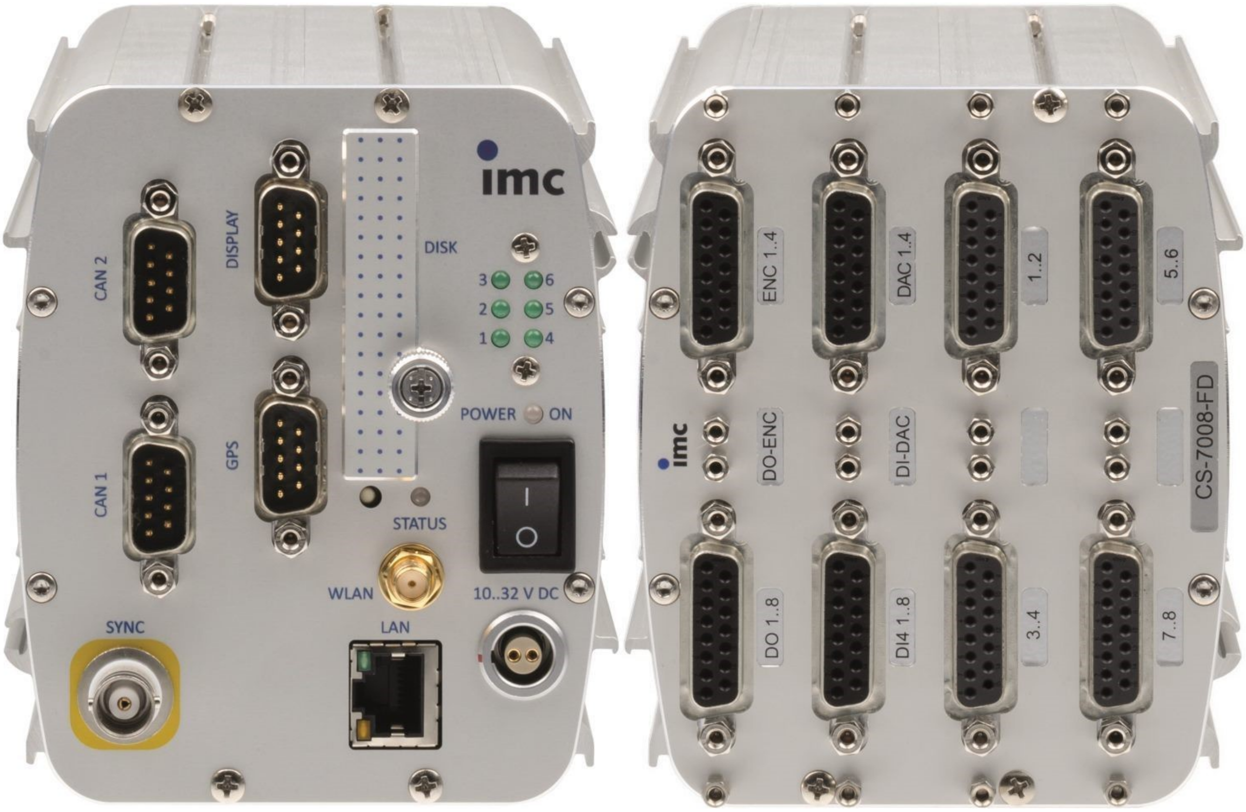
imc C-SERIES

Manual

Edition 11 - 2023-10-23



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 Hotline.

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 the imc hotline. 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 imc Customer Support / Hotline

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

imc Test & Measurement GmbH

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

E-Mail: hotline@imc-tm.de

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

International partners

For our international partners see https://www.imc-tm.com/imc-worldwide/.

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.

1.2 Legal notices

Quality Management

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

Each device is subjected to a 24-hour "burn-in" before leaving imc. This procedure is capable of detecting almost all cases of early failure. This does not, however, guarantee that a component will not fail after longer operation. Therefore, all imc devices are granted liability for a period of two years. The condition for this guarantee is that no alterations or modifications have been made to the device by the customer.

Unauthorized intervention in the device renders the guarantee null and void.

Notes on radio interference suppression

Devices of the imc C-SERIES 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 devices of the imc C-SERIES should not be longer than 30 m and they should be shielded and the shielding must be grounded.

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.

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

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 the imc C-SERIES 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/

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 imc Hotline or an experienced technician for help.

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 may void the user's authority to operate this equipment.

1.3 Explanation of symbols

CE Conformity

see CE chapter 1.2 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 1.2 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.

1.4 Last changes in content

Please help us to improve our documentation:

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

Responses and other feedback should be directed to the Hotline.

Amendments and bug-fix in Edition 10

Chapter	Amendment
Device overview 34	updated overview
UNI2-8 126	In the drawing, the screw terminal number for ±IN was wrong.

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

Devices of the imc C-SERIES are 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 devices of the imc C-SERIES 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.

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.

Industrial safety

We certify that the imc C-SERIES 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)*. This confirmation applies exclusively to devices of the imc C-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.

For repeat tests, a test voltage that is 1.5 times the specified working voltage should be used to test the isolation for the highly isolated inputs (e.g. measurement inputs for high-voltage applications).

* previously BGV A3.

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 :

- AC/DC-power adaptor with cable and pre-assembled plug
- DSUB-15 plugs:
  - 1x ACC/DSUBM-DI4-8, 15-pin DSUB plug for 8 digital inputs
  - 1x ACC/DSUBM-DO8, 15-pin DSUB plug for 8 digital outputs
  - 1x ACC/DSUBM-ENC4, 15-pin DSUB plug for 4 incremental counter inputs
  - 1x ACC/DSUBM-DAC4, 15-pin DSUB plug for 4 analog outputs
  - Set of plugs corresponding to the device's built-in amplifier (see corresponding data sheet)
- 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, 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", 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:

Device	LEMO plug type designation	Size
CS	FGG.**1B**.302 CLAD 52ZN	middle
CL	FGG.**0B**.302 CLAD 52ZN	small

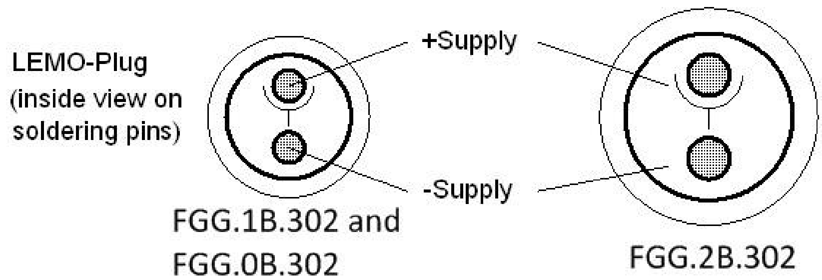
The permissible supply voltage range is 10 ... 32 V DC. The product package includes a corresponding desktop supply unit (15 V DC) as an AC-adapter for mains voltage (110 .. 240 V 50/60Hz). The DC-supply inputs of our imc measurement devices are not designed for a connection to a DC-grid.

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 1mH. Otherwise an additional parallel-capacitor is needed.

Pin configuration:



The +pin is marked with a red dot.

CS

CL

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.

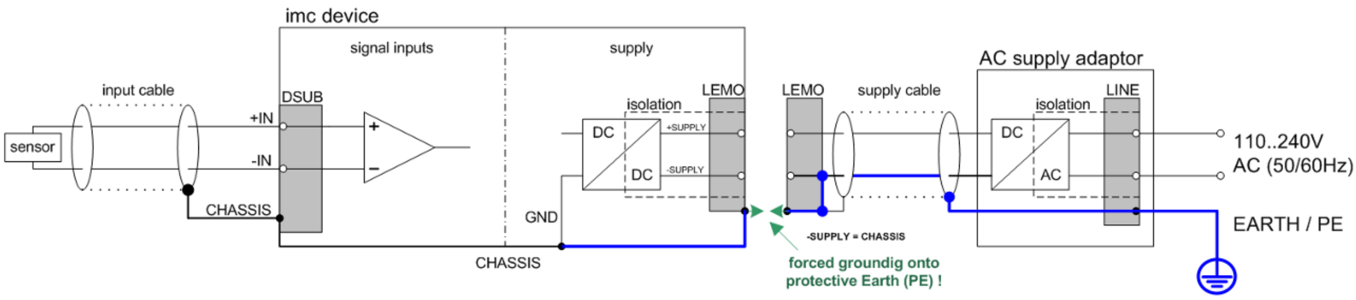
3.3.3.1 Devices with non-isolated power supply

CS devices — The DC-supply input on the device itself (LEMO-socket) is not galvanically isolated from the housing (CHASSIS): -SUPPLY input is galvanically connected to CHASSIS internally. That means the device's internal power supply circuitry is not isolated from the system reference ground or the frame ("CHASSIS").

3.3.3.2 Devices with isolated power supply

CL devices — The DC-supply input on the device itself (LEMO-socket, female) is galvanically isolated from the housing (CHASSIS): -SUPPLY input is not connected to CHASSIS internally. That means the device's internal power supply circuitry is isolated from the system reference ground/frame ("CHASSIS"). If the device is powered by an isolated DC-voltage source (e.g. battery), use the device's black grounding socket ("CHASSIS") or the LEMO supply cable's shielding to ground the device.

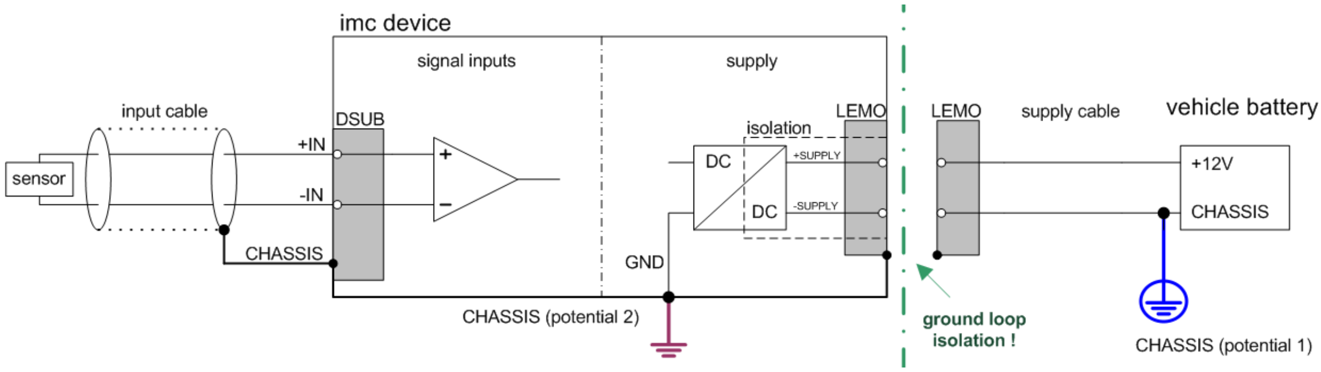
3.3.3.3 Grounding with the use of the included power adaptor



imc CL Devices

Use of the included table-top power adaptor is protected by the power plug's protection ground connection: at the adaptor's LEMO terminal, both the (-) pole of the supply voltage as well as the shielding and the plugs are connected with the power cable's protection ground.

3.3.3.4 Grounding with power supplied by a car battery



imc CL Devices with isolated DC-supply (e.g. battery)

If the power supply (e.g. car battery) and the measurement device are at different voltage levels, then if they were connected by the supply line, it would cause a ground loop. For such cases, the isolated internal device power supply ensures separation of the two voltage levels. The ground reference for the measurement device must then be established in a separate step.

For running on an isolated DC power supply source (e.g. battery), either the grounding socket terminal, a grounding contact on the device ("CHASSIS"), or the CHASSIS contact on the imc signal plugs must be used.

Isolated power inputs avoids ground loops in distributed topologies

With stationary installations and the use of (already isolated) AC/DC adapters, any system ground differentials between the device and the central or local power supplies may not be relevant. The big issue in such a case, in contrast to mobile, in-vehicle applications, is from where to obtain a reliable ground voltage. Since it is convenient to use the AC power supply's protection ground line as the ground voltage, the LEMO-terminated AC/DC adapters for imc measurement devices are designed so that the protection ground line is connected all the way through to the LEMO plug's housing, thus securing the device's voltage level to protection ground. Additionally, in the AC/DC-adaptor's LEMO-terminal (not the device's LEMO-socket!), the reference ground of the power adapter is connected with the housing's (CHASSIS) protection ground: Since the AC/DC power adapter is already isolating, as is the power input, this supply voltage's reference would not initially be defined and can be set arbitrarily. In particular for reasons of suppressing HF (high-frequency) interference signals stemming from the AC/DC switching power adapter, direct grounding is normally advisable.

3.3.3.5 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**").

To avoid compensation currents, always connect the shielding to one side (potential) only.If the imc DSUB block screw terminal plug is used, the shielding should be connected to the pull-relief clamp on the cable bushing. This part of the conductor-coated plastic plug housing has electrical contact to the device's housing, just as Terminals 15 and 16 (labeled: "CHASSIS", to the left and right of the imc-plug cable bushing) do; but is preferable to the "CHASSIS" terminals for optimum shielding.

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

The main switch of all CS-devices takes the form of a flip switch.

The main switch of the CL-devices takes the form of a rocker switch, which activates the device when it is tipped for approx. 1 second in the "ON" direction.

Activation

Devices with rocker switch will be activated by clicking for approx. 1 sec the "ON" position. Devices with 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.

- CS-devices: Upon activation, all 6 status LEDs blink twice.
- CL-devices: There are no LEDs in this device type. Instead the start procedure is seen on the display.

The device is activated

- CS-devices indicate the activated state by the Power LED shining.
- CL-devices indicate the activated state by the Display being on.

Deactivation

Devices with rocker switch will be deactivated by clicking for approx. 1 sec the "OFF" position. Devices with flip switch will be deactivated by setting the main switch to the "O" position.

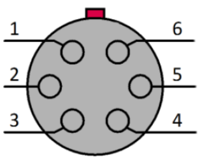
If the device is running a measurement, it does not deactivate immediately. First, any associated files are closed on the internal hard drive before the device switches off automatically. This process lasts for a maximum of about 10 sec. It is not necessary to hold the main switch down for this duration!

- CS-devices: The deactivation procedure changes the color of the Power LED.
- CL-devices: The deactivation procedure itself is not indicated. After 10 s, the device is completely deactivated and the display switches off.

3.3.7 Remote control of the CL main switch

Alternatively to the manual main switch on the device's front panel (only CL devices), it is possible to switch the device on and off by means of an electrical remote control contact. The terminal designated "REMOTE" on the device's rear panel makes this available: either brief or longer connection of the signals "SWITCH" and "ON" activates the device, connecting "SWITCH" with "OFF" switches it off.

LEMO.FGG.0B.306



LEMO	Signal	LEMO	Signal
1	OFF	4	SWITCH1
2	SWITCH	5	-BATT (internal testpin)
3	ON	6	-

Possible configurations:

Function	Jumper between
Switch on "normal"	SWITCH and ON
Switch on when connected to main supply only → "jumpered main switch "	SWITCH1 and ON
Switch off (switch off within 10 s)	SWITCH and OFF

3.3.8 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.

3.3.8.1 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 only for CL devices be changed using the imc operating software.

Reference

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

Please find the technical specs here: "General technical specs 133".

Please distinguish between NiMH batteries in CL devices from the Super-Caps, that are integrated in CS devices.

3.3.8.2 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.

3.3.8.3 Take-over threshold

The voltage threshold at which the storage battery takes over the power supply from the external source is approx. 9.75 V (8.1 V for CS). 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 10.9 V (9 V for CS), 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).

3.3.9 Rechargeable accumulators and batteries

3.3.9.1 Lead-gel batteries

Devices build before 2017 come with the optional UPS-Function containing maintenance-free **lead-gel batteries**. Charging these internal backup batteries is accomplished automatically when the activated device receives a supply voltage. Due to the inevitable leakage of charge we recommend that the device be activated for 6 to 9 hours at least every 3 months to prevent the batteries from dying.

In case the UPS is used a lot (many discharge and recharge cycles), the life time depends on how much (deep) it has been discharged (is the UPS buffering only for a short time or is the UPS discharged completely every time?). The manufacturer specifies 200 cycles @100% discharging and 1200 cycles @ 30% and 25°C ambient temperature. (that should be true in general for all Pb batteries.)

Do **not** throw the lead-gel accumulators in the household garbage.

3.3.9.2 NiMH batteries

The lead-gel batteries are replaced by a solution with NiMH batteries. For you as a user, this change does not represent a significant change in his previous operation of the device, see chapter "General technical Specs" 133. The battery type is marked on the device type plate: "**Contains NiMH Battery**" so that the devices can be distinguished externally.

Reference imc energy sources (batteries)

Devices from the imc C-SERIES delivered by imc after November 2022 will have a "battery label" 10 on the nameplate for integrated energy sources.

3.3.10 Removable storage

For saving measured data, all imc devices support a removable storage medium. The slot for the CF removable memory is located on the front of the devices, see adjacent figure.

Removing the removable memory when the device is switched on

If you remove the removable storage without notice, defective clusters may result. If you pull the data carrier during a running measurement, the data sets will not be completed!

- Press push-button (1) to change the data carrier.
- Status LED lights up, access to the removable storage device is terminated.
- As soon as the status LED flashes, remove the removable storage device.

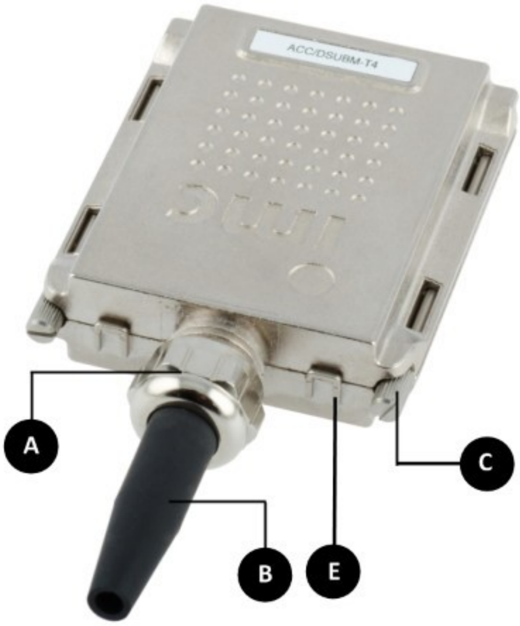
3.3.11 Signal connection

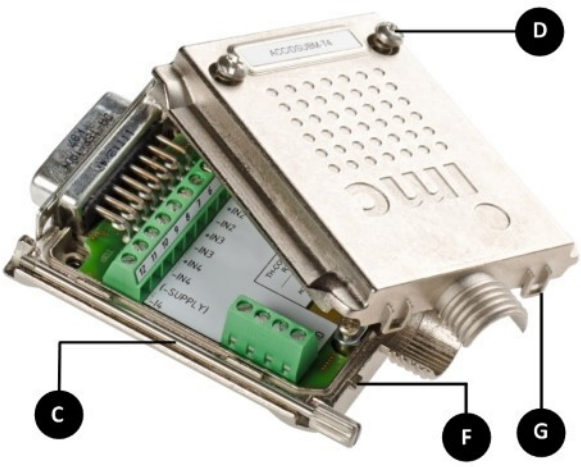
For devices with DSUB-15 connection technology, the convenient imc terminal plugs for solderless screw terminal connection are available as optional accessories.

ACC/DSUBM-xxx: snap the nose into the slot

Open the Metal plug:

1. Unscrew the cable fitting (cable gland) [A]
2. Remove the bend protection [B]
3. Unscrew the lid screws [D]
4. Lift the lid in the DSUB connection area and unfasten the nose of the slot





A: Cable fitting (cable gland)
B: Bend protection
C: Fastening screw for the devices' front panel
D: Lid screws
E: Locking key (Nose / Slot)
G: Slot
F: Nose

Close the Metal plug:

1. Assemble the lid by snapping the nose into the slot (see the picture above)
2. Audible click when the lid snaps in the front of the DSUB pod
3. Insert the bend protection
4. The pressure nut must be screwed back on
5. The lid screws can be tightened

Reference Pin configuration

Please find the pin configuration of each available plug in the chapter: Pin configuration 172.

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-training/customer-service/system-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 11 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 the imc Customer 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* 27" 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.

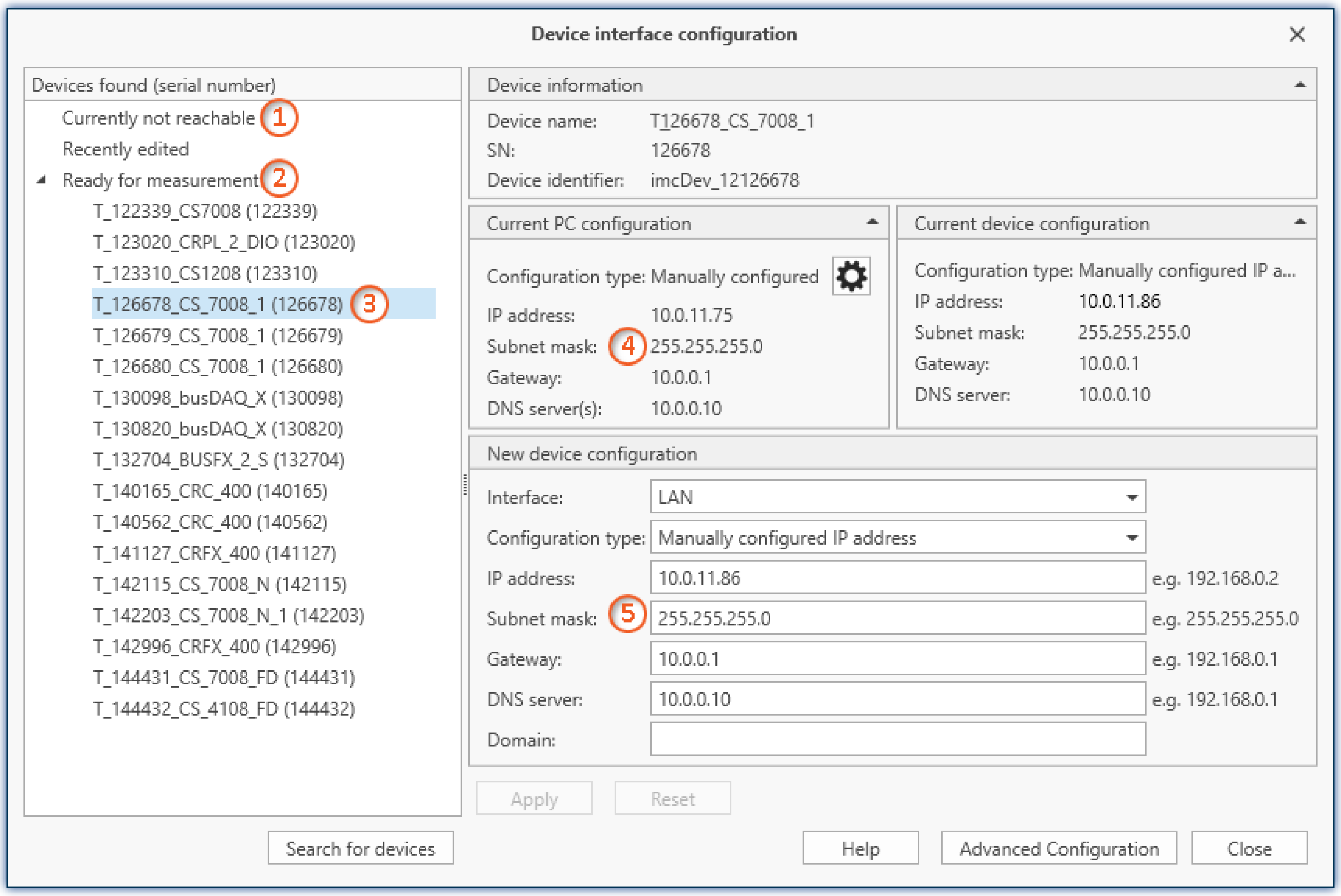
Ribbon	View
Setup-Configuration > Device interfaces ( )	Complete

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.

Select the device for making modifications ③.

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



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

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

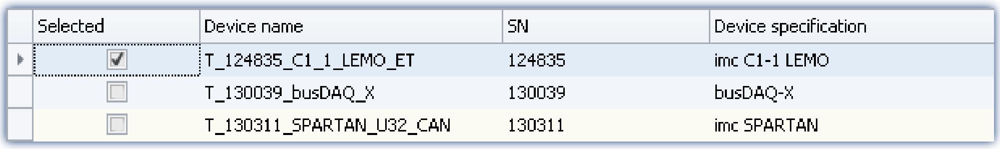
If the connection to the device is established via a modem or WLAN, start the program "*imc DEVICES Interface Configuration*" by clicking on the button: "*Advanced Configuration*" (see previous figure). An exact description is found in the software manual chapter: "*Setting Up - Connect the device*"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



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.

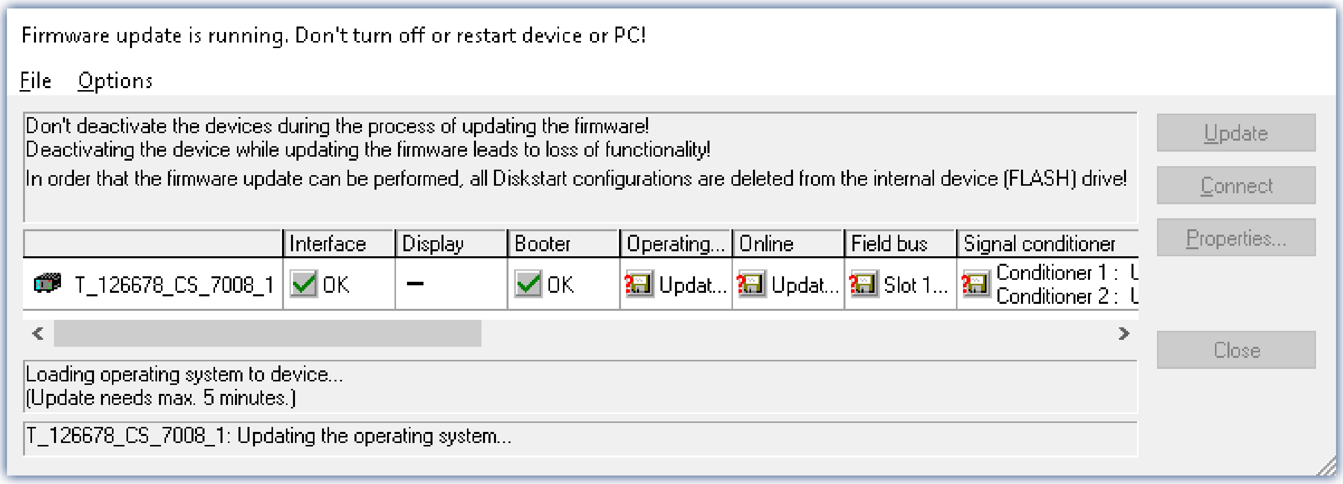
Warning Do not interrupt the firmware update!

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 diaplayed in the list.

Component	Description
Interface	Interface-Firmware (Ethernet)
Booter	Start-up program for the device upon switching-on
Operating system	Device operating system
Online	Online-functions and hard drive controller
Display	Operating system of the connected displays
Fieldbus	Fieldbus interfaces (e.g. CAN etc.)
Signal conditioners	Amplifiers

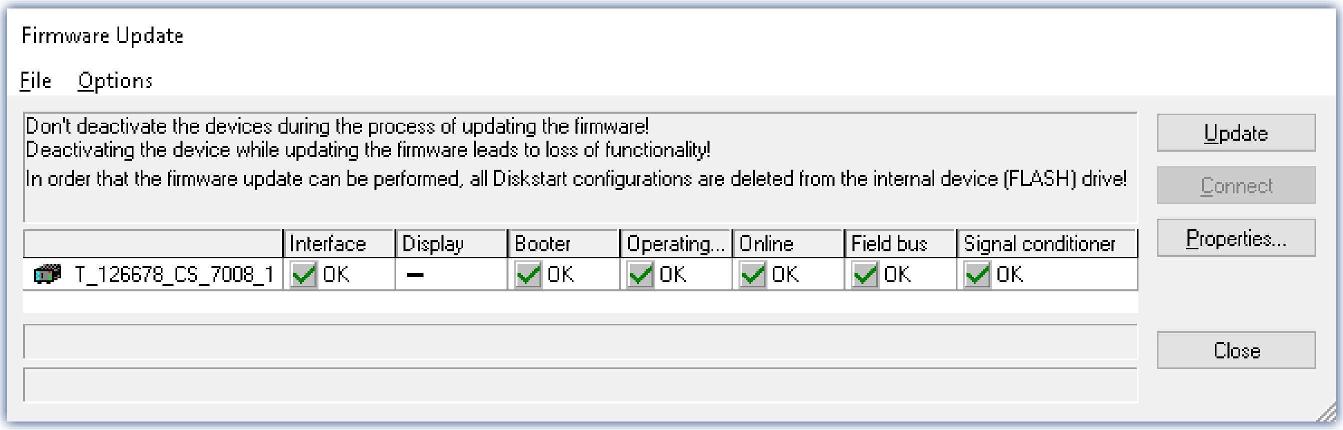
The following symbols for the individual firmware components appear in the list:

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 the imc Hotline. The firmware update may be continued with guidance from the Hotline.

Note

Firmware logbook

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

Update all components

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

6 Properties of the imc C-SERIES

The imc C-SERIES consists 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.

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 sum sampling rate. Along with the (maximum of) two "primary" sampling rates, the system can contain additional "sampling rates" resulting from the effects of certain data-reducing imc Online FAMOS-functions (ReductionFactor RF).

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.

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 C-SERIES series:

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

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	BUSDAQ*flex*	SPARTAN-R SPARTAN-N	CRSL-N	CRC-400 CRFX-400	C1-N C-SERIE-N	C1-FD C-SERIE-FD	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
imc STUDIO Monitor supported	●		●					●	●					—	—
Connections[4]	4		4					4	4					—	—
Data Storage															
CF	●		●					—	—					—	—
Express Card	—		—					●	—					—	—
CFast	—		—					—	●					—	—
USB	—		—					●	●	●	●	●	—	—	—
microSD	—		—					—	—					—	●
Storage on network drive	●		●					●	●					—	—
Internal hard disk	(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 Measurement types

6.2.1 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.

6.2.1.1 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**.

6.2.1.2 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.

With the imc Thermo plug, the connection terminals are already wired in such a way that this reference current loop is closed.

Note

If fewer than 4 PT100 units are connected, the current-loop must be completed by a wire jumper from the "last" RTD to -I4.

If you dispense with the "support terminals" (±I1 to ±I4) provided in the imc Thermo plug for 4-wire connection, a standard terminal plug or any DSUB-15 plug can be used. The "current loop" must then be formed between +I1 (DSUB Pin 9) and -I4 (DSUB Pin 6).

6.2.1.3 imc Thermo plug (T4)

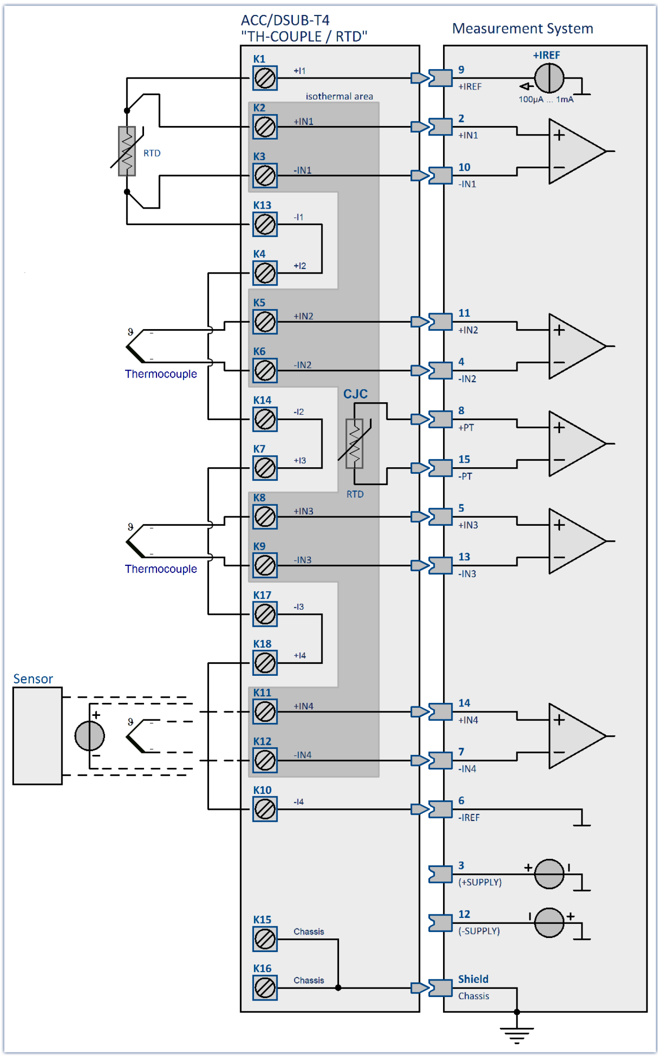
The imc Thermo plug contains a screw terminal block in a DSUB-15 plug housing with a built-in temperature sensor (PT1000) for **cold junction compensation**. This provides for direct connection of thermocouples of any type, directly to the differential inputs (+IN and -IN) without external compensation leads. That plug can also be used for **voltage** measurement.

The difficulty with thermocouple measurements are the "parasitic" thermocouples which inevitably form where parts of the contacts made of different materials meet. The temperature sensor measures the temperature at the connection terminal and compensates the corresponding "error"-voltage. Normally, the connection to this compensation point (inside the device) is made by special compensation leads or plugs made of material identical to the respective thermocouple type, in order not to create additional (uncontrolled) parasitic thermocouples.

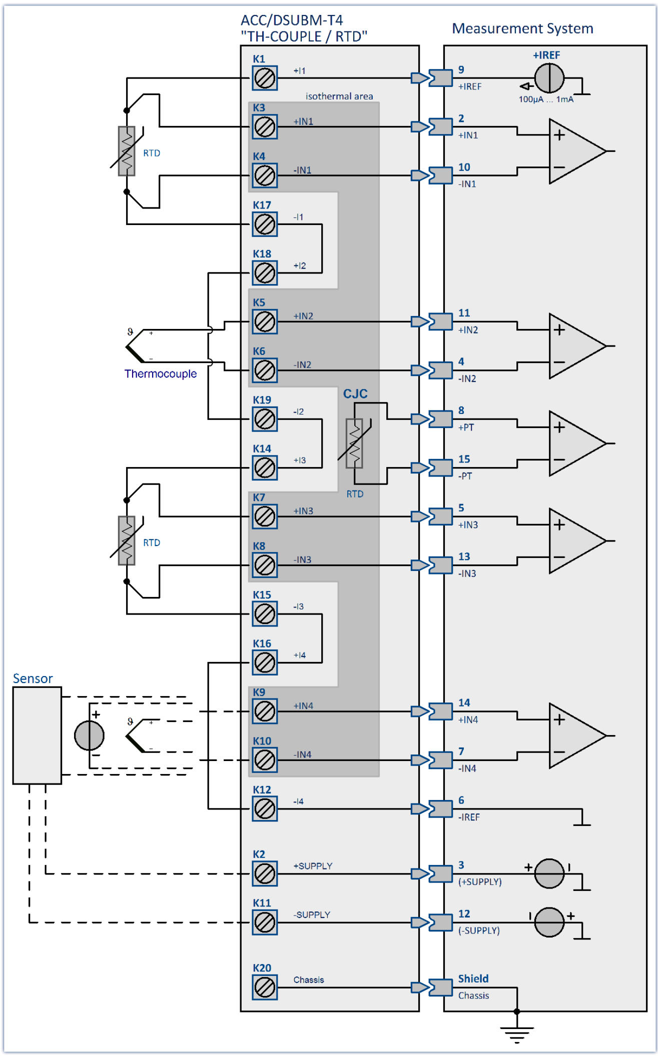
imc's system avoids the problem through the use of individual compensation sensors directly inside the plug, thus offering an especially simple, flexible and cost-effective connection solution.

6.2.1.3.1 Schematic: T4 plug

Plastic plug (ACC/DSUB-T4, discontinued)



Metal plug (ACC/DSUBM-T4)



6.2.2 Bridge measurement

Bridge channels are for taking readings from **measurement bridges** such as resistor bridges or strain gauges. The channels are equipped as **non-isolated differential** amplifiers and can alternatively be used for direct **measurement of voltages**.

There is a distinction among the following operating modes:

➢ **Sensor**
- Full bridge
- Half bridge
- Quarter bridge (120 Ω)

➢ **Strain gauge**
- Full bridge with 4 active strain gauges in uniaxial direction
- Full bridge with Poisson strain gauge in adjacent bridge arms
- Full bridge with Poisson strain gauge in opposing bridge arms
- Half bridge with one active and one passive strain gauge
- Half bridge with 2 active strain gauges in uniaxial direction
- Poisson half bridge
- Quarter bridge with 120 Ω strain gauge

6.2.3 Bridge measurements with wire strain gauges

Strain in this sense refers to the ratio of a body's original length to the change in length due to a force exerted upon it.

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

By selecting "*Strain gauge*" as the measurement mode, common bridge circuits and configurations for wire strain gauges are offered for selection. The scaling can be adjusted in terms of typical parameters for strain measurements such as the gauge factor or Poisson's ratio, the transversal expansion coefficient.

If a strain gauge adheres to a test object, the strain on the object is transmitted to the bridge circuit. The changes in the lengths of the bridge arms cause their impedances to change. There is a correlation between the changes in length and the changes 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, describing the ratio of relative length change to change in resistance

The changes in resistance caused by the strain are very small. For this reason, a bridge circuit is used to translate these changes 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:

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

Legend:	
Va	measurement voltage
Ve	excitation voltage

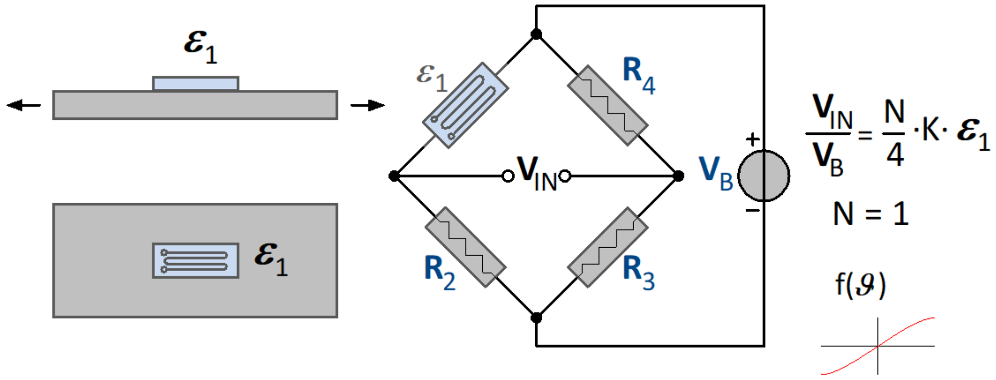
$$\varepsilon = \frac{V_a \cdot 4}{V_e \cdot k}$$

For concrete measurement tasks, the arrangement of the strain gauges on the test object is important, as well as the circuitry of the bridge. On the "Bridge circuit", you can select from among typical arrangements. A graphic below shows the position on the test object and the bridge circuitry. Notes on the selected arrangement are displayed in the text box.

