices list by means of the *3rd Party Device Management*, the device can be configured.

If the device is selected, a new dialog **Digital Scope** is shown.



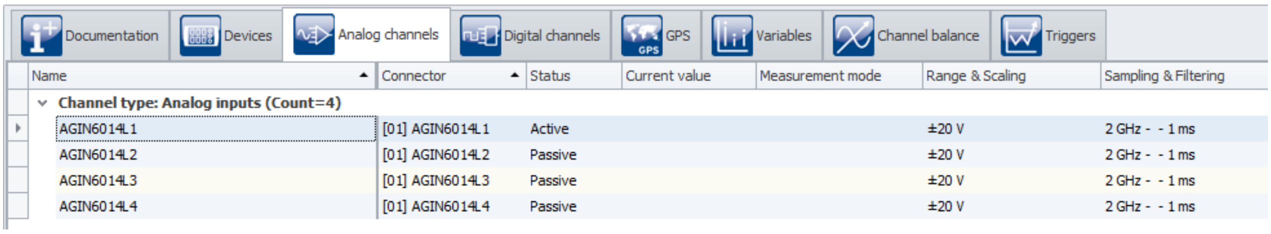
Action	Description
Reset	The device is reset and the input channels' default settings are loaded in imc STUDIO.
Edit configuration	Editing of the device-specific settings in the Browser via the web interface tool. Click on the opened web page on Browser Web Control at left next on the blue highlighted link Remote Front Panel. A Java-applet opens with settings options for the Agilent Scope.
Refresh configuration	The current settings which were set by the web-interface, for example, are read by the Agilent Scope and the parameter values are updated in imc STUDIO accordingly.

Note — **Problems with JAVA**

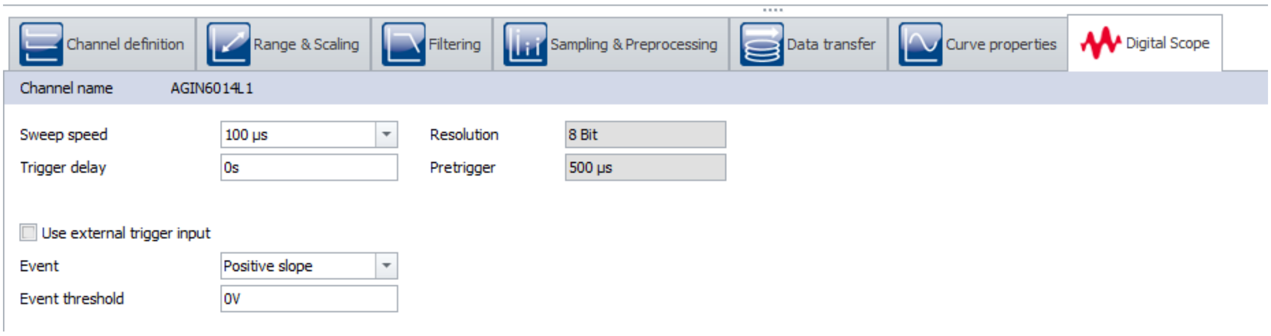
- If no window opens, check whether JAVA is installed.
- Furthermore, the Agilent Scope's IP should be shown in the **Java Control Panel** in the list of excepted web sites under *Security*.

17.2.5.3.3 Channel settings

On the *Analog channels* page there is a new dialog **Digital Scope**.



Analog channels



Special parameters of analog channels

Dependencies of channel parameters

Note	Sample time and Sweep speed

The sampling rate depends on the sweep speed setting. This setting also determines the measurement duration of individual snapshots.

Sampling rate & processing function

Depending on the kind of processing function selected, the values for the sampling rate settings adjust accordingly. The device offers four kinds of processing functions:

- Normal
- Averaging
- High resolution
- Peak detect (not yet implemented)

Sampling rate & status of input channels

The device has a total of four channels and two channel pairs:

- Channel 1 & Channel 2
- Channel 3 & Channel 4

Note	Reduction of the sampling rate

If both channels (Channel 1 and Channel 2, or Channel 3 and Channel 4) are activated, the sampling rate decreases by one half.

Sampling rate and processing function

The change of the sampling rate in relation to the sweep speed is presented in the table below.

Channel pairs not active

Sampling rate as a function of the processing function - Channel pairs are not active				
Sweep speed [ms]	**Normal**	**Averaging**	**High Resolution**	**Peak detect***
0.05	-	2 GHz	-	-
0.1	2 GHz	-	2 GHz	2 GHz
0.2	2 GHz	500 MHz	500 MHz	2 GHz
0.5	500 MHz	200 MHz	200 MHz	200 MHz
1	400 MHz	100 MHz	100 MHz	100 MHz
2	200 MHz	50 MHz	50 MHz	50 MHz
5	80 MHz	20 MHz	20 MHz	20 MHz
10	40 MHz	10 MHz	10 MHz	10 MHz
20	20 MHz	5 MHz	5 MHz	5 MHz
50	8 MHz	2 MHz	2 MHz	2 MHz
100	4 MHz	1 MHz	1 MHz	1 MHz
200	2 MHz	500 kHz	500 kHz	500 kHz
500	800 kHz	200 kHz	200 kHz	200 kHz
1000	400 kHz	100 kHz	100 kHz	100 kHz
2000	200 kHz	50 kHz	50 kHz	50 kHz
5000	80 kHz	20 kHz	20 kHz	20 kHz
10000	40 kHz	10 kHz	10 kHz	10 kHz
20000	20 kHz	5 kHz	5 kHz	5 kHz
50000	8 kHz	2 kHz	2 kHz	2 kHz

* not implemented at this time

Channel pairs active

Sampling rate as a function of the processing function - Channel pairs are active				
Sweep speed [ms]	**Normal**	**Averaging**	**High Resolution**	**Peak detect***
0.05	-	500 MHz	-	-
0.1	2 GHz	-	500	2 GHz
0.2	1 GHz	250 MHz	250 MHz	250 MHz
0.5	400 MHz	100 MHz	100 MHz	100 MHz
1	200 MHz	50 MHz	50 MHz	50 MHz
2	100 MHz	25 MHz	25 MHz	25 MHz
5	40 MHz	10 MHz	10 MHz	10 MHz
10	20 MHz	5 MHz	5 MHz	5 MHz
20	10 MHz	2.5 MHz	2,5 MHz	2,5 MHz
50	4 MHz	1 MHz	1 MHz	1 MHz
100	2 MHz	500 kHz	500 kHz	500 kHz
200	1 MHz	250 kHz	250 kHz	250 kHz
500	400 kHz	100 kHz	100 kHz	100 kHz
1000	200 kHz	50 kHz	50 kHz	50 kHz
2000	100 kHz	25 kHz	25 kHz	25 kHz
5000	40 kHz	10 kHz	10 kHz	10 kHz
10000	20 kHz	5 kHz	5 kHz	5 kHz
20000	10 kHz	2,5 kHz	2,5 kHz	2,5 kHz
50000	4 kHz	1 kHz	1 kHz	1 kHz

* not implemented at this time

Resolution and processing function

Depending on the selections for the **processing functions** and **processing values**, the **resolution in bits** (vertical bit resolution) changes accordingly.

The setting for the amount of processing values is only available for the processing function "Averaging".

Processing function & processing values & resolution in bits

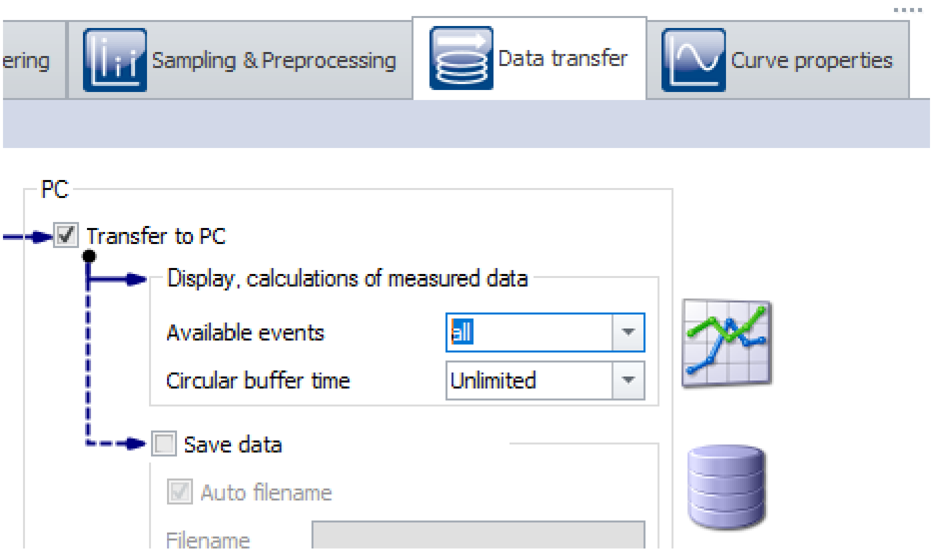
Processing function	Resolution in bits
Normal	8
High Resolution	12
Peak detect*	8
Averaging	*see table below*

* not implemented at this time

Averaging	
Processing values	**Resolution in bits**
2	8
4, 8	9
16, 32	10
64, 128	11
256, 512, 1024, 2048, 4096	12
8192, 16384, 32768, 65536	12

Settings for the display

In order to display all of the measured data ("shots") in the curve window, the channel's **circular buffer memory** must be set to *unlimited* and the **Available events** must be set to *all*.



Data transfer settings

17.2.5.4 fos4x

17.2.5.4.1 Getting started

It is possible to use **fos4x** devices in imc STUDIO as a 3rd-Party-Device. These devices can be configured and controlled via the imc STUDIO.

Preparations

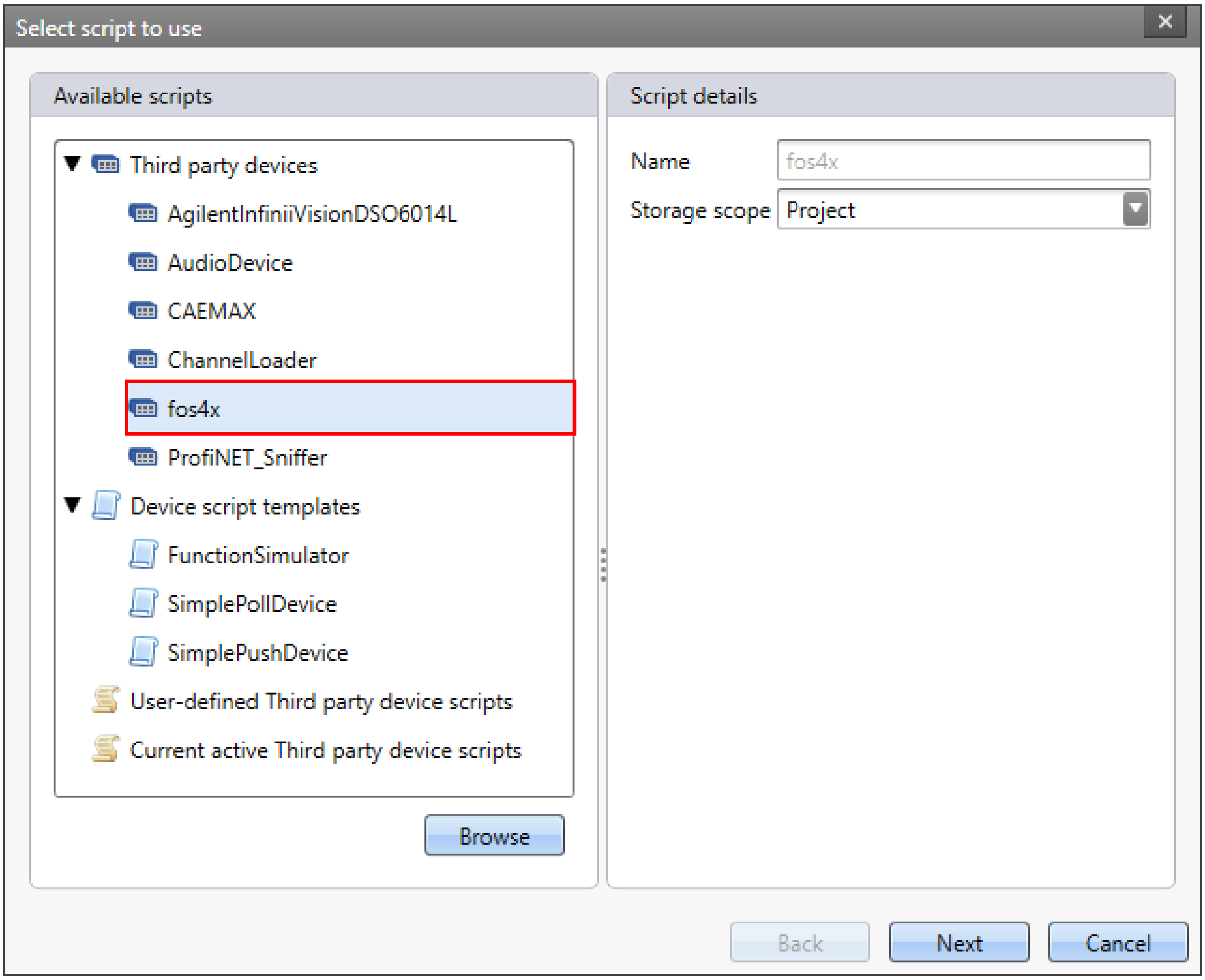
License activation

To use a fos4x-Device the license imc STUDIO 3PDI-fos4x is required.

Adding a device

Integrating a fos4x-Device

Go to the Setup–page. In the menu ribbon, click on *Setup Control > 3rd Party Device Management* and select *fos4x*.

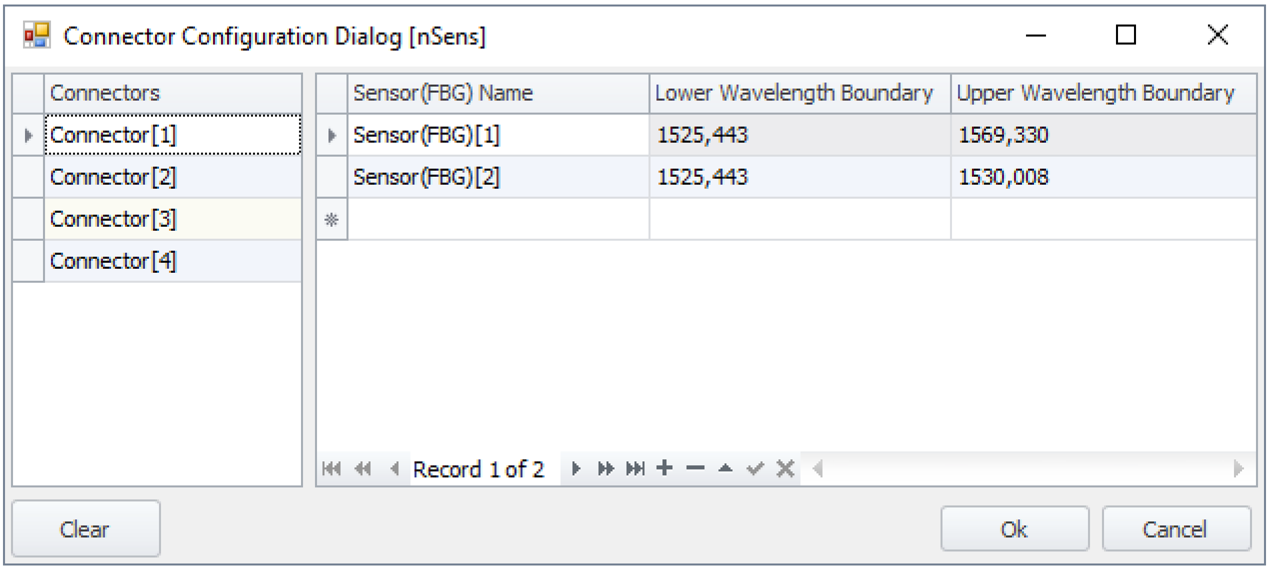


Third-Party-Device Management

17.2.5.4.2 Device settings

After the device has been added to the Devices list by means of the *3rd Party Device Management*, the device can be configured.

If a **fox4x nSens** is selected, the following dialog will be opened:



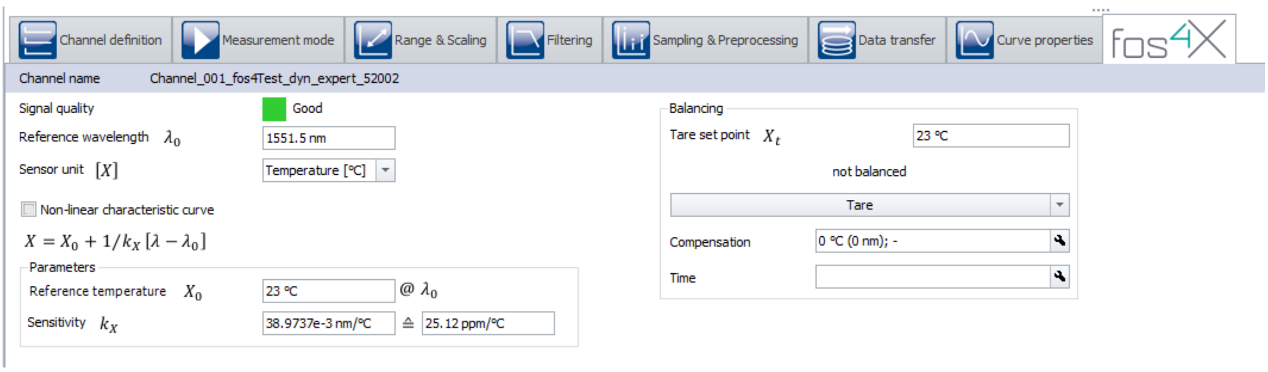
Configuration dialog (fos4x nSens)

Note — Verification of the measurement range

If the expected measurement value is either at the measurement range boundary or even outside of the range possible, the resulting bandwidth will not be practicable because imc STUDIO automatically applies a headroom of approx. 5nm. Therefore, overwrite the settings later, in order to ensure an adequately large bandwidth. If this isn't possible, change the location of the measurement value on the fos4X page.Seite.

17.2.5.4.3 Channel settings

On the *Analog channels* page there is a new dialog **fos4x**.



Analog channels (fos4x)

Reference

For further information, see **fos4x** data sheet or **fos4x** manual.

17.2.6 Device script templates

Chapter	Description
DeviceDriver and PushDeviceDriver 1885	Common component for data transfer.
FunctionSimulator 1886	Device for simulating signals (sine, cosine, rectangle, triangle, ...)
SimplePollDevice 1891	Template for a device getting data via *polling*.
SimplePushDevice 1894	Template for a device which runs a *callback* function when measurement data is available.

Note — Using different third party devices based on the same template

If you want to use different third party devices based on the same template, please read the following instructions:

- Select a different name, when using the template in the Third-Party-Device management
- Rename the class name via keyboard (CTRL + R)
- Change the AssemblyName in the C# project settings.

If this note is not considered, only one device will be shown in the device list.

17.2.6.1 DeviceDriver and PushDeviceDriver

Note

- Here, the virtual device classes which simulate data for the **examples** (SimplePollDevice, SimplePushDevice and FunctionSimulator) are described.
- They can be used for making one's own Third Party Device.
- To write an unmanaged Data-Transfer-Driver, you need some header files that can be provided to you on request.

DeviceDriver

For the Third Party Devices FunctionSimulator and the SimplePollDevice, there is a device class called DeviceDriver available in the Third Party Device script. It describes a virtual device which us used and governed by the respective Third Party Device Script.

In this class, there is a description of the device and its channels, as well as of methods for retrieving simulated data.

One important method here is ReadData(), by means of which you can access the virtual device's data from the DataTransferDriver. In this method, the corresponding mathematics functions (sine, cosine, trapezoid, ...) are calculated and returned in double-Array format.

PushDeviceDriver

For the device SimplePushDevice, there is a class PushDeviceDriver, which is derived from the DeviceDriver. When the object is created, a callback-method must be passed, which is called when data are available in the device.

```
internal class PushDeviceDriver : DeviceDriver {
   public PushDeviceDriver(DataTransferEnvironment environment, DataCallback dataCallback)
      : base(environment) {

      m_dataPumpTimer = new Timer(DataPumpProc, null, Timeout.Infinite, Timeout.Infinite);
      m_dataCallback = dataCallback;
   }
   // ...
}
```

In the simulation, by means of a timer, the method `DataPumpProc()` is implemented, which passes the data accordingly.

```
private DataCallback m_dataCallback = null;

private void DataPumpProc(object state) {
   if (Monitor.TryEnter(this)) {
      try {
         Synchronize();

         foreach (Channel channel in m_channels.Values) {
            double[] data = channel.ReadData(); // read data from device
            if (data != null && m_dataCallback != null) {
               m_dataCallback(channel.Name, new DataEventArgs(DataEvent.Data, data));
            }
         }
      } finally {
         Monitor.Exit(this);
      }
   }
}
```

17.2.6.2 FunctionSimulator

The FunctionSimulator is device which simulates various kinds of mathematics functions, including sine, cosine, triangle, sawtooth and squarewave.

It is also possible to adjust the frequency, the scaling and the offset.
The analog channels and Display-variables are set in the device/channel descriptions.

GetAvailableDevice

```
protected override void GetAvailableDevices(SetupNodeList deviceList) {
   // Add the currently available devices here! Example:
   var device = deviceList.GetOrAdd(ESetupNodeType.Device, "FunctionSimulator");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceNickname, value: "Function Simulator");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceSN, value: "");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceProduct, value: "");
}
```

GetDeviceDescription

```
protected override void GetDeviceDescription(SetupNode device) {
   // Add the full device description here! Channels, modules...

   AddDisplayVariable(device, "Scale", "Scale", "V");
   AddDisplayVariable(device, "Frequency", "Frequency", "Hz");
   AddDisplayVariable(device, "Offset", "Offset", "V");

   AddChannel(device, FunctionType.Sine.ToString(), "sin");
   AddChannel(device, FunctionType.Cosine.ToString(), "cos");
   AddChannel(device, FunctionType.Rectangle.ToString(), "rect");
   AddChannel(device, FunctionType.Sawtooth.ToString(), "saw");
   AddChannel(device, FunctionType.Triangle.ToString(), "tri");
   AddChannel(device, FunctionType.Noise.ToString(), "noi");
   AddChannel(device, FunctionType.DC.ToString(), "dc");
   AddChannel(device, FunctionType.Trapezoid.ToString(), "tra");
}
```

The capabilities of the FunctionType are stated in the Data transfer 1871.

