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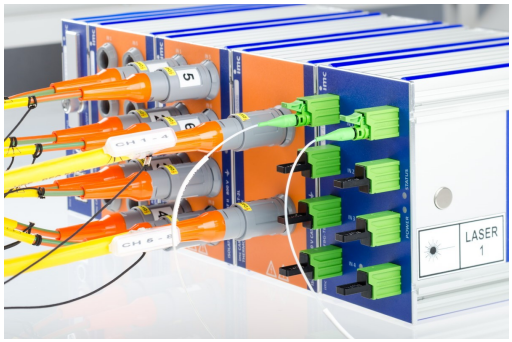
imc CANSAS

Modules and Software - Manual

Edition 20 - 2025-05-26



imc CANSASfit (CANFT)



imc CANSASflex (CANFX)



imc CANSASflex (CANFX)

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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.

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The software described in this document may only be used in accordance with the provisions of the "imc Software License Agreement".

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If you wish to receive a copy of the GPL sources used, please contact our tech support.

Notes regarding this document

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

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

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

This will protect you and prevent damage to the device.

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 10
1.1 Tech support 10
1.2 Service and maintenance 10
1.3 Legal notices 10
1.4 Explanation of symbols 13
1.5 Latest changes in this document (history) 15
2 Safety 16
3 Precautions for operation 19
3.1 After Unpacking... 20
3.2 Before Starting 20
3.3 Safety notes concerning laser setup 21
3.3.1 Optical product properties laser safety 21
3.3.2 Derivation of the laser class 21
3.3.3 Evaluation according to DGUV-11/BGV B2 22
3.4 Troubleshooting 22
4 Maintenance and servicing 23
4.1 Maintenance and Service 23
4.2 Cleaning 23
4.3 Transport 23
5 Startup 24
5.1 Data Carrier Contents 24
5.1.1 Setup-Program 24
5.1.2 Driver-software for the PC / CAN bus interface 24
5.2 System requirements 24
5.3 Integrating the CANSAS software in imc STUDIO 24
5.4 Installation of imc CANSAS software 24
5.5 Interface cards 26
5.5.1 KVASER interface cards 28
5.5.2 Ixxat interface cards 29
5.5.3 PEAK interface cards 29
5.5.4 Vector interface cards 30
5.5.5 IntrepidCS interface cards 32
5.6 Connections 33
5.6.1 CAN connection for the PC 33
5.6.2 CAN connection to CANSAS 33
5.6.3 CANSAS analog connections 33
5.7 Attachment mechanism CANSASfit (CANFT) modules 34
5.7.1 Power supply options with CANFT 35
5.7.2 Use with ARGFT base unit 37
5.7.3 CAN Terminator with CANFT 38
5.8 Attachment mechanism CANSASflex (CANFX) modules 39
5.8.1 Power supply options with CANFX 41
5.8.2 CAN Terminator with CANFX 42
5.9 CAN bus description 43
5.9.1 References to standards and literature 43
5.9.2 Bus-activation 43

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5.9.3 CAN bus wiring ... 44
5.9.4 Connecting the terminators ... 44
5.9.5 CAN data transfer rate ... 47
5.9.6 Number of CAN-nodes ... 48
5.9.7 Duplicate samples in during data capture ... 48
5.9.8 CANopen ... 49
5.9.9 Troubleshooting tips for disturbances of the CAN bus ... 50
6 Operation ... 53
6.1 Calling the program ... 53
6.1.1 Language setting - imcLanguageSelector ... 53
6.2 The user interface ... 54
6.2.1 Introduction ... 54
6.2.2 Toolbar ... 58
6.2.3 The Module Tree ... 59
6.2.4 Properties Display ... 60
6.2.5 Status bar ... 76
6.3 Working with the Module tree ... 77
6.4 Menu functions ... 81
6.4.1 Files ... 81
6.4.2 Edit ... 87
6.4.3 View ... 89
6.4.4 Module ... 91
6.4.5 Extra ... 104
6.4.6 Help - Info about CANSAS... ... 110
6.5 General notes on working with imc CANSAS modules ... 111
6.5.1 Readable configuration ... 111
6.5.2 MDB database ... 113
6.5.3 Reset-plug ... 114
6.5.4 Bus-off error - Change baudrate ... 116
6.5.5 Racks ... 117
6.5.6 Connecting to imc SENSORS ... 120
6.5.7 Sensor recognition ... 121
6.5.8 Guarding ... 122
6.5.9 Heartbeats ... 124
6.5.10 Synchronization ... 126
7 Virtual Channels ... 130
7.1 What are virtual channels? ... 130
7.2 Creating virtual channels ... 130
7.3 Data formats ... 133
7.4 Integer-arithmetic ... 134
7.5 Constraints ... 135
7.6 LEDs ... 136
7.7 Special module-specific characteristics ... 137
7.7.1 Acquisition modules ... 137
7.7.2 Output modules ... 139
7.8 Sampling Rates ... 141
7.9 Processing functions sorted by group ... 142
7.10 Function Reference ... 143
7.10.1 + (Addition) ... 143
7.10.2 - (Subtraction) ... 143
7.10.3 - (Negative sign) ... 144
7.10.4 * (Multiplication) ... 144
7.10.5 / (Division) ... 145

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7.10.6 1/x (Inverse) ... 145
7.10.7 Absolute value ... 145
7.10.8 Assignment ... 146
7.10.9 Band-pass filter ... 146
7.10.10 Barometer (only for P8 modules) ... 146
7.10.11 Bitwise AND ... 147
7.10.12 Bitwise NOT ... 147
7.10.13 Bitwise OR ... 148
7.10.14 Bitwise exclusive OR ... 149
7.10.15 Button status (only for UNI8 modules) ... 149
7.10.16 Channel-status word (only for UNI8 and CI8 modules) ... 150
7.10.17 Characteristic curve ... 151
7.10.18 Comparison function ... 152
7.10.19 Constant channel (only for acquisition modules) ... 153
7.10.20 Constant digital channel ... 153
7.10.21 Conversion to Float numerical format (only for acquisition modules) ... 153
7.10.22 Event counting (only for DI16 modules) ... 154
7.10.23 Exp. root mean square (RMS) ... 154
7.10.24 Extract bit from word ... 155
7.10.25 Fixed analog value (only for DAC8 and PWM8 modules) ... 155
7.10.26 Fixed digital value (only for digital output modules) ... 155
7.10.27 Fixed input range ... 156
7.10.28 Fixed scaling ... 156
7.10.29 Frequency determination (only for DI16 modules) ... 157
7.10.30 Greater ... 158
7.10.31 Greater value ... 158
7.10.32 High-pass filter ... 159
7.10.33 Hysteresis filter ... 159
7.10.34 LED-flash ... 160
7.10.35 Less ... 161
7.10.36 Less value ... 161
7.10.37 Logical AND ... 162
7.10.38 Logical NOT ... 162
7.10.39 Logical OR ... 163
7.10.40 Logical exclusive OR ... 163
7.10.41 Low-pass filter ... 164
7.10.42 Maximum ... 165
7.10.43 Mean value ... 165
7.10.44 Median filter ... 165
7.10.45 Minimum ... 166
7.10.46 Module-status word (only for UNI8 and CI8 modules) ... 166
7.10.47 Monoflop ... 167
7.10.48 Output status on LED (only for UNI8 and CI8 modules) ... 168
7.10.49 Output status word (only for C8, P8, INC4 and SC modules) ... 169
7.10.50 PulseSequenceEncoder (only for output modules) ... 170
7.10.51 Rectangle (only for DAC8 modules) ... 171
7.10.52 Resampling ... 171
7.10.53 Root-mean-square ... 172
7.10.54 SawTooth ... 172
7.10.55 Schmitt-Trigger ... 173
7.10.56 Short circuit status (only for UNI8 modules) ... 173
7.10.57 Sine (only for DAC8 modules) ... 174
7.10.58 Slope limiting ... 174
7.10.59 Smoothing based on 2 values ... 174
7.10.60 Smoothing based on 3 values ... 175
7.10.61 Square root ... 175
7.10.62 Standard deviation ... 176
7.10.63 Time determination (only for DI16 modules) ... 177
7.10.64 Triangle (only for DAC8 modules) ... 178

8 Measurement technique 179

8.1 Measurement modes 179

8.1.1 Temperature measurement 179
8.1.2 Bridge measurement 182
8.1.3 Bridge measurements with wire strain gauges 183
8.1.4 Bridge balancing 190
8.1.5 Incremental Counters Channels 191
8.1.6 Digital Inputs 206
8.1.7 Digital Outputs (CANSAS-DO8R, -DO16, -DO16R) 206

8.2 Sampling interval, output rate and filter 211

8.3 Sampling rates and SCx-modules (Scanner concept) 211

8.4 CAN bus: Delay times 214

8.5 Grounding and Shielding 216

8.5.1 Isolation 216
8.5.2 Grounding 216
8.5.3 Isolation voltage 217
8.5.4 Shielding 217

8.6 Blink codes 218

8.6.1 imc CANSASflex 218
8.6.2 CANSASfit (CANFT) 221
8.6.3 µ-CANSAS 221
8.6.4 Special/modules 222

8.7 Features and modules 223

8.8 Calibrating the modules 226

8.8.1 Prompt for next calibration 226
8.8.2 Recalibration overdue 228

8.9 TEDS 230

8.9.1 TEDS: Plug & Measure functionality for sensors 230
8.9.2 Operation in CANSAS Software 236
8.9.3 Plug & Measure - Assembly of the sensor clip 241

9 Properties of CANSAS modules 245

9.1 CANSASfit (CANFT) 246

9.1.1 LED display for all module types 247
9.1.2 Message Mapping for imc CANSASfit 247
9.1.3 DI-16: Digital inputs 248
9.1.4 ENC-6: pulse signals and incremental counter channelss 251
9.1.5 T-10: temperature measurement 262
9.1.6 UTI-6: voltage, current, temperature and resistance 264

9.2 CANFT/HISO modules 274

9.2.1 HISO-T-8: high voltage isolated 8-channel module 276
9.2.2 HISO-UT-6: high voltage isolated 6-channel module 277
9.2.3 HISO-HV-4 279

9.3 CANSASflex (CANFX) 280

9.3.1 C8 voltage, temperature, current 281
9.3.2 CI8 isolated voltage channels with current and temperature mode 289
9.3.3 DAC8 analog outputs 301
9.3.4 DCB8 bridge, strain gauges 308
9.3.5 DI16 digital inputs 315
9.3.6 DO16 digital outputs 318
9.3.7 DO8R, -DO16R relay outputs 321
9.3.8 FBG-T8 temperature for fiber optic sensors 323
9.3.9 INC4 incremental counter channels 331
9.3.10 P8 pressure 338
9.3.11 PWM8 pulse width modulation outputs 352

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9.3.12 SC16, SCI8, SCI16 voltage, current and temp. modes ... 356
9.3.13 UNI8: universal ... 372
9.4 CANFX/HISO modules ... 397
9.4.1 Voltage measurement ... 399
9.4.2 Current measurement ... 399
9.4.3 Temperature measurement ... 400
9.4.4 Resistance measurement ... 401
9.4.5 Bandwidth ... 401
9.4.6 Filter ... 401
9.4.7 Connection ... 401
9.5 µ-CANSAS ... 402
9.5.1 µ-CANSAS-V1 ... 403
9.5.2 µ-CANSAS-T1 ... 411
9.5.3 µ-CANSAS-B1 ... 413
9.6 CANSAS other modules ... 423
9.6.1 IGN ignition angle measurement module ... 424
9.6.2 IHR (I - High Resolution) ... 448
9.6.3 SENT: Gateway from SENT to the CAN-Bus ... 452
10 Technical Specs ... 472
10.1 CANFT ... 473
10.1.1 CANFT/DI-16 ... 475
10.1.2 CANFT/ENC-6 ... 476
10.1.3 CANFT/HISO-T-8 ... 480
10.1.4 CANFT/HISO-UT-6 ... 483
10.1.5 CANFT/HISO-HV-4 ... 488
10.1.6 CANFT/T-10 ... 491
10.1.7 CANFT/UTI-6 ... 495
10.2 CANFX ... 500
10.2.1 C8 ... 502
10.2.2 CI8 ... 505
10.2.3 DAC8 ... 509
10.2.4 DCB8 ... 510
10.2.5 DI16 ... 513
10.2.6 DO16 ... 514
10.2.7 DO8R, DO16R ... 516
10.2.8 FBG-T8 ... 517
10.2.9 HISO8 ... 521
10.2.10 HISO-HV4 ... 524
10.2.11 HISO-T-8-2L ... 526
10.2.12 IGN ... 529
10.2.13 IHR(-48V) ... 531
10.2.14 IHR(-48V)-R ... 534
10.2.15 IHR-RACK ... 537
10.2.16 INC4 ... 538
10.2.17 P8 ... 543
10.2.18 PWM8 ... 545
10.2.19 SC16 ... 546
10.2.20 SCI8, SCI16 ... 551
10.2.21 SENT ... 557
10.2.22 UNI8 ... 560
10.3 µ-CANSAS ... 568
10.3.1 µ-CANSAS-V1 ... 568
10.3.2 µ-CANSAS-T1 ... 570
10.3.3 µ-CANSAS-B1 ... 571
10.4 Synchronization line ... 573
10.5 Tables and diagrams ... 574

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10.5.1 Cable resistance as function of length and cross-section ... 574
10.6 Accessories ... 575
10.6.1 DSUB-screw terminals for measurement inputs ... 575
10.6.2 FBG-Temp s / xs / xxs ... 576
11 Pin configuration ... 578
11.1 CAN bus connectors ... 578
11.1.1 Standard module with DSUB-9 ... 578
11.1.2 CANSAS-SL with LEMO ... 580
11.1.3 µ-CANSAS with Autosport or LEMO ... 581
11.1.4 CANFT with LEMO ... 582
11.2 Power Supply ... 583
11.2.1 CANSAS ... 583
11.2.2 CANSAS-SL ... 584
11.2.3 µ-CANSAS ... 585
11.2.4 CANFX ... 585
11.2.5 CANFT ... 585
11.3 19" RACK ... 590
11.4 Signal connection ... 592
11.4.1 Modules with DSUB-15 ... 592
11.4.2 Modules with DSUB-9 ... 599
11.4.3 Modules with ITT VEAM ... 599
11.4.4 Modules with LEMO ... 600
11.4.5 Modules with Phoenix terminal block (-PH) ... 604
11.4.6 Modules with fiber optic connector ... 609
11.4.7 Terminal block (Weidmüller) ... 610
11.4.8 IGN ... 611
11.4.9 IHR ... 611
11.4.10 SENT ... 612
11.4.11 HISO-HV-4 ... 612
Index ... 613

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1 General introduction

1.1 Tech support

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

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

E-Mail: hotline@imc-tm.de

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

Tip for ensuring quick processing of your questions:

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

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

Product Improvement and change requests

Please help us to improve our documentation and products:

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

Our tech support 10 will be happy to receive your feedback.

1.2 Service and maintenance

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

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

E-Mail: imc-service@axiometrixsolutions.com

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

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

1.3 Legal notices

Quality Management



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

imc Warranty

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

Liability restrictions

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

The manufacturer declines any liability for damage arising from:

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

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

Guarantee

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

imc CANSAS modules 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 imc CANSAS modules 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.

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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 the imc CANSAS modules 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 tech support 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.

1.4 Explanation of symbols



CE Conformity

see CE chapter 1.2 10



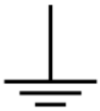
No household waste

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 10.



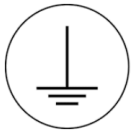
Potential compensation

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 10). A corresponding "China-RoHS" label is omitted for formal/economic reasons. Instead, the number in the symbol indicates the number of years in which no hazardous substances are released. (This is guaranteed by the absence of named substances).

Labeling integrated energy sources



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

Observe the documentation



Read the documentation before starting work and/or operating.

On/Off



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

1.5 Latest changes in this document (history)

Amendments and bug-fix in Users Manual Edition 19

Section	Amendments
CANFX/L-HISO-T-8-2L 602	New module added
CAN interface	Support of the Vector box 30 VX1135 (VX1000 series) with driver package from Vector
CAN bus DSUB-9	No voltage may be applied to pin 9 of the DSUB-9 (female) socket 578.

Amendments and bug-fix in Users Manual Edition 18

Section	Amendments
General	We have replaced the term "Hotline" with the name "Technical Support". Some chapters have been summarised and restructured, improved.

Amendments and bug-fix in Users Manual Edition 17

Section	Amendments
FBG-T8	As of imc CANSAS software version 2.2 R13, the 'Temperature measurement with calibration' measuring mode is also available.

Amendments and bug-fix in Users Manual Edition 16

Section	Amendments
Symbols	symbol added (ESD-sensitive components)
Technical Specs	power consumption updated: T-10, # 39185

Amendments and bug-fix in Users Manual Edition 15

Section	Amendments
ACC/CANFT-RESET	The new CANFT reset plug is available for all imc CANSAS*fit* modules. The technical support (firmware and software) of the reset functionality requires a imc CANSAS software version 2.2 R10 or higher.

Amendments and bug-fix in Users Manual Edition 14

Section	Amendments
CANFT/HISO-HV-4	new module added, pin configuration 612

2 Safety

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

Responsibility of the operator

imc CANSAS modules 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.

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.

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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 imc CANSAS 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 CANSAS 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.

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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.

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3 Precautions for operation

Certain basic rules of safety are always to be followed, even with 'safe' devices such as imc CANSAS. Unintended and/ or inappropriate usage of the device can be dangerous for the operator and/or surrounding persons and, in the worst case, can damage the test object or imc CANSAS itself. We strongly discourage the user from making any modifications to the measurement system whatsoever. Doing so can be especially dangerous because other users may be unaware of the changes.

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:
the device is visibly damaged,

- loose parts can be heard within the device,
- the device no longer functions properly,
- the device has been stored for a long period of time under unfavorable conditions (e.g. outdoors or high-humidity environments).

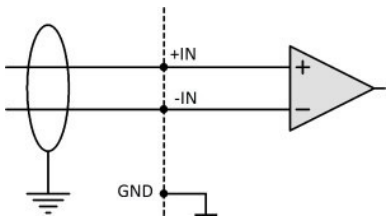
1. Always wait a few seconds before turning the device back on after it has been turned off. A general test of the system (e.g. voltages, operating condition, memory test) is performed during the boot sequence.
2. **WARNING!** Opening the housing or removing any parts not normally removable by hand can expose dangerous voltages. Always turn the device off and unplug the power supply before doing so!
3. It is strictly forbidden to repair or adjust an opened device which is plugged in. And if such work is absolutely necessary, then only specially trained personnel who are fully familiar with the procedures to be used may carry this out.

Reference

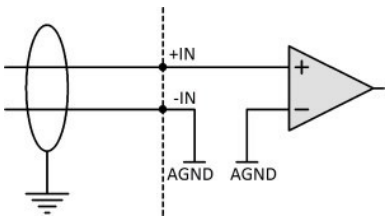
See also "Troubleshooting 22", in this chapter. Please refer to the specifications in the Appendix and the application hints for the different imc CANSAS modules for information on avoiding damage to the device due to inappropriate signal connection.

Note

Be sure to shield and ground the input and output cables properly. Connect the measurement signals as shown below to make measurements in compliance with the EMC guidelines:



Differential measurement



Single-ended measurement

For potential-isolated amplifier inputs it may be necessary to use double shielding.

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3.1 After Unpacking...

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 the supplied accessories for completeness (see scope of delivery according to imc data sheet).

Note that a imc CANSAS module must be configured before being taken into operation!

Warning ESD Warning

Despite protective measures, our components are sensitive to electrostatic discharge. Electrostatic charge may accumulate unnoticed and may even cause damage without your being immediately aware of it. Such damage can be avoided by carrying out all work at "safe" work stations and by utilizing packaging with electrostatic shielding when transporting sensitive components.
Always follow ESD precautions!

When handling static sensitive devices, observe the following guidelines:

- Always statically discharge yourself (e.g. by touching a grounded object) before handling static sensitive devices.
- Any equipment and tools used must also be free from static charge.
- Unplug the power cord before removing or inserting static sensitive devices.
- Handle static sensitive devices by their edges.
- Never touch a connection pin or conducting track on static sensitive devices.
- **Always ensure that electrostatic charge does not form at contacts between device sockets and their leads. Any charge which may develop here is to be lead off. Damage resulting from ESD is not covered in the guarantee.**

3.2 Before Starting

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.

We recommend that you allow an approx. 30 min. warm-up phase before starting a measurement.

Unless otherwise specified, the modules are designed for use in clean and dry environments. They are not to be operated in 1) exceedingly dusty and/ or wet environments, 2) in environments where danger of explosion exists nor 3) in environments containing aggressive chemical agents.

Always arrange your cables and signal leads in a safe fashion. Think prevention!

Never connect or disconnect signal leads during thunderstorms.

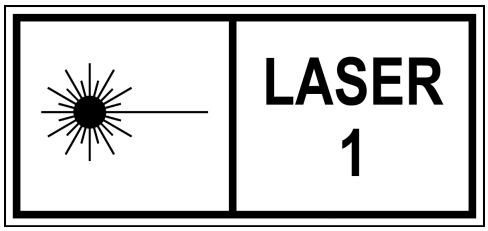
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Ambient temperature

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 Safety notes concerning laser setup

The fiber-optic FBG-T8 measuring device has laser class 1 in the case of maintenance and single faults. During fault-free operation of the measuring device, a maximum of 1.6 mW of accessible radiation is emitted at each connection point. According to Annex B, DIN EN 60825-2:2011-06, laser class 1 means that there are no unrestricted laser safety requirements. According to BGV B2, by complying with laser class 1, the accessible laser radiation can be classified as harmless even in the event of a single error.



The CANFDX/FBG-T8 device works with class 1 lasers, which means that the device is safe during normal operation. Nevertheless, looking directly into the beam of the Class 1 laser device may cause irritation to your eyesight. This is possible, for example, if the protective cover has been removed or if the device has been damaged in such a way that laser radiation can be released.

3.3.1 Optical product properties laser safety

The fiber optic FBG-T8 measuring device has a laser as light source. This is distributed via two splitters to four outputs each, whereby the power is the same on all outputs. The emission power of the light source is again reduced to approx. 1.6 mW by fixed 6 dB and 3 dB fiber couplers connected in series before the light from the fiber laser is directed to the fiber connectors accessible from the outside. Thus, the maximum light output per output fiber emitted by the FBG-T8 is reliably less than 10 mW. The emitted spectrum is between 1520 nm and 1570 nm.

3.3.2 Derivation of the laser class

3.3.2.1 Classification according to table 3 DIN EN 60825-1:2015-07

The emission spectrum of the light source lies between 1520 nm and 1570 nm and thus in the range between 1500 nm and 1800 nm of the standard. As "worst case" consideration, continuous irradiation (10^3 to $3 \cdot 10^4$ s) is assumed to be the emission duration. This results in a limit value of 10 mW optical power.

3.3.2.2 Bundled wires according table D.1 DIN EN 60825-2:2011-06

If the measuring channels are fed into a loose tube by means of a suitable cable, the laser class is evaluated in accordance with Section D.4.4, DIN EN 60825-2:2011-06. In the case of a broken loose tube, the following applies: The hazard class of the broken loose tube does not exceed the hazard class of the most dangerous optical fiber within the cable. The hazard class of the most dangerous optical fiber is 1, so the hazard class of the broken loose tube is also 1. There is a restriction here when considering precision-fractured loose tubes, which can, however, be ruled out as faults in use.

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3.3.3 Evaluation according to DGUV-11/BGV B2

The DGUV-11/BGV B2 demands: "When using a class 1 laser device as intended, no further protective measures are required. If the class changes during the maintenance of class 1 laser equipment, the protective measures for the higher class that occurs must be taken". The two maintenance and servicing measures on the CANFDX/FBG-T8 include cleaning the fiber optic connectors and connecting and disconnecting the electrical connectors during replacement. Due to the design, the laser class cannot rise above laser class 1. Therefore, no further protective measures are necessary for the intended use in accordance with BGV B2 and the safety requirements remain fulfilled even with these maintenance and servicing measures.

3.4 Troubleshooting

Only qualified technicians are allowed to make repairs on the device! Unauthorized opening or incorrect repair of the device may greatly endanger the user (electric shock, fire hazard). Devices which have been altered or tampered with no longer comply with their license and may not be used. In case of accident (e.g. damage to housing, terminals, modules or power supply, or exposure to liquids or foreign substances), turn the device off immediately, unplug the power cord and inform our tech support 10.

4 Maintenance and servicing

4.1 Maintenance and Service

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

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

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

Reference Device certificates and calibration protocols

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

4.2 Cleaning

Disconnect imc CANSAS devices from all circuits before cleaning. Only qualified personnel 16 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 Transport

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

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5 Startup

5.1 Data Carrier Contents

5.1.1 Setup-Program

The root directory on the Data-Carrier contains the file **SETUP.EXE**. Call this program in order to install the imc CANSAS configuration software.

5.1.2 Driver-software for the PC / CAN bus interface

The imc CANSAS application supports different types of interface cards. The driver software corresponding to the card used can be found on the Data-Carrier in the directory \Driver. It reflects the respective latest edition of the driver at the time of the Data-Carrier manufacture. As a rule, the current driver editions are provided by the manufacturer of the circuit boards as a CD or other hard copy, or are offered for download from the Internet.

Note Data carrier

The available driver on the imc CANSAS data carrier are tested and recommended by imc! Driver from the corresponding manufacturer may be newer but may not function correctly.

5.2 System requirements

Supported operating systems	Minimum requirements for the PC
Windows 10*/11*	1 GB RAM
Windows 8.1	100 MB free hard disk drive (NTFS format)

*released in conformance with the version of Windows 10/11 applicable at build date of imc software

5.3 Integrating the CANSAS software in imc STUDIO

If the imc CANSAS software has been installed, its user's interface can be called directly from imc STUDIO via a menu command, provided that a CAN bus interface is part of the hardware setup. However, certain functions and menu items aren't available for calling from the recording software. For example, the imc CANSAS configuration is not administered as an MDB-database, since it is saved along with the experiment under imc STUDIO. XML-export/import is possible. Access to the imc CANSAS hardware is provided via the imc hardware's CAN bus. This communicates via Ethernet, so that all interfaces incl. imc-USB as well as the Interface-Dialog are blocked.

5.4 Installation of imc CANSAS software

The software is started by running the file "Setup.exe". The supported operating systems are listed here 24. The installation process includes updating of the following drivers: MS DAO, MS-Jet Engine, MS OLE Automation, Crystal Records, Microsoft XML Parser.

The installation offers both a German and an English version of the software; make the choice in the first dialog which appears. The Welcome dialog provides in formation in the respective language on applicable legal provisions, as well as certain instructions for proceeding with the system.

The **second dialog** displays legal provisions and instructions on completing the installation procedure. The third dialog prompts the user to specify the installation folder's location. All files needed for running the imc CANSAS-module are then copied into this folder.

The next dialog is for selecting program components to install. The imc CANSAS Program files must be retained as active since they are essential for configuring imc CANSAS.

The component Report Export formats only needs to be installed if a imc CANSAS report on module configurations is to be saved in an extraneous format, such as in the form of an Excel file.

The *COM user* interface offers access to all functions when using a created program, e.g. by Visual Basic or C++. If you are going to develop your own programs, you should select COM developer. This option comes with an online-help and examples. To develop using *LabVIEW* select the option *LabVIEW* ™ Vis.

Note

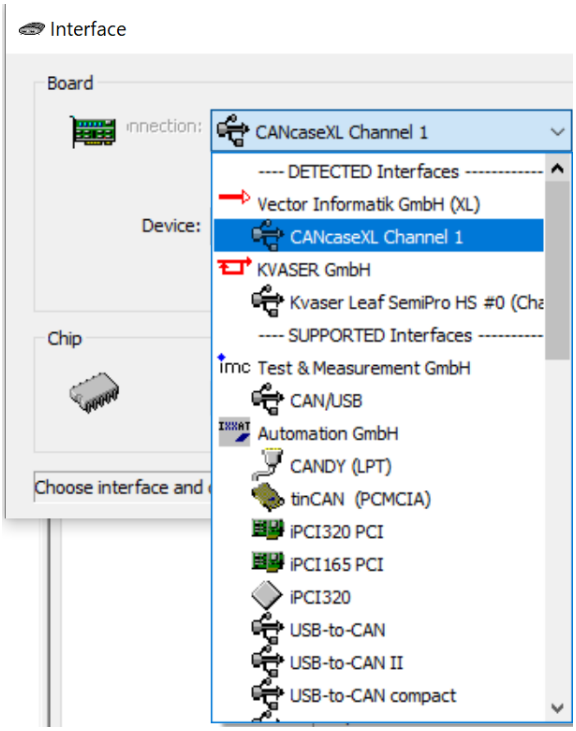
Installation of imc CANSAS does not serve to change a previous installation in terms of simply exchanging selected components. Instead, installation is carried out from scratch, completely. It is recommended to completely uninstall any previously present imc CANSAS software, particularly older versions, before installing new software! However, before uninstalling old software, any user's data stored in the program folder should be saved to other memory space or they will be lost. Such data are located in database files, for instance, under the name Imcan.mdb.

The next dialog is for selecting the program group which contains the shortcut icon for starting the module. A progress indicator bar is displayed during the actual installation process, indicating the extent of progress and which files are currently being copied.

The last dialog announces successful installation. If, however, the "Common Controls" are too old for the imc CANSAS software, the installation continues with the Microsoft installation of the common controls. This may make it necessary to reboot the computer.

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5.5 Interface cards



The interface cards supported by imc CANSAS are produced by many companies e.g. KVASER, Vector, PEAK, XXAT and HORIBA. A selection of their installation software is located in the directory *Driver*. The respective subdirectories may be further subdivided into the various interface types.

The functionality is provided by the manufacturer of the interface card or adapter. Please check the internet page of the manufacturer for driver updates also.

After correct installation and connected interface card, the device appears at the top of the list under ***DETECTED Interfaces***.

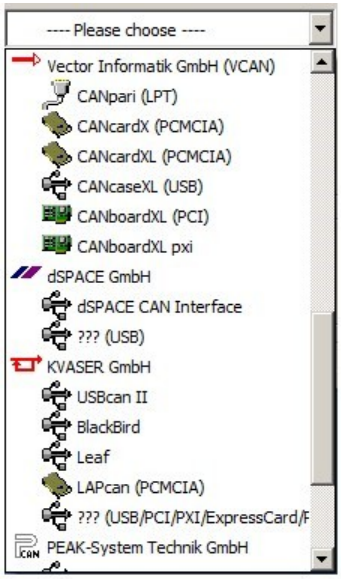
Note imc CANSAS and imc STUDIO

When using imc CANSAS from imc STUDIO, the CAN nodes of the imc devices are used as interface. No further settings are necessary for this in imc CANSAS.

Supported interfaces between PC and CAN-Bus

Manufacturer		
KVASER	CAN/USB Adapter Interface boards and modules - please consult vendor's documentation:	
	PCMCIA	LAPcan
	USB	USBcan II, BlackBird, Leaf Pro HS V2, U100
Vector Informatik GmbH	Interface boards and modules:	
	PCMCIA	CANcardX, CANcardXL
	USB	CANcaseXL, VN7600, VN7640
	Ethernet	VX1135 (VX1000 series)
	PCI	CANboardXL
	Parallelport	CANpari
	PXI	CANboardXL
DSPACE	Interface boards and modules - please consult vendor's documentation	
HORIBA	Interface boards and modules - please consult vendor's documentation	
IXXAT Automation GmbH	Interface boards and modules:	
	ISA-Interface	iPC-I320,
	PCI-Interface	iPC-I320, iPCI165, iPCI320
	Parallelport	CANDY
	PCMCIA	tinCAN
	USB	USB-to-CAN, USB-to-CAN II, USB-to-CAN compact, USB-to-CAN V2, USB-to-CAN FD compact

5.5.1 KVASER interface cards



imc CANSAS works with the KVASER -driver without problems for Win 10, 11.

After the driver has been installed, the computer must be re-started. Some FAQs about this subject can be found here 28.

5.5.1.1 FAQ for the KVASER interface

FAQ

Which version of imc CANSAS supports Kvaser Leaf SemiPro HS?

Antwort: The interface is supported by the imc CANSAS Version 1.9 R4.

How do I install my Kvaser interface (supplied by imc) so I can use it with imc CANSAS?

Answer: You can download the driver via the following link: http://www.kvaser.com/downloads/

Only **after** the driver is installed should you connect the interface to the PC. After the connection to the PC, the Windows Wizard will appear and display "*Found New Hardware*". Since you have already installed all the necessary driver data, you need only click through the menu. Windows detects and connects the driver data in this step automatically.

In the last step, the interface in the imc CANSAS software can be found under Tools -> Interface Activate. Then, click on "*Card*": *KVASER GmbH ???(USB/PCI/PXI/ExpressCard/PCMCIA)* 28 Then, check the box next to "*(Re)Activate interface*"...

I installed the driver for the imc CAN/USB adapter, but my interface is not detected! Why?

Answer: Up to the end of 2014, the imc CAN/USB adapter was supplied. At the end of the imc CANSAS installation, the dialog refers to the driver of this interface.

How you set up the *Kvaser Leaf SemiPro HS* interface for the imc CANSAS is described in the FAQ below.

I ordered an imc USB Interface and I received a Kvaser Leaf SemiPro HS Interface for my imc CANSAS. Is this a mistake?

Answer: No. At the end of 2014, the *imc CAN/USB* interface was replaced by the *Kvaser Leaf SemiPro HS* Interface.

5.5.2 Ixxat interface cards

USB-to-CAN FD; USB-to-CAN II

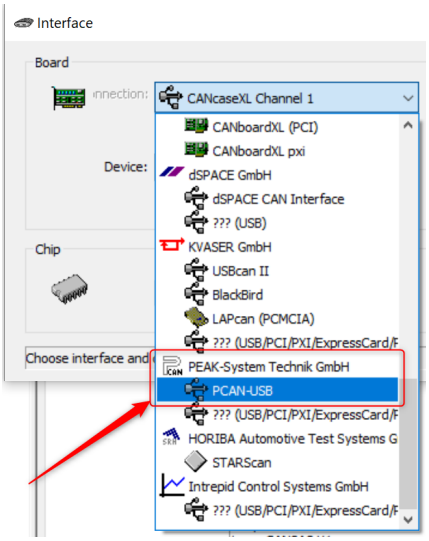
The driver for the Ixxat interfaces is to be used for imc CANSAS as follows:

1. Close imc CANSAS
2. If necessary uninstall all Ixxat drivers and
3. Run *VCI-Cleaner* to remove all driver remnants
4. Download the archive "*vci-v4-windows-10-8-7.zip*" from the page of the manufacturer Ixxat
5. After unpacking use the following two programs:
   - "*Ixxat VCI Setup 4.0.xxx.x.exe"* and
   - "*Add-Ons\IxxatVCI2onVCI4 Setup_version.exe*" (name and version varies with updates)
6. Run "***Ixxat VCI Setup 4.0.xxx.x.exe***" and restart the computer when prompted.
7. Execute the addon "***IxxatVCI2onVCI4 Setup_versionsnr.exe"***

Note Driver package

- If the "*USB-to-CAN FD*" adapter is not connected to the PC, it is not listed in the adapter selection box under "*SUPPORTED Interfaces*". After connecting it to the PC, it will be displayed under "*DETECTED Interfaces*".
- In Version 2.x, the Ixxat drivers are not real drivers but instead function as a "**wrapper-package**" for Version VCI 4.x's drivers. Thus, the Version VCI 2.x does not work alone. The Ixxat Version VCI 4.x is supported as of imc CANSAS software 2.1R2.
- By means of this wrapper functionality, imc CANSAS or another program is able to work with the newest VCI 4-drivers. Furthermore, all Ixxat-interfaces are thus available under a 64-bit Windows installation, as soon as the associated driver is available.
- Ixxat recommends the use of this new VCI-driver-combination for all Windows versions (as of Windows 2000). Further information can be found at the Ixxat web site www.Ixxat.com in the Internet.

5.5.3 PEAK interface cards



Please note the instructions in the PEAK documentation.

Drivers for PEAK interfaces can be found in "*Driver\Peak*".

After the driver has been installed, the computer must be re-started.

5.5.4 Vector interface cards

The imc CANSAS software does support the XL interface cards from Vector. The XL-interfaces are denoted by "(*XL*)". The XL-group offers an additional Vector-XL-interface item "*??? (USB/PCI/PXI/PCMCIA*)" for selection.

Interfaces for the old VCAN Vector driver library are displayed with the extension "(*VCAN*)".

As of imc CANSAS software 2.4 R1, the VX interface cards (e.g. VX1135) from Vector are supported.

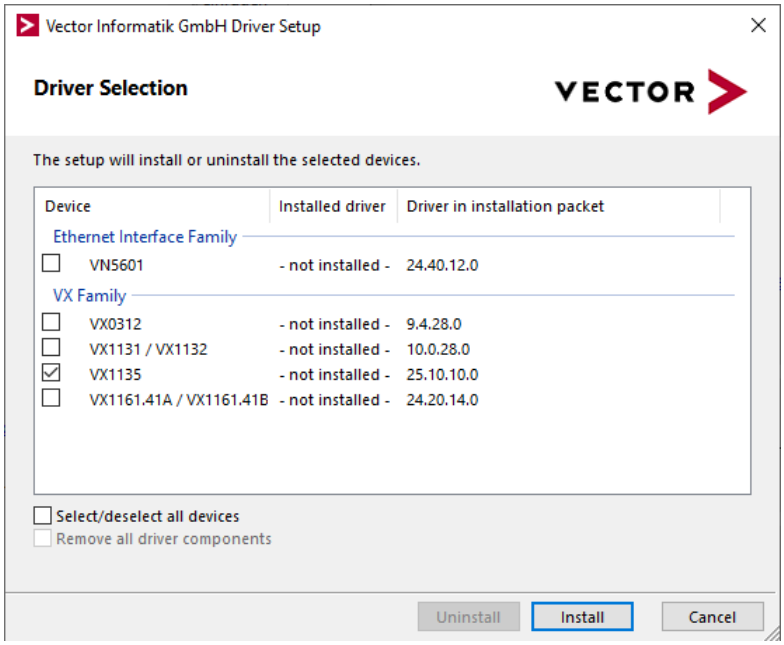
Notes — Vector Driver

- Installation of the driver is **absolutely necessary** for the card to support the imc CANSAS software!
- The operation of the Vector Hardware Manager has been changed compared to the former Vector Hardware Config tool. Please read the corresponding instructions provided by Vector, such as the Basic Concept and the Quick Start Guide.

Reference — Download the Vector Driver Setup

The Vector Driver Setup can be downloaded here (currently the version 25.10.18):
https://www.vector.com/int/en/download/vector-driver-setup-for-windows-10-and-11/

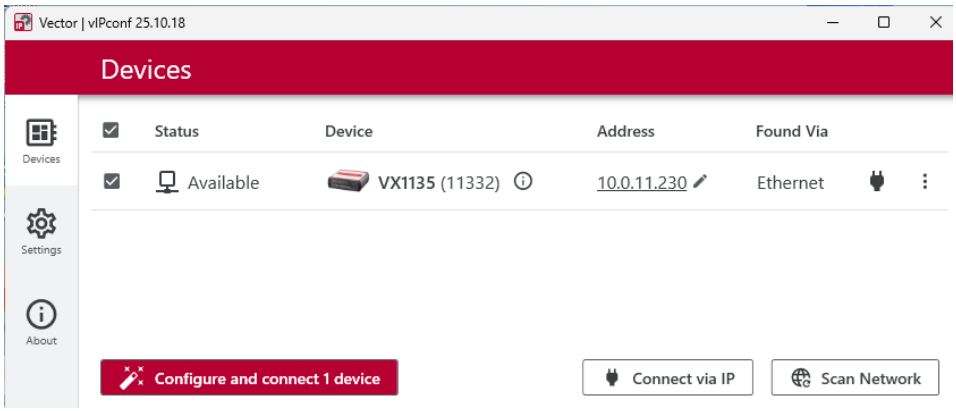
Example — VX1135



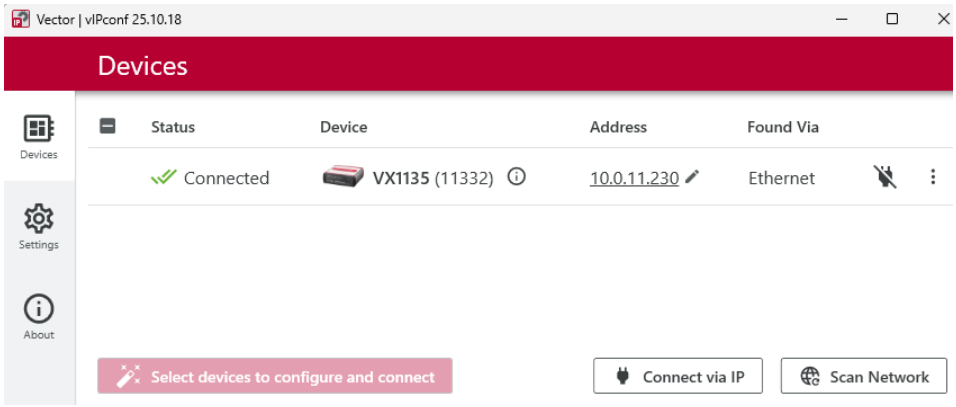
When you install the driver, select the device that you want to use with your imc CANSAS modules.

Note

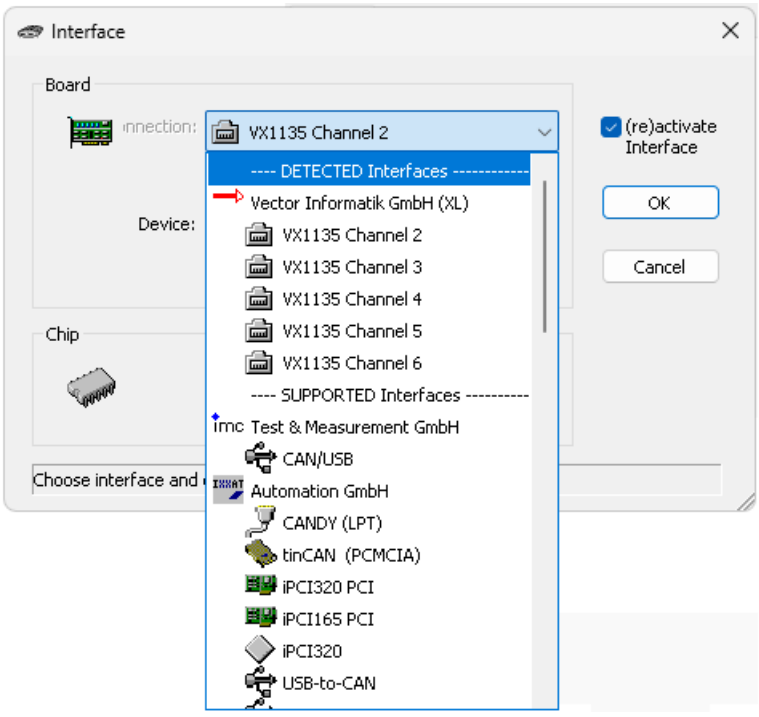
The IP address of the device must match the address of the PC. The **subnet mask must be: 255.255.255.0**. Perform a network scan with the vIPconf application.



To initiate the connection between the PC and the VX1135 device, confirm the "*Connect via IP*" button.



A successful connection between your PC and the VX1135 device is confirmed with the status "*Connected*".



In the imc CANSAS software, you can now select the channels of the VX1135 device under "***DETECTED interfaces***".

5.5.5 IntrepidCS interface cards

For Windows 10 imc CANSAS does support any interface cards from Vector.

Additionally, an additional interface item is available for selection in the Intrepid group: "*??? (USB/PCI/PXI/ExpressCard/PCMCIA*)". This corresponds to support of an arbitrary Intrepid interface type.

See the corresponding instructions provided by Intrepid under the Windows operating systems. To use the card, the driver installation appropriate to both the interface and operating system type must be used. It is preferable to use the current driver which comes with the card. Installation of the driver is **absolutely necessary** for the card to support the imc CANSAS software!

Note that the Vector driver often comes with an updated file named *Vcan32.dll*. This serves as a link for applications which want to use the card driver. This file is usually not automatically copied onto the PC by the Intrepid driver installation and must be copied to the imc CANSAS directory 'manually'! See Intrepid's instructions file for the driver installation, usually designated *Readme.txt*.

Installing the Intrepid driver adds an item "*CAN Hardware*" to the Windows Control Panel. This control program can be used to test any Intrepid interface. Otherwise, the program's functions aren't needed for running the imc CANSAS software.

Further information on the Intrepid cards can be found at the web site http://www.intrepidcs.com/. in the Internet. The most current driver software can also be obtained there as a download.

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5.6 Connections

General notes on power supply can be found here 583.

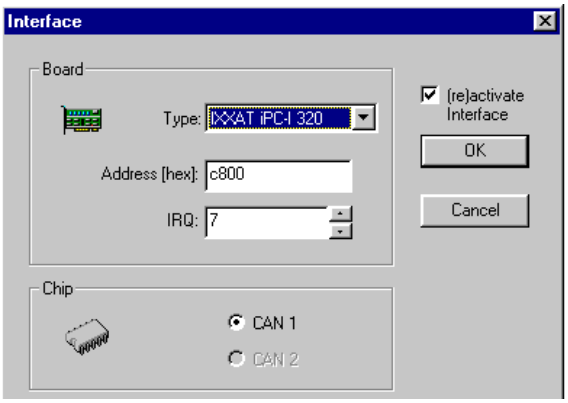
5.6.1 CAN connection for the PC

The access for CAN to the PC is provided via an ISA-bus card, PCI-bus card or a USB or parallel port adaptor.

To install the card or adaptor, please observe the notes and instructions in the booklet which comes with the card and use the corresponding driver.

Checking connections

A dialog called from the menu item in the imc CANSAS interface's '*Extras*' menu allows you to make settings for the CAN bus access and for interface parameters. Details are available in Chapter "Operation" - *Extras/ Interface* 104.



The integration assistant can integrate and configure both available and not yet available modules.

Details are available in Chapter "Operation" - *Module/ Integrate* 91.

5.6.2 CAN connection to CANSAS

The imc CANSAS-module possesses a full-grade CAN (Controller Area Network) connection for transmitting measurement data, and can send messages at up to 1 MBit/s. The CAN-connection is a node on the CAN bus, to which any number of CAN-devices can be connected, see CAN bus description 43.

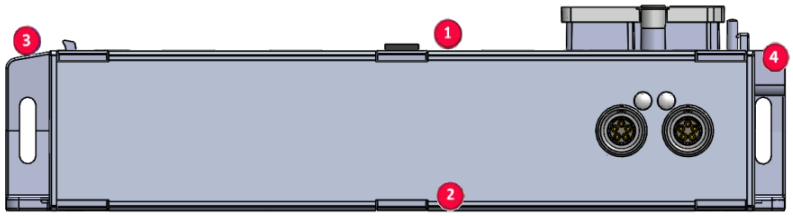
5.6.3 CANSAS analog connections

The imc CANSAS-module's measurement input connections consist of sockets for separate sets of measurements. Depending on the module type differential channels can be connected. For ease of connecting, special imc plugs having screw terminals can be ordered. The pin configuration is described in the chapter Pin configuration 592.

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5.7 Attachment mechanism CANSASfit (CANFT) modules

imc CANSAS*fit* (CANFT) modules can be mechanically and electrically connected via a click mechanism, without using any tool or cable.



Stacking the modules

1. Hook tongues into the grooves 3
2. Press modules together
3. To finish mechanical connection, press on the imc logo on the locking latch 4.
   You will hear a click.

Now the modules are mechanically locked and electrically connected!



locking latch

Detaching modules

1. Press the circle on the locking latch 4.
   You will hear a click.
2. Pull tongues 3 out of the grooves.

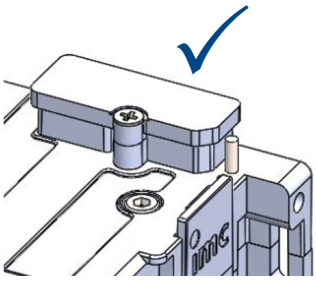
Protection

For technical reasons, the imc CANSAS*fit* modules are uncovered where the module connectors are made. When used in a controlled, dry environment, this should cause no problems.

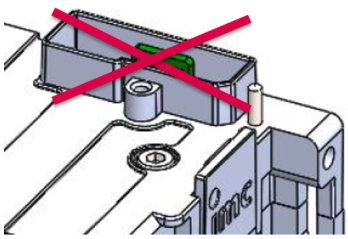
In order for an imc CANSAS*fit* module (or a group of modules attached in a substack) to be protected against foreign objects and moisture, please take the following steps:

Attach coverings to the module connectors on top 1 and bottom 2 sides of the module.

On the left side 3 of each module, there are two covers attached (parked position). Especially for the CANFT/HISO-xx modules 274, both covers must always be fastened to the connection points when the connectors are not used.



module connector protected



module connector not protected



parking position for the two covers

Explanation:

1. upper side of the module (side with USB-service connection*)
2. lower side of the module
3. "tongues", left side
4. locking latch, right side

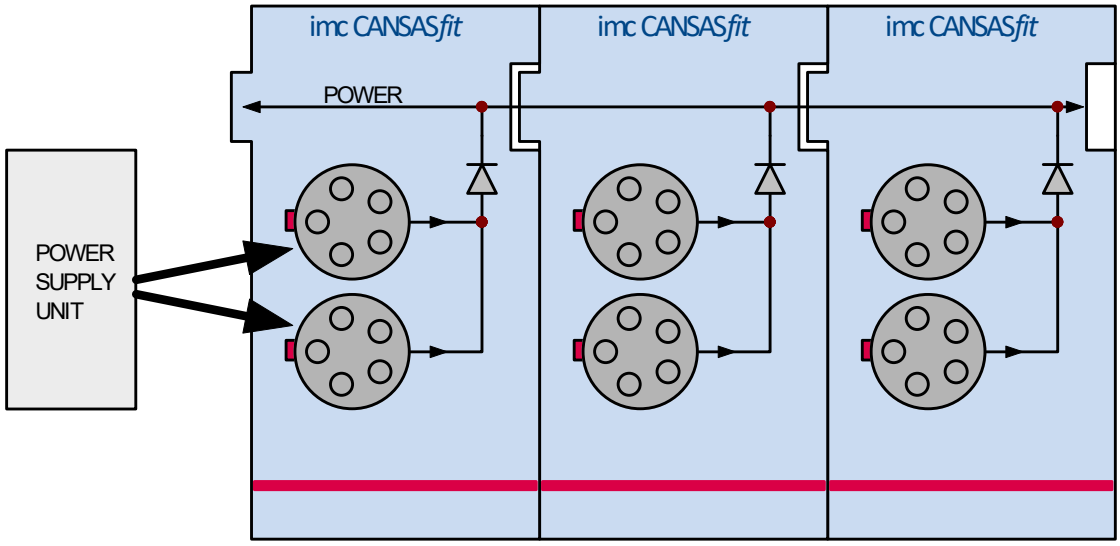
* The Micro-USB-connection is only for service- and diagnostic purposes.

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5.7.1 Power supply options with CANFT

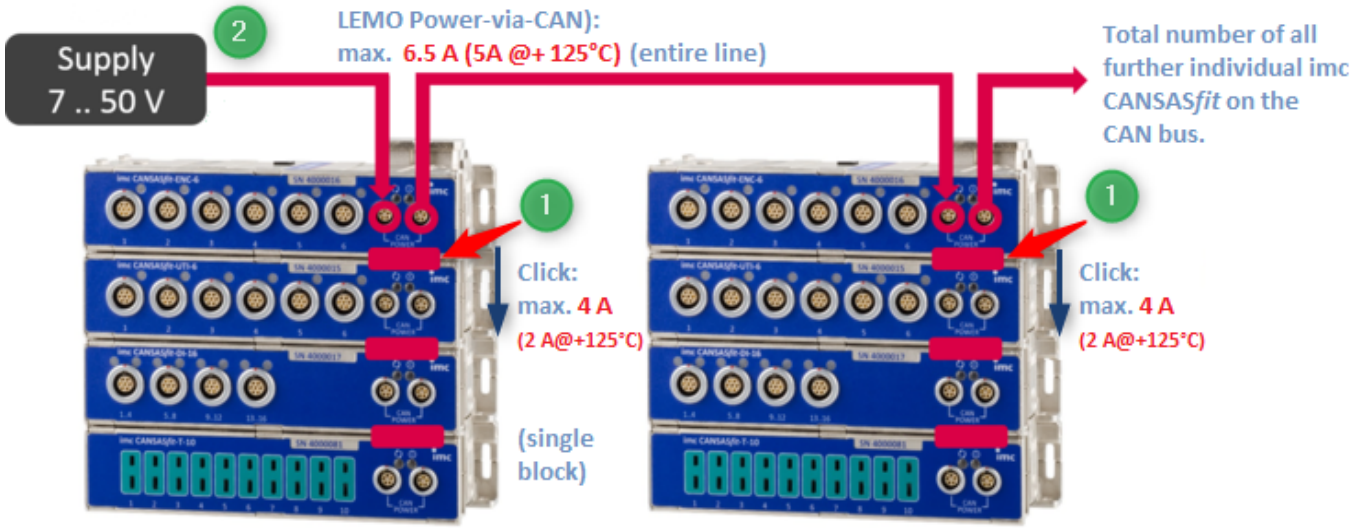
1. **Individual power supply**
   - DC 7 V to 50 V via LEMO.0B.305 (CAN/POWER, galvanically isolated input)
   - Activation / deactivation by connection of the power supply.

2. **Common supply of a module substack**
   The two CAN/POWER sockets (LEMO.0B.305) of one CANSAS*fit* module are **connected in parallel** and concerning power and CAN they can be handled like Y-cable.



Note Power supply

The supply can only be taken from a CAN / POWER socket that is supplied via the other CAN / POWER socket of the module.



pass through power limits and available power, see following example

In addition to the maximum number of modules in a block (8 modules) resulting from the termination, the maximum current that may flow through the first module must be taken into account. The following tables can be found in the technical data sheets of the modules:

Max. number of modules for direct coupling (block size with click mechanism)		
Parameter	**Value**	**Remarks**
Max. number of modules	8	limited by termination of internal CAN-Bus backbone (click junction)
Pass through power limits for directly connected modules (click-mechanism) 1		
Parameter	**Value**	**Remarks**
Max. current	4 A	at 25°C current rating of click connector
	-20 mA/K·ΔT_a	derating with higher operating temperatures T_a $\Delta T_a = T_a - 25°C$
Max. power	48W at 12 V DC 96 W at 24V DC	equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor and installations
	24 W at 12 V DC 48 W at 24 V DC	at +125°C
Available power for supply of additional modules via CAN-Kabel (LEMO.0B, "down stream") 2		
Parameter	**Value**	**Remarks**
Max. current	6.5 A	at 25°C current rating of LEMO.0B connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-15 mA/K·ΔT_a	derating with higher operating temperatures T_a $\Delta T_a = T_a - 25°C$
Max. power	78 W at 12 V DC 156 W at 24 V DC	equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor and installations
	60 W at 12 V DC 120 W at 24 V DC	at +125°C

1. The internal supply line for the module block may be loaded with a maximum of 4 A.
2. The two CAN/POWER sockets (LEMO.0B.305) of one CANSAS*fit* module are **connected in parallel** and concerning power and CAN they can be handled like Y-cable. This cable may be loaded with a maximum of 6.5 A.

Example

One module block consisting of **6x** *UTI-6-SUP* (2.2 W / 7 W), **1x** *ENC-6* (1.5 W/3.5 W) and **1x** *T-10* (1 W / 1.3 W). Data in brackets (typical/maximum). Operating temperature inside = 125 °C

Max. current per block = 4 A - (0.02 A/K*(125-25)K= 4 A-2 A= **2 A**

Max. total power= 6 x 7 W+ 3.5 W+1.3 W = **46.8 W**

AC/DC power supply 24 V	current = 46.8 / 24 V= 1.9 A	< 2 A-> OK
car battery 12 V	current =46.8 / 12 V= 3.9 A	> 2 A -> Not OK

5.7.2 Use with ARGFT base unit

imc ARGUS*fit* enables the integration of imc CANSAS*fit* modules. These are clicked onto the left side of the ARGUS*fit* base unit. Additional modules can be connected by cable to the LEMO socket "CANSAS".

The channels of these modules are fully integrated into the imc STUDIO setup page as analogue channels. Further CANSAS*fit* modules connected via a CAN F**D** module (interface) are integrated via the CAN editor and appear in the channel list as fieldbus channels.

Example A CANFT modules with base unit

All **CANFT modules clicked onto the ARGFT base unit** use a CAN node with 500 kBaud (node 1).

Example B

All CANFT **modules connected to the ARGFT base unit via cable** use a separate node with 500 kBaud (node 2).

- Both CAN nodes support imc CANSAS*fit* (CANFT) modules only.
  As long as the base unit is connected to a DC supply voltage, the CANFT modules are permanently supplied via the CANSAS socket regardless of the operating state (on/off) of the base unit.
- Blocks of up to 8 CANFT modules can be connected together if the power and the maximum current of the power supply allow this.

Excel-Calculator for CAN bus load with imc CANSAS*fit* modules:

- Derive max. number of modules / channels / data rates
- Simplified model and **rough worst case calculation** (@ 32 bit output)

Reference Download Excel-Calculator

Download.xlsx

https://www.imc-tm.com/fileadmin/Public/Downloads/Datasheets/imc_ARGUSfit/ARGUS-CANSASfit_Interface_CAN_Bus_Load.xlsx

Note **First use of CANSAS*fit* modules on the ARGUS**

It must be ensured that the CANSAS*fit* modules are operated with **imc CANSAS Software Version 2.3 R1** or higher before use on the imc ARGUSfit.
To do this, the module must be updated with the CANSAS software via a USB-CAN interface (e.g. KVASER) or an imc CRONOS/BUSDAQ device.

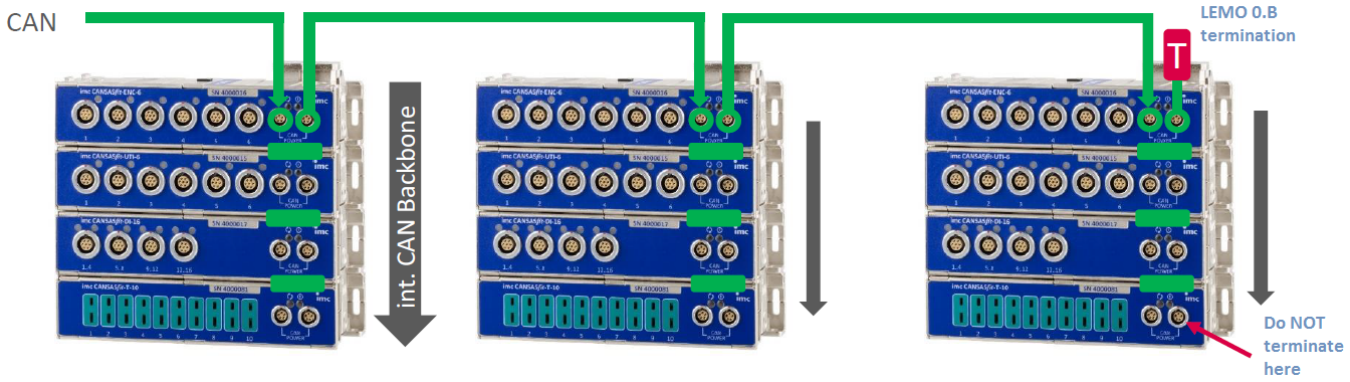
- This procedure is the minimum requirement for connecting these CANSAS*fit* modules to an ARGUS*fit* device for the first time. When connected to the ARGUS, the CANSAS*fit* module is updated with the appropriate firmware by imc STUDIO.

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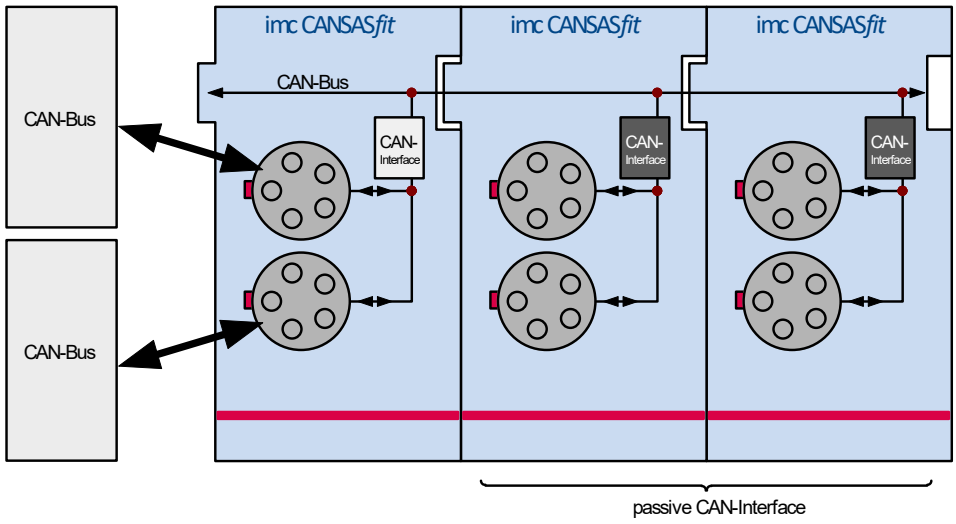
5.7.3 CAN Terminator with CANFT

The **modules in a CANSAS*fit* block** are connected via click connectors:

- The modules are electrically isolated and **internally terminated**
- The modules are designed for blocks of max. **8 modules**
- The **end of a block** may **NEVER be terminated** externally!
- If several blocks are interconnected, termination takes place at the bus end, at the first module of the last block.



The CAN bus is only at the left most module active (side with the visible USB service connection):

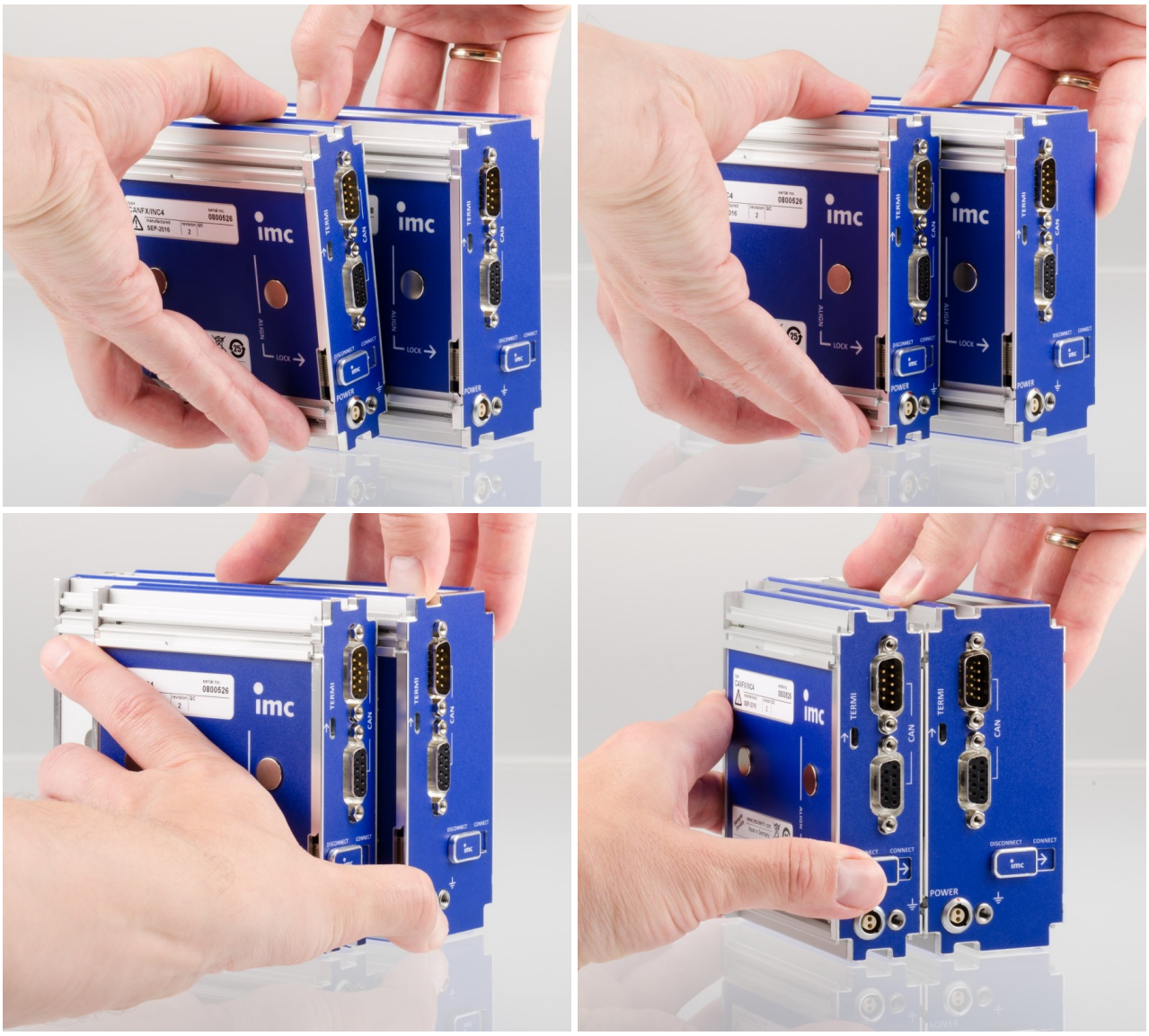


5.8 Attachment mechanism CANSASflex (CANFX) modules

imc CANSAS*flex* (CANFX) modules can be mechanically and electrically connected via a click mechanism, without using any tool or cable.

1. Insert the guide stub of the first module into the guide slot of the second module.

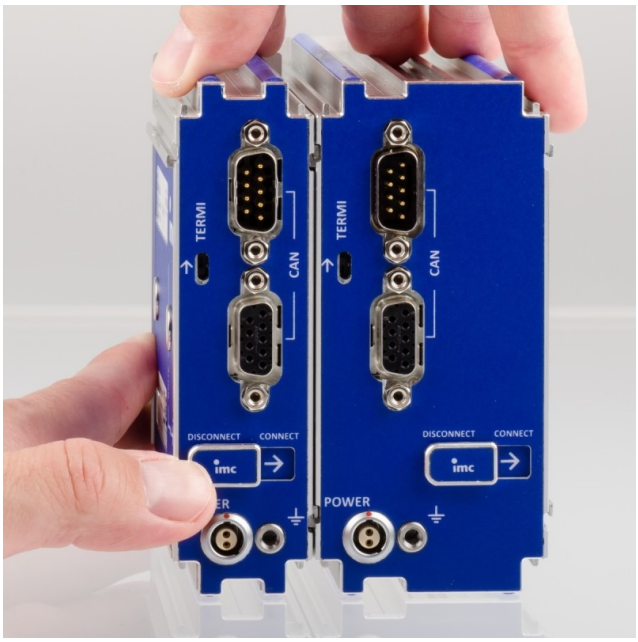
   The white arrow on the side of the module shows the position (**ALIGN**) at which you need to hook the module in. The engagement magnets aid in achieving the correct positioning (**LOCK**).

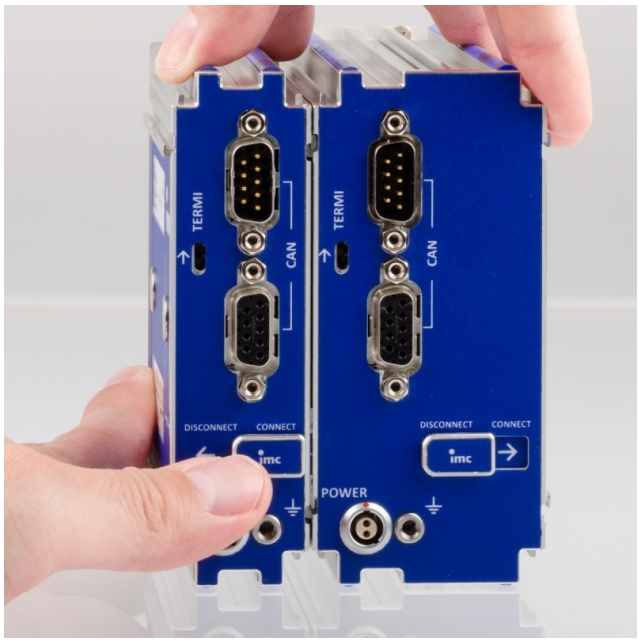


2. In order to be able to join the modules, the rear sides must be flush.

Reference Housing

The different available module variants are specified and listed in the data sheets. You can find in here an overview of all 280 modules.





3. Slide the locking latch to the "**CONNECT**"-position.
Now the modules are electrically connected and mechanically fastened. In order to separate the modules from each other again, slide the latch to the "**DISCONNECT**"-position.

Note

- The locked modules are assigned to node **CAN1**.
- Make sure that the locking latch engages beyond the mechanical resistance. Otherwise the power supply is connected, but not the CAN bus.
- During the running measurement, modules must not be disconnected from the system and reconnected (hot-plug during a running measurement is not supported). To avoid damage: Disconnect the supply lines before clicking or removing modules and turn off the system to ensure that the system is disconnected from the supply voltage.

Warning Magnetic fields

- In order to secure the mechanical handling and avoid displacement, the locking slider of each module in a block of modules should be closed (locking slider in "CONNECT" position).
- According to current scientific knowledge, **magnetic fields** of permanent magnets do not affect human health. For this reason, **health hazards due to the magnetic field are unlikely**. However, the functioning of heart pacemakers and implanted defibrillators can be affected (e.g. a heart pacemaker may be switched into test mode). Persons wearing such devices should maintain adequate distance.
  The magnetic fields are so strong in the immediate vicinity that sensitive electronic equipment such as data carriers, credit and debit cards, hearing aids, loudspeakers or sensitive ferromagnetic mechanical equipment such as pocketwatch mechanisms can also be affected or damaged.
  Contact with the magnets by food should be avoided. The magnets are protected with a coating (Ni, Au, Zn) to which some persons can have an allergic reaction (Nickel allergy).

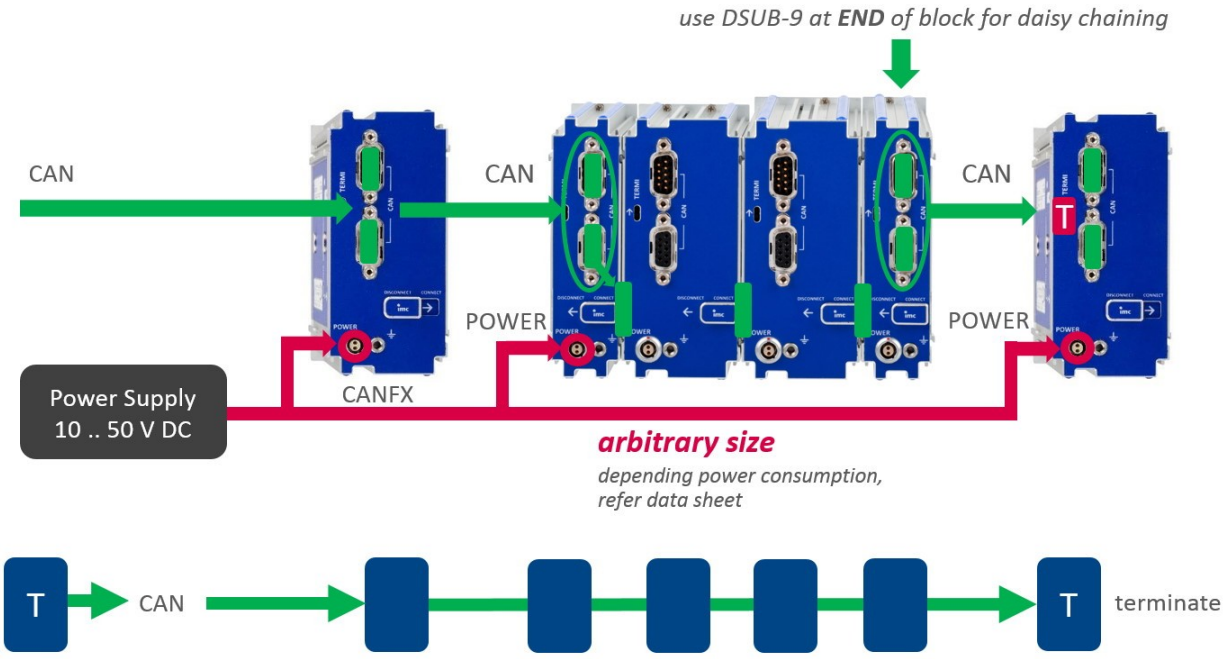
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5.8.1 Power supply options with CANFX

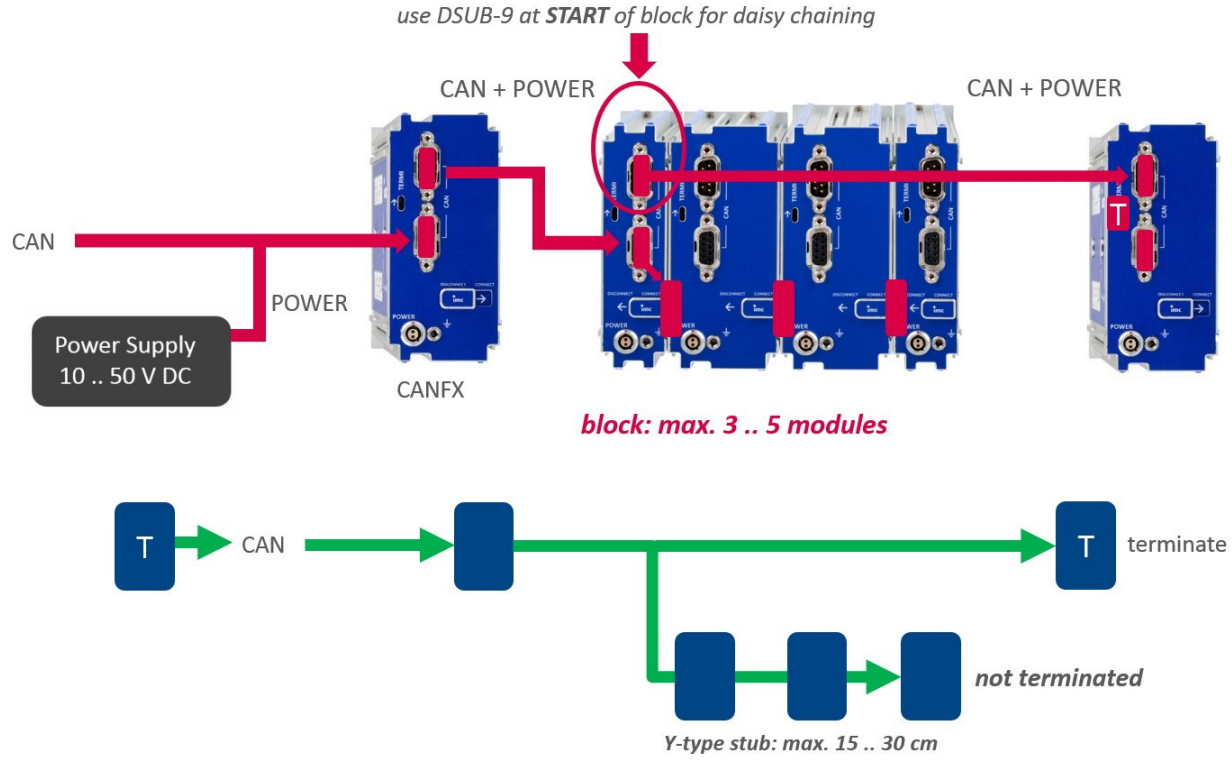
Power via CAN

The following figures: A) and B) show connection possibilities, depending on the use of power via CAN. If your device has the **Power via CAN** functionality, the **DSUB connection** on your device is labeled.

A) Power via CAN not used: no stubs, unlimited block size



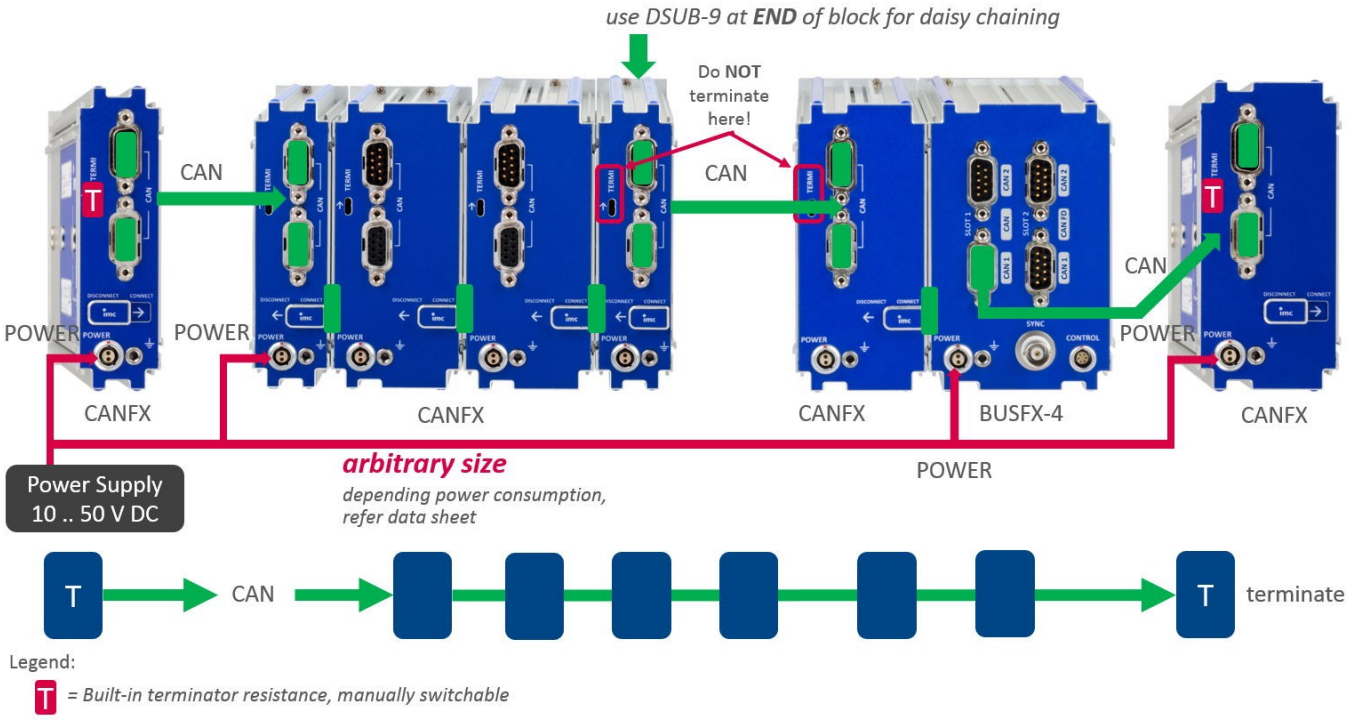
B) Use of Power via CAN: max. size of stub blocks (Y-type stub), according CiA®



5.8.2 CAN Terminator with CANFX

Each imc BUSDAQ*flex* (BUSFX) offers 2 CAN nodes as basic equipment. The imc CANSAS*flex* modules (CANFX), which are connected to the BUSFX device via the click connection 39, are located at the **CAN 1 node of slot 1** (see labeling on the device, *CAN 1*).

Terminators must be provided at the end of the CAN bus. The BUSFX device has internal terminators that can be activated by software. These can be activated individually for each node. If the BUSFX device is connected to one end, the termination can be activated in the CAN Assistant. As soon as CAN modules are connected to the CAN 1 node and additional clicked modules are connected 39 to the BUSFX device, no additional termination is allowed in the CAN Assistant.



Notes — CAN Terminator

- A ***Y-type stub*** cannot be terminated. Only the **bus end** has to be terminated: last module or **end** (not beginning) of the last block!
- A ***Y-type stub*** must not exceed a maximum length of 30 cm.

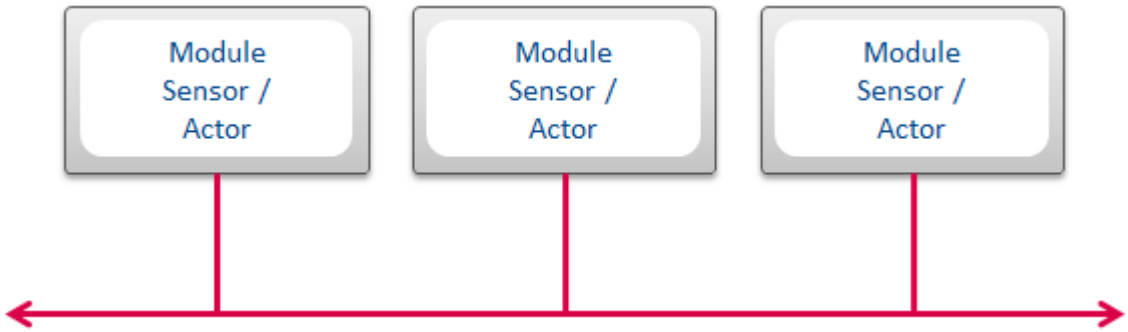
- **Connection of the terminators:**
  - **CANFX modules** are equipped with built-in terminator resistances which are **manually switchable**. Alternatively, terminator resistances can be connected between pin 2 and 7, using resistances of 120 Ω according to the CiA® standard.
  - **Terminate end of entire CAN bus** only. Otherwise, no further terminators may be connected.
  - Termination resistors, which are **activated via software to the BUSDAQ*flex* nodes**, remain active even if the device is set into sleep mode.

5.9 CAN bus description

The CAN bus (CAN = Controller Area Network) is a serial connection of all modules, with terminators at the line's ends. imc CANSAS is designed to be operated on a CAN bus which complies with CiA® standards (CiA Draft Standard 102 Version 2.0, CAN Physical Layer for Industrial Applications).

Multiple sensors and devices are connected onto the CAN bus and send data (at a fixed rate) via the bus. Each device (or sensor) transmits its data to the bus together with an identifier. The identifier provides an unambiguous indication of the source and sense of the data. An identifier is a packet of data up to 8 Bytes in length.

Each CAN-module is referred to as a node. A node can also be a sensor, control device, or a imc CANSAS-module's primary connection.



CAN-Bus

5.9.1 References to standards and literature

- CiA® Draft Standard 102 Version 2.0: CAN Physical Layer
- CAN Controller Area Network by Wolfhard Lawrenz, Hüthig Verlage, 1994 Heidelberg
- ISO / DIS 11898 (ISO 11519-2) for bus drivers
- ISO / OSI reference model

Note Remote Frame

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

5.9.2 Bus-activation

- CAN Transceiver as per ISO / DIS 11898
- galvanic isolation
- baud rate set using software
- standard identifier for CAN bus: 11 bit Identifier (0..2047) or 29 bit extended Identifier.

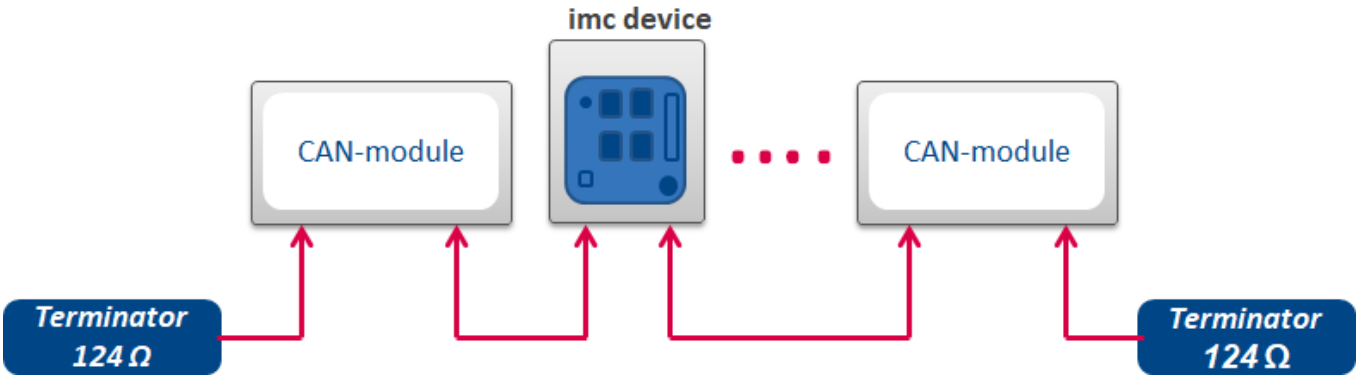
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5.9.3 CAN bus wiring

Connecting imc CANSAS without a tee-junction is *recommended*

In this case the module has 2 sockets; an input and an output as per CiA®: One 9-pin, male DSUB socket and one 9-pin, female DSUB socket or two 10-pin LEMO.1B.310 sockets at SL modules.

This is the preferable alternative for connecting, and this is the only alternative imc CANSAS is designed for. In this case it doesn't matter whether other sensors are connected with the CAN bus with or without tee-junctions. The illustration shows an example of several imc CANSAS-modules and an imc device all connected via CAN bus.



CANSAS connected without tee-junction

Connecting imc CANSAS with a tee-junction is *Not* recommended

If a module has only one terminal socket, then this one socket is 9-pin female. In this case, an external tee-junction must be used.

Note that with a CAN bus data transfer rate of 1Mbit/s, the tee-junction stub line may only be max. 30cm long. Therefore, if an external tee-junction is connected, plug the junction directly into the module socket.

5.9.4 Connecting the terminators

The terminators' resistance is 124 Ω as per CiA®.

Connect terminators between CAN_L and CAN_H (DSUB pins 2 and 7), if applicable.

Terminators are connected at both ends of the bus. There is no other place in the line where they may be connected. The bus must end at terminators.

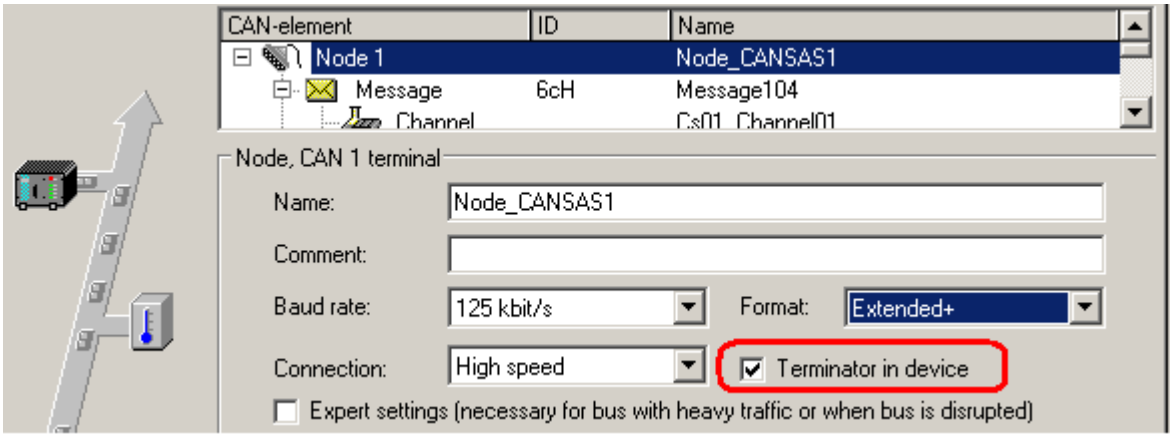
Warning Safety note

In general, it is OK to pull the CAN-plug during operation. When it is re-plugged afterwards, reset of the imc CANSAS-module's CAN-controllers will automatically be carried out, and then it will resume working with the CAN bus. However, the device is not designed to allow operation under these circumstances; it normally functions acceptably, but this cannot be guaranteed. For example, re-connecting can lead to an electrostatic discharge where voltages higher than permitted can develop and cause fatal damage to the circuitry. A person can receive a charge of 1000 V from an electric discharge; much higher than specified in ISO 11898. To ensure proper functioning, it is best to switch imc CANSAS off and then on again.

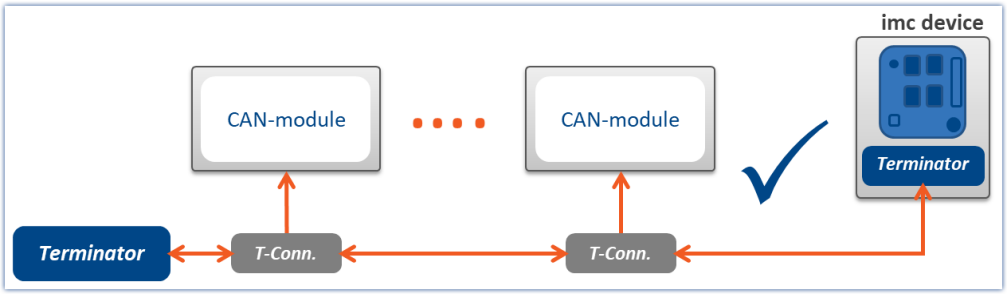
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5.9.4.1 Termination in data logger

Devices equipped with CAN bus interface, can switch a terminator resistor internal via software. If the device is connected at one end of the CAN line, an external Y-cable with terminator is not needed. The terminator is activated as follows in the imc STUDIO software's CAN-Assistant:



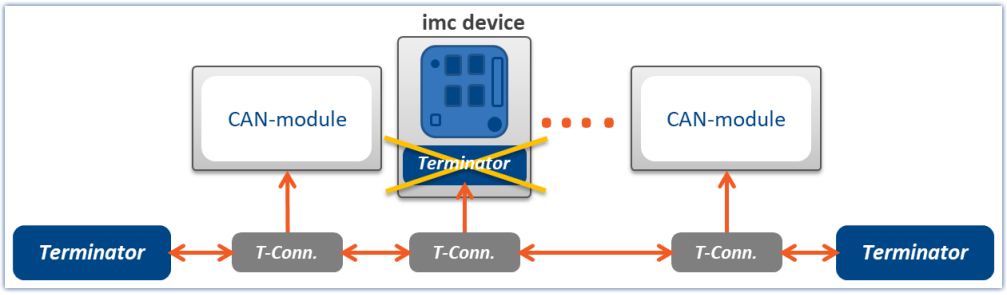
Terminator in imc datalogger - set in the CAN assistant



Correct termination

Warning

If the CAN bus is already terminated correctly, that option cannot be used!



Wrong termination

5.9.4.2 Termination with µ-CANSAS

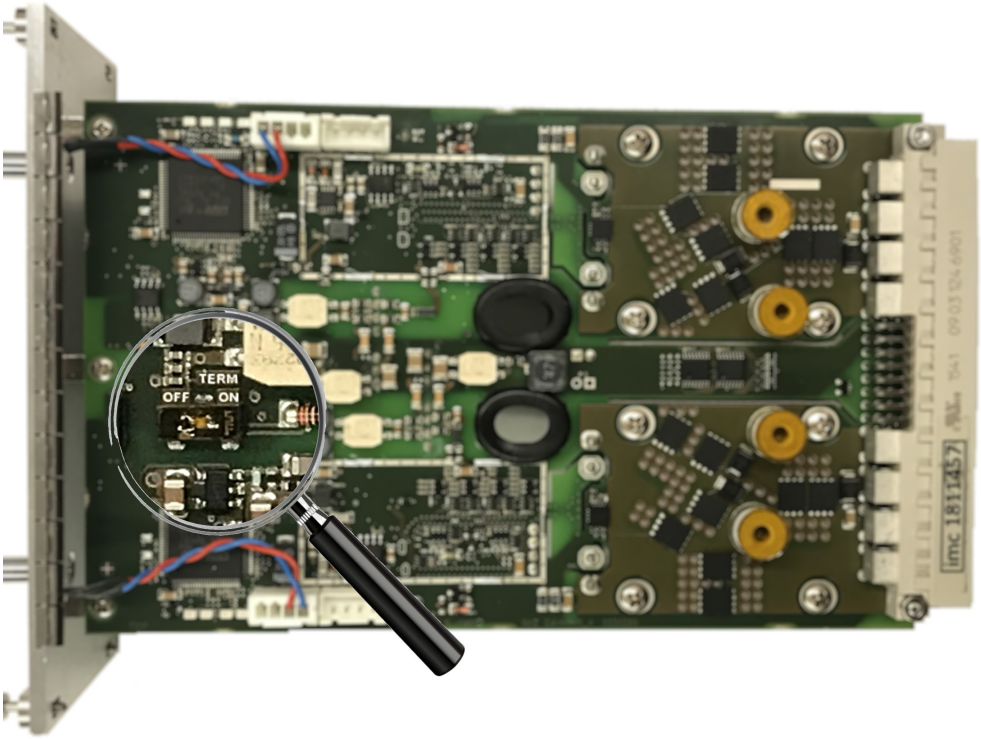
Note that there are imc µ-CANSAS 403 modules both with and without internal termination. The termination is already determined at the purchase order, and cannot be modified subsequently.

Terminated imc µ-CANSAS modules are distinguished by a "T":

Code	Name	Order code
1160030	imc µ-CANSAS-T1-AST	µ-CAN/µ-T1-AST
1160031	imc µ-CANSAS-V1-AST	µ-CAN/µ-V1-AST
1160032	imc µ-CANSAS-B1-AST	µ-CAN/µ-B1-AST

5.9.4.3 Termination with IHR

On each IHR plug-in module (CAN/IHR-R code no. 1050450, CAN/IHR-48V-R code no. 1050451) there is a terminating resistor available which can be switched on.



The marked position shows the position of the terminator on the plug-in module (centered on the handle side).

At the time of delivery this terminating resistor is not set.

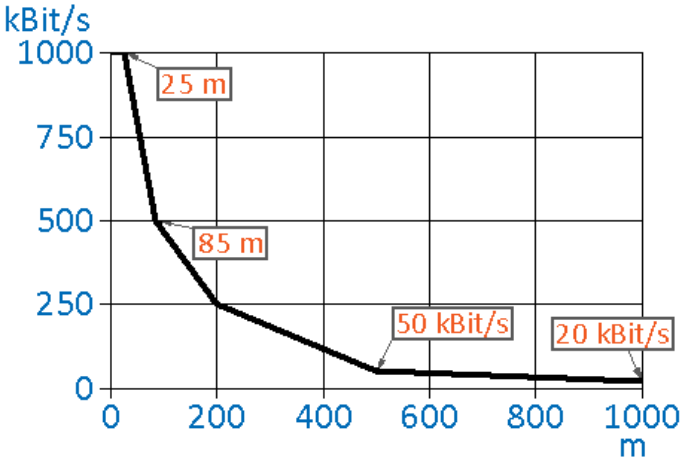
When operating several modules on a backplane only one terminating resistor must be switched on.

Reference IHR description

Please find here more information of the IHR modules 448.

5.9.5 CAN data transfer rate

As signal lead lines become longer, the maximum reliable data transfer rate decreases. Furthermore, the possible data rate depends on the bus timing, which in turn is determined by the hardware configuration and software version.



Data rate over line length for CANSAS-modulse or imc-USB Interface

The diagram shows the transfer rate for present-day imc CANSAS modules and the imc USB Interface.

Line length [m]	Data rate [kBit/s]
25	1000
85	500
200	250
500	50
1000	20

Devices from imc are built with electrical isolation from the bus. Devices without electrical isolation achieve somewhat higher values for the maximum line length: 40 m at 1000 kBit/s or 100 m at 500 kBit/s.

Net data rate

Conversely, the net data rate depends on the package size and on whether the Standard Frame or the Extended Frame is used. For instance, if each imc CANSAS message has been optimally packed in 8 Byte chunks, the Standard Frame is used and there are no further subscribers connected to the node, the rate reaches 576.6 kBit/s, amounting to 36 kSamples/s. The table shows the net data rates for 1 MBit/s.

Data length	Net data rate with	
	Standard Frame	Extended Frame
0	-	-
1	72,1 kBit/s	61,1 kBit/s
2	144,1 kBit/s	122,1 kBit/s
3	216,2 kBit/s	183,2 kBit/s
4	288,3 kBit/s	244,3 kBit/s
5	360,4 kBit/s	305,3 kBit/s
6	432,4 kBit/s	366,4 kBit/s
7	504,5 kBit/s	427,5 kBit/s
8	576,6 kBit/s	488,5 kBit/s

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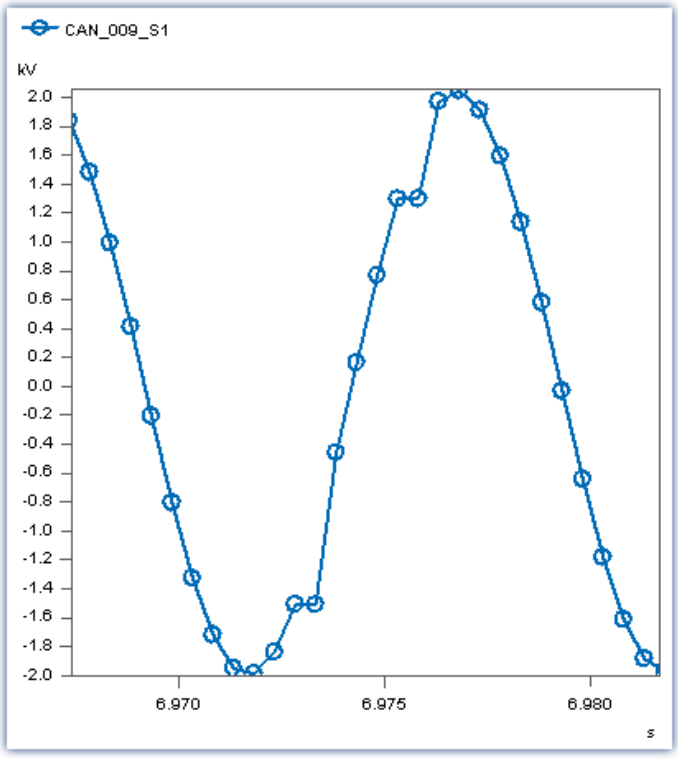
5.9.6 Number of CAN-nodes

Correlation between line length, number of nodes and cable cross section. The cross section of the line should increase in size as more CAN-nodes are served by the system.

Line length	Number of nodes/ Cable cross section		
	32	64	100
100 m	0.25 mm²	0.25 mm²	0.25 mm²
250 m	0.34 mm²	0.5 mm²	0.5 mm²
500 m	0.75 mm²	0.75 mm²	1.0 mm²

5.9.7 Duplicate samples in during data capture

Due to factors affecting the overall system, CAN bus modules feature a considerable amount of jitter (<100 µs) in outputting the measured data. If the data are recorded at a high sampling rate, some values may be duplicated or, in rarer cases, erroneous data may appear. This effect only concerns modules having a high sampling rate (e.g. imc µ-CANSAS, imc CANSAS*fit*)



Possible remedies:

a) **Universal**:
Sample the imc CANSAS channel with a time stamp instead of equidistantly.

b) **When using imc STUDIO**:
Use the CAN-1 synchronization 126. This is absolutely necessary if subsequent data processing is performed with in imc Online FAMOS.

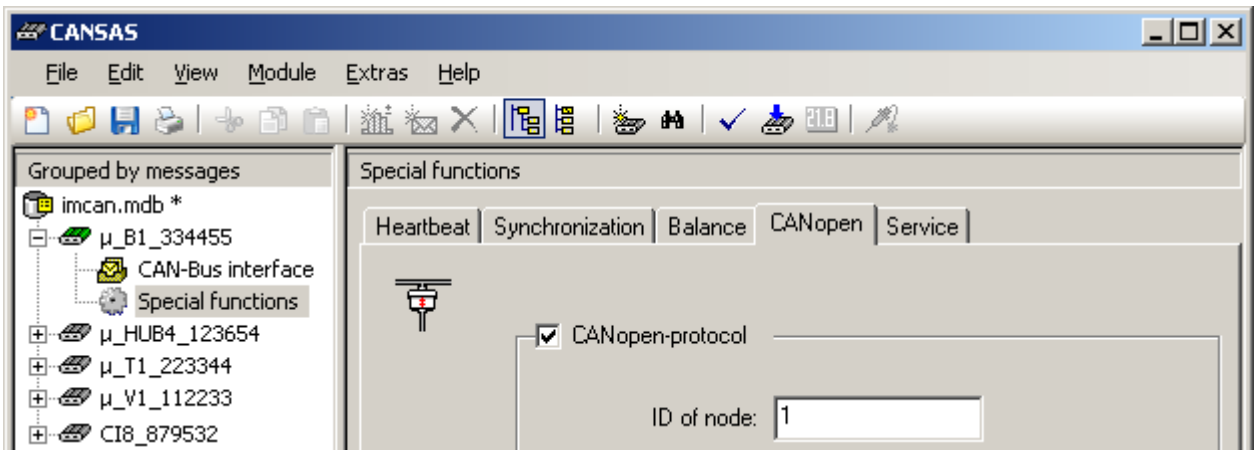
5.9.8 CANopen

CANopen® is a standardized protocol based on CAN with a 7-layer protocol stack for a variety of hardware and software. Its open structure allows automated configuration of a CAN-network of up to 111 nodes and up to 127 logical devices per node. At present this protocol is used in a every possible field. While it once was used primarily for drive-controlled machines, it is now found in off-road vehicles, medical equipment and even building automation.

By means of standardized communication objects for real-time data and configuration data, as well as additional communication objects, developers can avoid performing time-consuming implementation and specification work for the CAN bus. Uniform access to all device parameters is thus made possible.

imc CANSAS modules support the CANopen® protocol in accordance with "CiA DS 301 V4.0.2" and "CiA DS 404V1.2"; 4 PDOs in INT16, INT32, and FLOAT. Modules supporting CANopen® can be found here 280.

A imc CANSAS module can be set either as a Standard CAN bus or CANopen® module under the heading "Special functions" on the "CANopen" page. If it is set as a CANopen® module, then the node-ID can be entered in this window. In this case, the imc CANSAS module's entry in the tree diagram has only the two branches "Bus Interface" and "Special functions", along with their respective settings parameters. No other parameters can be set by means of imc CANSAS.



If "Readable configuration 111 = ON" is set, the CANopen® settings are saved in the module, so that they are available upon the respective module being integrated into the system.

Detailed descriptions of each module type are available in the separate CANopen® documentation. This can be found along with the module's ESD file on the imc CANSAS data carrier.

Note

After a conversion to the CANopen protocol, the module can only be parameterized with the CANopen software and no longer with the imc CANSAS software.

5.9.8.1 Limitations

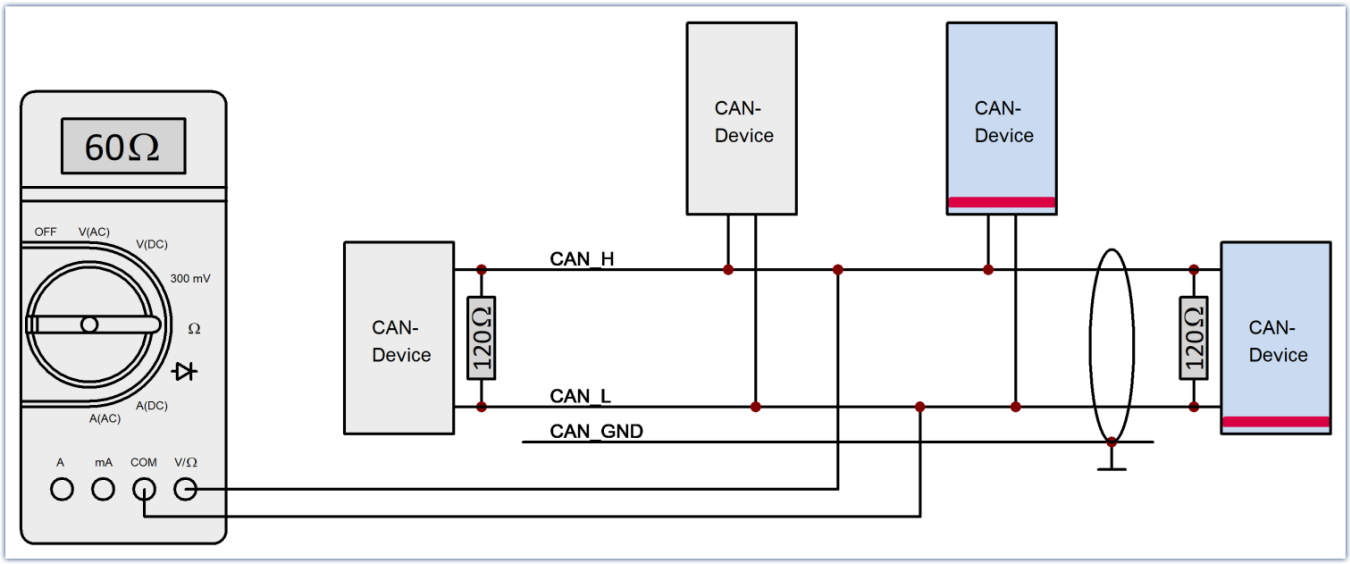
imc CANSAS modules with CANOpen® suffer certain limitations, since CANOpen® protocol does not include some functions:

- The imc CANSAS module is not able to generate virtual channels
- No control over LEDs

5.9.9 Troubleshooting tips for disturbances of the CAN bus

Disturbances of CAN bus transmission can be due to a variety of causes, from long signal lines to lines which are short-circuited. This section will introduce some simple procedures for checking the CAN bus, which may be able to detect any errors in the CAN bus wiring.

Simple inspection of the line termination

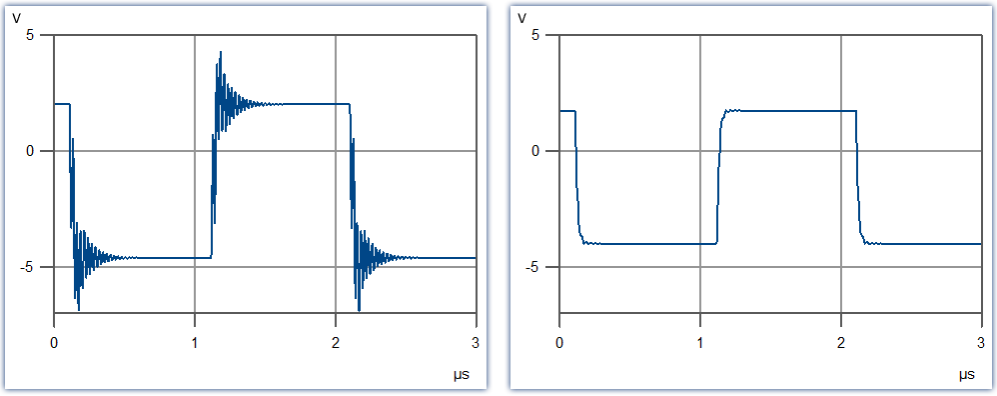


As an example, in order to be able to perform measurements using the CAN bus on board a vehicle, you must obtain access to the potential divider.

To test the CAN bus resistors between CAN-Low and CAN-High, the resistance measurement should generally be carried out so that the object under test must not be under current during the measurement.

The two termination resistors are connected in parallel and together form an equivalent resistance of 60 Ω.

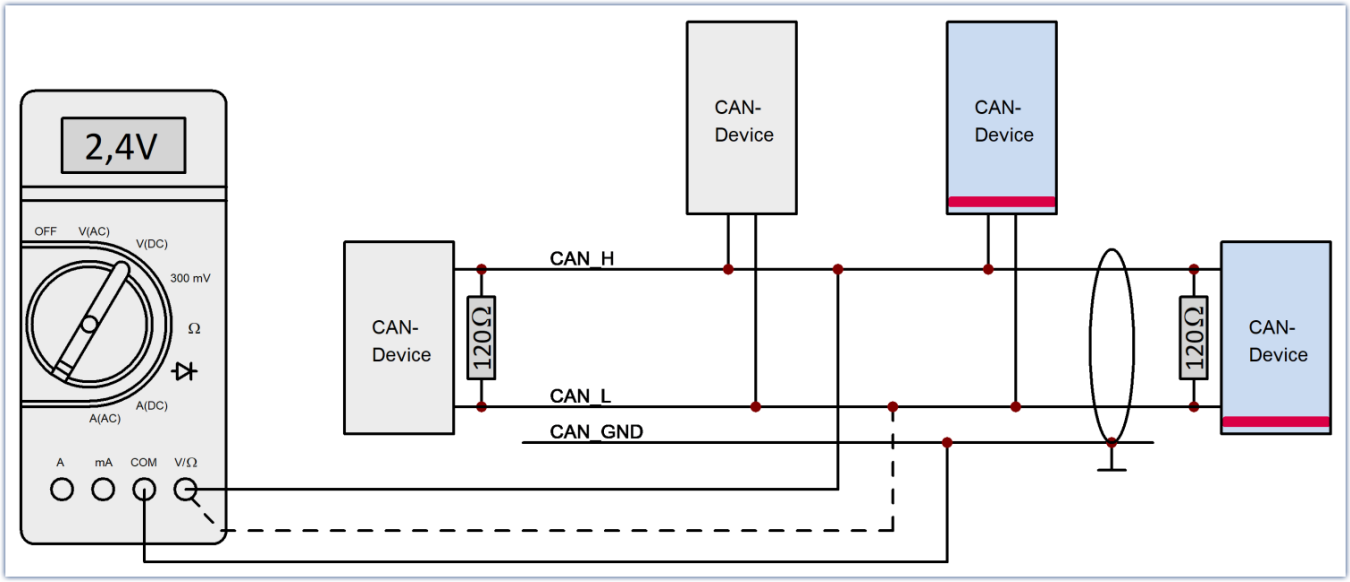
Bus Reflections



left: CAN bus signal not terminated
right: CAN bus signal terminated

Reflections at line branches can be minimized by keeping the branches as short as possible. By terminating lines at either end, the best possible combination of transfer rate and bus line length can be achieved.

DC-voltage measurement with high-speed CAN bus



A good multimeter can usually measure the recessive CAN bus level, measured to ground.

The two CAN bus levels are approximately equal.

For the CAN bus levels CAN-H and CAN-L, each measured to ground, the following approximations apply:

for CAN-H recessive approx. 2.4 V,

for CAN-L recessive approx. 2.6 V.

DC-voltage measurement with low-speed CAN bus

In contrast to high-speed bus coupling, the low speed bus coupling can also be run in single-wire mode.

Note Practical notes on measuring

- The DC-voltages apply with an operating voltage of 12 V.
- These voltages are guideline values and can deviate by a few multiples of 100 mV.
- No additional measurement instruments such as an oscilloscope, etc. may be used at the same time.

1. Possibility – the CAN bus is working correctly

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	OK	OK	3.3 V	1.8 V	1.5 V
Sleep-mode	OK	OK	4.9 V	0.1 V	4.8 V

2. Possibility - CAN_H or CAN_L not connected properly

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	not connected	OK	4.8 V	1.7 V	3.1 V
Sleep-mode	not connected	OK	4.9 V	0.1 V	4.8 V
Active	OK	not connected	3.3 V	0.2 V	3.1 V
Sleep-mode	OK	not connected	4.9 V	0.1 V	4.8 V

3. Possibility – short circuit between CAN_H or CAN_L and GND

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at GND	OK	4.8 V	0.1 V	4.8 V
Sleep-mode	at GND	OK	4.9 V	0 V	4.9 V
Active	OK	at GND	0.01 V	0.2 V	-0.2 V
Sleep-mode	OK	at GND	0 V	0.1 V	-0.1 V

4. Possibility – short circuit between CAN_H or CAN_L and SUPPLY

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at SUPPLY	OK	4.8 V	12 V	-7.2 V
Sleep-mode	at SUPPLY	OK	5.4 V	12 V	-6.6 V
Active	OK	at SUPPLY	12 V	0.2 V	11.8 V
Sleep-mode	OK	at SUPPLY	12 V	0.1 V	11.9 V

5. Possibility - CAN_H and CAN_L are connected

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at CAN_L	at CAN_H	2.9 V	2.9 V	0 V
Sleep-mode	at CAN_L	at CAN_H	2.5 V	2.5 V	0 V

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6 Operation

6.1 Calling the program

Once the imc CANSAS application has been successfully installed, it can be called from the Windows Start menu.



You can use the Start menu's 'Run'-command to start the application. To do this, find the file ***imc CANSAS.exe*.**

imc CANSAS enters various settings into the Windows System Registry. In the English program version, the main key is designated

```
HKEY_CURRENT_USER\SOFTWARE\imc Measurement and Control\Default\imc CANSAS
```

If you wish to work with personally customized settings, then call the file imimc CANSAS.exe using the calling parameter **/cMySettings**. In this case, the main key is designated

```
HKEY_CURRENT_USER\SOFTWARE\imc Measurement and Control\MySettings\imc CANSAS
```

Create a shortcut to imimc CANSAS.exe. In the menu for setting shortcut properties, supplement the call command by appending the parameter **/c(name)**.

Calling imc CANSAS from imc DEVICES/imc STUDIO

The imc CANSAS user interface can also be used directly within the imc DEVICES and imc STUDIO device software. However, some functions and menu items are not available when calling them from the device software. For example, the imc CANSAS configuration is not managed as an MDB database, as it is stored in the imc DEVICES/STUDIO experiment. An XML export/import is possible. The imc CANSAS modules are accessed via the CAN bus of the imc DEVICES/STUDIO measurement device. This communicates via Ethernet, so that the interface dialog of imc CANSAS is disabled.

6.1.1 Language setting - imcLanguageSelector



The software is provided with different languages, which can be selected with the program ImcLanguageSelector.

Thus installing several language versions of the software is not necessary. As default the language of the operation system will be used. In case of the imc product is not provided with the language of the WINDOWS version, English will be used.

The *ImcLanguageSelector* is located at *C:\Program files\Imc\Shared*.

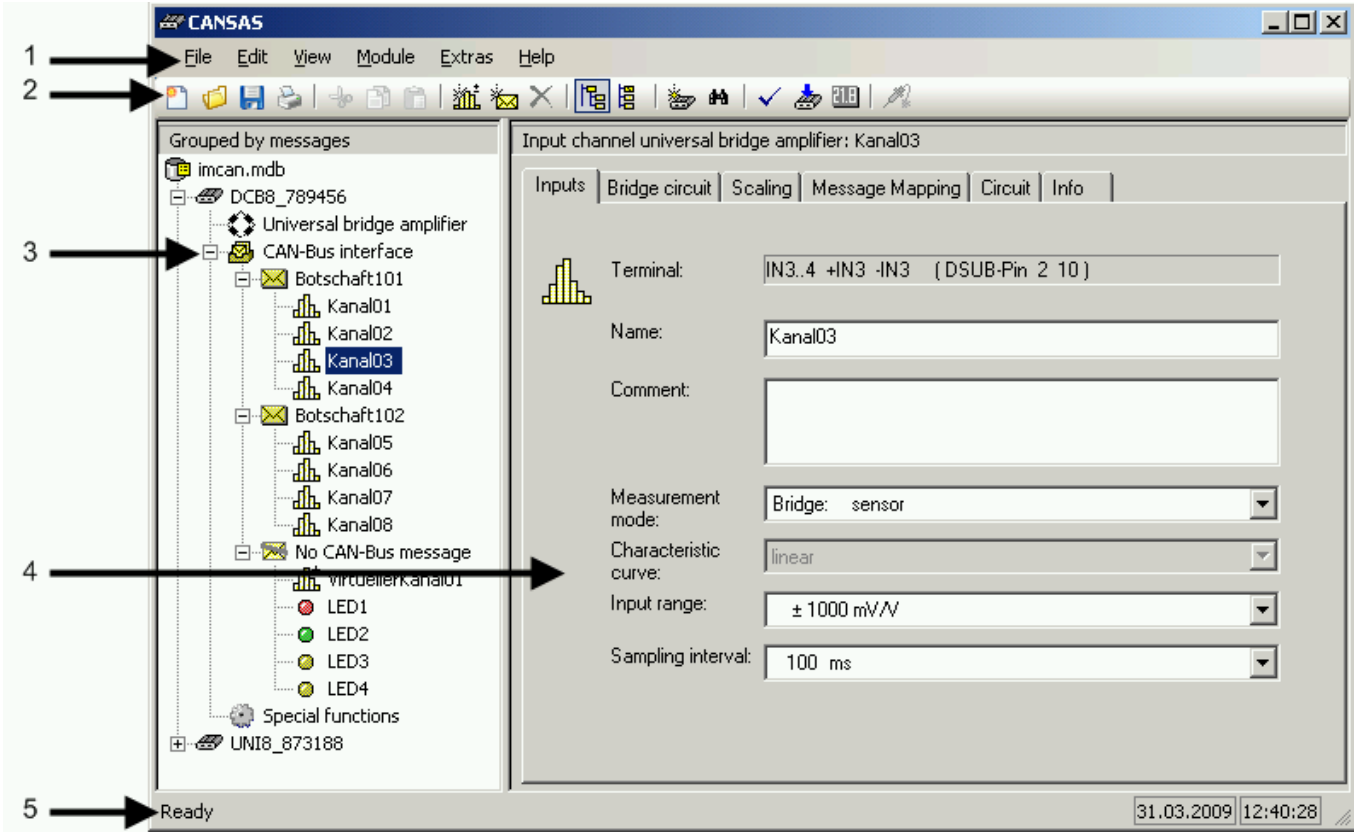


6.2 The user interface

6.2.1 Introduction

Upon starting, a welcoming screen pattern, which displays statements about the program version, appears.

The contents of the most recent module database are read in and the application window is set up in the manner shown below:



The application window features the following elements:

- Menu bar [1]
- Toolbar [2]
- Module directory tree [3]
- Properties dialog [4]
- Status bar [5]

6.2.1.1 "File"- menu

This menu offers functions for working with the database and for printing.

The menu's commands are as follows:

Command	Action
New	Creates a new database
Open...	Opens an existing database
Save	Saves all changes made to the current database
Save as...	Saves all settings in a different, user-specified database
Export...	Exports module settings in the project database format of the company Vector Informatik GmbH or in imc's CAN-Assistant format or as an XML-file.
Import…	Import module configuration from a XML-file.
Print...	Prints out the module settings
Print Preview	Displays a preview of the printout on the screen
Print Setup...	For selecting a printer and a printer connection
Exit	Closes imc CANSAS

6.2.1.2 "Edit"- menu

The menu's commands are as follows:

Command	Action
Undo	Cancels the effect of the last editing function performed
Cut	Removes data from the document into the Clipboard
Copy	Copies data into the Clipboard from the document. Copies a module configuration, if a module is selected.
Paste	Inserts data into the document from the Clipboard
New Message	Adds a new message to the module configuration
New Virtual channel	Adds a new virtual channel to the module configuration
Rename	Renames a module, message or channel
Delete	Deletes a module, a CAN-message or a virtual channel
Start imc-sensors	Starts imc - sensors database
Paste sensor...	Paste selected sensor from imc – sensor into selected channels, to set parameters.

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6.2.1.3 "View"- menu

The menu's commands are as follows:

Command	Action
Toolbar 89	Toggles toolbar ON/OFF
Status bar 89	Toggles status bar ON/OFF
Split 89	Splits the active window into two segments
Adjust 90	Adjusts the window size to make all entries on the right side visible
Grouped by 90	
messages	Groups the entries in the tree by message
channels	Groups the entries in the tree by channel
Expand modules 90	Expand all branches of selected modules
Expand all branches	Expand all branches of all modules, without regard of selection
Collapse all branches	Collapse all branches of all modules

6.2.1.4 "Module"- menu

The menu's commands are as follows:

Command	Action
Integrating-Assistant...	Integrates one or more imc CANSAS modules into the database
Find selections...	Finds selected CAN bus connected imc CANSAS modules
Find me...	Let the selected module red blinking for 5s
Check configuration...	Verifies the configuration
Configure...	Configures imc CANSAS modules
Configure + Shift	Configures imc CANSAS modules even if configuration has not been changed.
Measure	Conducts a measurement using the imc CANSAS modules
Sensors:	
Prepare plug-in	Set the module to default values. Afterwards sensors can be connected.
Read identifying data	Read the information from the EPROMS connected to the sensors.

6.2.1.5 "Extra"- menu

The menu's commands are as follows:

Command	Action
Interface...	Adjusting the PC / CAN bus interface
Options...	Dialog to set global options

6.2.1.6 "?"- menu (Help)

The menu's commands are as follows:

Command	Action
About imc CANSAS...	Shows the application version number

6.2.1.7 Control Menu

The Control menu is located on the title bar and comprises the following commands:

Command	Action
Restore	Restores the size and position of a window to its state before the command Maximize or Minimize was implemented.
Move	Once the arrow pointer appears, the window position can be shifted by using the arrow buttons. Note: the command is not available if the window is already in Maximize-mode.
Size	Once the arrow pointer appears, the window size can be altered by using the arrow buttons. Note: the command is not available if the window is already in Maximize-mode.
Minimize	Reduces the active window to an icon.
Maximize	Makes the active window fill the screen.
Close	Closes the window.

6.2.2 Toolbar

The toolbar extends horizontally near the top of the window, below the title bar. It offers quick access to many imc CANSAS tools via a mouse-click. If the mouse cursor is held for a short while over a screen button, a brief help text will appear as a 'tool tip'.

To toggle the toolbar on and off, you can use the item 'Toolbar' in the 'view'-menu, or (ALT, A, S).

Button	Action
	Creates a new database.
	Opens an existing database. The 'Open database' dialog appears, which allows you to select the desired file for opening.
	Saves all changes to the database.
	Prints out the module settings.
	Removes the highlighted data to the Clipboard.
	Copies the highlighted data to the Clipboard.
	Inserts the contents of the Clipboard to the designated position
	Adds a new virtual channel to the module
	Adds a new CAN-message to the module
	Deletes a module, a CAN-message or a virtual channel
	Checks the current configuration for errors
	Integrates an additional imc CANSAS module into system
	Configures the imc CANSAS module
	Takes a measurement using the imc CANSAS modules
	Finds all imc CANSAS modules connected to the CAN bus
	Groups the entries in the tree by message
	Groups the entries in the tree by channel
	Adjusts the window size to make all entries on the right side visible
	Shows the application version number

6.2.3 The Module Tree

The Module Tree represents the contents of the currently open database in a tree structure. The structure's branching serves to indicate the group membership relationships among the entries. Entries located on the same level are of equal rank. All entries of a particular type (e.g. input channels) are denoted by the same pictogram symbol.

The topmost entry (root) represents the module database. In this, multiple imc CANSAS modules are stored. Once the database icon is opened, the modules are displayed on the first hierarchy level. Opening a imc CANSAS module's symbol shows its 3 important components: CAN bus interface, input or output stage and the group of virtual channels. All previously defined CAN bus messages are located under the **CAN bus Interface** branch. Above this branch is the branch representing the input or output type, which depends on which module is involved. The branches of the individual channels appear under the CAN bus message branches. The **Virtual Channels** branch comprises all defined virtual channels and special channels such as LED's which shine in response to particular processing results. This manner of structuring the tree representation takes into account the logical relationships within the module, and this representational option is selected as the item **Grouped by channel** in the **View menu**.

A second manner of representation is called **Grouped by Message**. It gives more weight to the CAN bus and its messages. Up until the second hierarchy level, the appearance of the two different tree structures is the same. Once the imc CANSAS module's icon is opened, the entry for the input/output type and the CAN bus-Interface branch appear. The message definitions can be seen under the CAN bus-Interface branch. Opening the message's icons reveals which channel or virtual channels are associated with which message. Parallel to the message branch, there is a branch called **Without CAN bus Message**. This branch comprises all channels which were not assigned to a message and whose signals are thus are not transmitted. Select menu item **View/Grouped by Message** to implement this representational option.

Each entry on a tree has properties such as Name, Sampling Rate, etc. These are displayed in the segment on the right.

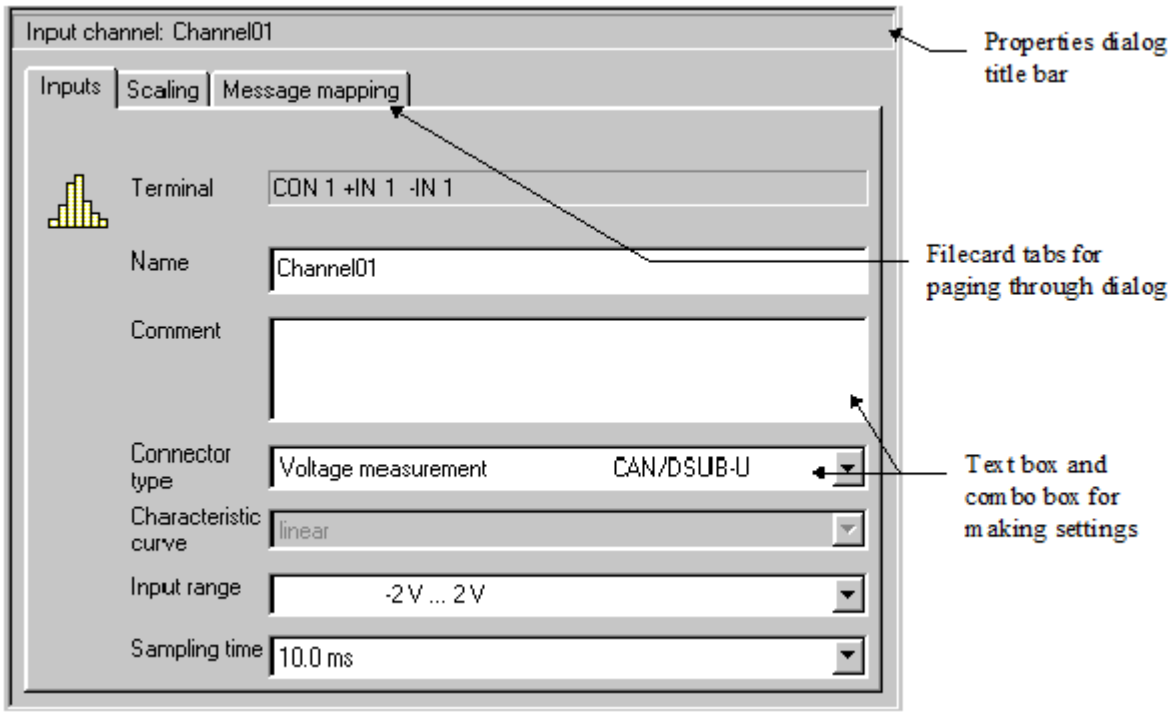
If multiple tree entries having the same properties are simultaneously selected, then the properties are reflected in the Properties dialog. If entries of different types are simultaneously selected, then the Properties dialog will indicate that stating the properties isn't possible.

The Module Tree has the following types of entries:

Symbol	Entry type	Properties
	Module database	name, size, number of module entries
	imc CANSAS module imc CANSAS module which has supplied information	name, serial number, firmware version, hardware version
	CAN bus interface	Baud rate, message-identifier
	Differential amplifier (module) inputs	type, time offset correction
	Input stage of a bridge amplifier (module)	Button functions, duration of shunt calibration and of bridge balance
	Input stage of a imc CANSAS-INC4 module	Switching threshold, hysteresis, low-pass filter
	Input stage of a imc CANSAS-DI16I module	Input voltage range, sampling time
	Output stage of a imc CANSAS-DO16R module	Output configuration
	Output stage of a imc CANSAS-DO8R module	
	Output stage of a imc CANSAS-DAC8 module	

Symbol	Entry type	Properties
	Virtual channels	none
	CAN-message	name, identifier, message length
	Without CAN-message	none
	Input channel	name, input configuration, input range, sampling rate, scaling, message mapping
	Digital input (bit) of a module	name, comment
	Digital input port of a module	name, comment
	Digital output (bit) of a DO8R module	name, comment, functionality, message mapping
	Analog output of a DAC8 module	name, comment, functionality, message mapping
	Virtual channel	name, function, units, message mapping
	Virtual special channel (LED)	name, function
	Hint or error message	none
	Special functions (synchronisation, heartbeat)	

6.2.4 Properties Display



Properties dialog for an input channel

In the right-hand segment of the application window, the properties of the currently selected Module Tree entry are displayed. Depending on the type the entry belongs to, the properties may appear on up to three 'index cards'. Paging through the cards is accomplished by clicking on the card tabs.

If multiple Module Tree entries are simultaneously selected, the Properties display will attempt to reflect their common properties. This will only work if the entries are of the same type, otherwise the Properties display will indicate that it's not possible.

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There is a header at the top of the Properties display in which the entry type and the names of the entries are stated.

The Properties display has various dialog boxes and combo boxes as well as text boxes. The properties of the imc CANSAS modules or input channels can be altered by making selections or entries. The alterations are applied as soon as the card is turned on or the current selection in the tree is changed, or prior to the execution of a menu command.

If the mouse cursor is held for a short while over a text or combo box, a 'tool tip' as a brief help text will appear.

If multiple Module Tree entries having the same type are concurrently selected, then "???" will appear in the relevant Properties dialog boxes. This means that this property of the various entries does not have a common value. If the input box is even disabled, this means that the property cannot be common to all the entries; an example is a channel's name.

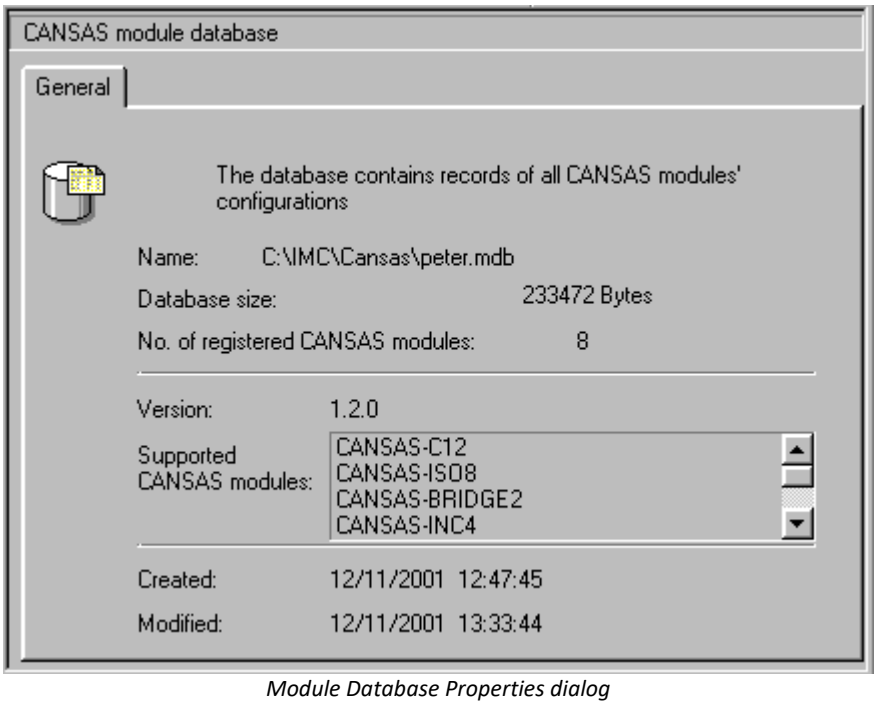
Combo boxes appear empty if the properties differ.

The size of the Properties dialog is automatically adapted when the size of the main window is changed. But it can occur that the Properties dialog cannot fit completely into the window if the window becomes very small. Use the menu command *'View/ Adjust'* to optimize the window size.

6.2.4.1 Module database

The display of the Module Database is accessed from the Module Database branch of the Module Tree, the first branch on the tree.

This virtual filecard shows a readout of some of the currently open Module Database's properties, including the complete filename, file size, and number of imc CANSAS modules stored.



Module Database Properties dialog

In the middle portion, the database version and module types supported by imc CANSAS are indicated.

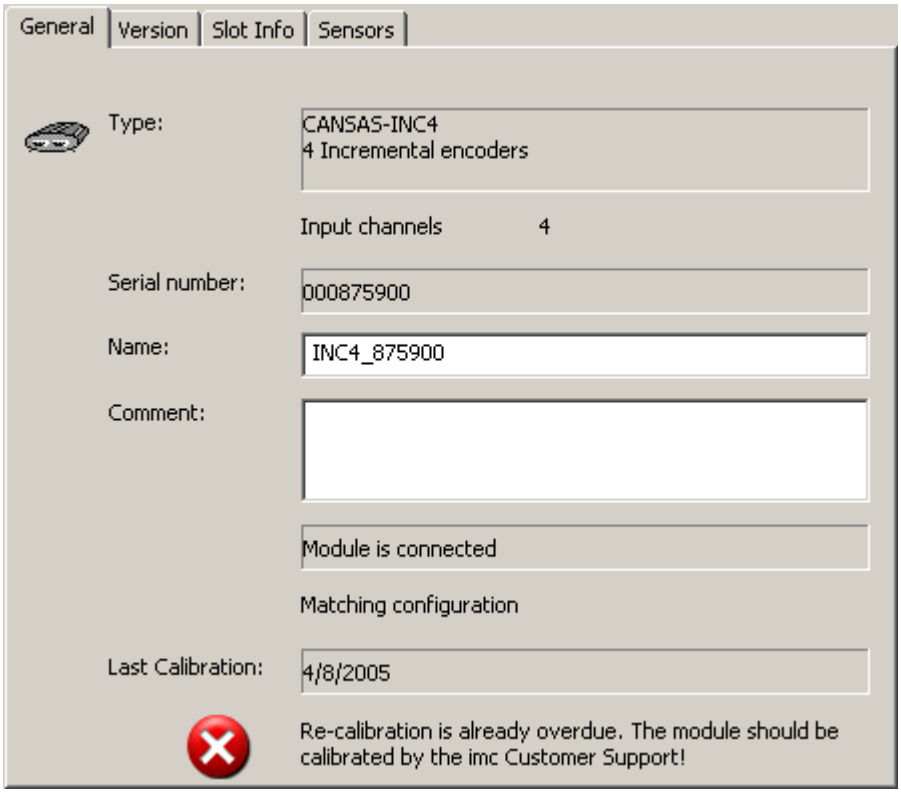
The lower portion of the card shows the date of creation, the date last modified and last accessed.

If the application was unable to open any module database, the statement "***unknown***" appears next to the Database-symbol in the Tree. The readout on the properties display is then empty.

6.2.4.2 CANSAS Module

The imc CANSAS module's properties depend on the module type. The following is a description of the properties common to all imc CANSAS modules.

6.2.4.2.1 General



CANSAS Module Properties dialog, Page 1

In addition to the imc CANSAS module type, the number of input channels is indicated. In the case of a imc CANSAS-INC4 module, there are 4 input channels.

The ***serial number*** is assigned when the imc CANSAS module is manufactured, and it is unique. It is the main criterion for ordering the modules in the module database. The serial number cannot be changed. It is automatically inquired and entered into the database when the module is introduced into the system.

The ***name*** can be specified arbitrarily. It is a means of identifying the module. There are only these limitations on the possibilities for the name:

- there must be a name,
- the name may not contain certain characters. All alphanumeric characters and the characters _ ~ are allowed. The first character may not be a digit,
- the name must be unique within the database,
- the name may contain no more than 64 characters.
- Incorrect names are displayed in the status bar.

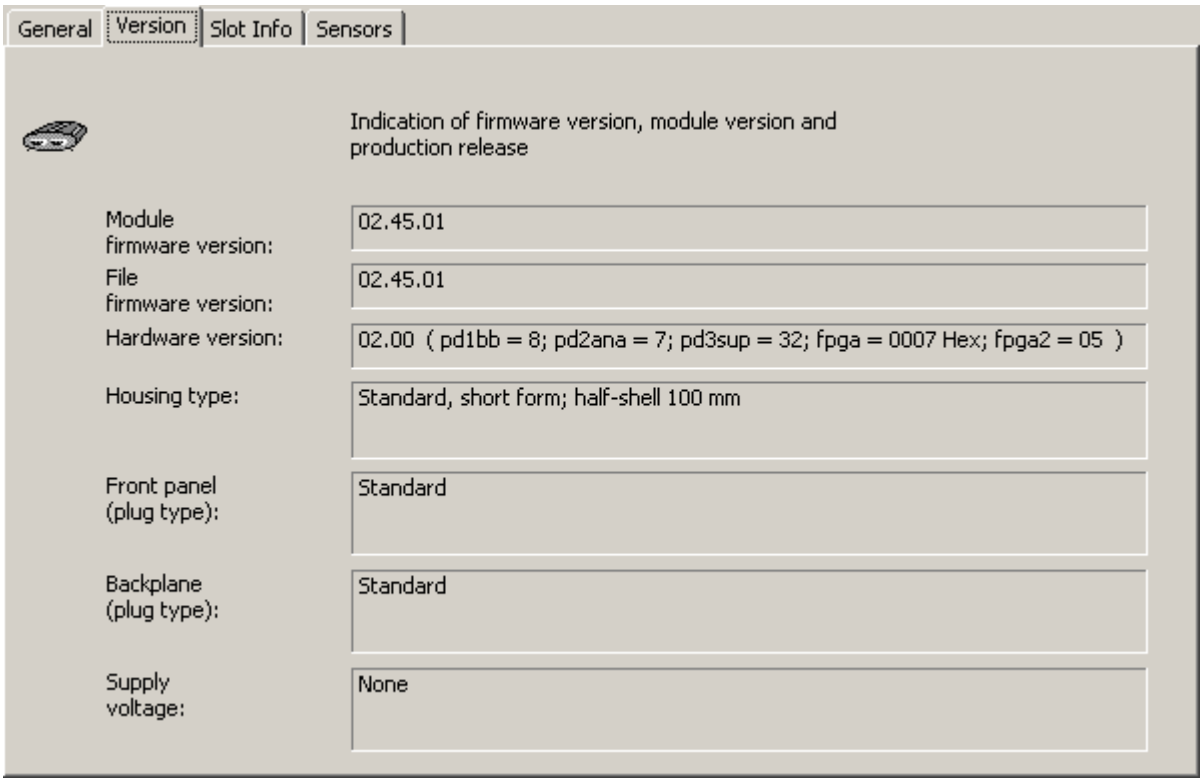
As soon as the cursor is moved off of the input box, the name is updated in the Module Tree.

The ***Comment*** box is provided for the purpose of making notes about the module.

Furthermore the following status information is displays:

- The box 'Connection' shows whether a connection to the imc CANSAS module has been made (Integrate, Configuration, Measurement, Find).
- Information, if the software settings are matching to the module configuration
- Status of calibration

6.2.4.2.2 Version



CANSAS Module Properties dialog, Page 2

The second index card contains information about the firmware and hardware versions.

The module firmware version is the version currently being implemented by the imc CANSAS module. It can only be indicated once a connection to the module has been established.

When the software is installed, a subdirectory named \FIRMWARE is created. The various firmware files are copied to this folder. There are different firmware files to reflect the varying module types and versions. When this page is displayed, the version number is read from the firmware file and indicated under **File firmware version**.

The hardware-version can only be indicated after a connection has been established.

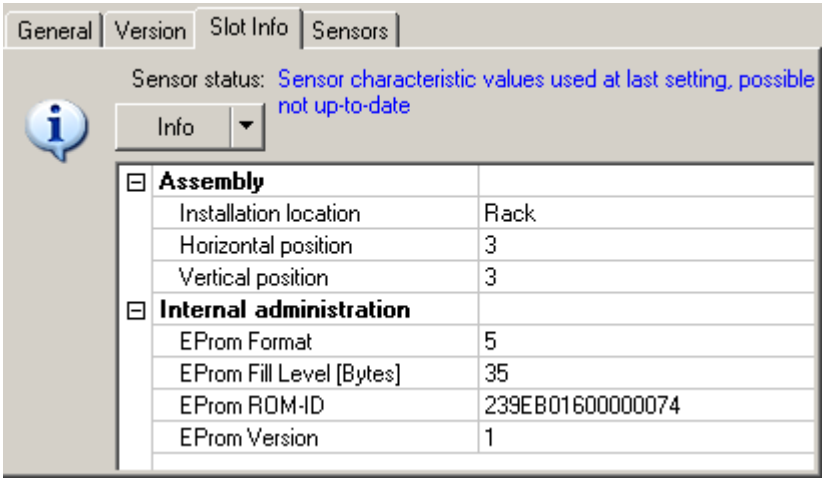
About the version number

The version number consists of a more-significant-digit part and a less-significant-digit part. For the system to work, the higher-value part of the hardware version number must agree with that of the firmware version. The firmware can only be updated if the lower-value part of the version number is different.

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6.2.4.2.3 SlotInfo

Display of slot identification. For further information see Racks slot identification 117.



Slot information

6.2.4.2.4 Sensors

Exchanging sensor information between the sensor-EPROM and sensor database. Further information see here 240.