Note

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

6.2.3.1 Quarter bridge for 120 Ohm strain gauge



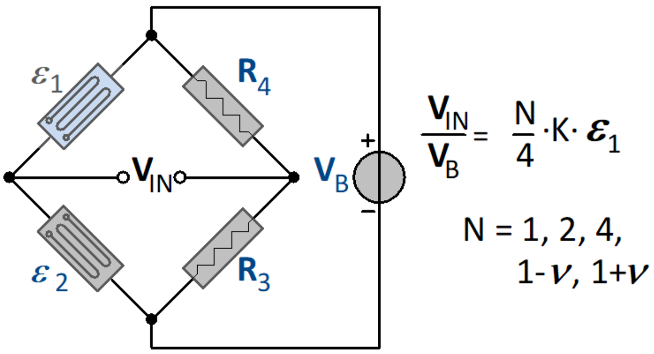
This strain gauge arrangement uses an **active** strain gauge which is positioned on the test object in a uniaxial stress field. This strain gauge is joined by three passive resistors within the module to form a full bridge. The strain gauge can have a resistance value of 120 Ω.

This arrangement does not come with temperature compensation. The strain is computed as:

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right] = \frac{4 \cdot 1000}{k} \cdot \frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

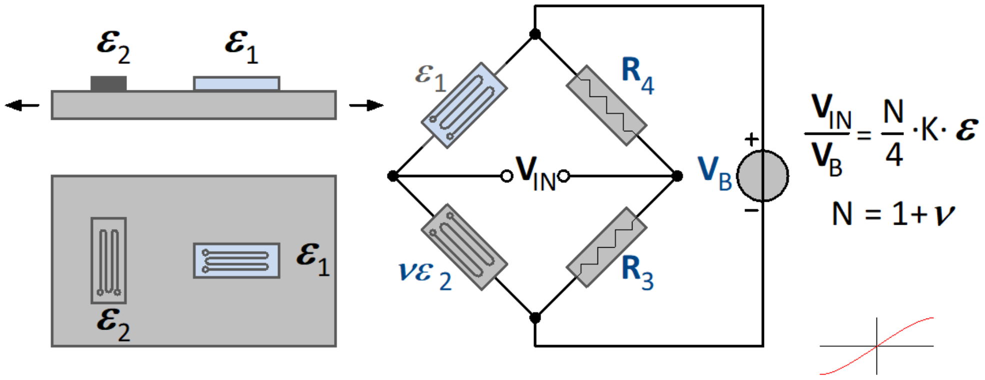
Legend:	
k	gauge factor

6.2.3.2 General half bridge



General half bridge with bridge completion in measurement device. N has to be set from a list.

6.2.3.3 Poisson half bridge

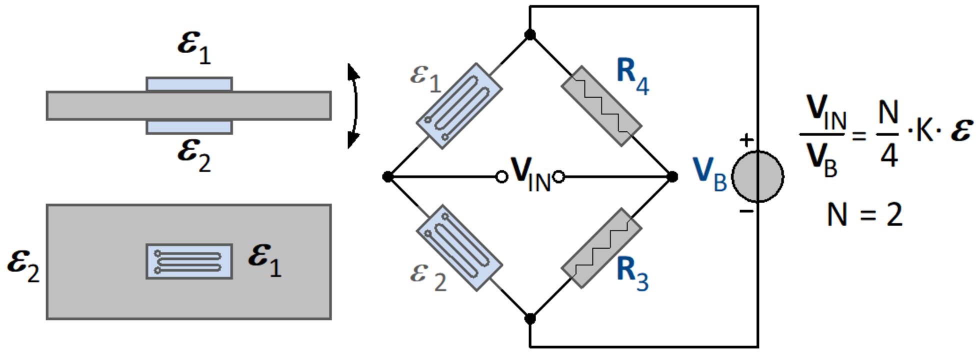


In this circuit, two active strain gauges are used. The strain gauge is positioned transverse to the main direction of strain. The transversal contraction is exploited. For this reason, the Poisson's ratio for the material, which is its transversal expansion coefficient, must be supplied along with the gauge factor. This circuit offers good temperature compensation. The strain is computed as:

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right] = \frac{4 \cdot 1000}{k \cdot (1+\nu)} \cdot \frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

Legend:	
k	gauge factor
v	Poisson's ratio of test object material

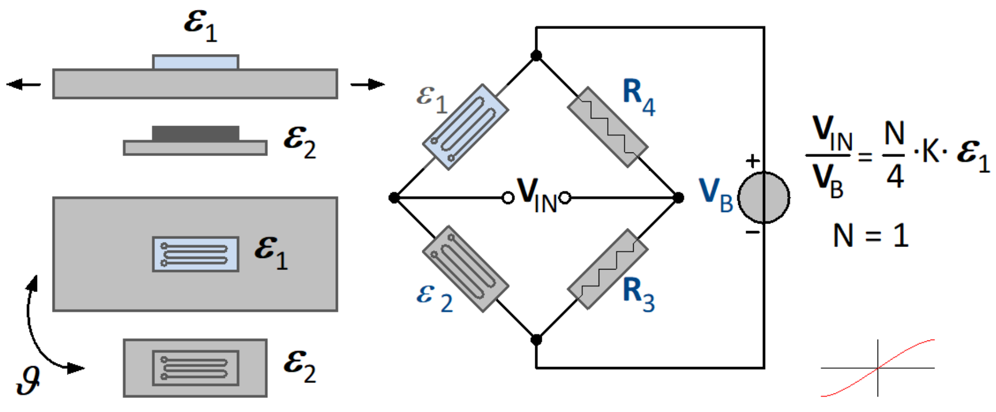
6.2.3.4 Half bridge with two active strain gauges in uniaxial direction



Two active strain gauges are placed under stress in opposite directions but equal magnitude, i.e. one strain gauge is under compression and another under equal tension. (bending beam circuit). This arrangement doubles the measurement's sensitivity to a bending moment. On the other hand, longitudinal force, torque and temperature are all compensated for. The strain is computed as:

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right] = \frac{4 \cdot 1000}{2 \cdot k} \cdot \frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

6.2.3.5 Half bridges with one active and one passive strain gauge

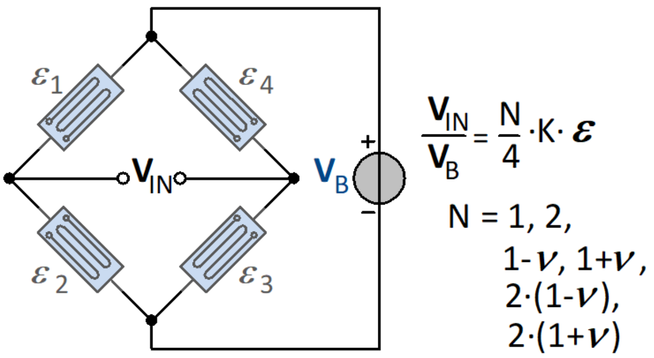


This circuit involves strain gauges. The first one is positioned on the test object, the second on a sample of the same material under the same ambient temperature and serves the purpose of temperature compensation. The strain is computed as:

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right] = \frac{4 \cdot 1000}{k} \cdot \frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

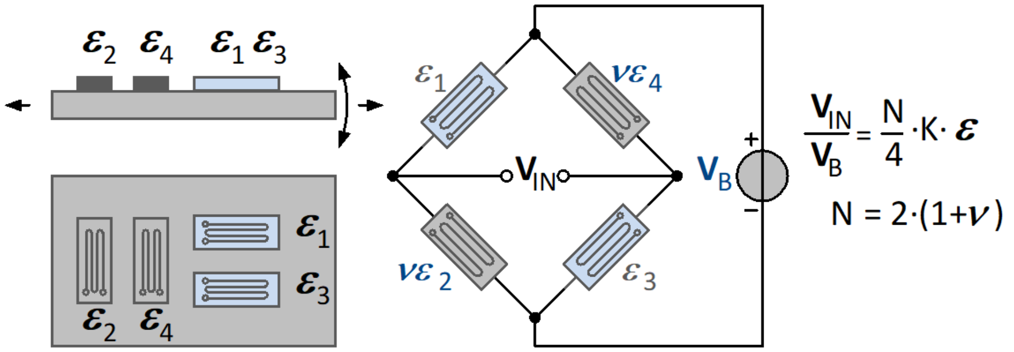
Legend:	
k	gauge factor

6.2.3.6 General Full bridge



General full bridge. N has to be set from a list.

6.2.3.7 Full bridge with Poisson strain gauges in opposed branches

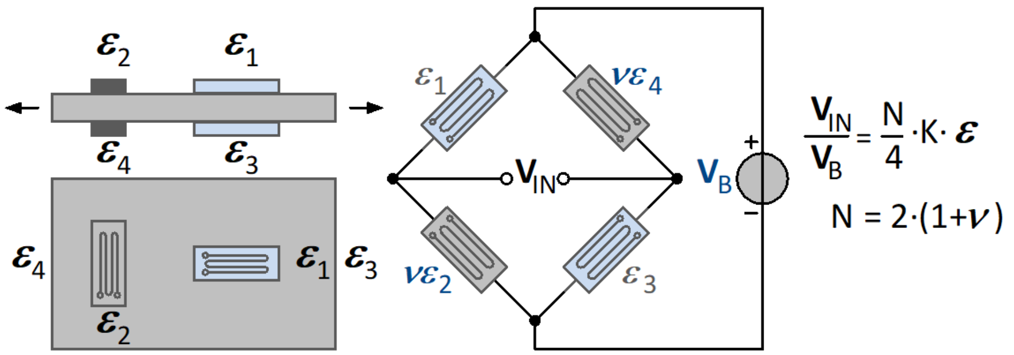


Two active strain gauges are positioned along the longitudinal strain and are joined by two transversally positioned strain gauges to complete the bridge (torsion bar arrangement). In the bridge, the longitudinal strain gauges are located in opposite branches. This circuit provides better exploitation of transversal contraction and longitudinal force as well as good temperature compensation. In this arrangement, the transversal expansion coefficient must be specified. The strain is computed as:

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right]=\frac{4\cdot 1000}{2\cdot k\cdot(1+\nu)}\cdot\frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

Legend:	
k	gauge factor
v	Poisson's ratio of test object material

6.2.3.8 Full bridge with Poisson strain gauges in adjacent branches

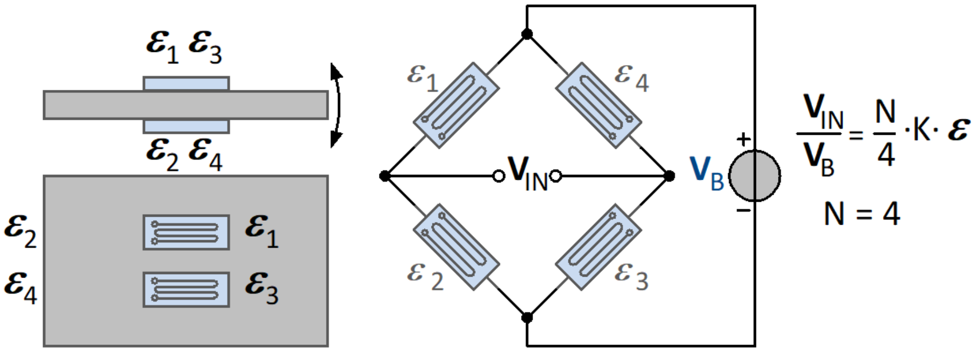


Full bridge with 4 active strain gauges. 2 active strain gauges complemented by 2 transverse Poisson strain gauges. They are located in opposed bridge arms. Higher exploitation of transverse contraction longitudinal expansion while providing good temperature compensation.

$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right]=\frac{4\cdot 1000}{2\cdot k\cdot(1+\nu)}\cdot\frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

Legend:	
k	gauge factor
v	Poisson's ratio of test object material

6.2.3.9 Full bridge with 4 active strain gauges in uniaxial direction



The circuit consists of 4 active strain gauges. Two are under compression and the others under equal tension. The strain gauges under tension are positioned in opposite bridge arms. The sensitivity to the moment of bending is increased. At the same time, longitudinal force, torque and temperature are compensated. The strain is computed as:

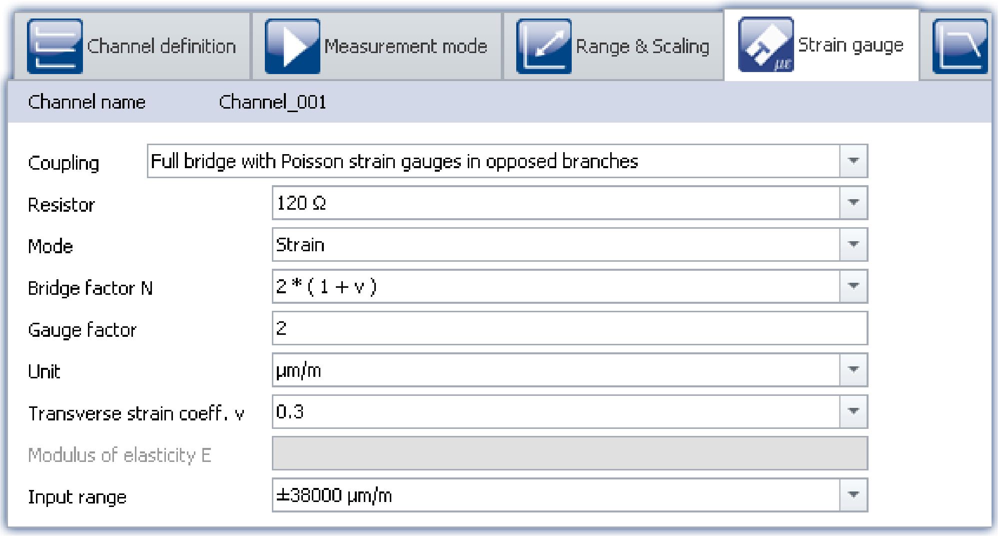
$$\varepsilon\left[\frac{\mu\mathrm{m}}{\mathrm{m}}\right] = \frac{4\cdot 1000}{4\cdot k}\cdot\frac{V_a}{V_e}\left[\frac{\mathrm{mV}}{\mathrm{V}}\right]$$

Legend:	
k	gauge factor

6.2.3.10 Scaling for the strain analysis

It is possible to choose whether to determine the strain or the mechanical stress suffered by the part. 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)



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.

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/mm^2. 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.

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.

6.2.4 Incremental Counters Channels

The incremental counter channels are for measuring **time** or **frequency**-based signals. In contrast to the analog channels as well as to the digital inputs, the channels are not sampled at a selected, fixed rate, but instead time intervals between slopes (transitions) or number of pulses of the digital signal are measured.

The **counters** used (set individually for each of the 4 channels) achieve time resolutions of up to 31 ns (32 MHz); which is far beyond the abilities of **sampling procedures** (under comparable conditions). The *sampling rate* which the user must set is actually the rate at which the system evaluates the results of the digital counter or the values of the quantities derived from the counters.

Note	Sampling rate for incremental counter channels

Only one sampling rate can be set per module.

The description of the Digital In- and Outputs, Inputs for Incremental counters. 76

6.2.4.1 Signals and conditioning

6.2.4.1.1 Mode

The various modes comprise the following measurement types:

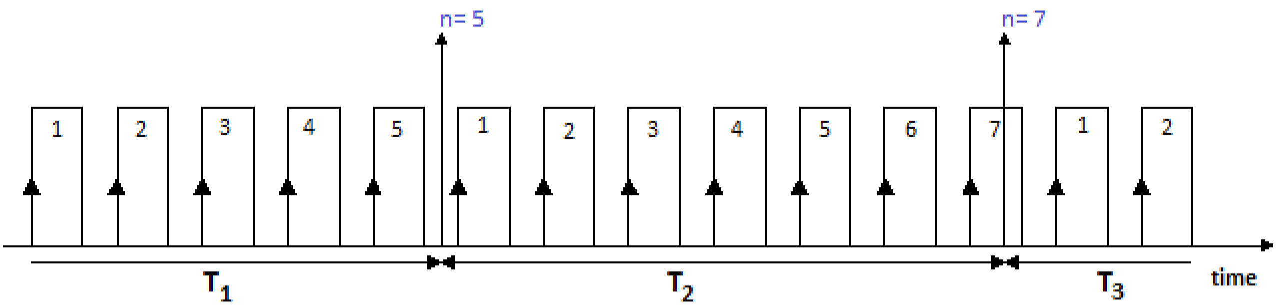
Event-counting	Time	Combined measurements
• events • distance(differential) • angle (differential) • angle (sum) • angle (abs 0-360°) • distance (sum)	• time • pulse time	• frequency • speed • RPM

Event-Counting

The following variables are derived from **Event counting**:

- events 51
- distance(differential) 51
- angle (differential) 51
- distance (abs.) 51
- angle (abs.) 51

The amount of events occurring within one sampling interval is counted. The event counter counts the sensor pulses within the sampling interval. **An event is a positive edge in the measurement signal which exceeds a user-determined threshold value**.

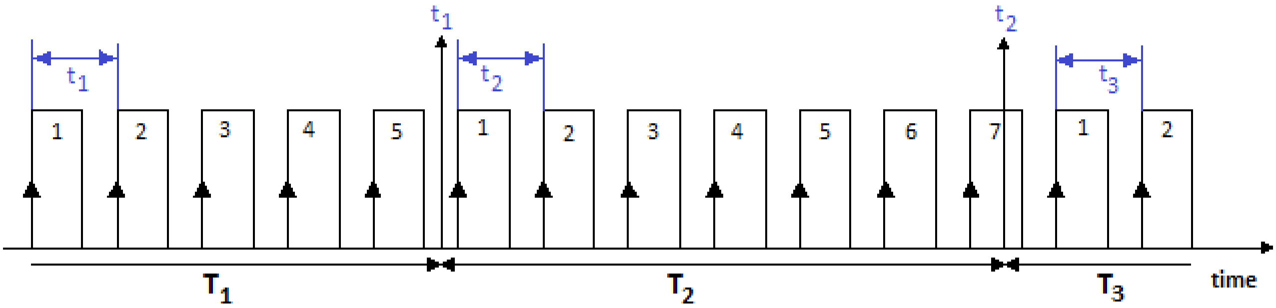


Time Measurements

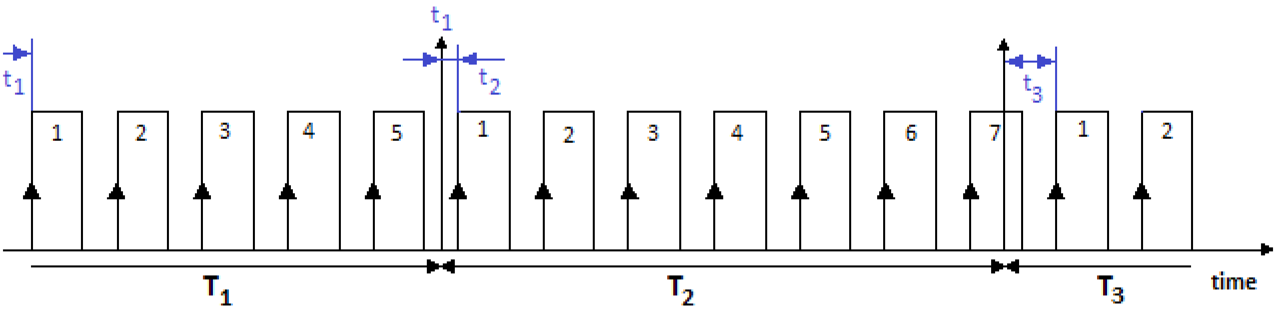
Exclusive measurement of **time** is performed as:

- time 52 (of two successive signal edges)
- pulse time 53 (time from the beginning of one sampling interval until the next signal edge)

Any other pulses occurring within the sampling interval are not evaluated for these measurement types.



time

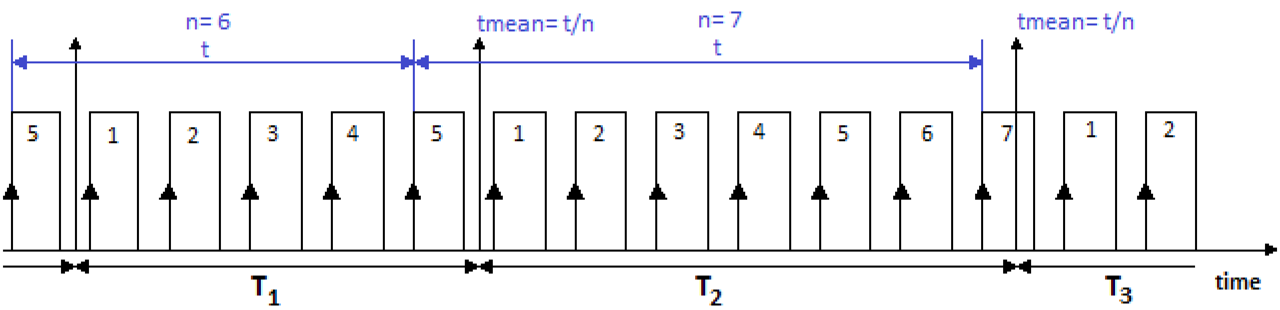


pulse time

Combination Mode

Determining a frequency and the derivative quantities RPM and velocity is based on the **combination of event counting and time measurement**. In other words, during a sampling interval, the number of events occurring as well as the time interval between the first and last event are measured:

- frequency 54
- speed 54
- RPM 54



The frequency is determined as the number of events counted divided by the time between the first and the last "complete" event in the interval. An event is complete when a positive edge is succeeded by a subsequent positive edge.

The frequencies must lie within the bandwidth of the module used. If the maximum frequency is exceeded during a measurement, the system returns the input range end value instead of the true measured values.

The derivative quantities displacement and angle measurement have the following settings:

- Choice of single-track and dual-track encoder 50
- Start of measurement with or without "Zero impulse" 50
- Number of pulses (per unit)

The input ranges and resolutions for the RPM or velocity also depend on the number of encoder pulses set. If the number of pulses is known, the RPM and velocity values can easily be computed using the above table according to:

Parameter	Description
RPM	Input range = ([Frequency input range in Hz] * 60 / [Encoder pulses per revolution]) in RPM Resolution = ([Frequency resolution in Hz] * 60 / [Encoder pulses per revolution]) in RPM

Behavior in response to missing signal pulses

If a sequence of signal pulses is slowing down and then one sampling interval elapses without any pulse, no calculation can be performed for that sampling interval. In that case, the system assumes that the rotation speed is simply decreasing and an attenuating signal course is extrapolated. This "estimated" measurement value is then closer to the true value than the value determined from the preceding sampling interval. This technique has demonstrated its validity in practice.

Note

In extreme cases, the sensor does not return any more pulses, e.g. in case of a sudden outage. Then the algorithm generates an attenuation curve, meaning values > 0, even if the measurement object is actually no longer moving.

6.2.4.1.2 Measurement procedures

Measurement procedures	Description
Differential measurement procedures	The quantities derived from *event-counting*, **Events, Distance** and **Angle** denoted by the annotation **(diff.)** are "differential" measurements. The quantity measured is the respective change of displacement or angle within the last sampling interval. (positive or, for dual-track encoders, negative also) or the newly occurred events (always positive). If, for instance, the total displacement is desired, it must be calculated by **integration** of the differential measurements using imc Online FAMOS functions.
Cumulative measurements	The quantities derived from *event-counting*, **Distance** and **Angle** appearing with the annotation **(abs.)** are "**cumulative**" measurements. In cumulative measurements, the return value is the **sum** of all displacement or angle changes, or of all event which occurred.

6.2.4.1.3 Scaling

A **maximum** value must be entered under ***Input range*** (max. frequency etc, depend on mode). This **Maximum** determines the scaling factor of the computational processing and amounts to the range which is represented by the available numerical format of 16bits. Depending on the measurement mode (quantity to be measured), it is to be declared as an input range's unit or in terms of a corresponding max. pulse rate.

In the interest of maximizing the **measurement resolution** it is recommended to set this value accordingly.

The ***Scaling*** is a sensor specification which states the relation between the pulse rate of the sensor and it's corresponding physical units (sensitivity). This is also the place to enter a conversion factor for the sensor along with any physical quantity desired, for instance, to translate the revolutions of a flow gauge to a corresponding volume.

The table below summarizes the various ***measurement types' units***; the **bold**/*cursive* letters denote the (fixed) primary quantity, followed by its (editable) default physical unit:

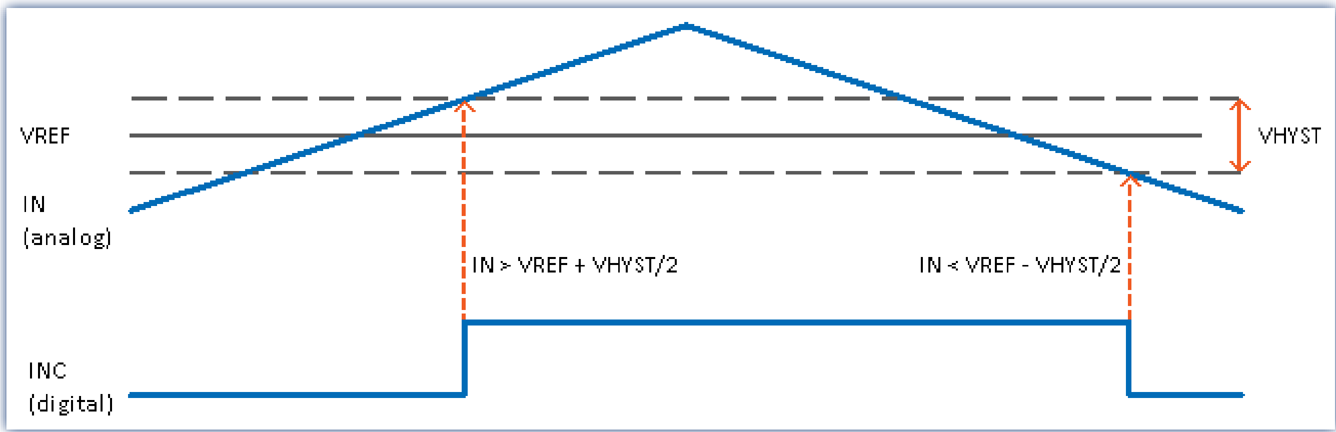
Measurement quantity	(Sensor-) scaling	Range	Maximum
Linear motion	**pulse**/*m*	m	m/s
Angle	**pulse**/*U*	U	U/min
Velocity	**pulse**/*m*	m/s	m/s
RPM	**pulse**/*U*	U/min	U/min
Event	**pulse**/*pulse*	1 pulse	Hz
Frequency	**Hz**/*Hz*	Hz	Hz
Time	**s**/*s*	s	s
Pulse time	**Hz**/*code*	Hz	Hz

6.2.4.1.4 Comparator conditioning

The incremental counters' special properties make **special demands for signal quality**: the very high resolution offered by the detector or counter means that even very short impulses can be captured and evaluated, which sampling-based measurement methods (such as for the digital inputs of the DI16 module) would not (or almost never) be able to detect. Therefore, the digital signals must have clear edges in order not to produce disturbed readings. Spurious impulses or contact bouncing can lead to artifacts such as enormous peaks in RPM-signals etc..

Simple sensors working on the principles of induction or photoelectric relays often emit unconditioned analog signals which must be evaluated according to a threshold condition. Aside from that, problems can occur even with conditioned encoder signals (e.g. TTL-levels) due to long cables, bad reference voltages, ground loops or interference. imc incremental counter channels are able to counteract these problems thanks to a special 3-stage conditioning unit.

First comes a high-impedance **differential amplifier** (± 10 V range, 100 kΩ) which enables reliable acquisition from a sensor even over a long cable as well as effective suppression of common mode interference and ground loops. Next, a (configurable) **smoothing filter** offers additional interference suppression adapted to the measurement situation. Lastly, a **comparator** with adjustable threshold and hysteresis serves as a digital detector. The (adjustable) **hysteresis** also serves to suppress interference.



The *digital signal* changes from **0 to 1** when the *analog signal* exceeds the **VREF + VHYST/2** threshold.

The *digital signal* changes from **1 to 0** when the *analog signal* falls below the **VREF - VHYST/2** threshold.

The size of the hysteresis represents the width of a range-band inside of which the signal can fluctuate (due to signal noise and interference) without an impulse being recorded.

Ranges:

- VREF (Threshold) = -10 V .. +10V
- VHYST (Hysteresis) = +100 mV...+4V
- Low pass filter: None, 20 kHz, 2 kHz, 200 Hz

6.2.4.1.5 Single-track / Dual-track encoder

The **single-track encoder** returns a simple pulse sequence. This means that the pulse count and the time between pulses can be determined, but not the rotation direction of the incremental counter.

A **dual-track encoder** returns two pulse sequences with a 90° offset. Along with the pulse frequency, the rotation direction can also be indicated as positive or negative. To configure a measurement with a dual-track encoder, set the parameter "***Counter signal***" which is on the Setup page "*Digital channels*" under the tab "*Encoder*", along with the desired "*Mode*".

Note Problems with two-point scaling of analog inputs

Affects both the devices belonging to the imc C-SERIES, and also any devices belonging to the imc SPARTAN and imc CRONOS families which are equipped with the digital multiboard: DI16-DO8-ENC4 or the DI8-DO8-ENC4-DAC4.

When an input is set to **dual-track encoder**, it is not possible to **calibrate** the scale with **two-point scaling** for any **analog inputs**. When you click "*Record*" to take a measurement, the following message appears: "*The device is not prepared to allow necessary initialization! Please execute menu action "Prepare" (device control)! imcDevices V2.x Adapter*"

However, the "*Prepare*" procedure does not solve the problem. Instead, temporarily set the incremental counter inputs of the modules affected to "*Single-track encoder*" in order to be able to measure the two data points used for two-point scaling.

6.2.4.1.6 Zero pulse (index)

The **zero pulse** starts the incremental counter channels' counter mechanism. This means the measured values are only recorded, if an event occurs at the **index-channel**. If measurement without a zero pulse is selected, the measurement starts directly upon starting the measurement.

The **index signal** is differential and set by the comparator settings of the **first** incremental counter channel of the module, even for modules that have several index tracks. The bandwidth is limited to 20kHz.

Note

- By default, the option "*Encoder w/o zero impulse*" is activated in imc STUDIO. If this option is deactivated and the zero pulse fails to appear, the encoder module does not start the measurement at all! In that case, the channels only return zero.

6.2.4.2 Mode (events-counting)

Mode - Events	Description
Events	The event counter counts the sensor pulses which occur during a single time interval (differential event counting). The interval corresponds to the sampling time set by the user. The maximum event frequency is about 500 kHz. **An event is a positive edge in the measurement signal which exceeds the user-set threshold value.** The derivative quantities displacement and angle measurement have the following settings: • Choice of single-track and dual-track encoder 50 • Start of measurement with or without "Zero impulse" 50 • Number of pulses (per unit)

Mode - Distance	Description
Distance (differential)	Path traveled within one sampling interval. For this purpose, the number of pulses per meter must be entered.
Distance (absolute)	Absolute distance. The differential distance measurement is converted to the absolute distance. By taking the zero impulse (the counter with no zero impulse should not be selected) into account, the absolute distance position is determined and indicated. Otherwise, the distance value is assumed to be 0° when the measurement begins.

Mode - Angle	Description
Angle (differential)	Angle traveled within one sampling interval. For this purpose, the number of pulses per revolution must be entered. The absolute angle can be calculated in imc Online FAMOS or determined by the mode Angle(abs).
Angle (absolute)	The differential angle measurement is converted to the **absolute** angle. By taking the zero impulse (the counter with no zero impulse should not be selected) into account, the absolute angle position is determined and indicated. Otherwise, the angle value is assumed to be 0° when the measurement begins.
Angle (sum)	The differential angle measurement is converted to the **cumulative** angle. In the process, any zero pulse is evaluated only one time. For this reason, angles which are > 360° are possible.

Note

When using incremental counter modules that work internally with a 16-bit counter, encoders with high pulse rates can lead to overflows. The count is always carried out with sign: 2^{16}= 65536, i. e. ±32767. With dual-track encoders the pulse number is quadrupled internally and leads to a maximum number of pulses per revolution of 8192. For encoders with more pulses per revolution, the hardware must have a 32 bit counter, e. g. imc CANSAS*fit*-ENC6, otherwise an event count must be carried out instead and converted with imc Online FAMOS.

6.2.4.3 Mode (time measurement)

Time measurement

The time measurement mode allows the definition of **edge conditions** between which the time interval is to be measured.

The following combinations are possible:

positive edge	>	negative edge:	(↑ > ↓)
negative edge	>	positive edge:	(↓ > ↑)
positive edge	>	positive edge:	(↑ > ↑)
The combination negative edge	>	negative edge:	(↓ > ↓) is not allowed

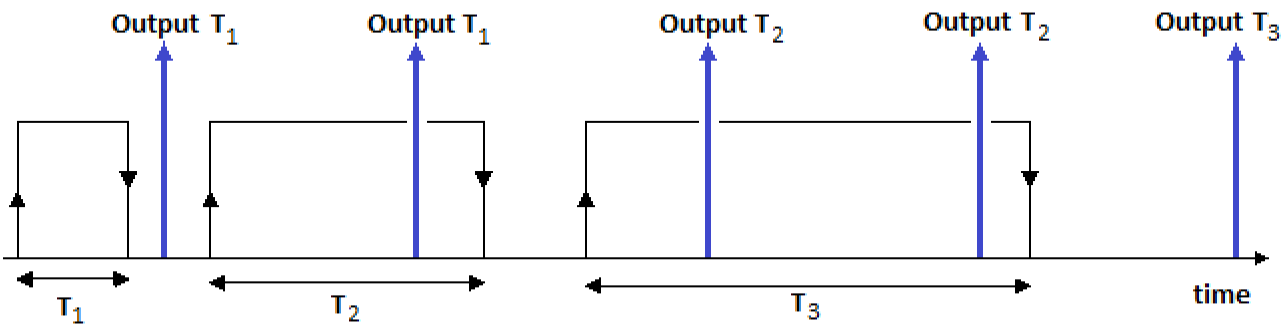
To ensure a high time resolution for the measurement results, suitable scaling must be set for the measurement. An **input range (INC4)** or **Max. time (s) (ENC-6)** specifies the maximum time interval which can be measured between the selected starting and stopping edge. **The time between the signal edges may not be greater than the selected input range.** If the maximum time interval is exceeded during measurement, the system returns the input value range end instead of the true measured value.

Input range	Time resolution	Input range	Time resolution
1 ms	31,25 ns	250 ms	8 µs
2 ms	62,50 ns	500 ms	16 µs
4 ms	125 ns	1 s	32 µs
8 ms	250 ns	2 s	64 µs
16 ms	500 ns	4 s	128 µs
30 ms	1 µs	8 s	256 µs
60 ms	2 µs	16 s	512 µs
120 ms	4 µs	30 s	1024 ms

Time resolution of INC4

The time resolution corresponds to the value of an LSB (Least Significant Bit).

During sampling intervals when no time measurement was possible (because either a starting or stopping edge was missing), the last valid return value continues to be returned until a time measurement is completed. If there is no valid return value, zero is returned. If more than one time measurement is completed during a single sampling interval (due to multiple starting and stopping edges), the last time measured is returned.



Above is illustrated a measured signal from which time readings are taken. Each reading starts at a positive edge in the signal and is stopped at a negative edge. The "up" arrows indicate the times at which the system returns a result. The returned values in this case are T1 –twice; T2 –twice; and T3.

Pulse Time

The point in time at which the edge is located within the sampling interval is determined. This information is needed by some functions in imc Online FAMOS, e.g. for determining the course of the RPMs from a pulse signal: OtrEncoderPulsesToRpm.

The measurement variable ***Pulse Time*** refers to phase-based data which is only relevant to special applications (particularly order-tracking analysis). It is required for subsequent online calculations. It represents the time between the last detected (asynchronous) pulse and the (synchronous) sampling time at which the counter readings were sampled and evaluated. The unit associated with this variable is called *Code*.

Note

The mode *Pulse Time* depends on the sampling rate. For all ENC-4 types, the entry is visible only if the sampling rate is equal or smaller 1ms. For HRENC-4 the sampling rate must be equal or less 100µs.

PWM

Pulse width modulation (PWM) is a type of modulation in which a technical variable (e.g. electrical current) switches between two values. In the process, the **duty cycle ratio is modulated at constant frequency**. PWM is also known as pulse duration modulation (PDM).

A good illustration of this modulation type would be a switch used to continually switch a heater on and off. The higher the ratio of the on-time to the off-time, the higher the average heating power is.

Measurement of PWM can not be performed directly with the device software. However, if the frequency is known, it is possible to perform it indirectly by time measurement with the following settings:

The **ratio** is the *Duration of HIGH (signal) level* over the *Period duration*.

The *Duration of HIGH (signal) level* is obtained by means of a **time measurement** from *positive to negative (signal) edge*.

The *Period duration* is the **inverse of the frequency**, which must be known.