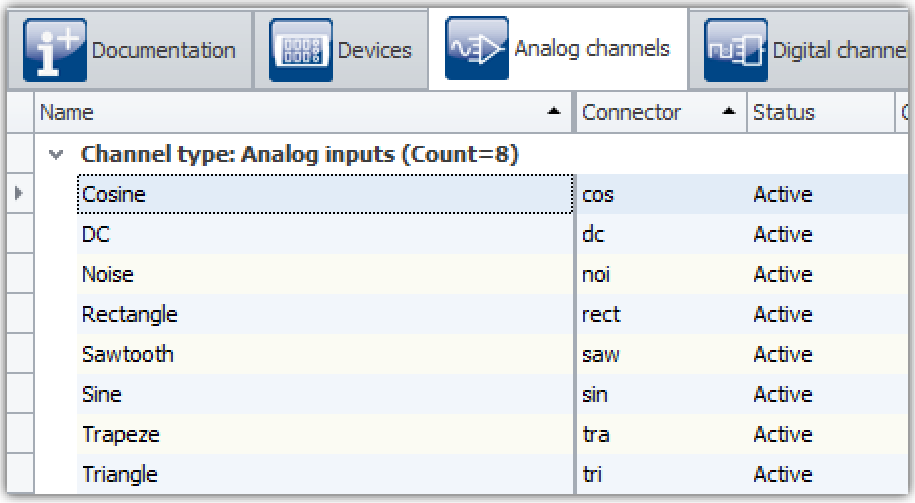
To make it easier to add analog channels, the function `AddFunctionChannelToDevices()` is provided here.

```
private void AddChannel(SetupNode device, string functionName, string functionNameShort) {
   var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, functionName);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: functionName);
   channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: functionNameShort);
   channel.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);

   channel.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.AnalogInput);
   channel.Parameters.UpdateOrAdd(EClassID.eXFormat, value: ParameterValues.eXFormat.Normal);
   channel.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEDOUBLE);

   channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.001, editorType:
EEditorType.ComboBox); // 1 kHz (default value)

   channel.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: "V"); // The original
(electrical) measurement unit
   channel.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: "V");

   channel.Parameters.UpdateOrAdd(EClassID.eExternalTriggerTarget, value: true);
}
```

The frequency, the scaling and the offset can be implemented with the help of the method `AddDisplayVariableToDevice()`.

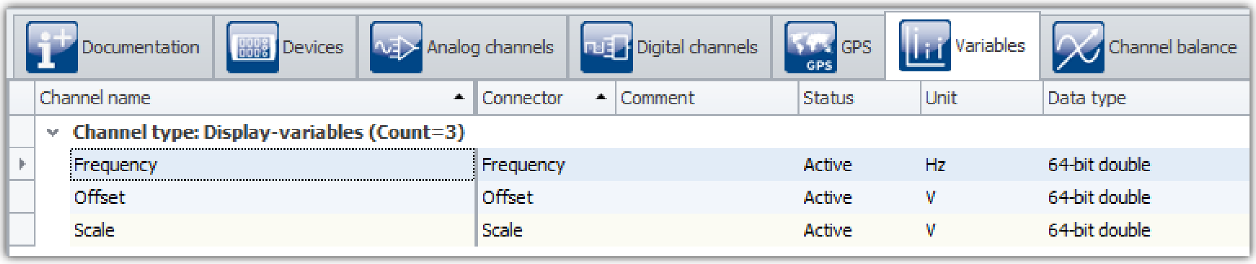
```
private void AddDisplayVariable(SetupNode device, string variableName, string variableNameShort,
string unit) {
   var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, variableName);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: variableName);
   channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: variableNameShort);
   channel.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.DisplayVar);
   channel.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: unit); // The original
(electrical) measurement unit
   channel.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: unit);
   channel.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEDOUBLE);

   channel.Parameters.Remove(EClassID.eSampleTime);
   channel.Parameters.Remove(EClassID.eDuration);
   channel.Parameters.Remove(EClassID.ePCTransferToHD);
}
```

The analog channels then appear on the Setup-page under *Analog channels*.



Setup: FunctionSimulator (Analog Channels)

The Display variables appear on the Setup-page under Variables.



Setup: FunctionSimulator (Variables)

DataTransferDriver.cs

The DataTransferDriver handles the data transfer from Third Party Device to imc STUDIO.

For this purpose, the Third Party Device-object must be known to the DataTransferDriver. With the help of this object, it is then possible to control the Third Party Device.

In this example, upon initialization the corresponding object DeviceDriver 1885 is created.

```
public class DataTransferDriver : AbstractDataTransferDriver {
// ...
   private DeviceDriver m_deviceDriver = null; // device object

   protected override ILogbookEntryBase[] Initialize(DataTransferEnvironment environment){
      m_deviceDriver = new DeviceDriver(environment); // initializing device
      return null;
   }
// ...
}
```

Upon downloading, the channel settings are applied and transferred to the device.

```
protected override ILogbookEntryBase[] Prepare(SetupNode configuration, DataTransferNodeList
dataTransferNodes) {
// ...
   m_deviceDriver.ConfigureChannel(child.Name, FunctionType.Sine, (double)sampleTime.Value); //
setting channels in the device
// ...
}
```

Additionally, the Display variables are set.

```
if (dataTransferNode.Name == "Frequency") {
   dataWriter.WriteData(1.0);
} else if (dataTransferNode.Name == "Offset") {
   dataWriter.WriteData(0.0);
} else if (dataTransferNode.Name == "Scale") {
   dataWriter.WriteData(1.0);
}
```

When starting and stopping, the datWriter is strted/stopped.

During measurement, the data are continually polled by the device via a timer and exported to imc STUDIO by the dataWriter. Likewise, the Display-variables re imported and processed.

```
public DataTransferDriver() {
   m_processDataTimer = new Timer(OnProcessData, null, Timeout.Infinite, Timeout.Infinite);
}
```

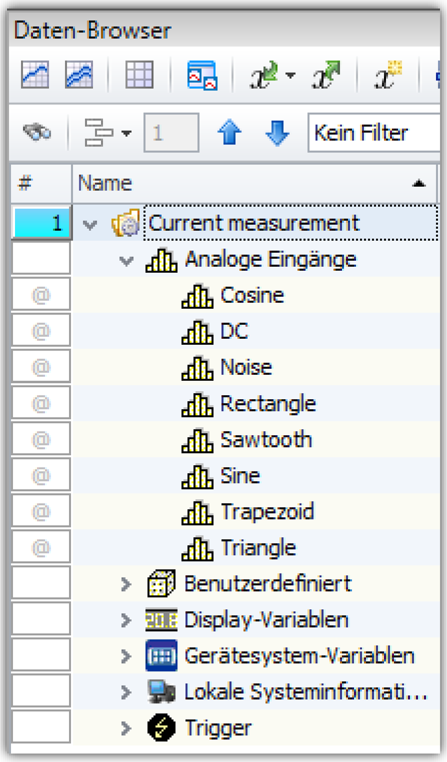
```
private void OnProcessData(object state) {
// ...
   // processing Display-variables
   if (dataTransferNode.Name == "Frequency") {
      if (dataReader.ReadData(out frequency) == EResult.Success) {
         if (frequency <= 0.1) {
            frequency = 0.1;
            dataWriter.WriteData(frequency);
         } else if (frequency >= 10000.0) {
            frequency = 10000.0;
            dataWriter.WriteData(frequency);
         }
      }
   } else if (dataTransferNode.Name == "Offset") {
      if (dataReader.ReadData(out offset) == EResult.Success) {
         if (Math.Abs(offset) > 1e20) {
            offset = Math.Sign(offset) * 1e20;
            dataWriter.WriteData(offset);
         }
      }
   } else if (dataTransferNode.Name == "Scale") {
      if (dataReader.ReadData(out scale) == EResult.Success) {
         if (Math.Abs(scale) > 1e20) {
            scale = Math.Sign(scale) * 1e20;
            dataWriter.WriteData(scale);
         }
      }
   }

   // data retrieved from the device and exported to STUDIO
   double[] data = m_deviceDriver.ReadData(dataTransferNode.Name);
   EResult result = dataWriter.WriteData(data);
//...
}
```

DeviceDriver.cs

For details on this topic, see the chapter DeviceDriver and PushDeviceDriver 1885.

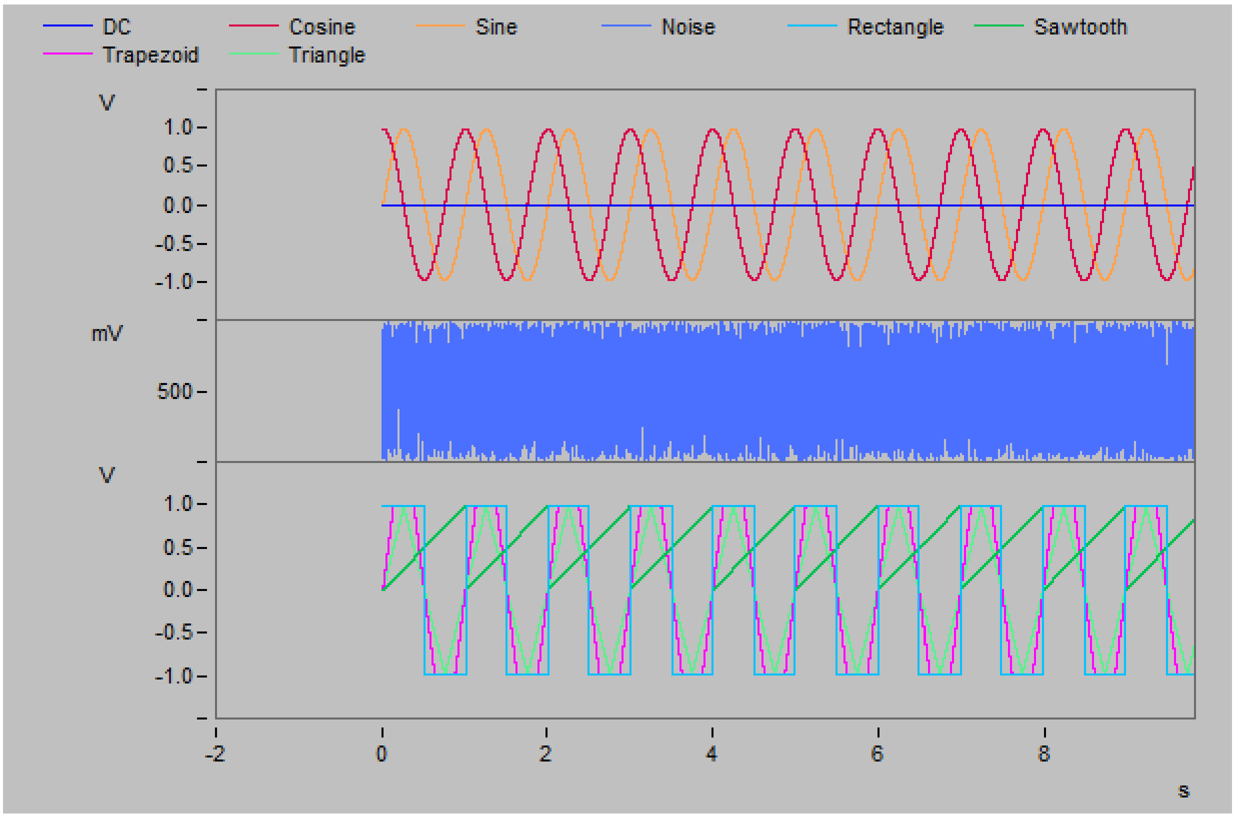
Functionality in imc STUDIO

After selection and configuration of the device, the channels and Display-variable are listed in the Data Browser.



Data Browser: FunctionSimulator

The signals can be displayed in the curve window.



Curve window: FunctionSimulator

By changing the Display-variables, it is possible to alter the frequency, amplitude and offset during runtime.

Note

- The FunctionSimulator can be used as trigger target action of an imc device.
- Important: The time zone in the imc device must be corresponding to the PC's time zone.

17.2.6.3 SimplePollDevice

One simple example of Third Party Device is the "SimplePollDevice", which generates a sine signal.

GetAvailableDevices

```
protected override void GetAvailableDevices(SetupNodeList deviceList) {
    // Add the currently available devices here! Example:
    var device = deviceList.GetOrAdd(ESetupNodeType.Device, "SimplePollDevice");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceNickname, value: "SimplePollDevice");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceSN, value: "");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceProduct, value: "");
}
```

GetDeviceDescription

In the device description, the channel information is presented. In this case, the channel is an analog channel named "Poll_Input_001", having a pre-set sampling interval of 0.01 seconds.

```
protected override void GetDeviceDescription(SetupNode device) {
   // Add the full device description here! Channels, modules...
//
   // Example code (equidistant channel with a float sample every 10ms):
   var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "Poll_Input_001");
   channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Poll_Input_001");
   channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "IN01");
   channel.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.AnalogInput);
   channel.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: "V"); // The original
(electrical) measurement unit
   channel.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: "V");

   channel.Parameters.UpdateOrAdd(EClassID.eXFormat, value: ParameterValues.eXFormat.Normal);
   channel.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEDOUBLE);
   channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.01, editorType:
EEditorType.ComboBox); // 100 Hz (default value)
}
```

The data transfer is handled by a special object of a class (*managed*).

```
public override IDataTransferDriverBase CreateDataTransferDriver() {
   return new DataTransferDriver();
}
```

DataTransferDriver.cs

The DataTransferDriver handles the transfer of data from the Third Party Device to imc STUDIO.

For this purpose, the Third Party Device-object must be known to the DataTransferDriver. With the help of this object, it is then possible to control the Third Party Device.

In this example, the corresponding object DeviceDriver 1885 is created in the initialization process.

```
public class DataTransferDriver : AbstractDataTransferDriver {
// ...
   private DeviceDriver m_deviceDriver = null; // Device-Object

   protected override ILogbookEntryBase[] Initialize(DataTransferEnvironment environment){
      m_deviceDriver = new DeviceDriver(environment); // Initializing device
      return null;
   }
// ...
}
```

Upon downloading, the channel settings are applied and transferred to the device.

```
protected override ILogbookEntryBase[] Prepare(SetupNode configuration, DataTransferNodeList
dataTransferNodes) {
// ...
   m_deviceDriver.ConfigureChannel(child.Name, FunctionType.Sine, (double)
sampleTime.Value); // Setting channels in the device
// ...
}
```

When starting and stopping, the dataWriter is started/stopped.

During measurement, the data are continually polled by the device via a timer and exported to imc STUDIO by the dataWriter.

```
public DataTransferDriver() {
   m_processDataTimer = new Timer(OnProcessData, null, Timeout.Infinite, Timeout.Infinite);
}
```

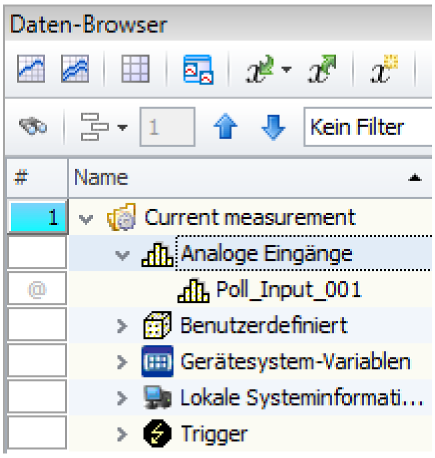
```
private void OnProcessData(object state) {
// ...
   double[] data = m_deviceDriver.ReadData(dataTransferNode.Name); // retrieving data from the
device
   EResult result = dataWriter.WriteData(data);
//...
}
```

DeviceDriver.cs

For details, see the chapter DeviceDriver and PushDeviceDriver 1885.

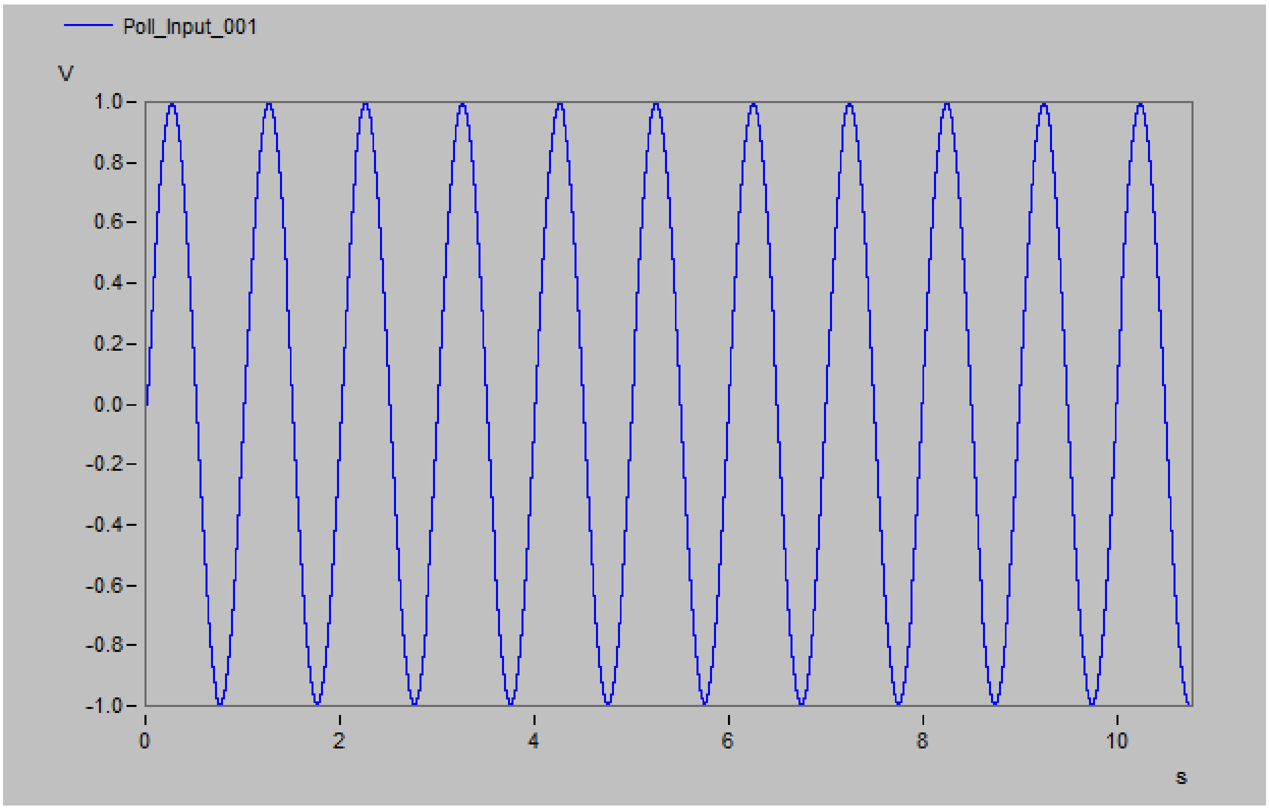
Functionality in imc STUDIO

After selection of the device and its configuration, the analog channel "Poll_Input_001" appears in the Data Browser.



Data Browser: SimplePollDevice

Once the measurement starts, the sine-signal generated can be displayed in a curve window.



Curve window: SimplePollDevice

17.2.6.4 SimplePushDevice

An additional example of Third Party Device is the "SimplePushDevice", which generates a sine-signal. In the process, the device initiates a callback.

GetAvailableDevices

```
protected override void GetAvailableDevices(SetupNodeList deviceList) {
   // Add the currently available devices here! Example:
   var device = deviceList.GetOrAdd(ESetupNodeType.Device, "SimplePushDevice");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceNickname, value: "SimplePushDevice");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceSN, value: "");
   device.Parameters.UpdateOrAdd(EClassID.eDeviceProduct, value: "");
}
```

GetDeviceDescription

In the device description, the channel information is presented. In this case, the channel is an analog channel named "Input_001" with a pre-set sampling interval of 0.01 seconds.

```
protected override void GetDeviceDescription(SetupNode device) {
   // Add the full device description here! Channels, modules...

   // Example code (equidistant channel with a float sample every 10ms):
   var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "Push_Input_001");
   channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Push_Input_001");
   channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "IN01");
   channel.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);
   channel.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.AnalogInput);
   channel.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: "V"); // The original
(electrical) measurement unit
   channel.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: "V");

   channel.Parameters.UpdateOrAdd(EClassID.eXFormat, value: ParameterValues.eXFormat.Normal);
   channel.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEDOUBLE);
   channel.Parameters.UpdateOrAdd(EClassID.eSampleTime, value: 0.01); // 100 Hz (default
value)
}
```

The data transfer is handled by a special object of a class (*managed*).

```
public override IDataTransferDriverBase CreateDataTransferDriver() {
   return new DataTransferDriver();
}
```

DataTransferDriver.cs

The DataTransferDriver handles the data transfer from Third Party Device to imc STUDIO.

For this purpose, the Third Party Device-object must be known to the DataTransferDriver. With the help of this objects, it is then possible to control to the Third Party Device.

In this example, upon initialization the corresponding object PushDeviceDriver 1885, which is described in the file DeviceDriver.cs, is created. The method `OnProcessData` is passed to the SimplePushDevice, and this method is called when data are finalized in the Third Party Device and can be transferred (*push*) to imc STUDIO.

```
public class DataTransferDriver : AbstractDataTransferDriver {
// ...
   private PushDeviceDriver m_deviceDriver = null;

   protected override ILogbookEntryBase[] Initialize(DataTransferEnvironment environment)    {
      m_deviceDriver = new PushDeviceDriver(environment, OnProcessData);
      return null;
   }
// ...
}
```

Upon downloading, the channel's settings are applied and transferred to the device.

```
protected override ILogbookEntryBase[] Prepare(SetupNode configuration, DataTransferNodeList
dataTransferNodes) {
// ...
   m_deviceDriver.ConfigureChannel(child.Name, FunctionType.Sine, (double)
sampleTime.Value); // setting channels in the device
// ...
}
```

When starting and stopping, the dataWriter is started/stopped.

During the measurement, the method `OnProcessedData()` is called, if the Third Party Device itself has concluded it data package and calls this event.

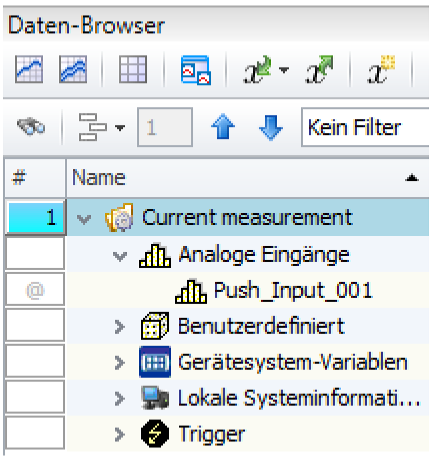
```
private void OnProcessData(string channelName, DataEventArgs e) {
// ...
   switch (e.DataEvent) {
      case DataEvent.Begin:
         dataWriter.Open();
         result = dataWriter.BeginWrite(e.Time.Value);
         // Error-Handling
         break;
      case DataEvent.Data:
         result = dataWriter.WriteData(e.Data);
         // Error-Handling
         break;
      case DataEvent.End:
         result = dataWriter.EndWrite();
         dataWriter.Close();
         // Error-Handling
         break;
      default:
         break;
   }
//...
}
```

DeviceDriver.cs

For more on this topic, see the chapter DeviceDriver and PushDeviceDriver 1885.

