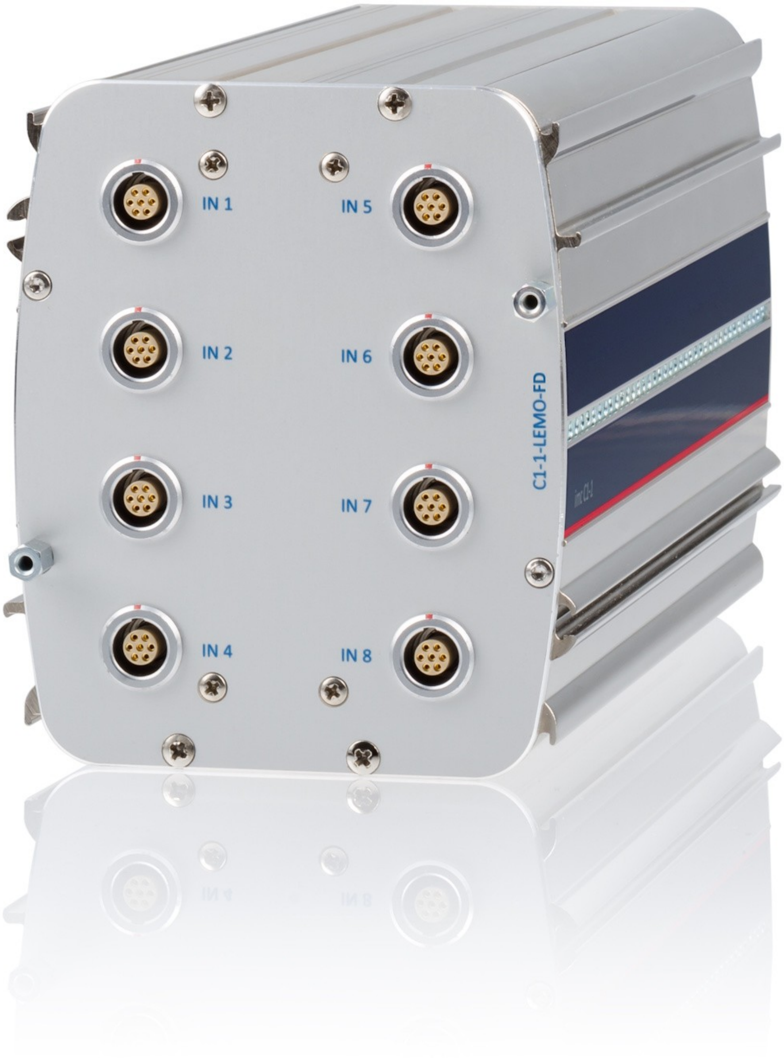
imc C1-1-LEMO(-VEAM)-FD

Manual

Edition 12 - 2025-11-06



imc Test & Measurement GmbH • Voltastr. 5 • 13355 Berlin • Germany

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 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/imc STUDIO Monitor installation medium in the folder "*Products\imc DEVICES\OSS*" or "*Products\imc DEVICEcore\OSS*" or "*Products\imc STUDIO\OSS*". If you wish to receive a copy of the GPL sources used, please contact our tech support.

Notes regarding this document

This document provides important notes on using the device / the module. Safe working is conditional on compliance with all safety measures and instructions provided. The manual is to be used as a kind of reference book. You can skip the description of the modules you do not have.

Additionally, all accident prevention and general safety regulations pertinent to the location at which the device is used must be adhered to.

These instructions exclusively describe the device, **not how to operate** it by means of **the software**!

If you have any questions as to whether you can set up the device / module in the intended environment, please contact our tech support. The measurement system has been designed, manufactured and unit-tested with all due care and in accordance with the safety regulations before delivery and has left the factory in perfect condition. In order to maintain this condition and to ensure safe operation, the user must observe the notes and warnings contained in this chapter and in the specific sections applicable to the concrete device. Never use the device outside the specification.

This will protect you and prevent damage to the device.

Training programs for introduction to the systems, and advanced workshops

We recommend that before you begin working with the device / the module you participate in an extensive training session. Such training will enable you to get started working efficiently much faster. Additionally, you will obtain valuable tips and information on how to use the software more effectively. More information is available on our homepage under "*Service & Training*" > "*imc ACADEMY*".

Special notes

Warning

Warnings contain information that must be observed to protect the user from harm or to prevent damage to property.

Note

Notes denote useful additional information on a particular topic.

Reference

A reference in this document is a reference in the text to another text passage.

Table of contents

1 General introduction

1.1 Tech support

If you have problems or questions, please contact our tech support:

Phone: (Germany): **+49 30 467090-26**

E-Mail: hotline@imc-tm.de

Internet: https://www.imc-tm.com/service-training/

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.

- The device's serial number appears on the nameplate.
- The program version designation is available in the About-Dialog.

Product Improvement and change requests

Please help us to improve our documentation and products:

- Have you found any errors in the software, or would you suggest any changes?
- Would any change to the mechanical structure improve the operation of the device?
- Are there any terms or explanations in the manual or the technical data which are confusing?
- What amendments or enhancements would you suggest?

Our tech support 6 will be happy to receive your feedback.

1.2 Service and maintenance

Our service team is at your disposal for service and maintenance inquiries:

Phone: (Germany): **+49 30 629396-333** (Mon.-Fri.: 9.00 - 12.00 and 13.00 - 17.00)

E-Mail: imc-service@axiometrixsolutions.com

Internet: https://www.imc-tm.com/service

Service and maintenance activities include, for example calibration and adjustment, service check, repairs.

1.3 Legal notices

Quality Management

Management System
ISO 9001:2015
ISO 14001:2015
TÜVRheinland
ZERTIFIZIERT
www.tuv.com
ID 0910085152

imc Test & Measurement GmbH holds DIN EN ISO 9001 certification since May 1995 and DIN EN ISO 14001 certification since November 2023. You can download the CE Certification, current certificates and information about the imc quality system on our website: https://www.imc-tm.com/quality-assurance/.

imc Warranty

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

Liability restrictions

All specifications and notes in this document are subject to applicable standards and regulations, and reflect the state of the art well as accumulated years of knowledge and experience. The contents of this document have been carefully checked for consistency with the hardware and the software systems described. Nevertheless, it is impossible to completely rule out inconsistencies, so that we decline to offer any guarantee of total conformity. We reserve the right to make technical modifications of the systems.

The manufacturer declines any liability for damage arising from:

- failure to comply with the provided documentation,
- inappropriate use of the equipment.

Please note that all properties described refer to a closed measurement system and not to its individual slices.

Guarantee

Before leaving production, each device passes several quality tests with approximately 24 hours of burn-in. This detects almost every early failure. Nevertheless, it is possible that a component may fail only after prolonged operation. Therefore, all imc products come with a two-year functional warranty. This is conditional on no modifications having been made to the device.

Any unauthorized tampering with the device will void the warranty.

Notes on radio interference suppression

imc C1 devices satisfy the EMC requirements for an use in industrial settings.

Any additional products connected to the product must satisfy the EMC requirements as specified by the responsible authority (within Europe[1]) in Germany the BNetzA - "Bundesnetzagentur" (formerly BMPT-Vfg. No. 1046/84 or No. 243/91) or EC Guidelines 2014/30/EU. All products which satisfy these requirements must be appropriately marked by the manufacturer or display the CE certification marking.

Products not satisfying these requirements may only be used with special approval of the regulating body in the country where operated.

All lines connected to the C1 should not be longer than 30 m and they should be shielded and the shielding must be grounded.

[1] If you are located outside Europe, please refer the appropriate EMC standards used in the country of operation.

Note

The EMC tests were carried out using shielded and grounded input and output cables with the exception of the power cord. Observe this condition when designing your setup to ensure high interference immunity and low jamming.

ISED-Notice

This device complies with CAN ICES-003 Class B standards.

FCC-Notice

This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult our tech support or an experienced technician for help.

Devices with WLAN comply with the radiation exposure limits set by the FCC for an uncontrolled environment. A minimum distance of 20 cm must be maintained during use.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this product that are not expressly approved by imc Test & Measurement GmbH may void the user's authority to operate this equipment.

Cables and leads

In order to comply with the value limits applicable to Class B devices according to part 15 of the FCC regulations, all signal leads connected to devices of imc C1 must be shielded.

Unless otherwise indicated, no connection leads may be long leads (< 30 m) as defined by the standard IEC 61326-1. LAN-cables (RJ 45) and CAN bus cables (DSUB-9) are excepted from this rule.

Only cables with suitable properties for the task (e.g. isolation for protection against electric shock) may be used.

ElektroG, RoHS, WEEE, CE

The imc Test & Measurement GmbH is registered with the authority as follows:
WEEE Reg. No. DE 43368136
valid from 24.11.2005

Reference

https://www.imc-tm.com/elekrog-rohs-weee/ and https://www.imc-tm.com/ce-conformity/
(for the C1 device variants the CE-certification of the C-SERIES devices applies).

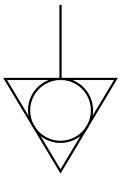
1.4 Explanation of symbols

CE Conformity

see CE chapter 1.3 6

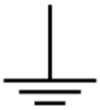
No household waste

Please do not dispose of the electrical/electronic device with household waste, but at the appropriate collection points for electrical waste, see also chapter 1.3 6.



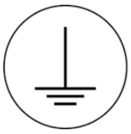
Potential compensation

Connection for potential compensation



Grounding

Connection for grounding (general, without protective function)



Protective connection

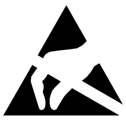
Connection for the protective conductor or grounding with protective function

Attention! General danger zone!

This symbol indicates a dangerous situation;
Since there is insufficient space for indicating the rated quantity at the measuring inputs, refer to this manual for the rated quantities of the measuring inputs before operation.

Attention! Injuries from hot surfaces!

Surfaces whose temperatures can exceed the limits under certain circumstances are denoted by the symbol shown at left.



ESD-sensitive components (device/connector)

When handling unprotected circuit boards, take suitable measures to protect against ESD (e.g. insert/remove ACC/CANFT-RESET).

Possibility of electric shock

The warning generally refers to high measurement voltages or signals at high potentials and is located on devices suitable for such measurements. The device itself does not generate dangerous voltages.

DC, Direct Current

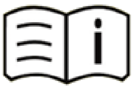
Supply of the device via a DC voltage source (in the specified voltage range)

RoHS of the PR China

The limits for hazardous substances in electrical/electronic equipment applicable in the PRC are identical to those in the EU. The restrictions are complied with (see chapter 1.2 6). A corresponding "China-RoHS" label is omitted for formal/economic reasons. Instead, the number in the symbol indicates the number of years in which no hazardous substances are released. (This is guaranteed by the absence of named substances).

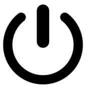
Labeling integrated energy sources

UxxRxx are integrated in the symbolism. "U" stands for the installed UPS energy sources,
if 0 = not installed. "R" stands for the installed RTC energy sources, if 0 = not installed. You can download the corresponding data sheets from the imc website:
https://www.imc-tm.com/about-imc/quality-assurance/transport-instructions/



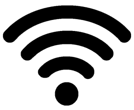
Observe the documentation

Read the documentation before starting work and/or operating.



On/Off

On/Off button (no complete disconnection from the power supply)



WLAN

Only the antennas supplied with the device may be used.
Maintain a distance of at least 20 cm.

1.5 History

Amendments and bug-fix in Edition 12

Section	Amendments
Assembly and connection	Overview 36 of available device variants added.

Amendments and bug-fix in Edition 11

Section	Amendments
Quarter bridge	Notes added for device-side addition of the quarter bridge.

Amendments and bug-fix in Edition 10

Section	Amendments
Storage media	updated description of recommended handling
Strain gauge measurement modes	wording, formulas and graphics revised

Amendments and bug-fix in Edition 9

Section	Amendments
UPS	new battery labeling on the name plate

Amendments and bug-fix in Edition 8

Section	Amendments
Connecting via LAN	The dialog for configuring the IP address of the device also provides the IP address of the PC. Thus, the first step was removed from the documentation, which presented different possibilities in Windows to determine the IP address.
Technical Specs	We added a general introduction to this chapter.

2 Safety

This section provides an overview of all important aspects of protection of the users for reliable and trouble-free operation. Failure to comply with the instructions and protection notes provided here can result in serious danger.

Responsibility of the operator

imc C1 is for use in commercial applications. The user is therefore obligated to comply with legal regulations for work safety.

Along with the work safety procedures described in this document, the user must also conform to regulations for safety, accident prevention and environmental protection which apply to the work site. If the product is not used in a manner specified by the manufacturer, the protection supported by the product may be impaired.

The user must also ensure that any personnel assisting in the use of the C1 device have also read and understood the content of this document.

Operating personnel

This document identifies the following qualifications for various fields of activity:

- *Users of measurement engineering*: Fundamentals of measurement engineering. Basic knowledge of electrical engineering is recommended. Familiarity with computers and the Microsoft Windows operating system. Users must not open or structurally modify the measurement device.
- *Qualified personnel* are able, due to training in the field and to possession of skills, experience and familiarity with the relevant regulations, to perform work assigned while independently recognizing any hazards.

Warning

- **Danger of injury due to inadequate qualifications!**
- Improper handling may lead to serious damage to personnel and property. When in doubt, consult qualified personnel.
- Work which may only be performed by trained imc personnel may not be performed by the user. Any exceptions are subject to prior consultation with the manufacturer and are conditional on having obtained corresponding training.

Industrial safety

We certify that imc C1 in all product configuration options corresponding to this documentation conforms to the directives in the accident prevention regulations in "Electric Installations and Industrial Equipment" (DGUV regulation 3, formerly known as BGV A3). This confirmation applies exclusively to devices of the imc C1-SERIES, but not to all other components included in the scope of delivery.

This certification has the sole purpose of releasing imc from the obligation to have the electrical equipment tested prior to first use (§ 5 Sec. 1, 4 of DGUV Regulation 3). This does not affect guarantee and liability regulations of the civil code.

Special hazards

This segment states what residual dangers have been identified by the hazard analysis. Observe the safety notes listed here and the warnings appearing in subsequent chapters of this manual in order to reduce health risks and to avoid dangerous situations. Existing ventilation slits on the sides of the device must be kept free to prevent heat accumulation inside the device. Please operate the device only in the intended position of use if so specified.

Danger

Lethal danger from electric current!

- Contact with conducting parts is associated with immediate lethal danger.
- Damage to the insulation or to individual components can be lethally dangerous.

Therefore:

- In case of damage to the insulation, immediately cut off the power supply and have repair performed.
- Work on the electrical equipment must be performed exclusively by expert electricians.
- During all work performed on the electrical equipment, it must be deactivated and tested for static potential.

Injuries from hot surfaces!

- Devices from imc are designed so that their surface temperatures do not exceed limits stipulated in EN 61010-1 under normal conditions.

Therefore:

- Surfaces whose temperature can exceed the limits under circumstances are denoted by the symbol shown at left.

Observe notes and warnings

Devices from imc have been carefully designed, assembled and routinely tested in accordance with the safety regulations specified in the included certificate of conformity and has left imc in perfect operating condition. To maintain this condition and to ensure continued danger-free operation, the user should pay particular attention to the remarks and warnings made in this chapter. In this way, you protect yourself and prevent the device from being damaged.

Read this document **before turning on the device for the first time** carefully.

Warning

Before touching the device sockets and the lines connected to them, make sure static electricity is diverted to ground. Damage arising from electrostatic discharge is not covered by the warranty.

3 Assembly and connection

3.1 After unpacking...

Check the delivered system immediately upon receiving it for completeness and for possible transport damage. In case of damage visible from outside, proceed as follows:

- Do not accept the delivery or only accept it with reservations
- Note the extent of the damage on the packing documents or on the delivery service's packing list.
- Begin the claims process.

Please check the device for mechanical damage and/ or loose parts after unpacking it. The supplier must be notified immediately of any transportation damage! Do not operate a damaged device!

Check that the list of accessories is complete (product package):

- AC/DC-power adaptor (10800066) with cable and pre-assembled LEMO plug
- LEMO plug for DC-powering
- Getting started with your imc measurement device (printed)

Note

File a claim about every fault as soon as it is detected. Claims for damages can only be honored within the stated claims period.

3.2 Before commissioning

Condensation may form on the circuit boards when the device is moved from a cold environment to a warm one. In these situations, always wait until the device warms up to room temperature and is completely dry before turning it on. The acclimatization period should take about 2 hours. This is especially recommended for devices without ET (extended environmental temperature range).

We recommend a warm-up phase of at least 30 min prior to measure.

Ambient temperature

The limits of the ambient temperature cannot be strictly specified because they depend on many factors of the specific application and environment, such as air flow/convection, heat radiation balance in the environment, contamination of the housing / contact with media, mounting structure, system configuration/single or block (click), connected cables, operating mode, etc. This is taken into account by specifying the operating temperature instead. Furthermore, it is not possible to predict any sharp limits for electronic components. Basically, reliability decreases when operating under extreme conditions (forced ageing). The operating temperature data represent the extreme limits at which the function of all components can still be guaranteed.

3.3 Notes on connecting

3.3.1 Precautions for operation

Certain ground rules for operating the system, aside from reasonable safety measures, must be observed to prevent danger to the user, third parties, the device itself and the measurement object. These are the use of the system in conformity to its design, and the refraining from altering the system, since possible later users may not be properly informed and may ill-advisedly rely on the precision and safety promised by the manufacturer.

Note

If you determine that the device cannot be operated in a non-dangerous manner, then the device is to be immediately taken out of operation and protected from unintentional use. Taking this action is justified under any of the following conditions:

I. the device is visibly damaged,
II. loose parts can be heard within the device,
III. the device does not work
IV. the device has been stored for a long period of time under unfavorable conditions (e.g. outdoors or in high-humidity environments).

1. Observe the data in the chapter "Technical Specifications" in the manual, to prevent damage to the unit through inappropriate signal connection.
2. Note when designing your experiments that all input and output leads must be provided with shielding which is connected to the protection ground ("CHASSIS") at one end in order to ensure high resistance to interference and noisy transmission.
3. Unused, open channels (having no defined signal) should not be configured with sensitive input ranges since otherwise the measurement data could be affected. Configure unused channels with a broad input range or short them out. The same applies to channels not configured as active.
4. If you are using a removable storage media, observe the notes in the imc software manual.
   Particular care should be taken to comply with the storage device's max. ambient temperature limitation.
5. Avoid prolonged exposure of the device to sunlight.

3.3.2 Power supply

Each device is powered by a DC-supply voltage which is supplied via a 2-pin LEMO-plug.

Type designation LEMO plug: FGG.**1B**.302.CLAD52ZN (ACC/POWER-PLUG1)

The permissible supply voltage range is 10 ... 32 V DC. The product package includes a corresponding desktop supply unit (15 V DC) as an AC-adapter for mains voltage (110 .. 240 V 50/60Hz). With regard to EN 61326-1 and EN 61010-1, the DC supply inputs are not specified for connection to a DC mains supply. DC networks are particularly extensive supply installations in the industrial sector. For these, increased safety margins are assumed for expected transient overvoltages in the event of a fault. This is comparable to the safety categories CAT II..IV in AC mains voltage systems.

Please note, that the operation temperature of the desktop supply is prepared for 0°C to 40°C, even if your measurement devices is designed for extended temperature range!

The package also includes a cable with a ready-made LEMO-plug which can be connected to a DC-voltage source such as a car battery. When using this, note the following:

- Grounding of the device must be ensured. If the power supply unit comes with a grounding line, it would be possible to ground the system "by force", by making a connection from this line to the plug enclosure (and thus to the device ground). The table-top power supply unit is made to allow this.
  This manner of proceeding may not be desirable because it may be desirable to avoid transient currents along this line (e.g. in vehicles). In this case the ground-connection must be made to the device directly. For this purpose a (black) banana jack ("CHASSIS") is provided.
- The feed line must have low resistance, the cable must have an adequate cross-section. Any interference-suppressing filters which may be inserted into the line must not have any series inductor greater than 1 mH. Otherwise an additional parallel-capacitor is needed.

Pin configuration:

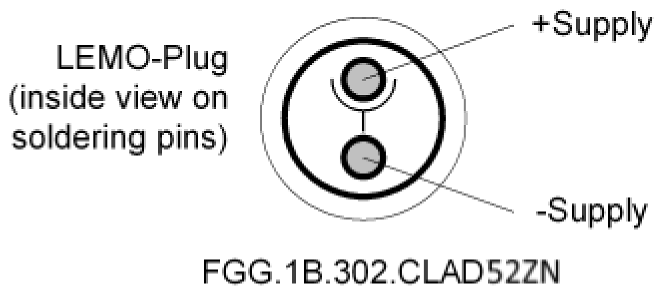


Fig. shows the view on top of the socket.
The +pin is marked with a red dot.

3.3.3 Grounding, shielding

In order to comply with Part 15 of the FCC-regulations applicable to devices of Class B, the system must be grounded.

3.3.3.1 Devices with non-isolated power supply

The DC supply input on the C1 / C1-1-XX device itself (LEMO socket) is not galvanically isolated from the housing (CHASSIS). That means the device's internal power supply circuit is not isolated from the system reference ground or the frame ("CHASSIS").

3.3.3.2 Shielding

Also, all **signal leads** to the device must be shielded and the shielding grounded (electric contact between the shielding and the **plug housing** "**CHASSIS**").

3.3.4 Potential difference with synchronized devices

When using multiple devices connected via the **SYNC socket** for synchronization purposes, 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.

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 plug at your device is equipped with a yellow ring it is already isolated and it is protected against potential differences.