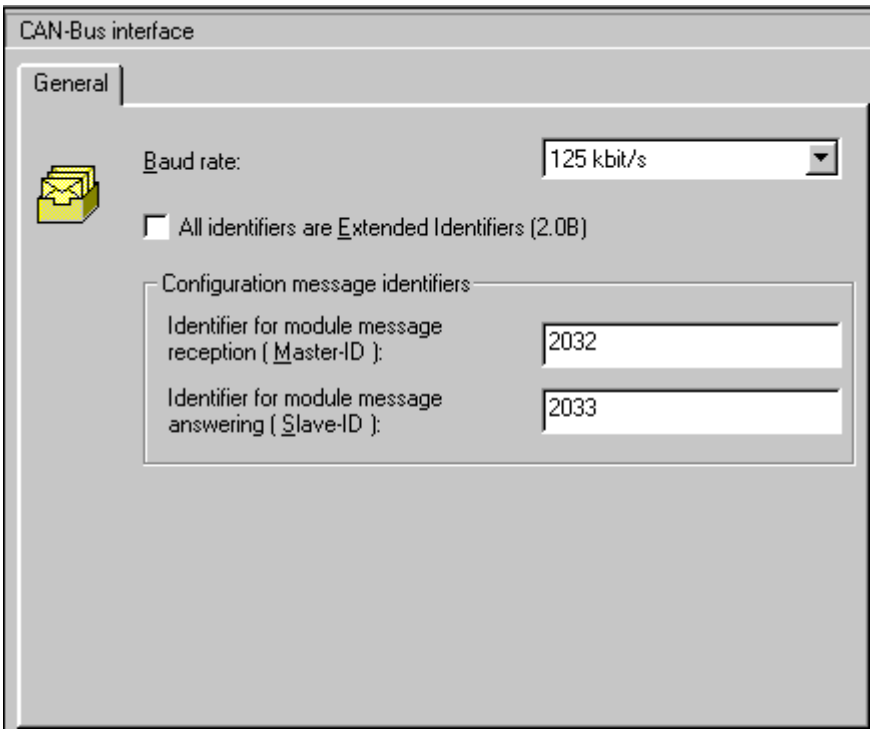
6.2.4.3 CAN bus Interface

General bus connection settings are made in the dialog on this virtual index card.

Once switched on, a imc CANSAS-module sends messages according to its configuration and to the Baud rate set for it. It also receives messages having the correct identifier for configuration messages (Master-ID).

Only one PC having imc CANSAS configuration software, and no other CAN-node, should transmit on the common CAN bus with the Master-ID.

If the imc CANSAS-module is started with a reset-plug connected, no messages which contain measured data are sent. A Baud rate of 125kbit/s is used and messages with the Standard Identifier 2032 are received.



CAN-Bus interface Properties dialog

Baud rate: The Baud rate is the rate at which individual bits are serially transmitted. All CAN bus modules must have the same clock rate. Baud rates from 20kbit/s to 1Mbit/s can be selected from the drop-down list box. The default setting is 125kbit/s.

All identifiers are Extended identifiers (2.0 B): All a module's identifiers, both those of the configuration messages and those of the other messages, can be either Standard identifiers (2.0 A Standard) or Extended identifiers (2.0 B Standard).

Extended identifiers are 29 bits long (ID's of 0 .. 536870912 are permitted), in contrast to a Standard identifier, which is 11 bits long (ID's of 0 .. 2047 permitted). Extended identifiers can only be used if all nodes of the common CAN bus are 2.0B supported or at least 2.0B passive.

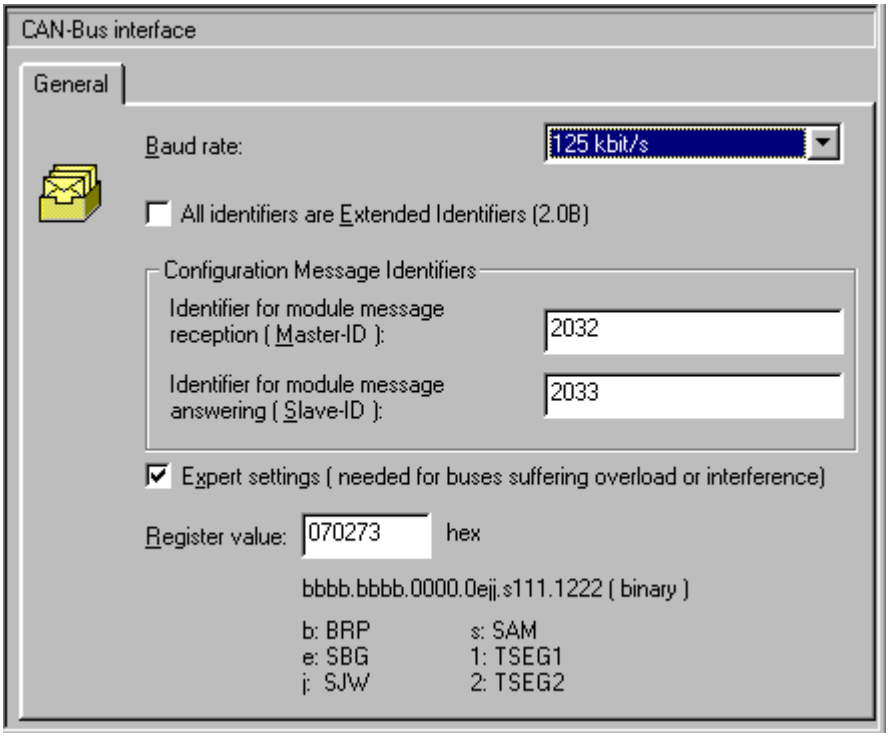
Configuration message identifiers: These identifiers are for configuring the imc CANSAS-modules via the CAN bus and normally can keep their default settings.

It can be useful to change an identifier if Extended identifiers are used, or if modules are to be configured from multiple PC's linked to a common CAN bus. Each PC in a common CAN bus system should have a unique pair of identifiers.

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Expert settings: By this means, the baud rate and other parameters which relate to it can be set by directly entering register values.

The expert settings are necessary in case of bus overload or interference, or for setting baud rates other than the selections appearing in the list.



The Register value must be entered as a six-digit hexadecimal number. The first two digits correspond to the bottom 8 bits of "Bit Configuration Register 2" of TMS320F243*. The other four digits correspond to "Bit Configuration Register 1".

The Baud rate is calculated as:

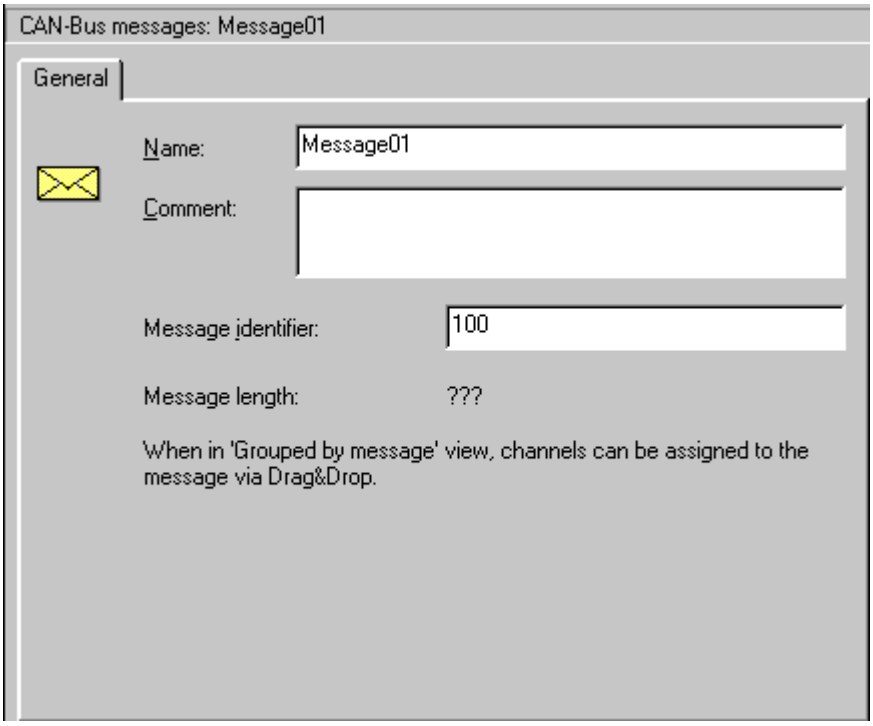
20 M Hz / ((BRP + 1) * (TSEG1 + 1 + TSEG2 + 1 + 1))

No Baud rates can be set which could not be set together with 16 M Hz.

BRP	7	"Baud Rate Prescaler"
SBG	0	"Synchronization on Both Edges" Should normally be zero: synchronizing to the falling, dominant edge, else to both edges.
SJW	2	"Synchronization Jump Width" Synchronization jump width: 0-3 = 1-4 time quanta
SAM	0	"SAMple point setting" 0: one sampling value; 1: three sampling values
TSEG1	14	"Time segment 1"
TSEG2	3	"Time segment 2"

6.2.4.4 CAN bus message

The dialog on this index card is used to define the properties of a CAN bus message.



CAN-Bus message Properties dialog

Name: A unique name by which to differentiate among various messages. As the default, the system suggests _i as the name of a new message, where i stands for the next number not yet used. There are only these limitations to the possibilities for the name:

- there must be a name,
- the name may not contain certain characters. All alphanumeric characters and the characters _ ~ are allowed. The first character may not be a digit,
- the name must be unique within the imc CANSAS module,
- the name may contain no more than 64 characters.

Comment: An accompanying text about the message; could be used to explain in detail the message name, or for any other notes.

Message identifier: The identifier gives an unequivocal statement of the source and interpretation of data. No two messages of a single module may have the same identifier. The identifier thus determines the priority of sending a message; equal priorities are not allowed. If two messages are simultaneously slated to transmit, the message with the lower-number identifier is sent first. Two messages from different imc CANSAS-modules may take the same identifier as long as the modules are not connected to the same CAN bus. Values which an identifier may take are: 0.. 2047 (Standard-format), 0.. 536870912 (Extended-format).

The identifier can also be defined in hexadecimal format. Append either "h" or "H" to the hexadecimal number, or prefix it with "0x" (e.g. 2ACH, e4h or 0xAC, 0xe4).

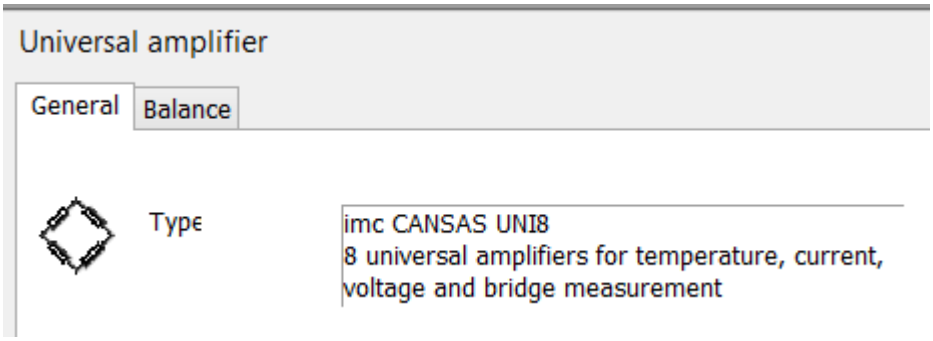
Message length: Number of bytes in a message; 1 to 8 bytes are possible. The message length is determined by the channels assigned to it. Only complete bytes can be sent in a message, therefore it is possible that not all bits in a transmitted byte actually contain information from a channel.

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6.2.4.5 Input/Output stage

This dialog shows the common properties of the input or output channels. The settings and information this filecard presents depends on the type of module involved.

The dialog elements for each module type are explained in Chapter Properties 280. Here we refer to the UNI8 module type as an example.

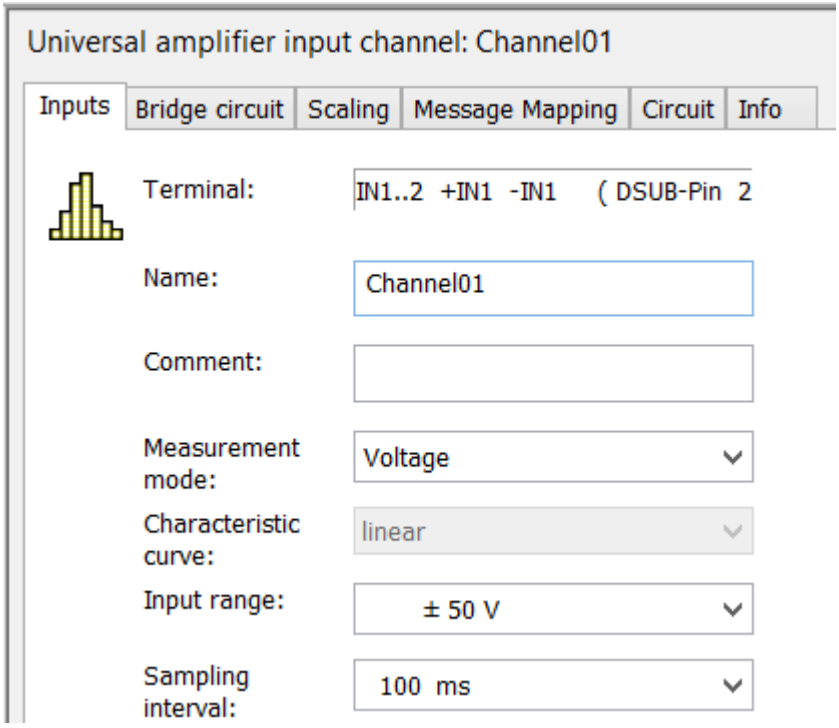


CANSAS UNI8 Differential amplifier Properties dialog

For the UNI8 module, the dialog indicates how many input channels are provided. All inputs are designed as universal channels allowing measurement of temperatures, amperage, voltage and bridges/strain gauges.

6.2.4.6 Input channel

This dialog serves to indicate and to alter the properties of an input channel. The dialog's structure is determined by the type of imc CANSAS module involved. The following is the dialog for a imc CANSAS UNI8 module input channel, for illustration purposes. The settings are arranged on several index cards.



The first page ***Inputs*** is for defining generalities as the name and comments. The connected device, input range and sampling rate can also be set here.

The setting **Terminal** indicates which of the two screw terminals the channel inputs are wired at the plug-internal screw terminals.

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The **Name** can be specified arbitrarily. It is a means of identifying the channel. There are only these limitations on the possibilities for the name:

- there must always be a name.
- the name may not contain the following characters: \ / : * ? " < > |. A name may not start with dot.
- the name must be unique within the database,
- the name may contain no more than 64 characters.

Incorrect names are displayed in the status bar.

When the cursor is moved away from the input box, the name is updated in the Module Tree.

When multiple channels are selected it's not possible to assign a name.

The box **Comments** is for notes pertaining to the channel.

On the page ***Bridge circuit***, you set the type of bridge/strain gauge-circuit. This is described in detail in the chapter Measurement modes 182 ff.

The page ***Scaling*** is for setting a custom scaling factor and offset.

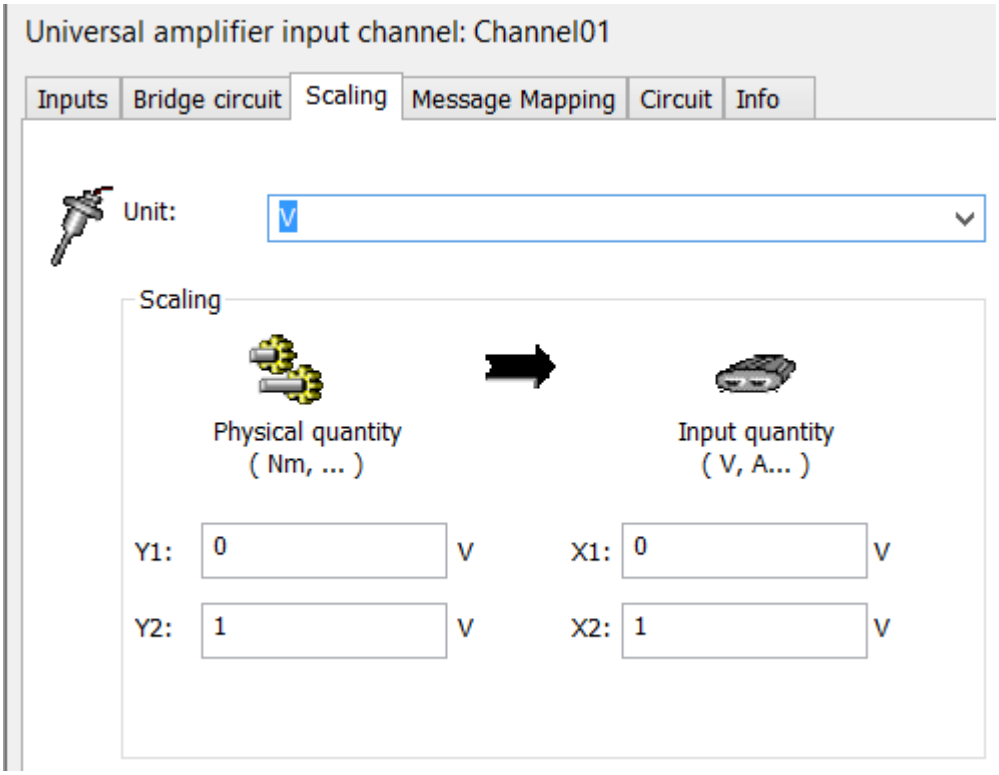
In the upper combo box the measurement unit can be set. A unit can be selected from the list or personally entered. Defining the scaling factor is accomplished using a two-point specification:

$$\textit{Custom scaling factor} = \frac{Y2 - Y1}{X2 - X1}$$

$$\textit{Custom Offset} = Y1 - \textit{Custom scaling factor} * X1$$

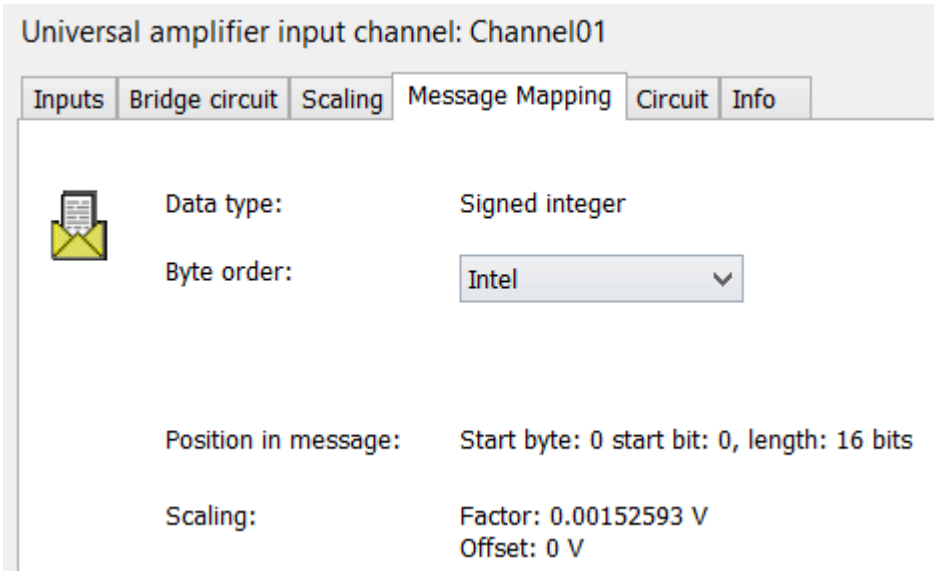
These scaling quantities are then taken account of in the input range indicator on the 1st index card.

Errors will result if X1 and X2 are equal. The faulty entry will be presented in the status bar.



CANSAS UNI8 Input Channel Properties dialog, Page Scaling

When temperature measurements are involved, all the controls on this page are disabled. The scaling factor is automatically 1 and the offset is 0. On the third index card, information about the placing of the channel data within the CAN-message is displayed.



imc CANSAS UNI8 input channel Properties dialog, Message Mapping

The message mapping comprises all information needed for a message receiver to read the channel signal.

Data type: *Signed integers* (16 Bit) or *floating-point number* (32 bit), depending on the module.

Byte order: Choices: Intel-format or Motorola-format. In Intel-format, the bits of a number are arranged in order of increasing numerical significance. One a Byte is filled, the notation for the number is continued in the next higher byte (beginning at Bit 0) until the full measure is reached. The starting bit in Intel-format is the number's Least Significant Bit.

In Motorola-format, the starting bit is the number's MSB. From the starting bit, the bits of a number are arranged in order of decreasing numerical significance. Once a byte is filled, the notation for the number is continued in the next higher byte (beginning at Bit 7) until the full measure is reached. This is then the number's LSB.

The bit order of each format is illustrated by the example below (Start byte: 5, Start bit: 3, number of bits: 18):

Intel-Format: The byte containing the LSB comes first.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5	X	X	X	X	LSB			
Byte 6	X	X	X	X	X	X	X	X
Byte 7				MSB	X	X	X	X

Motorola-Format: The byte containing themsB comes first.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5					MSB	X	X	X
Byte 6	X	X	X	X	X	X	X	X
Byte 7	X	X	X	X	X	LSB		

Position in message

The message's position depends on the channel's position and on the bit counts of the channels positioned further in front.

Starting byte: In which byte belonging to the message does the number begin? Byte 0 is the first transmitted byte of the CAN-message. In an 8 byte message, then, the bytes 0...7 are available.

Start bit: At which bit in the Starting-byte does the number begin?

No. of bits: Number of bits for the channel. The number is determined by the channel's data type.

For signed and unsigned integers the number is 16 bits.

For floating point numbers it's 32.

For a digital bit, 1.

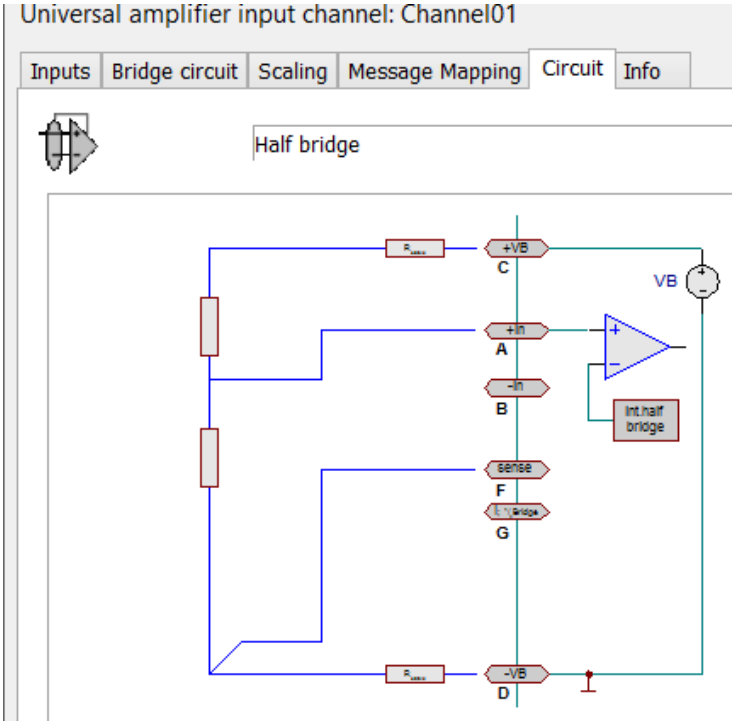
The bits proceed from the starting bit to the higher-index bytes.

Scaling

The message receiver must factor this value into the channel's signal values in order to obtain the input range set.

ScaledValue = UnscaledValue * Factor + Offset

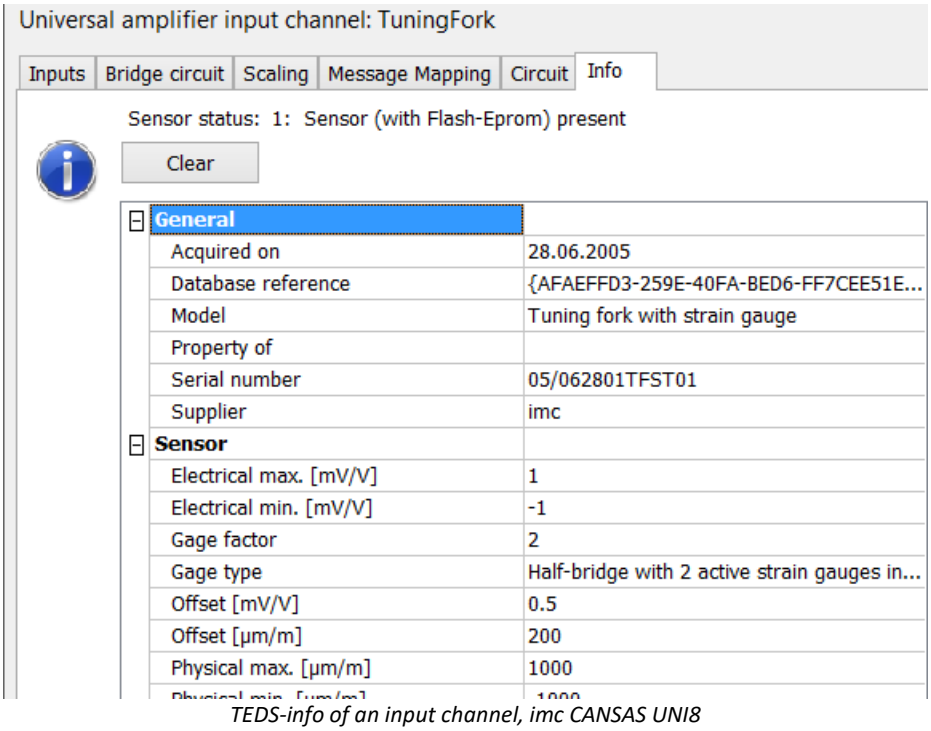
Circuit



Half bridge circuit of an input channel, imc CANSAS UNI8

Depending on the measurement type, the associated circuit diagram is displayed.

Info



TEDS-info of an input channel, imc CANSAS UNI8

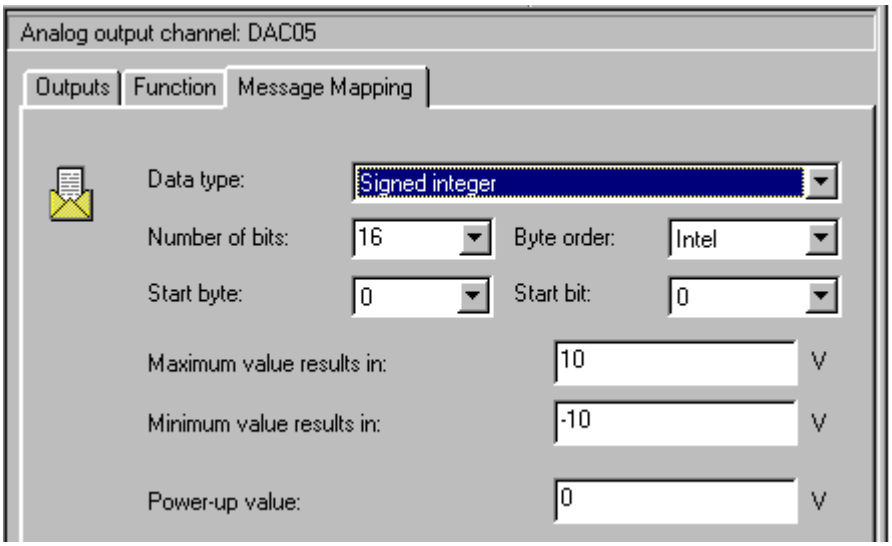
If a sensor is equipped with TEDS 230 information, this info appears listed on this page.

6.2.4.6.1 Message Mapping for output modules

The structure of the third card is different for data-outputting imc CANSAS modules such as DAC8 or RDO8R, and depends on whether or not the channel is assigned to a message.

If the channel isn't assigned to any message, the card is empty except for a notice.

If the channel is assigned to a message, the third card contains controls for letting the user define how the channel's values are to be interpreted from the message.



Properties dialog for a CANSAS DAC8 output channel, page 3

Data type: Signed or unsigned integers or digital bits can be read in.

Number of bits: Number of consecutive bits extracted from the message.

Byte order: Intel-Format or Motorola-Format.

Start byte: In which of the message's Bytes does the number begin? Byte 0 is the first Byte transferred in the CAN-message. Therefore, in an 8-Byte message, 0...7 are available.

Start bit: At which bit in the start Byte does the number begin? Bits 0..7 are possible. Bit 0 is the LSB (least significant bit), Bit 7 themsB.

Maximum value results in: The maximum binary number which can be extracted from the message is to be equated to this number.

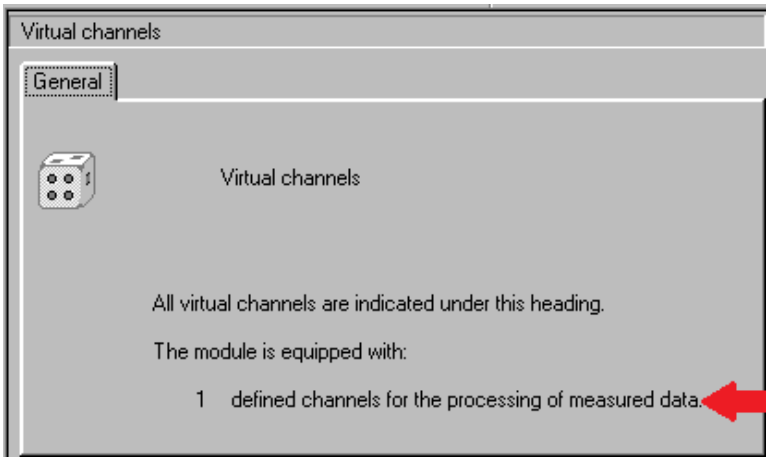
Minimum value results in: The minimum binary number which can be extracted from the message is to be equated to this number.

Power-up value: This value is used until the first message arrives. It must be consistent with the above specifications for the minimum and maximum values.

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6.2.4.7 Virtual channels

This dialog is a summary of all virtual channels. It will only appear if the Module Tree is grouped by channels. Its informational content is the number of defined virtual channels.



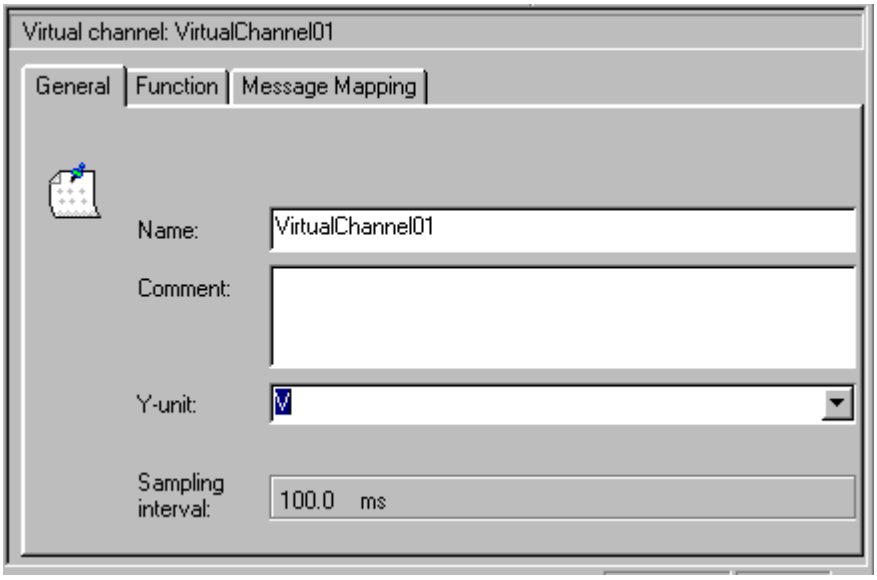
Number of defined virtual channels

Virtual Channels Properties dialog

6.2.4.8 Virtual channel

This dialog indicates a virtual channel's properties and lets you change them. Use and significance of virtual channels in imc CANSAS modules is described in the chapter 'Virtual Channels' 74.

The properties' controls are located on three index cards.



Virtual Channel Properties dialog (Page 1)

On the page General, the basic virtual channel parameters can be set. These are the channel's name, comment and y-unit. Additionally, the channel's pulse rate is indicated, which can differ from the parameter channel's pulse rate due to the data reduction possibilities.

Name: A name unique within the imc CANSAS-module, so that the channels can be distinguished from each other. Permitted characters include letters, numbers, "_" and "~", where the name's 1st character may not be a number. The maximum name length is 64 characters. The default name for a virtual channel is "VirtualChanneli", i: number of already present virtual channels + 1.

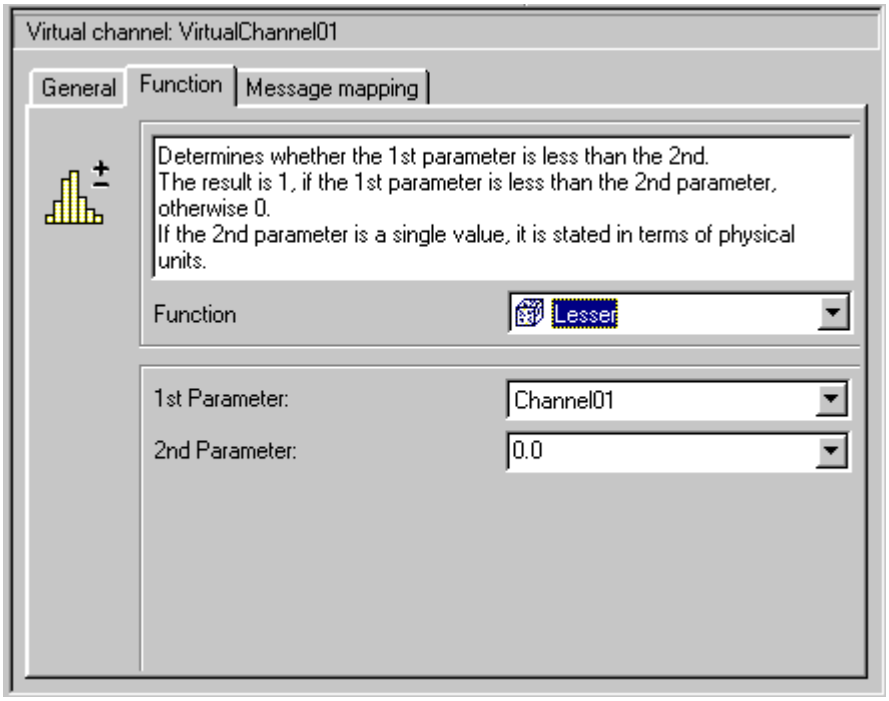
Comment: An accompanying text about the virtual channel. This text can be a detailed explanation of the channel's name or may be used for any other purpose. The comment's maximum length is 255 characters.

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Unit: A drop-down list box full of choices for the unit is presented. An arbitrarily set text, having up to 42 characters, can also be entered as the unit.

Sampling interval: The virtual channel's sampling rate, which results from the sampling rates of the channel-function's parameter channels, is indicated. In addition to the parameter channels' sampling rates, data reduction is also given consideration, if applicable.

On the **Function** page, you can specify how the virtual channel's values are computed. For this purpose, a function formula is selected and parameterized.



Virtual Channel Properties dialog (Page 2)

Function: In the drop-down list, the available functions, ordered by function group, are offered (an overview of the computational functions is to be found in the chapter 'Virtual Channels' 74). A help text about the function selected is presented.

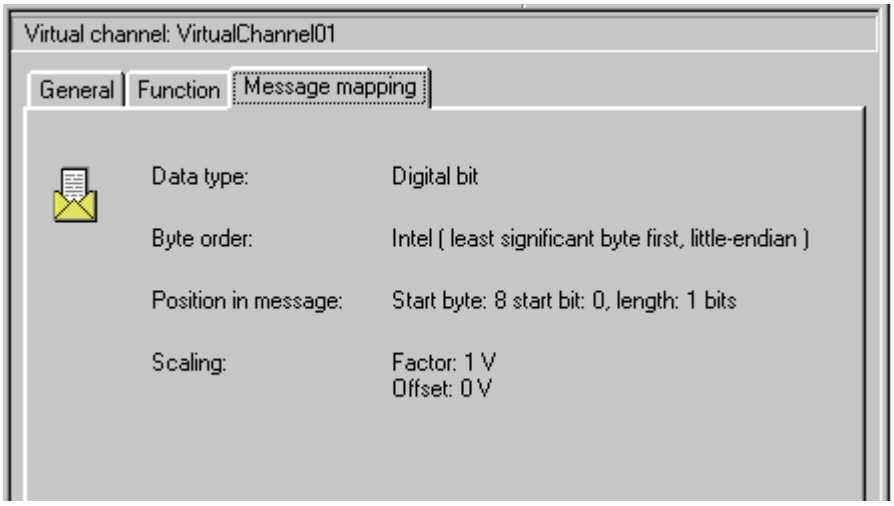
Function parameters: In the boxes below the function selection box, the function parameters can be set. A description of the function parameters can be found in the 'Functions Reference'.

The functions usually take one or two channels as their parameters. The channels can be physical channels or other virtual channels. If two channels are specified as parameters they must have the same sampling rate.

If the selected function's expression contains numerical constants or is combined in mathematical operations with parameter channels, it is given in the parameter channel's units. The parameter channel's scaling must be taken into account for the numerical constant.

The page **Message mapping** contains information on the data type, the position in the message and the channel's scaling.

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Virtual Channel Properties dialog (Page 3)

6.2.4.9 Special functions

Settings for heartbeat 124, synchronization 126 and if available for CANopen 49 ®.

6.2.5 Status bar



The Status bar is located at the imc CANSAS window's bottom edge. The menu item **'View/ Status bar'** lets you toggle the Status bar on and off.

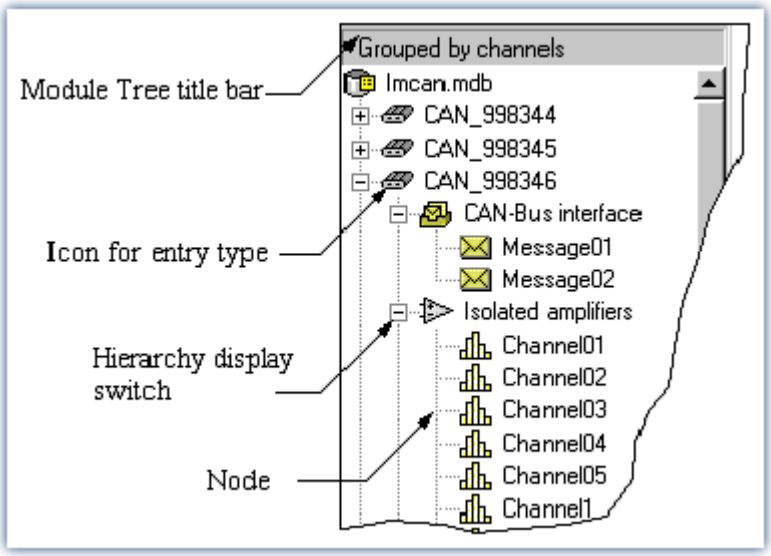
When you move through the menu using the arrow buttons, the left side of the status bar contains a description of the respective menu item's function. Similarly, this area will contain a description of the workings of toolbar softkeys if you click and hold the mouse over such a softkey. If, having read the softkey description, you decide not to use the command, move the mouse cursor off of the softkey and release the mouse button.

If an incorrect input is made, a corresponding error message will appear in the status bar.

The right side of the status bar displays the current time and date.

6.3 Working with the Module tree

The modules loaded from a database are displayed in the form of a directory tree. Each entry in the tree is accompanied by an icon which indicates the entry's type. The individual entries are attached to the tree by branch-lines. In front of the icons there are little softkeys containing either a plus sign or minus sign, which serve to let you expand or compact a branch.



Module Tree entries

Expanding and compacting entries

Entries which have subordinate entries can be expanded or compacted. The presence of subordinate entries is indicated by the little boxes with either plus or minus signs. A mouse-click on such a box either expands the branch concerned or collapses it; double-clicking has the same effect. The following actions can be initiated from the keyboard:

Key	Action
+ (numeric keypad)	The selected node is expanded by one branching level
- (numeric keypad)	The selected node is collapsed
* (numeric keypad)	The selected node is expanded through all branching levels
right arrow	The selected node is expanded by one branching level
left arrow	The selected node is collapsed

Selecting entries

One or multiple entries in the Module Tree can be selected at the same time. The properties of the selected entries are indicated in the right segment of the main window.

Clicking the mouse on an entry selects the entry. Clicking over an entry while holding <Shift> selects all entries in a row from the last selected to the present one.

Clicking over an entry while holding <Ctrl> adds it to the group of selected entries, regardless of its location in the tree; or if it is already selected, removes it from the group.

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The following actions can be initiated from the keyboard:

Combination of keys	Action
Pos 1	Selects the Database (root) icon.
End	Selects the last entry in the Tree.
↑	Selects the next entry above.
↓	Selects the next entry below.
→	Selects the first of the subordinate entries.
←	The next-higher-level entry is selected or the branch collapsed.
PgUp	The topmost visible entry is selected.
PgDown	The bottom-most visible entry is selected.
Shift + End	Multiple selection: all entries from the last selection to the end of the Tree.
Shift + Pos 1	Multiple selection: all entries from the last selection to the top of the Tree.
Shift + PgUp	Multiple selection: all entries from the last selection to the topmost visible entry.
Shift + PgDown	Multiple selection: all entries from the last selection to the bottom-most visible entry.
Shift + ↑	Multiple selection: all entries from the last selection to the next entry above.
Shift + ↓	Multiple selection: all entries from the last selection to the next entry below.
Ctrl + ↑	The focus is directed at the next entry above. The existing selection is retained.
Ctrl + ↓	The focus is directed at the next entry below. The existing selection is retained.
Ctrl + <Space>	Toggles the selection on/off in the entry with the focus..
Ctrl + End	The focus is shifted to the end of the Tree.
Ctrl + Pos 1	The focus is shifted to the top of the Tree.
Ctrl + PgUp	The focus is shifted to the topmost entry in the Tree.
Ctrl + PgDown	The focus is shifted to the bottom-most entry in the Tree.

Changing names

The Tree lets you edit the entry names. The following entry types' names can be edited:

- imc CANSAS module
- CAN message
- input/output channel
- virtual channel

If an already selected entry is clicked over, a small input box appears for editing the text. The editing process is completed by hitting the <Enter> key, or by selecting another entry. Thereafter, the new name is checked by the system and appears in the Properties display.

The editing process can be aborted by hitting <Esc>…

If an entry is in editing-mode, the commands 'Edit/Undo', 'Edit/Cut', 'Edit/Copy' and 'Edit/Paste' are available. In other words, the names can be edited with the help of the Clipboard.

Deleting entries

The following entry types can be deleted from the Module Tree:

- imc CANSAS module
- CAN message
- virtual channel

When a imc CANSAS module is deleted, all subordinate entries are also deleted. In order to be deleted an entry must be selected. Multiple entries can also be selected. When the <Del> key is pressed or the menu item 'Edit/Delete' is selected, a prompt for confirmation is posted. Deletion only takes place if the prompt is answered with 'Yes'.

Arranging input channels and virtual channels within messages

The manner of transmitting measurement values via the CAN bus is to be defined by assigning positions within messages to the various channels' data.

The assigning process is accomplished in the Tree by the drag&drop method.

For this purpose, the Module Tree must be in the mode 'Grouped by Message'. Activating this mode is done using the menu command 'View/Grouped by message'.

The defined CANmessages are listed under the entry 'CAN bus interface'. Under each CANmessage, the channels whose signals are transmitted in this message are listed. The position within the message's Tree-branch indicates its position within the message.

The bottom-most entry, entitled **Without CAN bus message**, comprises all channels not assigned to messages; these will not be transmitted.

Only channels and virtual channels can be re-arranged.

The following drag&drop operations are supported:

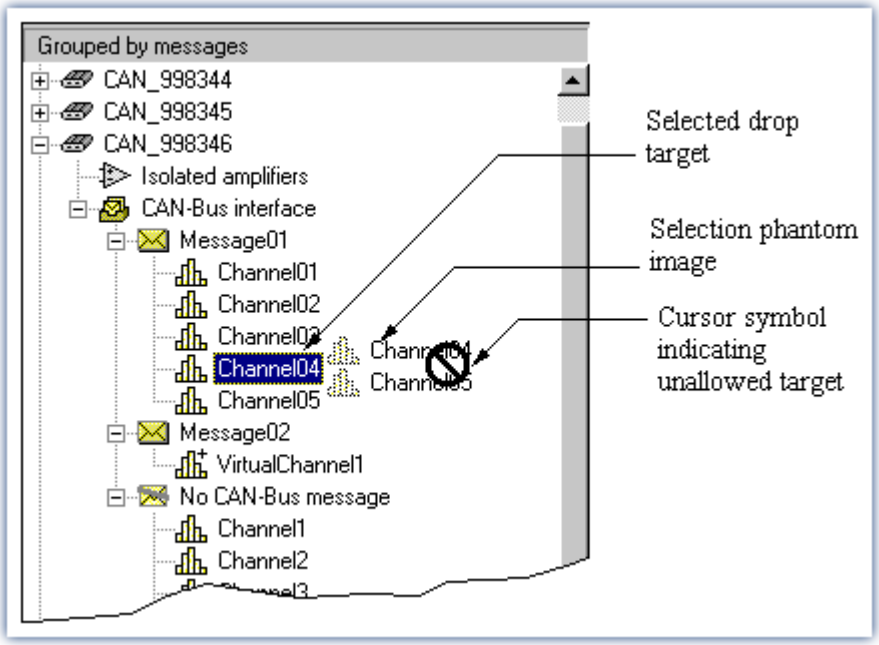
Shifting channels from 'Without CAN bus message' into a CAN bus message

Shifting channels from a CAN bus message into 'Without CAN bus message'

Shifting channels from a CAN bus message into another CAN bus message.

Shifting channels from a CAN bus message into another position within the same message.

The drag&drop operation can only be conducted within the confines of a single module.



Drag&drop in the Module tree

Procedure

Select the entries to be shifted.

The entries can be moved while the left mouse button is held down.

A shadow image of all the entries selected for shifting appears. The cursor gives an indication of whether a dropping destination is permitted. Select the dropping destination. The dragged selections are inserted into the position following the selected dropping destination. If the left mouse button is released on an allowed destination, the shifted entries will 'land' there. Otherwise, nothing happens. The Drag&Drop operation can be aborted by pressing <Esc>.

Obtaining information on the modules

When the mouse pointer is over the entry for a module, a help window appears, in which the module type and serial number is indicated.

Context menu

Right-clicking in the Module Tree opens a context menu which offers the most commonly used functions.

By right-clicking on the Tree's title bar, a context menu appears for toggling between **Grouped by channels** and **Grouped by messages**.

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6.4 Menu functions

6.4.1 Files

6.4.1.1 File - New

Purpose: Creates a new module database in imc CANSAS.

Shortcuts

Toolbar: 
Keyboard: CTRL+N

Remarks: Use this command to create a new, empty module database. The dialog 'Save new database as' appears. In this standard Windows dialog you specify the database's name and the directory it belongs to. The file always takes the extension .mdb.

Once the command Save is activated, the database has been established. The previously open database is closed and the new database becomes the active one.

Note

The new database is created by copying a database template. The database template is called empty01.mbd and should be located in the directory \TEMPLATE.

If there is no database template in \TEMPLATE, you will be prompted to correct the default directory in the dialog Set directory for data base template. In this dialog, the OK softkey is only accessible once the template has been located in the directory selected.

6.4.1.2 File - Open...

Purpose: Opening a module database

Shortcuts

Toolbar: 
Keyboard: CTRL+O

Remarks: This command lets you open another module database. The standard Windows dialog box Open Database lets you select an already existing database. Module databases always take the extension .mdb.

Once a database is opened, the previously open database is closed. The database's contents are read in and displayed.

6.4.1.3 File - Save

Purpose: Saves the current settings in the module database

Shortcuts

Toolbar: 
Keyboard: CTRL+S

Remarks: This command saves all changes to the database.

Saving is also performed automatically before another database is opened and before closing of the program. In these cases, the user is prompted for confirmation of saving.

6.4.1.4 File - Save as...

Purpose: Saves all settings to a different module database

Remarks: A special dialog entitled "Save as" appears, which allows the user to enter a name for the database.

6.4.1.5 File - Import

Purpose: For importing the configurations of imc CANSAS modules which are stored in files in XML-format.

6.4.1.6 File - Export...

Purpose: For exporting the CAN-configurations of the imc CANSAS modules selected. The CAN-configuration can be saved either as a CAN-database (*.DBC-files) or as a CAN-Assistant file (*.CBA-file). It is also possible to save in XML-format.

Remarks: Only the CAN-configurations of the selected imc CANSAS modules are saved in the file format specified, meaning that only messages and channels assigned to these messages are stored. Channels not assigned to any message are not affected. Sensor information (e.g. Baud rate, Standard-/Extended-format) is additionally saved.

With input modules (isolated amplifier-, differential amplifier-, bridge amplifier-, incremental counter- and digital input modules), the messages are entered into the CAN-Assistant configuration as Device receives messages. With output modules (digital relay-, digital output-, analog output modules), the messages are entered into the CAN-Assistant configuration as *Device sends messages*.

CBA-files can be loaded and edited using the CAN-Assistant of the imc devices operating software .

DBC-files can be generated and edited using the program CANdb (© Vector Informatik GmbH) from Vector Informatik GmbH. CANdb is a program for administering the CANalyzer (© Vector Informatik GmbH) CAN system database. DBC-files supported by the CANdb program versions 3.03 to 3.20 are generated. These versions of CANdb belong to the CANalyzer versions 2.0a to 3.0. More options for DBC export can be found under *Extras - Options* 108.

When saving in the **XML**-format, the extension .XML is used. The purpose of such XML-files is to transfer complete configurations (settings) of multiple modules.

6.4.1.7 File - Print

Purpose: Use this command to have the configuration of either one or all modules printed out.

Shortcuts

Toolbar: 
Keyboard: CTRL+P

Remarks: Calling this command does *not* cause a dialog to appear for selecting a range to print, or anything of the like. The process of printing begins immediately, but can be aborted via the progress report dialog which then appears.

Prerequisite: Only a *single* imc CANSAS module or the entire module database may be selected (selecting all of the modules one-by-one also works). If only one among multiple modules is selected, an error message will result.

6.4.1.8 File - Page Preview

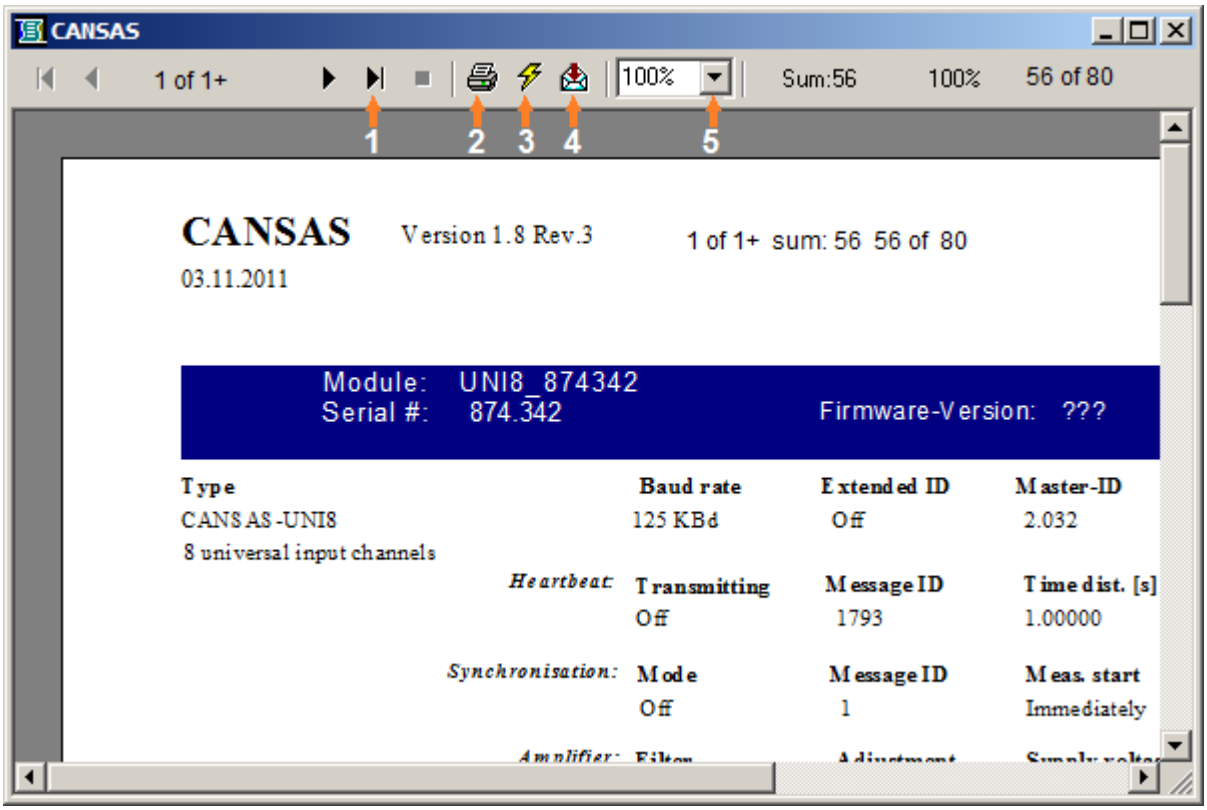
Purpose: Use this command to see a preview of the configuration printout as discussed above.

Remarks: Calling this command causes a Page Preview window to be opened on top of the main window. The Page Preview window displays one page of the configuration printout in accordance with the valid printing format. The window's own toolbar offers the ability to page forwards and backwards through the configuration report and to proceed with the printout over a specifiable range of the document and with a specifiable number of copies. It also lets you increase or decrease the size of the display, export the configuration report in various formats for other applications, or update the Page Preview with the database's most recent data. The last option is provided because the main window is still open parallel to the Page Preview window, and changes to the configuration could therefore be made which render the Page Preview window's information obsolete.

Prerequisite: Only a *single* imc CANSAS module or the *entire* module database may be selected (selecting all of the modules one-by-one also works). If only one among multiple modules is selected, an error message will result.

Procedure: Once the Page Preview window is opened, the softkeys arrayed across the top of the window offer a selection of various commands.

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Scroll forwards and backwards through the report [1]

Call the dialog for printing the report [2]

Call the dialog for updating the configuration report with the newest module database data [3]

Call the dialog for exporting the report [4]

Increase/decrease display size [5]

6.4.1.8.1 The 'Print' dialog

The following options let you influence how the document is printed out:

Printing range: Specify which pages of the document to print out:

- All prints the entire document
- Pages prints a range specified by the controls 'from' and 'to'

Copies: Specifies how many copies of the printing range defined above to print out.

Collate copies prints multiple copies by sequences of report pages, rather than making multiple copies of each page in separate batches.

6.4.1.8.2 The 'Export' dialog

The 'Export' dialog can be used to export the configuration report as a file formatted to be read by other applications. For instance, a report could be exported in the Microsoft Excel format and thus opened in Excel as a normal spreadsheet.

The Export function supports many common word processing, database and spreadsheet formats as well as a number of standard data transfer formats.

Format: This combo box lists all formats in which the report can be exported.

Target: This combo box lists all targets available to the report.

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Procedure: In the combo box *Format* the format in which the report is to be exported is specified. For instance, select Excel 4.0 (XLS) from the provided list if you wish to convert the report to Microsoft Excel 4.0 format.

Select an export *destination* in the combo box Destination.

If the report is to be saved in a file, select *file*.

If the report is to be added to an e-mail document as an attachment, an appropriate mail-program must be selected. Microsoft Mail (MAPI), Microsoft Exchange Mail (also called MAPI) and Lotus cc:Mail (VIM) are supported.

If the report is to be saved in a Microsoft Exchange folder, the Exchange folder must be selected from the list.

If the report is to be sent to a Lotus Notes database, select Lotus Notes database from the list.

If the report is to be exported to another application (for instance, MS Excel or Word), select the pertinent application.

Then click OK to start the exporting process.

If the report is exported to a diskette file or an application, a number of dialog boxes appear in which formatting details must be filled in by the user; the particular entries needed depend on the format specified in the dialog Export. After these details have been supplied, click OK and the dialog Select export file appears. Using the controls in this dialog, a filename and directory path can be specified for exporting the report.

Files receive a program-specific extension when they are exported to particular word processing, spreadsheet or database programs. In contrast, files which are exported in a standard format for data transfer (*.DIF, Data Interchange Format) are automatically assigned the extension *.TXT. However, the program in which the data are to be used may expect an extension different from *.TXT. In the pertinent program's manual you can find the information about which extension to use, and the corresponding extension can be specified in the dialog element Filename.

To finish, click on Save and the program will export the report to a file in the format specified.

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6.4.1.9 File - Print Setup...

Purpose: Use this command to specify a printer and make printer settings.

Remarks: Calling the command makes the Print Setup dialog appear.

6.4.1.9.1 The 'Print Setup' dialog

The following controls are provided:

Printer: Select the printer to use from the list of installed printers. To install a printer or set the port for a printer, use the Windows Control Panel.

Orientation: Choose between Portrait and Landscape.

Paper/Size: Select the size of the paper on which the report is to be printed.

Paper/Source: Some printers have multiple bins for feeding different types of paper to the printer. Select the bin here.

Properties: Calls a dialog offering additional controls for settings particular to your printer.

6.4.1.10 File - Close

Purpose: Ends the imc CANSAS session.

Shortcuts

Keyboard: ALT+ F4

Remarks: Alternatively, you can close the program from the Close-command in the Control menu, or by simply double-clicking on the Control menu box.

The program will automatically save the latest settings changes to the database without prompting for confirmation.

6.4.2 Edit

6.4.2.1 Edit - Undo

Purpose: Reverses the effect of the last command carried out.

Shortcuts

Keyboard: CTRL+Z

Remarks: You can use this item to undo the last editing action performed, wherever this is still possible. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

6.4.2.2 Edit - Cut

Purpose: Deletes data from an input box and transfers them to the Clipboard.

Shortcuts

Toolbar: 

Keyboard: CTRL+X

Remarks: Use this command to remove the currently selected data from the input box to the Clipboard. The command can't be used if there is no current selection. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

Data removed to the Clipboard by this command replace any data which previously were held in the Clipboard.

6.4.2.3 Edit - copy

Purpose: Copies data from a dialog box or module settings to the Clipboard

Shortcuts

Toolbar: 

Keyboard: CTRL+C

Remarks: Use this command to copy the currently selected data to the Clipboard. The command can't be used if there is no current selection. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

Data copied to the Clipboard by this command replace any data which previously were held in the Clipboard.

There is another possibility if the entry for a imc CANSAS module is selected in the Module Tree. In this case, all the settings for the entire module are copied to the Clipboard. Using the command ***Edit-Paste***, the settings can then be transferred to another module of the same type

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6.4.2.4 Edit - Paste

Purpose: Inserts Clipboard contents into an input box or settings into a different module.

Shortcuts

Toolbar: 
Keyboard: CTRL+V

Remarks: A copy of the Clipboard's contents is inserted at the cursor's location. If the Clipboard is currently empty the command is not available. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

If module settings are the contents of the Clipboard, they can be applied in the selected module. The command is only enabled if the module type whose settings are in the Clipboard matches the selected module type.

6.4.2.5 Edit - New

Purpose: Adds a new CAN-message or a virtual channel to a imc CANSAS module.

Shortcuts

Toolbar: 

Prerequisite: A single imc CANSAS module must be currently selected in the Module Tree. If multiple modules are selected, this command is not accessible.

The current selection can also be any of the various entries subordinate to a imc CANSAS module; the command will always apply to the corresponding module.

The command works in both Module Tree grouping modes.

Procedure: When the command is implemented, the entry for a new CAN bus message is placed under the CAN bus interface node. The message is automatically assigned a name.

If the Module Tree is in the mode Grouped by channels, a new entry is placed under the Virtual Channels node. If the Module Tree is in the mode Grouped by message, the new entry is placed under the Without CAN bus message node.

A name is assigned automatically. Then the program goes into editing-mode; the name can be changed. The changed name is applied once the <***Return***> key is pressed.

Other properties of the new virtual channel can be set in its Properties dialog.

6.4.2.6 Edit - Rename

Purpose: The name of a imc CANSAS module, a CAN-message of a channel in the Module Tree can be edited.

Shortcuts

Keyboard: F2

Remarks: The last entry selected can be edited.

6.4.2.7 Edit - Delete

Purpose: Deletes a imc CANSAS module, a CAN-message or a virtual channel.

Shortcuts

Toolbar: 

Keyboard: Del

Prerequisite: Virtual channels, CAN-messages and imc CANSAS modules can be deleted when they are selected. This function cannot be applied to other entry types.

If the imc CANSAS module entry is selected (either alone or together with other entries), the module is deleted along with all its subordinate entries.

Deletion of entries means removing them from the database. Using the command 'New', they can be readmitted to the database.

A prompt for confirmation will be posted before the deletion is carried out.

The command works in both Module Tree grouping modes.

6.4.3 View

6.4.3.1 View - Toolbar

Purpose: Toggles the toolbar On/Off

Remarks: When the toolbar is in the 'On' mode, a checkmark appears next to this menu item. The commands symbolized by the toolbar's icons are the most commonly needed commands in imc CANSAS.

6.4.3.2 View - Status bar

Purpose: Toggles the Status bar On/Off

Remarks: The status bar gives a short description of the workings of the currently selected menu item or currently pressed softkey, and also displays the current time and date. When the status bar is in the 'On' mode, a checkmark appears next to this menu item.

6.4.3.3 View - Split

Purpose: Allows changing the size of the Module Tree window and of the Properties window.

Procedure: After calling this command the mouse or the ***ARROW BUTTONS*** can be used to shift the window divider position. As soon as repositioning is complete, click the mouse or press <***ENTER***> to confirm the position. Pressing <***ESC***> causes the original window divider position to be restored.

The same effect can be achieved simply by positioning the mouse pointer over the window divider, waiting until the cursor takes on this appearance: ⇹, and moving the mouse to reposition.

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6.4.3.4 View - Adjust

Purpose: Alters the Properties window size to accommodate all settings' entries.

Shortcuts

Toolbar: 

Remarks: Since the size of the application window is adjustable and the Module Tree window's width can also be adjusted at the expense of the Properties display, it can occur that the Properties display is partly obscured. This command ensures that all elements of the Properties display remain in view.

6.4.3.5 View - Group by

Purpose: Groups the Module Tree entries by message or channels

Shortcuts

Toolbar: 

By message: This is a command which restructures the Module Tree. The entries for a module's channels are ordered to reflect their channels' arrangement within the CAN bus messages. All defined messages are arrayed under the CAN bus interface entry. There is also still an entry Without CAN bus message, which comprises all channels not yet assigned to a message and which therefore cannot be transferred. Once a CAN bus message's entry is opened, the constituent channels' entries are seen. The order of their listing reflects their arrangement within the CAN-message.

In this mode, channels can be assigned to and deleted from messages by means of drag&drop operations.

By channels: This is a command which restructures the Module Tree. The entries of a imc CANSAS module are sorted into the groups

- CAN bus interface
- Input/output stage
- Virtual channels.

The group **CAN bus interface** contains all defined messages.

The **group (Analog/Digital)** inputs contains all input channels; the group (Analog/Digital) outputs all output channels.

The heading **Virtual channels** represents all virtual channels defined as well as certain special channels (LED-triggering).

This mode is more convenient for making simultaneous settings for input/output channels and virtual channels.

Note

In this mode, it's not possible to assign channels to messages. For that purpose, use the Grouped by Message mode.

6.4.3.6 View - Expand all branches/Collapse all branches

Purpose: Show or hide all branches of the module tree.

Shortcuts: Ctrl + Num + / -

6.4.4 Module

6.4.4.1 Module - Integrating Assistant

Purpose: Incorporates a new imc CANSAS-module into the module database. This can be done either by accessing an actually existing module via the CAN-Interface (on-line) or by making an entry manually (off-line).

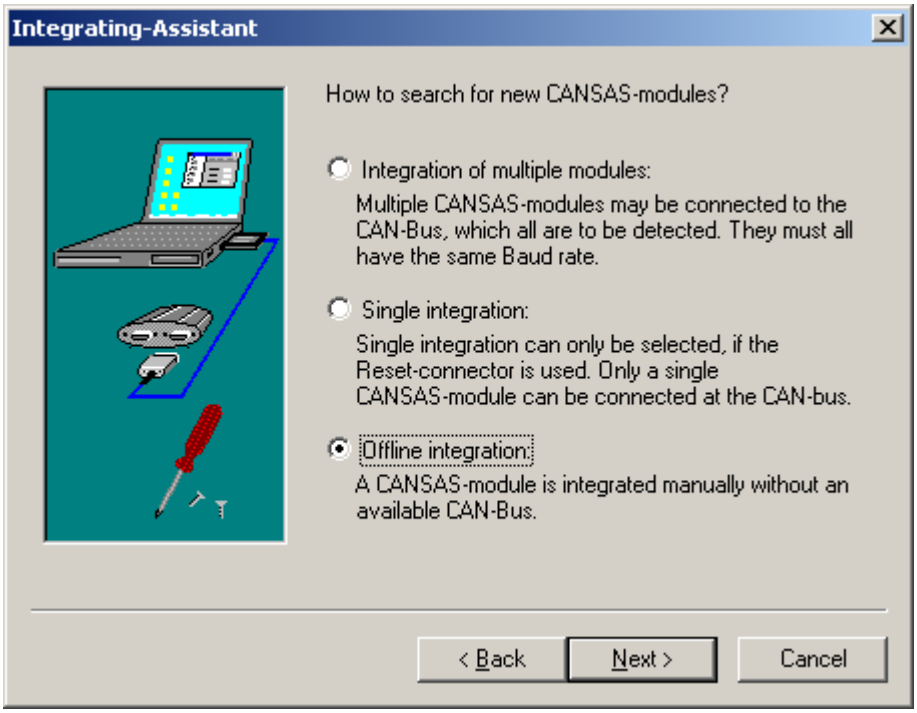
Shortcuts

Toolbar: 

Prerequisite: For on-line module integration, a supported hardware CAN-interface must be installed. The interface is selected and its parameters set in the dialog for the menu item *Extras/ Interface*. If this hasn't been done, the Integration Assistant will be closed after posting a corresponding message in explanation. Also, the imc CANSAS-module must be correctly connected to the CAN bus and ready to run.

For the module integration procedure, only the module to integrate may be currently connected to the bus involved. It's recommended to make a direct connection to the PC rather than going via the bus-complex.

Procedure: Integration of a module is accomplished with the help of the *Integration-Assistant's* sequence of dialogs. The softkeys *Next* and *Back* can be used to proceed to either the next step or the previous one. In the dialog succeeding the introductory dialog, the decision is made whether the module to integrate is accessed on-line:



selection dialog for integrating modules

Single integration: Integrates a new module on-line.

Choose this option to use this program to make the settings for a newly purchased imc CANSAS-module.

This is the preferable way to proceed as long as you have an actual module to integrate; the entry of the module's parameters will be handled automatically and the database settings will be compatible with the module.

Integration of multiple modules: It's possible to connect multiple modules, but they must all have the same Baud rate and firmware. If this is not the case, proceed as follows:

1. Use Single integration to find the modules one at a time.
   a. Give each of them the same Baud rate, Master – and Slave-ID.
   b. If you don't know what Baud rate the modules are set to, use the Reset plug to set them back to the factory setting (125 kBit). Please read the description of the correct use with the Reset plug in the chap. "Reset plug 114".
   c. If necessary, a firmware update is performed.
2. Once all the modules are using the same Baud rate, Master- and Slave-ID, they can all be connected to a common CAN bus.
   a. The bus will only work without errors if all the modules are using the same Baud rate.
   b. For working with one CAN-module, it doesn't matter which Master or Slave-ID it's using. However it's absolutely necessary for all modules to use the same IDs if they are integrated by means of Integration of multiple modules. We recommend setting the Master to ID= 2 and the Slave to ID=3, which are the default settings.
   c. Make sure that the ends are terminated with 120 Ω terminators.
3. Having followed these instructions, it will be possible to take measurement with multiple modules.

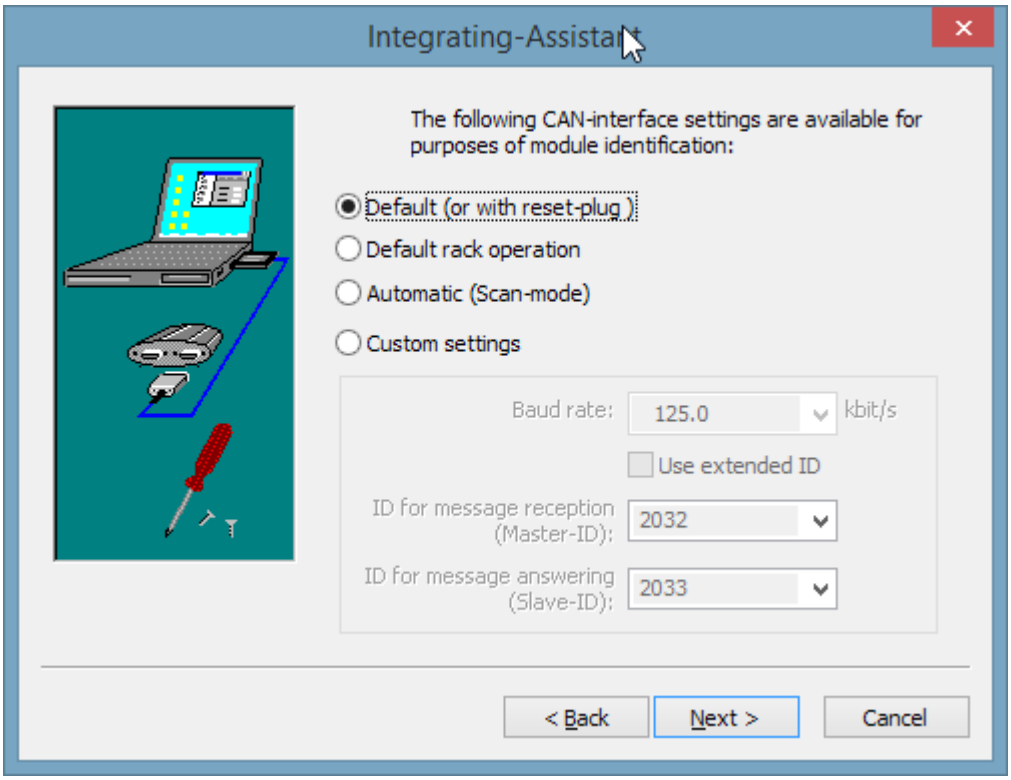
Offline integration: This is the only option if no imc CANSAS-module is currently available to connect to the system; this is mainly for demo purposes.

If you wish to use this option to make all settings for a genuine imc CANSAS-module manually, rather than automatically as above using Yes, then it is crucial that the module's serial number and type are entered exactly, AND that the module's Baud rate be the same as the default Baud rate.

The ensuing sequence of dialogs presented by the Assistant depends on the choice between *online* and offline; the description below illustrates the on-line case. In the first instance, the module's CAN-interface settings are made.

Default (or with reset-plug): The module's Baud rate and ID numbers for communication with the PC are assumed to take the default values. This is the case when a module is fresh from manufacture, in other words, if it has never been configured.

If a module has already been configured, its original, default state can be restored at any time by inserting the special Reset-plug, please read chap. "Reset plug 114".



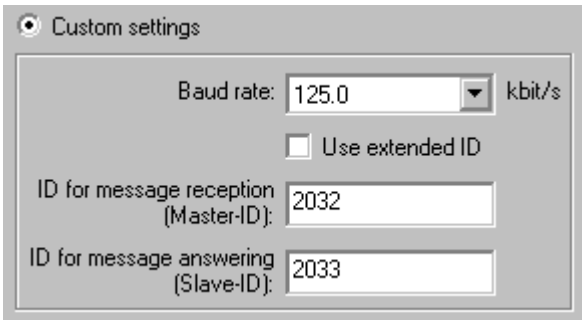
Default rack operation: Default settings for a new modules used in a rack. Baud rate is 500 kbit/s; Ids are 2 for receiving and 3 for send messages.

Automatic (Scan-mode): All baud rates are automatically adjusted successively until modules are found.

Warning

The extended ID range is not supported in the automatic search!

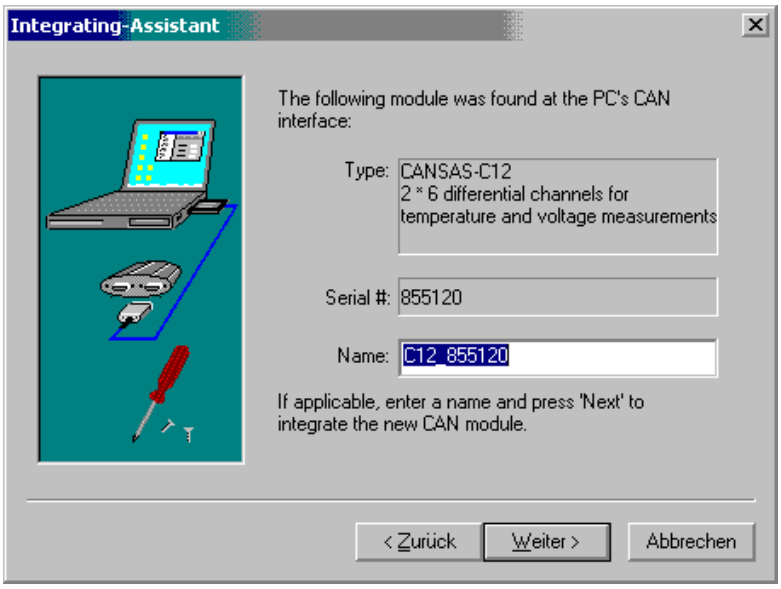
Custom settings:



The module's Baud rate and ID-numbers for communication with the PC can also be specified personally. But the values absolutely must match those valid for the module in order for the module to be recognized by the system. This is especially true of the Baud rate, which tends to be reconfigured more often than the ID-numbers! Note that only standard Baud rates can be selected here. This means that a module configured with a special Baud rate using Expert settings can only become a default-setting module by means of a Reset-plug!

Next: The next Assistant dialog prompts you to confirm the instruction to proceed with identification of the module via the PC's CAN-interface. The process can take some time. This is especially true if the PC-interface had not yet been used by the imc CANSAS program in the course of the session, since the interface initialization process still must take place beforehand.

Once identification is completed, the next dialog appears. This is the same dialog which would appear right after No (or: *off-line*) is selected. The dialog contains the settings which distinguish the module in the database:



Type: The imc CANSAS-module's type, e.g. 6 * 2 *differential input channels*.

When using the *on-line* option for integrating a module, this setting is handled automatically and cannot be changed.

In the *off-line* case, a selection must be made in the combo-box.

Serial number: The imc CANSAS-module's unique serial number, set at production.

When using the *on-line* option for integrating a module, this setting is handled automatically and cannot be changed.

In the *off-line* case, any number from 1 to 999999999 can be freely selected. If you are making settings for an actual module 'manually', however, the true serial number must be used.

Name: A unique name by which the imc CANSAS-module is designated in the database.

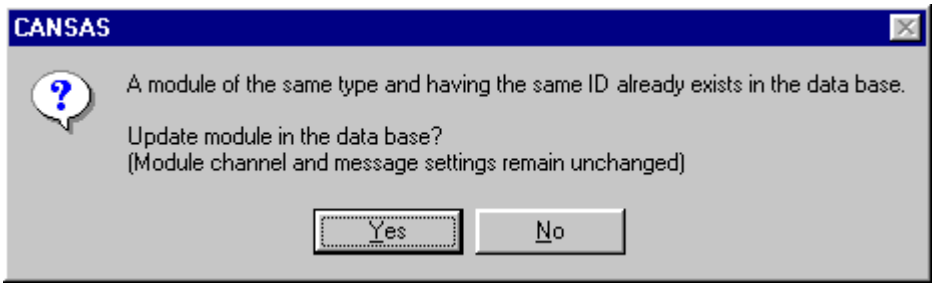
When using the *on-line* option for integrating a module, a default name, which is derived from the serial number, is offered. However, if the serial number in question is already registered in the database, the module name noted there is offered as the default.

Specifying and changing the name is permitted as long as the name is unique within the database.

Next: Completes the module-integration process. The data for the module are incorporated into the database.

If the data do not conform to accepted limitations, an error message will appear and signal a return to the previous dialog. Otherwise, the settings must be confirmed by pressing the softkey *Finish*. Once this is done, the module is integrated and can be configured using the software.

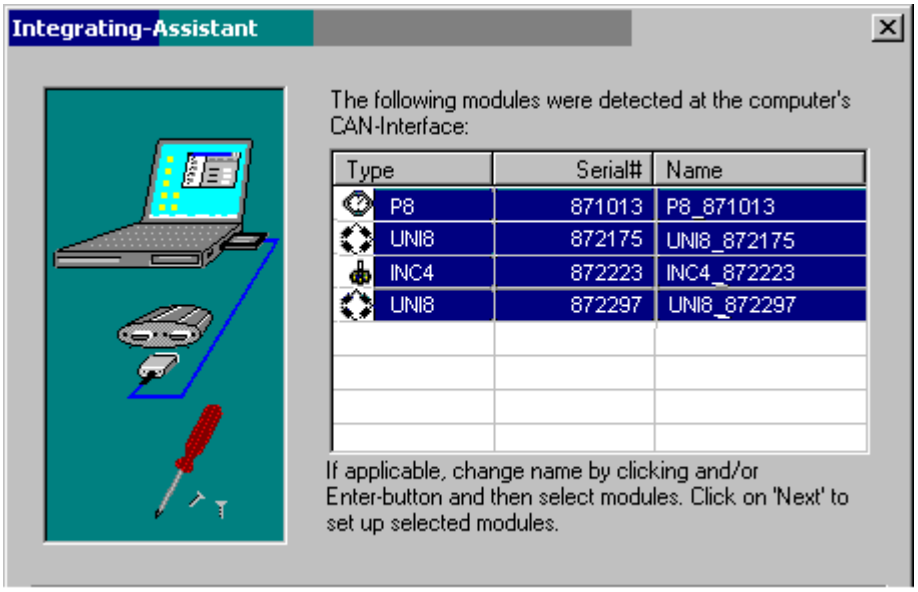
If a imc CANSAS-module of the same type and serial number is already registered in the database, the system asks whether the Baudrate, Master/Slave-ID and module ID numbers are to be updated, in other words, to be overwritten:



If a imc CANSAS-module of the same serial number but a different type is already registered in the database, the system asks whether the module is to be (completely) overwritten, including the channel and message settings.

When using the *on-line* option for integrating a module, this can never occur, since the serial number is unique and the serial number and module type are entered automatically. Only in the *off-line* option can this case arise.

When multiple modules are integrated, the following overview is displayed:



Select all modules you wish to enter into the database. Then press "*More*".

Note

If a new update of the software is used and the modules still have the firmware for Software version 1.2, a search for all modules on the bus will not work. In that case, simply load your existing database and reconfigure the modules. In this process, the firmware is updated.

6.4.4.2 Module - Find selections...

Purpose: Checks whether imc CANSAS-modules registered in the database are connected to the CAN bus.

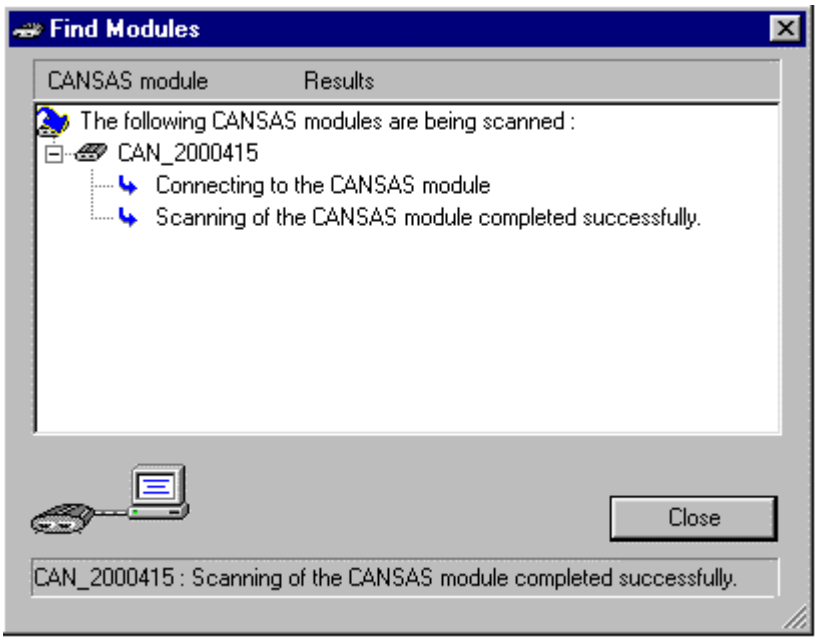
Shortcuts

Toolbar: 

Prerequisite: One or more imc CANSAS modules must be currently selected in the Module Tree. The search performed always affects all modules selected. It is enough to select a subordinate entry of a module to make the module involved count as selected. If the entry for the database is selected, a search for all modules belonging to the database is carried out.

Remarks: The search is accomplished using the dialog Find Modules. The search starts immediately.

The first stage comprises a check of whether the corresponding imc CANSAS module is connected to the CAN bus.



Dialog: Find Modules

Once a functioning connection has been established, the firmware version, hardware version and batch number are read out of the module. These properties are later indicated in the Properties dialog for each module.

If an error is detected at any stage of the search, this is indicated in the dialog. There is also an indication of any module which is found, and the search for the next module proceeds. The search can be aborted by pressing the Stop softkey.

When the dialog is closed, the Module Tree is updated. Modules located in the bus system are denoted by the symbol  .

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6.4.4.3 Module - Check configuration

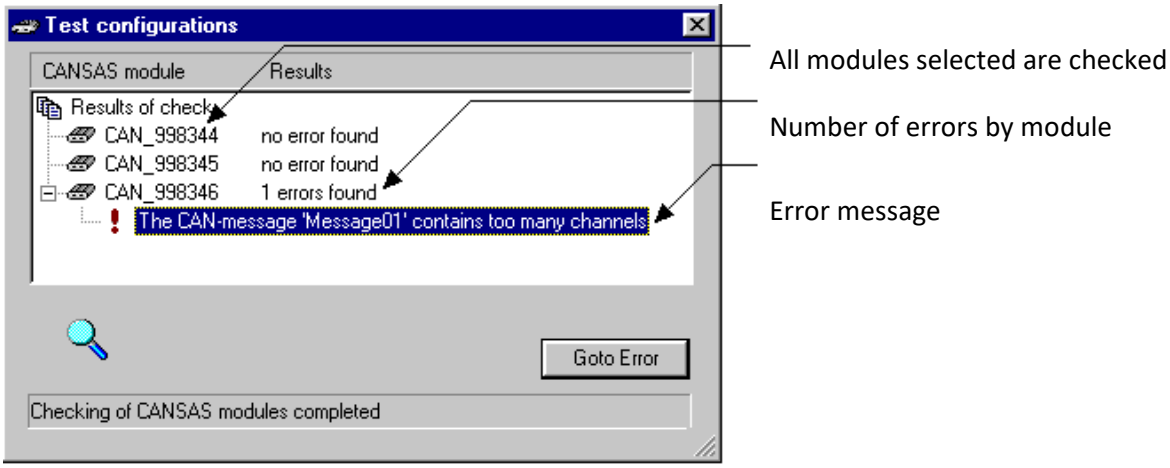
Purpose: Checks for errors in the configuration set for the imc CANSAS module.

Shortcuts

Toolbar: 

Prerequisite: One or more imc CANSAS modules must be selected; all modules selected are checked. The module itself or any subordinate entry can be selected; the function is applied to the module affected. If the Database entry is selected, all the modules will be checked.

Remarks: Calling the command makes the window "Test configurations" appear. The tests are started immediately and carried out without accessing the interface and module.



The Test configurations dialog

Each imc CANSAS module is tested on the following points:

- imc CANSAS- module names
- CAN-message names and channel names
- CAN bus interface settings
- CAN bus messages
- Virtual channels
- Input channels
- Module computational capacity
- Occupation of bus capacity by the module

If an error is detected, an error message is posted under the entry for the module affected. The system attempts to find and indicate any configuration errors. Once the tests are completed, one of the errors found can be selected. By pressing the softkey **Go to error**, the source of the error is selected in the Module Tree (this can also be accomplished by double-clicking the error's listing). This way, the error can be corrected by changing the appropriate setting in the Properties dialog.

Note

A imc CANSAS module can only be configured if the test is carried out successfully.

6.4.4.4 Module - Configure...

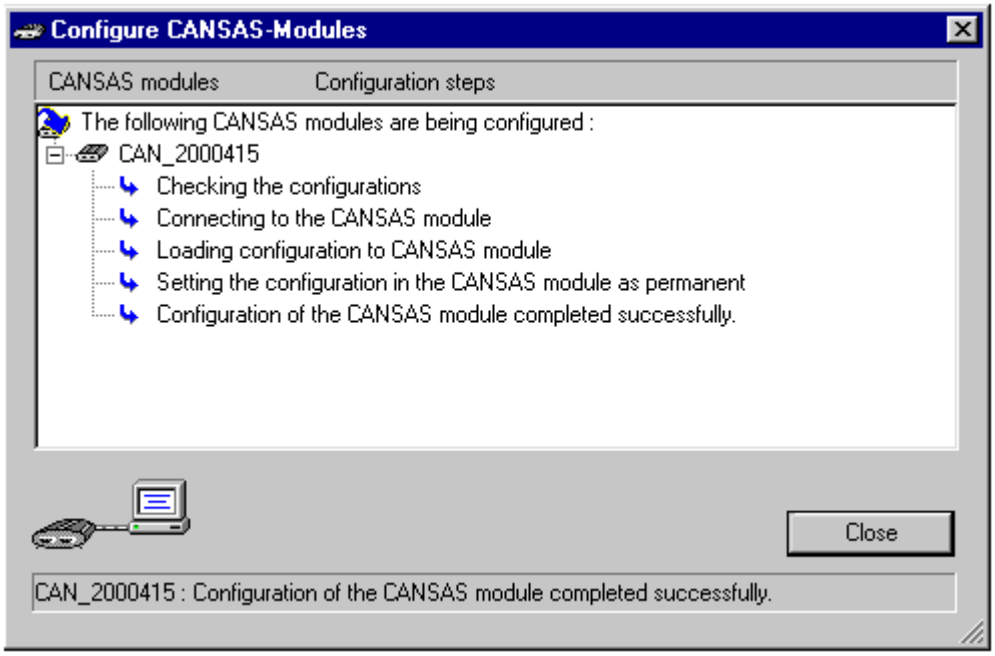
Purpose: Writes the configuration to the module.

Shortcuts

Toolbar: 

Prerequisite: One or more imc CANSAS modules must be currently selected in the Module Tree. Configuration performed always affects all modules selected. It is enough to select a subordinate entry of a module to make the module involved count as selected. If the entry for the database is selected, all modules belonging to the database are configured.

Remarks: Configuration is accomplished using the dialog Configure imc CANSAS-modules. The process starts immediately.



The Configure CANSAS-modules dialog

The configuration process includes a check of the settings. The same testing algorithm is used as for the command ***Edit/ Check configuration***..... If multiple modules are to be configured, they are all first tested. If an error is detected in any module, configuration is canceled.

The next step consists of checking whether the imc CANSAS module is connected to the CAN bus. Once a functioning connection has been established, the module's firmware version is compared with the firmware file.

If a discrepancy between the file firmware version and the module firmware version is discovered, the firmware must be loaded into the module and made permanent there. If the firmware file's version is older than that of the module, a prompt will be posted beforehand for confirmation that the older version should be loaded in the module.

Now the configuration noted in the module is compared with the configuration set in the PC. If they are the same, no configuration is loaded into the module; otherwise the new configuration is loaded into the module and made permanent there.

If an error is detected during the configuration stage, this will be indicated in the dialog. Configuration is resumed in the next module. By pressing the soft key ***Stop***, the user can abort the configuration process, if desired.

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6.4.4.5 Module - Measure...

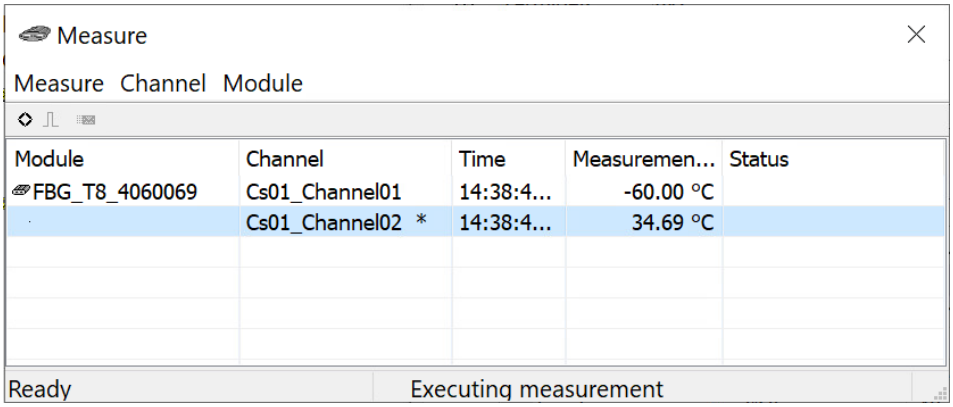
Purpose: Measurement data are read from the module.

Shortcuts

Toolbar: 

Prerequisite: The imc CANSAS modules from which measurement data are to be read must be selected in the Module Tree.

Remarks: Calling this command causes the Measure dialog, shown below, to appear:



Before actual measurement proceeds, a check of the firmware and the module configuration is performed automatically. If these are not compatible, a corresponding error message is displayed in the ***status bar***. Measurement by the module affected cannot be carried out; it would be necessary to perform the command ***Module/ Configure***... in preparation.

The displayed measurement values are constantly updated. The measuring process can be ended by selecting the menu item ***Close***.

If modules which can be balanced, such as **bridge modules** (UNI8, DCB8) or other **channels with zero adjustment** (e.g. UTI-6, FBG-T8), are present in the measurement, then the buttons in the toolbar are enabled.

With the command **Perform balancing of all selected channels** (bridge symbol), the bridge is automatically either zeroed or tared to the adjustment value on all selected channels.

The command ***Trigger shunt calibration*** causes the bridges of the **bridge modules** to be shunted. The bridges are thus trimmed in a defined way for a certain time. The command is useful for performing a function check.

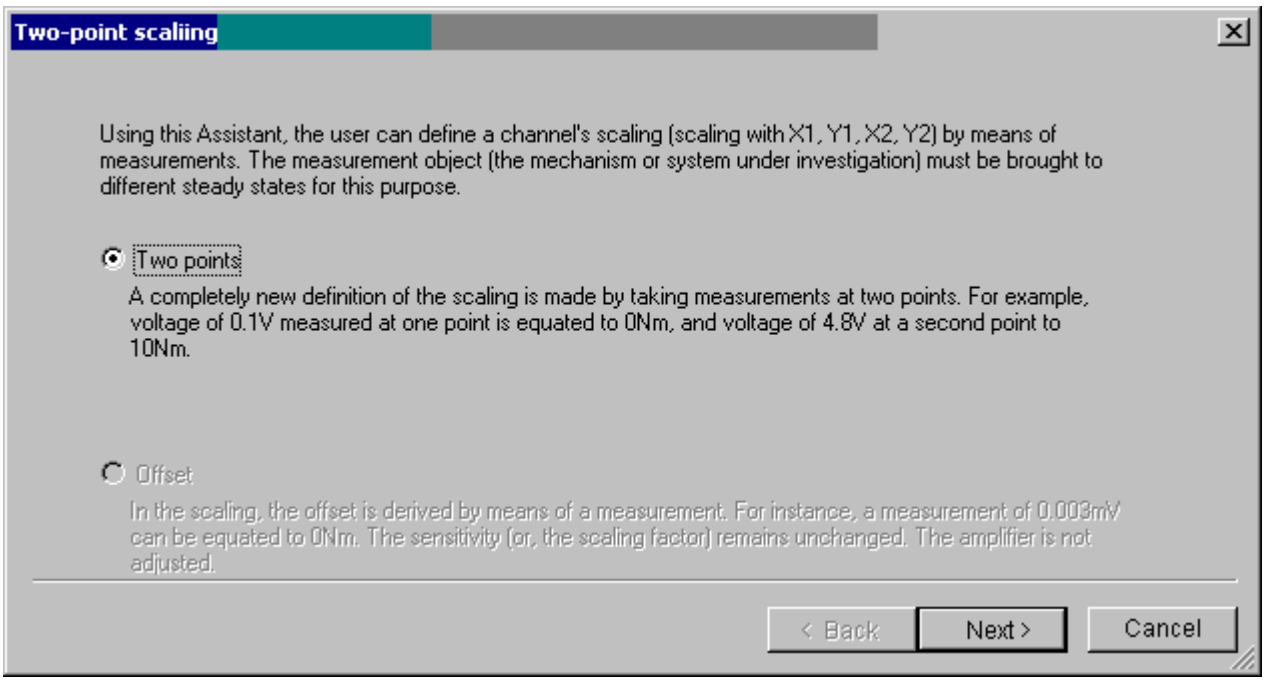
The menu bar **Output modules** is relevant to the DO or DAC8 module.

With these modules, the entry in the column *Measurement/output* value can be edited. Pressing the *Enter*- key switches to edit mode. The output value can be edited. Pressing the *Enter*- key then confirms the new value and applies it in the module. The *Esc*- key can be used to abort the new entry.

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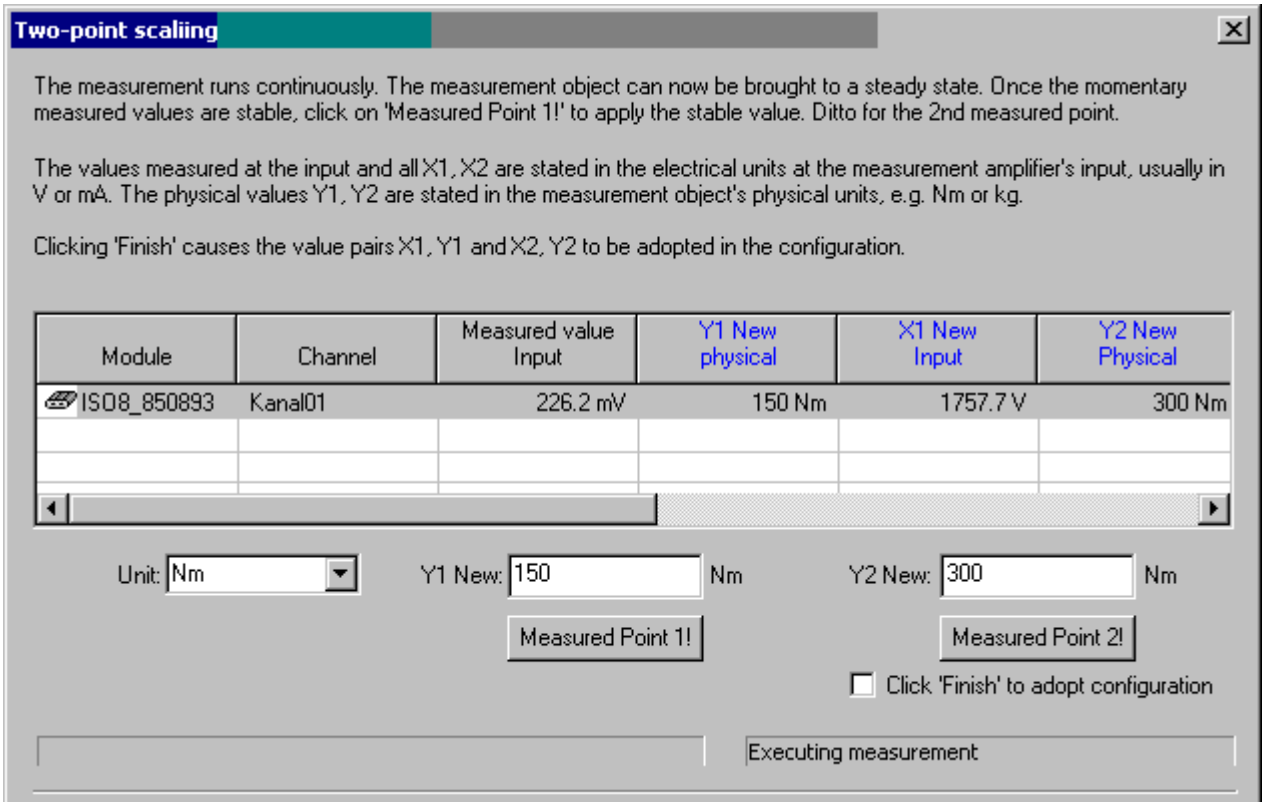
6.4.4.6 Module - Two-point-Scaling

Purpose:



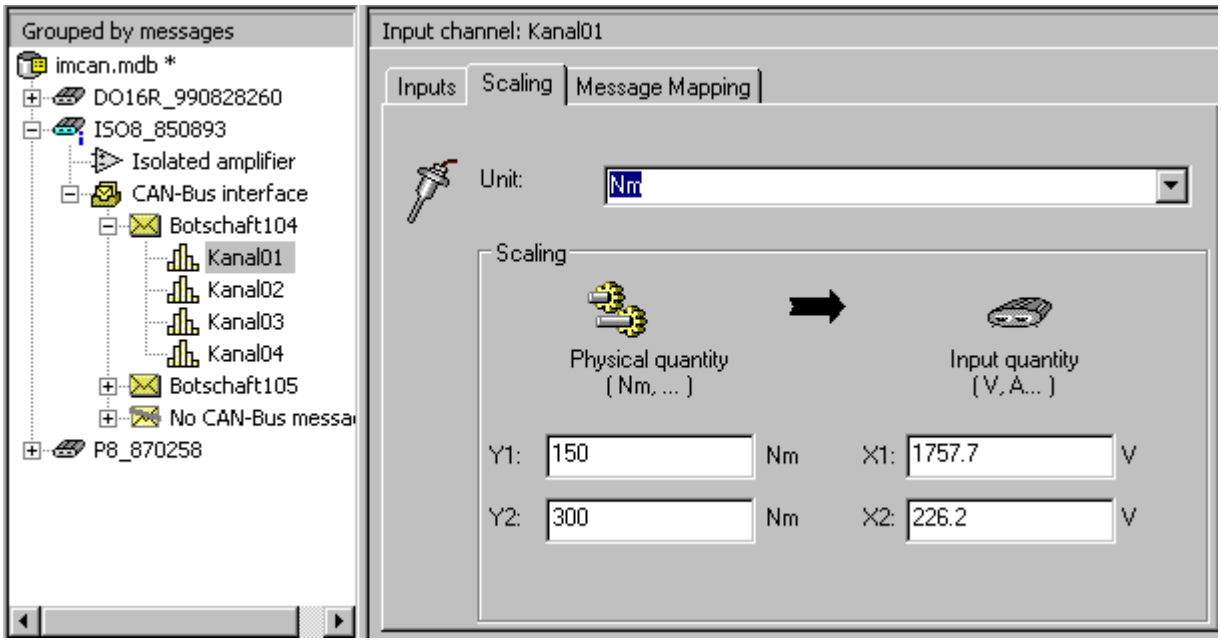
Scaling is defined by measuring two signal levels. The user gives the unit and the expected set point. The two points will be measured in succession and entered with the buttons *Measured Point 1! and Measured 2!.*

In the Assistant mode *Offset*, only the scaling offset is recomputed while the scaling factor remains unchanged.



If the box "Configure after 'Finish' " is checked, then this configuration is automatically updated in the module after exiting the dialog.

The scaling values can be checked on the Scaling tab afterwards.

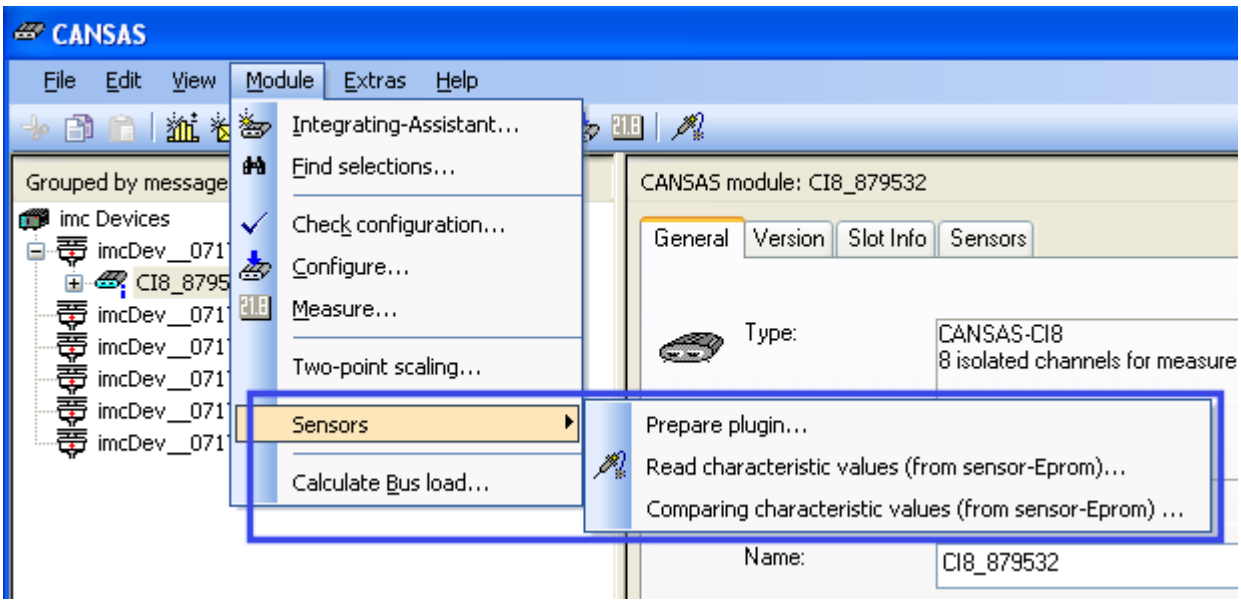


Limitations:

- This function is not available for:
  - Strain-gauge measurement
  - Temperature measurement
- The scaling distance between X1 and X2 must be at least 1/200 of the input range end value

6.4.4.7 Module - Sensors

Under *Sensors* there are three menu functions:



Prepare plugin...

Purpose: This is used to set the selected module's sensor supply voltage to +5 V. Perform this function prior to connecting sensors in order to avoid possible damage to the sensors due to overvoltage.

Read characteristic values (from sensor-EPROM)...

Purpose: Prepare and read sensor identification. This includes import of the plug-in location information, if it has been enabled (for module types supporting TEDS)

Shortcut:

Toolbar: 

Comparing characteristic values (from sensor-EPROM)...

Purpose: This indicates whether the sensors connected match those belonging to the module's current configuration.

6.4.4.8 Module - Calculate Bus load

This command can be used to compute the aggregate load of all modules selected.

Example:

The signals of 8 channels having 16 bits apiece are sent in 2 messages at one node at a Baud rate of 1MBit.

This results in 8 Bytes or 64 sits of payload data per message. Including interframe space, this results in 109 bits per message, of which 99 bits are subject to the stuff-bit rule.

The messages are sent at a data rate of 1kHz.

The Stuff-Bit rule stipulates: If five consecutive bits have the same state, one bit of the opposite state is inserted into the data stream. Depending on the data, these stuff-bits are inserted either frequently or rarely. Since this cannot be predicted, it is necessary to assume the worst case (longest message).

The resulting message length is thus:

109 bits + 0.2 * (99 bits) = 109 bits + 20 bits = 129 bits

Since there are two messages -> 258 bits

With a data rate of 1 kHz, this means: 258 bits *1000/s = 258000 bits/s

In reference to the node's Baud rate: 258 kBit/1000 kBit = 0.258 = 25.8%

6.4.5 Extra

6.4.5.1 Extras - Interface

Purpose: Sets up an interface for communication via CAN bus between the PC and imc CANSAS modules.

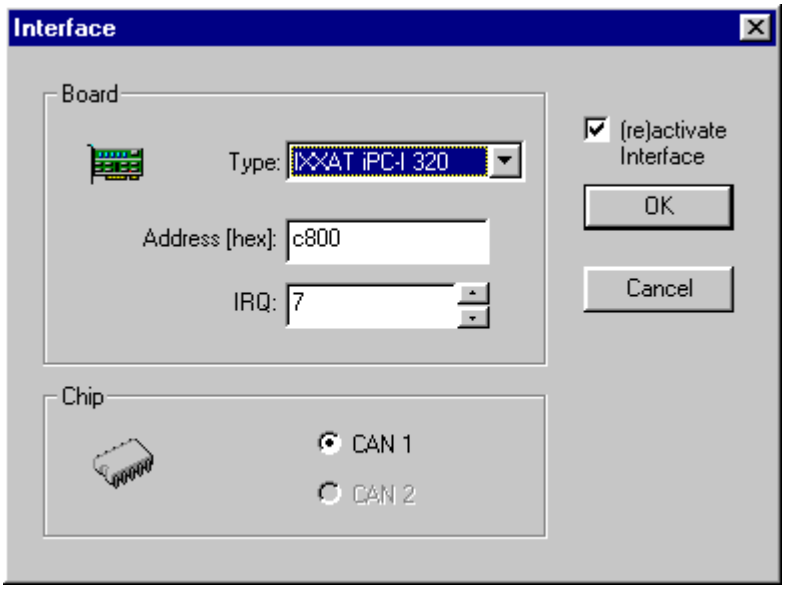
Prerequisites: An interface supported by this program must previously have been correctly installed as hardware using the corresponding board drivers. For this purpose, follow the instructions which come with the board. This product version supports various interface boards from the companies IXXAT, Vector and imc.

- From IXXAT: iPC-I 320 (ISA plug-in board), iPC-I 320/PCI (PCI- plug-in board) and tinCAN PC-Card (PCMCIA).
- From Vector: PC-Card CANCardX (PCMCIA) and CANpari (Parallelport-Dongle).
- imc offers a CAN/USB adapter as an interface.

The program only allows one active interface, therefore if multiple interfaces are installed as hardware it is only possible to alternate among them; it's not possible to set up several for simultaneous use.

In any case, only up to two CAN-Controller 1 are supported. If the interface board has two CAN bus terminals, then be sure to connect the imc CANSAS-module at the correct plug!

The Interface Dialog



The following options allow you to specify which interface to use and how it is configured.

Type: Select from the combo box which interface type is to be used with the PC. PC-Card-Interface (PCMCIA) or PC-plug-in board in the ISA or PCI version.

Address (enabled for Type: ISA plug-in cards): For entering the base address of the I/O-space used by the ISA-board. The setting must be a hexadecimal value in the range C000 to FE00 in steps of 8k. The default value is D000.

The range D000...D1FF is a free area in most Windows systems. Other possibilities would be, for instance, D200, D400 etc. See the documentation for the interface board for more detailed information.

This setting only pertains to ISA-Interface boards. Note: If an IXXAT ISA-card is used by means of the VCI driver software 2.x, the same value must also be used as in the control program *IXXAT Interfaces*. This program can be found in the Control Panel after VCI installation has taken place.

IRQ (enabled for Type: ISA plug-in cards): For entering the number of the IRQ used by the ISA-board. The default value is 7.

IRQ 7 is an interrupt vector which is usually free since it's mostly used by a PC's second printer interface. If this IRQ isn't available, IRQ 5 is to be recommended, which is for the most part only used in Windows-systems where DOS-Box-supporting sound hardware is installed. This is frequently the case when the sound hardware is PCI-compatible. Since the DOS-supporting property is rarely relevant, it's probably worth sacrificing it for the sake of gaining the use of its interrupt. IRQ 9 is another frequently free interrupt.

The IRQ to select depends upon what PC resources happen to be free. See the interface board documentation for more details on the IRQ settings. The IRQ value entered must match the corresponding jumper configuration of the plug-in board!

This setting only pertains to ISA-Interface boards. Note: If an IXXAT ISA-card is used by means of the VCI driver software 2.x, the same value must also be used as in the control program IXXAT Interfaces. This program can be found in the Control Panel after VCI installation has taken place.

Board No. (enabled for Type: PCI plug-in cards): For entering the index of the PCI-version CAN interface board. Possible entries are 0, 1, 2,... etc. The default is 0. Only use a number other than 0 if *more than one* CAN-PCI-board is installed in the PC!

This setting only pertains to PCI-Interface boards.

Slot (enabled for Type: PCMCIA drive): For entering the ID-number of the PCMCIA-slot in which the interface module is ported. The options are 1 and 0, 0 being the default.

This setting only pertains to PC-Card-Interfaces (PCMCIA).

LPT # (enabled for Type: parallel adapter): For entering the number of the PC parallel port terminal into which the adapter is plugged. Possible entries are 1, 2, ...

This setting only pertains to parallel port interfaces.

Automatic detection: When this option is active, the number of the parallel port into which the adapter is plugged is recognized automatically. This renders the previous dialog control obsolete!

This setting pertains only to parallel port interfaces which support automatic *LPT* recognition (Vector CANpari).

(Re)activate Interface: Specifies whether the interface is to be initialized upon confirmation of the interface settings using the *OK* softkey. A choice of Yes amounts to a check of whether the interface is present and responding properly. If No is chosen, initialization is delayed until accessing of the imc CANSAS module first becomes necessary.

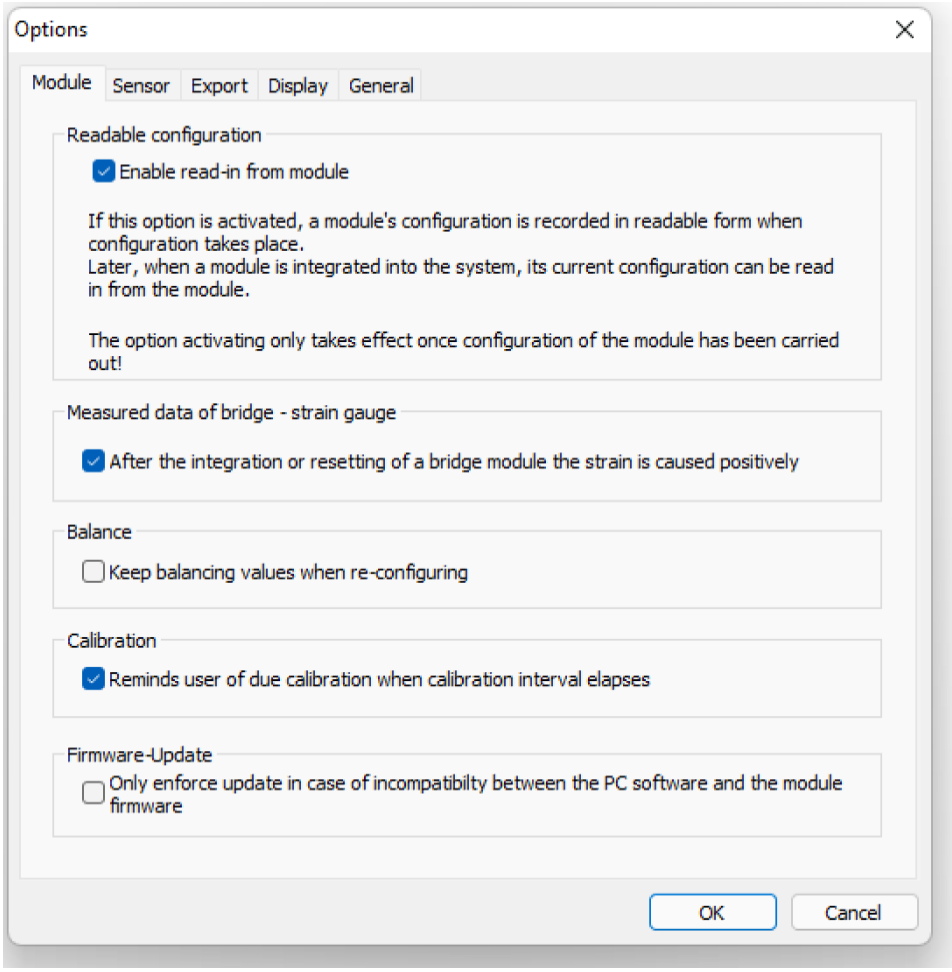
The initialization process can last a few seconds and is only performed once within a imc CANSAS session. By calling the Interface dialog after the interface has begun to be used and then closing it by pressing the *OK* softkey without having changed the settings, it is possible to reinitialize the interface if this option is set to Yes. This might come in handy if an unexpected problem ever arises when accessing the bus via the interface.

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6.4.5.2 Extras - Options

6.4.5.2.1 Module

Purpose: Settings options affecting the software's general behavior.



Readable configuration

It is possible to read a configuration into a module in such a way that it can later be read by the software. This makes it possible for a module's configuration to be taken up in the database although it was made on a different PC. See the description for "Readable configuration" below. 111

Measurement data of bridge - strain gauge

Give positive values for strain. Valid after reset or new integration of a module. -> Information to strain gauges 182.

Balance

If the option *Keep balancing values when re-configuration* is activated, adjustment values of **bridge channels** or of channels in **voltage measurement mode with zero balance** are preserved even if configuration changes such as channel designation or sampling rate are made. This **does not** apply to a configuration change that alters the **electrical adjustment value**, such as changing the **measurement range, bridge circuit**, or **bridge voltage.**

On this tab the default behavior is set, which is used when a new module is integrated. This option is supported by all module types, on whose *Balance* card this option is also offered, e.g. UNI8 378.

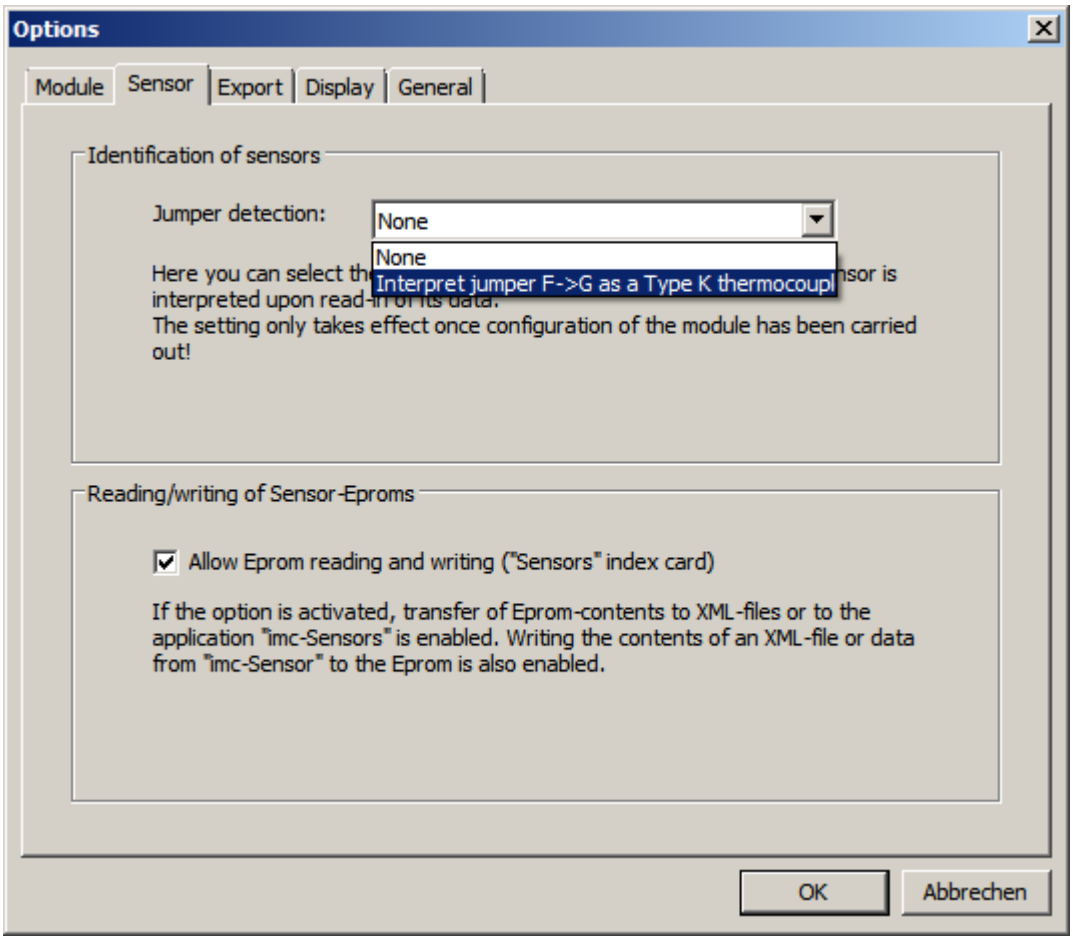
Calibration

Show state of calibration. For further information see here 226.

Firmware-Update

Enforce update in case of incompatibility between PC software and firmware of the module.

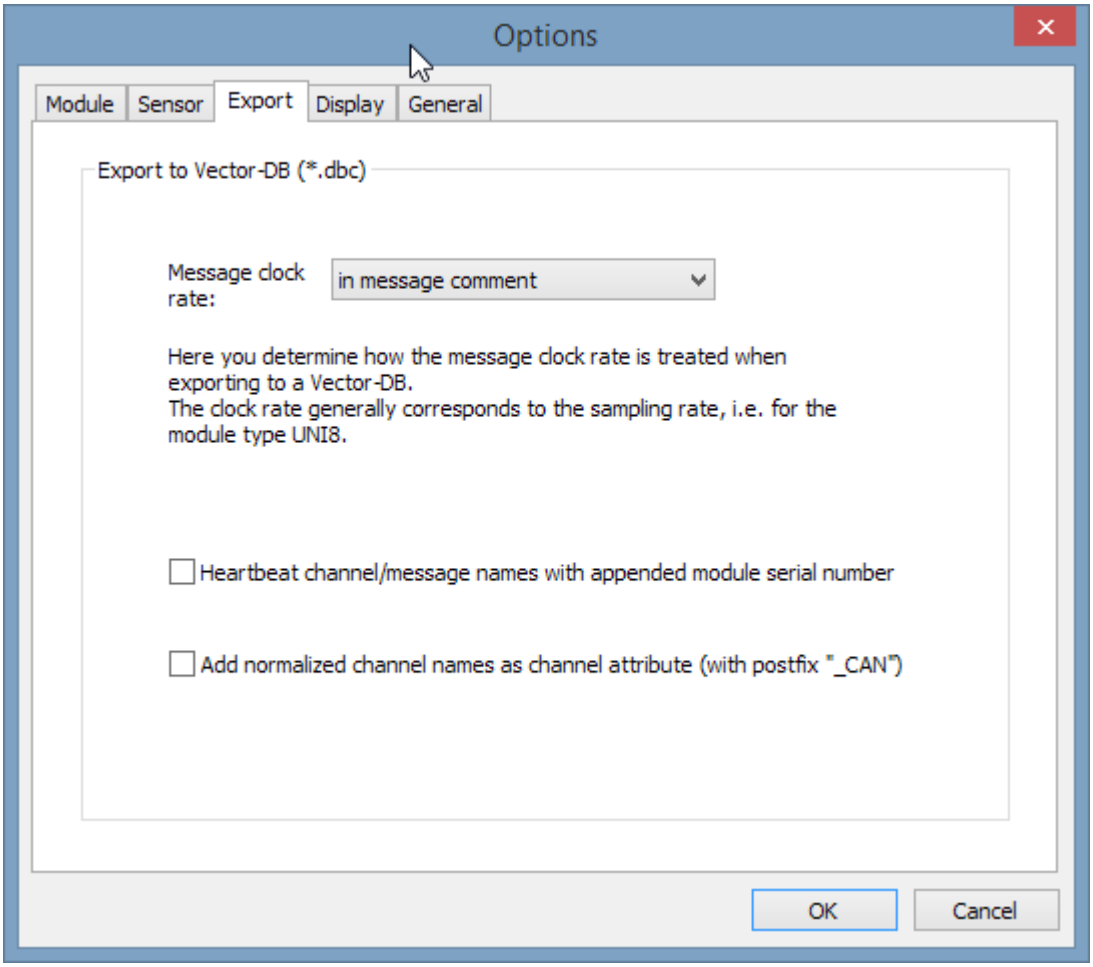
6.4.5.2.2 Sensor



Sensor: Identifying data: A jumper from F to G can be used for recognizing Type K thermocouples. Here, the recognition is enabled.

Sensor: Reading/writing of Sensor-EPROMs: unless this box is checkmarked, the Sensors page is disabled. Transfer of sensor information from EPROMs to XML-files or into imc-Sensors, or importing of XML-file content to EPROMs is not possible then. Normal export of sensor information from EPROMs is not affected.

6.4.5.2.3 Export



Message clock rate: Here you set how the message clock rate responds when exporting a configuration to a Vector database. For instance, for a module of type UNI8, the pulse rate generally corresponds to the sampling rate. The clock rate can be ignored, inserted in message comment or added as message attribute.

Heartbeat-channel/message names with appended module serial number: Heartbeat-channel and message names can be added automatically when exporting as DBC.

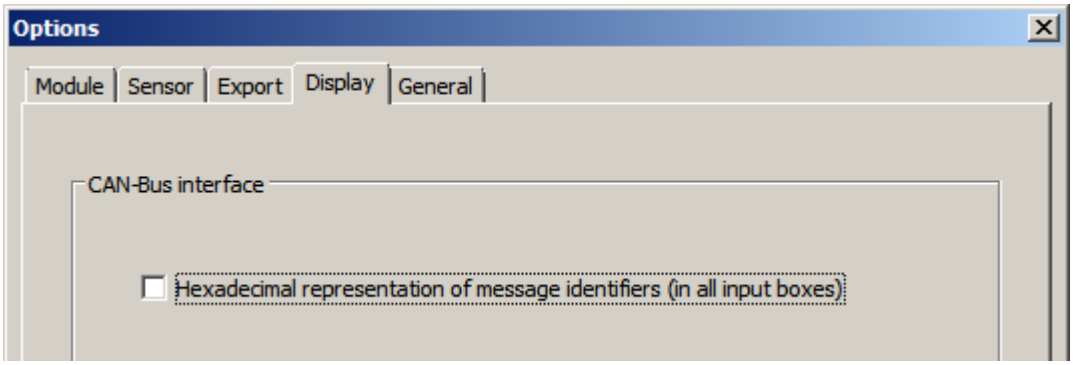
Add normalized channel names as channel attribute: Add channel attribute "_CAN" to channel names.

Note DBC Export

Up to CANSAS V1.9 "µMUSYC" was automatically entered in the DBC file for each channel. Starting from CANSAS 2.0 the entry was changed to "imc". It is possible to change this text with the Windows Registry. To do so, open the following entry in the registry:

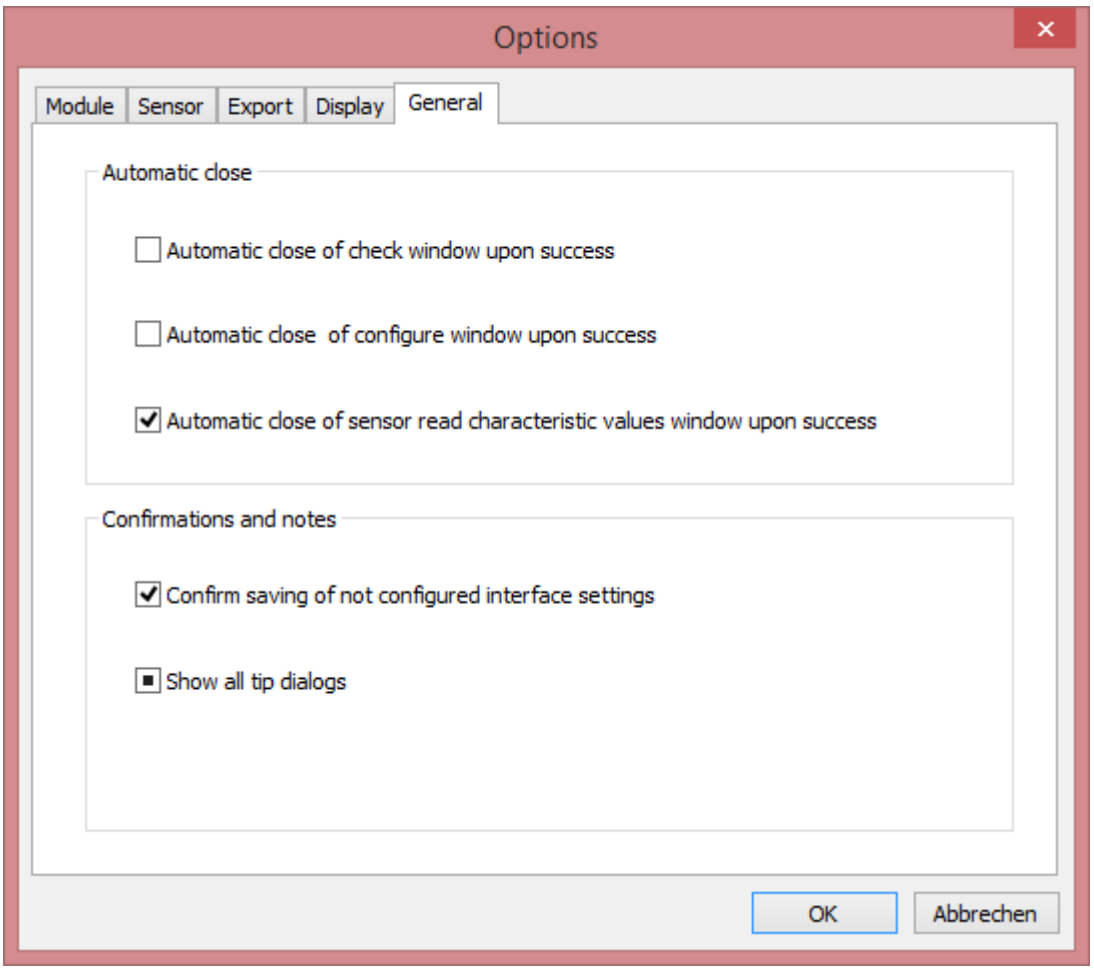
```
HKEY_CURRENT_USER\Software\imc Measurement and
Control\Default\CANSAS\DATABASE\DefaultTransmitterReceiver
```

6.4.5.2.4 Display



Display: CAN bus interface: this option box determines whether the message identifiers in all input boxes are to be expressed in hexadecimal format.

6.4.5.2.5 General



General:

- **Automatic closing:** Options affecting how dialog windows are closed, e.g. when configuring the modules or transferring sensor information from imc SENSORS.
- **Confirmation:** For confirming a save if the interface settings are not configured. Deactivation of showing all tip dialogs.

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6.4.6 Help - Info about CANSAS...

Purpose: This command causes the copyright information and the product version number to be displayed.

Shortcuts

Toolbar: 

Remarks: The appearing dialog also indicates the amount of free hard drive memory and free RAM.

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6.5 General notes on working with imc CANSAS modules

6.5.1 Readable configuration

This enables a configuration to be written into a module in such a way that it can later be read out again by the software. This means that a module's configuration can be adopted in the database although it was created using a different PC. See the description of the Options dialog 106.

The feature *Readable configuration* is generally not needed if there is a database containing the current or desired configuration of the imc CANSAS modules. The feature is needed if modules are configured in one place and later taken to be used somewhere where there's no database. If there is at least imc CANSAS software available where such a module is used, the setting can be read back in order to see how the module is really configured.

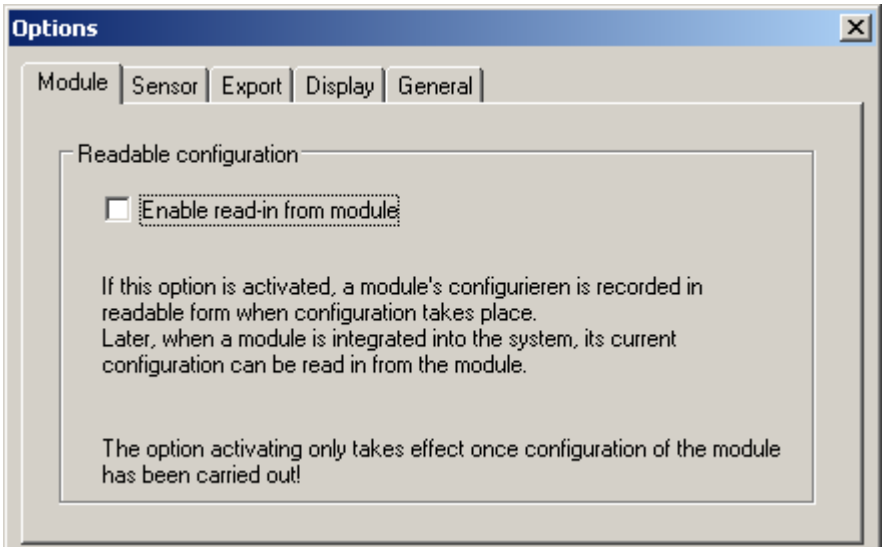
Notes

- As per standard, the "*Enable read-in from module*" option is activated for all modules (as of imc CANSAS software version 2.0R14) - see features and modules 223.
- If the software version is changed, and thus also the imc CANSAS firmware, after a configuration had been exported to the PC, then the configuration might not work properly when it is re-imported by the device.
- Error-free re-import is only ensured if one of the following conditions is met: if the imc CANSAS module is connected via the imc USB interface, or if the imc CANSAS module is connected via an imc measurement device having a CAN-interface.

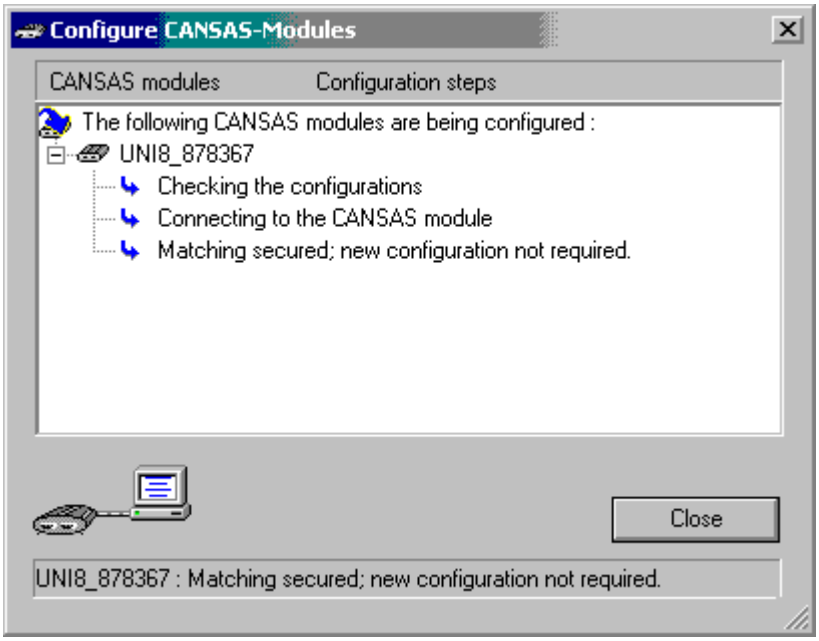
6.5.1.1 Operation

As per standard, the "*Enable read-in from module*" option is activated (as of imc CANSAS software version 2.0R14).

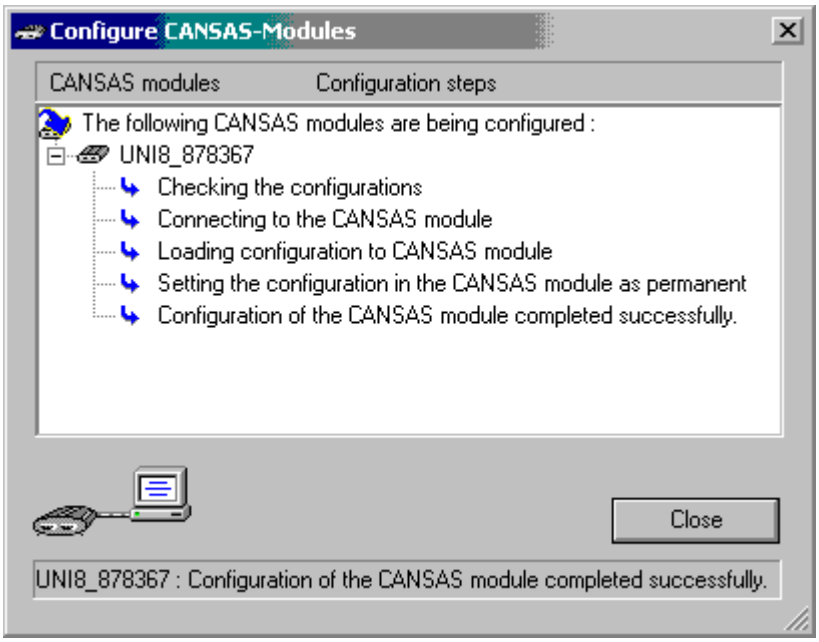
1. The menu item *Extras / Options* calls a dialog, in which you must select the index card *Module*.



2. Activate the option *Enable read-in from module* and confirm with *OK*.
3. Next, the imc CANSAS-module is configured.

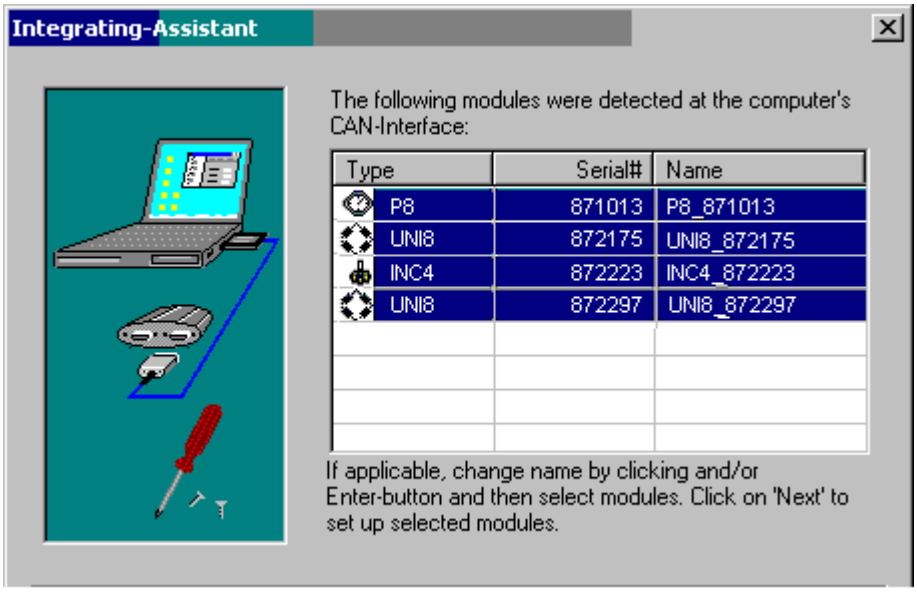


4. If the imc CANSAS module's configuration hasn't changed and for this reason the screen shown above is displayed, select the menu item *Module / Configure…*again, while holding down the *SHIFT-key*. This forces configuration to be carried out:



5. The module is now configured and its configuration is stored in the module in a way which can be read out.
6. You can now save the database.
7. While you work with the database which also contains the configured module, you can see its configuration.
8. Now suppose that you don't yet have this module in the database. For testing purposes you can empty the database, delete all modules or set up a new one. That is the typical situation: the database is empty, you have some imc CANSAS-modules already configured and want to know their configuration.
9. Now add the new modules using the Integration Assistant.
10. The modules are entered one again into the database, only this time they don't receive the standard configuration, but the configuration read out from the module instead.

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6.5.2 MDB database

All information is saved to a MDB database. Availability of this format in the dialog under the menu item *File / Open* is required, and generated when using *File / Save*.

There is an additional possibility to export or import either everything or portions of it in XML format using the menu items *File / Import* and *File / Export*.

Modules with absolutely incompatible properties are completely skipped and an associated message is posted upon opening.

6.5.3 Reset-plug

To reset an imc CANSAS module to factory settings, you need suitable reset plugs. For imc CANSAS*flex* or classic (CANFX, CAN) this connector is a 9-pin standard DSUB plug, which must be bridged between pin 3 and 4 (CAN/RESET).

For the modules of the imc CANSAS*fit* (CANFT) family, the ACC/CANFT-RESET plug must be used. This plug must be used in the correct orientation (see connector labeling) and into the corresponding socket on the bottom side of the module (2) 34. When opening the protective cover of the CANFT module, be aware of the restrictions.



ACC/CANFT-RESET

Note

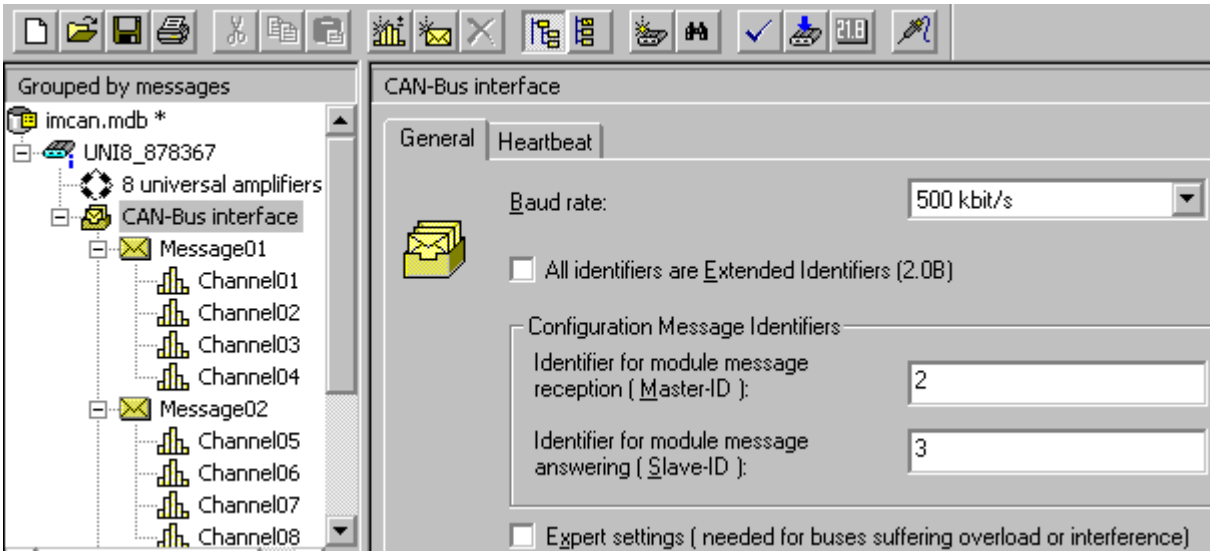
The plug ACC/CANFT-RESET is supported
imc CANSAS Software Version 2.2 R10 unterstützt.

Working with the Reset-plug:

1. Take a single imc CANSAS-module which you are unable to find on the CAN bus using the regular integrating procedure.
2. Disconnect the module's power supply.
3. Attach the Reset-plug to the module.
   - For **modules of the imc CANSAS*fit* family (CANFT)**, the Reset-plug has to be plugged into the corresponding socket on the bottom of the module (2) 34.
   - With **other CANSAS modules** the Reset-plug has to be inserted into one of the module's two CAN-sockets.
4. Connect the module via a suitable, short (up to 2 m) CAN bus cable with the CAN adaptor in the PC. For this purpose, use the free CAN socket or, in the case of CANFT, a CAN/POWER socket. No other CAN nodes should be connected. The reset plug does not contain a terminator. Due to the short cable, a terminator on the side of the CAN adaptor on the PC is sufficient. (For trouble-free operation with longer cables, the CAN bus should always be terminated correctly at both ends, see chapter "CAN bus wiring 44".
5. Now connect the power supply to the imc CANSAS-module. (If supply and CAN bus are routed in the same cable, this has already been done in step 4.)
6. The imc CANSAS-module boots up. You see the LED light up briefly. Then the LED goes off. The module has been reset.
7. Follow the dialog by pressing *Next* and finish the wizard.
8. Close the Assistant.
9. The module is located and adopted into the configuration software.
10. The Reset-plug is still connected.

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11. Now set the desired CAN-parameters for the module. To do this, select the entry *CAN bus-Interface* in the software in the tree at left, and on the right-hand side, select the index card General.



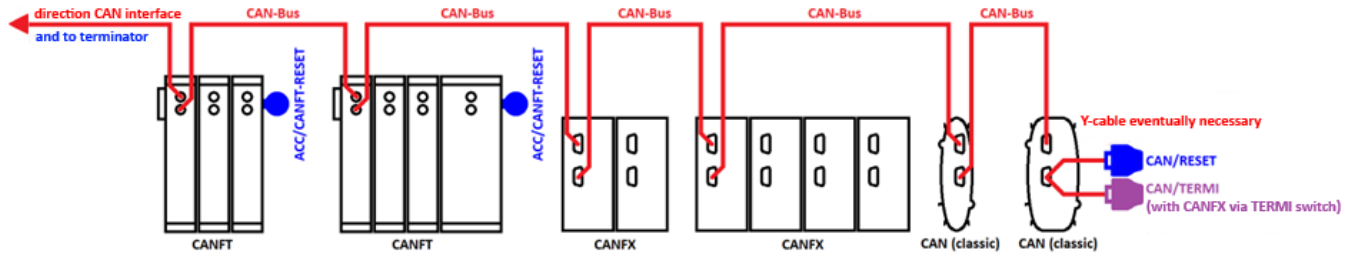
12. Next, the module must be configured: select menu *Modules /Configure…*
13. You can now disconnect Reset-plug. Confirm with *Yes*.
14. After successful configuration, the final prompt to disconnect the reset plug will appear, if it is still on the imc CANSAS module.
15. Reboot the module disconnecting power supply for a short period of time. Note that the CAN bus should be terminated at both ends with approx. 120 Ω each, see chapter "CAN bus wiring 44".