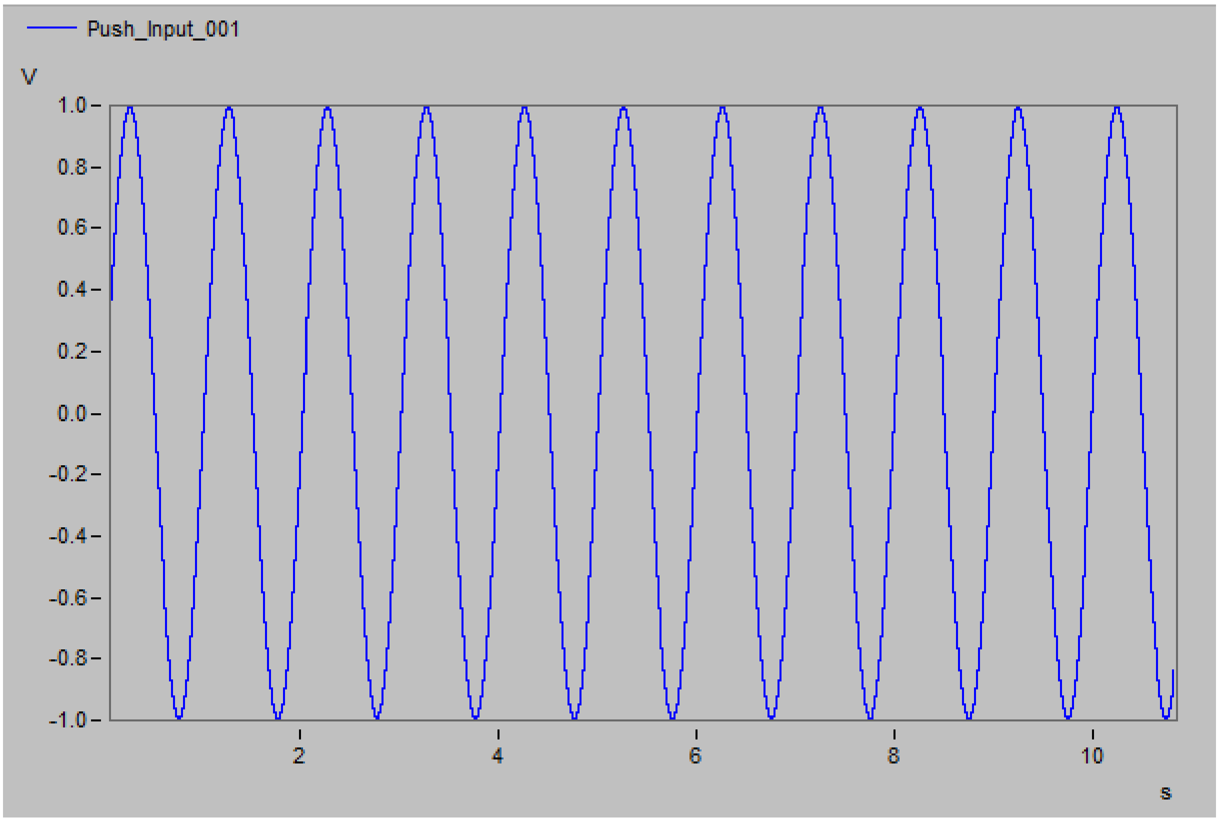
Functionality in imc STUDIO

After selection of the device and its configuration, the analog channel "Poll_Input_001" appears in the Data Browser.



Data Browser: SimplePushDevice

Once the measurement has been started, the sine-signal generated can be displayed in a curve window.



Curve window: SimplePushDevice

17.2.7 FAQ

FAQ

When importing an older experiment with a third party device, I get the error "System.IO.FileNotFoundException"

Answer: The given third party devices are imported as DLL. There are dependencies to other libraries. In the version 5.2 there are changes causing the following error message:

```
The Script "ChannelLoader" encountered: System.IO.FileNotFoundException: Could not load file
or assembly 'imc.Studio.Interfaces.V2, Version=5.0.2.0, Culture=neutral,
PublicKeyToken=68a4b1d388e6c0b6' or one of its dependencies. The system cannot find the file
specified.
File name: 'imc.Studio.Interfaces.V2, Version=5.0.2.0, Culture=neutral,
PublicKeyToken=68a4b1d388e6c0b6' [...]
```

To fix this error, please remove the corresponding third party device script (AudioDevice, ChannelLoader) with the help of the 3rd Party Device Management and add it again.

Contact the author of the third party device script if you have further questions.

17.2.8 Tutorial

Here you will find a list of tutorials:

Tutorial	Beschreibung
Add a channel 1897	A new channel is added to the SimplePollDevice.
Add a Display variable 1899	A Display variable for setting the signal frequency is added to the SimplePollDevice.

17.2.8.1 Extension of the SimplePollDevice

17.2.8.1.1 Add a channel

The task is to add an analog channel to the existing SimplePollDevice. For this purpose, a new experiment is created, and additionally the SimplePollDevice added to the device list via the 3rd Party Device Management, unless this already happened.

Note

While the changes are made, the SimplePollDevice may not be selected.

GetAvailableDeviceDevices

The device's name is changed to *SimplePollDeviceExtended*.

```
protected override void GetAvailableDevices(SetupNodeList deviceList) {
   // Add the currently available devices here! Example:
    var device = deviceList.GetOrAdd(ESetupNodeType.Device, "SimplePollDeviceExtended");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceNickname, value: "SimplePollDeviceExtended");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceSN, value: "");
    device.Parameters.UpdateOrAdd(EClassID.eDeviceProduct, value: "");
}
```

GetDeviceDescription

An additional channel having the same properties as the first channel is added. This segment can be copied and inserted. The new channel name is altered.

```
protected override void GetDeviceDescription(SetupNode device) {
   // Add the full device description here! Channels, modules... Example:
    var channel = device.Children.GetOrAdd(ESetupNodeType.Channel, "Poll_Input_001");
    channel.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Poll_Input_001");
    channel.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "IN01");
    // ... code is omitted
   var channel2 = device.Children.GetOrAdd(ESetupNodeType.Channel, "Poll_Input_002");
   channel2.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Poll_Input_002");
   channel2.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "IN02");
   // ... same settings as Input_001, code is omitted here
}
```

DataTransferDriver.cs

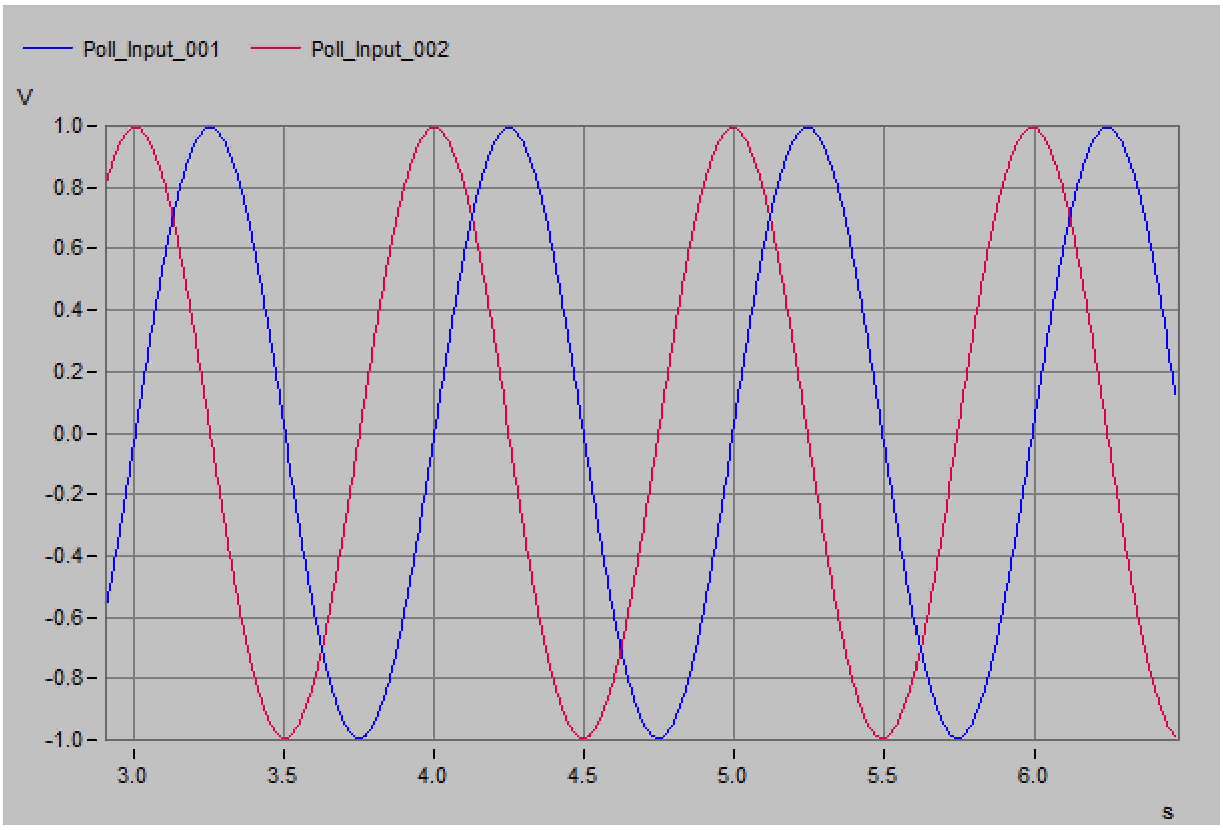
In the class DataTransferDriver, the SimplePollDevice is configured. In the method `Prepare()`, the channels are configured.

By default, sine-signals are generated for all channels. By polling the channel name, it is possible to set a different signal, e.g. cosine.

```
protected override ILogbookEntryBase[] Prepare(SetupNode configuration, DataTransferNodeList
dataTransferNodes) {
// ...
   if (sampleTime != null && sampleTime.Value is double) {

      // Channel 1 : Sine
      if (child.Name == "Poll_Input_001"){
         m_deviceDriver.ConfigureChannel(child.Name, FunctionType.Sine, (double)
sampleTime.Value);
      }

      // Channel 2 : Cosine
      if (child.Name == "Poll_Input_002"){
         m_deviceDriver.ConfigureChannel(child.Name, FunctionType.Cosine, (double)
sampleTime.Value);
      }

   }
//...

}
```

After selection of the device, the channels *Poll_Input_001* and *Poll_Input_002* appear in the list of analog channels, as well as in the Data Browser.

When a measurement is started, the channels can be displayed in the curve window.



Curve window: Extended SimplePollDevice

17.2.8.1.2 Add a Display variable

A Display variable is to be added, which adjusts the frequency for the analog signal.

GetDeviceDescription

The following segment is added to the `GetDeviceDescription`-method. The Display-variable "Frequency" is thus added to the device.

```
var displayVar = device.Children.GetOrAdd(ESetupNodeType.Channel, "Frequency");
displayVar.Parameters.UpdateOrAdd(EClassID.eChannelName, value: "Frequency");
displayVar.Parameters.UpdateOrAdd(EClassID.ePlugInName, value: "Freq");
displayVar.Parameters.UpdateOrAdd(EClassID.eStatus, value: ParameterValues.eStatus.Active);
displayVar.Parameters.UpdateOrAdd(EClassID.eChannelType, value:
ParameterValues.eChannelType.DisplayVar);
displayVar.Parameters.UpdateOrAdd(EClassID.eDivisionUnit, value: "Hz"); // The original
(electrical) measurement unit
displayVar.Parameters.UpdateOrAdd(EClassID.eUserUnit, value: "Hz");
displayVar.Parameters.UpdateOrAdd(EClassID.eDataType, value:
ParameterValues.eDataType.IEEEDOUBLE);

displayVar.Parameters.Remove(EClassID.eSampleTime);
displayVar.Parameters.Remove(EClassID.eDuration);
displayVar.Parameters.Remove(EClassID.ePCTransferToHD);
```

DataTransferDriver.cs

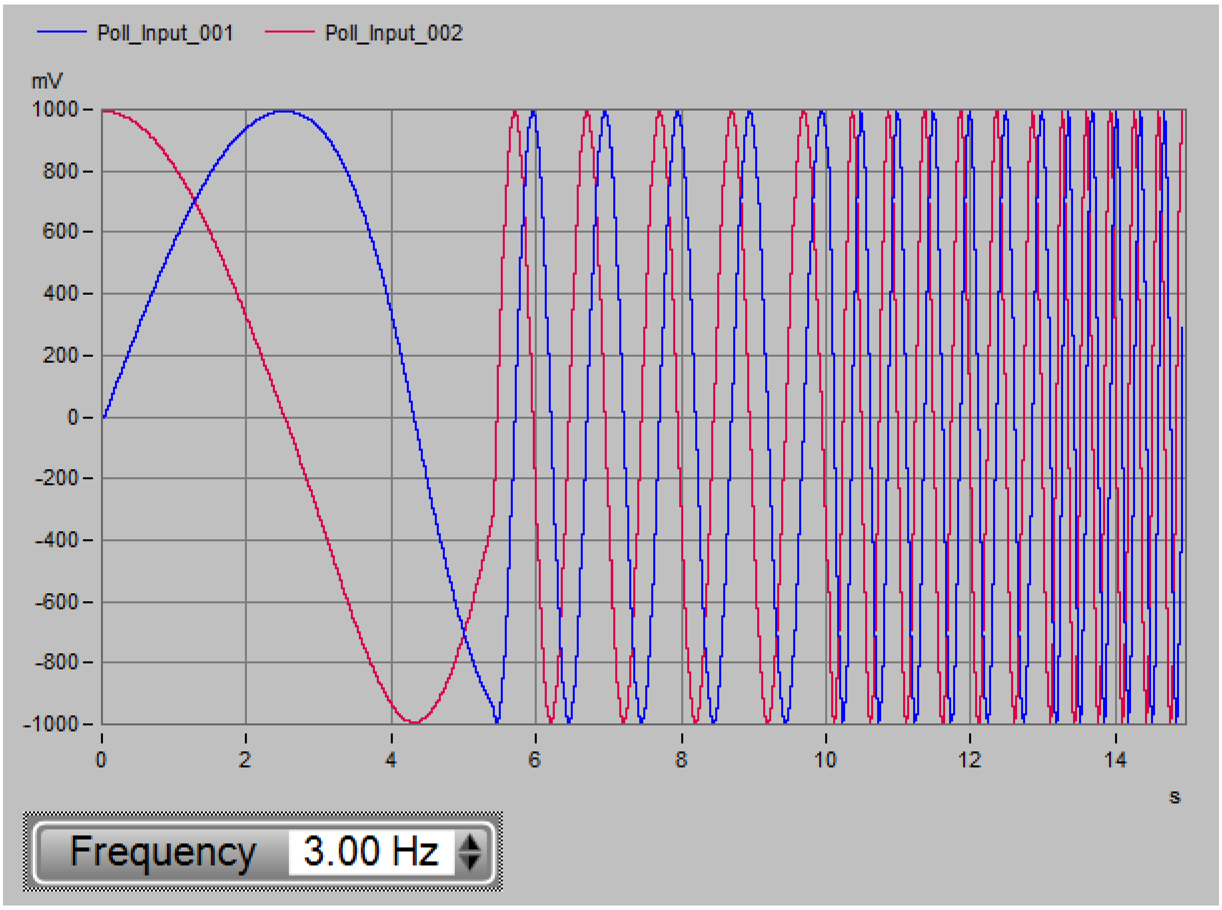
In the class DataTransferDriver, the following code must be amended/edited in the method `OnProcessData()`.

```
if (dataTransferNodes != null) {
   // defining parameters (inserting into existing framework)
   double frequency = 1.0;
   double offset = 0.0;
   double scale = 1.0;
// ...
}
```

```
if (dataTransferNodes != null) {
// ...
// importing Display-variable (foreach-block to be inserted before other foreach)
   foreach (DataTransferNode dataTransferNode in dataTransferNodes) {
      DataReader dataReader = dataTransferNode.Reader;
      if (dataReader != null){
         DataWriter dataWriter = dataTransferNode.Writer;
         if (dataWriter != null) {
            if (dataTransferNode.Name == "Frequency") {
               if (dataReader.ReadData(out frequency) == EResult.Success) {
                  if (frequency <= 0.1) {
                     frequency = 0.1;
                     dataWriter.WriteData(frequency);
                  } else if (frequency >= 10000.0) {
                     frequency = 10000.0;
                     dataWriter.WriteData(frequency);
                  } // frequency
               } // ReadData
            } // Name = Frequency
         } // dataWriter
      } // dataReader
   } // foreach
/ ...
}
```

```
// the existing foreach-block must be edited
foreach (DataTransferNode dataTransferNode in dataTransferNodes) {

   DataWriter dataWriter = dataTransferNode.Writer;
   if (dataWriter != null){
      // this line must be inserted for setting the frequency
      m_deviceDriver.SetTunableParameters(dataTransferNode.Name, frequency, offset, scale);
      double[] data = m_deviceDriver.ReadData(dataTransferNode.Name);
      // ...
   }
}
```

After closing the Editor and selecting the third-party device, the Display-variable is displayed in the Data Browser. The signal's frequency can now be altered by means of the Display-variable.



Curve window: SimpleDevice extended - Display Variable "Frequency"

Adjustment of the amplitude and offset can be accomplished by adding more Display-variables. On this subject, see also the FunctionSimulator 1886.

17.3 API

The **imc STUDIO API** (ApplicationInterface) is a programming interface which provides both the ability to freely develop programs and also **fundamental functions** belonging to imc STUDIO, such as:

- reading and writing of device and channel settings (Setup) ,
- access to the Panel and the Widgets,
- access to the Data Browser: creating, reading and writing variables,
- applying of imc FAMOS-functions to channels,
- executing menu actions in the ribbon,
- executing Sequencer commands,
- reaction to events.

This manual explains certain introductory points and describes the interfaces with imc STUDIO.

Note

- The **imc STUDIO API** is provided as part of the installation of imc STUDIO *Developer*.
- The programming language is a .NET programming language (e.g. C#, Visual Basic .NET) .
- You cannot use .NET-Core for the API
- The projects must be build as 32-bit version.

17.3.1 Licensing

The **imc STUDIO API** is marketed in conjunction with the **imc DATA API** as **imc API.**

To develop a project, the *imc API Developer* license is needed. To run the programs an *imc API Runtime* license is needed.

With **imc DATA API**, you obtain access to the functionalities of imc FAMOS, including of its Kits, the curve window and the data objects.

The *Base-Project* of the**imc STUDIO API** is installed on the computer as part of installation of the *imc STUDIO Developer*.

If functions from the *imc STUDIO Standard* Edition or higher are needed by **API**, a corresponding license must be activated via the License Manager.

Reference

For more information, see:

- First Steps 1901
- Base Interface 1903

17.3.2 First Steps

In the process of installing the **imc STUDIO Developer**, the primary project as well as extra sample projects are installed on this path:

"C:\Users\Public\Documents\imc\imc STUDIO\API\\"

The subfolder "Shared" contains the basic project which is required for making one's own projects.

The subfolder "Projects" contains executable sample projects.

Prerequisites for imc STUDIO API

- imc STUDIO Installation (Developer Edition)
- Development environment, including compiler for the .NET programming language (e.g. Visual Studio 2010 or higher)
- .NET Framework (Version depends on the imc STUDIO Version)
- Use of an WPF or Windows-Forms project

Note

It is recommended that you have only one imc STUDIO version installed at a time in order to avoid version conflicts with the assemblies.

Note .NET Framework Version

The calling application (*.exe) must be the same or higher .NET Framework version of the imc STUDIO API component.

In imc STUDIO 5.x **.NET Framework 4.0** is used.

17.3.3 Collaboration with the imc DATA API

Note License

To use the imc DATA API, also the **imc API Developer** or **imc API Runtime** license is required.

Reference

You will find more information in the imc API manual.

17.3.4 Specifying the imc STUDIO version

Warning

In the development process it is recommended that there is only one imc STUDIO version installed to avoid conflicts with the assemblies.

When using the completed application also parallel installation is possible.

The interface attempts to automatically detect the version of imc STUDIO Version and enters it into the configuration file default.ispc 1902..

The following steps are necessary in order to use a particular version of imc STUDIO in the imc STUDIO API:

In the **default.ispc**-file used, for each entry in the assembly, the corresponding version number must be entered. This number can be obtained from the application path of the corresponding imc STUDIO version.

In the Initialization 1903 the parameter correctVersionInISPC must be set to `false`. Otherwise the default.ispc is overwritten.

Product config file: default.ispc

By default, the **default.ispc** for the API is located in the following folder: C:\Users\Public\Documents\imc\imc STUDIO\API\Projects\AppDir

Notes on default.ispc

This file is loaded when an instance of imc STUDIO is started. The content indicates which components are to be loaded.

Along with the information whether a component is active, the file also contains the version number. This number must match the version number of the imc STUDIO installed; non-matching versions will cause the start to be canceled.

Therefore it is necessary to perform manual verification and, if applicable, alteration of the version:

1. Version of imc STUDIO installed:

   a. see file properties of **imc.Studio.Version.dll** in the imc STUDIO installation folder
2. Version specification in the file **default.ispc**
   a. To edit, the file can be opened in an XML- or text editor.
   b. The installed version of imc STUDIO must be indicated in the XML-tag **Version**: e.g. the plug-in **imc.Studio.PlugIns.Panel.dll**
3. If the versions don't match or if there is no version indicated:
   a. Change the text of the version within the tag <Version>**xxx**</Version>
   b. save **default.ispc**
   c. restart the program

Example of a plug-in component in default.ispc

```
<PlugIn>
      <PlugInType>DotNet</PlugInType>
      <StartUpClass>imc.Studio.PlugIns.Panel._ThePlugIn</StartUpClass>
      <Culture>neutral</Culture>
      <PublicKeyToken>68a4b1d388e6c0b6</PublicKeyToken>
      <AssemblyName>imc.Studio.PlugIns.Panel</AssemblyName>
      <Active>True</Active>
      <Version>5.2.0.6502</Version>
      <LoadPositionNumber>13</LoadPositionNumber>
 </PlugIn>
```

17.3.5 Base Interface

The project **imc.Studio.ApplicationInterface** is considered the Basis-project.

imc STUDIO has a core (imc STUDIO Core) having a framework onto which all functionalities sign on.

These functionalities only become operable in consequence of referencing various assemblies.

In order to make it easier to gain familiarity, the basis-project contains the most important references and provides simplification of these functionalities.

Note

- imc makes the source code of the basis-project available. It is highly recommended **not** to alter it. In future versions, the scope of functionalities will be expanded. Any changes would be lost upon updating and/or would need to be reconstructed.
- What is recommended is to create **one's own** imc STUDIO-class which is derived from `SimplifiedImcStudioComponent`. Here, it is possible to make any enhancements desired.

17.3.5.1 Initialization

Parameter

For the **initialization** of the imc STUDIO components, the following **parameters** must be provided:

```
imcStudioObject = new SimplifiedImcStudioComponent(<application folder>, <parent window>,
<installation folder> )
```

Parameter	Description
Application folder	• In the standard case, imc STUDIO is started from its application folder, e.g. "C:\ProgramData\imc\imc STUDIO\Applications_1". This is where the configuration is saved in **default.ispc** and loaded. • When setting a new folder for your application, the folder "AppDir" (application settings) from the Demo-projects belonging to imc STUDIO can be used. • For the purpose of modifying the components used, the file **default.ispc** can be copied from the STUDIO-applications folder (once all all components to be used have been activated in the imc STUDIO user interface). • Alternatively, for testing purposes a complete copy of the folder ".._1\" can be used. • To check which application folder is used by the current installation of imc STUDIO, have the properties of imc STUDIO's desktop link displayed.
Parent window	• Necessary for displaying dialogs from the imc STUDIO component • Necessary for controlling the multi-threading within imc STUDIO. • A *Windows.Forms* or *WPF*-window can be transferred.
Installation folder	• To start imc STUDIO, the installation folder must be provided as a parameter. • By default, imc STUDIO installs in "C:\Program Files (x86)\imc\imc STUDIO 5.2\" (or according to the respective version). • The path can be determined automatically by means of the following function: `SimplifiedImcStudioComponent.GetImcStudioInstallPath();`

Optional parameters

Parameter	Description
initialize	Initializes the imc STUDIO core during the constructor. If `false` is specified here, this will have to be rectified manually using the `Init()`-method.
applicationLoaded	Triggers the "imc STUDIO loaded" event.
correctVersionInISPC	Overwrites the imc STUDIO configuration file (default.ispc), so that all plug-ins specified have the same STUDIO core.

Note Initialize

If you want to initialize the component later, the applicationLoaded parameter must also be set to false in the constructor.

```
ImcStudioComponent = new SimplifiedImcStudioComponent(appDir, this, strImcStudioInstallPath,
false, false);
ImcStudioComponent.Init();
ImcStudioComponent.ApplicationLoaded(this);
```

17.3.5.2 Overview

Here, the main functions are described.

All objects themselves come with notes on their respective functionality and call parameters.