Note

The yellow ring on the SYNC socket indicates that the socket is shielded from voltage differences.

3.3.5 Fuses (polarity-inversion protection)

The device supply input is equipped with maintenance-free polarity-inversion protection. No fuses or surge protection is provided here. Particularly upon activation of the device, high current peaks are to be expected. When using the device with a DC-voltage supply and custom-designed supply cable, be sure to take this into account by providing adequate cable cross-section.

3.3.6 Main switch

3.3.6.1 Activation

Devices with a flip switch will be activated by setting the main switch to the "I" position. Successful "booting" of the device is confirmed by three short beeps. Upon activation, all 6 status LED flashes twice.

3.3.6.2 Deactivation

Devices with flip switch will be deactivated by setting the main switch to the "0" position. If the device is running a measurement, it does not deactivate immediately. First, any associated files are closed on the internal hard drive before the device switches off automatically. This process lasts for a maximum of 10 sec. It is not necessary to hold the main switch down for this duration.

3.3.7 UPS

Devices with DC supply input are equipped with an uninterruptible power supply (UPS). This allows for a continuous operation unaffected by temporary short-term outage of the main power supply. This type of operation is particularly useful for operation in a vehicle, permanently attached to starter lock and main power switch and thus not requiring manual control. Activation of UPS buffering is indicated by the power control LED (PWR) changing from green to yellow. With many imc measurement devices, active UPS buffering is additionally indicated by an acoustic buzzer signal.

The UPS provides backup in case of power outage and monitors its duration. If the power outage is continuous and if it exceeds the specific device's "buffer time constant", the device initiates an automatic shutdown sequence, which equals manual shutdown procedure: Any current active measurement is automatically stopped, data storage on flash card or internal harddisk is completed by securely closing all data files, and finally the device is actually switched off. This entire process may take a couple of seconds.

Thus, a typical application of this configuration is in vehicles, where the power supply is coupled to the ignition. A buffer is thus provided against short-term interruptions. And on the other hand, deep discharge of the buffer battery is avoided in cases where the measurement system is not deactivated when the vehicle is turned off.

If the power failure is not continuous but only temporary, the timer that monitors blackout duration is reset every time the main supply has returned to valid levels. The buffer time constant is a variable device parameter that can be configured according to system size and battery capacity. It can usually be written into the device under software control and is preconfigured to reasonable default values upon delivery (see description in the software manual).

Notes

- For an UPS functionality devices with ID code "**-FD**" (suffix) are equipped with **Super-Caps** instead of lead-gel batteries.
- For all other C1 models 48 (without ID code "-FD"), refer to the technical data for UPS and maintenance instructions of the lead gel accumulators in the previous manual version 4 R 3.
- imc C1 devices delivered by imc after November 2022 will have a "battery label" 10 on the nameplate for integrated energy sources.

3.3.7.1 Buffering time constant and maximum buffer duration

The buffer time constant is a permanently configurable device parameter which can be selected as a order option. It sets the maximum duration of a continuous power outage after which the device turns itself off.

The maximum buffer duration is the maximum (total) time, determined by the battery capacity, which the device can run on backup. This refers to cases where the self-deactivation is not triggered; e.g., in case of repeated short-term power-interruptions. The maximum buffer duration depends on the battery's current charge, on the ambient temperature and on the battery's age. The device automatically deactivates itself just in time to avoid deep discharge of the battery.

Note

The buffer time constant can be changed using the imc operating software.

Reference

See in the software manual under "*Device properties*" > "*Property: UPS*".

3.3.7.2 Charging power

The charging power depends on the device type, its hardware configuration, and the amount and type of rechargeable batteries installed. For this reason, there are a variety of combinations with charging power between 2.4 W and 16 W.

3.3.7.3 Take-over threshold

The voltage threshold at which the storage battery takes over the power supply from the external source is approx. 8.1 V. The take-over procedure is subjected to an hysteresis to prevent oscillating take-over. This would be caused by the external supply's impedance. This inevitable impedance lets the external supply rise again, right after take-over to internal buffering. Hysteresis in the take-over threshold will prevent oscillations due to this effect. If, during supply from of the buffering battery, the external supply voltage rises as high as 9 V, the external voltage takes over again from the buffering battery.

If you check these thresholds, note that when the supply voltage is overlaid with a high frequency interference or ripple-voltage, the minima are of key importance. In fact, the overlying interference could be caused by feedback from the device itself!

Note

- The voltage specification refers to the device terminals. Please consider the voltage drop of the supply line, when determining the voltage supply.
- During activation the supply voltage must be above the upper take-over threshold (≥11 V).

3.3.8 Storage media in the device

This section describes how to handle the storage media of the imc measurement devices and how to use them with imc STUDIO.

The storage media are exclusively for data acquisition with imc STUDIO.

Storage media with verified performance can be purchased as accessories from imc. Hard drives are ordered with the device and can only be installed subsequently by imc.

Note Manufacturer and Age of the storage medium

- 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.

3.3.8.1 For devices of the firmware group A (imc DEVICES)

Swapping the storage medium

Pressing the button 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. If the storage medium is removed while a measurement is in progress, the data records are not completed. Therefore, always proceed as follows when 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 button, in order to **avoid damage** to the storage medium.
2. Once the LED blinks, remove the storage medium.
3. Insert the new storage medium. Devices indicate by a short flash that the new drive has been successfully recognized.

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 in the imc STUDIO manual "*Setup pages - Configuring device*" > "*Storage options and directory structure*" > "*RAM buffer time*"). 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 button, in order to **avoid data loss and damage** to the storage medium. The LED will **shine continuously** in green.
2. Once the device is ready for removal of the storage medium, the LED **blinks**.
3. Remove the already full storage medium.
4. No announcement is necessary for inserting a storage medium.

3.3.8.1.1 Storage media

Storage media	Description
CF Cards (Compact Flash)	For devices of group A4 and A5 37: The device group exclusively uses CF cards for storage medium.

3.3.8.1.2 Data transfer

The internal storage medium can be accessed **directly via Windows Explorer**. Alternatively, the storage medium can be inserted into a **card reader** on the PC (suitable for large amounts of data due to faster transfer).

Warning

- Do **not use force** to insert or remove the device 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.

Note

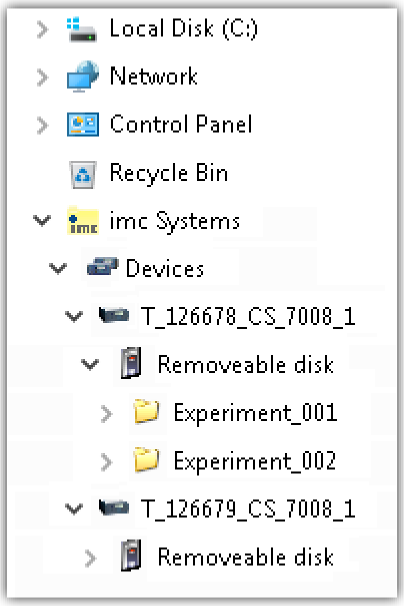
A tip on **interval saving**: Supposing the system's power supply suffers an outage during a measurement, it would not be possible to guarantee that the data file on the storage medium is terminated properly. This may lead to a failure to record the last measurement taken. Saving at intervals is a way to reduce this risk.

Access via Windows Explorer

The menu item "*Data (Device)*" () causes the Windows-Explorer to start while indicating the device selected.

Ribbon	View
Extra > Data (Device) ()	Complete
Home > Data (Device) ()	Standard

Access via "*imc Systems*" - an Explorer shell extension



While installing the operating software, if the option "*Extension for Windows-Explorer*" 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.

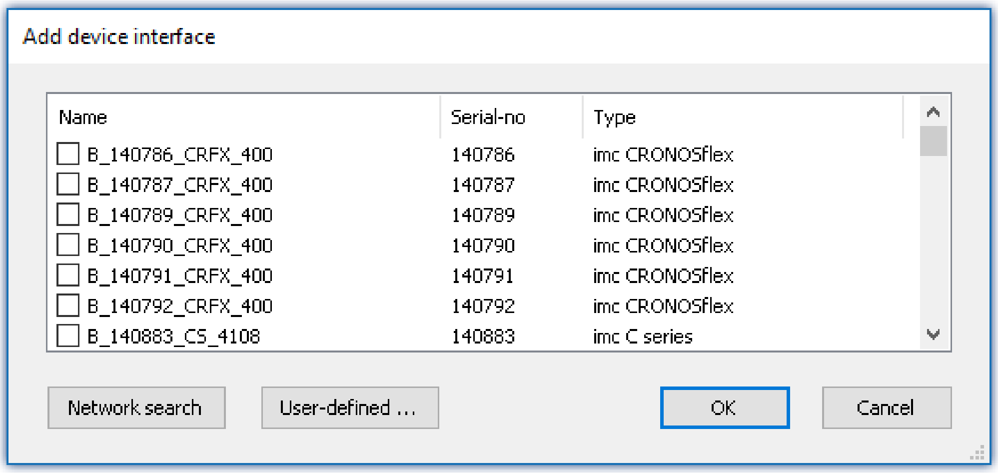
In order to get access to your device's storage medium, you must first add it to the tree diagram (see "*imc Systems - Adding a device* 22"). Subsequently, you are able to navigate to the desired data in the storage medium and thus to work with them.

3.3.8.1.2.1 imc Systems - Adding a device (Add)

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

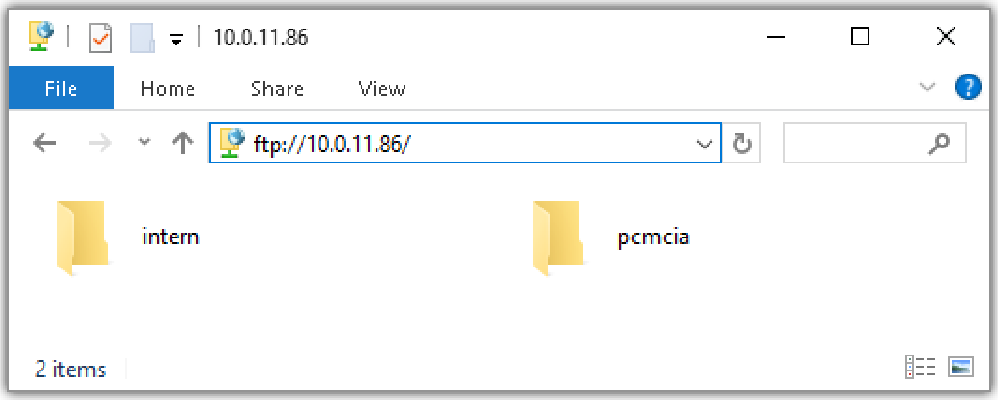
More information is presented in the imc STUDIO manual in the section: "*Setting Up - Connect the device*"

- General: "*Device connection via LAN*"
- "*Connection via a direct address*"

3.3.8.1.2.2 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.

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).

3.3.8.1.3 File system and formatting

Storage media with the file systems FAT32 and FAT16 (maximum 2 GB) are supported. It is recommended that a memory card be formatted 24 and possibly partitioned before use.

Note — Routine formatting protects the memory card

Routine formatting is recommended

Take every opportunity to format the storage medium. **Recommendation:** at least every **six months**.

In this way, any **damaged storage medium** can be detected and repaired if possible. A damaged file system may cause **data loss**. Or the **measurement system may fail to start** correctly.

In order to avoid data loss, any data still needed should first be saved!

Using a data storage medium in different devices

There are no known limitations. But it is recommended to always format the medium whenever transferring it in order to avoid data loss.

Additional notes

- To select the appropriate file system for the respective application, observe the notes on the data rate and on "*Avoidance of Data Overflow* 24".
- No limitations regarding the currently available storage medium volumes are known.
- The maximum filesize is 2 GB. In case a signal would exceed that limit, use interval saving.

Notes — General restrictions applicable to file systems

Please observe the general restrictions regarding the respective file systems.

3.3.8.1.3.1 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.
- Only **one(!)** partition may be created. Multiple partitions may cause the measuring device not to recognize the storage medium.

Warning — Please back up the data first

Formatting causes all data on the storage medium to be deleted. Before performing the formatting, ensure that all data have been saved on a different storage medium.

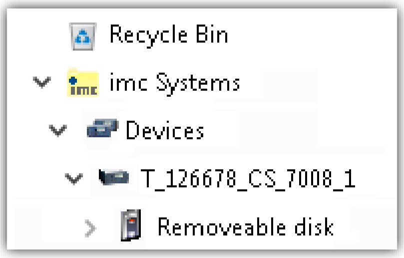
Note — Cluster size - Avoidance of Data Overflow

The size and number of assignment units (clusters) and thus also the file system 24 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 8 kB/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 larger than 512 MB are formatted with 8 kByte clusters and cards larger than 4 GB are formatted with 16 kByte clusters. Cards of up to 1 GB 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.

Formatting in the device (Recommended)



For **formatting in the device**, navigate via the Explorer shell "*imc Systems* 21" 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!*".

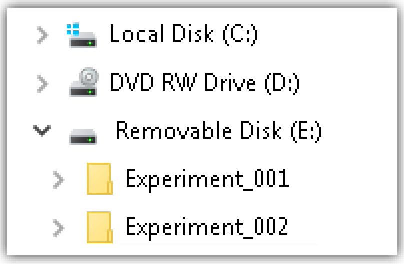
The device performs the formatting according to the following rule:

Drive size	Cluster size	File system
<= 512 MB	2 kB	FAT16
<= 4 GB	8 kB	FAT32
> 4 GB	16 kB	FAT32

Note

Formatting the storage medium 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 storage medium via the Windows-Explorer** 23, navigate to the desired storage medium. 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 24.

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.

3.3.8.1.4 Known issues and limitations

Known issues and limitations	Description
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 our tech support 6.
The system won't recognize the data storage drive	• Answer 1: Check the file system: The device supports FAT32/FAT16 24. • 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.
File system becoming gradually slower	As the count of folders increases, so does the time required by the system to access the data. In consequence, the data saving procedure becomes slower and data loss becomes possible. For this reason, creating more than 1000 folders is to be avoided.
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. 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 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**.
Data overflow due to improper cluster size	• With a storage medium formatted by Windows to FAT32 24, 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 24, data overflow can occur if a high aggregate sampling rate is generated by very many low-speed channels.

4 Maintenance and servicing

4.1 Maintenance and servicing

imc recommends performing a service check every 12 months. An imc service check includes system maintenance in accordance with the service interval plan as specified by the manufacturer and a complete function test (maintenance, inspection and revision).

Maintenance (*repair*) work may only be carried out by qualified personnel from imc Test & Measurement GmbH.

For service and maintenance work, please use the service form that you download from our website and fill out: https://www.imc-tm.com/service

Reference Device certificates and calibration protocols

Detailed information on certificates, the specific contents, underlying standards (e.g. ISO 9001 / ISO 17025) and available media (pdf etc.) can be found on our website, or you can contact us directly.

4.2 Cleaning

Always unplug the power supply before cleaning the device. Only qualified personnel 12 are permitted to clean the housing interior.

Do not use abrasive materials or solutions which are harmful to plastics. Use a dry cloth to clean the housing. If the housing is particularly dirty, use a cloth which has been slightly moistened in a cleaning solution and then carefully wrung out. To clean the slits use a small soft dry brush.

Do not allow liquids to enter the housing interior.

4.3 Storage

As a rule, the measurement device must be stored in a temperature range of -40°C to +85°C.

4.4 Transport

When transporting, always use the original packaging or a appropriate packaging which protects the device against knocks and impacts. If transport damages occur, please be sure to contact our tech support. Damage arising from transporting is not covered in the manufacturer's guarantee. Possible damage due to condensation can be limited by wrapping the device in plastic sheeting.

5 Start of operation Software / Firmware

5.1 Installation - Software

The associated measurement engineering software imc STUDIO, the configuration and operating interface for all imc instruments, provides the devices with exceedingly versatile functionality. It achieves comprehensive total solutions for everything from laboratory tests through mobile data logger application all the way to complete industrial test stations.

Use of the software requires a license, subject to the purchase order and configuration (see e.g. imc STUDIO manual product configuration / license).

In order to be able to install or uninstall imc STUDIO products, you must be registered with a user account possessing administrator rights to the PC. This applies to the overwhelming majority of all installations of Windows. However, if you are only logged on to your PC without administrator rights, log off and log back on with an administrator user account. If you do not possess an administrator user account, you will need the support or your system administrator or IT department.

You will find a detailed description to the installation of the software in the adequate manual or getting started.

5.1.1 System requirements

The minimum requirements of the PC, the recommended configuration for the PC, the supported operating system are mentioned in the data sheets and the imc STUDIO manual.

5.2 Connect the device

There are multiple ways to **connect the imc measurement devices with the PC**. In most cases, the **connection via LAN** (local area network, Ethernet) is implemented. See section "*Connecting via LAN in three steps* 30" for the **quickest way to connect** PC and measurement device.

But there are also other connection types:

- WLAN
- LTE, 4G, etc. (via appropriate routers)

These are described in a separate chapter in the software manual: "*Special options for connecting to the device*".

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.

Recommended network configuration

The latest and high-performance network technologies should be used to achieve the maximum transfer bandwidth. This means especially 1000BASE-T (GBit Ethernet). GBit Ethernet network devices (switches) are downward compatible, so that imc devices that only support 100 MBit Fast Ethernet can also be operated on them.

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 100 m 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. Under some circumstances, this may require using switches to subdivide the network into separate segments in order to govern the data traffic in a targeted way and thus optimize the data rate.

In very demanding applications, you might consider grouping multiple GBit Ethernet devices via even higher-performance sections lines of the network (e.g. via 5 GBit Ethernet) and to connect these groups to NAS-components, for instance, via these lines.

When such imc devices are included which use network-based PTP-synchronization (e.g. CRXT or CRFX-2000GP), then it is necessary to use network switches which fully support this protocol on the hardware side. Appropriate network components are also available as imc accessories (e.g. CRFX/NET-SWITCH-5) and are then electrically and mechanically fully compatible with the imc systems.

5.3 Connecting via LAN in three steps

The most common case is described below: the PC and the device are connected via cable or network 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 recognizes the device's hardware configuration. In that case, experiment configurations can be prepared without any connection to the device.

Step 1: Connecting the measurement device

To connect via LAN there are two options:

1. The measurement device is connected to an **existing network**, e.g. via network switch. Only with a switch is it possible to run multiple devices.
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. Modern PCs and network switches are usually equipped with Auto-MDI(X) automatic crossover recognition, so that it is not necessary to distinguish between crossed and uncrossed connection cables. Thus both cable types can be used.

Step 2: IP-configuration

Start imc STUDIO. Click the "*Device interfaces*" button ( ) to open the dialog for configuring the IP address of the device.

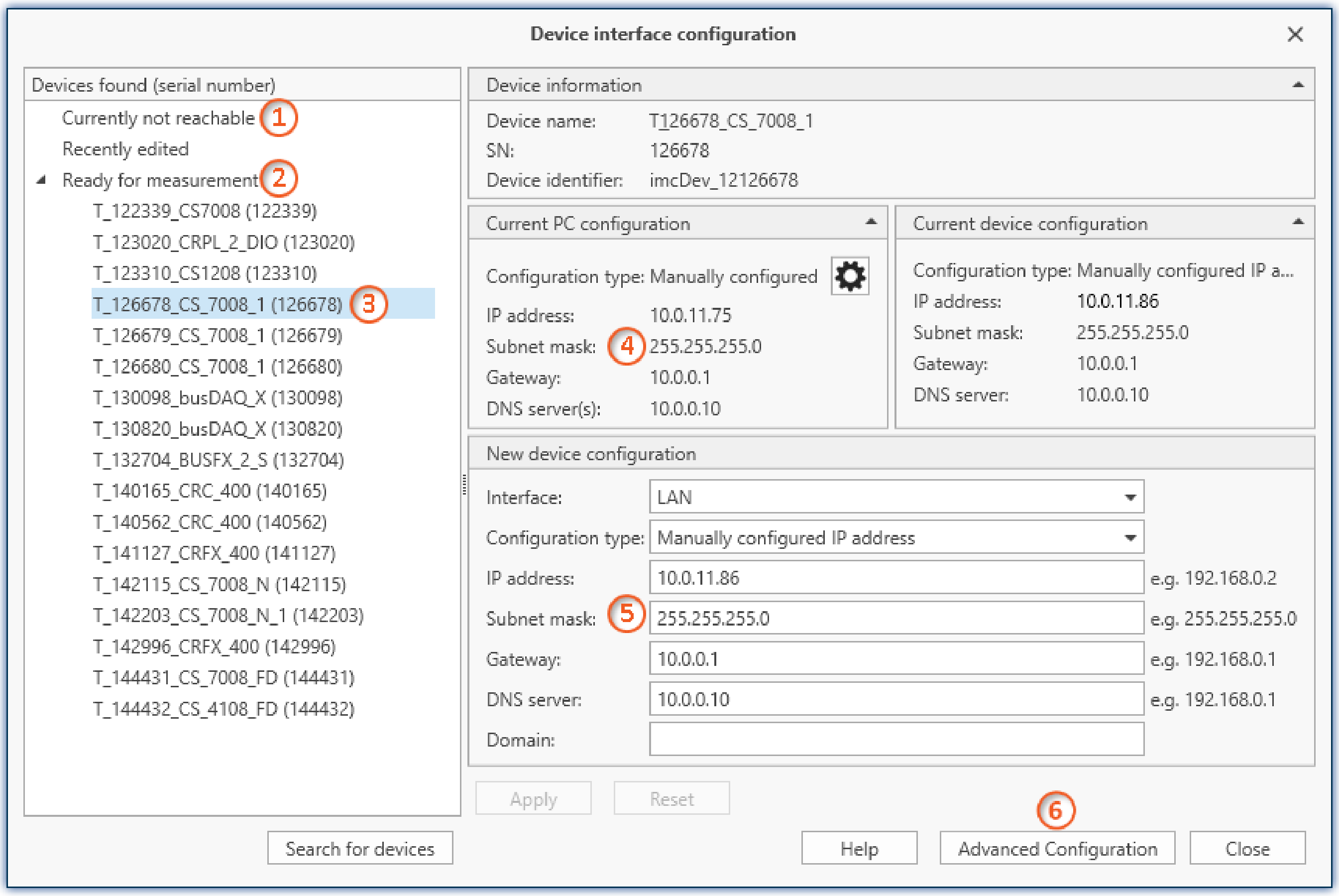
Ribbon	View
Setup-Configuration > Device interfaces ( )	Complete

If this **button** is **not present** in the view, 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 appears among the group "*Currently not reachable*" ①, it is necessary to modify the device's LAN-settings. If the device appears among the group "*Ready for measurement*" ②, you can leave the settings as they are or review them.