Notes

- The Reset-plug is not needed for normal operation. We highly recommend that you always operate all imc CANSAS-modules, which are used in a single environment, with the same CAN-parameters (i.e. Baud rate, Master-ID, Slave-ID).
- Be aware that the module checks whether the Reset-plug is attached upon every cold or warm start. If the Reset-plug is attached, the module starts with the default CAN-parameters. It doesn't start measurement at this point.
- There is no reason to attach the Reset-plug to a module during a running measurement. It will simply be ignored.
- Note that in certain situations the unit starts warm, for example when configuring, making a firmware update, when reading from and writing to sensor- or slot EPROMs as well as other cases.
- The module will not take measurements if it is started with the Reset-plug attached. It can only be prepared to take measurements if the Reset-plug is removed. Not only that, it must also be re-activated, for instance by briefly removing its power supply.
- If mysterious bus errors repeatedly occur when working with multiple imc CANSAS-modules (e.g. modules can't be found, configuration takes too long and doesn't always work), this may be caused by one of the following:
  - The CAN bus wiring is not OK (e.g. terminators, no branching).
  - The modules have different Baud rates. The CAN bus can only work properly if all the bus' participants have the same Baud rate. Always avoid joining modules with different Baud rates in a CAN bus circuit.

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Several imc CANSAS modules connected to each other can be reset simultaneously. The CAN bus should be cleanly constructed, i.e. terminated at both ends. A connected reset plug always affects all CANSAS modules on the CAN bus. An exception is imc CANSAS*fit* (CANFT). A connected ACC/CANFT-RESET only affects a block of CANFT modules clicked together. If there are different CANSAS units on one CAN node, an ACC/CANFT-RESET must be connected to each CANFT block clicked together and a CAN/RESET must be connected for all CAN or CANFX modules for resetting (if applicable).



6.5.4 Bus-off error - Change baudrate

When configuring the imc CANSAS modules, their Baud rates must be known. When the imc CANSAS software is exited, the last Baud rate to have been set is saved along with the database (*mdb-file* 113). This ensures that upon any later measurement, the imc CANSAS hardware and the PC are both using the same Baud rate.

If, however, an older database is loaded, it's possible for the database's Baud rate not to match the one used by imc CANSAS. A Bus-off error occurs.

Avoid Bus-off errors by observing the following:

- Any change of Baud rate must be made simultaneously for all modules.
- If different mdb-files are used to create the configurations, the same Baud rate must be used absolutely always.
- Whenever possible, a system should only use one single Baud rate value. Even if there are several nodes, the probability of an error is reduced.
- Consider using your option to order your imc CANSAS unit factory configured with the desired Baud rate.
- Use as the Master ID= 2 and the Slave ID= 3 (as with Standard Racks)

Note

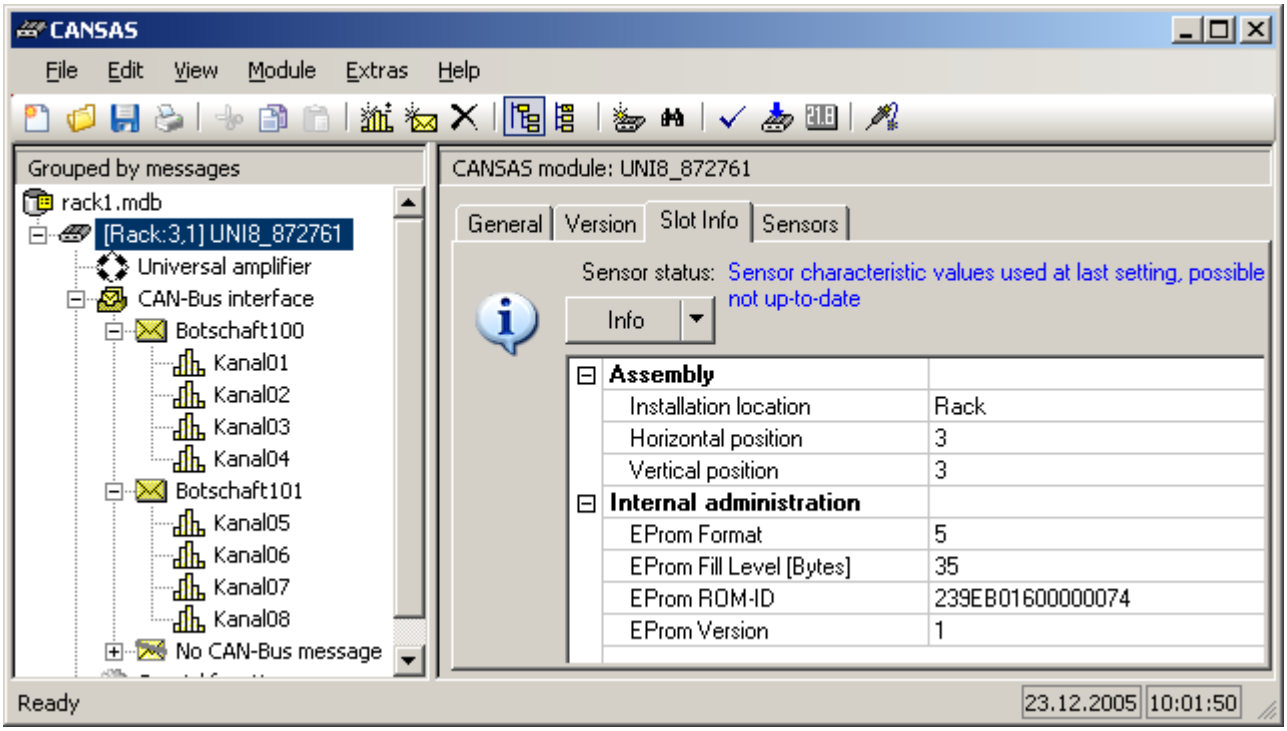
imc CANSAS is using the slave ID plus seven following IDs. If ID = 2 and Slave ID = 3, then the IDs 4..10 will also be reserved and can't be used for other purposes.

6.5.5 Racks

6.5.5.1 Racks, slot identification

In the 19" subracks or module cages produced by imc, there is an EPROM on the subrack's backplane for each slot. If a imc CANSAS-module is inserted into the slot, it is connected to the power supply, the CAN bus and to the slot's EEPROM as soon as it docks in. The EPROMs are factory-programmed to describe the Positions 1 .. 10 (or another highest position depending on the width of the cage).

The imc CANSAS operating software can query the contents of this EPROM. To do this, select the module in the tree on the left side of the user interface (the module's base entry), and on the right-hand side, the index card *Slot-Info*. Then hit the *Update* button. The EPROM's contents are read out. Naturally, the module must be connected in order for this to work, and must be in contact with the PC via the CAN bus and be inserted into a rack having EPROMs.



The illustration shows typical EPROM contents. The actual content can be overwritten by the user. The horizontal position is the slot's position number within the racks, where 1 refers to the leftmost slot.

The slot information is saved permanently in the database and upon exporting. In consequence, this information is also available offline.

Note

- The slot information is also available via the menu item Module - Sensors- Read characteristic values 102 (from sensor-EPROM).
- The slot recognition is not imported automatically when integrating new devices

6.5.5.2 Using CANSAS in a rack

- **Power**: Make sure to provide adequate power and appropriate voltage from the adapter which supplies the rack. We recommend a voltage of at least 24 V so that a small current and thus only moderate voltage drops at the backplane will result.

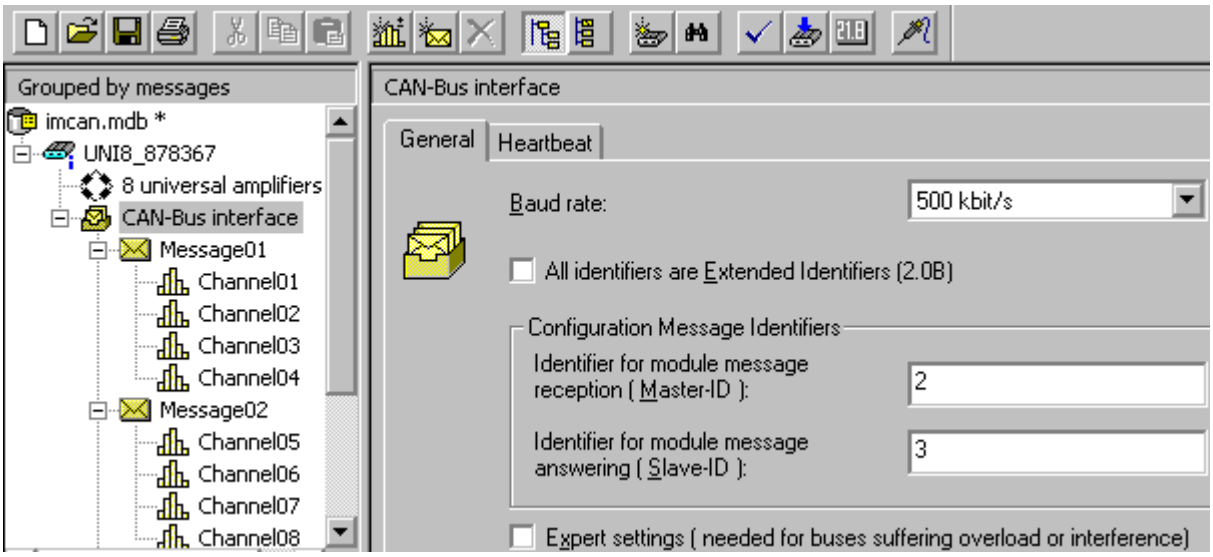
- **Plugging-in (Hotplug)**: While imc CANSAS-modules are already docked in the rack and measuring, no other modules should be inserted. Modules should always be either inserted into or removed from the rack with the power supply off. However, if it becomes necessary to insert modules during running operation, note that the modules' first contact with the terminal's supply voltage will produce a considerable inrush current. This current can cause a brief collapse of the voltage supply to the other modules, which means that undisturbed operation cannot be ensured in such cases.
- **CAN-plugs**: In the standard rack from imc, each slot has two CAN bus plugs. These two plugs are designed so that the inserted imc CANSAS-module receives the complete CAN bus and supply connection. But these plugs are not both equipped as per CiA©. In particular, the CAN bus is connected to only one of the two plugs. Only imc CANSAS modules should be connected at this plug. It is important not to use these plugs to, for instance, attach a Reset-plug or a CAN bus cable as a stub line.
- **Baud rate**: All imc CANSAS-modules in a rack must have the same Baud rate. If even only one of the modules or the PC is set to a different Baud rate, the CAN bus will not work. The CAN-controller components detect a bus-error and deactivate themselves. The CAN bus is programmed to do this. It is recommended that you work with only a single Baud rate within the test location or environs for which task the imc CANSAS-modules are places in the racks. Only then is it possible to freely combine modules, to insert them into racks and to have them automatically recognized by the user interface. The setting Standard- or Extended identifier should also be the same for all.
- **Master / Slave-ID**: Along with the Baud rate, a single Master- and Slave-ID should also be set for all the imc CANSAS-modules. Like the Baud rate, these two CAN bus identifiers absolutely should be the same throughout the measurement setup. The two identifiers enable the user interface to find any imc CANSAS-modules connected to the CAN bus and to make settings for them. When imc CANSAS-modules are first integrated into the system, always enter these two IDs along with the Baud rate. It is also only possible to find modules in the system with these identifiers. In this case it is desirable and even necessary that the same CAN-identifier is set for all modules. Note that for sending measurement values along the CAN bus it's exactly the other way around: in this case, all identifiers absolutely must be different (unique), for the CAN bus to operate.
- **Major customers / Factory-set Baud rate**: By default, imc CANSAS-modules are shipped with a Baud rate of 125k and Master/Slave ID 2032 and 2033. For major customers, the rack-operation alternative is available: Baud rate 500k and ID 2 and 3. This combination is especially recommended for operation in racks. If you are a major customer, arrange with our Sales personnel for all your imc CANSAS-modules to be pre-configured for rack operation. Then you can immediately employ virgin modules in your rack.

6.5.5.3 Rack maintenance

The rails in the 19"-subrack gradually become worn down and require a certain amount of maintenance. If it becomes difficult to insert or remove modules, then it's possible to lubricate the rails with such substances as Vaseline. Feel free to contact our Customer Service for suggestions.

6.5.5.4 Operating software, modification of the Baud rate

In the operating software, the Baud rate can be set individually for each module. To do this, select in the tree at left the entry *CAN bus interface*. This entry exists for every imc CANSAS-module type. On the right-hand side of the screen, select the index card *General*.



Observe the following notes:

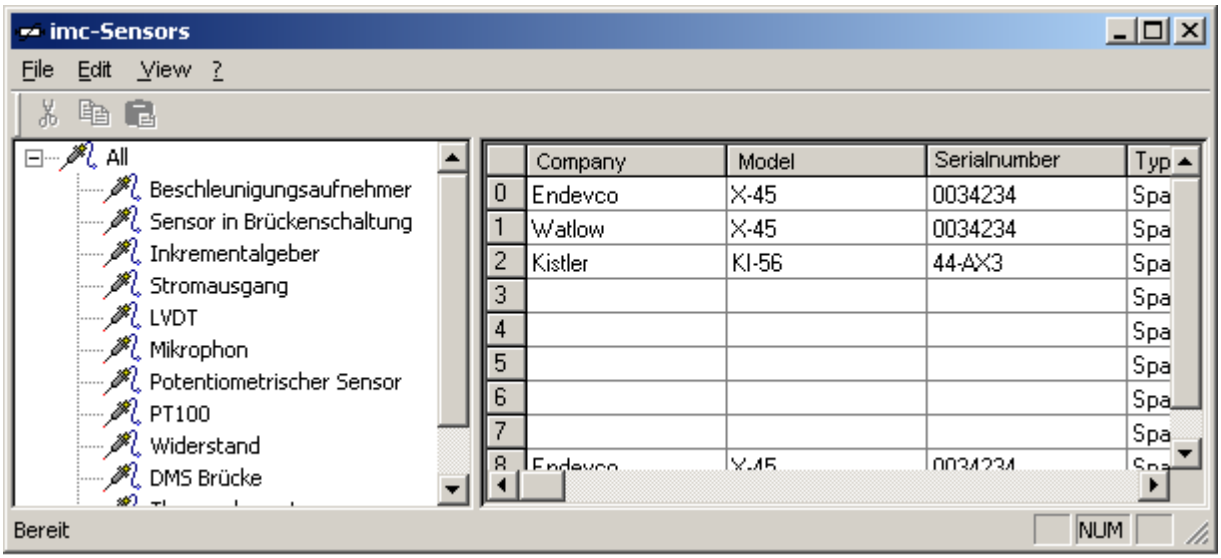
- If only a single module is connected to your CAN bus (in other words, only the two CAN-nodes PC and one imc CANSAS-module), then you can change the Baud rate and other settings as you wish and then configure the module. Once the module has been configured successfully, the imc CANSAS-module reboots and starts up with the new Baud rate. The PC also switches to the new Baud rate. You can then communicate with the module with this new Baud rate.
- If you use a CAN bus with multiple subscribers, they must all always have the same Baud rate. If even one subscriber has a different Baud rate, the CAN bus no longer works. The CAN-controllers detect bus errors and deactivate automatically; the CAN bus is designed to do so. If you wish to change the Baud rate for the entire CAN bus, this must be done for all subscribers at the same time.
- If you use the CAN bus just with the PC and otherwise only imc CANSAS-modules, the Baud rate can be changed for all subscribers at once. First set the new Baud rate for all modules in the user interface. The select all modules in the tree on the left side of the user interface. Then select the menu item *Modules / Configure*... The software recognizes that the Baud rate is to be changed, notifies all modules of the new Baud rate and has them all reboot at the same time. They all then boot up with the new Baud rate.
- The technique described above only works if all the modules already had a common Baud rate, so that it was even possible to address them all via the CAN bus. This technique is only available from the firmware for the software version V1.3Rev.11 onwards. If this isn't present, first configure the modules without changing the Baud rate in order to update the firmware.
- If you use other devices with your CAN bus (besides imc CANSAS-modules), changing the Baud rate is more difficult since these devices don't respond to the imc CANSAS software's boot command. In this case, these devices must be first removed from the CAN bus and changed separately. Afterwards they can be re-integrated into the system.
- If it ever does occur that modules with different Baud rates are joined in a common CAN bus, there will constantly be bus errors. imc CANSAS-modules will either not always show up during searches or not at all, or configuration fails etc. The symptoms are the same as for a physically defective bus, e.g., due to a line which is too long, or if there is too much interference or incorrect termination (e.g. the 120 Ω resistors needed at both ends of the CAN-line are missing). If you are certain that the trouble is caused by different module Baud rates, you can remove the offending modules from the system and set them to the correct Baud rate separately. Alternatively, you can use the Reset-plug, see description in chap. "Reset-plug 114".

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6.5.6 Connecting to imc SENSORS

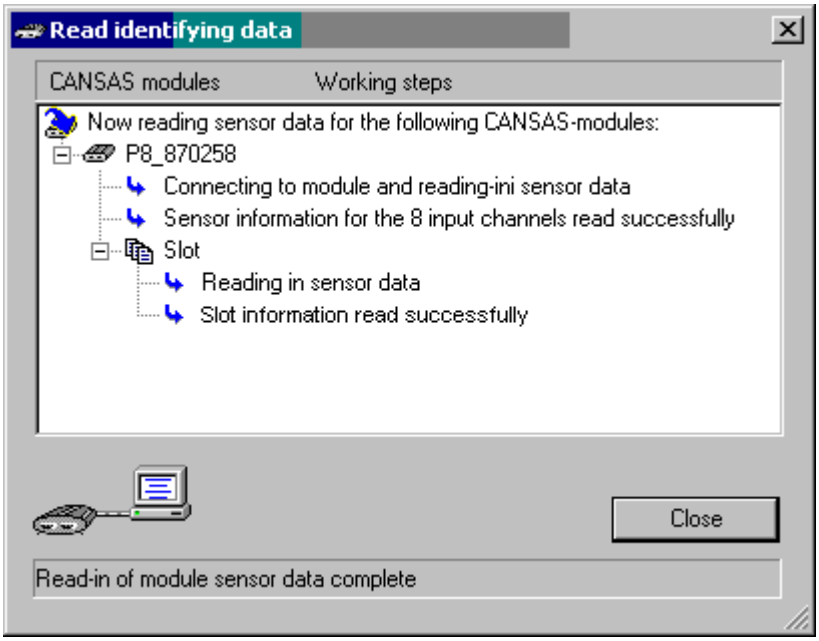
The sensor database imc SENSORS is a separate product and not an element of the imc CANSAS software. But the two programs work seamlessly in concert. Please refer also to the user's manual for the imc SENSORS software.

Start: imc SENSORS can be started from imc CANSAS using the menu item *Edit/ Start imc SENSORS*. This menu item is only enabled if imc SENSORS is installed and not yet started.



Transferring sensor properties: In the imc SENSORS user interface, select the sensor which is connected or to be connected. Use the drag&drop technique to move it to the corresponding channel's entry in the tree diagram of the imc CANSAS user interface. There, the target will be displayed as selected.

Once you have "dropped" the sensor, a dialog appears showing how the sensor settings were applied in the channel. Any error messages will also appear.



Progress indication dialog for read-in of sensor properties

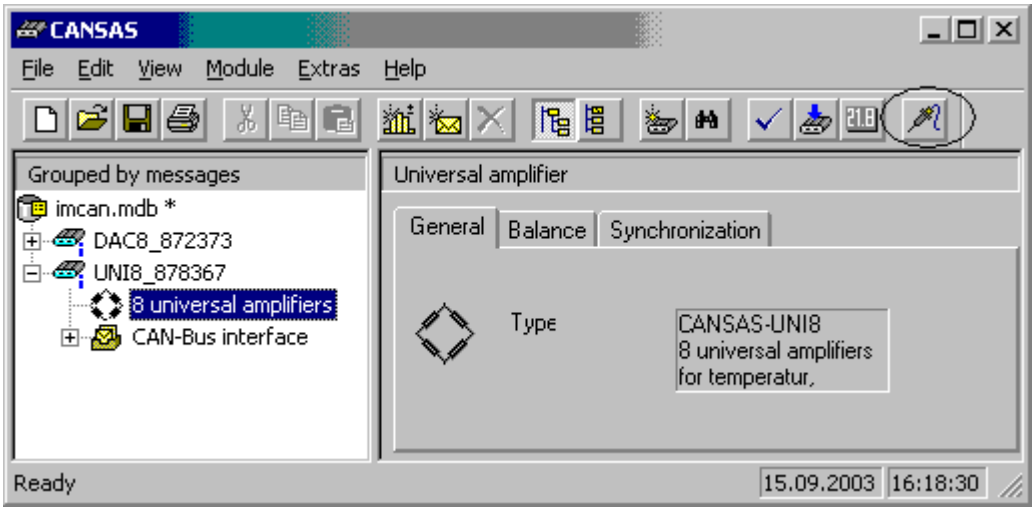
There is an alternative to the drag&drop procedure, in which you also first select the sensor in imc SENSORS. Next, select one or more channels in the tree diagram on the left side of the imc CANSAS user interface and the menu item *Edit / Add sensor...*. Then the sensors properties will be used for setting all the selected channels. This makes sense for sensor properties common to many units, independent of any serial number; for instance, a simple Type K thermocouple.

6.5.7 Sensor recognition

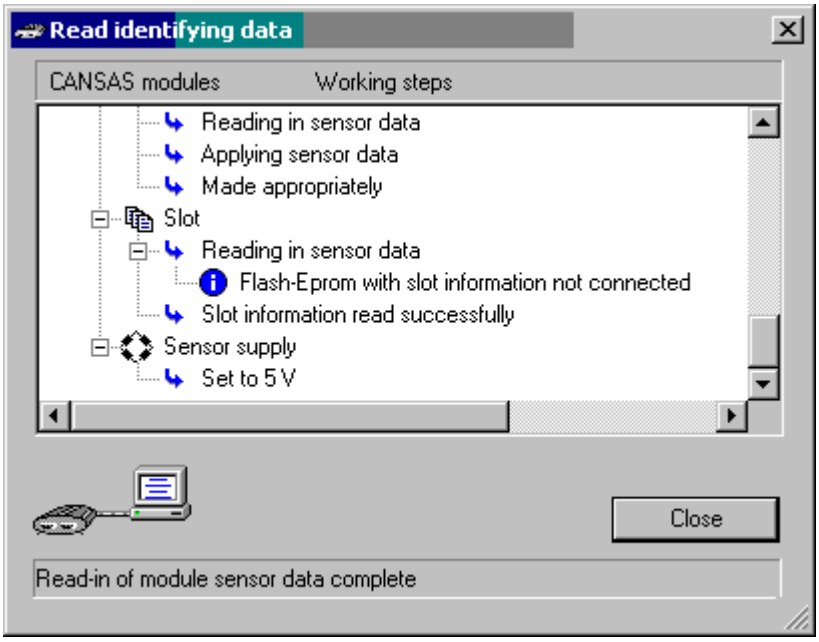
Some imc CANSAS-modules such as UNI8 are able to read-in sensors with EPROM. These are intelligent sensors in which an electronic spec sheet is stored in the EPROM. This spec sheet is also referred to as TEDS (Transducer Electronic Data Sheet), as described in the industrial standard IEEE 1451. The standard IEEE 1451.4 is of particular interest in this context. At this writing, however, this standard is as yet at the "proposed" stage, therefore not yet official. The electronic spec sheet contains information for administrating it, such as its manufacturer, model and serial number. Also data for scaling, such as sensitivity, and physical and electrical value range. And finally, it also contains data on the sensor's power supply and calibration.

Sensor recognition, for example in UNI8, proceeds according to the following pattern:

1. Before connecting sensors to the module, you must guard against any danger. For this purpose, you must keep in mind that UNI8 is an all-purpose module with built-in sensor feed. If this internal voltage source supplies 24 V, for instance, because a sensor needing this voltage either is or was connected, no sensor may be connected which can take, for example, only 5 V. The module must first be put in a "neutral" state. To do this use the menu item *Module / Sensors / Prepare plugin*... Then the UNI8 can be configured for a sensor feed of 5 V.
2. Connect the sensors to UNI8. The UNI8 should not be activated at the time. But note any peculiarities of the sensor used. Many sensors may actually be connected while the power supply for UNI8 is on; this is a so-called hot-plug procedure. At this point, the UNI8 (if activated), is not yet correctly configured.
3. Now it is possible to read out the EPROM-chip's sensor information. To do this, go to the tree diagram on the left-hand side of the user interface and there select the entry of the module whose connected sensors are to be read in. Then select the menu item Mod*ule / Sensors / Read identifier data*... Alternatively, the corresponding toolbar button can also be used:



4. Next, a dialog showing the details of which channels are connected to sensors with EPROM appears. It also shows how the sensor properties are transferred to channels settings.



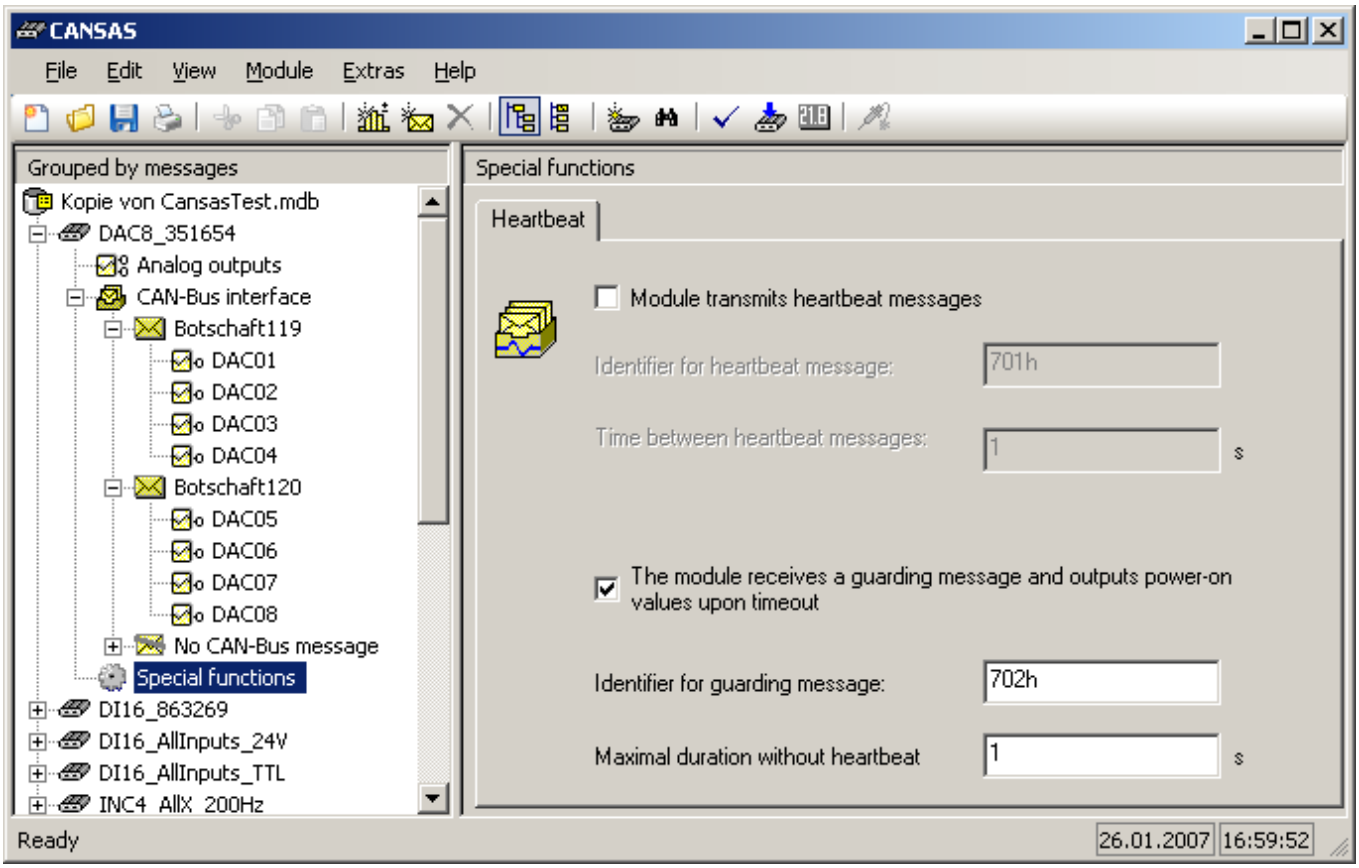
5. Then you can check the suggested settings for the measurement channels and also the global module settings such as sensor feed, and modify them if desired. In particular, check the data rate and channel names.
6. Finally, the module must be configured for these settings to take effect.

***Checking the connected sensors*:** Whenever it boots (start, cold-start or warm-start), UNI8 performs a check of the connected sensors. Of course, it is actually the EPROM of a connected sensor which is checked and not really the sensor itself. If the EPROM is the same as when configuration was performed (download or configuration), then it is assumed that the correct sensors are connected. The LED displays the appropriate blink-code (in default configuration). If the EPROMs don't match up, a different blink-code is displayed.

6.5.8 Guarding

Guarding is in imc CANSAS the reverse of heartbeats. This functionality is available only to the imc CANSAS output modules such as DAC8: a Master such as a process monitoring or automation system sends a cyclical message via the CAN bus. The imc CANSAS module monitors this signal. If the message fails, the imc CANSAS unit goes into a defined rest state, e.g. zero Volts at the output. This functionality is useful for securing operation of an installation where disturbance of the CAN-transmission or outage of the guidance system must be expected. It is recommended to have the guarding-message emitted at a rate of 1s, for example. Then in imc CANSAS, a monitoring interval (time-out) of twice that length is set. If the guarding-message fails for longer than that, in our example, for 2 seconds, so that imc CANSAS misses the message for that time, then all of the module's inputs go into a pre-determined rest state.

The guarding-message is set in the user interface by selecting the entry *Special functions* in the tree at the left, and the index card *Heartbeat* at the right.



There, select the identifier for the message. This identifier must be unique for each module, just like every identifier on the CAN bus in general. You can also specify the maximum interval which may elapse until the next time the imc CANSAS module receives this message. If this interval elapses and the message doesn't arrive, all of the imc CANSAS outputs go into their rest state.

If CAN-messages setting the output values finally do arrive, the module obeys as usual.

The guarding-message's content doesn't matter. The imc CANSAS-module only responds to its presence.

6.5.9 Heartbeats

All imc CANSAS-modules (excepting imc µ-CANSAS modules) can be made to transmit a so-called heartbeat message via the CAN bus. This message is basically a sign of life from the module. Just like an animal's pulse proceeds at a regular pace, this type of message works the same way. A master which monitors the entire CAN bus can thus determine on the basis of the regularly transmitted message whether a module is still alive (meaning: at least working well enough to send this message).

It is thus seen that this heartbeat message is mainly useful for output modules which don't send messages on their own but rather wait to first receive other messages from the CAN bus. Such modules include the DAC8 (analog outputs), the DO16 (digital outputs) or the DO16R (relay) or the PWM8 module (pulse-width modulated output). Without the heartbeat message, the bus master would hardly or only indirectly be able to recognize whether the modules are working at all.

Such a master exists in many situations, e.g., a test rig PC, which controls the overall test station, a guidance system or an automation system.

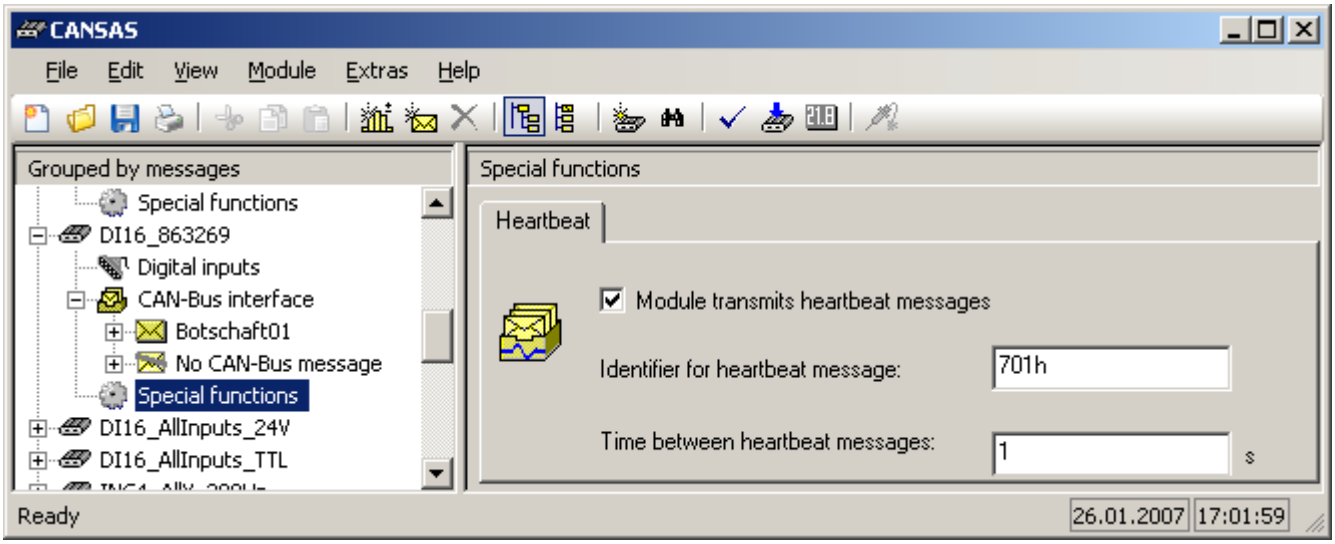
But the emission of heartbeats is also useful for modules which actually send their measurement data at regular intervals as CAN-messages via the CAN bus. The heartbeat message contains important information: The module's serial number and a 'Magic number' for its configuration. and additionally, in the case of sensor-detecting modules such as UN8, a bit which reflects whether the correct sensors are connected. On the basis of this number, the guidance system can determine the following:

- Is the correct imc CANSAS unit installed? Or could someone have removed and replaced it with a different one, which either is or isn't configured the same way? An experiment setup's record may include info on the measurement equipment used and its calibration. If the device was exchanged, this info would be missing. This situation can at least be detected.
- Is the module configured as it is supposed to be? Naturally, the data-recording measurement system must be able to rely on the imc CANSAS module being configured as it should be. Otherwise, acquired data may be interpreted incorrectly. If the imc CANSAS-module was reconfigured, it's at least possible to detect.
- In the case of sensor-recognizing modules it is even possible to notice whether the correct sensors are connected.

All this information isn't directly relevant to conducting a single, classical lab experiment. But at test stations where different personnel set up and conduct a variety of measurements, it can be crucial.

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The heartbeat-message is set in the user interface by selecting the entry *Special functions* in the tree at left, and going to the *Heartbeat* index card on the right-hand side.



There, select the identifier for the message. This identifier must be unique for each module, just like every identifier on the CAN bus in general. It is also possible to specify the interval at which the message is sent. Intervals in the range between 1s and 10s would be sensible.

Contents of a Heartbeat-message (64 Bit)

Bit 1 … 30	serial number of the module (30 Bit)
Bit 31	reserved
Bit 32	1, if the module is in sync mode; 0 else
Bit 33 … 64	configuration number of the module (32 Bit)

6.5.10 Synchronization

With many imc CANSAS acquisition modules (modules which measure physical quantities and send CAN-messages), there is the option to synchronize the data sampling of multiple modules.

Example

Each of a UNI8 module's channels is equipped with its own amplifier and A/D converter. All of the module's channels are sampled simultaneously. However, if multiple UNI8 units are used, note that each one has its own independent quartz timer. Therefore, the modules are not synchronized to each other unless special steps are taken. If an application requires synchronized capture on more than 8 channels, the *Synchronization* feature can be used.

In imc CANSAS, synchronization can be achieved in a variety of ways.

- **CAN-1 Protocol:** A CAN bus message is used for the synchronization. This message is sent at a 1s pulse rate by a imc CANSAS-module acting as the Master. Other imc CANSAS-modules acting as slaves receive this message and synchronize themselves to it. The message is formatted according to the "CAN-1" protocol. In case devices as imc BUSDAQ and imc CRONOS-PL are used as CAN logger, they should be set as CAN-1 Masters. This is the recommended option whenever these devices also capture the measured data.

  The condition for being able to perform synchronization via the CAN bus is that all the devices (both the master and all slaves) are connected to the same CAN bus line, and no gateway or router may be connected between them. In the CAN-1 protocol, special care is taken to provide high time-precision.

  Note

  If the imc CANSAS modules are configured by an imc device CAN interface through imc DEVICES software, only the imc device is allowed to be set as CAN-1 master.

- **TTL square 1s:** A line is laid between the imc CANSAS-modules on which communication by TTL-level takes place. One of the imc CANSAS-modules is declared the Master and generates a 1 Hz square-wave signal. Other imc CANSAS-modules are declared slaves. They respond to the signal by getting into synchronization. The square-wave signal can also be generated by an external generator. In all imc CANSAS-modules, one pin each in the CAN bus sockets is provided for the TTL-signal. The signal's reference ground is the CAN bus ground which also has a terminal in the connector. This arrangement enables the synchronization signal to be efficiently transferred along the CAN-cable.
- **DCF77:** This mode works like the square mode (also a 1 Hz TTL-level signal). But here, the square-wave signal conforms to the DCF77 standard. This means that it also contains the time and date information, which produces a gap in the 59th second of every minute. imc CANSAS has no use for the time/date information and uses the signal like an ordinary square-wave. imc CANSAS itself cannot be a DCF-master. For synchronization purposes, it can only play the role of slave.

For all synchronized operating data, a time accuracy of 100 µs or better is ensured if the communication between the master and slaves is working properly. Typically, the offset is even an order of magnitude smaller, about 10 µs.

All imc CANSAS modules configured as slaves for synchronization purposes are soon synchronized (after approx. 2 s) upon startup of a master. Internally, they work with a PLL which already begins to operate at the specified accuracy within a very short time.

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Note Limitations

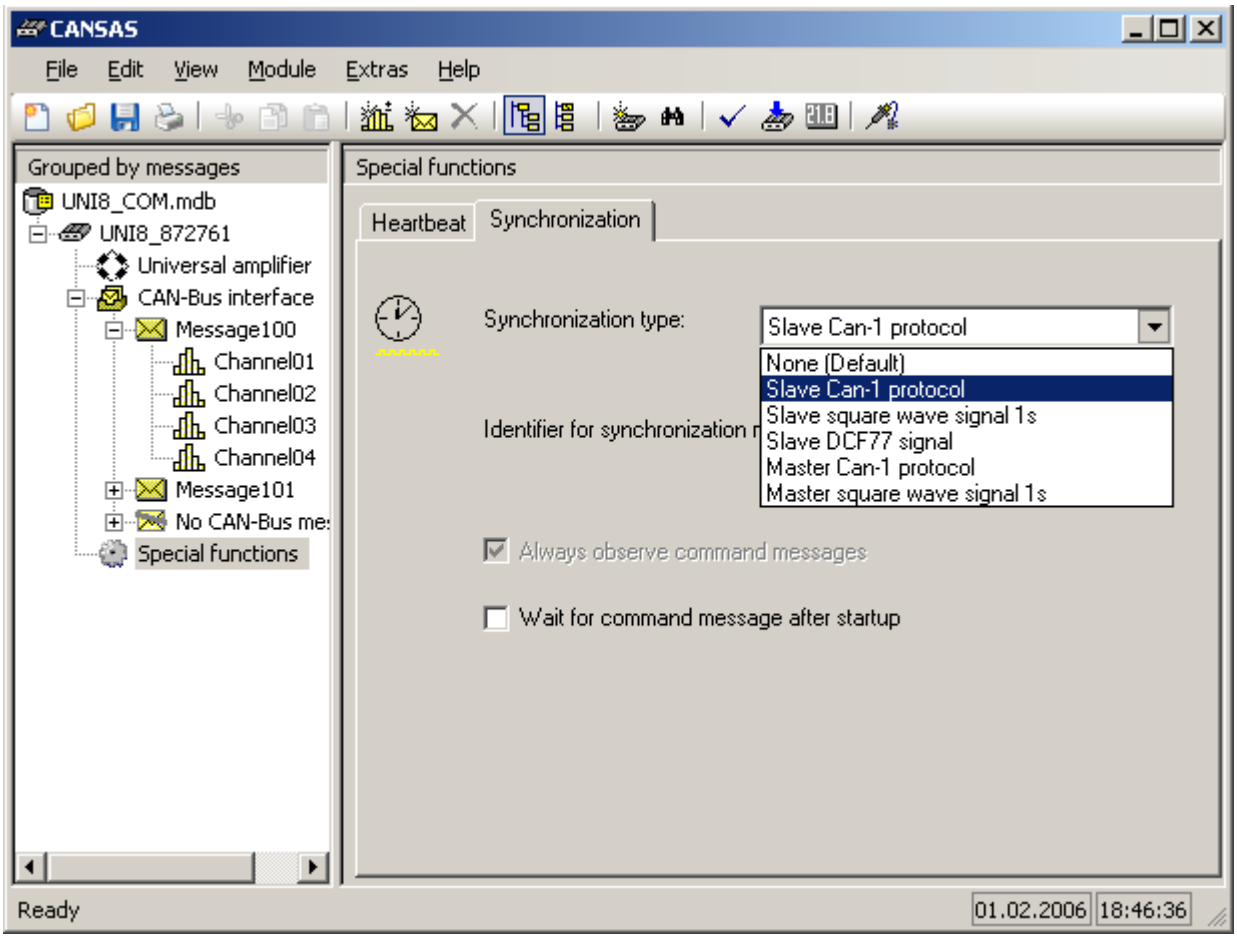
- In case a imc device (e.g. imc BUSDAQ-2, -X or BUSLOG) is operated in sleep/resume mode, synchronization after resume is not possible.
- Please note, that different filter settings cause different delays as well.
- Certain exigencies of the system cause incorrect values to be measured in the measurement mode "Temperature 179", when the module is operated with synchronization activated. Therefore, leave the synchronization deactivated for temperature measurement!

imc CANSAS as Master: If imc CANSAS is configured as Master for synchronization purposes, note the following: In the CAN-1 protocol, the Master stops all slaves after booting. Then comes a phase during which the module flashes yellow and red for 5s (this applies to all operating types) and does not yet measure. Then measurement starts. If there are slaves, they begin to measure at the same time. The purpose of this starting procedure is that different imc CANSAS-modules within a system can be activated simultaneously but need different amounts of time to boot.

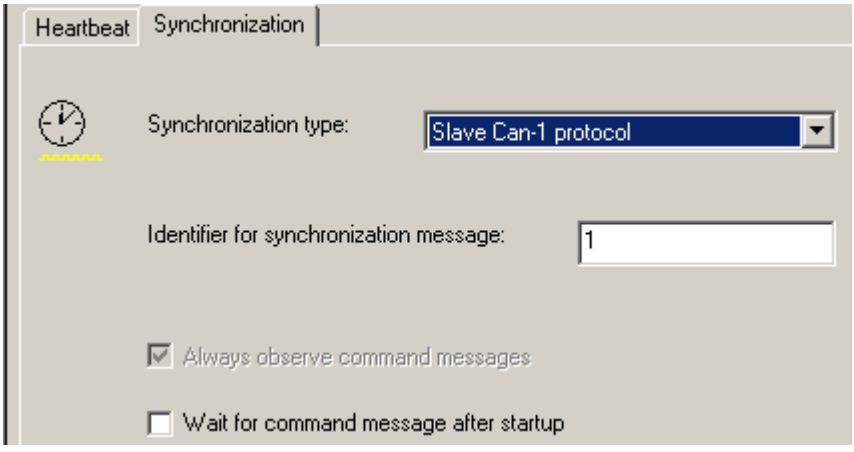
imc CANSAS as Slave: After booting, a slave waits for a signal from the master. If there is no master to send a synchronization signal, the slave doesn't start. Once the master does become active, the slave starts at the same time. If the master has an outage, the slave continues to work anyway. Of course, if that happens, it cannot really operate synchronously, but it does continue to measure at the same quartz-controlled pulse rate which it last had. If during such a situation a master suddenly is activated, what happened next depends on whether or not the master is (approximately) in the same beat as the slaves (and, in particular, shares the same phasing). If yes, the slave gradually adapts itself to the master's phase, which can take a few minutes. If not, the slave is totally re-synchronized. Towards this end, measurement is briefly interrupted and later re-started. In CAN-1 protocol, the newly-started master would stop all slaves anyway in order to start them simultaneously afterwards.

Setup:

Select **Special function** in the tree diagram at left. On the right side, select the index card *Synchronization*, in which you set the synchronization type. The default is *No synchronization*. The module can be set either as a master or slave for synchronization purposes, as desired. This is also where to set whether to use the TTL-signal (1s square-wave) or the CAN-1 protocol for synchronizing via the CAN bus.



If the CAN-1 protocol is used, the CAN bus identifier of a CAN bus message must be specified. This identifier should get high priority. The smaller the identifier, the higher its priority, e.g., 1. It isn't necessary for this message to have the highest priority, but it should be relatively high. Note that the identifiers which may be used for recognizing the imc CANSAS-modules (e.g. 2, 3 and 8 etc.) may not be the same as the identifier for synchronization.



There are also additional options:

- Always observe command messages: The messages are defined in the framework of the CAN-1 protocol. They enable the starting and stopping of measurements.
- Wait for command message after setup: If this is selected, the imc CANSAS module doesn't start the measurement right after booting. Instead it waits for a message which expresses the command *Start measurement*. These messages are also defined by the CAN-1 protocol.
- For these two options, the ID of the CAN bus message to be used must also be defined.

Time offset (Module type, Sampling frequency):

There is a slight time offset between a module's individual channels. This also applies to channels which are equipped with simultaneous Sample And Hold or in which the AD converters work simultaneously. This is because the individually conditioned channels possess analog components such as amplifiers and filters. These have narrow tolerances, but also slight deviations in their frequency response and thus also in the times for signal propagation through the components. However, in UNI8, for instance, these discrepancies are typically around 10µs.

Synchronization really only ensures that the instant in which a sample is taken is the same. But the signal propagation time through the module depends on many factors. These include the analog part with its anti-aliasing filter and any digital filters it may have. The filters (and the digital filters in general) are configured according to the sampling rate. This is because an anti-aliasing filter is selected which is appropriate for the sampling rate set. Thus, the signal propagation time varies with the sampling rate. Although this signal propagation time is constant for a given module type and a given sampling rate, if either of these factors change, so does the propagation time, which becomes noticeable when working with a variety of module types (e.g. UNI8 and P8). This offset is constant and can be corrected but it isn't zero. To simplify matters, it's recommended to use only one module type for real phase or propagation time measurements, and to set the same sampling rate for all measurement channels whose values are to be compared with each other.

Data acquisition:

When imc CANSAS-modules work synchronously, this makes certain demands on the data acquisition system. In general, it's necessary for the data acquisition system and the master (timer) of all the imc CANSAS module to be one and the same device. For an ideal match, use such devices as imc BUSDAQ and imc CRONOS-device. One such unit can then serve as the master, configured as per the CAN-1 protocol, and the imc CANSAS modules act as the slaves.

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7 Virtual Channels

7.1 What are virtual channels?

The imc CANSAS-module comes with a fixed number of physical channels whose signals can be transmitted along the CAN bus. However, additional, so-called virtual channels can be generated. These can be data streams computed from a physical channel's signal (e.g. the low-pass filtering of a physical channel). But virtual channels can also be completely artificial constructions (e.g. a sawtooth signal). Also, virtual channels can be used to achieve data compression.

Virtual channels are generally used to pre-process imc CANSAS-module data. For instance, passing huge amounts of data coming into imc CANSAS at a high sampling rate straight into the CAN bus would severely strain its capacities. The data can be pre-processed while still in the imc CANSAS system (e.g. in the form of averaging, filtering and subsequent data compression). Consequently, the data load transferred to the CAN bus can be reduced; only such data are sent to the CAN bus as are necessary for evaluation purposes.

7.2 Creating virtual channels



To establish a virtual channel, use the command 'New/ Virtual channel' in the 'Edit' menu or click on the corresponding tool.

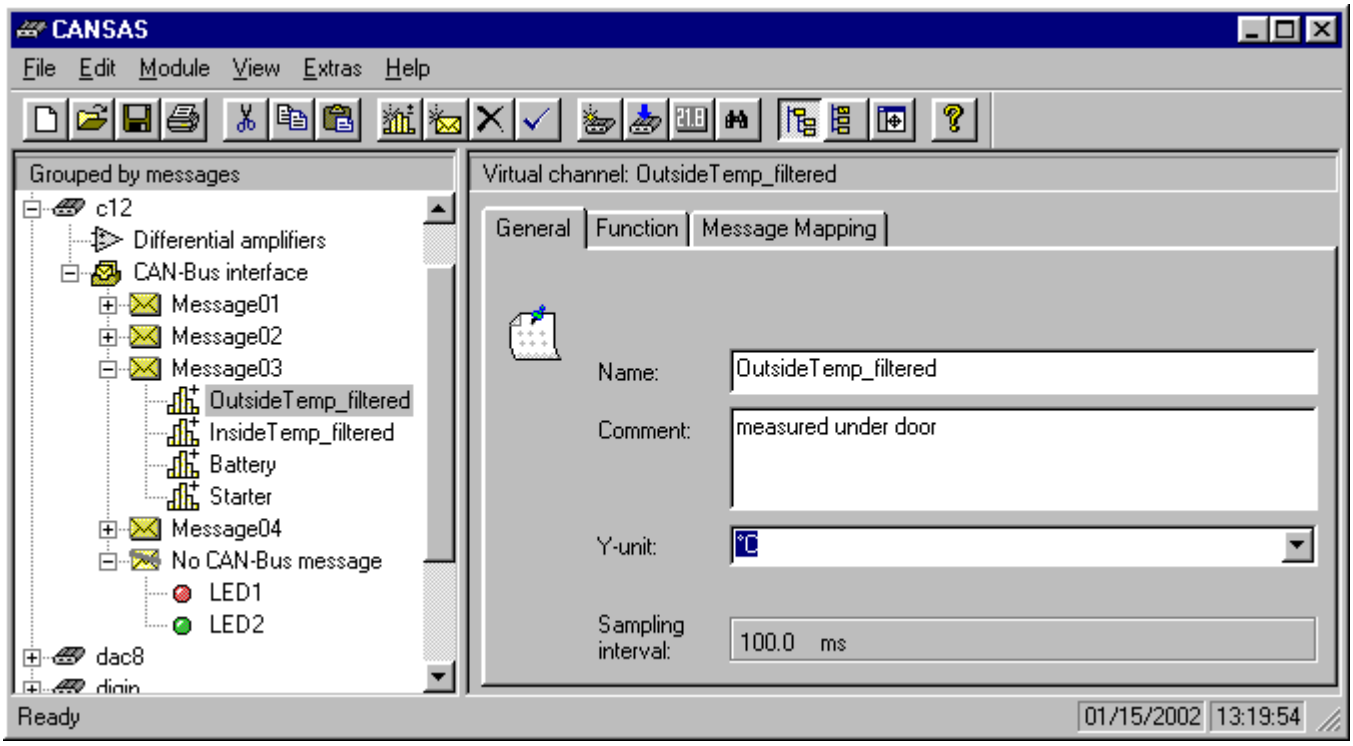
A new virtual channel is created. This virtual channel's entry in the Module Tree appears under *'Without CAN bus message'*. If the virtual channel is to be transferred on the CAN bus, it must be assigned to a message.

When a virtual channel is generated using the imc CANSAS operating software, it initially has default settings. There are different dialogs providing the ability to make settings for the virtual channel which are appropriate to your requirements. To do this, select the virtual channel's entry in the Module Tree. Clicking on one of the filecard tabs makes the desired dialog appear in the foreground.

General notes

This filecard contains the controls for the most basic parameters of a virtual channel. These are its name, comments, and Y-unit. The virtual channel's sampling rate is additionally displayed since it can differ from that of its parameter channels owing to the possibilities for data compression.

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Name: A designation unique within the imc CANSAS-module system, used to differentiate among the channels. Characters permitted in the name include the alphabet, numerals, "_" and "~", though the first character may not be a numeral. The name may take a maximum of 255 characters. The default name of a new virtual channels is "VirtualChannel_i", _i being the number of already present virtual channels + 1.

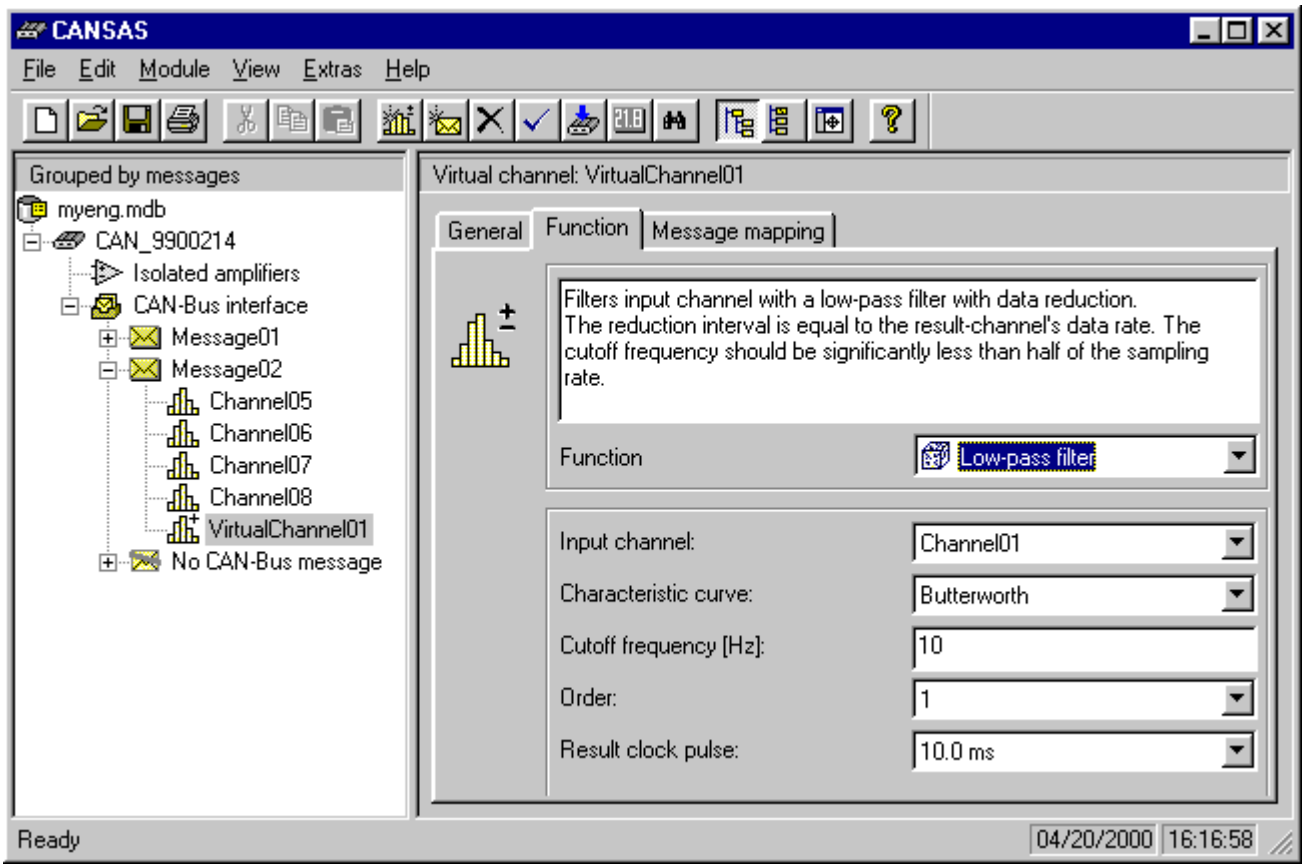
Comment: A text accompanying the virtual channel. The text could be a detailed explanation of the virtual channel's name, or any other notes on the channel. It may take a maximum of 255 characters.

Unit: A drop-down list box offers a selection of units. An arbitrary text having up to 45 characters can also be specified.

Sampling interval: Indicates the virtual channel's sampling time which is derived from the parameter channels chosen and from the data compression specified.

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Function: Specifies how the virtual channel is computed. This is done by selecting a calculational function and parameterizing it. The parameterizing process involves the Parameterize-dialog of the Formula Assistant, as in FAMOS or imc Online FAMOS (imc DEVICES).



Function: A selection of functions, arranged in groups (see the overview of functions 142 further down), is offered in a pop-down list box. Online help pertaining to the selected function is displayed.

Function parameters: The boxes below the function selection box are for setting the parameters. A description of the various functions' parameters can be found in the 'Function Reference'.

The functions generally take one or two channels as their parameters. The channels can be physical or already present virtual channels. If two channels are a function's parameters, they must share the same sampling rate.

If the functions can take numerical values as parameters for comparisons or other logical operations together with parameter channels, the values must be specified in the channel's physical units. It is then necessary to take the scaling (factor and offset) of the numerical value's parameter channel into account.

Message Mapping: See the information on input channel Properties 60 dialogs in Chapter Operation 111.

7.3 Data formats

The imc CANSAS-module supports the following data formats:

Data format	Size	Definition	Numerical range
Digital data format	1 bit	binary numbers	1 (TRUE) or 0 (FALSE)
Integer data format	2 byte	signed integers	-32767 ... +32767 or 8001h ... 7FFFh
Unsigned integer data format	2 byte	unsigned integers	0 ... +65535 or 0h ... FFFFh
Long data format	4 byte	signed integers	-2147483647 ... +2147483647 or 80000001h 7FFFFFFFh
Real data format	4 byte	Real numbers	-1,0E28 ... +1,0E28

Channels with digital data format return only the values 1 (TRUE) or 0 (FALSE). The scaling offset and factor are 1,0 and 0,0, respectively.

Channels with Integer data format return integers as complements on two in the range from 8001h (corresponding to -32767) to 7FFFh (corresponding to 32767). The numerical range is symmetrical. The value 8000h (corresponding to -32768) isn't used. Each channel has its own scaling factor and offset. The integer values are multiplied with the factor and the offset is added to the product. This transformation yields real numbers in the desired numerical range.

Channels with Unsigned integer data format return integers in the range from 0h (corresponding to 0) to FFFFh (corresponding to 65535). Each channel has its own scaling factor and offset. The integer values are multiplied with the factor and the offset is added to the product. This transformation yields real numbers in the desired numerical range.

Channels with Long data format return integers in the range from 80000001h (corresponding to 2147483647) to 7FFFFFFFh (corresponding to 2147483647). Each channel has its own scaling factor and offset. This numerical format is only used by the incremental counter module (totalizing events).

Channels with Real data format return real numbers in the range from -1,0E28 to 1,0E28. The numerical values have already been corrected with the scaling factor and offset. To transform a channel in Integer format to Real data format, the function "ToFloat" is available (see also "Conversion To Float 153" in the function reference). The Float-format as per IEEE is used. The results of calculational functions can be transformed to real numbers and transmitted on the CAN bus. However, channels in Real data format cannot be subjected to calculational operations. Channels in Digital or Integer format can be subjected to appropriate calculational operations.

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7.4 Integer-arithmetic

The imc CANSAS-module uses an integer processor. Calculational functions therefore must manage with 16-bit Integer-arithmetic. Computations with real numbers on the Integer-processor are possible in principle, but require excessive time. The computational functions' algorithms therefore are always compromises of processor time and precision.

The imc CANSAS-module mainly works with integers. The numerical range extends from -32767 to +32767 in whole numbers. Though scaling factor and offset can produce large real numbers, internally this small value range is all that is available for computations. This means that any real number range can be simulated, but that not every number within such a range can be expressed. There are always only 65535 different result values possible. Due to the number range's symmetry around the value 0 the number -32768 is not used.

For instance, with a factor of 1,0 and an offset of 0,0, the numerical range is -32767,0 ... +32767,0. A 13 as an integer stands for all value between 12,5 and 13,5. If the factor and offset are 100,0 and 0,0, 13 stands for all values from 1250 to 1350.

The results of computations can therefore in principle deviate from the technically correct value by 1 LSB. And some particular functions, such as inverse value, can deliver results which deviate from the expected results by several LSB's.

This difficulty is especially evident when multiplying two Integer-values: The result channel can also only be expressed as the Integer-values -32767 to +32767, just as the two channels which were multiplied. For instance, the product of 2^{15} and 2^{15} is 2^{30}. The value 2^{30} is reduced to 16 bits, so the lowest 16 bits are simply dropped. Taken together with technicalities of the value range scaling, cases can thus arise when 1 * 1 returns 0. But multiplication can be employed sensibly, as illustrated by the following example: Power = current * voltage. For measurement ranges of 0 .. 4 A for the current and 0 .. 5 V for the voltage, the result value range is 0 .. 20 W. The value range 0 .. 20 W can indeed be expressed sensibly with 16 bits.

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7.5 Constraints

Virtual channels which aren't used are automatically omitted from calculations. Virtual channels which are results of certain functions having the reduction factor 1 (i.e., the input channel's sampling rate is the same as the result's) are automatically treated as an allocation (e.g. Maximum, Minimum, Average).

Certain functions automatically carry out re-scaling, which is necessary whenever differently scaled channels are jointly subjected to computational operations (Addition, Subtraction, etc.) or to cancel out an offset (e.g. for SQRT or high-pass filters). The ***re-scaling*** changes the factor and the offset. The factor and offset are indicated on the virtual channel's Message Mapping Properties dialog. Re-scaling and its effects on the factor and offset are not discussed in the function descriptions.

The re-scaling does, however, produce a loss of precision which must be taken into consideration. If two input channels with substantially differing scaling are combined in an operation, the discrepancy can become large indeed.

There are limits on the ***processing power***. In particular, imc CANSAS modules supporting high sampling rates (> 2 kHz) will tend to exhaust the available processing resources when performing complex data processing at the highest possible sampling rate. However, by using data reduction (resampling and thus reduction of the data rate), even processing which is very taxing for such modules (for instance, filtering) can be carried out at a slower sampling rate. By contrast, imc CANSAS modules supporting only relatively slow sampling rates (<1 kHz) can indeed perform 4th order high-pass filtering on all input channels at the top sampling rate.

The ***number of virtual channels*** available is limited to a total of 100. The available channels depend on the module, because a certain number of virtual channels are already used internally. For example to calculate the temperature of a thermocouple, the cold junction compensation has to be calculated. Therefore an internal channel has to be used, which is not visible to the user.

If one module has both messages configured with slow data rates and with high rates, it may occur that the rapid messages are delayed in being transmitted. This happens whenever several messages having a slow rate are transmitted in rapid succession, which of course takes up much time. This time amount can also be (significantly) greater than the fastest data rate. The corresponding messages can contain virtual or physical channels. The problem usually arises whenever very many channels or low Baud rates are set. One possible remedy might be a higher Baud rate.

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7.6 LEDs

The imc CANSAS-module is equipped with one or more LED depending on the module. It is located to the right above the external power supply jack. It can shine red or green, or their combination yellow.

The manufactory default codes are described in chapter "Measurement technique" 218.

The LED can be under the user's control. The red and the green parts can each be set up just as virtual channels are. If both colors shine at once, it appears yellow. Making settings for the two color components can be accomplished using the imc CANSAS operating software via the Module Tree's entry "CAN bus Interface" under "Without CAN bus message". On the corresponding dialog pages, you can parameterize each of the color components in the same way as virtual channels.

An LED's control signal takes digital data format (1 (TRUE) corresponds to LED on and 0 (FALSE) to LED off). Any function whose result is in digital data format can be outputted by an LED. Here we will devote particular attention to the functions "Digital Constants" and "LED-Flash":

The function "Digital Constants" lets you generate digital functions. The constant's value is to be specified as either 0 (FALSE) or 1 (TRUE). When the constant is set to 1 (TRUE), the selected color component of the LED shines, otherwise is doesn't.

The "LED-Flash"-function makes the LED blink. For this purpose, the user must specify a pulse interval and how many pulses the LED is to shine and how many pulses it is to stay off. If "Flash" is set in the input box "Condition", the LED flashes the set color at the set pulse rate (see also "LED-Flash 160" in the Functions Reference).

To conserve computational capacity, functions with compressed input data are calculated with a time lag (see below under Sampling Rates 141). At pulse rates of 100 ms and higher, this phenomenon can be observed directly in yellow flashes (the red and green components flash on and off at an offset). Therefore it is recommended not to specify yellow flashes at higher rates than 50 ms.

The bridge amplifier module's two additional LEDs are also yellow. The red and green color components of these LEDs, however, are not separately programmable. Using the special bridge amplifier function "Output status on LED", info on the bridge amplifier's status can be output to these LEDs (see also "Output status on LED 168" in the function reference).

The LED card for these modules is status-oriented, i.e. there are no longer 1 or 2 LEDs, but only one (or more) module states. For each of the states listed, it is possible to set the LED and the flashing pattern by which it is indicated. For the description of the blinking code see imc µ-CANSAS 221.

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7.7 Special module-specific characteristics

7.7.1 Acquisition modules

Depending on the module type, acquisition modules process either analog or digital input data. The isolation and bridge amplifier modules, for example, take analog input data, and the digital acquisition module DI16 takes digital data. The imc CANSAS module then sends the incoming data to the CAN bus, either directly or after prior processing. Such prior processing is accomplished with the help of virtual channels; for instance, such a channel can contain the results of low-pass filtering applied to physical input data. After data processing, only the results are then transmitted by CAN bus.

The raw data always consist of the physical or digital input signals, which can then be subjected to any desired processing. All channels assigned to a message are then transmitted by CAN bus.

In order for data to be ready for transmission via CAN bus, the bits or bytes to be transmitted must be assigned to specific channels. To do this, use the drag&drop technique to position the Module Tree entries of channels in messages. Virtual channels as well as physical inputs can be positioned in the messages. In the message mapping dialog, a message's bit and Byte assignments, the number and order of bits, the numerical format of the channel data being transmitted and the scaling factor and offset are all indicated.

7.7.1.1 HISO8, CI8, SCxx, DCB8 and INC4

Isolation module HISO8, CI8 differential amplifier modules DCB8 and incremental counter module INC4

Up to 12 physical inputs are available depending on module type.

Sample application: A low-pass filter is to be applied to a physical input channel's signal and the results are to be transmitted by CAN bus. To do this, a virtual channel must be created and positioned in a CAN-message (via drag&drop). In the settings dialog for this virtual channel, a low-pass filter function can be selected and its parameters set.

7.7.1.2 P8

Pressure module P8

The pressure module has 8 physical channels.

The additional functions "Barometer" and "Status word" are available to this module under the function group heading "Pressure". See below in the functions' reference for descriptions of these functions.

For sample applications, refer to the material on the isolated amplifier module.

7.7.1.3 UNI8

Universal amplifier module UNI8

The universal amplifier module has 8 physical channels. Along with the red-green LED, it has 2 additional yellow LEDs, like the bridge amplifier does. These LEDs can be used for displaying module status information. For details, refer to the material on the bridge amplifier module.

The additional functions "Channel-status word", "Module-status word", "button status", "Status auf LED" and "short circuit status" are available to this module under the function group heading "Universal amplifier". See below in the functions' reference for descriptions of these functions.

For sample applications, refer to the material on the isolated amplifier module.

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7.7.1.4 DI16

Digital acquisition module DI16

This module has 16 digital inputs.

The additional functions "Event counting", "Frequency determination", and "Time determination" are available to this module under the group heading "Pulse signals". See below in the functions' reference for descriptions of these functions.

Sample application: A digital input bit is to be inverted and the results are to be transmitted by CAN bus. To do this, a virtual channel must be created and positioned in a CAN-message (using drag&drop). In the settings dialog for this virtual channel, the function "Logical NOT" can be selected and its parameters set.

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7.7.2 Output modules

The output modules are DAC8, PWM8, DO16R and DO8R. These modules receive their data in messages via the CAN bus. The CAN-messages can contain either analog or digital data. The channel data are extracted from the CAN-messages and then output on the process side either directly or after prior processing. Such prior processing is accomplished with the help of virtual channels; for instance, such a channel can contain the results of low-pass filtering applied to channel data received via CAN bus. Depending on the module type, either analog data (in the case of the analog output module) or digital data (in the case of the digital output module) can be outputted.

If data are to be read in to the output module, the bits and Bytes to be read in must be assigned to channels. To do this, use the drag&drop technique to position the Module Tree entries of channels in messages. Virtual channels as well as physical outputs can be positioned in the messages. The channels assigned to a message are automatically set on the function "Read-in CAN channel". In the message mapping dialog, a message's bit and Byte assignments, the number and order of bits, and the numerical format of the channel data to be extracted can be set. For analog data, the minimum and maximum values can additionally be set. Virtual channels can be processed in any way desired and then outputted.

7.7.2.1 DAC8

Analog output module DAC8

At the 8 analog outputs, voltages in the range from -10 V to +10 V can be outputted. Channels read in from the CAN bus and having this scaling, or virtual channels created with this scaling can be outputted directly. Otherwise the channels are automatically re-scaled, which results in a loss of precision. If for instance a 16-bit channel with an input range of -1 V ... +1 V is read in from the CAN bus and is to be outputted, the values which are read in are automatically transformed into the value range -10 V ... +10 V. Of the values -32767 to +32767 on the CAN bus, only the values -3276 to +3276 can be used for the D-A converter's output after scaling. This is because the range 1 V to +1 V is to be analog output. And if a channel with the input range 20 V..+20 V is transmitted by CAN bus, the values outside of the range +10 V to -10 V are truncated.

For some special functions, the results are re-scaled because of the integer arithmetic. Thus, the addition of two channels scaled to ±10 V results in a channel with an input range of ±20 V. If this result is to be analog output, it is automatically re-scaled to ±10 V.

The additional functions "Rectangle function", "Triangle", and "Sine" are available to this module under the group heading "Signal generator functions".

Sample application: A physical input channel is to be read in from the CAN bus, subjected to low-pass filtering and outputted at the Analog Output 1. To do this, a virtual channel must first be created and positioned in a CAN-message using the drag&drop technique. In the message mapping dialog for this virtual channel, the position of the bits to be extracted in the message and the data type can be set. Then the low-pass filter function must be set in the function setting dialog for Analog Output 1, the virtual channel created must be set as the function's parameter channel and the other parameters must also be specified.

The module also can output currents in the range 0 mA to 20 mA. If the module is switched to current supply mode, its output is still scaled as -10 V...+10 V. All positive voltages from 0 V to +10 V are mapped to 0 mA..20 mA. No negative voltages can be mapped, since the current supply can only provide current in one direction.

7.7.2.2 PWM8

Pulse-width modulated output module PWM8

This module is quite similar to the DAC8-module. In contrast to the DAC8-module, its output values are not voltages in the range -10 V ... +10 V but rather results taking the form 0% … 100%.

The module doesn't come with any additional functions.

7.7.2.3 DO8R, DO16R

Digital output module DO16R, relay module DO8R

The digital output modules can only output digital signals. If an analog signal is read in from the CAN bus, it must first be transformed to a digital signal, before it can become output. There are various functions for converting analog to digital data, such as the Schmitt-trigger function, the comparison functions or the function "Extract bit from word". Digital signals can be outputted either directly after being read in from the CAN bus or after prior processing. For the processing of digital inputs, the bit-wise logical NOT function is available, for example.

Sample application: A digital input bit is to be read in from the CAN bus, inverted and outputted at the Digital Output 1. To do this, a virtual channel must first be created and positioned in a CAN-message using the drag&drop technique. In the message mapping dialog for this virtual channel, the position of the bit to be extracted in the message and the data type (digital) can be set. Then the bit-wise logical NOT function must be set in the function setting dialog for Digital Output 1, the virtual channel created must be set as the function's parameter channel.

You can find further information about the modules, not concerning the Virtual Channels, in the chapter Properties of the Modules 280.

7.8 Sampling Rates

Depending on the modules, the allowed sampling intervals are 1 ms, 2 ms, 10 ms, 20 ms, 50 ms, ..., 1 min (other modules support faster sampling; for explanation purposes, a base rate of 2 ms is assumed). Virtual channels derived from functions without data compression have the same sampling rates as their parameter channels. If the function used to generate the virtual channel supports data compression, the resultant sampling rate can be smaller than that of the input channels (e.g. Maximum, Minimum, Average). The resultant sampling rate can never be greater than that of the input channels.

To conserve computational capacity, functions with compressed input data (e.g. sampling rate of 100 ms), are calculated with a time lag. The time lag has the effect that when data compression is present, more functions can be carried out simultaneously than if all the functions were applied at once to the same sample. This makes the processing of very involved configurations possible.

Take for instance 10 functions applied to data accumulating at a sampling rate of 10 ms. Instead of all the functions beginning to work immediately on the sample, one function's value is calculated at each ms after the sample arrives. This saves on computational exertion for the processor, but causes the results to be outputted with a time lag.

The larger a function's sampling rate is, the larger the time lag between its calculations can be. Interdependencies of parameters are, of course, unaffected. No data is lost, only the moment in which they are processed and in some cases when they are transmitted is delayed.

From a pulse rate of 100 ms onward, this phenomenon can be observed directly in the yellow flashing of the LED; the red and green components of the LED light flash with a mutual offset. Therefore, it's recommended to set a maximum sampling time of 50 ms for yellow LED flashing.

If one module has both messages configured with slow data rates and with high rates, it may occur that the rapid messages are delayed in being transmitted. This happens whenever several messages having a slow rate are transmitted in rapid succession, which of course takes up much time. This time amount can also be (significantly) greater than the fastest data rate. The corresponding messages can contain virtual or physical channels. The problem usually arises whenever very many channels or low Baud rates are set. One possible remedy might be a higher Baud rate.

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7.9 Processing functions sorted by group

Arithmetic
- Addition
- Division
- Inverse
- Multiplication
- Negative sign
- Subtraction

Statistics
- Exponential RMS
- Maximum
- Minimum
- Mean value
- Resampling
- Root-mean-square (RMS)
- Standard deviation

Linear filters
- Band-pass-filter
- High-pass filter
- Low-pass filter
- Smoothing based on 2 values
- Smoothing based on 3 values

Non-linear filters
- Hysteresis filter
- Median filter
- Schmitt-Trigger
- Slope limiting

Basic math functions
- Absolute value
- Assignment
- Constant digital channel
- Constant channel
- Characteristic curve
- Fixed analog value
- SawTooth
- Square root

Comparison functions
- Comparison function
- Greater
- Upper value
- Lesser
- Lower value

Logic operations
- Logical exclusive OR
- Logical NOT
- Logical OR
- Logical AND
- Monoflop

LED-function
- LED-flash

Bitwise relationships
- Bit-wise NOT
- Bit-wise OR
- Bit-wise AND
- Extract bit from word
- Bitwise exclutesive OR

Conversion
- Conversion to Float numerical format (only inputmoduls)
- Fixed input range
- Fixed scaling

Signal generator (only at output modules)
- PulseSequenceEncoder
- Rectangle function (only DAC8)
- Sine (only DAC8)
- Triangle (only DAC8)

Pulse signals (only at DI16 module)
- Event counting
- Frequency determination
- Time determination

Universal amplifier (only at DCB8; UNI8 module)
- Button status
- Channel status word
- Module status word
- Output status on LED
- Short-circuit status

Pressure function (only at P8 module)
- Barometer
- Output status word

Differential amplifiers (only at C8 module)
- Output status word

Incremental counter (only at INC4 module)
- Output status word

Scanner (only at SCxx module)
- Output status word

Isolated ampifier (only at CI8 module)
- Channal-status word
- Module-status word
- Output status on LED

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7.10 Function Reference

7.10.1 + (Addition)

The basic addition operation is carried out. The algorithm can be represented thus:

y [k] = u [k] + v [k] or y [k] = u [k] + c

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

1st parameter: Channel whose sample values are added to the 2nd parameter

2nd parameter:

Channel whose sample values are added to the corresponding sample value from the 1st parameter, or

numerical value added to each sample in the 1st parameter

Result channel: Channel containing the sum of the 1st and 2nd parameters

If two channels are added, they must share the same sampling rate. If the 2nd parameter is a numerical value, it must have the same physical unit as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameter is an input channel)	Integer
Integer or Digital	2nd parameter is a numerical value	Integer

7.10.2 - (Subtraction)

The basic addition operation is carried out. The algorithm can be represented thus:

y [k] = u [k] - v [k] or y [k] = u [k] - c

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

1st parameter: Channel from whose sample values the values in the 2nd parameterare subtracted

2nd parameter:

Channel whose sample values are subtracted from the corresponding sample value in the 1st parameter, or

numerical value subtracted from each sample in the 1st parameter

Result channel: Channel containing the difference of the 1st and 2nd parameters

If two channels are added, they must share the same sampling rate. If the 2nd parameteris a numerical value, it must have the same physical unit as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameteris an input channel)	Integer
Integer or Digital	2nd parameteris a numerical value	Integer

7.10.3 - (Negative sign)

The signs of the input channel's samples are reversed. Positive numbers become negative and vice-versa; the absolute values remain unchanged.

Input channel: Channel whose values' signs are to be reversed.	**Result channel**: Input channel values with inverted sign.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.4 * (Multiplication)

The basic multiplication operation is carried out. The algorithm can be represented thus:

y [k] = u [k] * v [k] or y [k] = u [k] * c

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

1st parameter: Channel whose sample values are multiplied with the 2nd parameter **2nd parameter**: Channel whose sample values are multiplied with the corresponding sample value from the 1st parameter, or numerical value multiplied with each sample in the 1st parameter	**Result channel**: Channel containing the product of the 1st and 2nd parameters

If two channels are multiplied, they must share the same sampling rate.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameteris an input channel)	Integer
Integer or Digital	2nd parameteris a numerical value	Integer

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7.10.5 / (Division)

The basic arithmetical operation Division is performed. The function follows the formula:

$y[k] = u[k] / c, \quad c \neq 0$

where k is the serial index, c a numerical constant, u is the input channel and y the result channel.

Input channel: Channel whose sample values are to be divided by a number	**Result**: Channel whose values are all divided by the number specified.
Input channel: Numerical value by which the sample values of the 1st parameter are to be divided	

The numerical value must be specified in the physical units of the input channel. In physical units of the input channel, the value may not be 0.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.6 1/x (Inverse)

The values from input channel are inverted. An input channel sample value of 0.0 is set as 0.0 in the result channel.

Input channel: Channel whose sample values are to be inverted	**Result**: Inverse values of the input channel's sample values.

The results of the Inverse-function can be imprecise. It is therefore recommended to re-scale the input channel accordingly.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.7 Absolute value

The absolute value of the input channel's sample values is determined. Positive values remain unaffected, negative values' signs are inverted. This function simulates an ideal rectifier.

Input channel: The absolute values of this channel's samples are taken.	**Result**: Channel with the absolute values of the input channel's sample values.

Data types:

Input channel	Result channel
Integer Digital	Integer Digital

7.10.8 Assignment

The input channel's values are directly assigned to the result channel; the result channel is a copy of the input channel.

Input channel: Channel whose sample values are assigned to the result channel	**Result**: The input channel's sample values.

Data types:

Input channel	Result channel
Integer Digital	Integer Digital

7.10.9 Band-pass filter

Filtering of the input channel with a band-pass filter. A bilinear transformation is used to compute the filter coefficients from the other parameters. The filter applied is always a 4th order band-pass filter.

Input channel: Channel to filter	**Result**: Filtered input channel
Filter characteristic: Butterworth, Bessel, Chebychev, ripple: 0.5 dB, Chebychev, ripple: 1.0 dB, Chebychev, ripple: 3.0 dB	**Lower and Upper cut-off frequency**: Lower and Upper cut-off frequency in Hz

A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.10 Barometer (only for P8 modules)

The result is the barometer's current measurement value. The barometer value is updated about once per second.

Result clock pulse: Pulse rate of the result channel	**Result channel**: Channel with current barometer values.

The barometer value is specified in bar.

Data types:

Input channel	Result channel
Integer	Integer

7.10.11 Bitwise AND

Parameter	Definition
1st parameter	Channel whose sample values are conjunctioned bit by bit with the respective value from the 2nd parameter.
2nd parameter	Channel whose sample values are conjunctioned bit by bit with the respective value from the 1st parameter, or numerical value which is conjunctioned with each value from the 1st parameter
Result	Channel containing the results of the bit-wise logical conjunctions

Description: Bit by bit conjunction operation performed on the two parameters. The sample values of the input channel are treated as whole 16-bit numbers. If both corresponding bits of the parameters' sample values are set, the corresponding bit of the result channel is set also, otherwise it is not.

Notes: If the function is carried out on two channels, they must share the same sampling rate.

If the 2nd parameter is a numerical value, it must be expressed as a hexadecimal number in the form: 0xiiii ($0 \leq i \leq F$). If, as an example, you want to subject the lowest 3 bits of the sample values to the AND operation, then the number 0x0007 must be specified as the 2nd parameter. If the operation should be performed only on the lowest bit (LSB), the number 0x0001 should be specified as the 2nd parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer	Integer (2nd parameter is an input channel)	Integer
Integer	Digital (2nd parameter is an input channel)	Integer
Digital	Integer (2nd parameter is an input channel)	Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a numerical value	Integer

7.10.12 Bitwise NOT

Parameter	Definition
Input channel	Channel whose sample values are negated bit by bit
Result channel	Channel containing the results of the bit-wise negation

Description: The sample values of Input channel are negated bit by bit. Integer values are treated as 16-bit numbers and each individual bit is negated, which means that if a bit has the value 0 (FALSE), it becomes 1 (TRUE) and vice-versa. For digital input channels, the single digital bit's value is switched to the other binary value.

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Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

7.10.13 Bitwise OR

Parameter	Definition
1st parameter	Channel whose sample values are disjunctioned bit by bit with the respective value from the 2nd parameter
2nd parameter	Channel whose sample values are disjunctioned bit by bit with the respective value from the 1st parameter, or numerical value which is disjunctioned with each vale from the 1st parameter
Result	Channel containing the results of the bit-wise disjunction.

Description: A bit by bit OR-operation is performed on the two parameters. The sample values of the input channel are treated as whole 16-bit numbers. If a bit is set in either of the parameters' sample values, the corresponding bit of the result channel is set (=1), otherwise it is not.

Notes: If the function is carried out on two channels, they must share the same sampling rate.

If the 2nd parameter is a numerical value, it must be expressed as a hexadecimal number in the form: 0xiiii ($0 \leq i \leq F$). If, as an example, you want to subject the lowest 3 bits of the sample values to the OR operation, then the number 0x0007 must be specified as the 2nd parameter. If the operation should be performed only on the lowest bit (LSB), the number 0x0001 should be specified as the 2nd parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer	Integer (2nd parameter is an input channel)	Integer
Integer	Digital (2nd parameter is an input channel)	Integer
Digital	Integer (2nd parameter is an input channel)	Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a numerical value	Integer

7.10.14 Bitwise exclusive OR

Parameter	definition
1st parameter	Channel, whose sample values are each to be subjected bit-by-bit to the XOR logic operation together with the sample values of the 2nd parameter.
2nd parameter	Channel, whose sample values are each to be subjected bit-by-bit to the XOR logic operation together with the sample values of the 1st parameters, or numerical value which is to be subjected to the XOR logic operation together with each of the sample values of the 1st parameter
Result	Channel with the results of the bit-wise XOR operation.

Description: The values of both parameters are jointly subjected bit-by-bit to the XOR logic operation. The sample values of the input channels consist of whole 16-bit numbers. If the bit corresponding to the current sample value is set for just one of parameters, that bit is set in the result, otherwise not.

Remark: For 2 channels to be subjected jointly to the XOR operation, they must both have the same sampling rate.

If the 2nd parameter is a numerical value, it must be expressed as a hexadecimal number in the form: 0xiiii ($0 \leq i \leq F$). If, as an example, you want to subject the lowest 3 bits of the sample values to the XOR operation, then the number 0x0007 must be specified as the 2nd parameter. If the operation should be performed only on the lowest bit (LSB), the number 0x0001 should be specified as the 2nd parameter.

Data types:

1st Input channel	2nd Parameter	Result channel
Integer or Unsigned Integer	Integer or Unsigned Integer (2nd parameter is an input channel)	Integer or Unsigned Integer
Integer or Unsigned Integer	Digital (2nd parameter is an input channel)	Integer or Unsigned Integer
Digital	Integer or Unsigned Integer (2nd parameter is an input channel)	Integer or Unsigned Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Unsigned Integer	2nd parameter is a numerical value	Integer or Unsigned Integer
Digital	2nd parameter is a numerical value	Integer

7.10.15 Button status (only for UNI8 modules)

Parameter	Definition
Result clock pulse	Clock pulse of result channel
Result channel	Channel representing button status signal

Description: Outputs button status of UNI8 module at specified sampling rate. If the button was pressed the returned result is 1 for the duration of one pulse, else 0. When the button is pressed only the signal edge is evaluated, i.e. it doesn't matter how long the button is held down. If the button function is set to "Activate balance" or "Activate shunt calibration", the button only takes effect if balancing (or shunt calibration) can be performed. During balancing or shunt calibration, the button status is ignored.

Since it is the signal edge which counts, only a single 1 appears between sequences of zeroes.

Data types:

Result channel
Digital

7.10.16 Channel-status word (only for UNI8 and CI8 modules)

Parameter	**Definition**
Result clock pulse	Pulse rate of result channel
Result channel	Current content of input channel's status word.

Description: A status word for channels of the universal amplifier module is outputted at the specified clock pulse. In the basic state the status word's value is 0. Therefore channels 1 ... 8 are not balanced.

Depending on the status, the following values are added:

+1	if stored adjustment values are used for Channel 1
+2	if Channel 1 was successfully adjusted/balanced
+4	if stored adjustment values are used for Channel 2
+8	if Channel 2 was successfully adjusted/balanced
+16	if stored adjustment values are used for Channel 3
+32	if Channel 3 was successfully adjusted/balanced
+64	if stored adjustment values are used for Channel 4
+128	if Channel 4 was successfully adjusted/balanced
+256	if stored adjustment values are used for Channel 5
+512	if Channel 5 was successfully adjusted/balanced
+1024	if stored adjustment values are used for Channel 6
+2048	if Channel 6 was successfully adjusted/balanced
+4096	if stored adjustment values are used for Channel 7
+8192	if Channel 7 was successfully adjusted/balanced
+16384	if stored adjustment values are used for Channel 8
+32768	if Channel 8 was successfully adjusted/balanced

The function is designed for displaying bridge channels, i.e. channels, which can be balanced to 0.

Data types:

Result channel
Unsigned Integer

7.10.17 Characteristic curve

The input channel is corrected according to a characteristic curve. The input channel values (X-values) and corresponding result values (Y-values) must be supplied. The result values for X-values lying between two adjacent input channel values are determined by linear interpolation of the corresponding Y-values. It is necessary for equal numbers of X- and Y-values to be supplied. A maximum of 60 each of X and Y-values is allowed. The X-values must be strictly monotonously growing.

The X- and Y-value data can, for example, be copied from the FAMOS Data Editor and inserted in the corresponding input boxes.

Input channel: Channel to be corrected according to a characteristic curve	**Result**: Input channel corrected by the characteristic curve
X-values: Specified input channel values	
Y-values: Result values assigned to the input channel values	

The X-values are expressed in the physical units of the input channel. The scaling of the result is automatically determined from the result values.

Data types:

Result channel	
Integer	

7.10.18 Comparison function

If the current value of the digital input channel does not equal zero, the result is the value of the output channel, otherwise it is the stated return value.

Input channel: Channel whose sample values determine whether the samples from 'Output channel' or the specified 'Result value' are adopted as return values of the function.	**Result value**: Number which is the function's return value whenever the Input channel's value is FALSE (= 0).
Output channel: Channel whose sample values are the function's return values if the Input channel's corresponding value is TRUE (<> 0).	**Result channel**: Channel containing the results of the decision function.

Input channel and Output channel must share the same sampling rate. Result value must be specified in the physical units of Output channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.19 Constant channel (only for acquisition modules)

Any given value from the input channel is replaced with the specified, constant value.

Input channel: Channel whose values are to be set to a constant value.	**Result value**: Constant-value channel.
Value: Specified numerical value	

The constant value is specified in the physical units of the input channel. The input channel's scaling remains intact.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.20 Constant digital channel

Generates a constant digital channel with the specified pulse rate and binary value 1 (TRUE) or 0 (FALSE).

Clock pulse: Data rate of result channel	**Result value**: Constant digital channel.
Digital value: Numerical return value, 1 (TRUE) or 0 (FALSE).	

The constant value is specified in the physical units of the input channel. The input channel's scaling remains intact.

Data types:

Result channel
Digital

7.10.21 Conversion to Float numerical format (only for acquisition modules)

Parameter	Definition
Input channel	Channel whose values are to be expressed in Float numerical format
Result channel	Values from Input channel expressed in Float numerical format

Description: Conversion of an integer (2 Byte) to a real number (4Byte) giving regard to the scaling factor and offset. The real number is determined by the algorithm:

y [k] = Factor * u [k] + Offset

where k is a serial index and u an input channel in Integer data format (devoid of scaling, i.e. without scaling factor or offset) y is the result channel in Real data format. Factor is the input channel's scaling factor and Offset Input channel's offset.

Data types:

Input channel	Result channel
Integer or Digital	Real

7.10.22 Event counting (only for DI16 modules)

Parameter	Definition
Input channel	Digital input channel in whose signal events are to be counted
Result clock pulse	Clock pulse rate of results channel
Result channel	Channel containing number of events.

Description: Returns number of events occurring at the digital channel within one result clock pulse period. An event is a transition from 0 to 1 (or nonzero), i.e., a positive edge.

Notes: Only digital input channels are allowed. The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms.

Data types:

Input channel	Result channel
Digital	Integer

7.10.23 Exp. root mean square (RMS)

Parameter	Definition
Input channel	Channel from whose sample values the moving RMS is to be calculated
Time constant	Time constant of the filter in s, Input range: 1.5 * Result pulse < Time constant ≤ 60000 * Result pulse
Result clock pulse	Sampling rate of the result channel
Result channel	Moving RMS of the input channel's sample values

Description: The moving RMS, with exponential weighting, of the input channel's sample values is calculated. If data reduction is specified, only every n-th result is written to the result channel. The reduction interval is the result channel's sampling rate (pulse). Each value returned is the respective RMS with exponential weighting of all input channel sample values accumulated at the moment. The algorithm for calculating the moving RMS is:

The input channel's sample values are first squared, then 1st order low-pass filtering (taking consideration of the time constant) is conducted and then the square root is taken. In a normal RMS calculation, all squared values are weighted equally when the mean is taken; in this case, a time-based weighting takes place.

Notes: Data reduction is recommended since the function smoothes the data. The reduction tends to reduce redundant data.

The pulse rate of the result channel may not be higher than that of the input channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.24 Extract bit from word

Parameter	Definition
Input channel	Channel from whose sample values a bit is to be extracted
Bit to be extracted	Bit 1 (LSB) .... Bit 16 (MSB)
Result channel	Channel containing extracted bit

Description: The specified bit is extracted from a number. The result is a bit, i.e. either 0 (FALSE) or 1 (TRUE). The 2nd parameter states the bit which is to be extracted: Bit 1 (LSB) .... Bit 16 (MSB).

Data types:

Input channel	Result channel
Integer	Digital
Unsigned Integer	Digital

7.10.25 Fixed analog value (only for DAC8 and PWM8 modules)

Parameter	Definition
Value	Fixed analog value, -10V ... +10V.
Result channel	Channel with constant (fixed) analog value

Description: Creates a channel with a fixed (constant) value. The value can be set to between -10V and +10V.

Data types:

Result channel
Integer

7.10.26 Fixed digital value (only for digital output modules)

Parameter	Definition
Digital value	Constant (fixed) digital value, either 0 (FALSE) or 1 (TRUE).
Result channel	Channel with constant (fixed) digital value

Description: Creates a channel with a fixed (constant) value. The value can be set to either 0 (FALSE) or to 1 (TRUE).

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Data types:

Result channel
Digital

7.10.27 Fixed input range

Parameter	Definition
Input channel	Channel to be re-scaled
Minimum	New lower limit of the value range
Maximum	New upper limit of the value range
Result channel	Re-scaled input channel

Description: The value range of a channel is re-scaled according to the user's specifications. The new range is defined by a new lower range limit (minimum) and a new upper range limit (maximum). All the input channel's sample values are linearly transformed to the result channel's new value range.

Notes: The function can only be carried out if the degree of stretching or contraction of the value range derived from the minimum and maximum is not too large.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.28 Fixed scaling

Parameter	Definition
Input channel	Channel to be re-scaled
Factor	New scaling factor, which together with the new offset determines a new value range
Offset	New offset, which together with the new scaling factor determines a new value range
Result channel	Re-scaled Input channel

Description: The value range of a channel is re-scaled on the basis of the new scaling factor and offset supplied by the user. The new lower range limit L_L and the new upper range limit L_U are calculated by:

$L_L = -32767 * |Factor| + Offset$ and $L_U = +32767 * |Factor| + Offset$

All sample values of the input channel are linearly transformed to fit the new result channel value range.

Notes: The function can only be carried out if the degree of stretching or contraction of the value range derived from the specified scaling factor and offset is not too large.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.29 Frequency determination (only for DI16 modules)

Parameter	Definition
Input channel	Channel for which a frequency is to be determined
Input range	The following input ranges can be set: 30 Hz 60 Hz 125 Hz 250 Hz 400 Hz 800 Hz 2 kHz 4 kHz
Result clock pulse	Clock pulse rate of results channel
Result channel	Results of frequency determination

Description: Determines a signal frequency for the digital input signal. The function's action is a combination of event counting and time measuring. An event is a transition from 0 to 1 (nonzero), i.e., a positive edge. During a sampling interval the events occurring as well as the time between the first and last occurrence are measured. The frequency is computed as the number of events divided by the time between the first and last complete event within the interval. An event is completed when the positive edge is succeeded by a subsequent positive edge. In order for a frequency to be determined, then, at least two complete events must be located within the interval.

If the frequency determined exceeds the input range, the result value is set to the specified input range's endpoint.

If no frequency can be determined for a result clock pulse interval, the last frequency result is repeated. If multiple frequencies are determined during one result clock pulse interval, the most recent result is returned.

Notes: The input range and the module's sampling rate influence the precision of the frequency measurement. Only digital input channels are allowed.

The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms. The higher the sampling rate is, the more exactly the frequency can be determined.

For the most precise frequency measurements, use the incremental counter module INC4.

Data types:

Input channel	Result channel
Digital	Integer

7.10.30 Greater

Parameter	Definition
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Digital channel; result value is respectively TRUE (1), if 1st parameter value > 2nd parameter value FALSE (0), if 1st parameter value ≤ 2nd parameter value

Description: The function determines whether the 1st parameter value is larger than the 2nd parametervalue. If the 1st parameter is greater, then 1 is returned, otherwise 0 is returned.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameteris a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameters input channel)	Digital
Integer or Digital	2nd parameters number	Digital

7.10.31 Greater value

The function determines which value from the two parameters is the highest.

1st parameter: Channel whose sample values are to be compared with the appropriate value from the 2nd parameter

2nd parameter:

Channel whose samples are to be compared with the corresponding values from the 1st parameter or

numerical value with which the sample values of the 1st parameter are to be compared

Result channel: Channel containing the respective highest sample value of the two parameters

If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st Input channel	2nd parameter	Result channel
Integer	Integer (2nd parameteris input channel)	Integer
Integer	Digital (2nd parameteris input channel)	Integer
Digital	Integer 2nd parameteris input channel)	Integer
Digital	Digital (2nd parameteris input channel)	Digital
Integer or Digital	2nd parameteris a number	Integer

7.10.32 High-pass filter

Filtering of the input channels with a high-pass filter. The filter coefficients are calculated from the parameters supplied by the user.

Input channel: Channel to be filtered

Characteristic: Filter characteristic

- Butterworth
- Bessel
- Chebychev, ripple: 0.5 dB
- Chebychev, ripple: 1.0 dB
- Chebychev, ripple: 3.0 dB

Cut-off frequency: Specified in Hz

Order: Filter order: 1 .. 4

Result: Filtered input channel

A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.33 Hysteresis filter

Parameter	Definition
Input channel	Channel to be filtered
Hysteresis width	Hysteresis width, for suppressing minor fluctuations
Result channel	Filtered input channel

Description: The hysteresis filters minor oscillations up to the size of the hysteresis width out of the input channel. The algorithm is as follows:

The 1st result value is set as the 1st sample value from the input channel. The trend is set as an upward trend.

If the signal is currently in an upward trend, then one of the three procedures below is followed, depending upon the status of the current signal value in the input channel:

- If the current signal value from the input channel is greater than the last value in the result channel, the current value in the input channel is adopted as the current value of the result channel.
- If the current signal value from the input channel is less than or equal to the last value in the result channel, but not less than: the last result channel value minus the hysteresis width (i.e., the negative discrepancy to the last value is within a tolerance range stated as the hysteresis width), the last result channel value is retained as the current result channel value.
- If the current signal value from the input channel is less than the last result channel value minus the hysteresis width (i.e., the negative discrepancy to the last value is outside the tolerance range stated as the hysteresis width), the current signal value from the input channel becomes the current value of the result channel, and the prevalent signal trend is now downward.

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If the signal is currently in a downward trend, then one of the three procedures below is followed, depending upon particulars of the current signal value in the input channel:

- If the current signal value from the input channel is less than the last value in the input channel, the current value in the input channel is adopted as the current value of the result channel.
- If the current signal value from the input channel is greater than or equal to the last value in the result channel, but not greater than: the last result channel value plus the hysteresis width (i.e., the positive discrepancy to the last value is within a tolerance range stated as the hysteresis width), the last result channel value is retained as the current result channel value.
- If the current signal value from the input channel is greater than the last result channel value plus the hysteresis width (i.e., the positive discrepancy to the last value is outside the tolerance range stated as the hysteresis width), the current signal value from the input channel becomes the current value of result channel, and the prevalent signal trend is now upward.

Notes: The hysteresis width is specified in the physical units of the input channel and must be ≥ 0. A hysteresis width of 0 returns the input channel as the result.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

7.10.34 LED-flash

Parameter	Definition
Result clock pulse	Result channel pulse rate
Clock pulse, LED on	Number of pulses during which the function returns 1 (TRUE) as the result, Value range: 0 ... 60000.
Clock pulse, LED off	Number of pulses during which the function returns 0 (FALSE) as the result, Value range: 0 ... 60000.
Condition	Flash Flash for overflow
Result channel	Channel containing results of the LED-flashing function.

Description: By assigning the function to an LED, the LED's flashing pattern can be set. At the pulse rate specified, the LED shines during the number of pulses specified for "LED on" and stays off during the number of pulses specified for "LED off", if the specified condition is met. Otherwise, the LED is off altogether.

If the condition 'Flash' is set, Parameters 2 and 3 are evaluated in the manner described; the channel data value is 1 (TRUE) during the pulses for which "LED on" is specified, and for the other pulses the return value is 0 (FALSE). If the function is applied to an LED, the LED will flash correspondingly.

If the condition 'Flash for Overflow' is set, Parameters 2 and 3 are evaluated in the manner described only if the CANSAS module FIFO's overflow (and thus the module is overloaded); in such a case, some data will not be processed or transferred via the CAN-bus. Otherwise, the function's return value is 0 (FALSE). If the function is applied to an LED, LED flashing indicates system overload.

Notes: The function can also be used to generate a rectangular signal. For this purpose, the LED-flash function must be assigned to a virtual channel. The result channel can be re-scaled if appropriate.

Data types:

Result channel
Digital

7.10.35 Less

Parameter	**Definition**
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Digital channel; result value is respectively TRUE (1), if 1st parameter value < 2nd parameter value FALSE (0), if 1st parameter value ≥ 2nd parameter value

Description: The function determines whether the 1st parameter value is less than the 2nd parameter value. If the 1st parameter is lesser, then 1 is returned, otherwise 0 is returned.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate.

If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st input channel	**2nd parameter data type**	**Result channel**
Integer or Digital	Integer or Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a number	Digital

7.10.36 Less value

Parameter	**Definition**
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Channel containing the respective lowest sample value of the two parameters

Description: The function determines which value from the two parameters is the lowest.

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Notes: If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st Input channel	2nd parameter data type	Result channel
Integer	Integer (2nd parameter is input channel)	Integer
Integer	Digital (2nd parameter is input channel)	Integer
Digital	Integer 2nd parameter is input channel)	Integer
Digital	Digital (2nd parameter is input channel)	Digital
Integer or Digital	2nd parameter is a number	Integer

7.10.37 Logical AND

Parameter	Definition
1st input channel	Channel whose sample values are conjunctioned with the respective value from the 2nd parameter.
2nd input channel	Channel whose sample values are conjunctioned with the respective value from the 1st parameter
Result channel	Digital channel containing the conjunction results.

Description: Logical conjunction of the two input channels. If the corresponding sample values from the two channels are both nonzero, the return value is 1; otherwise the return value is 0. Therefore, the following condition must be fulfilled so that the return value is 1:

$u[k] \neq 0$ and $v[k] \neq 0$

where k is a serial index, and v are the two input channels.

Notes: Both channels must share the same sampling rate.

Data types:

1st input channel	2nd input channel	Result channel
Integer or Digital	Integer or Digital	Digital

7.10.38 Logical NOT

Parameter	Definition
Input channel	The data to be negated
Result channel	Digital channel containing the results.

Description: The input channel is logically negated. The return value is 1 if the sample value is 0, otherwise the return value is 0.

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Data types:

Input channel	Result channel
Integer or Digital	Digital

7.10.39 Logical OR

Parameter	Definition
1st input channel	Channel whose sample values are disjunctioned with the respective value from the 2nd parameter
2nd input channel	Channel whose sample values are disjunctioned with the respective value from the 1st parameter
Result channel	Digital channel with the disjunction results.

Description: Disjunction operation performed on two channels. The return value is 1 whenever one of the sample values from the two channels is nonzero. Otherwise, the return value is 0. Therefore, one of the following two conditions must be fulfilled so that the return value is 1:

$u[k] \neq 0$ or $v[k] \neq 0$

where k is a serial index, and v are the two input channels.

Note: Both channels must share the same sampling rate.

Data types:

1st Input channel	2nd Input channel	Result channel
Integer or Digital	Integer or Digital	Digital

7.10.40 Logical exclusive OR

Parameter	Definition
1st input channel	Channel whose sample values are disjunctioned with the respective value from the 2nd parameter
2nd input channel	Channel whose sample values are disjunctioned with the respective value from the 1st parameter
Result channel	Digital channel containing the disjunction results.

Description: Exclusive disjunction operation performed on two channels. The return value is 1 whenever the corresponding sample values from each of the two channels are logically opposites. Otherwise, the return value is 0. Therefore, one of the following two conditions must be fulfilled so that the return value is 1:

$(u[k] = 0$ and $v[k] \neq 0)$ or $(u[k] \neq 0$ and $v[k] = 0)$

where k is a serial index, and v are the two input channels.

Notes: Both channels must share the same sampling rate.

Data types:

1st Input channel	2nd Input channel	Result channel
Integer or Digital	Integer or Digital	Digital

7.10.41 Low-pass filter

Parameter	Definition
Input channel	Channel to filter
Characteristic curve	Filter characteristic Butterworth Bessel Chebychev, ripple: 0.5 dB Chebychev, ripple: 1.0 dB Chebychev, ripple: 3.0 dB
Cut-off frequency	Specified in Hz
Order	Filter order 1 2 3 4
Result clock pulse	Result channel data rate
Result	Filtered input channel.

Description: Filtering of the input channels with a low-pass filter. The filter coefficients are calculated from the parameters supplied by the user.

Notes: A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.42 Maximum

Parameter	Definition
Input channel	Channel whose maxima within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Channel with the maxima of the input channel within the data reduction interval.

Description: The maximum values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the maxima found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

7.10.43 Mean value

Parameter	Definition
Input channel	Channel whose mean values within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Smoothed input channel

Description: The mean values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the mean values found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.44 Median filter

Parameter	Definition
Input channel	Channel to filter
Result channel	Filtered input channel.

Description: Performs median filtering on the last 3 sample values. The 3 sample values are ordered by their amplitude. The return value is the middle value in the ordered set. The result channel's first two values are the same as those of the input channel.

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Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.45 Minimum

Parameter	Definition
Input channel	Channel whose minima within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Channel containing the minima of the input channel within the data reduction interval.

Description: The minimum values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the minima found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

7.10.46 Module-status word (only for UNI8 and CI8 modules)

Parameter	Definition
Result clock pulse	Sampling rate of result channel
Result channel	Current content of result channel's status word

Description: Status word for universal amplifier module is outputted at the specified clock rate. In the basic state, the status word takes the value 0.

Depending on the status, the following values are added:

+1, if system is in the process of adjusting/balancing
+2, if system is in the process of performing shunt calibration
+4, if the module button is pressed (edge detection)
+8, if short circuit
+16, if the module is running in synchronized mode

Remark: If the function of the module button is set to "Activate balance " or "Shunt calibration", the system only takes not of the button if it is possible to perform calibration or adjustment/balancing. During balancing or shunt calibration, the button status is not regarded.

It is possible to run multiple CANSAS-modules in synchronicity to each other, to the DCF-signal or to µMUSYCS. For synchronized operation, the corresponding status value is added.

Data types:

Result channel
Unsigned Integer

7.10.47 Monoflop

Parameter	Definition
Input channel	Channel on which to perform the function.
Duration	Duration of the output pulse as a multiple of samples; range: 1 ... 65535
Re-triggerable?	Optionally yes or no
Result channel	Digital channel containing the evaluated pulses

Description: The monoflop outputs an impulse in response to signal value transitions from zero to nonzero. The return value is 1 during the impulse duration, otherwise 0. If the monoflop is not re-triggerable, the zero-to-nonzero transition is only detected after an existing impulse is completed. If it is retriggerable, the transition detection is always active and the response to a new transition to nonzero is a new impulse which accordingly prolongs the existing impulse.

Data types:

Input channel	Result channel
Integer or Digital	Digital

7.10.48 Output status on LED (only for UNI8 and CI8 modules)

Parameter	Definition
UNI8: Other or no sensors	The flashing pattern for the case that other or no sensors are connected to the module. See below for selection.
For "Not balanced"	What flashing pattern indicates that the channel has not been balanced? LED on LED off LED quick flashes LED normal flashes LED slow flashes LED long flash on, short blink off LED short blink on, long flash off
For "Stored balance values"	Sets flashing pattern for indicating that stored balance values used for channel. Selections see above.
For "Successfully balanced"	Sets flashing pattern for indicating that balance values used for channel. Selections see above.
For "Balance in progress..."	Sets flashing pattern for indicating that balance is in progress. Selections see above.
For "Shunt calibration in progress"	Sets flashing pattern for indicating that shunt calibration in progress. Selections see above. Additional selection: "No LED-display"
Result	LED-display

Description:

Status information on the bridge amplifier module is outputted on the LED. The information can reflect the status of either Channel 1, Channel 2, or both. If both channels are affected at once, the status must be the same in both for the corresponding LED-display to be output. See the table below for a list of the different states which can be represented:

For determining the status of both channels at once, the following must be noted: All status values except "Successfully balanced" and "Not balanced" can only apply to both channels at once, anyway, so they are the same for both channels. And if the channels have different status in terms of "balanced" or "Not balanced", then "Not balanced" takes precedence.

Universal amplifier module:

The status of the universal amplifier module's bridge channels is indicated by an LED. The function is designed for displaying bridge channels, i.e. channels which can be balanced to 0. As a rule, the status for all of the module's bridge channels is indicated. All status values except "Successfully balanced" and "Not balanced" can only apply to both channels at once, anyway, so they are the same for both channels. And if the channels have different status in terms of "balanced" or "Not balanced", then "Not balanced" takes precedence. If no bridge channel is configured, the flashing pattern will indicate "Successfully balanced".

If at least one sensor connected to the module was changed, the flashing pattern for "Other or no sensors" is displayed. This can mean that a connected sensor was disconnected, that a sensor was exchanged for another one or that a sensor was connected at a previously free terminal. The module only recognizes the change once it has been re-booted, e.g., briefly disconnected from the power supply.

Status	Definition
"not balanced"	The Flash doesn't contain stored balancing values, and balancing has not been performed since the module was activated.
"Stored balance values"	The balance values stored in the Flash are used, and balancing has not been performed since the module was activated.
"Successfully balanced"	Balancing has been performed since the module was activated.
"Balance in progress"	Balancing currently being performed.
"Shunt calibration in progress"	Shunt calibration currently being performed.

Data types:

Result channel
LED display

7.10.49 Output status word (only for C8, P8, INC4 and SC modules)

Parameter	Definition
Result clock pulse	Data rate of result channel
Result channel	Channel containing status word

Description: The status word is outputted at the specified clock rate. In the basic state, the status word is 0. Depending on the status and module, the following values are added to the status word:

Bridge amplifier module:

In the basic state (status word = 0), the bridge amplifier channels 1 and 2 are not balanced. Depending on the status, the following values are added:

+1 if stored balance values used for Channel 1

+2 if Channel 1 successfully balanced

+4 if stored balance values used for Channel 2

+8 if Channel 2 successfully balanced

+16 if balance currently being performed

+32 if shunt calibration currently being performed

+64 if button pushed (edge evaluation)

+128 if short circuit

Notes: If the button function is set to "Activate balance" or "Activate shunt calibration ", the button only takes effect if balancing (or shunt calibration) can be performed. During balancing or shunt calibration the button status is ignored.

Differential amplifier-, pressure- and incremental counter modules:

Depending on the status, the following values are added:

+1, if the module is running in synchronized mode

Remark: It is possible to run multiple CANSAS-modules in synchronicity to each other, to the DCF-signal or to µMUSYCS. For synchronized operation, the corresponding status value is added. In synchronized operation, 1 is added to the status value.

Data types:

Result channel
Unsigned Integer

7.10.50 PulseSequenceEncoder (only for output modules)

Parameter	**Definition**
Frequency curve [Hz]	Frequency curve read out from CAN-bus, from which a sequence of pulses is to be generated.
Result channel	Sequence of pulses

Description: This function generates a sequence of pulses like those typical of incremental encoder sensors. The pulse rate is determined by the sampling rate of the function's parameter channel. If the function is applied to a channel sampled at 10 kHz, for instance, then a measured frequency on that channel of 2.5 kHz results in the series 001100110011... If the frequency changes to 1.25kHz, the pulse sequence becomes 0000111100001111....

Notes: The parameter channel's signal must have only positive values. In spite of this, a signed quantity can serve as the parameter. For example, if a signal's range is given as -100Hz to +100Hz, only values > 0 will actually appear. Since the module works internally with signed quantities, a symmetric input range is actually even advantageous for the sake of the processing speed.

Note also that due to the discrete output rate, the output pulse signal is less precise the higher the measured frequency is.

Data types:

Input channel	**Result channel**
Integer	Digital

7.10.51 Rectangle (only for DAC8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel.
Cycles with "high" pulse	Number of sample intervals with "high" pulse as output
Cycles with "low" pulse	Number of sample intervals with "low" pulse as output
Amplitude with "high" pulse	Amplitude of "high" pulse in V?
Amplitude with "low" pulse	Amplitude of "low" pulse in V?
Results channel	Rectangular signal

Description: Output of a rectangular signal at the voltage output. The parameters to be set are the clock cycle for the function, the duration of the "high" pulse, and the amplitude in V. The number of cycles with a pulse multiplied by the specific clock cycle equals the duration of the "high" pulse. The number of cycles without a pulse multiplied by the clock cycle equals the duration of the "low" pulse. The amplitude of the "high" and "low" can be freely specified in the range from -10 V to +10 V.

Resulting frequency = 1 / ((No. of cycles with pulse + no. of cycles without pulse) * result clock rate).

Data types:

Result channel
Integer

7.10.52 Resampling

Parameter	Definition
Input channel	Channel to be re-sampled
Result clock pulse	Data rate of result channel
Result channel	Re-sampled input channel

Description: The mean values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the respective last values within the reduction interval.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

7.10.53 Root-mean-square

Parameter	Definition
Input channel	Channel from whose sample values the moving RMS is to be calculated
Result clock pulse	Sampling rate of the result channel
Result channel	Channel containing the moving RMS of the input channel's sample values

Description: The moving RMS (root-mean-square) value, with equal weighting of the values, is taken for each set of the input channel's sample values within the specified reduction interval. The reduction interval is given by the result channel's sampling rate (pulse).

The algorithm for calculating the moving RMS is:

The input channel's sample values within the reduction interval are squared and the squares are summed. The respective result is divided by the amount of samples in the reduction interval and of this the square root is taken.

Note: The pulse rate of the result channel may not be higher than that of the input channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.54 SawTooth

Parameter	Definition
Clock pulse	Data rate of result channel
Number of points	Number of points making up a single period; value range: 1 ... 32768.
Start	Starting value, offset of the sawtooth signal
Increment	Increment, slope of the offset signal.
Result channel	Sawtooth-signal

Description: Generates a sawtooth signal. The data rate of the return values is given by the clock pulse specified. The signal's values are arranged in groups of consecutive values; each group's amount of values is given by 'Number of points', and each group's first value is the value given for 'Start'. The subsequent values in each group are the sum of the respective last return value and the 'Increment'-value specified.

Notes: Start-value and Increment must be specified in terms of the input channel's physical units.

Data types:

Result channel
Integer

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7.10.55 Schmitt-Trigger

Parameter	Definition
Input channel	Channel to be filtered
Upper limit	Upper signal value which releases trigger
Lower limit	Lower signal value which releases trigger
Result channel	Filtered input channel

Description: A Schmitt-trigger with an upper and a lower threshold. The function generates ideal, square pulses. The only two possible return values are 0 and 1. The function can be used to reconstruct noisy signals for the purpose of subsequent processing, eliminating the noise. However, the shape of the original signal is also lost. The greater the distance between the two threshold values, the less susceptible the Schmitt-trigger is to noise.

The function uses the following algorithm:

For a non-negative scaling factor, the first return value is 1, otherwise 0.

If the last return value was 0, the new return value is 1 if the signal's sample value exceeds the upper threshold; otherwise, it is 0.

If the last return value was 1, the new return value is 0 if the signal's sample value drops below the lower threshold; otherwise, it is 1.

Both of these steps are performed on each sample value in the input channel.

Notes: The upper and lower limit must both be specified in terms of the input signal's physical units.

The upper limit's value must be greater than that of the lower limit.

A Schmitt-trigger is useful in cases where the important aspects of a sequence of pulses are the amount of pulses and their relative positions, but not their exact shape.

Data types:

Input channel	Result channel
Integer or Digital	Digital

7.10.56 Short circuit status (only for UNI8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel
Result channel	Channel containing short-circuit status

Description: Outputs short-circuit status of module at specified sampling rate. Result is 1 in case of short circuit, else 0.

Data types:

Result channel
Digital

7.10.57 Sine (only for DAC8 modules)

Parameter	Definition
Frequency	Frequency of sine signal in Hz
Phase	Phase of sine signal in degrees
Result channel	Sine signal

Description: A sinusoid voltage signal having the specified frequency and phase is output. The sine signal's amplitude is 10 V. Allowed frequency settings are: 1Hz ... 1000Hz (1 kHz). Allowed phase settings: 0° ... 359° (degrees). The result clock pulse is fixed at 0.1 ms.

The sine signal's period can only be multiples of 0.1ms.

The sine signal is generated with a resolution of 0.1ms. The higher the sine's frequency, the more coarsely the ideal form is approximated. If the signal is analog output, the staircase-shaped signal generated by the DA-converter is slightly filtered (at 5kHz). The resulting curve shape resembles a sine at high frequencies, but at lower frequencies the quality is quite high.

The phase is defined in relationship to other channels created alongside by the module.

Data types:

Result channel
Integer

7.10.58 Slope limiting

Description: Slope-limiting is performed on the input channel's sample values. The maximum difference in value between two consecutive sample values is limited to the maximum increment specified.

Notes: The maximum increment must be specified in terms of the input channel's physical units. If the specified maximum increment is 0, the return value is always the input channel's first sample value.

Data types:

Input channel	Result channel
Integer	Integer

7.10.59 Smoothing based on 2 values

Parameter	Definition
Input channel	Channel to be smoothed
Result channel	Smoothed input channel

Description: The input channel is smoothed by taking the average of 2 consecutive values. The digital filter on which the function is based operates according to the formula:

$$y[k] = (u[k-1] + u[k]) / 2$$

where k is a serial index, u the input channel and y the result channel.

The 1st value in the result channel is set as the 1st sample in the input value.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.60 Smoothing based on 3 values

Parameter	Definition
Input channel	Channel to be smoothed
Result channel	Smoothed input channel

Description: The input channel is smoothed by taking the average of 3 consecutive values. The digital filter on which the function is based operates according to the formula:

y [k] = 0.25 * u [k-2] + 0.5 * u [k-1] + 0.25 * u [k]

where k is a serial index, u the input channel and y the result channel.

The 1st value in the result channel is set as the 1st sample in the input value. The result channel's 2nd value is set as the average of the input channel's 1st and 2nd values.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.61 Square root

Parameter	Definition
Input channel	Channel containing sample values whose square root is to be taken
Result channel	Square roots of the input channel's values

Description: The square roots of the input channel's sample values are computed. When input channel sample values are negative, the return value is 0.

Data types:

Input channel	Result channel
Integer or Digital	Integer

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7.10.62 Standard deviation

Parameter	Definition
Input channel	Channel for which the standard deviation of values within each reduction interval is computed
Result clock pulse	Data rate of the result channel
Result	Sequence of standard deviation values representing each reduction interval in the input channel

Description: The value for the standard deviation is calculated for each reduction interval within the input channel signal. The reduction interval is equal to the result channel's clock pulse rate.

Standard deviation is a statistical quantity characterizing how the data's values are distributed around their arithmetic mean value. Channels whose values don't fluctuate strongly naturally have low values for standard deviation, whereas strongly fluctuating signals have relatively high standard deviations. The algorithm for determining the deviation is as follows:

The deviation of each sample value within the reduction interval is squared and all the squares are summed, divided by the number of values minus 1, and the square root of the result of this is taken.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

7.10.63 Time determination (only for DI16 modules)

Parameter	Definition
Input channel	Channel for whose signal events the time is to be determined
Input range	Maximum measurable time between selected starting and stopping edge 3 s 6 s 12s 25 s 50 s 100 s 3 min 5 min 15 min 30 min 60 min
StartStop	Triggering or stopping of the reading by a positive or negative edge: start pos. edge, stop pos. edge start pos. edge, stop neg. edge start neg. edge, stop pos. edge
Result clock pulse	Data rate of result channel.
Result channel	Channel containing time determination results

Description: Returns the time between two selectable events (Start/Stop) on the digital input channel.

The time between the two edges must not exceed the selected input range. If the time measurement does exceed the limit, the range's endpoint is returned.

If no current counter result can be determined for a result clock pulse interval, the last result is returned again. If multiple time counts are triggered during one result clock pulse interval, the most recent result is returned.

StartStop	Definition
Start pos, Stop pos	The time reading starts upon reception of a positive edge (transition from 0 to 1), and ends upon reception of the next positive edge.
Start pos, Stop neg	The time reading starts upon reception of a positive edge (transition from 0 to 1), and ends upon reception of the next negative edge (transition from 1 to 0).
Start neg, Stop pos	The time reading starts upon reception of a negative edge (transition from 1 to 0), and ends upon reception of the next positive edge (transition from 0 to 1).

Notes: The input range and the module's sampling rate influence the precision of the time measurement.

Only digital input channels are allowed.

The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms. The higher the sampling rate is, the more exactly the time can be determined.

For the most precise frequency measurements, use the incremental counter module INC4.

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Data types:

Input channel	Result channel
Digital	Integer

7.10.64 Triangle (only for DAC8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel.
No. of clock cycles with positive slopes	How many signal clock cycles are to have positive slopes?
No. of clock cycles with negative slopes	How many signal clock cycles are to have negative slopes?
Maximum amplitude	The maximum signal amplitude in V
Result channel	Triangular signal

Description: Outputs a triangle function at the voltage output. The specified number of clock cycles for the positive slope determines how many cycle durations the signal needs to reach the specified maximum amplitude. The specified number of clock cycles for the negative slope determines how many cycle durations the signal needs to return from the maximum amplitude back to 0 V.

Resulting frequency = 1 / ((No. of cycles with pos. slope + No. of cycles with neg. slope) * clock pulse)

The result clock pulse should be as close to 0.1ms as possible. The higher the pulse rate is, the more accurately the ideal signal shape is approximated. The resulting triangular signal period must not be too short. If the signal is analog output, the staircase-shaped signal generated by the DA-converter is slightly filtered (at 5kHz). The resulting curve shape resembles a triangle at high frequencies and a long signal period.

Data types:

Result channel
Integer

8 Measurement technique

8.1 Measurement modes

8.1.1 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.

For all current module series, the measured voltage is converted into the displayed temperature value according to the characteristics of the temperature scale ITS-90. For the "old" classic modules, the conversion is carried out with the temperature scale IPTS-68. The values that are outside the standard do not correspond to the specified accuracy.

Note Making settings with the imc CANSAS software

Depending on issues specific to the system, temperature measurement with imc CANSAS modules may return incorrect display data if there is breakage of the sensor while the module is operated with active Synchronization 126. **Therefore, leave the synchronization deactivated for temperature measurement**. In consideration of the slow sampling rate for temperature measurement, synchronization provides no real advantage anyway.

8.1.1.1 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**.

Note

Only one thermocouple characteristic curve can be selected at the same time for one module. So it is only possible to measure thermocouples of similar type at the same time. Only at the CANSAS modules SC16, SCI8, SCI16 and CI8 it is possible to select different thermocouple characteristic curves at the same time.

The endings from the measurement ranges can drift about 1 K from the device configuration.

8.1.1.2 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).

8.1.1.3 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.

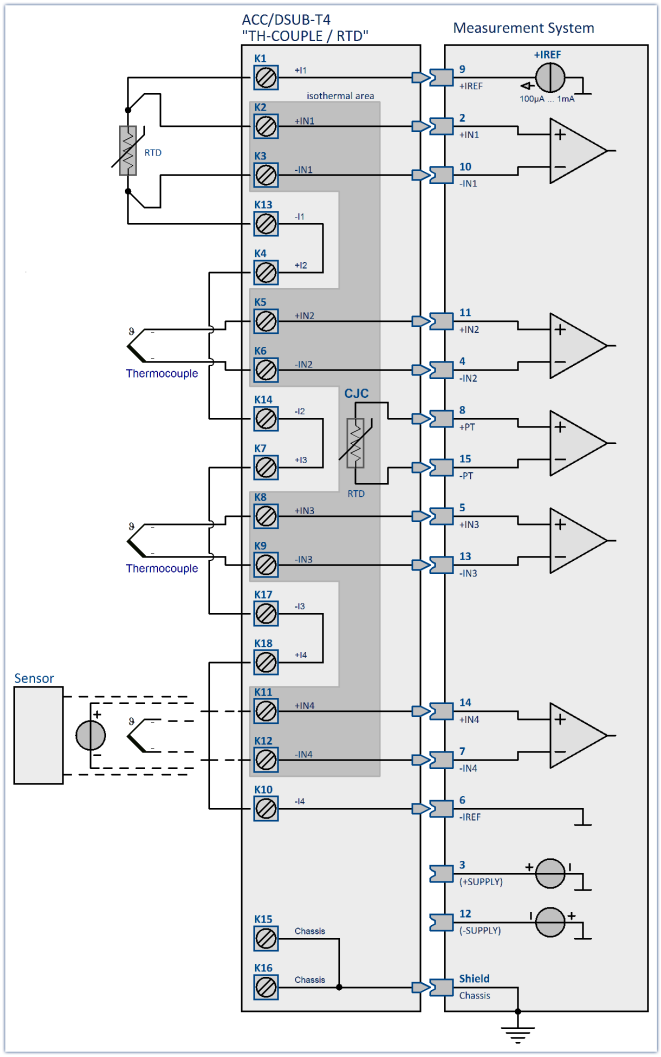
The difficulty with thermocouple measurements are the "parasitic" thermocouples which inevitably form where parts of the contacts made of different materials meet. The temperature sensor measures the temperature at the connection terminal and compensates the corresponding "error"-voltage. Normally, the 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.

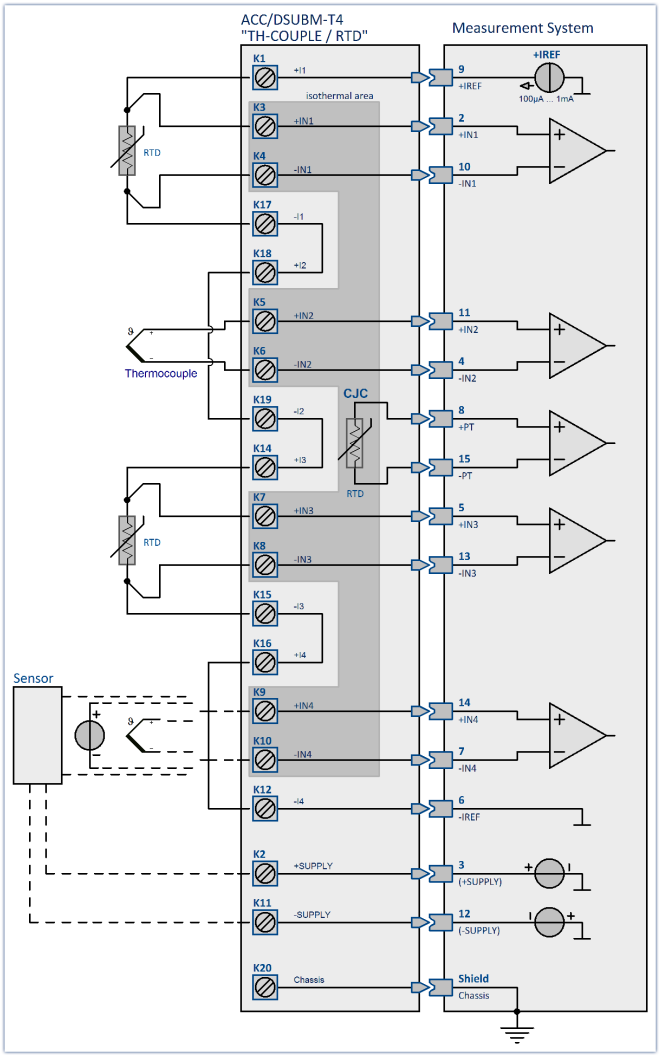
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8.1.1.3.1 Schematic: T4 plug

Plastic plug (ACC/DSUB-T4, discontinued)



Metal plug (ACC/DSUBM-T4)



8.1.2 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

8.1.3 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 on the Tab "Inputs", 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

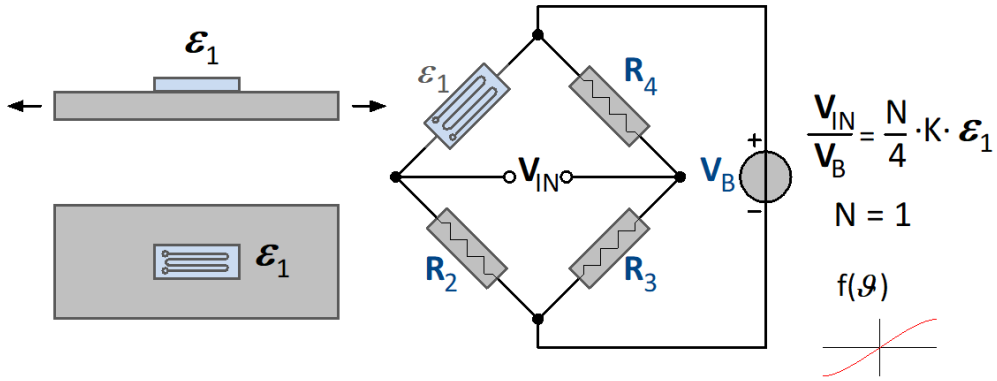
$$\varepsilon = \frac{V_a \cdot 4}{V_e \cdot k}$$

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 Tab "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 beneath.

Note

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

8.1.3.1 Quarter bridge for 120 Ohm strain gauge



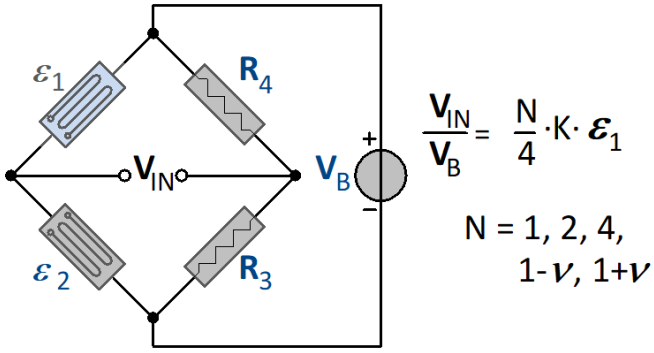
This strain gauge arrangement uses an **active** strain gauge which is positioned on the test object in a uniaxial stress field. This strain gauge is joined by three passive resistors within the module to form a full bridge. The strain gauge can have a resistance value of 120 Ω.

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

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

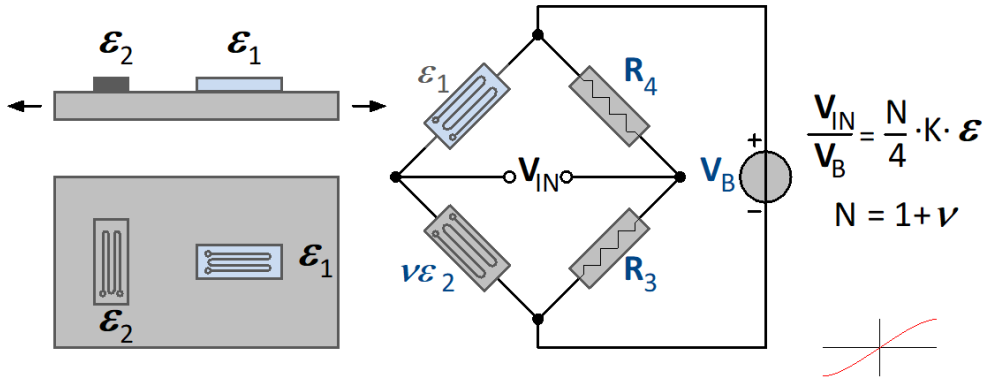
Legend:	
k	gauge factor

8.1.3.2 General half bridge



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

8.1.3.3 Poisson half bridge

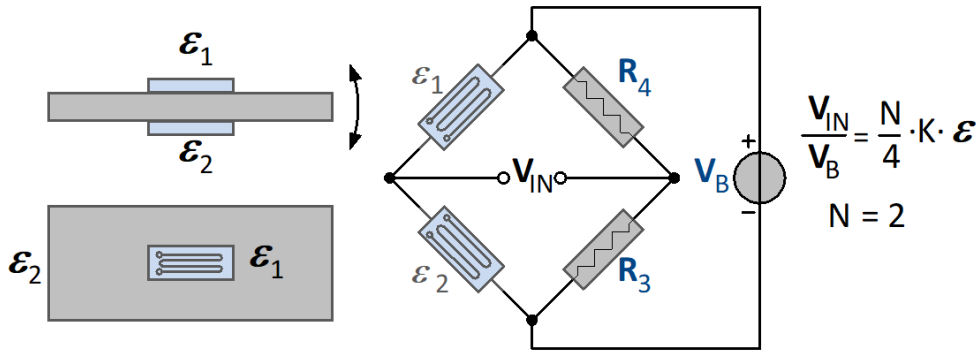


In this circuit, two active strain gauges are used. The strain gauge is positioned transverse to the main direction of strain. The transversal contraction is exploited. For this reason, the Poisson's ratio for the material, which is its transversal expansion coefficient, must be supplied along with the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

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

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

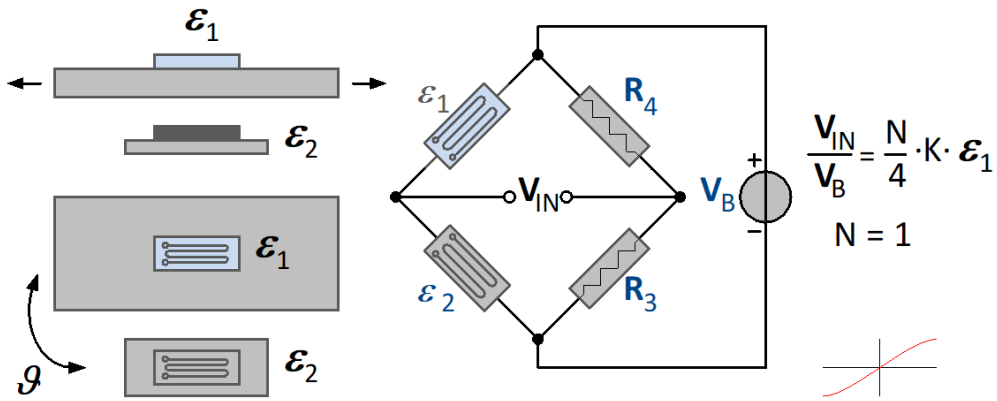
8.1.3.4 Half bridge with two active strain gauges in uniaxial direction



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:

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

8.1.3.5 Half bridges with one active and one passive strain gauge

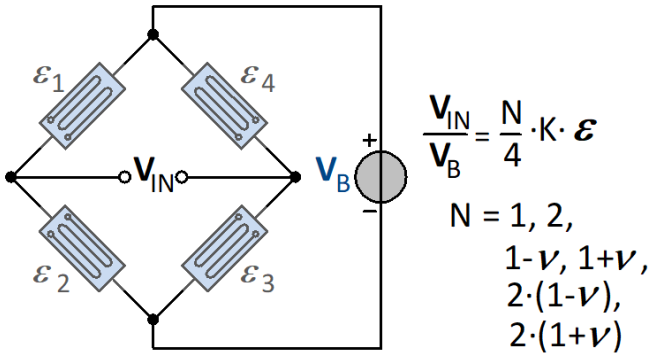


This circuit involves strain gauges. The first one is positioned on the test object, the second on a sample of the same material under the same ambient temperature and serves the purpose of temperature compensation. The strain is computed as:

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

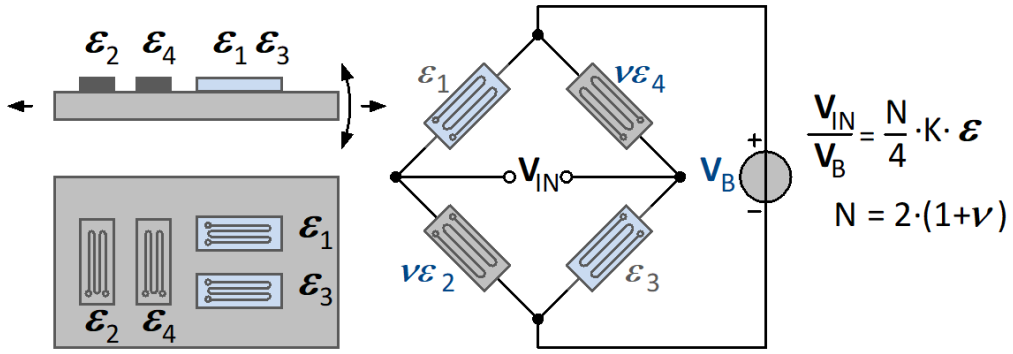
Legend:	
k	gauge factor

8.1.3.6 General Full bridge



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

8.1.3.7 Full bridge with Poisson strain gauges in opposed branches

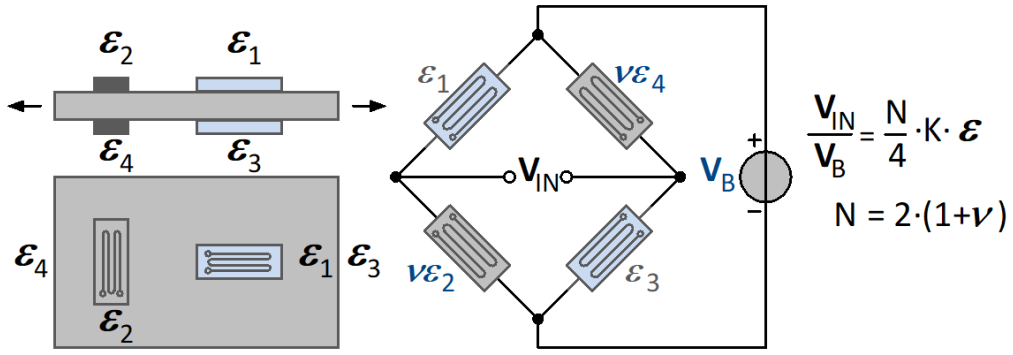


Two active strain gauges are positioned along the longitudinal strain and are joined by two transversally positioned strain gauges to complete the bridge (torsion bar arrangement). In the bridge, the longitudinal strain gauges are located in opposite branches. This circuit provides better exploitation 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:

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

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

8.1.3.8 Full bridge with Poisson strain gauges in adjacent branches

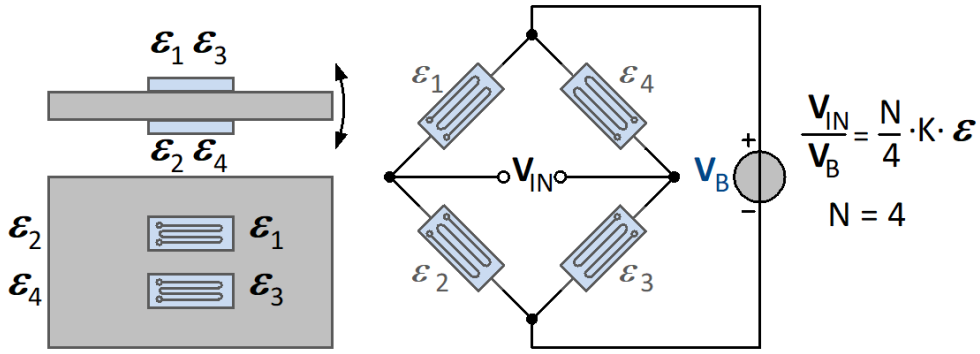


Full bridge with 4 active strain gauges. 2 active strain gauges complemented by 2 transverse Poisson strain gauges. They are located in opposed bridge arms. Higher exploitation of transverse contraction longitudinal expansion while providing good temperature compensation.

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

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

8.1.3.9 Full bridge with 4 active strain gauges in uniaxial direction

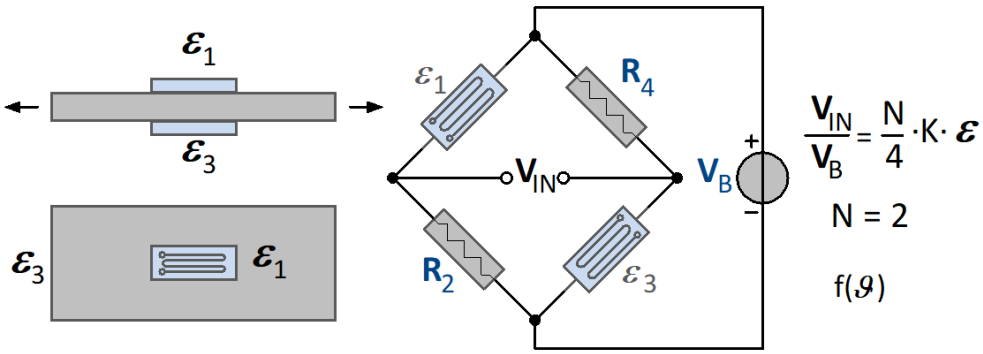


The circuit consists of 4 active strain gauges. Two are under compression and the others under equal tension. The strain gauges under tension are positioned in opposite bridge arms. The sensitivity to the moment of bending is increased. At the same time, longitudinal force, torque and temperature are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

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

Legend:	
k	gauge factor

8.1.3.10 Full bridge (Half bridge-shear strain) with two active strain gauges



Two active strain gauges are placed under stress in equal magnitude. For measurement of tension and compression (non-linear) to eliminate bending. Temperature gradient should be small. The strain is computed as:

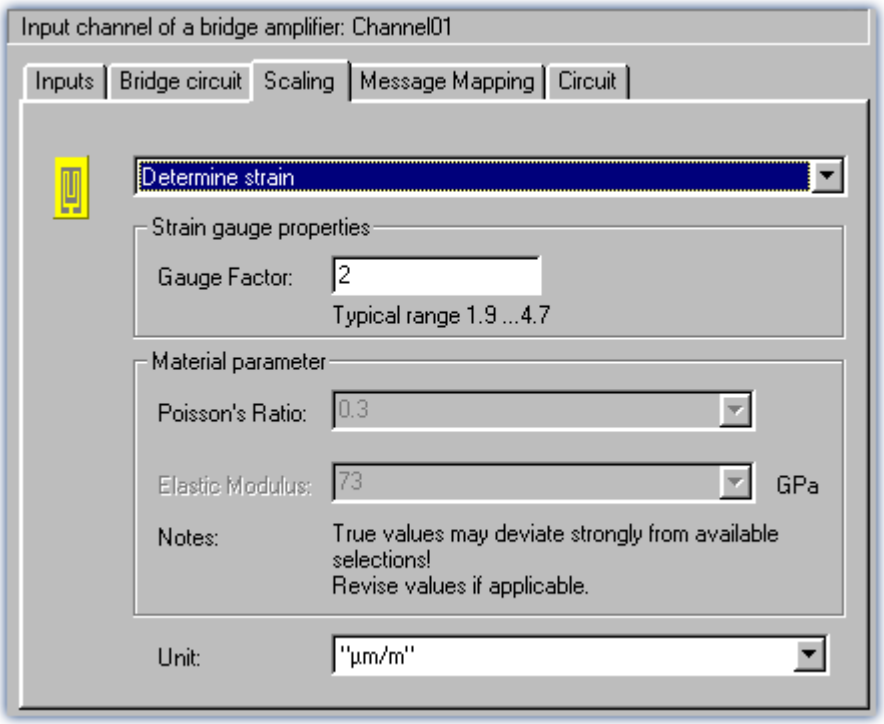
$$\varepsilon\left[\frac{\mu m}{m}\right] = \frac{4 \cdot 1000}{2 \cdot k} \cdot \frac{V_a}{V_e}\left[\frac{mV}{V}\right]$$

Legend:	
k	gauge factor

8.1.3.11 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.