Basis class: ImcStudioComponent	
Actions	Triggers the actions registered by the plugins; see *imc.Studio.ApplicationInterface.Constants.ActionNames*
Commands	for running commands
Datapool	access to measured data, or all data from a variety of sources. Generating one's own variables.
Documents	Access to applications-, project- and experiment settings and supply of supply of events for loading and saving
Environment	Gets global imc STUDIO variables (e.g. installation path)
Events	Registration of EventHandlers, e.g. for the event "device started", "device stopped"; see *imc.Studio.ApplicationInterface.Constants.EventNames*
InlineFamos	Configuration of an InlineFamos task (requires appropriate license).
Logbook	Access to logbook entries
Notifications	Internal communication between imc STUDIO components
Panel	Access to Panel-pages
Scripts	Access to imc STUDIO scripts
StorageManager	Controls storage of measured data on the hard drive.

Class: SimplifiedImcStudioComponent : ImcStudioComponent	
DevSetup	*DevSetupExtended* Functionality for, among other things, configuration of devices and channels (enhancement of the Basis-class's DevSetup-functionality)
Devices	*DevicesActions* Devices actions such as device search, connect, disconnect
Experiment	*ExperimentActions* Actions affecting the experiment such as Load, Save
Measurement	*MeasurementActions* Actions associated with the measurement such as Start, Stop
Windows	*WindowsExtended* Calling of dialogs and views present in imc STUDIO

Reference

For additional information, see the documentation on Scripting 1730.

17.3.5.3 Actions

The following actions are available in the Basis-project:

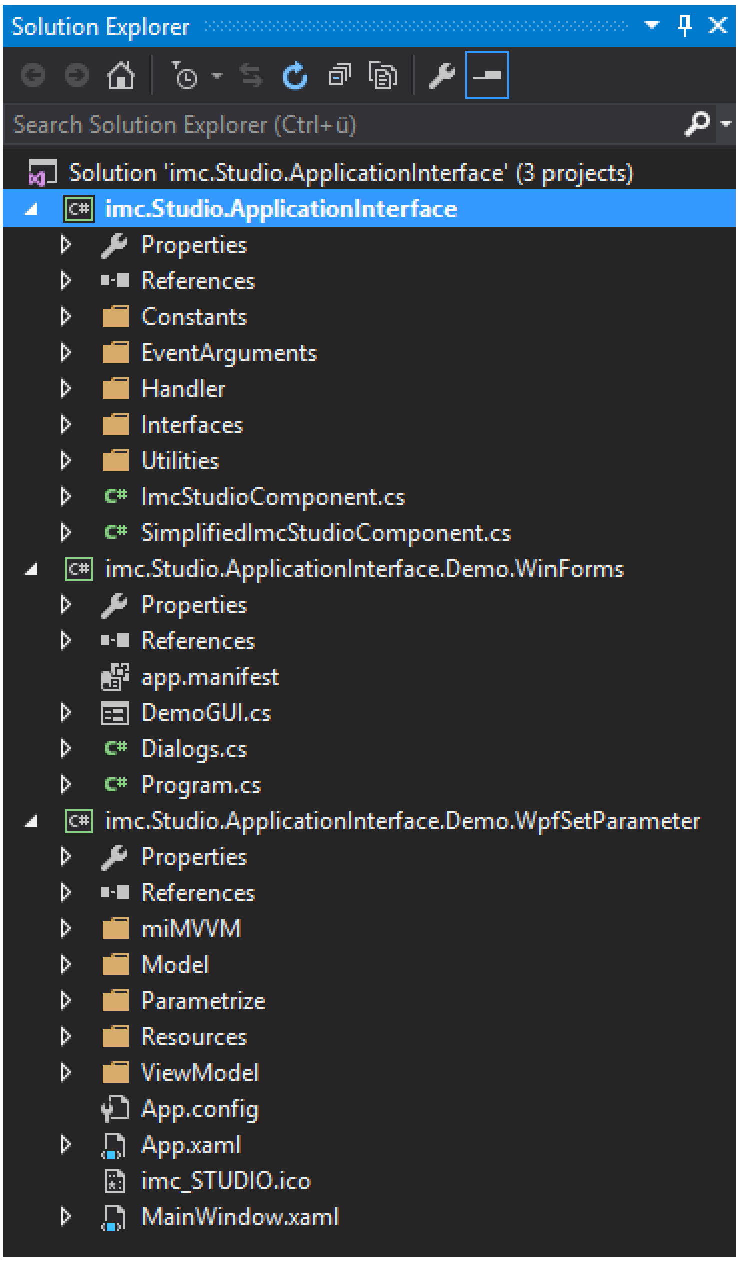
Actions in imc.Studio.ApplicationInterface.Constants	
ActionNames	various menu actions
DeviceActions	Connect, Disconnect ProcessConfiguration, Download, Reconfigure ReleaseAllTriggers ResumeDataStorage, SuspendDataStorage Start, Stop

17.3.6 Sample projects

The example projects are installed in the following folder:

C:\Users\Public\Documents\imc\imc STUDIO\API\Projects

Projects	**Description**
WinForms 1907	Simple GUI (Windows Forms) for using a device and configuring channels as well as displaying the channels in the curve window. Solution: imc.Studio.ApplicationInterface
WpfSetParameter 1909	Simple GUI (WPF) for using a device. Solution: imc.Studio.ApplicationInterface
WpfCalculate 1909	Simple GUI (WPF) for using a device and calculation of channels Solution: imc.Studio.ApplicationInterface.Demo.WpfCalculate



Solution Explorer (Visual Studio 2015)

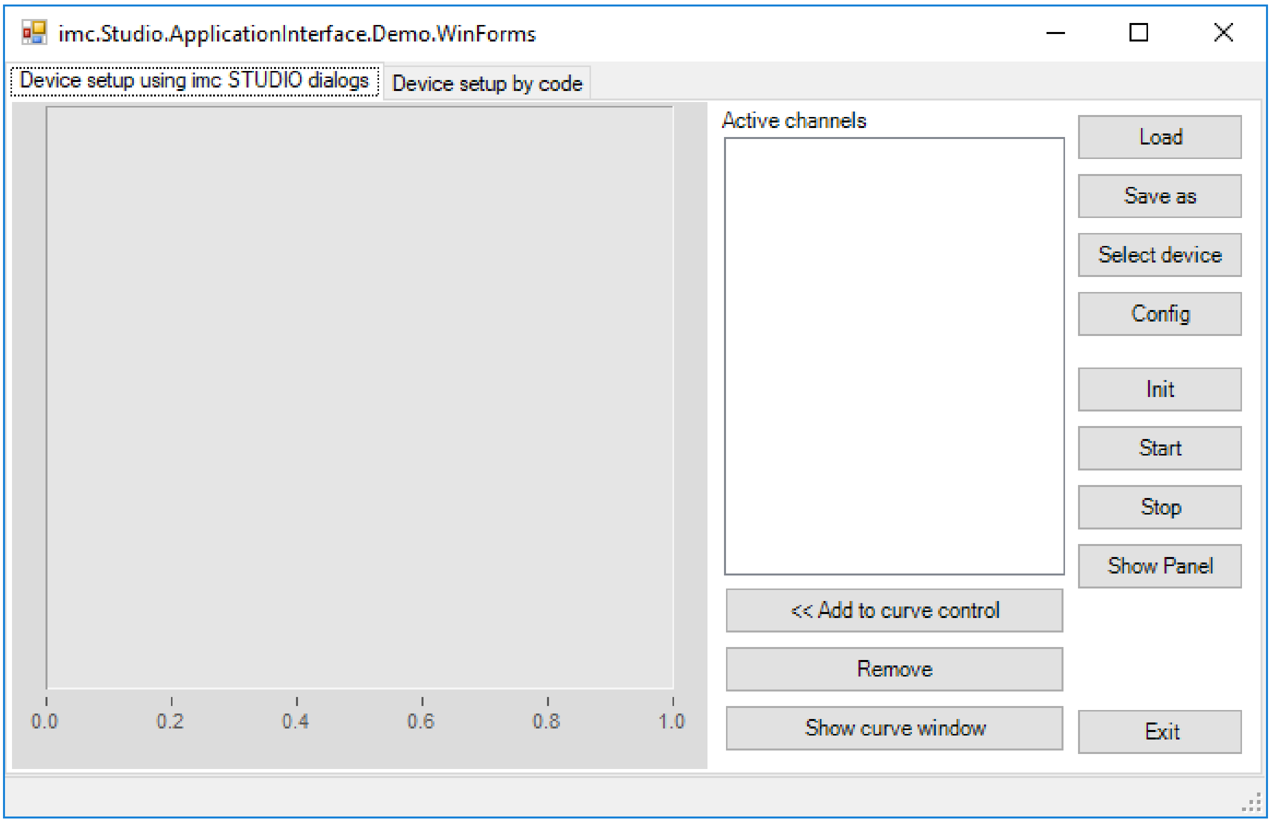
17.3.6.1 WinForms

Warning License required

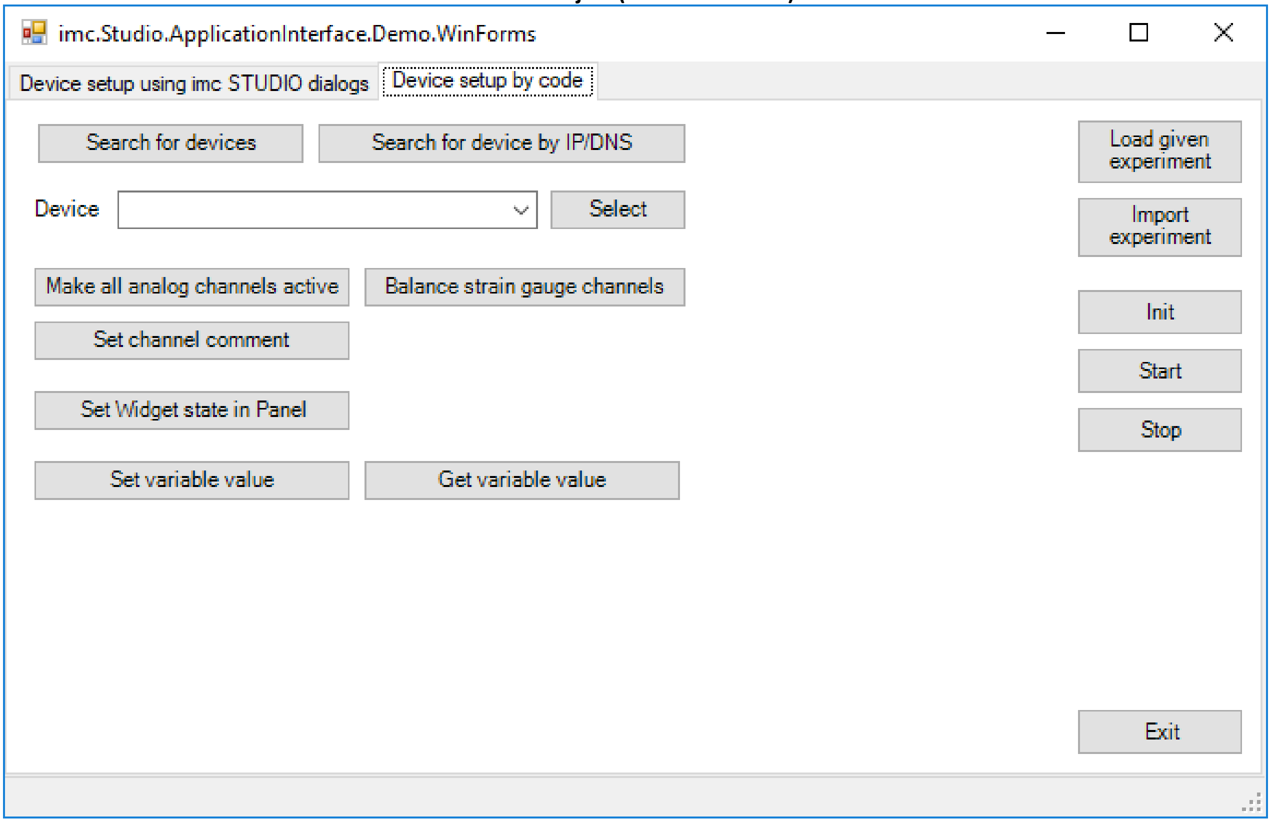
- To use the project in its entirety, a **imc API Developer** or **imc API Runtime** license is required.

imc.Studio.ApplicationInterface.Demo.WinForms

- Implementation in C# and WinForms
- Example of small-scope application for controlling a measurement.
- Calling of various dialogs for device searching and selection of devices, as well as the Setup-dialog for setting parameters.
- Start/Stop of measurement and visual output of data.



Demo Project (Windows-Forms)



Demo Project (Windows-Forms)

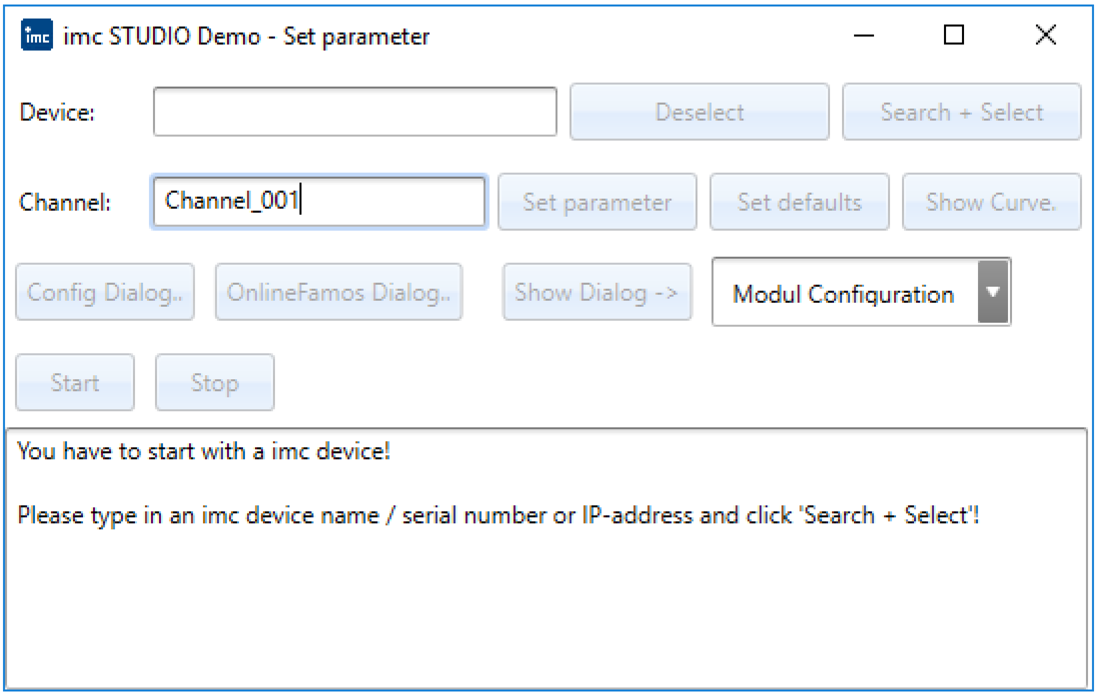
17.3.6.2 WpfSetParameter

Warning License required

- To use the project in its entirety, a **imc API Developer** or **imc API Runtime** license is required.

imc.Studio.ApplicationInterface.Demo.WpfSetParameter

- Implementation in C# und WPF
- Example of parameterization on command, without manual parameter entry.



Demo Project (WPF)

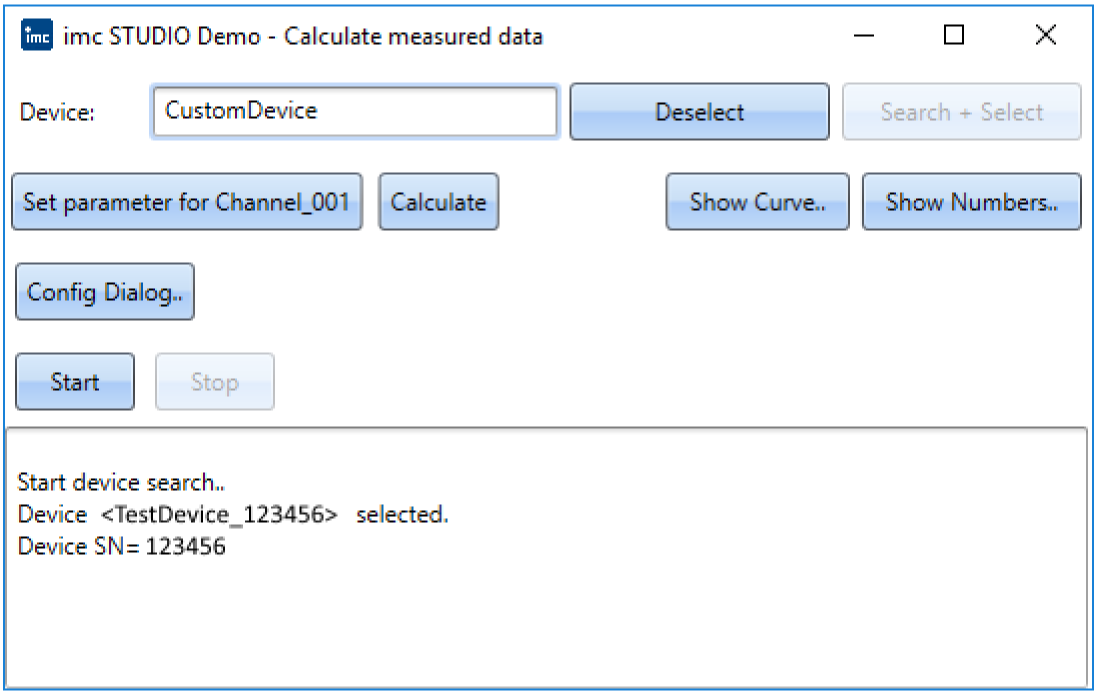
17.3.6.3 WpfCalculate

Warning License required

- To use the project in its entirety, a **imc API Developer** or **imc API Runtime** license is required.

imc.Studio.ApplicationInterface.Demo.WpfCalculate

- Implementation in C# und WPF
- Calculation of minimum, maximum and mean value.



Demo-Project (WpfCalculate)

17.3.7 User-created application

When creating one's own personal project (Windows.Forms or WPF, 32-bit), the following **references** must be incorporated.

The references are in the Global Assembly Cache (**GAC**), also see *C:\Windows\Microsoft.NET\assembly\GAC_MSIL.*

You need to compile the **Shared-Project** in *C:\Users\Public\Documents\imc\imc STUDIO\API\Shared* for getting the imc.Studio.ApplicationInterface.dll.

References	Content
imc.Studio.ApplicationInterface	Entry point for imc STUDIO (*in the Shared-Project*)
imc.Common.Interfaces	General imc components (Logbook,..)
imc.Studio.Interfaces	General imc STUDIO components
imc.Studio.Interfaces.V2	General imc STUDIO components
imc.Common.Components.DataObjects	Working with data
imc.Common.Controls.ImcCurves	Display of data

References	Content
PresentationFramework	Required by the SimplifiedImcStudioComponent-class
System.Windows.Forms	For use with WinForms

Namespaces	Content
imc.Studio.Tools.DevSetupGraphGenerator	EClassID (for parameterizing devices)
imc.Common.Components.DataManager imc.Common.Components.DataManager. Interfaces	Data objects such as DmChannel, DmFile, IDmChannel, IDmText.
imc.Studio.ApplicationInterface.Constants	Various actions and constants for parameterizing, e.g. ParameterValues

An example of Windows-Forms or alternatively WPF-project is presented here 1911.

17.3.7.1 Example

Initialization example of the imc STUDIO components

In the example code (C#), only the main functions are displayed without any inspection or error handling.

There are differences when calling imc STUDIO windows depending on whether the calling program is a WinForms- or a WPF-application.

The main difference is the basis class of the view (System.Windows.Forms or System.Windows.Window).

WPF application

```
using imc.Studio.ApplicationInterface;

public partial class WPFMainWindow : Window
{
   private SimplifiedImcStudioComponent _component;

   public WPFMainWindow ()
   {
      // Application path for this imc STUDIO application
      // imc Studio user interface has its own completely separate path for this!
      string appPath = @"C:\ProgramData\imc\imc STUDIO\Applications\AppDir";

      // Complete path for imc STUDIO installation which is to be used,
      // or zero if imc STUDIO and the main application are located in same folder
      // Example:
      string imcStudioInstallPath = @"C:\Program Files (x86)\imc\imc STUDIO 5.2";

      // Generating the imc STUDIO components instance
      _component = new SimplifiedImcStudioComponent(appPath, this, imcStudioInstallPath);
   }
```

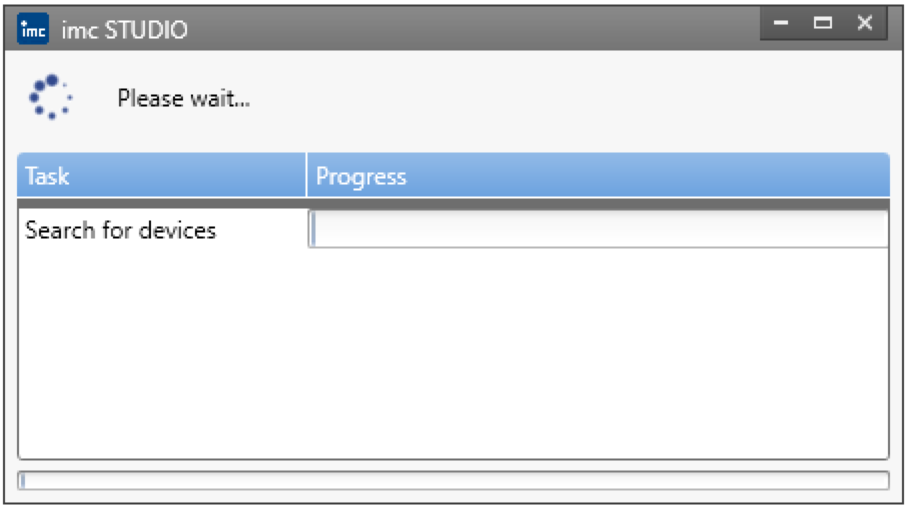
```
   protected override void OnClosing(CancelEventArgs e)
   {
      // Prompt whether to save before closing the application
      _component.ClosingImcComponent(this, e);
      if (!e.Cancel)
      {
         base.OnClosing(e);
      }
   }
```

```
  protected override void OnClosed(EventArgs e)
   {
      // Cleanup upon closing application
      base.OnClosed(e);
      _component.Dispose();
      _component = null;
   }
}
```

WinForm-application

```
using imc.Studio.ApplicationInterface;

public partial class WinFormsMainWindow : Form
{
   private SimplifiedImcStudioComponent _component;

   internal WinFormsMainWindow()
   {
      InitializeComponent();

      // Application path for this imc STUDIO application
      // imc Studio user interface has its own completely separate path for this!
      string appPath = @"C:\ProgramData\imc\imc STUDIO\Applications\AppDir";

      // Complete path for imc STUDIO installation which is to be used,
      // or zero if imc STUDIO and the main application are located in same folder
      // Example:
      string imcStudioInstallPath = @"C:\Program Files (x86)\imc\imc STUDIO 5.2";

      // Generating the imc STUDIO components instance
      _component = new SimplifiedImcStudioComponent(appPath, this, imcStudioInstallPath);
   }
   protected override void OnClosing(CancelEventArgs e)
   {
      // Prompt whether to save before closing the application
      _component.ClosingImcComponent(this, e);
      if (!e.Cancel)
      {
         base.OnClosing(e);
      }
   }
  protected override void OnClosed(EventArgs e)
   {
      // Cleanup upon closing the application
      base.OnClosed(e);
      _component.Dispose();
      _component = null;
   }
}
```

17.3.7.2 ProgressVisualizer



Progress-Dialog (ProgressVisualizer)

When you execute actions that exceed a certain duration, a progress dialog called ProgressVisualizer opens.