$PWM= t_{pulse}/t_{Period\ duration} * 100\%$ or $t_{pulse} * f * 100\%$

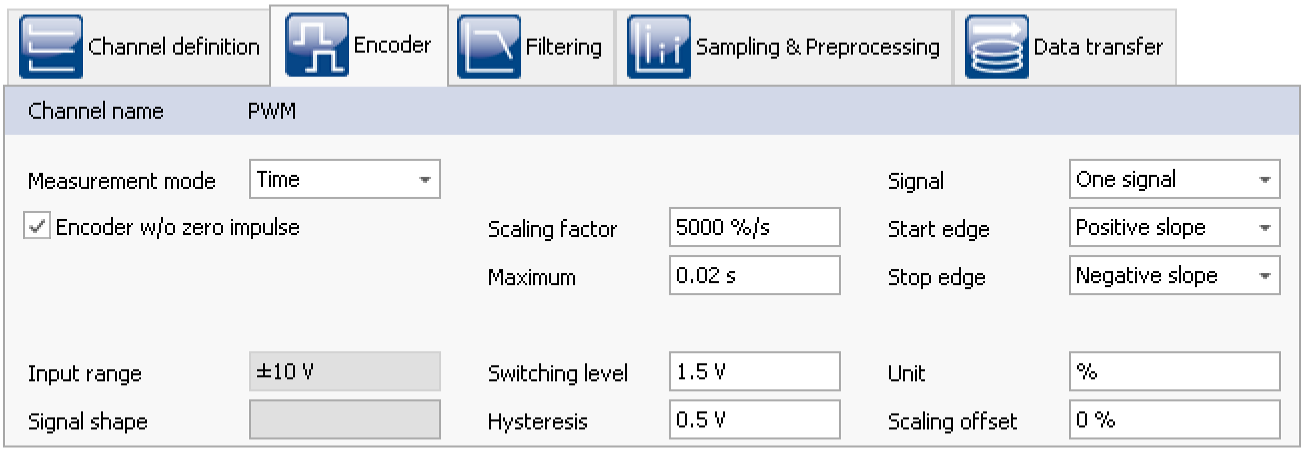
Example:

f= 50Hz, Pulse duration = 10ms

Scaling: $t_{pulse} * f * 100\%/ s = 5000\%/s$

at 10ms: 0.01s*5000%/s= 50%

This can be entered directly via the scaling:



Settings for PWM measurement in time mode

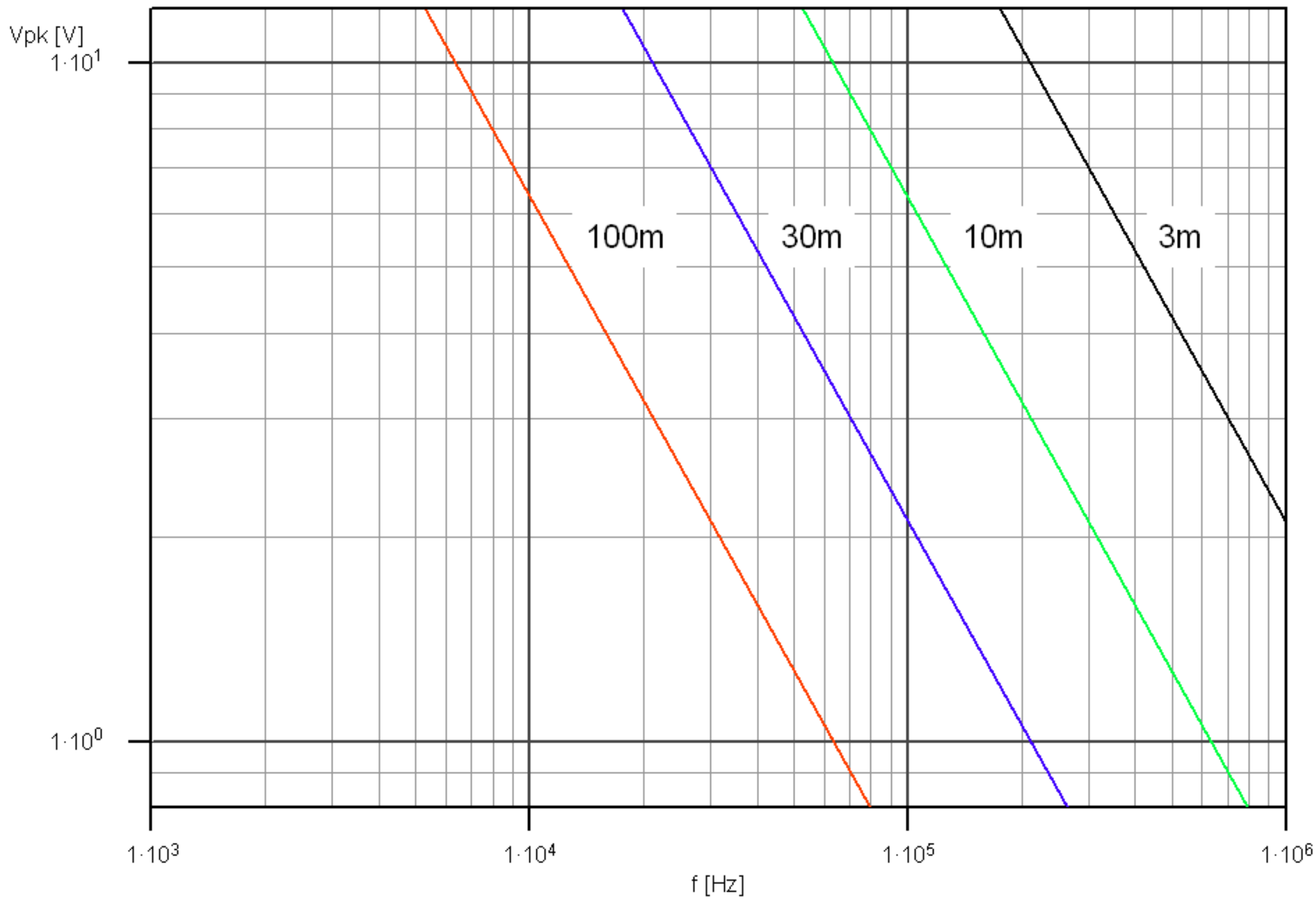
6.2.4.4 Mode (combined measurement)

Mode	Beschreibung
Frequency	Frequency is determined by means of a combination measurement 47. If the frequency was previously multiplied or divided, this can be reflected in the scaling value. The frequency is always unsigned, for which reason there is no dual-track encoder for it.
Speed	The sequence of pulses is converted to m/s by means of a combination measurement 47. Toward this end, the number of pulses per meter must be entered.
RPM	The sequence of pulses is converted to revolutions per minute by means of a combination measurement 47. Toward this end, the number of pulses per revolution must be entered.

6.3 Measurement with current-fed sensors (IEPE)

With current-fed sensors (e.g. ICP™-, DELTATRON®-, PIEZOTRON®-, PIEZOBEAM®-sensors), the capacitive burden on the signal due to the cable capacitance can lead to clipped amplitudes for higher frequencies. To avoid signal distortion, try to:

1. keep the cable short,
2. use a low-capacitance cable,
3. use a less sensitive sensor.



Maximum signal amplitudes as a function of the signal frequency and the cable length, with a 4 mA feed and a capacitance of 100 pF/m.

6.3.1 Supply current

The exact magnitude of the supply current is irrelevant for the measurement's precision. Values of 2 mA tend to be adequate. Only in the case of very high bandwidth and amplitude signals in conjunction with very long cables, supply currents may be a concern, as considerable currents are need to dynamically charge the capacitive load of the cable.

dynam. current headroom:	I	= 4 mA
cable capacity (typ. coax-cable):	C	= L · 100 pF/m
max. signal slew rate (full-power):	dU/dt	= 5 V · 2 · π · 25 kHz
-> max. cable length:	L_{max}	= 4 mA / (100 pF/m · 5 V · 2 · π · 25 kHz) = 50 m

Up to a **max. cable length of 50 m**, no limitations are to be expected as long as the conditions above are fulfilled.

Find here the description of the ICP-plug 56 and here technical specs: ACC/DSUB-ICP. 164

6.4 Measure with IEPE/ICP expansion plug

In general, imc plug is a plug with imc housing (formerly plastic today metal), which enables the connection of the sensors to the inputs of the measuring amplifier via a DSUB-15 plug connection. A distinction is made between terminal plugs and expansion plugs. While a terminal plug makes the amplifier characteristics or a subset of them accessible, the use of an expansion plug allows the amplifier characteristics to be changed.

In order to fulfill different measuring tasks, imc provides a variety of measuring amplifiers. It should be noted that the properties of the measuring amplifier used are changed (in the desired way) by the connected expansion plug. This expansion must be made known to the measuring system via the operating software.

6.4.1 IEPE/ICP-Sensors

The IEPE/ICP-channels are specially designed for the use of current-fed sensors in 2-wire-configuration.

IEPE, Integrated Electronics Piezo Electric, is the standard for piezoelectric transducers. IEPE (ICP)-sensors are typically employed in vibration and solid-borne sound measurements and are offered by various manufacturers as solid-borne sound microphones or accelerometers under different (trademarked) product names, such as: PCB: ICP-Sensor, KISTLER: Piezotron-Sensor, Brüel&Kjaer: DeltaTron-Sensor. The commonly used name ICP (Integrated Circuit Piezoelectric) is actually a registered trademark of the American manufacturer "PCB Piecotronics".

This sensor type is fed with a constant current of typically 4 mA and delivers a voltage-signal consisting of a DC-component (typ. +12 V) superimposed with an AC-signal (max. ±5 V). Typical source resistance values (internal resistance) of ICP sensors are on the order of magnitude of max. 100 Ω.

6.4.2 ACC/DSUB-ICP2 and ACC/DSUB-ICP4

As a special accessory for voltage channels, an ICP expansion plug is available. This plug can be used to directly connect current-fed ICP-sensors also at voltage channels. The ACC/DSUB-**ICP4** is equipped with four channels and the ACC/DSUB-**ICP2** with two channels, see the DSUB-15 pin configuration 176.

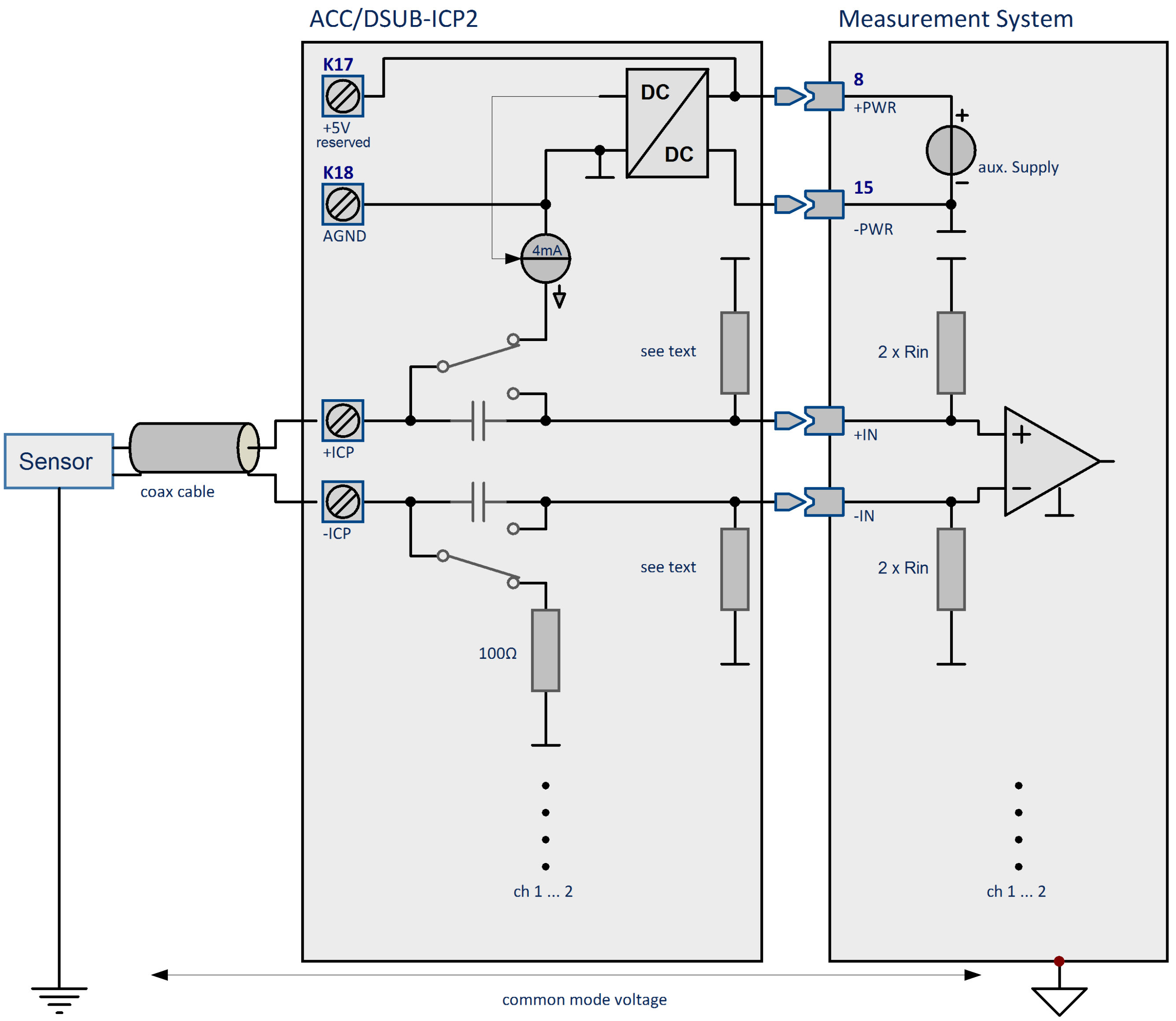
This (active) expansion plug having the same dimensions as the imc DSUB-plug, comes with additional conditioning equipment built into its housing and having the following **features**:

- Individual current sources for the current-fed IEPE/ICP-sensors
- Each source: 4.2 mA (typ.), voltage swing: max. 25 V, see technical details: ACC/DSUB-ICP 164
- Differential AC-coupling to block the signal's DC-component (approx. +12 V), typical with IEPE/ICP

- Each channel can be switched to DC-coupled voltage measurement or current-fed IEPE/ICP measurement (AC-coupled); ex-factory the **DIP-Switch** for each channel inside the plug is switched to IEPE/ICP measurement (AC-coupled)
- For the supply of this expansion plug, the amplifier used provides a voltage of 5 V. This voltage is short-circuit proof and independent of the voltage supply 117. The maximum load is 1.35 W. The ICP2 plug requires a maximum of 500 mW for its internal needs, the ICP4 plug requires 1 W. This means that the 5 V pin has 0.85 W or respectively 0.35 W available.

Note

The two channel plugs **ACC/DSUB-ICP2** in all variants can also be used with amplifiers that provide **four channels on one DSUB-15** socket. In this case only the **odd channel numbers (1, 3, 5, 7) can be used**.



DIP-Switch position ICP (DIP-Switch inside of the expansion plug):

- The AC-coupling is already provided by the ICP-plug, the **voltage channel is DC-coupled**.
- The measurement range must be adapted to the signal's AC-component, it can be adjusted within the range: ±5 V to ±250 mV
- The combination of the built-in coupling capacitor (2 x 220 nF corresponding to 110 nF diff.) with the impedance of the IEPE/ICP-plug (2 MΩ diff.) and the input impedance constitutes a high-pass filter. When connecting the plug or sensor, be aware of the transients experienced by this high-pass filter, caused by the sensor's DC-offset (typ. +12 V). It is necessary to wait until this phenomenon decays and the measured signal is offset-free!
- When the ICP-expansion plug is used, a considerable offset can occur (in spite of AC-coupling), which can be traced to the (DC-) input currents in conjunction with the voltage amplifier's DC input impedance. This remainder, too, can be compensated by high-pass filtering with imc Online FAMOS.

DIP-Switch position Volt (DIP-Switch inside of the expansion plug):

- The voltage channel is DC-coupled, the current source de-coupled.
- The voltage channel's input impedance is reduced by parallel connection with the IEPE/ICP-plug's impedance.

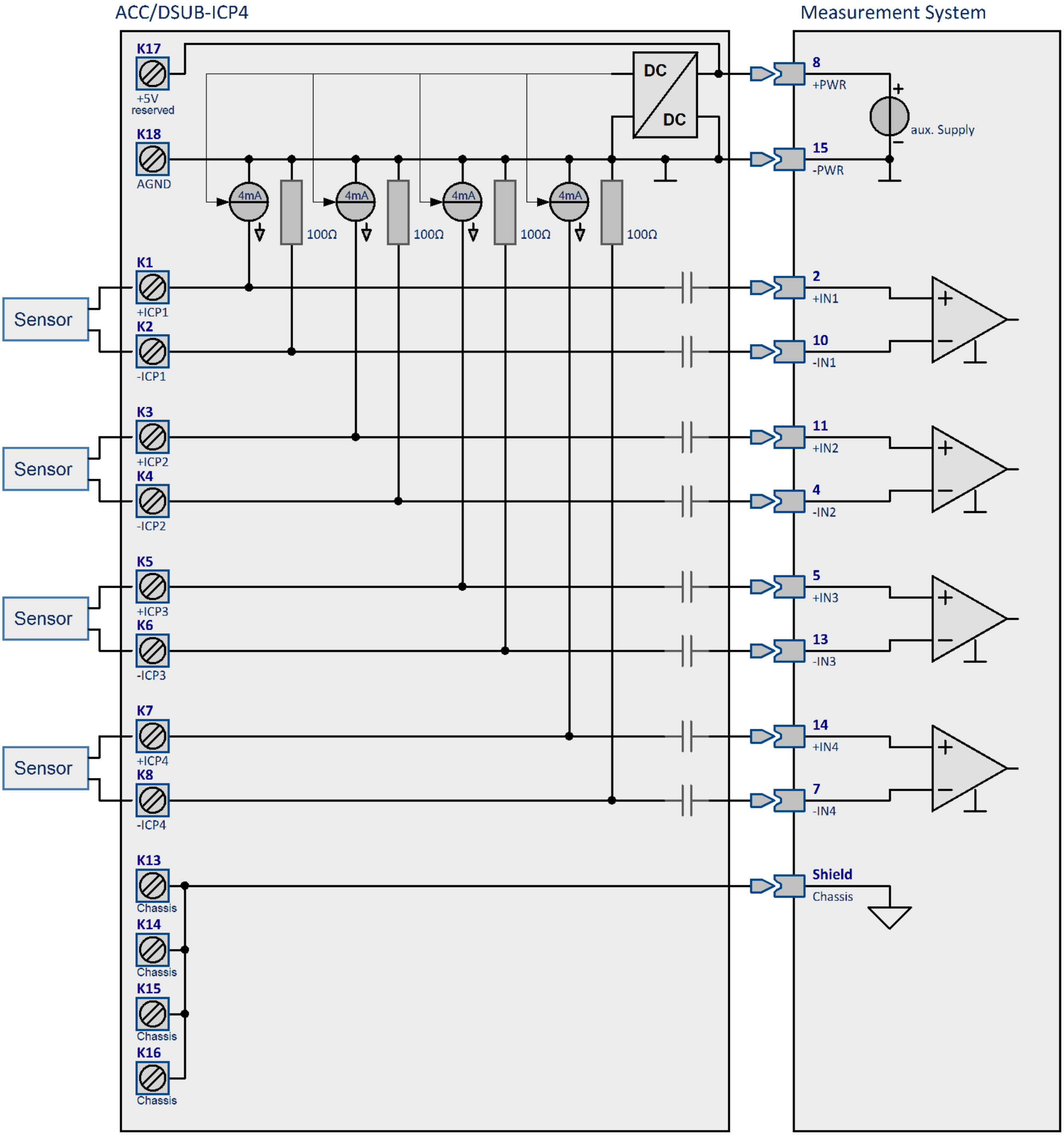
The voltage amplifiers' different input impedance values (with / without input divider) depend on the voltage range selected. The resulting high-pass cutoff frequencies and the time necessary for the 12 V-offset to decay to 10 µV are shown.

Range	diff. R_in	Result impedance	tau	fg	Settling (10 µV)
≥±5 V	1 MΩ	0.7 MΩ	73 ms	2.2 Hz	1.0 s
≤±2 V	10 MΩ	1.7 MΩ	18 ms	0.9 Hz	2.6 s

In terms of the shielding and grounding of the connected IEPE/ICP-sensor, note:

- We recommend using multicore, shielded cable, where the shielding (at the plug) is connected to the plug "CHASSIS", or can be connected to the pull-relief brace in the plug.

The following circuit schematic display an entire plug. The DIP switches are not included in order to achieve a more simple schematic.



6.4.3 ACC/DSUBM-ICP2I-BNC(-F,-S)

This expansion plug is used to extend imc measurement amplifiers with DSUB-15 sockets with an IEPE conditioning which allows the direct connection of 2 current-fed IEPE/ICP sensors, e.g. IEPE microphones, accelerometers of the type ICP™-DeltaTron®- or PiezoTron® etc.

The IEPE conditioning comprises 4 mA current supply and AC coupling and is channel-individually isolated. This ensures good ground loop suppression and allows operation of transducers that are either grounded or mounted with isolation towards CHASSIS ground.

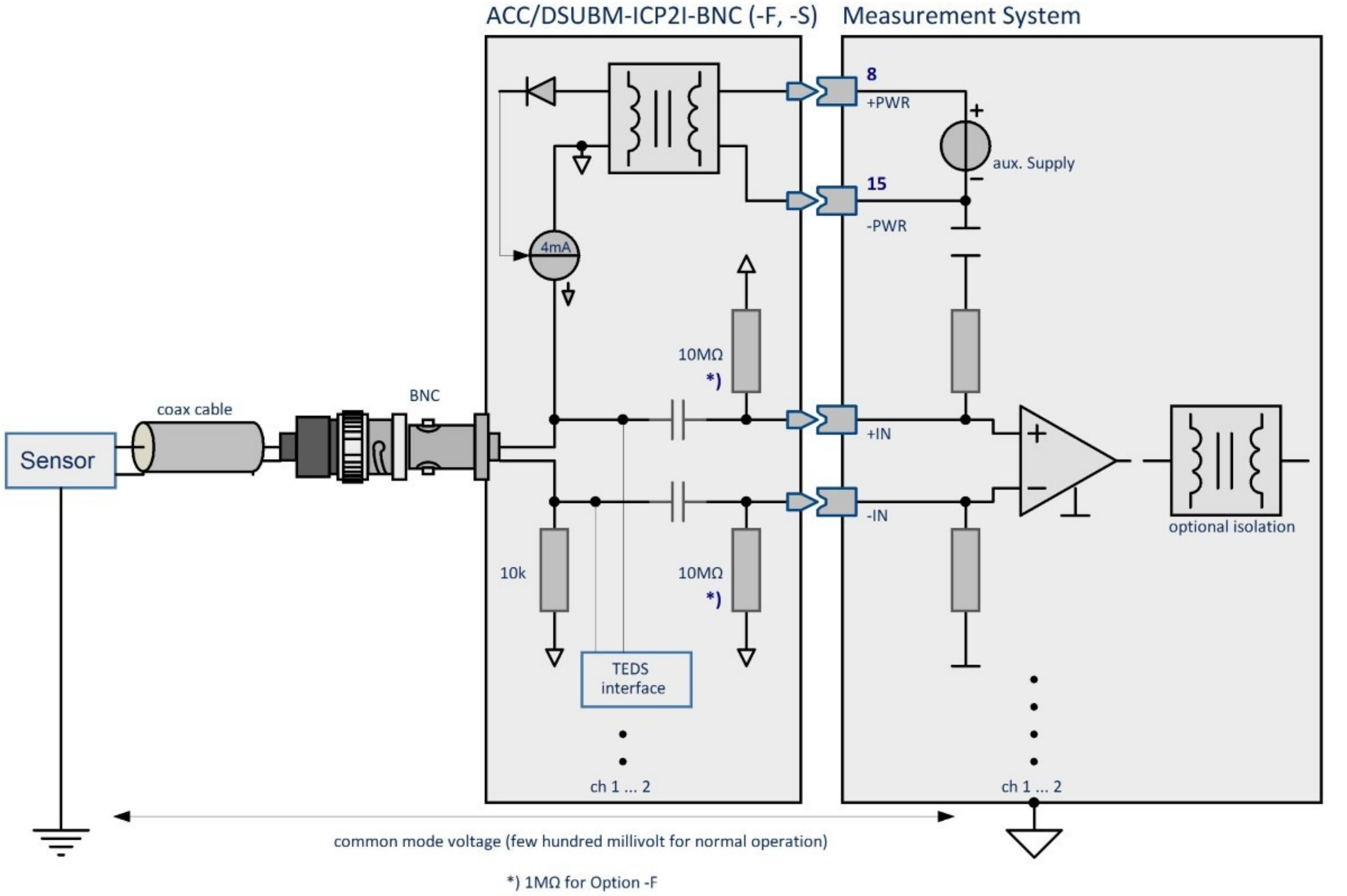
The expansion plug can be operated in conjunction with isolated and non-isolated voltage and bridge amplifier modules.

It has a TEDS interface for reading out information from the sensor, as long as it supports TEDS (Transducer Electronic Data Sheets according to IEEE 1451.4, Class I, MMI). Thanks to the isolated TEDS interface readout is also supported for grounded transducers as well as with triaxial sensors that have one single common ground lead. Furthermore (and independent from the sensor) the TEDS interface is also used to allow automatic detection of a connected plug by the involved amplifier (supported depending on amplifier type).

IEPE/ICP sensors deliver alternating AC signals which are superimposed on a static offset and decoupled by means of a high-pass ("HP", AC coupling, RC circuit). After connection and activation of the plug, full settling of this AC coupling can take well beyond 10 seconds.

Two variants of the expansion plug are available:

- The **S variant** (slow) achieves minimum cutoff frequency, thus limits the lower bandwidth of the sensor as little as possible. However, the transient response after plugging in (activation) can take longer (>10 seconds).
- The **F variant** (fast) settles faster (approx. 1 second) and therefore does not quite reach the minimum cutoff frequency, but with < 1 Hz is sufficient for very many applications in this form.



ACC/DSUBM- Expansion plug vs. dedicated ICP amplifiers

In contrast to dedicated IEPE/ICP mode amplifier types such as QI-4, AUDIO2-4 or ICPU2-8, this extension plug can provide IEPE support for more universal type amplifiers. This added flexibility comes at the expense of a somewhat limited handling comfort.

In particular it is important to be aware that the presence of the plug will dynamically change the properties and capabilities of the associated channel, which needs to be communicated to the host amplifier and the control software. The TEDS functionality is used for this detection process (independent of any sensor specific TEDS data!), which has certain implications for handling and operation.

Basic functionality (ICP-operation) does not require software support and has no associated requirements. However, for support of **sensor TEDS functionality** and for improved **offset performance** it is required that the plug is recognized and supported by the operation software. In particular this involves the activation of an additional digital high pass filter to remove some small residual offset that results from the high impedance AC coupling.

Supported amplifier types (full support vs. basic functionality)

Amplifier resp. Device family		CRFX, CRXT	CRC, CRSL	C-SERIES
UNI2-8	CS-7008-FD	✔✔	✔	✔
DCB2-8	CS-5008-FD	✔✔	✔	✔
B-8	--	✔✔	✔	✔
LV3-8	CS-1208-FD	✔✔	✔	✔
ISO2-8	CS-4108-FD	✗	✗	✗
ISOF-8	--	✗	✗	--
UNI-4	--	✔✔	✗	--
BR2-4	--	✗	✗	--
SC2-32	--	--	✗	--
LV-16	CS-1016-FD	--	✗	✗

- ✔✔ Software support with variant differentiation (-F/-S), full support of TEDS sensors including sensors of the type DS2431 and a improved offset performance
- ✔ Software support without variant differentiation (-F/-S), support of TEDS sensors except sensors of the type DS2431 and a improved offset performance
- ✗ only basic functionality (ICP-operation), no support of TEDS sensors and no improved offset performance
- -- amplifier is not part of this device family

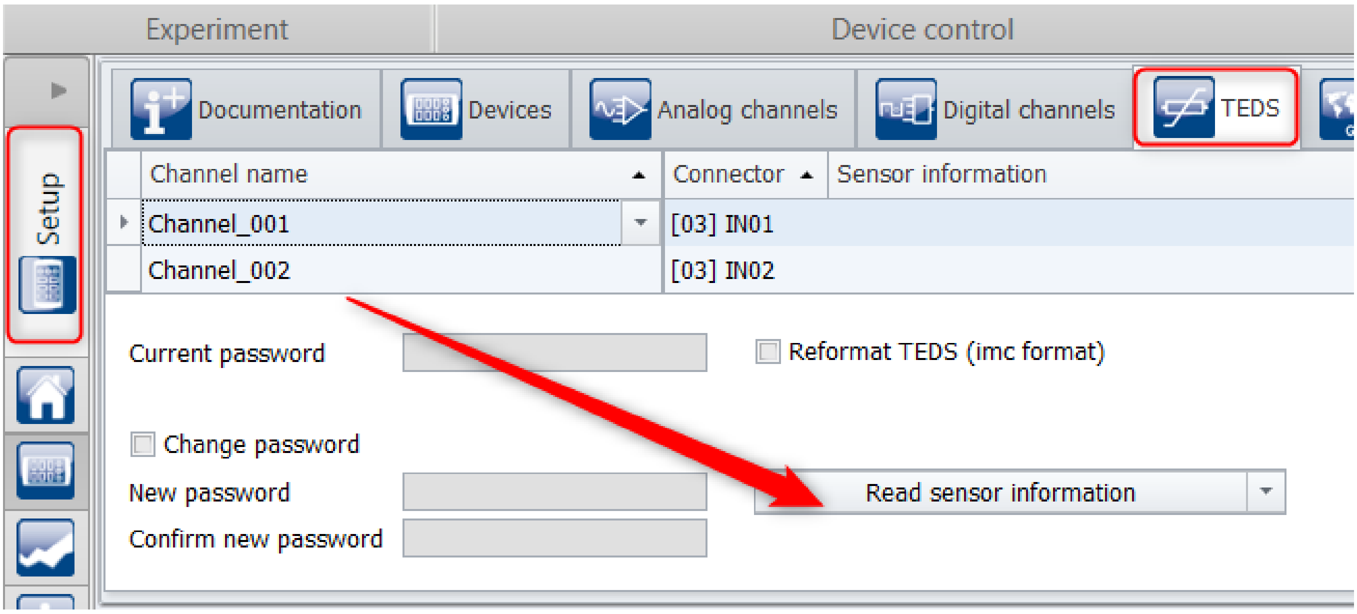
The variant differentiation (-S/-F) function is only supported in the CRFX and CRXT device platform:

- Amplifier types with full software support (especially UNI2-8, DCB2-8, B-8, LV3-8, UNI-4) also have matched transient response in the CRFX/CRXT context (digital high pass selected accordingly).
- In the CRC and C-SERIE context, on the other hand, although the lower AC cutoff frequency is determined by the connector variant (-S/-F), the settling time is relatively long for both variants because the additional digital high-pass is fixed at low cutoff frequency in both cases.
- The fast variant therefore does not settle quickly!
- On the other hand, in conjunction with amplifier types that do not offer software support (e.g. ISO2-8, ISOF-8, BR2-4, UNI-4 in CRC context, etc.), the extension plugs are not recognized at all and are therefore not extended with additional digital high-pass. Therefore the behavior is only determined by the analog RC time constants. Thus, both cutoff frequency and settling time are clearly differentiated in the sense of slow/fast, and the fast variant also settles fast. However, the improved zero point accuracy due to the digital high pass is omitted.

Reference

Technical Specs: ACC/DSUBM-ICP2I-BNC(-F,-S) 165

6.4.3.1 Plug recognition via TEDS function



Expansion plug without TEDS Information of the sensor

When using the IEPE/ICP-expansion plug without any sensor connected, or in conjunction with a simple passive sensor without any TEDS memory, the software acknowledges this procedure with "apparent" error messages which in reality, however, just reflect the fact that no **TEDS** data of the actual sensor are recognized.

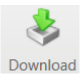
Typical **expected and normal "error"-messages** occurring in conjunction with valid recognition of the ICP-expansion plug:

6305 *The sensor is not connected correctly!*
Typically when a passive sensor is connected, or in case of short circuit.

6318 *The sensor is not connected directly, or is not making sensor information available!*
Typically when BNC terminal are left open / unused.

These two messages are actually the ***expected response*** to successful detection of the ***plug without sensor information!***

Triggering of plug recognition via "Download" (only CRC, C-SERIES)



With the **CRC/C-SERIES**, plug recognition is automatically triggered during the "**Download**" process. This only identifies the plug and error messages regarding non-existent sensor information 63 are omitted.

Therefor the measurement mode must be set to the compatible setting "*Voltage, DC-coupling*", otherwise an incompatible coupling is reported.

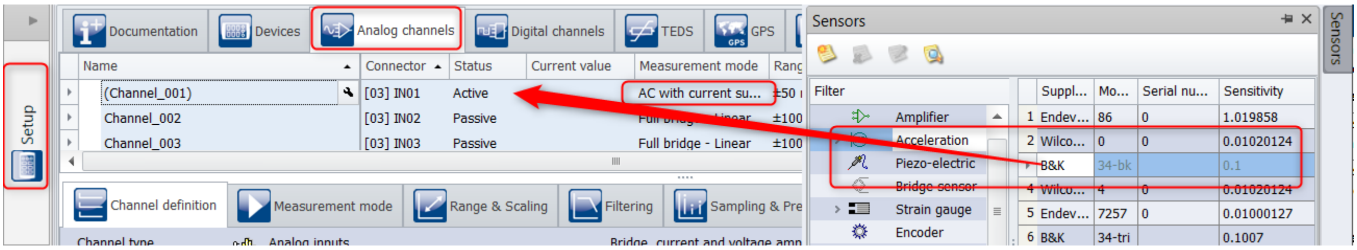
Note

The software is optimized so that the repeated execution of the *Download* function is only effective if the device settings have been changed. The plug attachment is not registered as a change in the device settings. In case of doubt it may therefore be necessary to force a new *download*, e.g. by switching a channel parameter back and forth.

Expansion plug in conjunction with/without TEDS-capable sensor

When a **sensor with its own TEDS memory** is connected, its read out properties are recognized, such as the scaling and the unit. Only in this case, where there is valid TEDS information about the sensor itself, the input coupling of the channel will be displayed as "*AC with current supply*".

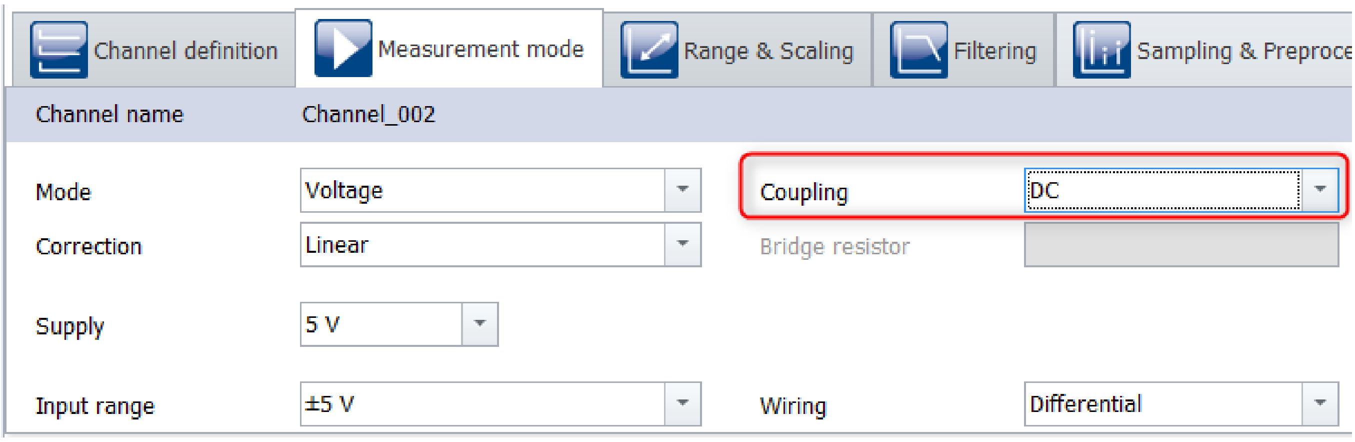
This AC coupling is also displayed if the sensor information is not read via TEDS, but when an ICP sensor is linked to the channel via the imc SENSORS database (drag&drop):



ICP expansion plug with TEDS information from the sensor or from the imc SENSORS database

IEPE/ICP-sensor without TEDS information

In the simple case of an IEPE/ICP-sensor ***without TEDS memory***, all of the amplifier's regular input couplings remain available, although among these, it is necessary to always select "***Voltage, DC-coupling***". All other couplings are invalid in connection with the expansion plug and cause the associated error messages to appear upon Download.



Erkannter ICP-Erweiterungsstecker, aber keine weiteren Sensorinformationen: Spannungsmodus DC-Kopplung

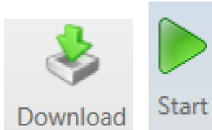
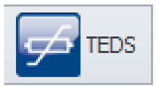
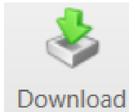
Note — ICP-sensor without TEDS

When using a simple **sensor without TEDS memory**, the recognition procedure will displayed with the messages above (#6305, #6318) 63, and the input coupling of the downstream amplifier will be displayed (*Voltage, DC-coupling*). However, the **expansion plug's AC-coupling and current feed**, as well as the digital high-pass filter, are actually in effect!

6.4.3.2 Software recognition

The ICP expansion plug supports ICP transducers with integrated TEDS memory (Class I MMI). The plug itself is also recognized via the TEDS functionality. The TEDS mechanism is used for plug recognition even when the actually used transducer that is connected to the plug does not support TEDS and does not incorporate any TEDS memory at all.

Depending on the device family involved, identification of the plug and the sensor, as well as resetting, are initiated/triggered by various circumstances:

Device family	Abbr.	Plug detection is caused by bei	Function
imc CRONOS*compact,* imc C-SERIES	CRC, CS, CL	Plug detection always takes place automatically every time the measurement is downloaded or under after changing the configuration upon start.	
		Reading of sensor data, however, is only possible via the TEDS function. The plug recognition is then updated as well.	
imc CRONOS*flex,* imc CRONOS-XT	CRFX, CRXT	No physical identification upon download, neither plug nor sensor.	
		Time of identification can be controlled by the function: *"TEDS – read sensor information*" The system not only attempts to read the sensor-TEDS memory, but will also attempt to identify any intermediate expansion plug.	

Additionally, with all device families: Plug detection by the device itself, always upon ***Power-Up.***

6.4.3.3 Further information

Verifying successful plug recognition

The successful identification of the expansion plug can especially be seen in the fact that the attempt to configure a bridge mode (e.g., half-bridge) will lead to the following message upon download:

6328 *The input coupling set is not supported by the imc clamp terminal connected*!
(message for **CRFX**)

6329 *All channels of the connected imc clamp terminal require the same input coupling*: AC with current feed or DC!*
(message for **CRC/C-SERIES**)

* As of imc STUDIO version 5.2 R15 the input coupling has been renamed to: "IEPE".

Only with CRFX: Alternatively, you can obtain verification with CRONOS***flex*** by pulling out the plug, forcing a "*Download*" (e.g. toggling the input range and returning it to original setting). This will lead to the following message:

6334 The required imc clamp terminal ACC/DSUB-ICP is not connected!

This test only works with **CRFX!** With **CRC** and **C-SERIES** however, it is not possible to do a check in this way: Here, successful plug recognition cannot be checked explicitly, but instead a new plug recognition is forced with each Download procedure. Thus, the no longer present plug along with its information would be deleted.

Deleting/resetting the plug recognition

Conversely, in order to delete this "hidden" information about a recognized ICP expansion plug, the plug must be physically disconnected and (particularly with CRFX) TEDS readout function must explicitly be forced. This leads to the regular "error" message (expected and correct behavior!):

6319 Either the imc terminal plug is not connected correctly or is unsuitable for the sensor communication!

Thus, software is forced to verify the presence of the plug, which fails as expected and resets the status to "*without ICP expansion plug*".

Plug vs. Sensor info

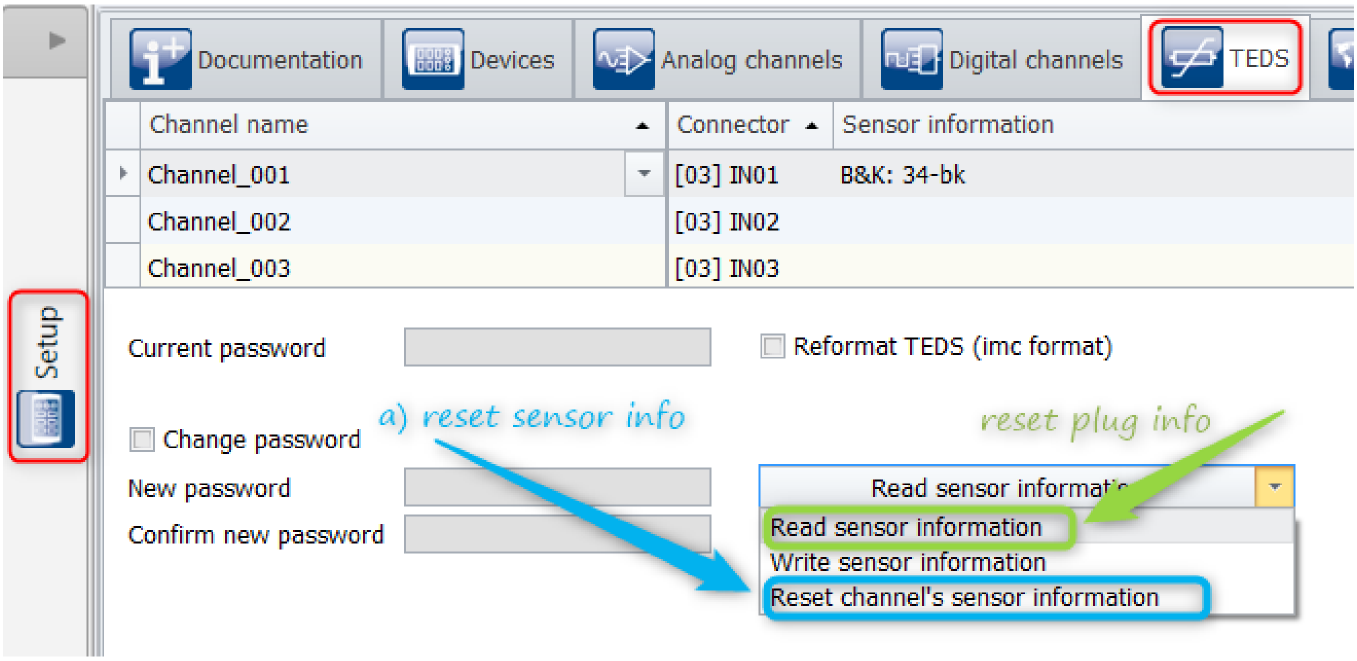
When resetting the recognition, there is a distinction between two stages:

a) Resetting the ***Sensor-information***

Using the TEDS-function "*Reset channel's sensor information*". This does **NOT** delete the **plug** information!

b) Resetting the **plug recognition**

By **unplugging the plug** and using the TEDS-function "*Read sensor information*". Only after completion of this process is the plug information deleted!