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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.

8.1.4 Bridge balancing

A significant characteristic of bridge measurements is the fact that the actual measurement signal is attended by an offset which can be **multiples of the input range**. Measurement bridges, consisting for instance of wire strain gauges , respond to minuscule changes in their components' resistance (in the mV/V = ppm = parts-per-million = 1E-6 range). The static initial asymmetry (offset) due to production tolerances or assemble conditions of the components, by comparison, can be in the range of mV/V, in other words in the range of the total input range or even multiples of it.

Since the offset also depends on the sensor connected it can't be calibrated for the device but must be balanced "**online", before starting the measurement**. The precondition for this is that the sensor used must be set up in the system the same way for the balancing as for the measurement and may **not be stimulated dynamically.**

8.1.5 Incremental Counters Channels

The incremental counter channels of CANSAS-INC4, CANSAS*fit*-ENC-6 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 10 ns (100 MHz); which is far beyond the abilities of **sampling procedures** (under comparable conditions). The *sampling rate* which the user must set is actually the rate at which the system evaluates the results of the digital counter or the values of the quantities derived from the counters.

8.1.5.1 Signals and conditioning

8.1.5.1.1 Mode

The various modes comprise the following measurement types:

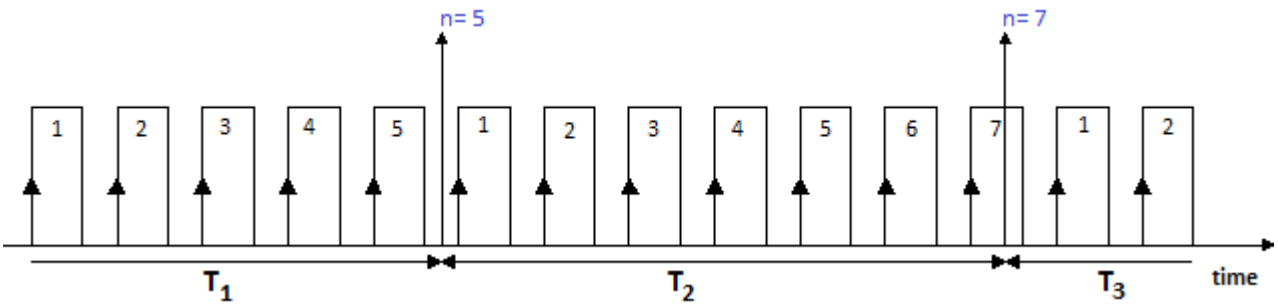
Event-counting	Time	Combined measurements
• events	• time	• frequency
• distance(differential)	• pulse time	• speed
• angle (differential)	• PWM	• RPM
• angle (sum)		
• angle (abs 0-360°)		
• distance (sum)		

Event-Counting

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

- events 201
- distance(differential) 201
- angle (differential) 201
- distance (abs.) 201
- angle (abs.) 201

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**.

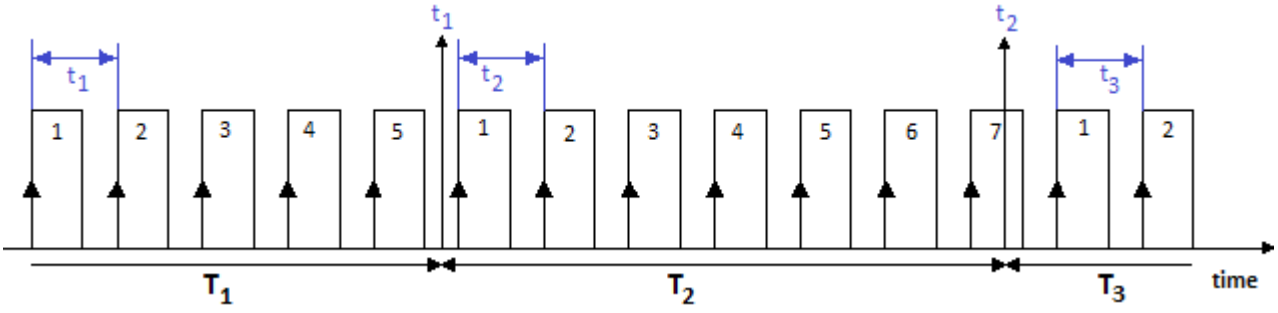


Time Measurements

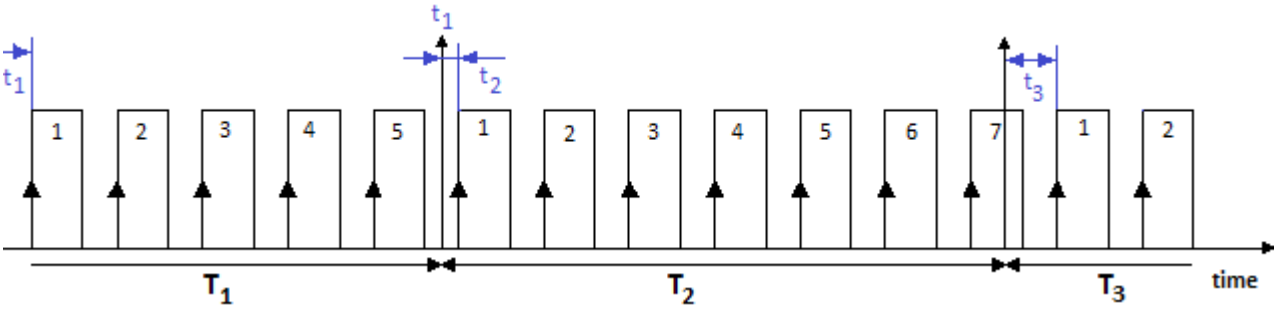
Exclusive measurement of **time** is performed as:

- time 202 (of two successive signal edges)
- pulse time 203 (time from the beginning of one sampling interval until the next signal edge)
- PWM 204

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



time

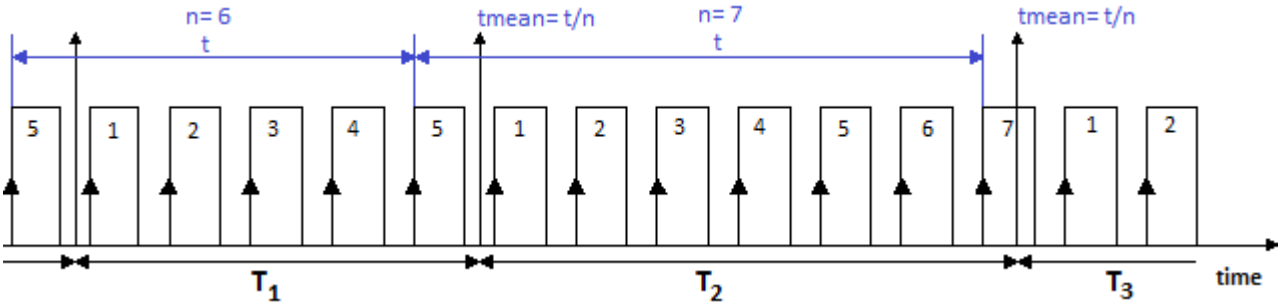


pulse time

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 205
- speed 205
- RPM 205



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 199
- Start of measurement with or without "Zero impulse" 199
- Number of pulses (per unit)

The frequency resolution of the measurement results depends on the input range selected.

Example CANSAS-INC4:

Input ranges and the corresponding frequency resolutions					
Index	**Input range**	**Frequency resolution**	**Index**	**Input range**	**Frequency resolution**
1	450 kHz	15,2588 Hz	8	3 kHz	119,2 mHz
2	200 kHz	7,6294 Hz	9	1,5 kHz	59,6 mHz
3	100 kHz	3,8417 Hz	10	750 Hz	29,8 mHz
4	50 kHz	1,907 Hz	11	450 Hz	14,9 mHz
5	25 kHz	0,9537 Hz	12	200 Hz	7,45 mHz
6	12,5 kHz	0,4768 Hz	13	100 Hz	3,73 mHz
7	7 kHz	0,2384 Hz	14	50 Hz	1,86 mHz

The scaling on the CAN bus is obtained by this formula:

Resolution = Clock / 2^{20+i}

i= index in the table above

Clock = 32.000.000 Hz

The formula comes from the oscillator and the integer calculation performed.

The resolution is the frequency resolution you see in the CAN bus message.

From the resolution you calculate: True Range = 32767 * Resolution.

Watch out: with i=1 you get a range > 450 kHz. That exceeds the limits of the comparator. So you can never go safely above 450 kHz!!

Example Example imc CANSAS INC4

Let Nominal (rounded) range = 200 Hz, thus i=12

Resolution = 32000000 / 2^{32} = 0.00745 Hz

True Range = 32767 * 0.00745 = 244.13 Hz

It will be OK to use true ranges instead of rounded ranges, if you figure out the range required for you measurement task.

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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 Encoders which indicates the zero position by a missing cog generate signal dips that are avoided by means of the measurement mode Missing tooth 200.
Velocity	Input range = ([Frequency input range in Hz] / [Encoder pulses per m]) in m/s Resolution = ([Frequency resolution in Hz] / [Encoder pulses per m]) in m/s

The number of encoder pulses must be between 1 and 999999.

The input range selected states the **input range end value**. The **highest frequency/RPM-value/velocity contained in the measured signal may not exceed this end value.** The **sampling interval** can take discrete values between 1 ms and 1 min and states the rate at which result values are returned.

Behavior in response to missing signal pulses

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

Note

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

8.1.5.1.2 Measurement procedures

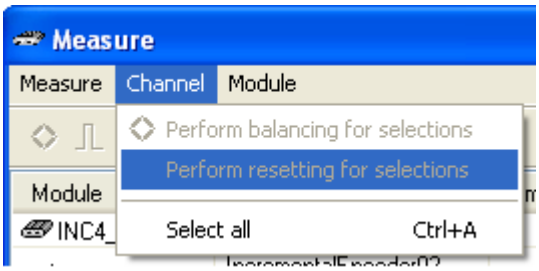
Measurement procedures	Description
Differential measurement procedures	The quantities derived from *event-counting*, **Events, Distance** and **Angle** denoted by the annotation **(diff.)** are "differential" measurements. The quantity measured is the respective change of displacement or angle within 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*, **Events, Distance** and **Angle** appearing with the annotation **(sum)** are "**cumulative**" measurements. In cumulative measurements, the return value is the **sum** of all displacement or angle changes, or of all event which occurred.With CANSAS INC4 (ENC6 in preparation) the value can be reset via a CAN message.

8.1.5.1.2.1 Resetting of summation with INC4

With the measurement modes involving summation (events, angle and displacement), it is possible to reset the sum to zero during a running measurement. This can be accomplished in either of two ways:

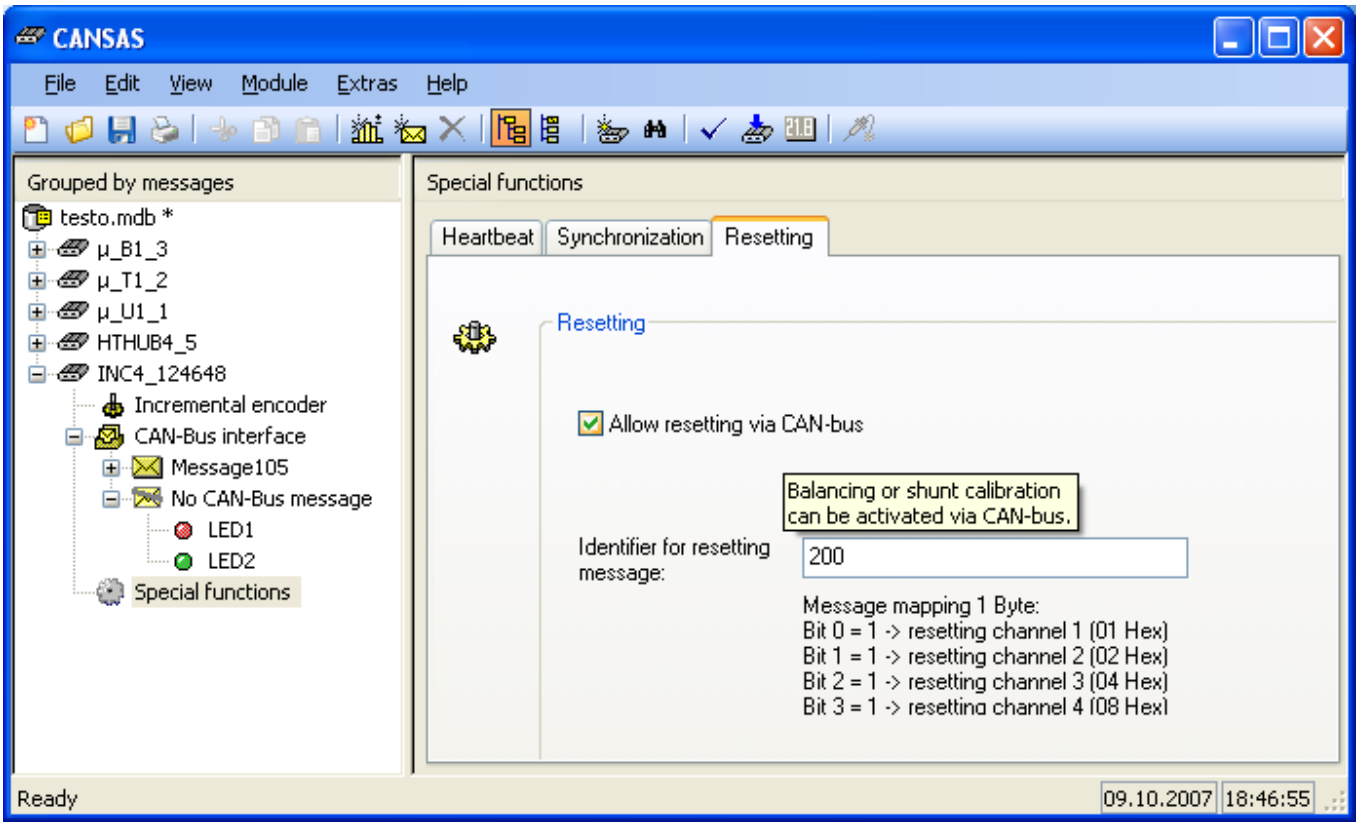
- *Measure dialog*: The reset command from the channel menu is used to manually reset all selected incremental counter channels.
- *Special Functions node*: On the Resetting page, it is possible to enable separate resetting of each channel by means of a CAN-Bus message.

Manual resetting by means of Measure dialog



Manual resetting of summation by means of Measure dialog

Resetting the summation by means of a CAN-bus message



Example INC4 Special functions: Resetting of summation

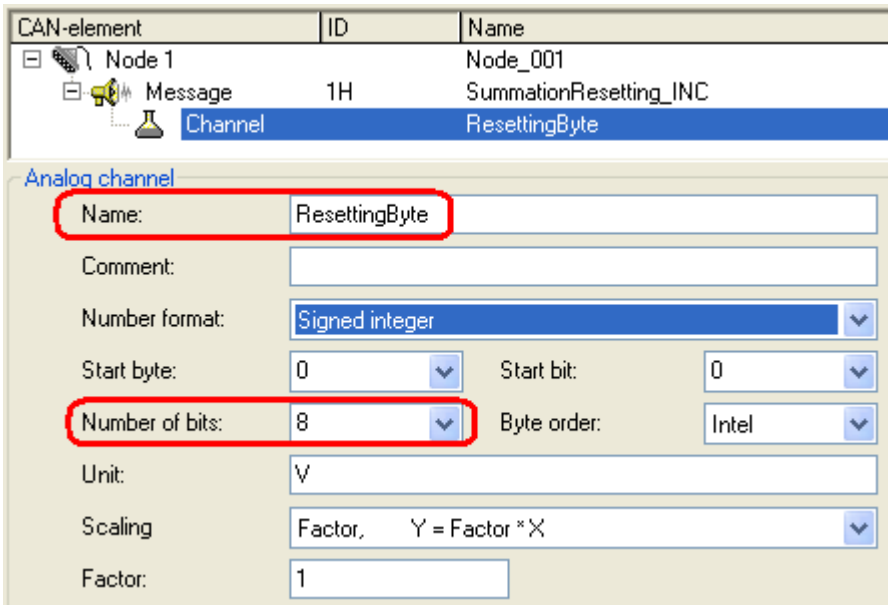
This dialog enables resetting of the summations of individual incremental counter channels.

The message identifier is set for all channels jointly. The respective channel is determined on the basis of the bit in the sent message's data byte.

Example:

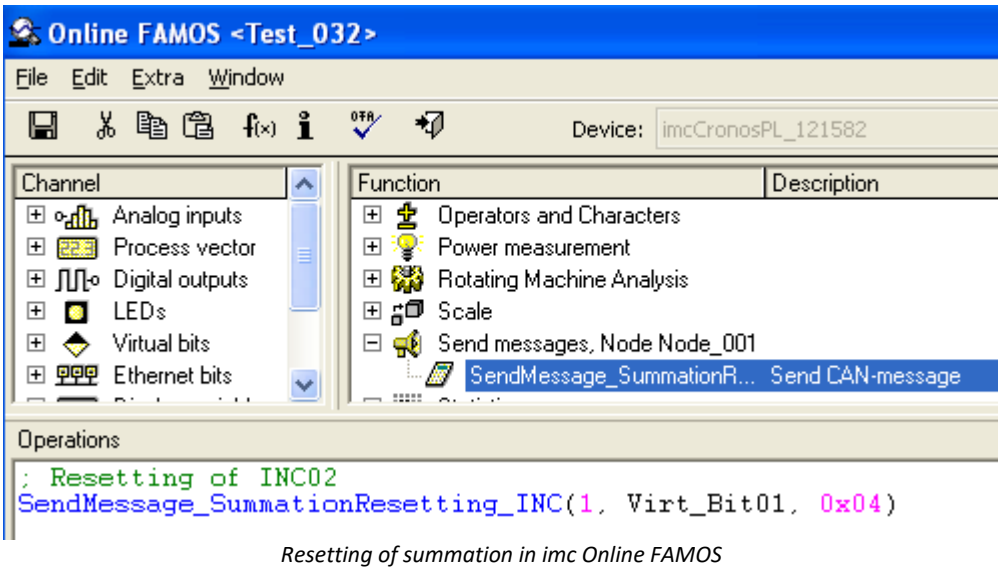
Identifier for reset-message = 200, Channel 2 is to be reset.

1. Create the message to be sent in the CAN-Assistant. A message having one data byte is required. Give a distinct name to this message. Then assign a channel to it. Since only one data byte is available, this channel's length can not exceed 8 bits. All other settings play no role at this point.



Resetting of summation in the CAN-Assistant

2. imc Online FAMOS (imc STUDIO) sends a message if the virtual bit Bit01 is set. In this message, the value 0x04H is set to INC4 and resets the value of the incremental counter channel 02.



Resetting of summation in imc Online FAMOS

8.1.5.1.3 Scaling

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

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

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

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

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

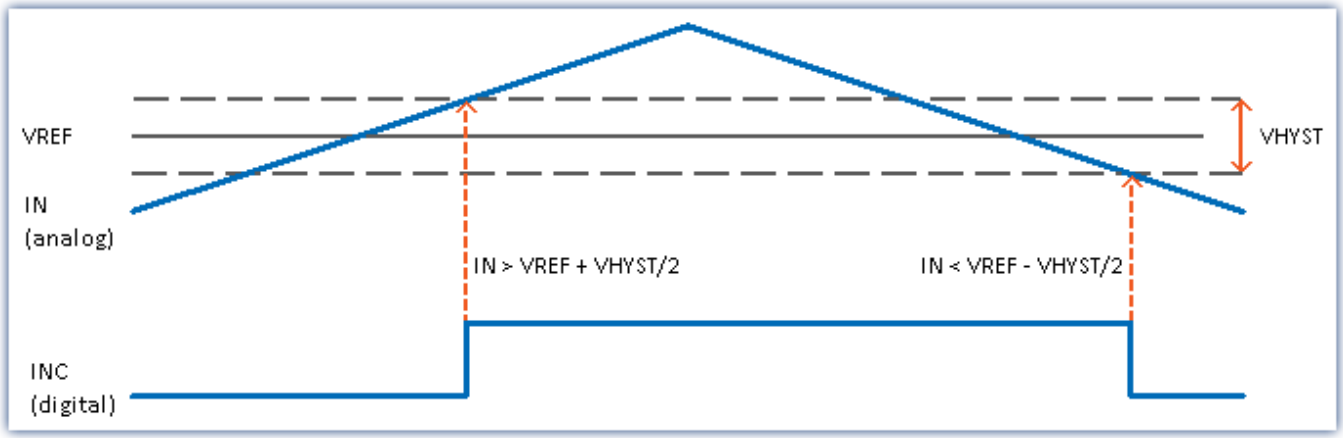
8.1.5.1.4 Comparator conditioning

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** 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.

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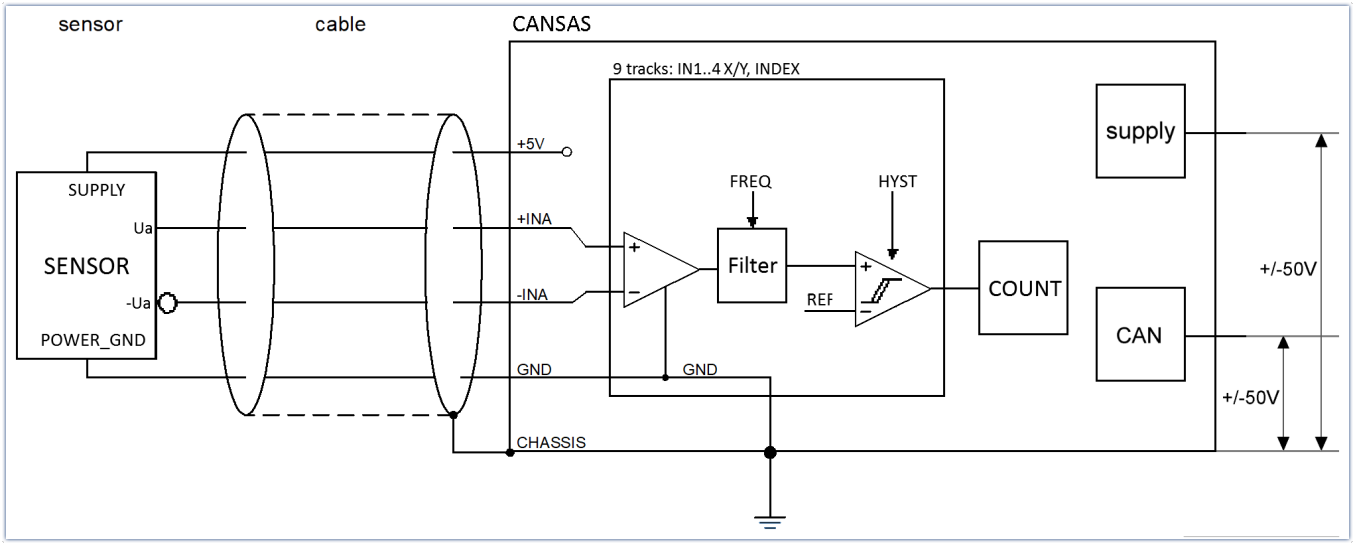


The *digital signal* changes from **0 to 1** when the *analog signal* exceeds the **VREF + VHYST/2** threshold.

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.

8.1.5.1.5 Block diagram



Note

- It is not sufficient to connect a differential voltage between +INX and -INX. The operational amplifier only works correctly if its reference ground (GND) is not floating but is grounded.
- A reference ground must be established in the measurement chain. There are various techniques as well as considerations. In some arrangements, grounding the sensor is preferred, in others grounding the measurement system (imc CANSAS chassis). Either way, ground loops must be avoided.
- Grounding is also recommended as a way of avoiding the buildup of high or dangerous potential differences between exposed conducting parts (such as the chassis) and ground.
- If the sensor does not make Power_Gnd and -Ua separately accessible, then they must be considered connected at the sensor. In that case that is simply the ground connection.

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8.1.5.1.6 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. A measurement with dual-track encoder is selected in the combobox "*Measurement mode*" together with the desired operation type.

8.1.5.1.7 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 activation of the imc CANSAS module.

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.

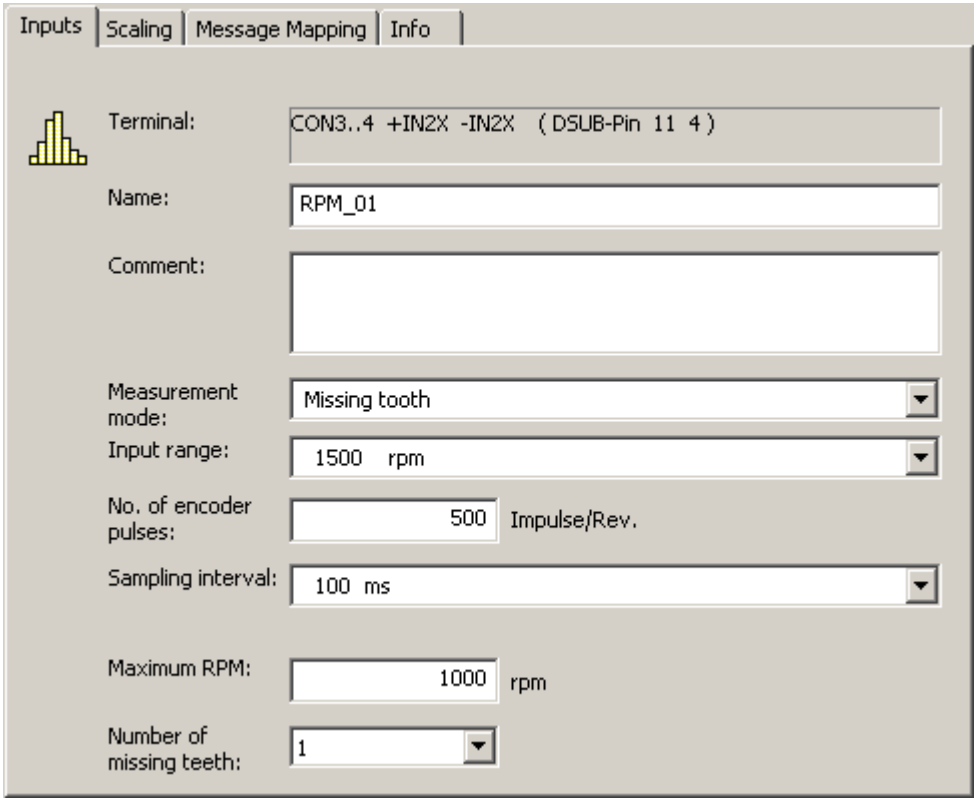
Note

- If the option "*Encoder with zero pulses*" is used and this is left out, the encoder module does not start the measurement at all! In that case, the channels only return zero.
- **The system only takes the zero pulse into account following configuration or after starting up the imc CANSAS module. Restarting the measurement does not cause a reset.**
- Depending on the particular CANSAS module, the index channel can pertain to multiple channels. With the INC4, there is one index channel for all four channels; with the ENC6, there are two index channels for a channel group having up to three channels.

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8.1.5.1.8 Missing tooth

RPM ***Missing tooth***



Example: CANSAS-INC4

This mode is suited to incremental counters which have one or two missing teeth per revolution for the purpose of angle recognition. The sensor then returns instead of 60 pulses/rev only 58. Such a sensor connected to the incremental counter input indicates messy dips in the rotation speed if the missing cogs do not return any pulse. This is avoided by means of the *Missing tooth* measurement mode, since this mode detects the missing cogs and interpolates around the apparent dip.

Note

For CANSAS-INC4, the following limitation applies: When the measurement mode Missing tooth is set for a channel, then the only measurement mode options left for all other channels are: Velocity, Frequency, RPMs.

8.1.5.2 Mode (events-counting)

Mode - Events	Description
Events	The event counter counts the sensor pulses which occur during a single time interval (differential event counting) or the sum of all events (cumulative 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 199 • Start of measurement with or without "Zero impulse" 199 • Number of pulses (per unit) The number of pulses may be between 1 and 999999. To obtain the greatest accuracy for imc CANSAS-INC4 measurement results over a wide dynamic range, it is recommended to select an appropriate **input range** for the task. Note that the input range can be expressed in terms of a different physical quantity than the measurement quantity. For instance, for event counting the input range is expressed as a frequency. The input range selected states the **input range end value**. The **highest frequency contained in the measured signal may not exceed this end value**. If this maximum frequency is exceeded during measurement, the system returns the input range end value at the points where the signal is out of bounds. The input ranges depend on the sampling interval selected and under some circumstances on the number of encoder pulses.

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.

8.1.5.3 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:

	Start measurement upon	Input	Stop measurement upon	Input
1.	positive edge	X-track	positive edge	X- track
2.	positive edge	X- track	negative edge	X- track
3,	negative edge	X- track	positive edge	X- track
4.	negative edge	X- track	negative edge	X- track
5.	positive edge	X- track	positive edge	Y- track
6.	positive edge	X- track	negative edge	Y- track

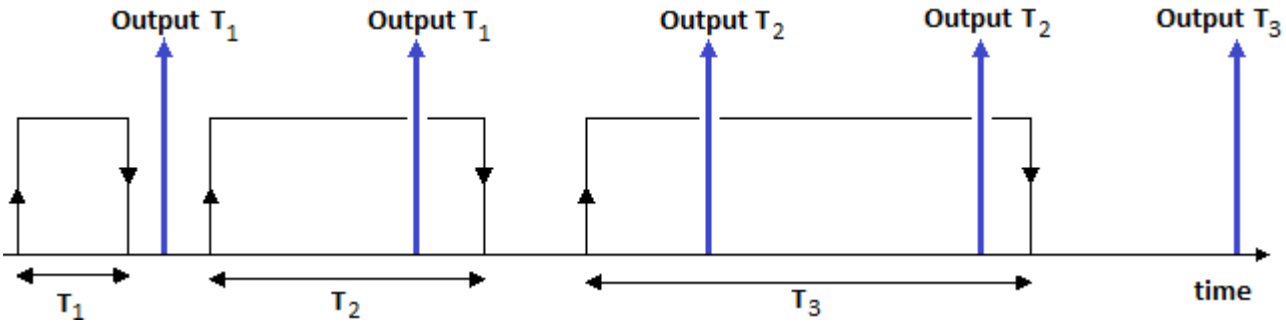
To ensure a high time resolution for the measurement results, suitable scaling must be set for the measurement. An **input range (INC4)** or **Max. time (s) (ENC-6)** specifies the maximum time interval which can be measured between the selected starting and stopping edge. **The time between the signal 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.

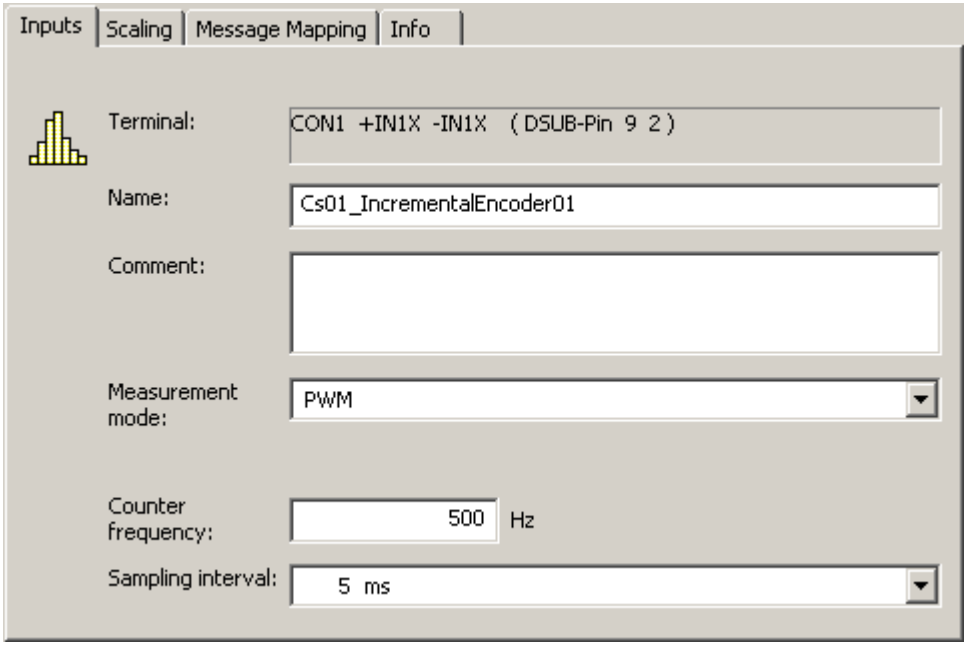
The measurement variable ***Pulse Time*** refers to phase-based data which is only relevant to special applications (particularly order-tracking analysis). It is required for subsequent online calculations. It represents the time between the last detected (asynchronous) pulse and the (synchronous) sampling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

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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).

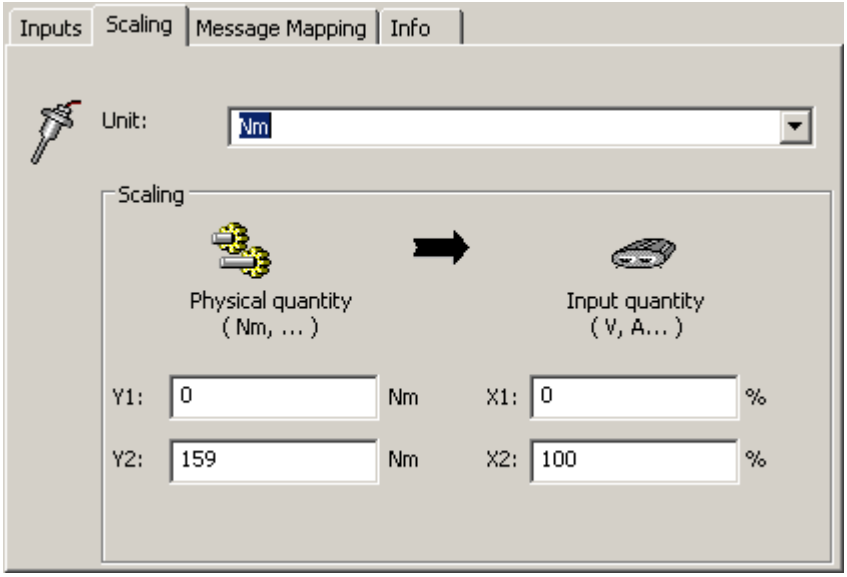
A good illustration of this modulation type would be a switch used to continually switch a heater on and off. The higher the ratio of the on-time to the off-time, the higher the average heating power is.



PWM settings dialog

Give the PWM emitter a fixed frequency. As part of PWM measurement, a time measurement is carried out. In every sampling interval, the duration from the first increasing slope to the next decreasing slope is determined. This pulse duration is compared to the period duration, resulting in a value between 0 and 100%.

On the Scaling page, you set how the percent value is interpreted:



PWM: Scaling dialog

Example:

Counter frequency: 500 Hz , sampling interval: 5 ms, 100% corresponds to 159Nm
At a pulse duration of 250µs, the following values result:
250µs *5001/s*100%= 12,5%
Indicated value = 12,5% x 159Nm/100%= 19,86Nm
The result is updated every 5 ms.

Note

- Correct indication of the **counter frequency** is absolutely necessary for this procedure.
- There is exactly **one pulse time** measurement **per sampling interval**. Change of the pulse times within one sampling interval, called jitter, is not recognized. If you record the data with an imc device, you can smooth the signal, averaging out the jitter by selecting the imc CANSAS channel's sampling rate to be as close as possible to the counter frequency. Then use imc Online FAMOS to smooth out the data stream.
- For a precise measurement, the **threshold value of the comparator must be adjusted**.
  Background: The duty cycle is determined by the time measurement between rising and falling edge. Since the input signal is not ideally rectangular, the time measurement is influenced by the threshold value of the comparator. The standard setting of the comparator of 1.5 V may lead to an offset in the PWM signal. See also comparator settings ENC-6 260, INC4 333.
- If the sampling interval is set to be faster than the counter frequency, the most recent result is outputted repeatedly.

8.1.5.4 Mode (combined measurement)

Mode	Beschreibung
Frequency	Frequency is determined by means of a combination measurement 192. 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 192. 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 192. Toward this end, the number of pulses per revolution must be entered.

8.1.6 Digital Inputs

The switching thresholds can be toggled between TTL and 24 V range.

The switching thresholds are:

	TTL- range	24 V range
Lower threshold	0.8 V	5.0 V
Upper threshold	2.0 V	8.0 V

8.1.7 Digital Outputs (CANSAS-DO8R, -DO16, -DO16R)

These modules are for digital output. The imc CANSAS-DO16R module has 16 digital outputs, which are switched using relais. DO16 (without "R") serves the same purpose with open collector outputs. The imc CANSAS-DO8R module has 8 relay switches. The output signals can be set by a CAN-message or by a calculation. The output's state upon module power-up is defined.

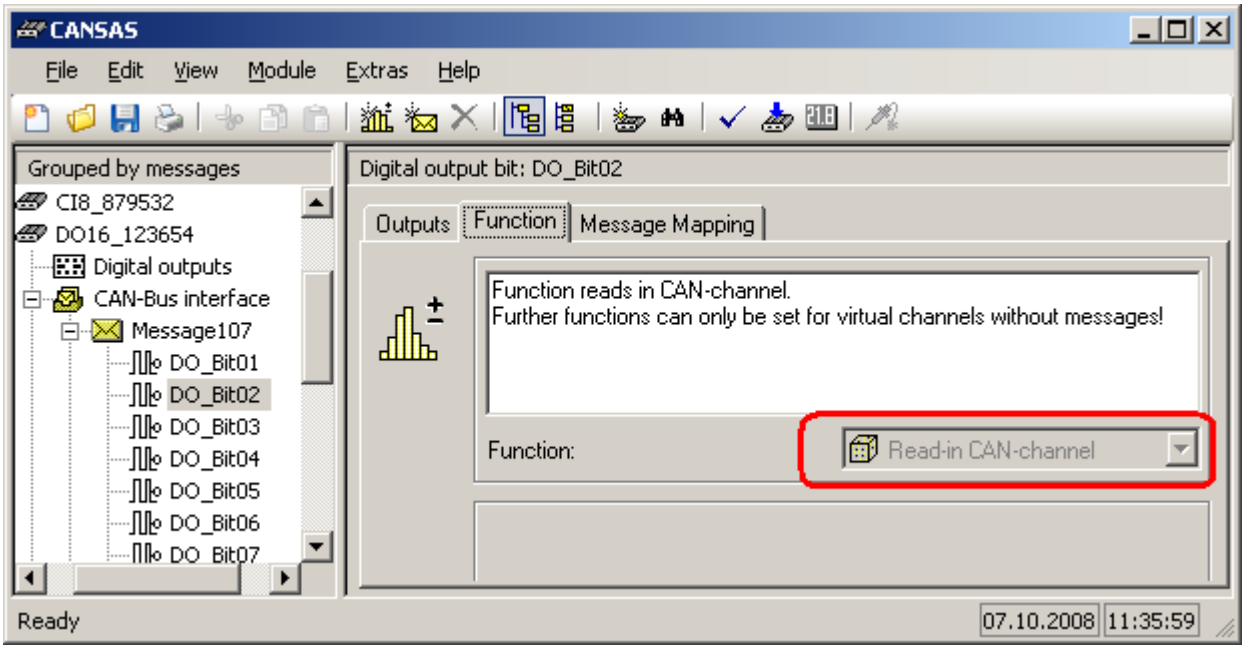
8.1.7.1 Outputs

All the outputs have switching times. For the module DO8R they can be up to 4 ms, for DO16 under 0,1 ms. In both cases the switching time is different for switching the output on or off.

In DO16R, each terminal's 8 outputs have a shared reference ground and are thus not isolated from each other. They are isolated from the 8 outputs of the other terminal, chassis, power supply and the CAN bus.

8.1.7.2 Connecting an output signal with a CAN-message

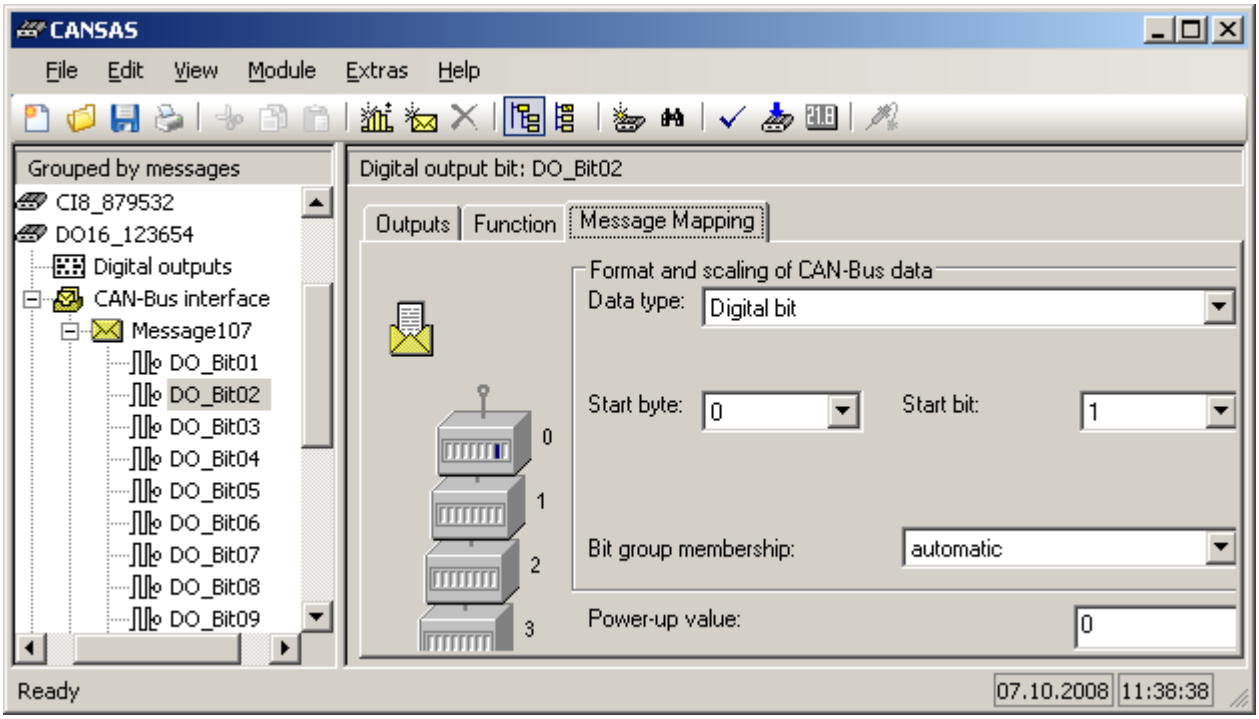
If a certain output bit is to be set by a CAN-message, that output bit must be positioned in a message. The output bit's module tree entry can be positioned as desired by drag&drop in the module tree at any position in the message or under "No CAN bus message". Note that the tree must be grouped by message for this to work (see View menu, item "Grouped by" 90). Then the output bit function **Read-in CAN-channel** is unalterably active.



output bit DO_Bit02 is in CAN-message Message01. **The function is always set to"Read-in CAN-channel".**

On the index card ***Message mapping***, the data type, start byte and start bit can be specified. It makes sense to select digital bit as the data type for the digital output signal. The settings for the starting byte and starting bit specify which bit in the message determines the output signal value.

In the lower portion of the card, the output signal's state upon activation of the module can be specified.

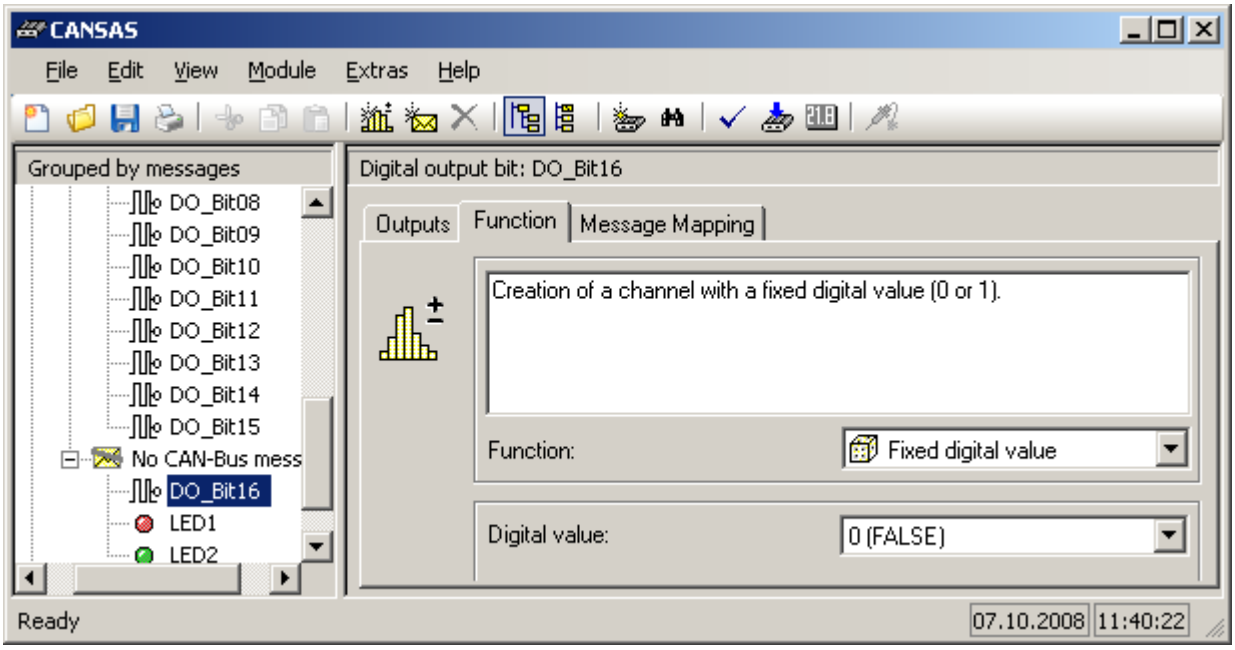


Message mapping dialog for a digital output bit

8.1.7.3 Calculated output signals

If the output signal is not assigned to any CAN-message (the corresponding entry in the module tree is entitled "No CAN bus message"), the signal value can be set according to a calculation. For this purpose, there are functions which can also be used for virtual channels (see chapter on virtual channels 74). If a digital bit is removed from a CAN-message, then the function "Fixed digital value" is assigned by default. A different function can be selected by the user.

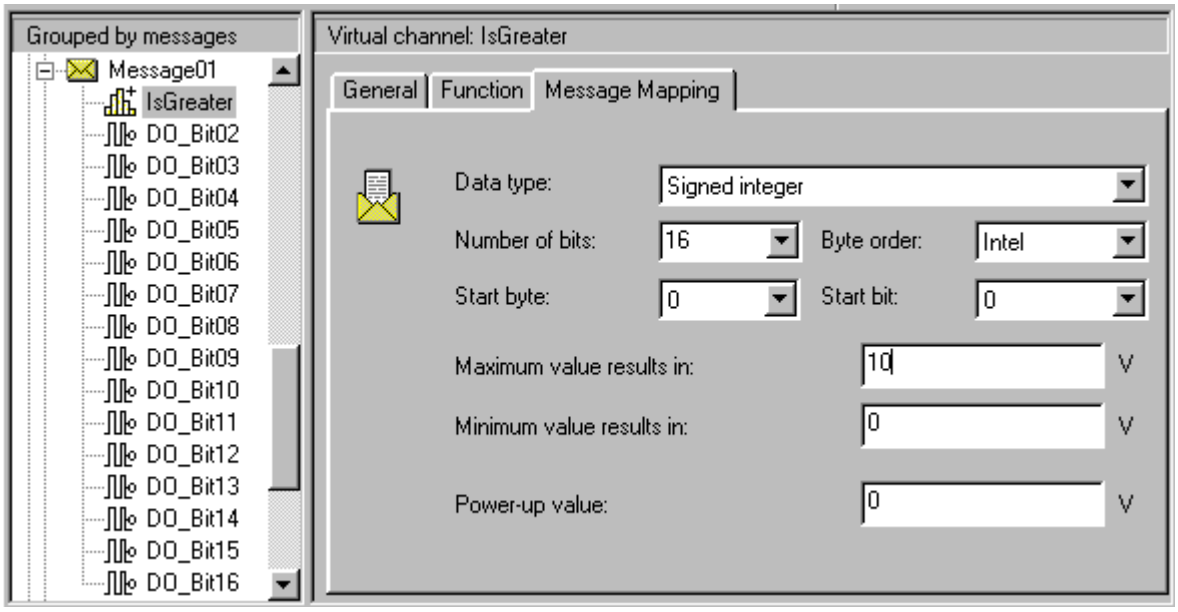
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Dialog for setting the defining function of an output signal not assigned to a message

A digital output module can also read out an analog quantity (e.g. in the form of a 16-bit integer) from the CAN bus. This quantity cannot be output in digital form, but it can be subjected to calculation. For instance, a value can be compared with a limit. The result of the comparison is a digital value (0 or 1), which can be output in digital form.

The illustration below shows as an example how the dialog for making CAN bus settings. Note that a virtual channel was created and was placed in the message. This virtual channel is called "IsGreater". It doesn't reflect the result of a calculation but simply assumes values read out of the CAN bus. This value can be used by other calculational functions. Therefore, the virtual channel could just as well be named "Channel with data from the CAN bus".

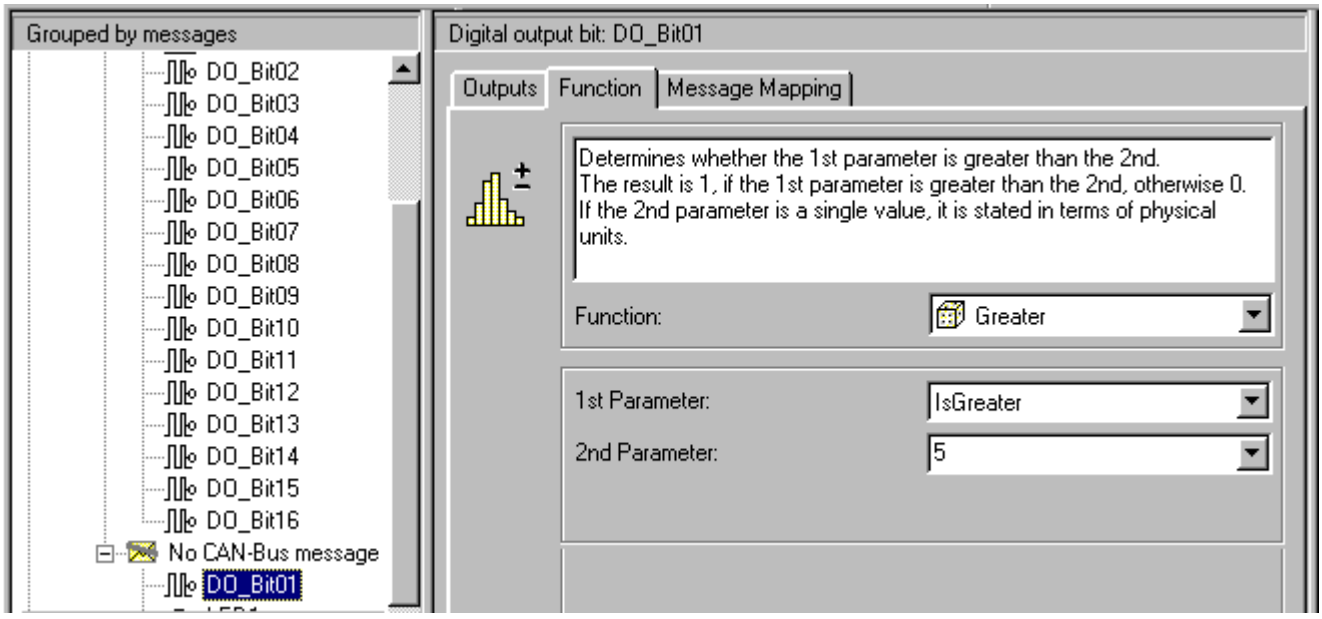


In this example, a 16-bit input quantity, scaled to take values from 0 V to 10 V, is read into the CAN bus. The unit indicated is permanently set as "V", but the system doesn't take it into account. Therefore it wouldn't matter if an RPM-value were read in which is scaled from 0 to 6000RPM and not 6000 V.

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The value which is valid when the unit is activated, the "Power-up value", is set to 0 V. This means that the virtual channel carries the value 0 V as long as no CAN bus message arrives. While this is the case, the system calculates with the value 0 V and sets the digital value which corresponds to that voltage. When a message finally arrives, the value transmitted replaces the virtual channel's last valid value. The calculational functions then are applied to this new value and a digital value is set to correspond to the new calculation result. The virtual channel's new output value remains valid until a new value arrives from the CAN bus.

The illustration below shows how the system performs a calculation with the channel. A digital output bit "DO_Bit01" appears under "No CAN bus message" in the module tree. This indicates that this bit is not under the direct control of any CAN bus message, but instead depends on a calculation. Therefore, a calculational function can be selected for this output bit. In this case, the function "Greater" is selected, and it evaluates the channel "IsGreater" as its input.



8.1.7.4 Notes on DO8R and DO16R

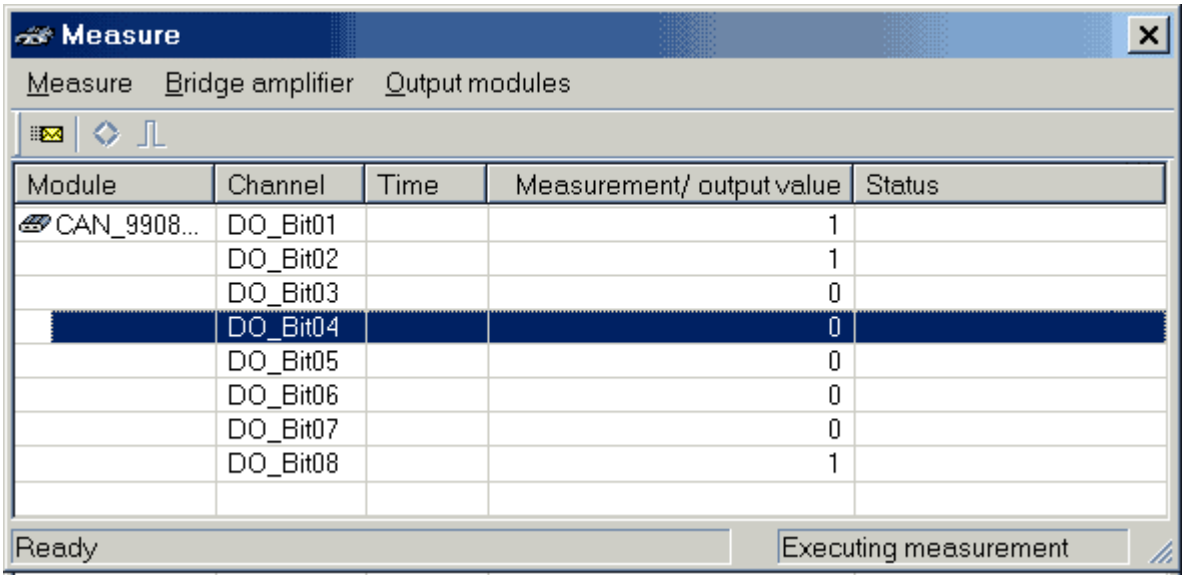
The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.

It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material.

8.1.7.5 Taking measurements with the digital output modules

In the dialog **Measure**, the digital output bits of a DO16R or DO8R module are listed only if they are assigned to a CAN-message. In such cases, the entry for the **Measurement/ output value** represents the signal's output value. Upon the start of the measurement, the **Power-up value** is displayed. The output signal can be influenced by editing the values in the column **Measurement/ output value**. Double-clicking in these cells, the editing mode is activated, and the value for the digital bits can be toggled between 0 and 1. When the ENTER-key is then pressed, the value is checked, accepted and sent to the module.

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Measure" dialog with DO8R or DO 16 modules"

For output modules, the items **Transfer all values** and **Transfer value after editing** under the Output modules menu are available.

Transfer value after editing

This function can be toggled on and off. If it is active, then any editing performed on the entry is immediately sent to the module. If the function is off, the new value becomes valid but is not transferred. This way, it is possible to set multiple bits and then transfer them as a unit by using the function Transfer all values.

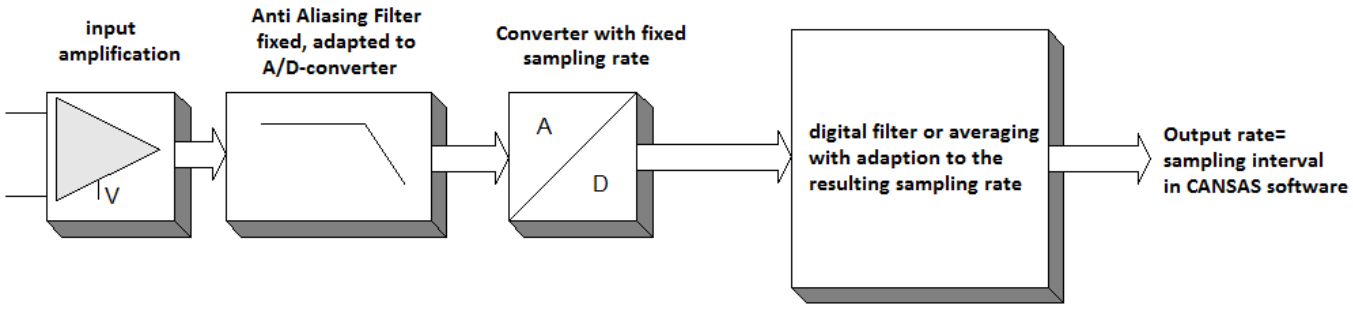
Transfer all values

This function transfers the output values of all output modules shown in the window to the modules.

8.2 Sampling interval, output rate and filter

In the module settings, along with the term "sampling rate", the term "output rate" is also mentioned. The technical background of this is as follows:

CANSAS has a fixed input-side sampling rate of (mainly) 1 kHz. This data stream is subsequently resampled at the "*sampling interval*" set by the user. In order to prevent aliasing, values can be either filtered with an appropriate low pass, or averaged. The averaging interval is then the sampling interval set by the user.



Sampling interval set in the dialog = the module's output rate

Example

User-set *sampling interval* (= output rate): 100 ms
On the input side, the CANSAS module converts the values at 1 ms
The filter is set to *Mean value*

Averaging over 100 values (100 ms/1 ms) is performed, which generates the resulting measurement values at a 100 ms clock rate.

8.3 Sampling rates and SCx-modules (Scanner concept)

The following is a discussion of data acquisition with multiplexers and the limitations associated with it. This will include a contrast of conventional scanners to systems working in the so-called Burst mode (e.g. SCI8, SC16).

Conventional scanner systems work at a fixed sampling rate, namely the highest rate at which switching between channels takes place (***fast scanning***). If the sampling rate actually set is less than the maximum possible data rate, then an average of multiple samples taken at the high sampling rate is computed (filtering).

The maximum sampling rate is substantially determined by the scanner's transients, i.e., the switching times and the transients of pre-amps, of analog (and any digital) filters, and of ADCs.

Since the system's bandwidth must be quite high for the transients to subside within the interval corresponding to the "*aggregate sampling rate*", while on the other hand the channel-sampling rate is lower by at least the factor n=channel count, the conditions for the Sampling Theorem will necessarily be violated. Aliasing effects which cannot be filtered out will result.

This dilemma, characteristic of scanner systems, can be significantly mitigated at least in the case of a flexibly configured, low-speed measurement (e.g. of temperature). For that purpose, the rigid sampling scheme is adapted in accordance with **block-measurement** and –averaging ("**Burst-mode**"). Thus, flexible adaptation of the scanner timing enables disturbance- and aliasing-free low-speed precision measurement.

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The Burst mode is based on making optimal use of the time spent while the signal experiences its transients. Not only a single measurement of the selected channel is performed, but a block measurement over a period of time at least equally long or a multiple of the time period. By this means, the total cycle time is mostly used for data acquisition and no longer mainly by the cumulative transient time.

The block measurement is performed by a high-speed analog/digital converter (ADC) having a data rate which is a multiple of the max. aggregate sampling rate. An anti-aliasing filter adapted to this data rate ensures aliasing-free acquisition within the block. This block is then digitally filtered and becomes a data stream whose bandwidth is flawlessly limited and perfect for frequencies above the block filter's. This data stream is in turn "re-sampled" at the actually intended channel sampling rate. While it is true that this channel rate is lower than the block-averaging filter's bandwidth, and that anti-aliasing effects could theoretically occur for that reason, the conditions are vastly less extreme than with "fast-scanning": the range of possible aliasing errors is now limited to between one-half of the channel sampling rate and the block filter's cutoff frequency. This range has a frequency ratio of approx. 14 to 28 (depending on the module type), and, with the sampling rate suitably selected, it lies below the critical frequency ranges from 50 Hz on, in which the relevant interference is expected.

This procedure thus has the following ***advantages***:

- flexible configuration of low-speed precision measurements and high-speed measurements with one and the same affordable scanner system
- Optimal aliasing-free noise suppression of even 50 Hz interference in spite of a scanner amplifier's relatively high bandwidth

Note the following constraints: The block averaging time is not channel-specific. It is based on the smallest sampling time set in the system. ***All channels used***, including ones not outputted directly but rather used to calculate ***virtual channels***, are instrumental! The procedure thus provides only advantages if all channels are set to one low-speed sampling rate which determines the noise suppression properties.

Note also that systems using a multiplexer also have a time offset between channels. This is automatically corrected computationally, in fact by means of a filter having a transit time (delay) which depends on the sampling rate. This additional delay is based on the highest-speed sampling rate set for the module.

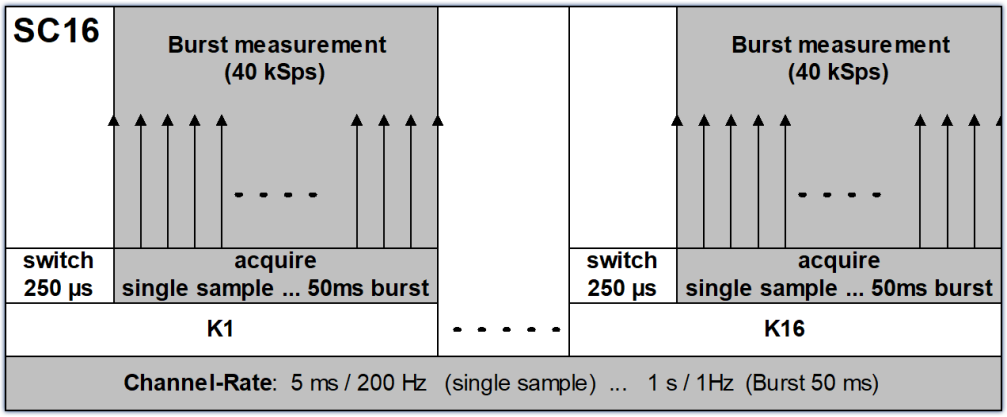
This (non-recursive) time-offset compensation filter additionally leads to a characteristic overtravel upon jumps in the signal. However, this property is independent of the Burt-mode's characteristics.

A summary of applicable **constraints**:

- The highest-speed sampling rate (of all used, including channels used to derive virtual channels) determines the averaging interval and thus the noise suppression properties of all channels.
- Additional signal transit time due to automatic time offset correction is determined by the highest sampling rate.

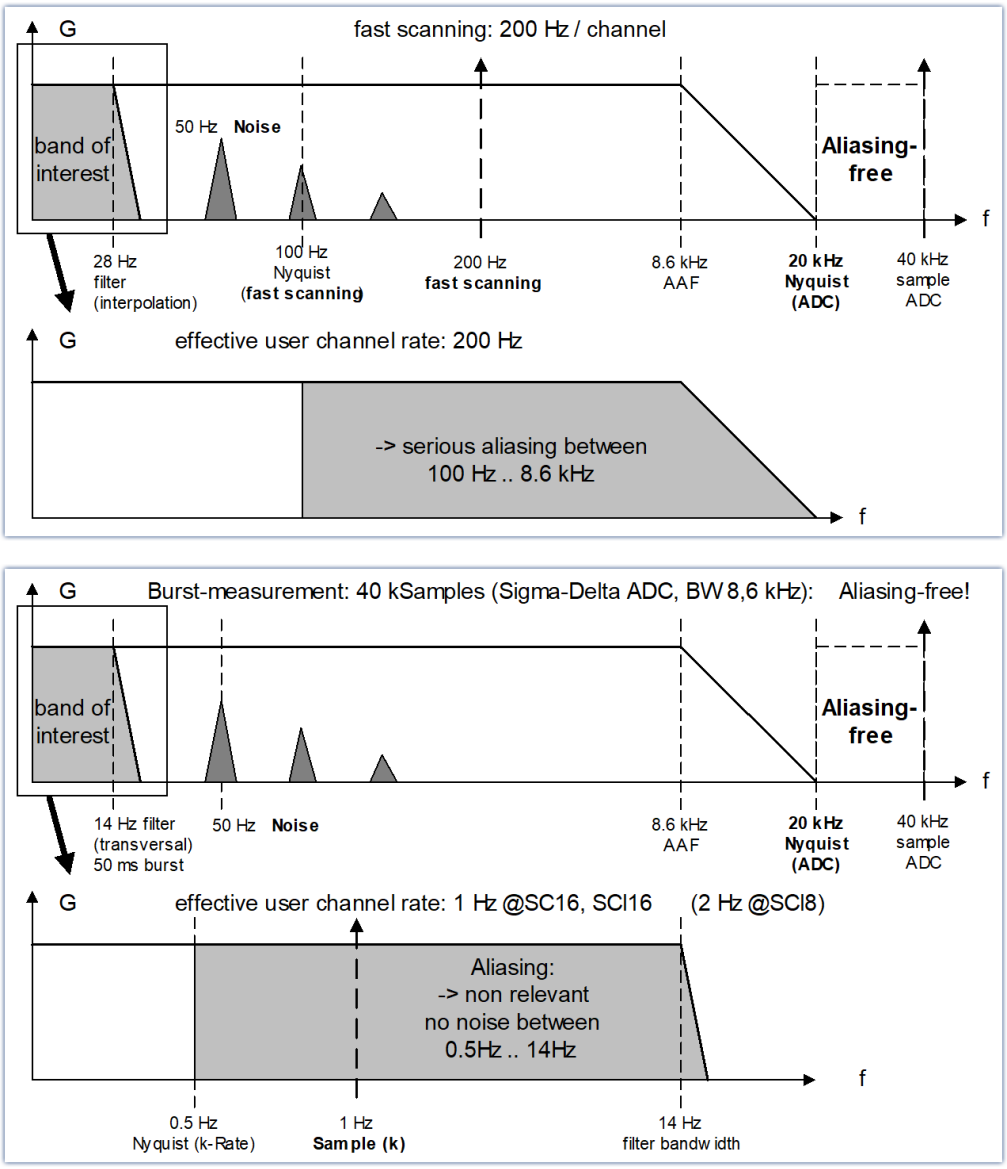
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Scanner timing:



Scanner timing

Filter concept: fast scanning vs. burst mode:



8.4 CAN bus: Delay times

Here we will deal with the question of how much delay there is between a measured value's acquisition and when it is outputted on the CAN bus. This is an important issue if the module is used for process control purposes, in which the system is to respond to the currently valid measurement value. For measurement tasks only involving data recording, the delay time is negligible.

The delay time is the time difference between a signal's sampling time and the instant and when the corresponding message is outputted on the CAN bus.

The following time intervals each make a contribution:

- The signal's propagation time through the input amplifier and the analog anti-aliasing filter.
- Delay time of the analog/digital converter
- Duration of the digital processing, e.g. correction and digital filtering
- Construction of the CAN-message. This involved waiting for acquisition of all measurement values to be included in the CAN-message.
- Waiting period until the CAN-controller has sent its last message and this message has been entered into the CAN-controller's register.
- The CAN-controller next tries to take the next best opportunity to put its message onto the CAN bus. This involves waiting for transmission disturbances and higher-priority messages to pass.
- The actual transfer of the CAN-message. For a full message and at 500 kbit/sec, this can be up to 0.2 ms.
- Additional time intervals may accrue in receiving the message.

In this context, it's only possible to state the delay time till the point when the CAN-controller is prepared to transmit the message. We assume that the CAN bus is undisturbed and there are no other modules currently outputting messages on the bus; only then can a module's delay time be stated. The user can then compute for his own CAN-configuration what delays will result from higher-priority messages.

The delay time is stated for the module's default setting. This means for four adjacent channels in a CAN-message, starting with Channel 1. One flashing LED and no additional virtual channels.

Other factors influencing the delay time:

- Other message structures. E.g. Channel 1 and Channel 16 in one message for a module (like the SCxx modules) using a multiplexer. Since Channel 1 is sampled at the beginning and Channel 16 really at almost the end of a sampling interval, the message can only be outputted at the end of the sampling interval, thus delaying Channel 1 significantly, and Channel 16 almost not at all. For quick response, only adjacent channels (e.g. 1 through 4) should be placed in a message.
- *Virtual channels* are always calculated after a delay. For swift response, no virtual channels should be packaged in a message.
- *Synchronicity*: In synchronized mode, old messages are outputted on the CAN bus following disturbances on the bus so that they can be collected in chronologically correct order without data loss by the data acquisition device. For swift response, the synchronized mode should not be used if bus disturbances are to be expected.
- Choice of CAN identifier: Messages for which the user wishes to have rapid responses *should have lower CAN-identifiers* (and thus higher priority) than other existing CAN-messages.
- Choice of sampling interval. Observe the tables in chapter 6 and their explanations.
- The specifications in the tables in chapter 6 are valid for:
  - For SCxx modules: Use the same sampling time for all channels.

  - Only position channels with the same sampling rate in a single message. Only then are the specifications in the table valid.
- With some module types, (such as SCxx modules), the filters can be deactivated. If the filters are deactivated, the delay times are correspondingly shorter. This is because the low-pass filters used cause delay. Only use of the filters ensures the validity of the spec sheet data concerning signal noise, suppression of common mode frequencies and synchronization of sampled values. If the filters are deactivated, the delay time is reduced, but in that case it's the user's responsibility to measure signals which are good enough not to need filtering and also that the synchronization of multiple channels doesn't play any role.

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8.5 Grounding and Shielding

8.5.1 Isolation

imc CANSAS modules consist of three components which are all mutually isolated as well as from the enclosure (CHASSIS):

- Input-/Output channels
- Power supply unit
- CAN bus

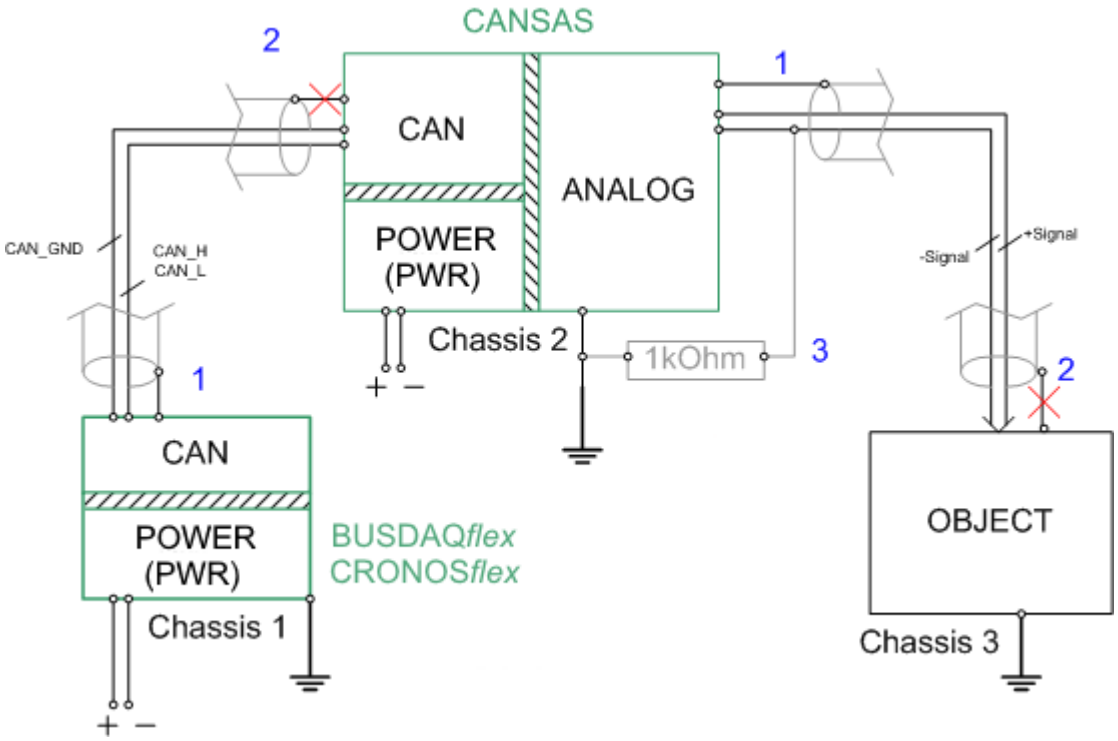
8.5.2 Grounding

It is assumed that the module housing (CHASSIS) is electrically grounded during installation, in the sense of a functional ground. The design of the functional earth connection varies, see technical data sheet.

When the module housing is grounded, the guidelines for "*Base-isolation*" (as per DIN 61010-1, pollution degree 1) are valid for the isolation voltages vis-à-vis the housing.

For the mutual isolation of the input channels, the valid guidelines are those for "*double isolation*" (as per DIN 61010-1, pollution degree 1).

Example for grounding



Note the following points:

1) The shielding for the CAN bus connection is grounded on one side.

2) The shielding may not be connected on both sides since ground loops could result otherwise.

3) In order to avoid common mode errors, the signal reference can be connected to imc CANSAS ground via a resistor.

8.5.3 Isolation voltage

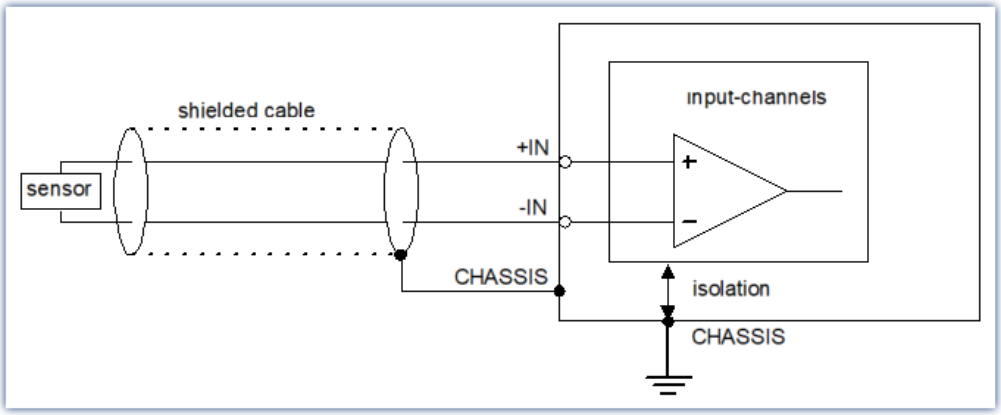
See the technical specs 472 of the respective module.

8.5.4 Shielding

As a matter of principle, the use of shielded and grounded cables is necessary for conforming to the EMC and noise suppression parameters.

In many cases the use of a cost-effective, multi-wire, single shielded cable is adequate (even for many cables).

Single shielding:



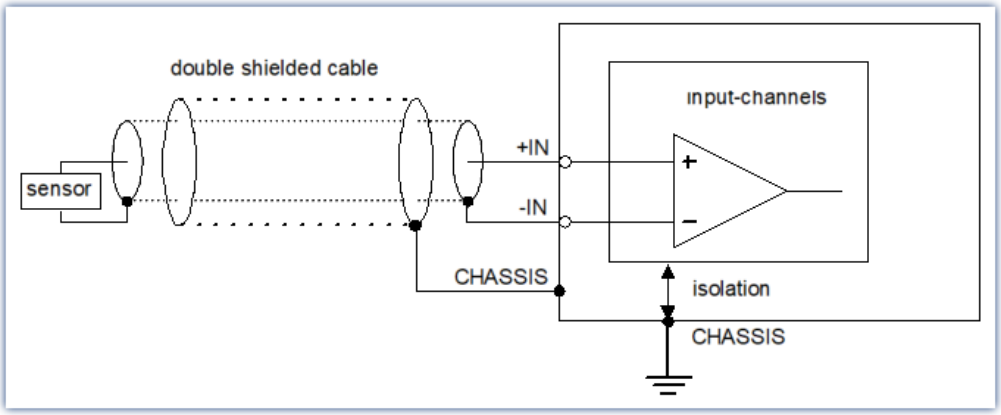
Single shielding

But some cases can require double-shielded cables, meaning a common, grounded (CHASSIS) ***sheath***, in which (perhaps multiple) ***individual coaxial lines*** are contained.

The following situation in particular can require double shielding in order to protect against noise.

- "high" internal resistance of the signal source (> 100 Ω)
- ungrounded signal sources (isolated or having high impedance to the CHASSIS and/or power supply reference ground)

Double shielding:



Double shielding

To avoid compensation currents, always connect the shielding to one side (potential) only.

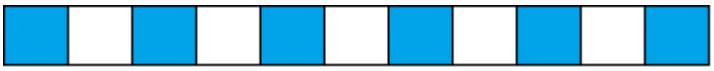
8.6 Blink codes

The imc CANSAS modules come with an LED which can shine in three colors.

8.6.1 imc CANSASflex

8.6.1.1 Normal operation

During normal operation, the LED of a CANSAS*flex* module flashes in a blue color. Once the power supply is connected to the device, various blinking codes are emitted, which depend on the module and on its firmware version, before the blinking pattern reverts to constant blue blinking.



imc CANSASflex

8.6.1.1.1 Successful configuration

Once a CANSAS*flex*-module has been configured successfully, a blinking code is emitted. The LED flashes purple once for a long duration, then once briefly blue, then once more purple and long and then goes off. A short time later, the device begins blinking again in indication of normal operation.



imc CANSASflex

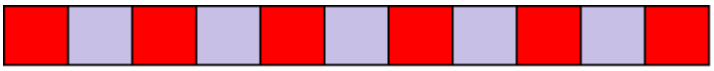
8.6.1.1.2 With device's Reset-plug

While the Reset-plug is attached at the device, the LED dies **not** flash. The LED also doesn't flash after withdrawal of the Reset-plug until either a configuration for the CANSAS*flex*-module has been successfully completed, or the module has been disconnected from the power supply and then reconnected to it.



8.6.1.1.3 Synchronization

If a **imc CANSAS*flex*** module is configured as the Master for synchronization purposes, then following successful configuration is alternates blinking in purple and red (blink code: ***"Wait for other module"***) until it is connected with another module via the CAN bus. For this, it doesn't matter whether or not the other module is set to the corresponding Slave-mode.



imc CANSASflex: Wait for other module

Once the connection has been securely set up, the module blinks normally again in blue.



imc CANSASflex

If there is no connection to any other module within 5 – 10 seconds, then a blinking code consisting of a mix between the code for normal operation and the code for "***Wait for other module***", namely alternating blue, purple and red, is emitted. The device is then in an undefined state.



imcCANSASflex: undefiniert, wenn nach 5-10s kein Synchronsignal empfangen wird.

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If a CANSAS*flex* module is configured as ***slave*** for synchronization, it flashes alternately **violet-red** after successful configuration.(blink code: ***"Wait for other module"***) until it is connected with another module via the CAN bus. Toward this end, the other module **must** be set to the corresponding Master-mode, in order to be able to provide the necessary synchronization signal. Once connection to an appropriately configured module has been achieved, the module resumes the normal blue blinking pattern.

If a module configured as a slave is to be disconnected from the synchronization signal after having been successfully synchronized, it reverts to the blink code ***"Wait for other module"*** (purple-red). Then it's sufficient to connect the module with another module to make it blink in blue once again. In this case, it continues blinking blue even though it isn't receiving a synchronization signal.



imc CANSASflex

8.6.1.2 Fault condition in device

If, however, a fault condition occurs in the device, then a special blinking code is emitted by the LED. This particular blinking code can indicate which error is involved.



A imc CANSAS device error's blinking code consists of a sequence of 7 blinks in various colors which depend on the particular error which occurred. This blinking code is emitted for the whole time, as long as the device is on.

The error code is commenced with the first three blinking signals in which the LED shines red three times. The LED's following four blinking signals make up the actual error code and provide information on the error's location and type. In this context, the first two flashes constitute the top-level code (location), while the last two flashes are the subordinate code (type). The error code's 7-flash signal is then repeated.

3 * RED	Same for every error message. Indication that an error occurred.
2 * X	Flashes for the top-level error code.
2 * Y	Flashes for the subordinate error code.
	X and Y can take the following combinations of color values:

Top-level code	Description	Subordinate code	Error description
RED --- YELLOW	CRC-error	RED --- RED	BOOTER
		RED --- YELLOW	FIRMWARE
		RED --- GREEN	PARAMETER BLOCK
		YELLOW --- YELLOW	CONFIGURATION
RED --- GREEN	Fault in analog	RED --- RED	PLUG ERROR
		RED --- YELLOW	MODULE TYPE
		RED --- GREEN	DIV THERMO
YELLOW --- GREEN	Access error in Flash	RED --- RED	NO ACCESS
		RED --- YELLOW	ERROR WRITING
		RED --- GREEN	DELETE ERROR BLOCK
		YELLOW --- RED	DELETE ERROR CHIP
		YELLOW --- YELLOW	FLASH PAGE TOO SMALL
GREEN --- RED	CAN Bus-access	RED --- RED	LINE TROUBLE
		RED --- YELLOW	PACKET LOST
GREEN --- YELLOW	Fifo	RED --- RED	FIFO FULL
		RED --- YELLOW	FIFO EMPTY
GREEN --- GREEN	General internal error	RED --- RED	ILLEGAL CALL
		RED --- YELLOW	ILLEGAL DATA
		RED --- GREEN	ILLEGAL LENGTH (structure)
		YELLOW --- RED	RAM TEST
		YELLOW --- YELLOW	NO ONLINE
		YELLOW --- GREEN	INITIALIZATION FPGA

Reference imc CANSAS UNI8

For the imc CANSAS module UNI8 222, there are additional blinking codes which, however, do not indicate device errors but rather a status or an external error.

8.6.2 CANSASfit (CANFT)

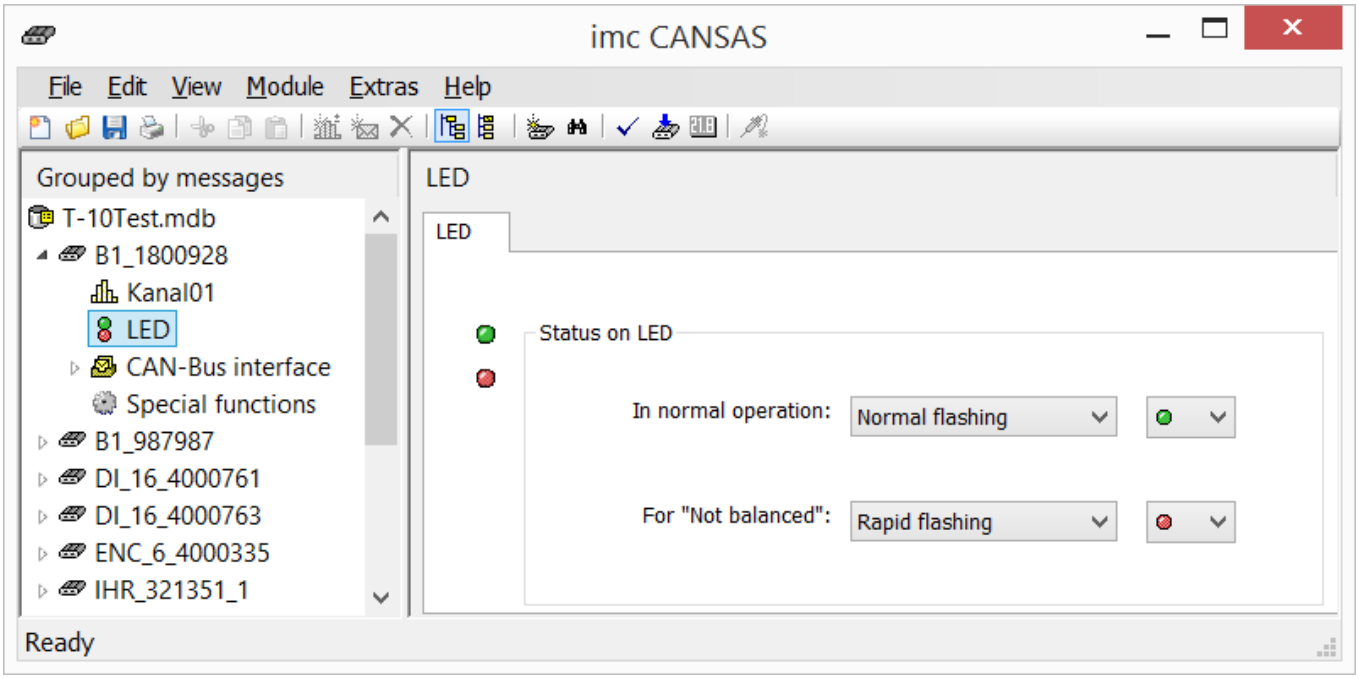
imc CANSAS*fit* modules provide two LEDs for the following color and blinking codes:

Power LED	Status LED	Significance
Green	Yellow, Green, Blue blinking, Yellow blinking, Green	Start: the CAN configuration that is integrated in the module will be started.
Green	Green	Normal operation (measurement is running)
Green	Yellow blinking	Configuration of the module is in preparation or rest plug connected
Green	Depending on current state	Module is supplied correctly
Green	Red/ green blinking	With T-10: Sensor breakage 263 detected in at least one active channel.
Red	Off	Error: polarity reversal error

Reference imc CANSAS*fit* Blinking codes

For more information on the blinking codes, see the descriptions of the modules ENC-6 260 and T-10 263.

8.6.3 µ-CANSAS



Single-channel imc µ-CANSAS modules have two LEDs that can flash green or red. For the states "*In normal operation*" and "*Not balanced*" it can be set whether the LED remains off, lights up and, if so, flashes permanently or quickly/slowly.

Note

- During configuration or firmware updates, the LEDs may flicker. Upon successful completion of the configuration or update, the LEDs resume to behave as previously described. With modules which allow zero balancing (taring), the red LED flashes during the balancing procedure at a high flashing frequency.
- The function *Status on LED* is not available for µ-CANSAS-B1.

8.6.4 Special/modules

8.6.4.1 UNI8 - TEDS

With the UNI8 module, particular blinking codes for status indication are already set as default settings. These can be arbitrarily changed and adapted to the user's own requirements. The default settings for the blinking codes for the respective modules are:

Module-status	Color	Blinking code
Other or no sensors [1]	RED	LED blinks rapidly
For "Not adjusted"	GREEN	LED blinks rapidly
For "Stored adjustment values"	GREEN	LED blinks normally
For "Successfully adjusted"	GREEN	LED blinks normally
For "Adjustment running..."	YELLOW	LED shines (no blinking)
For "Shunt calibration running..."	YELLOW	LED shines (no blinking)

[1] TEDS-sensors: blinks only red after a TEDS-sensor was connected any time before

8.6.4.2 FBG-T8

Parameter	Value	Remarks
Power-LED green	 power active	
Status-LED blue blinking blue, yellow blinking, purple yellow red	multicolor operating, run FW update prepare configuration error	overall status of module
Channel status-LED off green red	multicolor channel passive channel active, OK error	status for each channel errors regarding: Signal quality, allowable measuring range, operating temperature, system error

Module description imc CANSAS*fdx* FBG-T8 323.

8.7 Features and modules

Many features available with the imc CANSAS software version 1.4 are dependent on the hardware properties of particular imc CANSAS modules. This means a particular hardware version, i.e. a specific circuit board, is required in order to access the software features. The list below indicates which features are associated with which production dates. If you detect any discrepancies, please contact our tech support for an exact clarification of your hardware version.

Below is a table of general features available as of the production date stated. Explanations of the features appear further below.

Module	Slot	Synchronization			Readable configuration	imc SENSORS
		supported	master	slave		
B1	--	yes	--	CAN-1 protocol	yes	
C8	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	--
CI8	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	all
DAC8	as of 09-2003	--	--		as of 2006	--
L-DAC8	as of 07-2003	--	--		all	--
DI16	as of 06-2009	--	--		as of 2006	--
L-DI16	as of 07-2003	--	--		all	--
DO16	as of 12-2003	--	--		as of 12-2003	--
DO16R	as of 07-2003	--	--		all	
DO8R	as of 12-2003	--	--		as of 12-2003	--
ENC-6	--	--	--		as of 05-2018	--
FBG-T8	all	--	--		--	all
HISO8	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	all
IGN	--	--	--		all	--
INC4	as of 09-2003	as of 2006	--	CAN-1, DCF77, square wave 1 s	as of 2006	--
L-INC4	as of 07-2003	as of 09-2003	--	CAN-1, DCF77, square wave 1 s	all	--
P8	as of 07-2003	as of 08-2003	--		all	--
PWM8	all	--	--		all	--
SCI8	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	as of 02-2007
SCI16	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	as of 02-2007
SC16	all	all	CAN-1 protocol, square wave 1 s	CAN-1, DCF77, square wave 1 s	all	as of 02-2007
T1	--	yes	--	CAN-1 protocol	yes	
T-10	--	--	--		as of 05-2018	--
UNI8	as of 07-2003	as of 06-2003	--	CAN-1, DCF77, square wave 1 s	all	all
UTI-6	--	--	--		as of 05-2018	--
V1	--	yes	--	CAN-1 protocol	yes	

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Description of features

Feature	Definition
Slot	The EPROM (TEDS) with slot recognition is readable (and writable).
Synchronization	The data acquisition modules work in synchronization, i.e. the sampling is simultaneous. See the section Synchronization 126.
Readable configuration	A module's configuration can be saved to the module in a way which can be read back. This means that the configuration can be imported from the module when it is integrated into the system. See Extras - Options 106.
DAC8: outputs each set for I/U separately	The DAC8's output channels can each be switched separately between voltage and current. If the feature is not available, then it is only possible to switch between voltage and current for the entire module.
Sensor recognition	The EPROM of the sensor connected is readable. The data it contains can be used to make settings for the channels.
UNI8: Bridge measurement	Only for UNI8: measurement bridges can be connected.
imc-Sensors	The module is connected with the sensor database imc-Sensors. The data it contains can be used to make settings for the channels.
UNI8: sensor recognition by jumper configuration	A shorting jumper inside the connector is used to detect a Type K thermocouple.
UNI8: PT100 inside the connector	Only for UNI8: With thermocouple measurement, the temperature of the cold junction point can also be measured inside the connector by placing a PT100 inside the connector.
UNI8: current with built-in 120 Ω resistor	Single-ended current measurement with a 120 Ω resistor built into the module
UNI8: 350 Ω ¼-bridge	Connection and measurement of a 350 Ω ¼-bridge is possible.
UNI8: 120 Ω ¼-bridge	Connection and measurement of a 120 Ω ¼-bridge is possible.

DAC8: special feature from production date

Module	Outputs each set for I/U separately
DAC8	from 09-2003

PWM8: special feature from production date

Module	TTL	current > 1A
PWM8	all	all

UNI8: special feature from production date

Module	Sensor recognition	Bridge measurement	PT100 inside the connector	Sensor recognition by jumper configuration
UNI8	from 01-2003	from 03-2003	from 08-2003	from 07-2003

SCI8, SCI16, SC16: special feature from production date

Module	Sensorkennung / imc SENSORS
SCI8, SCI16, SC16	ab 02-2007

Storage of calibration values (calibration, taring)

Calibration values, which are set e.g. during a bridge adjustment, are stored in the module. In the settings of the respective module type you will find an option as to whether these remain stored in the module. This ensures that the adjustment is retained even after the power supply has been switched off.

Note

The calibration values are not stored in the configuration file (CBA, DCB, XML or FDB) on the PC.

General remarks on isolated channels:

When using an isolated channel (with or without supply), one should make sure the common mode potential is "defined", one way or another: Using an isolated channel on an isolated signal source usually does not make sense. The very high common mode input impedance of this isolated configuration (>1 GΩ) will easily pick up enormous common mode noise as well as possibly letting the common mode potential drift to high DC-level. These high levels of common-mode noise will not be completely rejected by the amplifier's common-mode (isolation-mode) rejection.

So, as a general rule: isolated amps should be used in environments where the common-mode level is high but "well defined" in terms of a low (DC-) impedance towards (non-isolated) system ground (CHASSIS).

In other words: isolated amps are used in environments where the common mode levels and noise are already inherent in the process and not just accidental results of the equipment's isolation.

If, in turn, the signal source itself is isolated, it can be forced to a common-mode potential, which is the potential of the measurement equipment. This is the case with a microphone: the non-isolated power supply will force the common mode potential of the microphone and amp-input to system ground instead of leaving it floating, which would make it susceptible to all kinds of noise and disturbance.

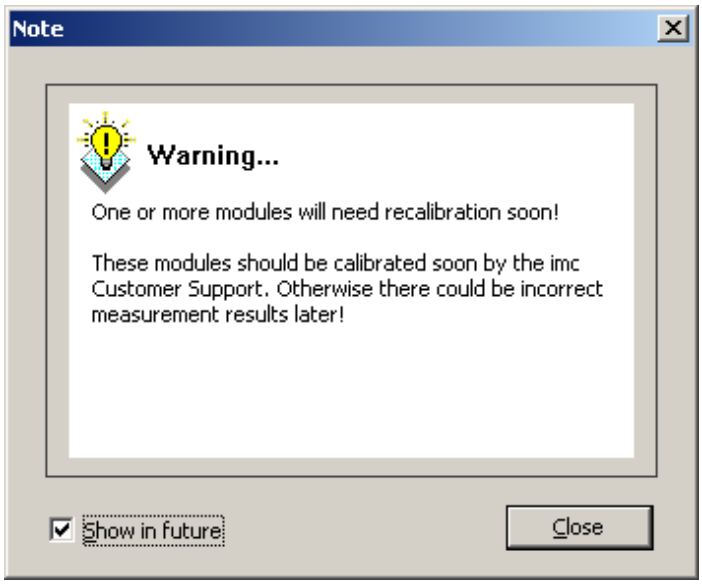
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8.8 Calibrating the modules

There are two stages of calibration reminders. First there is a preliminary warning which begins as of x months before the recommended calibration validity expiration. After elapse of the recommended validity term, a due date notification indicating the last calibration date is posted.

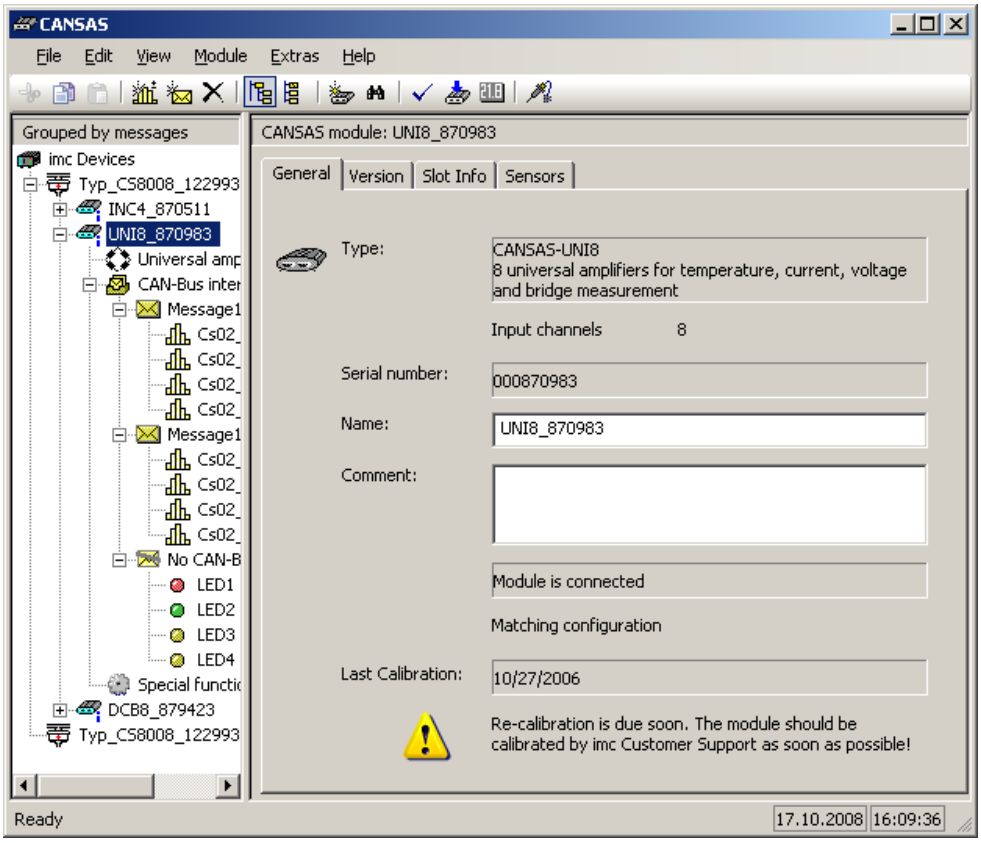
8.8.1 Prompt for next calibration

When a new module is integrated into the system, the following message appears if the recommended calibration date is has been reached:



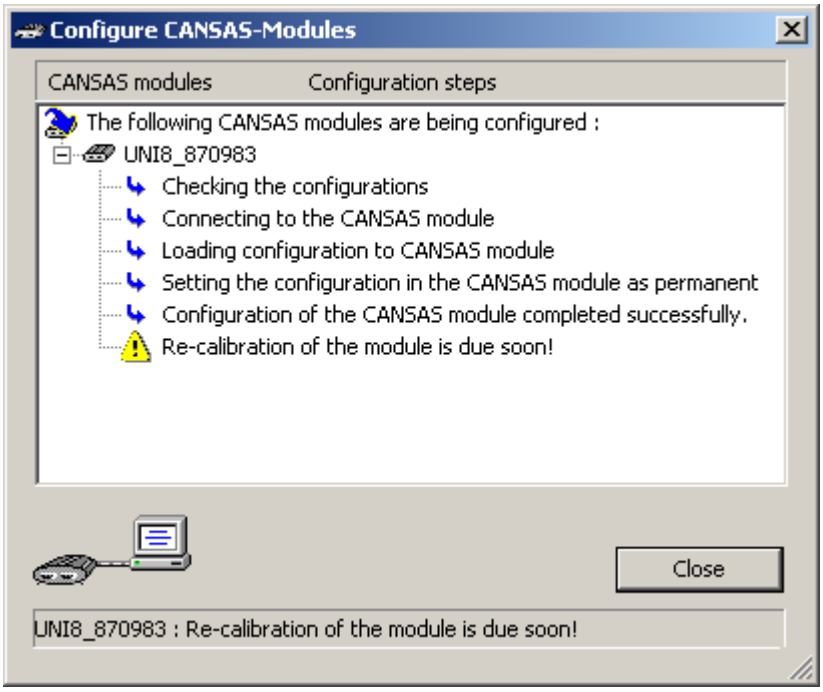
Hint for comming calibration during module integration

On the module's *General page,* an indication of the date of last calibration appears along with an exclamation point symbol:



Comming calibration at the module tab

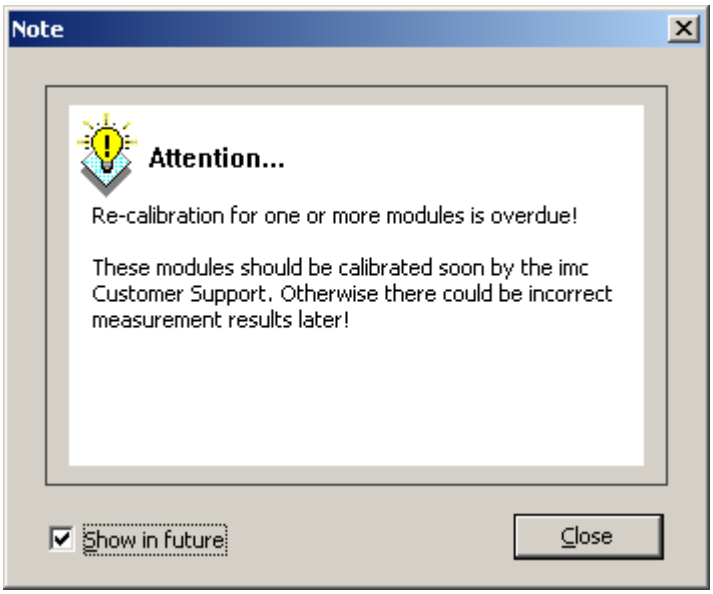
Upon initiating configuration, there is also an entry in the Information window:



Hint for comming calibration during configuration

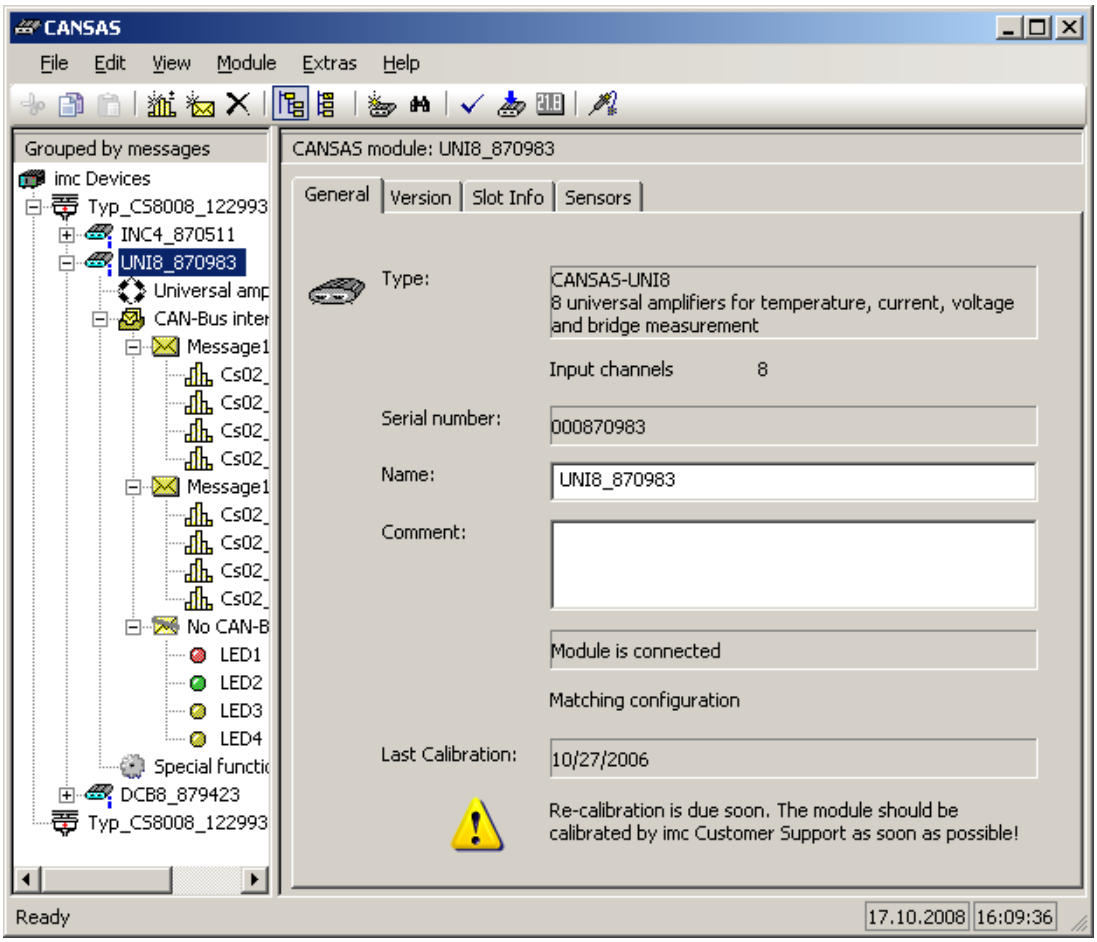
8.8.2 Recalibration overdue

When a new module is integrated into the system, the following message appears if the calibration validity has expired:



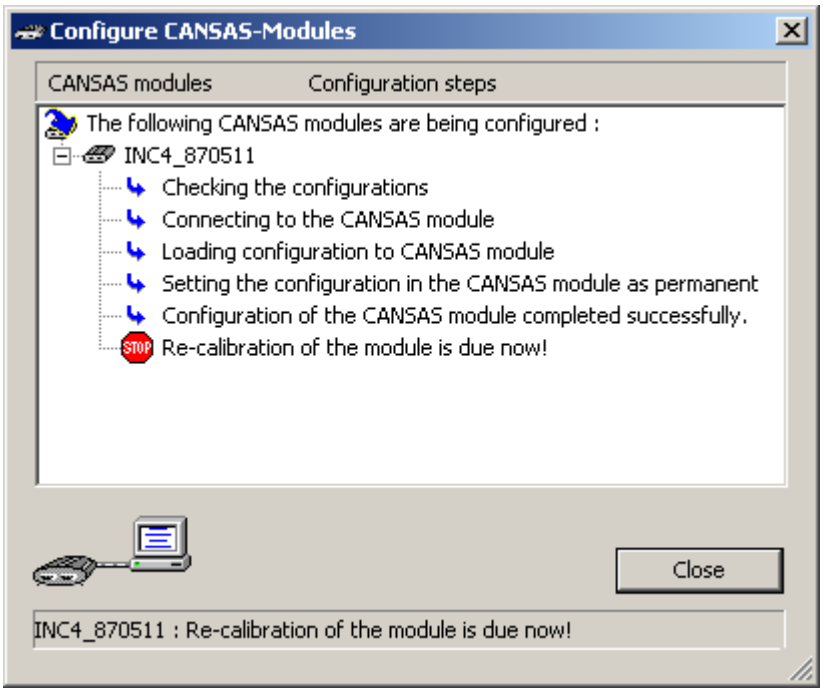
Warning, that re-calibration is overdue

On the module's *General page,* an indication of the date of last calibration appears along with an exclamation point symbol:



Re-calibration warning at the general module tab

Upon initiating configuration, there is also an entry in the Information window:



Re-calibration warning during configuration

8.9 TEDS

8.9.1 TEDS: Plug & Measure functionality for sensors

When connecting classic sensors such as strain gauges, thermometers or power meters to measurement devices, the user requires knowledge of sampling rates, scaling factors, units, etc. in order to be able to obtain the desired measurement results.

An additional problem is posed by the task of taking measurements of large-scale installations with high channel counts. In settings where there can be up to hundreds of measurement locations, for instance on board trains or planes, or for more complex measurements of road vehicles, extra difficulties can arise from the increased likelihood of incorrect connection of sensors to channels, or of incorrect device settings. Getting sensors mixed up is, unfortunately, a familiar situation.

For all these reasons, imc is now introducing an electronic data sheet which can be retrofitted to all commercially available sensors and which eliminates the problems spelled out above.

8.9.1.1 How can measurement be simplified for the user?

Complex, multifunctional user interface for making device settings are needed only in exceptional circumstances. The necessary parameters for making the measurement device's settings are recorded in "electronic spec sheets" linked to the sensors to be connected. The measurement device is able to both read and process these data, which are stored in so-called Transducer Electronic Data Sheets (TEDS). The sensor settings are made by the company's own measurement specialists.

This makes it possible for the measurement devices to be operated reliably by personnel less qualified in measurement engineering.

Ideally, the following conditions are provided:

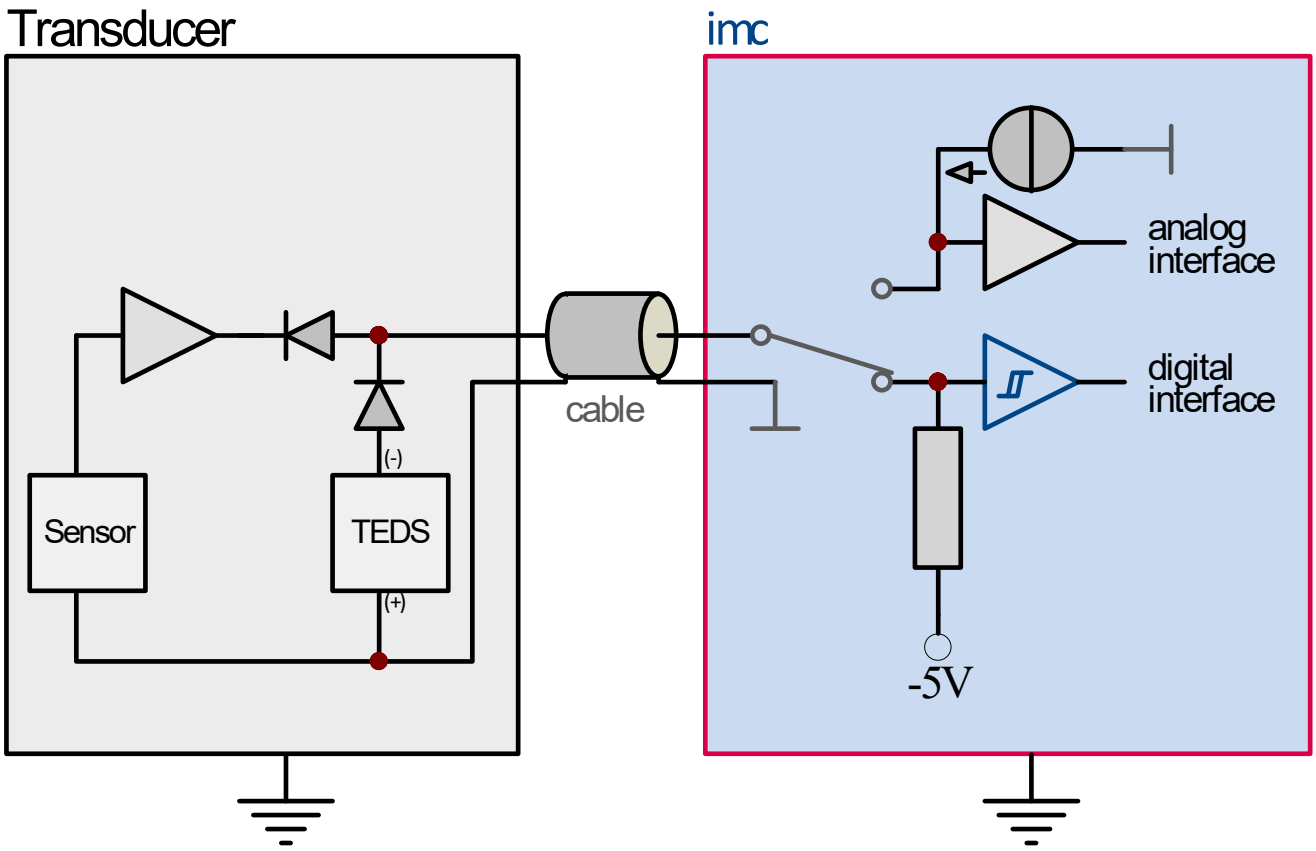
- All data relevant to measuring with a particular sensor (e.g. the sensor's preferred sampling rate) are contained in the electronic spec sheet linked to it,
- all sensors already present can be equipped with such an electronic data sheet,
- the user can connect the sensor at ***any*** input of an all-purpose measurement device,
- the user can ready the measurement system for operation at a single mouse-click, without needing skills in using a complex software interface, much less in actual programming,
- sensors can be interchanged without causing the entire measurement system, e.g., as a test station component, to require re-calibration.

8.9.1.2 Steps Towards Achieving "Plug & Measure" Functionality

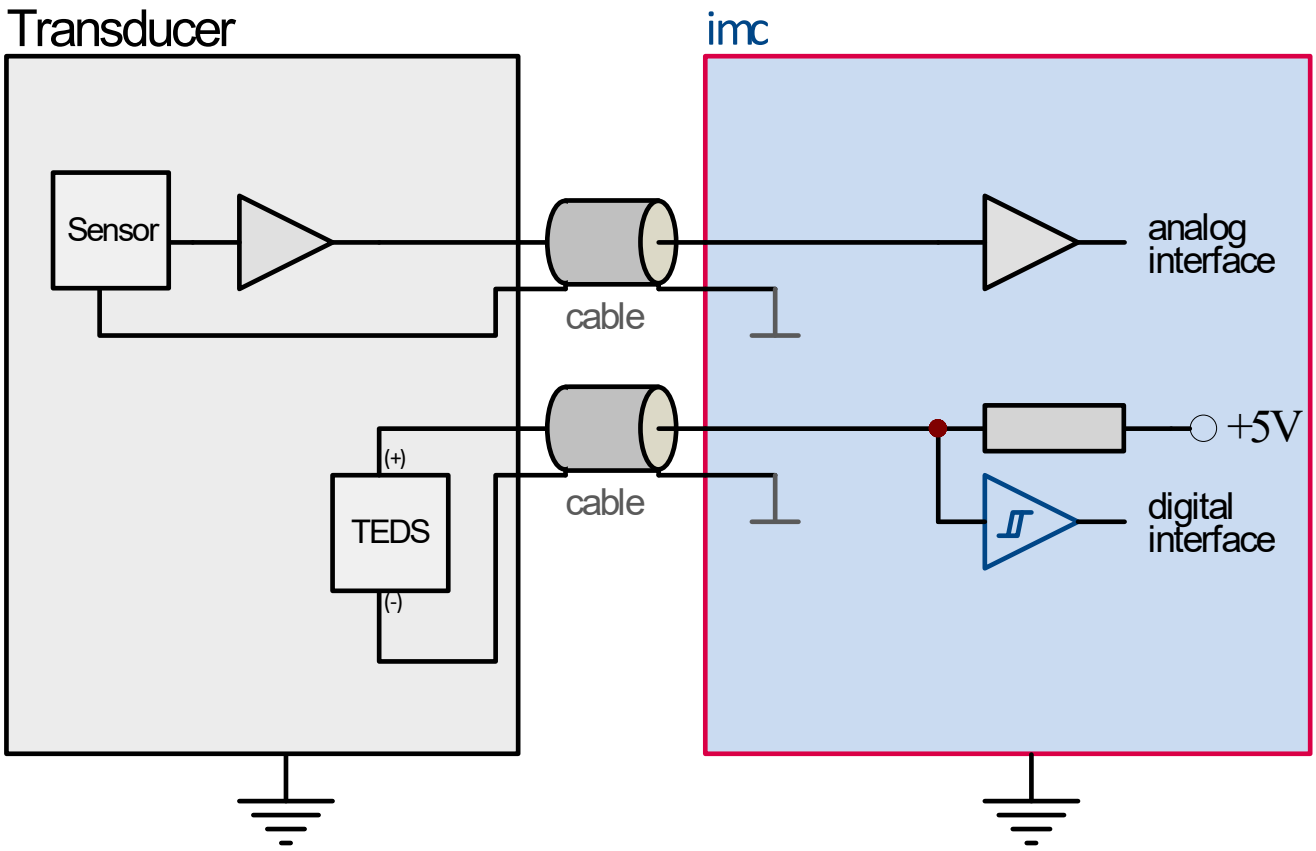
In the draft for the standard IEEE P1451 /1/, the standardization committee sets out the definition for a so-called "smart sensor". It's based on a TEDS which contains all information about the sensor available. This information can be used once the sensor has been connected to the measurement device. P1451.4 defines a so-called "mixed-mode interface", according to Class 1 both the sensor's measurement signal and TEDS-data can be carried on the same line.

- A "Mixed Mode Interface" sends/ receives TEDS data and receives analog signals.
- Class I interfaces are designed for constant-current-fed piezo-electrical sensors and use these sensors' quasi-standard (integrated electronic piezoelectric [IEPE] transducer).
- Class II interfaces are designed for bridges and other sensors.

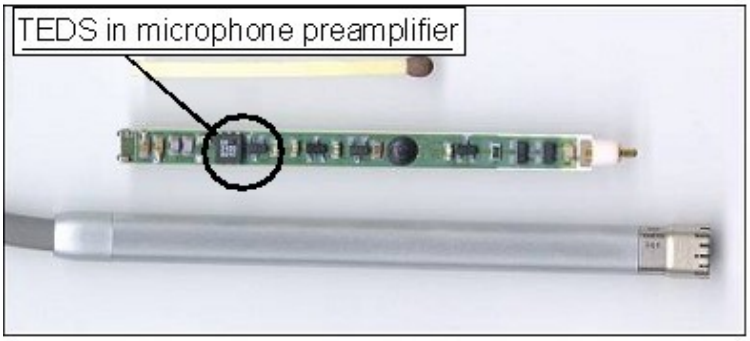
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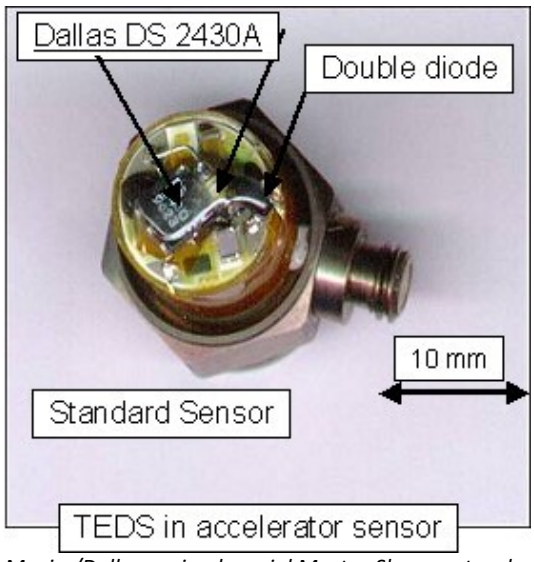


A Class I Mixed Mode Interface receives/ sends TEDS data and analog signals on the same line



A Class II Mixed Mode Interface receives/ sends TEDS data and analog signals on different lines. The sensor is not influenced.





The digital part of a TEDS interface is based on the 1-wire protocol of the company Maxim/Dallas, a simple serial Master-Slave protocol. The sensors could be for instance the EEPROMs – DS2430 (256 b) and DS2433 (4 Kb).

Naturally, sensor recognition only makes sense if the connected measurement devices are able to both read and process the sensor's characteristic data. With Plug & Measure you are able to equip ***every*** commercially available sensor with TEDS.

Most sensors used today (almost 100%) have no sensor recognition.

Another hurdle on the way to fulfilling the vision is the fact that certain sensors require customized signal processing. This means that it's not possible to assign just any sensor to just any input of a standard measurement device. In other words, not every sensor has a voltage output, but some require processing or a supply source. The newest generation of devices, which includes *UNI8*, confronts this dilemma by equipping every measurement channel to be able to measure every signal type, whether voltage, current, temperature using thermocouples or resistance thermometers or even measurement bridges or strain gauges. In other words, each channel is an all-purpose channel for practically every kind of physical measurement quantity. This approach does make each individual channel more expensive than a channel dedicated to just one quantity, but the enormous resulting advantages pay for themselves.

While constructing a measurement setup (positioning the sensors, cabling, and making settings for the measurement device) once required the skills of an experienced measurement engineer, the new automatic sensor recognition concept enables less qualified personnel to perform the procedure. Once a sensor has been positioned, it can be connected at any unoccupied channel of the measurement system. The particular channel and its number are no longer important, but rather the sensor's name as recorded in the sensor recognition. For the user, it doesn't matter to which physical channel a sensor was connected, since he's usually only interested in the channel's name (e.g. Velocity_FrontWheel_Left) and the physical assignment to a measurement channel is unimportant if every channel is identical.

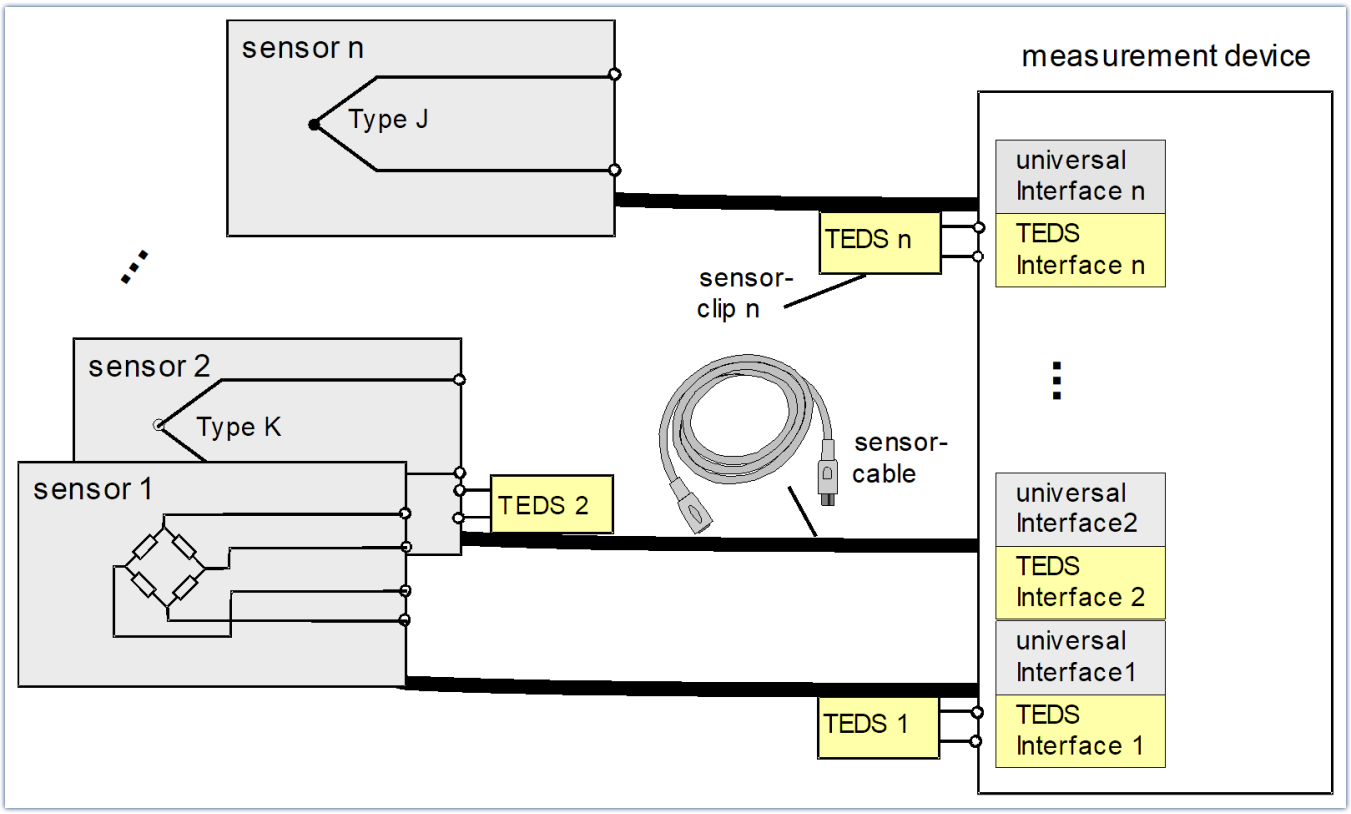


Fig 2: Sensors with freely assigned TEDS. The measurement device consists of n all-purpose sensor interfaces. The retrofitted TEDS can be connected either at the sensor (TEDS 2) or at the measurement system. the measurement channels are appropriate for practically any sensor, so that the sensors can be connected to any unoccupied input on the device.

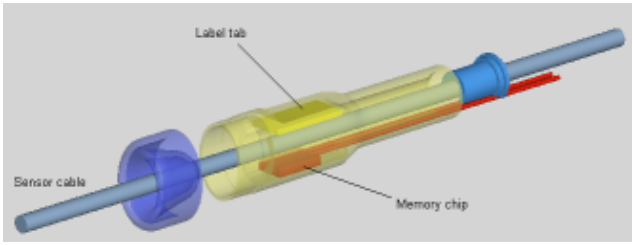
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8.9.1.3 Sensor database

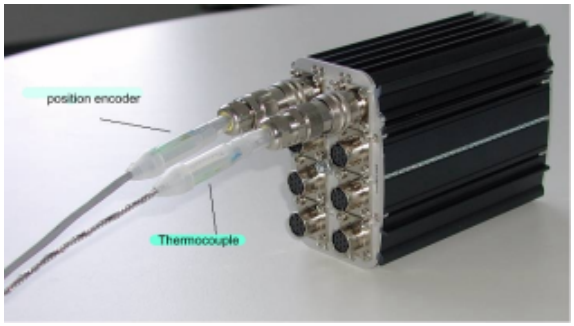
The simplest way to avoid repetitiously setting sensors is to build a database into the measurement device which contains all information about the sensor. imc's sensor database imc SENSORS is the ideal counterpart for Plug & Measure. How the database, TEDS and imc Devices work in concert is described in the manual imc Devices. For details on the sensor database, see the manual imc SENSORS.

Setting a measurement device with a single configuration command

The measurement device independently adopts the appropriate settings upon receiving a single configuration command. All information relevant to settings is recorded in the sensor's TEDS. If the configuration command "Configure System" is called, then all the data needed for making the device's settings are read out of the respective EEPROMS assigned to the sensors and the measurement device, including its signal conditioning, is correctly configured. Of course, there are parameters, which are to be set in the device itself, but which also can be saved to the sensor-TEDS. These include the measurement duration or the location for data storage. And of course, a user's interface is still needed, by which the sensor's settings data can be subsequently edited.



Structure of a sensor clip



A measurement device with sensors and clips connected

Another great advantage would result from the ability to not only retrofit sensors with TEDS but to also to file sensor characteristics in a database. However, this requires a PC having the appropriate database for making settings to the measurement device.

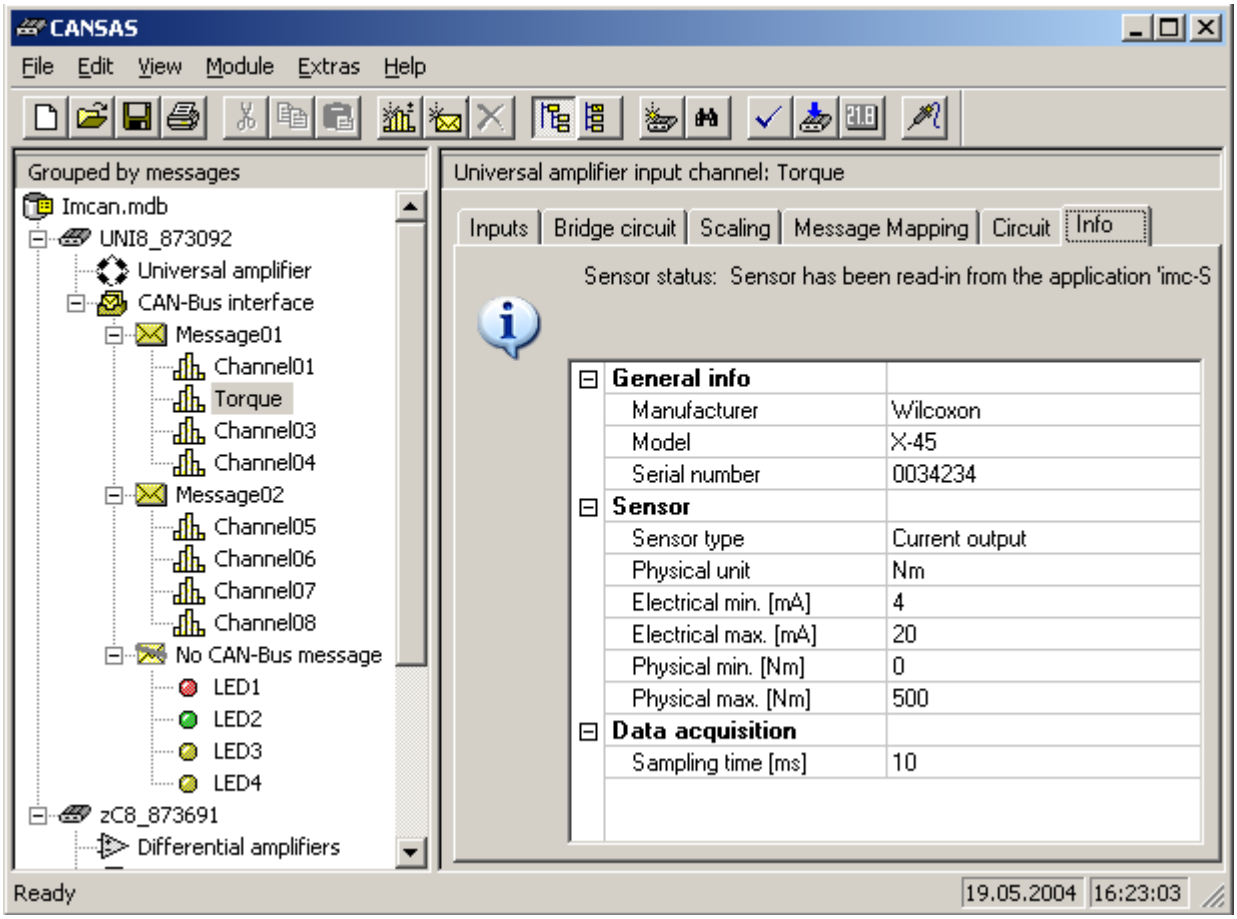


Fig. 4: An excerpt of the sensor description for a measurement channel connected to the CANSAS UNI8 module. the data are saved as an XML-file in the TEDS and can be called at any time. Along with sensor-specific data, the necessary channel-specific data (e.g. the sampling rate) are also noted.

The features presented above have already been implemented in already available measurement modules belonging to the imc CANSAS series. These include a pressure module, having eight built-in pressure cells, and the module UNI8 with eight uniform measurement inputs which support practically all sensors for physical measurement engineering. Both modules digitize the data they capture which they then transmit via the CAN bus.

In the pressure module, the sensor characteristics are already built into the sensor. Since the sensor itself fits inside the pressure interface nipple, a very compact design is required. If one or more sensors fail, they can simply be replaced. The replacement sensors automatically announce to the measurement device their characteristic data. Thus the measurement device resumes its state of readiness without needing re-calibration. The measurement device's uncertainty is added to the sensor uncertainty.

The second possibility is the clip-on pod, shown above, which contains the chip on which the sensor information is recorded. This solution is available for practically any sensor and turns a conventional sensor into a "smart sensor".

Sensors which already contain a PROM and can operate as per IEEE P1451.4 can also be connected to imc CANSAS UNI8.

Naturally, the user of this new kind of measurement engineering has direct access to the measurement device's settings via a conventional user interface. For example, if a sensor's TEDS states 500 Hz as its sampling rate, but the user wants to sample at 1 kHz, he can simply make and save this setting by means of the user interface.

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Another important aspect is the compatibility of the imc solution and any sensors having TEDS which are already present. Thanks to the specifications by IEEE 1451, all information stored in these sensors can also be used by imc devices. Such settings parameters which don't appear in the TEDS, such as the sampling interval, can be set later using the imc devices' operating interface.



Pressure sensor with built-in TEDS sensor recognition

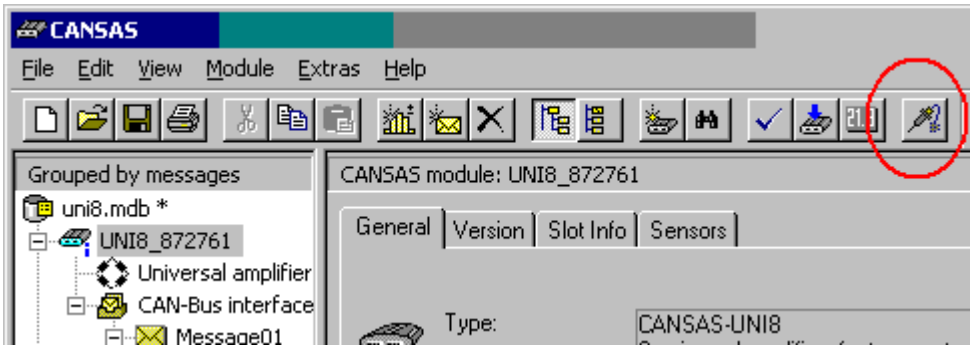
8.9.2 Operation in CANSAS Software

The device software supports export of sensor spec-sheet data from a sensor TEDS and the application of this information in configuring channels.

For configuring the sensor information, you need the product imc SENSORS. The use of this sensor database in imc CANSAS is described here 237. For a detailed description of the database itself, see the user's manual for imc SENSORS. Below, the import of already recorded sensor data to imc CANSAS is described.

8.9.2.1 Importing sensor data

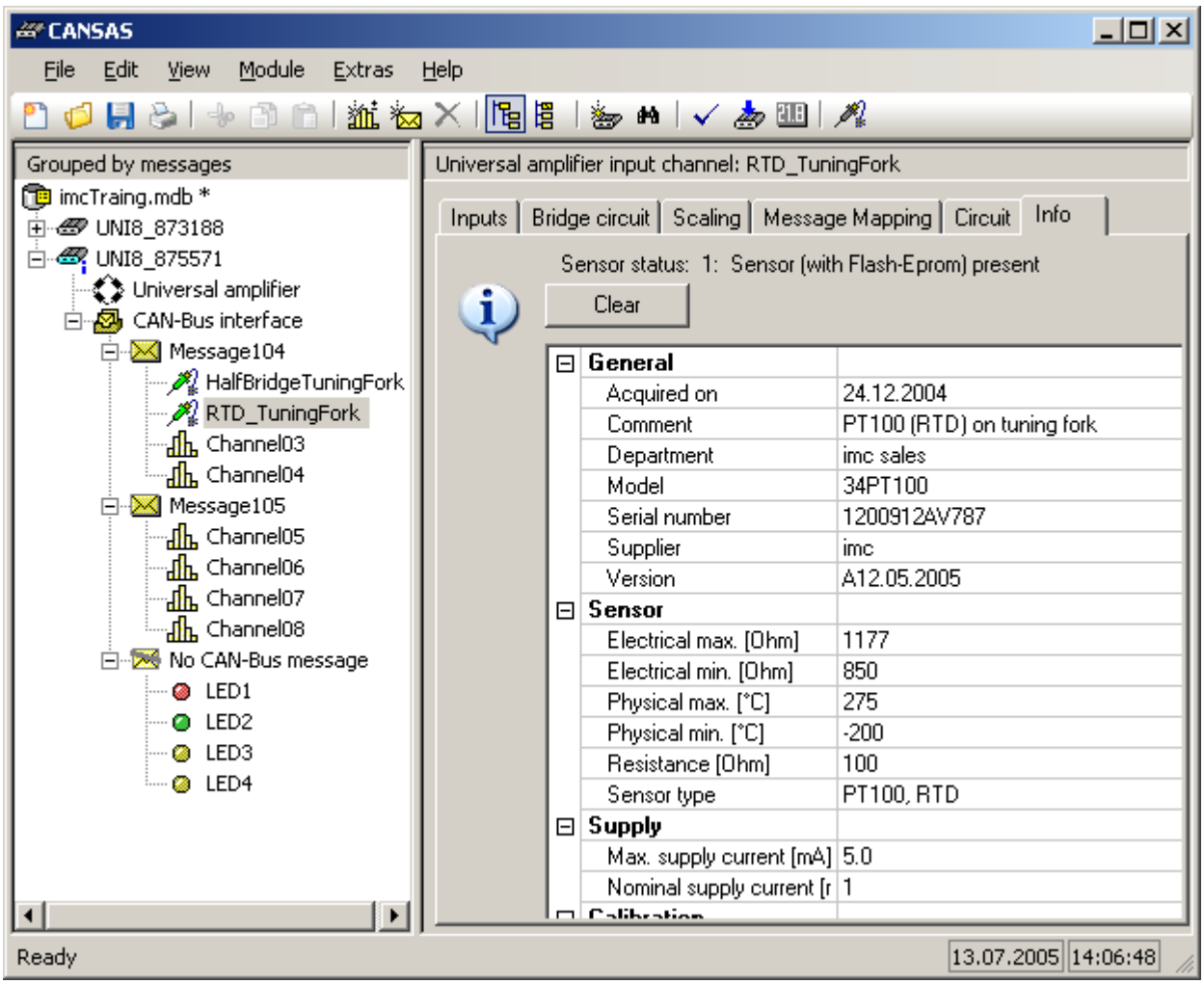
Import of Import of sensor spec-sheet data from all sensor TEDS takes place on menu item "*Module*" > "*Sensor*" > "*Read characteristic values (from Sensor-EPROM)*";alternatively corresponding toolbar button:



The sensor information is read out and used to configure the channels. TEDS- channels will be marked with a symbol.

8.9.2.2 Sensor information

The dialog page *Sensor* presents a detailed list of the selected sensor's technical specs. However, these sensor data cannot be edited here!



Note

In order to be able to edit the sensor spec-sheet data, the program imc SENSORS must be installed. The sensor database imc SENSORS administers such information for sensors. In this program, it's possible to set up, edit and administer entries for sensors; see Sensor-Database 237.

8.9.2.3 Saving imported sensor information in CANSAS

The sensor information once imported and linked to a channel are **saved with the imc CANSAS configuration**. If the configuration is later transferred (e.g. copied to another PC), this sensor information isn't lost!

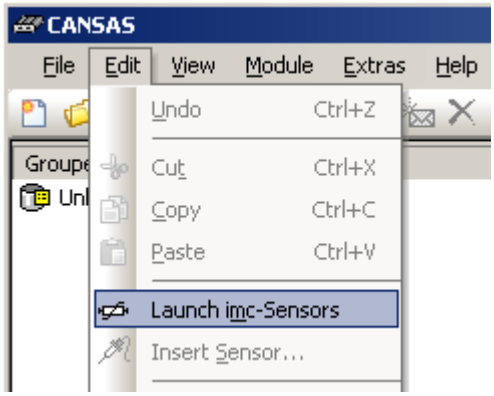
8.9.2.4 Sensor-Database

The device software supports the export of sensor information from a sensor database and the application of this information to configure measurement channels.

For this purpose, it's necessary to install the product *imc SENSORS*. The sensor database *imc SENSORS* administers the sensor information. Sensor entries can be created, edited and administered.