In your own applications, it is therefore useful to hide this and transfer the information to your own status element.

```
using imc.Common.Interfaces.Logbook;
using imc.Studio.ApplicationInterface;
using imc.Studio.Interfaces.V2.Core.Services.ProgressVisualizer;
```

```
private SimplifiedImcStudioComponent _component;
```

```
private void HideProgressVisualizer()
{
   var services = _component.Core.Services.GetAPI<API_CoreServices_V2>();
   var progressVisualizer =
services.ProgressVisualizer.GetAPI<API_CoreServicesProgressVisualizer_V3>();
   progressVisualizer.GUIEnableHideTemporary();

   progressVisualizer.TaskProgress += OnProgressVisualizerTaskProgress;
}
```

```
private void OnProgressVisualizerTaskProgress(object sender, ICoreServicesTaskEventArgsBase e)
{
   var taskEventArgs = e.GetAPI<API_CoreServicesTaskEventArgs_V1>();

   ProgressTask(taskEventArgs);
}
```

```
private void ProgressTask(API_CoreServicesTaskEventArgs_V1 taskEventArgs)
{
   _component.Logbook.LogEntry(ErrorSender, taskEventArgs.Text, 0,
ELogbookEntryCategory.Information);
}
```

17.3.7.3 Experiments

Activated project management

Load experiment

When loading experiments, the path relative to the database must be specified. This includes the project name.

```
var experimentPathInDatabase = @"StandardProject\Experiment_0001";
var result = studioComponents.Experiment.Load(experimentPathInDatabase);
```

Import experiment

When importing an experiment, the full path of the experiment file as well as the project name must be specified.

```
var projectName = StandardProject;
var experimentFileName = @"c:\temp\Test.imcStudio";
var result = _components.Experiment.Import(projectName, experimentFileName);
```

Save experiment

```
_components.Experiment.Save()
```

Save experiment as

Variant 1:

```
var experimentFileName = @"c:
\Users\Public\Documents\DB\StandardProject\Experiment_0001\Experiment_0001.imcStudio;
_component.Experiment.Save(experimentFileName);
```

Variant 2:

To use the ProjectManagement class, the following references must be added to the C# project.

This can also be done in Visual Studio via the tool-tip and "Show potential fixes".

- imc.Common.Interfaces (für IExperiment_V1)
- imc.Studio.Interfaces (für IProjectManagementBase)
- imc.Studio.Interfaces.V2 (für API_ProjectManagement_V7)

```
var currentExperiment = _component.ProjectManagement.CurrentExperiment;
currentExperiment.Name = "NewExperimentName";
component.ProjectManagement.ExperimentSaveAs(null, currentExperiment, false);
```

Save as dialog

```
_component.Experiment.SaveAs()
```

Without project management

Load experiment

```
var experimentFileName = @"c:\temp\Test.imcExp";
var result = _component.Experiment.Load(experimentFileName);
```

Save experiment

```
_components.Experiment.Save()
```

Save experiment as

```
var experimentFileName = @"c:\temp\Test.imcExp;
_component.Experiment.Save(experimentFileName);
```

17.3.7.4 Curve window

Note	License activation

For using the curve window control in your development environment you need to activate a **imc API Developer** license.

If you wish to use the curve window on one of your user interfaces (Windows.Forms, WPF, ...), perform the following necessary steps.

Adding the curve window to the toolbox

The instructions below demonstrate how to add the curve window to the toolbox on the basis of Visual Studio as an example:

1. Open the toolbox tool window (while your GUI designer is open)
2. From the context menu (opened by right-clicking), select "Choose Items..."
3. Select the tab ".NET Framework Components"
4. Click on the Browse button
5. Select the DLL from one of the following two paths:
   C:\ProgramData\imc\imc DATA API**7.3\Rx**\Assemblies\Release\x86\imc.Common.Controls.ImcCurves
   C:\ProgramData\imc\imc DATA API**7.3\Rx**\Assemblies\Release\x64\imc.Common.Controls.ImcCurves
   Rx is to be replaced with the revision number, e.g. "R1".
6. Two new entries will appear in the list: CimcCurveControl and CimcCurveGlobalSettings.
7. Leave the check mark for both of these and close the dialog with OK.
8. Subsequently, the curve window object will be available in the toolbox.

Usage in Windows.Forms projects

In Windows.Forms-projects, it is possible to use Drag&Drop to move the curve window-object in the Designer directly into the GUI.

Usage in WPF projects

1. In WPF-projects, the following references must be added to the project:
   - System.Windows.Forms
   - WindowsFormsIntegration
   - imc.Common.Controls.ImcCurves
2. In the Designer, the following namespace is used in the xaml-code:

```
xmlns:imc="clr-namespace:imc.Common.Controls.ImcCurves;assembly=imc.Common.Controls.ImcCurves"
```

3. Within the grid object, the WindowsFormsHost object containing the curve window is added:

```
<WindowsFormsHost>
   <imc:CimcCurveControl x:Name="mainCurveWindow" />
</WindowsFormsHost>
```

4. The curve window-object is not displayed visually, but it can be addressed in the code by its associated name.

Show data in a curve window

To display channels in a curve window (`mainCurveWindow`), the data object of the channel is needed.

The following shows how all Analog Channels are displayed in the curve window:

```
using imc.Studio.ApplicationInterface;
using imc.Common.Components.DataManager.Interfaces;
using imc.Common.Controls.ImcCurves;
using imc.Common.Controls.ImcCurves.Interfaces;
```

```
private SimplifiedImcStudioComponent _component;
```

```
private void AddChannelToCurveWindow(DataPoolVariable channelVariable)
{
   if (channelVariable != null)
   {
       var channel = channelVariable.GetContent<IDmChannel>();

       mainCurveWindow.AppendChannel(channel,
           imc.Common.Controls.ImcCurves.CwAppendConstants.AppendNewCosy, 0);
   }
}
```

```
private void UpdateCurveWindow()
{
   mainCurveWindow.Clear();

   _component.Datapool
       .Where(variable => variable.VariableProperties.Category == "Analog")
       .ToList()
       .ForEach(AddChannelToCurveWindow);
}
```

17.3.7.5 Using imc FAMOS functions

To use imc FAMOS functions the imc DATA API must be installed and licensed.

The imc FAMOS functions require a channel (IDmChannel) as parameter. You get this object from the Datapool.

As result type the imc FAMOS function also returns a channel (DmChannel).

To display this object in a curve window, it must be written to the Datapool.

When the object is written to the Datapool, a real copy is created so that the result object (DmChannel) can be disposed.

```
using imc.Studio.ApplicationInterface;
using Famos = imc.Common.Components.Famos;
using imc.Common.Components.DataManager.Interfaces;
```

```
private SimplifiedImcStudioComponent _component;
```

```
private void AddChannels()
{
   IDmChannel channel1 = _component.Datapool[Config.ChannelNamePrefix + "003"]?
.GetContent<IDmChannel>();
   IDmChannel channel2 = _component.Datapool[Config.ChannelNamePrefix + "004"]?
.GetContent<IDmChannel>();

   var sumChannel = Famos.Basic.Add(channel1, 0, channel2, 0);
   sumChannel.Name = Config.SumChannelName;

   var sumChannelVariable = CreateOrSetVariable(sumChannel.Name, sumChannel);
   AddChannelToCurveWindow(sumChannelVariable);
   sumChannel.Dispose();
}
```

```
private void SmoothChannel()
{
   var channel = _component.Datapool[Config.ChannelNamePrefix + "001"].GetContent<IDmChannel>();
   double smoothWidth = 10 * channel.xDelta;
   var smoothedChannel = Filter.Smooth(channel, smoothWidth);
   smoothedChannel.Name = Config.SmoothedChannelName;
   var smoothedChannelVariable = CreateOrSetVariable(smoothedChannel.Name, smoothedChannel);
   AddChannelToCurveWindow(smoothedChannelVariable);
   smoothedChannel?.Dispose();
}
```

```
private DataPoolVariable CreateOrSetVariable<T>(string name, T content)
{
   var variable = _component.Datapool[name];
   if (variable == null)
   {
       _component.Datapool.CreateVariable(name, content);
       variable = _component.Datapool[name];
   }

   variable.SetContent(content);
   return variable;
}
```

17.3.7.6 Commands

Import an OFA file

To import an Online FAMOS (OFA) file, the command "Import supplemental file" is used.

```
using imc.Studio.ApplicationInterface;
```

```
private SimplifiedImcStudioComponent _component;
```

```
/// <summary>
/// Imports an *.ofa file to a given device.
/// </summary>
/// <param name="fileName">OFA filename.</param>
/// <param name="deviceName">Device identifier (eDeviceName); e.g. imcDev__18123456.</param>
private void ImportOfaFile(string fileName, string deviceName)
{
   _component.Commands.Invoke("Die Zusatzdatei 'C:\\\\Training\\\\API_2018-11\\\\Misc\\\
\TestCalc.ofa' wird importiert",
          "<AppPlotFactoryCmd version=\"1\">" +
          "<common version=\"1\" cuid=\"ImportImcDevicesSatelliteFile\" caption=\"Zusatzdatei
importieren\">" +
          "<command version=\"1\"><properties version=\"1\">" +
          "<cmd owner=\"imc.Studio.PlugIns.AppPlot.Engine.AppPlotImportSatelliteFile\"
version=\"2\" cuid=\"ImportImcDevicesSatelliteFile\">" +
          "<filename>" + fileName + "</filename>" +
          "<overwrite>eOverwriteWithoutPrompt</overwrite><targetname />" +
          "<map><devsatimportmap>  " +
          "<devicename>" + deviceName + "</devicename>  <used>True</used></devsatimportmap>" +
          "</map></cmd></properties></command></common></AppPlotFactoryCmd>");
}
```

17.3.7.7 Windows (WinForms)

General

The desired window/control *windowControl* is added to the WinForm *form*:

```
using (var form = new Form())
{
    form.Width = windowUi.Width;
    form.Height = windowUi.Height;
    form.Text = "WindowName";
    form.Controls.Add(windowControl); // whereas windowControl is the desired control
    form.Dock = DockStyle.Fill;
    form.ShowDialog();
}
```

Logbook

```
private void ShowLogbook()
{
   var logbookUi = _component.Windows.GetWindowControl("Logbook").AsWinFormsControl();
   logbookUi.Width = 1200;
   logbookUi.Height = 500;
   logbookUi.Dock = DockStyle.Fill;

   using (var logbookForm = new Form())
   {
       logbookForm.Width = logbookUi.Width;
       logbookForm.Height = logbookUi.Height;
       logbookForm.Text = "Logbook";
       logbookForm.Controls.Add(logbookUi);
       logbookForm.Dock = DockStyle.Fill;
       logbookForm.ShowDialog();
   }
}
```

Setup pages: Devices

```
private void ShowDevicesPage()
{
   var devicesPageName = "Devices";
   var setupControl = _component.Windows.CreateSetupControl(devicesPageName);

   using (var devicesForm = new Form())
   {
       devicesForm.Width = 1000;
       devicesForm.Height = 800;
       devicesForm.Text = devicesPageName;
       devicesForm.Controls.Add(setupControl);
       setupControl.Dock = DockStyle.Fill;
       devicesForm.ShowDialog();
   }
}
```

Panel

```
private void ShowPanel()
{
   var panelControl = _component.Windows.Panel.AsWinFormsControl();

   if (panelControl == null)
   {
       MessageBox.Show(@"Panel was not found. Make sure that the Panel plug-in is properly
loaded!");
       return;
   }

   using (var panelForm = new Form())
   {
       devicesForm.Width = 1000;
       devicesForm.Height = 800;
       devicesForm.Text = @"Panel";
       devicesForm.Controls.Add(panelControl);
       setupControl.Dock = DockStyle.Fill;
}
```

17.3.7.8 Windows (WPF)

Logbook

```
private void AddLogbookToWindow()
{
   var logbookElement = CreateStudioLogbook(_studioComponent);
   Logbooks.Children.Add(logbookElement); // Logbooks is a StackPanel element
}
```

```
private static FrameworkElement CreateStudioLogbook(SimplifiedImcStudioComponent studioComponent)
{
   var logbookAsWpf = _cComponent.Windows.GetWindowControl("Logbook").AsWPFControl();

   var logbookElement = (logbookAsWpf as FrameworkElement);
   logbookElement.LayoutTransform = new ScaleTransform(0.8, 0.8);
   logbookElement.MaxWidth = 1024;
   logbookElement.MaxHeight = 800;
   return logbookElement;
}
```

Setup Seiten: Devices

```
private void ShowSetupPage()
{
   var devicesPageName = "Devices";
   var deviceUi = _component.Windows.CreateSetupControl(devicesPageName).AsWPFControl();
   deviceUi.Width = 1400;
   deviceUi.Height = 700;

   var window = new Window()
   {
       Width = deviceUi.Width,
       Height = deviceUi.Height,
       HorizontalContentAlignment = System.Windows.HorizontalAlignment.Stretch,
       VerticalContentAlignment = VerticalAlignment.Stretch,
       Content = deviceUi
   };

   window.ShowDialog();
}
```

Panel

```
private void ShowPanelAsWpf()
{
   var panelControl = _component.Windows.Panel.AsWPFControl();

   if (panelControl == null)
   {
       MessageBox.Show(@"Panel was not found. Make sure that the Panel plug-in is properly
loaded!");
       return;
   }

   Window w = new Window
   {
       Width = 1000,
       Height = 800,
       Content = panelControl
   };

   w.ShowDialog();
}
```

17.3.8 Distribution

In order to transfer the project you have developed, the following prerequisites must be met by the target computer:

- imc STUDIO is installed
- depending on the functional scope, activation of the appropriate licenses
- Activation of imc API Runtime license
- Deployment of the desired project
- Application folder (including default.ispc)

17.3.9 Notes

Tips

It is recommended to use imc STUDIO to make the project settings (such as views, Setup-pages, ...) by using the API-database path.

Known problems with 32-bit

When using a **32-bit** Windows operating system, problems can occur when the application's name is too long. The exact critical length can not be determined but is approx. 50 characters. The application could either not be started, or it ended spontaneously.

Curve window

For using the imc curve window, an activated license for **imc API Developer** is required.

18 imc Format Converter

The imc Format Converter provides the ability to convert measured data to a different format, e.g. to EXCEL data format. The imc Format Converter is integrated in **imc STUDIO** within the functionality of **Sequencer**'s ***Data Saving Assistent*** 1561 and ***Format Converter*** 1569.

Furthermore, the conversion capabilities of the Format Converter can be used independently of any other imc program installations, either within a **stand-alone program** by means of the **Windows-Explorer's context menu**.

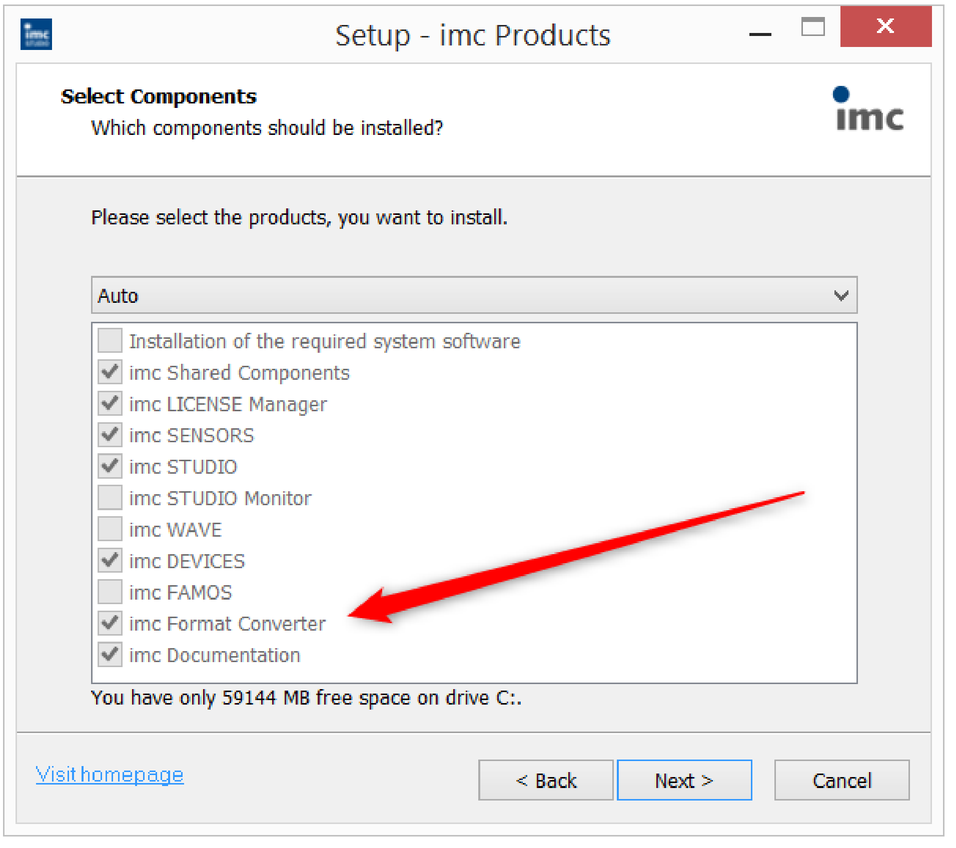
Export formats

The same export formats are supported which are also offered by imc FAMOS. These include:

- user-defined ASCII export-formats
- user-defined EXCEL export-formats
- MDF2.0, MDF3.0, MDF4, ASAM ATFX, ASAM ATFX NVH, Catman 5.0
- Google Earth Export, HEAD acoustics (also 4.5 compatible)
- Matlab 4 and 5, nSoft-DAC, RPC-3, Somat SIF (nCode output)
- TEAC TAFFmat and TEDAM, DIAdem TDM and TDMS
- Binary Universal File Format
- Universal File Format (UFF)

18.1 Installation

The installation file is located on the product DVD and is included in the installation by default.



Separate installation

Select the installationvariant: "*User-defined*" and select there only the imc Format Converter.

Notes	Interaction with other 32/64-bit programs

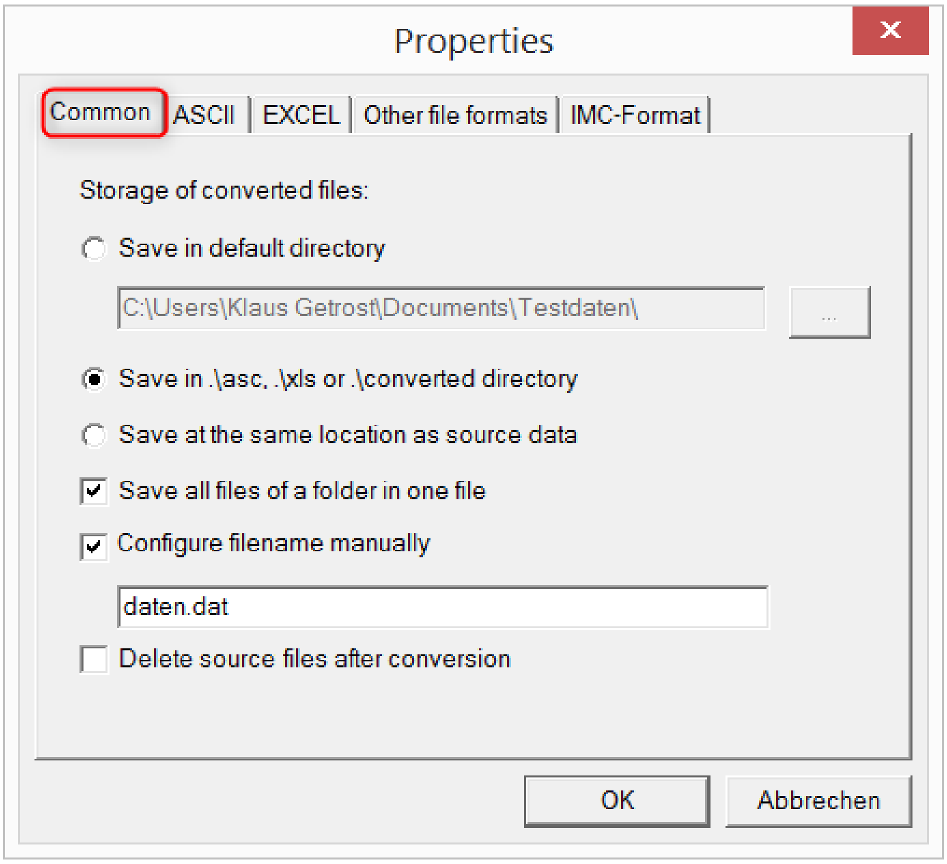
The imc Format Converter is currently only installed as a 32-bit program. Some components which the imc Format Converter uses are also installed by imc FAMOS. In conjunction with ongoing development of imc FAMOS, new export formats will be included with the installation of future updates. In order for these export templates to also be available to imc Format Converter, an installation of imc FAMOS in its 32-bit variant must be provided. However, this doesn't mean it is necessary to dispense with the 64-bit capabilities of imc FAMOS, both the 32-bit and 64-bit versions can be installed on the computer.

18.2 Settings

In the settings you specify whether the data are saved either individually or together, which templates are used for ASCII and EXCEL, or what other formats are used.

The settings remain intact, so that under normal circumstances you can immediately select data and convert them.

Data saving



Storage location for converted files:

Save in default directory: Free choice of a **target folder**. Even network drives are possible.

Save in .\asc, .\xls oder .\converted directory: The data are saved in their source folder but additionally in a **subfolder**. For ASCII in the *asc* folder, *xls* for EXCEL and *converted* for any other export formats.

Save at same location as source data: The data re saved on the same **level of the tree diagram as the source data, without subfolders**.

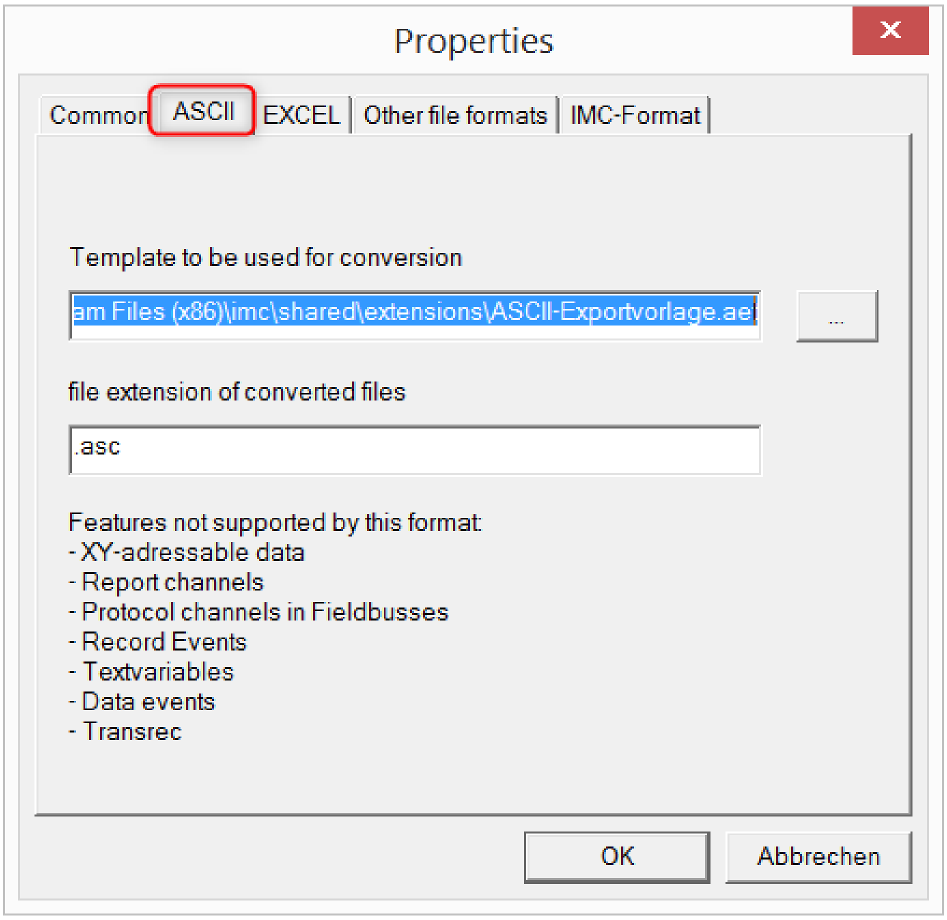
Manner of data saving:

Save all files of a folder in one file: All of a channel's files are saved **together in one file**.