Reset sensor- and plug info

Special note regarding the **CRC/C-SERIES**: As long as no SENSOR data are used, but only the plug recognition is to be reset, it is sufficient in this case to unplug the plug and to force a repeat of the Download procedure. Not applicable to CRFX.

Firmware-Update / behavior upon starting

In all device families, as a rule the stand-alone device performs plug recognition **upon Power-Up.** in order to be able to take into account any plug-specific processes for possible autostart configurations. If this has not been successfully verified, an automatic measurement will not be started and a corresponding error message is stored on the onboard flash (device memory). Therefore the plug must always be plugged in correctly at the time of Power-Up.

In contrast to this, the following applies to a **firmware update**: When a firmware update is performed, **the plug should not be plugged** in! The firmware update may change the properties of the amplifier. The reboot during the firmware update causes a new readout and the verification described above is missing. For this reason, if you are prompted to perform a firmware update, ensure that any expansion plugs are disconnected, before clicking on "*OK*" to initiate the update.

6.4.3.4 List of possible error messages and their causes

Alongside the routine status messages described above, other errors can occur, e.g., in conjunction with the loading of experiments which had been created with expansion plugs connected, or in conjunction with TEDS information from the sensor itself. The following notes are intended to help in trouble shooting.

2363 Combination of coupling and input setting not allowed

Cause: The channel settings (generated via TEDS or expansion plug) contradict the module properties.

This condition can occur when a device (with default properties) is to be run with an experiment which had been created in conjunction with expansion plugs (other properties). In order to resolve the problem, restore the hardware setup associated with the experiment or modify your experiment /create a new experiment.

This can also happen, when sensor-TEDS cause inappropriate channel settings. In order to fix this problem reset the sensor information 66:
TEDS-function: "*Reset channel's sensor information*"

Alternatively, you can import the appropriate sensors (TEDS) with appropriate coupling:
TEDS-function: "*Read sensor information*"

or make settings via the sensor database:
in conjunction with imc SENSORS: drag&drop from the tool window "*Sensors*"

6305 The sensor is not connected correctly

In conjunction with the ICP expansion plug:

Correct recognition of the expansion plug, however without using a sensor having its own active TEDS-memory: not an error!

In conjunction with "normal" TEDS sensors (e.g., with the ACC/DSUBM-TEDS-xxx clamp terminals):

Cause: As described in the message. Most often, the issue is reversed polarity. Switch around the two contacts of the 1Wire chips and try again.

6310 After preparation of the device, the imc terminal plug at the channel was switched!

Cause: A plug with plug information had been detected in the past and is affecting the module properties (modes, correction values). Message 6310 indicates that the expected plug has been disconnected and replaced. If this happened intentionally, the sensor information can be reset: 66
TEDS-function: "*Reset channel's sensor information*".

6318 The sensor is not connected directly, or is not making sensor information available!

Cause: Reading of sensor information (TEDS) was unsuccessful.

In conjunction with the ICP expansion plug:

Correct recognition of an expansion plug, without connected sensor (BNC open): **not an error!**

In conjunction with "normal" TEDS sensors, or ICP sensors having their own active TEDS memory:

Possibly either the TEDS memory type (1Wire-type) or the format is not supported. For clarification, please contact the Hotline.

6319 Either the imc terminal plug is not connected correctly or is unsuitable for the sensor communication!

Cause: The reading of sensor information (TEDS) was unsuccessful because TEDS is not supported by the plug or by the amplifier, or the plug was disconnected.

In conjunction with ICP- (or Q) expansion plug:

When using the function "*Read TEDS sensor information*": In case of intentional disconnection of the plug for purposes of resetting the plug recognition: **not an error!** When attempting to recognize an actually connected plug: Possibly, this plug is not supported by this particular amplifier. For clarification, please contact the Hotline.

If the message appears in conjunction with the Downloading of a test, then evidently a previously recognized expansion plug has been disconnected. If that was done intentionally, then you should *explicitly reset the plug recognition by using:* 66

*TEDS-function: "*Read sensor information".

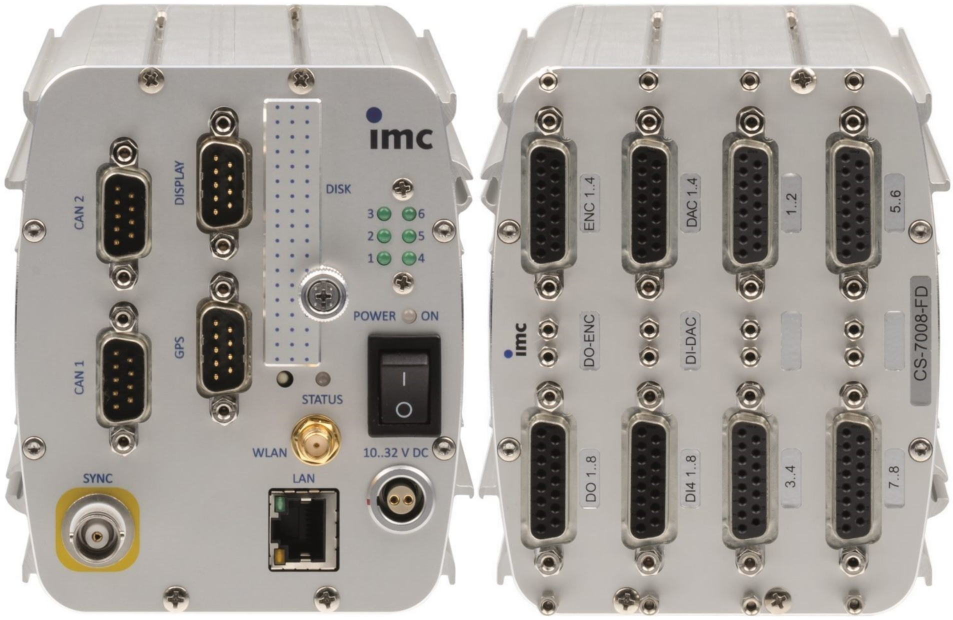
6328 The input coupling set is not supported by the imc plug connected!

Also: ***6329*** *All channels of the connected imc clamp terminal require the same input coupling: AC with current supply or DC! (The coupling mode "AC with current supply" has been renamed to "IEPE" as of imc STUDIO version 5.2 R15.)*

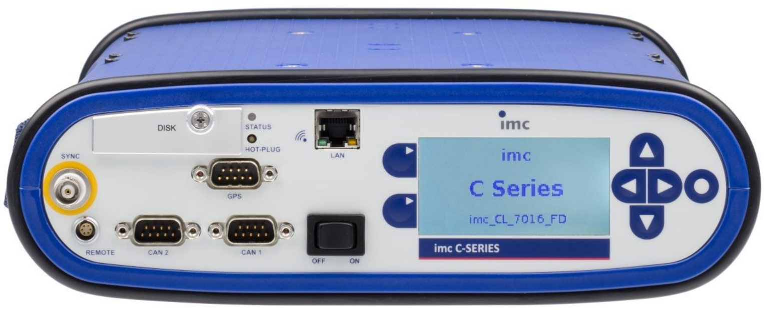
Cause: An expansion plug has been recognized which requires specific settings for the coupling (e.g., an ICP-plug requires either DC coupling or AC with current supply; no kind of bridge circuit would be allowed).

In order to fix the problem, make an appropriate setting for the amplifier: If you have already set the affected channels to "passive" for this purpose, then Downloading of the test is sufficient.

7 Device description



CS-7008-FD



CL-7016-FD

CL-7016-FD

Reference

CL devices are equipped ex-factory with an internal display at the front. Alternatively an external display 95 can be connected, but then the internal display will be deactivated ex-factory.

7.1 Hardware configuration of all devices

All devices belonging to the imc C-SERIES are equipped with:

- 4 incremental counter inputs
- 4 analog outputs
- 8 digital inputs
- 8 digital outputs

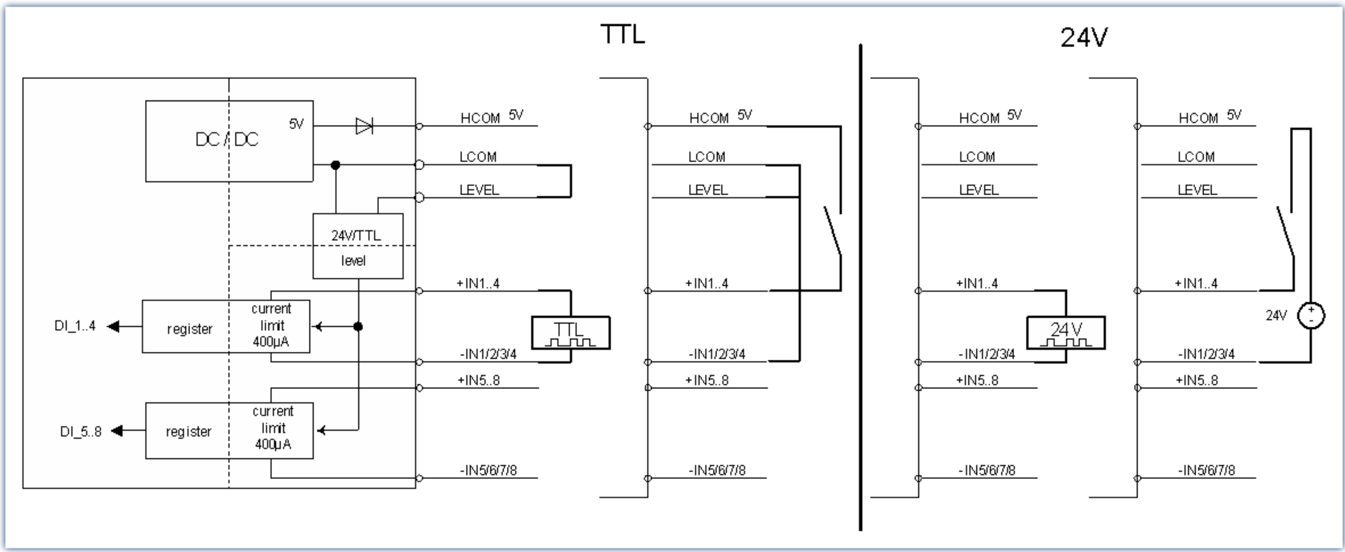
7.1.1 Digital In- and Outputs, Inputs for Incremental counters

There are 8 binary inputs, 8 binary outputs and 4 incremental counter inputs available.

7.1.1.1 Digital Inputs

The DI potion possesses 8 digital inputs which can take samples at rates of up to 10 kHz. Every group of four inputs has a common ground reference and are not mutually isolated. However, this input group is isolated from the second input group, the power supply and CAN-Bus, but not mutually.

The technical specification of the digital inputs 158.
The pin configuration of the ACC/DSUB(M)-DI4-8 175.



Open inputs are set to have LOW voltage by means of pull-down resistors

7.1.1.1.1 Input voltage

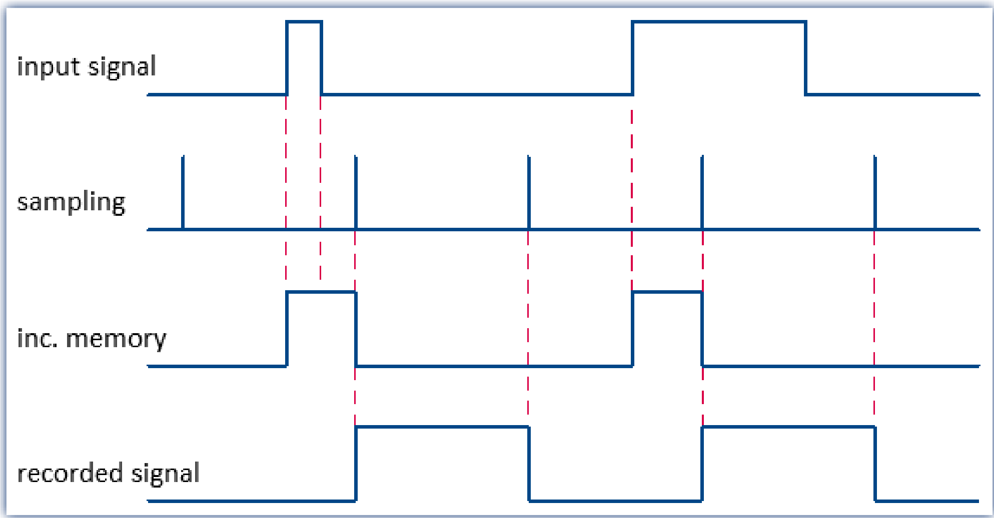
The input voltage range for a group of eight digital inputs can be set for either 5 V (TTL-range) or 24 V. The switching is accomplished by means of a jumper at the ACC/DSUBM-DI4-8 plug:

- If LEVEL and LCOM are jumpered, all 8 bits work with 5 V and a threshold of 1.7 V to 1.8 V.
- If LEVEL is not bridged with LCOM, 24 V and a threshold of 6.95 V to 7.05 V are valid.

Thus, an unconnected connector is set by default for 24 V. This prevents 24 V from being applied to the voltage input range of 5 V.

7.1.1.1.2 Sampling interval and brief signal levels

The digital inputs can be recorded in the manner of an analog channel. It isn't possible to select individual bits for acquisition; all 16 bits (digital port) are always recorded. The hardware ensures that the brief HIGH level within one sampling interval can be recognized.



7.1.1.2 Digital outputs

The digital outputs DO_01..08 provide galvanically isolated control signals with current driving capability whose values (states) are derived from operations performed on measurement channels using imc Online FAMOS. This makes it easily possible to define control functions.

Reference

The technical specification of the digital outputs 159.
The pin configuration of the ACC/DSUBM-DO8 175.

Important characteristics:

- available levels: 5 V (internal) or up to 30 V with external power supply
- current driving capability: HIGH: 15 mA to 22 mA LOW: 700 mA
- short-circuit-proof to supply or to reference potential HCOM and LCOM
- configurable as open-drain driver (e.g. as relay driver)
- default-state at system power-on:
  HIGH (Totem-Pole mode) or high-impedance (Open-Drain mode)

The eight outputs are galvanically isolated as a group from the rest of the system and are designed as Totem-Pole drivers. The eight stages' ground references are connected and are accessible as a signal at LCOM.

HCOM represents the supply voltage of the driver stage. It is generated internally with a galvanically isolated 5 V-source (max. 1 W). Alternatively, an external higher supply voltage can be connected (max. +30 V), which then determines the drivers' output level.

The control signal OPDRN on the DSUB plug can be used to set the driver type for the corresponding 8-bit-group either Totem-Pole or Open-Drain.

In Totem-Pole mode, the driver delivers current in the HIGH-state. In the Open-Drain configuration, conversely, it has high impedance in the HIGH-state, in LOW-state, an internally (HCOM) or externally supplied load (e.g. relay) is pulled down to LCOM (Low-Side Switch). With Open-Drain mode, the external supply driving the load, need not be connected to HCOM but only to the load.

Inductive loads (relays, motors) should be equipped with a clamp diode in parallel for shorting out switch-off transients (anode to output, cathode to positive supply voltage).

Power-up response:

0)	deactivated	high-Z (high resistance)
1)	power-up	high-Z (high resistance) High- and LowSide switch inactive
2)	first write access	With "Prepare measurement" following Reset or Power-up (setting procedure): activation of the output state with the mode set by the programming pin "OPDRN"

Example

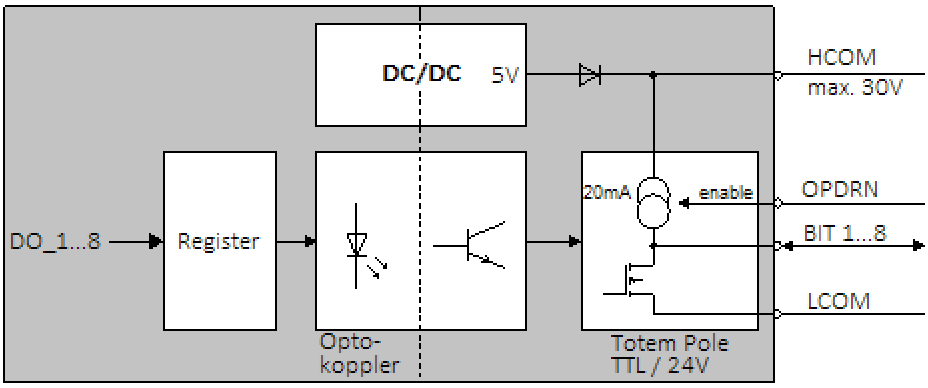
wire jumper between programming pin "OPDRN" and LCOM (-> Totem-Pole driver type)
Initialization (first setting procedure) with 0 (LOW)
→ resulting startup sequence: High-Z → LOW, without intermediate HIGH state !!
Without further steps the default initialization state while preparing measurement is: "LOW".

If a different state is desired, there are several options:

- Set the bit in imc Online FAMOS in the **control command "*OnInitAll*"**.
- Set the bit before the "Prepare" action via imc STUDIO. E.g. via the Data Browser or also automated via the **command "*Set variable*"**.

When "*preparing*" (reconfiguring) **imc Online FAMOS wins** and the value in the imc STUDIO variable is overwritten.

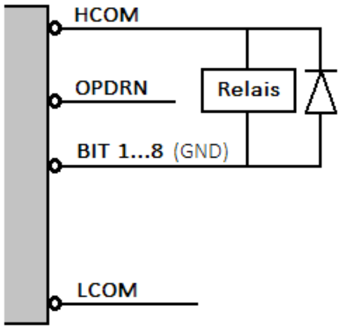
7.1.1.2.1 Block schematic



7.1.1.2.2 Possible configurations

5 V (internal)

Open Drain

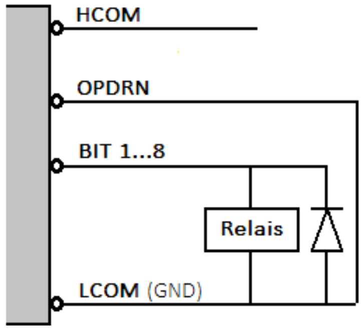


Device off: no continuity/high impedance (138 kΩ), 0 V at output

Device booting: no continuity/high impedance (138 kΩ), 0 V at output

After booting process:
no continuity/high impedance,
0 V at output, but all DO Bits = 1
DO Bit = 0 -> 5 V
DO Bit = 1 -> 0 V

Totem Pole



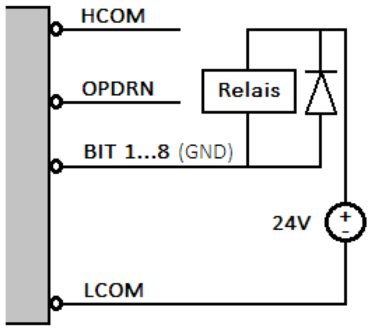
Device off: no continuity/high impedance

Device booting: no continuity/high impedance, 0 V at output

After booting process:
no continuity/high impedance,
0 V at output, but all DO Bits = 1
DO Bit = 0 -> 0 V
DO Bit = 1 -> 5 V

24 V

Open Drain

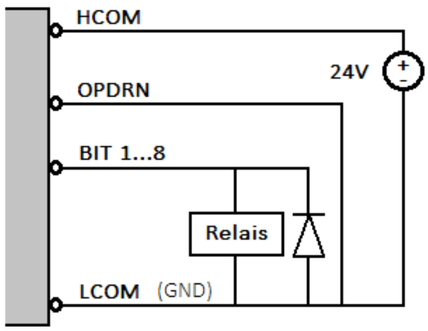


Device off: no continuity/high impedance (1.5 MΩ), 0 V at output

Device booting: no continuity/high impedance (1.5 MΩ), 0 V at output

After booting process:
no continuity/high impedance (1.5 MΩ),
0 V at output but all DO Bits = 1
DO Bit = 0 -> 24 V
DO Bit = 1 -> 0 V

Totem Pole



Device off: no continuity/high impedance (1.5 MΩ)

Device booting: no continuity/high impedance (1.5 MΩ), 0 V at output

After booting process:
no continuity/high impedance (1.5 MΩ),
0 V at output, but all DO Bits = 1
DO Bit = 0 -> 0 V
DO Bit = 1 -> 24 V

With **Totem Pole**, a maximum of **22 mA** load current is possible, totally independently of any externally connected voltage.

Open Drain is able to switch currents of up to **700 mA**. When using the internal 5 V power supply, note that the limit on total current at all outputs is 200 mA.

7.1.1.3 Incremental counter channels

You can find a general description in the chapter of the "*Incremental Counters Channels* 45".

Reference

The technical specification of the incremental counter channels 160.
The pin configuration of the ACC/DSUBM-ENC4 175.

7.1.1.3.1 Sensor types, synchronization

Index signal denotes the synchronization signal SYNC which is globally available to all four channels in common. If its function Encoder w/o zero impulse is not activated, the following conditions apply: After the start of a measurement the counters remain inactive until the first positive slope arrives from SYNC. This arrangement is independent of the release-status of the Start-trigger condition.

The index signal is armed for each measurement!

Note

If a **sensor without an index track** (Reset signal) is used, ***Encoder w/o zero impulse*** **must be selected**, otherwise the counters will remain in reset-state and will never be started because the enabling start-impulse will never occur!!

Incremental encoder sensors often have an index track (index signal, zero marker pulse) which emits a synchronization-signal once per revolution. The **index signal** is differential and set by the comparator settings of the **first** Incremental counter channel of the module. Its bandwidth is limited to 20 kHz by a permanently low-pass filter. If the input remains open, an (inactive) HIGH-state will set in.

The measurement types Linear Motion, Angle, RPM and Velocity are especially well adapted for direct connection to incremental encoder sensors. These consist of a rotating disk with fine gradation in conjunction with optical scanning and possibly also with electric signal conditioning.

One differentiates between single track and dual-track encoders. Dual-track encoders (quadrature encoders) emit two signals offset by 90° of phase, the tracks A and B (C and D). By evaluating the phase information between the A and B-track, the direction of turning can be determined. If the corresponding encoder type is selected, this functionality is supported.

The actual time or frequency information, however, is derived exclusively from the A(C) -track!

The measurement types Event, Frequency, and Time always are measured by single-track encoders, since in these cases no evaluation of direction or sign would make any sense. The sensor must simply be connected to the terminal for Track A (C).

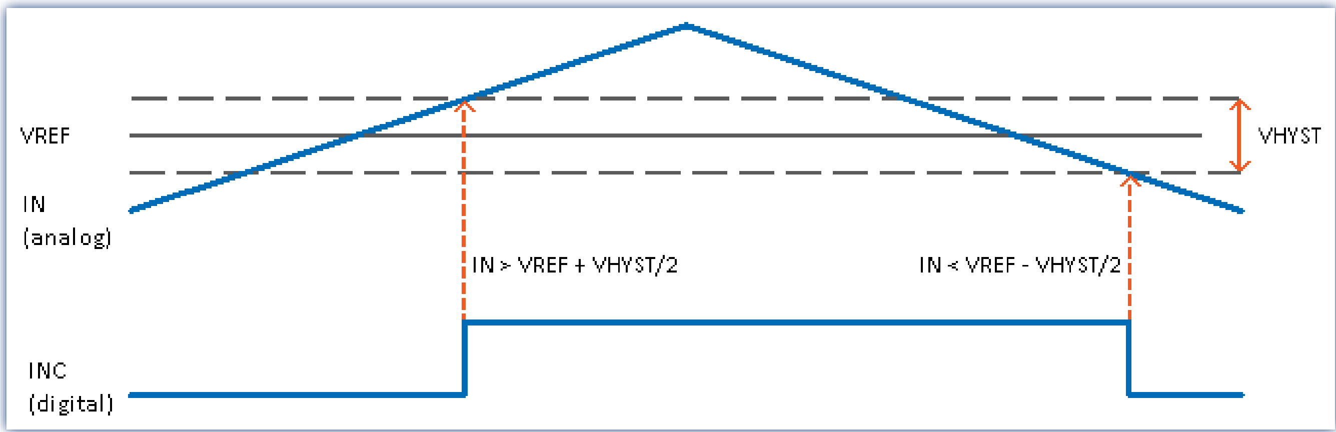
Since many signal encoders require a supply voltage, +5 V are provided at the connector socket for this purpose (max. 300 mA). The reference potential for this voltage, in other words the supply-ground connection for the sensor, is CHASSIS.

7.1.1.3.2 Comparator conditioning

The incremental counter channels' special properties make special demands on the signal quality: The very high time-resolution of the detector or counter means that even extremely short impulses which sampling measurement procedures (as at the digital inputs) would miss are captured and evaluated. Therefore the digital signals must have clean edges in order not to result in distorted measurements. Missed pulses or bounces could otherwise lead to drop-outs in the time measurements, or enormous "peaks" in the rpm-measurements.

Simple sensors such as those based on induction or photosensitive relays often emit only unconditioned analog signals which must be evaluated in terms of a threshold value condition. Furthermore long cables, ground loops or interference, can make the processing of even conditioned encoder signals (such as TTL-levels) difficult. The device, however, can counteract this using its special three-step conditioning unit.

To begin with, a high-impedance differential amplifier (±10 V range, 100 kΩ) enables reliable measurement from a sensor even along a long cable, as well as effective suppression of common mode interference and ground loops. A (configurable) filter (in preparation) at the next stage offers additional suppression of interference, adapted to the measurement set-up. Finally, a comparator with configurable threshold and hysteresis acts as a digital detector. The (configurable) hysteresis is an extra tool for suppressing noise:



If the analog signal exceeds the threshold VREF + VHYST/2. the digital signal changes its state (↑ : 0 ⇨ 1) and at the same time reduces the threshold which must be crossed in order to change the state back to 0 by the amount VHYST (new threshold: VREF - VHYST/2). The magnitude of the hysteresis therefore represents the maximum level of noise and interference that would not cause a spurious transition.

The threshold VREF is set to 1.5 V, the hysteresis VHYST is 0.5 V.
State transitions are therefore detected at the signal amplitudes:

1.75 V (← 0 → 1) and 1.25 V (↓ 1 → 0).

In future device versions, the threshold and hysteresis will be globally adjustable for all four channels within the range:

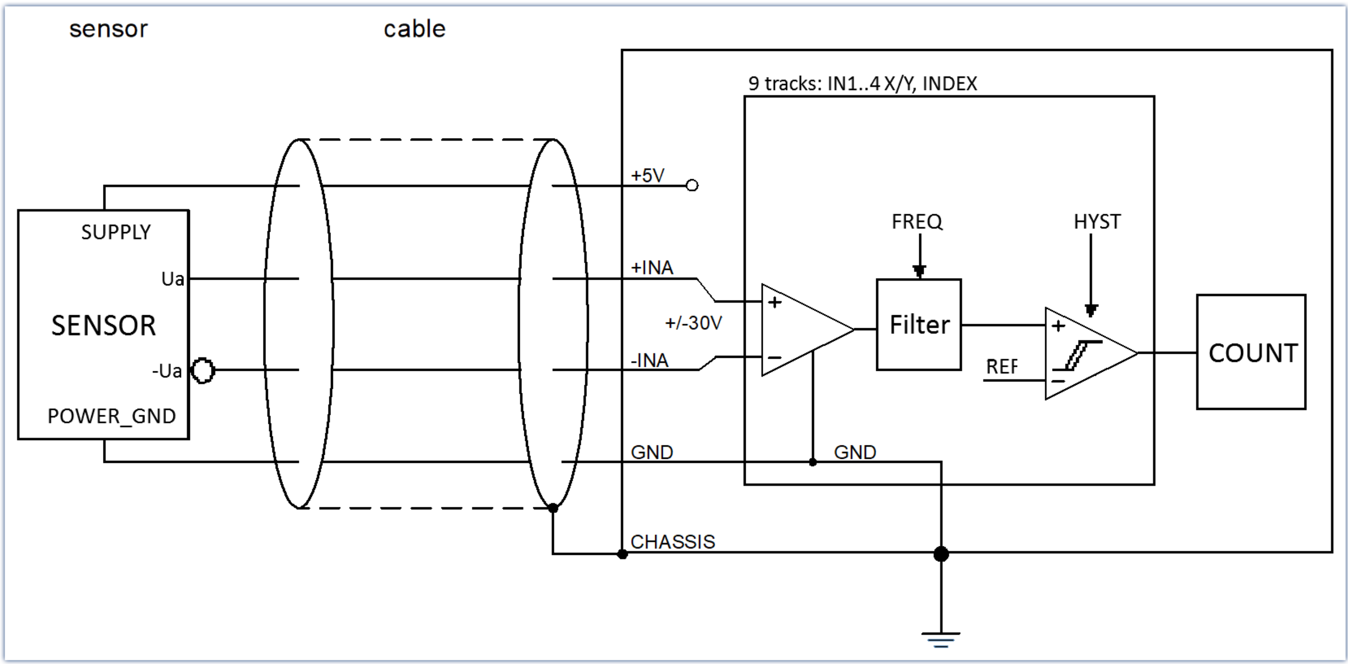
- VREF = ±10 V VHYST = +100 mV .. +4 V

Corner frequencies of the (2-pole) low-pass filter will be jointly configurable for both of a channel's tracks to the values: Low-pass filter: 20 kHz, 2 kHz, 200 Hz

7.1.1.3.3 Structure

Complete conditioning with individual differential inputs is provided for 4 tracks: they can be used for four channels with single-track encoders or for two channels with dual-track encoders.

Block schematic



Dual-track encoders (quadrature encoders) emit two signals offset by 90° of phase, the tracks A and B. By evaluating the phase information between the A and B-track, the direction of turning can be determined. If the corresponding encoder type is selected, this functionality is supported. The actual time or frequency information, however, is derived exclusively from the A-track!

Like the other channels, the Index-channel is fully conditioned. If its function is activated, it can take effect on all four channels.

7.1.1.3.4 Channel assignment

The plug used is the ACC/DSUBM-ENC-4 79. This plug enable all four incremental encoders to be connected at the same terminal.

As a prerequisite for the input differential amplifier to find the correct working point, the sensor must be ground referenced, i.e. it must have low resistance to ground (GND, CHASSIS, PE). This is not to be confused with the sensor's common mode voltage, which may be up to +25 V/-12 V (even for the –IN input!). It also does not matter that a differential measurement is configured for the high-impedance differential input. If this electrical connection to the system ground (CHASSIS) does not exist initially because the sensor is electrically isolated, then such a connection must be set up, for instance in the form of a wire jumper between the sensor's GND and POWER_GND contacts!

The 5 V (max. 100 mA, 300 mA upon request) supply voltage which the module provides at the terminals +5 V and GND can be used to power the sensors. If more voltage or supply power is needed, the sensor must be supplied externally, which means that it is absolutely necessary to ensure that this supply voltage is referenced to system ground!

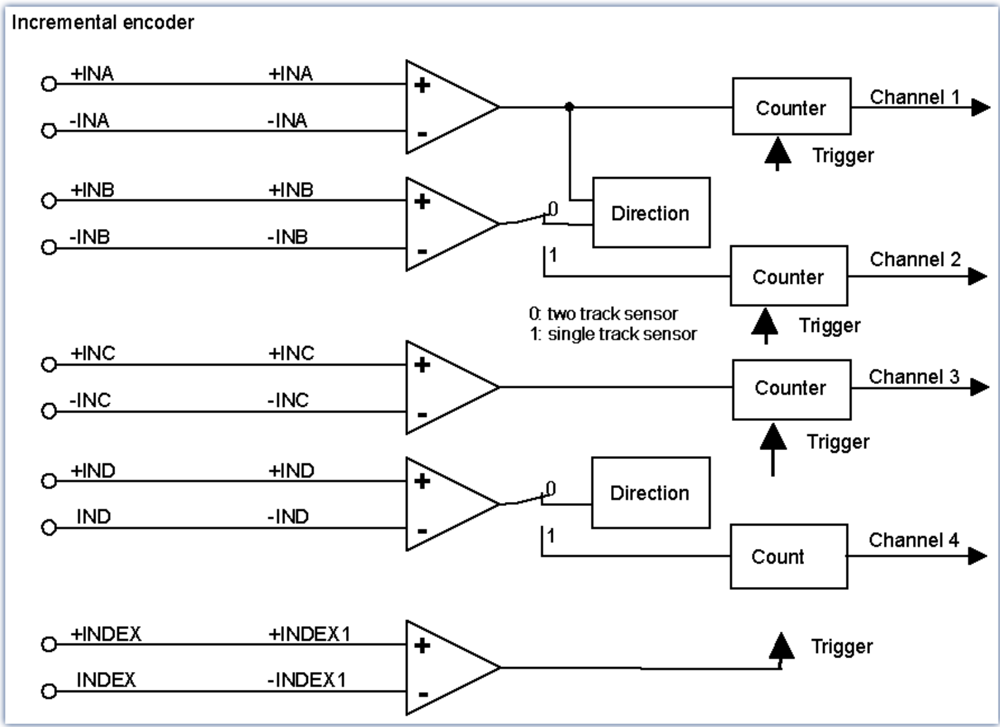
7.1.1.3.5 Incremental counter track configuration options

Mode	Channel 1	Channel 2	Channel 3	Channel 4
single-track encoder	●	●	●	●
dual-track encoder				
single-track encoder		shows signal value 0	●	●
dual-track encoder	●			
single-track encoder	●	●		shows signal value 0
dual-track encoder			●	
single-track encoder		shows signal value 0		shows signal value 0
dual-track encoder	●		●	

Reference

Please observe the notes on **two-point scaling** in the section "*Single-track / Dual-track encoder* 50".
Affects both the devices belonging to the imc C-SERIES, and also any devices belonging to the imc SPARTAN and imc CRONOS families which are equipped with the digital multiboard: DI16-DO8-ENC4 or the DI8-DO8-ENC4-DAC4.

7.1.1.3.6 Block schematic

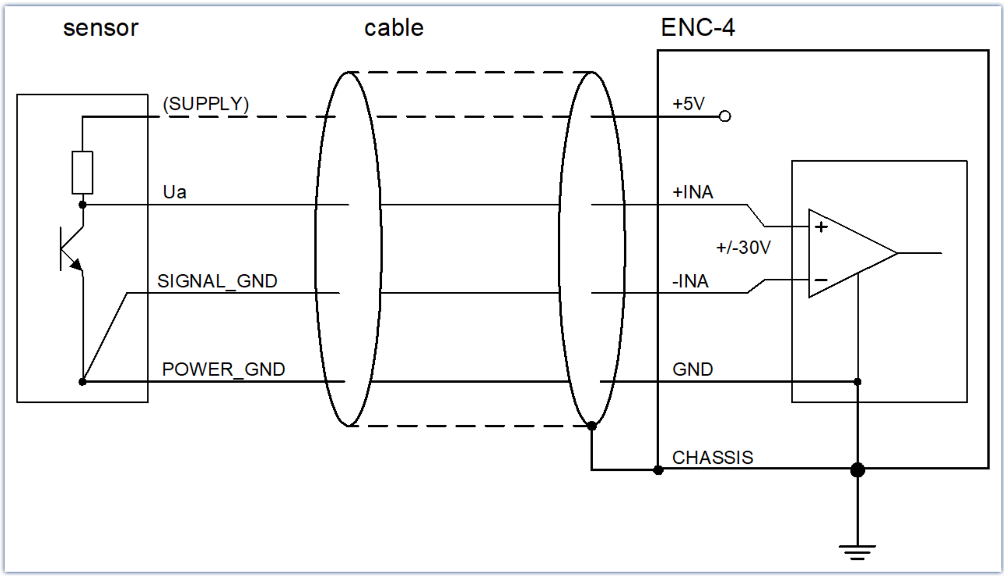


7.1.1.3.7 Connection

The pin configuration of the ACC/DSUBM-ENC-4 175

7.1.1.3.7.1 Connection: Open-Collector Sensor

Simple rotary encoder sensors are often designed as an Open-Collector stage which outputs a signal which ranges between the states 0 V and SUPPLY. In this case, the switching threshold should be set to half the SUPPLY voltage:

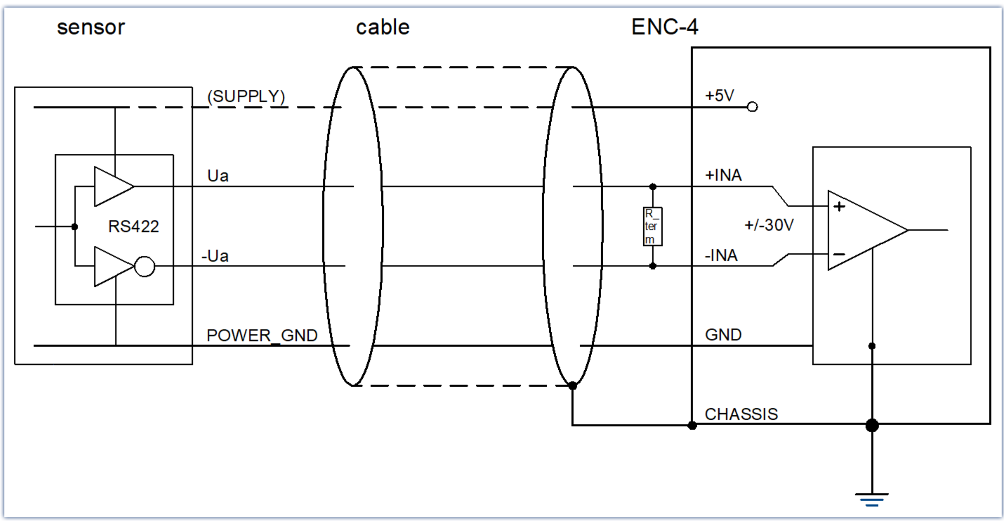


sensor with open-collector output

7.1.1.3.7.2 Connection: Sensors with RS422 differential line drivers

Commercially available rotary encoders are often equipped with differential line drivers, for instance as per the EIA-standard RS422. These deliver a complementary (inverse) TTL-level signal for each track. The sensor's data are evaluated differentially between the complementary outputs. The threshold to select is 0 V, since the differential evaluation results in a bipolar zero-symmetric signal: 3.8 V to 5 V (HIGH) or – 3.8 V to 5 V (LOW). Ground loops as pure common mode interference are suppressed to the greatest possible extent.