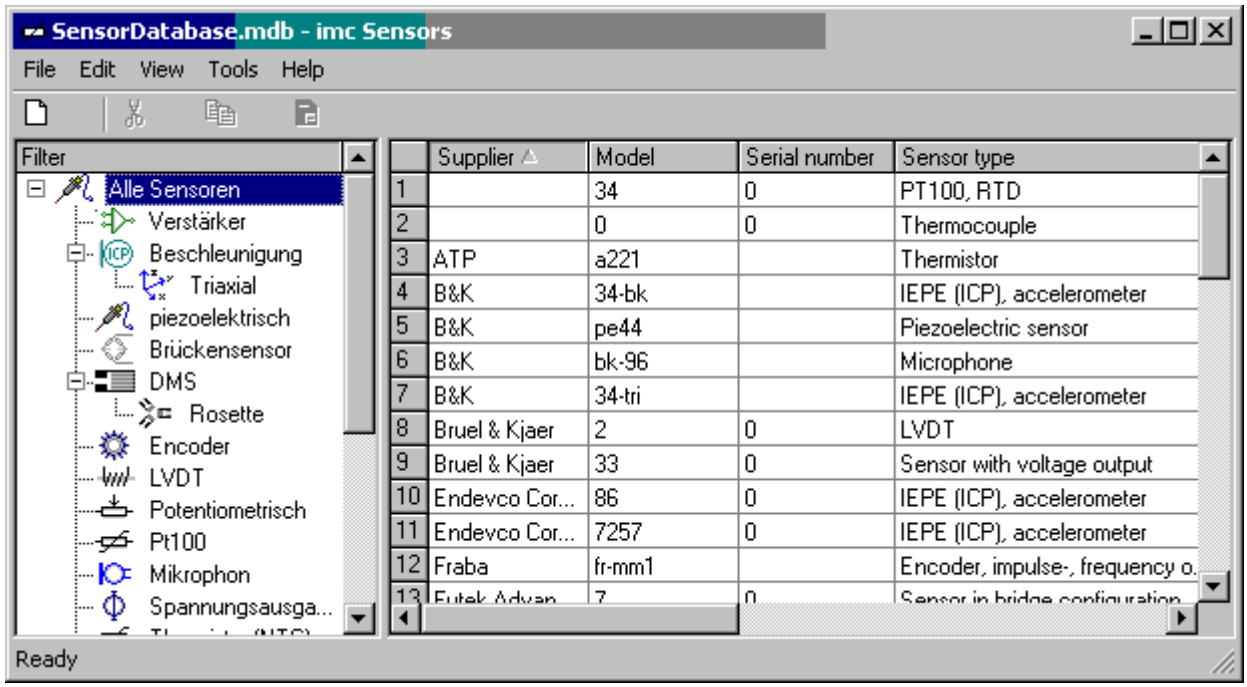
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8.9.2.4.1 Importing sensor information from the sensor database

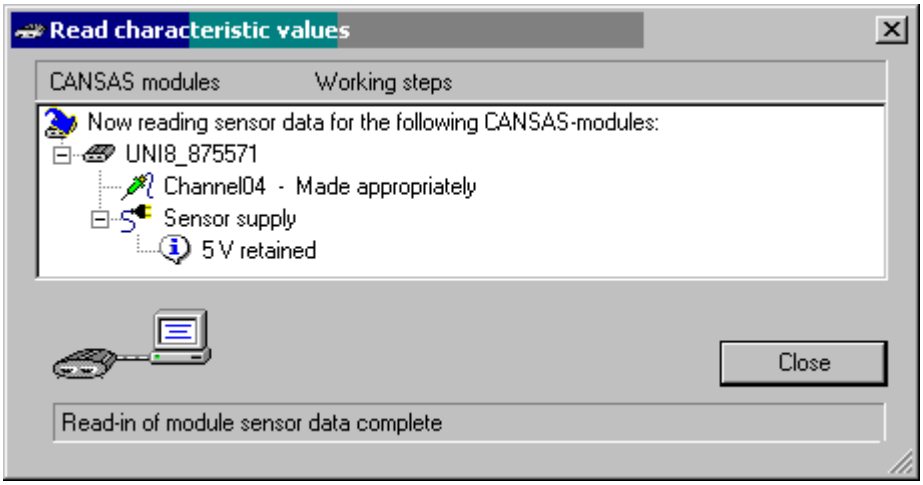


If *imc SENSORS* is installed, the sensor database can be started either via the menu item "*Edit*" > "*Start imc SENSORS*" or by clicking on the corresponding button in the toolbar.

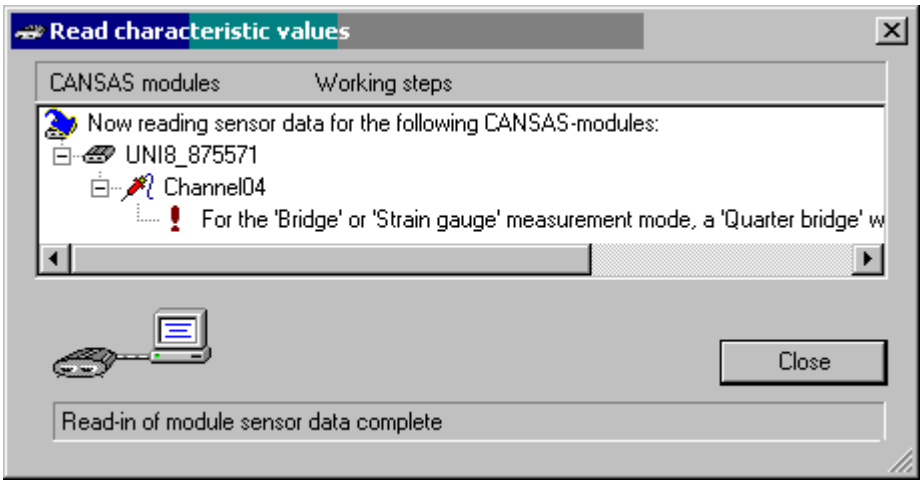
Once the desired sensor has been selected, the sensor information can be applied to the desired channel by means of drag&drop.



Alternatively, the imc CANSAS menu item "*Edit*" > "*Insert sensor*" can be used. Therefore *imc Sensor* has to be started and a sensor is selected.



The sensor information is only applied if the channel supports the corresponding properties. Otherwise, an error message is posted:

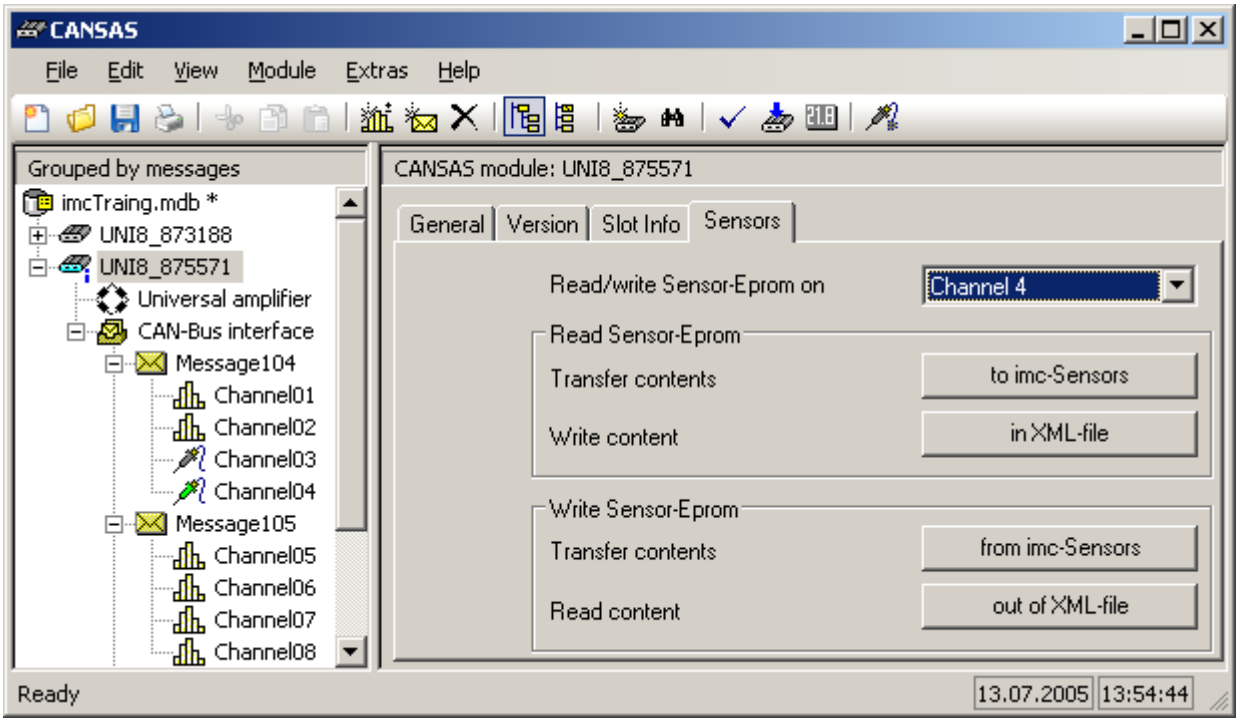


Note Characteristic curves

- When importing characteristic curves from TEDS or imc SENSORS to imc CANSAS, the characteristic curve may not comprise more than 60 measured points. If an attempt is made to import a characteristic curve with more than 60 measured points, a corresponding error message appears.
- As of imc CANSAS Version 1.6R6, characteristic curves are also accepted if the curve's X-values decrease strictly monotonically. Previously, only characteristic curves with strictly monotonically increasing X-values were permitted.

8.9.2.4.2 Exchanging sensor information between the sensor-Eprom and sensor database

With a module selected in imc CANSAS, the Sensors page in its dialog appears as follows:



The pop-down selection list determines which sensor information is imported or exported.

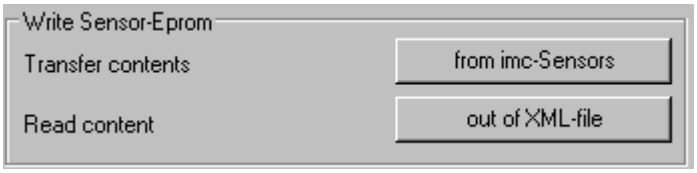
8.9.2.4.3 Read Sensor-Eprom



to imc-Sensors: Exports sensor-EPROM contents to the database *imc SENSORS. imc SENSORS* must be already open.

to XML-file: Exports information from sensor-EPROM and saves it to a file in XML-format. By this means, information from individual sensors can easily be exchanged.

8.9.2.4.4 Write Sensor-Eprom

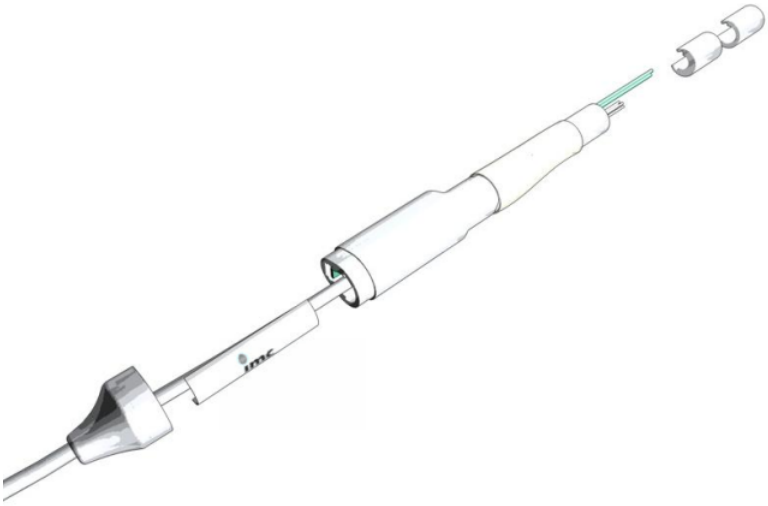


from imc-Sensors: The database *imc SENSORS* is open and a sensor is already selected. The information on the selected sensor is written to the sensor EPROM.

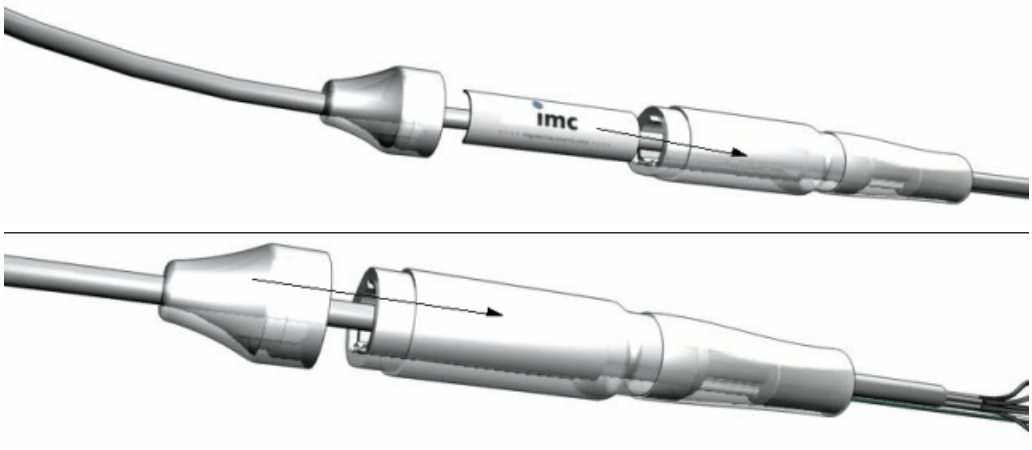
out of XML-file: Sensor information stored in an XML-file is written to the sensor EPROM.

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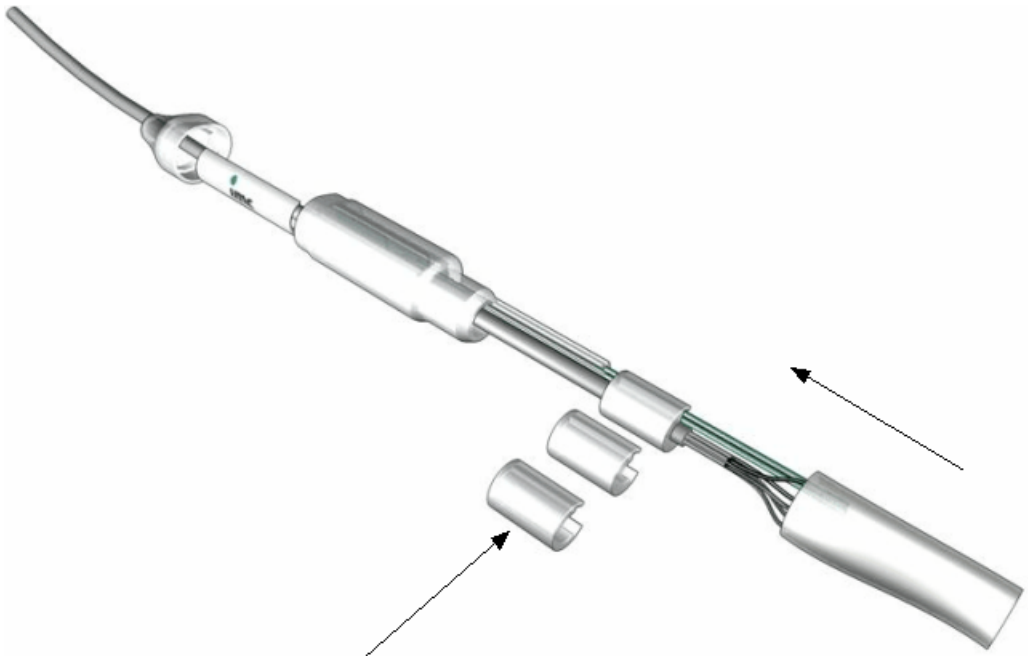
8.9.3 Plug & Measure - Assembly of the sensor clip



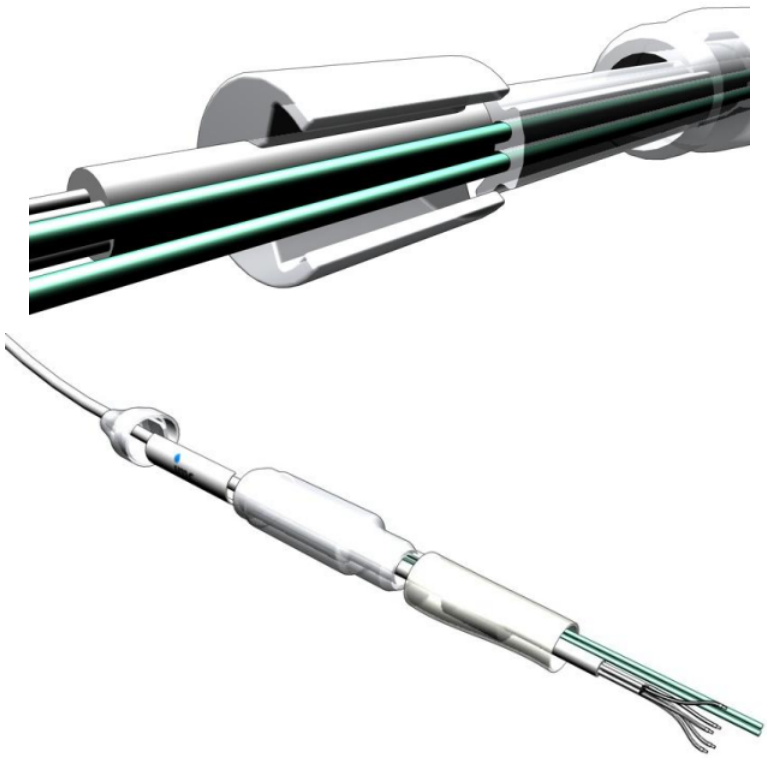
Thread all parts of the Plug & Measure sensor clip to the cable



Insert the written label into the housing. Put on the cap.



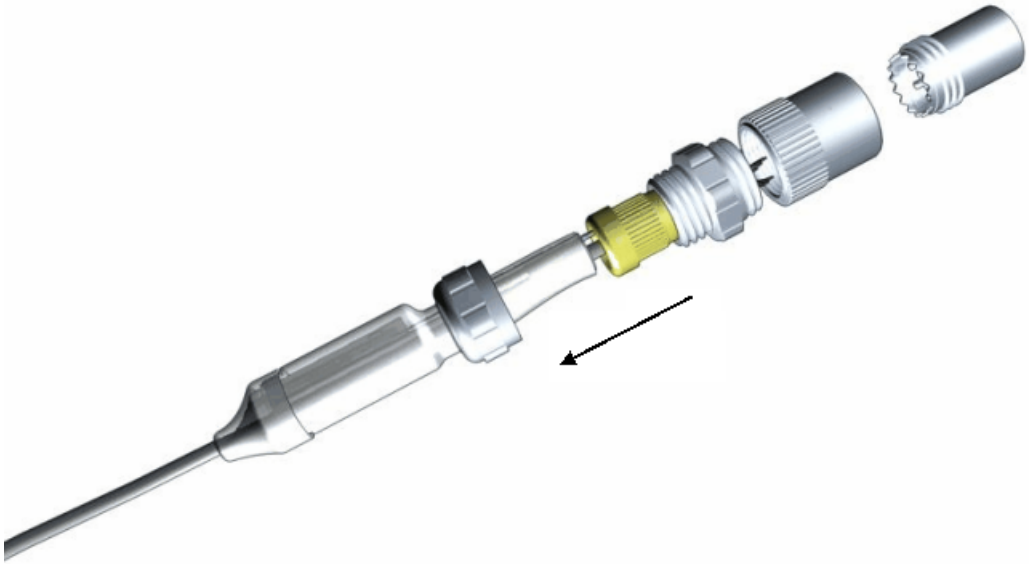
Put on the adaptation tube for the matching cable to the groove from the housing.



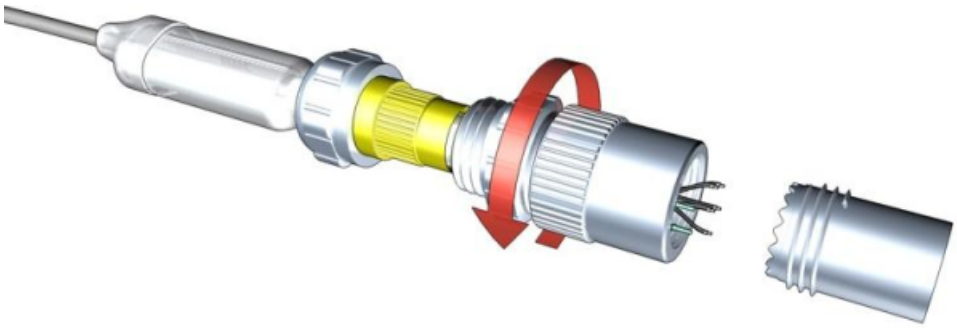
Cover the adaptation shell by the silicone tube over the base of the housing.
Adjust the adaptation shell inside the silicone tube.



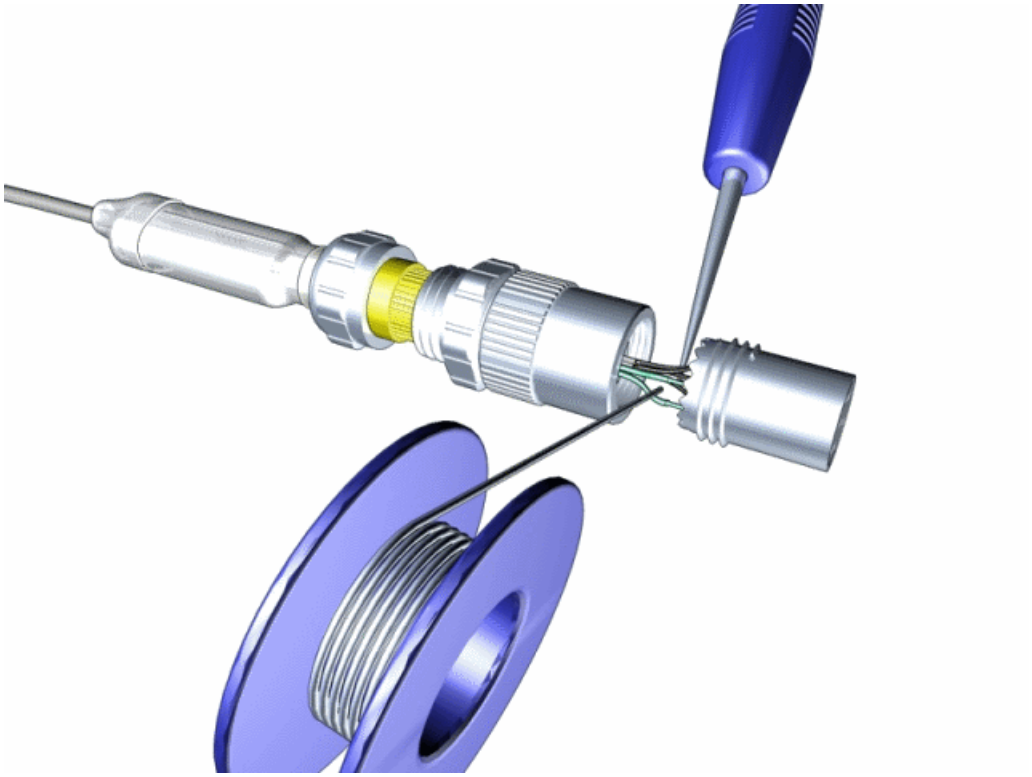
8.9.3.1 Assembly of the ITT-VEAM plug (UNI8)



Move the crimp gasket over the silicone tube.



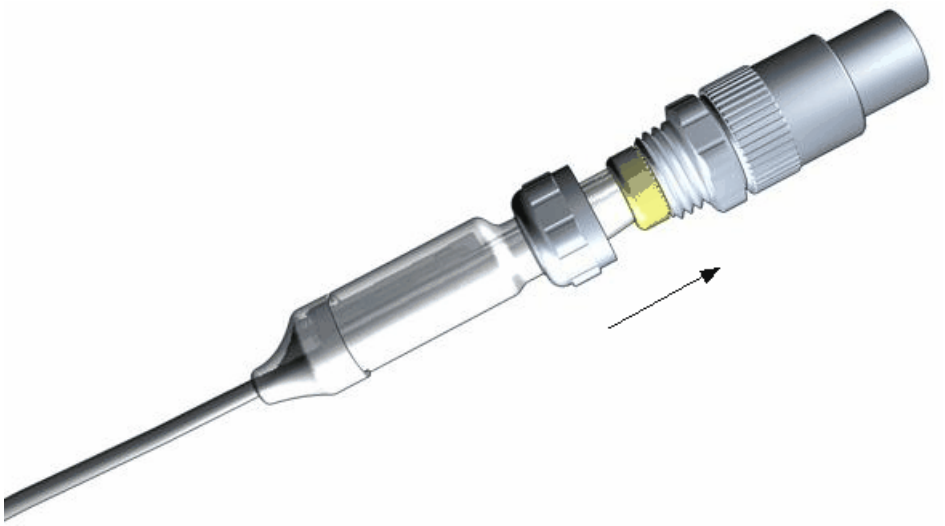
Screw together the connector and move them close to the crimp gasket.



Solder the cable to the pins of the connector.



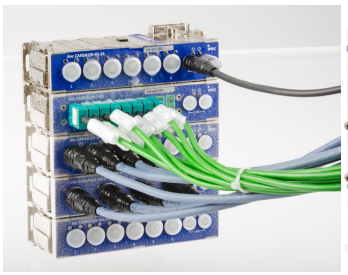
Remove the connector and screw them to the plug.



Bring together all parts and fix them with the screw cap.

9 Properties of CANSAS modules

imc CANSAS module series:

imc CANSAS*fit* CANFT	imc CANSAS*flex* CANFX	imc µ-CANSAS µ-CAN	imc CANSAS other modules
	e.g. CANFX/UNI8		e.g. CAN/IHR
			
Robust and compact modules for mobile measurements on vehicles and machines	Clickable modules for laboratory, test bench and mobile applications on machines, plants and vehicles	Ultra-compact and robust single channel measurement modules with CAN output	Measurement module for continuous measurement of idle current, operating current ans sleep modes

Reference

Properties of:

CANFT modules 246 CANFX modules 280 µ-CANSAS modules 402 other modules available 423

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9.1 CANSASfit (CANFT)

As a CAN-Bus-based test and measurement tool, the imc CANSAS*fit* series offers a selection of measurement modules which precondition and digitize sensor signals and output these as CAN-messages. Their design, the resistance to extreme environmental conditions and the supported sensors and signals make them particularly suited for applications in the fields of automotive engineering, vehicle testing, road trials and measurements on mobile machines.

imc CANSAS*fit* modules can be mechanically and electrically attached to each other by means of a click mechanism. When the module connectors are open, this is accomplished without the need for tools and without additional connecting cables.

For the use of the imc CANSAS*fit* modules according to the general specifications please use the protective covers, see chapter "attachment mechanism 34".

Application fields

- Ideal for vehicle testing and road trials
- Deployable in both distributed installations and centralized measurement setups
- Operable with CAN interfaces and CAN data loggers from either imc or third-party suppliers

Type	Module name imc CANSAS*fit*	Channels per module	Max. sampling rate per channel	Bandwidth	Remarks
Temperature	T-10 262	10	100 Hz	20 Hz	
Temperature	HISO-T-8 276	8	100 Hz	33 Hz	high voltage isolated
Voltage, current, temperature, resistance	UTI-6 264	6	1 kHz	400 Hz	
Voltage, temperature, resistance	HISO-UT-6 277	6	1 kHz	400 Hz	high voltage isolated
High voltage	HISO-HV-4 279	4	1 kHz	400 Hz	
Incremental counter	ENC-6 251	6	1 kHz	2 MHz	
Digital inputs	DI-16 248	16	1 kHz	100 kHz	

Module name imc CANSAS*fit*	as of imc CANSAS version	Heartbeat	TEDS as of version	Readable configuration	Remarks
T-10 262-K T-10, T-10-J, T-10-T	2.0 R7 2.0 R12	2.2 R7	-	2.0 R14	
UTI-6 264	2.0 R7	2.2 R7	2.2 R2	2.0 R14	
ENC-6 251	2.0 R7	2.2 R7	-	2.0 R14	
DI-16 248	2.0 R13	2.2 R7	-	2.0 R14	
HISO-UT-6 277	2.2	2.2 R7		2.2	
HISO-T-8 276	2.2	2.2 R7		2.2	
HISO-HV-4 279	2.2 R7	2.2 R7		2.2 R7	

Reference

Information on the mechanics, cabling and max. stackable number of modules, consider chapter "Startup" 34.

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9.1.1 LED display for all module types

The following description of the LED display applies to all module types. Module-specific blinking codes are provided with the description of the respective module:

- T-10 263
- UTI-6 264
- ENC-6 260
- DI-16 250

First generation T-10 and ENC-6 modules do not support any channel-specific LEDs. **First** generation UTI-6 and DI-16 do support only green LEDs. With these, any errors on even just one of the active channels is indicated by the global module status-LED (flashing red/green).

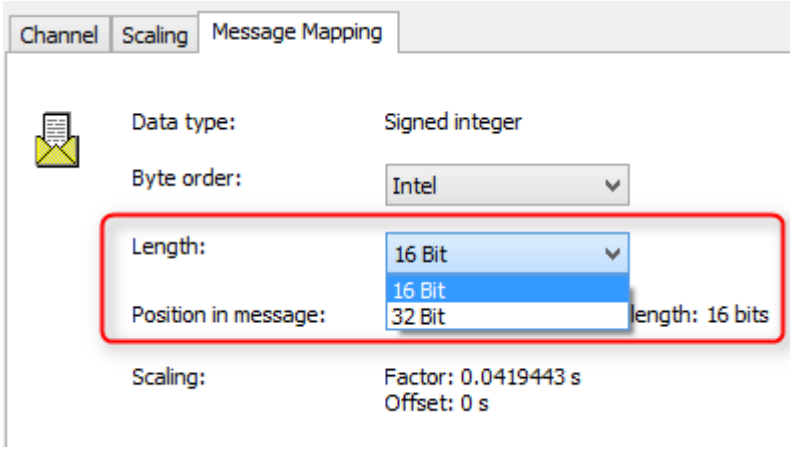
Later series are equipped with per-channel bi-color LEDs (red/green) and indicate the respective channel's error status on these. The global module status-LED is reserved for only general module status issues for these module types.

LED			Remarks
Power-LED		green red	actively supplied polarity error (except: CANFT/HISO variants)
Status-LED		green blue yellow yellow flasching red	active measurement initialization, firmware update etc. configuration setup waiting for configuration (e.g. reset plug detection) error

9.1.2 Message Mapping for imc CANSASfit

The modules belonging to the imc CANSAS*fit* family work at a resolution of **16** or **32-bit Integer** or **24-bit Float**.

The Byte order can be set to the standards of either **Intel** or **Motorola**.



Note

24 bits can only be set if the module identifier is used in Extended Format 65 (2.0B).

9.1.3 DI-16: Digital inputs

The DI-16, belonging to the imc CANSAS*fit*-series, enables the capture of up to 16 digital input signals at a maximum sampling rate of 1 kHz. The capture of digital signals can be performed either bitwise or as data words for all inputs. Either 5 V or 24 V can be selected via the software as the logic level..



CANFT/DI-16

Special Features

- High operating temperature endurance strength: -40°C to +125°C
- Sealing against dust and moisture in accordance with IP65
- Rugged and compact structure
- Snaps together with other units to provide solid mechanical and electrical connection

Reference

- Information on the connection mechanism is provided here. 34
- DI-16 technical specs 475
- Pinout of power supply and CAN (LEMO.0B) 582
- Pinout: Signal terminals (LEMO.1B) 603
- The minimum requirements for the imc CANSAS software are presented in the overview in the section: Properties of the imc CANSASfit modules 246.

Each input block can be configured separately. This includes the selection of two different operation modes:

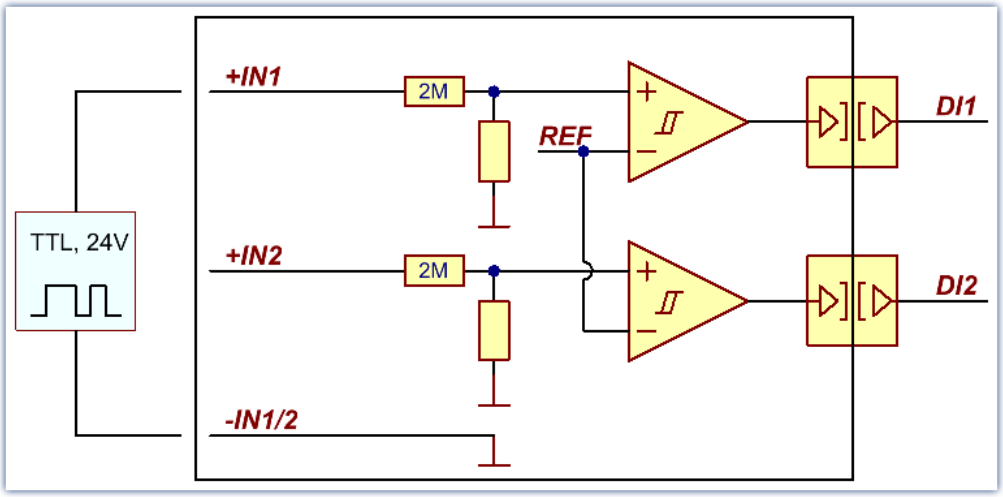
1. **Voltage mode:** For detecting voltage levels when using active sensors at either 5 V or 24 V logic level.
2. **Switch mode:** For detecting a passive contact's switching status. Here, the module returns a level of 5 V.

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9.1.3.1 Block circuit diagram

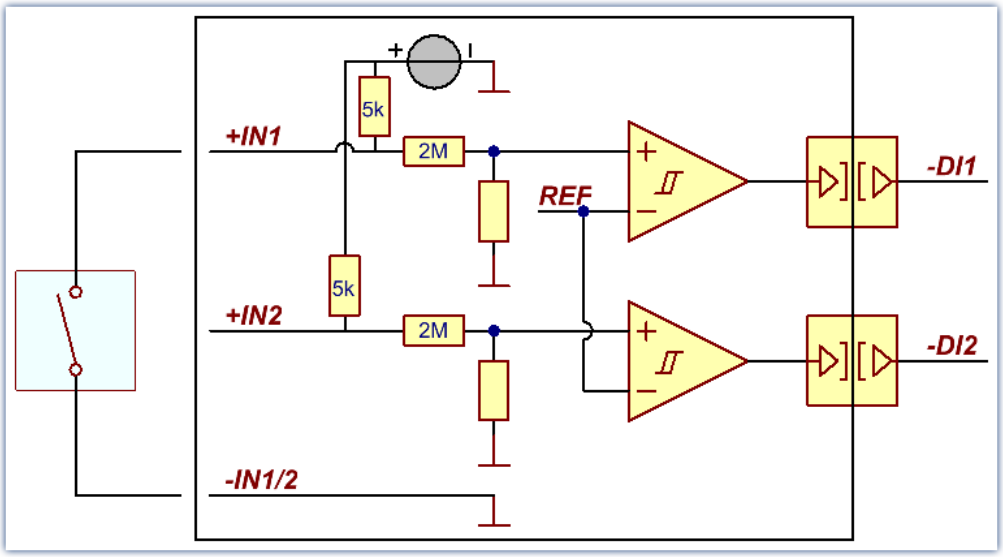
The wiring diagram of the two operation modes is illustrated below (example featuring input "IN1"):

Voltage mode:



Voltage mode: TTL (5 V) or 24 V logic level

Switch mode:



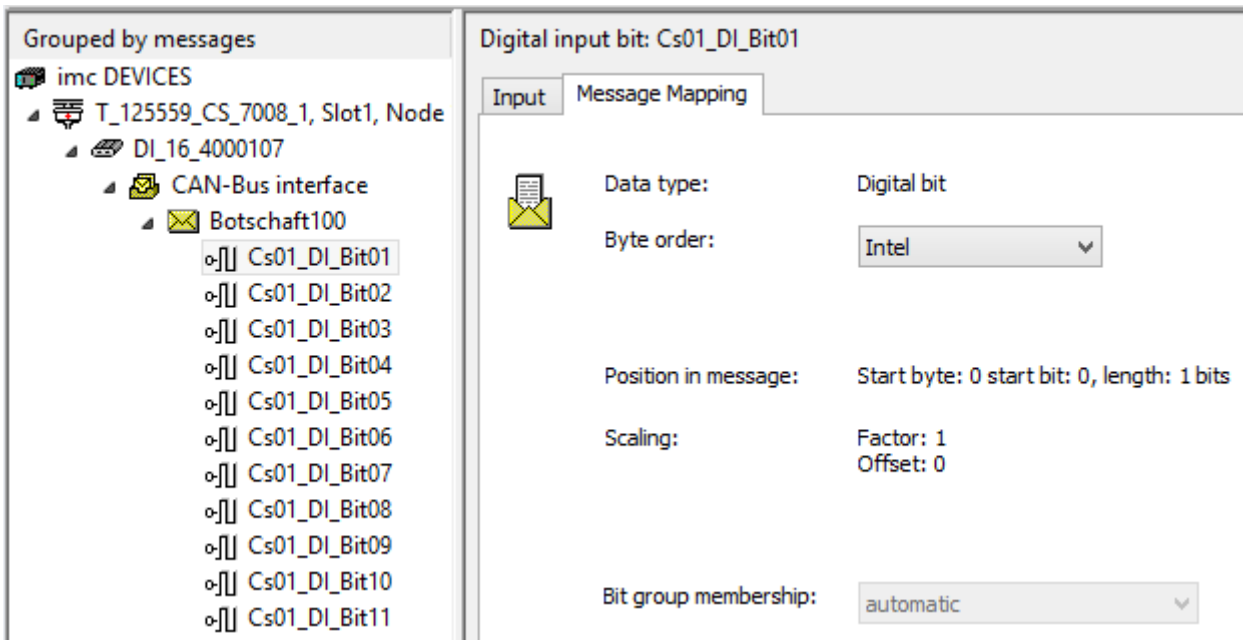
Switch mode: TTL (5 V) logic level

In Voltage Mode, it is additionally possible to select the input signal level (5 V or 24 V), in order to set the correct switching threshold. The two operating modes' input signals trip the logic levels as follows:

	HIGH-Level "1"	**LOW-Level "0"**
Voltage mode	Signal > Threshold	Signal < Threshold
Switch mode	contact closed	contact open

9.1.3.2 Message mapping

The byte order can be set to the standards of either **Intel** or **Motorola**.



9.1.3.3 Blink codes

DI-16 with individual channel-LED and one global module LED

For each input block, there is a control LED above the associated Lemo connector. The functioning of this control light is set in the software.

Parameter			Value
Status-LED		green	active measurement
		blue	Initialization, firmware update etc
		yellow	preparing configuration
		red	error
Channel status-LED		off	voltage mode: both bits of the group have an input signal level that is lower than the selected switching threshold ("low")
			contact mode: both bits of the group have a closed contact ("high")
		green	voltage mode: at least one bit of the group have an input signal level that is higher than the selected switching threshold ("high")
			contact mode: at least one bit of the group have an open input ("low")

9.1.3.4 Connection

Pin configuration LEMO plug 603.

9.1.4 ENC-6: pulse signals and incremental counter channelss

The ENC-6 module from the CANSAS*fit* series is a 6 channel pulse counter unit, suited to measure RPM, based on incremental encoder signals. It is generally capable to interface with any type of sensors that deliver pulse signals and can derive output values such as:

- RPM, speed, angle, displacement
- frequency, events, time, PWM



CANFT/ENC-6

The **analog bandwidth** (without low-pass filtering) of the isolated voltage channels is **2 MHz**.

Reference

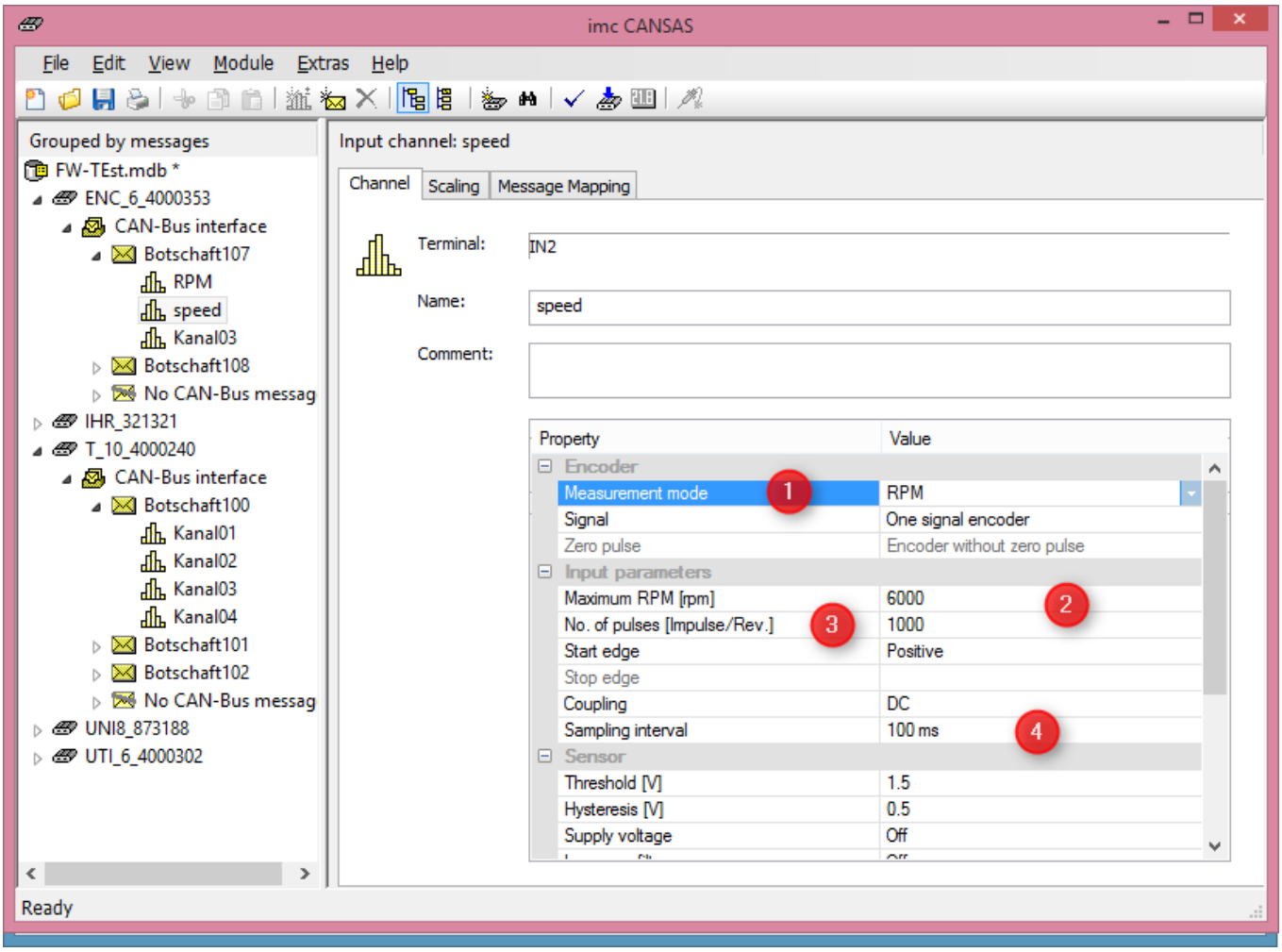
- Information on the connection mechanism is provided here 34
- ENC-6 technical specs 476
- Pinout of power supply and CAN (LEMO.0B) 582
- Pinout: Signal terminals (LEMO.1B) 603
- Properties of the imc CANSASfit modules 246.

9.1.4.1 Measurement modes

The following operation modes are available to select for each of the 6 channels separately. Derived variables from:

Event counting	Combination of event counting and time measurement	
• Events (differential, sum) • Distance (differential, sum) • Angle (differential, sum, absolute)	• Frequency • RPMs • Velocity	• PWM • Time measurement

A detailed description of how incremental encoder sensor signals are captured is presented in the chapter "Measurement types" 191.



[1] *Measurement mode* **[2]** *Measurement range* **[3]** *Entry for pulses per revolution* **[4]** *Sampling interval*

The **sampling interval** indicates at what "distance" in time the measurement result is outputted (or internally: at what interval the counters are evaluated).

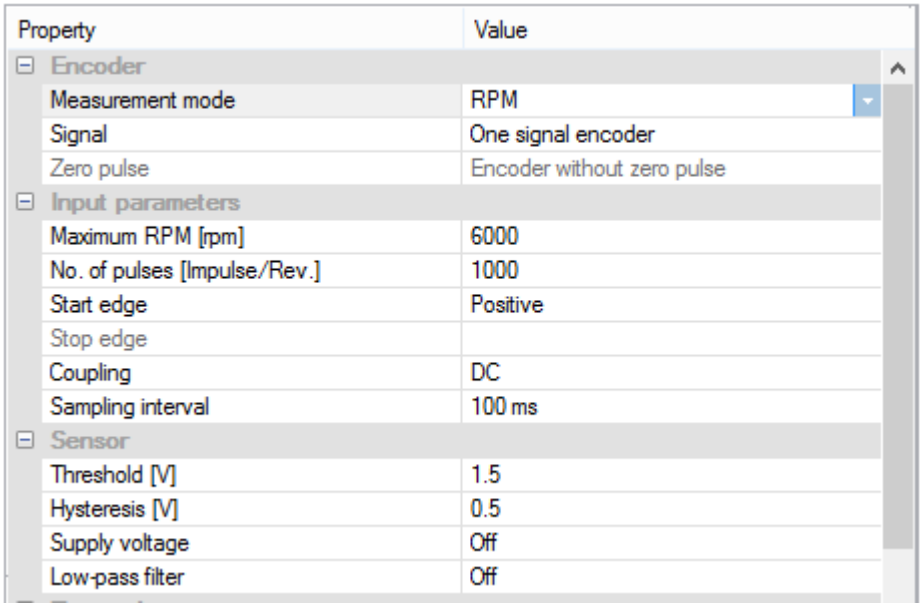
The available intervals are:

1 ms	10 ms	100 ms	1 s	10 s	60 s
2 ms	20 ms	200 ms	2 s	20 s	
5 ms	50 ms	500 ms	5 s	30 s	

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9.1.4.1.1 RPM

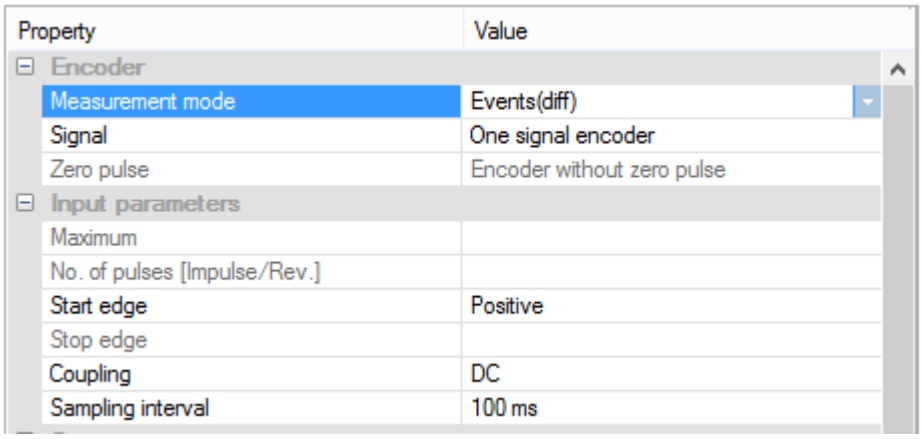
The unsigned rotation speed signal can be captured by a single-track encoder, or by a dual-track encoder with an indication of the forward and reverse directions.



Along with measurement modes for **single-signal** and **dual-track encoders**, the **pulse count per revolution** must be specified. In conjunction with the **maximalum rotation speed**, the measurement range's resolution is derived. The **index channel** is **not** evaluated.

9.1.4.1.2 Events

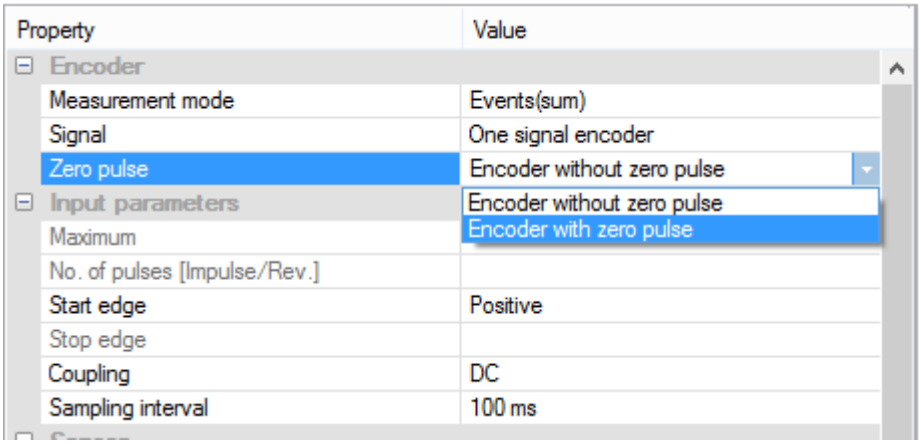
Events, differential



Differential **event counting** records the pulse count **within one** sampling **interval**. In this mode, the **index channel is not** evaluated. As well, **dual-track encoders** for counting upward and downward are not supported.

Besides the **measurement mode** and the **sampling interval**, no further parameters are necessary.

Events, cumulative



Cumulative event counting adds the count of all pulses. **Dual-track encoders** for counting upward and downward are supported.

In this mode, the **index channel** is evaluated. The count commences with the first zero pulse after activation.

The **maximum achievable value** is the result of the numerical format set.

Examples:

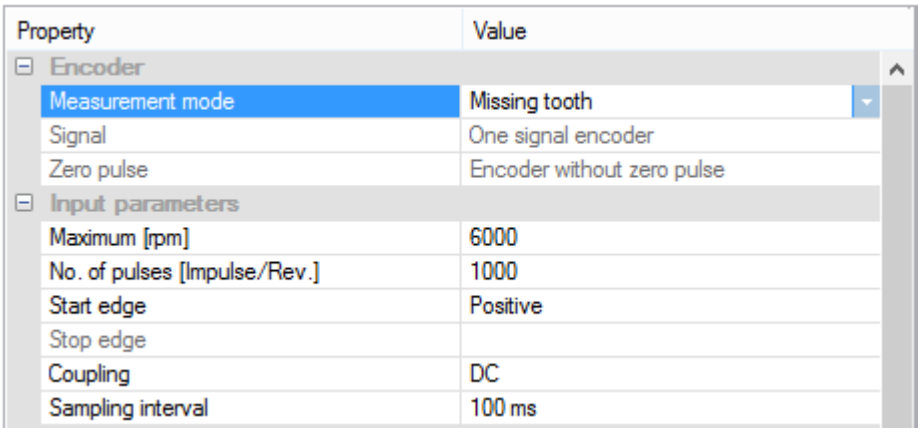
16-bit: $(2^{15}-1)=$ 32.767 pulses

32-bit: $(2^{31}-1)=$ 2.147.483.647 pulses, thus approx. $2{,}14*10^{9}$

Once the maximum displayable numerical value has been reached, the display reverts to zero.

9.1.4.1.3 RPM with missing tooth

Measurement of rotation speed using encoders having missing teeth is performed by means of a **single-track encoder**. The start occurs at the first gap.

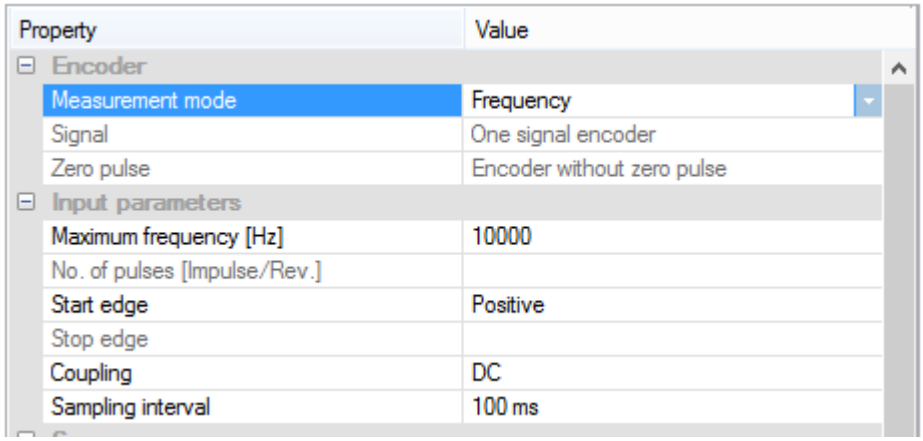


Along with the **pulse count per revolution**, it is also necessary to specify the **maximum rotation speed**. The maximum rotation speed determines the resolution of the measurement range.

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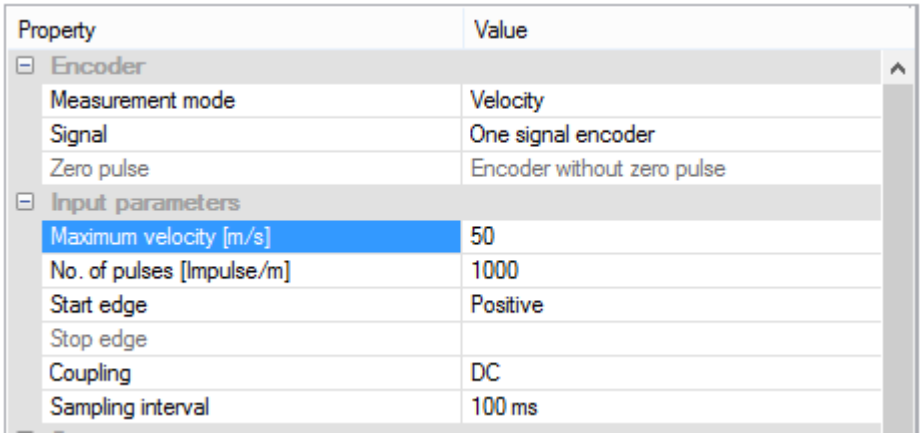
9.1.4.1.4 Frequency

To measure frequency, only a single-track encoder is used. The **maximum frequency** is indicative of the measurement range resolution.



9.1.4.1.5 Velocity

The unsigned speed signal can be captured by a **single-track encoder**, or by a **dual-track encoder** with an indication of the forward and reverse directions. The zero pulse on the **index channel** is **not** evaluated.

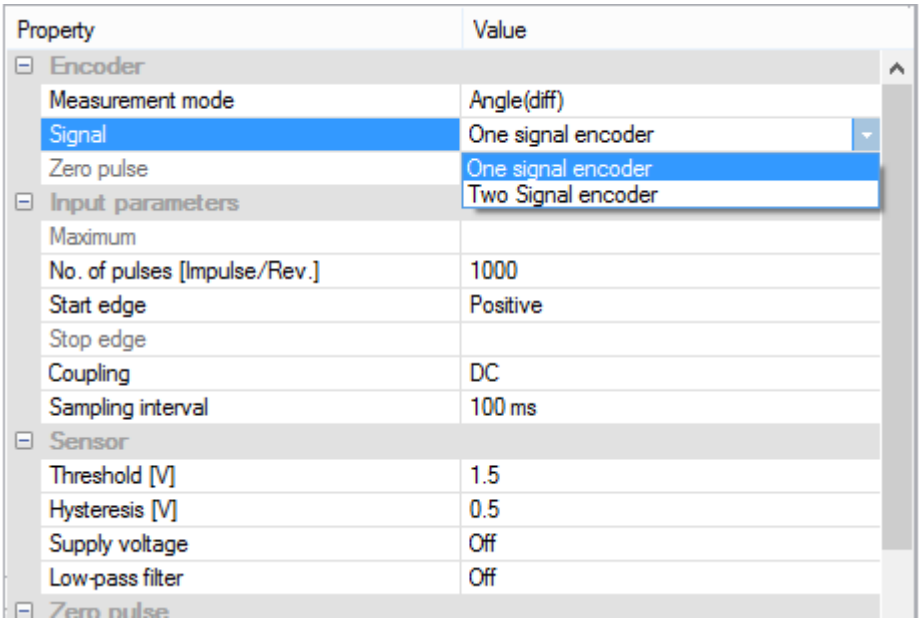


Along with measurement modes for **single-signal** and **dual-track encoders**, the **pulse count per meter** must be specified. In conjunction with the **maximalum speed**, the measurement range's resolution is derived.

9.1.4.1.6 Angle

Differential angle

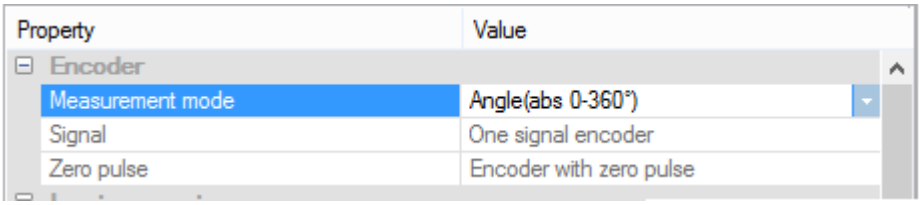
The unsigned angle signal can be captured by a **single-track encoder**, or by a **dual-track encoder** with an indication of the forward and reverse directions. There is **no** differential evaluation of the zero pulse on the **index channel**.



Along with the **measurement mode**, the **pulses per revolution** and the **sampling interval** must be specified. Specification of the measurement range is not applicable to angle measurement.

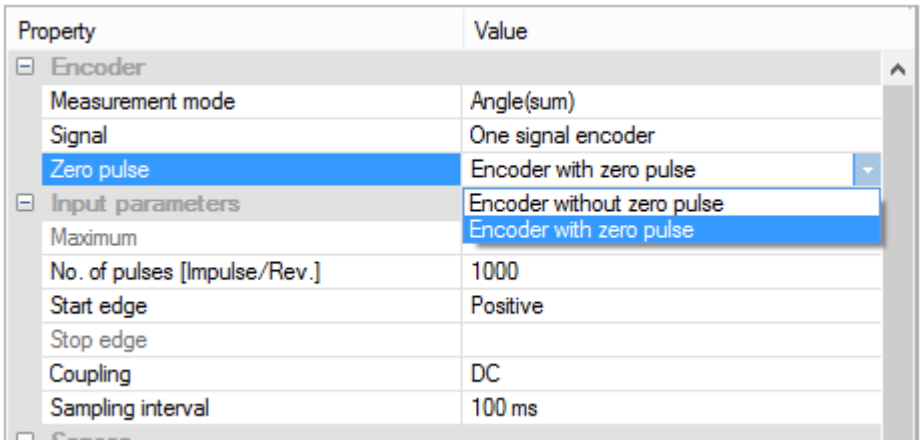
Absolute angle 0...360 °

The **absolute angle** can only be measured with a **single-track encoder** and **available zeropulse**.



Angle sum

The unsigned angle signal can be captured by a **single-track encoder**, or by a **dual-track encoder**.



A connected **index channel can be evaluated**. Once the module is switched on, the count begins upon the first zero pulse. Manual resetting via hardware or a CAN-message is in preparation.

The **maximum achievable value** is derived from the scaling and the numerical format set.

Examples:

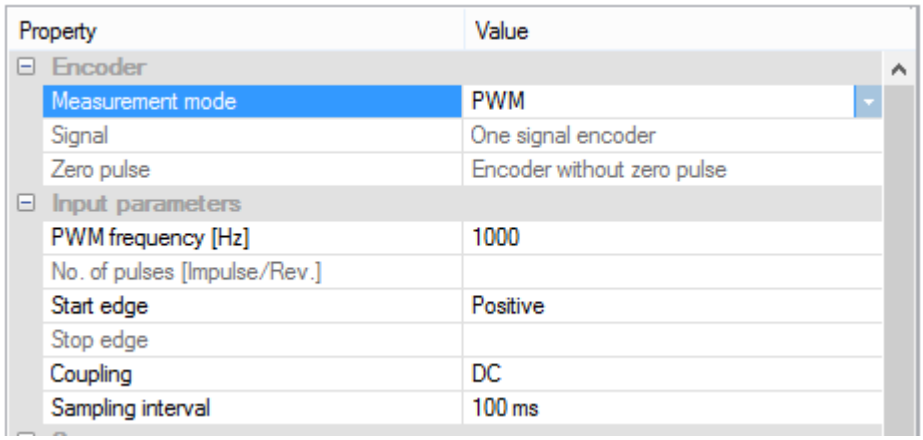
360 pulses/revolution with 16-bit: $(2^{15}-1)/360$ = 91.019 revolutions

3600 pulses/revolution with 32-bit: $(2^{31}-1)/3600$ = 596,523.235 revolutions, approx. 600 thousand revolutions

Once the maximum displayable numerical value has been reached, the display reverts to zero.

9.1.4.1.7 PWM

An unsigned PWM (**P**ulse-**W**idth-**M**odulation) signal is evaluated by means of a **single-track encoder**. The zero pulse on the **index channel** is **not** evaluated.



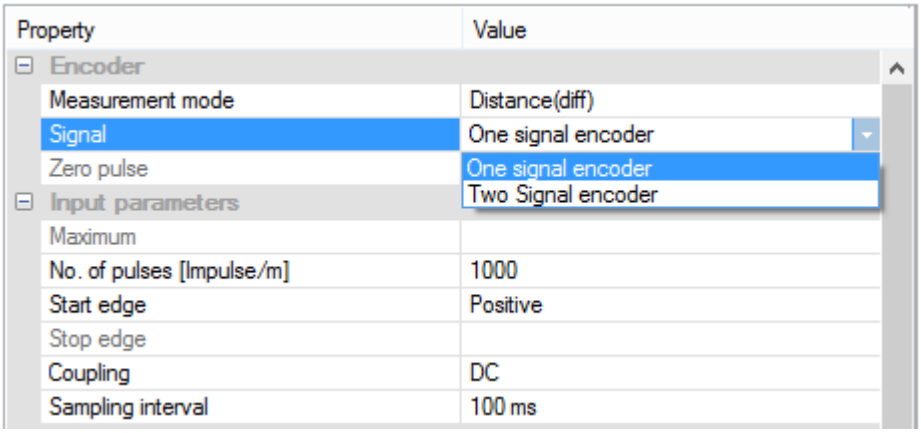
The result is a value between **0 and 100%** of the pulse width. The signal frequency of the PWM signals must be specified exactly. By means of the Start edge, you can determine whether the result represents the positive portion (Start edge=Positiv) or the negative portion (Start edge= Negative).

9.1.4.1.8 Distance

The **unsigned distance** signal can be captured by a **single-track encoder**, or by a **dual-track encoder** with an indication of the **forward and reverse** directions.

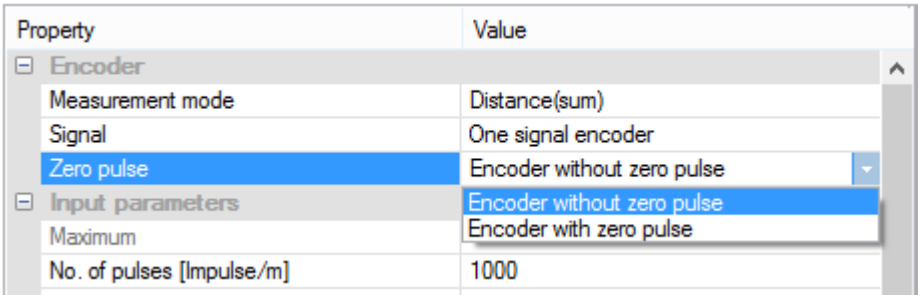
Along with the **measurement mode**, the **pulses per meter** and the **sampling interval** must be specified. Specification of the measurement range is **not** applicable to distance measurement.

Differential distance



In the mode Distance (differential), the **distance per sampling step** is determined. The zero pulse on the **index channel** is **not** evaluated in this mode.

Cumulative distance



The cumulative distance reflects the **total distance**. In this mode, the **index channel can be evaluated**. Once the device has been switched on, the count commences upon occurrence of the first zero pulse.

Manual resetting by means of hardware or CAN-message is in preparation.

The **maximum achievable value** is derived from the scaling and the numerical format set.

Examples:

$(2^{15}-1)/1000=$ 32.767m

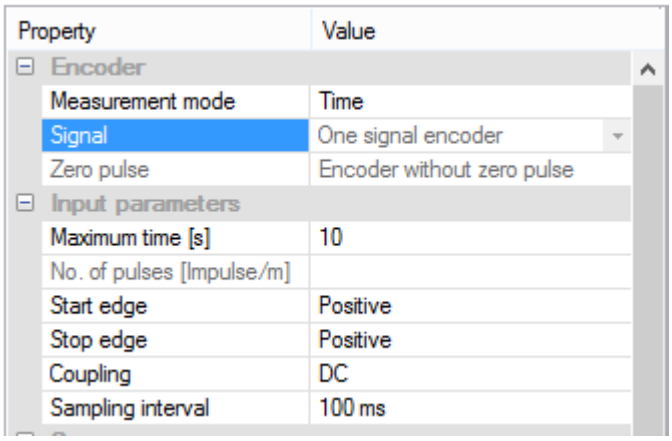
$(2^{31}-1)/2000=$

1000 pulses/m with 16-bit:	$(2^{15}-1)/1000$	=32.767m
2000 pulses/m with 32-bit:	$(2^{31}-1)/2000$	=1,073,741.824m, thus approx. 1073 km

Once the maximum displayable numerical value has been reached, the display reverts to zero.

9.1.4.1.9 Time

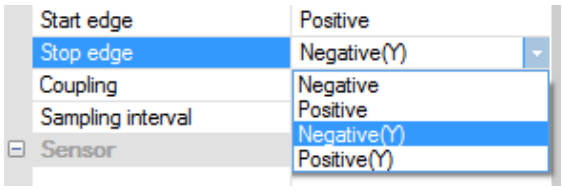
Time measurement is performed by means of **Signal: single-track encoder**.



The **Maximum time** determines the resolution of the measurement range. Possible values: 1ms - 20s.

The period of time to be measured is defined by means of the Start- and Stop edges.

Although the setting **single-track encoder** is fixed, it is possible to use a **dual-track encoder** to capture the Stop-edge. To do this, select the entry with "(Y)".



9.1.4.2 Encoders

	Single-track encoders		Dual-track encoders	
Measurement variable	**without**	**with zero pulse**	**without**	**with zero pulse**
RPM	√		√	
Events differential	√		√	
Events sum	√	√	√	√
Frequency	√			
Speed (velocity)	√		√	
PWM	√			
Distance, differential	√		√	
Distance, cumulative ("sum")	√	√	√	√
Angle differential	√		√	
Angle absolute		√		
Angle sum	√	√	√	√
Time	√		√(Y)	

9.1.4.3 LED blink codes

ENC-6 with individualized channel-LED and a global module-LED

Parameter			Value
Status-LED		green blue yellow red	active measurement initialization, firmware update etc. configuration setup error
Channel Status-LED		off green red	channel configured as passive channel active SUPPLY overload (for modules with bi-color channel LED)

9.1.4.4 Channel mapping

LEMO	1	2	3	4	5	6	
Group	group A			group B			
Channel	Channel_1	Channel_2	Channel_3	Channel_4	Channel_5	Channel_6	inputs
Sensor	1-signal 2-signal	1-signal	1-signal	1-signal 2-signal	1-signal	1-signal	sensor type
Tracks	+/- X1 +/- Y1	+/- X2	+/- X3	+/- X4 +/- Y4	+/- X5	+/- X6	diff. tracks
Index	index A			index B			zero pulse
	single-ended	single-ended	single-ended	single-ended	single-ended	single-ended	connection
Supply	+SUPPLY A GND A			+SUPPLY B GND B			+5V/+12V

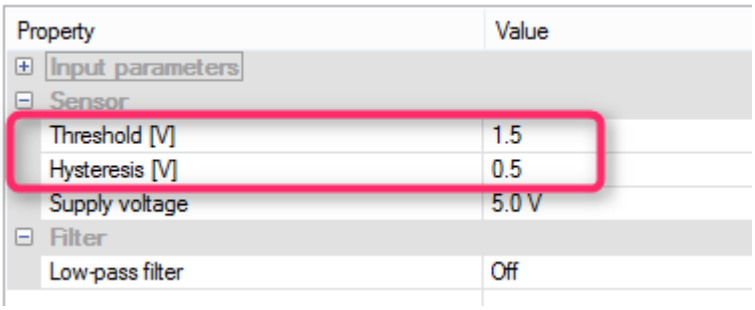
9.1.4.5 Comparator configuration

The conditioning can be set **individually** for all 6 incremental counter channels. For dual-track encoders, there is a uniform switching threshold.

The maximum input voltage range of the switching threshold is +/- 50 V; up to 12 V the range is linear.

The available hysteresis is 100 mV to a maximum of 40% of the threshold.

The parameters are entered by means of the table of the channel's properties:



9.1.4.6 Message mapping

The description of the message mapping in imc CANSAS*fit* is presented **here** 247.

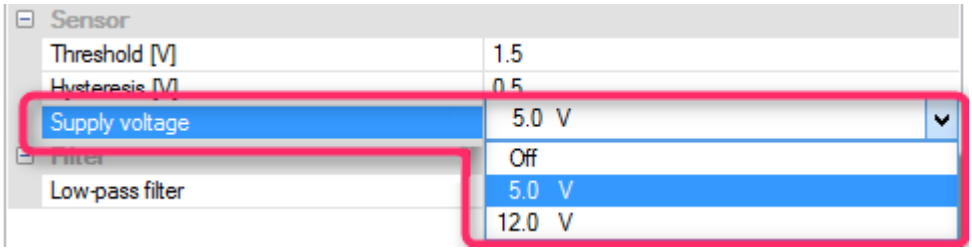
9.1.4.7 Sensor supply

The ENC-6 comes with a sensor supply which can supply **5 V or 12 V for each 3-channel group**.

In an ENC-6 module the groups consist of the input channels 1...3 and 4...6.
The maximum power and amperage are noted in the ENC-6 technical specifications 479.

On the LEMO socket 603, the sensor supply's contacts are the pins **3 (+SUPPLY)** and **4 (GND)**.

The voltage is set using the software:



Setting the supply voltage for CANSASfit-ENC-6

9.1.4.8 Connection

Pin configuration LEMO plug 603.

9.1.5 T-10: temperature measurement

The T-10 CANSAS*fit* is a 10-channel module for the measurement of temperatures with thermocouples.



Highlights

- per-channel isolated measurement inputs, individualized filters and ADCs
- High temperature resistance: -40°C to +125°C
- Extreme robust (IP65)
- small/compact
- Clickable with mechanical and electrical connection simultaneously

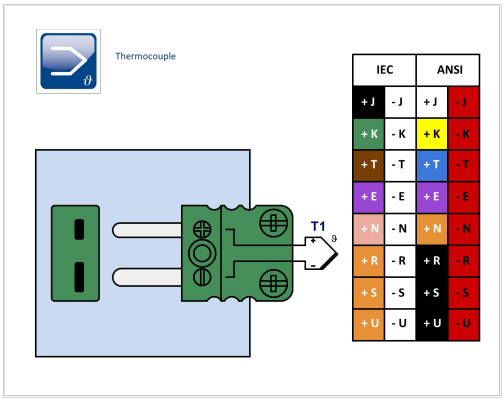
- The modules belonging to the imc CANSAS*fit* family work with a resolution of 16 bit integer or 24 bit float. Adjustable in tab "*Message Mapping*".

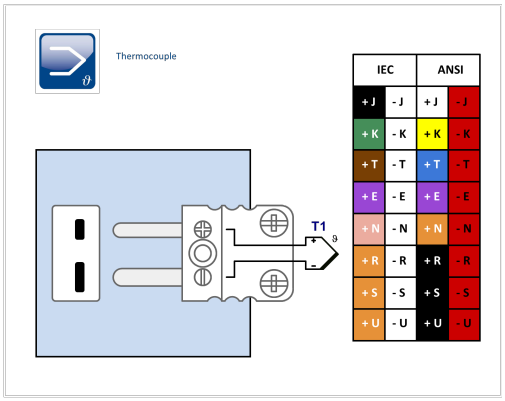
Reference

- Please find here information about the attachment mechanism 34
- Technical Specs T-10 491
- Pin configuration power and CAN (LEMO.0B) 582
- Please find in the chapter: Properties of the imc CANSASfit modules 246, an overview of the imc CANSAS Software version requirement.

9.1.5.1 Temperature measurement

The imc CANSAS*fit*-T-10 is designed for direct temperature measurement with thermocouples.





Module	type	color of the socket
T-10	K, J, T, E, L, N, B, S, R	white (**UNI**) max. 2 types simultaneously in the same configuration
T-10-K	K	green
T-10-J	J	white
T-10-T	T	white
T-10-N	N	pink

The **unit** is defined on the "*T-10 temperature measurement*" card, see Screenshot 276.

9.1.5.2 Open Sensor Detection

The module continuously checks whether the thermocouple is connected to the measuring input and displays a substitute value in case of an error (cable break).

Channels transmitted at 16 bits approach 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 sensor is broken, unless such temperatures could really occur at the measurement site.

Channels transmitted at 32 bits display a value of -2000°C and are thus unambiguously indicating sensor breakage.

The **replacement value** will be displayed:

- If at least one of the ***thermocouple's*** two lines breaks.
- If a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected.
- If the cold junction compensation is missing.

9.1.5.3 Message Mapping

The description of message mapping in imc CANSAS*fit* is presented here 247.

9.1.5.4 LED blink codes

T-10 modules of the first series do not have channel-specific status-LEDs for all active channels. In these modules, any error affecting any one of the active channels is indicated by the global module status-LED.

Later series will use bi-color LED (red/green), which each indicate the error status of the respective channel. For these types, the global module status-LED is reserved for indicating general module states.

For all available module variants the same LED blink codes are applicable.

T-10 with one global module LED

Parameter			Value
Status-LED		green	active measurement
		blue	initialization, firmware update etc.
		yellow	configuration setup
		red	error
		red/green flashing	cable breakage in at least one active channel

T-10 with individual channel-LED and a global module-LED

Parameter			Value
Status-LED		green	active measurement
		blue	initialization, firmware update etc.
		yellow	configuration setup
		red	error
Channel status-LED		off	channel configured as passive
		green	channel active
		red	overmodulation or cable breakage

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9.1.6 UTI-6: voltage, current, temperature and resistance

The UTI-6 is a 6-channel universal measurement amplifier which captures analog physical measurement variables, digitizes them and outputs the data via CAN-bus. Individually isolated, configurable and differential channels capture:

- Voltage (25 mV to 60 V)
- Current (20 mA sensors)
- Temperature (PT100, PT1000)
- Resistance (e.g. NTC)

For powering external sensors a software selectable sensor supply is integrated.

The modules belonging to the imc CANSAS*fit* family work with a resolution of 16 bit integer or 24 bit float. Adjustable in tab "*Message Mapping*".

Two variants of the UTI-6 module are available: The CANFT/UTI-6-SUP (with bipolar sensor supply) and the CANFT/UTI-6-TEDS (with unipolar sensor supply). The UTI-6-TEDS module supports TEDS for reading sensor information. Writing of TEDS is not supported by this module. The module variant without sensor supply is no longer offered.

Each channel captures signals up to a **bandwidth of 400 Hz** and can be **sampled at up to 1 kHz**.

The **negative measurement input** should be connected to the terminal of the source to be measured of which the impedance to device ground (Chassis) is lowest. This impedance is a parallel connection of a resistance and of a capacitance between the source and the reference voltage of the overall measurement setup.

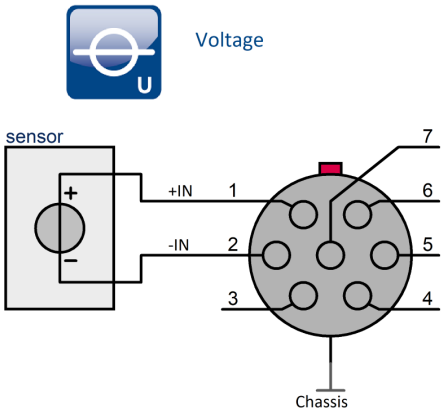
If a measurement input is deactivated by the user or if the device is not supplied with energy, then the impedance between the two measurement inputs +IN and -IN is approximately 1 MΩ.

This module does not support the option *Readable configuration* 111.

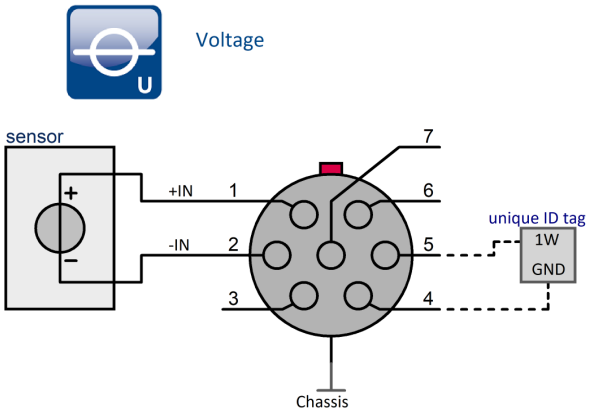
Reference

- Please find here information about the attachment mechanism 34
- Technical Specs UTI-6 495
- Pin configuration power and CAN (LEMO.0B) 582, Pin configuration signal connection 602
- Properties of the CANFT modules 246

9.1.6.1 Voltage measurement

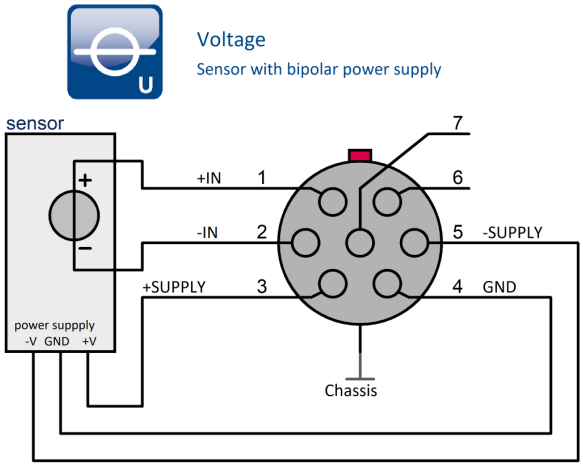


UTI-6-SUP

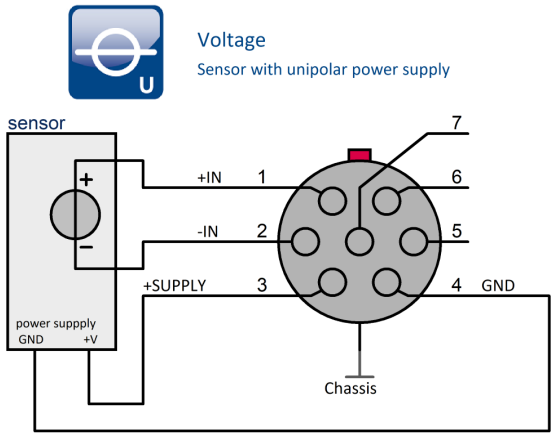


UTI-6-TEDS

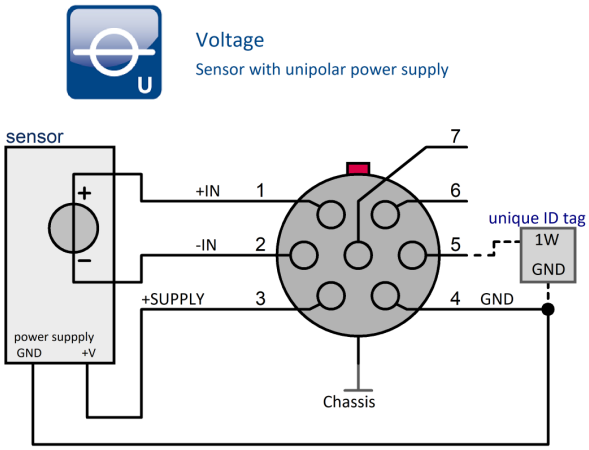
9.1.6.1.1 Voltage with bipolar power supply



9.1.6.1.2 Voltage with unipolar power supply



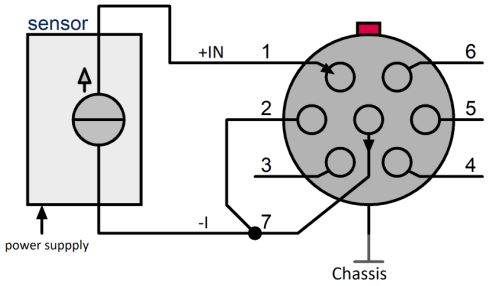
UTI-6-SUP



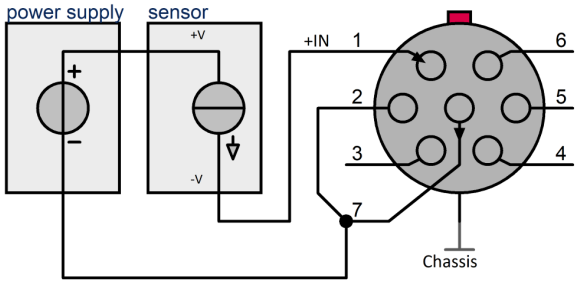
UTI-6-TEDS

9.1.6.2 Current measurement

The connection between **-IN** (pin 2) and **-I** (pin 7) must be made directly in the connector and the current must be applied to **-I** (pin 7). Any additional cable lead would falsify the internal 25 Ω shunt applied.

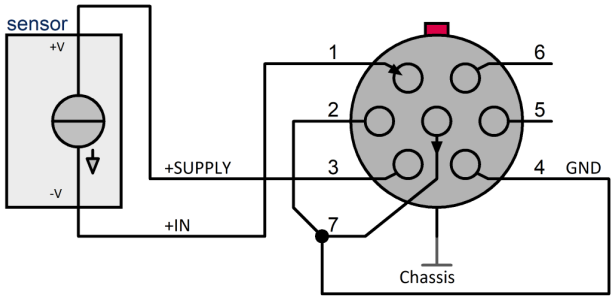


current measurement I (general)

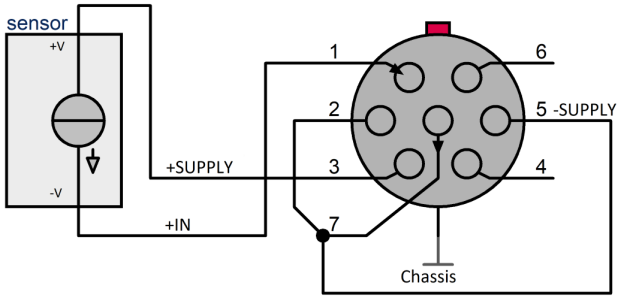


current measurement II

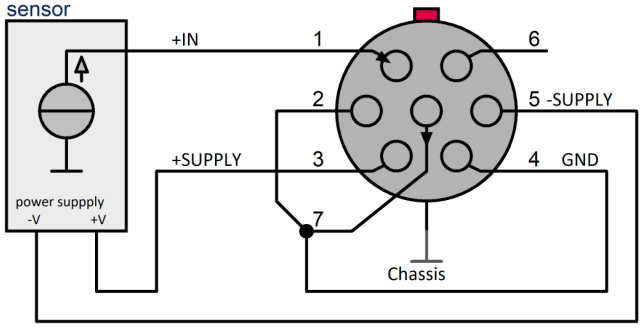
For current measurement, the current is passed through the device from "+IN" to "-I" and generates a voltage drop of approx. 25 mV per 1 mA, as shown in figures above. The current is powered by an external source with its own supply. With two-wire sensors, it is connected in series to the sensor, see Fig. current measurement II.



unipolar sensor supply 5 V to 15 V



unipolar sensor supply 24 V



3-wire sensor and bipolar sensor supply ±15 V

If the sensor is supplied by the measuring device, a distinction must be made between unipolar and bipolar supplied sensors. This can be recognized by the number of connections. Sensors with unipolar supply have two connections, sensors with bipolar supply have three connections. In the figures above, these two types are referred to as "Two-Wire Current Loop" and "Three-Wire Current Loop" respectively.

- The sensors with two-wire connection (unipolar supply) are encoders with the classic 0 mA/4 mA ... 20 mA current loop. The signal has only positive polarity.
  If the current loop requires a supply greater than 15 V (standard), the sensor must be connected to +SUPPLY and -SUPPLY according to Fig. "*unipolar sensor supply 24 V*". For the setting of the supply voltage of ±12 V, for example, 24 V are available for the current loop.

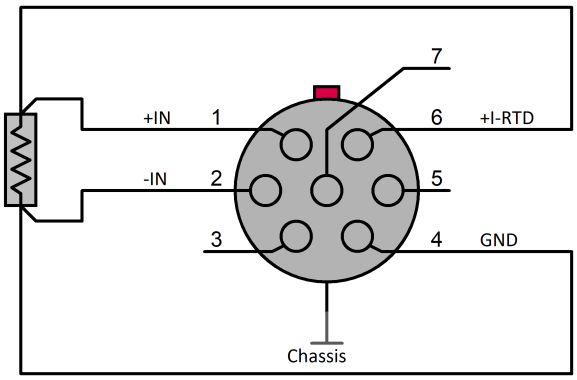
- Sensors with three-wire connection (bipolar supply) can supply signals of both polarity, see Fig. "*3-wire sensor*".

By default, the software imc CANSAS has a symmetrical measuring range for positive and negative levels. At 4 mA ... 20 mA current loops and the data format 2 byte integer, the value range -20 mA ... 20 mA is transmitted on the CAN bus (a scaling of the CAN message via virtual channel is not possible).

Note

Fig. 2b and Fig. 3 do not apply to the variant with TEDS: UTI-6-TEDS.

9.1.6.3 Resistance measurement



Note

Ensure good isolation!

The deviation due to the isolation resistance is:

$$\varepsilon = \frac{R}{R+R_{iso}} \cdot 100\%$$

A source supplies the resistance to be measured with a constant current. This creates a voltage across it, which is detected by the measuring input and used to calculate the resistance value. The voltage should be taken with separate lines in four-wire circuit (Kelvin connection) so that the current-carrying conductor resistances do not distort the result.

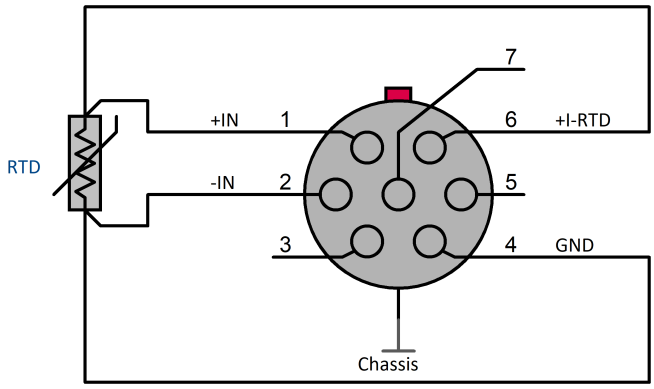
If the line resistances are negligibly small compared to the resistance, the two-wire circuit can be used. The measurement inputs +IN and -IN must be connected directly to +I-RTD or GND in the connector. So that the influence of the cable resistances remains smaller than the deviation of the measuring channel, the distance between resistance and measuring module should remain smaller than the values from the following table:

Cross section [mm²]	resistance per conductor length Cu at 20°C [mΩ/m]	corresponding to AWG
0.14	127	26
0.25	71	23
0.34	52	22
0.38	47	21
0.5	35	20

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max. cable length for 2-wire configuration [m]		cross section				
measurement range	supply current	0.14 mm²	0.25 mm²	0.34 mm²	0.38 mm²	0.5 mm²
100 kΩ	25 µA	142				
50 kΩ	50 µA	71	126			
25 kΩ	0.1 mA	35	63	86	96	126
10 kΩ	0.25 mA	14	25	34	38	51
5 kΩ	0.5 mA	7	13	17	19	25
2.5 kΩ	1 mA	4	6	9	10	13
1 kΩ	1.25 mA	1.4	3	3	4	5
500 Ω	1.25 mA	0.7	1.3	2	2	3
250 Ω	1.25 mA		0.6	0.9	1.0	1.3
100 Ω	1.5 mA					0.5

9.1.6.4 RTD measurement



We recommend **sampling at 100 ms and mean-value filtering**. By this means, any coupling of 50 Hz / 60 Hz interference by the sensor or cables is effectively suppressed. The signal needs between one and two sampling intervals (200 ms) for transients to subside. This time may also be prolonged by the sampling interval of CAN-Bus polling. On the other hand, if the CAN-Bus messages are recorded with a time stamp, the polling uncertainty is reduced and is in the range of a few microseconds.

The **unit** is defined on the "*UTI-6-High isolated amplifier*" card, see Screenshot.

The following table shows a rough approximation of the deviation per meter (copper cable, two-wire connection):

Cross section [mm²]	PT100 [K/m]	PT1000 [K/m]
0.08	1.2	0.12
0.14	0.7	0.07
0.25	0.4	0.04
0.34	0.3	0.03

Regardless of the type of connection (two-, three- or four-wire connection), good isolation must be ensured!

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T [°C]	ΔT (PT100) [K]	ΔT (PT1000) [K]
-200	0	0
0	0	-0.03
100	-0.01	-0.05
300	-0.01	-0.13
500	-0.02	-0.24
850	-0.05	-0.52

Table: Measurement error for isolation resistance of 10 MΩ

9.1.6.5 Filters

Channels in the voltage-, current- and resistance measurement mode can be filtered in a variety of ways.

Mean (default)

Several measured values, which are detected with the maximum sampling rate and fall within the selected sampling time, are combined to form an arithmetic mean value. The number is given by the ratio of the data rate on the CAN bus (sampling time) and the smallest sampling time (maximum sampling rate). The mean value formation has a low-pass filter effect - the settling occurs without overloading in approximately two sampling times.

Anti-aliasing filter (AAF)

Depending on the selected sampling rate, a low pass is set, which is about 40% of the sampling frequency. This filter has the largest useful bandwidth and a very steep transition from the transmission to the blocking range (very large blocking attenuation). The settling time is considerable. It should be used only with large interferences above the Nyquist frequency. The signal-to-noise ratio is about a factor of 2 better than in the case of mean value filter (averaging).

Bessel, Butterworth

Classical low-pass filters of 2nd or 8th order with selectable limit frequency. They are of lesser importance and represent a compromise between the frequency selectivity of the AAF filter and the transient behavior of the mean value formation.

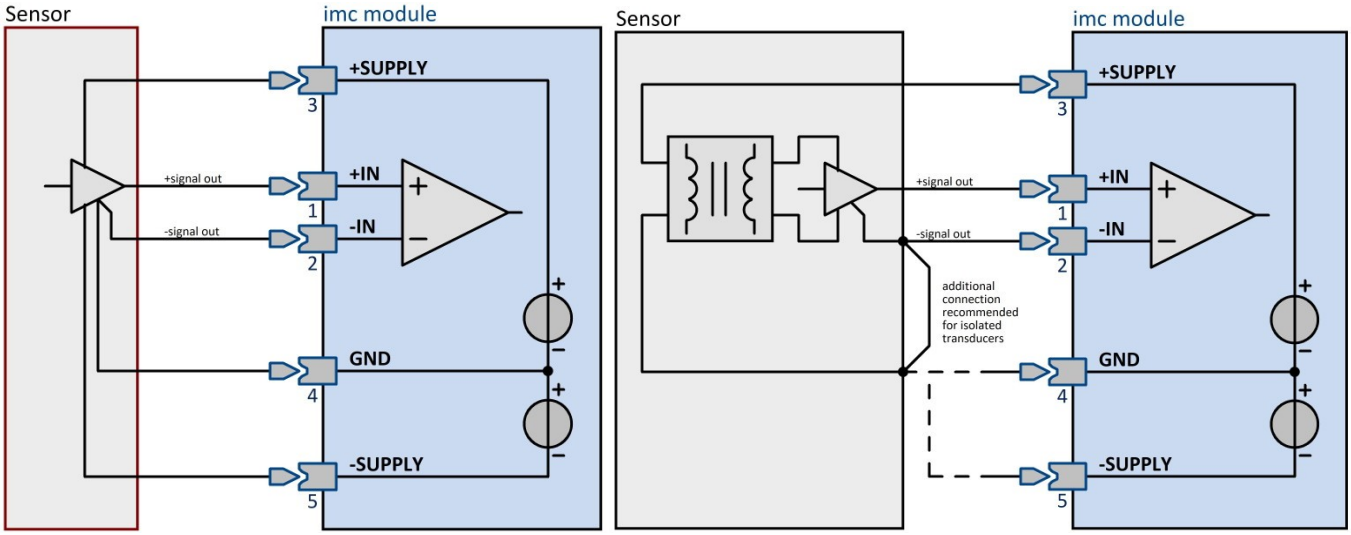
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9.1.6.6 Sensor supply

Each measurement input of UTI-6-SUP or of UTI-6-TEDS has a **voltage source** which can be used to supply transducers, sensors, etc. with power. The voltage can be set independently of the measurement inputs. Depending on the version of the operating software, its value can be either freely selected or in selectable levels.

The sensor supply of the UTI-6-TEDS is **unipolar**, see technical specs 497. The sensor supply of the UTI-6-SUP is **bipolar**, i.e. it consists of a positive (+SUPPLY) and a negative (-SUPPLY) voltage source which are symmetric (e.g. ±15 V) with regard to their common connection (GND), see Fig. "*UTI-6 with a non-isolated transducer in the sensor*". Loads can be connected requiring either **one or two supply voltage levels**. For supply voltage requirements above 15 V, transducers must be connected between ±SUPPLY. In this case, however, the operating software must be set for one half of the voltage (e.g. ±12 V for a 24 V sensor). The supply range from ±2.5 V to ±15 V or equivalently +5 V to +30 V covers nearly all commonly available sensors. But if this is still not sufficient, it is possible to combine the sensor supplies for adjacent inputs.

The available sensor supply power is approx. 0.5 W per channel (for more information see Table of technical specs 497). In case of overload or short-circuit, the channel's power supply unit switches off, indicated by the **red shining status indicator**. The voltage only returns after the configuration process or after switching the device off and then on again.



UTI-6-SUP with a non-isolated transducer in the sensor *UTI-6-SUP with isolated transducer in the sensor*

The sensor supply is electrically isolated from the device ground and also from other input channels. The voltages at the inputs (±IN) should be within the range of the supply voltage (±SUPPLY). Between the input voltage (±IN) and the inputs sensor supply (±SUPPLY), the voltage difference may not exceed ±50 V - above approx. 200 V the device might get damaged. This condition is usually not a problem because all passive sensors and most transducers generate their signal output voltage from the sensor supply with an electrical connection. We recommend an additional connection for isolated transducers, if the supply lines and the signal outputs of the transducer are galvanically isolated, see Fig. "*UTI-6-SUP with isolated transducer in the sensor*".

Note Short circuit

In case of a short circuit, the module is fully protected. For a complete recovery, the module may have to be switched on again.

9.1.6.7 Message Mapping

The description of message mapping in imc CANSAS*fit* is presented here 247.

9.1.6.8 LED blink codes

UTI-6 with individualized channel-LED and a global module-LED

Parameter			Value
Status-LED		green blue yellow red	active measurement initialization, firmware update etc. configuration setup error
Channel status-LED		off green red	channel configured as passive channel active overmodulation (>5 % of measurement range) or SUPPLY overload

9.2 CANFT/HISO modules

Within the imc CANSAS*fit* (CANFT) module series, the HISO series offers particularly high isolated types that are specially designed for use in high voltage environments.

Typical applications

- Testing in e-mobility environments
- Temperature measurement on high-voltage components of hybrid and electric vehicles, such as batteries, fuel cells and supply systems
- Environments where personnel safety has to be ensured

Only use electrically safe measuring cables and plugs suitable for the application. For example, use only genuine safety banana plugs with immovable connection insulation.

Safety instructions

In the following section, the residual risks are named which result from the hazard analysis. To reduce health hazards and avoid dangerous situations, observe the listed safety instructions.

Warning — Use in high-voltage environment



CANFT/HISO modules are specially designed for use in high-voltage environments.
Improper handling poses the risk of life-threatening electric shock.

- Use only qualified and trained personnel.
- Observe safety instructions and the five safety rules.
- CANFT/HISO modules may only be operated, when the module connectors are covered.

Improper opening operational safety and poses the risk of life-threatening electric shocks.

- Do not open the module housing.
- Do not make any mechanical or electrical modifications.

Warning

In the application, the specifications of the cables used, including the plug (specific manufacturing implementation of the plug connection), must always be observed. The following restrictions may apply:

Warning — Restrictions due to the Redel 2P plugs

Creepage distance may be too short up to the touchable stop between socket and plug (creepage distance is 22.5 mm).

Possible solution:

- For operation under voltage: no solution (observe 5 safety rules)
- For installation in a de-voltaged state and subsequent operation: Protect the plug against contact (sheathing/protective cover).

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Warning Restrictions due to the cable specification

The isolation strength between the wires is limited.

This also applies to (bundled) additionally isolated wires and restricts the routing of different HV circuits within a cable.

Possible solution:

- Route each HV circuit in a separate HV cable or only route HV circuits with the same or similar level of potential within one cable.

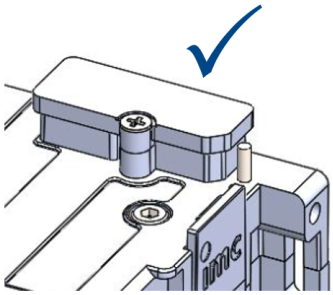
The isolation strength to the outside is limited.

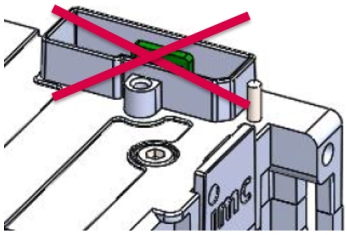
Possible solution:

- Route the HV cable in a suitable isolating sleeve (additional isolation). Caution! The colored cable marking will be lost/covered, so that additional external marking may be required.
- Route the HV cable protected against contact and suitably isolated from conductive parts (sheath/protective cover, distance).

Warning Cover module connectors

Both coverings of the module connectors 34 must always be attached to the connection points (see following pictures) if the modules are not coupled with other modules (upper side and lower side).





To maintain the degree of protection, the assembly of a complete system consisting of several modules must be carried out in a controlled environment (e.g. also sealing cap for click connectors).

9.2.1 HISO-T-8: high voltage isolated 8-channel module

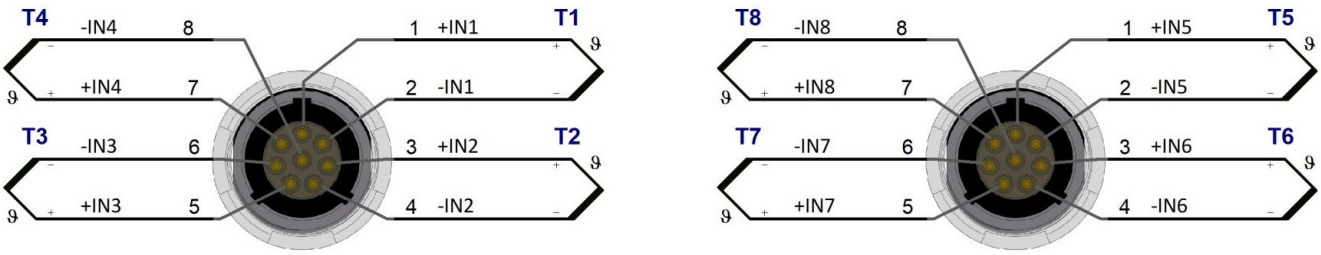
The HISO-T-8 module from the imc CANSAS*fit* series is an 8-channel module for measuring temperatures with thermocouples with particularly voltage-resistant isolation. Please note the different specification (IK, IP) from the imc CANSAS*fit* series. Each measuring input has a cold junction with its own cold junction compensation. The digitized measured values are transmitted via CAN bus.

Please note that HISO devices may only be installed and operated by qualified personnel.

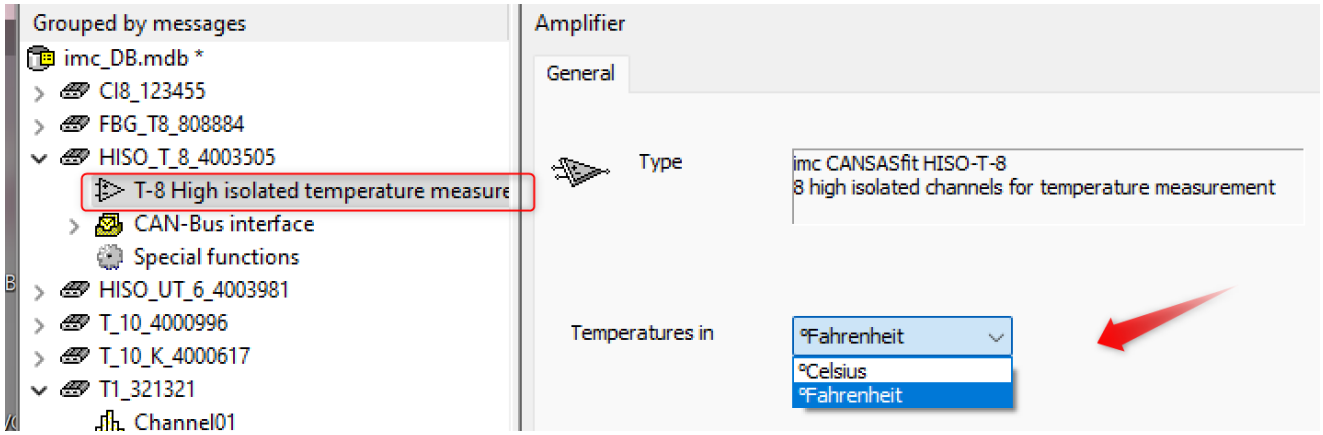
Reference

Technical Specs HISO-T-8 480

9.2.1.1 Temperature measurement



The **unit** is defined on the "*T-8-High isolated temperature measurement*" card:



ITS90 vs. IPST68

The measurement module uses the "International Temperature Scale of 1990" (ITS-90), and IPTS-68 is no longer supported. If the display of the temperature to be measured according to IPTS-68 is still required, a factor Y2=1.0001369 can be entered under User-specific scaling. Then the systematic measuring error remains smaller than ±0.028K in the range of -100°C to 500°C.

9.2.1.2 Open Sensor Detection

The module continuously checks whether the thermocouple is connected to the measuring input and displays a substitute value in case of an error (cable break). Channels whose measured values are transmitted in the data format 16 Bit INT show the smallest possible temperature of the measuring range as substitute value (-270°C). If, however, the data format 32 Bit FLOAT is set, the substitute value is -2000°C. The channel status is optically indicated by a red LED of the channel on the front of the device.

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9.2.2 HISO-UT-6: high voltage isolated 6-channel module

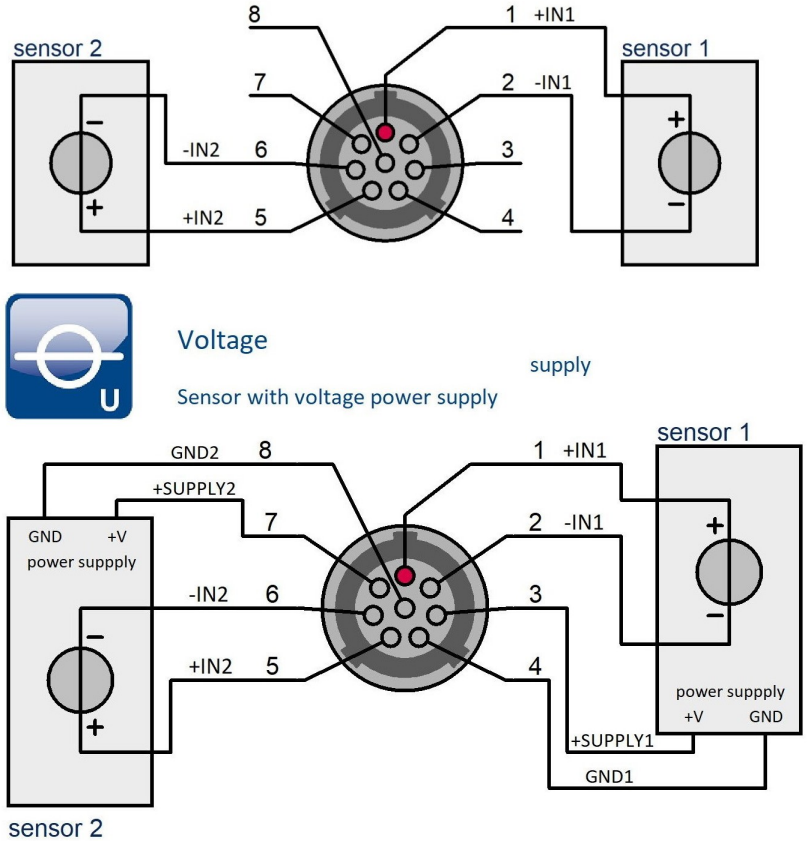
Within the imc CANAS*fit* (CANFT) module series, the HISO series offers particularly highly isolated types that are specially designed for use in high voltage environments. Please note the different specification (IK, IP → Technical Specs HISO-UT-6 483) from the imc CANAS*fit* series.

Please note that HISO devices may only be installed and operated by qualified personnel.

Note

- Within the imc CANAS*fit* (CANFT) module series, the HISO series offers particularly high-isolation types that are specially designed for use in high-voltage environments. Please note the specification which differs from the imc CANAS*fit* (CANFT) module series. (IK, IP → Technical Specs HISO-UT-6 483).
- Please also note that HISO devices may only be installed and operated by qualified personnel.

9.2.2.1 Measurement modes



Note Note concerning software version 2.2 R11

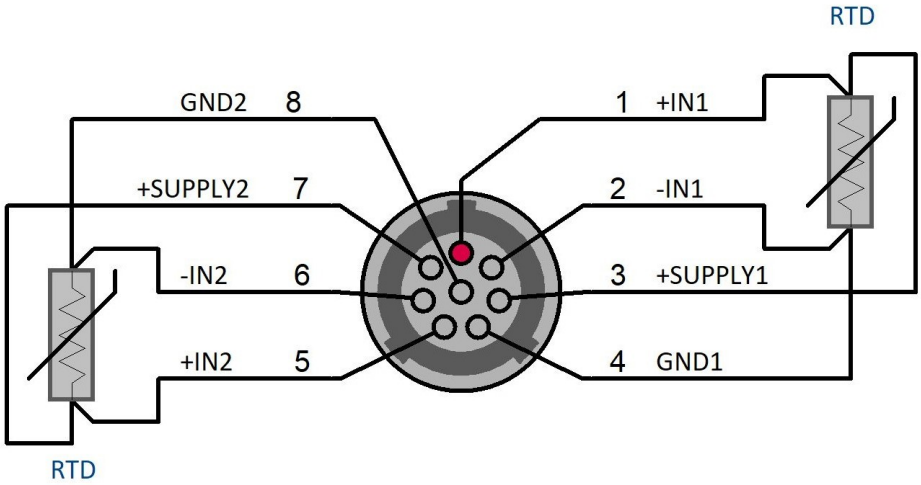
As of imc CANSAS software version 2.2 R11, the +5 V supply can no longer be switched off in the measurement ranges ≤2.5 V.



RTD

resistance temperature detector

(PT100, PT1000)

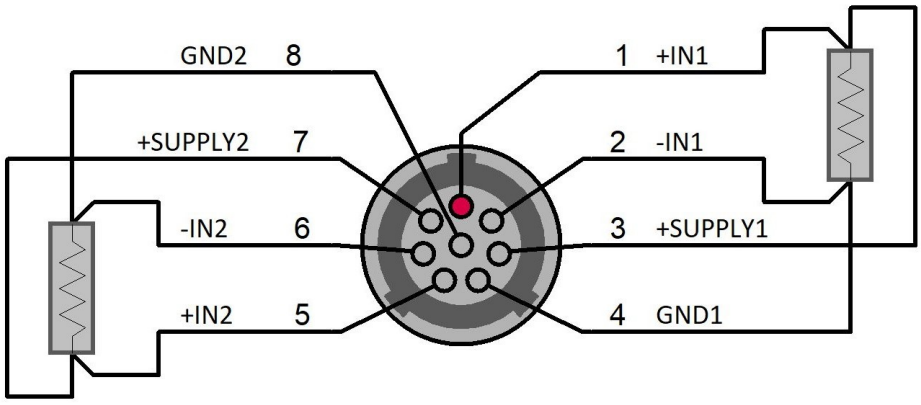


Temperature measurement

The **unit** is defined on the "*UT-6-High isolated amplifier*" card, see Screenshot 276.



Resistance



9.2.2.2 Filter

The filter setting "off" is not recommended because signal and noise components above the Nyquist-frequency have images into the bandwidth.

9.2.3 HISO-HV-4

High voltage isolated 4-channel CAN-based measurement module for high voltages (HV)

Within the imc CANSAS*fit* (CANFT) module series, the HISO series offers particularly highly isolated types that are specially designed for use in high voltage environments. Please note the different specification (IK, IP) from the imc CANSAS*fit* series.

The model **HISO-HV-4** is ideally suited for isolated measurements of high voltage signals up to 1500 V.

Reference

Technical Specs - CANFT/HISO-HV-4 488

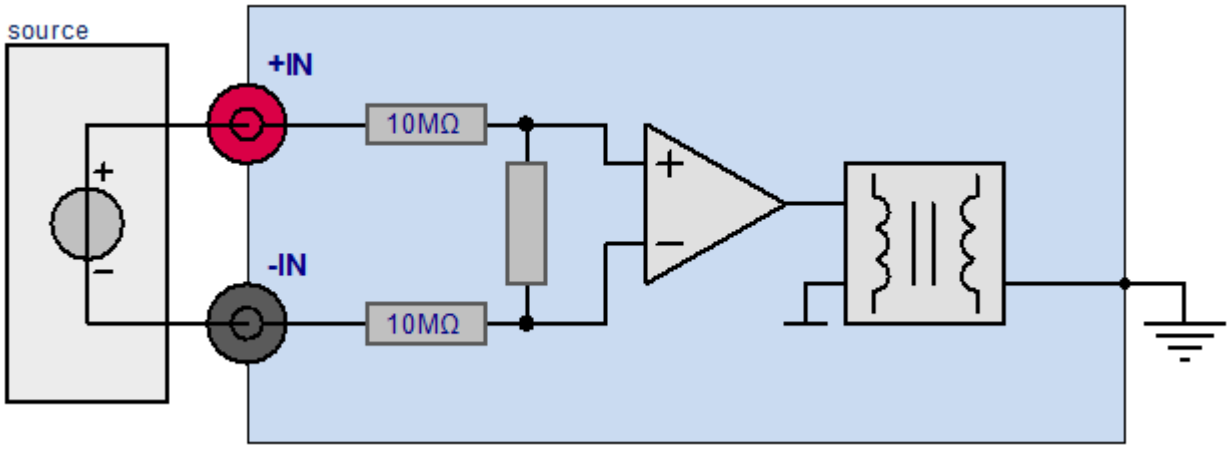
Highlights

- Highly isolated for measurement category 1000 V CAT II (according to safety standard DIN EN 61010)
- Test voltage: 5.4 kV AC_{rms}
- Channel by channel isolated measurement inputs, individual filter and ADC
- 400 Hz bandwidth at max. 1 kSps/channel sampling rate (CAN output rate)

Typical applications

- Testing in e-mobility environments (e.g., electric and hybrid vehicles)
- Measurement on battery modules and full stack HV batteries, DC link circuits in electric vehicles etc.
- Environments in which full personal safety must be guaranteed even in the event of faults.

9.2.3.1 Voltage measurement



CANFT/HISO-HV-4 is equipped with 8x laboratory safety sockets

9.3 CANSASflex (CANFX)

As a CAN bus-based measurement engineering tool, the imc CANSAS*flex* series offers a wide selection of measurement modules which process and digitize sensor signals and output these as CAN-messages.

The modules of the imc CANSAS*flex* series can be joined together mechanically and electrically by means of a latching ("click") mechanism, without the use of any tools nor the need for any extra cables, and also allows the CAN-logger imc BUSDAQ*flex* (BUSFX) to dock on directly. Depending on the module type, they are available in either long (L-), short, or both housing versions.

The imc CANSAS*fdx* family is largely identical and compatible to imc CANSAS*flex*, especially in terms of its mechanical and electrical properties. Differences mainly concern minor details of the software.

Besides fixed installations or operation on a laboratory bench, the modules are also designed to fit in a special 19" subrack to provide a convenient solution in test station settings.

Fields of application

- For test rigs, vehicle testing, road trials and all-purpose measurement applications
- Deployable both in decentralized, distributed and in centralized measurement setups
- Operable with CAN-interfaces and CAN-data loggers from either imc or 3rd-party manufacturers

Modes	Module	Channels per module	Max. sampling rate per channel	Bandwidth	Remarks
Voltage, temperature	C8 281	8	100 Hz	20 Hz	current with shunt plug
Voltage, temperature (isolated), resistor	CI8 289	8	1 kHz	440 Hz	current with shunt plug
Analog outputs	DAC8 301	8	5 kHz	5 kHz	
Strain gauge (DMS), bridge	DCB8 308	8	1 kHz	200 Hz	
Digital inputs	DI16 315	16	10 kHz	10 kHz	
Digital outputs	DO16 318	16	10 kHz	10 kHz	
Relay outputs	DO8R/DO16R 321	8 / 16	125 Hz	125 Hz	
Fiber optic temperature	FBG-T8 323	8	1 kHz	100 Hz	
Voltage, current, temp. (isolated), resistor	HISO 397	8 / 4	1 kHz	440 Hz	
Incremental counter	INC4 331	4	1 kHz	500 kHz	
Pressure	P8 338	8	1 kHz		
Pulse width modulation	PWM8 352	8	33 Hz to 10 kHz	10 kHz	
Voltage, temperature	SCI8, SCI16, SC16 356	8 / 16 /16	1 kHz / 500 Hz	42 Hz / 23 Hz / 28 Hz	
Voltage, temperature, current, bridge, resistor	UNI8 372	8	1 kHz	200 Hz	

9.3.1 C8 voltage, temperature, current

C8 modules are powerful analog input modules with 8 differential channels which can be individually filtered, amplified and digitalized.

Reference

Technical Specs C8 502

Variants	Properties
Standard (DSUB)	voltage measurement 60 V to 5 mV temperature measurement with thermocouples temperature measurement with PT100-resistors current measurement with shunt connector
LEMO	voltage measurement 60 V to 5 mV temperature measurement with PT100-resistors current measurement
BNC	voltage measurement over BNC sockets 60 V...5 mV
2T	temperature measurement with thermocouples over 2 pin TK sockets
Fischer, 5-pin 288 round sockets	voltage measurement 60 V to 5 mV supply voltage for external sensors 24 V to 2.5 V; ±15 V
SOURIAU, round socket	temperature measurement with thermocouples

Parameter	Value	Remarks
Dimensions (W x H x D)	30 x 110 x 93 30 x 110 x 146.5 50.3 x 110 x 146.5	CANFX-C8 (housing S0) CANFX-L-C8 (housing L0) CANFX-L-C8-2T(-Y), CANFX-L-C8-SUPPLY, CANFX-L-C8-BNC (housing L1)

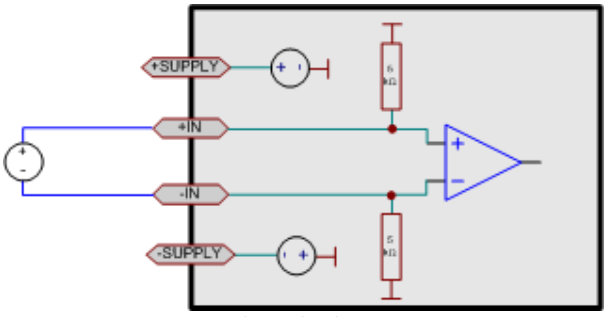
Reference

Observe further **CANFX** specific Specs 500: **terminal connections** and click mechanism

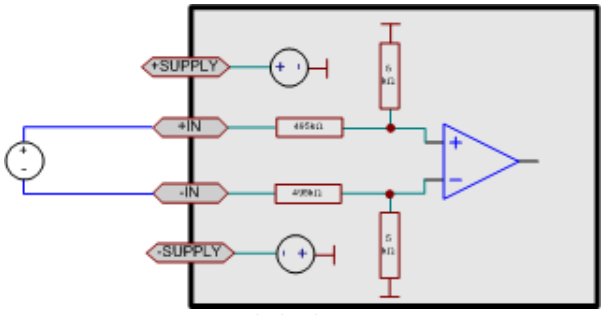
9.3.1.1 Voltage measurement

- ±60 V... ±2 V with divider
- ±1 V... ±5 mV without divider

A voltage divider is in effect in the voltage ranges ±60 V to ±2 V; the resulting input impedance is 1 MΩ - even when the device is deactivated. The input configuration is differential and DC-coupled.



without divider: <2V



with divider: >= 60V

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

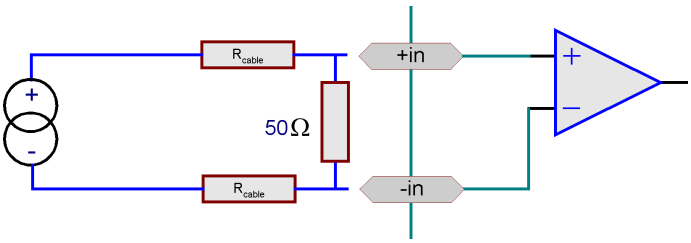
The recommended standard DSUB plug is: ACC/DSUBM-U4 594.

Example

The imc CANSAS-module is grounded. Thus, the input D is also at ground potential. If the voltage source itself is also grounded, it's referenced to the imc CANSAS 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.

If the voltage source has no ground reference: The voltage source's potential floats freely in relation to imc CANSAS ground. In such a case, a reference to ground must be set up. One way to do this is to ground the voltage source itself. It is also possible to connect the negative signal input to imc CANSAS' ground, in other words, connect "-IN" and GND. You must make certain that the signal source's potential really can be adjusted to the potential of imc CANSAS ground without causing a significant current to flow. If the source can't be adjusted (because it is fixed), the imc CANSAS unit is in danger of sustaining permanent damage.

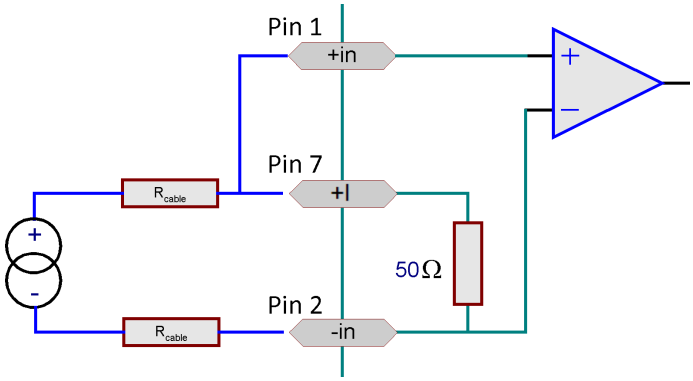
9.3.1.2 Current measurement



- ±40 mA ... ±2 mA

For current measurement, a shunt is built into the imc current connector (ACC/DSUBM-I4).

The terminal "(GND)" must not be connected, especially not grounded!

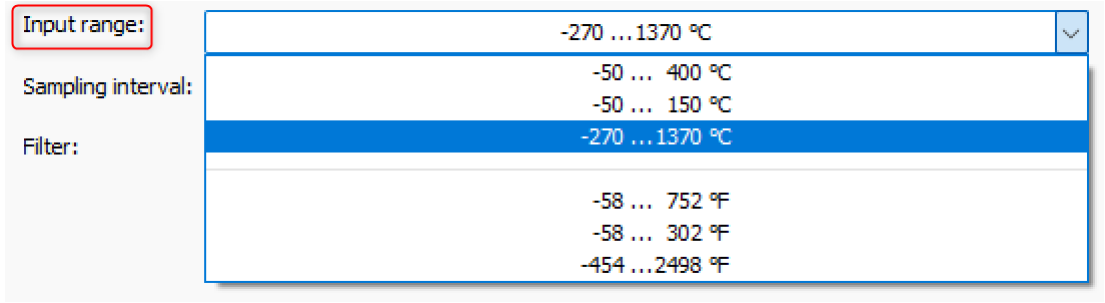


With the **housing model SL** with **LEMO** connectors, current measurement is connected via an internal 50 Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN. For current measurement, the pins +I and +IN must be shorted. This connection may only be made for current measurement purposes, and must be cleared for all other measurement types. For this reason imc offers a cable specially constructed with this connection exclusively for current measurement.

9.3.1.3 Temperature measurement

The C8-module's channels are designed for measurement with **thermocouples and PT100-sensors** (RTD, platinum resistance thermometer as per DIN and IEC 751). Any combination of sensor types can be connected. All common thermocouple types with their characteristic curves are supported. However, it is only possible to measure with multiple thermocouples at the same time if they are all of the same type. Thus, two Type K channels will work, but not 1 channel Type K and one channel Type B won't. A combination of thermocouple measurement and PT100 measurement on multiple measurement inputs is at the same time possible with an imc thermo plug 181.

The **unit** in ° **Celsius** or **Fahrenheit** is set via the *Input range* of the channel.



9.3.1.3.1 imc thermoplug (type: Standard DSUB)

The terminal point compensation for the thermocouple measurements is either built-in or is handled by the imc-Thermoplug, depending on the device variety.

The patented imc-Thermoplug (ACC/DSUBM-T4), which is a pod containing a DSUB-15 screw terminal and a built-in temperature sensor (PT1000), provides **cold junction compensation**. This enables any type of thermocouple to be directly connected to the differential inputs (+IN and -IN) without the need for a compensation line:

A sensor measures the temperature at the connection terminal and correspondingly compensates the thermoelectric voltage. Normally, a special compensation line or plug made of the same material as the particular thermocouple type must be used to connect the terminal to the cold junction (reference point) in the device interior, in order to prevent the formation of additional (uncontrolled) parasitic thermocouples.

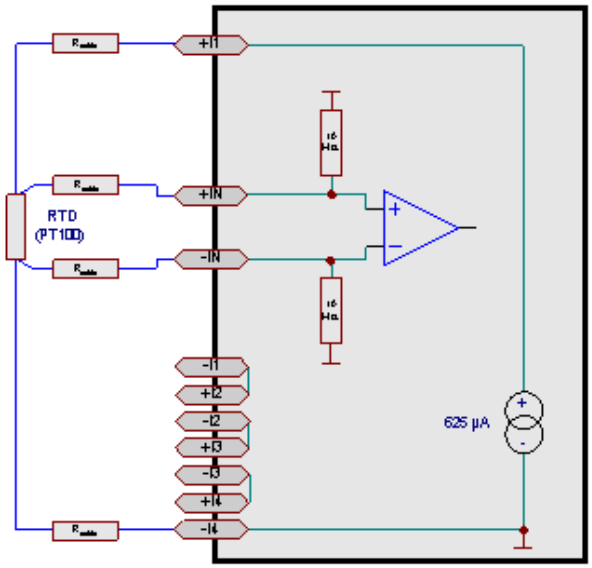
The imc system avoids this problem by means of individual compensation sensors directly inside the connector pod and thus provides a convenient, flexible and affordable interconnections solution.

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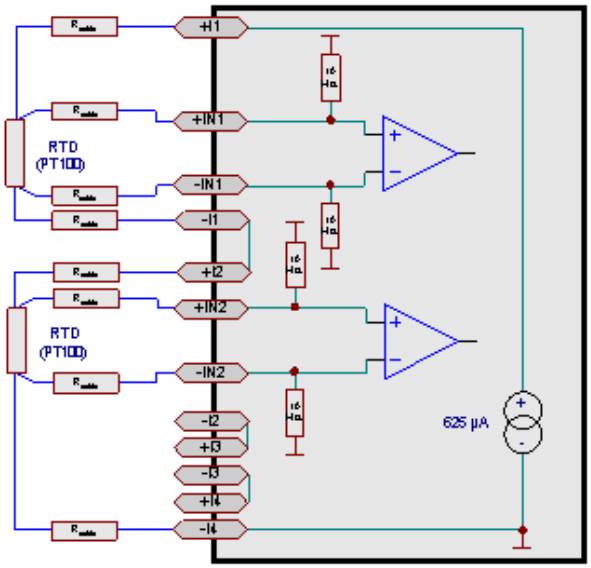
9.3.1.3.2 Measurement with PT100 (RTD) (Type: Standard DSUB)

Besides thermocouples, it's also possible to connect ***PT100 sensors*** directly in ***4-wire-configuration***. A (supplementary) reference current source feeds up to four sensors connected in series jointly.

When the **imc-Thermoplug** is used, the connection terminals are already wired in such a way that this reference circuit is "automatically" closed.



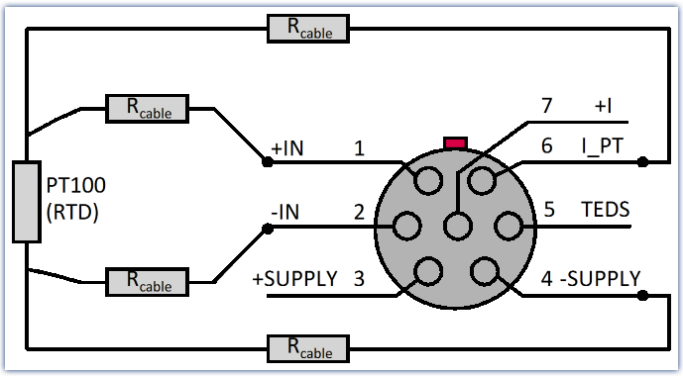
Example for one PT100 in 4-wire configuration



Example for two PT100 in 4-wire configuration

9.3.1.3.3 Measurement with PT100 (RTD) (Type: LEMO)

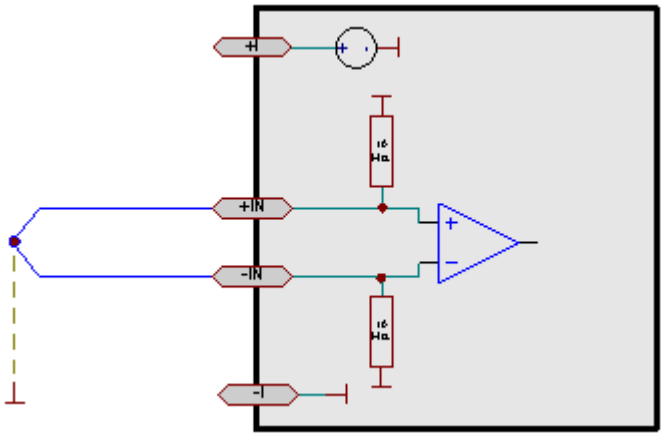
With the LEMO terminals at the IP65 housing SL it's only possible to connect ***PT100*** sensors directly in ***4-wire-configura***tion. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



Connection scheme of a PT100 sensor with LEMO terminals

9.3.1.3.4 Thermocouple measurement (Type II: round plugs)

The cold junction required for the operation of thermocouples is located within the connector pod and its temperature is measured and accounted for by the measurement device.



Thermocouple (isolated and referenced to external potential by means of spot-welded contact)

The thermocouple is mounted in such a way that it already is in electrical contact with the imc CANSAS module's 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 C8 unit is grounded itself, the necessary ground reference exists.

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

9.3.1.4 Optional Sensor supply

The DSUB-15 sockets each provide a terminal for an optional **supply voltage** (±2 %) for external sensors.

When selecting a positive (unipolar) voltage supply (e.g. 5 V), it is gripped between +SUPPLY and GND. When using a bipolar voltage supply (±15 V), +SUPPLY and -SUPPLY must be connected to the sensor supply, GND is in between then, which is 0 V. For the imc CANSAS-SL-C8-L-SUPPLY there is only an unipolar voltage supply available.

Without supply module, there is no voltage provided for connected sensors.

The supply voltage can only be set at one common setting which applies to all measurement inputs.

Note Important!

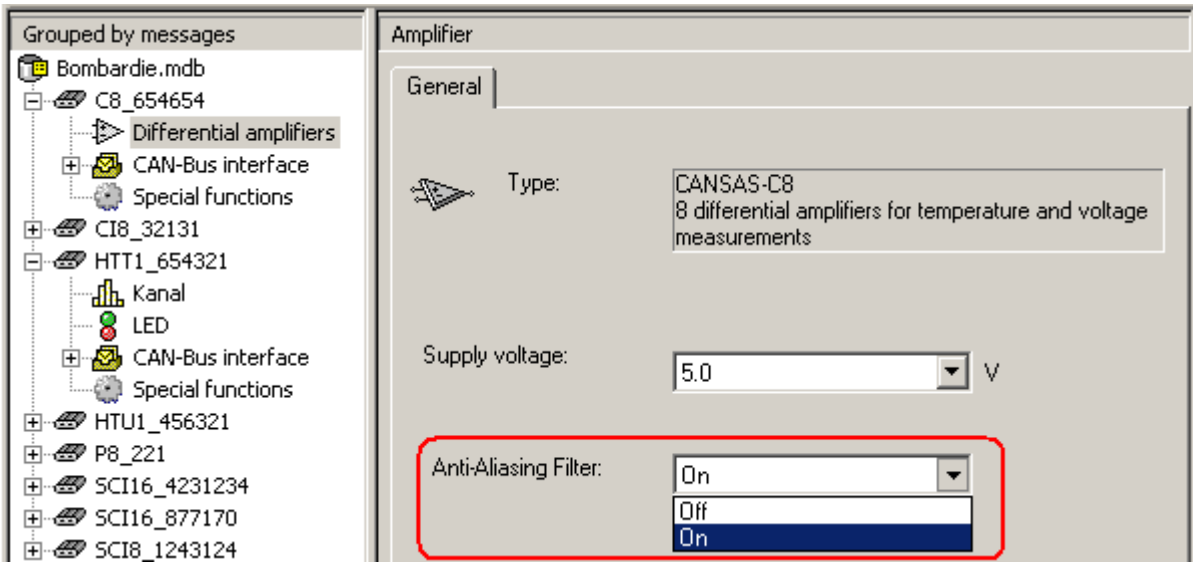
Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the imc CANSAS module could be damaged.

Reference

The technical specification of the SUPPLY 504.

9.3.1.5 Sampling intervals, filters and anti-aliasing

For each of the 8 channels, the sampling interval can be freely set to between 10 ms an 60 s. C8 comes with a hardware-based, permanent anti-aliasing filter, an analog-digital-converter (ADC) using the sigma-delta method, and finally a digital low-pass filter adapted to the sampling rate.



- **On**: Additional digital low-pass filter.
- **Off**: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.

The table below shows which resulting filter is used.

For temperature measurement (PT100 and thermocouples):

Sampling rate	Filter
10 ms	Critical damping, 4th order, cutoff frequency 12 Hz
20 ms	Critical damping, 4th order, cutoff frequency 6 Hz
50 ms	Critical damping, 4th order, cutoff frequency 2 Hz
100 ms	Critical damping, 4th order, cutoff frequency 1 Hz
200 ms	Critical damping, 4th order, cutoff frequency 0,5 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0,2 Hz
1s	Critical damping, 4th order, cutoff frequency 0,1 Hz
2s ..60s	Arithmet. mean over the duration of the sampling interval of values sampled at 100 Hz

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All other measurement types (voltage, current and resistance):

Sampling rate	Filter
10 ms	Butterworth, 2nd order, cutoff frequency 20 Hz
20 ms	Butterworth, 2nd order, cutoff frequency 10 Hz
50 ms	Butterworth, 2nd order, cutoff frequency 4 Hz
100 ms	Butterworth, 2nd order, cutoff frequency 2 Hz
200 ms	Butterworth, 2nd order, cutoff frequency 1 Hz
500 ms	Butterworth, 2nd order, cutoff frequency 0,4 Hz
1s	Butterworth, 2nd order, cutoff frequency 0,2 Hz
2s ..60s	Arithmet. mean over the duration of the sampling interval of values sampled at 100 Hz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti- aliasing filters (e.g. with damping of 96dB at one-half of the sampling frequency).

If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

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9.3.1.6 Connection C8

9.3.1.6.1 Standard variant (DSUB-15)

For the pin assignment of the DSUB-15 plugs see here 594.

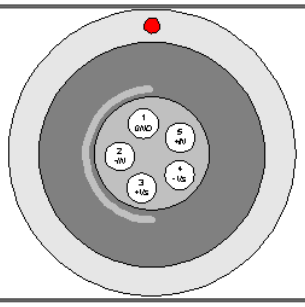
9.3.1.6.2 Fischer round socket (5-pin)

The eight measurement inputs connected by the round plugs IN1 through IN8 are for voltage measurement only. They are differential and not mutually isolated.

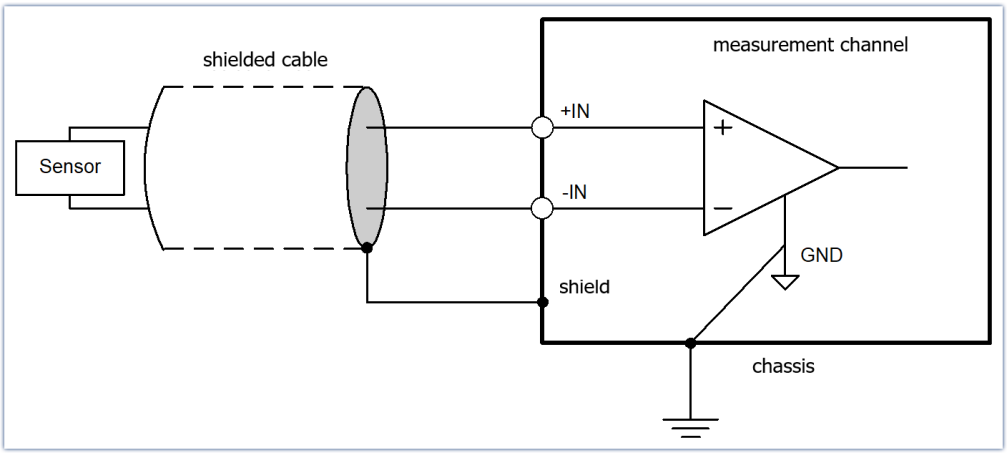
The device comes with a voltage supply unit for the supply of sensors.

Pin configuration of round plug:

Pin	Signal
1	measurement ground (GND)
2	neg. measurement input (-IN)
3	positive sensor supply (+Vs)
4	negative sensor supply (-Vs)
5	pos. measurement input (+IN)



The measurement inputs should be connected using a shielded cable in which both the positive and neg. measurement inputs (+IN and -IN) are located inside the shielding. the shielding must be connected to the terminal pod housing.



9.3.1.6.3 SL Variety LEMO

see pin configuration of LEMO terminals 600.

9.3.2 CI8 isolated voltage channels with current and temperature mode

Each of the module CI8's **isolated voltage channels** has its own isolated amplifier, operated in the voltage mode. Along with **voltage measurement, current measurement** (with DSUB via a shunt plug), **resistor** and **temperature measurement** are provided, depending on the terminal connection (see technical data).

The CI8 module supports **TEDS** to read and write sensor information.

Beside working with CAN bus per default, the CI8 is also configurable as **CANopen**® module.

The **analog bandwidth** (without low-pass filtering) of the isolated voltage channels is 440 Hz(-3 dB).

Reference

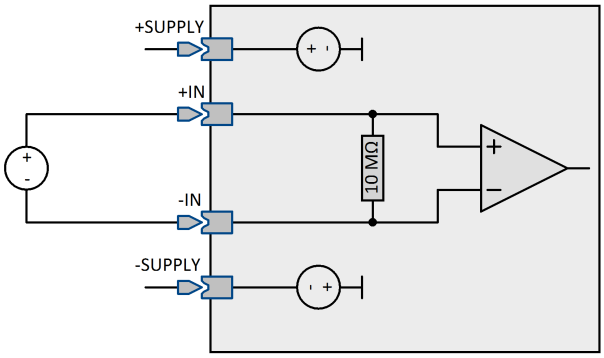
Technical Specs CI8. 505

9.3.2.1 Voltage measurement

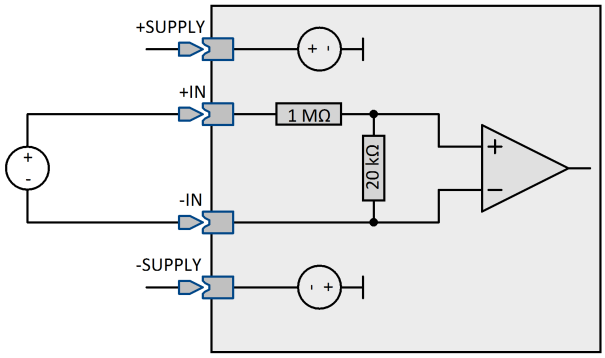
- Voltage: ±60V ... ±5V with divider
- Voltage: ±2V ... ±50mV without divider

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 6.7 MΩ. If the device is de-activated, the impedance is always 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

Note

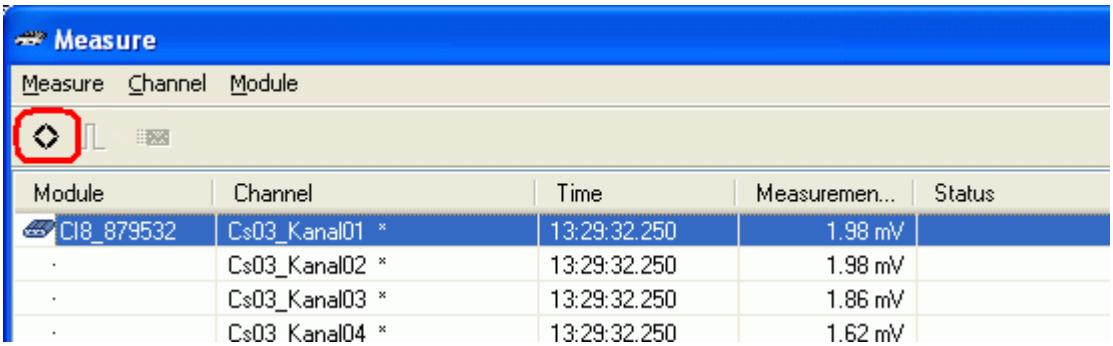
The measurement of IEPE/ICP sensors with optional DSUB-15 terminal connector ACC/DSUB-ICP4 is possible.

9.3.2.1.1 Voltage measurement with zero balancing

In the measurement mode *voltage measurement with zero balancing*, it is possible to balance the measured value.

This is accomplished for all selected channels either by means of the channel menu command Balance in the measurement window or on the Balance page accessed via the module node Isolated amplifier.

Balancing using the Measure dialog



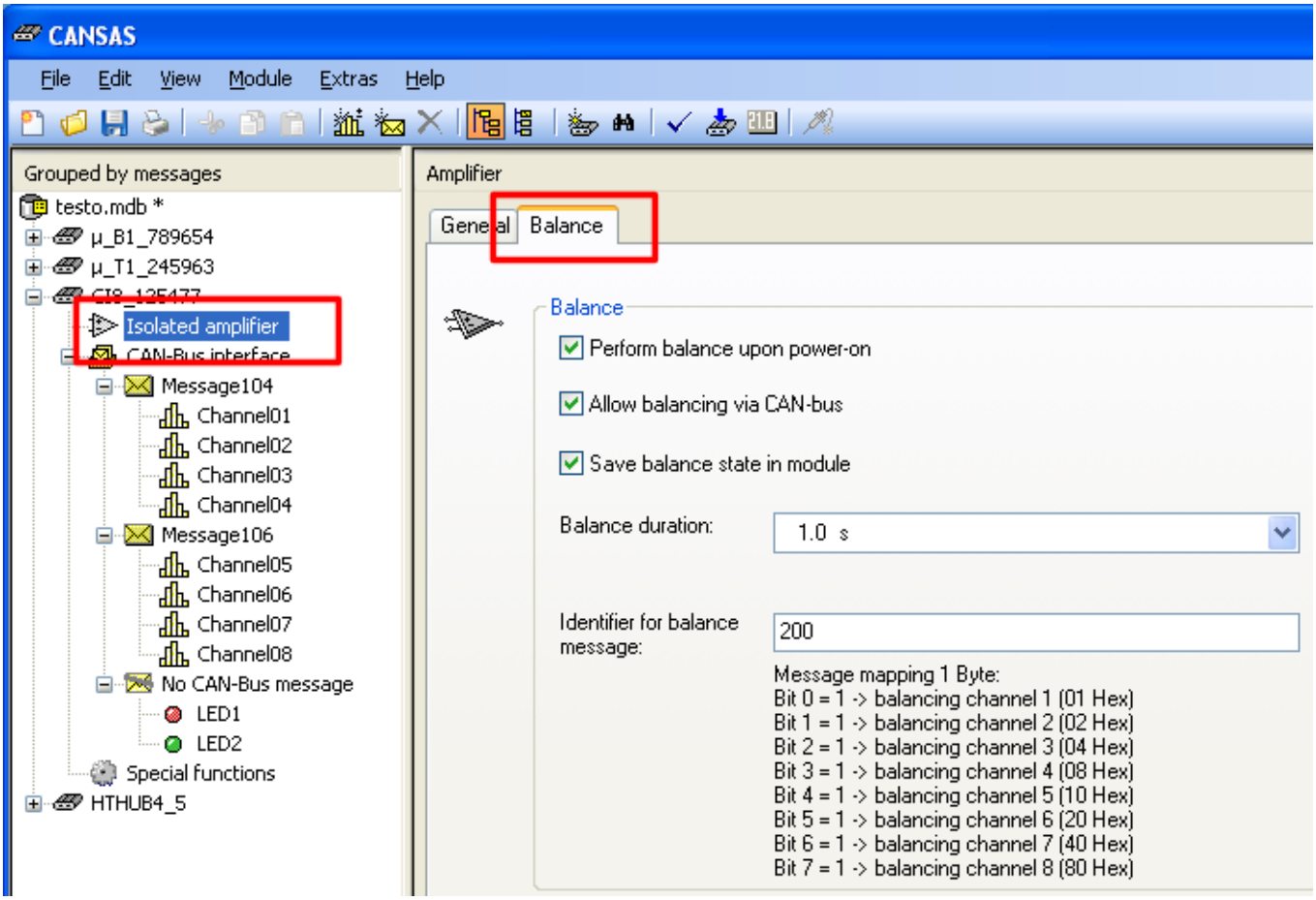
Zero balancing in the Measure dialog

Input range [V]	Compensable initial offset* [V]		Input range [V]	Compensable initial offset* [V]
±50	0.3		±0.5	0.09
±20	10		±0.2	0.09
±10	5		±0.1	0.19
±5	10		±0.05	0.24
±2	0.35		±0.02	0.27
±1	0.19			

In the Measure window, balancing is performed by selecting one or more channels and clicking on the Balance button.

Balancing using the Balance dialog

This dialog is available under the CI8's node *Isolated amplifier*. It enables automatic balancing each time the device is activated. You can also store the balancing values in the module permanently, so that they are not lost as soon as the device is deactivated. It is also possible to perform a balancing procedure at a specific point in time as desired.