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

Select the device for making modifications ③.



Display of measurement devices found and of the IP address

Set the **IP address manually** if you are not using DHCP. The device's IP address ⑤ must match with the PC's address ④. To conform to the network mask, only the device portion may be different (see example).

Example

In the example shown, the fixed IP 10.0.11.75 with subnet mask 255.255.255.0 is selected for the PC. For measurement devices, any numbers would be suitable which begin with 10.0.11. and then do not contain 0, 75, or 255. The 0 and the 255 should not be used, if possible, due to their special significance. The 75 is the computer's number.

Example for IP settings	PC	Device
IP address	10 . 0 . 11 . 75	10 . 0 . 11 . 86
Network mask	255 . 255 . 255 . 0	255 . 255 . 255 . 0

Open the dialog for configuring the **WLAN settings** via the "Advanced Configuration" button ⑥. Please refer to the imc software manual for a description of the dialog.

If the configuration type: "*DHCP*" is used, **the IP address is obtained automatically** from the DHCP-server. 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.).

If there is a **direct connection** between the device and the PC by a cable, then **DHCP should not be used**.

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

Note Connection via modem or WLAN

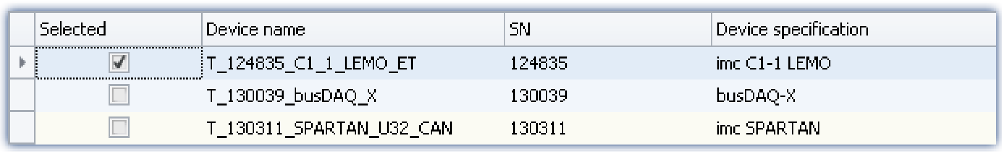
If the connection to the device is established via a modem or WLAN, start the program "*imc DEVICES Interface Configuration*" by clicking on the button: "*Advanced Configuration*" (see previous figure). An exact description is found in the software manual chapter: "*Setting Up - Connect the device*"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

Step 3: 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*".

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.



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 the component "*Setup*".

Reference Time zone

Now check whether the correct time zone is set for the device. For more info, see the description of the software manual under the keyword "*Device properties*".

5.4 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.

Note

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

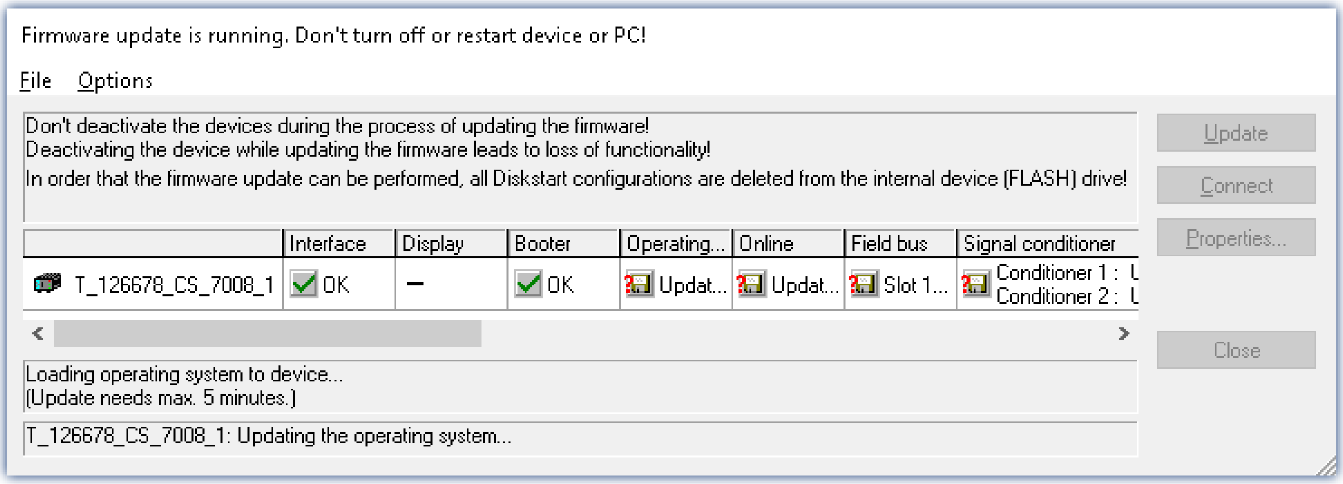
Warning Do not interrupt the firmware update!

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!

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

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 diplayed 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
Fieldbus	Fieldbus interfaces (e.g. CAN etc.)
Signal conditioners	Amplifiers

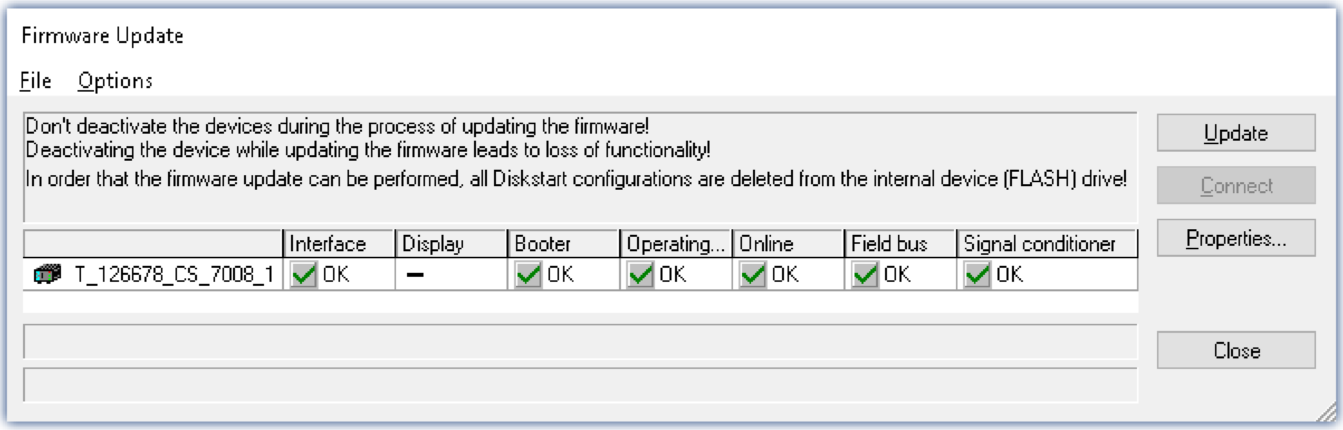
The following symbols for the individual firmware components appear in the list:

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 number 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 **Be sure to observe in case of error**

- 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 Firmware 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, to access services in parallel that are accessible via 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 our tech support 6. The firmware update may be continued with guidance from the tech support.

Note

Firmware logbook

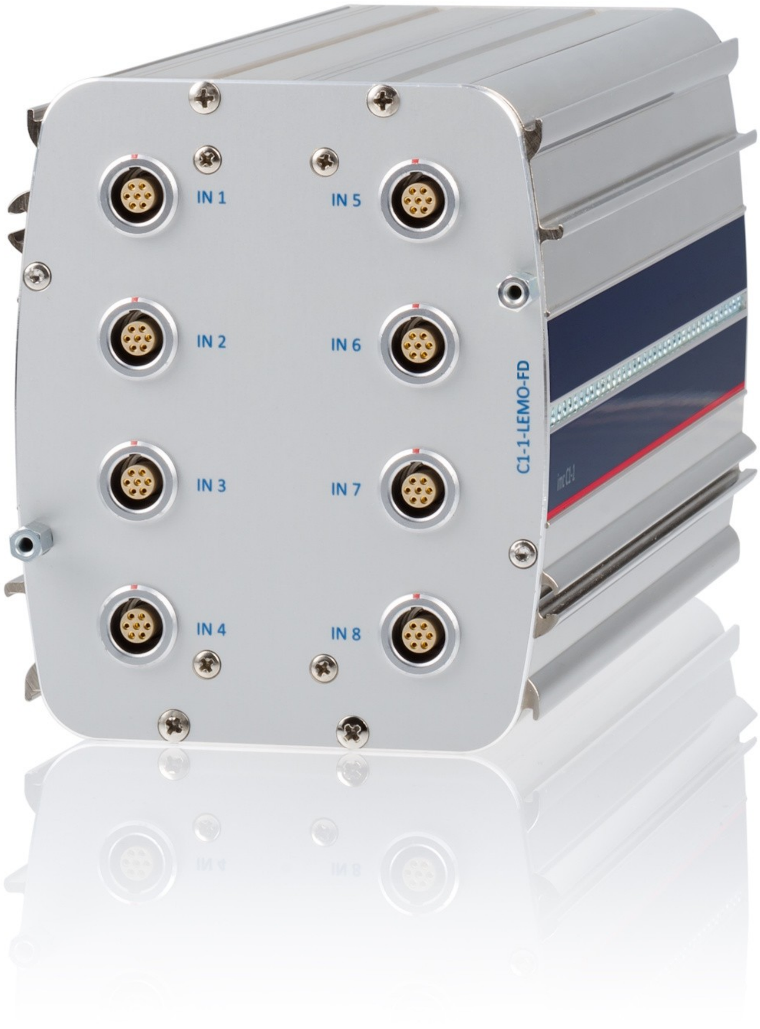
The "*File*" menu offers a function for working with the firmware log file. Every action taken during a firmware update plus any errors which may occur are recorded in a log file. This log file can be displayed with menu "*File*" > "*Show log file*".

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 tech support.

6 Properties of the imc C1 devices

C1 devices consist of smart network-capable, unventilated compact measurement devices for all-purpose measurement of physical quantities. These devices can operate either in computer-aided or autonomous mode and are lightweight, compact, and robust, thus, especially well adapted to applications in R&D or in the testing of mechanical and electromechanical components of machines, on board vehicles, or in monitoring tasks in installations.



Overview of the available C1 devices

Order code	article no.	housing	analog channels	properties
C1-1-LEMO-FD	14000136			CAN FD, Super-Cap UPS and LEMO.1B sockets for signal connection
C1-1-LEMO-FD-ET	14100070	CS alu profile	8	for extended temperature range
C1-1-VEAM-FD	14000160			CAN FD, Super-Cap UPS and ITT.VEAM sockets for signal connection

6.1 Device overview

Some of the capabilities discussed in this document only pertain to certain device models. The associated device groups are indicated at the respective locations. The groups are shown in the following table.

— not available	● standard	o optional
CRXT imc CRONOS-XT	CRFX imc CRONOS*flex*	CRC imc CRONOS*compact*

imc device	SPARTAN	BUSDAQ	BUSLOG*flex*	BUSDAQ*flex*	SPARTAN-R SPARTAN-N	CRSL-N CRC-400	C1-N C-SERIE-N	C1-FD C-SERIE-FD	CRFX-400	CRFX-2000	CRC-2000G	CRC-400GP	CRFX-2000G	CRFX-2000GP	CRXT	EOS	ARGUS*fit*
Driver package	imc DEVICES															imc DEVICE*core*	
Firmware group	**A**															**B**	
Device group	**A4**				**A5**					**A6**	**A7**					**B10**	**B11**
SN[1]	13				14					16	19					4120	416
TCP/IP Interface [MBit/s]	100				100					100	1000					1000	1000
Sampl.Rate[2] [kHz]	400				400					2000 / 400 [3]	2000 / 400 [3]	2000 / 400 [3]	2000	2000	2000	4000	5000
STUDIO Monitor supported	●				●					●	●					—	—
Connections[4]	4				4					4	4					—	—
Signal processing in the device																	
Online FAMOS	o	o	—	o	o	●	●	●	●	●	●					—	●
Preprocessing original channel	●	—	—	—	●	●	●	●	—	●	●	●	—	—	—	—	—
Preprocessing monitor channel	●	—	—	—	●	●	●	●	—	●	●	●	—	—	—	—	●
Data Storage																	
CF	●				●					—	—					—	—
Express Card	—				—					●	—					—	—
CFast	—				—					—	●					—	—
USB	—				—					●	●	●	●	●	—	—	—
microSD	—				—					—	—					—	●
Storage on network drive	●				●					●	●					—	—
Internal hard disk	o	(o)[5]	—	—	o	o	—	—	o	o	o					●	—
Synchronization																	
DCF	●				●					●	●					—	—
IRIG-B	—	—	●	●	●					●	●					●	●
GPS	●	●	—	(●)[6]	●					●	●					—	●
NTP	—	—	●	●	●					●	●					●	●
PTP	—				—					—	—	●	—	●	●	—	—
Phase offset correction	—	—	●	●	●					●	●					●	●

1 Extend serial number range by four digits (three for imc EOS)
2 Max. aggregate sampling rate (see data sheet)
3 2000 via EtherCAT else 400
4 Number of imc STUDIO Monitor-connections or imc REMOTE (as of 14xxxx) connections
5 not available for imc BUSDAQ-2
6 not available for imc BUSDAQ*flex*-2-S

6.2 Operating software

- imc BUSDAQ*flex*, imc BUSDAQ, imc SPARTAN, imc C-SERIES and measurement devices from the imc CRONOS-series is operated using the operating software **imc STUDIO**. The operating software enables complete manual and automatic setting of the measurement parameters, real-time functions, trigger machines and data saving modes. Display of measurement plots in the curve window and, as well as experiment documentation in the Report Generator, are integral elements of the software. There are extensive triggering options and data storage options adapted to particular applications. Together with the supplementary software imc Online FAMOS, the raw data can be processed in real time to yield the result data in the desired format, and can be displayed.
- imc CANSAS modules can be configured directly from the operating software if the imc CANSAS software is on the same computer. A separate connection from the imc CANSAS module to the PC, e.g. via a USB-CAN adapter, is not necessary.
- For special tasks such as system integration in test rigs, there are comfortable interfaces for all common programming languages like Visual Basic ™, Delphi ™ or LabVIEW.

6.3 Sampling interval

Among the system's physical measurement channels, up to two different sampling times can be in use. For the possible sampling time see the technical specification in this manual.

The sampling rates of the **virtual channels** computed by imc Online FAMOS do not contribute to the aggregate 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).

There is one constraint when selecting two different sampling rates: **Two sampling rates** having the ratio 2:5 and lower than 1ms are not permitted (e.g. 200 µs and 500 µs).The sampling rates of **Fieldbus channels** are not subject to any particular rule and may be as diverse as desired. The **aggregate sampling** rate of the system is the **sum of the sampling rates** of all active channels.

6.4 TEDS

imc Plug & Measure is based on the TEDS technology conforming to IEEE 1451.4. It fulfills the vision of quick and error-free measurement even by inexperienced use. TEDS stands for Transducer Electronic Data Sheet and amounts to a spec sheet containing information about a sensor, a measurement location and the measurement technology used. It is stored in a memory chip which is permanently attached to the sensor, and can be read and processed by the measurement equipment. Besides this, the memory also include a number (unique ID) by which the sensor can be uniquely identified.

A TEDS sensor or a conventional sensor equipped with a sensor recognition memory unit is connected to the device. The sensor recognition contains a record of the sensor's data and the measurement device settings. The device reads this info and sets itself accordingly. Any inapplicable sensor information is rejected, and a notification is posted accordingly. For more information, refer to the software user's manual under "*Read sensor information*".

Note Used TEDS chip (storage)

Devices of the imc C1-1-LEMO(-VEAM)-FD series:

- support imc TEDS DSUB plugs (DS 2433)
- do not support sensor type DS 2431, e.g. imc Triaxial Accelerometers (SEN/ACC-ADxx).

6.5 Measurement types

6.5.1 Temperature measurement

Two methods are available for measuring temperature. Measurement using a **PT100** requires a constant current, e.g. of 250 µA to flow through the sensor. The temperature-dependent resistance causes a voltage drop which is correlated to a temperature according to a characteristic curve.

When measuring with **thermocouples**, the temperature is determined via the series of voltages of different alloys. The sensor generates a temperature-dependent voltage which is relative to the terminal point on the plug. To find the absolute temperature, the temperature of the terminal point must be known. This is determined with a **PT1000** directly in the terminal plug and requires a special plug type.

The measured voltage is converted into the displayed temperature value according to the characteristics of the temperature scale IPTS-68.

Note Making settings with imc software

A temperature measurement is a voltage measurement whose measured values are converted to physical temperature values by reference to a characteristic curve. The characteristic curve is selected using the "Correction" parameter on the " Measurement mode" tab. Amplifiers which enable bridge measurement, must first be set to the "*Voltage*" measurement mode in order for the temperature characteristics curves to be available for selection.

6.5.1.1 Thermocouples as per DIN and IEC

The following standards apply for thermocouples, in terms of their thermoelectric voltage and tolerances:

Thermocouple	Symbol	max. temp.	defined up to	(+)	(-)
	DIN IEC 584-1 (2014-07)				
Iron-constantan (Fe-CuNi)	**J**	750°C	1200°C	black	white
Copper-constantan (Cu-CuNi)	**T**	350°C	400°C	brown	white
Nickel-chromium-Nickel (NiCr-Ni)	**K**	1200°C	1370°C	green	white
Nickel-chromium-constantan (NiCr-CuNi)	**E**	900°C	1000°C	violet	white
Nicrosil-Nisil (NiCrSi-NiSi)	**N**	1200°C	1300°C	red	orange
Platinum-Rhodium-platinum (Pt10Rh-Pt)	**S**	1600°C	1760°C	orange	white
Platinum-Rhodium-platinum (Pt13Rh-Pt)	**R**	1600°C	1760°C	orange	white
Platinum-Rhodium-platinum (Pt30Rh-Pt6Rh)	**B**	1700°C	1820°C	n.a.	n.a.
		DIN 43710			
Iron-constantan (Fe-CuNi)	**L**	600°C	900°C	red	blue
Copper-constantan (Cu-CuNi)	**U**	900°C	600°C	red	brown

If the thermo-wires have no identifying markings, the following ***distinguishing characteristics*** can help:

- Fe-CuNi: Plus-pole is magnetic
- Cu-CuNi: Plus-pole is copper-colored
- NiCr-Ni: Minus-pole is magnetic
- PtRh-Pt: Minus-pole is softer

The color-coding of compensating leads is stipulated by DIN 43713. For components conforming to IEC 60584: **The plus-pole is the same color as the shell; the minus-pole is white**.

6.5.1.2 PT100 (RTD) - measurement

RTD (PT100) sensors can be directly connected in 4-wire-configuration. An additional reference current source feeds a chain of up to 4 sensors in series

6.5.2 Bridge measurement

This chapter describes the different bridge types and circuits of the bridge channels.

6.5.2.1 Definition of terms

Strain is the ratio between the original length of a structure and the change in length due to the effect of a force.

$$\varepsilon = \frac{dL}{L}$$

If a strain gauge is attached to a measuring object, the strain is transferred to the measuring grid of the strain gauge when the object is stretched. The change in length caused in the measuring grid causes a change in resistance. There is a proportionality between the change in length and the change in resistance:

$$\varepsilon = \frac{dL}{L} = \frac{dR/R}{k}$$

Legend:	
ε	strain
dL	change in length
L	original length
dR	change in resistance
R	resistance of strain gauge
k	Gauge factor (k factor), describing the ratio of relative length change to the change in resistance

The changes in the resistance caused by the strain are very small. For this reason, a bridge circuit is used to translate the changes in resistance into voltage changes. Depending on the circuit, from one to four strain gauges can be employed as bridge resistors.

Assuming that all bridge resistors have the same value, we have

$$V_a = V_e \cdot \frac{dR}{4 \cdot R} = \frac{V_e}{4} \cdot k \cdot \varepsilon$$

Legend:	
V_a	measurement voltage
V_e	excitation voltage

$$\varepsilon = \frac{V_a \cdot 4}{V_e \cdot k}$$

For concrete measurement tasks, the arrangement of the strain gauges on the test object is important, as well as the circuity of the bridge. On the "bridge circuit", you can select among typical arrangements. A drawing below this drop down menu shows the position of the strain gauge on your test object and the corresponding bridge circuit. Notes on the selected arrangement are displayed in a text box.