The illustration below shows the circuiting. The reflection response and thus the signal quality can be further improved by using terminator resistors.



sensor with RS422 differential output

7.1.2 Analog outputs

The analog outputs DAC 01 to 04 provide 4 analog output channels to be used as dynamic control and actuator signals. The outputs can be defined as the results of calculations performed by imc Online FAMOS on data from combinations of measurement channels.

The pin configuration of the corresponding DSUB-15: ACC/DSUBM-DAC4 175.

The technical specification of the module DAC-4 161.

Highlights

- ±10 V level at max. ±10 mA driver capability and 250 Ω load
- ensured startup level 0 V without undefined transient states
- short-circuit protected against ground.

7.1.3 Storage Media

Alongside transfer to the PC, it is also possible to save measured data on removable data storage media. The operating software allows free selection of data storage options (see the description of data storage in the operating software's user manual). imc measurement devices of a particular device group are compatible with particular data storage media, such as CF-Card, CFast-Card or USB data volumes.

imc device	serial no.	device group	CF	CFast	USB
CRONOS*flex* CRFX-2000GP, CRONOS*compact* CRC-400GP	19XXXX	A7	-	✔	✔
CRONOS*flex* CRFX-2000GP, CRONOS*compact* CRC-400GP, C-SERIE, SPARTAN-R, CRONOS-SL, BUSDAQ*flex* (BUSFX)	14XXXX	A5	✔	-	-
SPARTAN, BUSDAQ*flex* (BUSFX), CRONOS-SL	13XXXX	A4	✔	-	-

Certain devices can be equipped with a hard drive (see chap. "device overview" in each manual). A distinction is drawn between **removable and internal storage media**.

Removable and internal storage media

Internal storage media can not be interchanged, but rather are permanently installed inside the device. They are usually magnetic or SSD harddrives. Use of such media is the best approach whenever the required storage capacity exceeds data volumes which removable media can provide. The internal storage media exclusively serve the purpose of data acquisition. Hard drives are ordered along with the device, and can only be retrofit by imc for existing equipment.

Otherwise, this drive is displayed as internal storage. Irrespective of the hotplug capability, the drive can always be exchanged while the device is deactivated, so that the accumulated data can be conveniently analyzed or archived.

Guidelines for proper handling of the removable storage media

- **Always insert only one removable storage medium (either CFast or USB).**
  In the case of multiple installed storage options (CFast & USB) the device does only support one storage volume at a time. Which one is determined upon activation, and there is no fixed sequential order. For this reason, remove any data storage volumes which you do not wish to use for the measurement before activating the device. When one removable data storage volume is currently inserted and an additional one is then inserted, the status-LED flashes red one time to indicate that the removable volume can not be used.
- Ensure that sufficient time is available for the exchange. The time needed for registering and deregistering with the system depends on the data carrier and on the channel count. As a guideline value, we recommend at least 30 s, even for simple configurations.
- Formatting of the 1 TB SSD hard drive can only take place when it is inserted in the device. It is important that this hard drive is only formatted in FAT32.

Exchanging the data carrier

In case you are using a removable storage medium, please be aware that before you remove it (if the device is switched on), the Hotplug button must be pressed to ensure that storage medium can be safely removed.

When you click on the Hotplug button, you request the system to remove the removable data carrier. In response, the device stops access to the data carrier (LED lights up). If you remove the drive without prior notification, defective clusters can occur in consequence. If you unplug the data carrier during a running measurement, data sets will not be closed but rather end up corrupted. For this reason, when exchanging the data carrier, proceed as follows:

1. Press the Hotplug button
2. Once the status LED is flashing, remove the data carrier.
3. Insert the new data carrier. The LED flash briefly to acknowledge that the new drive has been recognized successfully.

Note File system & writing performance

The following **file systems** are supported: FAT16 up to 2 GB, **FAT32** up to 8 TB (max. possible size, that is supported with this file system). Please find further details in the software manual.

The **writing performance** is not actually indicated by "Speed-Grades" or similar parameters. The writing performance can not be estimated as a calculated data rate expressed in Byte/s. Instead, it depends strongly on the properties of the medias' controller chips and the operating conditions, in particular on the number of channels or files to be processed in parallel.

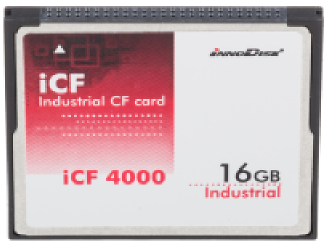
Reference

Please find a detailed description of internal removable storage media in the software manual, chapter "Device hard disk, removable drive".

Removable CF Storage Media Cards

Overview of the available storage media

Order code	article number
ACC/CF-2.0-GB-ET	13500020
ACC/CF-8.0-GB-ET	13500079
ACC/CF-16.0-GB-ET	13500081
ACC/CF-32.0-GB-ET	13500137



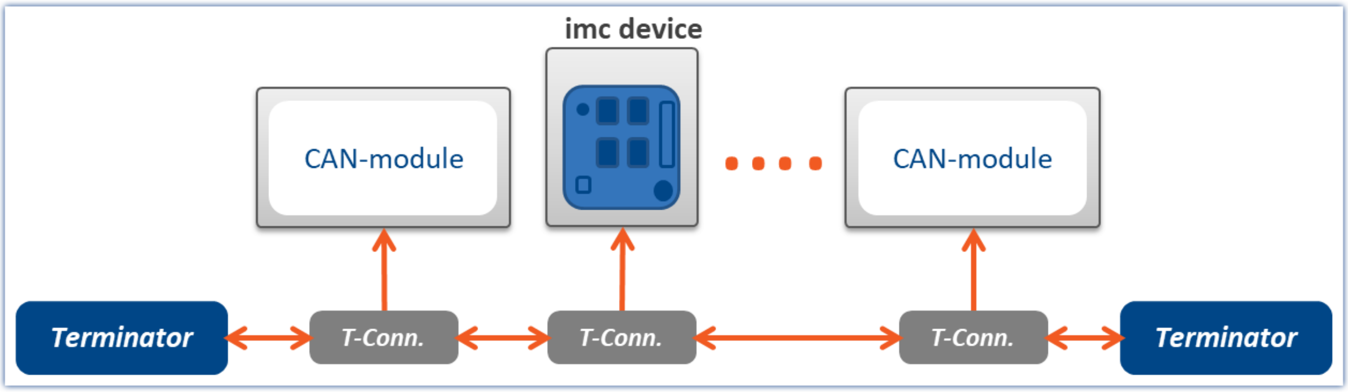
Operating conditions - removable CF storage media

Storage temperature:	-65°C to 150°C	
Operating temperature:	-40°C to 85°C	condensation allowed (extended temperature range)
Shock protection	in operation 1000 g	

7.1.4 Fieldbus interfaces

7.1.4.1 CAN, 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 C-SERIES 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 C-SERIES 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.

Reference

- Please finde in the following chapter the technical specs 162 and
- in the following chapter the DSUB-9 pin configuration 179.

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":

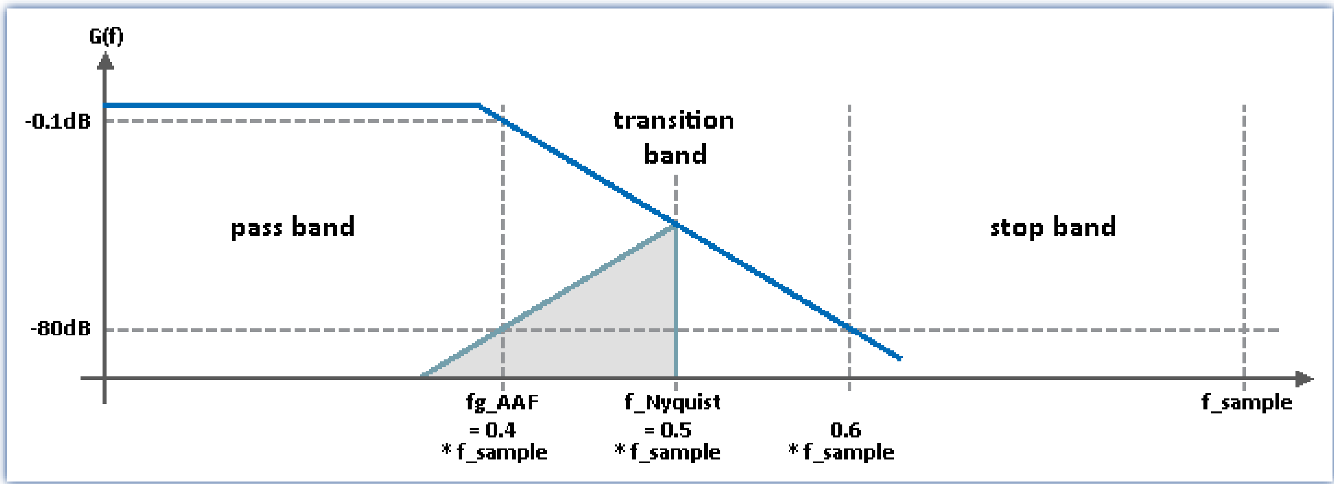
The (digital) anti-aliasing filters are elliptical Cauer filters. Their "tight" characteristic curve in the frequency range makes it possible to have the cutoff frequencies approach the sampling and Nyquist frequencies much closer without having to make a compromise between the bandwidth and freedom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

7.2.2.1 External +5 V supply voltage

For a majority of the imc measuring modules there is a **5 V supply voltage** available for an external sensors or for the IEPE/ICP expansion plug. This source is not isolated; its reference potential is identical to the overall system's ground reference.

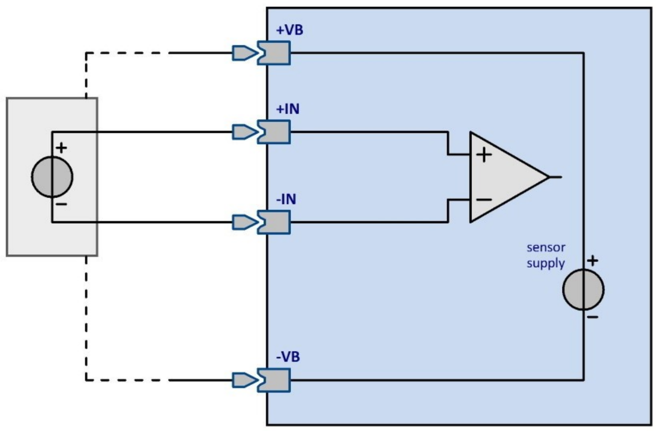
The +5 V supply outputs are electronically protected internally against short-circuiting and can each be loaded up to max. 160 mA (short-circuit limiting: 200 mA, refer to the data sheet of the used module). The sensor's reference potential, in other words its supply-ground connection is the terminal "GND". The used pins 175 at the DSUB-15 plug Vcc=+5 V and GND fulfill a double function for amplifiers, that can be used for temperature measurement. They provide the supply for the build in cold junction compensation of the thermo plug (ACC/DSUBM-T4 37). In this case, the 5 V supply can not be used for external sensors.

7.2.2.2 Sensor supply module

Some modules (C-10xx, C-12xx 141, C-41xx 148) can optionally be equipped with an adjustable sensor supply. This will not cause an enlargement of the width of those modules. In order to differentiate between the modules we add a suffix to the name of the module: "..-SUPPLY Find here technical details of the sensor supply 169.

Note

Important: The settings are made via software interface. Make sure that the sensor supply is not set too high before connecting a sensor. Otherwise, the sensor could suffer damage.



The sensor supply is unipolar and can be led out with DSUB-15 plugs at +VB and -VB (or +SUPPLY and -SUPPLY, see typing label in your plug). Only five selectable settings are available per module. The configurations can be taken from the respective module data sheet. The voltage can be set globally for all channels of a module. All channels of a module form a channel group.

A bipolar supply voltage of ±15 V instead of the unipolar 15 V is available as special request. The sensor supply voltage is in this variant not isolated (to CHASSIS). This is also recommendable in most cases. With this **±15 V option** the pin 6 is the reference at least with the U4 plug 175.

Example

+15 V via pin 6: GND and pin 3: +VB (+SUPPLY), -15 V via pin 6: GND and pin 12: -VB (-SUPPLY), +30 V via pin 12: -VB -(SUPPLY) and pin 3: +VB (+SUPPLY). Each table with the pinning in chapter "*Pin configuration*" list in a foot note the reference, if there is a reference.

If an isolated, active sensor is both fed with an isolated supply and measured with an isolated channel, then (due to isolation drift or capacitive interference coupling) an uncontrolled common mode voltage will emerge unless a common mode voltage is imposed from outside (or, for instance, by targeted grounding) which may be too strong interference to suppress. Only if the sensor to be supplied with power is already affected with a common mode voltage due to the measurement setup, or if the -SUPPLY return lines are already exposed to uncontrolled ground loops, an isolated sensor supply may be advisable.

Note

The supply voltage is set on each channel group and does apply to **all inputs** of this group. For the number of channels per group is depending on the type of device.

7.2.3 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.

7.2.4 SYNC

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.

Note

- To use the SYNC input, IRIG B must be supported. SYNC use with BUSDAQ*flex* (serial number circle 13...) is therefore also 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

Technical details: synchronization 137

7.2.4.1 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.

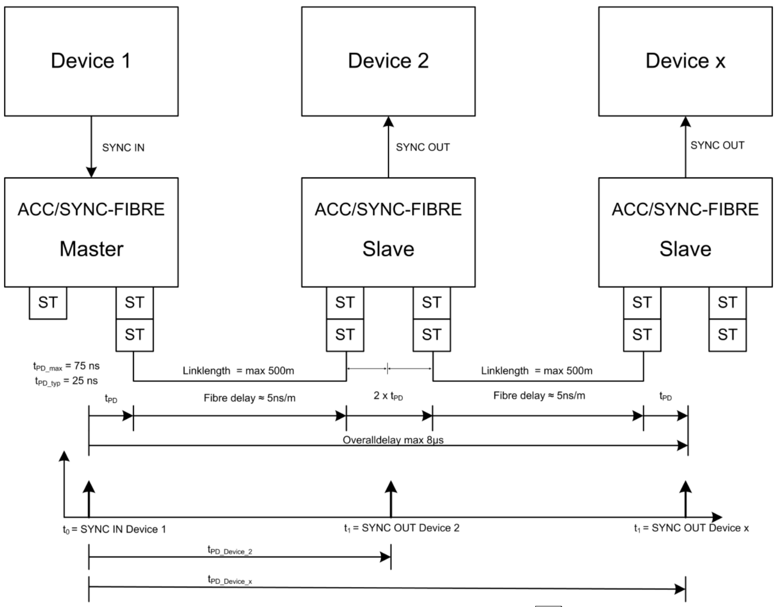
In areas of high electrical interference, or where long-distance signal transmission is needed, the signal can be conducted via fiber optic cabling with total isolation and no interference. For this purpose, the externally connectable optical SYNC adapter ACC/SYNC-FIBRE is available.

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 167

7.2.5 IRIG-B module

This external IRIG-B module can convert a time signal in IRIG format to the GPS format NMEA 0183 and thus be used for synchronization of different devices.

The expansion module exclusively supports amplitude modulated IRIG signals according to the standards IRIG-B1xx! This is why it can be used both to upgrade older imc device generations which provided no IRIG-B support at all, and to enhance current imc device generations with additional capabilities regarding modulated signals: While many up-to-date imc device series (CRFX, CRC, C-SERIES) offer IRIG-B synchronization via their standard BNC synchronization plug as a standard feature (including DCF-77 / IRIG-B auto-detection), this path only supports direct unmodulated TTL-signals (IRIG-B0xx).

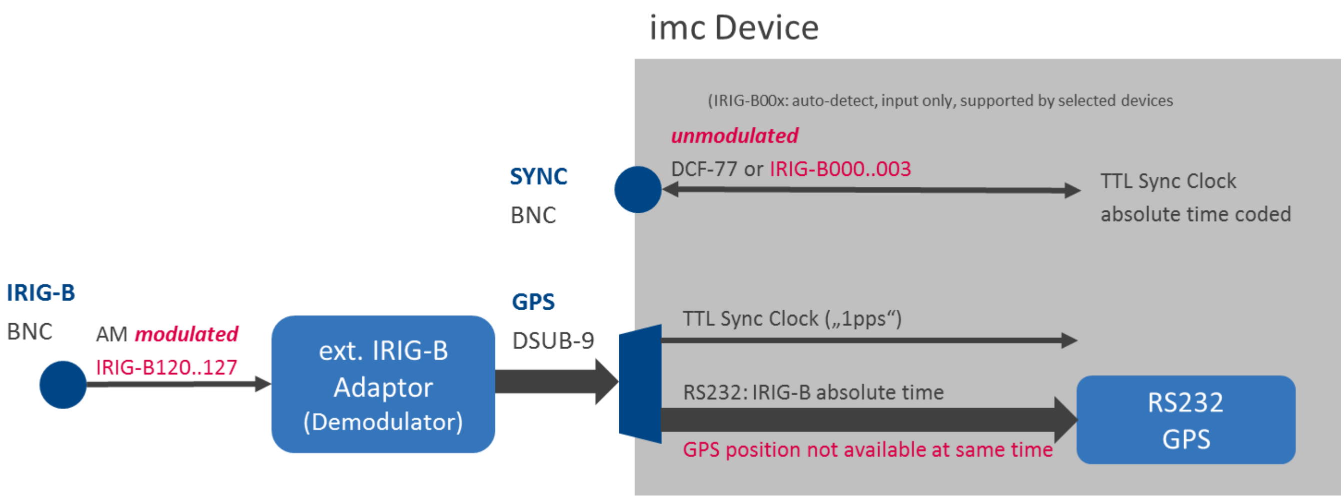
The definition of the various IRIG time codes is specified in the IRIG standard 200-98. This adaptor module supports sub-standards IRIG-B120 through B127. These are characterized by 100 pulses per second, AM (amplitude-modulated) sinusoidal signal, 1 kHz carrier frequency, BCD Time-of-Year.

The module's rear panel holds the DSUB-9 plug, which is connected to the measurement system's GPS plug via the included RS232 expansion cable. The pinout of the DSUB-9 plug directly conforms to the "GPS" connectors pin configuration, which is uniform to imc measurement systems.

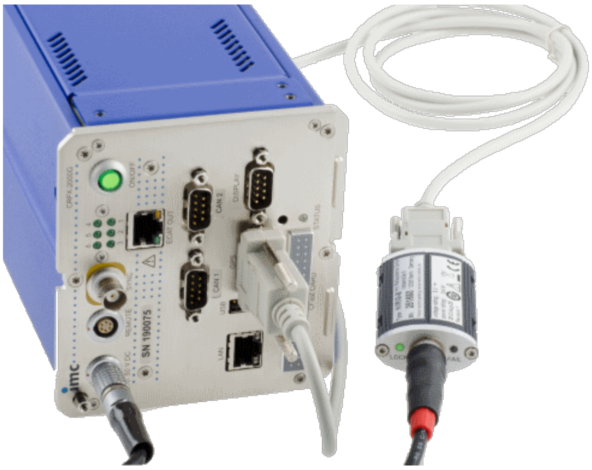
When using the IRIG-B adaptor in conjunction with this GPS port, absolute time information is captured via this RS232 interface, and additionally, synchronization of the device's system clock is performed by means of an additional clock signal ("1 pps") provided on a dedicated pin of the DSUB-9 terminal. While this occupies the port, simultaneous capture of GPS geo positioning information is not supported at the same time.

Note

The operating software (imc STUDIO) will denote the used synchronization type as "GPS", simply because the respective port is used to interface the IRIG-B module.



The module's front panel has one BNC plug and two LEDs. The LOCK LED shines when the input signal is synchronized with the IRIG-B module. If the input signal is not valid or not synchronized with the IRIG-B module, the FAIL LED shines.



The IRIG-B module comprises a realtime clock (RTC) with a backup battery, which is set to time and date according to the IRIG B-signal received. If the IRIG B year codes received equal "00" (depending on used sub-standard) these are ignored and only RTC time and day values are set, while the year continues to reflect the value resulting from counting since the last update with a valid year number. This means that the year number is incremented at the turn of the new year.

To monitor an imc measurement system's synchronization status, it is possible to use the imc Online FAMOS function "**IsSynchronized()**". Its return value is "1" if the device is synchronized to an external time reference; otherwise, a "0" is returned.

Loss of the external time signal is detected within 1 – 2 seconds. However, the process of restoring synchronization can last approx. 20 – 25 seconds.

Technical Specs of IRIG-B 168.

7.2.6 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 °
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

GPS information	Description
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

RS232 port settings

For imc devices to be able to use a GPS receiver, the following conditions must be met:

- **Baud rate**: Possible values are 4800, 9600, 19200, 38400, 57600 or 115200
- 8 bit, 1 stop bit, no flow control
- The following **NMEA strings** must be sent: ***GPRMC, GPGGA, GPGSA***. The order of the strings must be adhered to.
  Additional strings should be deactivated. If this is not possible, all other strings must be **before** the GPGSA string!
- The receiver must deliver a **1 Hz clock**.
- The rising edge of the clock must mark the second specified in the next GPRMC string.
- All three strings should be sent as soon as possible after the 1 Hz clock, so that there is sufficient time for processing between the last string and the next 1 Hz clock.

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 178

7.2.7 WiFi connection

Measurement devices can optionally be equipped with a built-in WiFi (WLAN) adaptor. An alternative wireless network connection may especially useful in applications such as mobile test drives. Measurement devices can be equipped with WiFi adaptors conforming to the standard IEEE 802.11g, which achieve maximum gross transfer rates of 54 Mbit/s, more specifications see chapter Technical details: WiFi 170.

WiFi (WLAN) antenna for a CRx - 400 system (see device overview 34)

Each antenna of the corresponding system is labeled ex-factory at imc Berlin:

- *imc CRx - 400; antenna with SMA Male — only fits with devices with RP-SMA (SMA Female)*
- *imc CRx - 2000; antenna with RP-SMA plug (SMA Female) — only fits with devices with SMA Male*

WiFi (WLAN) antenna for a CRx - 2000G system

The "2000G" devices allow installation of optional WiFi (WLAN) adaptors conforming to the standard IEEE 802.11n, which by using multiple antennas provides higher data rates. Two externally connectable antennas are supported (standard SMA connection), which together achieve a data rate of 300 Mbit/s.

The WLAN antenna with an SMA male terminal is no longer offered by the manufacturer. imc has a modified substitute antenna from the same manufacturer (this affects systems shipped as of August, 2014). For this reason, imc has changed the connection terminals on the devices (SMA Male). Devices previously having RP-SMA (SMA Female) terminals will instead have SMA Male terminals in future.

There is a new label for the new antenna to differentiate:

WiFi (WLAN) antenna for CRx - 400 system

- *imc CRx - 400 Typ 2; antenna with RP-SMA plug (SMA Female) — only fits with devices with SMA Male*

The antenna labeled: "imc CRx - 2000" can be used for all imc CRONOS with built-in WiFi (WLAN) adaptor (SMA Female).

In order to make the label of the antenna for all devices uniform, we changed the label as follows:

Please pay attention to the terminal connection on your device!

WiFi antenna with RPSMA (female) is only compatible to RPSMA (male) on your device.

WiFi - antenna with RPSMA (female)

connection at your device RPSMA (male)

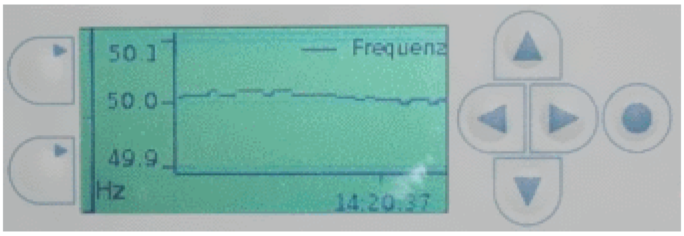
WiFi - antenna with SMA (male)

connection at your device SMA (female)

7.2.8 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.



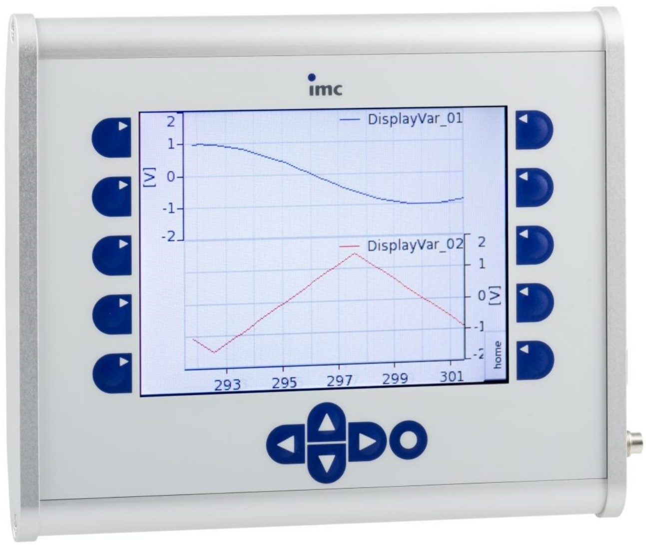
integrated display, only with CL and PL devices

imc CL-xx devices are equipped with an integrated display.

The Display's interaction with the measurement device is handled by means of virtual Display variables or bits, which can either be evaluated for the purpose of status indication or set in order to affect the measurement process.

Detailed descriptions of the functions are presented in the chapter *Display* of the imc software manual.

7.2.8.1 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 163".

- 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 CS-1016-FD

CS-1016 is a 16-channel measurement device, for voltage and current measurement tasks, with sampling rates of up to 20 kHz per channel.

Technical details: CS-1016-FD analog inputs 138.

The device come with 16 differential, non-isolated input channels which can be used for measuring voltage 96. In addition, current 96 measurement by means of a shunt plug and the use of an IEPE (ICP) 96-expansion plug are provided for. The channels each come with 5th order ("analog", fixed-configuration) anti-aliasing filters, whose cutoff frequency is 6.6 kHz.

7.3.1 Voltage measurement

- Voltage ranges: ±250 mV, ±1 V, ±2.5 V, ±10 V

The input impedance is 10 MΩ referenced to system ground or 20 MΩ differential. The inputs are DC-coupled. The corresponding connection terminal is designated ACC/DSUBM-U4 175

7.3.2 Current measurement

- Current ranges: ±5 mA, ±20 mA, ±50 mA

For current measurements, a special plug with a built-in **shunt** (50 Ω) is needed ACC/DSUBM-I4 176.

For current measurement with the special shunt-plugs ACC/DSUBM-I4, input ranging only up to max. ±50 mA (corresponding to 2 V or 2.5 V voltage ranges) are permitted due to the measurement shunt's limited power dissipation in the case of static long-term loading.

Note

Configuration is carried out in the voltage mode, but an appropriate scaling factor is entered which allows direct display of current values (0.02 A/V = 1/50 Ω).

7.3.3 Current fed sensors

At the DSUB-15 sockets, a permanent 5 V supply voltage for external sensors 87 is available. This voltage source is grounded to the measurement device's frame. The description of measurement with ICP sensors is presented here. 56 For the measurement of current-fed sensors we recommend the expansion plug ACC/DSUBM-ICP2I-BNC(-F,-S) 56.

7.3.4 Bandwidth

The channels' **max. sampling rate** is 20 kHz (50 µs sampling interval). The **analog bandwidth** (without digital low-pass filtering) is 6.6 kHz (-3 dB).

7.3.5 Connection

The analog channels are equipped with four DSUB-15 plugs (4 channels / plug).

ACC/DSUBM-U4 175

7.4 CS-1208-FD

CS-1208-FD is a 8-channel universal measurement device, respectively, for voltage and current measurement tasks (20 mA), with sampling rates of up to 100 kHz per channel.

In particular, the high bandwidth of 48 kHz, the input ranges from 50 V to 5 mV and the low signal noise predestine this device for high-performance voltage measurements.

Reference

Technical details: CS-1208-FD analog inputs 140.

7.4.1 Voltage measurement

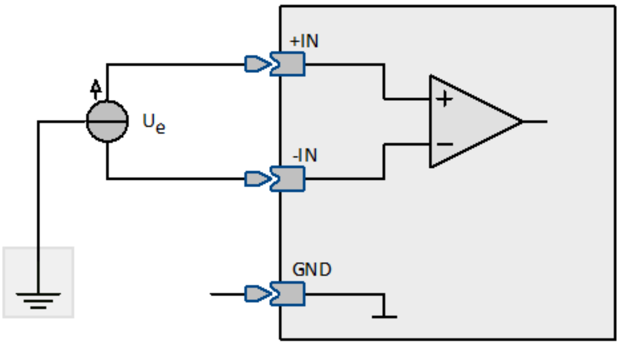
- Voltage: ±5 mV to ±50 V

In the voltage ranges ±50 V and ±20 V, a voltage divider is in operation; the resulting input impedance is 1 MΩ. In the voltage ranges ±10 V to ±5 mV, by contrast, the input impedance is 20 MΩ. When the device is deactivated, it drops to about 1 MΩ.

The input configuration is differential and DC-coupled.

7.4.1.1 Voltage source with ground reference

The voltage source itself already is referenced to the device's ground. The voltage source is at the same potential as the device ground.



Example

The unit is grounded. Thus, the input GND is at ground potential. If the voltage source itself is also grounded, it is referenced to the device ground.

It isn't any problem if, as it may be, the ground potential at the voltage source deviates from the ground potential of the device itself by a few degrees. The maximum permitted common mode voltage must not be exceeded.

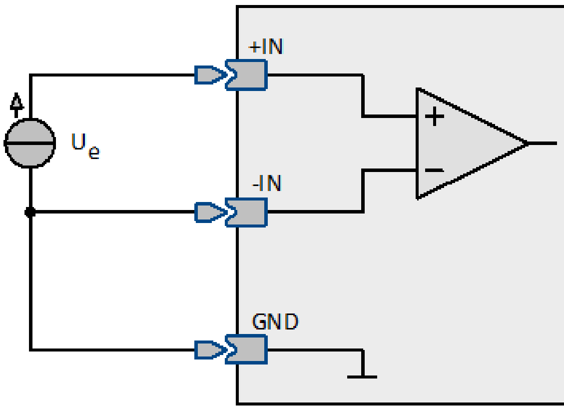
Note

In this example, the negative signal input -IN may not be connected to the ground contact GND in the device. Otherwise, a ground loop would result, through which interference could be coupled in.

In this case, a true differential (but not isolated!) measurement is performed.

7.4.1.2 Voltage source without ground reference

The voltage source itself has no reference to unit's ground, but instead, its potential floats freely vis-à-vis the device ground. If a ground reference cannot be established, it's also possible to connect the negative signal input –IN to the ground contact GND.



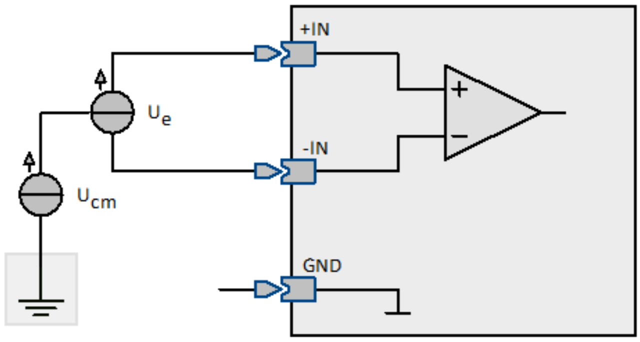
Example

A voltage source which isn't grounded (e.g. a battery) and whose contacts have no connection to ground potential is measured. The device is grounded.

Note

When –IN and GND are connected, be sure that the signal source's potential can actually be drawn to the device ground's potential without an appreciable current flowing. If the source can't be brought to that potential level (because it turns out to be at fixed potential after all), there is a risk of permanent damage to the amplifier. If IN and GND are connected, a single end measurement is performed. This isn't a problem unless a ground reference already existed.

7.4.1.3 Voltage source at other, fixed potential



In the input ranges <20 V, the common mode voltage Ucm must lie within the range ±10 V. It is reduced by one-half of the input voltage.

7.4.1.4 Voltage measurement: With taring

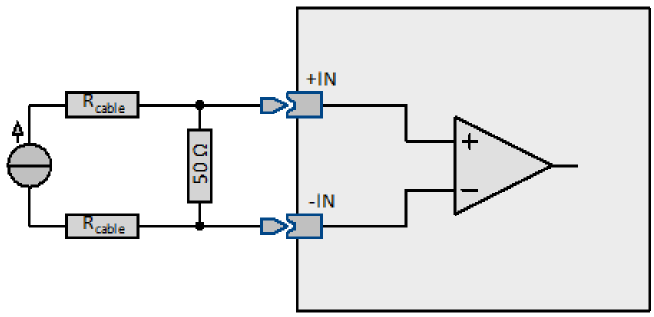
With voltage measurement, it's possible to tare a zero offset to restore correct zero. For this purpose, select the menu item *Settings -> Amplifiers (balance etc.)...*, and on the screen's index card *Common*, under *Balancing*, select the option *Tare* for the desired channel. The input range correspondingly is reduced by the amount of the zero adjustment. If the initial offset is so large that it's not possible to adjust it by means of the device, a larger input range must be set.

7.4.2 Current measurement

- Current: e.g. ±50 mA to ±1 mA

For current measurement, the DSUB plug ACC/DSUBM-I4 must be used. This plug is not included in the standard package. It contains a 50 Ω shunt.

In addition, voltage can be measured via an externally connected shunt. The appropriate scaling must be set in the user interface. The value 50 Ω is only a suggestion. The resistance should be sufficiently precise. Make note of the shunt's power consumption.



In this configuration, too, the maximum common mode voltage must be located within the range: ±10 V. This can generally only be assured if the current source is also already referenced to ground.

If the current source has no ground reference, there is a danger of the unit suffering unacceptably high overvoltage. It may be necessary to create a ground reference, for instance, by grounding the current source.

Note

Since this procedure is a voltage measurement at the shunt resistor, voltage measurement must also be set in the imc operating software.

The scaling factor is entered as 1/R and the unit as A (0.02 A/V = 1/50 Ω).

7.4.3 Current fed sensors

At the DSUB-15 sockets, a permanent 5 V supply voltage for external sensors 87 is available. This voltage source is grounded to the measurement device's frame. The description of measurement with ICP sensors is presented here. 56 For the measurement of current-fed sensors we recommend the expansion plug ACC/DSUBM-ICP2I-BNC(-F,-S) 56.

Note DSUB-15 sockets

Triaxial sensors are only supported when using a metal plug ACC/DSUB**M**-ICP2I-BNC(-F, -S) plugged on the measuring amplifier.

The use of plastic plugs (ACC/DSUB-ICP2, ACC/DSUB-ICP4) in connection with triaxial sensors is not possible.

When using the two channel ICP plug: ACC/DSUBM-ICP2I-BNC(-S/-F) in combination with the analog inputs, which provide four channels per socket, only channels 1 and 3 can be used.

7.4.4 Bandwidth

The **max. sampling rate:** 100 kSamples/s (10 µs sampling interval) and **analog bandwidth**: 48 kHz (-3 dB).

7.4.5 Connection

Please find here the DSUB-15 pin configuration 174.

7.5 CS-3008-FD

The measuring inputs (non-isolated, differential inputs) are used for voltage measurement and allow direct connection of any IEPE type sensors via BNC, such as ICP™, DeltaTron®, accelerometers or microphones, see technical details 143.

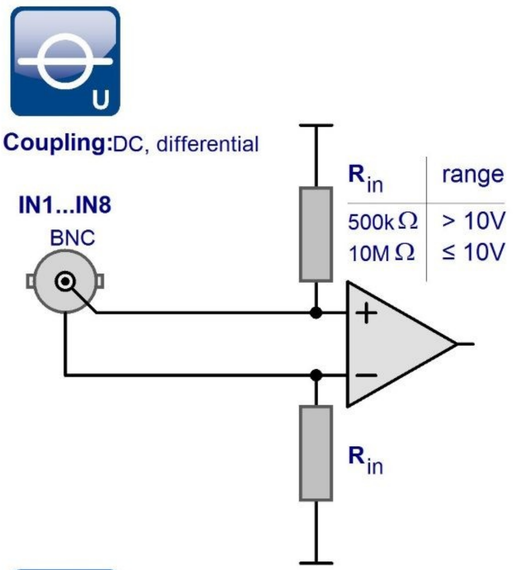
7.5.1 Voltage measurement

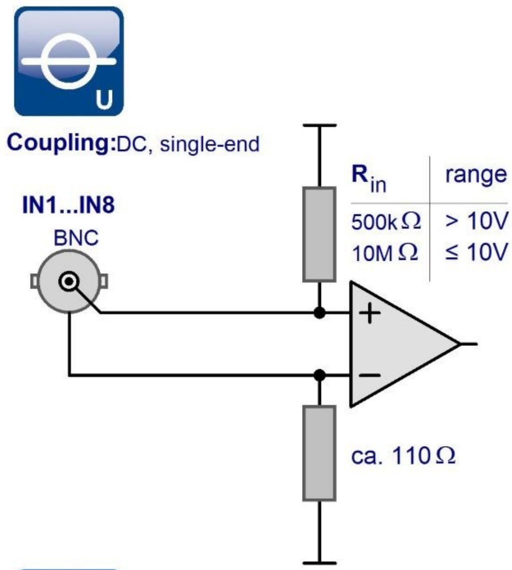
- Voltage: ±50 V to ±5 mV

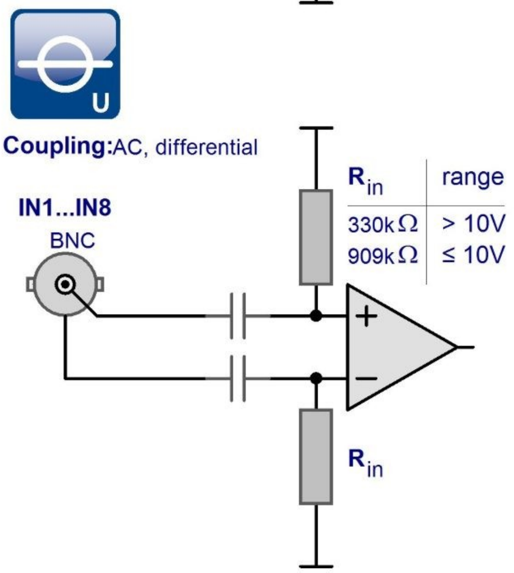
In the voltage ranges ±50 V and ±20 V, a voltage divider is in operation; the resulting input impedance is 1 MΩ in DC mode and 0.67 MΩ in AC mode. In the voltage ranges ≤±10 V, by contrast, the input impedance is 20 MΩ in DC and 1.82 MΩ in AC mode. When the device is deactivated, it drops to about 1 MΩ.

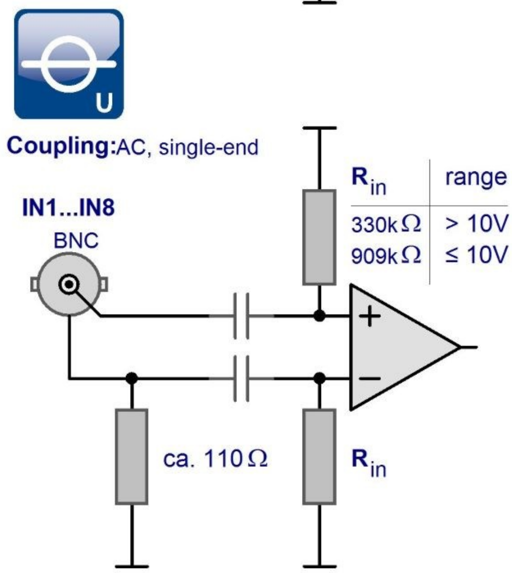
With the AC coupled ICP-measurement the DC voltage is suppressed by a high pass filter of 0.37 Hz for all ranges ≤±10 V. For the ranges ≥±20 V the low pass cut-off frequency is 1 Hz.