Balancing dialog for CI8

Perform balance upon power-on:

Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

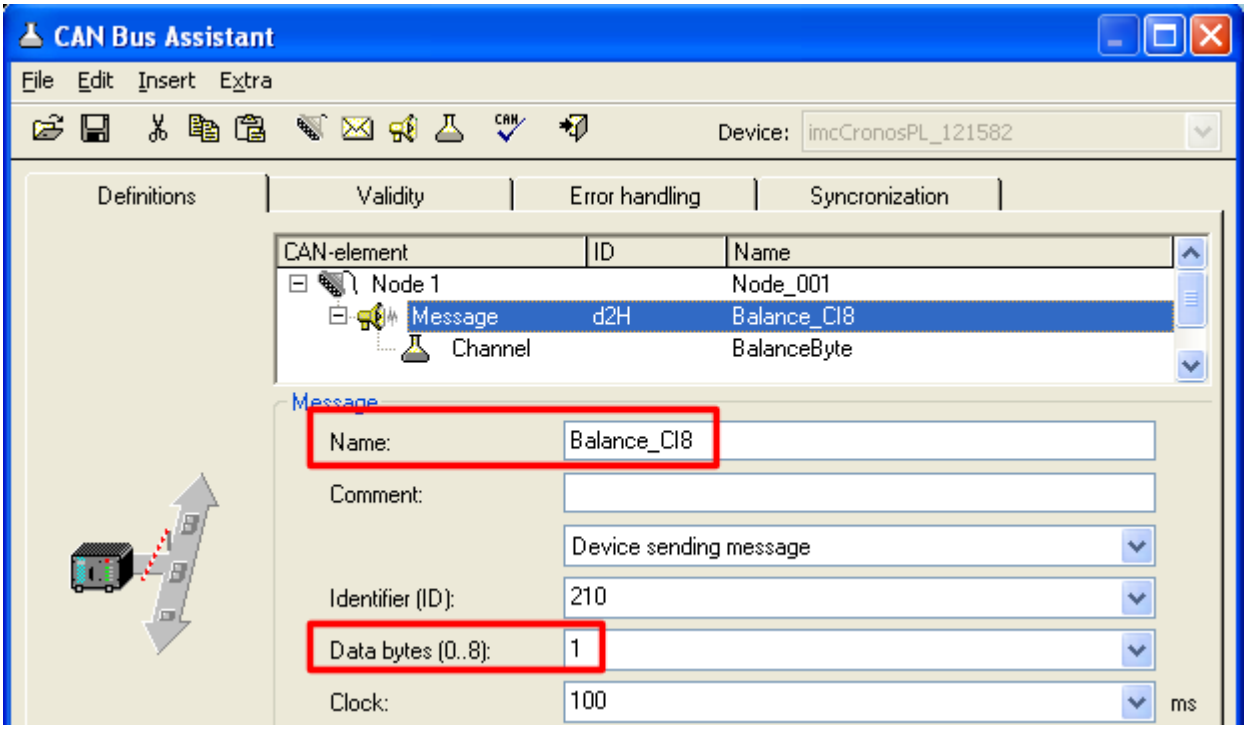
Allow balancing via CAN bus:

This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option *Save balance state in module*, since in that case the balancing value remains intact even after deactivation.

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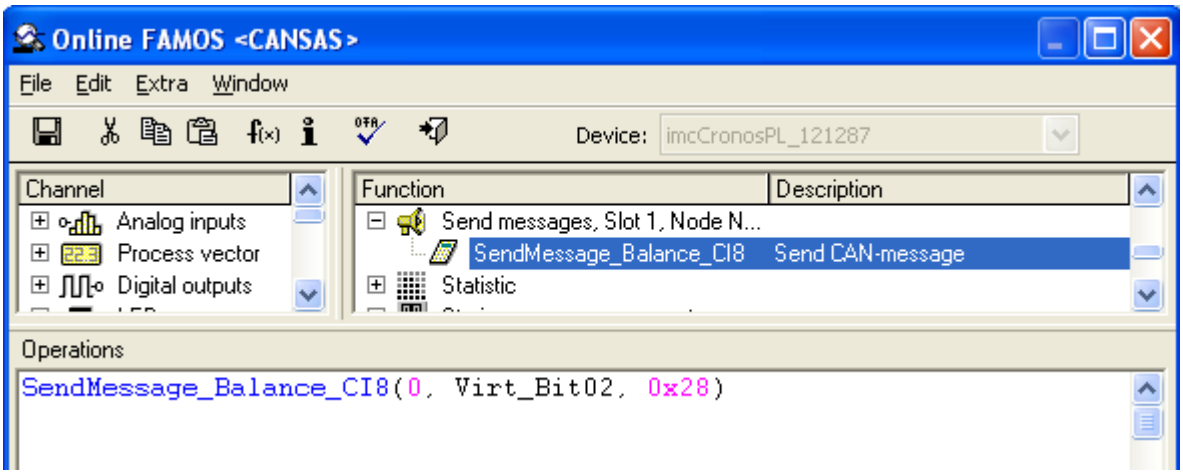
Example: Identifier for balance message = 210, channels 3 and 5 are to be balanced.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN Assistent

2. imc Online FAMOS (imc DEVICES) sends a message if the virtual bit Bit02 is set. In the data byte, the value 28Hex is transmitted, which consists of the values for channel 3= 0x08H plus channel 5= 0x20H.



Balancing message in imc Online FAMOS

Save balance state in module:

This optional setting ensures that the balancing values are not lost once the device is deactivated.

Balance duration:

Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

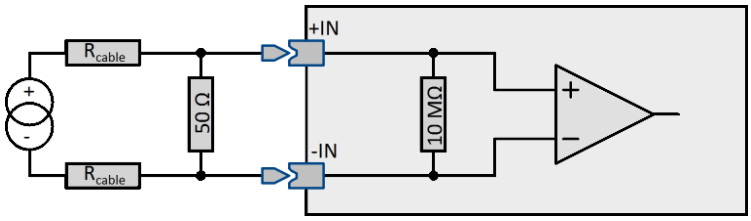
Identifier:

A message to perform balancing must bear the identifier set here.

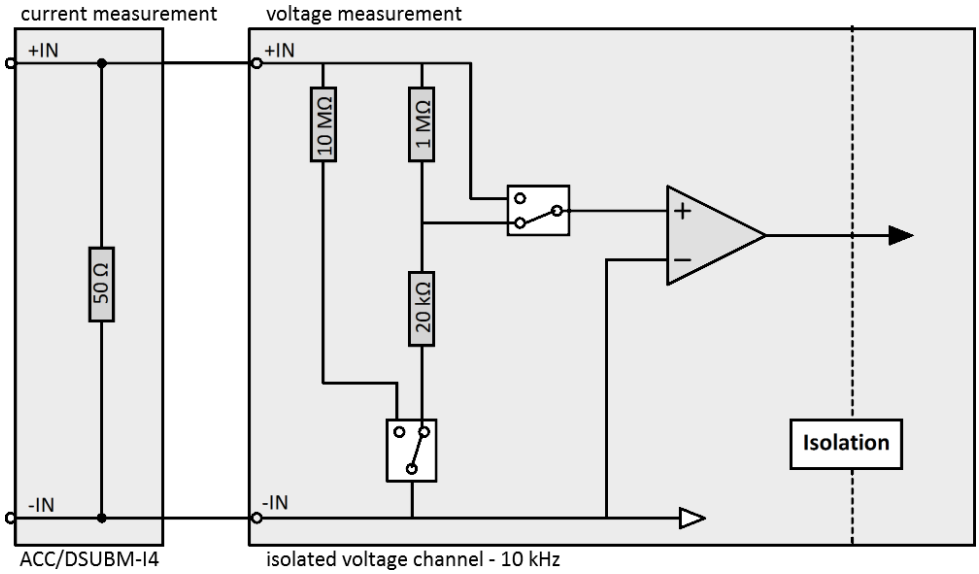
9.3.2.2 Current measurement

- Current: ±20 mA, ±10 mA in 2 ranges

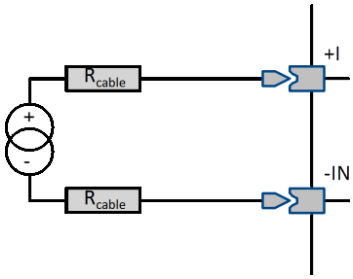
A special plug (ACC/DSUBM-I4) with a **built-in shunt** (50 Ω) is needed for current measurement. Configuration is performed in voltage mode, whereby an appropriate scaling factor is entered in order for amperage values to be displayed (20 mA/V = 1/50 Ω).



Input stage block schematic



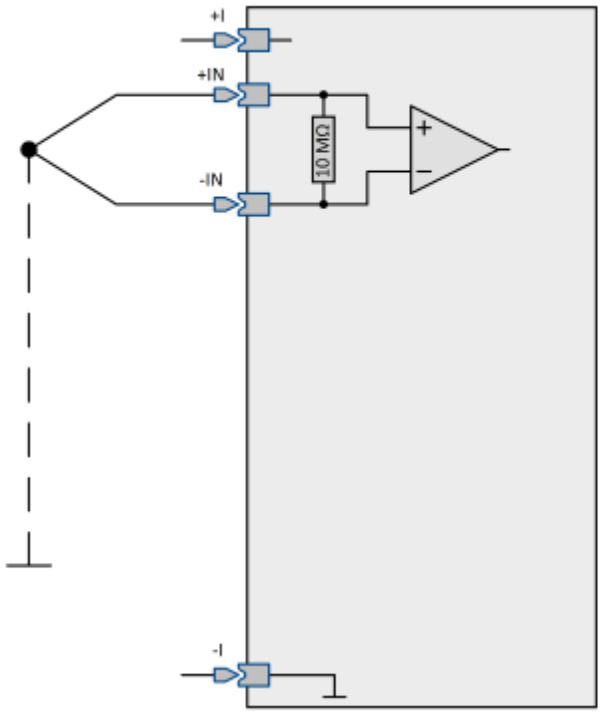
With the LEMO module variant current measurement is connected via an internal 50 Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN.



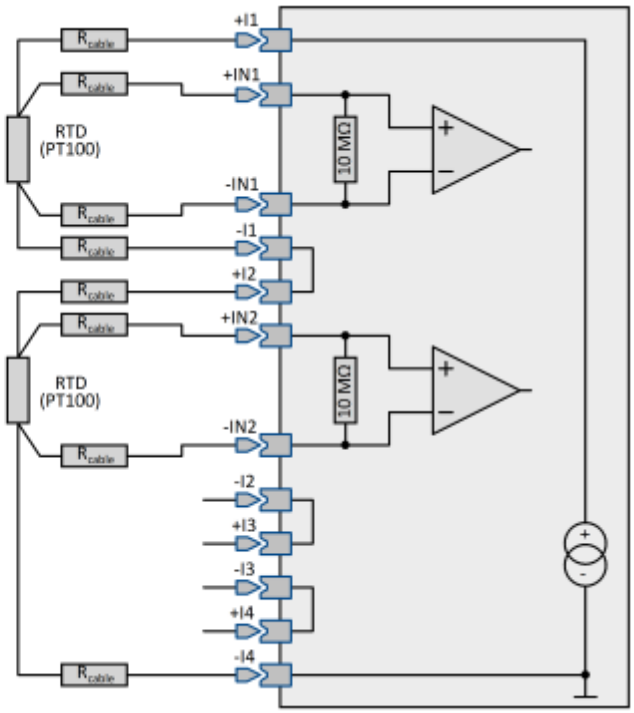
9.3.2.3 Temperature measurement

The CI8 temperature channels are designed for direct connection of **thermocouples** and **PT100**-sensors (RTD, platinum-resistance thermometers, PT1000 with CANSAS-L-PT1000). **Any combination** of both sensor types can be connected using the imc thermo plug (ACC/DSUBM-T4); all common thermocouple types are supported along with their particular characteristic curves.

The **unit** in ° **Celsius** or **Fahrenheit** is set via the *Input range* 283 of the channel.



configuration for thermocouples



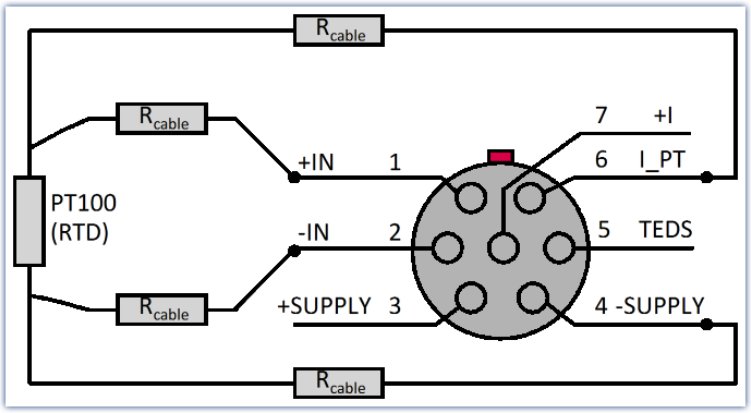
Example: configuration for two PT100 (RTD) with ACC/DSUBM-T4

Note

- For the thermocouple measurement the imc thermo plug 181 (DSUB-15) is highly recommended.
- The mode for thermocouples is also available for the CI8 LEMO variant. Using this variant please note, that the cold junction compensation must be completed externally (e.g. with ice water).

9.3.2.3.1 Measurement with PT100 (RTD) (Type LEMO)

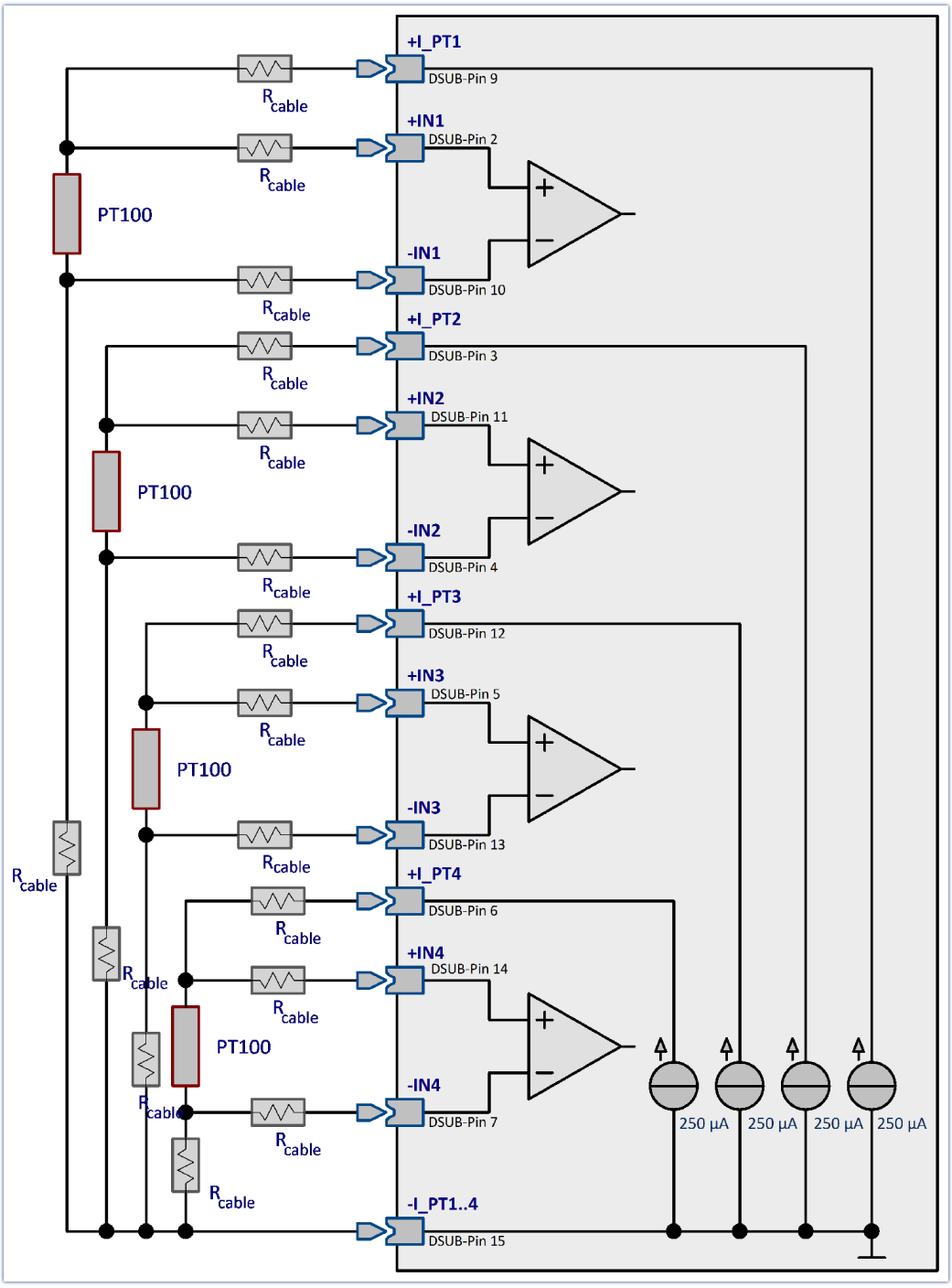
With the LEMO terminals at the IP65 housing SL it's only possible to connect **PT100** sensors directly in **4-wire-configuration**. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



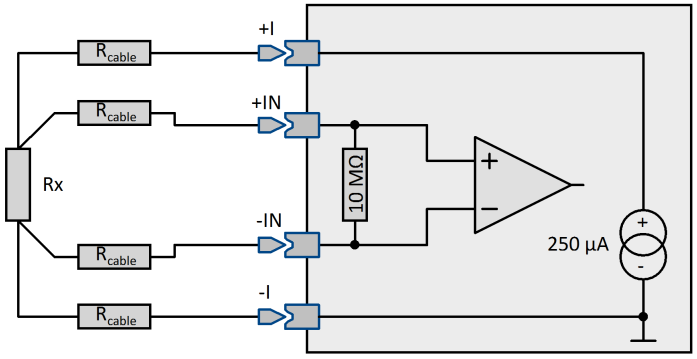
PT100 connection scheme

9.3.2.3.2 CI8-PT

The CANFX/L-CI8-PT is ideal for a 4-wire PT100 measurement with channel individual current sources:



9.3.2.4 Resistance measurement



There are four ranges for resistance measurement: 0 Ω to 1000 Ω, 500 Ω, 250 Ω and 150 Ω. The measurement is carried out using four-wire technology. The resistor is supplied via two wires (+I, -I). The two Measuring inputs (+IN, -IN) serve as sense lines. By using these Sense-cables, the voltage at the resistor can be precisely determined. The voltage drop along the current-carrying cable does not cause a measurement error.

The resistance to be measured is fed from a reference current source. For the module variants with channel-specific connectors (LEMO, ITT-Veam etc.) these are individual sources. Modules with DSUB-15 connection technology, on the other hand, have one global source for each 4-channel connector, which feeds the resistors to be measured in series. If all 4 channels are operated in resistance mode, this limits the max. usable measuring range, since the reference current source has a limited voltage swing (sufficient for max. 2000 Ω).

Notes

- This mode ist not available for PT1000 variant.
- The indicated measurement value changes to zero if the connection between I+ and IN+ is broken. If only the connection to the resistor at IN+ is broken, the indicated value is the input range end value.
- If the measurement is performed via the ACC/DSUBM-T4 connector, the resistors are connected in a row and they are supplied from only one common current source. The sum of all resistors must then not exceed exceed 2000 Ω The connection must be made as for temperature measurement with PT100 sensors.

9.3.2.5 Optional Sensor supply

The CI8 can be enhanced with the sensor supply unit *SUPPLY*, which provides an adjustable supply voltage for active sensors.

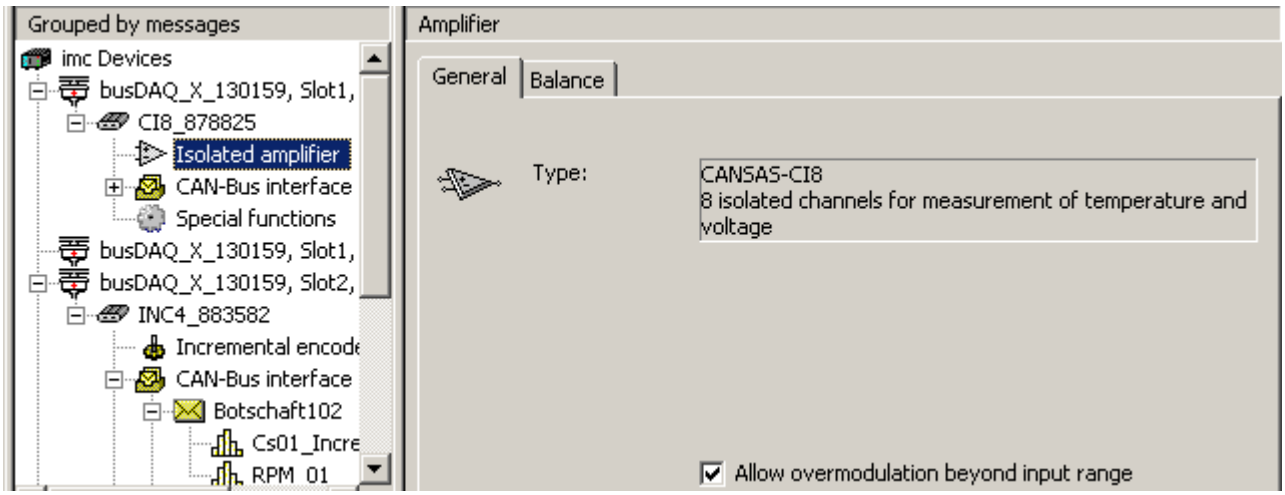
The supply outputs are electronically protected internally against short circuiting to ground. The reference potential, in other words the sensor's supply ground contact, is the terminal GND.

Reference

For technical specification of the SUPPLY see here 508.

9.3.2.6 Allow overmodulation beyond input range

The option "*Allow overmodulation beyond input range*" makes it possible to exceed the input range by about 20 %. This applies globally for all of the module's channels and for all measurement modes except for the temperature mode.



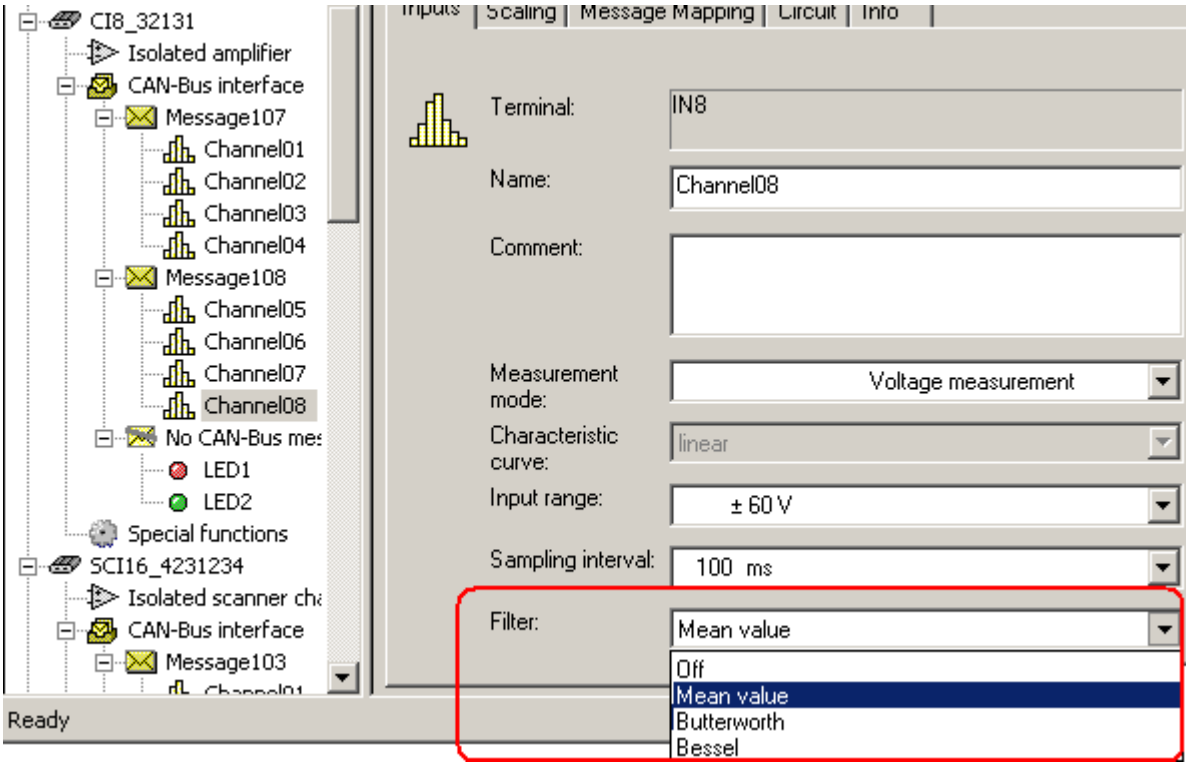
CI8 amplifier tab: Allow overmodulation beyond input range

If additionally the measurement mode *"Voltage: allow zero-balance"* is selected, note that both functions use up the input range's headroom.

Notes

- This operation type is not within the system's specs and can lead to saturation effects, distortions and non-linearities.
- This option has no effect on resistance measurement.

9.3.2.7 Filter



With the CI8, the filter settings can be made for each channel separately.

Off: Last sampled value of a sample interval (output rate) 211.

Mean value (averaging): The output value is averaged by (Sampling interval[ms] / 1 ms) samples. For temperature measurement, only this function is available.

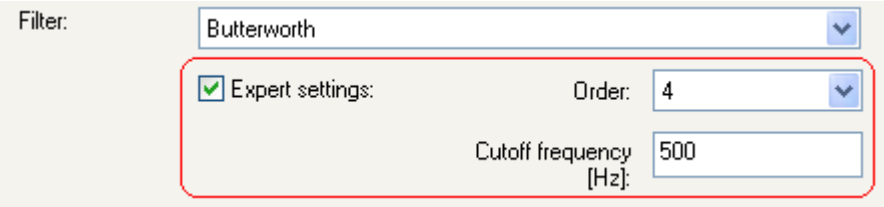
Butterworth: The input signal is filtered by a Butterworth low pass filter 2nd order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals ≥2 s only the mean value function will be used.

Bessel: The input signal is filtered by a Bessel low pass filter 2nd order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals ≥2 s only the mean value function will be used.

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Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured.



Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0.001 Hz	251 Hz
	2	0.004 Hz	251 Hz
	3	0.005 Hz	221 Hz
	4	0.005 Hz	251 Hz
Butterworth	1	0.001 Hz	251 Hz
	2	0.007 Hz	251 Hz
	3	0.009 Hz	251 Hz
	4	0.02 Hz	251 Hz

9.3.2.8 Connection CI8

Reference

Observe the **CANFX** specific Specs 500: the **terminal connections**
Find here for the pin assignment of the DSUB-15 594, LEMO 600 and ITT-VEAM 599 plugs.

Find here the pin assignment of the CANFX/L-CI8-PT 598 variant.

Note Software minimum requirement / measurement modes

Operation of the CANFX/L-CI8-PT module requires at least imc CANSAS software version 2.2 R2. A thermocouple measurement and a current measurement are not supported.

9.3.2.8.1 LEMO variant

Reference

See pin configuration of LEMO terminals 600.

9.3.3 DAC8 analog outputs

This DAC8 module outputs the user's choice of current or voltage signals on 8 analog outputs. The desired output signals can either be extracted directly from a CAN message or derived from received CAN-messages or specified functions (e.g. squarewave, sawtooth etc.) by means of the module's computational capacities.

Reference

Technical Specs DAC8. 509

9.3.3.1 General notes DAC8

The module has 8 digital / analog converters (DAC, D/A converters). This type of module's outputs can be configured as either voltage or current sources individual for every channel. The voltage range is from -10 V to +10 V at a resolution of 16 bits. The current supply works in the range from 0 to 20 mA and has 15-bit resolution. The outputs' refresh frequency is 10 kHz.

The output signal can be governed either by CAN-message or by internal logic. The outputs' status upon power-up is defined.

The 8 outputs have a common ground. Thus, they are not mutually isolated, but they are isolated from the voltage supply and the CAN bus.

9.3.3.2 Analog portion

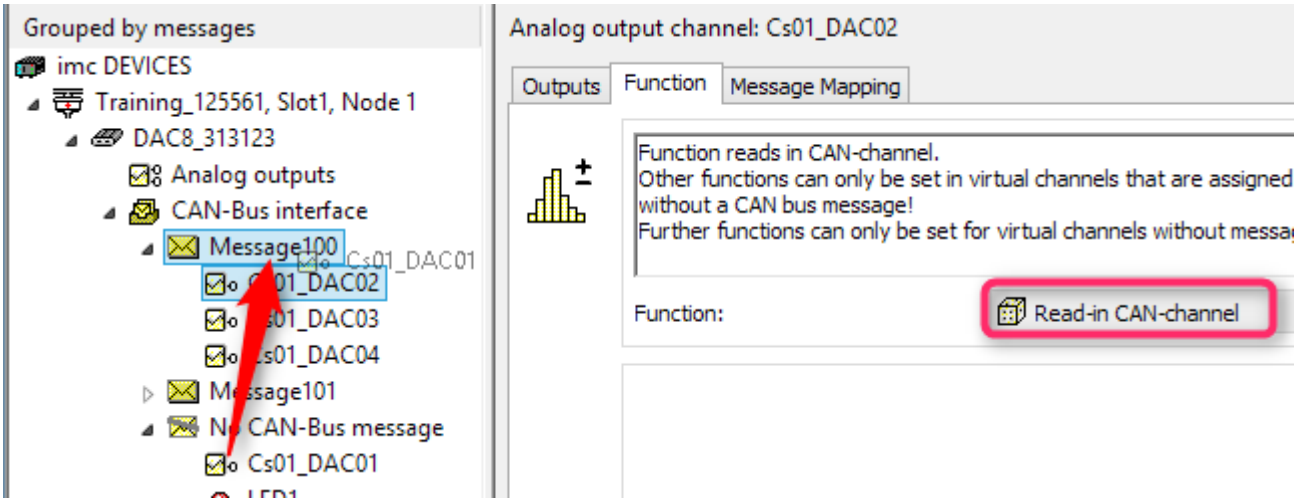
In the DAC8 module, the D/A converter outputs are not directly connected to the terminal plug. Instead, they are connected via a 2nd order Butterworth filter with a cutoff frequency of 5 kHz. This suppresses "glitches" (typical spurious impulses experienced by D/A converters upon power-up) and the otherwise very angular signal shape is rounded. A signal shape thus results which appears more natural and doesn't display the otherwise typical staircase look. This also reduces the harmonics in the signal.

Additionally, there is a relay connected in front of each output. The relay only closes after the transients in the D/A converter and the filter have subsided, which appear upon activation of the module.

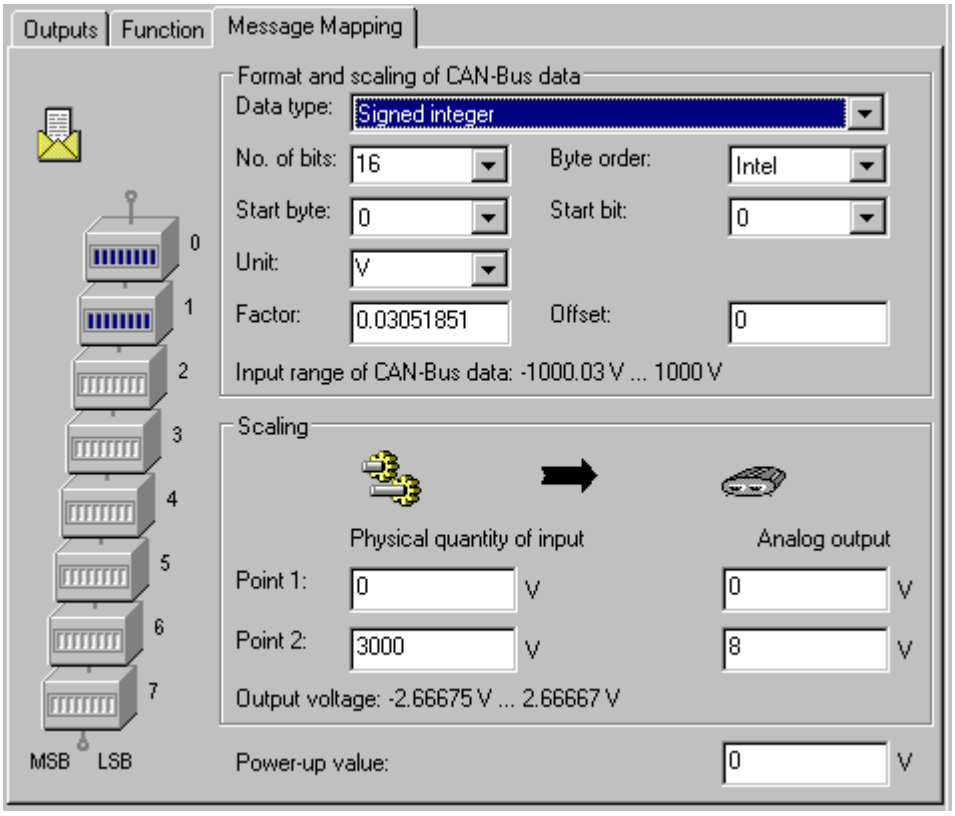
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9.3.3.3 Linking the output signal to a CAN-message

If an output is to be controlled by a CAN message, it is necessary for the output signal to be positioned in a message. This is accomplished by means of Drag&Drop applied to the output's channel in the module tree diagram. Note that the tree diagram is organized according to messages. Subsequently, the function for the output signal Read-in-CAN-channel is set permanently.



Output signal DAC01 is positioned in message "Message 100".
The function is set to "Read-in CAN-channel"



Message mapping for an analog output signal

9.3.3.4 Message Mapping

To begin, the expected numerical range is to be defined. The available choices for ***Data type*** include signed and unsigned integers and a digital bit. Specify the resolution of the numbers as the ***No. of bits*** (8, 12 or 16 bits). The number's position within the message must also be determined, meaning in which Byte and at which of the Byte's bits. For the scaling, the selected ***Unit*** is entered in the dialog's lower portion. The scaling ***Factor*** for a 16-bit quantity is computed thus:

For unsigned integers

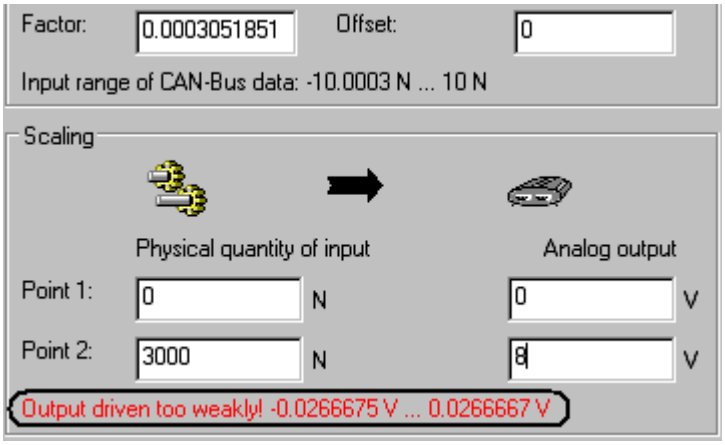
$$\text{Scaling factor} = \frac{\text{maximum value} - \text{minimum value}}{65535} \qquad \text{Offset} = \text{minimum value}$$

For signed integers

$$\text{Scaling factor} = \frac{\text{maximum value} - \text{minimum value}}{32767-(-32767)} \qquad \text{Offset} = \text{min value} - \text{scaling factor} * (-32767)$$

The Initial value upon activation is outputted on the output channel until the first CAN bus message is received. As soon as a CAN bus message arrives, a new value is computed for the output in accordance with the specified transformation operation, and this new value is outputted in analog form. This value also retains its validity until arrival of a subsequent message.

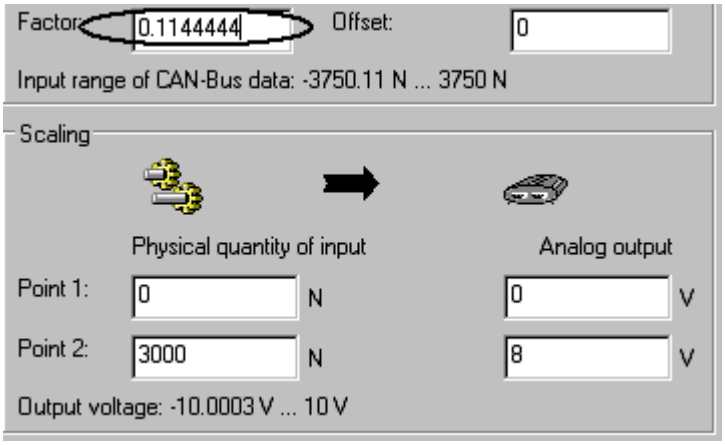
The value range on the CAN bus, set by the control **Analog output**, is between 0 V and +8 V in the example shown. The physical input quantity has been set to range from 0N to 3000N. Taken together with the scaling factor specified in the control higher up in the dialog, the resulting possible output voltage range is –2,667 V to +2,667 V. This means that the maximum output voltage range isn't being utilized.



DAC output is driven too weakly

For ideal utilization of the DAC, the scaling factor must be selected to result in an output range of 10 V to +10V:

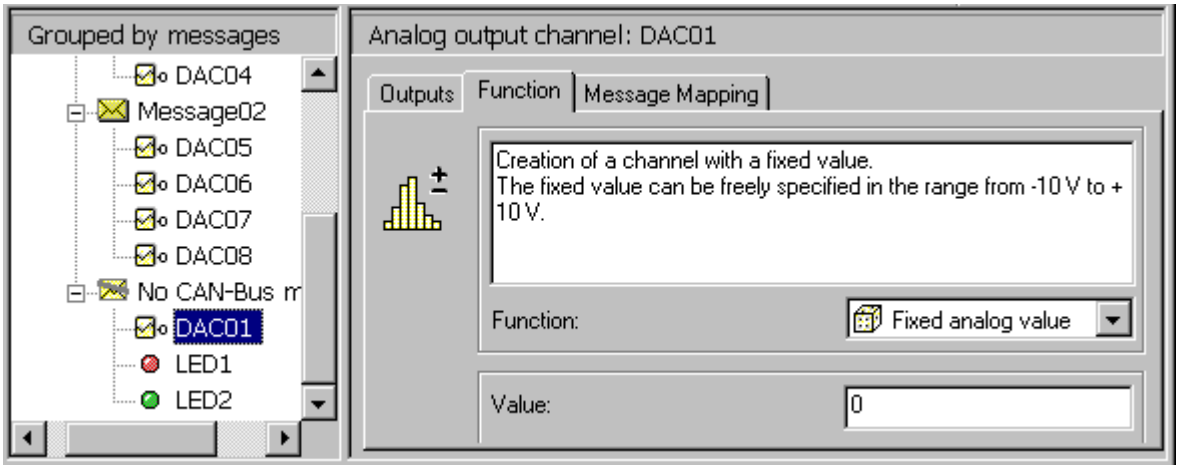
Although it is possible to set an output voltage range of, for instance, -20 V to +20 V, but any specification over ±10 V will be limited to ±10 V.



DAC output is driven perfectly

9.3.3.5 Calculating the output signal

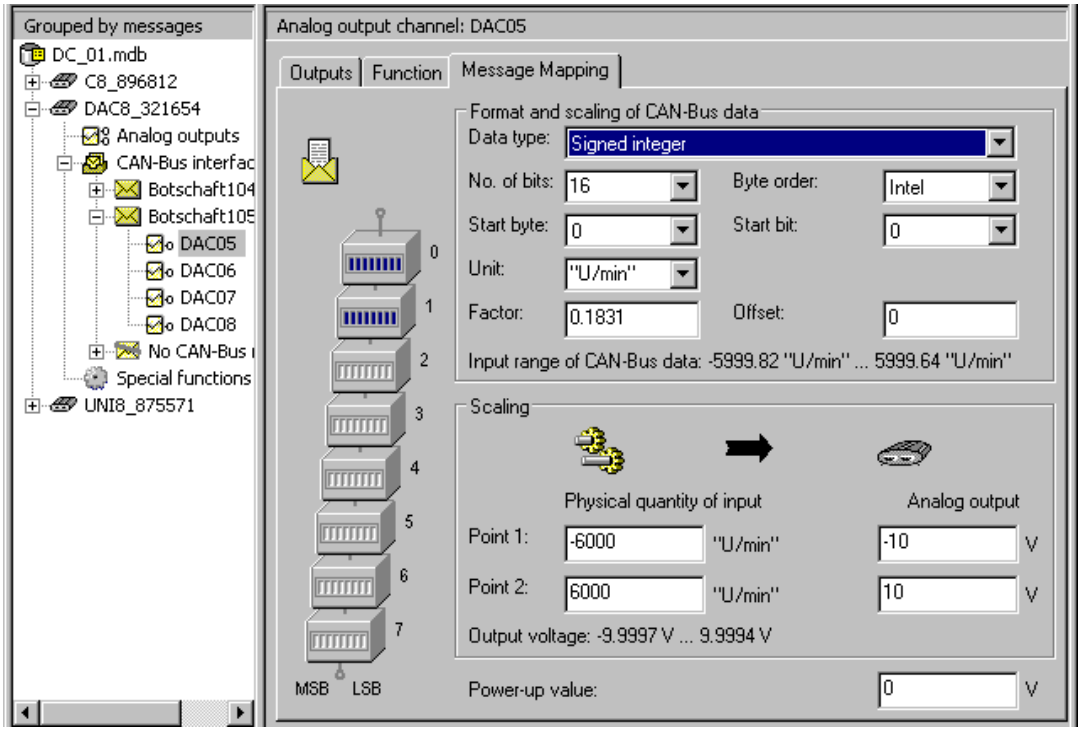
If the output signal is not assigned to any CAN message (the entry for this is located in the module tree under the node "Without CAN bus message"), the signal can be devised to correspond to a calculation. For this purpose, functions are provided which can also be applied to the virtual channels (see the chapter "Virtual Channels 74"). When an analog output signal is removed from a CAN-message, then by default, the function "Fixed analog value" is assigned to it. However, a different function can be selected. In the following example, the 3rd output is set to take the fixed value 0 V.



"Function" tab for an analog signal which is not included in any CAN-message

The example below demonstrates how an rpm-value in the range –6000RPM to +6000RPM is read into the CAN bus and outputted at DAC05.

The dialog shows the corresponding CAN bus settings:



In this example, a 16-bit measurement quantity, scaled so that its minimum is -6000 and its maximum is +6000, is read into the CAN-Bus.

The initial value (power-up value) is set to 0 V. After the unit is activated, the output DAC05 is held to the value 0 V, until a CAN-Bus message arrives. Only once a message arrives, the converted value replaces the initial value.

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The scaling is set in such a way that 10 V are applied to DAC05 when the RPM value captured is 6000 U/min.

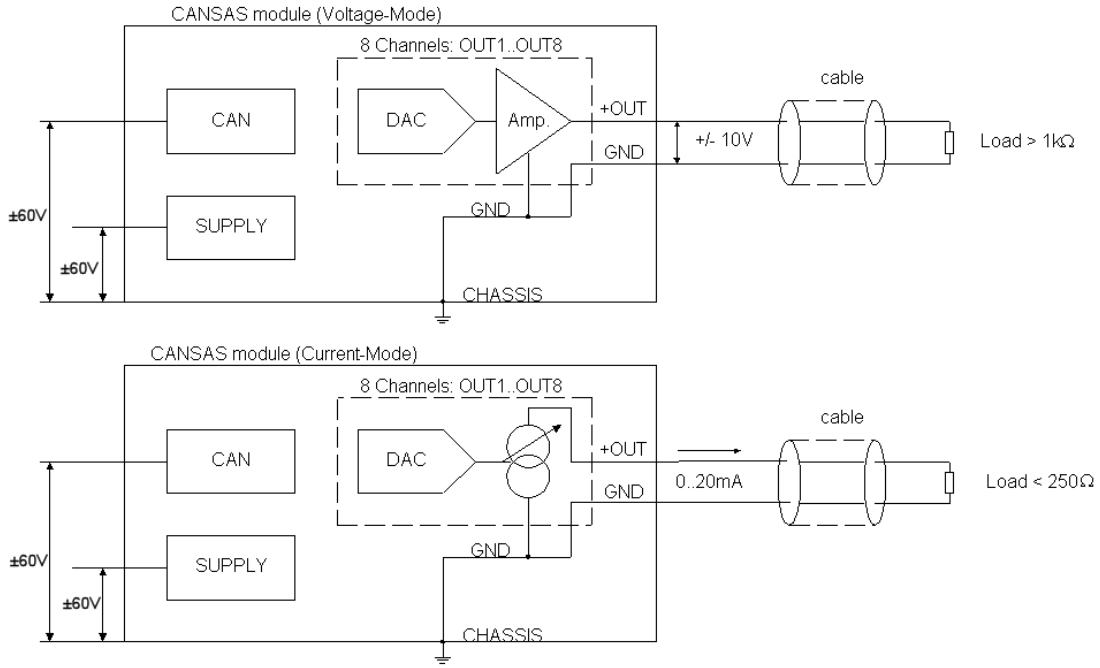
9.3.3.6 Configuring the outputs

The DAC8 module's outputs can be configured either as voltage or current sources. The corresponding settings are made in the dialog accessed via the Module Tree entry **Analog outputs**.

The default is voltage output.

If the setting is switched to current source, note the following: the module remains configured as for outputting voltage in the range -10 V to +10 V. However, values which would otherwise be outputted as +10 V are instead outputted as a current of 20 mA, and values which would otherwise be transformed as 0 V become 0 mA. The current range is always positive, since the current source can only drive a current in one direction. Therefore, values otherwise mapped to negative voltages are ignored in current output mode.

9.3.3.7 DAC8 block diagram

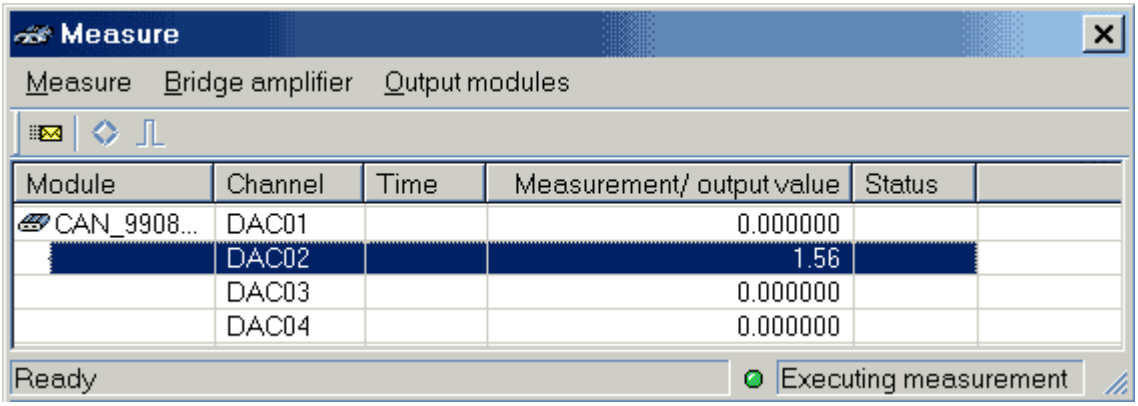


Note

- If the module's outputs are voltages (upper figure), make sure that the load impedance never falls below 1 kΩ or that the load current never exceeds 10 mA. For current output (lower figure), a load impedance below 500 Ω must be set. This limits the voltage at the current's source to 10 V.
- The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.
- It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material and is connected with GND.
- The DAC8 module's analog outputs are usually connected to the voltage or current inputs of other devices. Make sure that no ground loops are created as a consequence.
- It is highly recommended that the cables containing the analog leads be shielded. The DAC8 module's plug is provided with a shielding terminal.

9.3.3.8 Taking measurements with the analog output modules

In the dialog **Measure**, the analog output bits of a DAC8 module are listed only if they are assigned to a CAN-message. In such cases, the entry for the **Measurement/ output value** represents the signal's output value. Upon the start of the measurement, the **Power-up value** is displayed. The output signal can be influenced by editing the values in the column **Measurement/ output value**. By double-clicking in these cells, the editing mode is activated, and the value for the analog bits can be toggled between 0 and 1. When the ENTER-key is then pressed, the value is checked, accepted and sent to the module.



Measure dialog for the DAC 8 module

For output modules, the items **Transfer all values** and **Transfer value after editing** under the Output modules menu are available.

Transfer value after editing: This function can be toggled on and off. If it is active, then any editing performed on the entry is immediately sent to the module. If the function is off, the new value becomes valid but is not transferred. This way, it is possible to set multiple bits and then transfer them as a unit by using the function Transfer all values.

Transfer all values: This function transfers the output values of all output modules shown in the window to the modules.

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9.3.3.9 Connection

Reference

- Please find here the DSUB-15 594 and ITT-VEAM 599 pin assignment.
- Please observe the **CANFX** specific Specs 500, e.g. the **terminal connection** and the power supply options.

9.3.4 DCB8 bridge, strain gauges

This module provides eight differential, analog inputs with integrated sensor supply for the measurement of resistive bridges or strain gauges, as well as voltage.

Reference

Technical Specs DCB8. 510

The eight inputs IN1 to IN8 whose terminals are four DSUB plugs are for voltage- and bridge measurement. They are **non-isolated differential amplifiers**. They share a common voltage supply for sensors and measurement bridges.

The DCB8 module is also available in the PROTECT model, having ESD and transients protection. See the description of the UNI8 396 for properties and information on its constraints.

9.3.4.1 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. 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

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 1 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.

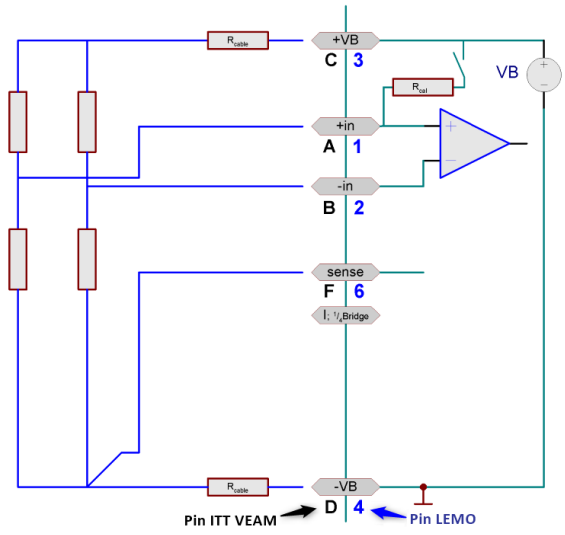
Bridge measurement is set by selecting as measurement mode either *Bridge: sensor* or *Bridge: strain gauge* in the operating software. The bridge circuit itself is then specified under the tab Bridge circuit, where *quarter bridge, half bridge* and *full bridge* are the available choices.

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.

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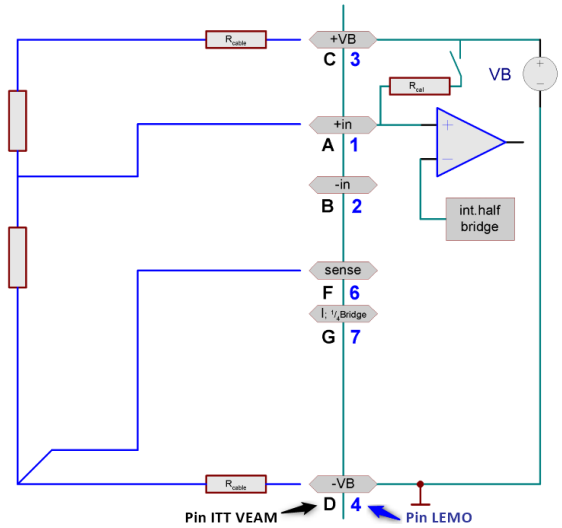
9.3.4.1.1 Full bridge



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.

9.3.4.1.2 Half bridge

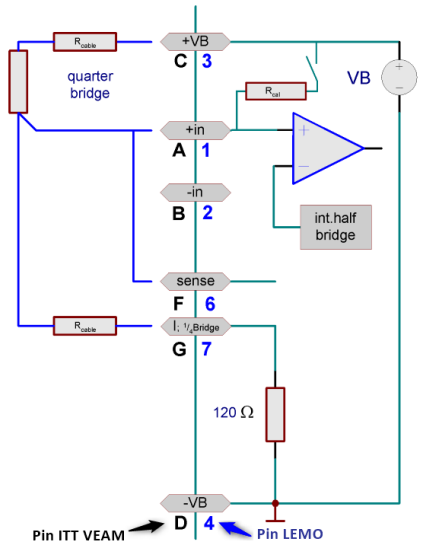


A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has four terminals to connect. For information on the effect and use of the Sense lead SENSE, see the description of the full bridge.

The amplifier internally completes the full bridge itself, so that the differential amplifier is working with a genuine full bridge 309.

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.

9.3.4.1.3 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.

By default there is an internal 120 Ω completion resistor for bridge measurement. A 350 Ω completion resistor for quarter bridge measurement is available as an alternative.

9.3.4.1.4 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 = 2.5 V) [mV/V]	bridge balancing (VB = 5 V) [mV/V]	bridge balancing (VB = 10 V) [mV/V]
±1000	200	500	150
±500	200	100	250
±200	30	100	50
±100	30	15	50
±50	6	15	7
±20	20	3	7
±10	20	10	15
±5	7	10	5
±2	9	3	5
±1	-	4	5
±0.5	-	-	-

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9.3.4.1.5 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 174.66 kΩ shunt. The results are:

Bridge resistance	120 Ω	350 Ω
174.7 kΩ	0.171 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!
- For the special case of shunt calibration: If at least one channel is set to voltage, and zero-point adjustment, and no channel is set to bridge or strain gauge, then upon triggering of a shunt calibration both the status and the LED_function status indicate a shunt calibration, but it is not carried out. When adjustment is set, it is indicated after being triggered and also carried out.

Balance

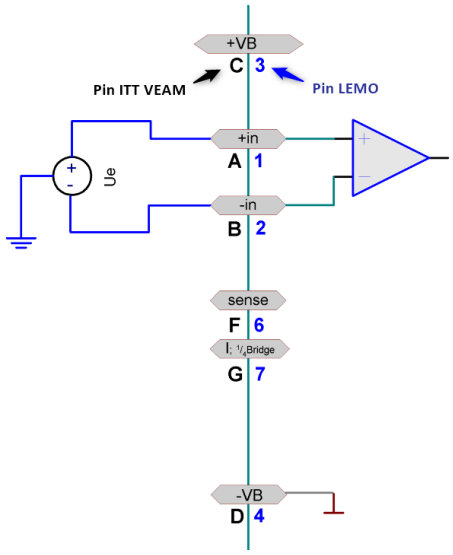
- To ensure that the balancing values are retained even after configuration changes, the option "*Keep balancing values when re-configuring*" must be activated on the module's amplifier board*Balance* . The default setting for new integration is specified on the *Module* card in the Options dialog 106 in menu *Extra*. This new option is available as of imc CANSAS software version 2.2 R7 and is not activated by default after installation.

9.3.4.2 Voltage measurement

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

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

9.3.4.2.1 Voltage source with ground reference



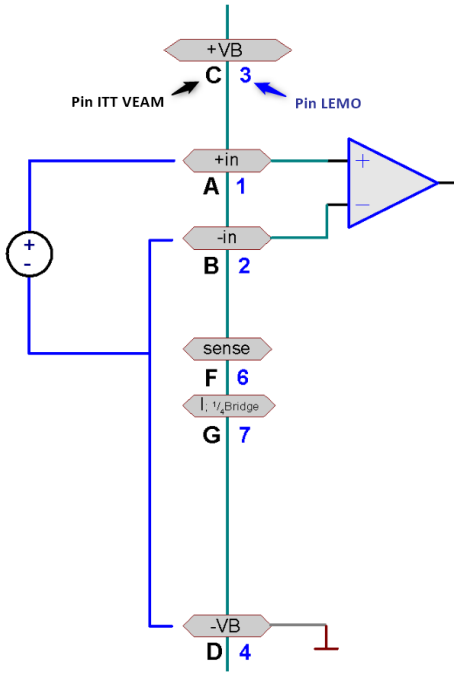
The voltage source itself already has a connection to the device's ground. The potential difference between the voltage source and the device ground must be fixed.

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.

9.3.4.2.2 Voltage source without ground reference



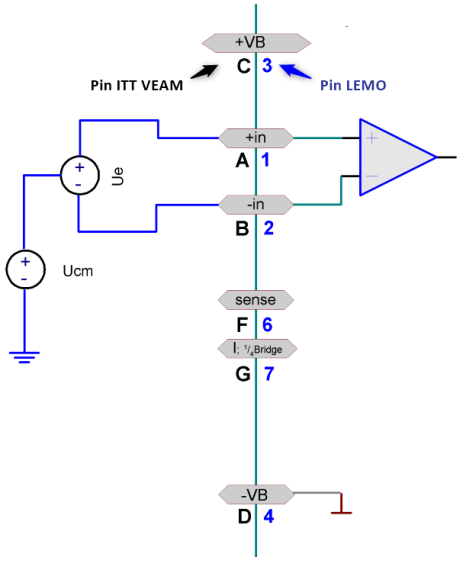
The voltage source itself is not referenced to the device ground but is instead isolated from it. In this case, a ground reference must be established. One way to do this is to ground the voltage source itself. Then it is possible to proceed as for "Voltage source with ground reference". Here, too, the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

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9.3.4.2.3 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.

9.3.4.2.4 Voltage measurement with zero-adjusting (tare)

In voltage measurement, it is possible for the sensor to have an initial offset from zero. For such cases, use the operating software to select the measurement mode "*Voltage: allow zero-balance*" for the desired channel. The measurement range will be reduced by the offset correction If the initial offset is too large for compensation by the device, a larger input range must be set.

Measurement range [V]	Compensable initial offset [V]
±10	1.6
±5	6.5
±2	0.9
±1	1.9
±0.5	0.08

Measurement range [V]	Compensable initial offset [V]
±0.2	0.3
±0.1	0.015
±0.05	0.06
±0.02	0.008
±0.01	0.018
±0.005	0.023

For notes on triggering the adjustment, refer to the section on bridge measurement 311.

9.3.4.3 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.

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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!

Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the CANSAS-module could be damaged.

There is a 5 V pin at the imc connector. That voltage is not available for the CANSAS-modules, only for CRONOS-PL!

9.3.4.4 Bandwidth

The channels' **maximum sampling rate** is 1 kHz (1 ms). The analog bandwidth (without digital low-pass filtering) is 200 Hz (-3 dB).

9.3.4.5 Connection

For the signal connections, it is possible to use either **DSUB-15** (CANSAS-x-DCB8-D), **ITT-VEAM**-plugs (CANSAS-x-DCB8) or **LEMO**-plugs (CANSAS-x-DCB8-L). In the connection diagrams, the numbering for LEMO and custom ITT VEAM connectors appear alongside of the labeling in the terminals:

LEMO	ITT-VEAM	imc-plug ACC/DSUB-UNI2
1	A	+IN
2	B	-IN
3	C	+VB
4	D	-VB
5	E	TEDS (OneWire)
6	F	sense
7	G	Quarter bridge completion / sense for PT100 3-wire configuration

ITT-VEAM-plugs 599

9.3.5 DI16 digital inputs

The DI16 module allows the capture of up to 16 digital input signals at a maximum sampling rate of 10 kHz. The data can be captured either bitwise or as data words for all of the inputs; the module's input voltage can be selected in the software as either 5 V or 24 V. The threshold values for evaluating the inputs' logic level can accordingly be software-selected for either 5 V or 24 V signals.

Beside working with CAN bus per default, the DI16 is also configurable as **CANopen**® module.

Reference

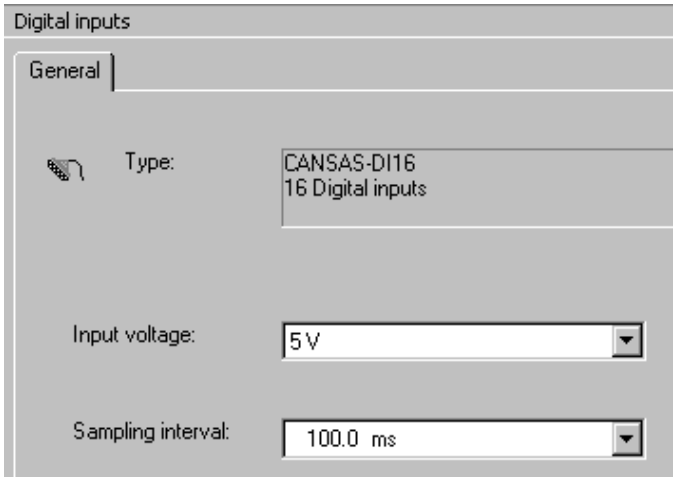
Technical Specs DI16 513
General Technical Specs for the CANFX variant 500: CANFX specific Terminal connections, power supply options, pass through power limits for directly connected modules (Click-mechanism)

The 16 digital inputs can all be sampled together as a digital word. For this purpose, a digital port can additionally be configured. If the entire port is sampled, it can return values from 0 (zero) to 65535, in other words it is interpreted as an unsigned 16-bit integer. However, if only a single bit is used, its data type is "digital" and it occupies only 1 bit on the CAN bus.

9.3.5.1 Settings

The properties which can be specified for the digital channels are Name and Comment.

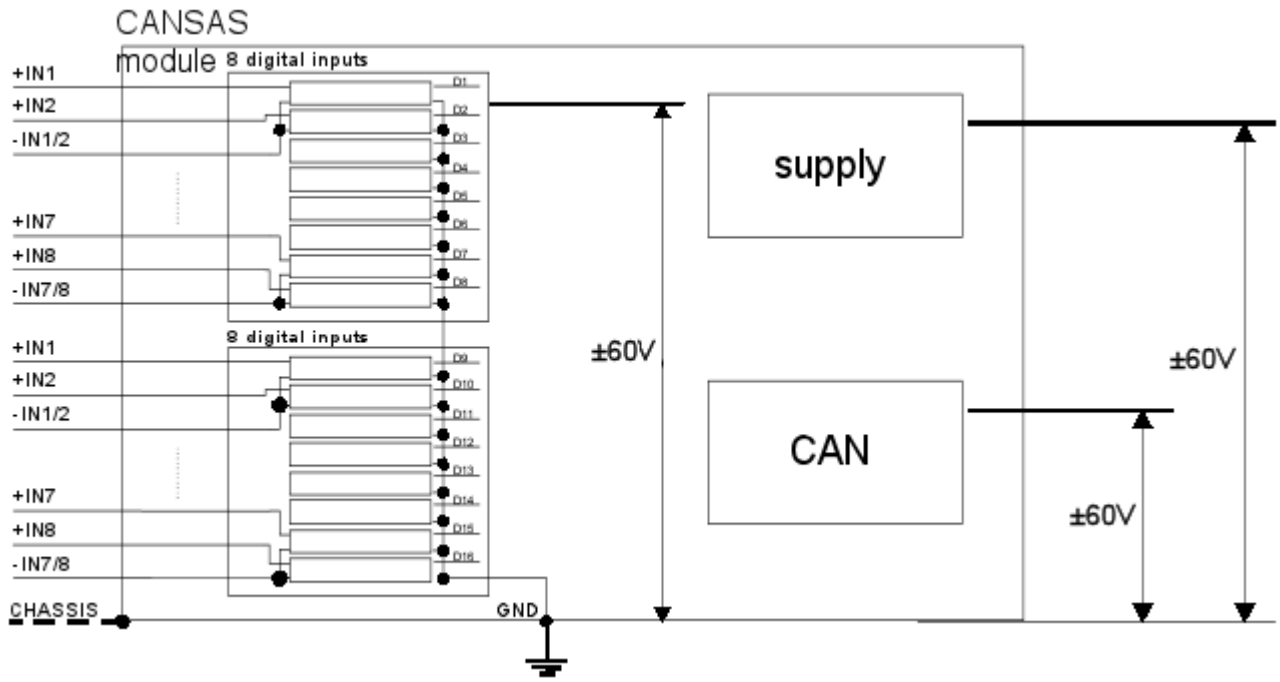
In the dialog **Digital inputs**, the properties applicable to all the digital channels are set.



Input voltage:

The input voltage range for all the digital inputs can be toggled between 5 V (TTL-range) and the 24 V range.

9.3.5.2 Block diagram



Note

- The DI16 module's inputs are organized in pairs which are isolated from other inputs. The pairs' own reference grounds are not connected to the DI16 module's internal ground or CHASSIS. Eight inputs are accessible per socket.
- Open inputs are set to LOW "0".
- The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.
- An example for digital inputs: -IN7/8 is the shared ground connection for the inputs +IN7 and +IN8. This ground is not connected to the chassis.
- It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material.

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9.3.5.3 Sampling Interval

In this module, the sampling interval is set in common for all inputs.

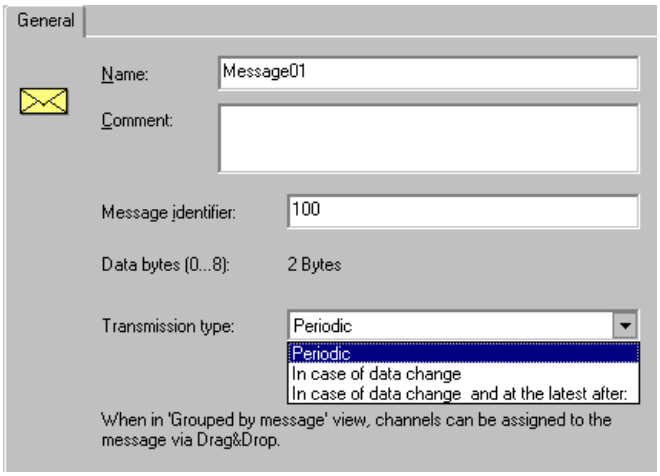
0.1 ms	1 ms	10 ms	100 ms	1 s	10 s	1 min
0.2 ms	2 ms	20 ms	200 ms	2 s	20 s	
0.5 ms	5 ms	50 ms	500 ms	5 s	30 s	

Note

The digital inputs are sampled at intervals of 0.1 ms, no matter what the specified sampling interval is. But afterwards the data is reduced to fit the specified sampling interval.

9.3.5.4 CAN bus message dialog

The CAN bus messages from the DI16 module come with an extra setting:



Transmission type

This determines when messages are transmitted.

Periodic: At the rate set for the assigned channel.

In case of data change: The message is sent only if at least one value of the assigned channel's signal has changed since the last transmission.

In case of data change or at the latest after: The message is sent only if at least one value of the assigned channel's signal has changed since the last transmission or if a specified time interval elapses since the last transmission.

Note

The DI16 module is not equipped to evaluate pulse sequences from incremental encoders or to conduct precise time or frequency measurements. Due to its discrete pulse rate of 0.1 ms, the resolution is limited. For the tasks mentioned, the INC4 module is the suitable choice.

9.3.5.5 Connection DI16

References

General Technical Specs for the CANFX variant 500 : **CANFX specific** Terminal connections, power supply options, pass through power limits for directly connected modules (Click-mechanism)

Please find here 594 the standard DSUB-15 pin assignment
Pin configuration of DI16-Ph variant with Phoenix terminal blocks 604
Pin configuration of DI16-V variant with ITT VEAM terminals 599

9.3.6 DO16 digital outputs

The DO16 module provides 16 digital outputs to serve as control signals via CAN. The outputs are configurable independently for each 8-bit channel group, either as Open-Drain or Totem-Pole.

Reference

Technical Specs DO16. 514

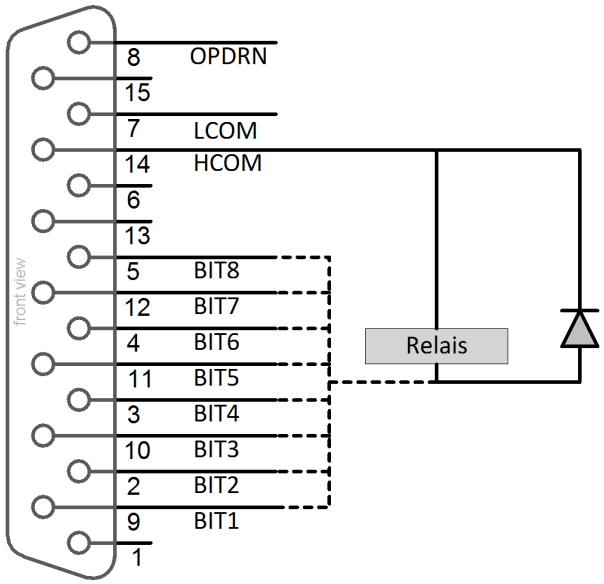
Please find here 594 the standard DSUB-15 pin configuration and
the pin configuration of Phoenix terminal blocks 605 (with DO16-Ph module variant)

9.3.6.1 Configuring the outputs

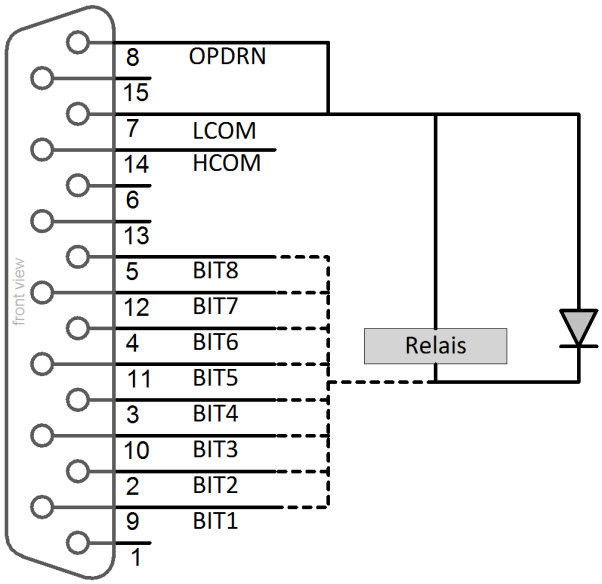
The DO16 module's outputs can be configured as open-drain or as totem-pole output stages. This setting applies to a whole channel group, meaning that signals 1 to 8 (DO 1..8) share one settings, as well as the signals 9 to 16 (DO 9..16). This setting must be made in the software dialog accessed via the module tree entry **Digital outputs**.

The OPDRN control signal can be used to specify for the 8-bit group whether the driver is to operate as a totem pole or as an open drain output.

Open Drain



Totem Pole



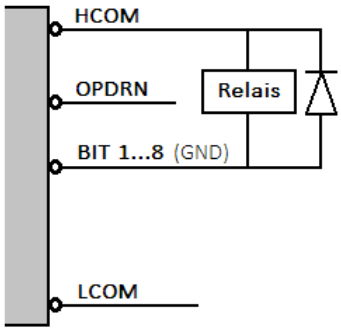
9.3.6.2 Starting up the DO16 module

When the module is started, the outputs are set to the value "0". If a power-up value other than 0 (zero) is set, it only comes into effect after the module has been activated. To boot the module typically takes < 1 s. It is recommended to set "0" as the power-up value in the channel's message mapping dialog, if possible. Only then will there not be any jump after booting.

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9.3.6.3 Possible configurations

Open Drain



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

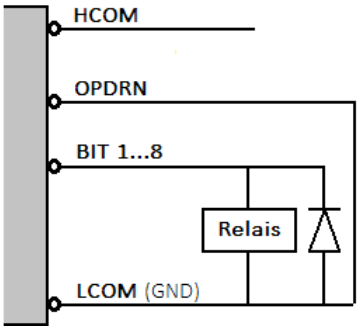
Device booting: no continuity/high impedance (138 kΩ), 0 V at output

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

5 V (internal)

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

Outputs configured as Open drain

At the output of each channel x (denoted in the connection terminal by "Bit x"), there is a transistor configured as an open collector. When a target value of "0" (low) is output, the transistor is switched through (conducts). The result is that the output is connected to ground (denoted by LCOM in the connection terminal). For a target value of "1" (high) at the output, the transistor is closed (has high impedance). In order for there to be a defined voltage in for this state, the output must be connected to the positive voltage supply via a load. HCOM's voltage differential to LCOM is 5 V and can take a small load; refer to the technical specs for more info. Instead of HCOM, an external source of (higher) voltage can be connected via the load or a pull-up resistor.

Outputs configured as Totem-Pole

In totem pole mode the output is configured as a low-impedance driver switching between the two supply rails 0 V and 5 V.

For a target value of "1" (high), the internal supply voltage 5 V, referenced to LCOM, is applied to the output. If an external voltage > 5 V to LCOM is applied at HCOM's terminal, it is used instead of the internal 5 V. A voltage of 5 V is accessible at HCOM which can take a small load; refer to technical specs for details.

For a target value of "0" (low), the output is connected with LCOM and thus is at a differential of 0 V to LCOM (LCOM being the reference).

Each of the two plugs has its own independent references. LCOM is basically the plug's reference ground, and HCOM the plug's supply. LCOM comes from "Low" and "common", whereas HCOM comes from "High" and "common".

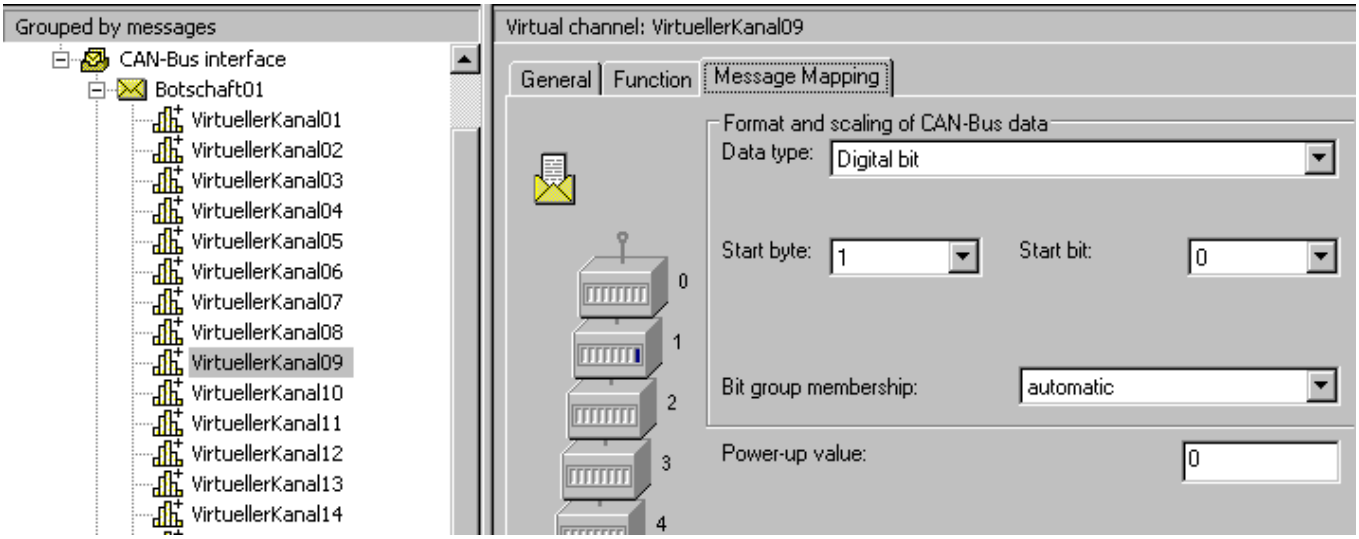
The DSUB socket CON1 is access for Bits 1...8; CON2 for Bits 9...16.

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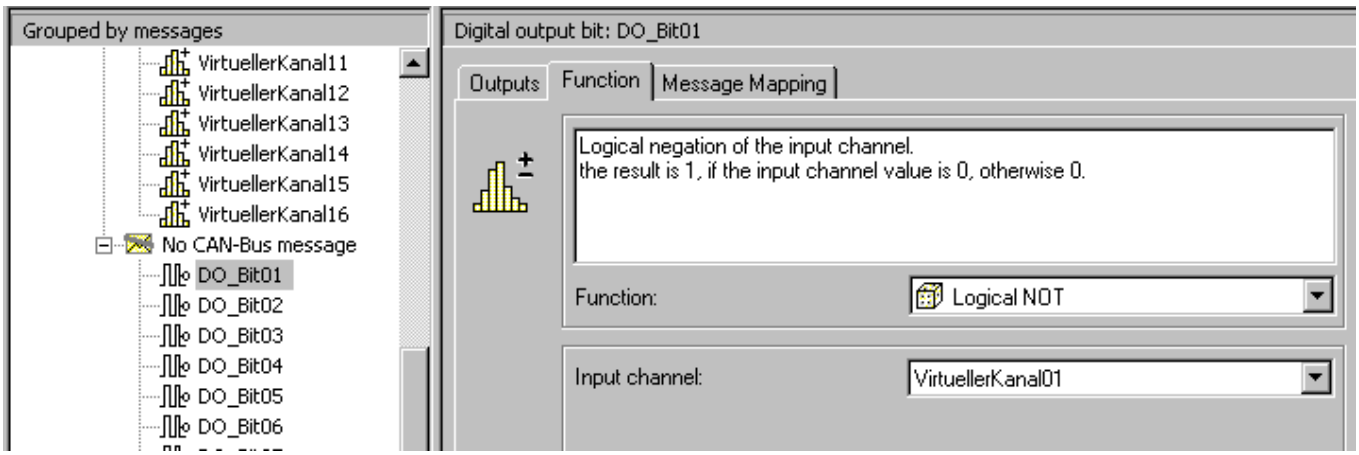
9.3.6.4 Invert Output

A setting in the imc CANSAS software enables inversion of the DO16 logic. To do this, the following configuration steps are necessary (these instructions describe inversion of all 16 outputs):

1. The existing digital outputs (designated by default as *DO_Bit01 – DO_BIT16 in Message01*) must be relocated to the folder *Without CAN bus message*.
2. 16 virtual channels must be set up and relocated to Message01which previously contained the outputs.
3. The setting for the virtual channels on the page Message mapping are changed so that *Virtual Channel01* has start byte 0 and start bit 0 until *VirtualChannel16* has start byte 1 and start bit 7.



4. The settings for the digital output bits in the folder *Without CAN bus message* must be adapted so that the function Logical NOT and the input channel *VirtualChannel01* are assigned to output bit DO_BIT01 on the dialog page Function. The other 15 channels must be treated analogously.



9.3.7 DO8R, -DO16R relay outputs

The DO8R and the DO16R provide 8 and/or 16 relays, respectively, independent relays with changeover contacts. Four relays are available per DSUB connection, each with one changeover (opening and closing) contact per bit (SPDT: Single Pole Double Throw), see Fig. "DSUB 322". A second variant of the module is equipped with Phoenix connections, see Fig. "Phoenix 322", connection type: Push-in spring connection for a nominal diameter of: 1 mm^2.

Beside working with CAN bus per default, the module is also configurable as **CANopen®** module.

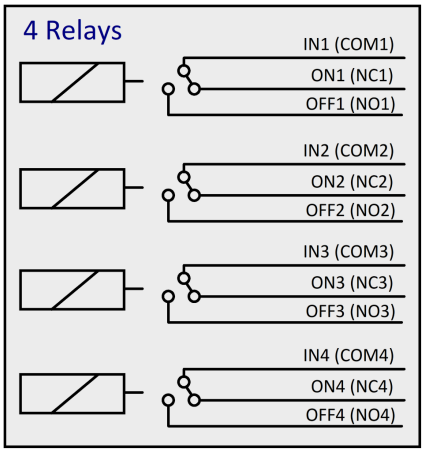
Properties

- Potential-free relay contacts for switching low and medium power signals and loads
- Free interconnection of circuits with any current direction
- Can be used as signal multiplexer or circuit breaker
- Safe startup with fixed initial state ("ON" / "NC")

Reference

Technical Specs DO8R, -DO16R 516

9.3.7.1 Block diagram DO8R, DO16R



Depending on the logical signal state, the contact "IN" is connected with "ON" or "OFF". This signal path is potential-free and can be operated with signals in any direction and with contact powers of up to 0.3 A at 125 V AC or 1 A at 30 V DC.

For the Phoenix variant, the contacts are named as follows: COM, NC (Normally Closed) and NO (Normally Open).

Contact-Configuration	switch	IN / COM = ON / NC (logic signal 0)
		IN / COM = OFF / NO (logic signal 1)
Power-up Default	ON / NC	defined state at module startup: logical 0

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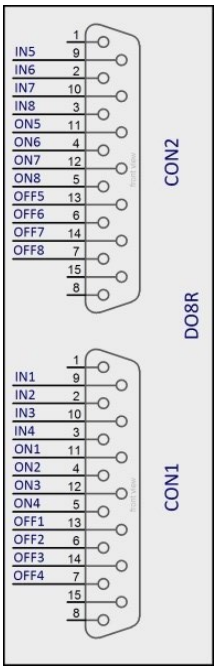
9.3.7.2 Starting the DO8R, DO16R module

The relay's switching state is ON respectively NC upon activating the module. If a power-up value other than 0 (zero) is set on the CAN-board, it only comes into effect after the module has been activated. To boot the module typically takes <1 s.

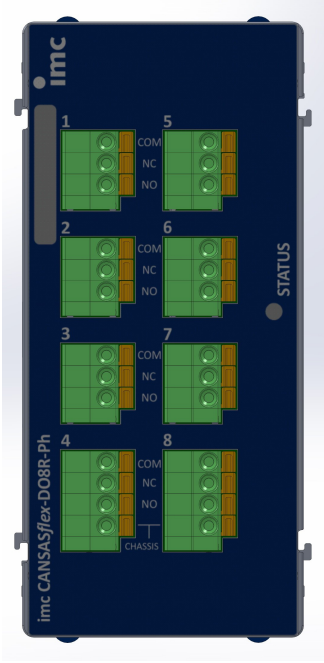
Recommendation

If the software sets the value "0" as the rest state, the relays don't switch over after the system boots. If the user wishes "1" to be the rest state, we recommend that the relay's ON (NC) and OFF (NO) be connected the opposite way around, rather than setting the value by software.

9.3.7.3 Connection



DSUB



Phoenix

We recommend the ACC/DSUBM-plug for the DSUB variant. Pin configuration see: DSUB-15 plug 594.

Reference

- Please observe the **CANFX** specific Specs 500, e.g. the **terminal connection**
- Pin configuration of the module variant with Phoenix terminal blocks 605

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9.3.8 FBG-T8 temperature for fiber optic sensors

The CAN measurement module **imc CANSAS*fdx*-FBG-T8** is an 8-channel fiber-optic interrogator, that allows the measurement of temperatures with FBG sensors. The optical signals of fiber-optic sensors according to the **Fiber Bragg grating** principle ("FBG") are detected with an opto-electronic unit, digitized, analyzed, processed and output via CAN bus.

Reference

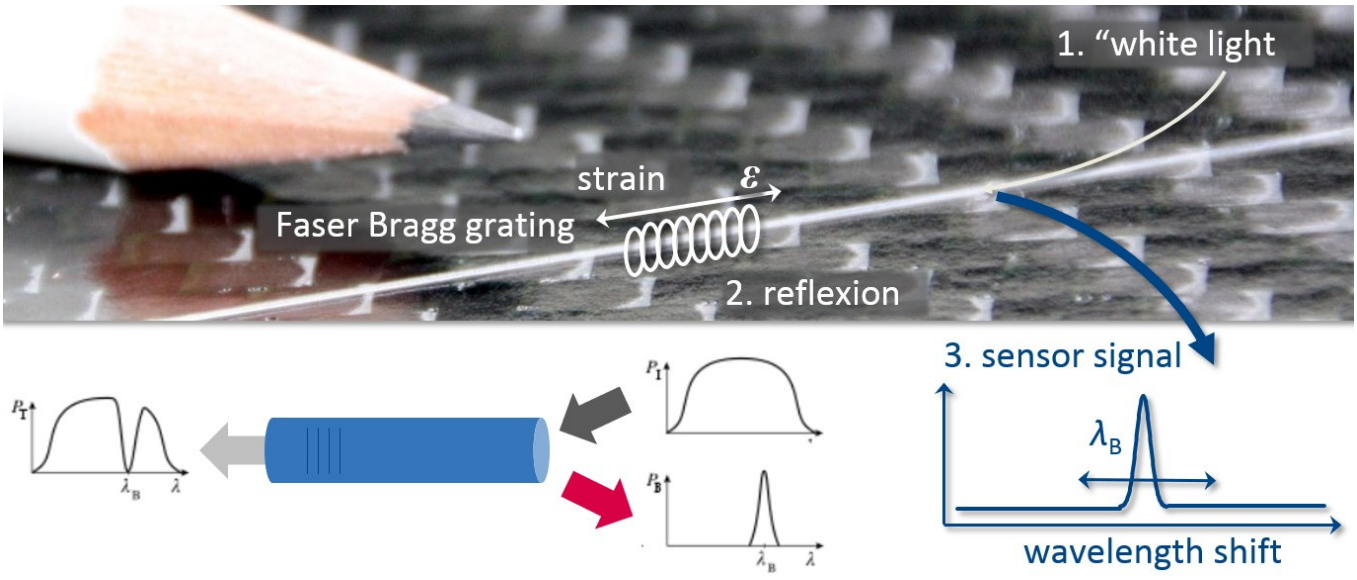
Technical data imc CANSAS FGB-T8 517 module,
technical data imc FBG-Temp 576 sensors (accessories)

Handling Guide

General recommendations on handling and installation of FBG sensors are explained in a short **"Handling Guide"**. We advise careful consideration of these hints:
https://www.imc-tm.de/fileadmin/Public/Service_Training/Support/Handling_Instructions_for_FBG_Applications.pdf

9.3.8.1 Measuring principle (Fiber Bragg Grating)

The module is equipped with a broadband light source that emits into the connected fiber-optic sensors. At one point in the fiber, a Bragg grating reflects a certain wavelength of the incoming light, depending on the current value of the measured variable. The wavelength λ of the reflected light of the fiber Bragg grating sensor is proportional to the physical quantity being measured (e.g., temperature). This reflected spectrum is analyzed, converted into physical measured values and output as messages on the CAN Bus, where they can be recorded with a CAN data logger such as imc BUSDAQ*flex*.

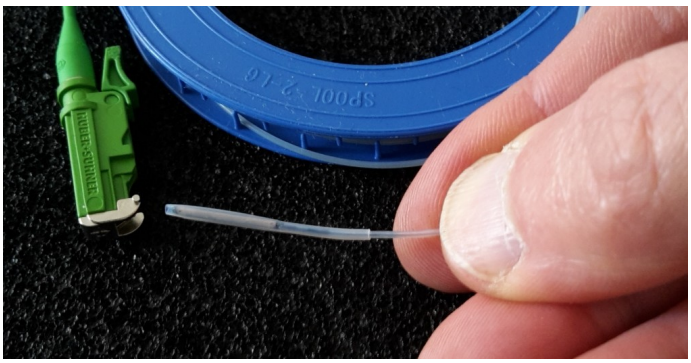


Sensors

Operation of the module is recommended with specially designed fiber-optic sensors, which are offered as accessories:

The FBG temperature sensors of type "imc FBG-Temp s/xs/xxs" are based on glass fibers that are integrated in a glass capillary housing with an extremely small diameter and are particularly suitable for demanding applications in the field of e-mobility.

Extension cables are available for plug-in termination with standard fiber-optic connectors of type E2000/APC.



Reference

Technical Specs imc FBG-Temp 576 sensors

9.3.8.2 Notes on usage

The mounting of the rigid sensor area as well as the transition to the flexible glass fiber should be done very carefully to avoid sensor breakage.

The passive supply line must be protected against damage such as buckling, crushing and compressing: While only a slight undercutting of the minimum specified bending radii during the measurement leads to possible temporary signal errors, very drastic bending and squeezing can irreversibly damage the fiber!

The passive part of the fiber (feed line), even far away from the active sensor, can lead to slight measurement deviations under the influence of mechanical bending. These effects are not due to a strain sensitivity of the active sensor part, but to changes in the optical polarization behavior of the signal. This is specified in the technical data of the associated measuring instrument as "reproducibility", which also includes repeated mating cycles of the connectors. Wire fixation is recommended.

Analogous to fiber optics in general, possible parasitic reflections on polluted connectors must be minimized. It is therefore strongly recommended to clean the connectors on both sides with a cleaning pin, which is available as an accessory, before each mating operation. The connectors are specified for a nominal 1000 mating operations. In order to protect the connectors on the device in particular in the event of frequent replugging, routine use of an additional short extension ("sacrificial cable"), which can be easily replaced if necessary, is recommended.

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Min. allowed bending radius

Warning Destruction

- Observe the limits of the mechanical resistance!
- Strain relief and bend protection at the plug should prevent destruction.

- A **bend** leads to light emission and loss of intensity in the fiber. Observe the permissible values given in the data sheet (e.g. 5 mm for one winding).
- Finally, the bending influences the polarization behavior of the sensors and thus the proportion of polarization-related effects in the measurement accuracy. This influence on the polarization behavior is not directly correlated with the degree or the radius of the bend and is already effective with small movements, therefore a fixation of the feed fibers is recommended!

Cleaning the connectors

- It is recommended to clean the connector terminals of the sensor, the module and the extension cable before each connection. To do this, use the **cleaning stylus** (FBG/FIBER-CLEAN), available as an accessory.

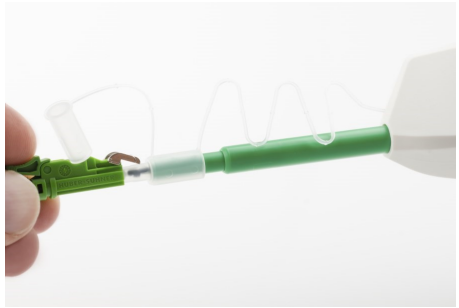


- Any inputs not used need to be covered with protective caps (FBG/E2000-CAP-10).
- Cleaning of **both sides** during each plugging process:

Socket



Plug



Reference Status LEDs

Classification of the intensity of the signal is possible, please observe the FBG-T8 blinking codes 222.

Please observe the Handling Guide

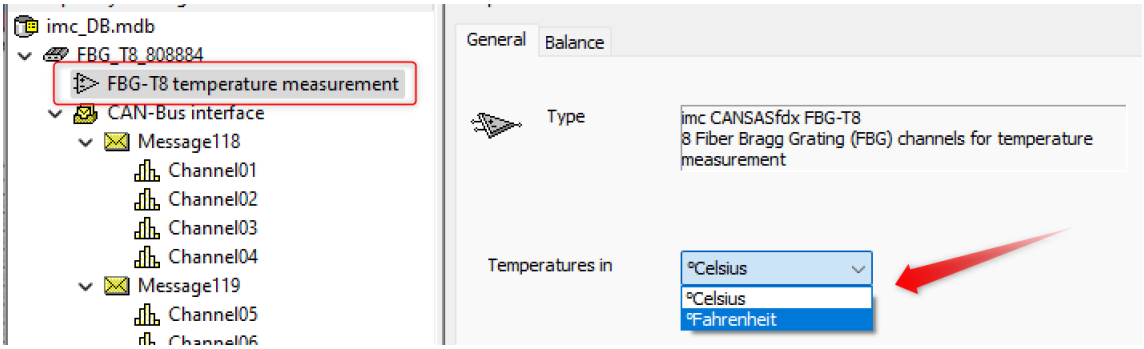
Tutorial video on cleaning:

Thorough and consequent cleaning of the fiber connectors is mandatory. This procedure is shown in a short tutorial video: https://www.youtube.com/watch?v=scM7NGy-cQc

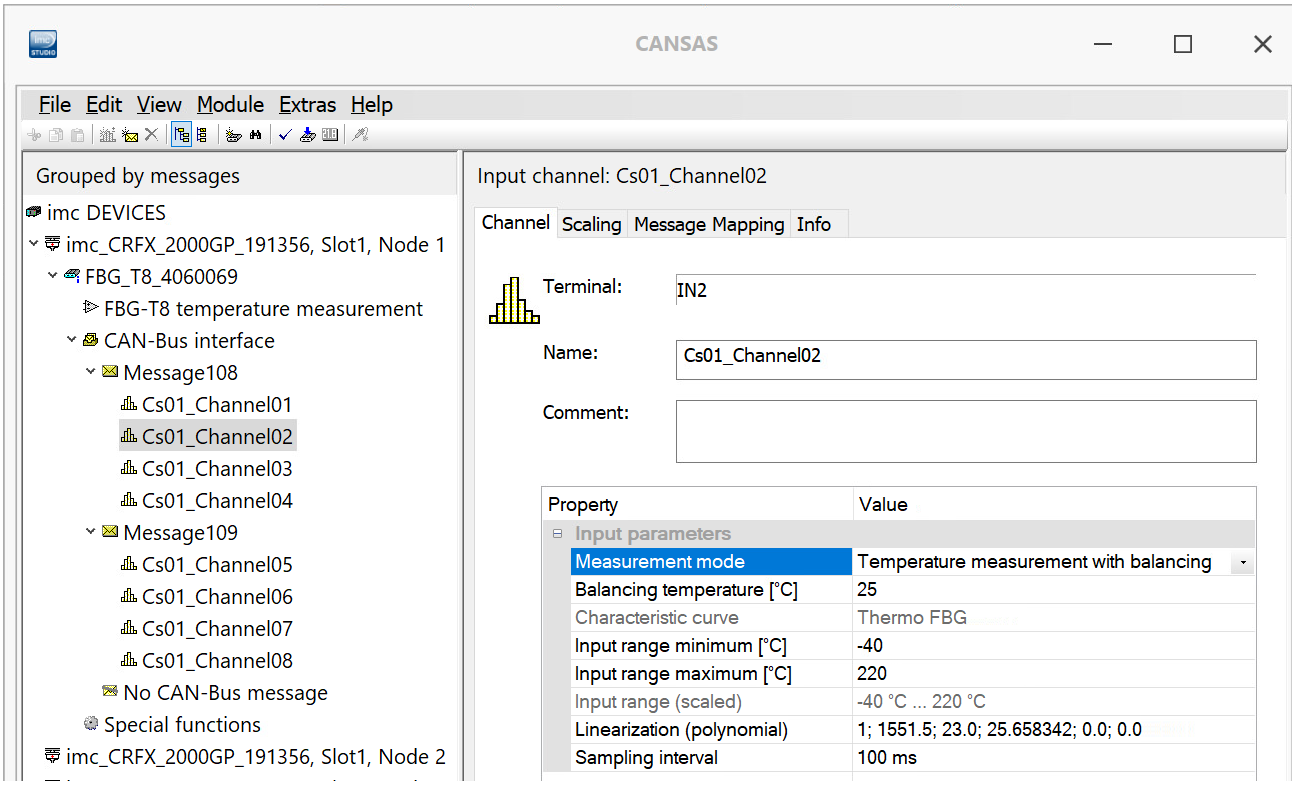
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9.3.8.3 Configuration

The **unit** is defined on the "*FBG-T8 temperature measurement*" card:



Select the channel to enter the properties:



Measurement mode: Temperature measurement with balancing

For *Temperature measurement with balancing*, the channel can be tared to the "*Balancing temperature*". The adjustment takes place in the Measure window 99, upon power-on or via a CAN message. These options are activated in the branch *FBG-T8 temperature measurement* on the *Balance* tab.
Temperature measurement with balancing is supported from version 2.2 R13.

Balancing temperature [°C]

Temperature preset to which the reading is calibrated.

Characteristic curve

Thermo FBG (fixed)

Input range

To optimize the resolution (LSB), the input range can be set as small as possible.

Linearization (polynomial)

Along with the imc FBG-Temp sensor, you receive a calibration certificate and an Excel file. This file states the specific coefficients for the linearization polynomial according to the sensor's serial number. The version number, wavelength and the six polynomial coefficients are copied as text into the channel properties.

These data are composed of the following pattern:

			5th degree polynomial				
Version	***Conductor wavelength***	d	***ax***	ax^2	***ax^3***	ax^4	***ax^5***

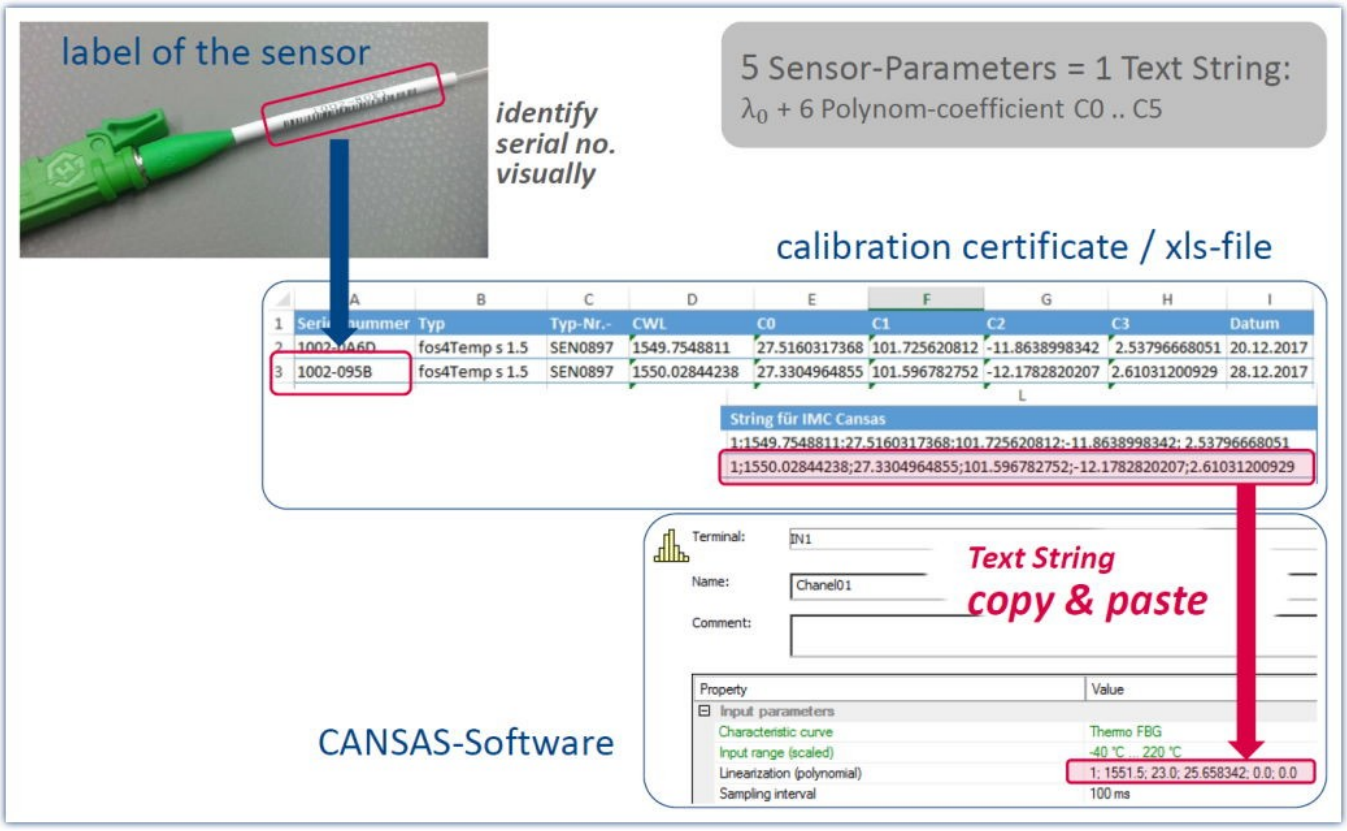
Example: 1;***1549.88308909***;24.93686663;***105.506495243***;-14.1850773611;***2.79517368873***;-11.1731625611;***1.57657269745***

The coefficients are inserted in the properties separated by semicolons. See also the following chapters *Entering coefficients manually* 327 and *Transmission from imc SENSORS* 328.

Sampling interval

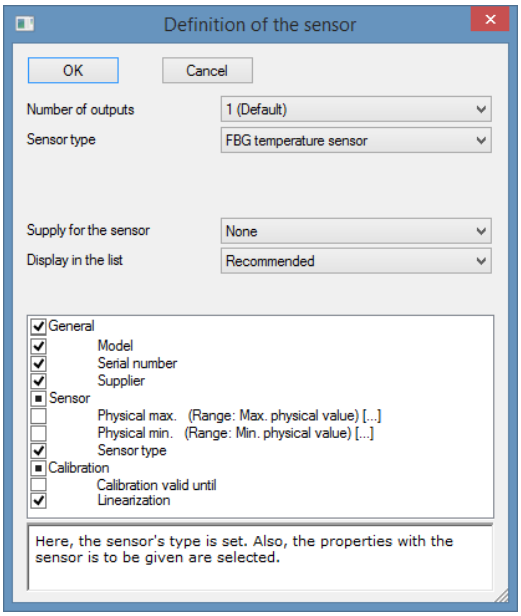
The sampling time of the channel and thus the transmission interval of the message.

9.3.8.3.1 Entering coefficients manually



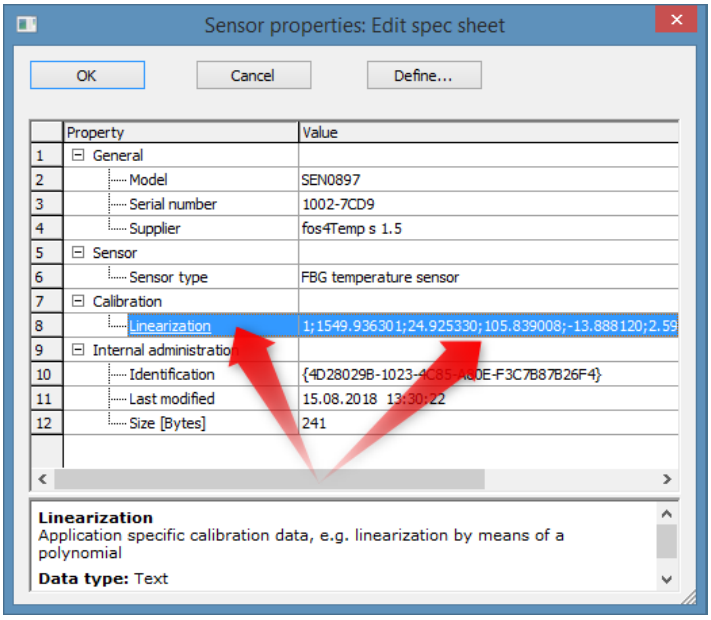
9.3.8.3.2 Transmission from imc SENSORS

When imc SENSORS is used, the coefficients are transferred via the "*Linearization*" property.



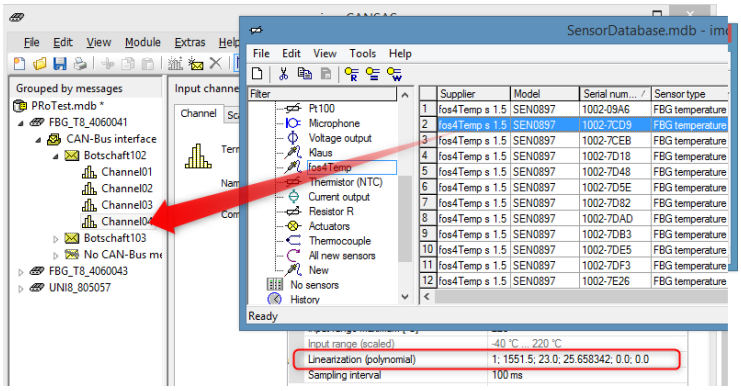
To do this, activate the "*Linearization*" property in the definition dialog.

"Linearization" in section "Calibration"



Enter the text: *"Version", "Wavelength", "d", "ax", "ax²", "ax³", "ax⁴", "ax⁵.*

"Linearization" contains the coeffizients of the linearization polynomial

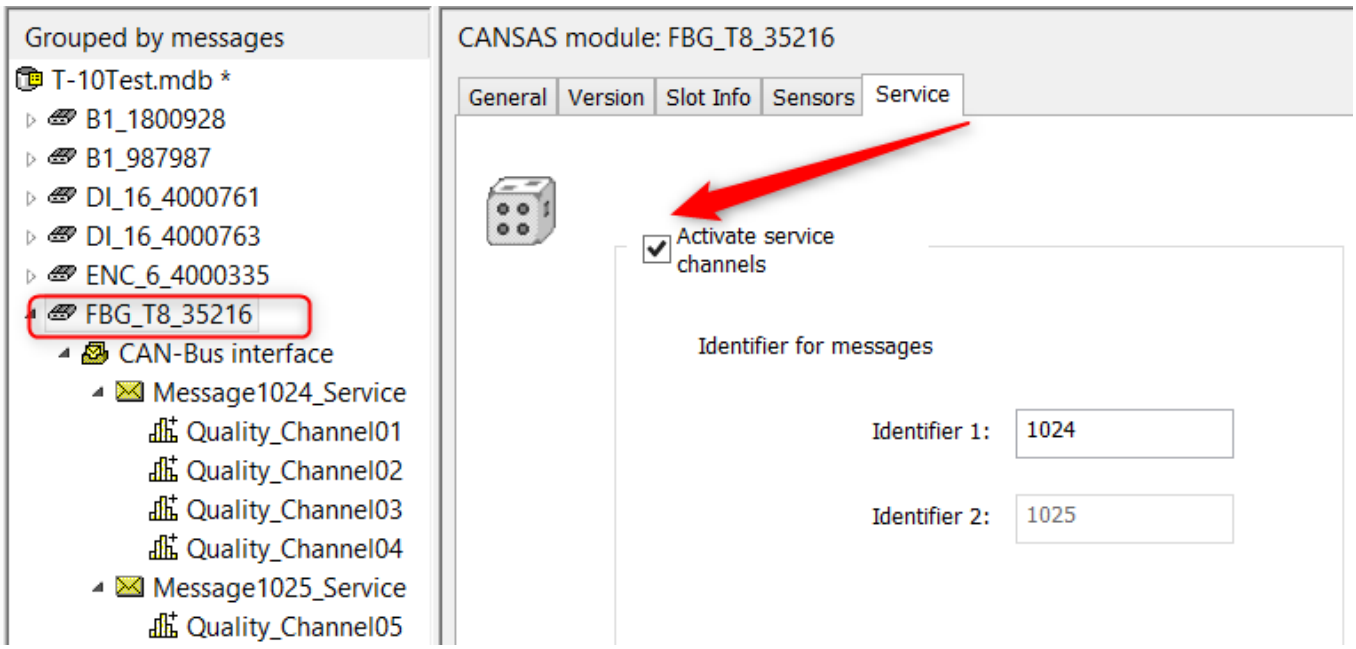


Drag the sensor with the mouse to the desired channel.

Drag&Drop of the sensor from imc SENSORS to the channel in imc CANSAS

9.3.8.3.3 Service channels

The service channels are activated on the page ***Service*** of the module's main node.



Activate service channels

This creates two messages which provide one channel for each of the FBG-T8's inputs, on which codes indicating the channel's quality are outputted.
This can be important, for instance, for detecting a contaminated connection between the sensor and the device, and for cleaning it accordingly. Certain kinds of contamination or incorrectly plugged LWL-connectors can cause measurement imprecision by multiple whole degrees, which can only be indicated by the signal quality code.

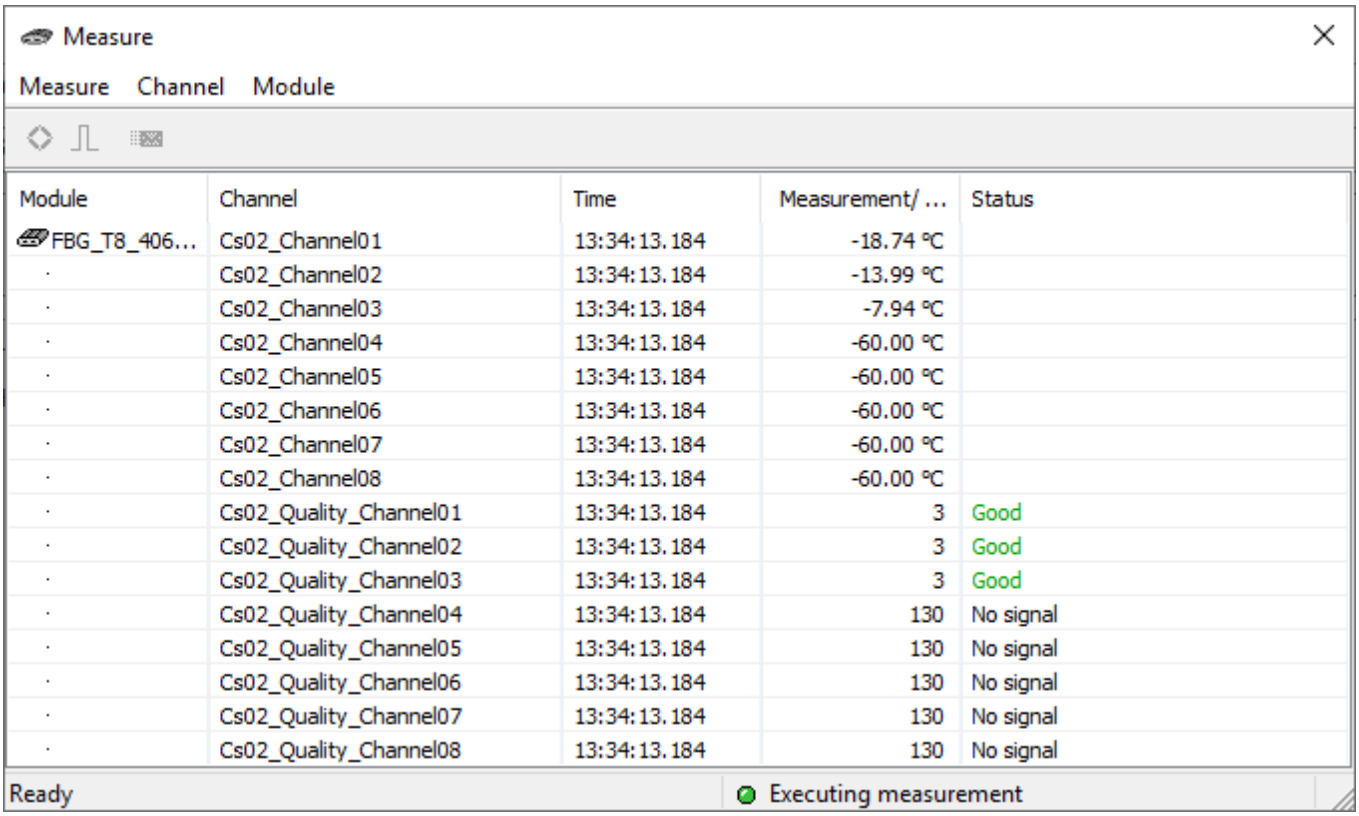
Interpretation of the codes

Quality	Value	Reason
Good	3	The sensor signal is good
Warning	68	Temperature Low
	69	Temperature High
	70	Signal Level Low
	71	Signal Level High
	72	Measurement Signal near Lower Bound
	73	Measurement Signal near Upper Bound
Error	128	System Error
	129	Calibration Missing
	130	No Signal
	131	?
	132	Temperature too Low
	133	Temperature too High
	134	Signal Level too Low
	135	Signal Level too High
	136	Measurement Signal exceeds Lower Bound

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	137	Measurement Signal exceeds Upper Bound
	185	Booting/init

In the measurement window, the quality and codes are displayed in the *Status* column:



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9.3.9 INC4 incremental counter channels

4 inputs for incremental encoder sensors

Measurement modes

displacement, angle, events, time,
frequency; velocity, RPM

Beside working with CAN bus per default, the INC4 is also configurable as **CANopen**® module.

The **analog bandwidth** (without low-pass filtering) of the isolated voltage channels is **500 kHz**.

Reference

Technical Specs INC4. 538

9.3.9.1 Measurement quantities

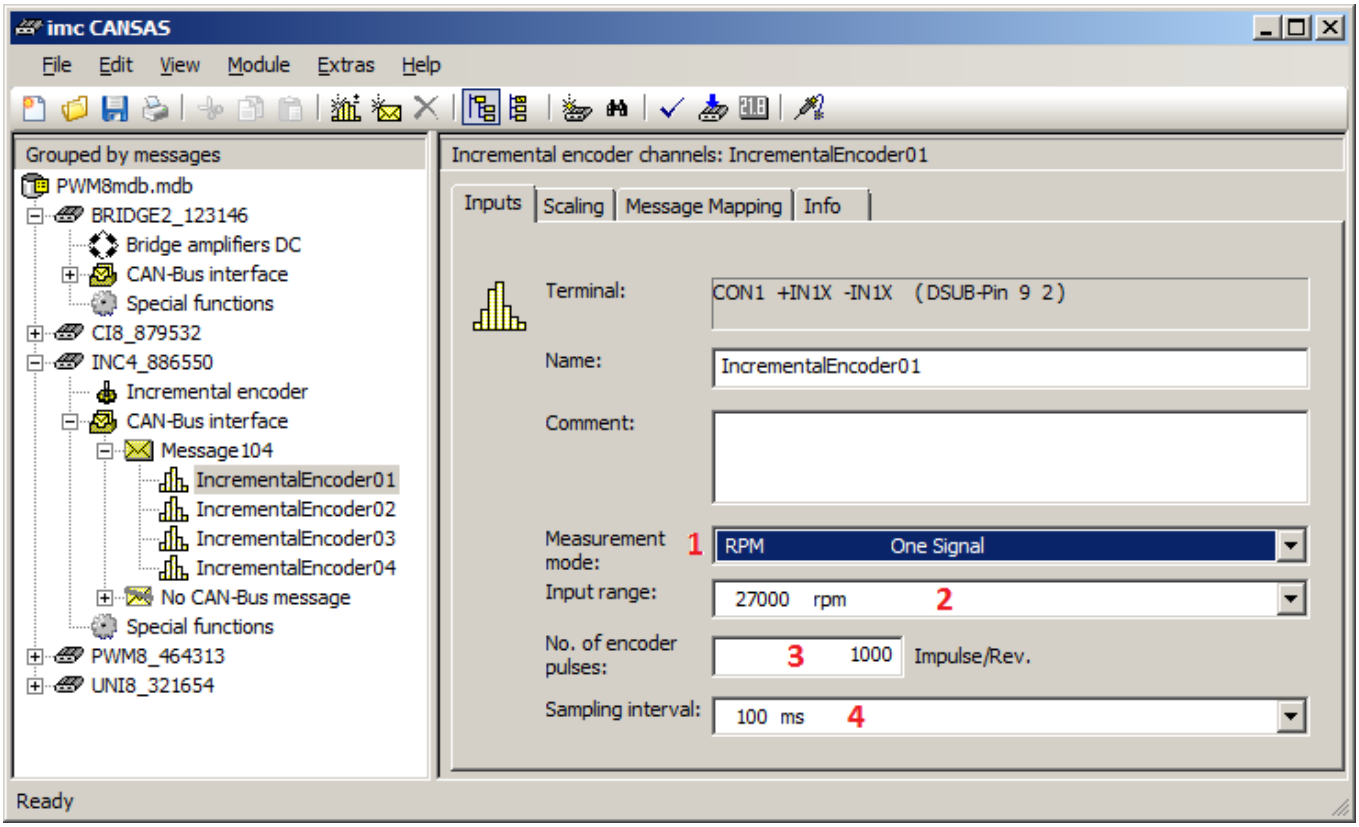
The following operating modes can be set separately for each of the 4 channels:

event counting:	time measurements:	combination of counting and time measurements:
• Events (differential) • Events (cumulative) • Displacement (differential) • Displacement (cumulative) • Angle (differential) • Angle (cumulative)	• Time measurement • PWM	• Frequency • Rpm • Velocity

A detailed description of incremental encoder sensors data acquisition is found in Chapter "Measurement technique". 191

Setting the operating mode: IncrementalEncoderOx -> Index card "Inputs" -> Combo box "Measurement mode"

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[1] *measurement mode* **[2]** *measurement range* **[3]** *number of pulse per rotation* **[4]** *sample rate*

The **sampling interval** determines at what rate result values are returned (or internally: at what intervals the counter findings are evaluated).

Setting the sampling interval:

IncrementalEncoder0x -> Index card "Inputs" -> Combo box "Sampling interval"

The available selections are:

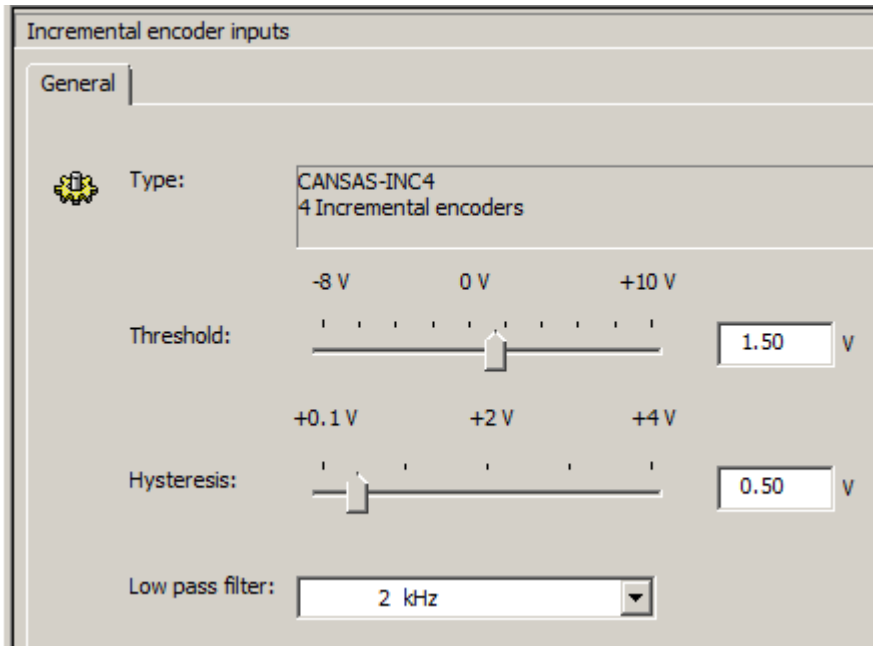
1 ms	10 ms	100 ms	1 s	10 s	1 min
2 ms	20 ms	200 ms	2 s	20 s	
5 ms	50 ms	500 ms	5 s	30 s	

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9.3.9.2 Comparator configuration

Setting the switching threshold:
Incremental encoder -> Index card "General" -> Input box "Switching threshold"
Setting the hysteresis:
Incremental encoder -> Index card "General" -> Input box "Hysteresis"
Setting the input low pass filter:
Incremental encoder -> Index card "General" -> Combo box "Low pass filter"

Setting the switching threshold or hysteresis can be accomplished either using the sliding button or the input box to the right of the sliding button:



The conditioning set is valid for all 4 incremental counter channels, as well as for the index-channel (zero pulse). The only exception is that the index channel has a fixed frequency filter (20 kHz).

- Note on setting the threshold:
  Note that the input voltage range is only -8 V..+10 V. Thus, a threshold of +10 V is possible, but not recommendable. To avoid overloading the input amplifier (from which it can only recover slowly), a divider should be connected for high input voltages.
- Note on setting the hysteresis below 300 mV (out of specification):
  Setting the hysteresis below 300 mV is possible, but it is not recommended unless the input signal amplitude is below 1 V in all active incremental counter channels of a module. Lower hysteresis settings combined with larger input signals may result in an input signal falsely registering in more than one channel.

9.3.9.3 Sensor types, synchronization

Zero pulse (Index signal) denotes the synchronization signal SYNC which is globally available to ***all four channels in common***. If measurement mode with ***zero pulse*** channel has been selected (e.g. Angle (diff) One Signal & zero pulse), the following conditions apply: After the start of a measurement the counters remain inactive until the ***first positive slope arrives at +INDEX***. This arrangement is independent of the release-status of the Start-trigger condition.

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Note

- The pins for the zero pulse (index) is connected to CON1 only!
- **The zero pulse is only considered after configuring or reboot of the imc CANSAS INC4. A restart of the measurement without restart of the imc CANSAS does not reset the index channel!**

Incremental encoder sensors often have an index track (index signal, zero marker pulse) which emits a synchronization-signal once per revolution. The SYNC-input is differential and set by the comparator settings. 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.

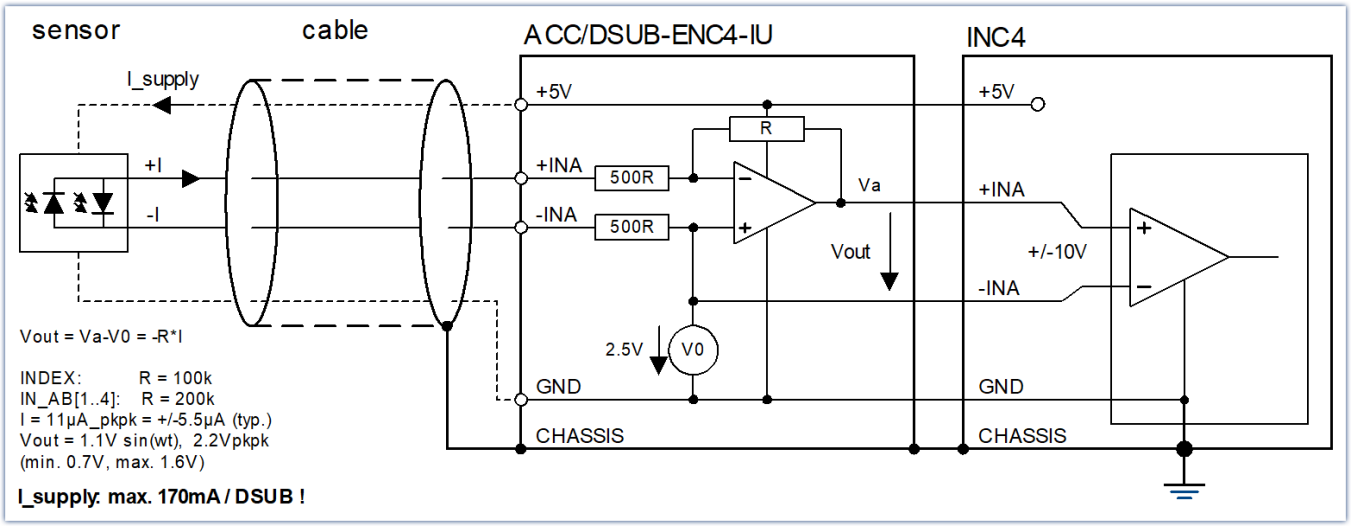
The measurement types Linear Motion, Angle, RPM and Velocity are especially well adapted for direct connection to **incremental encoder sensors**. These consist of a rotating disk with fine gradation in conjunction with optical scanning and possibly also with electric signal conditioning.

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).

9.3.9.4 Sensors with current signals



For a rotational encoder working with current signals, the current/ voltage plug ACC/DSUBM-ENC4-IU can be used. It is possible to power the sensor from the INC4 module. The pertinent specifications are: max. supply current: 170 mA per DSUB-terminal. Higher supply current should be provided externally.

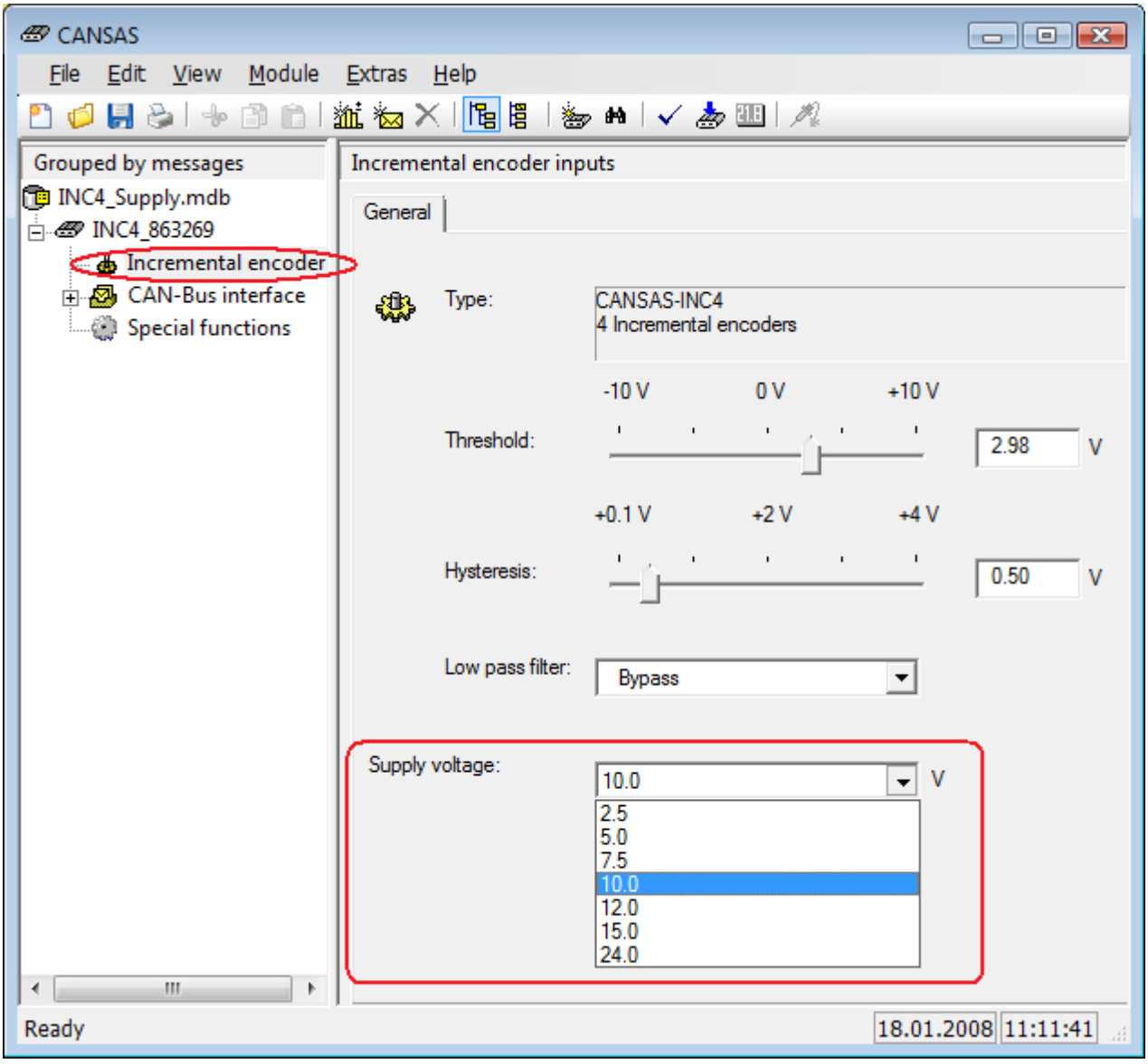
9.3.9.5 Sensor supply (INC4-SUPPLY)

The module INC4-V-SUPPLY is equipped with a sensor supply module 539.

The sensor supply with DSUB-15 is connected at PIN 15 = clamp 14 = -SUPPLY and PIN 8 = clamp 17 = +SUPPLY.

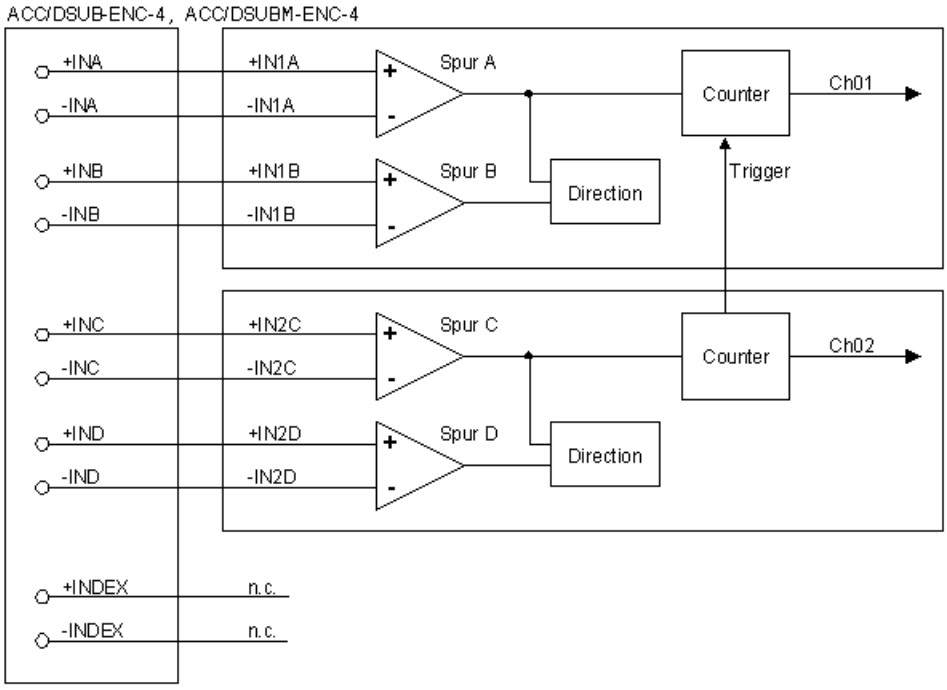
The sensor supply is connected via the pins C (+SUPPLY) and D (-SUPPLY) at the ITT VEAM connector.

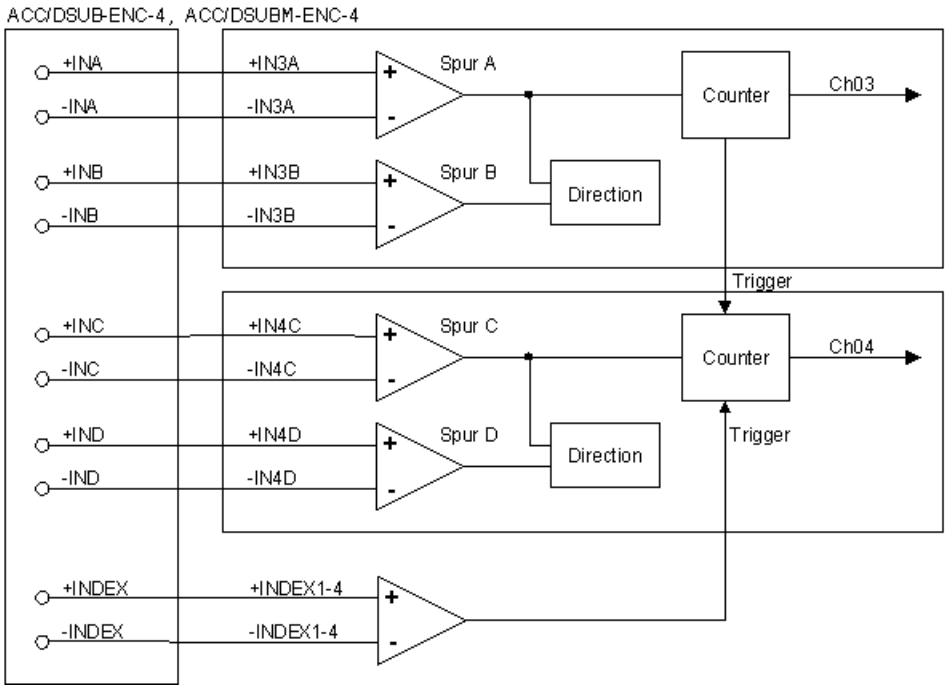
The supply voltage is set by the software:



Sensor supply settings for INC4-SUPPLY

9.3.9.6 Channel assignment





For each ENC-4 plug, 2 single-track encoder or 2 dual-track encoder can be connected.

- With 2 single-track encoders, the signals of the first one are applied to ±INA and its second track to ±INC. ±INB and ±IND remain free.
- With 2 dual-track encoders, the signals of the first one are applied to ±INA and its second track to ±INB. At the second one analog to C and D.

9.3.9.7 Connection

Please note the number of channels:

- The INC4 module contains 4 counters. Each of the counters leads to a channel that can be connected to the CAN bus.
- Each counter has 2 input signals: An X and a Y track
- Each input signal is measured differentially, i.e. it occupies 2 pins on the connector.

Each of the 4 incremental counter channels has an X and Y track for connecting a dual-track encoder. If a single-track encoder is used, it must be connected to the X track and the positive Y track must be short-circuited to the negative Y track. If the index input is not used, the positive index channel must be short-circuited to the negative index channel.

Despite the differential measurement, the input voltage at none of the input pins may deviate by more than +10 V or -10 V from the module ground. Otherwise the input amplifier goes into saturation, from which it only slowly comes out again. The differential voltage itself may also only be between -10 V and +10 V. If the input voltage is higher (maximum ± 50 V against the chassis), a displacement of the threshold or hysteresis is possible, which leads to unwanted results. In addition, the saturation behaviour of the input circuit causes a switching delay which can affect the measurement results.

The inputs are not isolated from each other. They are all related to the mass of the module (housing, chassis, ground, ground). An earth connection is also provided in the connection plugs (in addition to the ground of the integrated sensor supply voltage).

Even with differential measurement, a ground reference may have to be established between the encoder and the imc module.

For further information, please refer to the block diagram 198.

Reference

- For the DSUB-15 pin configuration - see here 594
- For the LEMO pin configuration (CAN/SL-INC4-L) - see here 600
- For the DSUB-9 pin configuration (CAN/K-INC4) - see here 599.

9.3.10 P8 pressure

The P8 pressure module measure either absolute pressure or in relation to ambient pressure.

Reference

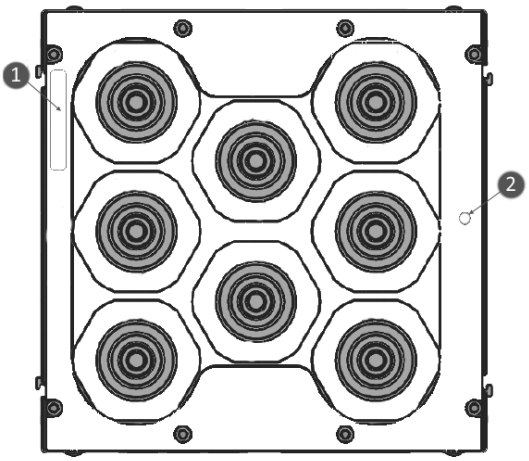
Technical Specs P8 543

9.3.10.1 General remarks

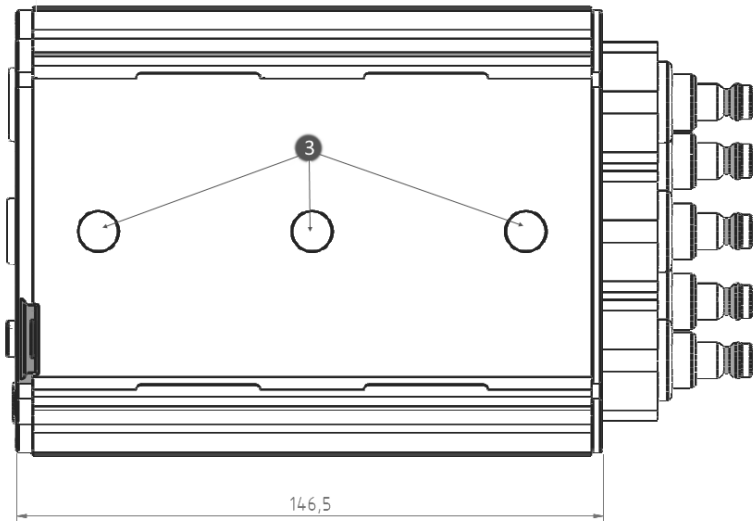
The pressure module CANFX/L-P8-GX (housing type L4) contains eight pressure sensors built into attachment nipples. Using an appropriate coupling, tubes carrying gases or fluids whose pressure is to be measured can be connected at the nipples. In the module's interior is an additional pressure sensor which serves as a barometer and constantly measures the ambient air pressure.

Mechanical drawings with dimensions

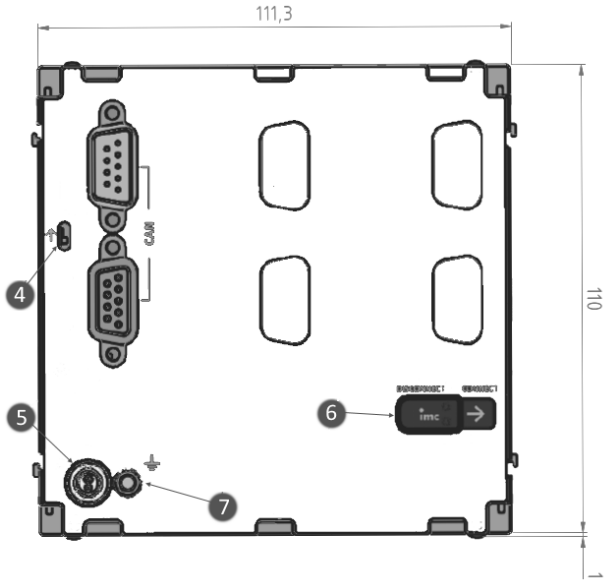
front



side view



rear view



Legend:

1: Serial number label
2: Status LED (blue / red)
3: magnet (depending on model)
4: adjustable CAN terminator
5: supply socket (LEMO)
6: locking slider CAN/supply
7: ground connection M3

Shown in standard operating orientation: housing type L4; width (W) = 111.3 mm.

9.3.10.2 Absolute and relative pressure

The 8 inputs have a fixed combination of sensors which depends on the model of the P8-module.

Absolute pressure sensors measure absolute pressure. A typical input range is 0..10 bar. Absolute pressure can never be less than 0 bar, since 0 bar is already a vacuum. If no medium is connected to a nipple with a built-in absolute pressure sensor, then that sensor will measure the ambient air pressure. You would then obtain measurement values around 1 bar.

Relative pressure sensors measure pressure in relationship to the ambient air pressure. In this case, one side of the sensor's membrane has contact to the medium to be measured, and to the surrounding air on the other side. Depending on which side presses harder, the membrane is bent toward one side. Thus relative pressure can be either positive or negative. Input ranges of ±300 mbar are typical. If nothing is connected to the nipples, they deliver measurements of around 0mbar. The measurement value is positive if the pressure of the medium is higher than the atmospheric pressure.

9.3.10.3 Barometer

The barometer inside the module can be used to obtain a measurement of relative pressure using the absolute pressure sensor. The module itself refers to the built-in barometer and takes the difference. Use the software to select the measurement type for each channel separately, which is equipped with an absolute pressure sensor. A sensor with the input range 0...10 bar then can produce a relative pressure input range of 1 bar..+9 bar, in other words, shifted down by 1 bar. The built-in barometer requires permanent contact to the surrounding air.

9.3.10.4 Sensors

The pressure module is equipped with high-performance sensor which enable precise pressure measurement. Each sensor is calibrated individually by means of a characteristic curve array over the entire temperature range. Thus the typical non-linear behavior of pressure sensors is compensated.

A little EPROM on each pressure sensor records its characteristic data (incl. its characteristic curve array). The sensor and EPROM are to be seen as an inseparable unit which complies with the standard IEEE1451. This means that the module is especially servicing-friendly. The sensor's characteristic data can be queried via the operating software.

The sensors are rather robust and can withstand pressures higher than the input range; refer to the spec sheet for details on limit values. The pressure must not exceed the indicated limits, otherwise the membrane may sustain permanent damage.

Note also in this context that there is a minimum pressure for absolute pressure sensors. Even though the input range is generally given as starting at 0bar (e.g. 0...10bar), the pressure may not fall below the minimum stated in the spec sheet. The sensors are not designed for measurement in near-vacuum conditions. Violating the sensor's minimum pressure requirement can also lead to permanent damage.

The sensor is designed for a particular temperature range which must also not be violated; see the spec sheet. The spec sheet also specifies a maximum temperature for the medium measured. The medium may, indeed, (occasionally) be hotter than the sensor, but if the sensor gets too hot, its accuracy is diminished. In particular, the characteristic curve array for correction of the temperature-dependency is gauged for 85°C.



Reference Pressure transducer

A detailed overview of available integrated transducers (permanently installed, order option) is available in a separate document (PDF): imc CANSAS*flex* P8 data sheet or in the imc CANSAS*flex* price list.

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9.3.10.5 Factors affecting pressure measurement

Precise pressure measurement requires observance of and compliance with certain constraints.