Configure file name manually: **Name of the target file** in which all channel files are saved together.

Delete source files after conversion: Once the data have been converted, the **source files can be deleted automatically**, in order to make memory space free. This setting can make sense when all data are saved together in the imc format.

ASCII



Format template to be used for conversion:

By default, ASCII export templates are located in the folder *"C:\Program Files (x86)\imc\Shared\Extensions"* and use the file extension ***.aet**. Owners of imc FAMOS are also able to personally create or modify these templates. In this case, the aet-files are saved in the folder *"C:\ProgramData\imc\Common\Def"*.

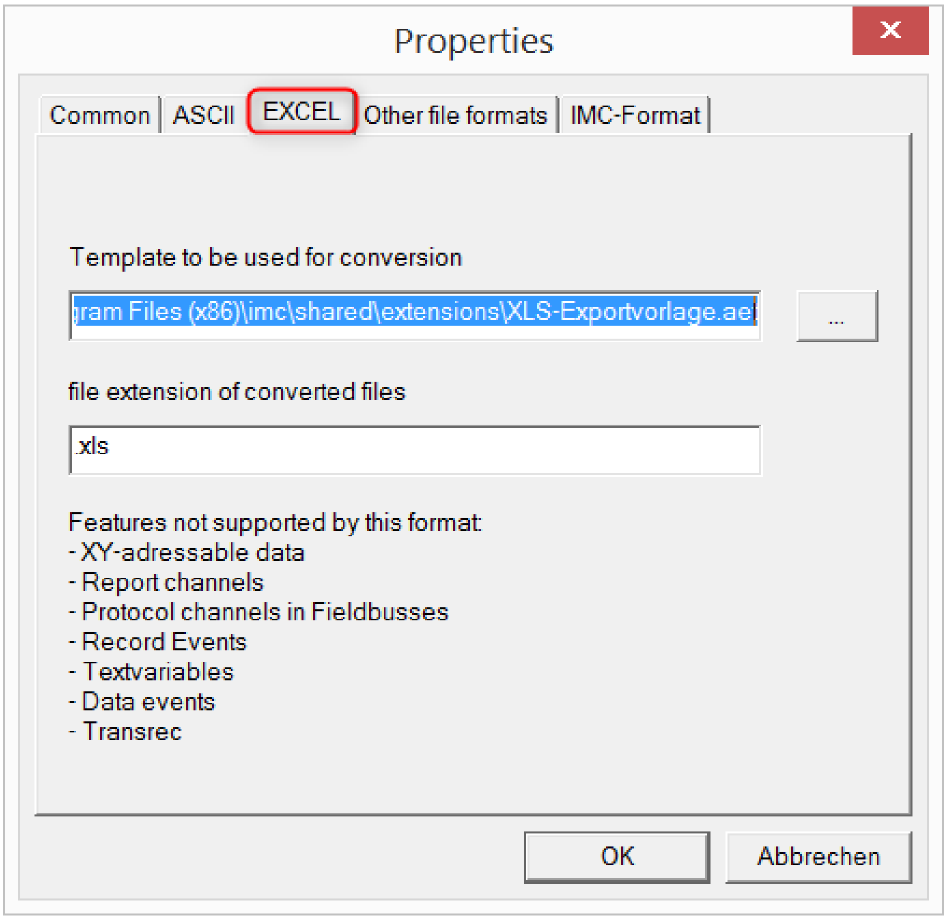
By default, the file extension is *"asc"*, but any arbitrary one can be specified here.

Special variable types which can **not** be exported as ASCII data are listed on this tab page.

Notes | File extensions

In imc FAMOS the file extension is specified with the ASCII template. Within imc FAMOS this file extension is added to the ASCII file. With imc Format Converter the file extension specified here is used instead.

EXCEL



Format template to be used for conversion:

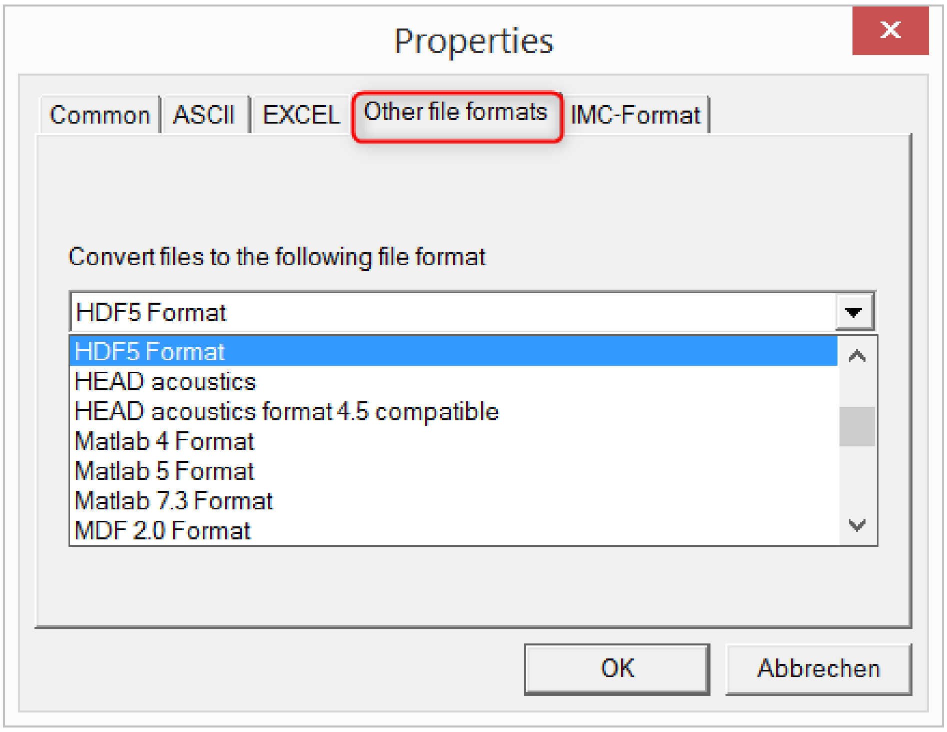
For EXCEL files, a similar technique is used as for ASCII 1924. By default, the file extension is *"XLS"*, but can be arbitrarily specified here.

Variable types which are **not** exported correspond to those for ASCII-export 1924.

Notes	File extensions

If the XLS**x** format was selected as the export template, it must be here as the file extension. The imc Format Converter does not import the specified file extension from the AET file.

Other file formats



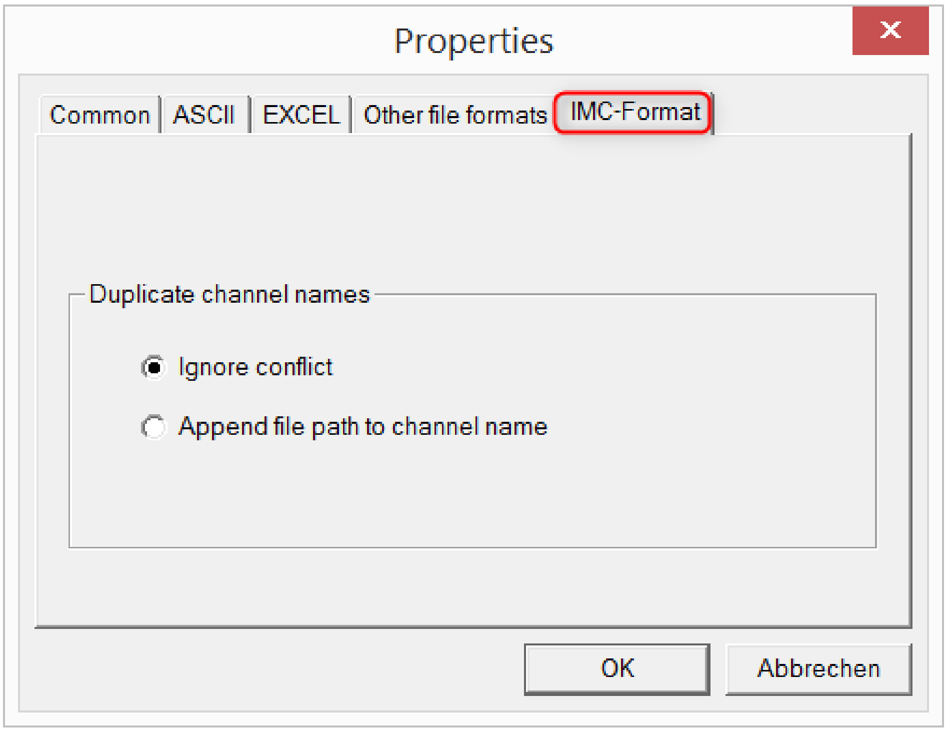
Convert files to the following file format:

Selection of the format in which the data are to be saved. Installation of the imc Format Converter makes certain export formats available. Otherwise, what selections are available depends on what version of imc FAMOS is installed in the 32-bit variant 1922.

Options

If the format selected comes with additional export options, these can be set by means of the dialog opened by clicking on the button "*Options*". Descriptions of the options appear in the document ***ImportExportFilter.pdf***, of which a copy is imported along with the imc FAMOS installation. Alternatively, the document is available from the imc homepage.

imc-Format



Handling duplicate channel names

Ignore conflict: If files are overwritten due to duplicate channel names, the conflict is not reported.

Append file path to channel name: A unique channel name is generated from the file path.

Notes Whay save in the imc-format?

The imc Format Converter is designed for imc data, so why is there an imc-Format option? imc devices allow complex data structures in which channels can be recorded at different moments in time (using triggers). For this reason, the channels are saved as individual files. Using the imc Format Converter, you are able to join the data sets accumulated into one single file after the measurement. One appropriate group of settings on the page "*Common* 1923" to accomplish this would be:

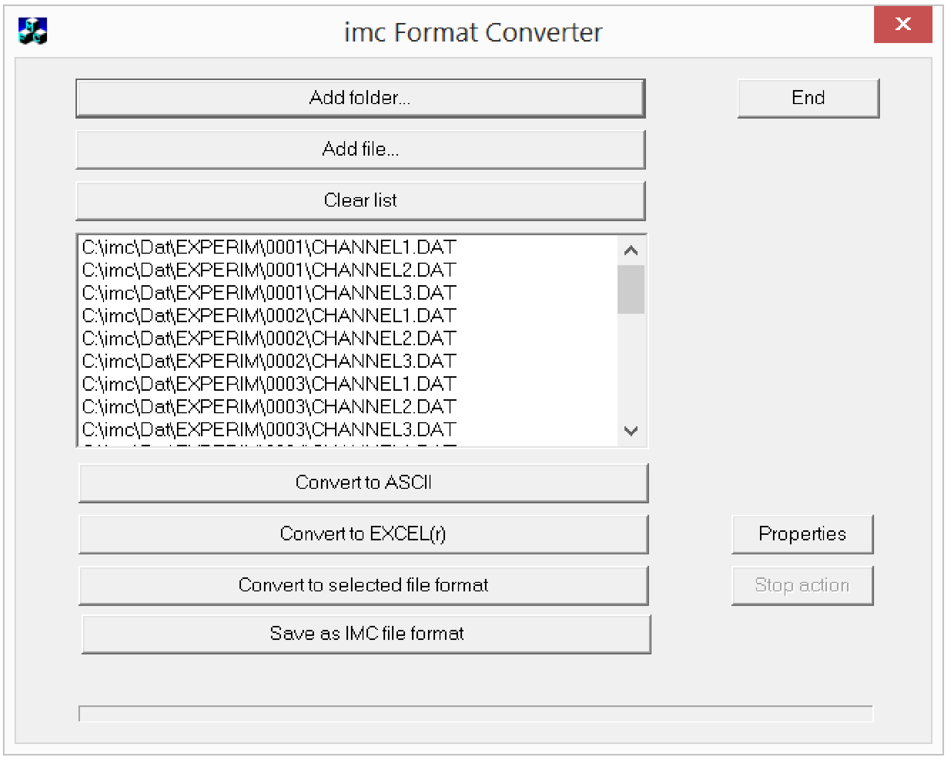
Save at same location as source data = active

Save all files of a folder in one file = active

Delete source files after conversion = active

18.3 Format Converter as standalone-program

There is no shortcut for starting the standalone version. Start "*imcFrmtCvrt.exe*" directly from the installation folder, normally "*C:\Program Files (x86)\imc\imc Format Converter*\"



Add folder...

Select the folder of measured data desired. Subfolders will also be imported and appear in the Files list.

Add file...

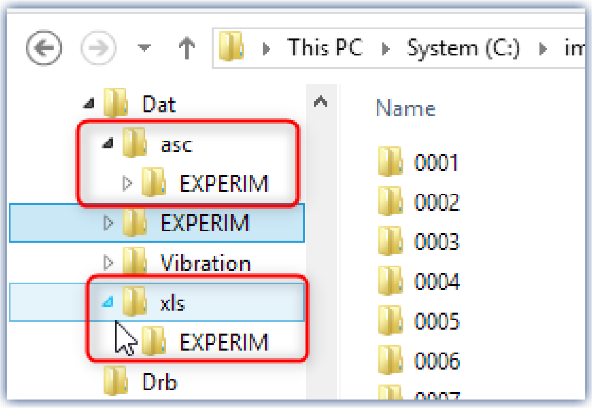
Selection of individual files.

Clear list

All entries are deleted from the Files list.

Convert to ASCII/EXCEL(r)

The standard variant for converting data to ASCII 1924- or EXCEL 1925-files. Toward this end, a "asc" or "xls" folder is created on the same level as the folder of measured data, in which the data are saved in the same folder structure. Depending on the settings, either individual files or tables are generated, in which all data are saved in a file.



Convert to selected file format

The data are saved in the format which was selected under "*Settings* 1926". The target folder is a subfolder of the same folder, with the name "*converted*". This option allows all signals to be saved jointly in a single file. Furthermore, a filename with file extension must be entered in the settings 1923.

Save as IMC file format

For saving all files in a folder to a single file in imc format. Observe the necessary settings on the Common tab page 1927.

18.4 Command line parameters

The imc Format Converter can be run via command lines. In the simplest case, the settings last applicable in the imc Format Converter are used, e.g. including the target file. If multiple files are to be converted, these are defined in an XML-file 1930.

Command line options

	Description	Example
-a	conversion to "*ASCII*"	imcFrmtCvrt.exe -a <files or paths>
-e	conversion to "*EXCEL*"	imcFrmtCvrt.exe -e <files or paths>
-k	conversion to "*Other data formats*"; The format selected in the settings is used, e.g. MDF	imcFrmtCvrt.exe -k <files or paths>
-i	import and use configuration from a setup xml-file (imc Devices mode) enables complete remote control. Under some circumstance, a variety of settings can be required for the export. Beyond the default settings, it is possible to provide a Setup.xml by means of -s. A description of the XML is then no longer needed.	imcfrmtcvrt -i -s d:\setup.xml imcfrmtcvrt -i d:\setup.xml <files or paths>
-s	(Setup) without any additional parameters opens the familiar settings dialog	
-h	(hidden) only in conjunction with -i: Suppression of all windows and error messages	imcfrmtcvrt -i -h d:\setup.xml <files or paths>
-l	Write all information from windows and error messages to a LOG-file	
-h -l	Write all information from windows to a LOG-file in spite of suppression	imcfrmtcvrt -i -h -l d:\setup.xml d:\Logfile.log <files or paths>

For the purpose of determining **target files**, the imc Format Converter **settings** are used.

Specifying the files to convert in an xml-file

You can specify in an xml-file which files are to be converted. This can be necessary for instance when the command line is not sufficiently long. Depending on the Windows version, the line length is between 2000 and 8000 characters. The files to be converted are then are specified in an xml-file.

Example Sample XML-file

This xml-file must have the following content:

```
<Converter_V1>
<DestinationPath>
    <SourceFile>d:\Test\data\e01 (08).RAW</SourceFile>
    <SourceFile>d:\Test\data\e02 (08).RAW</SourceFile>
</DestinationPath>
</Converter_V1>
```

Calling the file

Example 1:

```
imcfrmtcvrt -a d:\data.xml
```

All files specified in the file: "*d:\daten.xml*" are converted to "ASCII" (-a)

Example 2:

```
imcfrmtcvrt -i -h -l d:\setup.xml d:\Logfile.log d:\Data.xml
```

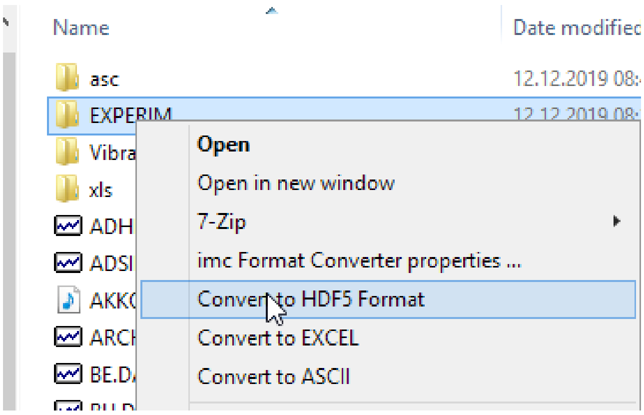
All files specified in the file: "*d:\daten.xml*" are converted.

The parameters for the conversion are defined in the file "*d:\setup.xml*" (-i).

All notifications are suppressed (-h) and saved in the log-file (-l): "*d:\Logfile.log*".

18.5 Conversion via the Windows Explorer

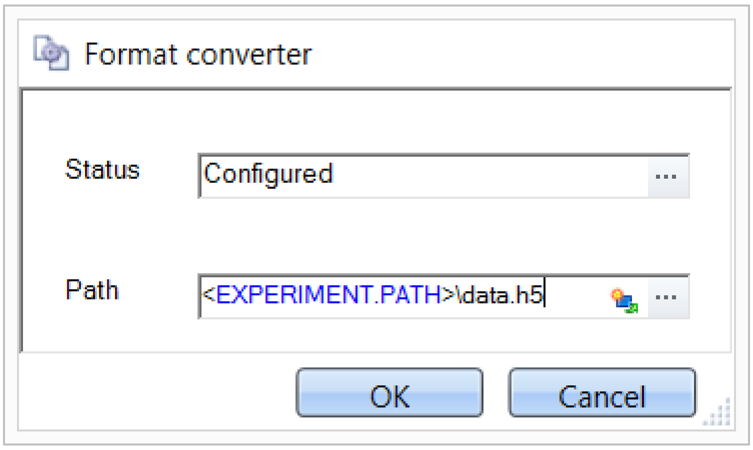
Installation of the imc Format Converter expands the Windows Explorer's context menu. The current templates for export of ASCII 1924 and EXCEL 1925, as well as the export format last selected on the page "*Other file formats*" 1926 can then be applied directly to a folder or files:



18.6 Format Converter as imc STUDIO command

Calling

Via the Sequencer: "*External calls*" > "*Format converter*":



Configuration of the command: Format Converter

Status

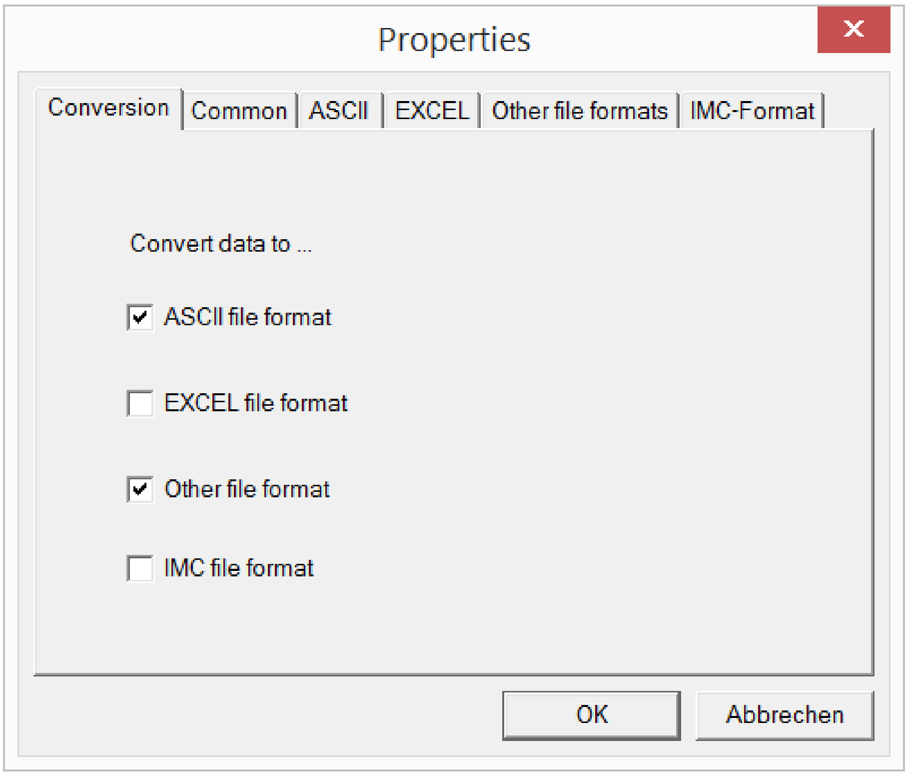
Immediately upon opening the command's configuration, the status is set to "*not configured*".

Path

- If just **one** file (*.dat, *.raw) of measured data is specified here, you can select whether to **convert either only the single file, or all files of measured data** 1923 which the **folder** contains.
- If a **folder** is specified here, then **all files of measured data in the folder** are converted:
  - If the option "*Save all files of a folder in one file*" among the settings on the tab page "*Common*" 1923" (see the segment on "*Status*") is selected, then **all files of measured data** present in the specified folder are converted to **a single target file**.
  - If the option is **not selected**, then each file of measured data which the folder contains, the data are converted to **a separate file**.

Using the button [...] in the box "*Status*" you can open a dialog via which you can make all the settings for the conversion:

- Conversion: Target format. It is also possible to select multiple formats.
- Common 1923: Storage location and whether individual files or a multi-file is to be created.
- ASCII 1924: Selection of the export template and specifying of the file extension.
- EXCEL 1925: Selection of the export template and specifying of the file extension xls or xlsx.
- Other file format 1926: Selection of the format and if necessary its formatting options.
- IMC-file format 1927: Save the data to a file in the imc format, or as a copy to a different memory location.