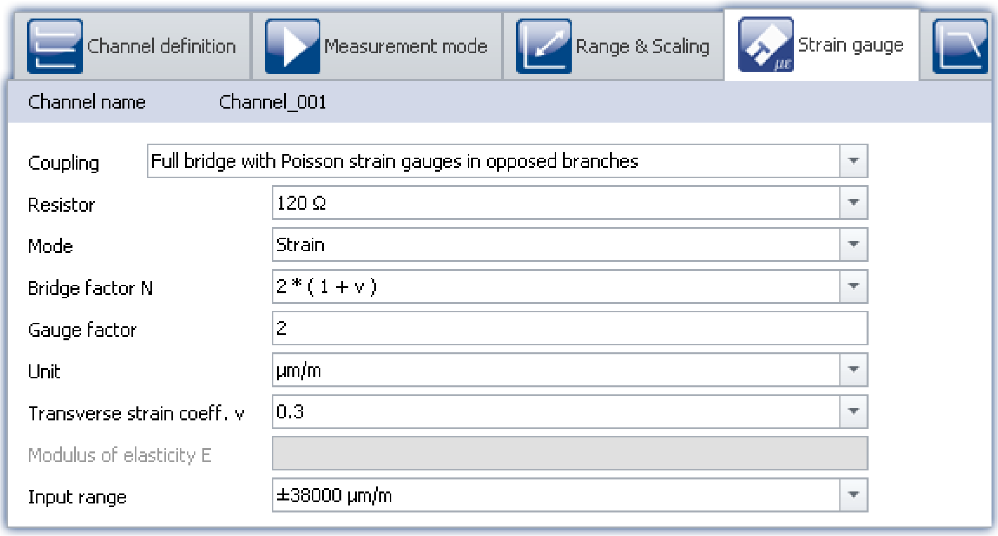
Note

For an easier operation, ranges that are unsuitable are hidden in the operating software.

Scaling for the strain analysis

It is possible to decide whether the strain or the mechanical stress should be determined. In the range of elastic deformation, the axial stress (force / cross section) is proportional to the strain. The proportionality factor is the modulus of elasticity.

Mechanical stress = modulus of elasticity · strain (**Hooke's law**)



By selecting the "Strain gauge" measurement mode, common bridge circuits and strain gauge arrangements are offered. The scaling can be set using the typical parameters for strain measurements such as K-factor or transverse strain coefficient.

Gauge factor (k factor)

The K-factor is the ratio by which the mechanical quantity (elongation) is transformed to the electrical quantity (change in resistance). The typical range is between 1.9 and 4.7. The exact value can be found in the spec sheet for the strain gauge used. If the value entered for this parameter is outside of this range, a warning message will appear but the module can still be configured.

Unit

When the strain is determined, the readings appear with the unit µm/m.
For the mechanical stress one can toggle between GPa and N/ mm^2.

1 GPa = 10^3 N/ mm^2

Note that the elastic modulus is always in GPa.

Transverse strain coeff.

(poisson's ratio): If a body suffers compression or tension and is able to be freely deformed, then not only its length but also its thickness changes. This phenomenon is known as transversal contraction. It can be shown that for each kind of material, the relative change in length is proportional to the relative change in thickness D. The transversal elongation coefficient (Poisson's ratio) is the material-dependent proportionality factor. The material constant is in the range 0.2 to 0.5.

In bridge circuits where the strain gauges are positioned transversally to the main direction of strain, this constant must be supplied by the user. The ratios for various materials are available in the list box. These values are only for orientation and may need to be adjusted.

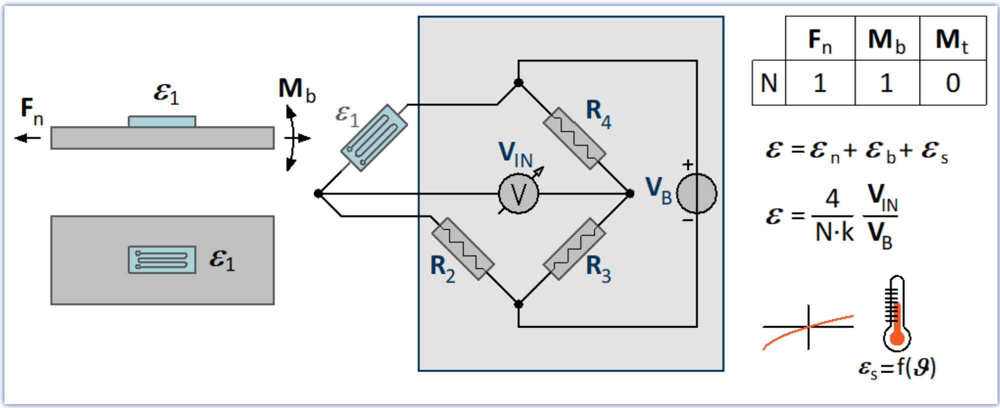
Elastic modulus

The elastic modulus E, is a material parameter characterizing how a body is deformed under the action of pressure or tension in the direction of the force. The unit for E is N/mm². This value must be entered for the mechanical stress to be determined The e-moduli for various materials are available in the list box. These values are only for orientation and may need to be adjusted.

6.5.2.2 Quarter bridge

6.5.2.2.1 Quarter bridge with internal completion resistor

This bridge circuit uses an active strain gauge and internal completion resistors for strain measurement of tension, compression or bending. The strain gauge is located in the uniaxial stress field on the measurement object. This strain gauge is supplemented by three passive resistors in the module (internal supplementary resistors) to form a full bridge.



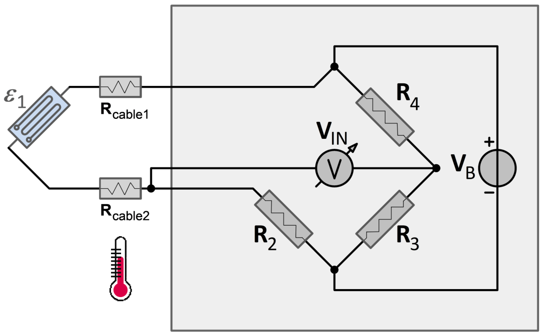
	F_n	M_b	M_t
N	1	1	0

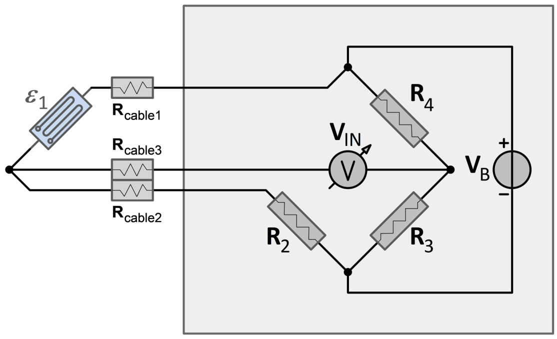
$$\varepsilon = \varepsilon_n + \varepsilon_b + \varepsilon_s$$

$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

The configuration does **not** compensate the thermal influence.

With the completion resistor R2 to the quarter bridge on the device side, the connection to the sensor resistor is possible in a two- or three-wire circuit.



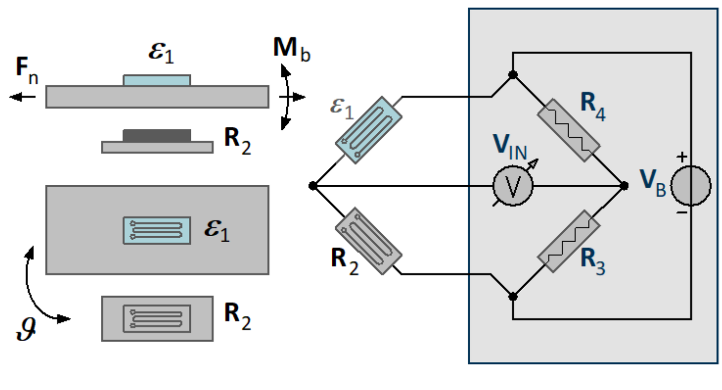


With the two-wire circuit, the temperature-related changes in the cable resistances R_{cable1} and R_{cable2} do not cancel each other out, which leads to a temperature drift in the measurement. In addition, it is not possible to take into account the signal reduction caused by the cable resistances. The two-wire circuit should therefore only be used if the cable resistances are very small (short cable length, large conductor cross-section) or only low measurement uncertainty is required. The three-wire circuit is preferable.

6.5.2.2.2 Quarter bridge - temperature compensated

This bridge circuit uses **an active strain gauge** and **a passive strain gauge** to compensate for the influence of temperature and for strain measurement of tension, compression or bending. The active strain gauge is located in the uniaxial stress field on the measurement object. The passive strain gauge is not under load and is mounted on a component made of the same material and at the same temperature as the active strain gauge.

This strain gauge is supplemented by two passive resistors in the module (internal supplementary resistors) to form a full bridge.



	F_n	M_b	M_t
N	1	1	0

$$\varepsilon = \varepsilon_n + \varepsilon_b$$

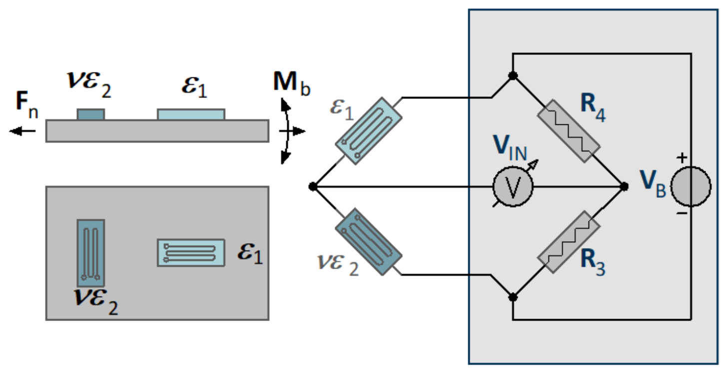
$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

The configuration does compensate the thermal influence (*insensitive to temperature changes*).

6.5.2.3 Half bridge

6.5.2.3.1 Poisson half bridge

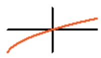
This bridge circuit uses two active strain gauges for strain measurement of tension, compression or bending. The second strain gauge is positioned on the measurement object transverse to the main strain direction. The transverse contraction is utilized. For this reason, in addition to specifying the K-factor of the strain gauge, it is also important to specify the transverse strain coefficient of the material.



	F_n	M_b	M_t
N	$1+\nu$	$1+\nu$	0

$$\varepsilon = \varepsilon_n + \varepsilon_b$$

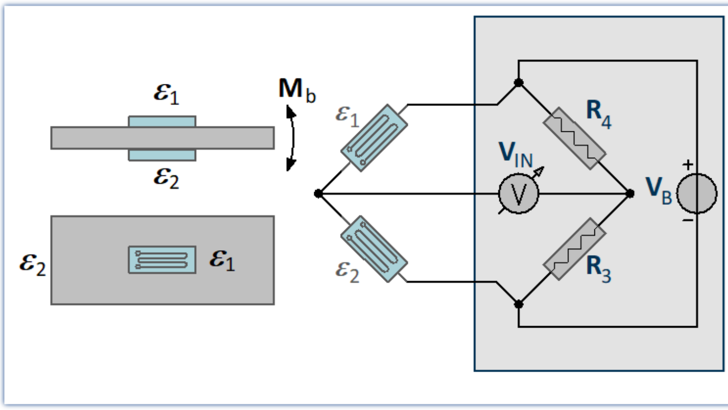
$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$



This configuration offers good temperature compensation.

6.5.2.3.2 Half bridge with two strain gauges in uniaxial direction

Two active strain gauges are placed along one axis under equal tension with opposite directions. Typical **bending beam circuit**: One strain is under compression and the other under equal tension. Double sensitivity for the bending moment, compensates for longitudinal forces, torsion and temperature.



	F_n	M_b	M_t
N	0	2	0

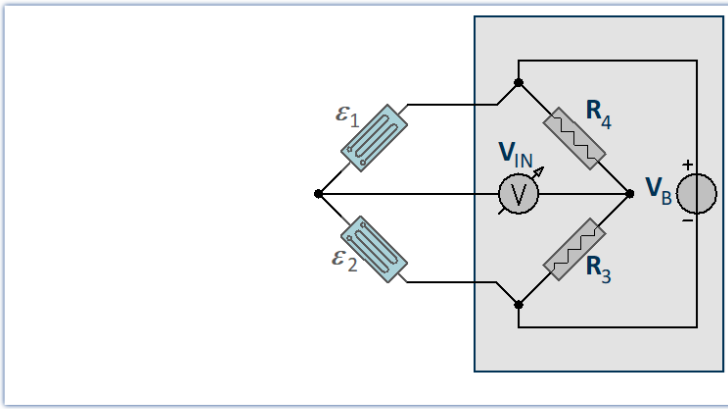
$$\varepsilon = \varepsilon_b$$

$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

Longitudinal forces, torsion and temperature changes are compensated.

6.5.2.3.3 Half bridge - general strain gauge

Freely configurable half-bridge circuit with bridge completion in the measuring device. N must be selected from a list.



$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

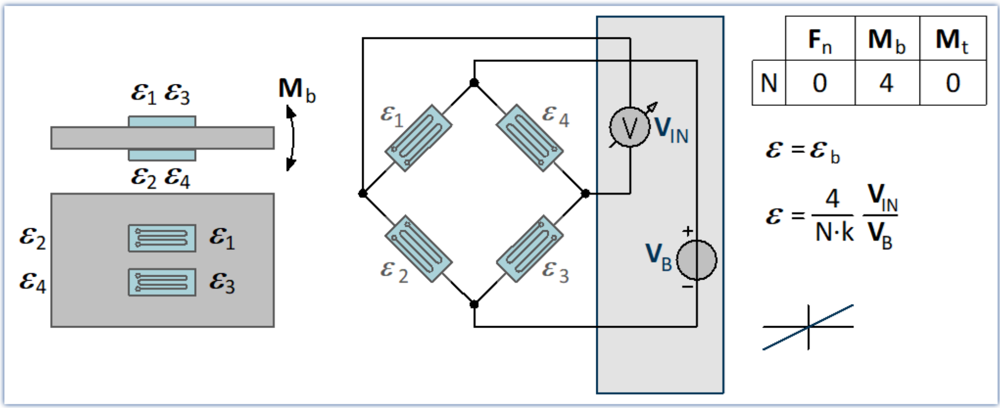
$$N = \begin{cases} 1 \\ 1-\nu \\ 1+\nu \\ 2 \end{cases}$$

6.5.2.4 Full bridge

6.5.2.4.1 Full bridge with four strain gauges - bending beam

General full bridge circuit for the bending moment

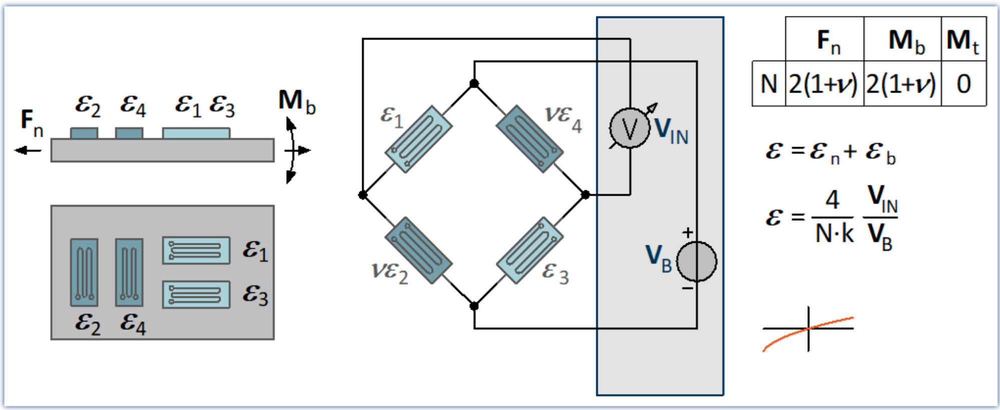
This bridge circuit uses four active strain gauges. Two of them are under compression and two are under equal tension, located on opposite sides of the structure.



The sensitivity of the bending moment is increased. At the same time, longitudinal force, torque and temperature are compensated for.

6.5.2.4.2 Full bridge consisting of two Poisson half bridges - installed on one side of the structure

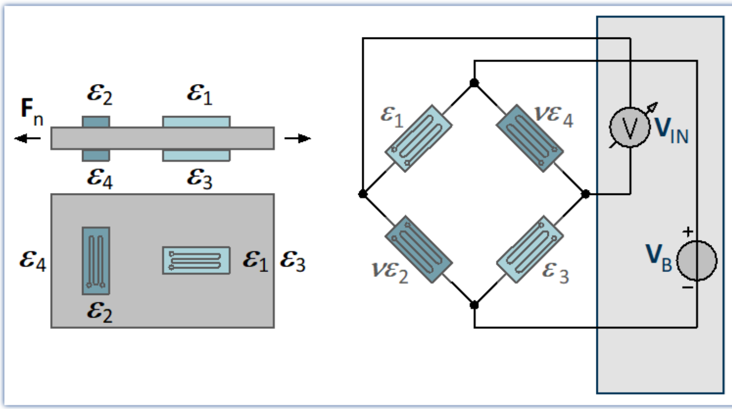
This bridge circuit uses a full bridge with four active strain gauges. Two active strain gauges are supplemented by two transversely arranged strain gauges to form Poisson half bridges, which are located in the diagonally opposite bridge branches (*tension rod arrangement*). This circuit results in a high sensitivity by utilizing the transverse contraction and the normal strain with good compensation of the temperature influence. Strain measurement of **tension, compression or bending**.



In this circuit, the specification of the transverse strain coefficient of the material is important. The arrangement is **insensitive** to temperature changes.

6.5.2.4.3 Full bridge consisting of two Poisson half bridges - installed on opposite sides of the structure

This bridge circuit uses a full bridge with four active strain gauges. Two active strain gauges are supplemented by two transversely arranged strain gauges to form Poisson half bridges, which are located in the diagonally opposite bridge branches. This circuit results in a high sensitivity by utilizing the transverse contraction and the normal strain with good compensation of the temperature influence. Suitable for strain measurement of **tension or compression**.



	F_n	M_b	M_t
N	$2(1+\nu)$	0	0

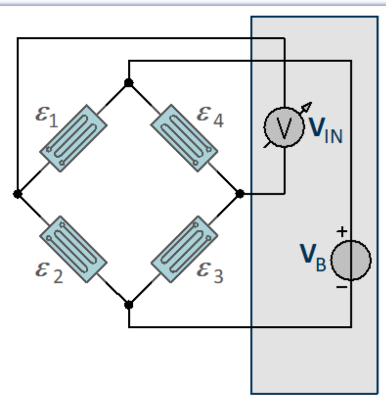
$$\varepsilon = \varepsilon_n$$

$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

This circuit offers **good** compensation for temperature influences.

6.5.2.4.4 Full bridge - general strain gauge

Freely configurable full bridge circuit. The bridge factor N must be specified via list selection.



$$\varepsilon = \frac{4}{N \cdot k} \frac{V_{IN}}{V_B}$$

$$N = \begin{cases} 1 \\ 1-\nu \\ 1+\nu \\ 2 \\ 2(1-\nu) \\ 2(1+\nu) \\ 4 \end{cases}$$

7 Device description

	C1	C1-1-LEMO	C1-1-LEMO-N	C1-1-LEMO-FD C1-1-VEAM-FD
Analog Inputs	8	8	8	8
Voltage measurement	•	•	•	•
Current measurement	•	•	•	•
Thermocouple	•	•	•	•
RTD / PT100 measurement	•	•	•	•
Strain gauge / Bridges	•	•	•	•
Bridge type and operation	1/4, 1/2, 1/1, DC	1/4, 1/2, 1/1, DC	1/4, 1/2, 1/1, DC	1/4, 1/2, 1/1, DC
Max. sampling rate	100 kHz	100 kHz	100 kHz	100 kHz
Bandwidth	14 kHz	48 kHz	48 kHz	48 kHz
Sensor supply	••	••	••	••
TEDS	•	•	•	•
Support of data storage on a network drive (NAS)	-	-	•	•
CAN Bus	•	•	•	•
CAN FD Bus	-	-	-	•
UPS	lead-gel batteries	lead-gel batteries	lead-gel batteries	Super Caps
Standard equipped with isolated SYNC connection	-	-	•	•
Availability	-	-	-	•

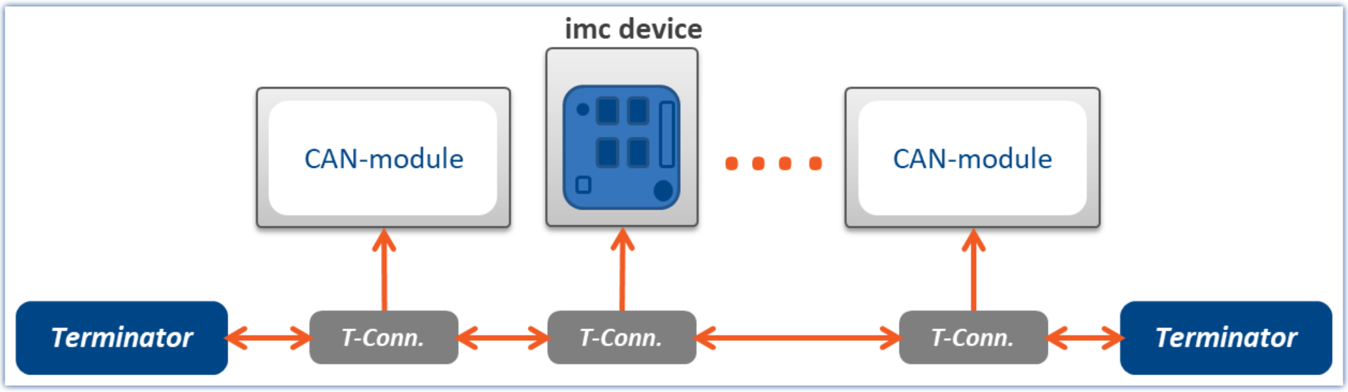
Reference

- Please find the technical specs for UPS with Super Caps in the chapter technical specs in this manual 74.
- For all **discontinued C1 models with lead-gel batteries**, please refer to the previous manual version 4 R3 for the technical specs.