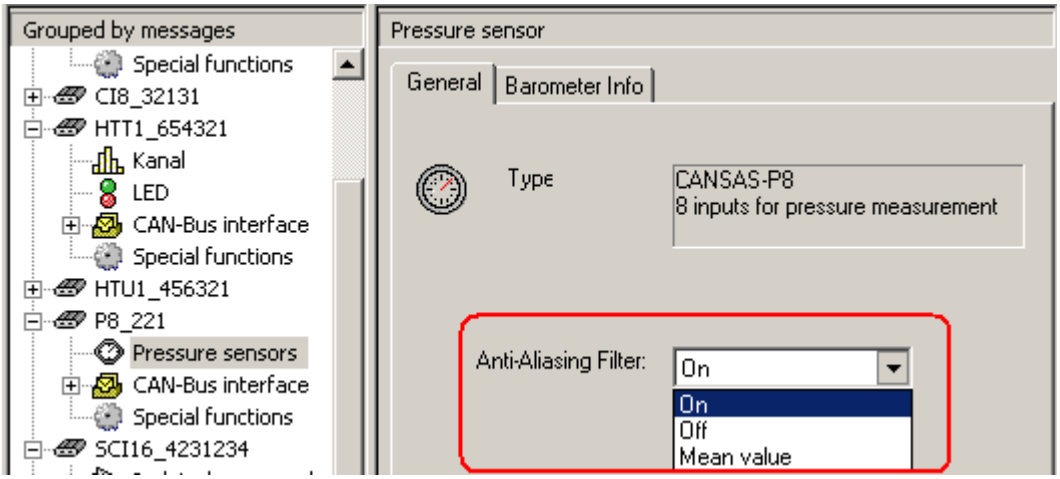
1. **Position-dependence**: The measured value returned depends on how the sensor is positioned when in use. For this reason, observe the "preferred mounting position". This is the position in which the sensors are calibrated at the factory. The sensors' high sensitivity can lead to offset errors when the position is changed, due to the effect of gravity upon the sensor's own oil column. It is important to compensate for this offset, especially for measurements of relative pressure around zero. This can be accomplished using the operating software.
2. **Frequency response**: The sensors' natural frequency is higher than the maximum measurable frequency of 500 Hz. However, the frequency response of the signal connected to the CAN bus is not only determined by the sensor's frequency response but also by the anti-aliasing filter in the pressure module's electrical portion.
3. **Motion**: If the module is moved, the forces acting on it (e.g. inertia operating on the medium to measure or the membrane itself) can cause measurement distortion. Not that the pressure module responds sensitively to pressure on the membrane, but that these forces can be caused by pressure in the medium.
4. **Drift**: Highly sensitive pressure sensors come with a certain amount of drift. This means that the error in the measurement value is not constant, but time-dependent. Of course, the error remains below the limit stated in the spec sheet. The drift usually takes the form of a creeping change in the offset. Therefore, in measurements of relative pressure, the offset should be tared to zero every once in a while. This can be done with the help of the operating software.
5. **Air bubbles**: Pockets of air must be avoided, especially with fluid media.
6. **Elevation differences**: If there is a difference in elevation between the sensor and the measurement site, the pressure differential affects the measurement. This must be taken account of, especially with fluids, and can be compensated by subtraction.
7. **Leaks**: Only the precise coupling mechanisms specified for the particular medium may be used or else you risk leakage.
8. **Low-pass**: When connecting the medium, the low-pass behavior of long tubes must be considered. To measure rapid pressure change, keep the tubing as short as possible.

Note

You risk permanent damage by pulling the tube off self-closing nipples under high pressure. The pressure remains intact at the sensor. If the temperature rises subsequently, the sensor could be permanently damaged. Therefore, always ensure ventilation.

9.3.10.6 Sampling intervals, filters and anti-aliasing

For each of the 8 fast pressure channels, the sampling time can be freely set to between 1 ms and 60s. The pressure module comes with a fixed frequency hardware anti-aliasing filter, an analog-digital converter (ADC) according to the Sigma-Delta method and a digital low-pass filter adapted to the sampling rate.



On: Additional digital low-pass filter.

Off: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.
Mean value: The output value is averaged by (Sampling interval[ms] / 1 ms) samples.

The following table shows which resulting filter is to be used:

sampling rate	filter
1 ms	Critical damping, 4th order, cutoff frequency 250 Hz
2 ms	Critical damping, 4th order, cutoff frequency 120 Hz
5 ms	Critical damping, 4th order, cutoff frequency 50 Hz
10 ms	Critical damping, 4th order, cutoff frequency 25 Hz
20 ms	Critical damping, 4th order, cutoff frequency 12 Hz
50 ms	Critical damping, 4th order, cutoff frequency 5 Hz
100 ms	Critical damping, 4th order, cutoff frequency 2 Hz
200 ms	Critical damping, 4th order, cutoff frequency 1 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0,5 Hz
1s	Critical damping, 4th order, cutoff frequency 0,2 Hz
2s ..60s	arithmetic mean over the duration of the sampling interval of values sampled at 1 kHz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti- aliasing filters (e.g. with damping of 96dB at one-half of the sampling frequency).

If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

The frequency response only pertains to the device's electrical portion. The frequency response of the sensors themselves and of their leadwires is not accounted for.

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9.3.10.7 Operating software

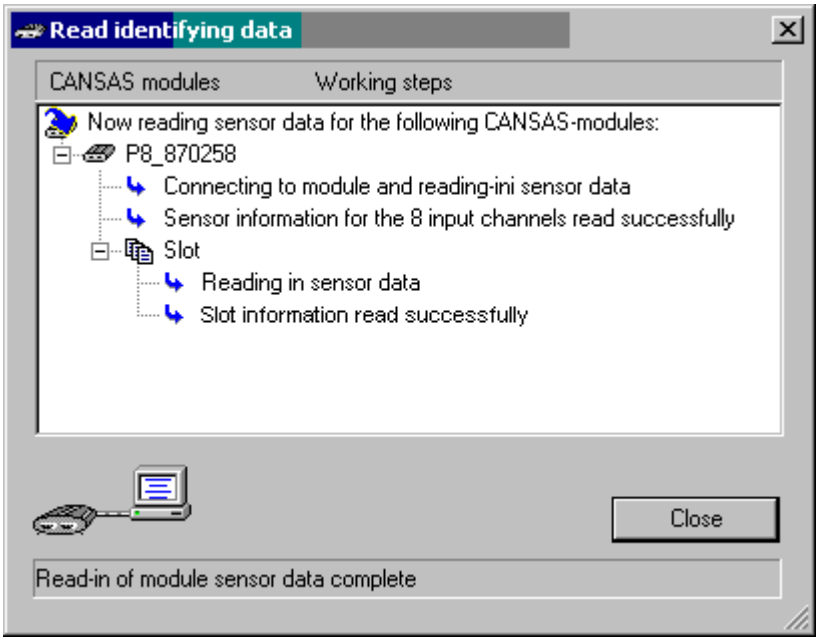
9.3.10.7.1 Module integration

To work with and make settings for a pressure module, it must first be entered in the database. This is done the usual way. When a new entry is made, the sensor's characteristic data are read in upon recognition of a pressure module and the input ranges for the channels are set accordingly.

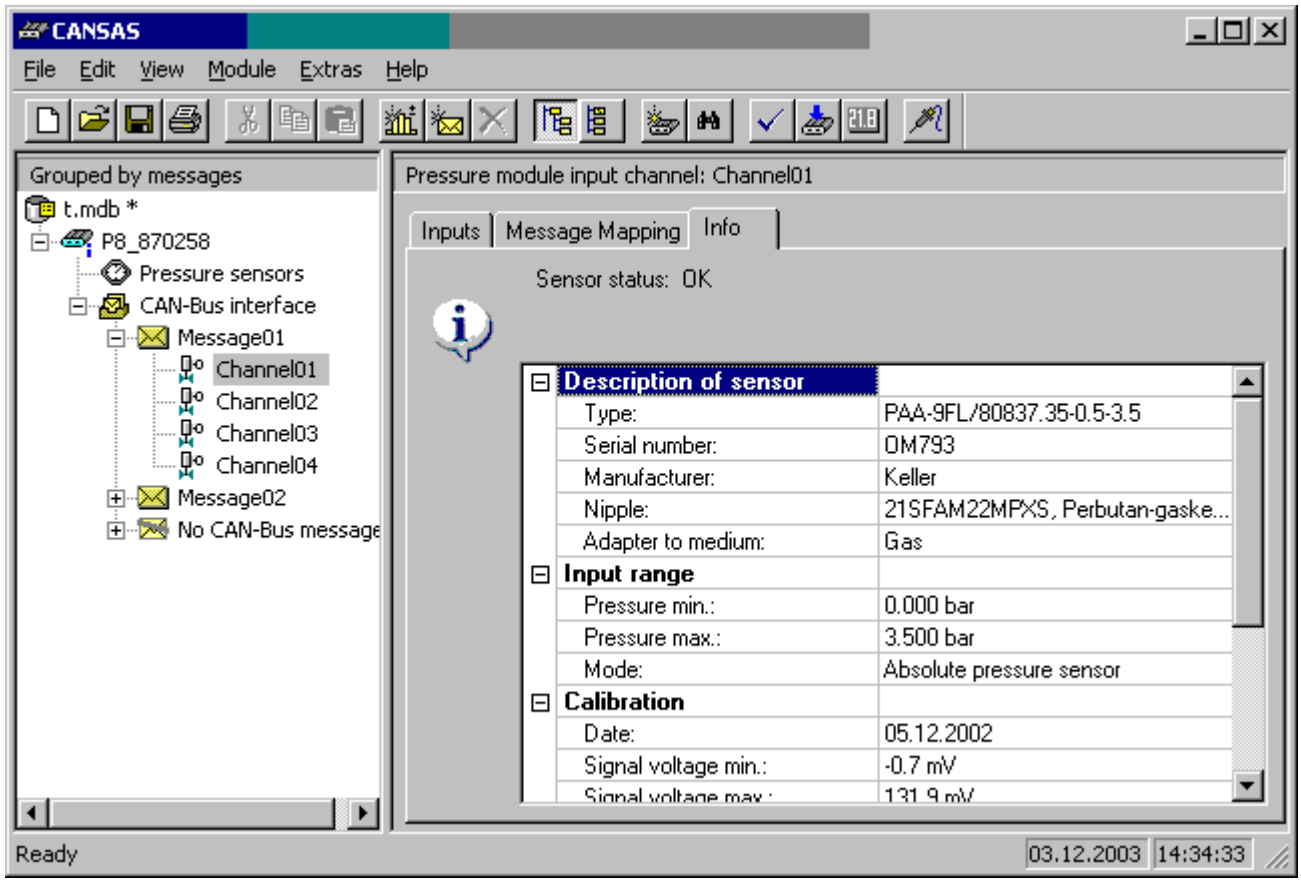
Attention when performing module integration off-line: Since there is no connection to an actual pressure module, all sensors are assumed to have an input range of 0..10 bar. If you already make the configuration for a module with its serial number entered correctly, it is still necessary to perform module integration of the module when it is first really connected, in order to have the input ranges correctly stated in the database.

9.3.10.7.2 Read-in of sensor data

If a pressure module is selected in the tree diagram on the left side of the user interface, it is possible to select the menu item Module / Sensors / Read identifier data... for that module (or alternatively, the corresponding toolbar button). This causes the characteristic data of all sensors to be read in. You can take a look at these characteristic data by selecting an individual channel of the module and accessing the index card Info on the right.



Progress indication dialog for read-in of sensor properties

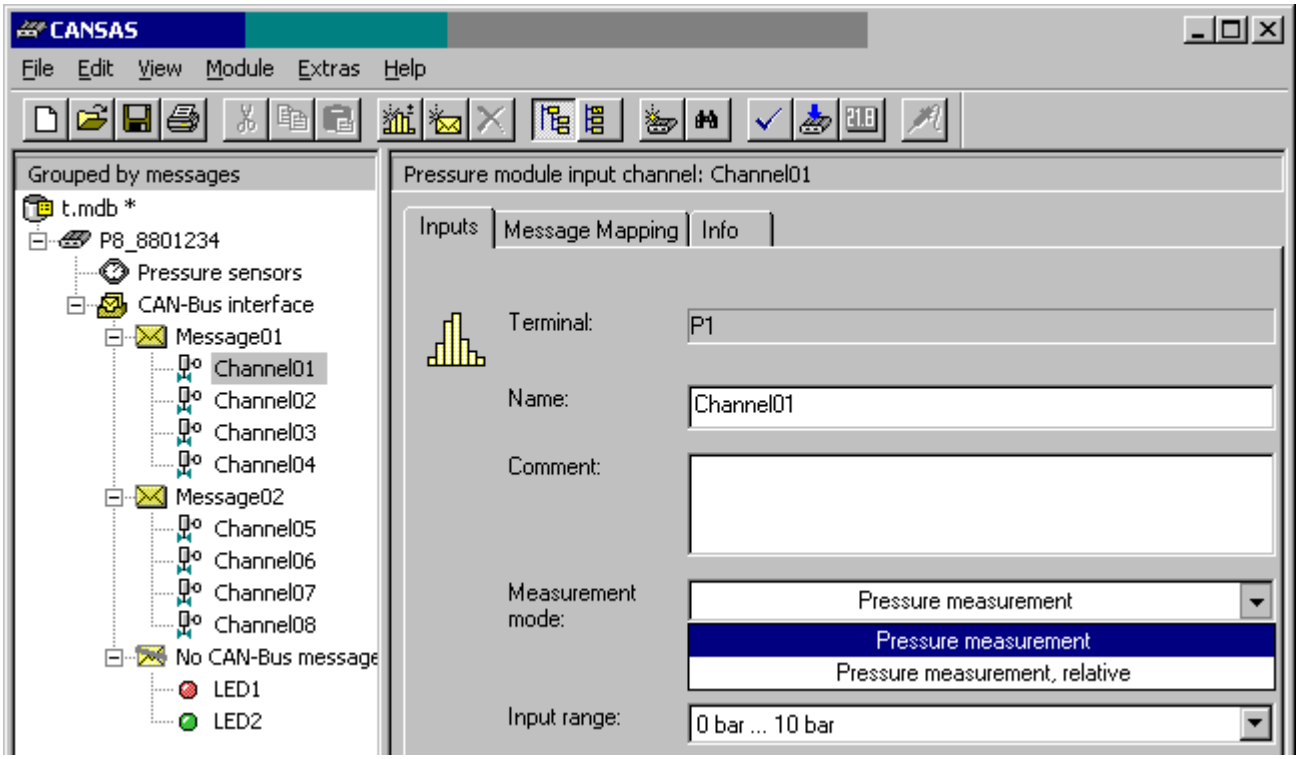


Pressure sensor properties

In addition, the characteristic data of the built-in barometers are also read in. These can be viewed by selecting Pressure measurement in the tree diagram and the index card "Barometer-Info" on the right.

9.3.10.7.3 Measurement mode

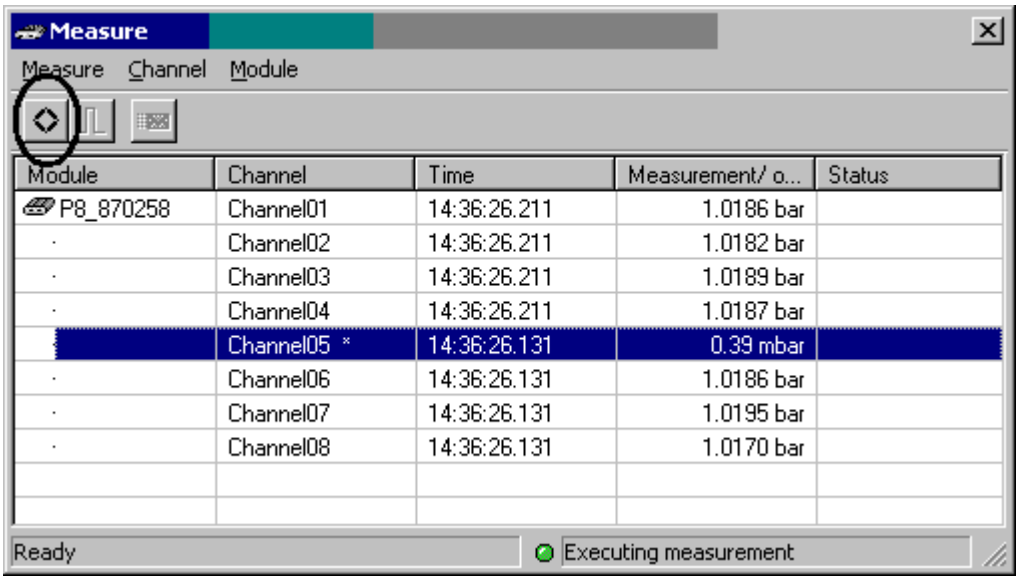
For the selected channels, the measurement mode "Pressure measurement" can be selected for absolute pressure measurements, or "*Relative pressure measurement*" for measurements of relative pressure. Note that absolute pressure sensors are also able to perform relative pressure measurements thanks to the built-in barometer. Relative pressure sensors, by contrast, can only measure relative pressure.



Setting the measurement mode

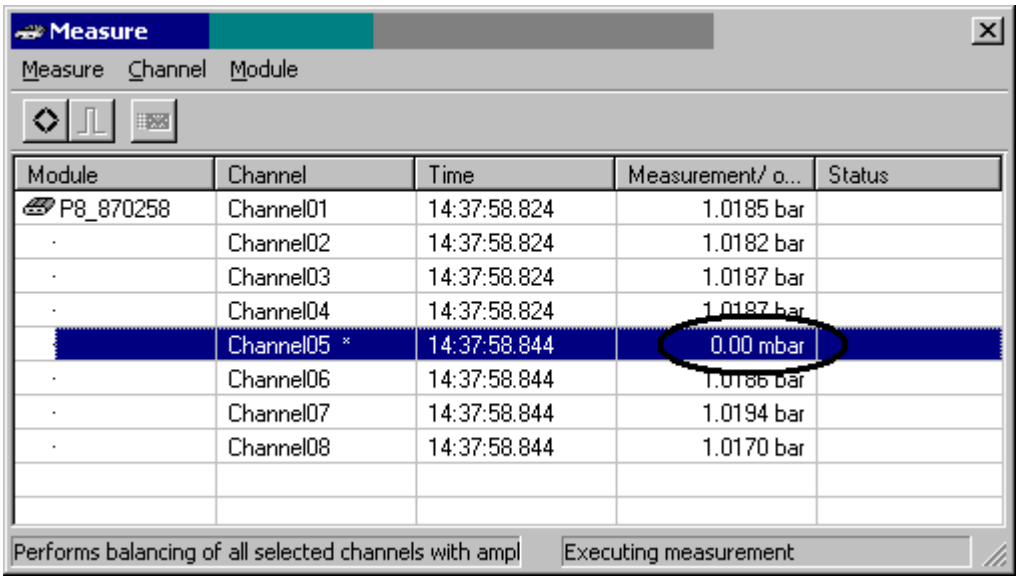
9.3.10.7.4 Balancing

To be able to zero-balance (tare) all relative pressure channels, you must first open the measurement window using the menu item *Module / Measure*.... Before performing the balancing procedure, first disconnect the couplings from the pressure module's nipples after having made sure that the tubes are empty and that there is no large pressure differential to the ambient air. Then select the channels which you wish to balance. Then choose the menu item *Channel / Perform balancing for selections*.



Measurement: before using the tare-function

A few seconds later, the zeroing has been completed. The offset values are written to the module's Flash-EPROM and are subsequently used for corrections.



Measurement: after using the tare-function

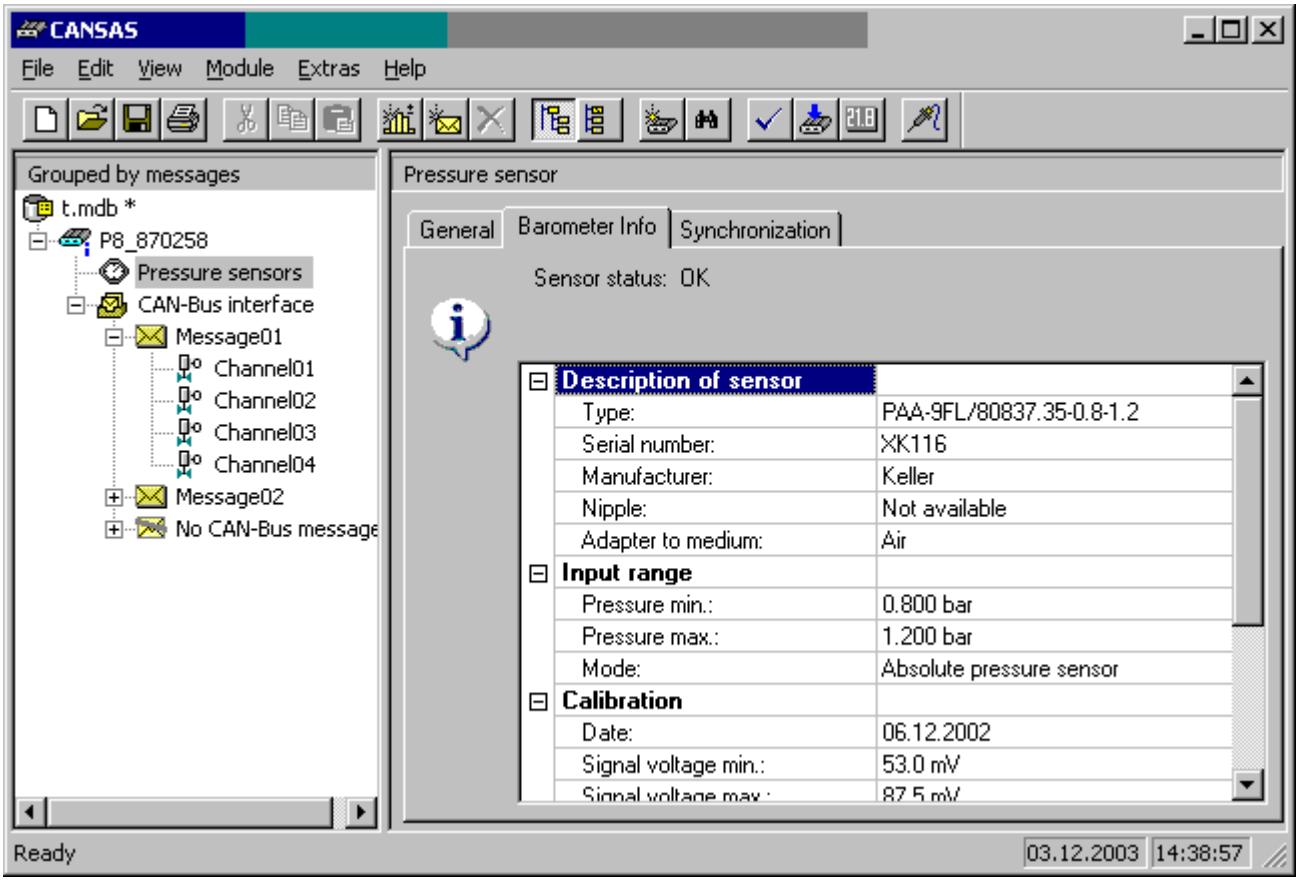
The tare-function can only work if the relative pressure is near zero (which it should be in such a situation). Taring for absolute pressure channels is not possible. If you have an offset to compensate in such a case, use a virtual channel. Even after using the tare-function, the measurement value is usually not precisely 0,0mbar, but may be off by a few bits. The value is only 0,0 for the purposes of the measurement channel's specified accuracy.

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9.3.10.7.5 Barometer

Each P8 pressure module is equipped with a barometer whose input range is 800 mbar.. 1200 mbar, enabling it to measure the pressure of the surrounding air. Its purpose is to determine the relative pressure in case an absolute pressure sensor is being used.

The information on the barometer's pressure sensor is available via the operating software. To access it, select in the tree diagram at left the entry "*8 pressure sensors*" and at the right, the index card *Barometer-Info*. Then select the menu item *Modules / Sensors / Read identifying data...* (or alternatively the corresponding button in the toolbar). Then the information will appear:



9.3.10.7.5.1 Barometer readings

The P8 pressure module comes with 8 high-speed inputs for external pressure channels. In addition, there is the built-in barometer, which is digitalized only very slowly. This is because the ambient air pressure is assumed to change only very slowly. The built-in barometer's readings can only be accessed using a virtual channel. To do this, create a virtual channel and select the function "Barometer". You can specify the rate at which the barometer's readings are to be subjected to further processing. Note that the barometer actually obtains a new reading only about every 1,2 s.

All you can do is to set at which rate this value is queried, not measured. It hardly makes any sense to set a faster clock rate than 500 ms. Any subsequent processing should only be used in exceptional cases or for checkups. It should not be used to take the difference between an absolute pressure and a relative pressure reading. For such purposes, begin by setting relative pressure measurement as the channel's measurement mode. This will produce much better measurement results.

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9.3.10.7.5.2 Built-in error recognition ("Min/Max values"):

If, after a brief self-diagnostic performed after starting up, the module detects an error in its analog portion or in the sensor recognition, the input range minimum of the channel affected is indicated. If this error occurs, it usually doesn't only affect this pressure sensor, but also the other channels. The P8-module must be repaired. In that case, please contact our tech support 10.

9.3.10.8 Maintenance

If nipples are not used (meaning: no couplings with tubes are attached), they should be covered with the included caps.

The nipples should always be kept clean.

The built-in barometer needs permanent contact to the surrounding air. In the (extruded) rack-housing, small air inlets are present. In the IP65-housing there are Goretex (R) membranes protected by plastic hoods. Always be sure that air can reach the module interior. Make sure the membrane is free of dust, grease and fluids. If it is clogged, the internal barometer will no longer work properly and relative pressure measurement cannot be performed.

Quick-release couplings and nipples are **expendable parts** not requiring maintenance if handled properly. However, if used with non-lubricating fluids, especially heavily degreasing fuels, it is necessary to apply lubrication regularly. The sealing region and actuating elements of couplings and nipples may require cleaning. Specifications of mating cycles (Chapter 7) always pertain to normal usage with proper care.

Installation notes:

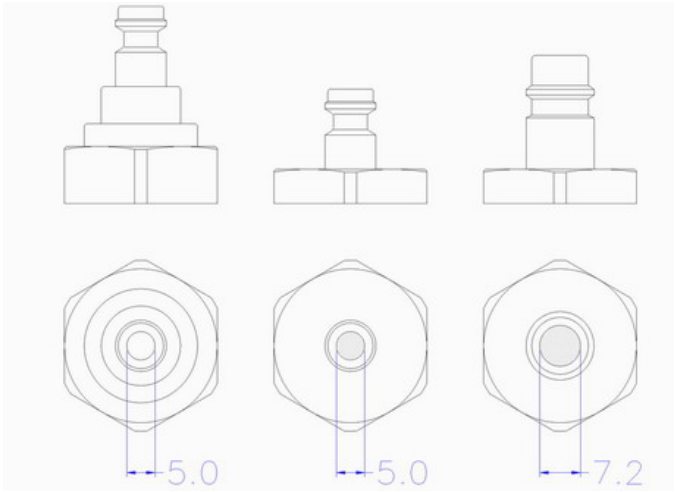
The permissible operating pressure of the tubes used must not be exceeded. The tubes must be attached in a manner which avoids slippage. Threading must be sealed properly, which means that the sealant must be compatible with the fluid, whether gaseous, vapor or liquid. Either quick-release coupling having a valve are to be used, or during use you must ensure that the flow is halted before de-coupling. If the connection point for the pressure measurement vibrates, it is necessary to hook it up to the quick-release coupling via a flexible tube which is at least 30 cm long in order to adequately isolate the coupling from the vibration. When couplings and attachments are not connected, they should be covered by protective caps to prevent contamination or other damage.

Warning

When hooking up a coupling, especially one under pressure, fluid can escape. Be sure to take precautions against any dangers this could entail.

9.3.10.9 Pressure terminals, aggressive media

The eight measurement input nipples allow the measured substances to be hooked up directly and easily via quick-release couplings. An optional low-leakage model is available.



The properties of the sealing materials can be adversely affected by chemical and temperature processes. When selecting sensors, connector nipples, and couplings, be aware of the measured materials' chemical properties, see technical specs 543. The nipples' shape and material are of particular importance. For instance, nipples of brass and stainless steel are available. The type and material of the sealing gasket are also crucial and must be suitable for the medium to be measured.

9.3.10.10 Table of Chemical Resistance

All specifications are for orientation purposes only and no responsibility is taken for their correctness. They are meant to apply to 1) pure substances, 2) unless otherwise indicated, at room temperature, 3) for saline solution, acids and aqueous solutions, moderate concentrations. [1]

A =resistant B =fairly resistant C =conditionally resistant D =not resistant

Medium	Sealant		
	NBR	FPM	EPDM
Acetate (ethyl- and amyl-)	D	D	B
Acetic acid 10%	D	B	A
Acetone	D	D	A
Acetylene	A		A
Alkalines			A
Alum	B	A	A
Ammonium nitrate	A		A
Ammonium sulfate solution	A		A
Ammonium, liquid	C	C	A
Amyl acetate	D	D	A
Amyl alcohol	B	B	A
Aniline	D	C	B
Barium chloride	A	A	A
Barium sulfide	A	A	A
Benzene	D	A	D
Blast furnace gas	D	A	D
Borax	B	A	A
Butane	A	A	D
Butyl alcohol	A	A	A
Calcium hydroxide	B	A	A
Carbon dioxide, dry	A	B	B
Carbon disulfide	D	A	D
Carbon-bisulfite		A	

Medium	Sealant		
	NBR	FPM	EPDM
Carbonic acid	B	A	A
Caustic potash	B	C	A
Chromate 10%	D	A	B
Citric acid	A	A	A
Coal gas		A	
Coke oven gas, hot	D	A	D
Compressed air	A	A	
Cooling water	A	A	
copper chloride	A	A	A
Creosote	D	A	B
Cresol		A	
Crude oil	A	A	
Cyclo-hexane	A	A	D
Diesel oil	A	A	
Diesel oil up to 120° C		A	
Emulsion, water-oil	A		
Ethanol amine	B	D	B
Etheric oils	B	A	
Ethyl alcohol	A	A	A
Ethylene	A	A	
Avgas BP, Exxon, Shell	A	A	
Aviation engine oil and turbine oil, Esso: 35	A	A	
Formalin	A		A
Formic acid	C	C	B
Frigen / Freon F 11-12	A	A	
Gas containing naphthaline		A	
Gasoline, refined	A	A	
Gear oil	A	A	D
Glucose	A	A	A
Glycerin	A	A	A
Glycol	A	A	A
Heat transfer oil up to 250° C			
Heating oil S	B	A	D
Heating oil up to 120° C			A
Heating oil up to 180° C			
Heating oil up to 200° C		A	
Helium	A	A	A
Hexane	A	A	D
Hydraulic fluid – Phosphate ester		A	
Hydraulic fluid HSA-oil in water	A	A	
Hydraulic fluid HSB-water in oil	A	A	
Hydraulic fluid HSC-Glycol-water	A	A	
Hydraulic fluid HSD-water-free		A	
Hydraulic fluid -hydrocarbons		A	
Hydraulic oil, mineral-based	A	A	D
Hydrogen cyanide	B	A	A
Hydrogen peroxide 10%	D	B	B
Hydrogen sulfide, dry	A	A	B

Medium	Sealant		
	NBR	FPM	EPDM
Hydrogen sulfide, moist	C	A	B
Hydrogen vapor 20° C	A	A	A
Illuminating gas	B	A	C
Isopropyl alcohol	A		A
Kerosene JP 1		A	
Ketone (Aethylmethyl)			A
Cresol, cresylic acid	D	A	C
Synthetic resin (no nitro solution).		A	
Latex, liquid	A		
Linseed oil	A	A	C
Lubricant oil	A	A	
Magnesium carbonate	A	A	A
Magnesium hydroxide	A	A	A
Magnesium sulfate	A	A	A
Mercury	A	A	A
Methane	A	A	D
Methanol CH3OH (pure)	C	D	A
Methyl alcohol	A	D	A
Methyl-Benzol		A	
Methylethylketon			A
Milk	A	A	A
Mineral oil	A	A	D
Naphtensäure	B	A	D
Naphtha	A	A	D
Naphthaline	D	A	D
Natural gas	B	A	D
Natural gas	A	A	
Nitric acid 33%		A	
Nitrogen	A	A	A
Nitro-solution, (no synthitic resin thinn)			A
Oleic acid	A	A	A
Oleic acid	A	A	
Oxalic acid	B	A	A
Paraffin	A	A	D
Pentachlorophenol	D	A	B
Petrolaether	A	A	D
Petrol	A	A	
Phenol solution		B	D
Phosphoric acid, cold <45%	B	A	A
Salt solution		A	A
Potassium cyanide	A	A	A
Potassium dichromate		A	A
Potassium sulfate	A	A	A
Propane gas	A	A	A
Saline solutions	A		B
Oxygen, fat free			A
Seawater	A	A	A
Soap solution.	B	A	A

Medium	Sealant		
	NBR	FPM	EPDM
Soda solution		A	A
Sodium acetate	B	D	A
Sodium bicarbonate	A	A	A
Sodium carbonate (soda)	A	A	A
sodium chloride (table salt)	A	A	A
Sodium cyanide	A		A
Sodium hydroxide 20%	D	B	A
Sodium sulfide	A	A	A
Spirits of ammonia	A		A
Sulfur dioxide, gas	D	A	B
Tar	B	A	D
Titanium tetrachloride, Titanium (IV) chloride	B	A	D
Toluene	C	A	
Toluene, dry	D	A	D
Town gas	B	B	D
Transformer oil	A	A	D
Transmission oil	A	A	D
Trichloroethylene ("Tri")	C	A	D
Turbo oil MIL-L-7808	B	A	D
Vacuum (reinforced valve springs)	A	A	
Vapor up to 170° C = 8,076 kp/cm²	D	D	A
Vapor up to 250° C = 40,56 kp/cm²	D	D	D
Vegetable oils	A	A	D
Water above 80° C		A	A
Water up to 80° C	B	A	A
Water, de-ionized	A	B	
Water, demineralized	B	B	
Water, distilled	C	B	A
Xylol	D	A	D

[1] Source: "Walther Präzision Schnellkupplungssysteme" At the time stated, the information provided was correct to the best of our knowledge; however we offer no guarantee either explicitly or implicitly that components manufactured from these materials will function satisfactorily in the applications intended by the customer. The customer bears sole responsibility for evaluating the components prior to using them, especially in applications in which component failure can lead to injury and/or damage of property. Please note that the elastomer parts have a limited lifespan and that we therefore strongly recommend a program of inspection and replacement carried out at regular intervals. All specifications on the material are intended strictly for orientation purposes. Every application is subjected to unique environmental influences which must be taken into account when selecting materials.

9.3.11 PWM8 pulse width modulation outputs

The output module **PWM8** generates pulse-width-modulated signals, either from values sent by the CAN bus, or from internally computed values.

Reference

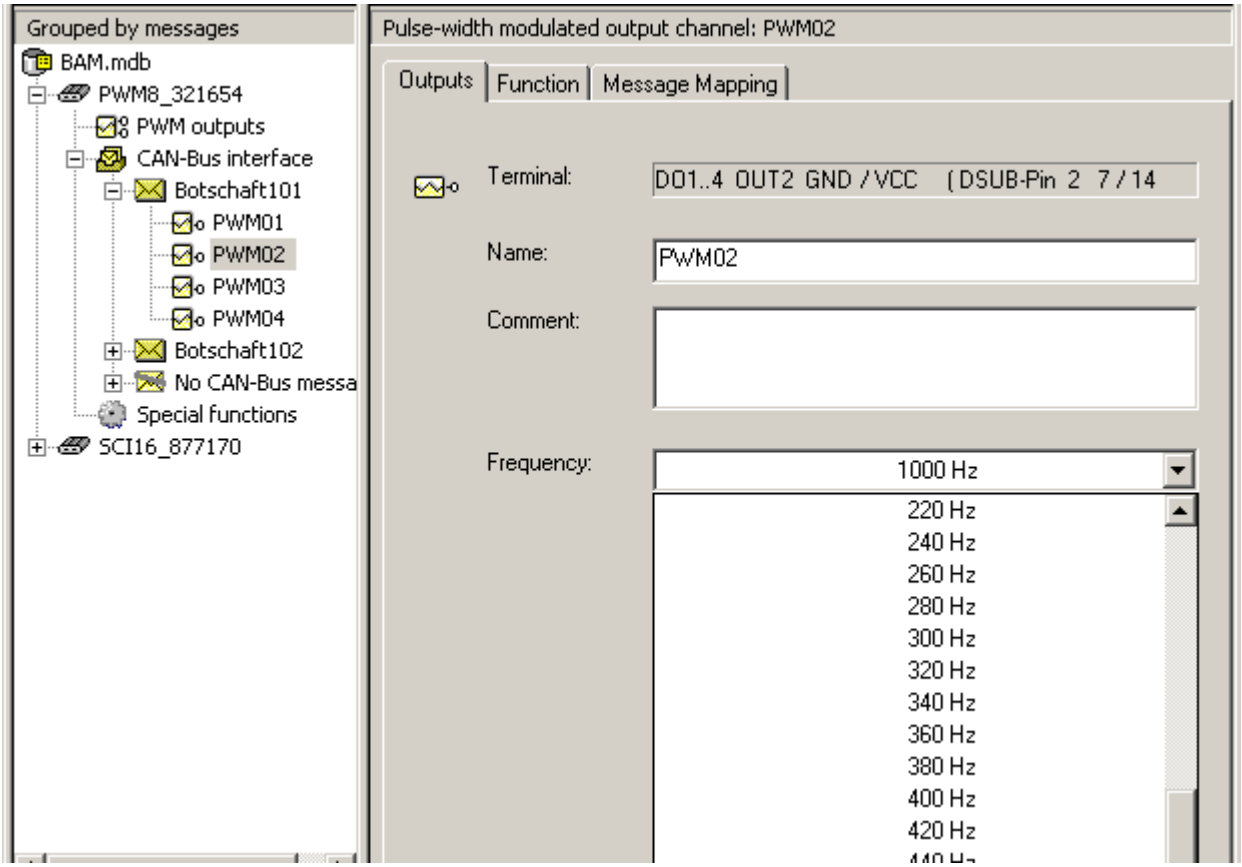
Technical Specs PWM8. 545

9.3.11.1 General

For the purpose of using pulse-width-modulated signals as a control signal, the PWM module can be used. For the output, you can choose between TTL and an external voltage source (Open Drain). The module variant with BNC sockets is limited, it can only output TTL signals.

In addition to the standard CAN bus protocol, the device can also be configured as a CANopen® module.

The frequency is fix and can be be set for each channel group (channel 1-4 and 5-8):

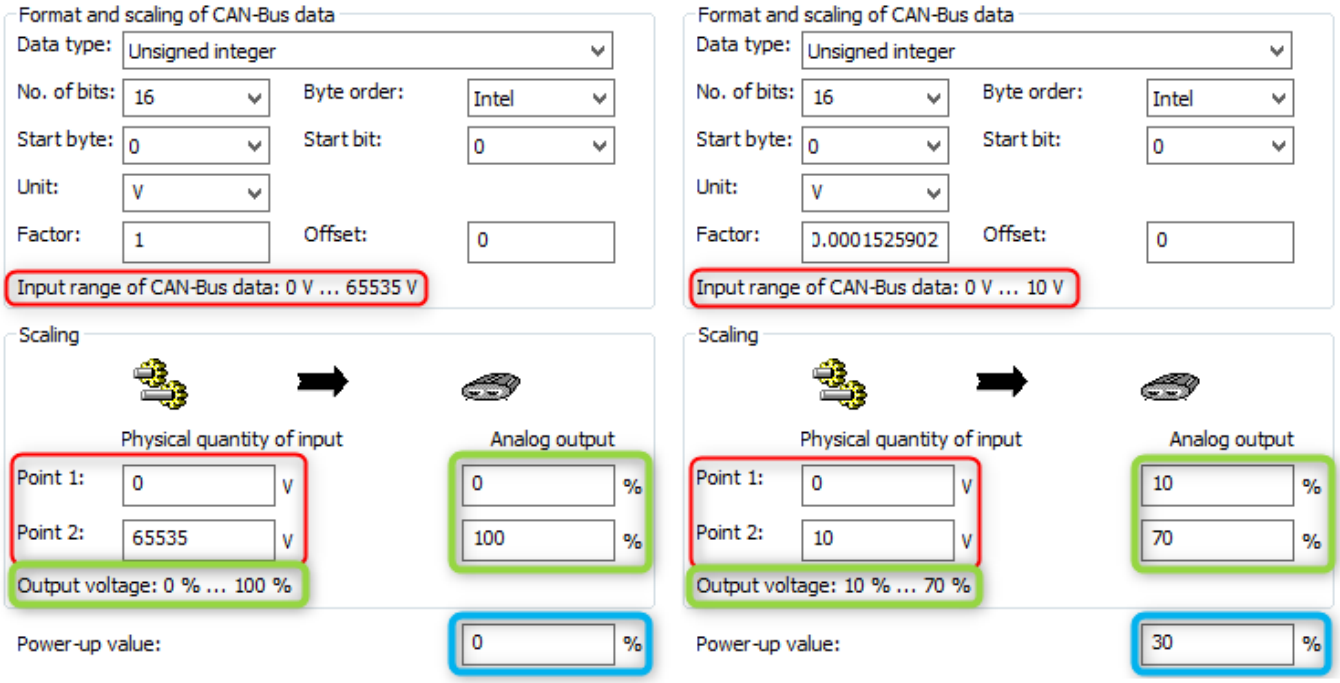


Each 4-channel group in a connector is isolated from the other connector's channels and from the power supply and CAN bus.

9.3.11.2 Scaling

The scaling of the duty cycle ratio has to be entered on the *Message Mapping* card.

By default, a voltage is expected as input variable, which is physically interpreted according to the module or sensor properties - in case of a PWM module as a pulse width. The preset unit is therefore "V". It is harmless and can be kept. The presetting of the valence of a bit is a factor that maps 16 bit unsigned integers to the value range 0 V ... 10 V.



The preset integer value range of 2^16 expects a value between 0 and 65535. With the preset factor 1.525902e-4 the result is 10 or with "V" as unit the physical input variable of 10 V. Alternatively, the factor can be set to e.g. 1 and thus the physical input quantity to 0 to 65535 V (corresponding to the CAN bus value) or to 1.525902e-3 and thus the physical input quantity to 0 to 100 V (corresponding to a possibly desired PWM range 0 to 100 %).

In any case a scaling must be made that the input variable can also be interpreted as the desired pulse width. This also makes it possible to specifically omit a range that must not be controlled. Likewise, a start value should be defined for the time until the first received input value, which corresponds to a safe state in the application (default setting is 0 %). This value must be in the scaled output range.

CAN message	PWM modulation with examplary scaling			
	0 % .. 100 %	50 % .. 100 %	0 % .. 50 %	10 % .. 70 %
65535	100 %	100 %	50 %	70 %
32767	50 %	75 %	25 %	40 %
6554	10 %	55 %	5 %	16 %
0	0 %	50 %	0 %	10 %

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9.3.11.3 Delay time

The delay time varies between the arrival of a new PWM-value in a CAN message and the PWM output. It depends on the internal condition of the module. The time can be calculated like this:

T_delay = T_process + T_period

T_process = A value between 0.2 ms ...1 ms. It is the time to get the CAN bus message, to proceed and send it to the PWM output.

T_period = 0...1/***F_output***

F_output is the selected output frequency (cycle duration of the PWM-signal). A new PWM-value can be proceeded not before the previous cycle is over.

Example: The output frequency is 10 kHz (= 0,1 ms PWM-cycle duration).

T_delay_min = 0.2 ms + 0 ms = 0.2 ms

T_delay_max = 1 ms + 0.1 ms = 1.1 ms

9.3.11.4 Connection PWM8

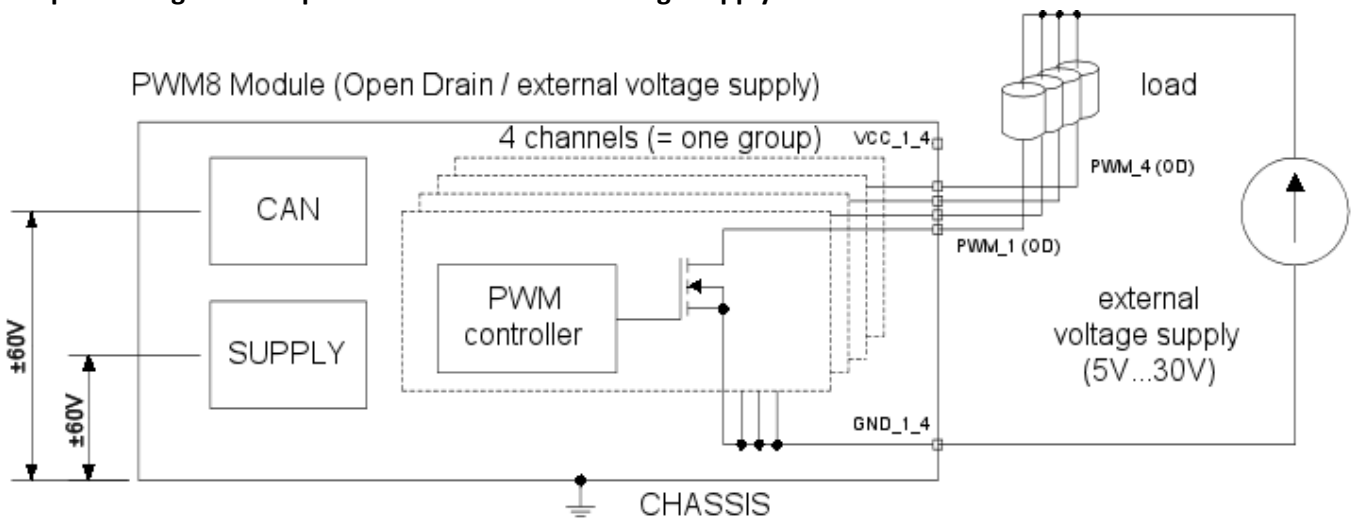
DSUB-15 standard pin configuration: ACC/DSUBM-PWM 594.

ITT Veam: please find here the pin configuration of CAN/L-PWM8-V 599.

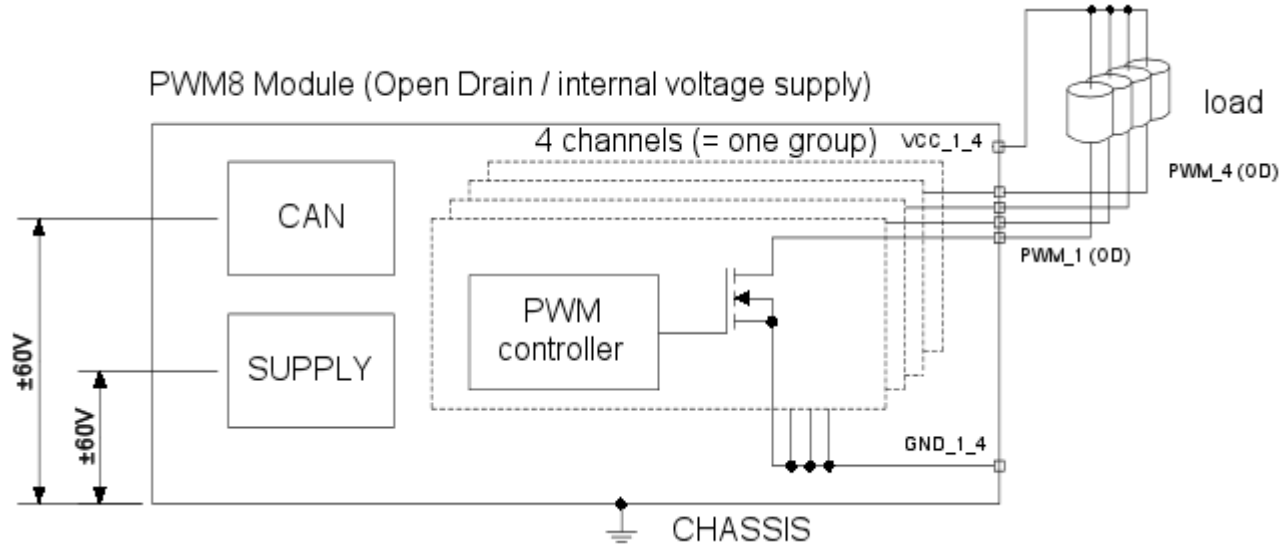
Note

The 4 outputs in a connector are isolated from the outputs of other connectors, from the supply and from the CAN-Bus, but not channel-to-channel.

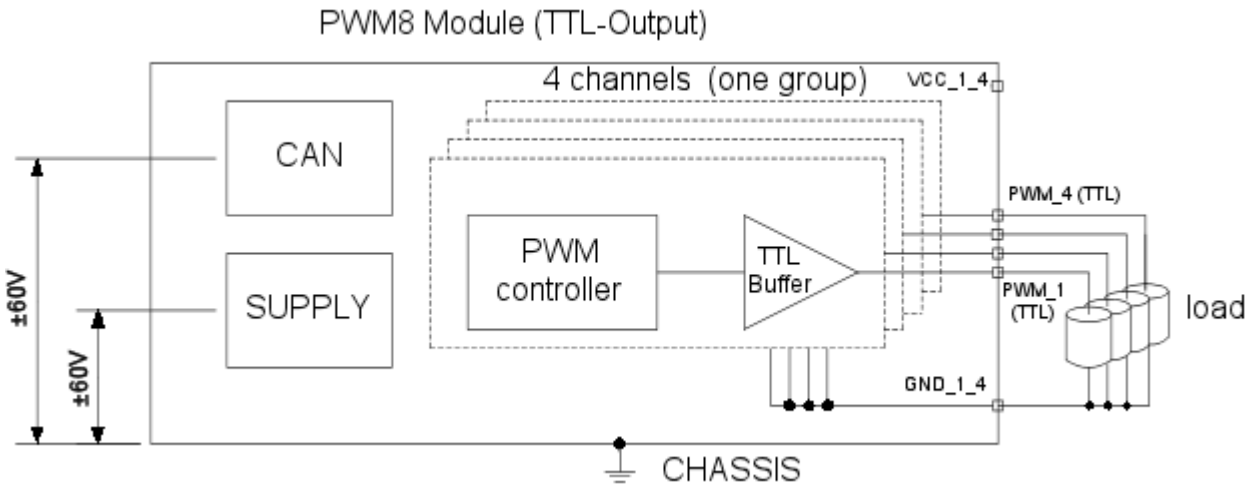
Outputs configured as Open drain with *external* voltage supply



Outputs configured as Open drain with *internal* voltage supply



Outputs configured as TTL



9.3.12 SC16, SCI8, SCI16 voltage, current and temp. modes

The imc CANSAS modules SCI8, SCI16 and SC16 have 8 or 16 input channels respectively. The modules belonging to the SCIxx group (SCI8, SCI16) have extended isolation properties, with channel-to-channel isolation and common mode voltage of up to 60 V (with a test voltage of 300 V). The SC16's isolation voltage values are limited to 40 V (Common mode voltage and max. protected channel-to channel isolation) at a working range of channel to channel isolation of 15 V (for specified accuracy).

All SC variants (from March, 2006) support **TEDS** to read and write sensor information.

Beside working with CAN bus per default, the modules are also configurable as **CANopen**® modules.

All three modules of this family are based on a scanner concept with block isolation, in which a multiplexer is combined with an isolated measuring amplifier. In the SCIxx group, the switching matrix is realized with ***optical relays***, which offers extended isolation properties compared to the SC16 which has ***electronic switches***. What both groups have in common is that the inputs are provided with differential properties by a measuring amplifier isolated block-to-block, which adjusts itself to the respective common mode voltage of the connected source. This adjustment of the voltage entails reverse-charging of the capacitors present and thus a short-term burden on the signal source. If the signal voltage is unaffected by such factors (e.g. in the case of thermocouples, batteries, and PT100-units fed from the SCxx- module), there is practically no compromising of the measurement in any typical applications, since the measurement system automatically compensates for the feedback effect. The maximum allowed source impedance (refer to the technical specs) which may not be exceeded is so high that it doesn't usually present any limitations.

Due to this property, however, the modules belonging to this family are not suitable for signal sources which respond to these dynamic feedback effects. This can apply to active sensors or calibrators, for instance, whose output level is low-frequency filtered or which is not able to correct quickly enough for the dynamic load fluctuations.

Connection

The choices for signals to connect include ***voltage, current***, or any DIN-***thermocouples*** or ***PT100***s. The "Opto"-modules SCI8 and SCI16 enable direct connection of signals up to ±60 V. SC16, by contrast supports input ranges of ±100 mV to ±10 V directly and supports the extended input ranges up to ±60 V by means of a special divider connector (ACC/DSUB-UD4).

The ***interconnections*** used are ***DSUB-15*** terminals. One connector serves four signals.

Each channel can be connected individually which means it's possible to connect a voltage, a temperature and a current all via on terminal. This can result in certain limitations if, for instance, a current measurement is carried out with a shunt connector and a temperature measurement with a thermocouple. Since these measurement types require a dedicated connector, only one measurement type can be performed per DSUB.

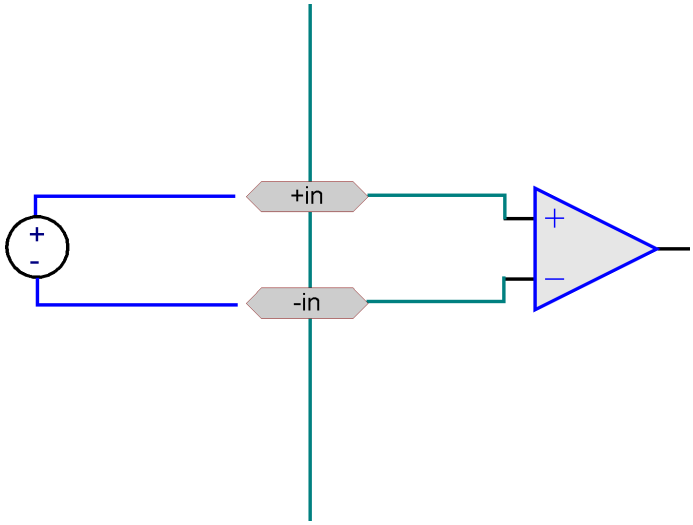
In principle, it's possible to carry out both a voltage measurement and a thermocouple measurement using the same thermo-connector. Likewise, a PT100 measurement can be carried out using just a standard connector, although doing this would prevent the convenient four-wire connection scheme from being used.

To avoid ***crosstalk***, which is typical for scanner systems, it is recommended to ***short circuit*** the inputs of the channel, which are not in use.

Reference

Technical Specs SC16 546 and the technical data SCI8 and SCI16 551

9.3.12.1 Voltage measurement



- ±60 V... ±100 mV (only SCI8, SCI16)
- ±10 V... ±100 mV (SC16)
- ±60 V bis ±20 V (SC16 with divider plug)

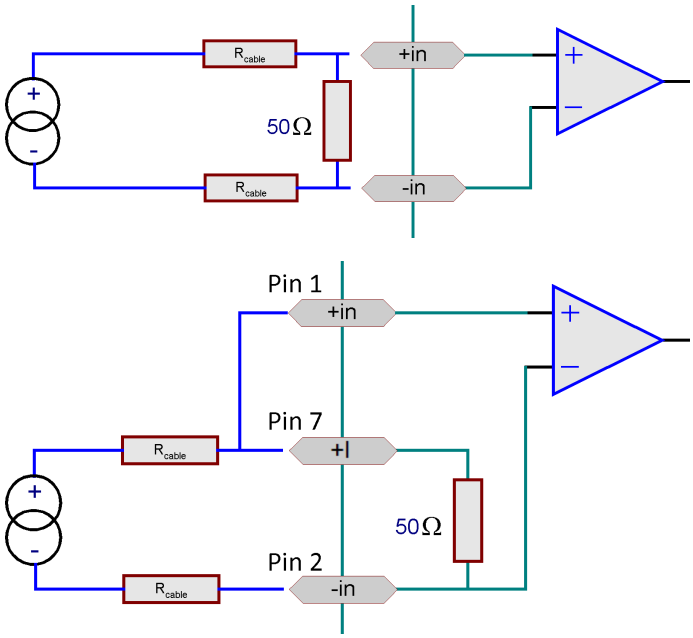
The input impedance in the ranges ±20 V and ±60 V is 1 MΩ, otherwise 10 MΩ. The input configuration is differential and DC-coupled.

The standard plug is used for voltage measurement (ACC/DSUBM-U4); the thermo plug (ACC/DSUBM-T4) is also supported.

The terminal "(GND)" must not be connected, especially not grounded!

The connection schemes for isolated and non-isolated signal sources are indistinguishable!

9.3.12.2 Current measurement



- ±40 mA ... ±2 mA

For current measurement, a **shunt** is built into the imc current connector (ACC/DSUB-I4).

The terminal "(GND)" must not be connected, especially not grounded!

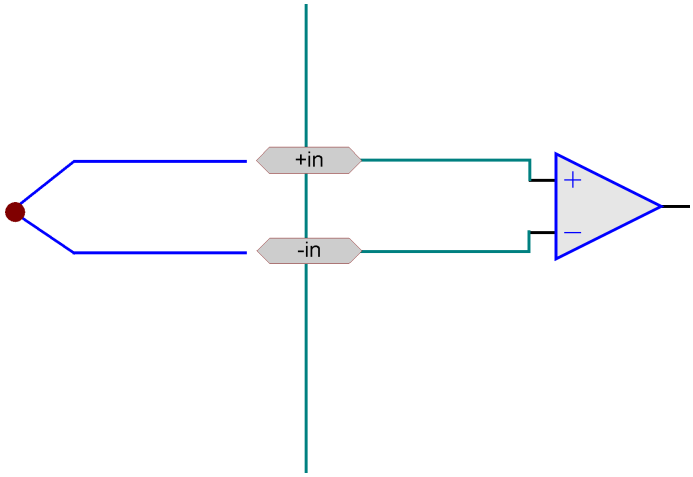
With the **housing model SL** with **LEMO** connectors, current measurement is connected via an internal 50 Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN. For current measurement, the pins +I and +IN must be shorted. This connection may only be made for current measurement purposes, and must be cleared for all other measurement types. For this reason imc offers a cable specially constructed with this connection exclusively for current measurement.

9.3.12.3 Temperature measurement

The input channels are designed for measurement with **thermocouples** and **PT100-sensors** (RTD, platinum resistance thermometers as per DIN and IEC 751). A combination of thermocouple measurement and PT100 measurement on multiple measurement inputs is at the same time possible with an imc thermo plug.

The **unit** in ° **Celsius** or **Fahrenheit** is set via the *Input range* 283 of the channel.

9.3.12.3.1 Thermocouple measurement



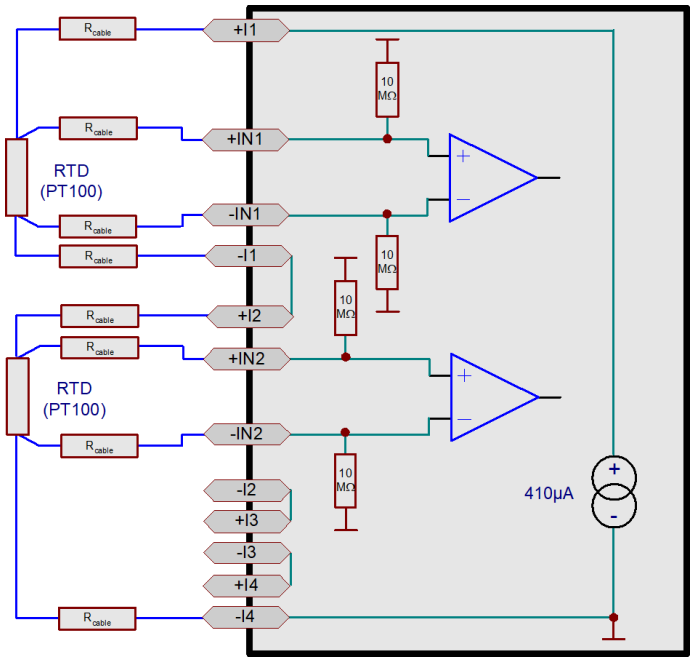
The common thermocouple types make use of linearization by characteristic curve. All common thermocouple types with their characteristic curves are supported. A combination of thermocouple measurement and PT100 measurement is possible.

The cold-junction compensation necessary for thermocouple measurements is built into the imc thermo-plug (ACC/DSUBM-T4 181).

Effective suppression of interference at 50 Hz or 60 Hz is only guaranteed from sampling rates of 1 s or slower (SCI8 from 0.5 s). For precise temperature measurement, appropriately selected sampling rates are therefore strongly recommended!

For further information see Chapter: Measurement technique – sampling rates, scanner-concept 211.

9.3.12.3.2 PT100 (RTD) - Measurement



Along with 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 plug 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 here 181). 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 connectors 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.

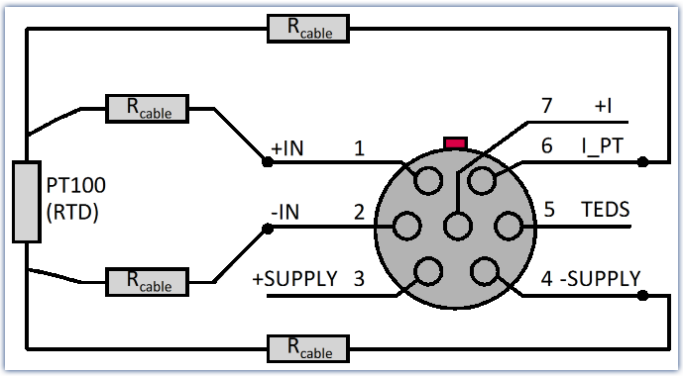
PT100 sensors are fed from the module and have no set voltage reference in the sense of an external common mode voltage. It is also not permissible to set one up, for instance by grounding one of the four connection cables.

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The PT100 reference current source is connected to the internal reference of the differential amplifier, which has block-to-block isolation. It thus assumes the common mode voltage of all other connected channels by turns, as long as they are operated in mode other than PT100.

9.3.12.3.3 PT100 (RTD) - Measurement (Type: LEMO)

With the LEMO terminals at the IP65 housing SL it's only possible to connect ***PT100*** sensors directly in ***4-wire-configuration***. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



Connection scheme of a PT100 sensor with LEMO terminals

9.3.12.3.4 Open sensor detection

SC modules come with the ability to detect not connected sensors. In case of a breakage within a short time (only a few samples), the measurement signal generated by the module 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 sensor is broken, unless such temperatures could really occur at the measurement site.

The bottom of the input range will be displayed:

- if at least one of the ***thermocouple's*** two lines breaks
- if a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected.
- if the cold junction compensation is missing
- For ***PT100*** in case of a short-circuit.

For PT100, 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.

9.3.12.3.5 Deactivate open sensor detection

In case the temperature measurement is checked by a controlled calibrator, an interaction might evolve between the high impedance calibrator output and the device input. Than the signal comes in noisy and not usable for calibration. The following procedure can be used to deactivate the open sensor detection:

Message 1:

The CAN-ID is the master-ID of the configured module (default: 2032). 8 bytes, Intel-format.

Contents	0xC0	0x00	Slave-ID (Standard 2033)	0x00000000
Bit	0-7	8-15	16-31	32-63

Message 2:

The CAN-ID is the master-ID of the configured module (default: 2032). 8 bytes, Intel-format.

Contents	0xC5	0x00	Serial number	On-/Off-command	0x00
Bit	0-7	8-15	16-47	48-55	56-63

- Serial number of the module as 32 Bit number
- Command to activate the open sensor detection: 0x11
  Command to deactivate the open sensor detection: 0x10

After the module has executed the second message, the module sends an answer message e6 using the slave-ID.

Example to switch of the open sensor detection:

Slave-ID for this example is 2033 (= **0x 07 f1**)

Serial number of the example module is 871682 (= **0x 00 0d 4d 02**)

Note the reverse order of the slave ID and serial number in the messages.

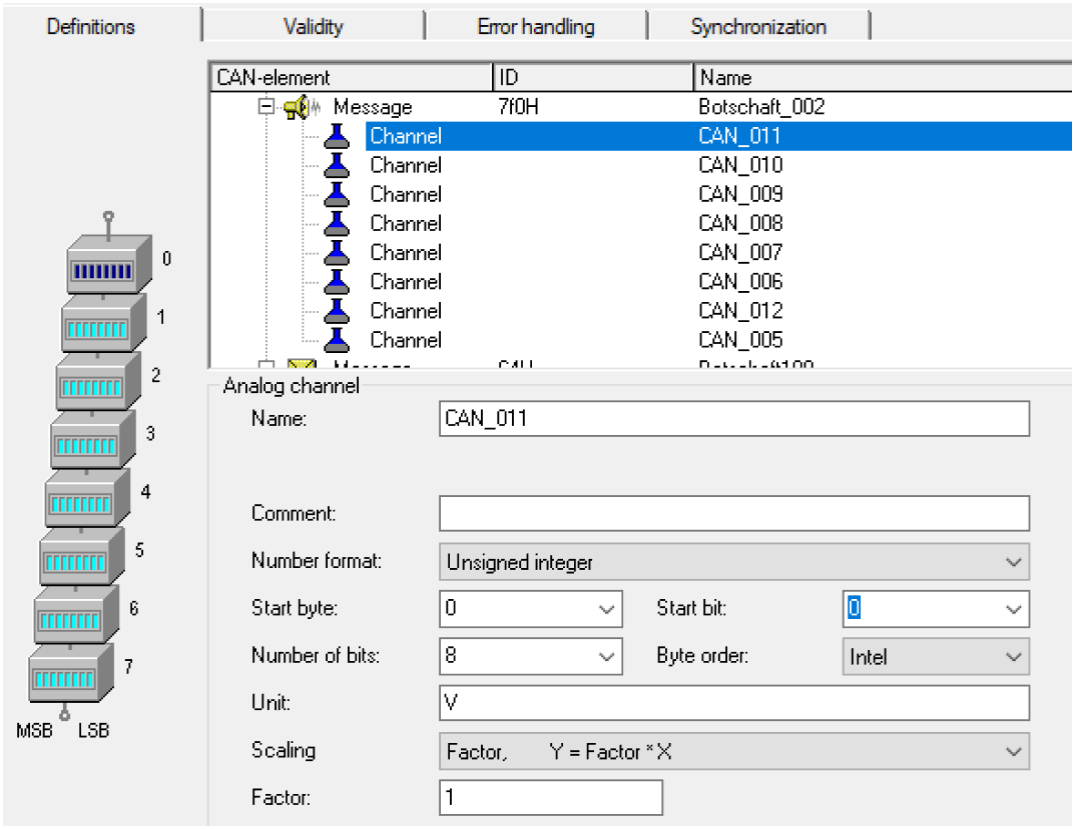
The message on the bus would look like:

```
message 1: c0 00 f1 07 00 00 00 00
message 2: c5 00 02 4d 0d 00 10 00
answer     e6 xx xx xx xx xx xx xx
```

Message 1 is sent first and then Message 2 (delay > 1 ms).

The effect of that change takes up to several 100 ms.

With the CAN Assistant and imc Online FAMOS, it would look like this:



CAN-Assistent: Sendebotschaft

imc Online FAMOS Code with control commands

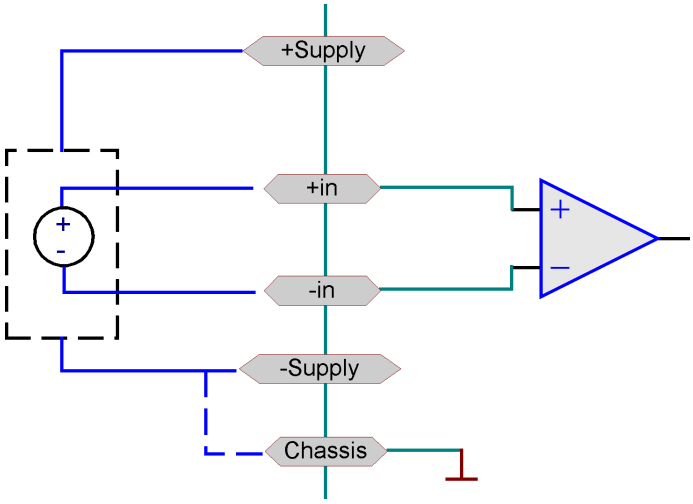
```
; Constantly repeated between the trigger start and the trigger end
OnTriggerMeasure(BaseTrigger)
   if Virt_Bit01 = 1
      StartTimerSingle(1, 0.1)
      StartTimerSingle(2, 0.3)

       Virt_Bit01 = 0
   End
End

OnTimer(1)
   SendMessage_Botschaft_002(0, 0.1, 0xc0, 0x00, 0xf1, 0x07, 0x00, 0x00,
0x00, 0x00)
 End

OnTimer(2)
   SendMessage_Botschaft_002(0, 0.1, 0xc5, 0x00, 0x02, 0x4d, 0x0d, 0x00,
0x11, 0x00)
End
```

9.3.12.4 External sensor supply (optional)



The modules SCI8, SCI16 and SC16 can optionally be equipped with a sensor supply. The supply is unipolar and connects to the DSUB-15 terminals. The voltage is globally adjustable from 2,5 V to 24 V and applies to both connection terminals.

Bipolar supply voltages are not supported with these modules.

The sensor supply voltage is always isolated (by block), both to the frame and to the block-isolated amplifier potential. In order to avoid that the common mode voltage is uncontrolled (due to isolation drift or capacitive interference), it should be determined externally. Unless this is already handled by the connected sensors, it can be accomplished by means of a connection to the module's CHASSIS.

The contact "(GND)", by contrast, must not be connected and especially not grounded!

Warning

The supply voltage is set on a module-by-module basis and does not apply to all inputs. The settings are made via software interface. Make sure that the sensor supply is not set too high before connecting a sensor. Otherwise, both the sensor and the imc CANSAS module could suffer damage.

9.3.12.5 Connection SC16, SCI8, SCI16

For the pin assignment of the DSUB-15 plugs see here. 594

The concept of block-level isolation is associated with certain crucial constraints which affect the use of the connection terminals or the grounding of certain contact pins:

Example: Voltage measurement with ACC/DSUB-U4, current measurement with ACC/DSUB-I4:

The terminals designated "(GND)" may not have external connections or have externally determined voltage levels, and in particular may not be grounded!
They carry the internal isolated reference potential of the block-wise isolated input amplifier ("GND_ISO").

Pin(1) of the DSUB-15 connector also has a particular feature:

It carries a signal which serves the purpose of TEDS sensor recognition. This signal, too, is referenced to the internal, block-wise isolated parts of the circuit and may not be grounded (CHASSIS).

For this reason, not in particular:

For SCxx / SCIxx –modules, only connectors of the type "ACC/DSUB" or of the "TEDS/DSUB" group may be used!

Only these connectors, in contrast to those previously used, have NO connection from DSUB(1) to CHASSIS.

If "conventional" connectors are used which have this connection, the module's block-wise isolation would be cancelled! This would also mean the loss of the measurement inputs' differential properties and thus of the module's fundamental functionality. Protection mechanisms prevent module damage in such cases, but instead, apparently "random" measurement errors as well as "mysterious" effects can result!

SC-modules higher than PD50 (February 2007) support ***TEDS***.

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9.3.12.5.1 SL Variety LEMO

see pin configuration of LEMO terminals 600.

9.3.12.6 Sampling rates

The explanations provided in Chapter "Measurement technique", "Sampling rates – Scanner concept 211" reveal the following advantages and constraints:

Advantages:

- flexible configuration of slow precision measurements and high-speed voltage measurements with one and the same affordable scanner system
- optimal aliasing-free noise suppression of even 50 Hz interference in spite of relatively high bandwidth of a scanner amplifier

Constraints:

- the highest sampling rate (of all those used, even of the channels used to derive virtual channels) determines the averaging interval and thus the noise suppression properties of all channels
- extra signal transit time due to automatic time offset correction is determined by the highest sampling rate.

Maximum sampling rate, recommended for temperature measurement
(optimum 50 Hz noise suppression):

SCI8:	>= 500 ms (2 Hz)
SC16, SCI16:	>= 1s (1 Hz)

9.3.12.7 Isolation - Concept

The modules SCI8, SCI16 and SC16 are based on a "scanner"-concept: the channels are sampled in succession and connected with an isolated differential amplifier. The potential levels between the signal source and amplifier are compensated by adapting the amplifier's supply reference to the source's common mode voltage, namely via a (low-impedance) switch.

The difference between SC16 and SCI16 consists mainly in the ***maximum possible isolation voltage*** of their channels.

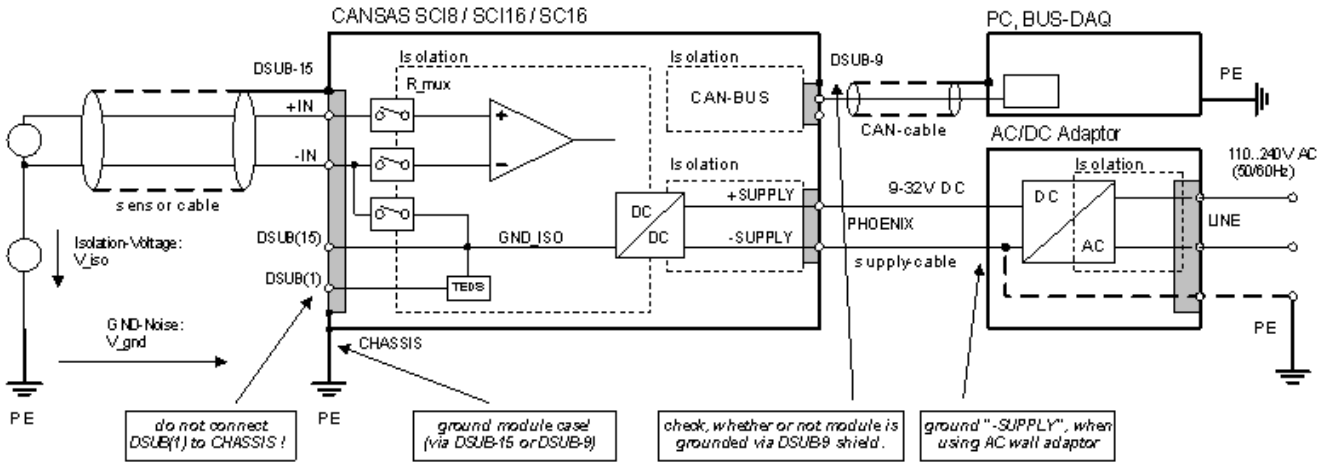
What all modules have in common is their design as an isolated differential amplifier with "block"-isolation. Block isolation refers to the fact that the input channels are not only isolated from each other (max. 60 V for SCI-x modules, 15 V for SC16), but additionally isolated as a group ("en bloc") from the frame, to a degree which can even exceed the maximum channel isolation strength (max. 60 V for SCI-x modules, 40 V for SC16). This isolation strength is known as the "maximum common mode input voltage".

Due to the components used, the channels of SCI8 and SCI16 units are mutually isolated to a strength of 60 V.

With SC16, then, the maximum input voltage at an input pin may exceed the frame's voltage level by up to 40 V ("max. common mode voltage"), as long as the differential between any two input pins doesn't exceed 15 V ("max. channel isolation").

The block isolation between the CAN bus's functional units and the "voltage supply" is defined accordingly.

The concept of block-wise isolation allows relatively large common mode voltages, as long as the maximum voltage differential between the module's channels is not exceeded.



Note

The contacts +I and -I of the DSUB-15 connector are exclusively for connecting RTD (PT100) sensors, which have neither a galvanic connection to a different electric potential nor are grounded. These pins are connected with the internal ungrounded module ground GND_ISO. Since the ungrounded module is periodically connected with the common mode potentials of the signal sources, grounding these contacts can lead to damage from short circuiting.

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on the standard connector:
"+I" = DSUB(9), Terminal K1, "(RES.)"
"–I" = DSUB(6), Terminal K10, "(GND)"

The same applies to the terminals GND and +5V: with this conditioner type, these contacts are not used for the supply voltage. They are reserved for special functions (cold junction compensation) and remain free!

If one of these pins were to be short circuited, the module's block-wise isolation would be cancelled! This would mean the loss of the measurement input's differential properties and thus of the module's basic functionality. Protection mechanisms prevent module damage in such cases, but instead, apparently "random" measurement errors as well as "mysterious" effects can result!

Two things are critical for undisturbed operation:

- **The module frame must be connected to protection ground in order to achieve effective shielding.**
- **If switching power adapters (e.g. plug power units) are used, the output should be grounded. This will be explained in detail below.**

9.3.12.8 Isolation of the voltage supply module

The module is supplied with direct current of 9 to 32 V. The internal supply unit is isolated, so that its potential level doesn't have any effect.

(The supply module under discussion here is not to be mistaken for the optional sensor supply! The sensor supply, which is also designated ±SUPPLY, is available at the DSUB-15 connectors.)

The block-wise isolation concept enables a substantial (DC-) isolation voltage between the supply unit and the remaining module parts. This is especially important with in-vehicle measurements:

In such set-ups, a electrical connection between the voltage supply and the module frame would create problems. Due to transient and electrostatic charges, considerable potential differentials can develop between the (-) vehicle battery ("grounded" at the contact "CHASSIS1") and the module frame ("grounded" at the contact "CHASSIS2"). This leads to strong compensation currents via the supply cable.

The voltage source is already grounded with the battery; any further grounding via the module is not permitted. For this reason the device's supply block must be isolated.

Conversely, switching power adapters make an additional aspect noticeable:

In spite of their excellent static isolation, electrically isolated devices will inevitably have very small capacitances. These capacitances (the AC/DC adapter's and the internal DC/DC converter's isolation capacitances) make it possible for high-frequency components of the switching power adapter (e.g. 100 kHz, 220 V!) to be coupled in via the input circuitry. The HF-circuit is closed by the signal source, which is either directly galvanically grounded or coupled to ground via leakage capacitances.

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This mechanism can increase noise or cause offset errors which accumulate due to non-linear rectification in the input amplifier. This problem is called RF-interference and, depending on the circuit, can be unavoidable with highly sensitive amplifiers having a large bandwidth. The amplifier's quality may limit the problem, but complete RFI immunity can never be achieved. For this reason, it's generally advisable to ground the common mode voltage supply of a switching power adapter.

In cases in which RFI problems occur with switching power adapters whose supply's static isolation voltage potential is already determined and rules out electrical grounding, a large (ceramic) capacitance connected between SUPPLY and CHASSIS could help! A suitable 1nF capacitor is already present internally and should succeed in suppressing the problems described in most cases!

9.3.12.9 Filter

The signal passes through the following filter stages one at a time.

1. **Hardware**: Pre-filter for the ADC (analog-digital converter), which works according to the Sigma-Delta procedure and requires a relatively high-frequency, fixed-frequency low-pass filter: Low-pass 60 kHz, 3rd order. This filter cannot be deactivated.
2. **ADC**: Low-pass effect of the ADC itself. Its cutoff frequency is around 8 kHz. Its characteristic is a 3rd order rectangular filter.
3. **Noise suppression**: Noise suppression filter, dependent on the sampling rate. This is a low-pass filter with Hanning characteristics. See the table for the cutoff frequency. The cutoff frequency is far above a channel's sampling frequency. The filter counteracts the aliasing and suppresses noise and disturbances, but not in the sense of a perfect anti-aliasing filter. This filter cannot be deactivated. With some modules and at top sampling rates, this filter stage is omitted.
4. **Compensation**: Compensation filter, dependent upon the sampling rate. This filter adjusts the sampling instant. This compensates for the fact that measurement is based on the use of a multiplexer. The filter returns data which simulate simultaneous sampling on all channels. This filter can be deactivated with the option "Filter / No filter". The filter also is the main cause of delay on the CAN bus. It also mainly determines the module's resulting cutoff frequency. The filter has Hamming-characteristics. It is omitted for very slow sampling frequencies.
5. **Averaging**: Formation of a mean value. If the individual channels have different sampling rates, then the multiplexer operates at only one single (high) sampling rate. The channels with slower sampling rates are generated by forming arithmetical means of the sample values, where the measured values from the previous filter stage are averaged over the whole sampling interval. With the option "No filter", this averaging replaces the current value from the previous filter stage. With very slow sampling rates, the value is also generated by taking averages.

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Remarks

- The filters are designed so that noise is suppressed as much as possible in spite of the multiplexer on which measurement is based.
- If high-performance anti-aliasing is required, then modules such as C8 and UNI8 with their high-performance analog portions are recommended.
- If interference at mains frequency (50 Hz, 60 Hz) in the measurement of thermocouples (or even the measurement of small voltages in general) is to be suppressed, then a sampling rate must be selected for every channel for which the noise suppression filter's cutoff frequency is a maximum of around 20 Hz. E.g. for the SC16 the sampling rate should be 1s or slower!

The multiplexer's highest switching frequency:

module	max. switching freq. [Hz]	highest recommended sampling frequency [Hz]
SC16	200	100
SCI16	167	50
SCI8	330	100

In the tables above, the Specified sampling interval is stated, which is set in the user's interface. In the module itself, a slightly different sampling interval is operative due to the multiplexer and its maximum switching frequency. Nevertheless, you obtain correct data at the desired rate over the CAN bus.

9.3.12.9.1 SC16 Filter



Off: Block averaging but no time offset correction

On: Block averaging but and time offset correction

With a configured sampling rate of 2 ms internal interpolation processes are applied. Minimum internal sampling rate is 5 ms. There is no averaging for sampling rates 5 ms and 10 ms only the current value will be outputted.

specified sampling interval	filter cutoff frequency noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
2 ms	20000 Hz	28 Hz	
5 ms	20000 Hz	28 Hz	
10 ms	1300 Hz	14 Hz	
20 ms	650 Hz	7 Hz	
50 ms	260 Hz	2.8 Hz	
100 ms	130 Hz	1.4 Hz	
200 ms	65 Hz	0.7 Hz	
500 ms	26 Hz		
1 s	13 Hz		
2 s	6 Hz		
5 s	6 Hz		Yes
10 s	6 Hz		Yes
20 s	6 Hz		Yes
30 s	6 Hz		Yes
60 s	6 Hz		Yes

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9.3.12.9.2 SCI16 Filter

Filter settings:

Off: Block averaging but no time offset correction

On: Block averaging but and time offset correction

With the configured sampling rates of 2 ms and 5 ms internal interpolation processes are applied. Minimum internal sampling rate is 5 ms. There is no averaging for sampling rates 5 ms and 10 ms only the current value will be outputted.

specified sampling interval	filter cutoff frequency noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
2 ms	-	23 Hz	
5 ms	-	23 Hz	
10 ms	-	14 Hz	
20 ms	700 Hz	7 Hz	
50 ms	280 Hz	2.8 Hz	
100 ms	140 Hz	1.4 Hz	
200 ms	70 Hz	0.7 Hz	
500 ms	28 Hz		
1 s	14 Hz		
2 s	7 Hz		
5 s	7 Hz		Yes
10 s	7 Hz		Yes
20 s	7 Hz		Yes
30 s	7 Hz		Yes
60 s	7 Hz		Yes

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9.3.12.9.3 SCI8 Filter

Filter settings:

Off: Block averaging but no time offset correction

On: Block averaging but and time offset correction

With the configured sampling rates of 1 ms and 2 ms internal interpolation processes are applied. Minimum internal sampling rate is 3 ms. There is no averaging for sampling rates 5 ms and 10 ms only the current value will be outputted.

specified sampling interval	filter cutoff frequency Noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
1 ms	-	42 Hz	
2 ms	-	42 Hz	
5 ms	-	28 Hz	
10 ms	700 Hz	14 Hz	
20 ms	350 Hz	7 Hz	
50 ms	140 Hz	2.8 Hz	
100 ms	70 Hz	1.4 Hz	
200 ms	35 Hz	0.7 Hz	
500 ms	14 Hz		
1 s	7 Hz		
2 s	3 Hz		Yes
5 s	3 Hz		Yes
10 s	3 Hz		Yes
20 s	3 Hz		Yes
30 s	3 Hz		Yes
60 s	3 Hz		Yes

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9.3.12.10 Delay

	delay time [ms]					
	SC8I		**SCI16**		**SC16**	
sampling time	without filter	with filter	without filter	with filter	without filter	with filter
2 ms	4	6	10	15	12	13
5 ms	5	7	8	14	2	8
10 ms	3	7	7	16	4	15
20 ms	4	25	6	31	8	30
50 ms	11	37	20	38	15	76
100 ms	28	73	43	157	40	160
200 ms	61	150	85	306	75	310
500 ms	121	294	200	200	160	160
1000 ms	250	250	400	400	320	320
2000 ms	500	500	800	800	630	630

With slower sampling times the filter will not always be calculated completely. Therefore delay times may be similar with and without filtering.

The table indicates typical delay times, for the respective most strongly delayed channels.

The SCxx modules possess certain particularities:

- The highest sampling rates can cause longer delay times than slower sampling rates, depending on the system. The cause is the multiplexer on which the module is based. This multiplexer doesn't change channels at the highest clock rate. The reconstruction filter used also causes increased delay. If the delay time is to be short, then you must select sampling rates with sufficiently short delay. This may well be a slower sampling rate. In that case, the higher sampling rates produce finer intermediate values, which however feature delayed processing.
- With a SCxx module, if different sampling rates are used, the overall delay time results as per the following rule:
  - For channels with the highest sampling rate used, the delay time is determined by this sampling rate.
  - For channels with a slower sampling rate, the resulting delay time is that of the fastest sampling time plus the sampling interval which is set.
- With SCxx modules, the delay time depends on the channel. For instance, if Channels 1, 2, 3 and 4 are contained in a message, then Channel 1 was sampled first, then Channel 2 and finally Channel 4. Thus the most current (the newest) measured value in the message comes from Channel 4. Conversely, the measured value from Channel 1 is the most delayed one.

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9.3.13 UNI8: universal

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.

The CAN-Bus measurement module imc CANSAS-UNI8 is an analog input module with 8 channels which are individually filtered, amplified and digitized; the module is ideal for the measurement of:

- Voltage
- Current (20 mA sensors)
- Temperature (thermocouple, PT100)
- Bridge and strain gauge measurements (full-, half- and quarter bridge 120 Ω, optional 350 Ω)
- Resistance

For the supply of external sensors and bridge measurement a sensor supply with adjustable voltages 2.5 V to 24 V is included.

Reference

Technical Specs UNI8. 560

To supply external sensors or bridges the module is equipped with a sensor supply 389 with an adjustable supply. Supports TEDS 230 (Transducer Electronic Data Sheets).

The measurement inputs whose terminals are DSUB plugs (ACC/DSUBM-UN2 594) are for voltage, current, bridge, PT100 and thermocouple measurements. They are non-isolated differential amplifiers. They share a common voltage supply for sensors and measurement bridges.The technical specs of the *UNI8: universal* 560.

9.3.13.1 Voltage measurement

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

Within the voltage measurement ranges ±50 V and ±20 V, a voltage divider is in effect; the resulting input impedance is 1 MΩ.

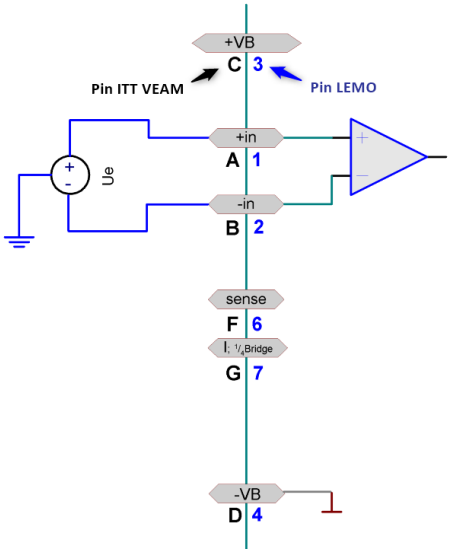
By contrast, in the voltage ranges ±10 V and ±5 mV, the input impedance is 20 MΩ. For the deactivated device, the value is approx. 1 MΩ.

In the input ranges <20 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.

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9.3.13.1.1 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

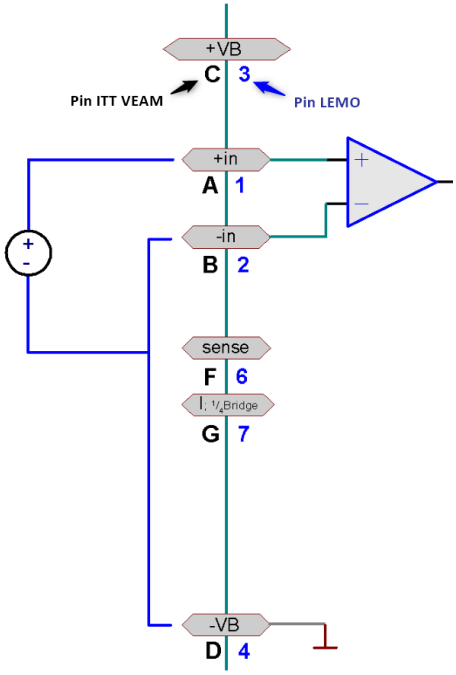
The device is grounded. Thus, the input -VB is also at ground potential. If the voltage source itself is also grounded, it's referenced to the device ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common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

9.3.13.1.2 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 373. 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

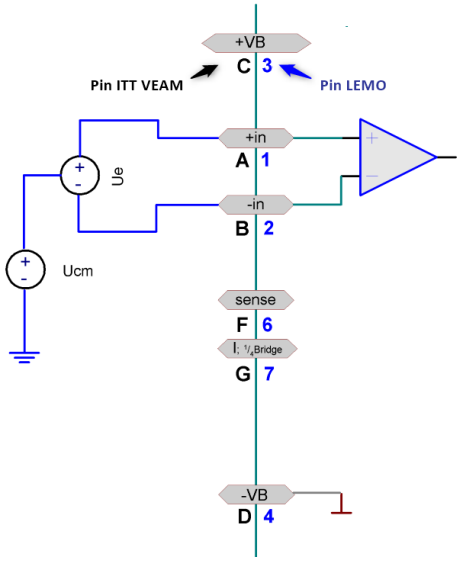
An ungrounded voltage source is measured, for instance a battery whose contacts have no connection to ground. The device module is grounded.

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.

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9.3.13.1.3 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 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 UNI8 cannot be used.

9.3.13.1.4 Voltage measurement with zero-adjusting (tare)

In voltage measurement, it is possible for the sensor to have an initial offset from zero. For such cases, use the operating software to select the measurement mode "*Voltage: allow zero-balance*" for the desired channel. The input range will be reduced by the initial offset. If the initial offset is too large for compensation by the device, a larger input range must be set.

Measurement range [V]	Compensable initial offset* [V]
±50	8.4
±20	38.4
±10	1.6
±5	6.5
±2	0.9
±1	1.9

Measurement range [V]	Compensable initial offset* [V]
±0.5	0.08
±0.2	0.3
±0.1	0.015
±0.05	0.06
±0.02	0.008
±0.01	0.018
±0.005	0.023

* The maximum initial unbalance is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 50 V and of 20 V is 58.4 V, then the resulting possible initial unbalance is 8.4 V in the 50 V input range and 38.4 V in the 20 V input range.

Reference

For notes on triggering the adjustment, refer to the section on bridge measurement 378.

9.3.13.2 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. 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

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!)

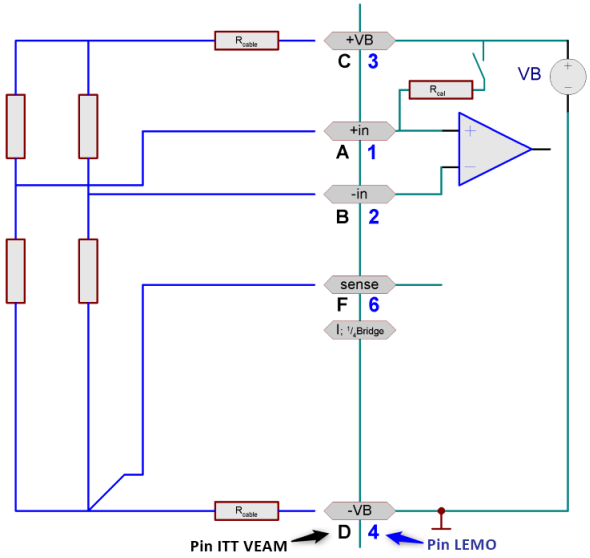
- For typical measurements with **strain** gauges, the ranges 5 mV/V to 1 mV/V are relevant.
- There is a maximum voltage which the **potentiometer sensors** are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

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!

9.3.13.2.1 Full bridge



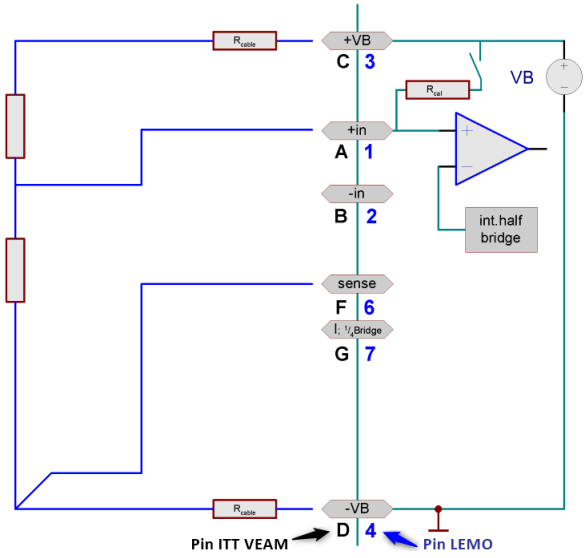
A full bridge has four resistors, which can be four correspondingly configured strain gauges or one complete sensor which is a full sensor internally. The full bridge has five terminals to connect. Two leads +VB and -VB serve supply purposes, two other leads +IN and -IN capture the differential voltage.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

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9.3.13.2.2 Half bridge



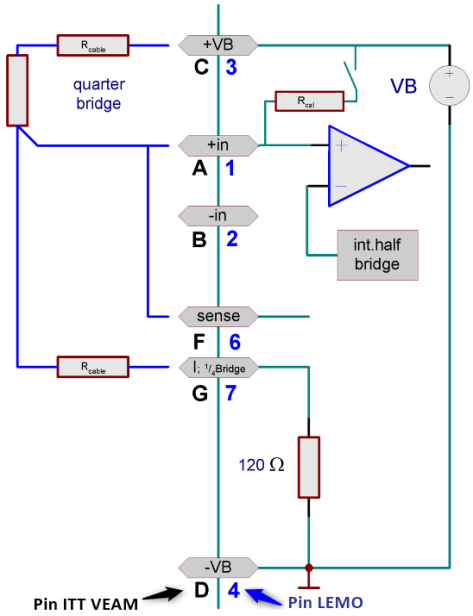
A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has 4 terminals to connect. For information on the effect and use of the SENSE lead, see the description of the full bridge 376.

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.

9.3.13.2.3 Quarter bridge



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

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 376 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.

Note

By default the UNI8 comes with a 120 Ω internal bridge completion resistor. A 350 Ω internal bridge completion resistor is alternatively possible as an order variant for the purpose of quarter bridge measurement

9.3.13.2.4 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.

The bandwidth (without lowpass filter) is for DC-bridge measurement 200 Hz, too.

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	150
±500	200	100	250
±200	30	100	50
±100	30	15	50
±50	6	15	7
±20	20	3	7
±10	20	10	15
±5	7	10	5
±2	9	3	5
±1	-	4	5
±0.5	-	-	-

9.3.13.2.5 Balancing and shunt calibration

The amplifier 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 the CAN-Bus. Select the CAN-message ID on the Balance tab.
  - The message's 4th bit must be "1" (0x10) in order to trigger balancing.
  - The message's 5th bit must be "1" (0x20) in order to trigger shunt calibration.
- Balancing / shunt triggered by the button: CANSAS-UNI8's button can be used to initiate balancing of all bridge channels. For this purpose, the button's function must be specified on the General-tab as Activate balance.
- It is possible to perform balancing / shunt in the Measure-window belonging to the CANSAS configuration software for each bridge channel separately. The channels to be balanced must be selected.
- In shunt calibration, the bridge is unbalanced by means of a 174.7 kΩ shunt (between +VB and +IN). The results are:

Bridge resistance	120 Ω	350 Ω
174.7 kΩ	0.171 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!
- Shunt calibrations are a special case: If at least one channel is set to Voltage, allow zero-balance and no channel is set for bridge or strain gauge measurement, then upon activation of a shunt calibration, both the status bar and the function Output status on LED will indicate a shunt calibration, but none will be carried out. Conversely, if balancing is set, it will be indicated and carried out, too, upon activation.

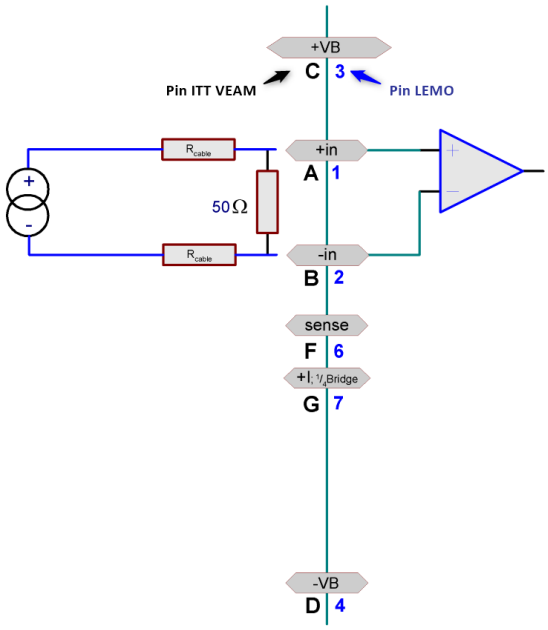
Balance

- To ensure that the balancing values are retained even after configuration changes, the option "*Keep balancing values when re-configuring*" must be activated on the module's balancing board or the module board in the options dialog 106. This new option is available as of imc CANSAS software version 2.2 R7 and is not activated by default after installation.

9.3.13.3 Current measurement

9.3.13.3.1 Differential current measurement

Only for devices with DSUB-15 sockets in combination with imc plug ACC/DSUBM-I2 594



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.

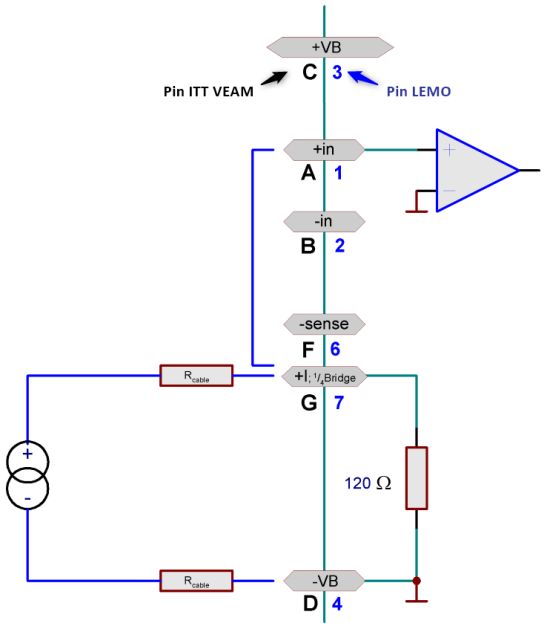
The maximum common mode voltage must be in the range ±10 V for this circuit, too. This can generally only be ensured if the current source itself already is referenced to ground. If the current source is ungrounded a danger exists of exceeding the maximum allowed overvoltage for the amplifier. The current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

9.3.13.3.2 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.

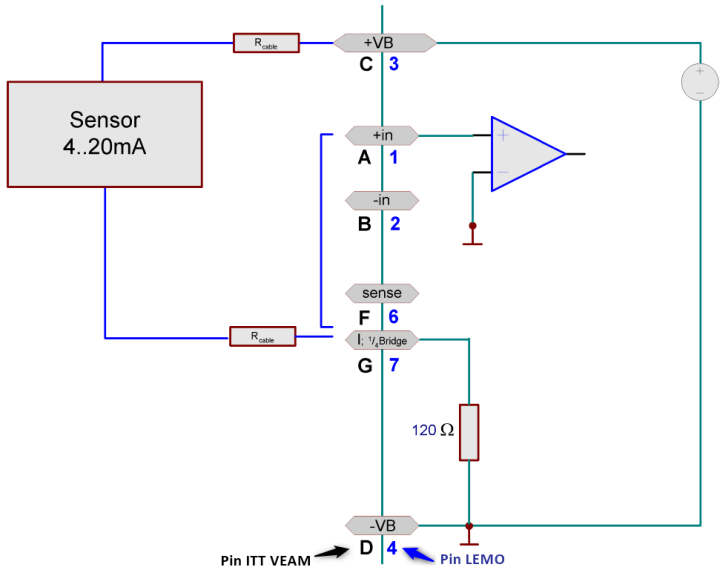
Note that the jumper between *+IN* and *+I; ¼Bridge* should be connected right inside the plug.

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.

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9.3.13.3.3 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.

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9.3.13.4 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.

The **unit** in ° **Celsius** or **Fahrenheit** is set via the *Input range* of the channel.

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.

9.3.13.4.1 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.

Reference

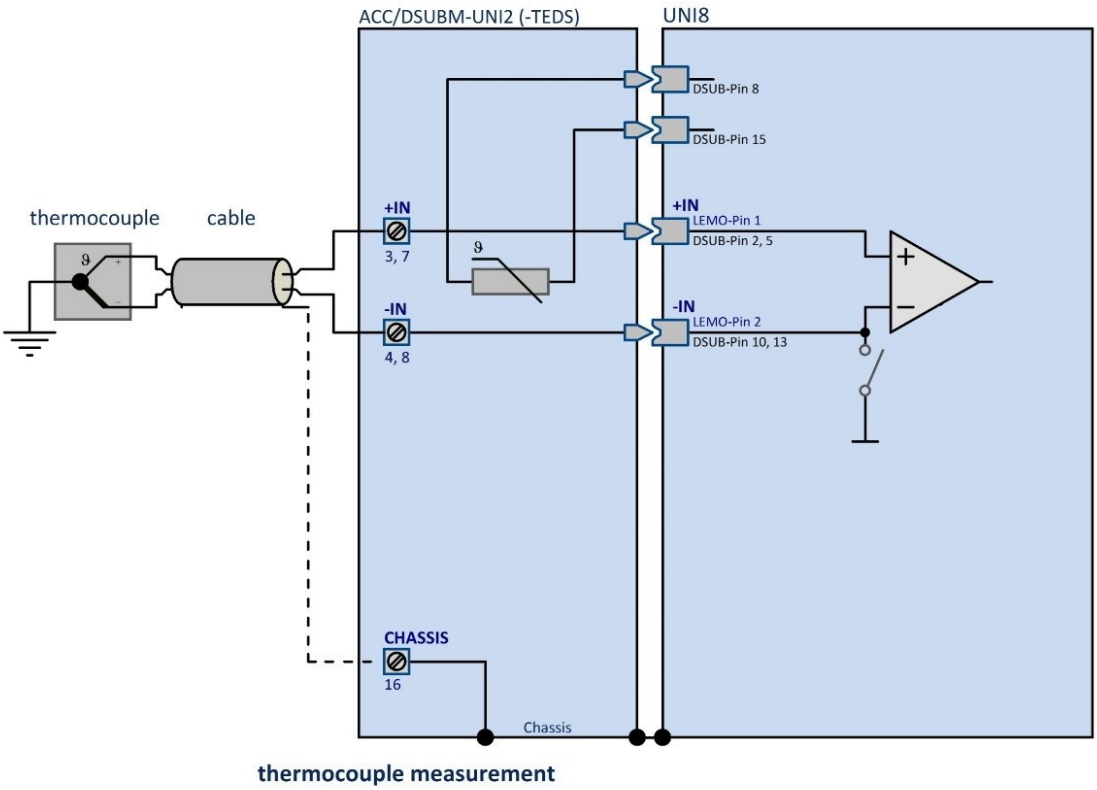
Please find here a description of the available thermocouples 180.

9.3.13.4.1.1 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.

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In the CANSAS operating software, select the measurement mode "***Thermocouple (mounted with ground reference)***".

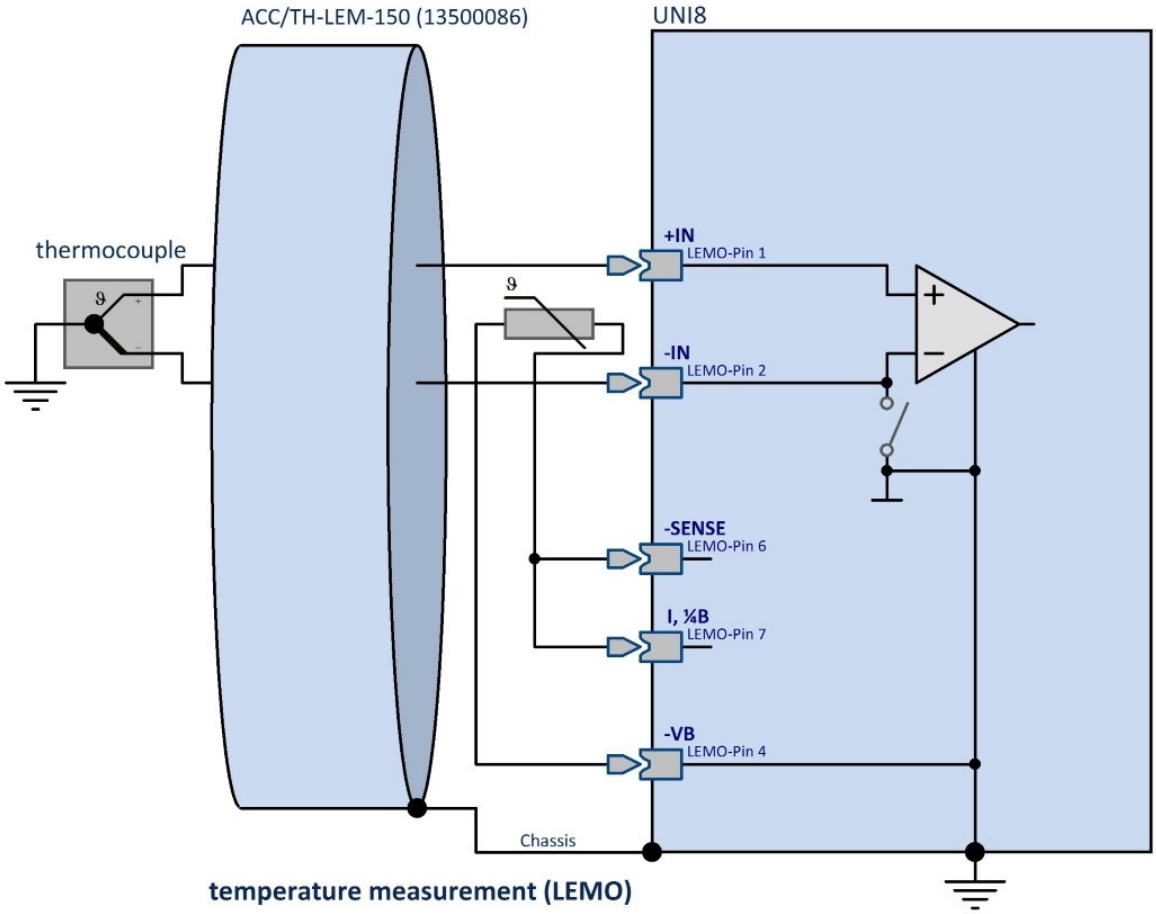


It is not a problem if the ground potential at the thermocouple differs from that of the device units by a few volts. However, the maximum allowed common mode voltage may not be exceeded.

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 select the operating mode "Thermocouple (mounted without ground reference)", there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. Compensation currents are a danger with every single-ended measurement. For that reason, single-ended measurement is really only allowed -and only then really necessary- if the thermocouple has no ground reference of its own.

- Note that with **LEMO connection** 600 an external PT100 must be integrated in the connector as cold junction compensation. In addition, the ***ACC/TH-LEM-150*** connector is available as an accessory: a LEMO. 1B connector with integrated cold junction compensation.
  For ITT VEAM the integrated cold junction compensation ***CAN/UINST-PT1100*** is provided for the corresponding CAN/UINST-7 connector.

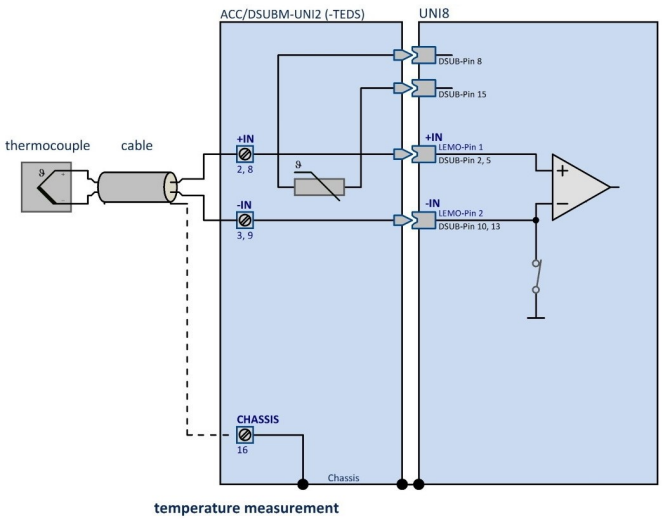


temperature measurement (LEMO)

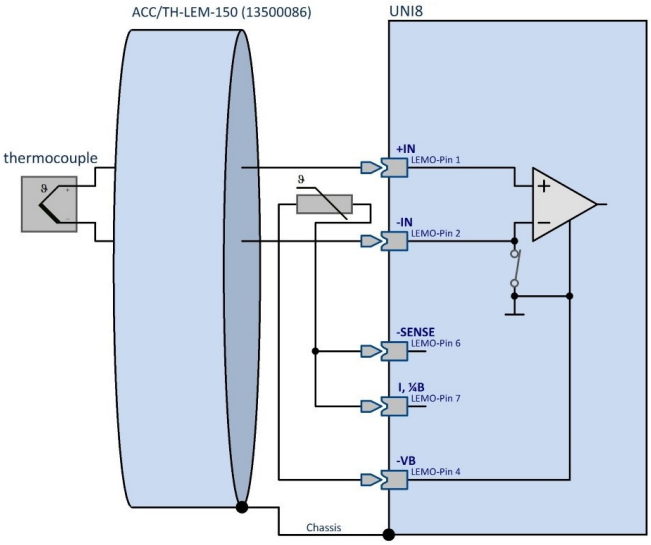
9.3.13.4.1.2 Thermocouple mounted without ground reference

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

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



temperature measurement



temperature measurement (LEMO)

In the CANSAS operating software, select the measurement mode "***Thermocouple (mounted without ground reference)".***

In this measurement mode, the UNI8 module itself provides the ground reference by having Terminals -IN and -VB connected internally. Then a measurement which is practically single-ended (ground-referenced) is performed. There is no disadvantage to this if there was no ground reference previously.

Warning The thermocouple itself may not be ground referenced!

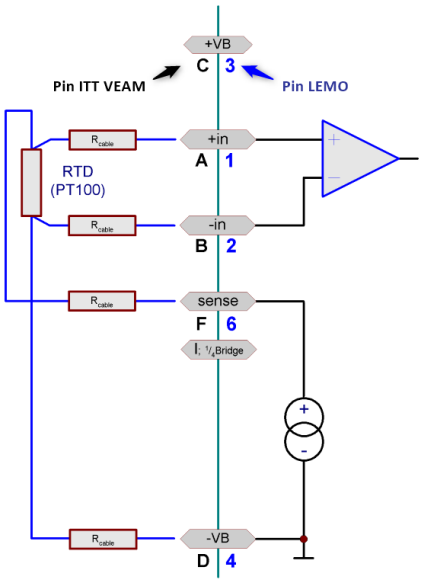
If it was mounted with a ground reference, there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. Compensation currents are a danger with every single-ended measurement. For that reason, single-ended measurement is really only allowed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

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9.3.13.4.2 PT100/ RTD measurement

Along with thermocouples, **PT100** can be connected directly in **4-wire-configuration** (DSUB-plug: ACC/DSUBM-UN2 594). 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.

9.3.13.4.2.1 PT100 in 4-wire configuration

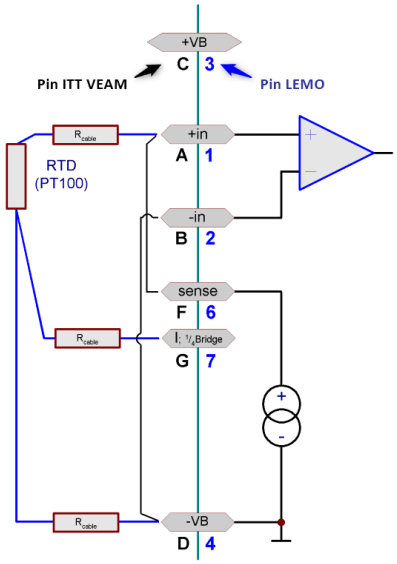


The PT100 is supplied with constant current via two lines (-SENSE and -VB). The other two serve as Sense-leads. By using the lines (+IN und -IN), the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error. The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

9.3.13.4.2.2 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.

9.3.13.4.2.3 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.

The cable resistance that has to be compensated (simple line) is not supposed to be more than 7 Ω (ca. 140 m cable length with 0.35 mm², consider overview of cable resistance as function 574)

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9.3.13.4.3 Open sensor detection

The amplifier comes with the ability of open sensor detection.

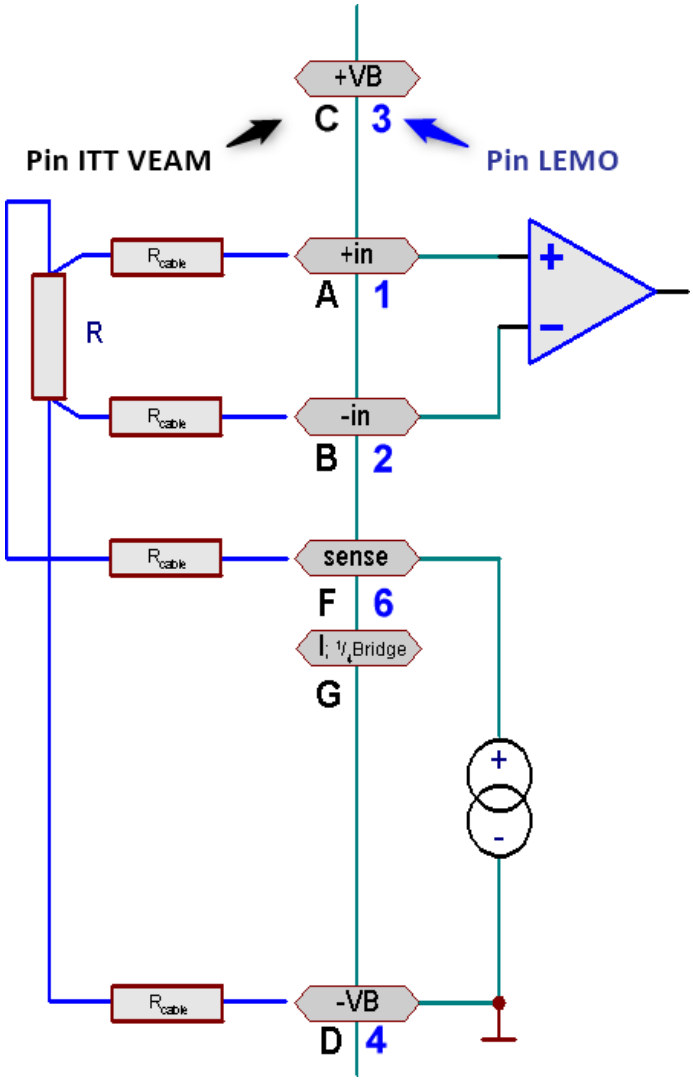
Thermocouple: If at least one of the thermocouple's two lines breaks, then within a short time (only a few samples), the measurement signal generated by the amplifier approaches the bottom of the input range in a defined pattern. The actual value reached depends on the particular thermocouple. In the 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.

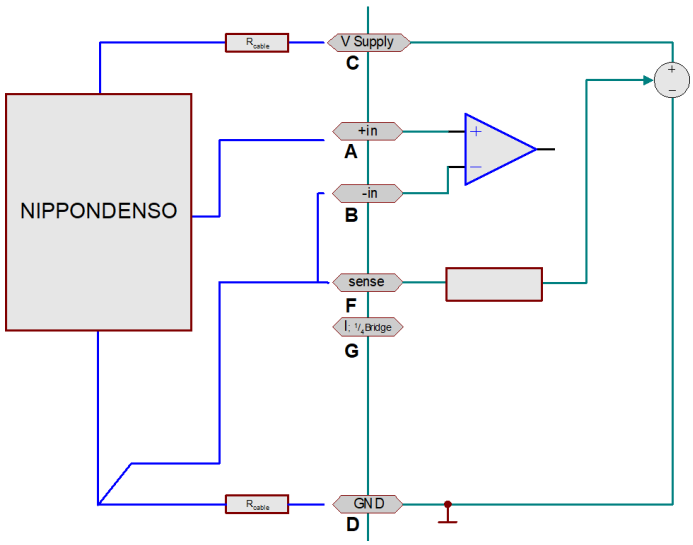
9.3.13.5 Resistance measurement



For resistance measurement there is only one input range: 0 Ω to 800 Ω. Each resistor is fed by a separate current source with approx. 1.2 mA. The measurement uses 4-wire configuration.

The resistor is supplied by 2 lines. The other two lines serve as sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

9.3.13.6 Sensors requiring adjustment of their supply



e.g. for Nippondenso pressure sensors

This applies especially to Nippondenso pressure sensors, for instance.

If a sensor's supply must not be susceptible to voltage drop along the supply cable, it can be adjusted by the device. The option Adjust control as per: in the settings interface's dialog *Universal amplifiers / General* must be selected.

If the resistors in the feed lines are equal, the supply voltage is adjusted at the sensor– the voltage drop along the cable is compensated.

The sensor is supplied via +SUPPLY (V_{Supply}) and GND. The sensor returns the measurement signal in reference to its own ground.

UNI8 makes a differential measurement of the signal between +IN and -IN.

Note that there must be a jumper between -IN and -SENSE. SENSE (pin F) is the Sense connection. It serves to measure the voltage drop at the lower voltage feed line.

Adjustment can only be activated for either 5 V or 10 V supply. It can only compensate up to 0.5 V for the supply and return lines together. This means that UNI8's internal voltage source can deliver a maximum of 0.5 V more voltage.

Adjustment works slowly (with a time constant of some seconds) in order to compensate a static voltage drop.

9.3.13.7 User-defined characteristic curves

User-defined characteristic curves created e.g. by imc SENSORS, can be proceeded.

9.3.13.8 Sensor supply module

UNI8 channels are enhanced with a sensor supply unit, which provides an adjustable supply voltage for active sensors. The reference potential, in other words the sensor's supply ground contact, is the terminal GND.

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

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

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

Note

- Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the CANSAS-module could be damaged.
- There is a 5 V pin at the imc plug. That voltage is not available for the CANSAS-modules, only for the imc CRONOS-series!

The technical data of the sensor supply is listed in the data sheet of the 560 CANSAS-UNI8.

9.3.13.9 Bandwidth

The channels' maximum sampling rate is 1 kHz(1 ms).

The analog bandwidth (without digital low-pass filtering) is 200 Hz

9.3.13.10 Connection

The analog channels are equipped with **DSUB-15** plugs (CANSAS-x-UNI8-D), **ITT-VEAM**-plugs (CANSAS-x-UNI8) or **LEMO**-plugs (CANSAS-x-UNI8-L) **ITT-VEAM**-plugs (C1) or **LEMO**-plugs (C1-1-LEMOSA).

In the connection diagrams, the numbering for LEMO and custom ITT VEAM plugs appear alongside of the labeling in the terminals:

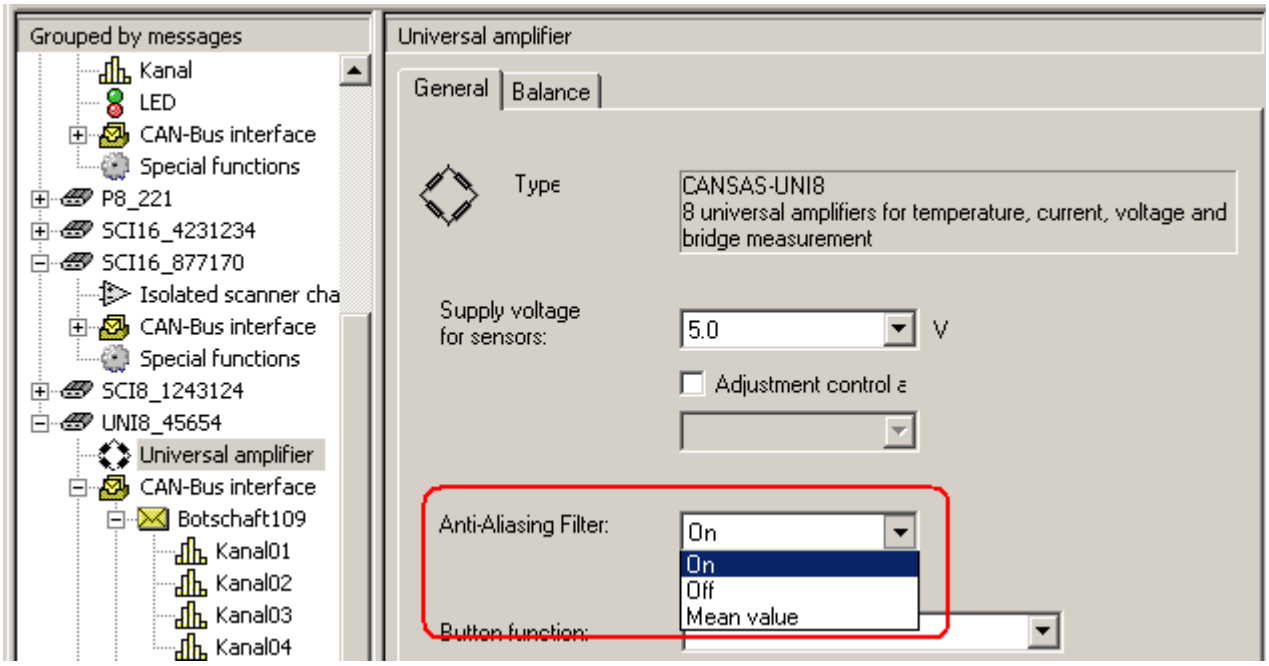
LEMO	ITT-VEAM	imc-plug ACC/DSUB-UNI2 or -B2
1	A	+IN
2	B	-IN
3	C	+VB
4	D	-VB
5	E	TEDS (OneWire)
6	F	sense
7	G	Quarter bridge completion / sense for Pt100 3-wire configuration

Find here the pin configuration of the DSUB-15 plugs 594, ITT-VEAM-plugs 599 and the LEMO-plugs 600.

9.3.13.11 Sampling intervals, filters and anti-aliasing

For each of the 8 channels, the sampling interval can be freely set to between 1 ms an 60 s. UNI8 come with a hardware-based, permanent anti-aliasing filter (AAF), an analog-digital-converter (ADC) using the sigma-delta method, and finally a digital low-pass filter adapted to the sampling rate.

The hardware-based AAF is suitable for the 1 ms input frequency. The digital low-pass filter is set to the sampling rate and can be switched off on the card General of the UNI8. Alternatively to the digital AAF it is possible to avoid noise simply by averaging through processing arithmetic mean function.



On: Additional digital low-pass filter.

Off: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.

Mean value: The output value is averaged by (Sampling interval[ms] / 1 ms) samples.

The table below shows which resulting filter is used. For temperature measurement (Pt100 and thermocouples):

Sampling rate	Filter
1 ms	Critical damping, 4th order, cutoff frequency 120 Hz
2 ms	Critical damping, 4th order, cutoff frequency 60 Hz
5 ms	Critical damping, 4th order, cutoff frequency 25 Hz
10 ms	Critical damping, 4th order, cutoff frequency 12 Hz
20 ms	Critical damping, 4th order, cutoff frequency 6 Hz
50 ms	Critical damping, 4th order, cutoff frequency 2 Hz
100 ms	Critical damping, 4th order, cutoff frequency 1 Hz
200 ms	Critical damping, 4th order, cutoff frequency 0.5 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0.2 Hz
1 s	Critical damping, 4th order, cutoff frequency 0.1 Hz
2 s to 60 s	Arithmet. mean over the duration of the sampling interval of values sampled at 1 kHz

All other measurement types (voltage, current, bridges and resistance):

Sampling rate	Filter
1 ms	Butterworth, 2nd order, cutoff frequency 220 Hz
2 ms	Butterworth, 2nd order, cutoff frequency 110 Hz
5 ms	Butterworth, 2nd order, cutoff frequency 40 Hz
10 ms	Butterworth, 2nd order, cutoff frequency 20 Hz
20 ms	Butterworth, 2nd order, cutoff frequency 10 Hz
50 ms	Butterworth, 2nd order, cutoff frequency 4 Hz
100 ms	Butterworth, 2nd order, cutoff frequency 2 Hz
200 ms	Butterworth, 2nd order, cutoff frequency 1 Hz
500 ms	Butterworth, 2nd order, cutoff frequency 0.4 Hz
1 s	Butterworth, 2nd order, cutoff frequency 0.2 Hz
2 s to 60 s	Arithmet. mean over the duration of the sampling interval of values sampled at 1 kHz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti- aliasing filters (e.g. with damping of 96 dB at one-half of the sampling frequency).

If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

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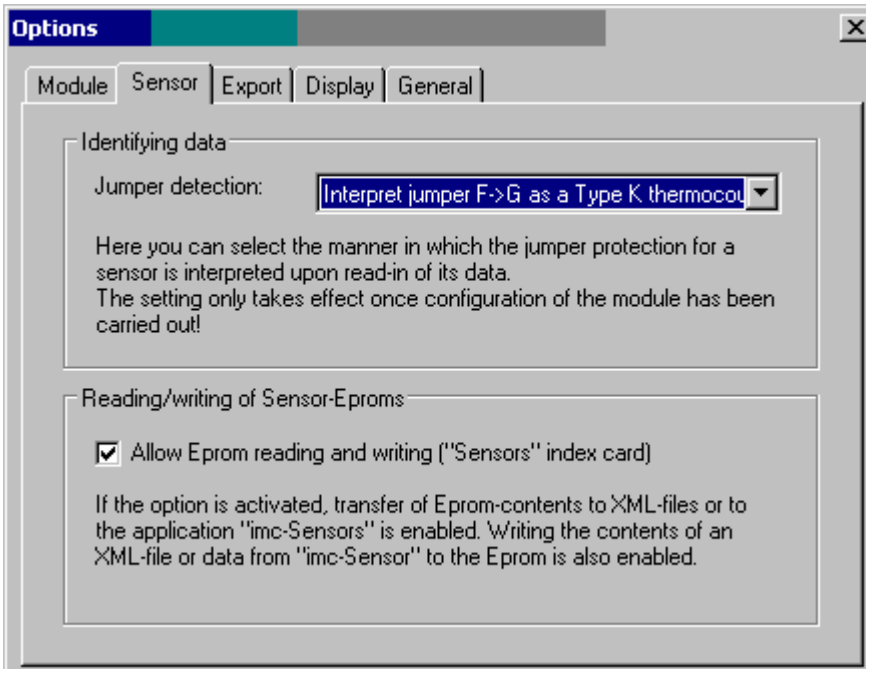
9.3.13.12 Recognition of sensor by means of wire jumpers

Besides the convenient sensor recognition capability provided by an EPROM (TEDS), there is also the possibility to use wire jumpers to broadly specify the sensor type. However, only a thermocouple of type K can be unambiguously recognized in this way. This option must be set globally in the CANSAS software.

Go to the menu item

Extras -> Options… -> Sensor and select under

Identifying data -> Interpret jumper F-G as a Type K thermocouple.



The UNI8 unit will enter a Type K thermocouple as connected in the configuration:

The following shows the existing possibilities and how UNI8 interprets them:

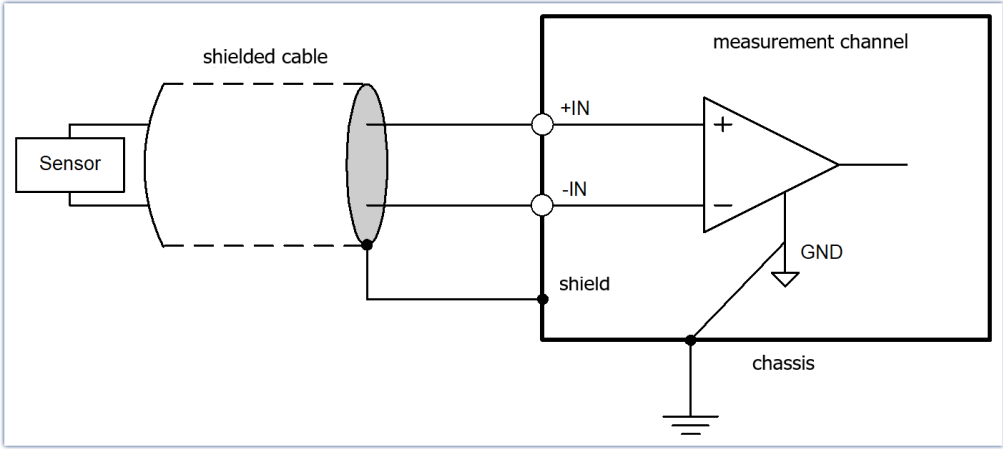
Signal source	Connection pins	The module recognizes
no measurement source	D-E open	ext. current source on, overload between +Sense and Sense
thermocouple Typ-K	F-G jumpered D-E open	ext. current source on, no voltage between +Sense and –Sense, thermocouplemounted without ground reference*
RTD (Pt100) 3-line/ 4-line, ¼ bridge resistance/ potentiometer Nippo Denso sensors with voltage adjustment	D-E jumpered RTD connected	sensible value for Pt100 (R<1000Ω)
unknown measurement source	D-E jumpered	Pt100 overloaded
measurement source with sensor recognition EPROM	Chip an D-E	

*Before version 1.8 the jumper F-G configured "Thermocouple with ground reference".

9.3.13.13 Connection

For the pin assignment of the DSUB-15 plugs see here 594.

The measurement inputs should be connected using a shielded cable, in which the differential inputs A and B (+IN and -IN) are enclosed in the shielding

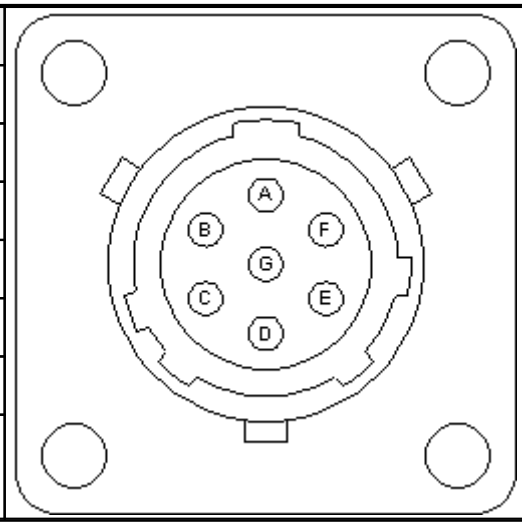


Warning

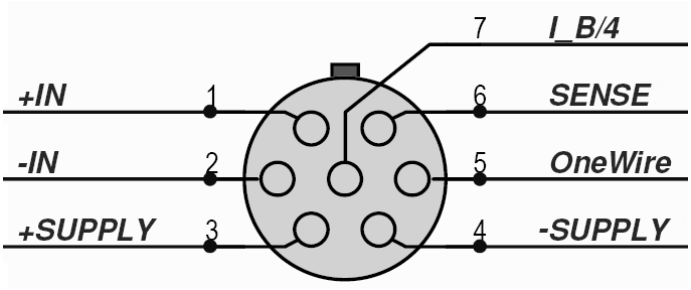
The CANSAS-module must be grounded. Its frame is metal and conducting. The ground connection passes through a bolt on the back plane. Leaving aside safety considerations, grounding is usually necessary for measurement-technical reasons. Lack of grounding is often the problem in cases of noisy measurement values.

9.3.13.13.1 Pin configuration of round plugs ITT-VEAM (MIL-C-26482)

Signal	PIN/Circuit
pos. measurement input	A
neg. measurement input	B
positive sensor supply	C
negative sensor supply (device ground)	D
sensor recognition	E
sense-lead, RTD current source	F
quarter bridge completion, Sense-lead for RTD 3-wire plug	G



9.3.13.13.2 Pin configuration of round plugs LEMOSA

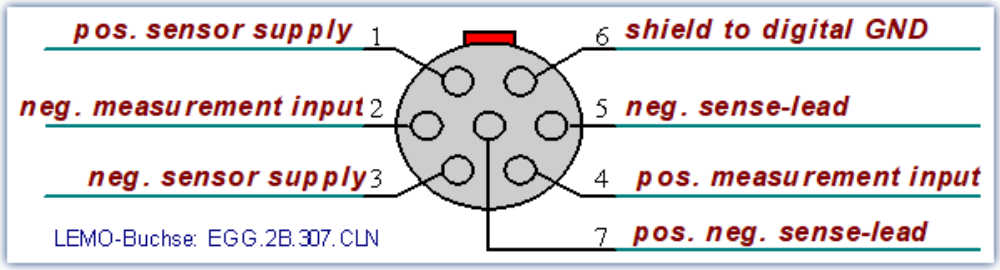


(view from outside to the device)

Signal	PIN	circuit
pos. measurement input	1	A
neg. measurement input	2	B
positive sensor supply	3	C
negative sensor supply (device ground)	4	D
sensor recognition	5	E
sense-lead, RTD current source	6	F
quarter bridge completion, Sense-lead for RTD 3-wire plug	7	G

This pin configuration applies also to CANSAS-SL-UNI8-L, see modules with LEMO plugs 600.

9.3.13.13.3 Pin configuration of round plugs ZF LEMO



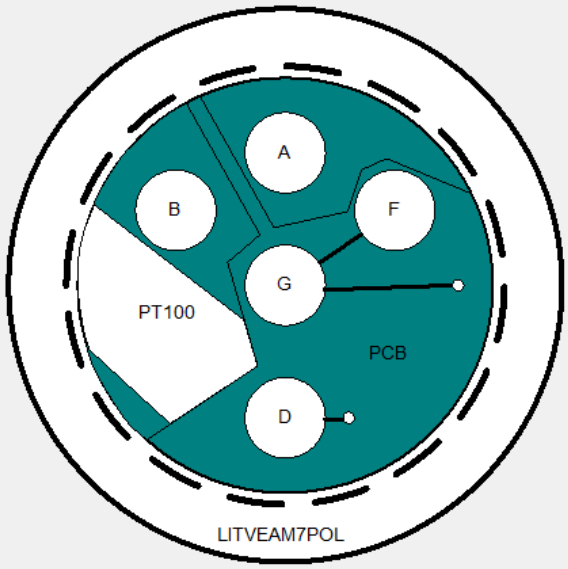
(view from outside to the device)

Signal	PIN	Circuit	Note!
positive sensor supply	1	C	In this model, the contacts labeled G and E in the circuit diagram are omitted. Thus, the following functions are no longer available: 1. sensor recognition 2. ¼ bridge completion and measurement 3. thermocouples with PT100 in the plug 4. 3-wire PT100 measurement 5. single ended current measurement 6. sensors with current signal
neg. measurement input	2	B	
negative sensor supply (GND)	3	D	
pos. measurement input	4	A	
negative sense-lead	5	F	
shield to digital GND	6	D	
positive sense-lead	7	---	

9.3.13.14 Assembly instructions for ITT VEAM with Pt100 inside of connector

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

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

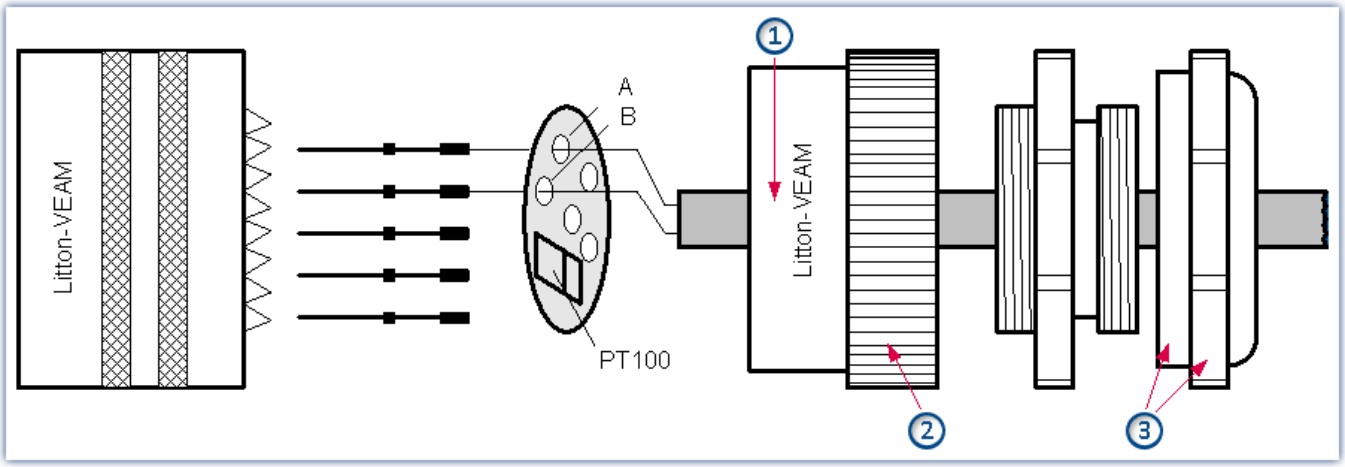


PT100 junction plate for ITT VEAM

Warning

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

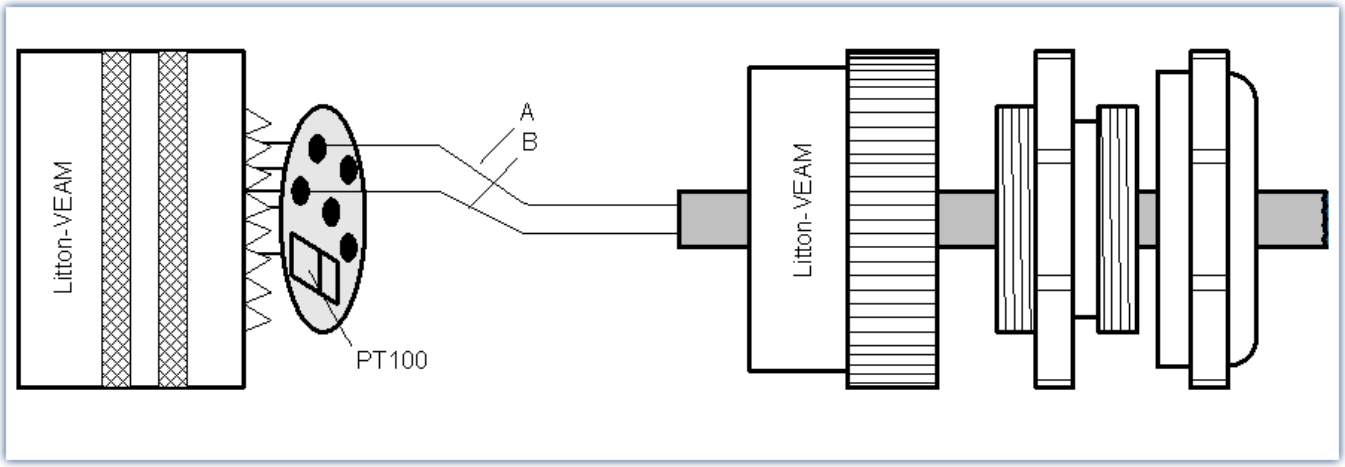
9.3.13.14.1 Connection using crimps



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

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9.3.13.14.2 Connection by soldering



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

Warning

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

9.3.13.14.3 Recommended tools

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

9.3.13.15 UNI8/DCB8-PROTECT

The UNI8 and DCB8 modules are also available in PROTECT model versions. These are equipped with DSUB-15 terminals and special protection from ESD (electrostatic discharge).

Suppressor diodes are used at the sensor supply which can limit the signal to 25 V even in response to high transients.

Furthermore, **discharge tubes** at the inputs +IN and SENSE protect against transient voltage surges (approx. 90 V trigger).

ESD filters with inductors and ferrite resistors are used at the terminals +-VB, +-PT100, IN and SENSE.

Additionally, TEDS is supported.

Note

These measures entail the following constraints:

- The sensor supply is limited to a maximum of 15 V
- Shunt calibration of bridges is no longer accurate.
- PT100 measurement in 3-wire mode is typically subject to an offset of 1.1 K

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9.4 CANFX/HISO modules

The CAN-Bus measurement modules imc CANSAS*flex*-HISO allow safe and precise measurement with 8 thermocouples (type K) which are mounted on high-voltage components with common mode voltage levels of up to 800 V, or the measurement of PT100/1000 respectively voltages, see specs 521.

The CANFX/L-HISO-HV4 allows a differential voltage measurement up to 800 V on four channels.

HISO8-T-8L	HISO8-T-2L	HISO8-L	HISO8-4L	HISO-HV4	
Thermocouple (TC) type K 400		Voltage 399, PT100, PT1000 400 and Resistance 401		Voltage 399	
					Isolation 800 V (AC/DC) Specs
High-voltage-proof special sockets (LEMO):					
8x TC single plug LEMO.2P 2-pin 601	2x TC common plug LEMO.2P 8-pin	8x PTx single plug LEMO.1P 5-pin 601	4x PTx / voltage-common plug LEMO.2P 8-pin 601	4x2 safety-**laboratory** sockets specs 524	

HISO-T-8-2L



LEMO.2P

Isolation **1400 V** Specs

Only use electrically safe measuring cables and plugs suitable for the application. For example, use only genuine safety banana plugs with immovable connection insulation.

Safety instructions

In the following section, the residual risks are named which result from the hazard analysis. To reduce health hazards and avoid dangerous situations, observe the listed safety instructions.

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Warning Use in high-voltage environment



CANFX/HISO modules are specially designed for use in high-voltage environments.
Improper handling poses the risk of life-threatening electric shock.

- Use only qualified and trained personnel.
- Observe safety instructions and the five safety rules.
- CANFX/HISO modules may only be operated, when the module connectors are covered.

Improper opening operational safety and poses the risk of life-threatening electric shocks.