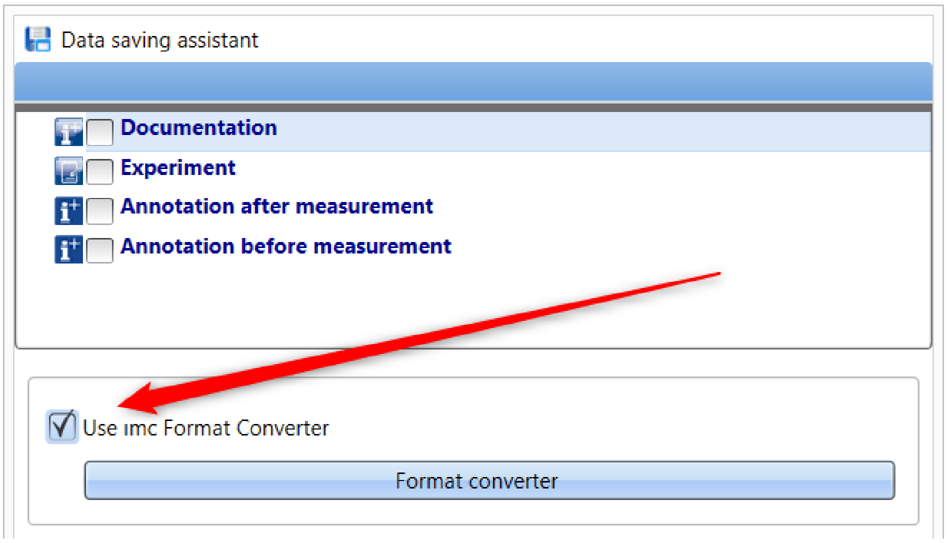
Setting the Format Converter

18.7 Converting via the Data Saving Assistant

Calling

Via the Sequencer: "*Read/write data*" > "*Data saving assistant*"

Along with supplemental information on the measurement, the "*Data saving assistant*" also allows the use of the imc Format Converter. Clicking on the button "*Format Converter*" opens its settings dialog, with which you can configure the imc Format Converter in accordance with the description of the imc STUDIO-command 1932.



Format Converter as component of the Data Saving Assistant

19 Miscellaneous

This chapter contains tips and tricks, frequently asked questions (FAQ), hints for debugging and more.

- Tuning, Tips and Tricks 1935
- FAQ 1940
- Troubleshooting 1948
- Glossary 1950

- The latest changes to the imc STUDIO documentation

19.1 Tuning, Tips and Tricks

Find some tips to optimize the use of imc measurement devices.

- Curve window updating 1935
- Jiggling display and heavy burdening of the processor 1936
- Long-term measurement 1936
- Data overflow (Tips) 1937
- Avoid large sampling times 1937
- Multiple-triggered signals 1938
- imc Online FAMOS - Computation uncertainty in summations 1938
- imc Online FAMOS - Insufficient global RAM 1939
- imc Online FAMOS - Digital Filters 1939
- Pulse spikes in the signal 1939

19.1.1 Curve Window Updating

Many curve updates per second during a running measurement make it easy to view the data plotting.

→ Tip: Fast interface

The Ethernet connection needs to be as free of interference as possible.

→ Tip: Small segment

The curve window requires longer to plot the data if the number of data displayed is large or if the curve window itself is simply very large. If the number of channels displayed is reduced, the speed is increased. The time needed for drawing the plot also depends on your graphics card's power.

→ Tip: Fewer channels transferred to the PC

If data from fewer channels are transferred to the PC, the performance improves. The other channels are saved to the internal device hard drive, for instance.

→ Tip: Monitor channels

For viewing purposes, channels whose data points have already been averaged or simply more slowly sampled channels (monitor channels) can be used. Data storage can then be performed on the fast-scanning channels.

19.1.2 Jiggling Display and Heavy Burdening of the Processor

The presence of many channels can burden the PC if a virus protection program scans the data captured.

We strongly recommend removing imc STUDIO from the virus scan.

Reference	See
Recommended virus scanner settings 39	

19.1.3 Long-term Measurement

Say, for instance, you wish to make a really long measurement. You start a new experiment. You set the channel sampling interval to 1ms, and the measurement duration to *undefined*. Then you set the channel data to be displayed in the curve window and start the measurement. Here's what happens:

1. The measurement runs smoothly, at first.
2. After a while, there seem to be pauses for several seconds. The software seems to run more slowly.
3. Later, a "Data overflow"-message appears.

Diagnosis: As measurement data are captured by the measurement device, the operating system requests memory. Also, the relocation of memory space can take considerable time. If this time is too long, the device is no longer able to stash the data, the PC doesn't read the data out in time, data are lost, a data overflow occurs.

→ Tip: Ring buffer memory

- If the purpose is only to view data, than a circular memory buffer (ring buffer) should be set on the PC for each channel (Storage dialog). The ring buffer memory has a certain capacity, e.g. 30 minutes. This memory is demanded only once at the start of the measurement and is cyclically overwritten. It is then possible to show up to the last 30 minutes in the curve window. The system continues to work at constant speed, for as long as needed.
- Data can also be saved without the circular buffer memory. This will not require any of the operating system's RAM.

→ Tip: Scroll-mode

When the curve window is used to display data, it should be used in *Scroll-mode* 1265 (right mouse-click in curve window, context menu, Communicator). In Scroll-mode, the curve window always displays the same amount of data, so it always keeps the same speed. If you don't set the X-axis to Automatic (or Unzoom), the amount of data displayed constantly increases and plotting takes longer and longer. Scroll-mode actually cannot prevent data overflow in the PC-RAM! But it is a helpful technique for keeping the displayed time window constant.

Warning

A high number of folders on the internal storage medium could cause loss of data!
See chapter *Avoidance of Data Overflow* > *Data rate* 755.

19.1.4 Data Overflow - Tips

If the error message *Data overflow* appears during a measurement, it means that some measured data have been lost. The device buffers captured data for a specified time interval. If the PC is too busy to read in data for longer than this time, the device memory will run out of capacity and any newly captured data will overwrite the previous data.

→ Tip: Increase buffer time

Use the controls on the page: **Analog/Digital channels** in the dialog: **Data transfer** to set a greater buffer time for each channel. "Auto" is only 10s; it is often possible to set a much longer time. Set the same buffer time for all channels transferring data to the PC, and make it as long as possible. Channels which are only processed by the device don't need extensive buffering; 2s are usually enough.

→ Tip: Reduce data rate

If possible, reduce the data rate by means of the data reduction functions in imc Online FAMOS.

→ Tip: PC processing time, Scroll-mode

Avoid performing actions with the PC which demand much processing time. E.g., working with other applications, using Unzoom or automatic X-axis in the curve window when there are huge amounts of data, using complicated curve window display options like Waterfall, Color map, many events, plotting with big dots, ...

Warning

A high number of folders on the internal storage medium could cause loss of data!
See chapter *Avoidance of Data Overflow* > *Data rate* 755.

19.1.5 Avoid Large Sampling Times

Say, for instance, a temperature is to be measured, and that 1 sampling per 10s is sufficient resolution. If a sampling time of 10s is set for the temperature channel in the configuration dialog, then there are 3 unfortunate consequences:

1. There is no averaging. If the signal is not subjected to analog smoothing, there will be no noise suppression. High frequency noise will cause aliasing errors.
2. Since two data points must be sampled before a measurement can start by trigger, it takes 20s for the temperature channel, and even other, faster sampling channels to begin measuring.
3. At least one more sample must be made before the measurement of a channel can be stopped. Therefore, the system's response to pressing the "Stop" button is considerably delayed.

→ Tip: Mean ()

- Set a higher sampling rate in the Configuration dialog. Especially for temperature measurement, sampling rates of at least 200Hz should be set, if no analog anti-aliasing filter is used. Use averaging to reduce the data to the sampling rate desired.
- To the extent possible, use the imc Online FAMOS function *Mean()* instead of the *Arith. Mean* on the page: **Analog/Digital channels** in the dialog: **Sampling & Preprocessing**. Only the *Mean* function avoids the Start/Stop-delay.

19.1.6 Multiple-triggered Signals

Signals which cause multiple trigger releases generate Events which can accumulate to a data volume which overloads the system.

→ Tip: Last Event

Use the curve window menu item *Configuration* > *Events, Segments, Periods*. In the dialog which appears, select the page Events. Enter how many of the most recent events you really wish to have displayed. In that case, the curve window plot will always be drawn at the same speed.

19.1.7 imc Online FAMOS - Computation Uncertainty in Summations

Goal: An incremental counter is to be used to find a cumulative displacement. An incremental counter delivers 400 pulses per meter = 2.5 mm/pulse.

If imc Online FAMOS computes the total displacement as:

```
Total_Path = sum (incremental_Channel, 1)
```

then the computed path will deviate from the actual displacement after a while.

Why does this happen?

imc Online FAMOS processes channel data in so-called Float format:

Float = 4 byte real number = 7 significant digits

4-Byte Float

-3.4028235E+38 to -1.1754944E-38, 0.0E+0, +1.1754944E-38 to +3.4028235E+38

In this system, rational numbers such as 2.5 can only be represented with limited precision. The number 10/4 is not expressed as 2.5 but rather as 2.4999999... This amounts to a discrepancy of 0.000223516% and is actually negligible. However, if this error is compounded throughout a calculation, larger errors can result. In this case, a new value is added to the sum every 2ms (assuming every 2ms 1 pulse = 2.5mm), in other words 500 times per second = 30.000 times per minute = 1.800.000 times per hour etc.

Thus a small cause can produce a large effect.

→ Approaches to a solution: imc Online FAMOS

1. Rounding

```
_inc=Round(Inc_1*400) ;400 pulses/m
Path_online2=sum(_inc,1)/400
```

2. Fewer samples = set a longer sampling interval.

Reduce the error in consequence of aggregate summation by reducing the terms summated:

- On the page: **Analog/Digital channels** in the dialog: **Sampling & Preprocessing**, set sampling for every 1 sec, for instance, instead of 2ms.
- Or in **imc Online FAMOS**

```
;500 = 1/ sampling interval = 1 / 2 ms    400 = pulse count / m
;take path increments every 1sec with resolution 1.
Inc_1s=mean(Inc_1,500,500)*(400*500)
Inc_1s_round=Round(Inc_1s)  ;round to whole number
;summation and division by pulse count.
Path_1s=sum(Inc_1s_round,1)/400
```

19.1.8 imc Online FAMOS - Insufficient Global RAM

When imc Online FAMOS is exited, a check is made of whether there is enough space in the device's global RAM for the virtual channels which were set up. If the input channels already take up too much of the device's buffer memory, the virtual channels cannot be created.

→ Tip: Temporarily slow down input channels

- Exit imc Online FAMOS, in spite of syntax-errors. Set a large sampling time for the input channels.
- Call imc Online FAMOS. Change anything, which will cause imc Online FAMOS to be re-compiled (e.g. enter and delete a space). Then exit imc Online FAMOS again.
- Now set on the page: **Analog/Digital channels** in the dialog: **Data transfer** the desired RAM buffer duration for each channel.
- Then go to the page: **Analog/Digital channels** in the dialog: **Sampling & Preprocessing** and set the desired sampling time for the input channels.

19.1.9 imc Online FAMOS - Digital Filters

Due to numerical problems, the ratio of the sampling frequency to the cutoff frequency with filters may not exceed a certain amount.

The following rule applies:

fsample/fg < (Order)th Root(1000000); where fsample= sampling frequency and fg = cutoff frequency

Examples:

Order	Ratio	fsample/fg
1st	1st Root(1000 000)	< 1000000
2nd	2nd Root(1000 000)	< 1000
3rd	3rd Root(1000 000)	< 100
4th	4th Root(1000 000)	< 32
5th	5th Root(1000 000)	< 16
6th	6th Root(1000 000)	< 10
7th	7th Root(1000 000)	< 7
8th	8th Root(1000 000)	< 6

The occurrence of numerical problems also depends on the filter characteristics set and on the particular implementation of the filter.

19.1.10 Pulse Spikes in the Signal

If the data capture is performed without using an analog low-pass filter, then disturbed signals may show outliers, peaks or spikes.

→ Tip: Nonlinear filters

Use the imc Online FAMOS functions *Median3()*, *Median5()* and *SlopeClip()* to cut out such disturbances. If low-pass filters are used (whether analog or digital), the peaks are only "mashed flat" and cause a local offset error.

19.2 FAQ

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- Synchronization 1946
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- Timed start 1947

19.2.1 Start delay

Question: Why does it take so long to start or stop measurement?

Answer: If one of the data capture channels is using the function *Arith. Mean* on the page: **Analog/Digital channels** in the dialog: **Sampling & Preprocessing**, then even for all other channels the data are displayed in the curve window only after the following delay:

t_1 = Number of samples to be averaged * sample time.

E.g. 10000 * 1ms = 10s.

Furthermore, the system needs up to two samples to settle. Thus the complete start process takes:

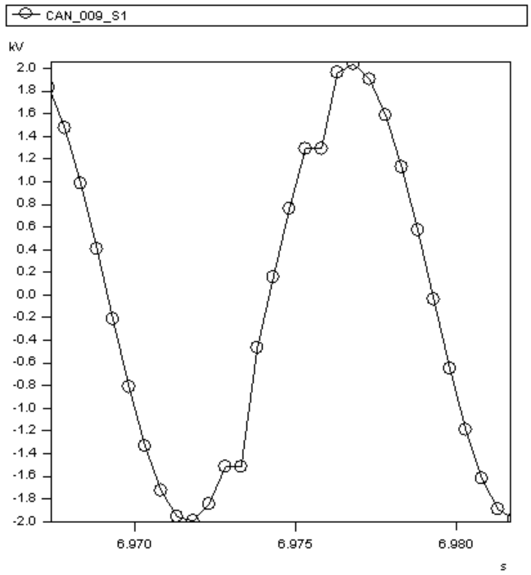
$t_{start}= t_1 * 2 = 20s$

19.2.2 CAN

Q: Why is the CAN-TimeStampASCII history not displayed completely?

Answer: The pretrigger for CAN-TimeStampASCII is never greater than 512Bytes. Even if a longer pretrigger time is set, a maximum of 512Bytes history is shown.

Q: At high sampling rates with CAN-Bus modules, some indicated values are duplicated or, in rarer cases, incorrect.



Answer: The CAN-Bus modules feature a considerable amount of jitter in outputting the measured data due to factors affecting the overall system. If the data are recorded at a high sampling rate, some values may be duplicated or, in rarer cases, erroneous data may appear.

Solution:

a) **Universal**:
Sample the CAN-Bus channel with a time stamp instead of equidistantly.

b) **When using imc STUDIO**:
Use the CAN-1 synchronization. This is absolutely necessary if subsequent data processing is performed with in imc Online FAMOS.

19.2.3 Data Overflow - FAQ

Q: Why does data overflow occur after a certain duration of measurement, although the connection is OK?

Answer: If the buffer duration is too small, data overflow can result, in which case measured data are lost. The data captured subsequently are then generally false or missing.

See also Data overflow (tips) 1937

19.2.4 Display / Display-Editor

Q: A change made to the single-line list on the Display doesn't take effect.

Answer: Any change must be confirmed by pressing Enter.

Q: Display is not recognized, Display-Editor is not in menu or editor shows different display type.

Answer: The display is not configured correctly.

You wish to use an external imc Display with your measurement device, which has a DSUB-9 Display terminal:

1) Start imc STUDIO, connect your device
2) Open the device properties using the Ribbon *Setup-Configuration* > *Device properties* 194
3) Set your type of display; Apply with *OK*
4) Close imc STUDIO and deactivate the device, connect the display to the measurement device; switch on the display.
5) Switch the device on, so the display indicates a connection to the device.
6) Your display may run a firmware update when preparing the measurement.

19.2.5 Device Hard Drive

Q: The system won't recognize the data storage drive.

Answer 1: Devices support **FAT32**.

Answer 2: If there are two storage media simultaneously plugged into your device, only one media will be detected (e.g. USB and CFast). Only the first plugged media will be detected.

Q: My 16MB card doesn't work.

Answer: Flash drives up to 16MB must first be erased before it can work.

Note

Setting up more than 1000 folders is to be avoided, since it slows down the file system substantially.

19.2.6 Incremental Counters

Problem: Measured value does not settle at zero

Answer: This problem is seen where RPM, velocity or frequency signals trail off to zero.

Whenever individual pulses are missing, the system measures the elapsed time and interpolates an RPM- (or velocity, etc.)-value on this basis. Physically speaking, this is the most realistic assumption to make about a rotating machine, but using this technique means that some results are only estimates.

If no pulses arrive for a long time, there is no definitive information on which to base calculations. In this case, the last value calculated may remain >0.

19.2.7 Network

Q: Why does it take so long to start the imc STUDIO- Software on my laptop?

Answer: A laptop normally operated within a company network is usually set to DNS. Working with imc STUDIO in stand alone mode can lead to substantial delay until Windows gives up trying to find the DNS in the non-existent network.

Solution: switch off DNS

Q: Why does IF-Config not allow setting the Address/Subnet, for example as 192.168.0.167 / 255.255.252.0?

Answer: The imc measurement devices exchange information via Subnet broadcasts consisting of Etherbits, for example. The Subnet broadcast address is composed of the IP-address and the subnet mask. The combination described would result in an impermissible value. For this reason, IF-Config prevents the user from setting this combination of values.

Solution: Set subnet to 255.255.255.0.

19.2.8 imc Online FAMOS

Q: A data stream in imc Online FAMOS is processed in conjunction with a Display variable. This isn't performed accurately down to a single sample.

Answer: When trying to multiply a status cell with a waveform, the processing depends on how the internal FIFOs are filled. Thus, slight offsets can occur.

Q: There are problems in imc Online FAMOS when using experiments at long path names.

Answer: When trying to multiply a status cell with a waveform, the processing depends on how the internal FIFOs are filled. Thus, slight offsets can occur.

Q: The field bus channels are not available in imc Online FAMOS, but they are listed in the main dialog.

Answer: Field bus channels recorded in time stamping mode, can't be proceeded in imc Online FAMOS.

Q: When outputting to a DAC, not every value is outputted?

Answer: Two possible causes:

1. imc Online FAMOS needs longer than the sampling interval for the throughput of the channels to be processed. This means that the data come in chunks, of which only the respective last value can be transferred on to the DAC.
2. The sampling rate multiplied by the input channel's RAM buffer duration is > 2^16. However, the addressing is accomplished using a 16-bit pointer. This means that the samples are not addressed individually but rather in blocks. In imc Online FAMOS, the data are then also transferred in blocks. However, only the respective last value in a block is transferred to the DAC.

Q: How many channels @100kHz sampling rate can be proceeded online by the function SoundPressureLevel simultaneously?

Answer: Online FAMOS can proceed up to 3 channels (independently from the main board).

19.2.9 Parameterizing Bridges

Q: How can I parameterize a bridge in imc STUDIO, if my scaling factor is unknown?

Answer: Condition: The bridge can be unbalanced with a defined load.

We demonstrate the issue using the example of torque measurement, in which a weight is used to apply a defined torque of 4.17 Nm to the shaft.

1. Calculating the actual scaling factor: Activate the channel on the page: **Analog/Digital channels** in the dialog: **Channel definition**. Set the desired sampling rate (Dialog: **Sampling & Preprocessing**). Leave the scaling factor (Factor) (Dialog: **Range & Scaling**) at the default value *1 "mV/V" / "mV/V"*.
2. Select the desired bridge type (half-, full-, quarter bridge in the Voltage mode) in the dialog: **Measurement mode** and set the necessary power supply. Initially, the maximum possible input range is selected.
3. Save the experiment and then on the page: **Channel balance** in the dialog: **Balance** select the desired channel from the channel list. Activate bridge balancing in the column *Balance*.
4. Once the bridge has been balanced, the shaft is stressed with the defined torque and a measurement is performed. The measured value is, for instance, 0.5mV/V (bridge diagonal voltage). Naturally, this value is relatively imprecise, since the input range is 500mV/V.

5. Stop the measurement. On the page: **Analog/Digital channels** open the dialog: **Measurement mode** and then select the next bigger input range from 0.5mV/V, in other words 1mV/V and then repeat the measurement. Now you obtain a more exact measured value of, for example, 0.541mV/V.
6. Using this value, we can calculate the scaling factor: 4.17 Nm/0.541 mV/V = 7,708 "Nm" /mV/V. This value can now be entered in the dialog: **Range & Scaling** for the scaling factor Factor.
7. You now have a choice of input ranges in physical units in the dialog: **Measurement mode**. Here, select the maximum expected number of measured values as the desired input range.
8. If the input range was changed, it is necessary to repeat the bridge balancing!

Note

- **Caution: Every time the input is changed, it is necessary to perform bridge balancing again before starting the measurement!**
- The balancing values are stored with the experiment and imported by the device upon preparation of the measurement. This means that after activating or deactivating the measurement device, the balancing values are not available in the device! Exception: Autostart / Diskstart.

19.2.10 Scaling and Input Range

imc STUDIO returns measured data correctly scaled in the appropriate physical unit. However, there are a number of different settings possibilities which may cause confusion.

Basically the input range is derived from the selected electrical input range on the page: **Analog/Digital channels** in the dialog: **Measurement mode** and the scaling factor (Factor) on the page: **Analog/Digital channels** in the dialog: **Range & Scaling**.

The following possibilities are available:

- Scaling factor without offset 1944
- Scaling factor with offset 1945
- Calculated two-point scaling 1945
- Two-point scaling by means of the amplifier adjustment dialog 1945

19.2.10.1 Scaling Factor without Offset

If the expected electrical input range is not known, ignore step 1 below.

In the example, a full bridge is described which returns a maximum electrical value of 35mV/V at a scaling factor of 356.65 N per mV/V.

1. Input range

On the page: **Analog/Digital channels** in the dialog: **Range & Scaling**, select the appropriate input range so as to make the maximum expected value fall in the upper third of the input range.

For an expected maximum value of 35mV/V, the appropriate input range is 50mV/V.

2. Scaling factor

Enter the scaling factor as the Factor; in this example 356.65 N/mV/V.

3. Input range

Note that afterwards the input range is also indicated together with the physical unit.

The full bridge used in the example normally causes an offset in its rest state. For measurement bridges, this offset should always be compensated using on the page: **Channel balance** the dialog: **Balance**.

19.2.10.2 Scaling Factor with Offset

The example presents a displacement sensor which delivers 0V at -11.55mm. The scaling is 0.2597V/mm. The maximum value is 25mm.

1. Input range

On the page: **Analog/Digital channels** in the dialog: **Measurement mode**, select the appropriate voltage range.

The total displacement is 25-(-11.55)mm= 36.55mm. This means that the sensor delivers a max. value of 36.55mmx0.2597V/mm = 9.492V. If necessary, set the coupling to DC and then set an input range of 10V.

2. Scaling factor

Go to the dialog: **Range & Scaling**. The scaling factor must be converted to physical units per volts:

Y-factor= 1/ 0.2597V/mm= 3.8506mm/V

Note that the value must be expressed in the SI-unit "m" and not "mm".

3. Offset

Enter the offset if -11.55mm.

4. Input range

The offset entered causes the input range to shift.

19.2.10.3 Caluculated Two-point Scaling

The example describes a pressure sensor delivering a current of 4 to 20mA. The spec sheet indicates that 4mA represents applied pressure of 0bar and 17.5mA represents 10bar.

1. Input range and Coupling

On the page: **Analog/Digital channels** in the dialog: **Measurement mode**, select the appropriate current range.

The UNI-8 used in our example must first be set for DC-coupling. Next select current measurement and then an input range of 20mA.

2. Range & Scaling

Go to the dialog: **Range & Scaling**.

3. enter the values

Next enter the two value pairs from the spec sheet.

19.2.10.4 Two-point Scaling by means of the Amplifier Adjustment Dialog

Along with calculated two-point scaling which is performed by the measurement system's motherboard, it is possible to have the scaling performed already by the amplifier module. In this case, it is no longer necessary to deal with the offset and factor on the page: **Analog/Digital channels**. However, this method requires measurements of both reference points which means a connection is needed to the device.