7.1 Fieldbus interfaces

7.1.1 CAN FD

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.



imc C1-1-LEMO(-VEAM)-FD with connected Y-adaptor

Note that for a transfer rate of 1 Mbit/s to the CAN-Bus the stub line of a tee-junction may only be up to 30 cm long. In general, the wiring within imc C1-1-LEMO(-VEAM)-FD is already 30 cm long. Therefore if an external tee-junction is connected, the junction must be connected straight into the terminal.

In this context it doesn't matter whether the other sensors are connected via tee-junction or not. The illustration simply shows the options available.

Find here the technical details 82 and the pin configuration 87 of the CAN FD interface.

Connecting the terminators

- Terminator-resistance is 120 Ω as per CAN in Automation (CiA).
- If terminators are connected, then between Pins 2 and 7.
- Terminators are only applied at the ends of the bus; nowhere else in the line. The bus must always end at a terminator.

Note

With High-Speed CAN a termination on each node can be activated by software.

7.2 Miscellaneous

7.2.1 Filter settings

Theoretical background

The filter setting is especially important in a signal-sampling measurement system: the theory of digital signal processing and especially the **sampling theorem** (Shannon, Nyquist) state that for such a system, the signal must be restricted to a limited frequency band to ensure that the signal has only negligible frequency components beyond one-half of the sampling frequency ("Nyquist-frequency"). Otherwise, "aliasing" can result – distortions which cannot be removed even by subsequent filtering.

The imc device is a sampling system in which the sampling time (or sampling rate) to be set is subject to this condition. The low pass filter frequency selected thus hinges on how band-limited the signal to be sampled at that rate is.

The control AAF for the filter setting stands for "Automatic Anti-aliasing Filter", and automatically selects the filter frequency in adaptation to the sampling rate selected. The rule this is based on is given by:

AAF-Filter frequency (-80 dB) = sampling frequency · 0.6 = Nyquist frequency · 1.2

AAF-Filter frequency (-0.1 dB) = sampling frequency · 0.4 = Nyquist frequency · 0.8

General filter concept

The imc system architecture is actually a two-step system in which the analog signals are sampled at a fixed "primary" sampling rate (analog-digital conversion with Sigma-Delta ADCs). Therefore a fixed-frequency analog low pass filter prevents aliasing errors to this primary rate. The value of this primary rate is not visible from the outside, depends on the channel type and is generally greater than or equal to the sampling rate which is selected in the settings interface.

The filter to be set is realized as a digital filter, which offers the advantage of precise characteristic and matching with respect to magnitude and phase. This is especially important for the sake of matching of channels which are jointly subjected to math operations.

For any data rate to be set in the system configuration (f_sample), then digital anti-aliasing filters (low pass filters) ensure compliance with the conditions for the Sampling Theorem. Three cases can be distinguished.

Implemented filters

Filter-setting "Filter-Type: without":

Only the (analog) anti-aliasing filter, matched to the primary data rate is in effect.
This setting can be useful if maximum bandwidth reserves are to be used and there are known limitations on the measured signal's spectral distribution, which justify not performing consistent filtering.

Filter-setting "Filter-Type: AAF":

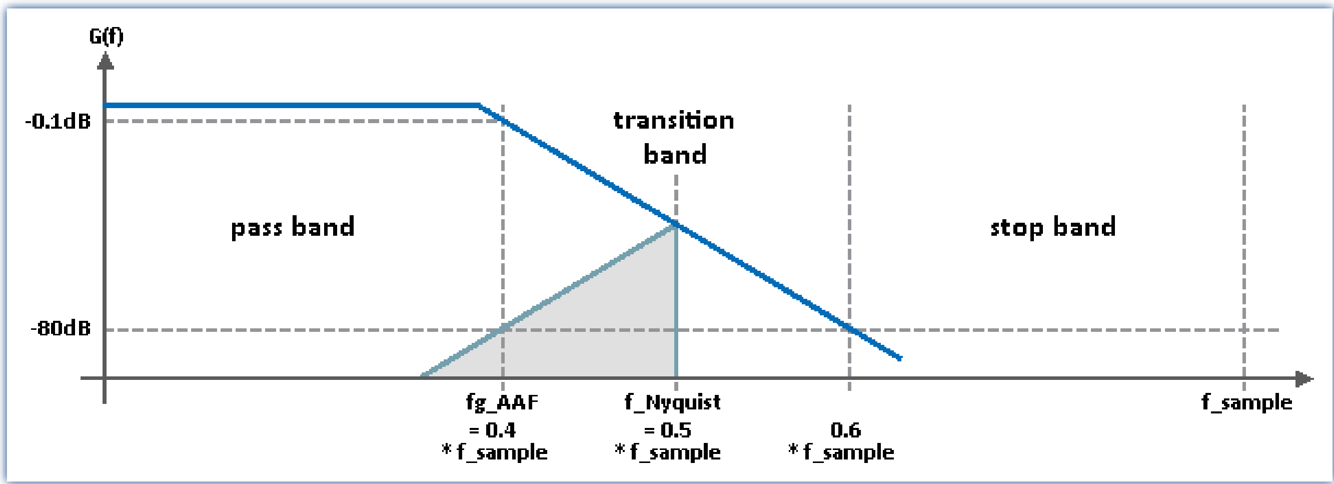
The (digital) anti-aliasing filters are elliptical Cauer filters. Their "tight" characteristic curve in the frequency range makes it possible to have the cutoff frequencies approach the sampling and Nyquist frequencies much closer without having to make a compromise between the bandwidth and freedom from aliasing.

The automatic selection of the cutoff frequency in the setting "AAF" is based on the following criteria:

- In the pass band, a maximum (AC-) gain uncertainty of 0.06% = -0.005 dB is permitted. The pass band is defined by the cutoff frequency at which this value is exceeded.
- The stop band is characterized by attenuation of at least -80 dB.
  This damping is considered sufficient since discrete disturbance frequencies can never reach 100% amplitude: the input range is mostly filled by the useful signal.
- The transition band is typically situated symmetrically around the Nyquist-frequency. This ensures that the aliasing components reflected from the stop band back into the pass band are adequately suppressed, by at least -80 dB. Remnant components from the frequency range between Nyquist-frequency and stop band limit only reflect back into the range beyond the pass band (pass band to Nyquist), whose signal content is defined as not relevant.

The criteria stated are fulfilled with the Cauer-filters by the following configuration rule:

- fg_AAF (-0.1 dB) = 0.4 · f_sample
- Characteristics: Cauer; Filter-order: 8th order



Filter-setting "Filter-type: Low pass" (band pass and high pass):

A low pass frequency can be set manually, which satisfies the application's requirements. In particular, a cutoff frequency significantly below the Nyquist frequency can be set which guarantees eliminating aliasing in any case, though consequently "sacrificing" the corresponding bandwidth reserves.

with fg_AAF (3 dB) = f_sample / 4	attenuation at Nyquist-freq.:	1/64	= -36 dB
with fg_AAF (3 dB) = f_sample / 5	attenuation at Nyquist-freq.:	1/244	= -48 dB
with fg_AAF (3 dB) = f_sample / 10	attenuation at Nyquist-freq.:	1/15630	= -84 dB

- Characteristics: Butterworth, 8th order (48 dB/octave)

Other possible filter settings are "*band pass*" and "*high pass*" - both 4th order.

7.2.2 LEDs and BEEPER

6 Status LEDs and a beeper are provided as additional visual and acoustic "output channels". They can be used just as standard output channels in imc Online FAMOS by assigning them the binary values "0" / "1" or functions taking the Boolean value range. Interactive setting and Bit-window display for these output channels is neither especially useful nor supported. It is not possible to deactivate the beeper by software. The beeper indicates the starting buffering period of the UPS.

7.2.3 Synchronization

Synchronization with other devices

In order to synchronize the device to an absolute time reference and/or synchronize multiple imc devices (even of different types) use the SYNC terminal. That connector has to be connected with other imc devices or a DCF77/IRIG B signal generator.

Synchronization with GPS

The measuring device can be synchronized to absolute time using a GPS receiver 53 connected to the GPS socket.

Note

- To use the SYNC input, IRIG B must be supported. SYNC use with BUSDAQ*flex* (serial number circle 13...) is therefore additionally possible.
- The yellow ring on the SYNC socket indicates that the socket is shielded from voltage differences.
- See also chapter *Synchronization* in the imc software manual.

Reference Synchronization

Technical details: synchronization 83

7.2.3.1 Optical SYNC Adapter: ACC/SYNC-FIBRE

One fundamental feature of all imc measurement devices, is their ability to synchronize multiple devices, even of differing models, and to operate them all in concert. The synchronization is typically accomplished by means of a Master/Slave process via the electrical SYNC-signal, which terminates on the devices at a BNC socket.

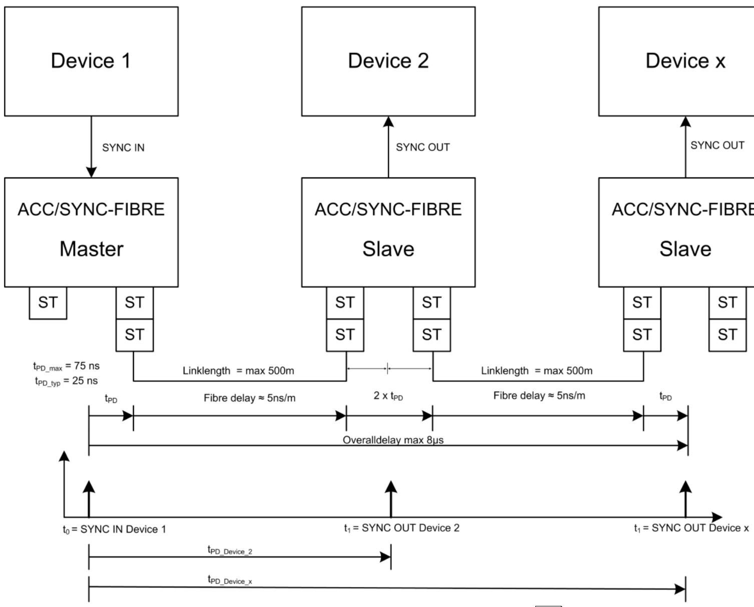
In areas of high electrical interference, or where long-distance signal transmission is needed, the signal can be conducted via fiber optic cabling with total isolation and no interference. For this purpose, the externally connectable optical SYNC adapter ACC/SYNC-FIBRE is available.

When this adapter is used, the BNC socket is not, but rather one of the DSUB-9 sockets for the GPS, DISPLAY or MODEM, which then conducts both the isolated electrical SYNC signal and additionally a supply voltage which is required by the adapter, as well as supplying directional indication (Master to Slave).

For this reason, any imc measurement devices used must be remodeled in accommodation to one of the DSUB-9 sockets. Once either the MODEM or the GPS socket has been remodeled, it is no longer usable for its original purpose. For the GPS socket, this does not apply. Even parallel operation is possible (via Y-cable), if the GPS-data are only used for the position data and the adapter is used for the SYNC signal.

For whichever signal (adapter or BNC) is currently connected, both the electrical and the optical mode can be used, however not both at the same time.

The plug is designed for the extended environmental range. The imc measurement devices used with this adapter require some modification.



Find here technical details: ACC/SYNC-FIBRE 85

7.2.4 GPS

At the 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 imc Online FAMOS.

GPS signals are **available as**: process vector variables and fieldbus channels.

GPS information	Description
pv.GPS.course	Course in °

GPS information	Description
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 ...
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 fieldbus 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

GPS-Receiver

The **GARMIN GPS receivers** supplied by imc are set ready for operation and provide a 1 Hz or 5 Hz pulse, depending on the model.

The following conditions must be met in order to use other GPS receivers from imc devices:

- **RS232 port settings**
  - **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.

NMEA-Talker IDs

Supported NMEA-Talker IDs:

- GA: Galileo Positioning System
- GB: BeiDou (BDS) (China)
- GI: NavIC (IRNSS) (India)
- GL: GLONASS, according to IEIC 61162-1
- GN: Combination of multiple satellite systems (GNSS) (NMEA 1083)
- GP: Global Positioning System (GPS)
- GQ: QZSS regional GPS augmentation system (Japan)

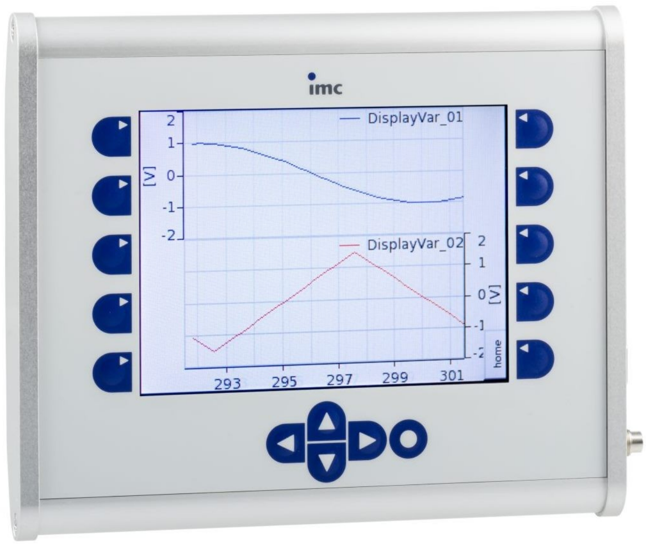
DSUB-9 pin configuration 87

7.2.5 Operation without PC

To operate your imc measurement device, you don't necessarily need a PC. Your device will start the measurement independently, if an autostart has been prepared. Using the display, you can use its keyboard to control the measurement. The display serves as a comfortable status indicator device and can replace or complement the imc operating software when it comes to controlling the measurement. It can even be used where no PC can go.

The Display can be connected or disconnected at any time without affecting a running measurement. This makes it possible, to check the status of multiple devices running simultaneously one at a time.Detailed descriptions of the functions are presented in the chapter *Display* of the imc software manual.

7.2.5.1 Graphical display



The imc graphical display allows the user to interact with a running measurement process by displaying system status and allowing parameter adjustments via the membrane touch panel.

If the measurement device is prepared for opening a particular configuration upon being activated, it's possible to carry out the measurement without any PC. The Display serves as a convenient status indicator.

The **description of the control elements** and their function can be found in the imc STUDIO manual chapter "*imc Display Editor*".

Properties:

- 320 x 240 pixels in 65536 colors
- Housing dimensions approx. 306 x 170 x 25 mm; Readout screen size: approx. 11.5 cm x 8.6 cm
- Bore diameter for Display fixing: diameter core hole 5.11 mm, diameter exterior 6.35 mm (1/4" - 20 UNC),
- Weight: approx. 1 kg, more properties see chapter "Technical Specs 84".

- The Display is controlled by a serial RS232 connection. The update frequency can't be changed. It depends on the load of the device, which is at best 15 Hz.
- The Display must be powered via the 3-pole Binder socket.

7.3 Analog inputs

C1-1-XX are 8-channel universal measurement devicesCS-7008-FD and CL-7016-FD are 8- and 16-channel universal measurement devices with sampling rates of up to 100 kHz per channel. They are especially well suited to frequently changing measurement tasks. Practically every sensor- or signal type can be connected directly to any of the measurement amplifier's all-purpose channels. The input channels are differential and equipped with per-channel signal conditioning including filters.

Parameter	Value	Remarks
Measurement modes	bridge-sensor	C1(ITT-VEAM)
	bridge: strain gauge	C1-1-LEMOSA (LEMO)
	voltage	
	current	
	thermocouples	single-ended or external shunt
	temperature sensor PT100 (3- and 4-wire)	

To supply external sensors or bridges the module is equipped with a sensor supply 70 with an adjustable supply. Supports TEDS 38 (Transducer Electronic Data Sheets).

The measurement inputs are for voltage, current, bridge, PT100 and thermocouple measurements. They are non-isolated differential amplifiers. They share a common voltage supply for sensors and measurement bridges.

Reference

The technical specs of the C1-1-XX 77

7.3.1 Voltage measurement

- Voltage: ±50 V to ±5 mV

Within the voltage measurement ranges ±50 V and ±25 V, a voltage divider is in effect; the resulting input impedance is 1 MΩ.

By contrast, in the voltage ranges ±10 V and ±5 mV, the input impedance is 20 MΩ. For the deactivated device, the value is approx. 1 MΩ.

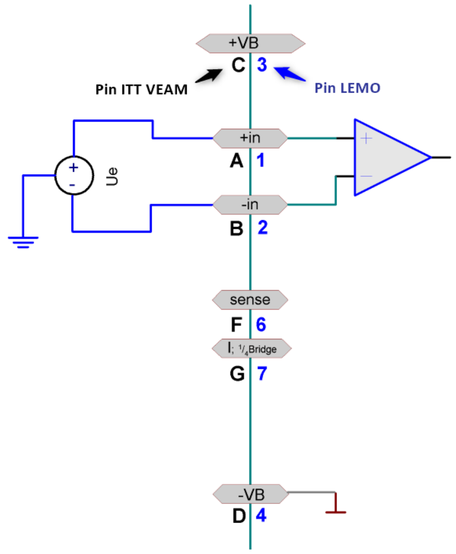
In the input ranges <25 V, the common mode voltage[1] must lie within the ±10 V range. The range is reduced by half of the input voltage. The input configuration is differential and DC-coupled.

[1] The common mode voltage is the arithmetic mean of the voltages at the inputs +IN and -IN, referenced to the device ground. For instance, if the potential to ground is +10 V at +IN and +8 V at -IN, the common mode voltage is +9 V.

Note

With the predecessor C1: If the input signal level violates the negative measurement range boundary, then the measurement readings are not limited to the maximum measurement range boundary value. Instead, the measurement readings are displayed within the range corresponding to the measurement range setting. This effect occurs in the measurement ranges 50/60 V, 10 V, 2/2.5 V and 0.5 V.

7.3.1.1 Voltage source with ground reference



The voltage source itself already has a connection to the device's ground. The potential difference between the voltage source and the device ground must be fixed.

Example

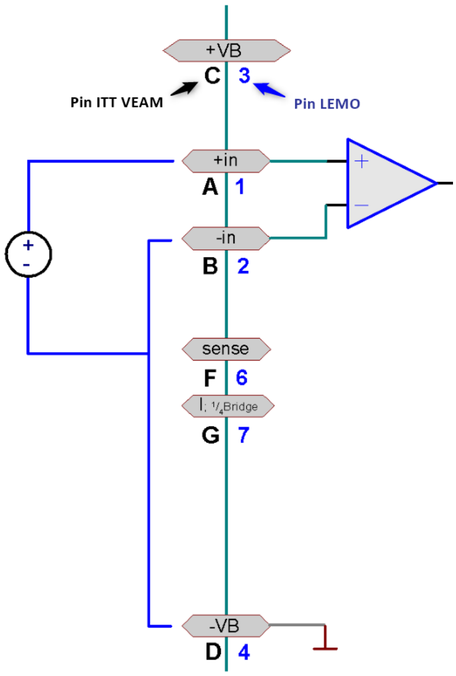
The device is grounded. Thus, the input -VB is also at ground potential. If the voltage source itself is also grounded, it's referenced to the device ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common mode voltage must not be exceeded.

Warning

In this case, the negative signal input -IN may not be connected with the device ground -VB. Connecting them would cause a ground loop through which interference could be coupled in.

In this case, a genuine differential (but not isolated!) measurement is carried out.

7.3.1.2 Voltage source without ground reference



The voltage source itself is not referenced to the amplifier ground but is instead isolated from it. In this case, a ground reference must be established. One way to do this is to ground the voltage source itself. Then it is possible to proceed as for Voltage source with ground reference 58. Here, too, the measurement is differential. It is also possible to make a connection between the negative signal input and the device ground, in other words to connect -IN and -VB.

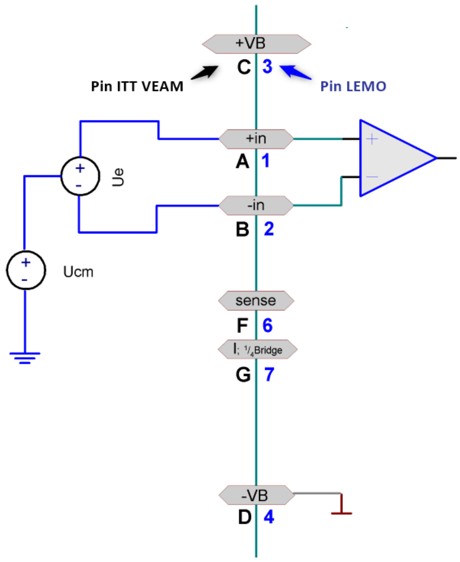
Example

An ungrounded voltage source is measured, for instance a battery whose contacts have no connection to ground. The device module is grounded.

Warning

If -IN and -VB are connected, care must be taken that the potential difference between the signal source and the device doesn't cause a significant compensation current. If the source's potential can't be adjusted (because it has a fixed, overlooked reference), there is a danger of damaging or destroying the amplifier. If -IN and -VB are connected, then in practice a single-ended measurement is performed. This is no problem if there was no ground reference beforehand.

7.3.1.3 Voltage source at a different fixed potential



The common mode voltage (V_{cm}) has to be less than ±10 V. It is reduced by ½ input voltage.