7.5.1.1 Input coupling





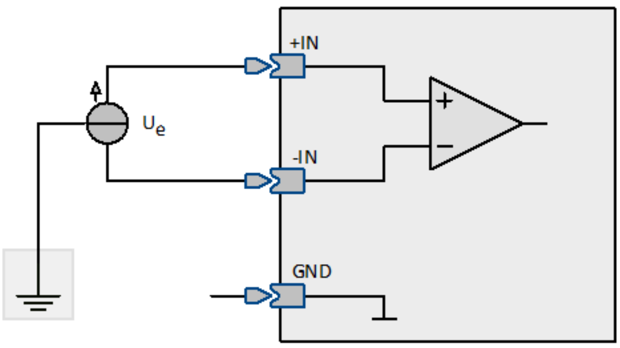




Note

- In the coupling mode "AC with current supply" respectively "IEPE", an open-circuit current-fed voltage of about 30 V is present at the BNC sockets, which can cause damage to other (non-current-fed) sensor types. For that reason, this mode should only be set for appropriate sensors. It is assured that no current feed is active when the device is started. This state remains in effect until the measurement is first prepared, no matter what is set in the user's interface.
- When a channel is not active, there will be no current-fed voltage in the settings mode AC with current feed as of firmware version 2.7 R3.
- As of imc STUDIO version 5.2 R15 the coupling mode "AC with current supply" is renamed to "IEPE".

7.5.1.2 Case 1: Voltage source with ground reference



The voltage source itself already is referenced to the device's ground. The voltage source is at the same potential as the device ground.

Example

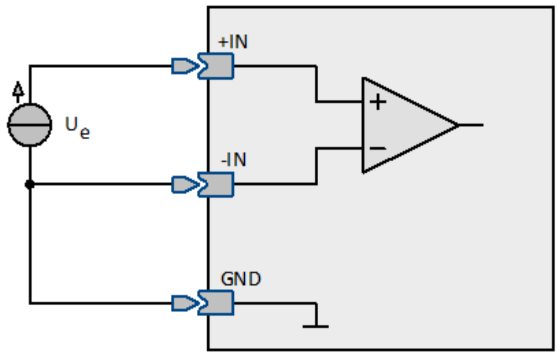
The measurement system is grounded. Thus, the input GND is at ground potential. If the voltage source itself is also grounded, it is referenced to the device ground. It isn't any problem if, as it may be, the ground potential at the voltage source deviates from the ground potential of the device itself by a few degrees. The maximum permitted common mode voltage must not be exceeded.

Note

In this case, the negative signal input -IN may not be connected to the ground contact GND in the device. Otherwise, a ground loop would result, through which interference could be coupled in.

In this case, a true differential (but not isolated!) measurement is performed.

7.5.1.3 Case 2: Voltage source without ground reference



The voltage source itself has no reference to the device's ground, but instead, its potential floats freely compared to the device ground. If a ground reference cannot be established, it's also possible to connect the negative signal input –IN to the ground contact GND.

Example

A voltage source which isn't grounded (e.g. a battery) and whose contacts have no connection to ground potential is measured. The measurement system is grounded.

Note

When –IN and GND are connected, be sure that the signal source's potential can actually be drawn to the device ground's potential without an appreciable current flowing. If the source can't be brought to that potential level (because it turns out to be at fixed potential after all), there is a risk of permanent damage to the amplifier. If IN and GND are connected, a Single ended measurement is performed. This isn't a problem unless a ground reference already existed.

7.5.2 Bandwidth

The channels' **max. sampling rate** is 100 kSamples/s (10 µs sampling interval). The **analog bandwidth** (without digital low-pass filtering) is: 48 kHz (-3 dB). In AC mode the lower cut off frequency is 0.37 Hz for all ranges ≤±10 V, else 1 Hz.

7.5.3 Connection

The terminal connections are of the type BNC.

7.6 CS-4108-FD, CL-4124-FD

CS-4108-FD and CL-4124-FD are 8- and 24-channel universal measurement devices, respectively, with sampling rates of up to 50 kHz per channel. They are specially designed for measurement tasks in environments with unclear voltage fields such as test rigs or large-scale machinery. The input channels are electrically isolated, differential and equipped with per-channel signal conditioning including filters.

The isolated voltage channels have their **own isolated amplifier**, operated in the voltage mode.

Along with voltage measurement, current measurement via a shunt plug and temperature measurement via temperature plug ACC/DSUBM-T4 can be performed. The use of the ICP-expansion plug 56 is also possible, however it **cancels the isolation**.

Reference

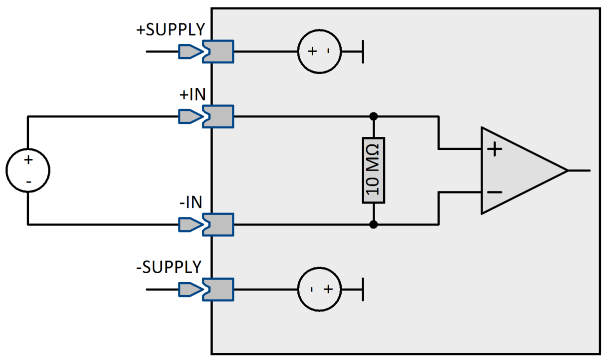
Technical details: CS-4108-FD, CL-4124-FD analog inputs 145

7.6.1 Voltage measurement

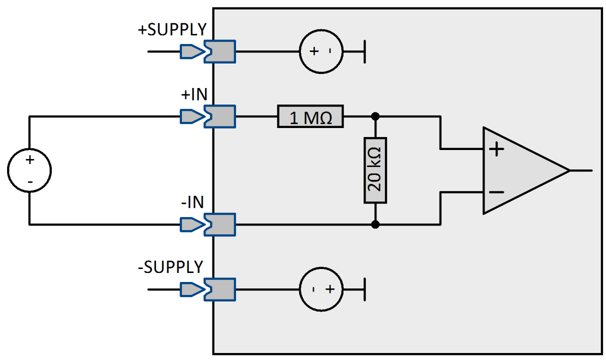
- Voltage: ±60 V to ±5 V with divider
- Voltage: ±2 V to ±50 mV without divider

An **internal pre-divider** is in effect in the voltage ranges ±60 V to ±5 V. In this case, the differential input impedance is 1 MΩ, in all other ranges 10 MΩ. If the device is de-activated, the impedance is 1 MΩ.

The inputs are DC-coupled. The differential response is achieved by means of the isolated circuiting.



configuration for voltages <5 V



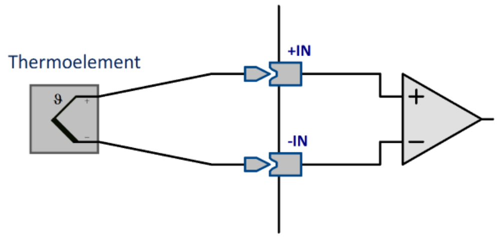
configuration for voltages >2 V with internal divider

7.6.2 Temperature measurement

The input channels are designed for measurement with **thermocouples and PT100**-sensors (RTD, platinum resistance thermometers). Any combinations of the two sensor types can be connected.A detailed description of temperature measurement is presented here 35.

Temperature measurement is performed with the imc plug ACC/DSUBM-T4 37. Thermocouples can alternatively be captured using two-pin thermo-plugs.

7.6.2.1 Thermocouple measurement



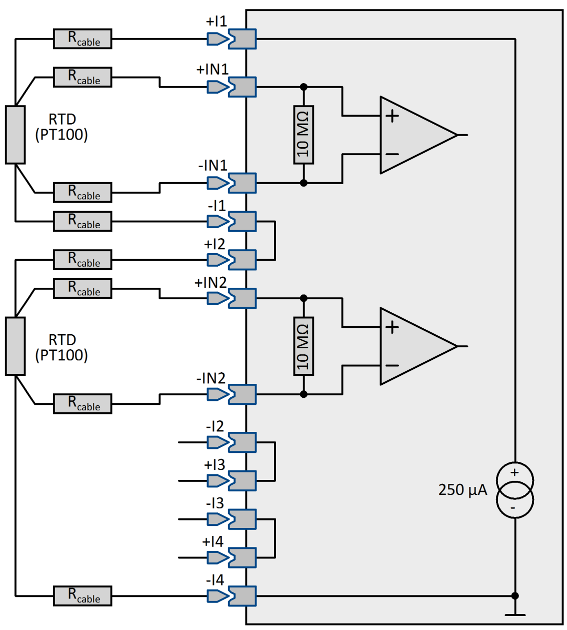
The common thermocouple types make use of linearization by characteristic curve.

The cold-junction compensation necessary for thermocouple measurements is built into the imc thermo-plug (ACC/DSUBM-T4 37).

Reference

Please find here the DSUB-15 pin configuration 174.

7.6.2.2 PT100 (RTD) - Measurement



Along with thermocouples, **PT100** sensors can also be connected, in **4-wire configuration**. An extra reference current source feeds an entire chain of up to four serially connected sensors.

The imc-thermo plugs (ACC/DSUBM-T4) 176 has 4 contacts which are available for the purpose of 4-wire measurements. These current-supply contacts are internally wired so that the reference current loop is automatically closed when all four PT100 units are connected. This means that the –I contact of one channel is connected to the +I contact of the next channel (see the sketch imc thermo plug 37). Therefore, for channels not connected to a PT100 sensor, a wire jumper must be used to connect the respective "+Ix" and "-Ix" contacts.

Normal DSUB-15 plugs don't come with these extra "auxiliary contacts" for 4-wire connections. This means that you must take steps to ensure that the reference current flows through all PT100 units. Only "+I1" (DSUB(9), Terminal K1, "(RES.)") and "–I4" (DSUB(6), Terminal K10, "(GND)") are available as a contact or DSUB-15 pin, respectively. The connections "–I1 = +I2", "–I2 = +I3", and "–I3 = +I4" must be wired externally.

PT100 sensors are fed from the module and don't have or even require an arbitrarily adjustable reference voltage in the sense of an externally imposed common mode voltage. It is also not permissible to set one up, for instance by grounding one of the four connection cables: the PT100 reference current source is referenced to the device's frame (CHASSIS), and is thus not isolated.

7.6.3 Current fed sensors

At the DSUB-15 sockets, a permanent 5 V supply voltage for external sensors 87 is available. This voltage source is grounded to the measurement device's frame. The description of measurement with ICP sensors is presented here. 56 For the measurement of current-fed sensors we recommend the expansion plug ACC/DSUBM-ICP2I-BNC(-F,-S) 56.

Note	DSUB-15 sockets

Triaxial sensors are only supported when using a metal plug ACC/DSUB**M**-ICP2I-BNC(-F, -S) plugged on the measuring amplifier.

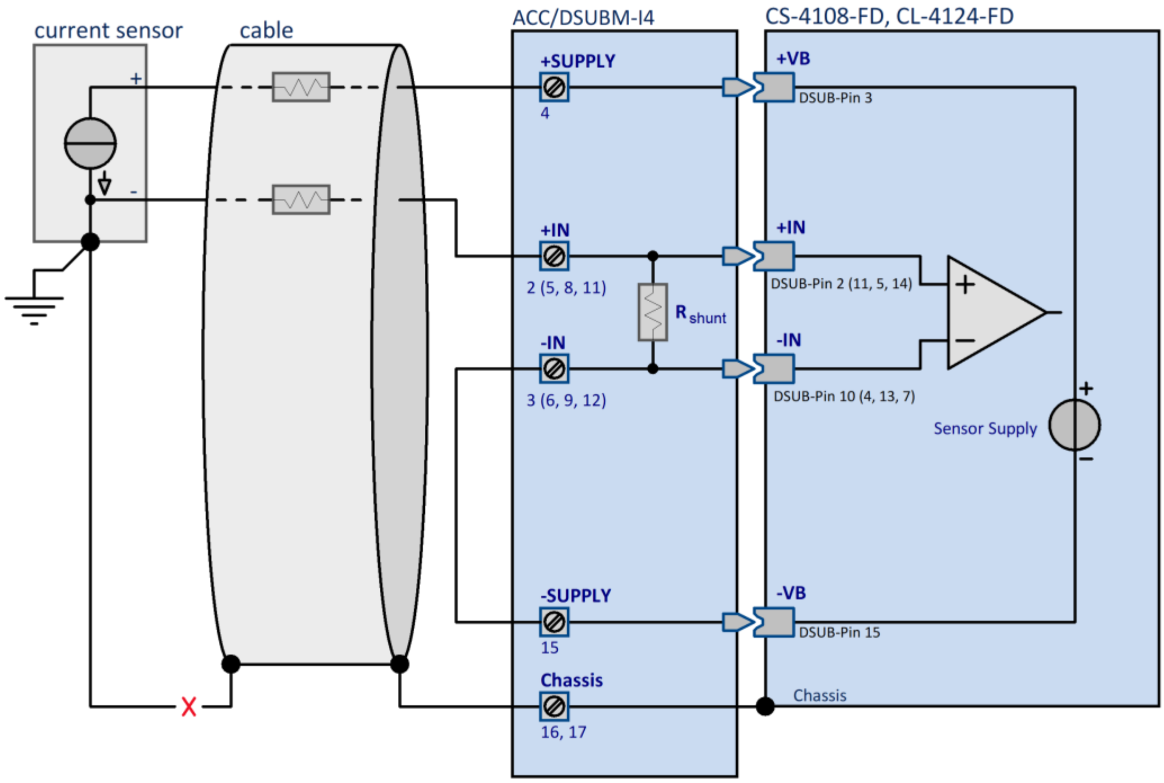
The use of plastic plugs (ACC/DSUB-ICP2, ACC/DSUB-ICP4) in connection with triaxial sensors is not possible.

When using the two channel IEPE plug: ACC/DSUBM-ICP2I-BNC(-S/-F) in combination with the analog inputs, which provide four channels per socket, only channels 1 and 3 can be used.

7.6.4 Current measurement

- Current: ±40 mA, ±20 mA, ±10 mA ... ±1 mA in 6 ranges

A special plug (ACC/DSUBM-I4) with a built-in **shunt** (50 Ω) is needed for current measurement. For current measurement with the special shunt-plugs ACC/DSUBM-I4, inputs ranging only up to max. ±50 mA (corresponding to 2 V or 2.5 V voltage ranges) are permitted due to the measurement shunt's limited power dissipation in the case of static long-term loading.



current measurement

> **Note**
>
> Since this procedure is a voltage measurement at the shunt resistor, **voltage measurement** must also be set in the imc Software.
>
> The **scaling factor** is entered as 1/R and the unit as A (e.g. 0.02 A/V = 1/50 Ω).

7.6.5 Bandwidth

The channels' **max. sampling rate** is 100 kHz (10 µs). The **analog bandwidth** (without digital low-pass filtering) is 11 kHz (-3 dB).

7.6.6 Connection

For **signal connections**, **DSUB-15** plugs can be used.

Reference

Please find here the DSUB-15 pin configuration 174.

7.7 CS-5008-FD, CL-5016-FD

This C-50xx devices provides eight differential, analog inputs with integrated sensor supply for the measurement of resistive bridges or strain gauges, as well as voltage, current and IEPE/ICP-sensors.

A software selectable sensor supply is included, for powering of external sensors or resistive bridge / strain gauge networks. Technical details: CS-5008-FD, CL-5016-FD analog inputs 149

7.7.1 Bridge measurement

The measurement channels have an adjustable DC voltage source which supplies the measurement of bridges such as strain gauges. The supply voltage for a group of 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 ex-factory this amplifier can be build with 2.5 V bridge supply and/or 1 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 (optional)	±1000 to ±2
1 (optional)	±1000 to ±5

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 set by the maximum available current from the source and by the dissipation in the sensor (temperature drift!) and in the device (power consumption!)

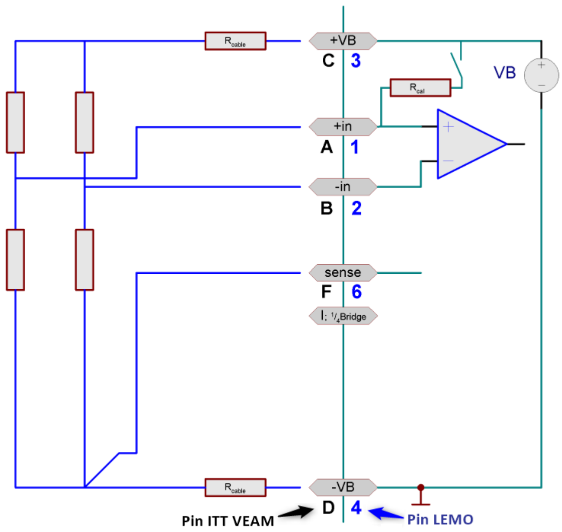
- For typical measurements with **strain gauges**, the ranges 5 mV/V to 0.5 mV/V are particularly relevant.
- There is a maximum voltage which the **potentiometer sensors** are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

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 to angle a maximum range on the not used voltage measurement. An open entry in half- or quarter bridge mode can annoy the neighbor channels if this is also in half- or quarter bridge mode.

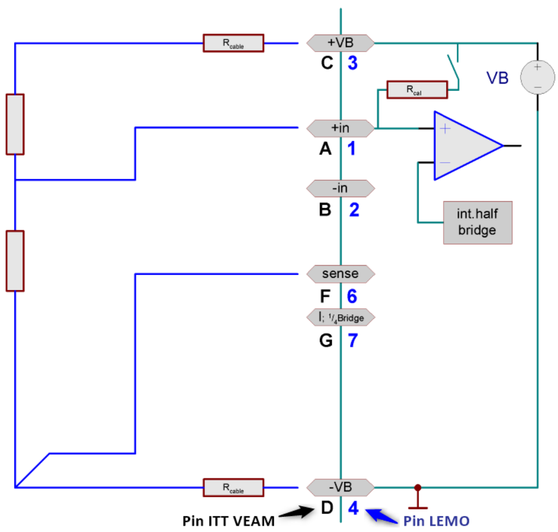
7.7.1.1 Full bridge



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. In this case the bridge can be connected at four terminals by omitting the Sense line.

7.7.1.2 Half bridge

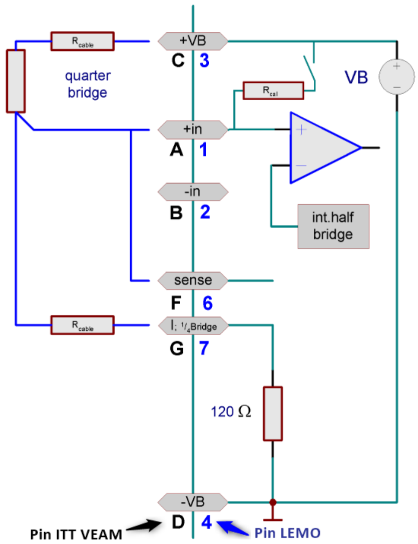


A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has four terminals to connect. For information on the effect and use of the Sense lead SENSE, see the description of the full bridge.

The amplifier internally completes the full bridge itself, so that the differential amplifier is working with a genuine full bridge 110.

> 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.

7.7.1.3 Quarter bridge



A quarter bridge can consist of a single strain gauge resistor, whose nominal value can be 120 Ω or 350 Ω.

The amplifier internally completes an additional 120 Ω or 350 Ω quarter bridge switchable by software.

The quarter bridge has 3 terminals to connect. Refer to the description of the full bridge for comments on the Sense lead. However, with the quarter bridge, the Sense lead is connected to +IN and SENSE jointly.

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

7.7.1.4 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 (F)* 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 = 5 V) [mV/V]	bridge balancing (VB = 10 V) [mV/V]
±1000	500	150
±500	100	250
±200	100	50
±100	15	50
±50	15	7
±20	3	7
±10	10	15
±5	10	5
±2	3	5
±1	4	5
±0.5	-	-

7.7.1.5 Balancing and shunt calibration

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

- Balancing / shunt calibration upon activation (cold start) of the unit. If this option is selected, all the bridge channels are balanced as soon as the device is turned on.
- Balancing / shunt calibration via graphical user interface of device software (channel balance respectively amplifier balance)
- In shunt calibration, the bridge is unbalanced by means of a 59.8 kΩ or 174.66 kΩ shunt. 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

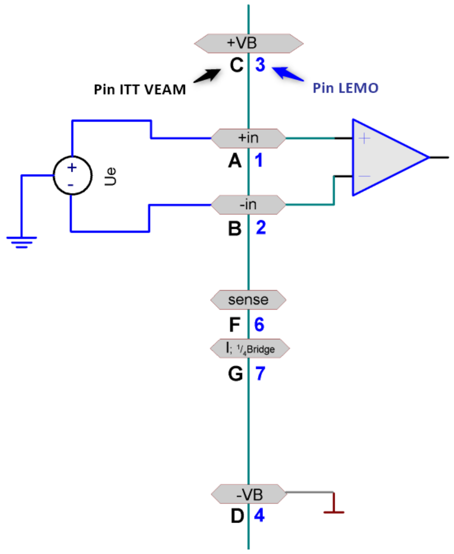
- We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!

7.7.2 Voltage measurement

- Voltage: ±10 V to ±5 mV in 9 different ranges

The input impedance is 20MΩ. (1MΩ when switched off)

7.7.2.1 Voltage source with ground reference



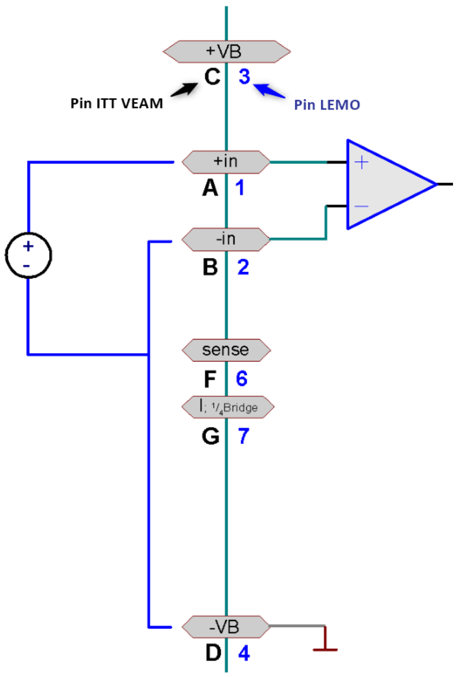
The voltage source itself already has a connection to the device's ground. The potential difference between the voltage source and the device ground must be fixed.

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.

Important: 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.

7.7.2.2 Voltage source without ground reference

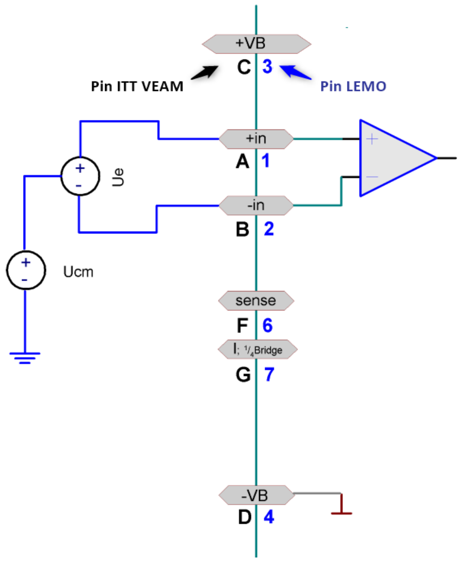


The voltage source itself is not referenced to the device ground but is instead isolated from it. In this case, a ground reference must be established. One way to do this is to ground the voltage source itself. Then it is possible to proceed as for "Voltage source with ground reference". Here, too, the 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 module is grounded.

Important: 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.

7.7.2.3 Voltage source at a different fixed potential



The common mode voltage (U_{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 device itself is grounded. Since the common mode voltage is greater than permitted, measurement is not possible. Also, the input voltage difference to the device ground would be above the upper limit allowed.

7.7.3 Current measurement

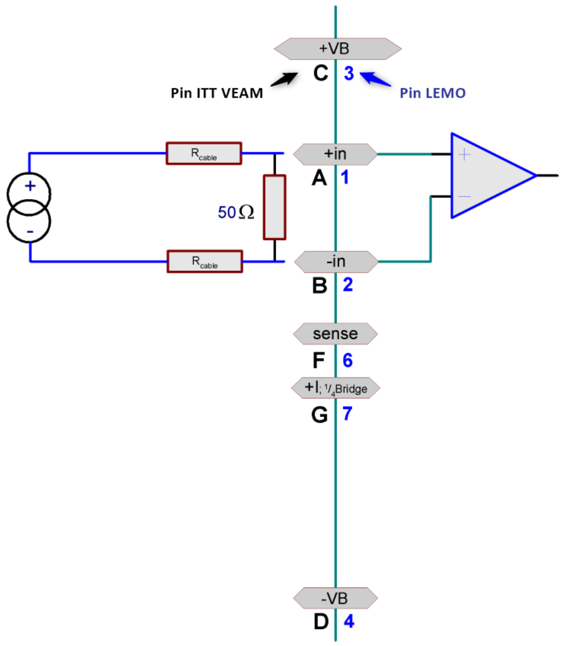
The current measurement is realized with shunt plug or with ground reference via the internal quarter bridge completion.

7.7.3.1 Differential current measurement

Note Requirement

The following statements only apply for modules with DSUB sockets.

- Current ±50 mA to ±1 mA



For current measurement could be used the DSUB plug ACC/DSUBM-I2. That plug comes with a 50 Ω shunt and is not included with the standard package. It is also possible to measure a voltage via an externally connected shunt. Appropriate scaling must be set in the user interface. The value 50 Ω is just a suggestion. The resistor needs an adequate level of precision. Pay attention to the shunt's power consumption.

The **maximum common mode voltage** must be in the range ±10 V for this circuit, too. This can generally only be ensured if the current source itself already is referenced to ground. If the current source is ungrounded a danger exists of exceeding the maximum allowed overvoltage for the amplifier. The current source may need to be referenced to the ground, for example by being grounded.

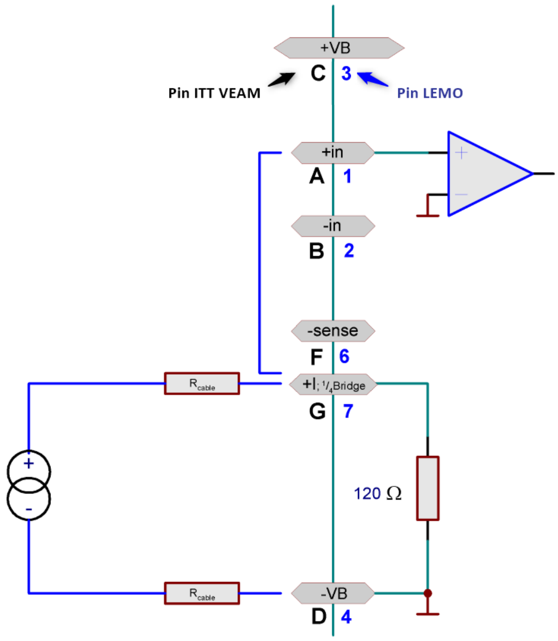
The sensor can also be supplied with a software-specified voltage via Pins +VB and -VB.

Note

Since in this procedure a voltage measurement at the shunt resistor is involved, it is necessary to configure the imc software for voltage measurement. The scaling factor is entered as 1/R and the unit set is A (0.02 A/V = 1/50 Ω).

7.7.3.2 Ground-referenced current measurement

- Current: ±50 mA to ±2 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-ended 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.

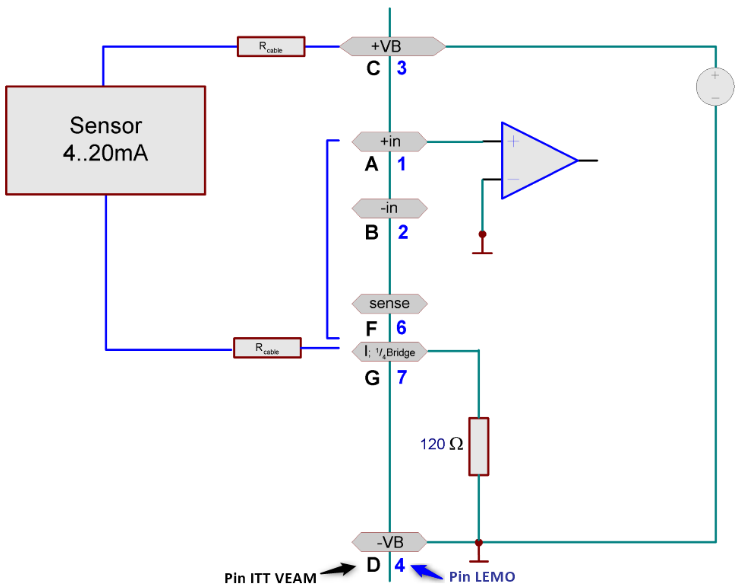
Note that the jumper between *+IN* and *+I; ¼Bridge* should be connected right inside the plug.

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.

7.7.3.3 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 sensor is supplied with power via Terminals *+VB* and *+I;* $\frac{1}{4}_{Bridge}$.

The signal is measured by the amplifier between *+IN* and *I;* $\frac{1}{4}_{Bridge}$. For this reason, a wire jumper must be positioned between Pins *+IN* and *I;* $\frac{1}{4}_{Bridge}$ inside the plug.

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.

7.7.4 Current fed sensors

For the measurement of current-fed sensors we recommend the expansion plug ACC/DSUBM-ICP2I-BNC(-F,-S) 56.

Note DSUB-15 sockets

Triaxial sensors are only supported when using a metal plug ACC/DSUB**M**-ICP2I-BNC(-F, -S) plugged on the measuring amplifier.

The use of plastic plugs (ACC/DSUB-ICP2, ACC/DSUB-ICP4) in connection with triaxial sensors is not possible.

7.7.5 Sensor supply

The channels are enhanced with an integrated sensor supply unit, which provides an adjustable supply voltage for active sensors. 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 a group of eight channels.

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.

Note

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!

7.7.6 Bandwidth

The channels' **maximum sampling rate** is 100 kHz (10 µs). The analog bandwidth (without digital low-pass filtering) is 5 kHz (-3 dB).

7.7.7 Connection

Reference

Please find here the DSUB-15 pin configuration 174

7.8 CS-7008-FD, CL-7016-FD

CS-7008-FD and CL-7016-FD are 8- and 16-channel universal measurement devices, respectively, 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.

To supply external sensors or bridges the module is equipped with a sensor supply 129 with an adjustable supply. The analog channels supportsTEDS(Transducer Electronic Data Sheets).

The measurement inputs whose terminals are DSUB plugs (ACC/DSUBM-UN2 175) are for voltage, current, bridge, PT100 and thermocouple measurements. In addition the use of an IEPE/ICP-expansion plug is possible. They are non-isolated differential amplifiers. They share a common voltage supply for sensors and measurement bridges.

Reference

Technical details: CS-7008-FD, CL-7016-FD analog inputs 153

7.8.1 Voltage measurement

- Voltage: ±50 V to ±5 mV; DSUB-plug: ACC/DSUBM-UNI2

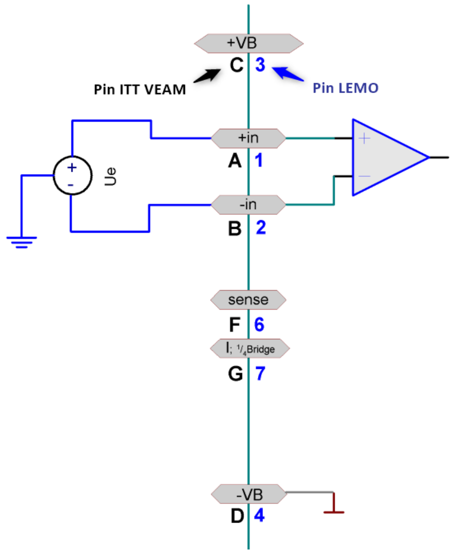
Within the voltage measurement ranges ±50 V and ±25 V, a voltage divider is in effect; the resulting input impedance is 1 MΩ.

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.

7.8.1.1 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

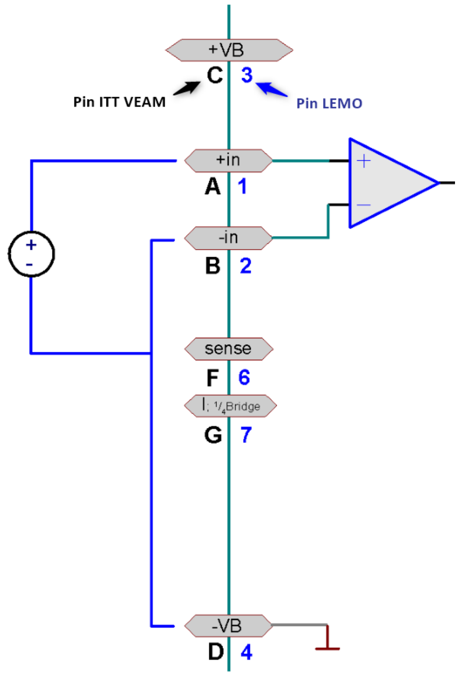
The device is grounded. Thus, the input -VB is also at ground potential. If the voltage source itself is also grounded, it's referenced to the device ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common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

7.8.1.2 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 119. 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.

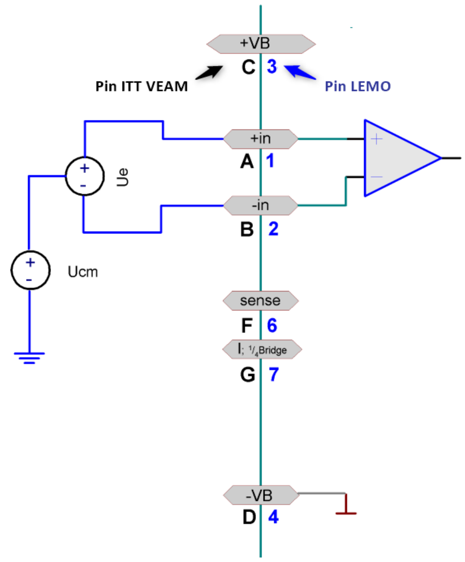
Example

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.

7.8.1.3 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 C-70xx cannot be used.

7.8.2 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!)

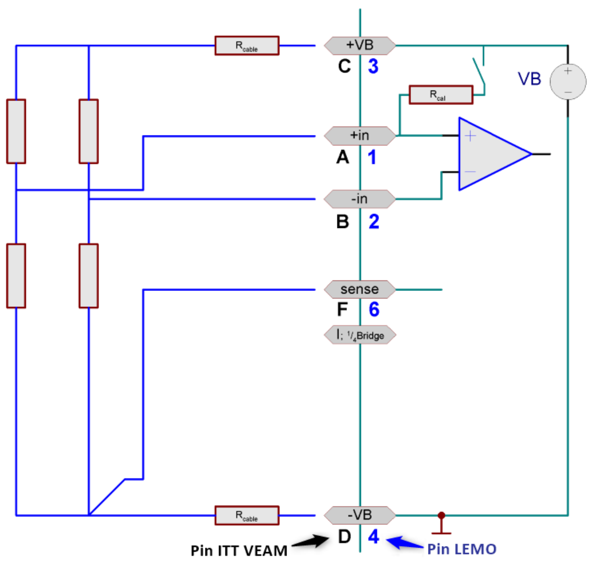
- For typical measurements with **strain** gauges, the ranges 5 mV/V to 0.5 mV/V are relevant.
- There is a maximum voltage which the **potentiometer sensors** are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

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!

7.8.2.1 Full bridge

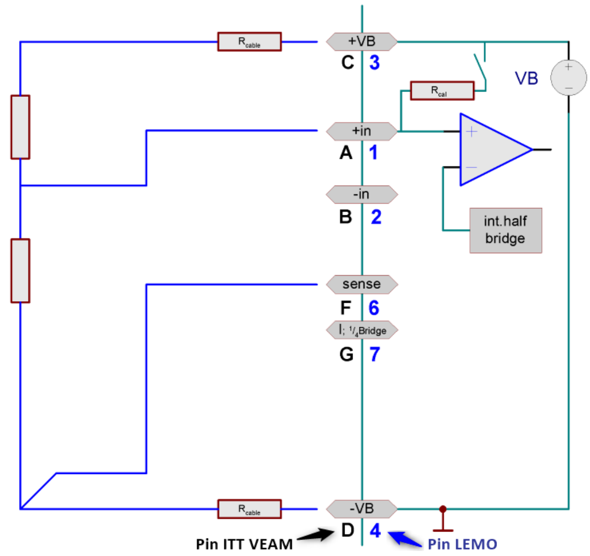


A full bridge has four resistors, which can be four correspondingly configured strain gauges or one complete sensor which is a full sensor internally. The full bridge has five terminals to connect. Two leads +VB and -VB serve supply purposes, two other leads +IN and -IN capture the differential voltage. 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.

7.8.2.2 Half bridge



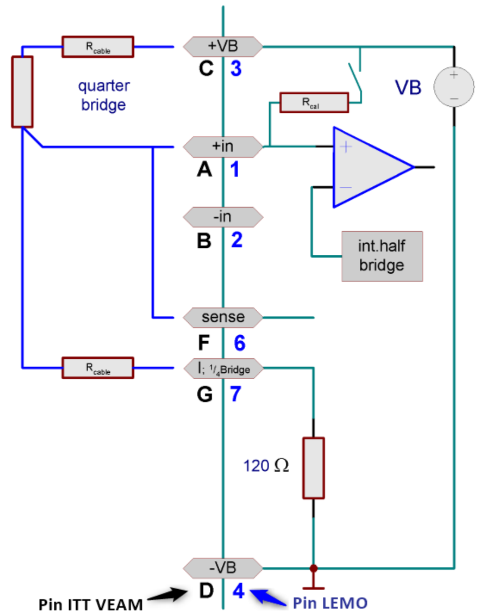
A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has 4 terminals to connect. For information on the effect and use of the SENSE lead, see the description of the full bridge 121.

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.

7.8.2.3 Quarter bridge



A quarter bridge can consist of a single strain gauge resistor, whose nominal value can be 120 Ω or 350 Ω. C-70xx 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 121 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.

7.8.2.4 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 = 2.5 V) [mV/V]	bridge balancing (VB = 5 V) [mV/V	bridge balancing (VB = 10 V) [mV/V
±1000	200	500	240
±500	500	100	700
±200	40	400	60
±100	140	20	200
±50	200	70	10
±20	20	100	35
±10	30	14	50
±5	7	18	7
±2	9	3,5	10
±1	-	4,5	2
±0,5	-	-	5

7.8.2.5 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 95 (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

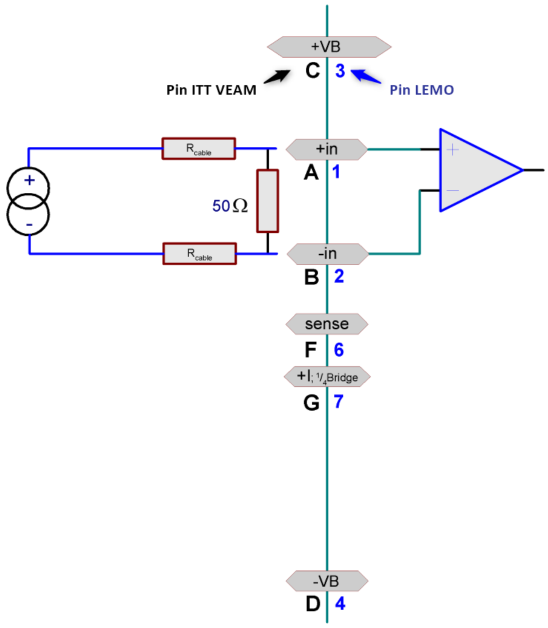
The procedures for balancing bridge channels also apply analogously to the voltage measurement mode with zero-balancing.