With this technique, you need to know the expected electrical measurement value in order to be able to select the appropriate input range. This may no longer be changed later, since that would make the adjustment values obsolete.

In the example below, a power sensor is to measure the load on a crane. A standard weight of 100kg is available. The sensor delivers a maximum of 8V.

1. Input range and Coupling

On the page: **Analog/Digital channels** in the dialog: **Measurement mode**, select the appropriate voltage input range. If necessary, set the coupling to DC and then select an input range of 10V.

2. Scaling factor

Go in the dialog: **Range & Scaling** . Enter 1N /V as the Factor.

3. Channel balance: Point 1

Activate the device and connect it with the PC.

Go on the page: **Channel balance** in the dialog: **Scaling / Cable compensation without Sense configuration**.

Connect the sensor and enter 0 N under *Point 1 set value*. Measure the unstressed crane by clicking on the button *Scaling point 1*.

4. Channel balance: Point 2

Apply a load to the crane with the standard weight. The force in Newtons is 100kgx9.861m/s^2= 986.1N. Click on *Scaling point 2*.

5. Input range

In the *Scaling* column, click on the button: *Two-point scaling*

Go back to the page: **Analog/Digital channels** in the dialog: **Range & Scaling**. The resulting input range is displayed.

The method is recommended because it takes the entire measurement chain into account.

It is theoretically possible to enter an additional Y-factor, and an offset.

19.2.11 Synchronization

Q: Why are channels of one device not synchronized?

Answer 1: You are using different filter settings. Also the setting AAF for different sampling rates result in different low-pass filter settings. To sample two channels absolutely synchronous, the filter and sampling rate rate settings must be the same.

Answer 2: The RAM-buffer time is too big. In certain cases, the RAM-buffer 720 size could result in sample shift.

Answer 3: Channels are assigned to different triggers. Only with curve window setting *date/time absolute* the channels are displayed correctly in respect of time. If the curve window is set to *linear* (s) the time of the triggers will be displayed together.

Reference

Other scenarios are described in the chapter on synchronization 335.

19.2.12 Triggers

Q: My measurement is started by the transition of a virtual bit from *0* to *1*. This only works at the first start. If I start the measurement again without re-doing the preparation, it doesn't work.

Answer: The virtual bit is set the first time and isn't set back afterwards. At the next start, the bit is already *1*, and no more transition from *0* to *1* takes place.

Solution: Once the trigger has been released, the bit must be set back again, which can also be handled at the end.

Problem:

- Virtual bit is the Start/Stop trigger for a channel;
- Using RecordEvent(..), the trigger's starting and stopping times are to be recorded:

  RecordEvent(vrtB1_Start_K2, "Trigger K2 ON")

  RecordEvent(Not vrtB1_Start_K2, "Trigger K2 OFF")

--> the first notification to arrive is "Trigger K2 OFF"

- The bit was set = 0 upon starting.

Solution: The *RecordEvent* function only indicates transitions from 0 to 1, but the VirtBit_01 in the *OnTriggerMeasure* of Trigger_01 is 1. If one wanted to make a record of this first event, the calls of the *RecordEvent* function must be made in *Trigger_48*.

19.2.13 Working with two Monitors

Q: How does one move dialogs which are positioned on disconnected monitors?

Answer: Dialogs can be moved by means of Windows key combinations:

1. Select the imc software from the Windows taskbar.
2. Press key combination ALT+Space (to open the dialog's system menu)
3. Press key *m* for *moving*.

Now the cursor is located on the invisible dialog title bar. Move the window with the four cursor keys.

19.2.14 Timed Start

Q: Although I started measurement by timer, the first samples are only read a few seconds later.

Answer: Same effect as described above (in the chapter Arithmetic mean 1940). If you start your measurement with "Timed start" at, for example, 5:00 PM or on any full hour, there may be a delay before measurement actually begins, due to causes within the system and dependent upon the particular sampling rate specified. An inauspicious choice of the sampling rate may lead to a delay of several seconds.

19.3 Troubleshooting

Note

Only qualified technicians[1] are allowed to make repairs on the device! Unauthorized opening or incorrect repair of the device may greatly endanger the user (electric shock, fire hazard). Devices which have been altered or tampered will no longer comply with their license and may not be used. In case of accident (e.g. damage to housing, terminals, modules or power supply, or exposure to liquids or foreign substances), turn the device off immediately, unplug the power cord and inform the imc Hotline 10.

[1] Authorized / qualified personnel refers to persons familiar with the setup, installation, commissioning, and operation of the product and who hold certification for their respective skills.

- The device cannot be switched on 1948
- Error message when starting measurement 1948
- Device not found or measurement data is not displayed 1948
- Making a measurement 1949
- Hardware defects 1949
- Problems saving to internal drive 1949
- Error description 1950

19.3.1 The Device cannot be Switched on

- Check the power supply and the fuses (below the power switch).
- After switching off the unit, wait at least 10 seconds before switching it back on.
- Switch the system off and disconnect all lines except the power supply. Then try again to switch the unit on.

19.3.2 Error Message when Starting Measurement

If error messages appear when starting the device, please check the following first:

- Check the connection between the unit and your PC (see "*Setting Up - Connect the device* 43").
- Next, check that the correct connection type has been specified. (i.e. Ethernet, TCP/IP, PPP - see device model plaque).
- Turn the device off and then on again. Select Ribbon "*Home*" > "*Disconnect*" followed by "*Connect*".

The latter command reads the hardware configuration into the software.

19.3.3 Device not found or Measurement Data is not displayed

Error Message 103 - Check the device <=> PC connection and the power supply.

With Ethernet-interface: If your device is not located after using *Device search*, see the notes in Setting Up - Connect the device 43.

19.3.4 Making a Measurement

There are several steps involved in performing a measurement. With imc STUDIO, it is important they be carried out as listed below.

Errors can occur if, for example, an experiment is loaded before the device has been connected with the PC both physically via interface cable and in the software.

1. Create new experiment or open an existing one (Ribbon *Home* > *New experiment* or *Open experiment*)
2. Select devices
3. Ribbon *Home* (or *Setup-Control*) > *Connect*
4. Create a signal configuration (on the page: **Analog/Digital Channels**)
5. Selection and configuration of the data storage (on the pages: **Devices** in the dialog: **Storage** and **Analog/Digital Channels** in the dialog: **Data transfer**)
6. Prepare measurement (Ribbon *Home* (or *Setup-Control*) > *Download*)
7. Connect signals
8. Adjust amplifiers (on the page: **Channel balance**)
9. Save experiment (Ribbon *Home* > *Save experiment*)
10. Start measurement (Ribbon *Home* (or *Setup-Control*) > *Start*)

19.3.5 Hardware Defects

If measurements still return implausible results, follow these instructions to determine whether the hardware is defective:

1. Switch off device and disconnect all external power and signal input lines from the device.
2. Reconnect the power supply and switch device on: Does it boot correctly?
3. Connect the device to the PC (in accordance with the interface type)
4. Start the imc STUDIO software
5. Select the device
6. Select Ribbon *Home* (or *Setup-Control*) > *Connect*
7. Select Ribbon *Home* (or *Setup-Control*) > *Download*
8. Start measurement (measurement duration 10s)
9. Select channel and display as curve
10. Restart measurement (measurement duration 10s)

19.3.6 Problems Saving to Internal Drive

For detailed explanations see chapter Device Hard Disk, removable drive 744

An error will occur if the device is prepared for an Autostart measurement involving the device harddisk and no µHD is in the device when it is switched on.

19.3.7 Error Description

To help locate defects when sending a unit back for repairs, please enclose a description of the error(s) encountered and, if applicable, a graph of expected versus incorrectly returned signal courses, as well as the following information for our imc Hotline 10:

- Device serial number
- Software version used, export of the version information (About)
- Windows operating system version
- Experiment file from the database: <Experiment>.imcStudio

19.4 Glossary

Term	Description
µ-Disk	PCMCIA-, CF-, ExpressCard, USB-data storage or device hard drive exclusively for data acquisition under imc STUDIO.
action	Functions which carry out specific activities, such as starting the measurement, bridge balancing, or file operations, are designated here as actions.
Adjustment	Adjustment means tuning an instrument's readout deviation to within defined tolerances. A calibration is performed before and after adjustment.
aggregate sampling rate	Sum of the sampling rates of all active channels, which the device is able to process. See Technical Specs.
application	A program which runs under MS-Windows.
arming	Arming the triggers means preparing it to be released. Before the trigger is armed, it makes no difference whether or not the trigger condition is met.
Calibration	Investigation of an instrument's actual state based on specified target values.
Curve Manager	The Curve Manager is included with imc applications FAMOS, imc STUDIO, SEARCH and imc-DEVICES. It enables you to display your data in freely configurable "curve windows". These can contain any number of channels or computed variables, with individual or common axes. For complete information, see the manual Panel > Curve Window 1126.
Data Manager	The Data Manager is a component of the Curve Manager, see the manual: Panel > Curve Window 1126.
data set	A group of related numerical values, e.g. a series of temperature measurements in sequence.
digital I/O	Each device is equipped with binary input channels with TTL or 24V level or free relay contacts (alarm outputs).
display variables	The interaction between imc STUDIO and the optional display is conducted through the use of virtual display variables or bits, which the user either can have evaluated for the purpose of display; or can modify for the purpose of influencing the measurement process.
DSP	Abbreviation for Digital Signal Processor. The processor inside the device for online calculations, data management and data storage.
events	Defined state of or course within a measurement signal. (See the chapter Sources and events 399).

Term	Description
File format	The file format for the measurement files is identical to the one used by imc FAMOS. It is based on the DSF-Standard format.
Filter Design	A graphics-based filter designing program from imc.
Hot-Plug	Switching the device hard-disk while a measurement is running. (See Hot-Plug 745)
imc FAMOS	Program for subsequent signal analysis (Fast Analysis and Monitoring of Signals).
imc FAMOS Reader	Program for visualization, graphical analysis and measurement documentation, able to work with any data format.
imc Online FAMOS	With imc Online FAMOS lit is possible to calculate result channel signals. The functions are performed in real-time as part of the capacity of the DSP. (See chater imc Online FAMOS 835)
imc Online FRAME	imc Online FRAME is a program package for measurement engineering consisting of two user interfaces, a compiler and a mathematics library. It can be considered an extension of imc Online FAMOS. Its capabilities include open- and closed-loop control tasks as well as evaluation and intermediate processing of measurement results during the actual measurement.
measurement	The process beginning when the Start button is pressed (or when the device is activated if it is running in Autostart mode). The device stops measurement independently one all of the measurement's parts are finished. All captured data which are saved to the hard drive as belonging to a measurement are placed in a common folder.
measurement duration	The duration of a measurement can be determined by multiplying the number of samples with the of sampling interval.
monitor-scanner-inputs monitor-digital I/O	Monitor channels provide you with a means of observing data without recording it. They also make it possible to capture a channel at two sampling rates, one for recording and one for monitoring. It's also possible to make a triggered temperature measurement and have the respective most recent data point displayed as a number by means of a monitor channel.
multi-machine mode	Multi-machine mode makes it possible to conduct a measurement of a slowly-changing quantity in the background, while in the foreground several trigger machines initiate the recording of faster processes.
multi-monitoring	During a measurement it may be of interest to observe the data acquired by one device on multiple other PCs. Not to be confused with the Monitor channels in the standard software. One PC is designated the Master and it exports the configuration to a device and performs the measurement. A special program is needed for the purpose of viewing the data on the passive PCs. Contact imc if interested.
Multiple triggering	One trigger is released multiple times to capture portions of a measurement of limited duration. (See the chapter Multiple triggering (Multi-shot operation) 407)
net bits	Network-wide virtual bits which can be evaluated by the devices' trigger machines.
Official Calibration	In contrast to regular calibration this is an inspection of whether an instrument's indicated value lies within legally stipulated tolerances. Such official calibration can only be performed by government officials. The procedure includes inspection and certification. During the official calibration's validity period, the specified operational error limits must not be exceeded.
Pretrigger	The duration of data acquisition prior to a trigger event.

Term	Description
sample	Digital data point belonging to a measurement signal.
scanner inputs	The scanner channels are the analog input channels of the device. Since the acquisition of data is not really analog, but rather the active measurement channels are scanned at a certain rate, one speaks of scanning the input channels.
synchronous operation	Synchronized measurements on multiple devices.
time base	The device's internal clock. The time bases of multiple devices may drift apart over time during operation. Information on synchronization and drift: "*Synchronization* 301".
Transitional Recording	Signal-dependent data reduction procedure (see the chapter imc Online FAMOS 835)
trigger	Event-dependent starting or stopping of data recording
trigger machine	Up to 48 mutually independent triggers can be defined. (See chapter Trigger Machine 397)
Unzoom	Reverses the zoom function, displaying the entire picture.
virtual bits	32 digital bits of information (to be regarded as a 32-bit register) available in the internal memory for control purposes. Virtual bits can be set or read by imc Online FAMOS or in response to events.
virtual channel	Results signal channel computed from the input channels by imc Online FAMOS
Zoom	Command to enlarge a portion of a window; the opposite is Unzoom.

19.5 Last Changes

19.5.1 in Doc. Rev. 4.17

Chapter	Amendments
Notes / Quality Management	The note about the GPL sources has been updated.

19.5.2 in Doc. Rev. 4.16

Setting Up - Software

Chapter	Amendments
System requirements	The list of operating systems supported has been revised Windows 10, Windows 8.1~~, Windows 7~~

19.5.3 in Doc. Rev. 4.15

Setup - Advanced Device Functions

Fieldbusses

Chapter	Amendments
CAN: Definition 550	Requirement added: Sending directly from the CAN Assistant requires imc Online FAMOS.
CAN: Message Definition 550 and Nodes Definition 537	Added note about sending messages in the "Extended+" format selection.

imc Online FAMOS and imc Inline FAMOS

Chapter	Amendments
Conditions, Case-differentiation and CAN-transmission with Channels	Notes added: Boolean variables from files

Automation

Chapter	Amendments
Repository	Note added: "*States in the repository*"

Scripting

Chapter	Amendments
Menu bar and context menu	Context menu description supplemented.

API

Chapter	Amendments
Windows (WPF)	Setup page added
Windows (WinForms)	Logbook added
Experiments	Experiment functions added.

19.5.4 in Doc. Rev. 4.14

Setting Up - Software

Chapter	Amendments
User-defined	• Limiting the installation options For the driver and firmware package for imc STUDIO (imc DEVICES), only such components are still offered which are used in imc STUDIO. The following components are no longer installed/provided: "COM-Interface", "imc Online FRAME", "CAN Database - Import" • New name for the selection option imc DEVICES In order to make it clear that the firmware is required for use of the imc devices, the name in the product selection list has been modified: "*Firmware and driver package imc DEVICES (CRONOS, C-SERIES, SPARTAN, BUSDAQ)*"

imc STUDIO (general)

Chapter	Amendments
Project Menu	Menu item "*New experiment*" - Without "*imc STUDIO Project Management*" The description has been extended as follows: : The device currently selected remains selected. However, the device's configuration will be reset.

Setup - Device (general)

Chapter	Amendments
Device Properties 194	The following properties, which are not used, have been hidden: "*Options*" > "*imc DEVICES* " and "*imc CANSAS*"

Setup - Advanced Device Functions

Fieldbusses

Chapter	Amendments
J1587-Bus Interface	The chapter has been removed.

Storage Options and Directory Structure

Chapter	Amendments
Targeted Data Saving, or Saving Subsequent to Measurement	Predefining the data storage path for "Save current Measurement Date as"

imc Messaging

Chapter	Amendments
Various	The parameters for "Send e-mail" have been updated; e.g. TLS is no longer supported in most cases.

imc Online FAMOS and imc Inline FAMOS

Chapter	Amendments
Context Menu	You are able to completely expand or collapse the control commands in the Editor by means of a context menu entry.

imc Online/Inline FAMOS Function Reference

Chapter	Amendments
Functions: max, min, mean, rms and stdev	The maximum ratio of window width to reduction width has been increased to 1000:1 (previously 10:1).

Sequencer, Events and Commands

Command Reference

Chapter	Amendments
Import MFB configuration	For the purpose of importing a CAN-configuration by means of this command, the file type **.dbc* can now also be imported.

Video

Chapter	Amendments
Setup Configuration	Hint removed, as it is no longer valid: "The device search reports whether or not it found any devices. This report only pertains to imc devices. Any cameras will not be taken into account in the concluding report."

19.5.5 in Doc. Rev. 4.13

Setup - Advanced Device Functions

Fieldbusses

Chapter	Amendments
Profinet Interface 670	New
Ethernet-Bus Interface	The chapter has been removed.

Panel

Chapter	Amendments
Data Browser 1070	Paragraph about column selection added.
Fullscreen	Paragraph added indicating that the fullscreen view on a monitor is saved with the experiment.
Multi-lingual text input	New description: In many cases, titles and zone-texts can be pre-defined for multiple languages.

Automation

Chapter	Amendments
Source Code - Find and Replace and Repository	Note added: "*Find/Replace variables in imc FAMOS sequences*"

Sequencer, Events and Commands

Chapter	Amendments
Useful options	Description of the option "*Reduce logbook entries*".

Command Reference

Chapter	Amendments
Run imc FAMOS sequence Transfer Table 1470	The syntax in the Variables list has been described in more detail.

Video

Chapter	Amendments
Camera: Basler	Info on compatibility of Basler Pylon versions corrected.

Third Party Device Interface

Chapter	Amendments
3rd Party Device Management	List of third-party-devices refreshed.

19.5.6 in Doc. Rev. 4.12

imc STUDIO (general)

Chapter	Amendments
Options - Logbook files 111	New option described: • Delete logbook files: After the specified number of days elapse, the logbook files are deleted automatically.

Setup - Device (general)

Chapter	Bug-fix
Metadata Assistant - Meta-data in Channels	• Changes made to the metadata during the measurement are not reflected in the file. The settings are fixed as they are at the time the measurement starts. • Metadata are also saved in the channels in the device.

Setup pages - Configuring Device

Chapter	Amendments
Trigger - Dwell time: Artificially prolonging events 403	Note about older firmware versions (≤ 2.9) deleted, since these are no longer supported.
Timed start - Start option 345	Note on "*Automatic timed start*" added: "*OnInitAll*" is run each time measurement is started.
Encoder 373	Note added to indicate that the sampling rate of all encoder channels of one module (e.g. CRFX) or a device (e.g. C-SERIES) must always be the same.

imc Online FAMOS and imc Inline FAMOS

Chapter	Amendments
Creating a Variable	Notes added: Double-initialization of variables in the OnInitAll-block.

imc Online/Inline FAMOS Function Reference

Chapter	Amendments
General information about the Accu* functions	The Accu-functions are now also available in imc Online FAMOS.
AccuLength	Description of the AccuLength-function amended. It no longer returns the length of the channel, as previously described, but rather the count of data points.
VectorChannel 1024 and VectorStatic 1026	Maximum element count of "*100000*" entered for the functions "*VectorChannel* 1024" and "*VectorStatic* 1026".

Panel

Chapter	Amendments
Data Browser 1073	Description for the column: "*Event time*" supplemented and corrected: In response to what dependency conditions channels are displayed when an event time is selected.
Properties - Widget	Description of the Widget property: "*Factor*".

Sequencer, Events and Commands

Chapter	Amendments
User-defined events	Two examples added to illustrate gating by means of conditions.

Command Reference

Chapter	Amendments
Run imc FAMOS sequence	Variables can now be transferred both from a saved measurement and additionally from the "*Current Measurement*". The latter by means of the variable-suffix: *@CurrentMeasurement*.
Format converter	Description updated and expanded.

Video

Chapter	Amendments
Setup Configuration	Warning expanded: In certain cases, cameras fail to receive Stop-signal when the CPU-load is high.
Camera: Basler acA645-100 gc	Installation description for Windows 10 updated, since no patch is required her any longer.

Scripting

Chapter	Amendments
Events	This chapter was added.
Default dialog response	New Dialog-IDs were added..

API

Chapter	Amendments
Initialization	Add Information about initialization.
Windows (WinForms)	How to show Devices page added.

Chapter	Bug-fix
Initialization	Installation path was not correct.

imc Format Converter

Chapter	Amendments
All	A description of the imc Format Converter has been added. • The imc Format Converter as a stand-alone program • Calling via the command line parameter • Conversion via the context menu • Calling by means of imc STUDIO: imc Format Converter-command and via the Data Saving Assistant

19.5.7 in Doc. Rev. 4.11

imc STUDIO (general)

Chapter	Amendments
Options	Description added: • Resetting options 110 • Save current Measurement Data - Variable export 117: beforehand which file type the command "*Export variable*" is to use for saving the variables.
Experiments, Projects and the Database	Note added regarding important effects of creating a new project; e.g., variables in the current experiment are reset.
Project Menu	Note added to indicate that the variables are reset when the project is saved under a new name.

Setup - Device (general)

Chapter	Amendments
Parameter set	Export by means of the menu item "*Setup-configuration*" > "*Export Configuration*": More detailed description of the selection: "*Visible columns on current page*" Note added describing the cases in which the column "*Balance scaling information*" is also exported.
Device Properties 194	GPS receiver - Displays the available information on the GPS receiver.

imc Online FAMOS and imc Inline FAMOS

imc Online/Inline FAMOS Function Reference

Chapter	Amendments
BitNot	Description supplemented for imc Inline FAMOS: The function `BitNot` with an optional parameter for the data format.
IF	Description supplemented with examples of possible syntax.

Panel

Chapter	Amendments
Context Menu	Access Rights to the Page - Notes added: What settings for user rights apply to a page when it is created in "imc Standard User" status.
Design Mode	Activating Design mode while in Full-screen mode
Page printout or print to PDF	Additional descriptions for the Report-pages • Font in printout • PDF with vector-elements • Report-pages - adjusting the size • Report page template - page header

Sequencer, Events and Commands

Command Reference

Chapter	Amendments
Run imc FAMOS sequence	The command has been supplemented with the option "*Always overwrite existing files*". When results are saved with the measured data, a prompt appears to provide notification that a file with the same name already exists in the folder. By means of this option, you can always overwrite the file without any previous prompt.

Scripting

Chapter	Amendments
Menu bar and context menu	"Add existing Scripts" was renamed to "Import Scripts"
Export and Import	• "Add existing Scripts" was renamed to "Import Scripts" • Note for adding the menu action "Import Scripts" to the ribbon

Miscellaneous

Chapter	Amendments
imc CANSAS - CANSER GPS	Notes on the module: CANSER GPS have been deleted from the documentation.

19.5.8 in Doc. Rev. 4.10

Chapter	Amendments
Miscellaneous	imc CRONOS-XT has been included at various locations in the description.

Setup pages - Configuring Device

Chapter	Amendments
Channel table 352	Data from the technical data sheet have been added: Maximum channel count per device

Setup - Advanced Device Functions

Fieldbusses

Chapter	Amendments
CAN: Validity 549	Option for: deleting/adding transmitting channels from/to the log channel

Storage Options and Directory Structure

Chapter	Amendments
Data File Format	Notes on the FAMOS.ZIP-Format: Limitations of compression more clearly defined.

imc REMOTE WebServer

Chapter	Amendments
Miscellaneous	Notes on the format for WEBRemote encryption.

Scripting

Chapter	Amendments
Panel	New events "PageCreated" and "PageDeleted" are described.

Third Party Device Interface

Chapter	Amendments
Time stamped	Usage of Time stamped channels.

19.5.9 in Doc. Rev. 4.9

Chapter	Amendments
Miscellaneous	The new imc devices have been included in the documentation: imc CRONOS-XT.

API

Chapter	Amendments
General	Added more chapters about ProgressVisualizer, curve window and imc FAMOS functions.

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