Example

Suppose a voltage source is to be measured which is at a potential of 120 V to ground. The system itself is grounded. Since the common mode voltage is greater than permitted, measurement is not possible. Also, the input voltage difference to the amplifier ground would be above the upper limit allowed. For such a task, the C1-1-XX cannot be used.

7.3.2 Bridge measurement

Measurement of measurement bridges such as strain gauges. The measurement channels have an adjustable DC voltage source which supplies the measurement bridges. The supply voltage for a group eight inputs is set in common. The bridge supply is asymmetric, e.g., for a bridge voltage setting of VB=5 V, Pin +VB is at +VB=5 V and Pin -VB at -VB=0 V. The terminal -VB is simultaneously the device's ground reference.

Per default 5 V and 10 V can be selected as bridge supply. As an option the amplifier can be build with 2.5 V bridge supply. Depending on the supply set, the following input ranges are available:

Bridge voltage [V]	Measurement range [mV/V]
10	±1000 to ± 0.5
5	±1000 to ± 1
2.5	±1000 to ± 2

Fundamentally, the following holds: For equal physical modulation of the sensor, the higher the selected bridge supply is, the higher are the absolute voltage signals the sensor emits and thus the measurement's **signal-to-noise ratio** and drift quality. The limits for this are determined by the maximum available current from the source and by the **dissipation** in the sensor (temperature drift!) and in the device (power consumption!)

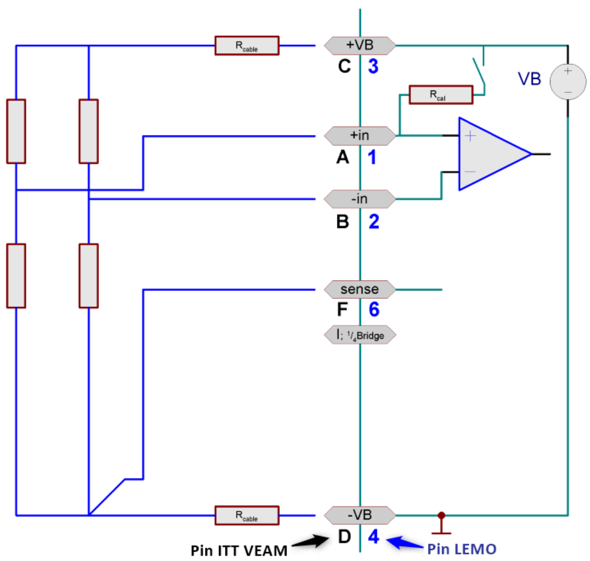
- For typical measurements with **strain** gauges, the ranges 5 mV/V to 0.5 mV/V are relevant.
- There is a maximum voltage which the **potentiometer sensors** are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

Bridge measurement is set by selecting as measurement mode either *Bridge: Sensor* or *Bridge: strain gauge* in the operating software. The bridge circuit itself is then specified under the tab Bridge circuit, where quarter bridge, half bridge and full bridge are the available choices.

Note

We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!

7.3.2.1 Full bridge



A full bridge has four resistors, which can be four correspondingly configured strain gauges or one complete sensor which is a full sensor internally. The full bridge has five terminals to connect. Two leads +VB and -VB serve supply purposes, two other leads +IN and -IN capture the differential voltage. The 5th lead SENSE is the Sense lead for the lower supply terminal, which is used to determine the single-sided voltage drop along the supply line. Assuming that the other supply cable +VB has the same impedance and thus produces the same voltage drop, no 6th lead is needed. The Sense lead makes it possible to infer the measurement bridge's true supply voltage, in order to obtain a very exact measurement value in mV/V.

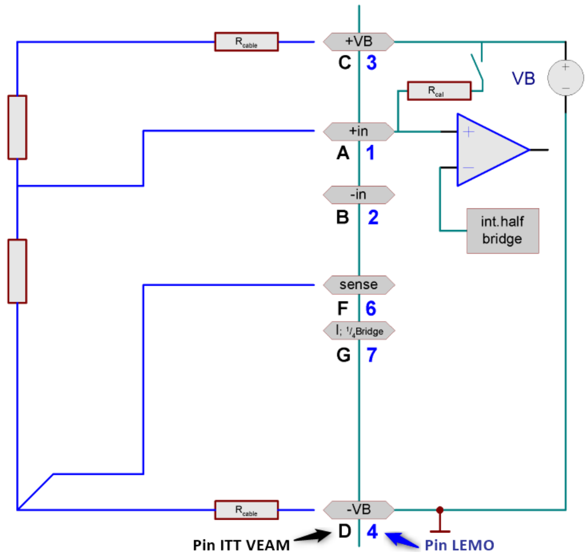
Please note that the maximum allowed voltage drop along a cable may not exceed approx. 0.5 V. This determines the maximum possible cable length.

If the cable is so short and its cross section so large that the voltage drop along the supply lead is negligible, the bridge can be connected at four terminals by omitting the Sense line.

Note

For the predecessor model C1 pin -SENSE must never be unconnected! In that case, -SENSE and -VB must be jumpered.

7.3.2.2 Half bridge



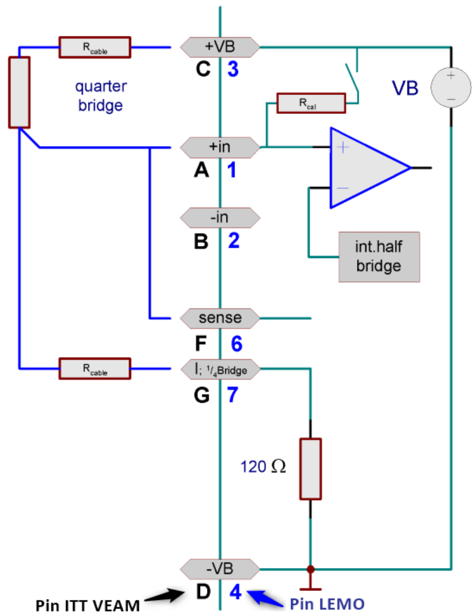
A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has 4 terminals to connect. For information on the effect and use of the SENSE lead, see the description of the full bridge 60.

The amplifier internally completes the full bridge itself, so that the differential amplifier is working with a full bridge.

Note

It is important that the measurement signal of the half bridge is connected to +IN. The -IN access leads to implausible measured values and influences the neighbor channels.

7.3.2.3 Quarter bridge



A quarter bridge can consist of a single strain gauge resistor, whose nominal value can be 120 Ω or 350 Ω. C1-1-XX internally completes an additional 120 Ω that can be switched to a 350 Ω quarter bridge.

For quarter bridge measurement, only 5 V can be set as the bridge supply.

The quarter bridge has 4 terminals to connect. Refer to the description of the full bridge 60 for comments on the SENSE lead. Note that at the quarter bridge the sense line is connected to +IN and -SENSE jointly. There is **no voltage drop** on the cable between the **quarter bridge and +IN and SENSE** because there is no current flowing into the high impedance inputs of +IN and SENSE. The current through the **quarter bridge** flows off **to I_1/4B** and causes a **voltage drop** there, which can be detected at **-SENSE**.

If the sensor supply is equipped with the option "±15 V", a quarter bridge measurement is not possible. The pin I_1/4Bridge for the quarter bridge completion is used for -15 V instead.

7.3.2.4 Sense and initial unbalance

The **SENSE** lead serves to compensate voltage drops due to cable resistance, which would otherwise produce noticeable measurement errors. If there are no sense lines, then **SENSE** must be connected in the terminal plug according to the sketches above.

A bridge measurement is a relative measurement (**ratiometric procedure**) that calculates what fraction of the supplied bridge excitation voltage is given off from the bridge (typically in the 0.1% range, corresponding to 1 mV/V). Calibration of the system in this case pertains to this ratio, the bridge input range, and takes into account the momentary magnitude of the supply. This means that the bridge **supply's actual magnitude** is not relevant and need not necessarily lie within the measurement's specified overall accuracy.

Any initial unbalance of the measurement bridge, for instance due to mechanical pre-stressing of the strain gauge in its rest state, must be zero-balanced. Such an unbalance can be many times the input range (bridge balancing). If the initial unbalance is too large to be compensated by the device, a larger input range must be set.

Possible initial unbalance

input range [mV/V]	bridge balancing (VB = 1 V) [mV/V	bridge balancing (VB = 2.5 V) [mV/V]	bridge balancing (VB = 5 V) [mV/V	bridge balancing (VB = 10 V) [mV/V
±1000	500	200	500	210
±500	600	600	100	600
±200	40	40	400	50
±100	100	100	20	190
±50	18	180	60	10
±20	40	25	90	30
±10	20	30	13	40
±5	10	6	18	7
±2	-	9	3	9
±1	-	-	4	2
±0.5	-	-	-	2

7.3.2.5 Balancing and shunt calibration

The amplifier offers a variety of possibilities to trigger bridge balancing:

- Balancing / shunt calibration via user interface of the software (channel and/or amplifier balance)
- Balancing / shunt calibration via display 56 (see software manual)
- In shunt calibration, the bridge is unbalanced by means of a 59.8 kΩ or 174.7 kΩ shunt (between +VB and +IN). The results are:

Bridge resistance	120 Ω	350 Ω
59.8 kΩ 174.7 kΩ	0.5008 mV/V 0.171 mV/V	1.458 mV/V 0.5005 mV/V

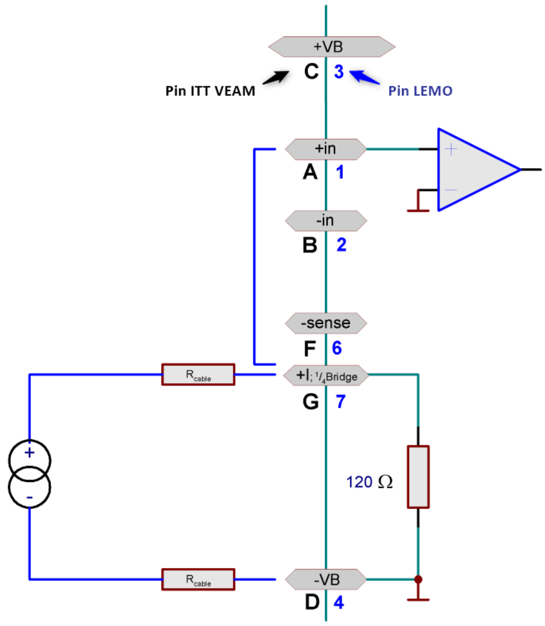
The procedures for balancing bridge channels also apply analogously to the voltage measurement mode with zero-balancing.

Note

- We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!

7.3.3 Current measurement

7.3.3.1 Ground-referenced current measurement



- Current: e.g. ±50 mA to ±1 mA

In this circuit, the current to be measured flows through the 120 Ω shunt in the amplifier. Note that here, the terminal -VB is simultaneously the device's ground. Thus, the measurement carried out is single-end or ground referenced. The potential of the current source itself may be brought into line with that of the units ground. In that case, be sure that the device unit itself is grounded.

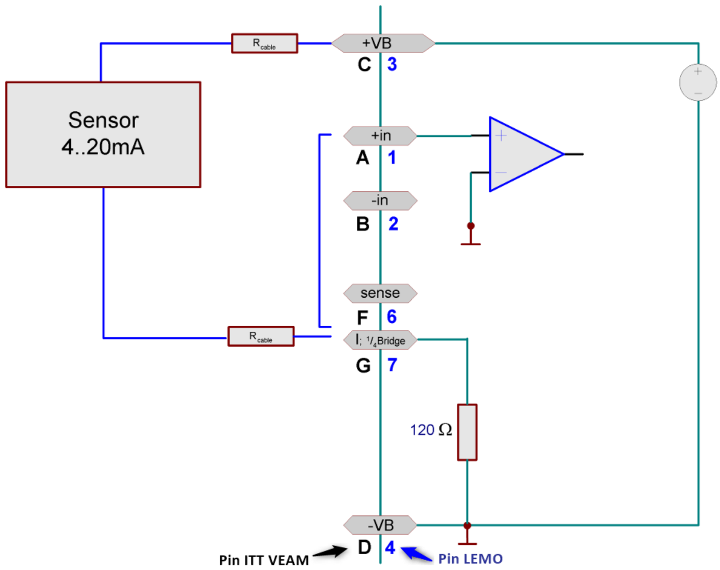
In the settings interface, set the measurement mode to current.

Note that the jumper between *+IN* and *+I; ¼Bridge* should be connected right inside the plug.

Note

For an (optional) sensor supply with ±15 V ground referenced current measurement is not possible. The pin I;¼Bridge is used as -15 V pin.

7.3.3.2 2-wire for sensors with a current signal and variable supply



- e.g. for pressure transducers 4 mA to 20 mA.

Transducers which translate the physical measurement quantity into their own current consumption and which allow variable supply voltages can be configured in a two-wire circuit. In this case, the device has its own power supply and measures the current signal.

In the settings dialog on the index card *Universal amplifiers / General*, a supply voltage is set for the sensors, usually 24 V. The channels must be configured for current measurement.

The signal is measured between +IN and -VB. A wire jumper must be positioned between pins +IN and +I, ¼Bridge inside the plug.

The sensor is supplied with power either via terminals +VB and +I; ¼Bridge or via an external sensor supply.

Note

There is a voltage drop across the resistances of the leadwires and the internal measuring resistance of 120 Ω which is proportional to the amperage. This lost voltage is no longer available for the supply of the transducer (2.4 V = 120 Ω * 20 mA). For this reason, you must ensure that the resulting supply voltage is sufficient. It may be necessary to select a leadwire with a large enough cross-section.

7.3.4 Temperature measurement

The amplifier channels are designed for direct measurement with **thermocouples** and **PT100-sensors**. Any combinations of the two sensor types can be connected.

7.3.4.1 Thermocouple measurement

The cold junction compensation necessary for thermocouple measurement is built-in the imc plug ACC/DSUBM-UNI2 (DSUB-15), ACC/TH-LEM-150 (LEMO) und im CAN/UINST-PT100 (ITT VEAM) and is measured automatically.

Note

- In the imc software user interface, the option isolated thermocouple (default setting) must be activated under Settings - Configuration - Amplifier. This only is available with Coupling DC.
- For former version C1: When using thermocouples, the ICP-supply is no longer available.

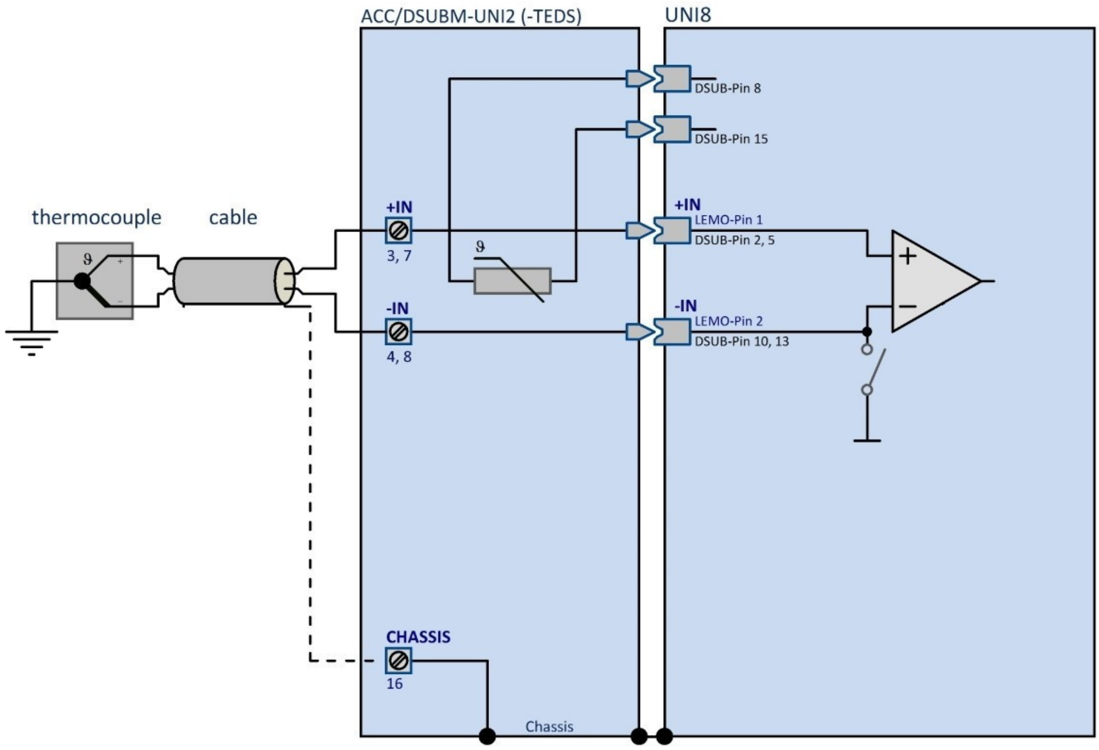
Reference

Please find here a description of the available thermocouples 39.

7.3.4.1.1 Thermocouple mounted with ground reference

The thermocouple is mounted in such a way that it already is in electrical contact with the device ground / chassis. This is ensured by attaching the thermocouple to a grounded metal body, for instance. The thermocouple is connected for differential measurement. Since the unit is grounded itself, the necessary ground reference exists.

In the operating software, don't activate the option "***Isolated thermo couple***" at the amplifier tab.



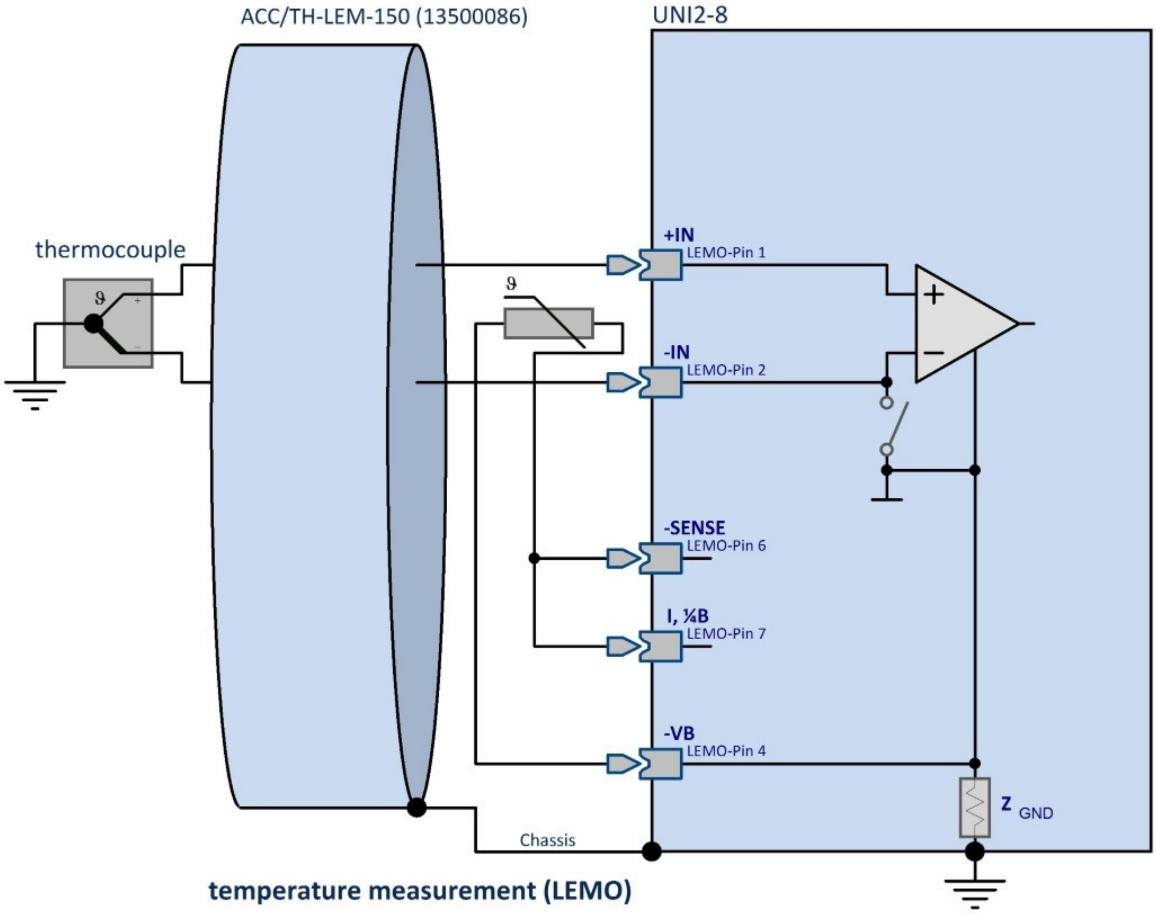
thermocouple measurement

It is not a problem if the ground potential at the thermocouple differs from that of the device units by a few volts. However, the maximum allowed common mode voltage may not be exceeded.