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!

7.8.3 Current measurement

7.8.3.1 Differential current measurement



For current measurement the DSUB plug ACC/DSUBM-I2 is mandatory. The ACC/DSUBM-I2 comes with a 50 Ω shunt and is not included with the standard package. It is also possible to measure a voltage via an externally connected shunt. Appropriate scaling must be set in the user interface. The value 50 Ω is just a suggestion. The resistor needs an adequate level of precision. Pay attention to the shunt's power consumption.

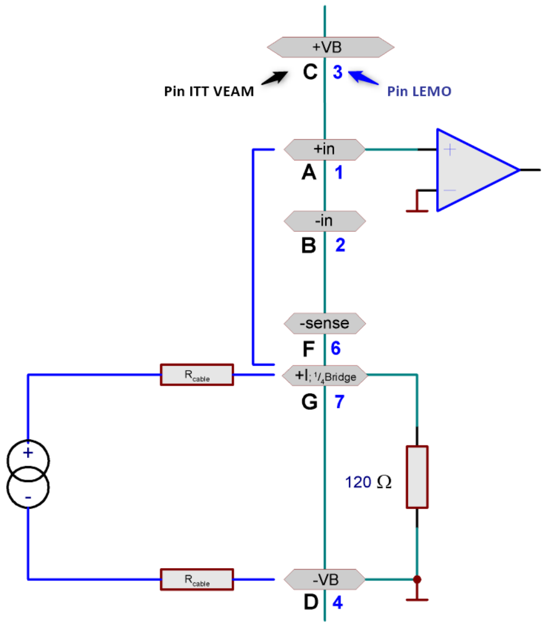
The maximum common mode voltage must be in the range ±10 V for this circuit, too. This can generally only be ensured if the current source itself already is referenced to ground. If the current source is ungrounded a danger exists of exceeding the maximum allowed overvoltage for the amplifier. The current source may need to be referenced to the ground, for example by being grounded.

The sensor can also be supplied with a software-specified voltage via Pins +VB and -VB.

Note

- Since this procedure is a voltage measurement at the shunt resistor, voltage measurement must also be set in the imc DEVICES interface.
- The scaling factor is entered as 1/R and the unit as A (0.02 A/V = 1/50 Ω).

7.8.3.2 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.

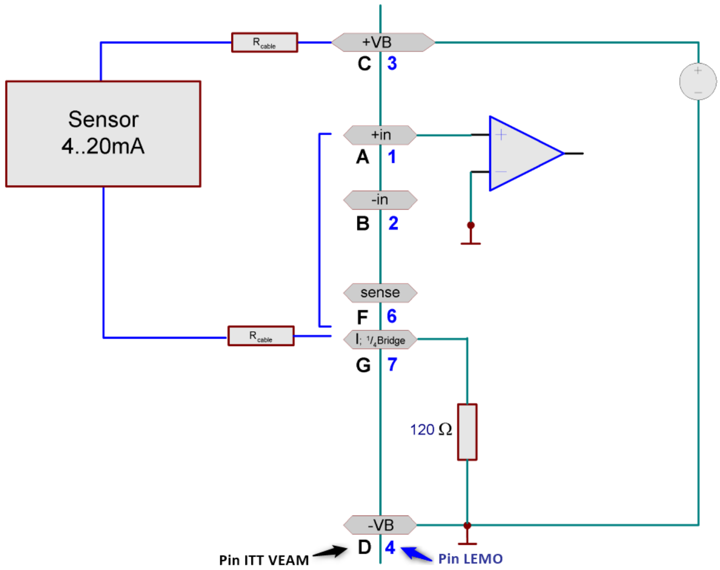
In the settings interface, set the measurement mode to current.

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.

7.8.3.3 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.

7.8.4 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.

Note

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 from the base page of the imc Software configuration dialog. Amplifiers which enable bridge measurement, must first be set to Voltage mode (DC), in order for the temperature characteristic curves to be available on the base page.

7.8.4.1 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.

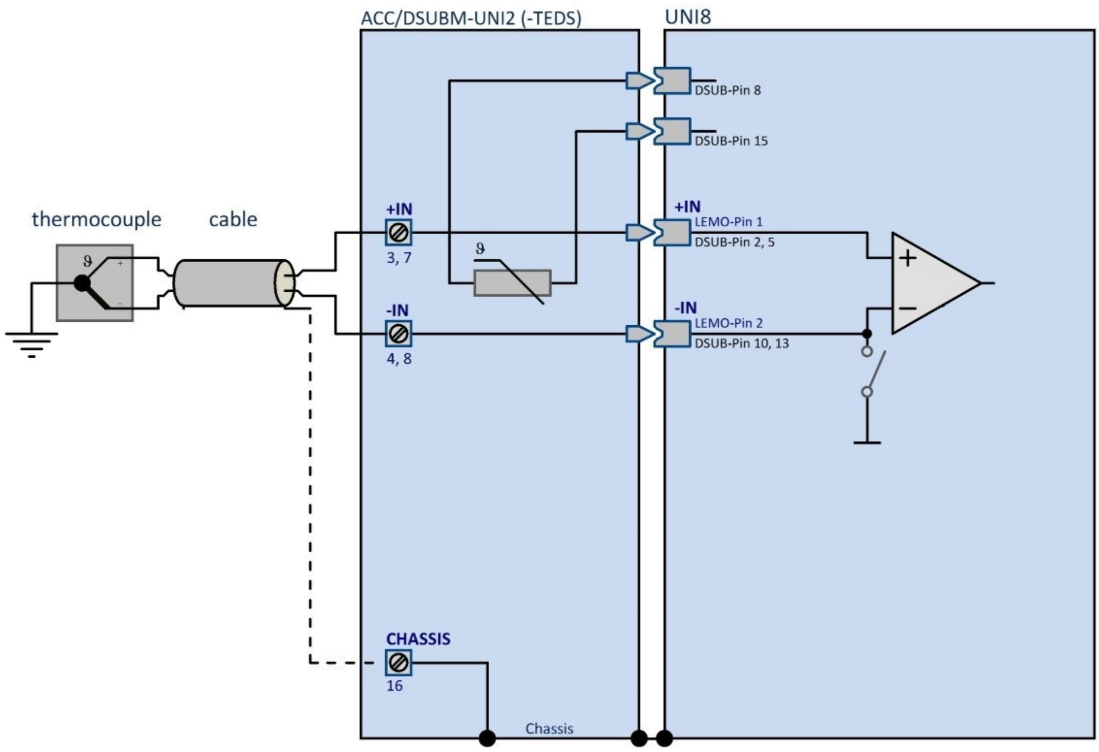
Reference

Please find here a description of the available thermocouples 35.

7.8.4.1.1 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.

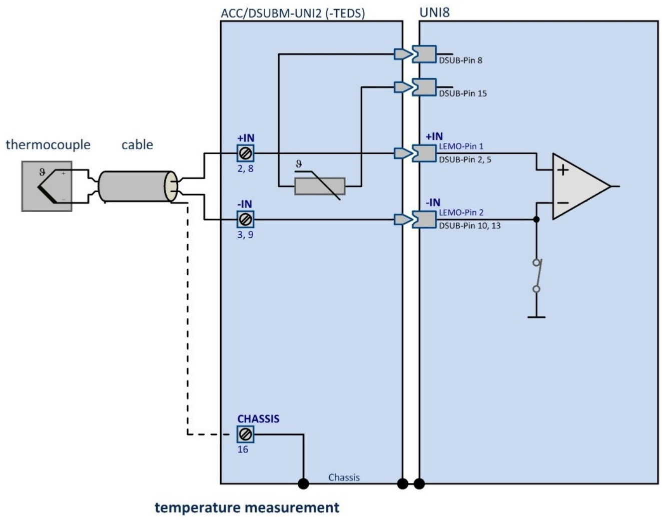
Note

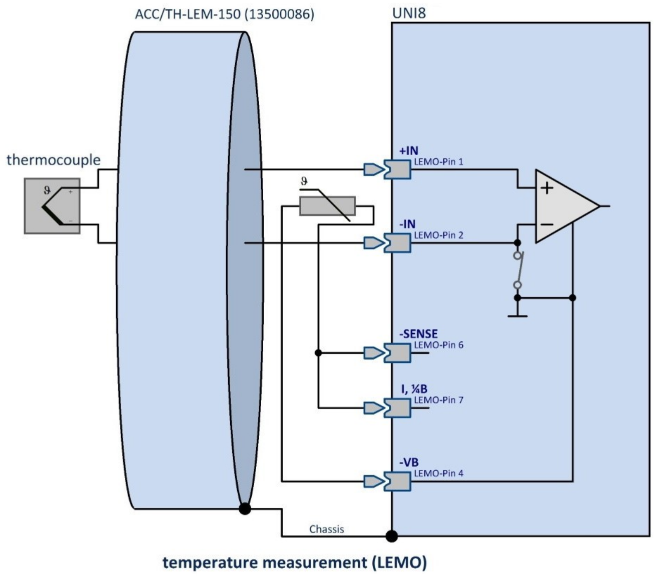
- The negative signal input -IN may not be connected to amplifier ground point -VB. Connecting them would cause a ground loop through which interference could be coupled in.
- If you accidentally activate the option "Isolated thermocouple" on the Amplifier page, there is a danger that a large compensation 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.

7.8.4.1.2 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.





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.

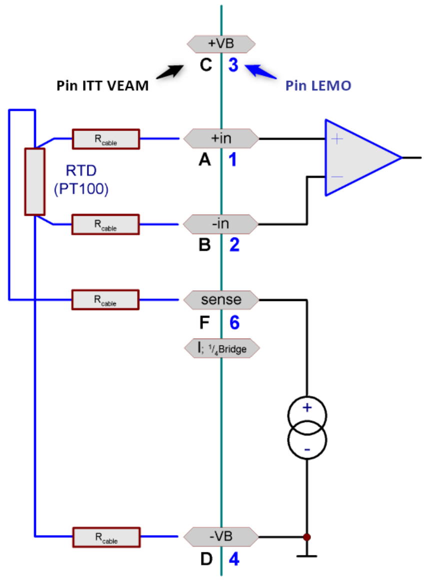
Warning The thermocouple itself may not be ground referenced!

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.

7.8.4.2 PT100/ RTD measurement

Along with thermocouples, **PT100** can be connected directly in **4-wire-configuration** (DSUB-plug: ACC/DSUBM-UN2 175). 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.

7.8.4.2.1 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

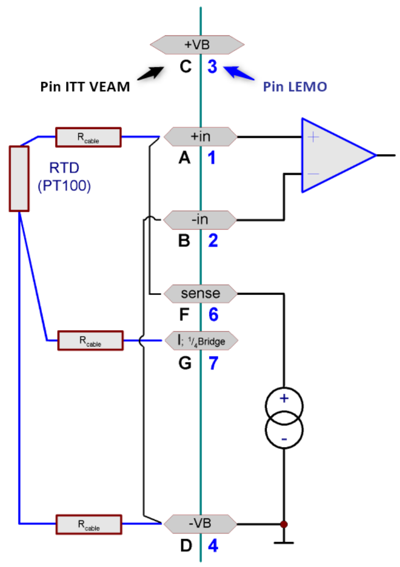
4-wire measurement is not possible with order option:

- sensor supply with ±15 V

7.8.4.2.2 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.

7.8.4.2.3 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

7.8.4.3 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.

7.8.5 Current fed sensors

For measurement of current-fed sensors we recommend the expansion plug ACC/DSUBM-ICP2I-BNC(-F,-S) 56.

Note	DSUB-15 sockets

Triaxial sensors are only supported when using a metal plug ACC/DSUB**M**-ICP2I-BNC(-F, -S) plugged on the measuring amplifier.

The use of plastic plugs (ACC/DSUB-ICP2, ACC/DSUB-ICP4) in connection with triaxial sensors is not possible.

7.8.6 Sensor supply module

C-70xx 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 a group of eight channels.

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!

7.8.7 Bandwidth

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

The analog bandwidth (without digital low-pass filtering) is 48 kHz (-3 dB).

7.8.8 Connection

Find here the pin configuration of the DSUB-15 plugs 174

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

Parameter	Value	Remarks
Housing type	alu profile plastic portable housing	CS CL
Ingress protection	IP20	
Terminal connection		
Terminal connection DI, DO, INC, DAC	1x DSUB-15 1x DSUB-15 1x DSUB-15 1x DSUB-15	8 digital inputs 8 digital outputs 4 incremental counter inputs 4 analog outputs
Further terminal connection	RJ45 CF-Card Slot 2x DSUB-9 DSUB-9 DSUB-9 BNC LEMO FGG.1B.302 LEMO FGG.0B.302 LEMO FGG.0B.306	Ethernet (100 MBit), PC/network removable storage two CAN FD nodes external display (CS) external GPS module synchronization supply CL supply CS REMOTE
Weight	ca. 2 kg ca. 3.5 kg	CS CL
Dimensions (WxHxD) in mm	95 x 111 x 185 270 x 85 x 300	CS CL

Power supply	Value	Remarks
Power supply	10 V to 32 V DC	
Isolation of supply input	not-isolated isolated	CS CL
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 coverage	complete system	

Super-Caps in CS		
UPS and Data integrity	**Value**	**Remarks**
UPS	integrated	Super-Caps
Charging time of the Super-Caps	6 min.	minimum required active operation for full UPS functionality
UPS coverage	complete system	
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 s); with fully charged Super-Caps (after minimum operating duration)

NiMH batteries in CL		
UPS and Data integrity	**Value**	**Remarks**
UPS	integrated	**NiMH batteries**, with automatic charge control
UPS delay per power outage	30 sec. (Default), configurable	"buffer time constant": required duration of a continuous outage that will trigger auto shutdown procedure
Effective buffer capacity	≥55 Wh	typ. 23°C, battery fully charged
Max. buffer duration	typ. 90 min.	total buffer duration depending on device variant total power consumption ≤35 W
Minimum charging for 1 min. buffer duration	typ. 17 min	typ. 23°C, for empty battery
Additional power consumption during charging time	3.5 W (typ.)	device activated
Charging capacity	2.5 W (typ.)	device activated
Charging time ratio: charging- and discharging duration	buffer time * 1.2 * (total power / 2.5 W)	worst case example: total power consumption of system 35 W, puffer duration 1 min., resulting charging duration typ. 17 min.
Charging time for complete battery recovery	36 h	device activated

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 counter) 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	

<table>
<tr><th colspan="10">Maximum channel count per device</th></tr>
<tr><td colspan="2">Active channels</td><td>512</td><td colspan="7">active channels of the current configuration:
Total sum of analog, digital, fieldbus and virtual channels as well as possible monitor channels</td></tr>
<tr><td colspan="2">Fieldbus channels</td><td>1000</td><td colspan="7">Number of defined channels (active and passive);
Currently activated channels are limited by the total number of activated channels (512).</td></tr>
<tr><td colspan="2">Process vector variables</td><td>800</td><td colspan="7">The process vector is a collection of single-value variables, each containing the latest current measured values. A process vector variable is automatically created for each channel.</td></tr>
<tr><th colspan="2"></th><th colspan="3">without monitor channels</th><th colspan="5">with monitor channels</th></tr>
<tr><th>Channel type</th><th>determined by</th><th>limit (aktive+passive)</th><th>activated</th><th>total activated</th><th colspan="2">limit (aktive+passive)</th><th>activated</th><th>total activated</th></tr>
<tr><td rowspan="2">Analog channels</td><td rowspan="2">depending device type</td><td rowspan="2">8..24</td><td rowspan="2">8..24</td><td rowspan="11">512</td><td>Channel</td><td>8..24</td><td rowspan="2">16..48</td><td rowspan="11">512</td></tr>
<tr><td>Monitor</td><td>8..24</td></tr>
<tr><td rowspan="2">Incremental counter</td><td rowspan="2">standard</td><td rowspan="2">4</td><td rowspan="2">4</td><td>Channel</td><td>4</td><td>4</td></tr>
<tr><td>Monitor</td><td>4</td><td>4</td></tr>
<tr><td rowspan="2">Digital DI-Ports</td><td rowspan="2">standard</td><td rowspan="2">1</td><td rowspan="2">1</td><td>Port</td><td>1</td><td>1</td></tr>
<tr><td>Monitor</td><td>1</td><td>1</td></tr>
<tr><td>Digital DO/DAC-Ports</td><td>standard</td><td>2</td><td>2</td><td>Port</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">Fieldbus-channels</td><td rowspan="2">definable (dbc)</td><td rowspan="2">1000</td><td rowspan="2">512</td><td>Channel</td><td rowspan="2">1000</td><td rowspan="2">512</td></tr>
<tr><td>Monitor</td></tr>
<tr><td>Virtual channels (OFA)</td><td>definable (OFA)</td><td>-</td><td>512</td><td>-</td><td>-</td><td>512</td></tr>
</table>

DI-ports (respectively channels) have monitor-ports, DO/DAC-ports in contrary do not have monitor-ports

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	dry, non corrosive environment within specified operating temperature range	
Rel. humidity	80% up to 31°C, above 31°C: linear declining to 50%	according IEC 61010-1
Ingress Protection	IP20	
Pollution degree	2	
Operating temperature (Standard)	-10°C to 55°C	without condensation
Operating temperature (extended, "-ET" version)	-40°C to 85°C	condensation temporarily allowed
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	specific tests or certifications upon request

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

8.2 CS-1016-FD analog inputs

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Analog inputs	16	
Measurement modes	voltage measurement current measurement current fed sensors (IEPE/ICP)	 with shunt plug ACC/DSUBM-I4 with DSUB-15 expansion plug ACC/DSUB-ICP4, not isolated ACC/DSUBM-ICP2I-BNC-S/-F [1], isolated

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤20 kHz	per channel
Bandwidth	0 Hz to 6.6 kHz 0 Hz to 5 kHz	-3 dB (analog AAF 5th order) -0.2 dB
Filter (digital) cut-off frequency characteristic order	 2 Hz to 5 kHz	 Butterworth, Bessel (digital) low pass filter 8. order Anti-aliasing filter: Cauer 8. order with $f_{cutoff} = 0.4\ f_s$
Resolution	16 Bit	internal processing 24 Bit
TEDS	conforming to IEEE 1451.4 Class II MMI	esp. with ACC/DSUBM-TEDS-xx (DS2433) not supported: DS2431 (typ. IEPE/ICP sensor)
Characteristic curve linearization	user defined (max. 1023 supporting points)	see detailed overview of supported device family

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overvoltage protection		±40 V	permanent channel to chassis
Input coupling	DC		
Input configuration	differential		
Input impedance	20 MΩ		differential, >10 kΩ off-state
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-extension plug independent of integrated sensor supply, short-circuit protected power per DSUB-plug

1 When using the two-channel IEPE plug in combination with the analog inputs, which provide four channels per socket, only channels 1 and 3 can be used.

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±10 V, ±5 V, ±2.5 V, ±1 V, ±500 mV, ±250 mV		
Gain: error drift	0.02 % ±8 ppm/K·ΔT_a	≤0.05 % ±30 ppm/K×DTa	of reading ΔT_a=|T_a -25°C|; with T_a= ambient temperature
Offset: error drift	0.02 % (±18 µV/K)·ΔT_a (±2 µV/K)·ΔT_a	≤0.05 % (±45 µV/K)·ΔT_a (±5 µV/K)·ΔT_a	of range ±10 V to ±2.5 V ±1 V to ±250 mV ΔT_a=|T_a -25°C|; with T_a= ambient temperature
Max. common mode voltage		±12 V	
Common mode rejection Ranges ±10 V to ±2.5 V ±1 V to ±250 mV	 -90 dB -108 dB	 -80 dB -97 dB	common mode test voltage: ±10 $V_=$ and 7 V_{rms}, 50 Hz
Channel to channel crosstalk Ranges 10 V to ±2.5 V ±1 V to ±250 mV	 -90 dB -116 dB		test voltage: ±10 $V_=$ and 7 V_{rms}, 0 Hz to 50 Hz; range: ±10 V
Noise	12 µV_{rms}		bandwidth: 0.1 Hz to 1 kHz

Current measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 mA, ±20 mA, ±10 mA, ±5 mA		50 Ω shunt in terminal plug
Max. over load	±60 mA		permanent
Input configuration	differential		50 Ω shunt plug (ACC/DSUBM-I4)
Gain: error drift	 0.02 % (±20 ppm/K)·ΔT_a	 ≤0.06 % ≤0.1 % (±55 ppm/K)·ΔT_a	of reading plus error of 50 Ω shunt ΔT_a=|T_a -25°C|; with T_a= ambient temperature
Offset: error drift	 0.02 % (±30 nA/K)·ΔT_a	 ≤0.05 % (±60 nA/K)·ΔT_a	 of range ΔT_a=|T_a -25°C|; with T_a= ambient temperature

Find here the description of the CS-1016-FD 96. Technical data of the sensor supply (option) 169.

8.3 CS-1208-FD analog inputs

Channels, measurement modes		
Parameter	**Value**	**Remarks**
Analog inputs	8	4 channels per plug (2x DSUB-15)
Measurement modes	voltage measurement current measurement current fed sensors (IEPE/ICP)	voltage (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) with DSUB-15 expansion plug: ACC/DSUB-ICP4, not isolated ACC/DSUBM-ICP2I-BNC-S/-F [1], isolated

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤100 kHz	per channel
Bandwidth	0 Hz to 48 kHz 0 Hz to 30 kHz	-3 dB -0.1 dB
Filter (digital) cut-off frequency characteristic 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 8.order with f_{cutoff} = 0.4 f_s
Resolution	16 Bit	internal processing 24 Bit
TEDS	conforming to IEEE 1451.4 Class II MMI	esp. with ACC/DSUBM-TEDS-xx (DS2433) not supported: DS2431 (typ. IEPE/ICP sensor)
Characteristic curve linearization	user defined (max. 1023 supporting points)	

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overvoltage protection		 ±80 V ±50 V	permanent, differential input range >±10 V or device switched 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 optional sensor supply, short circuit proof power per DSUB-plug

1 When using the two-channel IEPE plug in combination with the analog inputs, which provide four channels per socket, only channels 1 and 3 can be used.

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 V, ±25 V, ±10 V, ±5V, ±2.5 V, ±1 V... ±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 reading
Gain drift	10 ppm/K·ΔT_a	30 ppm/K·ΔT_a	$\Delta T_a = \lvert T_a - 25\ °C \rvert$; T_a = ambient temperature
Offset error	 0.02 %	 ≤0.05 % ≤0.06 % ≤0.15 %	of the range, at 25 °C >±50 mV ≤±50 mV ≤±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 $\Delta T_a = \lvert T_a - 25\ °C \rvert$; T_a = ambient temperature
Nonlinearity	30 ppm	≤90 ppm	
Common mode rejection ranges ±50 V to ±25 V ±10 V to ±50 mV ±20 mV to ±5 mV	 80 dB 110 dB 138 dB	 >70 dB >90 dB >132 dB	Common mode voltage (DC..60 Hz): ±50 V ±10 V ±10 V
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}	bandwidth 0.1 Hz to 50 kHz 0.1 Hz to 1 kHz 0.1 Hz to 10 Hz

Current measurement with shunt plug			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 mA, ±20 mA, ±10 mA, ±5 mA, ±2 mA, ±1 mA		50 Ω shunt in terminal plug
Shunt impedance	50 Ω		external plug ACC/DSUBM-I4
Over load protection		±60 mA	permanent
Maximum input voltage		-11 V to +15 V	between ±IN and CHASSIS
Input configuration	differential		50 Ω shunt in terminal plug
Gain error	0.02 %	≤0.06 % ≤0.1 %	of reading plus error of 50 Ω shunt
Gain drift	+15 ppm/K·ΔT_a	+55 ppm/K·ΔT_a	$\Delta T_a = \lvert T_a - 25\ °C \rvert$; T_a = ambient temperature
Offset error	0.02 %	≤0.05 %	of the range
Current 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

Sensor supply module (Cx-12xx-SUPPLY)				
Parameter	**Value typ.**		**max.**	**Remarks**
Configuration options	5 selectable settings			The sensor supply module always has 5 selectable voltage settings. default selection: +5 V to +24 V
Output voltage	Voltage (+2.5 V) +5.0 V +10 V +12 V +15 V +24 V (±15 V)	Current 580 mA 580 mA 300 mA 250 mA 200 mA 120 mA 190 mA	Netpower 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 optional, special order, +12 V or 15 V can be replaced by +2.5 V preferred selection with 2.5 V: +2.5 V, +5.0 V, +10 V, +12 V, +24 V optional, special order: +15 V can be replaced by ±15 V
Isolation Standard: option, upon request:	non isolated isolated			output to case (CHASSIS) nominal rating: 50V, test voltage (10sec.): 300 V, not available with option ±15 V.
Short-circuit protection	unlimited duration			to output voltage reference ground
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

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8.4 CS-3008-FD

Inputs, measurement modes, terminal connection		
Parameter	**Value**	**Remarks**
Inputs	8	
Measurement modes	voltage measurement IEPE-sensor with current-fed	

Sampling rate, Bandwidth, Filter, TEDS			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate	≤100 kHz		per channel
Bandwidth	0 Hz to 48 kHz 0 Hz to 30 kHz		-3 dB -0.1 dB
Filter (digital) cut-off frequency characteristic 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 8.order with $f_{cutoff} = 0.4\ f_s$
Filter cut-off frequency (high pass, 3rd order,-3 dB)	 0.43 Hz 1.06 Hz 0.07 Hz 0.13 Hz		CRFX/ICPU2-8 standard version ICP, ranges ≤±10 V ICP, ranges >±10 V special version CRFX/ICPU2-8(-D)-70mHz * ICP, ranges ≤±10 V ICP, ranges >±10 V
Resolution	16 Bit		internal processing 24 Bit
TEDS	conforming to IEEE 1451.4 Class I Mixed Mode Interface		TEDS-data and analog signal shared wire [2] supports TEDS type DS2433 not supported DS2431 (typ. IEPE sensor)
Characteristic curve linearization	user defined (max. 1023 supporting points)		

* The special versions are available on request. However, they should only be used when actually needed, as the settling times are correspondingly extended (up to the minute range).
not supported DS2431 (typ. IEPE/ICP sensor)

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overvoltage protection		±50 V	continuous channel to chassis
Maximum input voltage		-11 V to +15 V	between ±IN and CHASSIS; input range ≤±10 V
Input coupling	AC, DC, AC with current feed (ICP)		
Input configuration	differential Single-ended		software-configurable
Input impedance range >±10 V range ≤±10 V	 333 kΩ 0.67 MΩ 1 MΩ 908 kΩ 1.82 MΩ 20 MΩ		at DC-voltage resp. 50 Hz ICP (Single-ended) AC (differential) DC (differential) ICP (Single-ended) AC (differential) DC (differential)

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 V, ±25 V, ±10 V, ±5 V, ±2.5 V, ±1 V, ..., ±5 mV		
Gain error	0.02%	≤0.05%	of the reading, at 25°C
Gain drift	(+20 ppm/K)·ΔT_a	(+80 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 input range, at 25°C >±50 mV ≤±50 mV ≤±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	ranges >±10 V range ±10 V bis ±0.25 V ranges ≤±0.1 V
CMRR (common mode rejection ratio) Input ranges: ±50 V to ±10 V Input ranges: ±5 V to ±50 mV Input ranges: ±25 mV to ±5 mV	 62 dB 92 dB 120 dB	 >46 dB >84 dB >100 dB	common mode voltage (DC..60 Hz): ±50 V ±10 V ±10 V
Noise	 14 nV/√Hz 0.4 μV_{rms}		DC coupling 1 kHz bandwidth 0.1 Hz to 1 kHz

Constant current supply	Value typ.	min. / max.	Remarks
ICP current sources	4.2 mA/channel	±10%	
Compliance voltage	25 V	>24 V	
Source impedance	280 kΩ	>100 kΩ	

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[1] ICP is a registered trade mark of PCB Piezotronics Inc., Delta Tron is a registered trade mark of Bruel & Kjaer Sound and Vibration; PIEZOTRON, PIEZOBEAM is a registered trade mark of Kistler

[2] Only galvanically insulated sensors. For more detailed information, please refer to chapter "MMI-TEDS" in imc CRONOS manual.

8.5 CS-4108-FD, CL-4124-FD analog inputs

Channels, measurement modes		
Parameter	**Value**	**Remarks**
Channels	8 24	CS CL 4 channels per DSUB
Measurement modes	voltage measurement current measurement thermocouple, RTD (PT100) current fed sensors (IEPE/ICP)	voltage (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) thermo plug (ACC/DSUBM-T4) with IEPE DSUB-15 extension plug: ACC/DSUB-ICP4, not isolated ACC/DSUBM-ICP2I-BNC-S/-F [1], isolated, basic functionality (ICP-operation)

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤100 kHz ≤10 kHz	per channel at temperature measurement
Bandwidth	0 Hz to 11 kHz 0 Hz to 8 kHz 0 Hz to 1 kHz	-3 dB -0.2 dB -0,1 dB at temperature measurement
Filter (digital) cut-off frequency characteristic type and order	 2 Hz to 5 kHz	Butterworth, Bessel low pass filter: 8th order high pass filter: 4th order band pass: LP 4th and HP 4th order Anti-aliasing filter: Cauer 8.order with $f_{cut-off} = 0.4\ f_a$
Resolution	16 Bit	internal processing 24 Bit
TEDS - Transducer Electronic DataSheets	conforming to IEEE 1451.4 Class II MMI	esp. with ACC/DSUBM-TEDS-xx (DS2433) not supported: DS2431 (typ. IEPE/ICP sensor)
Characteristic curve linearization	user defined (max. 1023 supporting points)	

1 When using the two-channel IEPE plug in combination with the analog inputs, which provide four channels per socket, only channels 1 and 3 can be used. Only the IEPE base functionality is supported by this module, see also TD ACC/DSUBM-ICP2I-BNC.

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation	galvanically isolated		channel-to-channel and against system ground (housing, CHASSIS, PE), as well as against common reference of all PT100 current sources and TEDS. not isolated when using ICP plug and PT100 mode
nominal rating test voltage	±60 V ±300 V (10 s)		
Overvoltage protection	±60 V ESD 2 kV transient protection: automotive load dump ISO 7637		differential input voltage, continuous human body model R_i=30 Ω, t_d=300 µs, t_r<60 µs
Input coupling	DC		
Input configuration	differential, isolated		
Input impedance	6.7 MΩ 1 MΩ 50 Ω		range ≤±2 V and temperature mode range ≥±5 V or device powered down with shunt plug ACC/DSUBM-I4
Input current operating conditions on overvoltage condition		1 nA 1 mA	for operation $\|V_{in}\|$ > 5 V on ranges <±5 V or device powered-down
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 plug independent of optional sensor supply, short circuit proof power per DSUB-plug

Voltage measurement				
Parameter	**Value typ.**	**min. / max.**	**Remarks**	
Voltage input ranges	±60 V / ±50 V / ±25 V / ±10 V ±5 V / ±2 V / ±1 V / ±500 mV ±250 mV / ±100 mV / ±50 mV			
Gain error	<0.02 %	<0.05 %	of the measured value, at 25 °C	
Gain drift		6 ppm/K·ΔT_a 50 ppm/K·ΔT_a	ranges ≤±2 V ranges ≥±5 V	over full temp. range
Offset error	0.02 %	<0.05 %	of the measurement range, at 25°C	
Offset drift		2.5 ppm/K·ΔT_a	over entire temperature range $\Delta T_a = \|T_a - 25°C\|$; with T_a = ambient temperature	
Non-linearity	<120 ppm		range ±10 V	
Signal noise	2.5 µV_{rms} 20 µV_{pkpk}		bandwidth 0.1 Hz to 1 kHz; in the range: ±50 mV	
IMR (isolation mode rejection)	140 dB 64 dB	>130 dB >60 dB	range ≤±2 V range ≥±5 V	R_{source}= 0 Ω, f=50 Hz
Channel isolation	>1 GΩ, < 40 pF		channel-to-ground / CHASSIS (case)	
	>1 GΩ, <10 pF		channel-to-channel	
Channel isolation (crosstalk)	>165 dB (50 Hz) >92 dB (50 Hz)		range ≤±2 V range ≥±5 V	R_{source} ≤100 Ω

Current measurement with shunt plug			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±40 mA / ±20 mA / ±10 mA ±5 mA / ±2 mA / ±1 mA		
Shunt impedance	50 Ω		external plug ACC/DSUBM-I4
Input configuration	differential		
Gain error	<0.02 %	<0.05 % <0.1%	of the measured value, with 25 °C additional error of 50 Ω in plug
Gain drift		6 ppm/K·ΔT_a 50 ppm/K·ΔT_a	ranges ≤±2 V ranges ≥±5 V (over entire temp. range)
Offset error	0.02 %	<0.05 %	of the measurement range
Offset drift		2.5 ppm/K·ΔT_a	over entire temperature range $\Delta T_a=\lvert T_a -25°C\rvert$; with T_a = ambient temperature

Temperature measurement - thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement mode	R, S, B, J, T, E, K, L, N		
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		<±0,6 K <±1.0 K <±1.5 K	type K, range -150°C to 1200°C type T, range -150°C to 400°C type N, range 380°C to 1200°C type K, range -200°C to -150°C type T, range -200°C to -150°C type N, range -200°C to 380°C
Temperature drift	±0.02 K/K·ΔT_a		$\Delta T_a=\lvert T_a -25°C\rvert$; with T_a = ambient temperature
Error of cold junction compensation		<±0.15 K	with ACC/DSUBM-T4
Temperature drift	±0.001 K/K·ΔT_a		$\Delta T_a=\lvert T_a -25°C\rvert$; with T_a = ambient temperature

Temperature measurement – PT100		
Parameter	**Value**	**Remarks**
Measurement range	-200°C to +850°C -200°C to +250°C	
Resolution	0.063 K (1/16 K)	
Gain error	<±0.05%	of measured value (corresponding resistance)
Offset error	<±0.2 K	with 4-wire configuration
Offset drift	±0.01 K/K ΔT_a	$\Delta T_a=\lvert T_a -25°C\rvert$; with T_a = ambient temperature
Sensor feed	250 µA	non-isolated

<table>
<tr><th colspan="6">Sensor supply (Cx-41xx-SUPPLY)</th></tr>
<tr><th>Parameter</th><th colspan="2">Value typ.</th><th colspan="2">max.</th><th>Remarks</th></tr>
<tr><td>Configuration options</td><td colspan="4">5 selectable settings</td><td>The sensor supply module always has 5 selectable voltage settings.
default selection: +5 V to +24 V</td></tr>
<tr><td>Output voltage</td><td>Voltage
(+2.5 V)
+5.0 V
+10 V
+12 V
+15 V
+24 V
(±15 V)</td><td colspan="2">Current
580 mA
580 mA
300 mA
250 mA
200 mA
120 mA
190 mA</td><td>Netpower
1.5 W
2.9 W
3.0 W
3.0 W
3.0 W
2.9 W
3.0 W</td><td>set jointly for all eight channels
optional, special order: +12 V or 15 V can be replaced by +2.5 V
preferred selection with 2.5 V:
+2.5 V, +5.0 V, +10 V, +12 V, +24 V
Special order: +15 V can be replaced by ±15 V. With the LEMO variant, TEDS support is omitted with this choice, see manual.</td></tr>
<tr><td>Isolation
Standard:
option, upon request:</td><td colspan="4">
non isolated
isolated</td><td>
output to case (CHASSIS)
nominal rating: 50V, test voltage (10sec.): 300 V, not available with option ±15 V</td></tr>
<tr><td>Short-circuit protection</td><td colspan="4">unlimited duration</td><td>to output voltage reference ground</td></tr>
<tr><td>Accuracy of output voltage</td><td colspan="2">
<0.25 %</td><td colspan="2">
0.5 %
0.9 %
1.5 %</td><td>at terminals, no load
at 25°C
over entire temperature range
plus with optional bipolar output voltage</td></tr>
<tr><td>Max. capacitive load</td><td colspan="4">>4000 µF
>1000 µF
>300 µF</td><td>2.5 V to 10 V
12 V, 15 V
24 V</td></tr>
</table>

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8.6 CS-5008-FD, CL-5016-FD analog inputs

Channels, measurement modes, terminal connection		
Parameter	**Value**	**Remarks**
Inputs	8 16	CS CL
Measurement modes	voltage measurement current measurement bridge sensor strain gauges current-fed sensors (IEPE/ICP)	 ACC/DSUBM-I2 shunt-plug or Single-ended (internal shunt) ACC/DSUBM-B2 full, half, quarter bridge with DSUB-15 extension plug: ACC/DSUBM-ICP2I-BNC-S/-F, isolated

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤100 kHz	per channel
Bandwidth	0 Hz to 5 kHz	-3 dB
Filter (digital) cut-off frequency characteristic order	 1 Hz to 2 kHz	 Butterworth, Bessel (digital) low pass or high pass filter 8th order band pass, LP 4th and HP 4th order Anti-aliasing filter: Cauer 8.order with $f_{cutoff} = 0.4\ f_s$
Resolution	16 Bit	internal processing 24 Bit
TEDS	conforming IEEE 1451.4 Class II MMI	esp. with ACC/DSUBM-TEDS-xx (DS2433) not supported: DS2431 (typ. IEPE/ICP sensor)
Characteristic curve linearization	user defined (max. 1023 supporting points)	

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overvoltage protection		±40 V	permanent
Input coupling	DC		
Input configuration	differential		
Input impedance	20 MΩ	±1%	
Auxiliary supply voltage available current internal resistance	 +5 V 0.26 A 1.0 Ω	 ±5% 0.2 A <1.2 Ω	only with DSUB-15 variant 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	±10 V, ±5 V, ±2.5 V, ±1 V... ±5 mV		
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 input range at 25°C range >±50 mV range ≤±50 mV range ≤±10 mV
Offset drift	(±0.7 µV/K)·ΔT_a (±0.1 µV/K)·ΔT_a	(±6 µV/K)·ΔT_a (±1.1 µV/K)·ΔT_a	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
Nonlinearity	10 ppm	50 ppm	
CMRR (common mode rejection ratio)	110 dB 138 dB	>90 dB >132 dB	DC and f≤60 Hz range ±10 V to ±50 mV range ±25 mV to ±5 mV
Noise (RTI)	0.6 μV_{RMS} 0.14 μV_{RMS}	1.0 μV_{RMS} 0.26 μV_{RMS}	bandwidth 0.1 Hz to 1 kHz bandwidth 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
Input configuration	differential		
Gain error	0.02%	0.06% 0.1%	of reading, at 25°C plus error of 50 Ω shunt
Gain drift	(15 ppm/K)·ΔT_a	(55 ppm/K)·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Offset error	0.02%	0.05%	of range, at 25°C
Noise (current)	0.6 nA_{RMS} 0.15 nA_{RMS}	10 nA_{RMS} 0.25 nA_{RMS}	bandwidth 0.1 Hz to 1 kHz bandwidth 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
Input configuration	Single-ended		internal current backflow to -VB
Gain error	0.02%	0.06%	of reading, at 25°C
Gain drift	(15 ppm/K)·ΔT_a	(55 ppm/K)·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Offset error	0.02%	0.05%	of range, at 25°C
Noise (current)	0.6 nA_{RMS} 0.15 nA_{RMS}	10 nA_{RMS} 0.25 nA_{RMS}	bandwidth 0.1 Hz to 1 kHz bandwidth 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 ranges	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ...		
bridge supply: 10 V	... ±0.5 mV/V		
bridge supply: 5 V	... ±1 mV/V		
bridge supply: 2.5 V	... ±2 mV/V		(as an option)
bridge supply: 1 V	... ±5 mV/V		(as an option)
Bridge excitation voltage (as an option)	10 V 5 V (2.5 V and 1 V)	±0.5% ±0.5%	The actual value will be dynamically captured and compensated for in bridge mode.
Min. bridge impedance	120 Ω, 10 mH full bridge 60 Ω, 10 mH half bridge		
Max. bridge impedance	5 kΩ		
Internal 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 reading
Offset error	0.01%	0.02%	of input range after automatic bridge balancing
automatic shunt calibration	0.5 mV/V	±0.2%	for 120 Ω and 350 Ω
Cable resistance for bridges (without return line)	<6 Ω <12 Ω		10 V excitation 120 Ω 5 V excitation 120 Ω

Sensor supply					
Parameter	**Value typ.**		**max.**	**Remarks**
Configuration options	5 selectable settings			The sensor supply module always has 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"
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
Compensation of cable resistances	3-line control: SENSE line as refeed (-VB: supply ground)			calculated compensation with bridges
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V to 10 V 12 V, 15 V 24 V

The description of the CS-5008-FD, CL-5016-FD. 109

8.7 CS-7008-FD, CL-7016-FD analog inputs

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Inputs	8 16	CS CL
Measurement modes	voltage measurement current measurement thermocouple measurement PT100 (3- and 4-wire configuration) bridge sensor strain gauge current-fed sensors (IEPE/ICP)	ACC/DSUBM-UNI2 Single-ended (internal shunt) or shunt plug ACC/DSUBM-I2 full, half, quarter bridge with DSUB-15 expansion plug: (ACC/DSUB-ICP2, not isolated ACC/DSUBM-ICP2I-BNC-S/-F, isolated)

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤100 kHz	per channel
Bandwidth	0 Hz to 48 kHz 0 Hz to 30 kHz 0 Hz to 10 Hz	-3 dB -0.1 dB -3 dB for temperature measurement
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 $f_{cutoff} = 0.4\ f_s$
Resolution	16 Bit	internal processing 24 Bit
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)
Characteristic curve linearization	user defined (max. 1023 supporting points)	

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	ΔT_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 ΔT_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 with bridge supply: 10 V with bridge supply: 5 V with bridge supply: 2.5 V with bridge supply: 1 V	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ... ... ±0,5 mV/V ... ±1 mV/V ... ±2 mV/V ... ±5 mV/V		 (as an option) (as an option)
Bridge supply (as an option)	10 V 5 V 2.5 V and 1 V	±0.5 % ±0.5 %	The actual value will be dynamically captured and compensated for in bridge mode.
Minimum bridge impedance Maximum bridge impedance	120 Ω full bridge 60 Ω half bridge 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 CS-7008-FD, CL-7016-FD. 118

8.8 Technical Specs DI / DO / ENC / DAC

8.8.1 Digital Inputs

Parameter	Value	Remarks
Channels	8	common ground reference for each 4-channel group, isolated from the other input group
Configuration options	TTL or 24 V input voltage range	configurable at the DSUB globally for 8 Bits: • jumper from LCOM to LEVEL: activates TTL-mode • LEVEL unconnected: activates 24 V-mode
Sampling rate	≤10 kHz	
Isolation strength	±50 V	tested ±200 V isolated to system ground, supply and channel-to-channel
Input configuration	differential	
Input current	max. 500 µA	
Switching threshold	1.5 V (±200 mV) 8 V (±300 mV)	5 V level 24 V level
Switching time	<20 µs	
Supply HCOM	5 V max. 100 mA	electrically isolated from system (case), Configuration signal "LEVEL" is referenced to HCOM, LCOM
Terminal connection	DSUB-15	ACC/DSUBM-DI4-8

Find here the description of digital inputs 71.