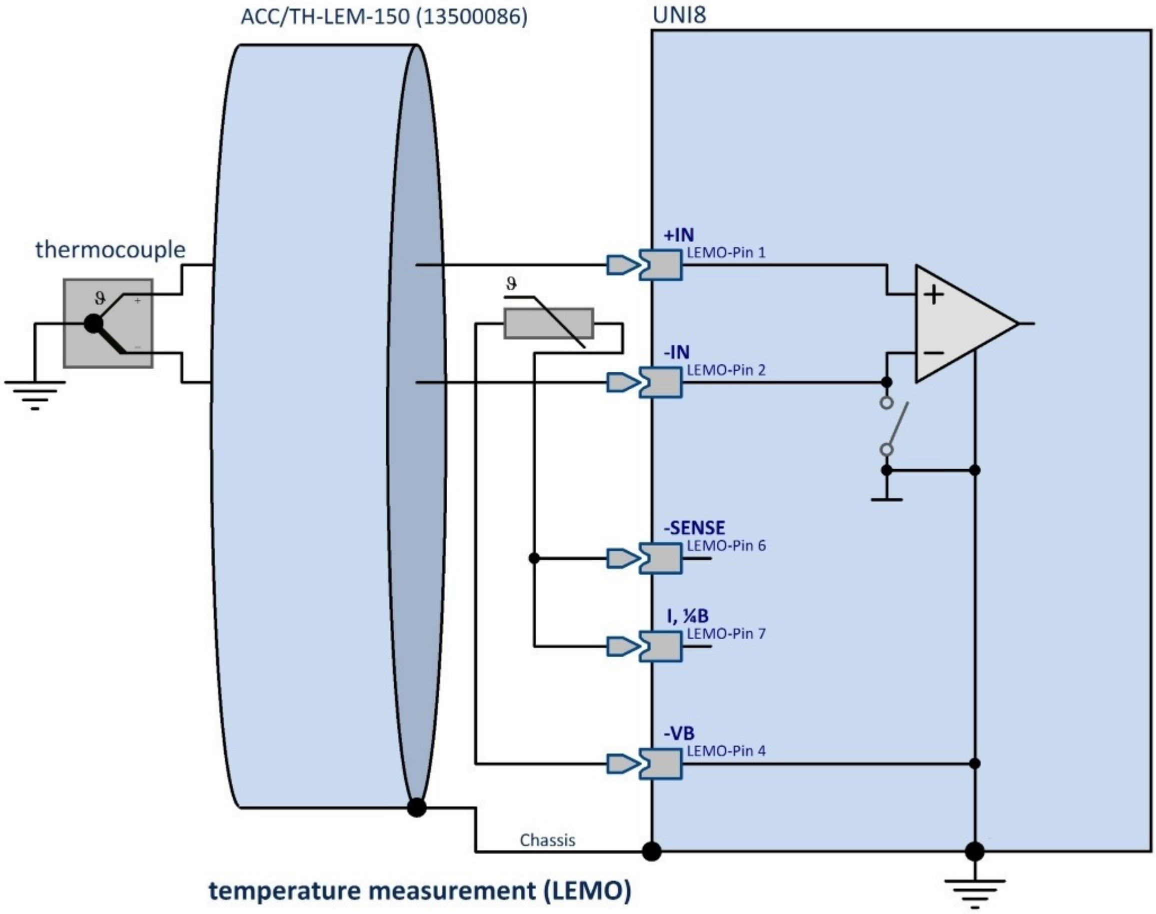
Note

- The negative signal input -IN may not be connected to amplifier ground point -VB. Connecting them would cause a ground loop through which interference could be coupled in.
- If you accidentally activate the option "Isolated thermocouple" on the Amplifier page, there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. Compensation currents are a danger with every single-ended measurement. For that reason, single-ended measurement is really only allowed -and only then really necessary- if the thermocouple has no ground reference of its own.

- Note that an external PT100 must be integrated in the connector as cold junction compensation. In addition, the ***ACC/TH-LEM-150*** connector is available as an accessory: a LEMO. 1B connector with integrated cold junction compensation.
  For ITT VEAM the integrated cold junction compensation ***CAN/UINST-PT1100*** is provided for the corresponding CAN/UINST-7 connector.



LEMO	is the 7-pin LEMO
DSUB	15-pin DSUB
Z_{GND}	is ca. 500 kΩ for CRFX, else 0 Ω

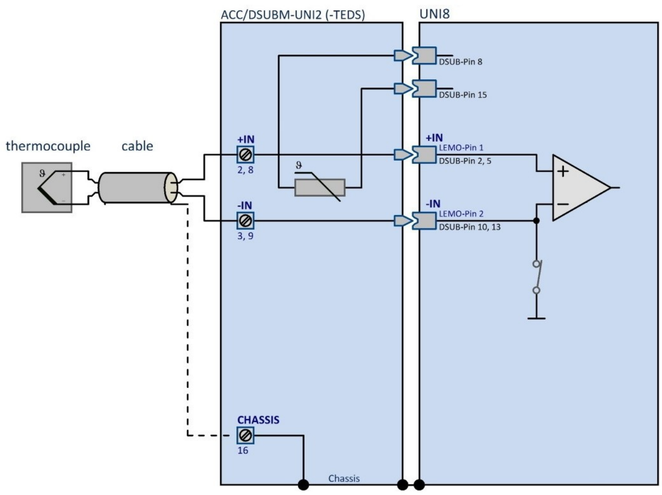


temperature measurement (LEMO)

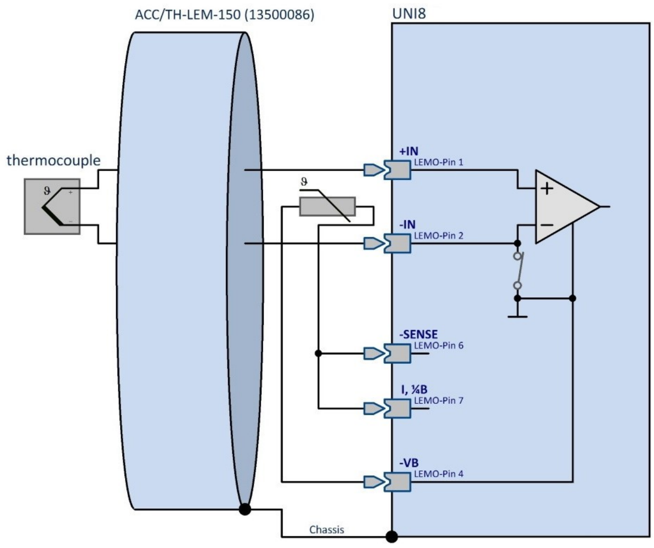
7.3.4.1.2 Thermocouple mounted without ground reference

The thermocouple is installed with electrical isolation from the device's Ground / Chassis and is therefore not connected with the device's ground. This is achieved by, among other techniques, having the thermocouple adhere to non-conducting material. As a result, the thermocouple's voltage floats freely against the amplifier ground voltage.

In this case, the amplifier must provide the necessary ground potential.



temperature measurement



temperature measurement (LEMO)

In the operating software, activate "***Isolated thermo couple***" at the amplifier tab. In this measurement mode, the unit itself provides the ground reference by having Terminals -IN and -VB connected internally. This connection is only made in the Thermocouple mode and not with voltage measurements.

Warning The thermocouple itself may not be ground referenced!

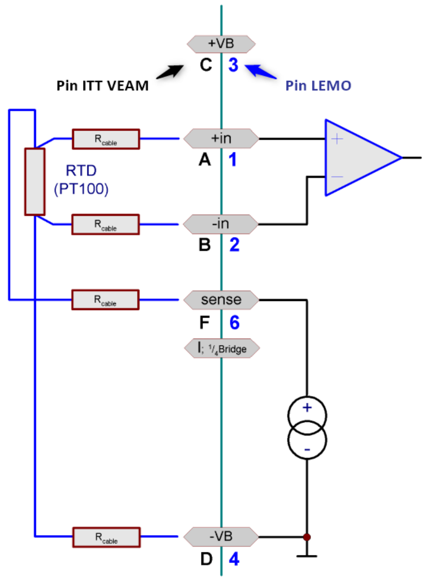
If it was mounted with a ground reference, there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. Compensation currents are a danger with every single-ended measurement. For that reason, single-ended measurement is really only allowed -and only then really necessary- if the thermocouple has no ground reference of its own.

Note that with LEMO connection 86 an external PT100 must be integrated in the connector as cold junction compensation. In addition, the ***ACC/TH-LEM-150*** connector is available as an accessory, a LEMO. 1B connector with integrated cold junction compensation. For ITT VEAM the integrated cold junction compensation ***CAN/UINST-PT1100*** is provided for the corresponding CAN/UINST-7 connector.

7.3.4.2 PT100/ RTD measurement

Along with thermocouples, **PT100** can be connected directly in **4-wire-configuration** . The 4-wire measurement returns more precisely results than the 3-wire measurement since it does not require the resistances of both leads which carry supply current to have the same magnitude and drift. The 2-wire measurement provides the most inaccurate results due to the cable resistances. Each sensor is fed by its own current source with approx. 1.2 mA.

7.3.4.2.1 PT100 in 4-wire configuration



The PT100 is supplied with constant current via two lines (-SENSE and -VB). The other two serve as Sense-leads. By using the lines (+IN und -IN), the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error. The 4-wire configuration is the most precise way to measure with a PT100.

Note

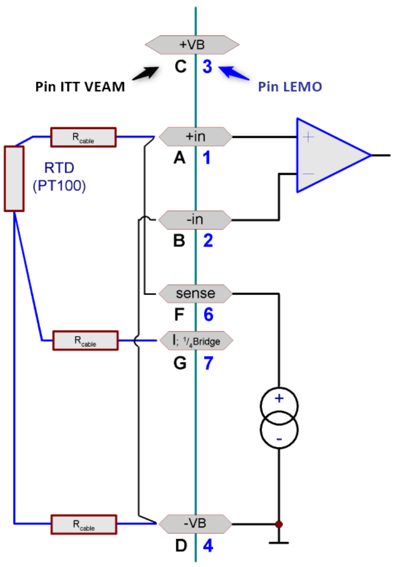
4-wire measurement is not possible with order option:

- sensor supply with ±15 V
- The former C1 equipped with a 350 Ω quarter bridge completion.

7.3.4.2.2 PT100 in 2-wire configuration

PT100 in 4-wire configuration must be set in the software. The connection is the same as for the 4-wire configuration, but +IN must be connected to -SENSE and -IN to -VB via bridges in the plug. The **cable resistances** of the supply lines are recorded in addition to the RTD and **lead to the most inaccurate measurement** and are therefore not recommended.

7.3.4.2.3 PT100 in 3-wire configuration



The PT100 is supplied with constant current via two lines (-SENSE and -VB). Another line (I, 1/4B) measures the voltage across the supply line and uses it to compensate for parasitic voltage drops. It is assumed that the resistances of the supply lines have the same size and the same temperature drift.

It is important, that the connection between +IN to -SENSE and -IN to -VB is made directly at the module.

Note

3-wire measurement is not possible with order option:

- sensor supply with ±15 V
- the former C1 equipped with a 350 Ω quarter bridge completion.

7.3.4.3 Open sensor detection

The amplifier comes with the ability of open sensor detection.

Thermocouple: If at least one of the thermocouple's two lines breaks, then within a short time (only a few samples), the measurement signal generated by the amplifier approaches the bottom of the input range in a defined pattern. The actual value reached depends on the particular thermocouple. In the case of Type K thermocouples, this is around -270°C. If the system is monitoring a cutoff level with a certain tolerance, e.g. Is the **measured value <-265°C**, then it's possible to conclude that the probe is broken, unless such temperatures could really occur at the measurement location.

The open sensor detection is also triggered if a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected. If a thermocouple is later connected after all, it would take the period of a few measurement samples for transients in the module's filter to subside and the correct temperature to be indicated. Note also in this context that any thermocouple cable's connector which is recently plugged into the amplifier is unlikely to be at the same temperature as the module. Once the connection is made, the temperatures begin to assimilate. Within this phase, the Pt100 built into the plug may not be able to indicate the real junction temperature exactly. This usually takes some minutes to happen.

RTD/Pt100: If the leads to the Pt100 are broken, then within a short time (only a few samples), the measurement signal generated by the amplifier approaches the bottom of the input range, to about 200°C, in a defined pattern. If the system is monitoring a cutoff level with a certain tolerance, e.g. Is the **measured value <-195°C**, then it's possible to conclude that the probe is broken, unless such temperatures could really occur at the measurement location. In case of a short-circuit, the nominal value returned is also that low.

In this context, note that in a 4-wire measurement a large variety of combinations of broken and shorted leads are possible. Many of these combinations, especially ones with a broken Sense lead, will not return the default value stated.

7.3.5 Sensor supply module

C1-1-XX channels are enhanced with a sensor supply unit, which provides an adjustable supply voltage for active sensors. The reference potential, in other words the sensor's supply ground contact, is the terminal GND.

The supply voltage can only be set for all measurement inputs per module.

The supply outputs are electronically protected internally against short circuiting to ground. The reference -potential, in other words the sensor's supply ground contact, is the terminal GND.

> The supply voltage can only be set for all measurement inputs in common. The voltage selected is also the supply for the measurement bridges. If a value other than 5 V or 10 V is set, bridge measurement is no longer possible!

7.3.6 Bandwidth

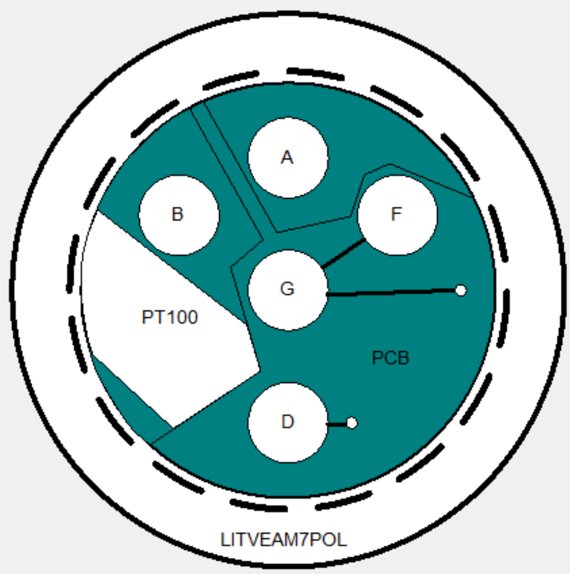
The channels' maximum sampling rate is 100 kHz(10 µs).

The analog bandwidth (without digital low-pass filtering) is 48 kHz (-3 dB). For the former *C1* the bandwidth has been limited to 14 kHz.

7.3.7 Assembly instructions for ITT VEAM with Pt100 inside of connector

For taking thermocouple measurements with Pt100 inside of the connector, you receive an junction plate onto which a Pt100 is soldered. The order in which the parts are assembled is crucial. Connection to the cable can take the form of either soldering or crimp connection.

7-pin LITVEAM-connector		Thermocouple	Pt100
designation	pin	designation	pin
+IN	A	Pos.	
-IN	B	Neg.	
+VB	C		
-VB	D		1
SenseID	E		
I-PT; Sense	F		2
SensePT	G		2

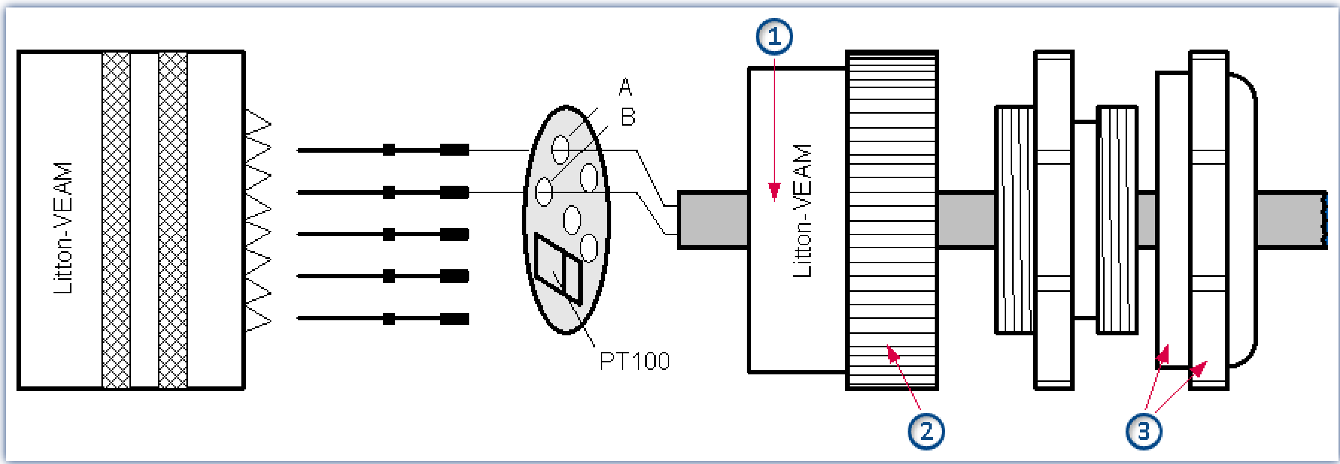


PT100 junction plate for ITT VEAM

Warning

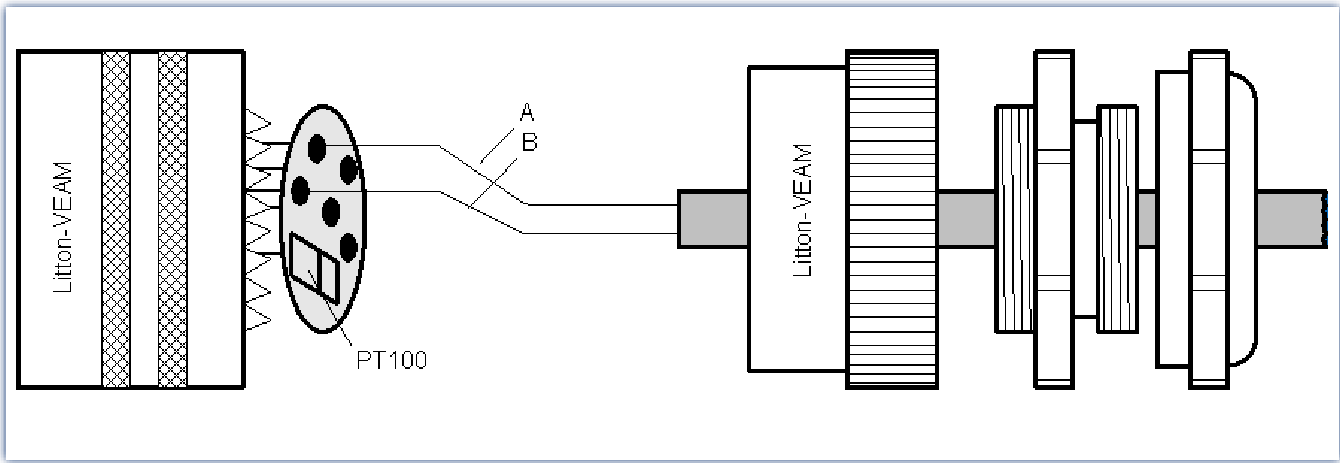
Be certain that the Pt100's contacts aren't shorted. 100 Ω must be measured between Pins G and D!

7.3.7.1 Connection using crimps



1. Thread the thermocouple's cable through the ITT VEAM connector's spacer (②) and strain relief (③).
2. Pass the thermocouple's (①) leads through the plate's holes.
3. Crimp the leads into the contacts.
4. Press the two crimped contacts and the other three contacts into the ITT VEAM connector.
5. Push the Pt100 plate onto the contacts.
6. Solder the contacts to the plate.

7.3.7.2 Connection by soldering



1. Press all the contacts into the ITT-VEAM connector.
2. Fit the Pt100 plate over the contacts and solder.
3. Thread the thermocouple's cable through the ITT VEAM connector's spacer and strain relief.
4. Solder the thermocouple's measurement leads.

Warning

Be certain that the Pt100's contacts aren't shorted. 100 Ω must be measured between Pins G and D!

7.3.7.3 Recommended tools

- VEAM contact inserter T98143
- For crimping:
  - Crimping pliers by DML M22520/1-01
  - Crimping adapter M22520/1-02

8 Technical Specs

All devices described in this manual are intended at least for normal ambient conditions according to IEC 61010-1. In addition, the extended ambient conditions apply according to the explicitly stated technical data.

The data sheets in this chapter "Technical Specs" correspond to the separately managed data sheets. In addition to the tables, the separate data sheet contains module and device photos, drawings with dimensions, accessories and imc part numbers. This additional information would go beyond the scope of this manual. In individual cases it may happen that we publish a new data sheet before there is a new manual edition. The valid data sheets are always available on the imc website:
www.imc-tm.com/download-center/product-downloads

The specified technical data refer to the reference conditions, such as the specified preferred position of use (see respective technical data sheet) and an ambient temperature of 25 °C as well as compliance with the specifications for use (see chapter "Precautions for operation") and for grounding and shielding.

For device variants with BNC connection technology in particular (established for certain measurement tasks), gapless shielding is not initially guaranteed due to the design, as the negative pole of the measurement input is directly connected out as a coaxial outer conductor. Any interference coupled to the measuring lines thus has an asymmetrical effect on the measuring input. As a result, the accuracy specifications specified in the tables may be exceeded during the fault. Appropriate measures are taken to meet the EMC requirements for these devices as well. For the acceptance criterion A, a measuring accuracy of 2 % is assumed in the unshielded case for the reasons mentioned. If significant RF interference is to be expected in the measurement environment and if the limited accuracy is insufficient, the shielding measures shall be implemented in accordance with the above sections, i.e. the coaxial test lead shall be shielded.