8.8.2 Digital outputs

Parameter	Value		Remarks
Channels / bits	8 bit		Group of 8 bits, galvanically isolated; common reference potential ("LCOM") for each group
Isolation strength	±50 V		to system ground (case, CHASSIS)
Output configuration	totem pole (push-pull) or open-drain		configurable at the DSUB globally for 8 Bits: • jumper from OPDRN to LCOM: totem pole • OPDRN unconnected: open-drain
Output level	TTL or max. U_{ext}-0.8 V		internal, galvanically isolated supply voltage by connecting an external supply voltage U_{ext} with "HCOM", U_{ext} = 5 V to 30 V
State upon system power up	high impedance (High-Z)		Independent of output configuration (OPDRN-pin)!
Activation of the output stage following system start	upon first preparation of measurement		with initial states which can be selected in the experiment (High / Low) in the selected output configuration (OPDRN-pin)
Max. output current (typ.)	HIGH	LOW	
TTL 24 V-logic open-drain	15 mA 22 mA ---	0.7 A 0.7 A 0.7 A	 external clamp diode needed for inductive load
open-drain with intern. 5 V supply		160 mA	for all outputs
Output voltage	HIGH	LOW	for load current:
TTL	>3.5 V	≤0.4 V	I_{high} = 15 mA, I_{low} ≤0.7 A
24 V-logic (U_{ext} = 24 V)	>23 V	≤0.4 V	I_{high} = 22 mA, I_{low} ≤0.7 A
Internal supply voltage	5 V, 160 mA (isolated)		available at terminals
Switching time	<100 µs		
Terminal connection	DSUB-15		ACC/DSUBM-DO8

The description of the digital outputs 73.

8.8.3 ENC4: Pulse counter for incremental encoder

Parameter	Value		Remarks
Channels	4 + 1 (5 tracks)		four single-tracks or two two-track channels one index track
Measurement modes	Displacement (abs), Displacement (diff), Angle (abs), Angle (diff), Event, Frequency, Speed, Velocity, Time and Puls Time Measurement		only if the sampling rate is ≤ 1 ms
Sampling rate	≤50 kHz		per channel only one sampling rate for all 4 channels allowed
Time resolution of measurement	31.25 ns		counter frequency: 32 MHz
Data resolution	16 bits		
Input configuration	differential		
Input impedance	100 kΩ		
Input voltage range	±10 V		differential
Common mode input range	min. -11 V	max. +25 V	
Switching threshold	-10 V to +10 V		detection level selectable per channel
Hysteresis	min. 100 mV		selectable per channel
Analog bandwidth	500 kHz		-3 dB (full power)
Analog filter	Bypass (no Filter), 20 kHz, 2 kHz, 200 Hz		selectable (per-channel) 2nd order Butterworth
Switching delay	500 ns		signal: 100 mV squarewave
CMRR	70 dB 60 dB	50 dB 50 dB	DC, 50 Hz 10 kHz
Gain error	<1 %		of input voltage range @ 25 °C
Offset error	<1 %		of input voltage range @ 25 °C
Overvoltage strength	±50 V		to system ground
Sensor supply	+5 V, 300 mA		not isolated (reference: GND, CHASSIS)
Terminal connection	DSUB-15		ACC/DSUBM-ENC4

The description of the incremental counter channels 76.

8.8.4 Analog outputs

Parameter	Value typ.	min. / max.	Remarks
Channels	4		
Output level	±10 V		
Load current	max. ±10 mA / channel		
Resolution	16-bit		15-bit, no missing codes
Non-linearity	±2 LSB	±3 LSB	
Max. output frequency	50 kHz		
Analog bandwidth	50 kHz		-3 dB, low pass 2nd order
Gain error	<±5 mV	<±10 mV	-40 °C to 85 °C
Offset error	<±2 mV	<±4 mV	-40 °C to 85 °C
Terminal connection	DSUB-15		ACC/DSUBM-DAC4

The description of the analog outputs 81.

8.8.5 UPS

Parameter	Value	Remarks
Input supply	10 V to 32 V_{DC}	
Internal battery voltage	4 V (CS) / 24 V (CL)	
UPS battery type	Lead-gel	
Buffer time constant	1 sec. (CS) / 30 sec. (CL and CX)	at 25°C ambient temp. 5 to 30 sec selectable the duration of a continuous outage which triggers device deactivation. Other configurations upon request
Effective buffer capacity	≥3.5 Wh (CS) / ≥5.1 Wh	typ. 23°C, battery fully charged
Minimum charging time for 1 min. buffer duration	≤19 min. (CS) / ≤21 min.	for empty battery @ 23°C
Charging time ratio CL	buffer time * (total power/ 4 W)	
Charging time for empty battery	6 h	device activated!
Charging capacity	1.1 W (CS) / 1.5 W (CL)	

To the description of the UPS.

8.9 CAN FD 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.

8.10 Miscellaneous

8.10.1 Color Display

Parameter	Color Display
Display	5.7^2 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: operating temperature ≤+85°C: 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 95 and the DSUB-9 pin configuration 178.

Included accessories article no.

- Modem cable in the extended temperature range
- ACC/POWER-SUPPLY AC/DC power supply unit 1350043
- ACC/POWER-PLUG4 power plug 1350052

8.10.2 ACC/DSUB-ICP

Parameter	Value (min / max)		Remarks
option for	C-10xx, C-12xx, C-41xx, C-50xx, C-60xx, C-70xx		
Inputs	 4 2		differential, not isolated ACC/DSUB-ICP4 ACC/DSUB-ICP2
Input coupling	DC ICP		 current source, 1st order high-pass
Current drain per connector		<0.2 A <0.1 A	ACC/DSUB-ICP4 ACC/DSUB-ICP2
Voltage measurement			
Input voltage max. voltage ICP		 ±60 V -3 V to 50 V ±3 V	permanent to chassis at +IN1, ..., +IN2 bzw. +IN4 at -IN1, ..., -IN2 bzw. +IN4
Input impedance voltage ICP	 1 MΩ 10 MΩ 20 MΩ 0.33 MΩ 0.91 MΩ		depending on the measurement ranges of the measurement inputs differential single end
ICP™-, DELTATRON®-, PIEZOTRON®-Sensors			
Highpass cutoff frequency	3 Hz 1 Hz	±20 % ±20 %	-3 dB, AC, corresponding to input impedance of the used measurement input 1 MΩ 10 MΩ, 20 MΩ
ICP-current source	4.2 mA	±10%	
Voltage swing	25 V	>24 V	
Source impedance	280 kΩ	>100 kΩ	

Find here the description of the IEPE (ICP)-expansion plug 56.

8.10.3 ACC/DSUBM-ICP2I-BNC-S/-F

Parameter	Value typ.	min./ max.	Remarks
Compatible channel types	imc measurement amplifier		with DSUB-15 sockets
Full support			only with CRFX, CRXT device family: software support with variant differentiation (-F/-S), full support of TEDS sensors including sensors of type DS2431 and a improved offset performance
	bridge amplifiers UNI2-8, UNI-4, DCB2-8, B-8 Cx-70xx, Cx-50xx		types with 2 channels per DSUB-15 imc CRONOS device series similar imc C-SERIES devices
	voltage amplifier LV3-8 Cx-12xx		types with 4 channels per DSUB-15: first and third channel used imc CRONOS device series similar imc C-SERIES devices
Basic support			basic ICP operation
	Bridge amplifiers BR2-4		types with 2 channels per DSUB-15 imc CRONOS device series
	Voltage amplifiers ISO2-8, ISOF-8, LV-16, SC2-32 Cx-10xx, Cx-41xx		types with 4 channels per DSUB-15: first and third channel used imc CRONOS device series similar imc C-SERIES devices
Inputs	2		BNC
Input coupling	ICP		current source, 1st order high-pass
Isolation	channel wise isolated ICP-conditioning (current source)		the isolation of each measurement channel depends on the amplifier used (e.g.: ISO2-8 is isolated)
Isolation voltage		≤±50 V	to system ground (CHASSIS) and channel-to channel
Max. input voltage		<±40 V	at BNC input
Constant current feed	4.2 mA	±10%	
Voltage swing	24 V	>22 V	
Current source impedance	340 kΩ	>100 kΩ	in parallel with input impedance of the amplifier
Error indication	LED		open sensor detection and short circuit detection
TEDS	conforming to IEEE 1451.4 Class I MMI supported for selected amplifier and only with CRFX / CRXT		sensor with current feed supported as of imc STUDIO 5.0R1

AC-coupling: High pass cut-off frequency (-3 dB) and typ. settling time - Note (1)			
Parameter	**Value typ.**		**Remarks**
	variant -S "slow"	**variant -F "fast"**	
AC-coupling	235 nF 10 MΩ	235 nF 1 MΩ	RC high pass in the plug The resulting high pass is formed with the additional input impedance of the amplifier (depending on type and measuring range).
Typ. settling time ts	approx. 10 s	approx. 1 s	when connecting and activating
For amplifier types **with software support**			detection, additional digital high pass
imc CRONOS*compact* (CRC), C-SERIES			
UNI2-8, DCB2-8, LV3-8	0.40 Hz	<1 Hz **ts approx. 5 s**	*long settling time for both variants; for the F variant: settling time: ts = 5 s*
imc CRONOS*flex* (CRFX)			
UNI2-8, DCB2-8, LV3-8	0.12 Hz	<1 Hz	time constant of the digital HP specifically matched for S- and F-variant
All other amplifier types **without software support**			no detection, without digital high pass
Depending on input impedance:			
10 MΩ	0.14 Hz	<1 Hz	e.g. ISO2-8, measurement ranges ≤2 V
1 MΩ	0.75 Hz	<1.5 Hz	e.g. ISO2-8, measurement ranges ≥5 V

(1) The cut-off frequency and settling time is determined by the combination of an analog AC coupling (depending also on the amplifier's input impedance) and a digital high-pass (if supported).

The digital highpass is intended to suppress residual offset that can be caused by the amplifiers bias currents in conjunction with the high impedance RC circuit.

Reference

Please find here the description. 60

8.10.4 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

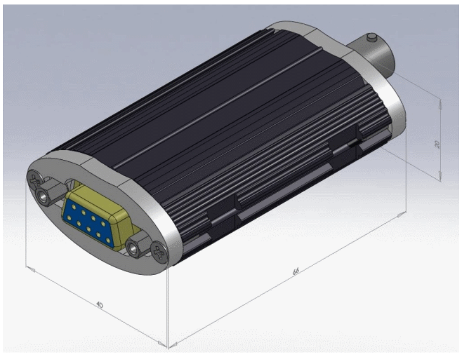
Find here the description of the ACC/SYNC-FIBRE 89.

8.10.5 IRIG-B

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
Supported IRIG formats	B120..B127		Amplitude modulated (AM) signal evaluation of BCD-Time-Of-Year and BCD-Year
Input signal amplitude		max. 12 V_{SS} min. 0.8 V_{SS}	Level for mark-period (high) Level for space-period (low)
Input impedance	600 Ω		
Terminal connection	DSUB-9 (female) BNC		for connection with imc device IRIG input
IRIG-input shielding connection	System ground		
Output signal	RS232		Baud rate: 38400, no parity 8N1
Output data format	NMEA 0183		
Delay of the 1 pps-signal	<2 µs		dedicated signal for system clock synchronization of imc device
Jitter of the 1 pps-signal	±500 ns		Input signal: 12 V_{SS} without jitter
Supply power consumption	5 V, 70 mA		via DSUB connector
Operating temperature range (standard)	-40°C to +70°C		no condensation
Extended environmental range (optional)	-40°C to +85°C		condensation temporarily allowed
Storage temperature	-40°C to 85°C		
Dimensions	39 x 20 x 60		in mm, W x H x D
Weight	approx. 70 g		
imc article number	1270059		external IRIG-B module

Find here the description of IRIG-B 90.

Is only available for devices of group A5-A6 34



8.10.6 SUPPLY Sensor supply module

Parameter	Value typ.	max.	Remarks
Configuration options	5 adjustable ranges		The sensor supply module always got 5 selectable voltage ranges. Default ranges: +5 V to +24 V
Output voltage	Voltage | Current | Netpower (+2.5 V) | 580 mA | 1.5 W +5.0 V | 580 mA | 2.9 W +10 V | 300 mA | 3.0 W +12 V | 250 mA | 3.0 W +15 V | 200 mA | 3.0 W +24 V | 120 mA | 2.9 W (±15 V) | 190 mA | 3.0 W		set globally for all channels of an amplifier special order: +12 V can be replaced by +2,5 V. +15 V can be replaced by ±15 V
Isolation Standard: option, upon request:	 non isolated isolated		 output to case (CHASSIS) nominal rating: 50 V, Test voltage (10 sec.): 300 V, not available with option ±15 V.
Short-circuit protection	unlimited duration		to output voltage reference ground
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
Efficiency	typ. 72% typ. 66% typ. 55% typ. 50%		10 V to 24 V none isolated 5 V 10 V to 24 V isolated 5 V
Max. capacitive load	>4000 µF >1000 µF >300 µF		2.5 V to 10 V 12 V, 15 V 24 V

The description of the sensor supply. 87

8.10.7 WiFi

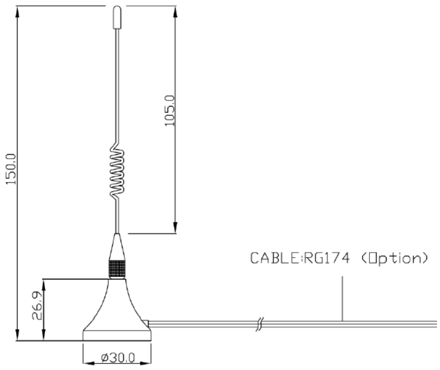
Single band	Value	Remarks
Standards	IEEE 802.11bgn	
Certification	WiFi certified (WMM)	
Data rate	150 Mbps 54 Mbps 11 Mbps	IEEE 802.11n IEEE 802.11g IEEE 802.11b
Operating frequency	2.412 GHz ... 2.462 GHz channel 1...11, 5 MHz separation	IEEE 802.11bgn ISM Band
Network type	Ad-Hoc, managed	
RF output power	+20 dBm +17 dBm	IEEE 802.11b (CCK) IEEE 802.11g (OFDM)
Receiver sensitivity	-73 dBm -86 dBm	IEEE 802.11g (54 Mbps) IEEE 802.11b (11 Mbps)
Encryption	WEP to 104 Bit WPA-PSK TKIP/RC4 WPA2-PSK CCMP/AES	open system (8 to 63 characters) [1] (8 to 63 characters) [1]
Modulation	DSSS (DBPSK, DQPSK, CCK) OFDM (BPSK, QPSK, 16-QAM, 64-QAM)	IEEE 802.11b IEEE 802.11gn
Operating temperature range	-30°C to +85°C	operating (ET version)
Power consumption	1.5 W	

Antenna - ACC/WLAN-ANT-RP-SMA		
Parameter	**Value**	**Remarks**
Type	clip on antenna	
Connector	RP-SMA (female)	reverse-SMA, antenna side: female
Flexibility	flexible joint bend and rotate	degrees of freedom for positioning
Operating frequency	single band / dual band 2.4 GHz / 5 GHz	
Antenna gain	1.5 dBi, 2.1 dBi	2.4 GHz / 5 GHz
Impedance	50 Ω	
Operating temperature range	-20°C to +65°C	
Mechanical dimensions	L: 108 mm / 82.5 mm diameter: 7.8 mm / 10 mm	with / without flexible joint diameter: antenna / SMA

Antenna - ACC/WLAN-MAG-ANT-RP-SMA		
Parameter	**Value**	**Remarks**
Type	magnetic base antenna	with 1.5 m cable
Connector	RP-SMA (female) with 1.5 m low loss cable	reverse-SMA, antenna side: female
Flexibility	magnetic attachment	
Operating frequency	single band 2.4 GHz	
Antenna gain	5 dBi	2.4 GHz
Voltage standing wave ratio	<1.6 : 1	characterizes cable transmission loss
Impedance	50 Ω	

Antenna - ACC/WLAN-MAG-ANT-RP-SMA		
Parameter	**Value**	**Remarks**
Weight	50 g	

Mechanical dimensions - ACC/WLAN-MAG-ANT-RP-SMA:



Find here the description of WiFi 94 (WLAN) connection.

1 Access Point required

9 Pin configuration

imc C-SERIES-FD device models analog channels

	size		connector	speed		voltage mode				current		temp		ICP, supply			bridge mode				
device name	housing	channels	connectors	max. sampling rate (per channel)	signal bandwidth (-3dB)	isolated voltage mode	min. voltage range (mV)	voltage up to 10V	voltage up to 50/60V	20mA internal shunt	20mA shunt plug	Thermocouple (TC)	RTD (PT100)	ICP mode integrated	ICP plug	sensor supply	full bridge	half bridge	quarter bridge	DC excitation	single SENSE
Voltage Measurement				(Cx-1xxx)																	
CS-1016	S	16	DSUB-15	20 kHz	6,6 kHz		250	●			●				o	o					
CS-1208	S	8	DSUB-15	100 kHz	48 kHz		5	●	●		●				o	o					
Voltage & Temperature Measurement				(Cx-41xx)																	
CS-4108	S	8	DSUB-15	100 kHz	11 kHz	●	50	●	●		●	●	●		o	o					
CL-4124	L	24	DSUB-15	100 kHz	11 kHz	●	50	●	●		●	●	●		o	o					
Audio & Vibration Measurements				(Cx-30xx)																	
CS-3008	S	8	BNC	100 kHz	48 kHz		5	●	●					●							
Bridge & Strain Gauge Measurements				(Cx-50xx)																	
CS-5008	S	8	DSUB-15	100 kHz	5 kHz		5	●		●	●				o	●	●	●	●	●	●
CL-5016	L	16	DSUB-15	100 kHz	5 kHz		5	●		●	●				o	●	●	●	●	●	●
For Universal Use				(Cx-70xx)																	
CS-7008	S	8	DSUB-15	100 kHz	48 kHz		5	●	●	●	●	●	●		o	●	●	●	●	●	●
CL-7016	L	16	DSUB-15	100 kHz	48 kHz		5	●	●	●	●	●	●		o	●	●	●	●	●	●

Key: ● Standard, o optional, (●) restricted

DSUB-15 Connector plugs overview

Type / Description	Article #	Order Code	TEDS	CS-10xx	CS-12xx	CS/CL-41xx	CS/CL-50xx	CS/CL-70xx
				Device types: compatible (○) std. delivery (●)				
Screw terminal plugs for signals								
DIO-ENC-DAC signals (all device types)								
Plug with screw terminals for 4 digital inputs: DI4-8	**1350174**	ACC/DSUBM-DI4-8		●	●	●	●	●
Plug with screw terminals for 8 digital outputs: DO-8	**1350173**	ACC/DSUBM-DO8		●	●	●	●	●
Plug with screw terminals for 4 pulse counter input: ENC4	**1350171**	ACC/DSUBM-ENC4		●	●	●	●	●
Plug with screw terminals for 4 analog outputs: DAC4	**1350177**	ACC/DSUBM-DAC4		●	●	●	●	●
Analog Inputs (depending on device type)								
Plug with screw terminals for 4 voltages: U4	**1350166**	ACC/DSUBM-U4		●	●	○		
Plug with screw terminals for 2 bridges/strain gauge: B2	**1350170**	ACC/DSUBM-B2					●	○
Plug with screw terminals for 4 temperatuers (incl. CJC) or volt: T4	**1350167**	ACC/DSUBM-T4				●		
Plug with screw terminals for 2 universal channels (incl. CJC): UNI2	**1350169**	ACC/DSUBM-UNI2						●
Plug with screw terminals and shunts for 4 currents (20 mA): I4	**1350168**	ACC/DSUBM-I4		○	○	○		
Plug with screw terminals and shunts for 2 currents (20 mA): I2	**1350180**	ACC/DSUBM-I2					○	○
Screw terminal plugs for signals (with TEDS)								
Analog inputs with TEDS (plug & measure)								
Plug with screw terminals for 4 voltages: U4 (TEDS)	**1350189**	ACC/DSUBM-TEDS-U4	✓	○	○	○		
Plug with screw terminals for 2 bridges/strain gauge: B2 (TEDS)	**1350191**	ACC/DSUBM-TEDS-B2	✓				○	○
Plug with screw terminals for 4 temp. (incl. CJC) or volt.: T4 (TEDS)	**1350190**	ACC/DSUBM-TEDS-T4	✓			○		
Plug with screw terminals for 2 uni channels (incl. CJC): UNI2 (TEDS)	**1350188**	ACC/DSUBM-TEDS-UNI2	✓					○
Plug with screw terminals, shunts for 4 currents (20 mA): I4 (TEDS)	**1350192**	ACC/DSUBM-TEDS-I4	✓	○	○	○		
Plug with screw terminals, shunts for 2 currents (20 mA): I2 (TEDS)	**1350193**	ACC/DSUBM-TEDS-I2	✓				○	○
Extension plugs								
DSUB-Extension plugs for IEPE/ICP								
Extension plug for 4 IEPE/ICP transducers: ICP4 (screw terminals)	**1350032**	ACC/DSUB-ICP4		○	○	○		
Extension plug for 2 IEPE/ICP transducers: ICP2I (isolated, 2 x BNC)	**1350199**	ACC/DSUBM-ICP2I-BNC	✓		○		○	○
Filter-Plug for ESD suppression								
In-line filter plug ESD (compatible with all amplifier types)	**1350211**	ACC/DSUBM-ESD		○	○	○	○	○

9.1 DSUB-15 pin configuration

The **Standard plug** is a 1:1 DSUB-15 to screw terminal adapter. It can be used for all modules which come with the corresponding pin configuration.

The **Special plugs** do not offer direct adaption from the DSUB pins to the screw terminals, but instead come with extra functions:

- For current measurement (up to 50 mA) with voltage channels the **Shunt plug** (ACC/DSUBM-I2 and I4) have a built-in 50 Ω shunt. The scaling factor 0.02 A/V must be set in order to display the current value.
- For temperature measurements, a special, patented **Thermo plug** (ACC/DSUBM-T4) is available. This DSUB-15 plug is suited for measurement of voltages as well as temperatures with PT100 and thermocouples with integrated cold junction compensation (CJC). Any types of thermocouples can be connected at the differential inputs (+IN and -IN). It also has additional "auxiliary contacts" for connecting PT100 in 4-wire configurations, where the reference current loop is already pre-wired internally.The Thermo plug can also be used for normal voltage measurement.
- The **IEPE/ICP plug** (ACC/DSUB-ICP2 and ICP4) provide a current supply source as well as a capacitive coupling.
- The **TEDS plugs** store sensor information according to IEEE1451.4 for use with imc Plug & Measure (integrated TEDS chips DS 2433).

Note — The screw terminals of the plug

- To connect the measurement leads with the screw terminals, suitable leads should have a maximum cross section of 1.5 mm^2 incl. cable end-sleeve.
- The terminals' screw heads only have secure electrical contact once they are tightened to a connection wire. For this reason, a control measurement (for instance with multimeter probe tips) at "open" terminals can falsely mimic a missing contact!
- Cable shielding must be connected at CHASSIS (DSUB frame) as a rule. At some plugs, V_{CC} (5 V) is available, with a maximum load current of typically 135 mA per plug.

In general: DSUB pin 1 is internally reserved.

9.1.1 Universal plug

Metal plug

ACC/DSUBM-		UNI2
DSUB Pin	Terminal	UNIVERSAL
9	1	+VB1
3	2	-VB1
2	3	+IN1
10	4	-IN1
11	5	I1_1/4B1 (1)
4	6	-SENSE1
5	7	+IN2
13	8	-IN2
14	9	I2_1/4B2 (1)
7	10	-SENSE2
12	11	+VB2
6	12	-VB2
15	15	(GND)
8	18	(+5V)
	13	
	14	
⏚	16	CHASSIS
⏚	17	CHASSIS

The abbreviation VB stands for the bridge sensor supply and can be equated with the sensor supply, abbreviation: SUPPLY.

(1) if the special version of the amplifier is equipped with the ±15 V option, then this pin = -15 V

9.1.2 Standard plug

Metal plug

ACC/DSUBM-		B2	U4
DSUB Pin	Terminal	BRIDGE	VOLTAGE
9	1	+VB1	(RES.)
2	2	+IN1	+IN1
10	3	-IN1	-IN1
3	4	-VB1	(+SUPPLY)
11	5	[+SENSE1_1/4B1]	+IN2
4	6	-SENSE1	-IN2
12	7	+VB2	(-SUPPLY)
5	8	+IN2	+IN3
13	9	-IN2	-IN3
6	10	-VB2	(GND) *
14	11	[+SENSE2_1/4B2]	+IN4
7	12	-SENSE2	-IN4
15	15	GND	(GND)
8	18	+5V	(+5V)
	13		
	14		
⏚	16	CHASSIS	CHASSIS
⏚	17	CHASSIS	CHASSIS

[ ] : 1/4 Bridge with Cx-70xx and Cx-50xx

* if special version with ±15 V option, then this pin 6 is the reference

In general: DSUB pin 1 is internally reserved.

Metal plug

ACC/DSUBM-		ENC4, ENC4-IU	DI4-8	DO-8	DAC4
DSUB Pin	Terminal	INC.-ENCODER	DIGITAL IN	DIGITAL OUT	ANALOG OUT
9	1	+INA	+IN1	BIT1	
2	2	-INA	+IN2	BIT2	DAC1
10	3	+INB	+IN3	BIT3	AGND
3	4	-INB	+IN4	BIT4	
11	5	+INC	-IN1/2/3/4	BIT5	DAC2
4	6	-INC	+IN5	BIT6	AGND
12	7	+IND	+IN6	BIT7	
5	8	-IND	+IN7	BIT8	DAC3
13	9	+INDEX	+IN8		AGND
6	10	-INDEX	-IN5/6/7/8		
14	11	+5V	+HCOM	HCOM	DAC4
7	12	GND *	LCOM	LCOM	AGND
15	15	(-SUPPLY)	LCOM	LCOM	
8	18	(+SUPPLY)	LEVEL	OPDRN	
	13				
	14				
⏚	16	CHASSIS	CHASSIS	CHASSIS	CHASSIS
⏚	17	CHASSIS	CHASSIS	CHASSIS	CHASSIS

* if special version with ±15 V option, then this pin is reference

9.1.3 Special plug

Metal plug

ACC/DSUBM-		T4
DSUB Pin	Terminal	TH-COUPLE/RTD
9	1	+I1
3	2	(+SUPPLY)
2	3	+IN1
10	4	-IN1
11	5	+IN2
4	6	-IN2
5	7	+IN3
13	8	-IN3
14	9	+IN4
7	10	-IN4
12	11	(-SUPPLY)
6	12	-I4 (GND) *
	15	-I3
	18	+I2
15	13	GND
	14	+I3
	16	+I4
	17	-I1
	19	-I2
	20	CHASSIS

Metal plug

ACC/DSUBM-		I4	I2
DSUB Pin	Terminal	CURRENT	CURRENT
9	1	(RES.)	+SUPPLY1
2	2	+IN1	+IN1
10	3	-IN1	-IN1
3	4	(+SUPPLY)	-SUPPLY1
11	5	+IN2	
4	6	-IN2	
12	7	(-SUPPLY)	+SUPPLY2
5	8	+IN3	+IN2
13	9	-IN3	-IN2
6	10	(GND)	-SUPPLY2
14	11	+IN4	
7	12	-IN4	
15	15	(GND)	(GND)
8	18	(+5V)	(+5V)
	13		
	14		
⏚	16	CHASSIS	CHASSIS
⏚	17	CHASSIS	CHASSIS

DSUB-	ICP4	ICP2
Terminal	ICP	ICP
1	+ICP1	+ICP1
2	-ICP1	-ICP1
3	+ICP2	
4	-ICP2	
5	+ICP3	+ICP2
6	-ICP3	-ICP2
7	+ICP4	
8	-ICP4	
9		
10		
11		
12		
13		
14	CHASSIS	CHASSIS
15	CHASSIS	CHASSIS
16	CHASSIS	CHASSIS
17	+5V	+5V
18	AGND	AGND

* if the special version of the amplifier is equipped with the ±15 V option, then this pin 6 is the reference

9.1.4 TEDS plug

ACC/DSUBM-TEDS-		UNI2
DSUB Pin	Terminal	UNIVERSAL
9	1	+VB1
3	2	-VB1
2	3	+IN1
10	4	-IN1
11	5	I1_1/4B1 (1)
4	6	-SENSE1
5	7	+IN2
13	8	-IN2
14	9	I2_1/4B2 (1)
7	10	-SENSE2
12	11	+VB2
6	12	-VB2
15	15	TEDS_GND
8	18	(+5V)
	13	TEDS2
	14	TEDS1
⏚	16	CHASSIS
⏚	17	CHASSIS

ACC/DSUBM-TEDS-		B2	U4
DSUB Pin	Terminal	BRIDGE	VOLTAGE
9	1	+VB1	(RES.)
2	2	+IN1	+IN1
10	3	-IN1	-IN1
3	4	-VB1	(+SUPPLY)
11	5	[+SENSE1_1/4B1]	+IN2
4	6	-SENSE1	-IN2
12	7	+VB2	(-SUPPLY)
5	8	+IN2	+IN3
13	9	-IN2	-IN3
6	10	-VB2	GND
14	11	[+SENSE2_1/4B2]	+IN4
7	12	-SENSE2	-IN4
15	15	(GND), TEDS_GND	TEDS_GND
8	18	(+5V)	(+5V)
	13	TEDS1	TEDS1
	14	TEDS2	TEDS2
⏚	16	CHASSIS	CHASSIS
⏚	17	CHASSIS	CHASSIS
	19		TEDS3
	20		TEDS4

(1) if the special version of the amplifier is equipped with the ±15 V option, then this pin = -15 V

(2) if special version with ±15 V option, then this pin 6 is the reference

[ ] : 1/4 Bridge with UNI2-8 and DCB2-8

ACC/DSUBM-TEDS-		T4
DSUB	Terminal	TH-COUPLE/RTD
9	1	+I1
3	2	(+SUPPLY)
2	3	+IN1
10	4	-IN1
11	5	+IN2
4	6	-IN2
5	7	+IN3
13	8	-IN3
14	9	+IN4
7	10	-IN4
12	11	(-SUPPLY)
6	12	-I4
	15	-I3
	18	TEDS4
15	13	TEDS_GND
	14	+I3
	16	+I4
	17	TEDS3
	19	TEDS2
	20	TEDS1
	21	-I1
	22	+I2
	23	-I2
	24	CHASSIS

ACC/DSUBM-TEDS-		I4	I2
DSUB Pin	Terminal	CURRENT	CURRENT
9	1	(RES.)	+SUPPLY1
2	2	+IN1	+IN1
10	3	-IN1	-IN1
3	4	(+SUPPLY)	-SUPPLY1
11	5	+IN2	
4	6	-IN2	
12	7	(-SUPPLY)	+SUPPLY2
5	8	+IN3	+IN2
13	9	-IN3	-IN2
6	10	GND	-SUPPLY2
14	11	+IN4	
7	12	-IN4	
15	15	TEDS_GND	TEDS_GND
8	18	(+5V)	(+5V)
	13	TEDS1	TEDS1
	14	TEDS2	TEDS2
	16	CHASSIS	CHASSIS
	17	CHASSIS	CHASSIS
	19	TEDS3	
	20	TEDS4	

9.2 Pin configuration of the REMOTE socket (female)

Please see the pinout in the chapter: Remote control of the CL main switch.

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 95 and the technical data of the displays 163.

9.3.2 GPS

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

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

9.3.3 CAN FD

DSUB-PIN	Signal	Description	Use in device
1	+CAN_SUPPLY	optional supply	unused as per standard* (supply I < 1 A)
2	**CAN_L**	**dominant low bus line**	connected
3	**CAN_GND**	**CAN Ground**	connected
4	nc	reserved	do not connect
5	-CAN_SUPPLY	optional supply	unused as per standard* (supply I < 1 A)
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

Find here the technical data and the cabling 84 of the CAN-Bus interface.

* The CAN FD Interface can be equipped ex-factory with the option "**Power via CAN**".

The DSUB-9 sockets are labled.

CAN FD Interface with Power via CAN

The special option Power via CAN includes the internal connection of the unbuffered supply voltage of the device to the first two nodes "CAN1" and "CAN2" of the CAN interface of a device. This makes it possible to supply connected CANSAS modules (or CAN-based sensors) via the CAN cable. A cable with sufficient cross-section is required. The load current is a maximum of 1 A per node and is limited by a current limiter, which does not provide safe short-circuit protection.

Direction of electric current and fuse

- The direction of current flow is unidirectional, protected by diodes: the device supplies CAN bus participants. Current flow into the device is blocked.
- The diodes also decouple the supply lines of the two CAN nodes from each other.
- Overload protection is provided by an over current protection in the form of inert PTC components ("PolySwitch"). These will be reset in case and the operational again.
- The **fuse does not provide complete protection against destruction in the event of a short circuit**! Rather, it serves to limit the current at a slowly increasing load, such as the successive connection of a large number of imc CANSAS modules. On the other hand, it is not always possible to protect against very fast increasing currents, such as a hard short-circuit on the cable, safely and quickly enough!
- The current limit depends on the operating temperature (internal temperature of the unit):
  2.2 A (0°C)
  1 A (+70°C)
  0.74 A (+85°C)

The corresponding maximum power in the event of a fault (short circuit) then depends on the supply voltage used.

Guaranteed power available via CAN (Spec: 1 A) up to 70°C indoor temperature

Power consumption reserves:

- This design guarantees a current of 1 A per node (up to 70°C). In addition, the PTC fuse then slowly starts limiting the current and "disconnecting" the loads. The generally low consumption of the CANSAS modules should not be underestimated, since the power is achieved by the current at a low supply voltage. Even a UNI8 with a power consumption of max. 15 W (with connected sensors) achieves this limit with a current of 1 A at 15 V. In addition, there is the voltage drop for long cables and small cross-sections. It is always necessary to first calculate the power consumption and the expected currents.
- Due to its technology, the CAN bus is ideally suited for retrofitting a system. It can easily happen that the current load and the cross-section have been designed correctly at first, but then modules are added which do not comply with the specification.

USV-buffering:

- The CAN-supply is not buffered. It is not tapped at the output of the device UPS but directly at the LEMO power supply. For this reason, this power is not included in any limits for the total device power, as long as these are decisively determined by the UPS. Since a current and no power limitation is provided, a UPS buffering would also not be possible without further ado, because with 2 nodes with 1 A current limit (typically!) and a maximum input voltage of 30 V or even 50 V, considerable power results.
- Since Power-via-CAN is not coupled to UPS or startup logic, this CAN supply is not deactivated when the device is switched off, but is always active as soon as the main supply (LEMO) is powered.

Reference:

- The CAN supply voltage is identical to the main power supply (wide range, LEMO) and has corresponding potential reference. The pins on the DSUB-9 are marked with ±CAN_SUPPLY.
- In contrast, the pin "CAN-GND" has nothing to do with this: This is rather the electrical and logical completely independent reference of the CAN bus signals. It is electrically isolated from the rest of the system (housing, power supply, system electronics). CAN_GND should always be used independently of the power supply so that the CAN_H and CAN_L levels are reliably detected.

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