8.1 General technical specs

Power supply	Value	Remarks
Power supply	10 V to 32 V DC	
Max. power consumption	<20 W	
Isolation of supply input	non-isolated	
AC/DC adaptor	110 V to 230 V AC	external adaptor included in delivery
Auto start upon power up	configurable	automatic start of measurement

UPS and Data integrity	Value	Remarks
Autarkic operation without PC	✔	
Self start (automatic data acquisition operation)	configurable	timer, absolute time, automatic start when power supply is available
Auto data-saving upon power outage	✔	buffering (UPS) with "auto-stop": auto-stop of measurement, data storage and automatic shutdown
UPS	integrated	Super-Caps
Charging time of the Super-Caps	6 min.	minimum required active operation for full UPS functionality
UPS coverage	entire device	
UPS delay per power outage	1 s	"buffer time constant": required duration of a continuous outage that will trigger auto shutdown procedure fix parameter: not changeable in device configuration!
Effective buffer capacity	100 mWh	sufficient for auto-stop (max. 12 sec.); with fully charged Super-Caps (after minimum operating duration)

Data acquisition, trigger		
Parameter	**Value**	**Remarks**
Max. aggregate sampling rate	400 kS/s	
Channel individual sampling rates	selectable in 1–2–5 steps	
Number of sampling rates: analog channels, DI and counter	2	usable simultaneously in one configuration
Number of sampling rates: fieldbus channels	arbitrary	
Number of sampling rates: virtual channels	arbitrary	data rates generated via imc Online FAMOS (e.g. via reduction)
Monitor channels	✔ for all channels of the types: analog, DI and counter (incremental encoder) and CAN	doubled channels with independent sampling and trigger settings
Intelligent trigger functions	✔	e.g. logical combination of multiple channel events (threshold, edge) to create triggers that start and stop acquisition of assigned channels
Multi.triggered data acquisition	✔	multiple trigger-machines and multi-shot
Independent trigger-machines	48	start/stop, arbitrary channel assignment
Direct onboard data reduction: arithmetic mean, min, max.	✔	
Extensive real-time calculation and control functions	✔	included in standard delivery (via imc Online FAMOS)
External GPS signal receiver	O	
Internal WiFi (WLAN) adaptor	O IEEE 802.11g (1 antenna) max. 54 MBit/s	

Storage, signal processing		
Parameter	**Value**	**Remarks**
Internal flash storage	CF-card	removable cover for the CF slot
Removable flash storage media	CF	recommended media available at imc; the specified operating temperature range of the media is relevant
Storage on NAS (network storage)	✔	alternatively to onboard Flash storage
Arbitrary memory depth with pre- and post trigger	✔	maximum pretrigger limited by size of Circular Buffer RAM; posttrigger only limited by available mass storage (Flash)
Circular buffer mode	✔	cyclic overwrite of circular buffer memory on mass storage media
Synchronization	DCF 77 GPS IRIG-B NTP	Master / Slave via external GPS-receiver TTL via network

Operating conditions		
Operating environment (Standard)	dry, non corrosive environment within specified operating temperature range	
Ingress Protection	IP20	
Operating temperature (Standard)	-10°C to 55°C	without condensation
Operating temperature (extended, "-ET" version)	-40°C to 85°C	condensation temporarily allowed
Rel. humidity	80% up to 31°C, above 31°C: linear declining to 50%, according DIN EN61010-1	
Shock and vibration resistance	IEC 60068-2-27, IEC 60068-2-64 IEC 61373 category 1, class A and B MIL-STD-810 Rail Cargo Vibration Exposure U.S. Highway Truck Vibration Exposure	
Extended shock and vibration resistance	upon request	

8.2 C1-1-LEMO(-VEAM)-FD - analog inputs

Inputs, measurement modes, terminal connection		
Parameter	**Value**	**Remarks**
Inputs	8	
Measurement modes	voltage measurement current measurement thermocouple measurement bridge sensor strain gauge PT100 (3- and 4-wire configuration)	 LEMO plug with built-in cold-junction compensation (CJC) ACC/TH-LEM-150 full, half, quarter bridge
Terminal connection LEMO VEAM	 8x LEMO.1B.307 8x ITT VEAM	1 channel per socket

Sampling rate, Bandwidth, Filter, TEDS			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate	≤100 kHz		per channel
Bandwidth C1-1-xx C1	 0 Hz to 48 kHz 0 Hz to 30 kHz 0 Hz to 14 kHz		 -3 dB -0.1 dB -3dB
Max. Signal Slew-Rate	1.2 V/µs		
Filter (digital) cut-off frequency characteristic type and order	 10 Hz to 20 kHz		 Butterworth, Bessel low pass or high pass filter: 8th order band pass: LP 4th and HP 4th order Anti-aliasing filter: Cauer 8th order with $f_{cutoff} = 0.4\ f_s$
TEDS Transducer Electronic Data Sheets	conforming to IEEE 1451.4 Class II MMI		esp. with ACC/DSUBM-TEDS-xx (DS2433) not supported: DS2431 (typ. IEPE/ICP sensor)

General			
Parameter	**Value typ.**	**min. / max**	**Remarks**
Overvoltage protection		 ±80 V ±50 V	permanent, differential input range >±10 V or device off input range ≤±10 V
Input coupling	DC		
Input configuration	differential		
Input impedance	1 MΩ 20 MΩ		range >±10 V range ≤±10 V
Auxiliary supply voltage available current internal resistance	 +5 V 0.26 A 1.0 Ω	 ±5 % 0.2 A <1.2 Ω	for IEPE/ICP-expansion plug independent of integrated sensor supply, short-circuit protected power per DSUB-plug

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±50 V, ±25 V, ±10 V, ±5 V, ±2.5 V, ±1 V to ±5 mV		
Maximum input voltage		-11 V to +15 V	between ±IN and CHASSIS; input range ≤±10 V
Gain error	0.02 %	0.05 %	of the measured value, at 25 °C
Gain drift	10 ppm/K·ΔT_a	30 ppm/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Offset error	 0.02 %	 ≤0.05 % ≤0.06 % ≤0.15 %	of the range, at 25 °C range >±50 mV range ≤±50 mV range ≤±10 mV
Offset drift	±40 µV/K·ΔT_a ±0.7 µV/K·ΔT_a ±0.1 µV/K·ΔT_a	±200 µV/K·ΔT_a ±6 µV/K·ΔT_a ±1.1 µV/K·ΔT_a	range >±10 V range ±10 V to ±0.25 V range ≤±0.1 V $\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Non-linearity	30 ppm	90 ppm	
CMRR (common mode rejection ratio)	 80 dB 110 dB 138 dB	 >70 dB >90 dB >132 dB	DC and f≤60 Hz range ±50 V to ±25 V range ±10 V to ±50 mV range ±25 mV to ±5 mV
Noise	3.6 μV_{rms} 0.6 μV_{rms} 0.14 μV_{rms}	5.5 μV_{rms} 1.0 μV_{rms} 0.26 μV_{rms}	range 0.1 Hz to 50 kHz range 0.1 Hz to 1 kHz range 0.1 Hz to 10 Hz

Current measurement with shunt plug			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±50 mA, ±20 mA, ±10 mA, ±5 mA, ±2 mA, ±1 mA		
Shunt impedance	50 Ω		external plug ACC/DSUBM-I2
Over load protection		±60 mA	permanent
Maximum input voltage		-11 V to +15 V	between ±IN and CHASSIS
Input configuration	differential		
Gain error	0.02 %	0.06 % 0.1 %	of the reading, at 25 °C additional error of 50 Ω in plug
Gain drift	15 ppm/K·ΔT_a	55 ppm/K·ΔT_a	ΔT_a= $\lvert T_a$-25°C$\rvert$; with T_a = ambient temperature
Offset error	0.02 %	0.05 %	of the range, at 25 °C
Noise	 40 nA_{rms} 0.7 nA_{rms} 0.17 nA_{rms}	 70 nA_{rms} 12 nA_{rms} 0.3 nA_{rms}	Bandwidth: 0.1 Hz to 50 kHz 0.1 Hz to 1 kHz 0.1 Hz to 10 Hz

Current measurement with internal shunt			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±50 mA, ±20 mA, ±10 mA, ±5 mA, ±2 mA, ±1 mA		
Shunt impedance	120 Ω		internal
Over load protection		±60 mA	permanent
Maximum input voltage		-11 V to +15 V	between ±IN and CHASSIS
Input configuration	Single-ended		internal current sink to -VB
Gain error	0.02 %	0.06 %	of the reading, at 25 °C
Gain drift	15 ppm/K·ΔT_a	55 ppm/K·ΔT_a	ΔT_a= $\lvert T_a$-25°C$\rvert$; with T_a = ambient temperature
Offset error	0.02 %	0.05 %	of the range, at 25 °C
Noise	 40 nA_{rms} 0.7 nA_{rms} 0.17 nA_{rms}	 70 nA_{rms} 12 nA_{rms} 0.3 nA_{rms}	Bandwidth: 0.1 Hz to 50 kHz 0.1 Hz to 1 kHz 0.1 Hz to 10 Hz

Bridge measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Mode	DC		
Measurement modes	full, half, quarter bridge		bridge supply ≤5 V with quarter bridge
Input range	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ...		
with bridge supply: 10 V	... ±0,5 mV/V		
with bridge supply: 5 V	... ±1 mV/V		
with bridge supply: 2.5 V	... ±2 mV/V		(as an option)
with bridge supply: 1 V	... ±5 mV/V		(as an option)
Bridge supply	10 V 5 V	±0.5 % ±0.5 %	The actual value will be dynamically captured and compensated for in bridge mode.
(as an option)	2.5 V and 1 V		
Minimum bridge impedance	120 Ω full bridge 60 Ω half bridge		
Maximum bridge impedance	5 kΩ		
Quarter bridge completion	120 Ω, 350 Ω		internal, switchable per software
Input impedance	20 MΩ	±1 %	differential, full bridge
Gain error	0.02 %	0.05 %	of the reading, at 25 °C
Gain drift	20 ppm/K·ΔT_a	50 ppm/K·ΔT_a	ΔT_a= |T_a-25°C|; with T_a = ambient temperature
Offset error	0.01 %	0.02 %	of input range, at 25°C, after automatic bridge balancing
Automatic shunt-calibration (calibration jump)	0.5 mV/V	±0.2 %	for 120 Ω and 350 Ω

Temperature measurement - Thermocouples			
Parameter	**Value typ.**	**min./ max.**	**Remarks**
Measurement mode	J, T, K, E, N, S, R, B		
Measurement range	-270 °C to 1370 °C -270 °C to 1100 °C -270 °C to 500 °C		type K
Resolution	0.063 K (1/16 K)		16-Bit integer
Measurement error		 0.06 % 0.05 %	type K of measurement range, at 25 °C of reading (total uncertainty min. 0.85 K)
Drift	0.02 K/K·ΔT_a	0.05 K/K·ΔT_a	ΔT_a= |T_a-25°C|; with T_a = ambient temperature
Error of cold junction compensation		±0.15 K	with ACC/DSUBM-UNI2, at 25 °C
Cold junction drift	±0.001 K/K·ΔT_a		ΔT_a= |T_a-25°C|; with T_a = ambient temperature

RTD (PT100)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	-200 °C to 850 °C -200 °C to 250 °C		
Resolution	0.063 K		
Measurement error 4-wire measurement 3-wire measurement		0.25 K +0.02 % 0.1 K +0.02 % 0.42 K +0.03 % 0.38 K +0.02%	-200 °C to 850 °C of measured value of resistance -200 °C to 250 °C of measured value of resistance -200 °C to 850 °C of measured value of resistance -200 °C to 250 °C of measured value of resistance Precision for 3-wire mode: with individual adjustment, only (special version upon request)
Drift		0.01 K/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Sensor feed (PT100)	1.25 mA		

Sensor supply					
Parameter	**Value typ.**		**max.**		**Remarks**
Configuration options	5 selectable settings				always 5 selectable voltage settings default selection: +5 V to +24 V
Output voltage	Voltage (+1 V) (+2.5 V) +5.0 V +10 V +12 V +15 V +24 V (±15 V)	Current 580 mA 580 mA 580 mA 300 mA 250 mA 200 mA 120 mA 190 mA	Power 0.6 W 1.5 W 2.9 W 3.0 W 3.0 W 3.0 W 2.9 W 3.0 W		set jointly for all eight channels upon request, also 2.5 V and 1 V settings are available, for example by replacing the +12 V or +15 V setting. An arbitrary set of 5 setting can be chosen preferred selections: +24 V, +12 V, +10 V, +5.0 V, +2.5 V +15 V, +10 V, +5.0 V, +2.5 V, +1 V upon request, special order: +15 V can be replaced by ±15 V. This eliminates the internal current- and quarter bridge measurement.
Isolation	non isolated				output to case (CHASSIS)
Short-circuit protection	unlimited duration				to output voltage reference ground: "-VB"
Compensation of cable resistances	3-line control: SENSE line as refeed (-VB: supply ground)				calculated compensation with bridges
Accuracy of output voltage	<0.25 %		0.5 % 0.9 % 1.5 %		at terminals, no load at 25°C over entire temperature range plus with optional bipolar output voltage
Max. capacitive load			>4000 µF >1000 µF >300 µF		2.5 V to 10 V 12 V, 15 V 24 V

Find here the description of the C1-1-XX. 57

8.3 Fieldbus: Technical Details

8.3.1 CAN FD Bus Interface

Parameter	Value	Remarks
Number of CAN-nodes	2	one galvanically isolated node per connector
Terminal connection	2x DSUB-9	
Topology	bus	
Transfer protocol	configurable per software: CAN FD (ISO Standard) (max. 8 MBaud) non-ISO CAN FD (Draft) (max. 8 MBaud) CAN High Speed (max. 1 MBaud) CAN Low Speed (max. 125 KBaud)	individually for each node current standard according ISO 11898-1:2015 former draft (Bosch) according ISO 11898 according ISO 11519
Operating principle	Multi Master principle	
Direction of data flow	sending and receiving	
Baud rate	5 kbit/s to 8 Mbit/s	configurable via software; maximum is depending on selected protocol (FD/High/Low Speed)
Termination	120 Ω	switchable by software for each node
Isolation strength	±60 V	to system ground and case
Direct access for configuration of imc CANSAS modules	yes	via the CAN node of the device with imc STUDIO (CAN High Speed Mode only)

Note Remote Frame

imc devices actually does not support Remote Frames (RTR) according to CAN specification.

8.4 Synchronization and time base

Time base of individual device without external synchronization			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Accuracy RTC		±50 ppm 1 µs (1 ppm)	not calibrated (standard devices), at 25°C calibrated devices (upon request), at 25°C
Drift	±20 ppm	±50 ppm	-40°C to +85°C operating temperature
Ageing		±10 ppm	at 25°C; 10 years

Time base of individual device with external synchronization signal				
Parameter	**GPS**	**DCF77**	**IRIG-B**	**NTP**
Supported formats	NMEA / PPS[(1)]		B000, B001 B002, B003[(2)]	Version ≤4
Precision	±1 µs			<5 ms after ca. 12 h[(3)]
Jitter (max.)	±8 µs			
Voltage level	TTL (PPS [(1)]) RS232 (NMEA)	5 V TTL level		---
Input impedance	1 kΩ (pull up)	20 kΩ (pull up)		---
Input connection	DSUB-9 "GPS" not isolated	BNC "SYNC" (isolated) (test voltage: 300 V, 1 min.)		RJ45 "LAN"
Cable shield connection		BNC: isolated Signal-GND (marked with yellow ring)		---

Synchronization of multiple devices via DCF (Master/Slave)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Max. cable length		200 m	BNC cable type RG58 (propagation delay of cable needs to be considered)
Max. number of devices		20	only slaves
Common mode SYNC not-isolated	0 V		with non-isolated BNC connector: devices must have the same ground voltage level, otherwise signal integrity issues (signal artifacts and noise) may result
SYNC isolated		max. 50 V	with isolated BNC connector: SYNC-signal is already internally isolated, for reliable operation even with different ground voltage level (ground loops)
Voltage level	5 V		
DCF input/output	"SYNC" connection		BNC

(1) PPS (Pulse per second): signal with an impulse >5 ms is necessary
(2) using BCD information only
(3) Max. value, concerning the following condition: first-synchronization

8.5 Miscellaneous

8.5.1 Color Display

Parameter	Color Display	
Display	5.7² TFT	
Colors	65536	
Resolution	320 x 240	
Backlight	LED	
Contrast (typ.)	600:1	
Brightness (typ.)	450 cd/m^2	
Connection cable	RS232, max. 2 m	
Dimensions (W x H x D)	192 x 160 x 30 mm (w/o connectors)	
Display area	approx. 11.5 x 8.6 cm	
Weight	approx. 1 kg	
Supply voltage	9 V to 32 V_{DC} 6 V to 50 V_{DC} upon request	
Power consumption	approx. 3 W with 100% back light	
Temperature range	-20°C to +60°C ≤+85°C	operating temperature module interior temperature
Rel. humidity	80% up to 31°C, above 31°C: linear declining to 50%, according DIN EN61010-1	
Terminal connections	DSUB-9 (female) for connection to measurement device 3-pin Binder (metal) ESTO RD03 series 712, 3-pin for external current supply	
Miscellaneous	membrane touch panel with 15 buttons robust metal frame anti-reflection coated glass pane to protect display	

Description the display 56 and the DSUB-9 pin configuration 86.

Included accessories article no.

- Modem cable in the extended temperature range
- ACC/POWER-SUPPLY AC/DC power supply unit 13500043
- ACC/POWER-PLUG4 power plug 13500052

8.5.2 ACC/SYNC-FIBRE

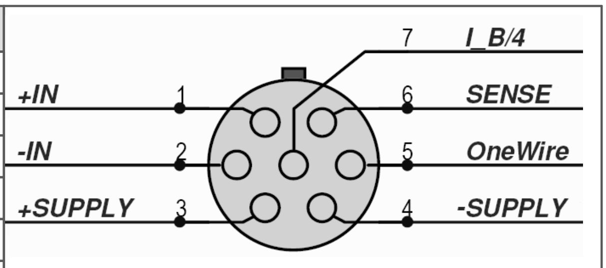
Parameter	Value typ.	min./ max.	Remarks
Compatible with	GPS-connection imc measurement device		Modification of the GPS-connection is necessary (device preparation for SYNC-FIBRE). The simultaneous use of both SYNC-FIBRE and the device's SYNC plug (BNC) is not allowed. Only the SYNC-FIBRE or the SYNC plug (BNC) can be used.
Terminal connection	2x ST plug 1x DSUB-9		FOC connection with measurement device
Supply	5 V	±10%	out of device internal sensor supply
Power consumption	0.5 W	±10%	
Propagation Delay tPD	25 ns	75 ns	SYNC-In to Opto-Out or Opto-In to Sync-Out
Link length		500 m	Length of the fiber optic distance between two ACC/SYNC-FIBRE
Total delay		8 µs	SYNC-In first device to SYNC-Out last device
Fiber Optics plug type	ST		
Fiber Optics	50 / 125 µm 62.5 / 125 µm		
Wave length	820 nm		
General			
Extended environmental range	-40°C to + 85°C		condensation temporarily allowed

Find here the description of the ACC/SYNC-FIBRE 53.

9 Pin configuration

9.1 LEMO

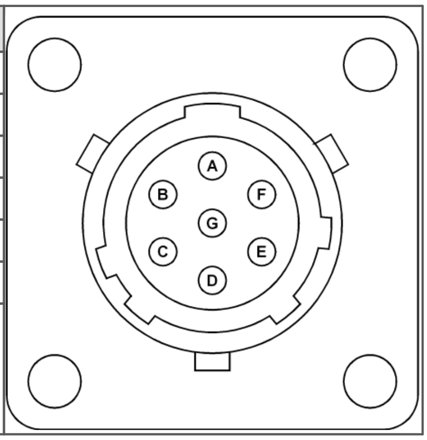
LEMO PIN	Signal
1	+IN
2	-IN
3	+SUPPLY
4	-SUPPLY (GND)
5	TEDS (OneWire)
6	SENSE/PT100 current source
7	quarter bridge completion / sense for PT100 3-wire configuration



view on top of the socket

9.2 ITT VEAM

Signal	PIN/circuit
positive measurement input	A
negative measurement input	B
positive sensor supply	C
negative sensor supply (ground)	D
sensor recognition	E
sense-lead, RTD-current source	F
quarter bridge completion, sense lead for RTD 3-wire connector	G



9.3 DSUB-9 pin configuration

9.3.1 Display

DSUB-PIN	Signal	Description	Use in device
1	DCD	Vcc 5V	connected
2	RXD	Receive Data	connected
3	TXD	Transmit Data	connected
4	DTR	5V	connected
5	GND	ground	connected
6	DSR	Data Set Ready	connected
7	RTS	Ready To Send	connected
8	CTS	Clear To Send	connected
9	R1	Pulldown to GND	connected

Supply for the graphical display

Connector	+9 V to 32 V	- (0V)	nc
Binder	1	2	3
Souriau	B	C	A

To the description 56 and the technical data of the displays 84.

9.3.2 GPS

DSUB-9		GPS 18x - 5Hz	remarks
Pin	**Signal**	**Color**	Garmin GPS receiver
1	Vin	Red	
2	RxD1*	White	
3	TxD1	Green	
5	GND, PowerOff	2x Black	
7	PPS (1 Hz clock)	Yellow	
4,6,8 and 9	-	-	

* Pin configuration at measurement device. At the GPS-mouse Rx and Tx are interchanged.

9.4 Pin configuration of the fieldbusses

9.4.1 CAN FD Interface

DSUB-PIN	Signal	Description	Use in device
1	nc	reserved	do not connect
2	**CAN_L**	**dominant low bus line**	connected
3	**CAN_GND**	**CAN Ground**	connected
4	nc	reserved	do not connect
5	nc	reserved	do not connect
6	**CAN_GND**	**optional CAN Ground**	connected
7	**CAN_H**	**dominant high bus line**	connected
8	nc	reserved (error line)	do not connect
9	nc	reserved	do not connect

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imc ACADEMY - Training center

The safe handling of measurement devices requires a good knowledge of the system. At our training center, experienced specialists are here to share their knowledge.

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