- Do not open the module housing.
- Do not make any mechanical or electrical modifications.

Warning

In the application, the specifications of the cables used, including the plug (specific manufacturing implementation of the plug connection), must always be observed. The following restrictions may apply:

Warning Restrictions due to the cables and Redel plugs

1. Restrictions due to the cable specification

The isolation strength between the wires is limited.

This also applies to (bundled) additionally isolated wires and restricts the routing of different HV circuits within a cable.

Possible solution:

- Route each HV circuit in a separate HV cable or only route HV circuits with the same or similar level of potential within one cable.

The isolation strength to the outside is limited.

Possible solution:

- Route the HV cable in a suitable isolating sleeve (additional isolation). Caution! The colored cable marking will be lost/covered, so that additional external marking may be required.
- Route the HV cable protected against contact and suitably isolated from conductive parts (sheath/protective cover, distance).

2. Restrictions due to the REDEL 2P plug

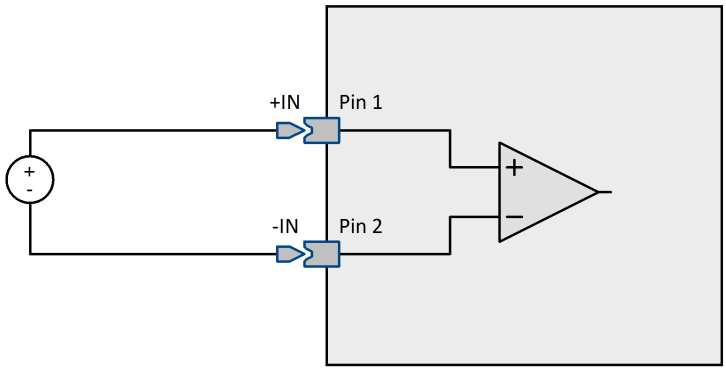
Creepage distance may be too short up to the touchable stop between socket and plug (creepage distance is 22.5 mm).

Possible solution:

- For operation under voltage: no solution (observe 5 safety rules)
- For installation in a de-voltaged state and subsequent operation: Protect the plug against contact (sheathing/protective cover).

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9.4.1 Voltage measurement



configuration for voltage measurement

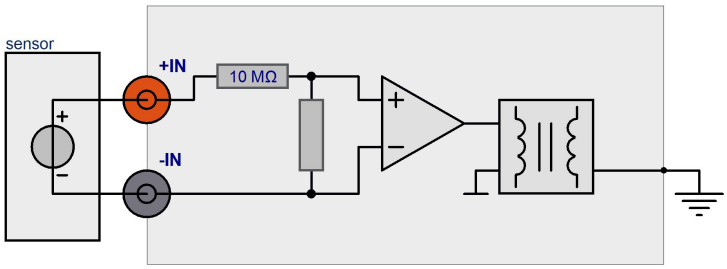
Measurement ranges:
±20 mV to ±100 V

The differential input impedance is 6.7 MΩ in ranges up to ±2 V. For all other ranges and if the device is de-activated, the impedance is always 1 MΩ.

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

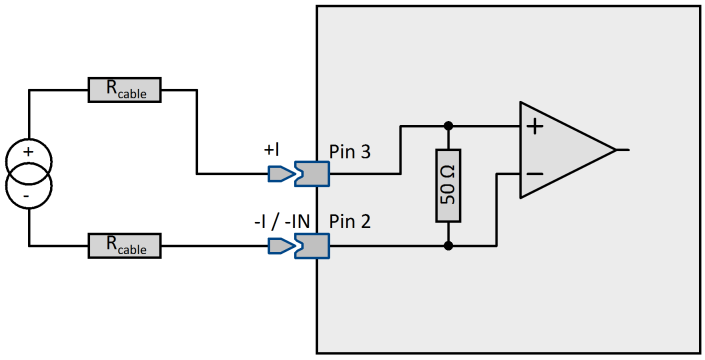
Reference

The corresponding measurement ranges of the HISO-HV4 can be found in the chapter Technical Data 524.



configuration for the HISO-HV4

9.4.2 Current measurement



configuration for current measurement

Measurement ranges:
±20 mA, ±10 mA

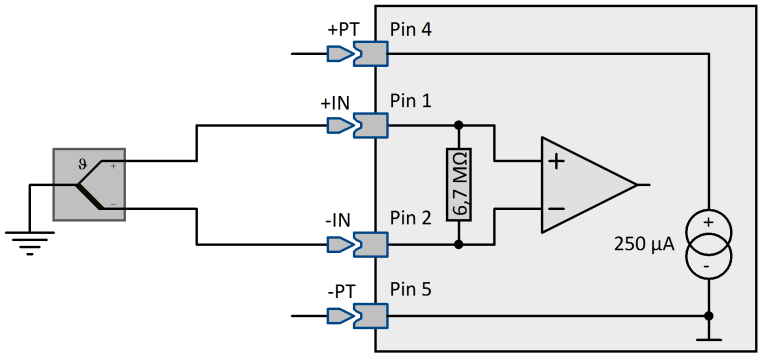
The current is measured via an internal 50 Ω shunt. The current signal has to be connected to +I and -IN / -I.

9.4.3 Temperature measurement

The input channels are designed for direct connection of thermocouples and PT100 / PT1000 sensors.

The **unit** in ° **Celsius** or **Fahrenheit** is set via the *Input range* of the channel.

9.4.3.1 Thermocouple measurement



configuration for thermocouples

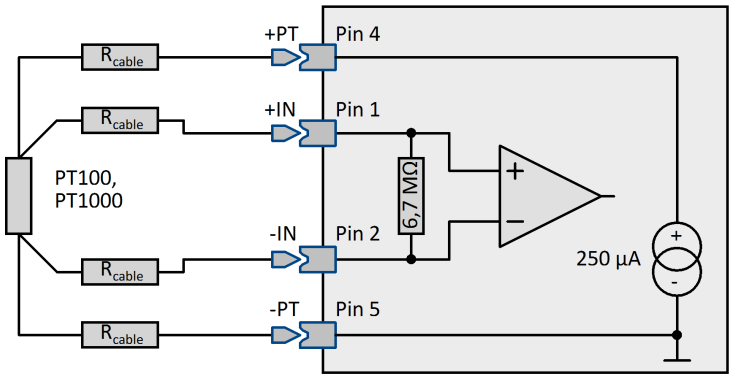
Temperature ranges:
-270°C to +1370°C
-50°C to +400°C
-50°C to +150°C

Thermocouple type K

Reference

Pin configuration HISO8-L (LEMO.1P) 601

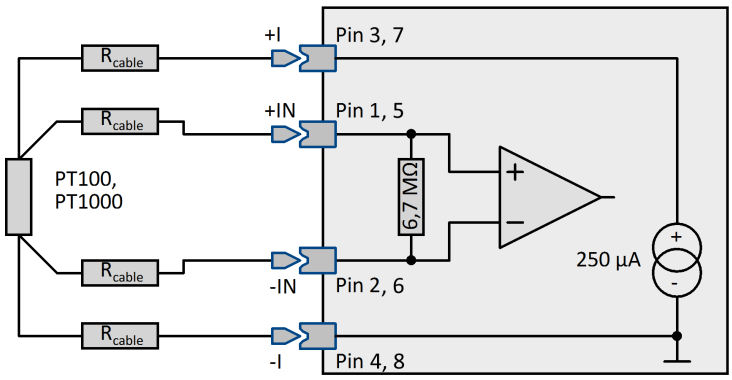
9.4.3.2 PT100, PT1000 (RTD) - Measurement



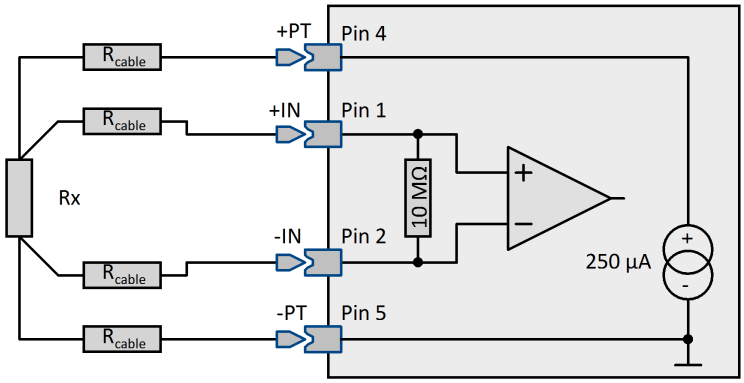
Measurement range:
-200°C to +850°C
-50°C to +150°C

A PT100 or a PT1000 sensor is connected in a 4-wire configuration. Each connected sensor is feed individually from a separate reference voltage supply.

Configuration for HISO8-4L module variant



9.4.4 Resistance measurement



Measurement ranges:

0 Ω to 1000 Ω
0 Ω to 500 Ω
0 Ω to 250 Ω
0 Ω to 150 Ω

Each resistor is fed by a separate current source with approx. 250 µA. The measurement uses 4-wire configuration. The resistor is supplied by two lines (+I, -I). The other two measurement inputs (+IN, -IN) serve as Sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

Open sensor detection:

The indicated measurement value changes to zero if the connection between +I and +IN is broken. If only the connection to the resistor at +IN is broken, the indicated value is the input range end value.

9.4.5 Bandwidth

The channels' **max. sampling** rate is 1 kHz (1 ms). The **analog bandwidth** is 440 Hz (-3 dB).

9.4.6 Filter

The filter settings can be made for each channel separately.

Off: Last sampled value of a sample interval (output rate).

Mean value (averaging): The output value is averaged by (Sampling interval[ms] / 1 ms) samples. For temperature measurement, only this function is available.

Butterworth: The input signal is filtered by a Butterworth low pass filter 2nd order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals ≥2 s only the mean value function will be used.

Bessel: The input signal is filtered by a Bessel low pass filter 2nd order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals ≥2 s only the mean value function will be used.

9.4.7 Connection

Reference

- pining HISO8-T-2L, HISO-T-8-2L 602 LEMO.2P socket;
  separate document for matching cable: TD_ACC-CABLE-4HV-T.en
- pining HISO8-T-8L 601 LEMO.2P socket; separate document for matching cable: TD_ACC-CABLE-HV-T.en
- pining HISO8-L 601 LEMO.1P socket; separate document for matching cable: TD_ACC-CABLE-HV-L1P.en
- pining HISO8-4L 601 LEMO.2P socket; separate document for matching cable: TD_ACC-CABLE-2HV.en

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9.5 µ-CANSAS

As a CAN bus based measurement engineering tool, the imc µ-CANSAS offers a selection of miniaturized measurement modules which process and digitize 1-channel sensor signals and output these as CAN messages.

Field of application

- For test rigs, vehicle testing, road trials and all-purpose measurement applications
- Deployable both in decentralized, distributed and in centralized measurement setups
- Operable with CAN-interfaces and CAN-data loggers from either imc or 3rd-party suppliers

Type	Module name imc CANSAS/	Channels per module	Max. sampling rate per channel	Bandwidth	Remarks
Voltage	µ-CAN-V1 403	1 / 4	2 kHz	840 Hz	
Temperature	µ-CAN-T1 411	1 / 4	100 Hz	20 kHz	
Bridge	µ-CAN-B1 413	1 / 4	2 kHz	840 Hz	

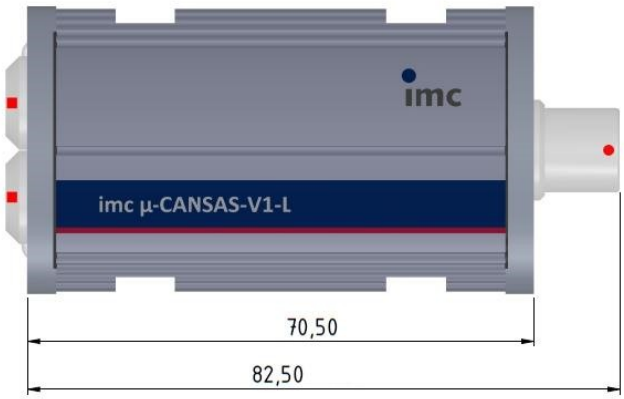
Reference

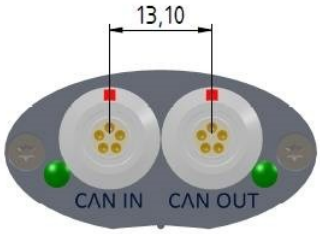
Please find here the description of the µ-CANSAS LED blink codes 221.

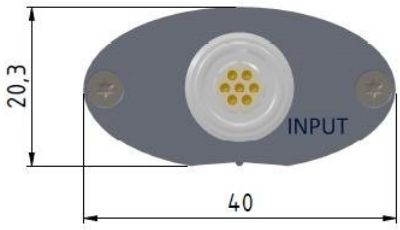
9.5.1 µ-CANSAS-V1

1-channel voltage measurement amplifier

The single-channel module imc µ-CANSAS-V1 was designed to be used in very warm environments. It serves to capture voltages ranging from ±100 mV to ±60 V. The module provides a sensor supply voltage of 5 V or 10 V. Interference frequency components can be canceled by means of various filter types. The zero-taring capability enables the module to compensate for offsets.







Overview of the available variants:

Order Code	Article No.	Housing	Signal-connector	CAN-connector
CAN/µ-V1-AS	11600009	µ-CANSAS profile	1x 8-pin Phoenix (MPT0,5/8) with waterproof cable grommet	1x 6-pin Autosport (AS208-35PA)
CAN/µ-V1-L [1]	11600002	µ-CANSAS profile	1x 7-pin LEMO.HGG.1B.307	2x 5-pin LEMO.HGG.0B.305

[1] CAN/µ-V1-L modules that are delivered before October 2015 are equipped with an 8-pin Phoenix (MPT0,5/8) terminal strip with waterproof cable grommet.

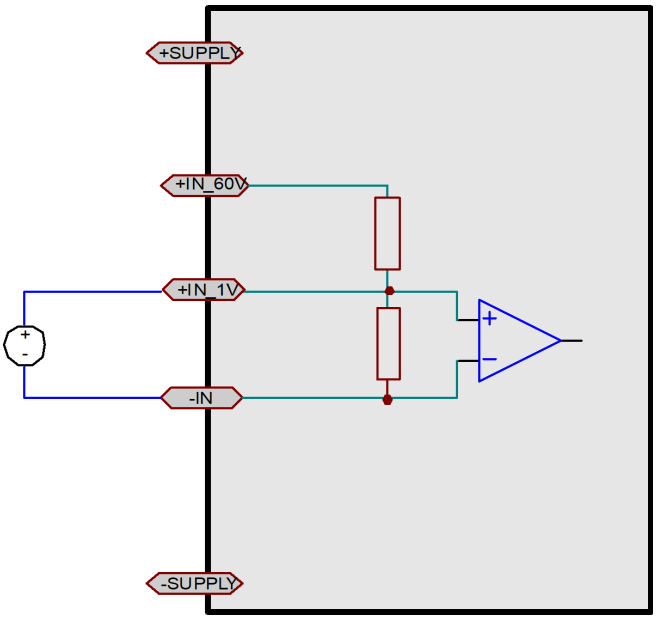
Notes

- Synchronization is performed exclusively as Slave according to the CAN1-protocol and is provided under the node Special functions.
- Connection depends on input range either via +IN_60 V with divider (2..60V) or via +IN_1 V without divider (0,1..1V) and -IN_COM
- Beside working with CAN bus per default, the module is also configurable as CANopen® module.
- The functions of the LEDs are described in section imc CANSAS blinking 218 codes.
- Technical data imc µ-CANSAS-V1 568

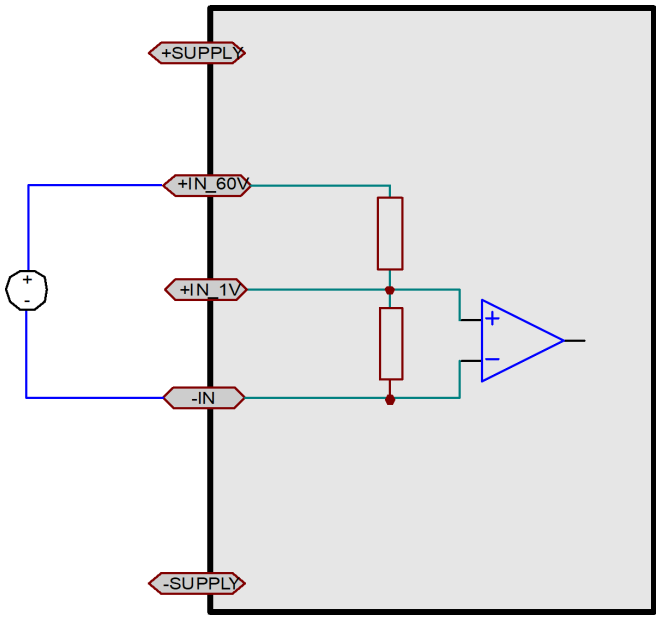
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9.5.1.1 Voltage measurement

- Voltage: ±60 V ... ±2 V connection via +IN_60 V and -IN_COM
- Voltage: ±1 V ... ±100 mV connection via +IN_1V and -IN_COM



Connection diagram for voltage up to ± 1V



Connection diagram for voltage > ± 1V

The differential input impedance for measurement of voltages from ±60 V to ±2 V is 900 kΩ; for measurement of voltages from ±1 V to ±100 mV it is 5 MΩ. The input is DC-coupled. The differential behavior is achieved due to the insulated design.

Note

For voltage measurement in which zero-balancing (taring) is not permitted, the setting No function should be selected as the status display for For "Not balanced" in the LED dialog. Otherwise, the setting for the selected LEDs' behavior in normal operation mode is not displayed.

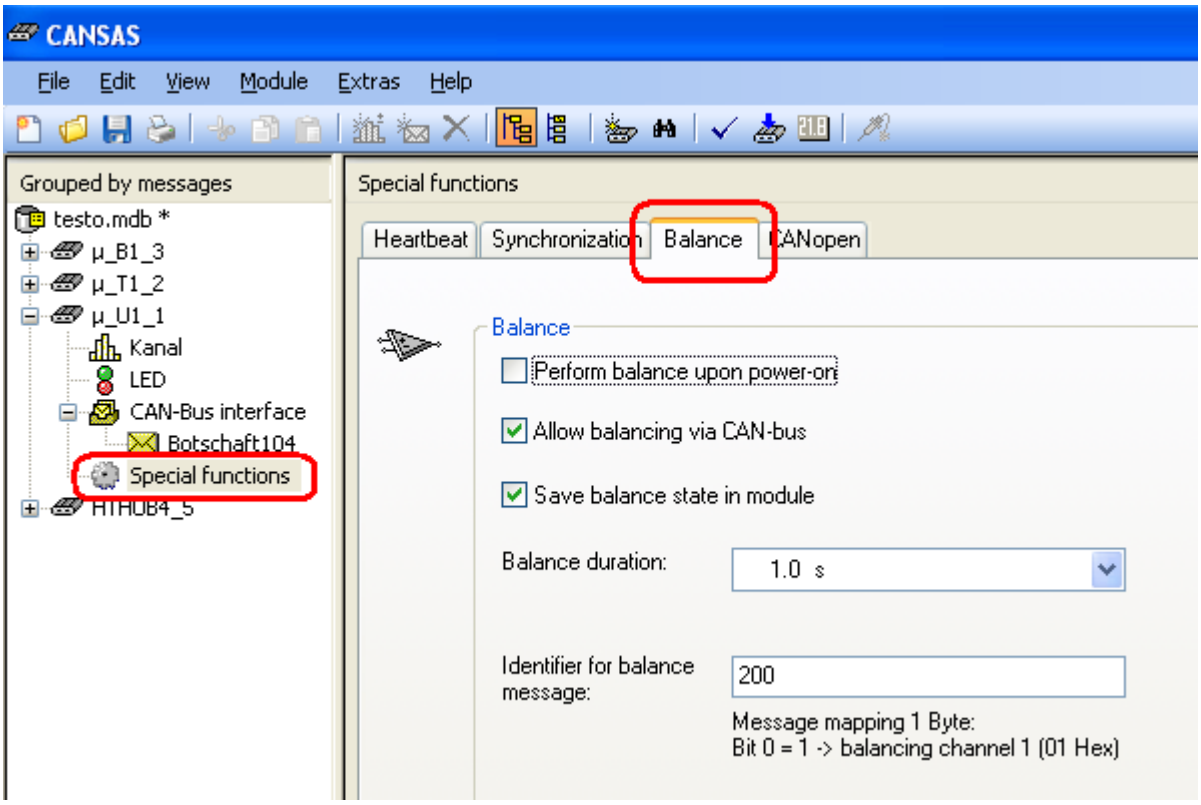
9.5.1.2 Voltage measurement: With zero-adjusting

In the measurement mode Voltage: allow zero-balance it is possible to perform balancing (taring) of the value measured. This is accomplished either by means of the channel menu command *Perform balancing for selections* in the Measurement window or on the page *Balance* under the module node Special Functions. The initial offset may be many times the input range. If the initial offset is too large for compensation by the device, a larger input range must be set.

Input range	Compensable initial offset*	Input range	Compensable initial offset*
±50V	20V	±1V	0,17V
±20V	15V	±0,5V	0,09V
±10V	7V	±0,2V	0,09V
±5V	12V	±0,1V	0,19V
±2V	15V		

*The maximum initial unbalance is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 50 V is 70 V and the one for the 20 V setting is 35 V, then the resulting possible initial unbalance is 20 V in the 50 V input range and 15 V in the 20 V input range.

The Balance dialog is located in the node Special Functions. It enables automatic balancing each time the device is activated. You can also store the balancing values in the module permanently, so that they are not lost as soon as the device is deactivated. It is also possible to perform a balancing procedure at a specific point in time as desired.



µ-CANSAS-V1: balancing dialog

Save balance state in module:

This optional setting provides that the balancing values are not lost once the device is deactivated.

Balance duration:

Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

Identifier:

A message to perform balancing must bear the identifier set here.

9.5.1.2.1 Balance upon power-up

Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

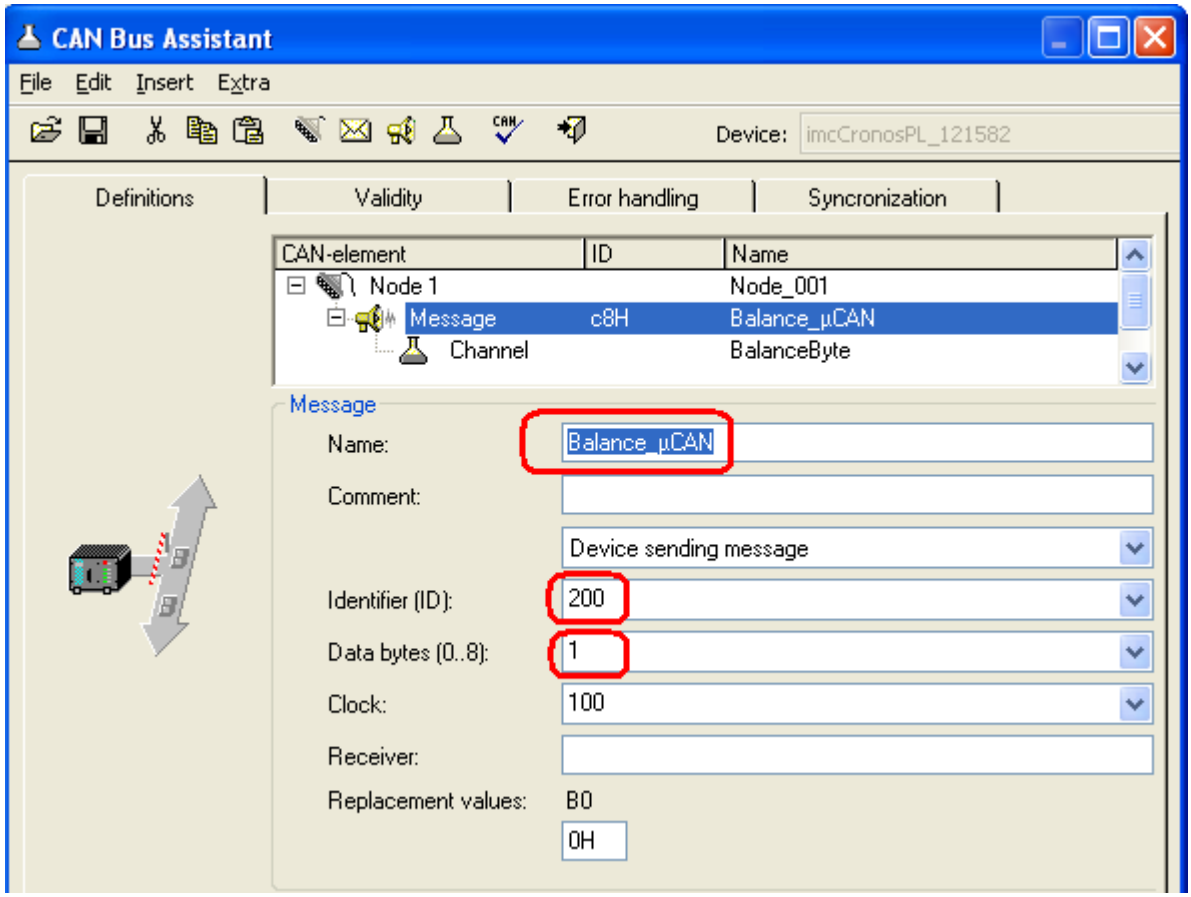
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9.5.1.2.2 Activating balance via CAN bus

This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option *Save balance state in module*, since in that case the balancing value remains intact even after deactivation.

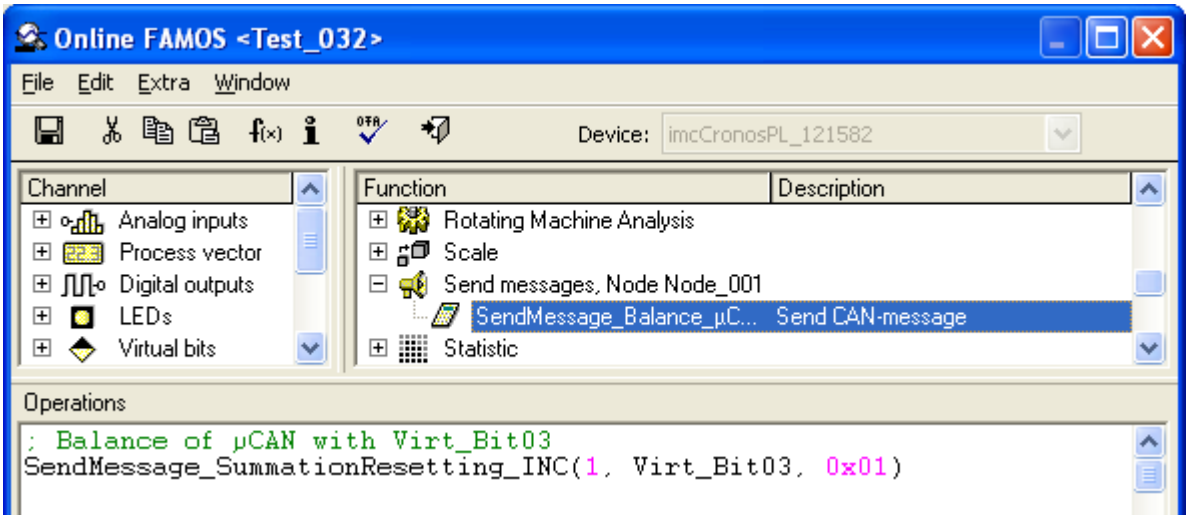
Example: Identifier for message to perform balancing = 200.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN-Assistant

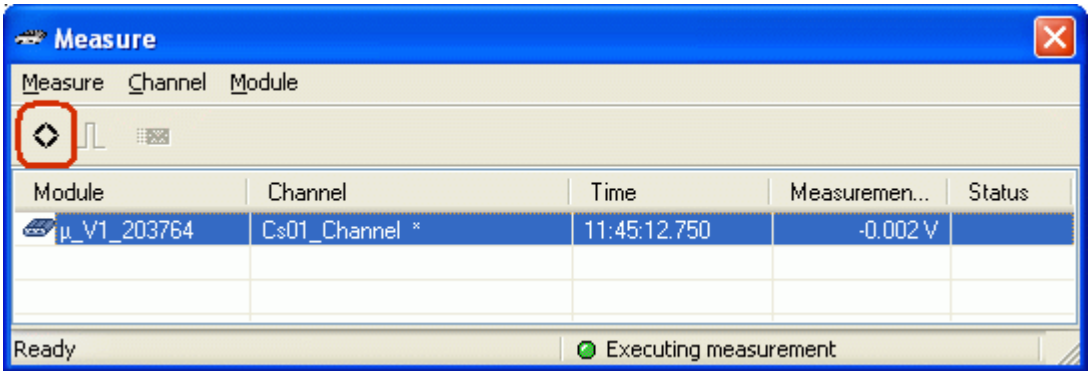
2. imc Online FAMOS sends a message if the virtual bit Bit03 is set. In the data byte, the value 01Hex is transmitted.



Balancing message in imc Online FAMOS

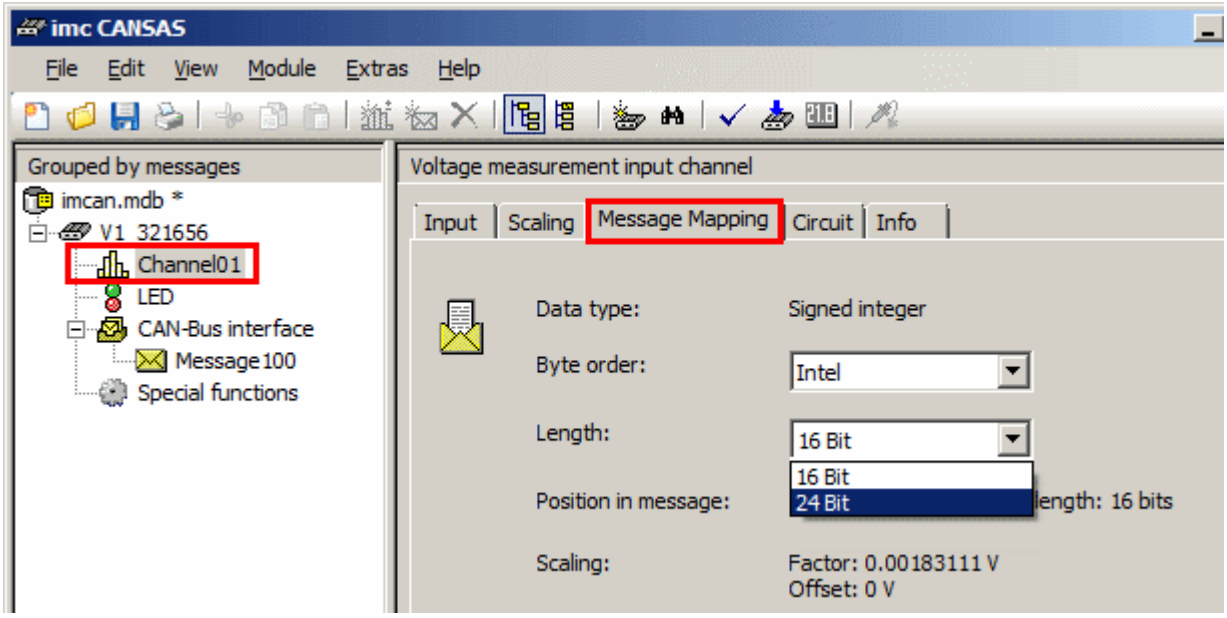
9.5.1.2.3 Voltage balancing via measurement window

In the measurement window, the balancing is performed by selecting the channel and touching the *Balance* button. Alternatively, the *Channel* menu offers the command *Perform balancing for selections.*



µ-CANSAS-V1: voltage balancing via measurement window

9.5.1.3 Message Mapping



µ-CANSAS Message Mapping

The modules belonging to the imc µ-CANSAS group work with a maximal resolution of 24 bits. Be aware that with **µ-CANSAS** modules, no scaling is taken into account if 32-bit resolution was selected. As of CANSAS Software version 2.0 R8 the *message mapping* page will not offer a message length of 32 Bit any more. In former software versions this option was available but not supported.

If the values from four imc µ-CANSAS modules are to fit into one message, then a channel's length is limited to 16 bits. Since a message can transport a maximum of 8 data bytes, this amounts to only 2 bytes per channel. If 24 bits per channel are to be used, at least two messages must be created for four channels

9.5.1.4 External Supply voltage +5 V/+10 V (isolated)

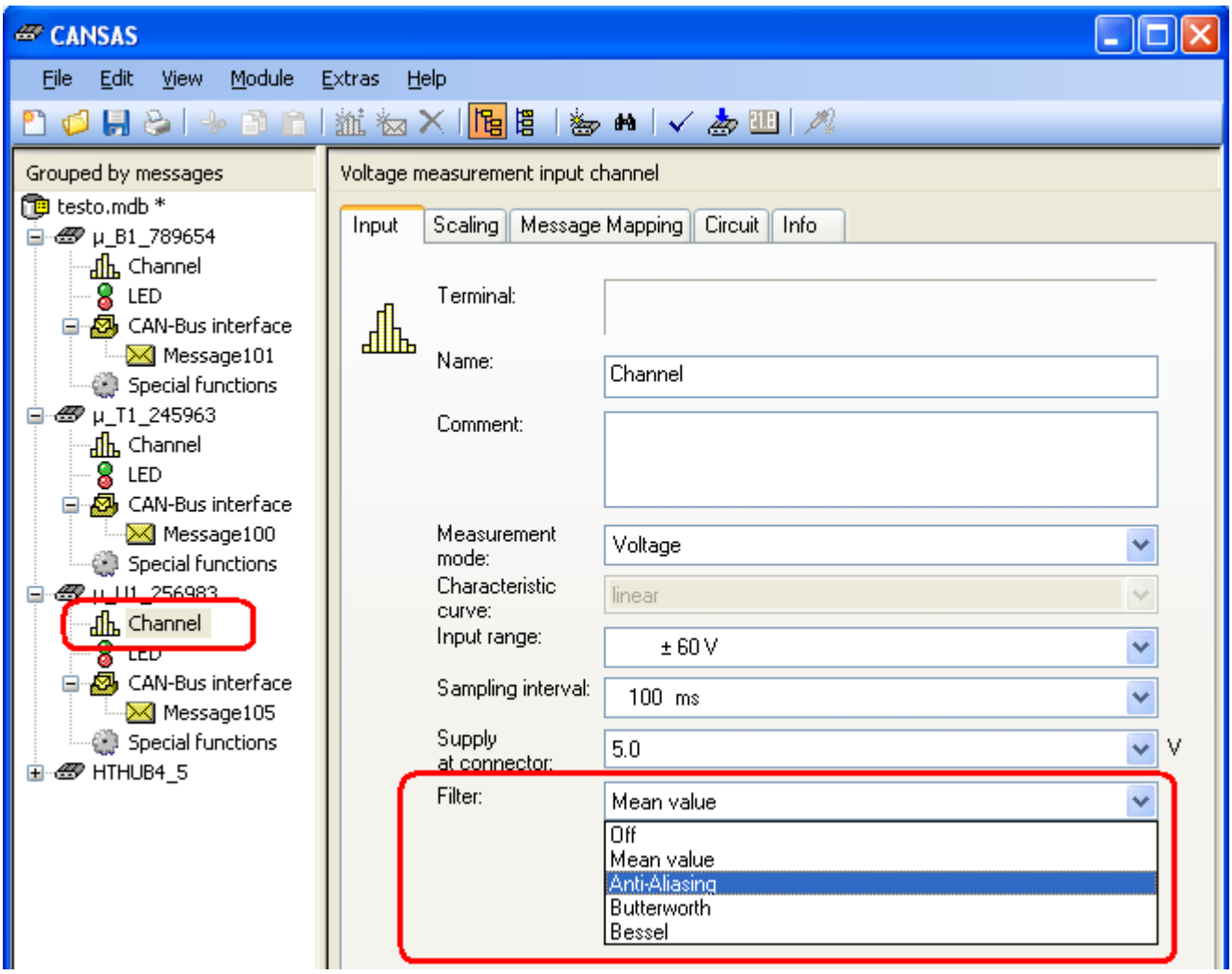
At the imc µ-CANSAS-V1's connection terminals, a supply voltage which is software-adjustable to either **+5 V** or **+10 V** is available for external sensors. This source is insulated and is connected via the contacts +SUPPLY and -SUPPLY.

Internally, this +5 V/+10 V supply output is electronically **protected** from short-circuiting and can carry a maximum load of **210 mW**.

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9.5.1.5 Sampling interval, filter

For imc µ-CANSAS-V1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the imc µ-CANSAS-V1 extends from 60 s to 0.5 ms.



µ-CANSAS-V1 Filter settings

Off: Output of the last value sampled at the output clock rate set

Mean value: The output value is the mean value over (output clock rate [ms] / 500 µs) values.

Anti-Aliasing-Filter: Low-pass filtering of the input signal with critical damping characteristics, 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at the 0.5 ms output clock rate)

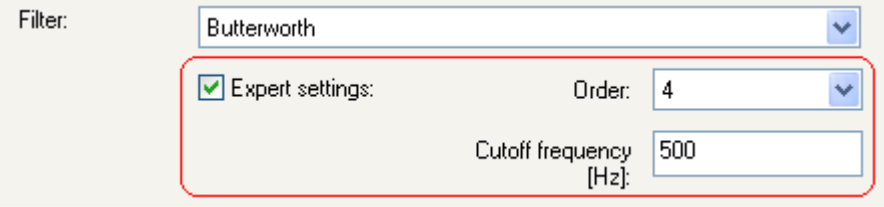
Butterworth: Filtering of the input signal with Butterworth characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0.5 ms output rate). At output intervals ≥ 2 s, an averaging filter is automatically used.

Bessel: Filtering of the input signal with Bessel characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0.5 ms output rate). At output intervals ≥ 2 s, an averaging filter is automatically used.

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Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured. The Expert Settings are only available for the filter types Butterworth and Bessel.



µ-CANSAS-V1: Expert Settings Filter

Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0.002 Hz	400 Hz
	2	0.008 Hz	400 Hz
	3	0.009 Hz	380 Hz
Butterworth	1	0.002 Hz	400 Hz
	2	0.02 Hz	400 Hz
	3	0.02 Hz	400 Hz

Note

Please note the hint concerning double values with imc CANSAS modules and imc STUDIO 48.

9.5.1.6 µ-CANSAS-V1 connection

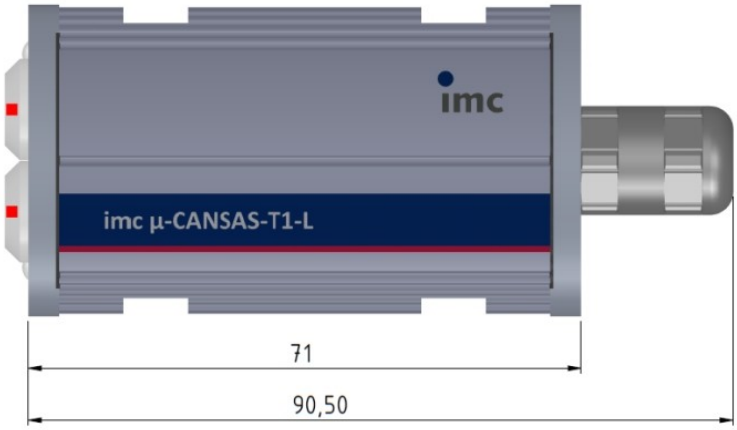
Available module variant	signal (sensor) connection	CAN bus connection
CAN/µ-V1-AS	1x 8-pin Phoenix	1x 6-pin Autosport 581
CAN/µ-V1-L delivered before OCT 2015	1x 8-pin Phoenix	2x 5-pin LEMO 0B 582
CAN/µ-V1-L delivered after OCT 2015	1x LEMO.HGG.1B.307 600	2x 5-polig LEMO 0B 582

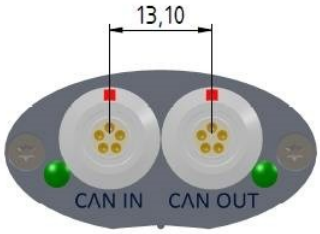
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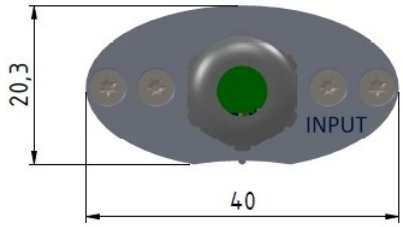
9.5.2 µ-CANSAS-T1

1-channel temperature measurement amplifier

imc µ-CANSAS-T1 is a 1-channel differential measurement amplifier with 24-bit A/D-conversion for temperature measurements. The conditioned and digitalized signal from analog sensors can be outputted as a CAN- or CANopen® signal. **imc µ-CANSAS-T1** is particularly designed for use in extremely warm environments.







Overview of the available variants

Order Code	Article No.	Housing	Signal- connector	CAN- connector
CAN/µ-T1-AS	11600008	µ-CANSAS profile	1x 8-pin Phoenix (MPT0,5/8) with waterproof cable grommet	1x 6-pin Autosport (AS208-35PA)
CAN/µ-T1-L	11600001	µ-CANSAS profile	1x 8-pin Phoenix (MPT0,5/8) with waterproof cable grommet	2x 5-pin LEMO.HGG.0B.305

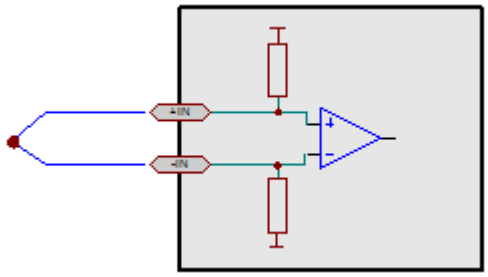
Notes

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node Special functions.
- Beside working with CAN bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section imc CANSAS blinking 218 codes.
- The **unit** in ° **Celsius** or **Fahrenheit** is made on the *Scaling* tab of the channel.

Technical data imc µ-CANSAS-T1. 570

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9.5.2.1 Temperature measurement



µ-CANSAS-T1: Connection diagram

The imc µ-CANSAS-T1 is designed for direct temperature measurement with **thermocouples**; all commercially available thermocouple types 180, with their characteristic curves are supported. In contrast to the normal imc CANSAS modules the module imc µ-CANSAS-T1 is using the standard IEC584-1 / ITS90 to convert the voltage.

9.5.2.2 Open sensor detection

µ-CANSAS-T1 modules from June 2015 come with the ability to recognize breakage in the probe lines. In the technical data 570, the revisions are listed, from which the modules were equipped with this capability. In case of a breakage within a short time (only a few samples), the measurement signal generated by the module 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 sensor is broken, unless such temperatures could really occur at the measurement site.

The bottom of the input range will be displayed:

- if at least one of the ***thermocouple's*** two lines breaks
- if a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected.
- if the cold junction compensation is missing

9.5.2.3 Message Mapping

See chapter: Message Mapping for µ-CANSAS-V1 408.

9.5.2.4 Sampling interval, filter

For imc µ-CANSAS-T1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the imc µ-CANSAS-B1 extends from 60 s to 0.5 ms. With imc µ-CANSAS-T1, the following filter is set:

Mean value: The output value is the mean value over (output clock rate 211 [ms] / 500µs) values. For temperature measurement, only averaging filtering is available.

9.5.2.5 µ-CANSAS-T1 connection

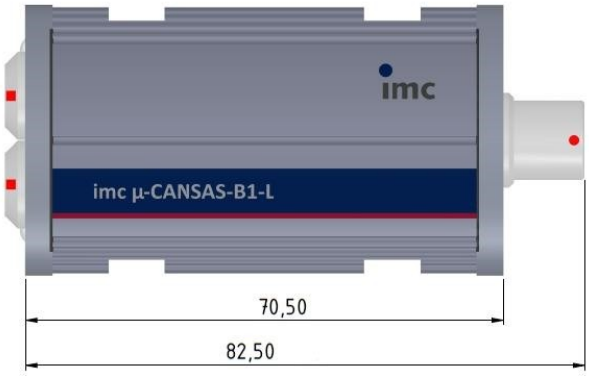
variant	signal (sensor) connection	CAN bus
µ-CAN-T1-AS	1x 8-pin Phoenix	1x 6-pin Autosport 581
µ-CAN-T1-L	1x 8-pin Phoenix	2x 5-pin LEMO 0B 582

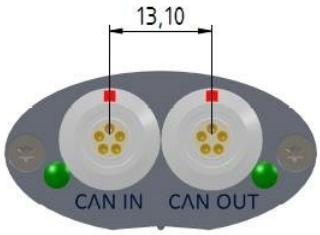
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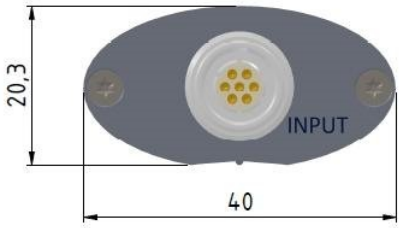
9.5.3 µ-CANSAS-B1

1-channel bridge amplifier

imc µ-CANSAS-B1 is a 1-channel differential measurement amplifier with 24-bit A/D-conversion for bridge measurements The conditioned and digitalized signal from analog sensors can be outputted as a CAN- or CANopen® signal. **imc µ-CANSAS-B1** is particularly designed for use in extremely warm environments.







Overview of the available variants

Order Code	Article No.	Housing	Signal-connector	CAN-connector
CAN/µ-B1-AS	11600010	µ-CANSAS profile	1x 8-pin Phoenix (MPT0,5/8) with waterproof cable grommet	1x 6-pin Autosport (AS208-35PA)
CAN/µ-B1-L [1]	11600003	µ-CANSAS profile	1x 7-pin LEMO.HGG.1B.307	2x 5-pin LEMO.HGG.0B.305
CAN/µ-H-B1	11600035	plastic DIN-Rail housing	plugable terminal block (Weidmüller)	plugable terminal block (Weidmüller)
CAN/µ-H-B1-2.5V	11600040	plastic DIN-Rail housing	plugable terminal block (Weidmüller) 610	plugable terminal block (Weidmüller)

[1] CAN/µ-B1-L modules that are delivered before October 2015, are equipped with one 8-pin Phoenix terminal block (Typ MPT0,5/8) with waterproof cable grommet.

Reference

Please find here a mechanical drawing 421 with dimensions of CAN/µ-H-B1 and CAN/µ-H-B1-2.5V.

The bridge channels of almost all B1 modules have a DC power source (5 V) for the power supply of the measurement bridge. µ-H-B1-2.5V works with 2.5V bridge power supply.

Note

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node Special functions.
- Beside working with CAN bus per default, the module is also configurable as CANopen® module.
- The functions of the LEDs are described in section imc CANSAS blinking 218 codes.
- Function "**Identifier for balance message**" (page "**Special functions**": "**Balance**"): the maximum identifier for the message is 2047, even if the module was configured for the extended identifier.

Technical data imc µ-CANSAS-B1. 571

9.5.3.1 DC-bridge measurement

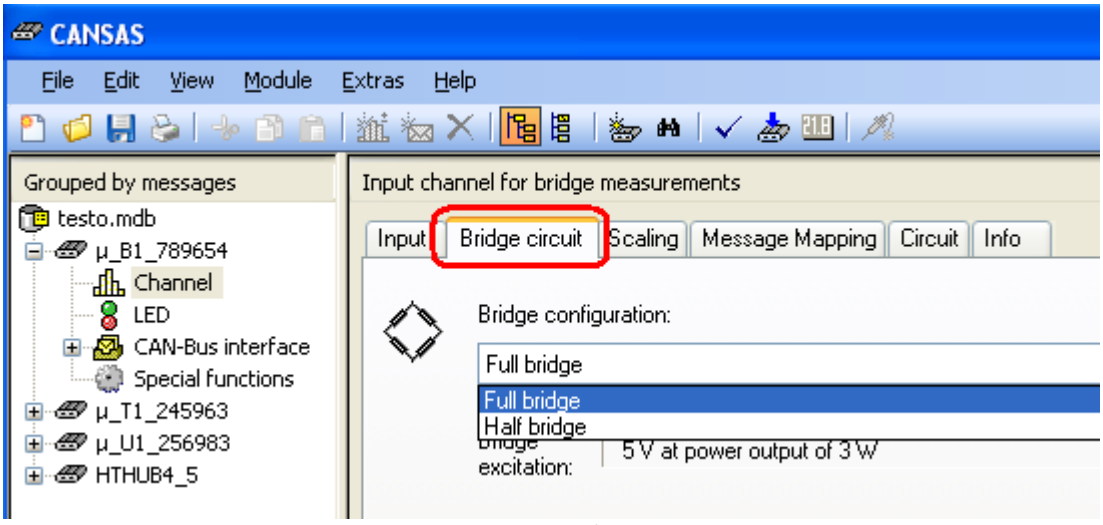
The current carrying capacity of the imc CANSAS module's voltage source allows the connection of **120 Ω measurement bridges in all input ranges**.

The **Sense-terminal** provides compensation of voltage dissipation along long cables, which would otherwise cause noticeable measurement errors. If only plain cables are available, so that it is not possible to connect the Sense-line directly to the sensor, then **in all cases, +Sense must be connected** with **+VB** and **-Sense with -VB** at the terminal connector.

Bridge measurements are relative measurements (**ratiometric procedure**), in which there is an evaluation of what fraction of its supply input the bridge outputs (typically in the 0,1% range, corresponding to 1 mV/V). Calibration of the system is based on this ratio, the bridge input range. This means that the **actual magnitude of the bridge supply** does not matter and need not necessarily lie within the measurement's rated total accuracy.

The following bridge types can be used as sensors with imc µ-CANSAS-B1:

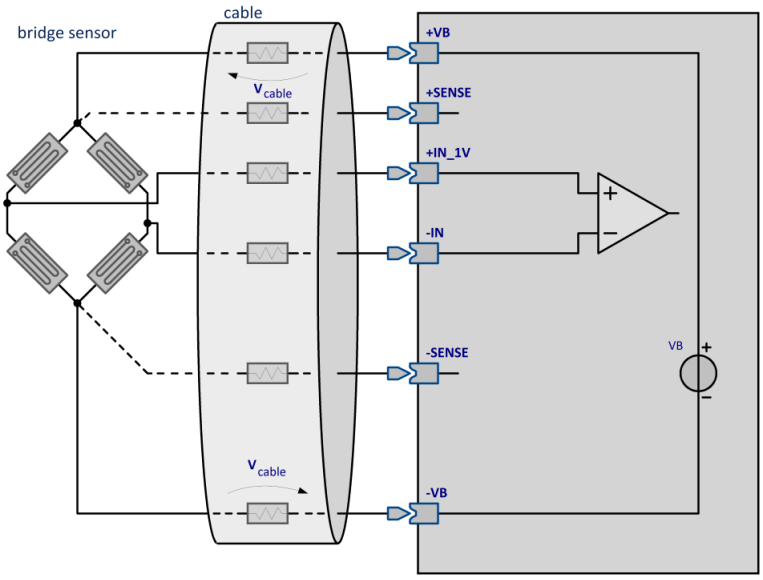
- Full bridge
- Half bridge



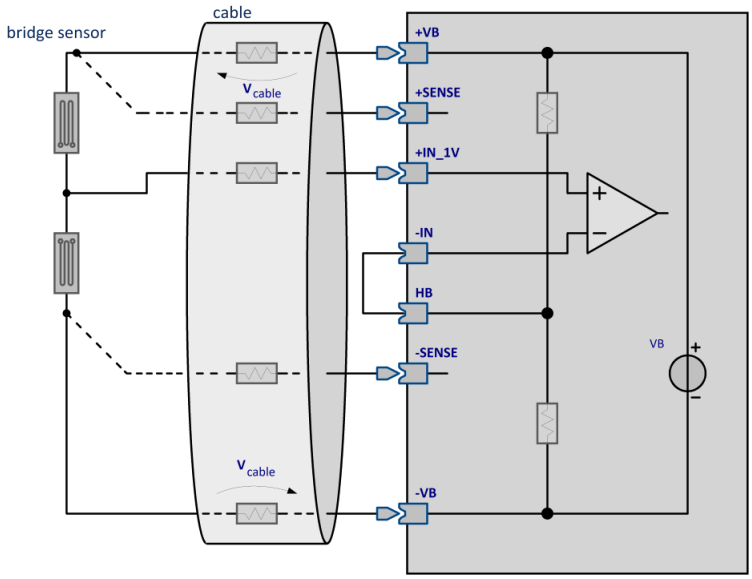
µ-CANSAS-B1: Bridge circuit

When using strain gauges, all common positioning arrangements are available options for the module.

9.5.3.2 Full bridge



9.5.3.3 Half bridge



In many applications the sensor only comprises half of the full bridge, in other words two opposed variable resistors. The other half must be completed using a (highly constant) symmetric resistant conductors. With the imc µ-CANSAS bridge channel, this half-bridge completion is already available as a **pre-configured internal circuit**. It has an external contact "HB" at the terminal connector and only needs to be connected with the input pin -IN by means of a **wire jumper**.

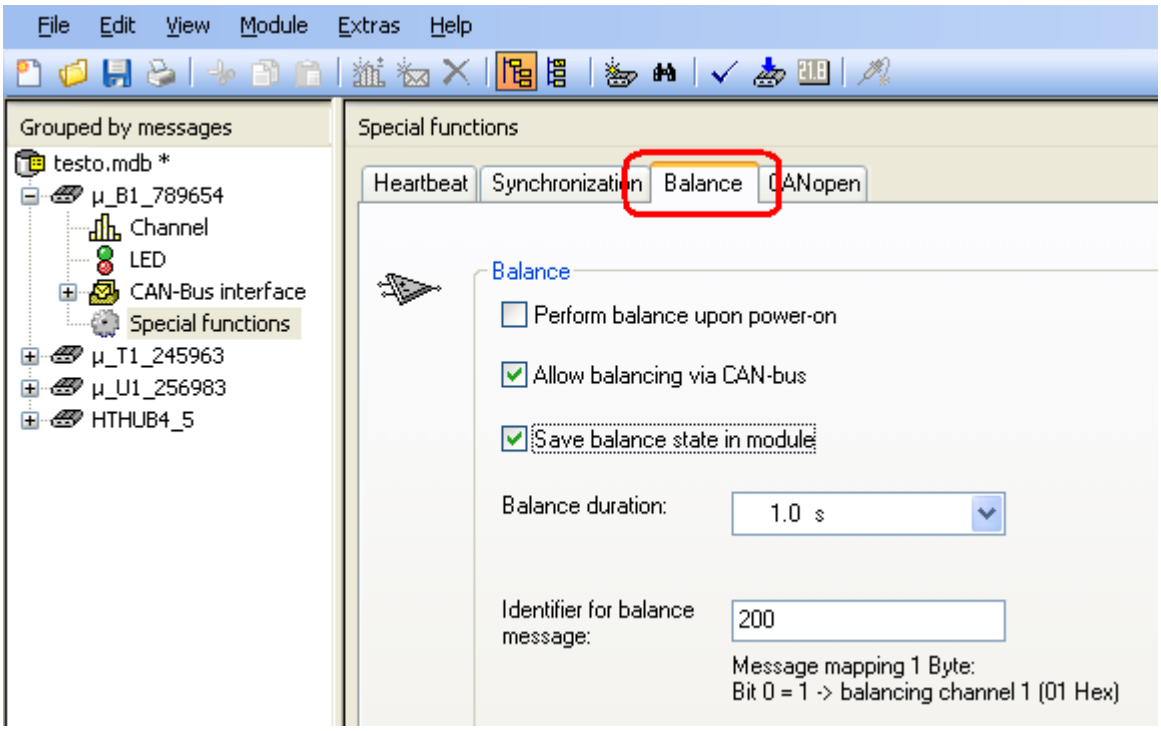
Warning when measuring full bridge take away the jumper

For a full bridge measurement, the wire bridge (*jumper*) between pin 13 (-IN) and pin 14 (HB) **must be removed again**.

Input ranges - full and half bridge:

- Voltage: ±200 mV/V ... ±0,5 mV/V connected at +IN_1V and -IN

9.5.3.4 Bridge balancing



µ-CANSAS-B1: Balancing dialog

With imc µ-CANSAS-B1, there are a variety of ways to perform balancing:

- Bridge balancing upon power-up 417 automatically balances out the zero offset as soon as the module is activated.
- With Perform bridge balancing via the CAN bus 417, a CAN bus message initiates the balancing process.
- The balancing procedure is performed in the measurement window.

Save balance state in module:
This optional setting ensures that the balancing values are not lost once the device is deactivated.

Balance duration:
Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

Identifier:
A message to perform balancing must bear the identifier set here.

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. If the initial unbalance is too large to be compensated by the device, a larger input range must be set.

Input range [mV/V]	Bridge balancing*(VB = 5V) [mV/V]	*The bridge balancing is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 200 mV/V is 235 mV/V and the one for the 100 mV/V setting is 118 mV/V, then the resulting possible initial unbalance is 35 mV/V in the 200 mV/V input range and 18 mV/V in the 100 mV/V input range.
±200	-30/+35	
±100	-18/+19	
±50	-18/+19	
±20	-38/+39	
±10	-45/+45	
±5...±0.5	-50/+50	

9.5.3.4.1 Bridge balancing upon power-up

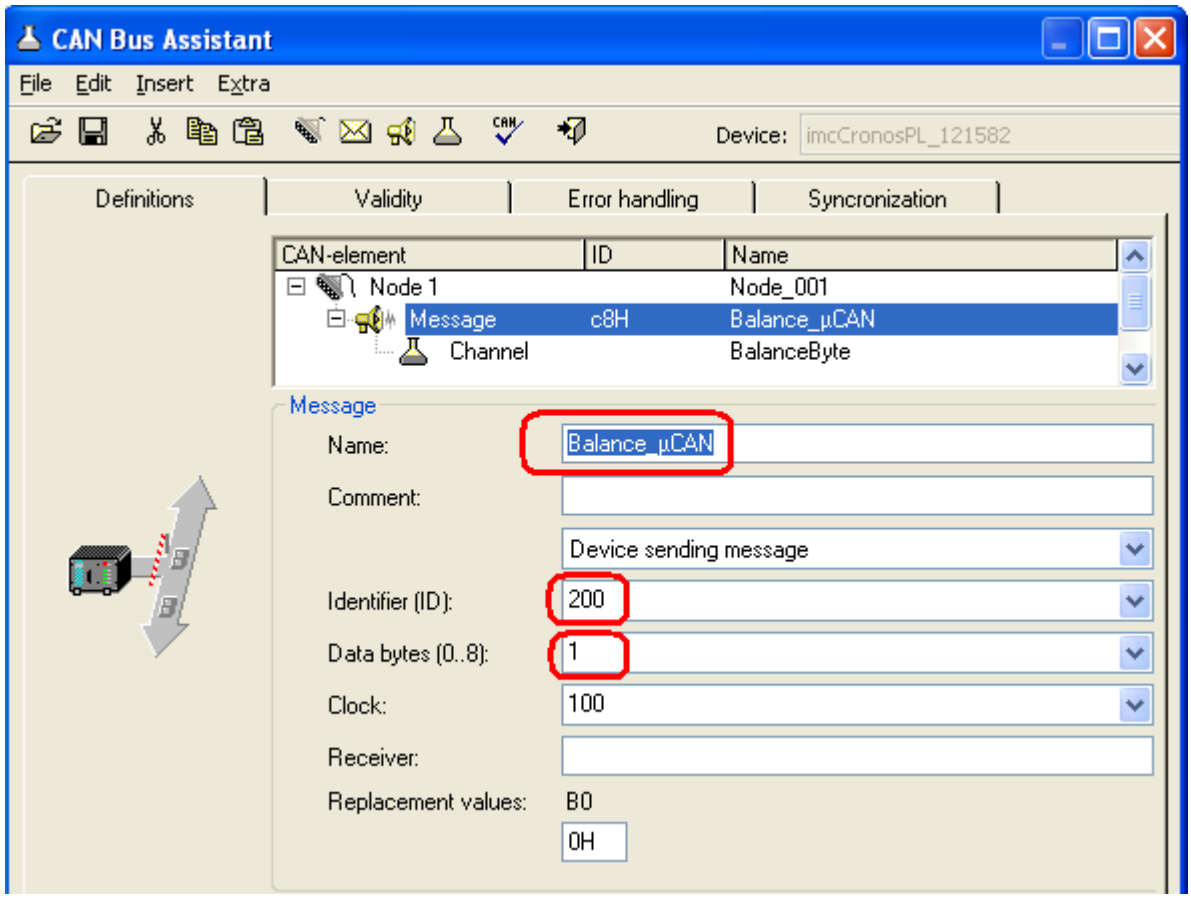
Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

9.5.3.4.2 Perform bridge balancing via the CAN bus

This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option Save balance state in module, since in that case the balancing value remains intact even after deactivation.

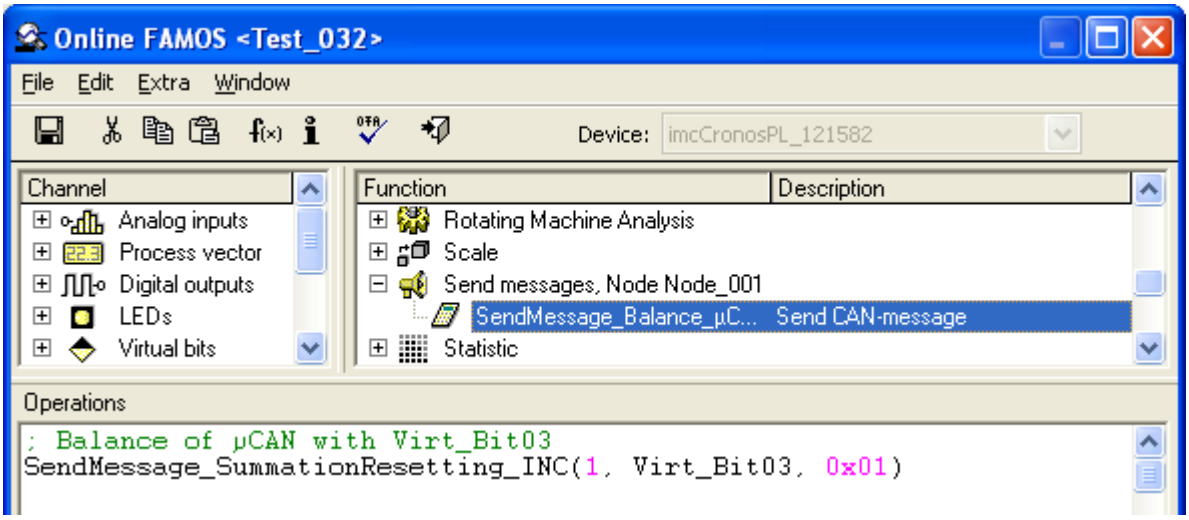
Example: Identifier for message to perform balancing = 200.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN Assistenten

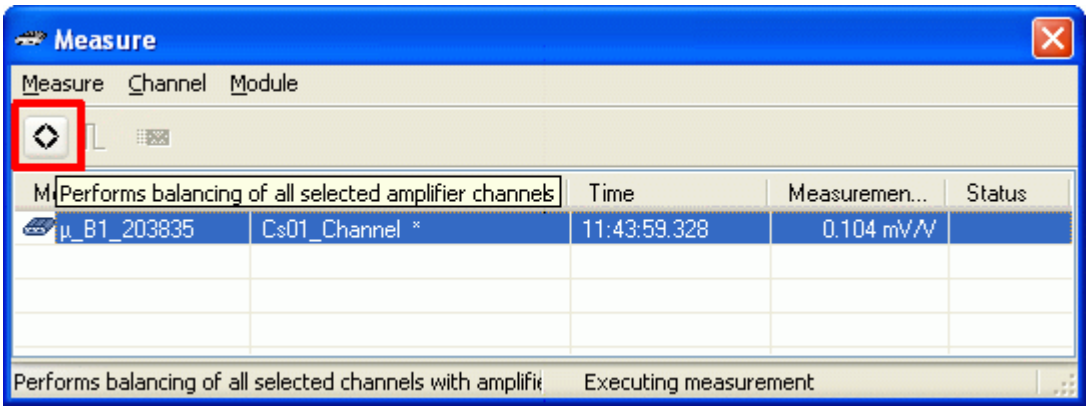
2. imc Online FAMOS sends a message if the virtual bit Bit03 is set. In the data byte, the value 01Hex is transmitted.



Balancing message in imc Online FAMOS

9.5.3.4.3 Balancing in the measurement window

In the measurement window, the balancing is performed by selecting the *channel* and touching the *Balance* button. Alternatively, the Channel menu offers the command *Perform balancing for selections.*



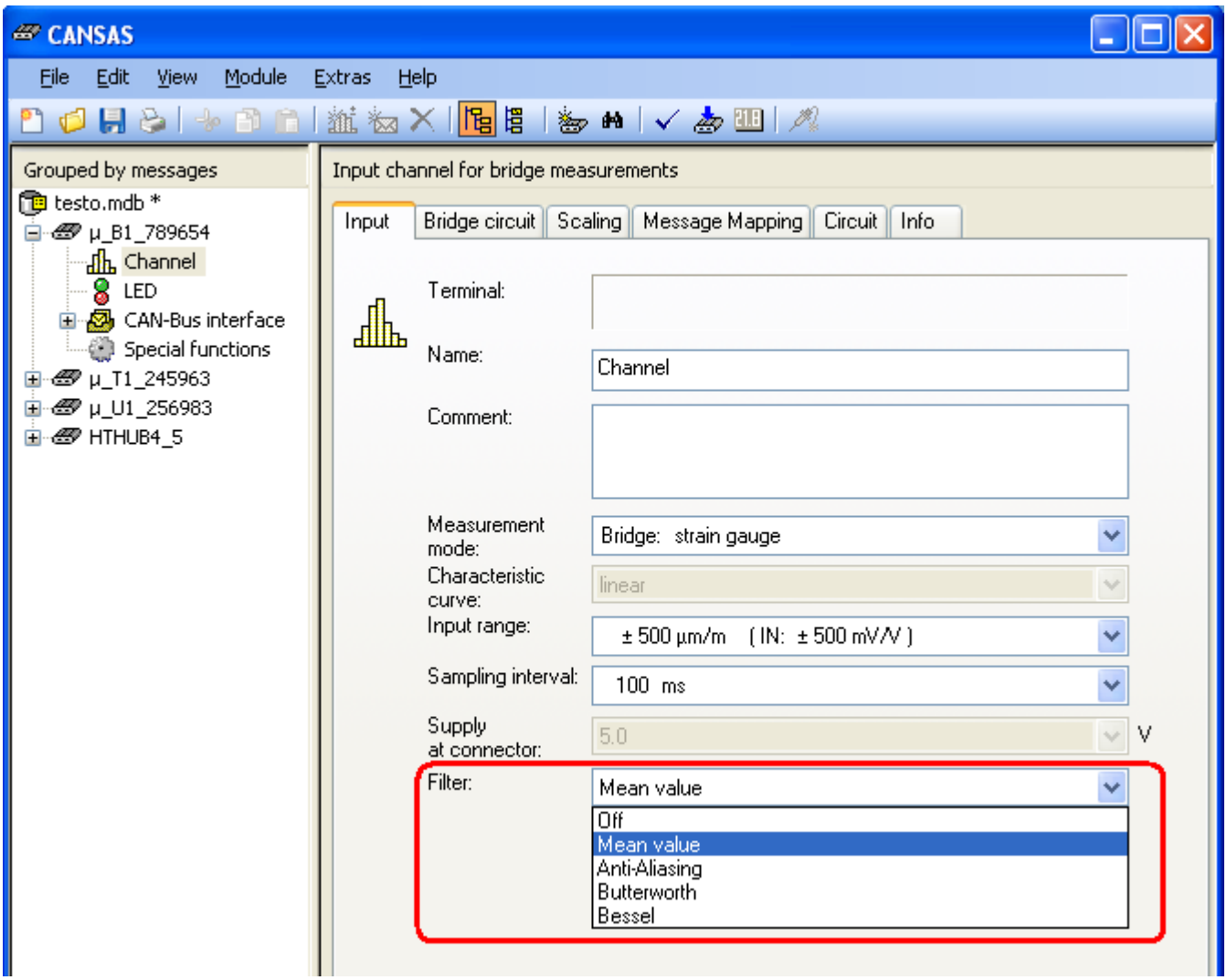
µ-CANSAS-B1: voltage balancing via measurement window

9.5.3.5 Message Mapping

See chapterMessage Mapping for µ-CANSAS-V1 408.

9.5.3.6 Sampling interval, filter

For imc µ-CANSAS-B1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the imc µ-CANSAS-B1 extends from 60 s to 0.5 ms.



µ-CANSAS-B1 Filter settings

The following filter are available:

Off: Output of the last value sampled at the output clock rate 211 set

Mean value: The output value is the mean value over (output clock rate [ms] / 500 µs) values. For temperature measurement, only averaging filtering is available.

Anti-Aliasing-Filter: Low-pass filtering of the input signal with critical damping characteristics, 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at the 0.5 ms output clock rate)

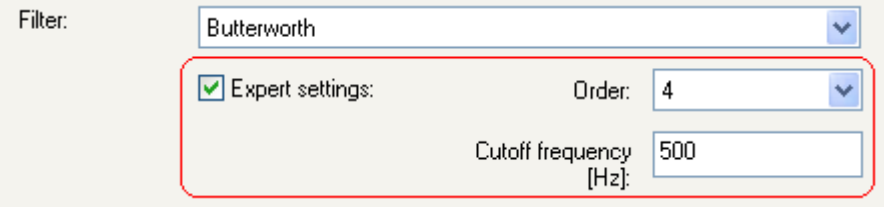
Butterworth: Filtering of the input signal with Butterworth characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0.5 ms output rate). At output intervals >= 2 s, an averaging filter is automatically used.

Bessel: Filtering of the input signal with Bessel characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0.5 ms output rate). At output intervals >= 2 s, an averaging filter is automatically used.

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Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured. The Expert Settings are only available for the filter types Butterworth and Bessel.



µ-CANSAS-B1: Expert Settings Filter

Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0,002 Hz	400 Hz
	2	0,008 Hz	400 Hz
	3	0,009 Hz	380 Hz
Butterworth	1	0,002 Hz	400 Hz
	2	0,02 Hz	400 Hz
	3	0,02 Hz	400 Hz

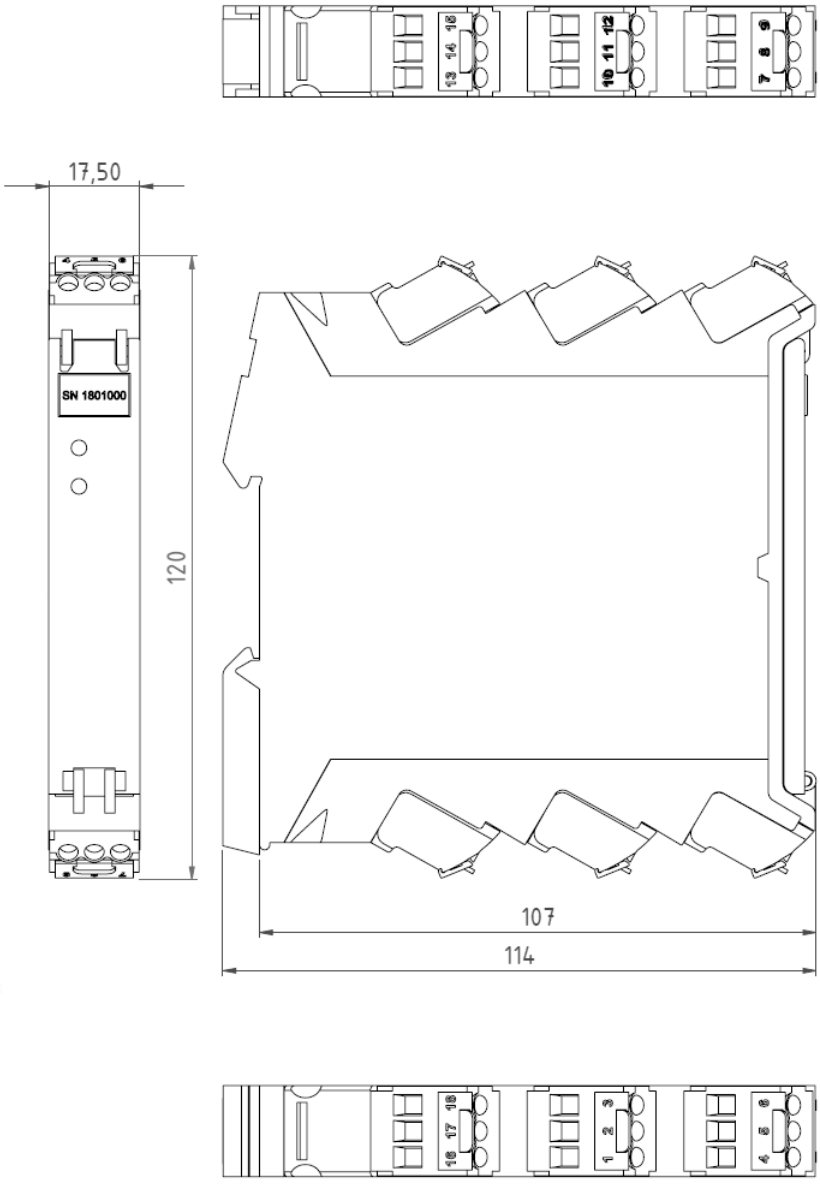
Note

Please note the hint concerning double values with imc CANSAS modules and imc STUDIO 48.

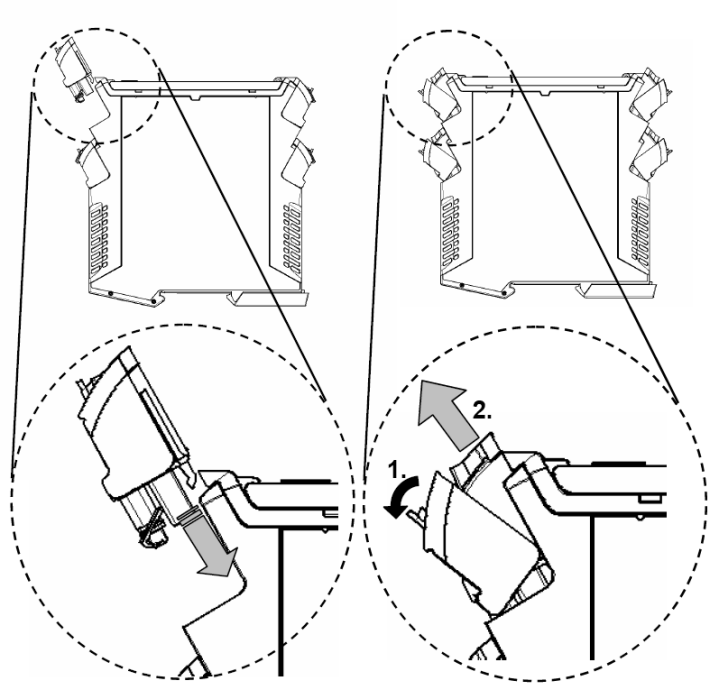
9.5.3.7 µ-CANSAS-(x-)B1(-x) connection

Module variant	signal (sensor) connection	CAN bus
µ-CAN-B1-AS	1x 8-pin Phoenix	1x 6-pin Autosport 581
µ-CAN-B1-L	1x 8-pin LEMO 600	2x 5-pin LEMO 0B 582
µ-CAN-H-B1	Weidmüller terminal block	Weidmüller terminal block
µ-CAN-H-B1-2.5V	Weidmüller terminal block	Weidmüller terminal block

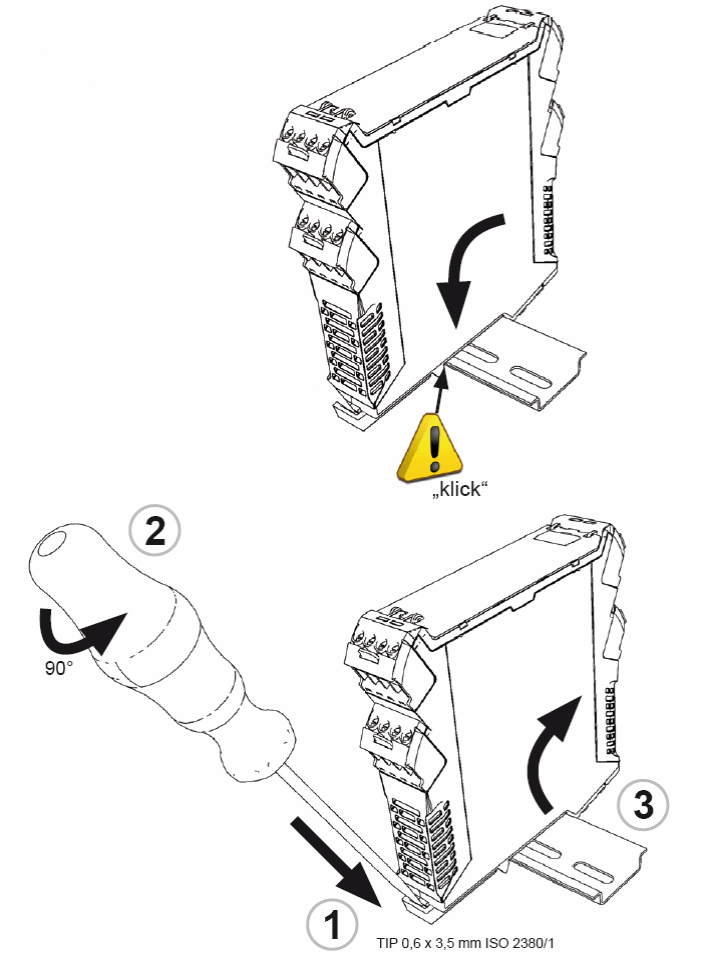
Dimension µ-CAN-H-B1 and µ-CAN-H-B1-2.5V



9.5.3.7.1 Plug and unplug the Weidmüller connector



9.5.3.7.2 DIN-Rail mounting



9.6 CANSAS other modules

imc CANSAS modules for further special application fields.

Type	Module name imc CANSAS/	Channels per module	Max. sampling rate per channel	Bandwidth	Remarks
Ignition angle measurement	IGN 424	3	200 Hz	500 kHz	
SENT sensors	SENT 452	8			
Current measurement with extremely high resolution	IHR 448	2	1 kHz		



imc CANSAS-IGN


imc CANSAS*flex* SENT


imc CANSAS-IHR

Minimum software version

Type	as of imc CANSAS version	CANopen® as of version	TEDS as of version	Remarks
IGN 424	1.7	-	-	
IHR der Rev. <8	1.9 R10	-	-	
IHR der Rev. ≥8	2.0 R7			
IHR-48V	2.0 R14			
IHR-48V-R	2.1 R7			
SENT 452	1.8	-	-	

9.6.1 IGN ignition angle measurement module

imc CANSAS-IGN is a module for determining the ignition angle of gasoline engines. The module has electrically insulated inputs for connecting the ignition signal, a crankshaft sensor and a reference signal, as well as any camshaft signal. Based on the ignition time and the crankshaft position, the module determines the ignition angle and the engine's current rotation speed.

Reference

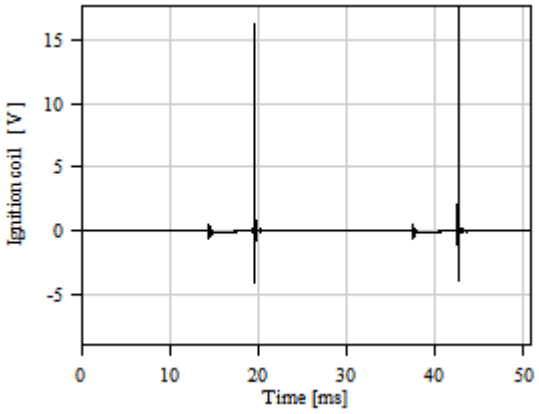
Technical Specs IGN 529

Ignition signal

The ignition signal is measured to determine the exact moment of ignition. Based on this time and the crankshaft position, the module determines the ignition angle.

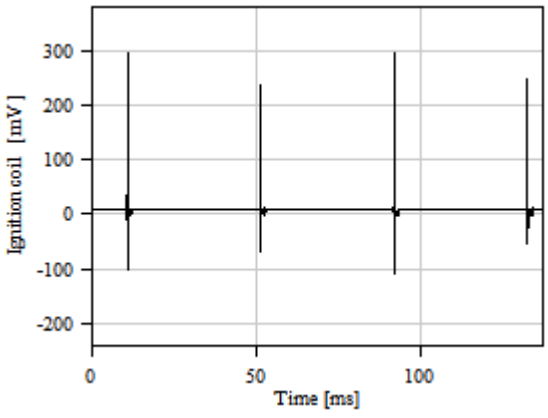
The ignition signal can be captured by**inductive transducers** (e.g. clamp ignition sensor).

The resulting signal contains the typical pointed and high pulses at the moment of ignition. The measurement is performed at the ignition coil's **secondary line**. The pulses can reach up to 100 V.



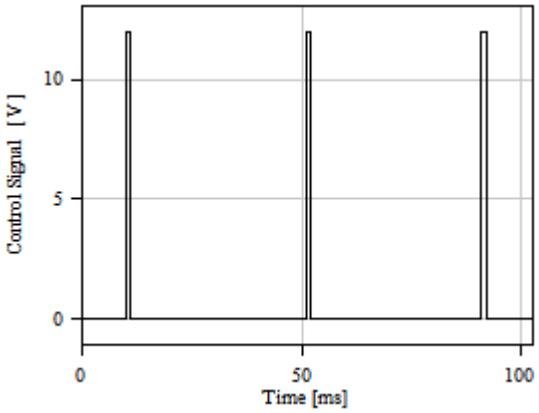
Ignition signal: High level

The ignition signal can also be captured at the ignition coil's **primary side** by means of a clamp ignition sensor. In that case the shape is similar, but the signal levels substantially lower:



Ignition signal: Low level

Direct signal capture at the control lines is also possible. In that case, this is generally a logic level:



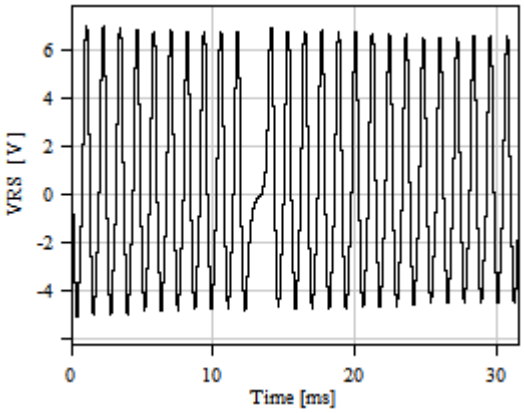
Ignition signal: Logic level

Crankshaft sensor

The reference angle is determined by means of a crankshaft sensor. The sensor determines the crankshaft's current position, in other words, its angle.

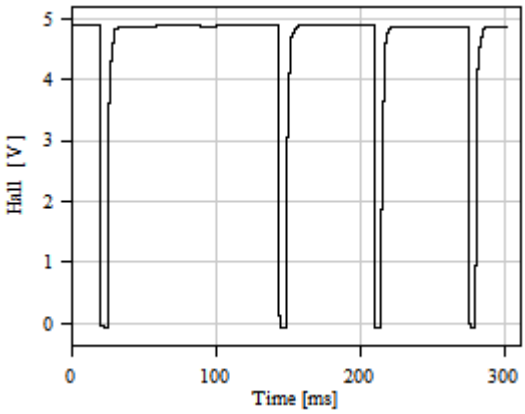
Possible sensors:

The typical case is an inductive approach sensor. this is the motor's own sensor working by the Variable Reluctance principle (VRS, variable reluctance sensor). The sensor samples the flywheel-cogwheel and returns one pulse per cog. Typically, one or two cogs will be missing to indicate the zero position. The signal's amplitude depends on the RPMs.



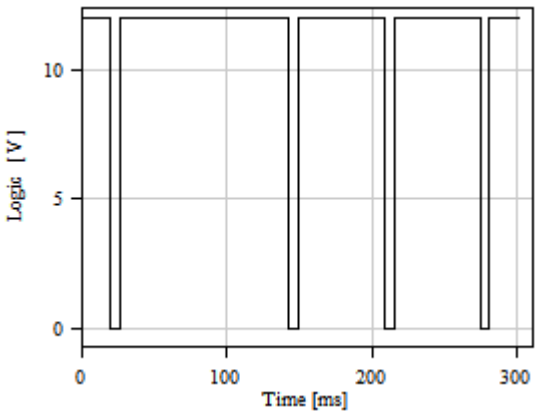
Motor's nuilt-in inductive pickup (VRS)

Alternatively, a Hall-sensor is used.



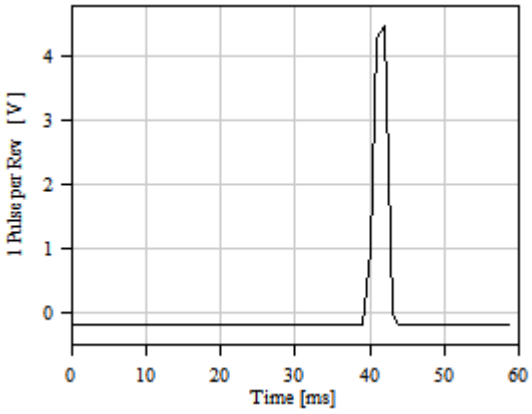
Hall sensor

Signals with digital levels are also possible:



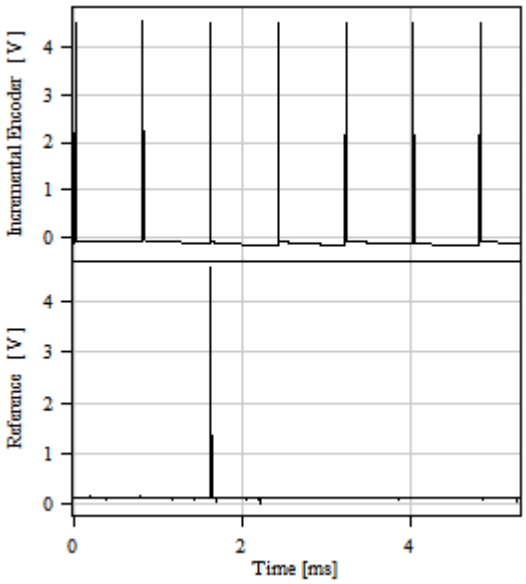
Logic level signal

It is also possible to use a sensor returning only one pulse per crankshaft revolution:



1 pulse per revolution

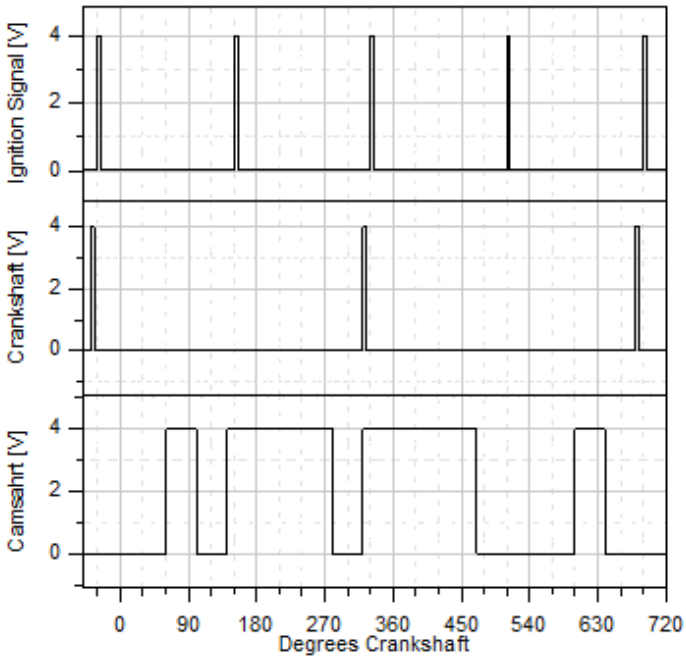
It is also possible to use an incremental encoder having an additional zero output, which is connected to the imc CANSAS-IGN as the reference signal (REF). The zero output then indicates the crankshaft's zero marker.



Incremental counter with zero output

For monitoring selected cylinders, a **camshaft sensor** must be connected.

This sensor returns one impulse per revolution of the camshaft.



Camshaft sensor

Precision

imc CANSAS-IGN captures when the signals cross defined thresholds, at a resolution of fractions of microseconds. From these data it is possible to calculate the ignition angle with precision of 0.1 crankshaft degree and better, even at high RPMs. Thus, if there even is any imprecision, then it is in determining the pulse times. This is mostly because the pulses are not steep enough and a threshold value must be determined. then the threshold selection influences the time when the pulse is detected. Also, the sensor equipment is subject to transit times which vary with the RPMs and cannot be corrected. The sensor equipment itself has some imprecision. For instance, cogwheels may not be manufactured exactly, VRS sensors return RPM-dependent phase shifts. Some of the effects can be compensated by appropriate parameterization of imc CANSAS-IGN, but some can't.

Monitoring of selected cylinders

imc CANSAS-IGN can monitor selected cylinders by means of the camshaft position. The camshaft signal is only relevant if this monitoring has been configured. The condition for the monitoring is tat the ignition signal includes all of the cylinders' ignition pulses.

Snapshot-Mode

To parameterize imc CANSAS-IGN appropriately, a so-called Snapshot-mode can be configured. In that case, the module takes brief snapshots of the input signal at high data rate in a storage volume. Next, the storage content is read back at a slower data rate via the CAN bus. This provides the user with a very good view of the signal's course, making it possible to set sensible levels for recognizing signal edges. But it also becomes possible to check in advance the effects of smoothing filters, AC-circuits, etc..

9.6.1.1 Interference suppression

- The inputs' electrical insulation prevents interference from adjacent channels to be picked up.
- An anti-aliasing filter of ca. 500 kHz provides some interference suppression.
- Low-pass filters can be parameterized to provide interference suppression.

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- Parameterized hysteresis filter suppress noise and interference peaks with a lower level than the hysteresis width.

When pulses follow upon each other rapidly, only the first is taken into consideration. In that case, the maximum RPMs are dtermined and subsequent pulses are ignored if they are nearer than 50 % of the expected regular distance.

Further, with the ignition angle an range of at least ca. 10 degrees (but a maximum of 20 ms) is covered, within which subsequent pulses are ignored. The ignition produces strong oscillations, but only the first edge of the first pulse determines the ignition time, while the many subsequent oscillations no longer do.

Correct grounding is also important. See Grounding bolt 428.

9.6.1.2 Housing

The installation kit includes pre-mounted brackets. These can be unscrewed either completely to be removed, or partially to change their angle. This is to make it possible to fasten the module in the test station area or in a switching cabinet.

9.6.1.2.1 Grounding bolt

For safe operation according to specifications, the housing must be grounded by means of the grounding bolt. The module's housing is not electrically in contact with the power supply voltage or with the inputs. The grounding bolt ensures adequate grounding. Other regions of the housing are mostly not appropriate for adequate grounding, since the housing has a coat of paint.

9.6.1.2.2 LEDs

The module comes with an operation status LED using the customary imc CANSAS LED flashing code 218. The LED is next to the power supply terminal.

It also comes with **four** additional green LEDs which indicate for the three input channels (Sparc, Angle, Ref) whether the signal connected is plausible. The following states can be indicated:

- LED shining continuously: Plausible signal with plausible pulse frequency.
- LED not shining: No signal or a signal whose pulses can no be detected.
- LED flashing very rapidly: A signal with significantly too high pulse sequence has been applied.

The LEDs only roughly reflect the signal state. Please be aware that a rapid transition between states may cause ambiguous LED flashing patterns, for instance if very slow pulses cause the LED to flash briefly. When signals are very erratic, it is best to disregard the LEDs.

9.6.1.2.3 Display

Thanks to the built-in Display unit, it is possible to read measured values even at a distance of several meters. The Display indicates the momentary ignition angle (in degrees) and the current momentary RPMs. If the measured values are outside of the valid range, the readout displays "---".

The momentary ignition angle is an averaged value of ignition impulses. All the ignition impulses extracted from the signal over the configured averaging duration are averaged.

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9.6.1.3 Operation modes

9.6.1.3.1 Default operation type

The ignition angle is stated in degrees before TDC (Top Dead Center). If the angle is positive, then it is *before* TDC. If it is negative, then it is *after* the TDC. The ignition angle is limited to the range -180 degrees .. +180 degrees; narrower (configured) limits can apply.

The RPMs are determined by finding the time for one full revolution. In the process, the rotation speed fluctuations within a revolution, which are typical of combustion engines, are not considered. Instead, the value is stabile and representative.

9.6.1.3.1.1 Message

In default operation mode, the module cyclically sends messages on the CAN bus. The clock rate and the CAN-identifier are software-configurable. The message content for Intel-Byte-syntax:

Signal	Start bit	Start byte	Bit count	Integer	Offset	
Ignition angle	0	0	16	signed	0.0	0.01 degree / LSB
RPMs	0	2	16	unsigned	0.0	0.5 RPM / LSB

If the ignition angle can not be determined or it is invalid, the value 8000H = -32768 is entered in the message for the ignition angle.

If the RPMs are less than the permitted (configured) range, or cannot be determined, the value 0 is entered for the RPMs.

If the RPMs are higher than the permitted (configured) range, the value FFFFH = 65535 is entered in the message for the RPMs.

If *Monitoring of selected cylinders* is used, the module additionally sends one message on the CAN bus per monitored cylinder. The CAN-identifier can be software-configured. The clock rate is the same as for the message described above. Message content with the Intel byte order:

Signal	Start bit	Start byte	Bit count	Integer	Offset	Scaling factor
Ignition angle AVG	0	0	16	signed	0.0	0.01 Degrees / LSB
Ignition angle Min	0	2	16	signed	0.0	0.01 Degrees / LSB
Ignition angle Max	0	4	16	signed	0.0	0.01 Degrees / LSB

If the ignition angle can not be determined or it is invalid, the value 8000H = -32768 is entered in the message for the ignition angle AVG, Min, Max.

Note

Using the menu item "*File / Export*...", it is possible to generate a .dbc or .cba file containing the scaling information in the respective format.

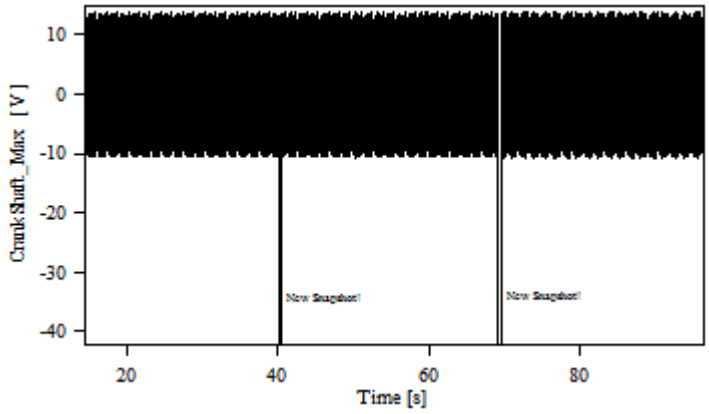
9.6.1.3.2 Snapshot operation mode

Data recorded at high speed are played back in slow motion. For instance, data written to the internal buffer at 1 MHz and then into the CAN bus at 1 ms are shown in a connected CAN measurement device's curve window as a plot at a speed 1000 times slower.

Multiplication factor = Sampling rate_ADC / Output rate_CAN

In the Snapshot mode, there is a short sequence of values outputted on the CAN bus once transfer of data from the internal buffer to the CAN bus has been completed, which indicates the end of the data. The values on all channels are [-Fullscale]-values, meaning 8000H. These values were not really measured and are not actual signals at the inputs! Following this short sequence, a new snapshot is recorded in the internal buffer and immediately outputted on the CAN bus.

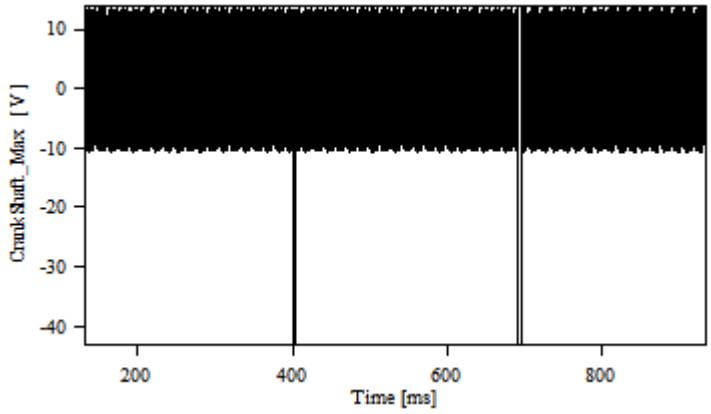
Below is shown a typical Snapshot, illustrating the signal from an engine's own crankshaft sensor (VRS).



Snapshot on the CAN-Bus

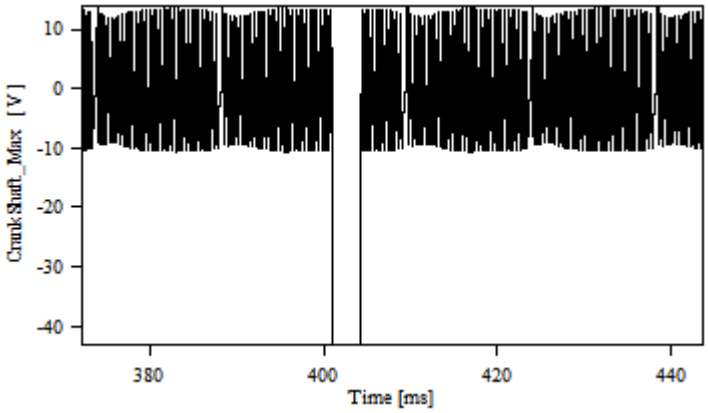
The negative peaks in the recorded CAN bus signal, which clearly are not derived from the crankshaft sensor but indicate the start of the next snapshot. In this case, data gathered with a 100 kHz data rate and 30000 points buffer are transferred to the CAN bus at 1 kHz. In other words, a snapshot every 30 s.

After correction of the time base, the result is:



Snapshot rescaled

Now it is possible to magnify a segment in order to investigate the missing tooth gap:

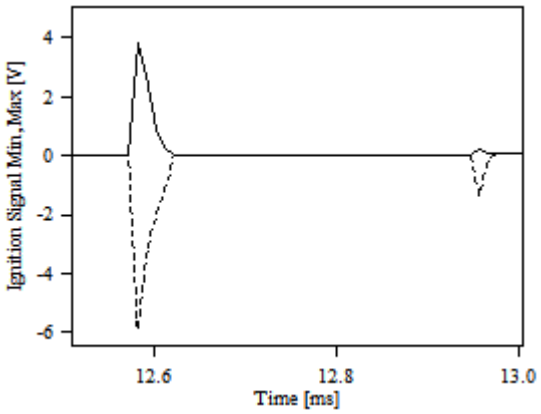


Snapshot zoom

Here is shown a magnified except around the start of a new snapshot. The first valid measurement value is located to the right of the positive edge of -43 V (substitute value 8000H in the gap). The missing tooth gaps are clearly seen in the actual signal plot.

For each channel in the snapshot message, there is a minimum and a maximum value. These are needed in order to evaluate the signal correctly, if a different sampling rate than 3 MHz is stated. For example, if 100 kHz is set, the AD converter will still sample at 3 MHz. One each minimum and maximum value is generated from every 30 values. By displaying the Min- and Max-values in a curve window, one sees a "tunnel" through which the actual signal travels. If the tunnel is too wide, then one can assume that (important) signal components are not being displayed and a higher sampling rate should be chosen.

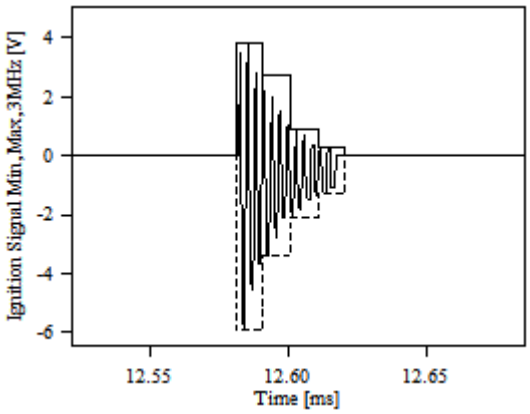
For instance, an ignition signal is sampled at 100 kHz:



Ignition signal with snapshot at 100 kHz

The discrepancy between the Minimum and Maximum is clearly seen. The true course of the signal is between the two envelope lines.

With a 3 MHz clock rate, the oscillation is reflected correctly. The envelope lines Min/Max-plots are displayed as stair-steps, which graphically illustrate the scope of the Min/Max-calculation.



Ignition signal with snapshot at 3 MHz

9.6.1.3.2.1 Message

In Snapshot-mode, the module cyclically sends two messages on the CAN bus. The clock rate and the CAN-identifier are software-configurable. The message content for Intel-Byte-syntax:

Message 1:

Signal	Start bit	Start byte	Bit count	Integer	Offset	Scaling factor
Spark (min)	0	0	16	signed	0.0	0,00132694 V / LSB
Spark (max)	0	2	16	signed	0.0	0,00132694 V / LSB
Crankshaft (min)	0	4	16	signed	0.0	0,00132694 V / LSB
Crankshaft (max)	0	6	16	signed	0.0	0,00132694 V / LSB

Message 2:

Signal	Start bit	Start byte	Bit count	Integer	Offset	Scaling factor
Reference (min)	0	0	16	signed	0.0	0,00132694 V / LSB
Reference (max)	0	2	16	signed	0.0	0.00132694 V / LSB
Camshaft (min)	0	4	16	signed	0.0	0.00132694 V / LSB
Camshaft (max)	0	6	16	signed	0.0	0.00132694 V / LSB

All values between snapshots are set to 8000H = -32768.

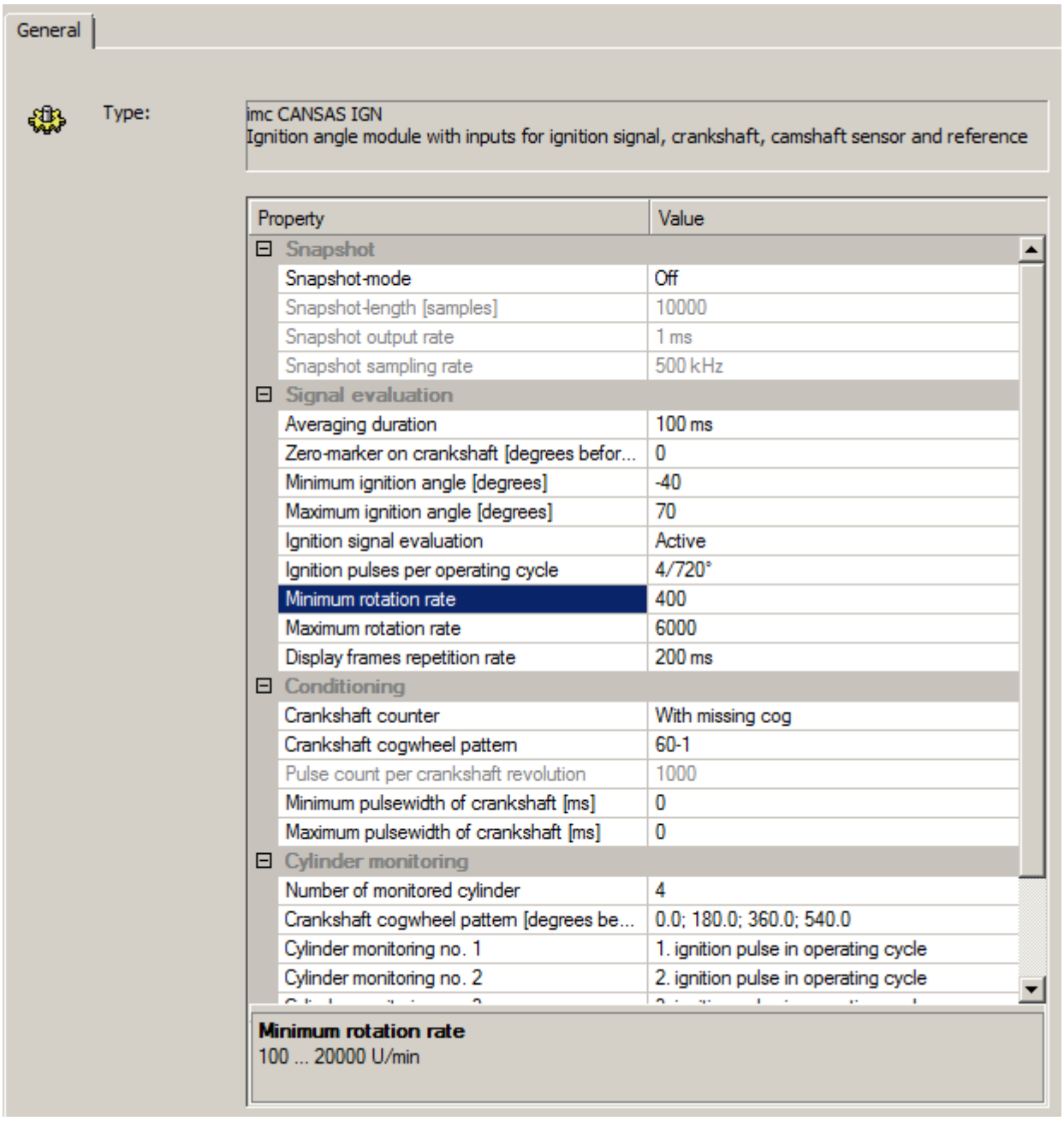
Note

By means of the menu item *"File / Export*...", it is possible to generate a .dbc or .cba file containing the scaling information in the respective format.

9.6.1.4 Parameterization

General parameters

If the node "*Ignition angle module*" is selected in a imc CANSAS-IGN module in the tree diagram on the left side of the imc CANSAS user interface, then on the right side, a table for setting the module's general parameters appears.



Snapshot-mode:

"*On*": The Snapshot mode can be tuned on/off.

"*Off*": No Snapshot mode. Default operation instead (angle and RPM are determined)

Note: These input channel parameters are also observed in Snapshot mode. For this reason, these parameters must also be well defined:

- switchable pull-up resistor to 5 V
- coupling (AC /DC)
- low-pass filter
- absolute value formation

Please also be sure to adjust the CAN-ID correctly.

Snapshot length

Length of Snapshot in samples. Lengths from 1000 to 30000 samples are available. Note that a small buffer leads to fast buffer update rates. E.g. with a Snapshot output rate of 1ms, the complete transfer takes between 1 s and 30 s.

This parameter can only be edited in Snapshot mode.

Snapshot output rate

After this period, the next CAN message, containing the measurement values of the Snapshots for the next sample is sent. This is the clock rate at which the messages are sent. Periods between 1ms and 10ms are possible. The shortest possible time is recommended in order to transfer the contents of the internal Snapshot buffer as quickly as possible. Naturally, the CAN bus' baud rate must be adequately high.

This parameter can only be edited in Snapshot mode.

Snapshot sampling rate

This is the sampling rate at which measured values are transferred into the internal buffer. Sampling rates of 20 kHz up to 3 MHz are possible. Please note that at the highest sampling rates only a very brief signal segment can be captured due to the internal buffer's length limitations. Please refer to the chapter "Snapshot operation mode" for more details.

This parameter can only be edited in Snapshot mode.

Averaging time / output rate

The currently calculated instantaneous values for the ignition angle and the RPM are averaged (arithmetically) over the duration set. Averaging periods of 5ms to 1 s are possible. Once the averaging is completes a CAN-message is outputted in which the averaged values are stated. If the display is updated again, the last mean values determined are displayed. As the duration for the averaging increases, the result values become more stable, but the output appears more stagnant. On the analog outputs, as well, the mean values are outputted immediately upon being calculated.

If monitoring of selected cylinders is used, the CAN-messages assigned to the cylinders are outputted at the same clock rate.

Zero marking on the crankshaft [degrees before TDC]

The angle specified here will be added to the calculated ignition angle. This parameter accounts for the fact that, in general, the zero angle marking on the crankshaft is not at the top dead center (TDC), but a small angle before it. Entered in degrees (-180° to +360°), a positive value indicates degrees *before* TDC, while a negative value indicates a zero mark *after* TDC.

For instance, if the zero mark is +70° before TDC, then enter 70 for this parameter. Conversely, if the zero mark was 120° after TDC, enter -120.

With incremental encoders having a zero pulse, the zero mark is clearly the position where this zero pulse occurs. However, rotational sensors which lack a zero pulse, such as a magnetic pickup on a gear, the zero mark is typically the first tooth (or more precisely, the last edge of the tooth) after the gap. In other words, if a tooth produces positive pulses, then the first negative signal edge after the missing tooth is the zero mark.

Aside of TDC offsets, this parameter may be used to introduce any general offset into the angle calculation if necessary for user specific conditions or site specific standards.

Minimum, Maximum ignition angles

The expected range for the ignition angle is localized here. For instance, to within a range of

-70 .. + 30 degrees.

This contributes to angles incorrectly calculated due to interference being suppressed already in the device. Thus, the range should be selected to be as narrow as possible.

The range span must be sufficiently small for the number of cylinders. The span is the difference between the maximum and minimum ignition angle. Example: With a 4-cylinder, 4-stroke engine there is an ignition every 180 degrees, namely 4 at equal distances over the complete 720 degree work cycle. If there is an ignition at 170 degrees, then this is 10 degrees before TDC. If there is another ignition at 350 degrees, this is also 10 degrees before TDC. In this case the maximum span for this engine is 180 degrees. For engines with higher cylinder counts, this span becomes less.

Engine	max. span
2 cylinder, 4 stroke	360
3 cylinder, 4 stroke	120
4 cylinder, 4 stroke	180
5 cylinder, 4 stroke	72
6 cylinder, 4 stroke	120
8 cylinder, 4 stroke	90
10 cylinder, 4 stroke	72
12 cylinder, 4 stroke	60

Furthermore, a 3-cylinder engine responds in this regard like a 6-cylinder one in which only every 2nd ignition does not occur.

In no case may the span be exceeded when entering the parameters! Incorrect calculation of the ignition angle would result!

Ignition signal processing

If the ignition signal is to be evaluated, this parameter is set to "active". This is the normal setting.

Only in exceptional cases where the module is used only for determining the RPMs and no ignition signal is connected, this parameter is set to "passive".

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Ignition pulses per work cycle

This is where to set how many ignitions per work cycle. Available for selection: 2/720 degrees ... 12/720 degrees. These are available for 4-stroke engines in which the work cycle is 720 degrees.

This parameter contributes to the ability of not only the first or just one cylinder's ignition pulses to be in the signal but ignition pulses from all cylinders. For instance if a 4-cylinder, 4-stroke engine has ignition at the first cylinder at -10 degrees, and the next ignition at 170 degrees, then KW, then both had ignition at 10 degrees before TDC. imc CANSAS-IGN uses the specification (in this case 4/720 degrees) in order to convert the 170 degrees to -10 degrees, since it knows from this parameter that there is ignition every 180 degrees.

Minimum, maximum RPM

The expected RPM range. RPMs determined to be above the maximum RPM are indicated in the Display with "---". This amounts to overmodulating the input range. The upper limit should therefore be specified with some reserve capacity. For instance, if the engine rotates at up to 6000 RPM, the upper limit may not be set to 6000, since a slight fluctuation (6001 RPM) would already exceed the limit. Instead it would make sense to set the upper limit to 7000. The upper limit may extend up to 20000 RPM. However, it is not advisable to simply set this maximum value, since setting unrealistically high values increases the risk of capturing disturbance pulses. This is because imc CANSAS-IGN suppresses pulses which are implausibly high, in response to which the corresponding LED flashes rapidly. The best value for orientation is the highest rotation speed expected.

If the signal falls below the minimum rotation speed during measurement, the system indicates 0 RPM. Therefore, as the minimum to set, a value well below the idling speed is recommended. The lower limit prevents creeping rotation from being indicated but ensures that zero is promptly indicated. The value for the minimum rotation speed's parameter may extend to 100 RPM.

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Display update rate

This parameter determines at which rate the device's display's picture is refreshed. Rates between 200ms and 1s are possible. It isn't worth having the display refreshed at a higher rate than the averaging duration, since the Display is actually showing averaged values. With more strongly fluctuating signals, a slower refresh rate is recommended in order to make viewing even possible.

Crankshaft sensor

What kind of sensor is connected to the crankshaft in order to obtain information on the crankshaft's angle?

- Sensor with missing teeth: E.g. the engine's own sensor on a cogwheel. The gear pattern must be specified separately in the parameter "*Crankshaft gear pattern*".
- Sensor with additional zero-pulse (REF): Incremental encoder whose number of markings is to be specified in the parameter "*Pulse count per crankshaft revolution*". The incremental encoder has an additional zero-output which is to be connected to imc CANSAS-IGN's signal-output "REF".
- Counter with one pulse per revolution: only one pulse is returned per revolution of the crankshaft.

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Crankshaft gear pattern:

For all sensors with missing teeth, the gear pattern is selected here.

60-1	1 of 60 teeth missing
60-2	2 adjacent teeth of 60 missing
36-1	1 of 36 teeth missing
36-2	2 adjacent teeth of 36 missing
36+1	1 of 36 teeth is filled in to make one wide tooth.
24-1	1 of 24 teeth missing

Pulse count per crankshaft revolution

For all sensors with a zero-output, you can specify how many pulses the sensor returns per crankshaft revolution. The amount of markings or subdivisions of the sensor. May lie between 2 and 3600.

Minimum, maximum pulse width

For the crankshaft sensor, the allowed pulse width is specified.

In general, 0 (zero) is specified. The zero indicates that no check is to take place. For instance, if the maximum is zero, it means that there is no maximum pulse width. The pulse may be as wide as desired. If the minimum is zero it means that the pulse may be as narrow as it can.

When working with values other than zero, in other words, when there is to be verification, note that a pulse will be ignored if it is too narrow or too wide. This can in turn only happen if at the moment the signal edge is recognized the pulse width is already available to the device. If one has a positive pulse, then the negative edge must be the edge set for the crankshaft signal. The (short) pulse begins with the positive edge and ends with the negative one. At its end, its duration is known. If the duration is to short or too long, the edge is ignored. If the positive edge is set where there is a positive pulse, then the time between pulses is measured and used as the determining criterion. The positive edge may thus only be used with negative pulses.

Number of monitored cylinders

If no monitoring of individual cylinders is desired, a zero is entered (default value). The camshaft sensor is ignored. However, the module still determines the ignition angle.

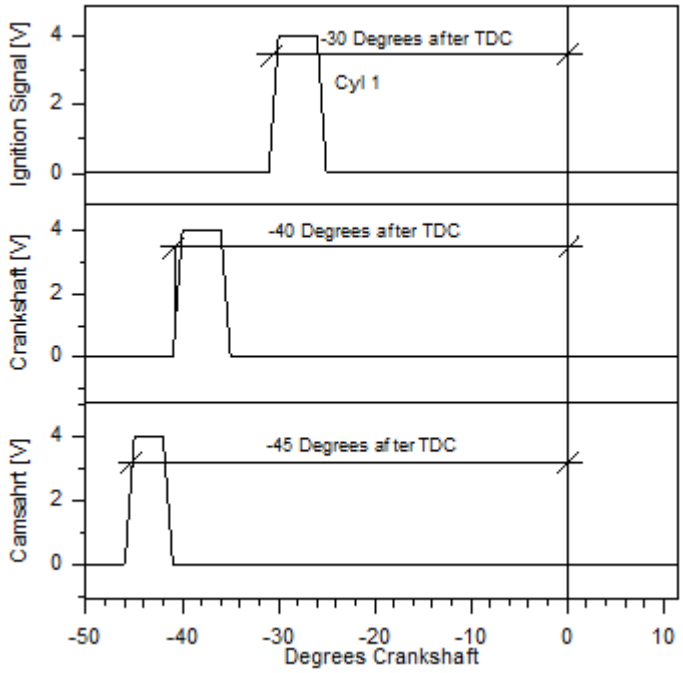
If *Monitoring of selected cylinders* is desired, then the amount of cylinders is entered in this box. One to four cylinders are possible. The camshaft signal must be connected to the imc CANSAS-IGN's CAM terminal. The signal returns one or more pulses per camshaft revolution. Based on the camshaft position, it is possible to assign each ignition impulse. The condition for this is that the ignition signals include all of the cylinders' ignition impulses. For each monitored cylinder, the ignition angle's mean value, minimum and maximum values are determined. These results are outputted as CAN messages. The values of the cylinders monitored do not appear on the Display.

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Camshaft pattern (degrees after top dead center)

If monitoring of selected cylinders is activated and the camshaft sensor is connected, the position at which the camshaft sensor returns pulses is entered here. Die The pulses' angle-positions are expressed in crankshaft degrees after the first cylinder's top dead center. The value range is typically 0 .. 720 degrees, thus encompassing one complete duty cycle or a full revolution of the camshaft. Angles can also be expressed as negative values if they refer to positions before the first cylinder's top dead center. The value range is from -720 to +720 degrees. All angle positions must be stated in increasing order. In order for the pattern to be uniquely identifiable, the distances between the values must be different, which also is always the case with a real camshaft. The individual angle positions can be separated from each other by spaces or semicolons.

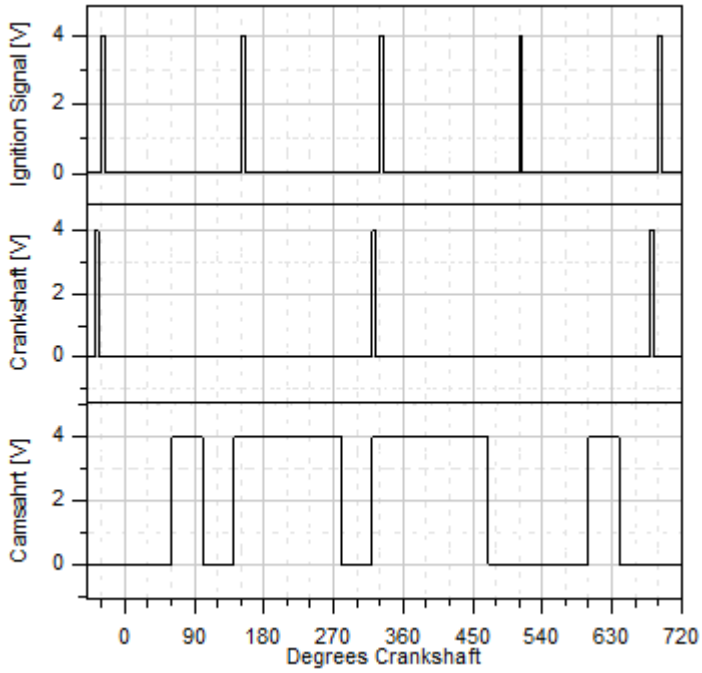
The camshaft pattern is specified by stating a trigger signal edge's angle positions. The channel Camshaft's parameter *Trigger signal edge* (see channel parameters) defines which is the applicable signal edge. If the positive edge is specified, the camshaft pattern must contain the angle positions of all positive edges.



Thus, entering -45 degrees is equivalent to entering 675 degrees.

If the camshaft measurement wheel is not used, but a separate sensor is installed instead which returns only one pulse per revolution of the camshaft, its angle position is stated, e.g. 30 for 30 degrees after the first cylinder's top dead center (TDC).

The following example shows a typical signal plot. The 4-stroke engine's duty cycle extends from 0 to 720° of the crankshaft. The preceding duty cycle goes from -720 to 0 degrees. What is shown are ignition pulses at 30 degrees before TDC. The crankshaft's zero-marker is at 40 degrees before TDC ("40" is entered for the parameter *Zero-marker on crankshaft [degrees before TDC]*).



The camshaft's pulse sequence shows positive edges at 60, 140, 320 and 600 degrees. The same pulse sequence shows negative edges at 100, 280, 460 and 640 degrees. The decision whether positive or negative edges are used is easy to make: the distances between the positive edges are 80 = 140-60, 180 = 320-140, 280 = 600-320, 180 = 60 + 720 - 600. Conversely, the distances between the negative edges are 180 = 280 - 180, 180 = 460-28, 180 = 640-460, 180 = 100+720-640 degrees. All negative edges thus have the same distances. So, it is not possible to recognized at which position the camshaft is located simply by observing the negative edges. But the positive edges have significant differences in their respective distances. For this reason, the camshaft channel parameter *Trigger signal edge* is set to "positive". In the input box for the camshaft pattern, the text 60 140 320 600 (the sequence of positive edges) is entered.

Alternatively, the sequence -120 60 140 320 can be specified, since -120 and 600 denote the same position.

It is not necessary to state either the zero-marking or its position exactly. In order to state the ignition angle exactly, only the crankshaft position is always used. Conversely, the camshaft position is only for the purpose of determining which cylinder currently is receiving an ignition impulse. A tolerance of roughly 40 degrees is acceptable. Thus, it is sufficient to state the position to within 40 degrees.

For engines having adjustable camshafts (also variable camshaft control or variable valve control), the angle between the crankshaft and the camshaft changes within certain limits. The ignition angle module covers this case.

Note when stating the angle positions for the camshaft that the distances between individual signal edges, in particular, must be stated precisely. Thus, it is less important whether the sequence specified is 60, 140, 320 or 70, 150, 330.

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1st - 4th cylinder monitoring

With *Monitoring of Selected Cylinders* activated, the cylinders are selected by means of these parameters. Depending on the amount of cylinders to be monitored, the corresponding amount of boxes are to be configured. For each of the cylinders to be monitored, its position in the ignition order is specified. The particular cylinder is assigned to the 1st ignition pulse in the duty cycle, or the 2nd, etc.

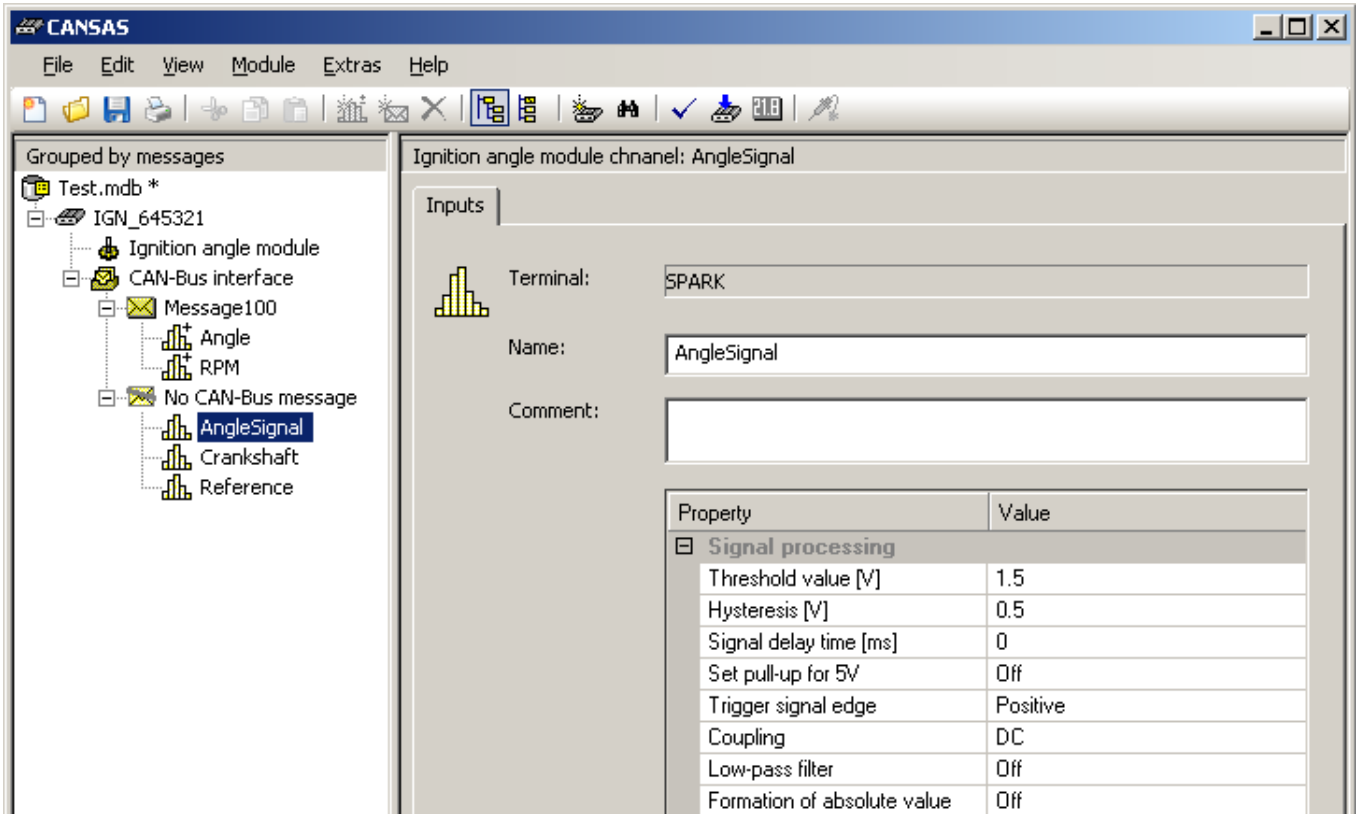
Please observe the ignition order. For instance, if the ignition order is 1-4-2-3, then the 2nd ignition is in the 4th cylinder. Thus, if the 4th cylinder is to be monitored, the "2nd ignition impulse in the duty cycle" must be selected.

It is assumed that the ignition impulses are distributed evenly through the duty cycle and that the amount of ignition impulses per duty cycle is correctly configured in the associated parameter (see above).

Example: Assume we have a 4-cylinder 4-stroke engine with a 720° duty cycle. Every 180°, there is a firing (ignition). If the firing occurs at 30° before TDC, then the positions of the firings within the duty cycle are at -30°, (180-30)°, (360-30)° and (540-30)°. The individual cylinders' TDC angles within the duty cycle are 0°, 180°, 360° and 540°. The cylinder whose TDC is at 0° is considered the first in the duty cycle.

9.6.1.4.1 The channel's parameters

If on the left side of the imc CANSAS user interface's tree diagram, one of the input channels (ignition signal, crankshaft, reference) in a imc CANSAS-IGN module is selected, then on the right side a table for setting the input channel parameters appears. Multi-selection of the channels is possible.



Threshold:

A signal edge is detected when a certain signal level is crossed. This threshold value/level is stated in Volts. It can lie between -40 V and +40 V. A resolution of 0.1V should also not be exceeded. This means that sensible thresholds would include, for instance: 0 V, 0.1 V, 0.2 V, ...

Hysteresis:

In order to prevent that low-level noise in a not very steep edge causes multiple crossings through the threshold value, it is possible to enter a hysteresis here. Only once this hysteresis has been crossed, the edge detector monitors the signal from the other direction. The hysteresis can be stated between 0 V (= no hysteresis) and 40 V.

Signal delay:

If a signal arrives delayed at the edge detector, then it is possible to specify the delay time using this parameter. The time specified here directly affects how the ignition angle is determined, since determining it involves observing the ratios of time differences between various pulses. The signal delays are observed in forming the time differences.

E.g. the following effects can delay a signal:

- the original signal itself is already delayed
- the sensor causes delay
- external conditioning, lines cause delay
- (different) conditioning in imc CANSAS-IGN can also cause delay, especially low-pass filters!
- a signal's edge is not very steep. The threshold value is in the middle of the edge, not at its start.

Delay times are not always easy to determine. However, an imprecise or incorrectly entered time can cause significant errors in determining the ignition angle.

The delay time is stated in ms, and may not have decimal places. Even microseconds make a difference!

The Snapshot mode can help to determine the delay times, particularly with edges which are not very steep. This is because depending on ow high the threshold value is, there can be a different delay with respect to the actual start of the edge.

Thus, even with low pass filters (e.g. imc CANSAS-IGN's adjustable 1st order low-pass) it is not easy to determine the delay time according to the rule of thumb (0.16 / cutoff frequency). This rule of thumb is only valid with a suddenly jumping input signal, for instance, if the threshold value is about 63% of the peak height. If the threshold value is different, the delay can be significantly different. Since the threshold value and the signal shape are relevant, the imc CANSAS software is not able to automatically correct any delay caused by a configured low-pass filter.

Pull up to 5 V:

A resistor can be switched on at each input to 5 V. If this resistor is switched "*ON*", then an external switch (switch to 0 V) can easily be connected. Otherwise, the resistor is not used ("*OFF*").

This parameter is also effective in Snapshot mode.

Trigger edge:

The edge detector determines the threshold crossing only in the specified edge direction: positive or negative. In the case of the 4th channel (camshaft), the trigger edge is used in conjunction with the camshaft pattern.

Coupling:

AC- or DC-coupling can be selected. With AC-coupling, a 1st order high-pass filter is connected between in order to eliminate a DC-offset. With DC-coupling, this high-pass filter is not connected between. The high-pass filtering comes before the optional absolute value formation and thus before the edge detector.

This parameter is also effective in Snapshot mode.

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Low-pass filter:

Optionally, a low-pass filter can be set in the parameters in order to smooth the signal and suppress noise. Brief outliers are also reduced. The low-pass filter can be varied between 2 kHz and 100 kHz cutoff frequency. The low-pass is always 1st order and can also be turned off entirely.

Note that in addition to this configurable low-pass, the analog low-pass is also present, which can not be turned off.

If a low-pass filter is used, it is absolutely necessary to adapt the signal delay time accordingly.

The low-pass filter comes after the optional absolute value formation and before the edge detector.

This parameter is also effective in Snapshot mode.

Absolute value:

Optionally the absolute value can be formed. This may be of interest for the ignition signal if the ignition sensor can also be connected in a different orientation.

Formation of the absolute value is performed following the optional AC-coupling, but before the optional low-pass filtering and thus before the edge detector.

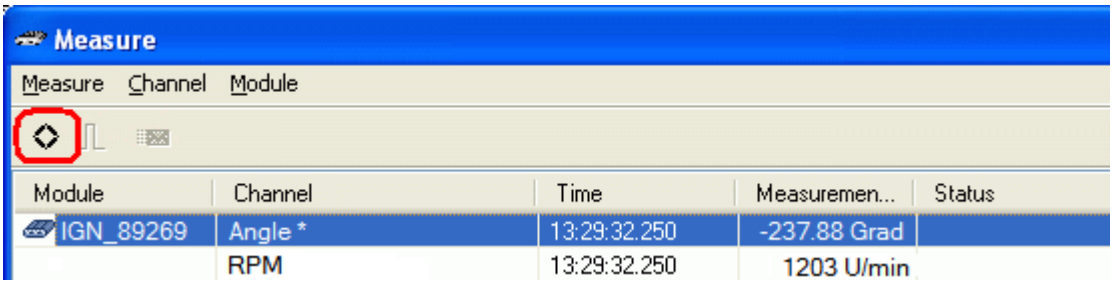
This parameter is also effective in Snapshot mode.

9.6.1.4.2 Offset adjustment

The offset is adjusted at factory.

It is recommended to have the offset rechecked and adjusted once per year. For this purpose, imc offers maintenance servicing.

The user can also perform the offset adjustment. To do this, one short circuit connector must be connected to each input channel. Subsequently the menu item "*Module / Measure*" is called.



The adjustment button is clicked next.

If adjustment was not successful, there is a readout on the device's display.

Subsequently, a control measurement should be performed in Snapshot mode.

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9.6.1.5 Tips

Rotation speed or ignition angle not readable

The numerical values are only clearly visible to the human eye if the same value remains visible sufficiently long. A display refresh interval of 500ms is recommended in order to be able to even read rapidly changing numerical values.

As well, a longer averaging period can contribute to making the readout more stabile. It is especially helpful to make the averaging period and the display refresh rate match.

If the values do not change as rapidly, it is also possible to set both to 200ms.

Readout of rotation speed shows "---" in the Display

Either no signal or an implausible value, i.e. the currently calculated RPM is higher than the value configured for the parameter *"Maximum rotation rate*". In such a case, the LED for the crankshaft will not necessarily flash rapidly. It only flashes rapidly if the RPM is significantly too high, but not for minor range violations. To perform a test, it is possible to set the parameter "*Maximum rotation rate*" to the highest permitted value 20000, since the RPMs may actually be higher than expected. But later be sure to reset the limit as low as possible for purposes of interference suppression.

If the value calculated is incorrect for the rotation speed, then the number of teeth per revolution can be checked, or the threshold/hysteresis. This is because the module may be detecting too many signal edges.

Ignition angle shows "---" in the display

If the rotation speed is 0 or invalid, ten it is not even possible to calculated a value for the ignition angle. However, if the RPM value is valid, then there is a variety of possible causes. The LED for the ignition signal must shine constant green or else the ignition signal must be checked. The LED for the reference signal must shine constant green if an incremental encoder with zero-output is used. If it does not shine constant green, the reference signal should be checked.

If the input signals are in order, then it is worth extending the permitted ignition angle range as a test: temporarily set a lower value for the *"Minimum ignition angle*". The value should be as low as possible (see table for the description of the parameters Minimum, Maximum ignition angles). For instance, if measuring a 4-cylinder 4-stroke engine, the difference between the two may be 180 degrees. So, if the maximum value is set to 70 degrees, the minimum may be set to -110 degrees. For interpreting the values, note that all angles measured are brought to the range -110..+70 degrees by adding or subtracting multiples of 180 degrees. Thus, if 77 degrees were measured, then 77-180 degrees = -10 degrees are shown. You must take this ambiguity into account.

The value for the crankshaft's zero-marking can be checked. An incorrect value there leads to an offset of the angle display.

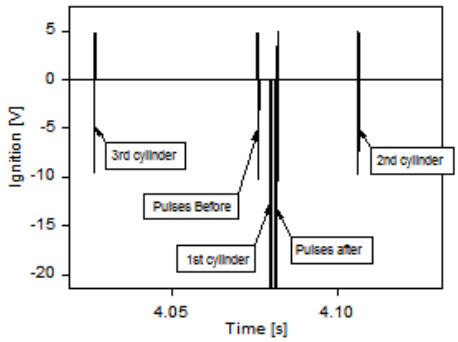
Ignition angle shows random numbers

The display of the ignition angle is not stable but shows apparently random numbers. If at the same time the RPM is incorrect, then the RPM should first be checked. If the RPM is correct and stabile, then the number of *"Ignition pulses per work cycle"* should be checked. Further, the settings for the threshold value and the hysteresis of the ignition signal should be checked. When working with an incremental encoder having a zero-output, also check the reference signal.

If no Logic Level Signal is provided by the control electronics for capturing the ignition time, but it is instead captured by a clamp ignition sensor, then the pre-conditioning of the signals as well as the threshold value and hysteresis must be given special attention.

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Example:



3-cylinder ignition signal

The ignition clamp sensor is connected in such a way that it surrounds the 1st cylinder's ignition line. The other cylinders' signals however are coupled in, as well as the pulses before and after the actual ignition.

The conditioning must now be parameterized in such a way that the 1st cylinder's pulse is captured in all cases.

It doesn't matter if the other cylinders' pulses are also captured. Since in this case 3 "*Ignition pulses per work cycle"* was set, the device knows that the ignition pulses are 240 degrees apart. So, if for instance the 2nd cylinder's ignition pulse is captured, then 240 degrees are subtracted from its angle.

The interference pulses directly after the ignition pulse ("pulses after") are no problem either. The imc CANSAS-IGN hardware suppresses pulses which do not closely follow another one.

What is critical is suppression of pulses BEFORE the actual ignition pulse ("pulses before"). If the edge detector recognizes these pulses as valid pulses, then this point in time is assumed to be the ignition time, so that in consequence incorrect ignition angles are determined. By means of low-pass filtering and a suitably large hysteresis, it is possible to compensate for these pulses before the ignition time. One interesting possibility is offered by forming the absolute value plus subsequent low-pass filtering. By this means, isolated fluctuations will lead to a tiny "hill", while a package of multiple fluctuations results in a large "hill" where a threshold is easy to set.

It is worth being cautious about too much smoothing, which might cause the actual ignition pulse to appear too weak, so that the "pulses after" dominate and are the only ones recognized. This, too, would lead to the ignition time being determined incorrectly.

In any case, with such signals it is worth checking whether the sensor can be set to a better position.

9.6.1.6 IGN terminal

9.6.1.6.1 Inputs (BNC)

4 isolated BNC sockets for 4 isolated input channels:



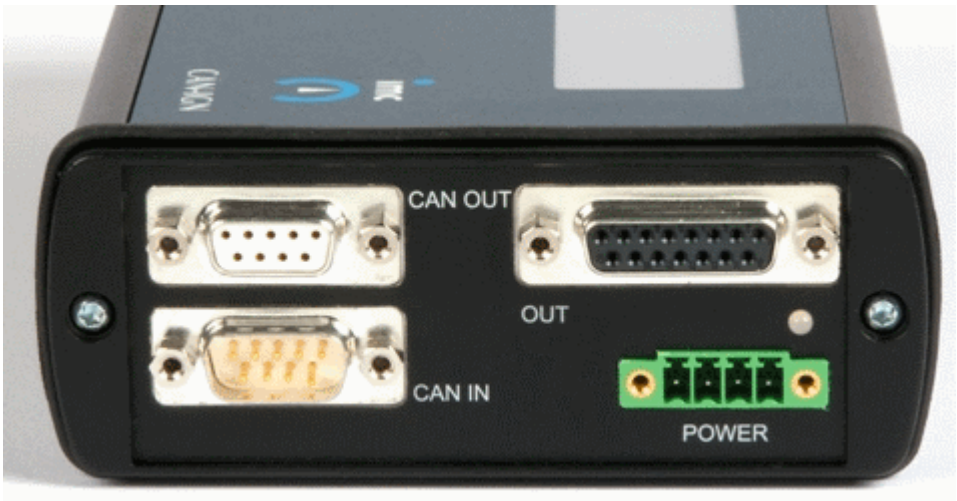
CANSAS-IGN: BNC inputs

- SPARK: connector for the ignition signal
- ANGLE: connector for the crankshaft sensor
- REF: If an incremental encoder is used as the crankshaft sensor, the incremental encoder's zero-output is connected here.
- CAM: The camshaft sensor is only connected to this input in the case of Monitoring of Selected Cylinders. This returns one pulse per revolution of the camshaft.

Uniform conditioning is provided for all 3 signals: voltage isolation, bandwidth approx. 600 kHz, 40 V input range.

9.6.1.6.2 Output (DSUB-15)

This terminal provides the analog and digital outputs and auxiliary power supply. The outputs and power supply are not isolated against the module's power supply.



CANSS-IGN: CAN-connector and analog/digital outputs

Pin	Signal	Reference
1	TTL1 (Spark)	Pin 9
2	TTL2 Crankshaft	Pin 10
3	TTL3 (Ref)	Pin 11
4	TTL4 (CAM)	Pin 12
5	+5 V (max. 200 mA)	Pin 13
6	+12 V (max. 100 mA)	Pin 13
7	DAC1 AngleOut (ignition angle)	Pin 15
8	DAC2 SpeedOut (RPMs)	Pin 15
9	Digital Ground 0 V	
10	Digital Ground 0 V	
11	Digital Ground 0 V	
12	Digital Ground 0 V	
13	Ground 0 V	
14	not connected	
15	Analog Ground 0 V	

The analog outputs AngleOut and SpeedOut return voltage signals which are proportional to the ignition angle and the rotation speed, respectively.

Scaling of the analog outputs:

Signal	Output voltage	..corresponding to	Remarks
AngleOut	-10 V to +10 V	-100 to +100 degrees	substitute value: -10 V, if the ignition angle can not be determined (currently).
SpeedOut	0 V to +10 V	0 to 10000 RPM	substitute value: 0 V, if the ignition angle can not be determined (currently).

The voltages at the analog outputs must be captured differentially, where the reference is Analog Ground = Pin 15.

The power supply voltages (5 V and 12 V) are provided for the supply of sensors. For the negative pole, Pin 13 = Ground is used.

The TTL-outputs (Spark, Crankshaft, REF, CAM) transfer pulses arriving at the inputs Spark and Angle with a slight delay to TTL-level. So, as reference use Pin 9 = Digital Ground. The delay is due to the analog conditioning, any digital filtering configured, and the selection of the threshold values.

Pins 9, 10, 11, 12 and 13 are directly connected with each other internally.

Digital Ground and Analog Ground are both at approximately the same voltage level, but slightly de-coupled from each other by certain electrical components, so that currents through Digital Ground and the associated voltage drops do not affect Analog Ground and the quality of the analog output signals.

The output REF then only reflects the impulses of the input REF, if an operation mode with a crankshaft counter having a zero-impulse is selected. Only then is the input REF used at all. In the other operation modes, the output REF returns one impulse per revolution of the crankshaft. The impulse comes in response to the first tooth following the gap for counters with a gap missing.

The outputs are not defined in Snapshot mode.

9.6.2 IHR (I - High Resolution)

The IHR module provides two independent channels for measurement of currents, with automatic and dynamic range switching during a running measurement. This achieves an extremely high resolution of approx. 30 bits/180 dB.

The IHR module is available in two different housing variants. On the one hand as a measuring module (desktop device) and on the other hand as a plug-in module for the 19" rack (IHR-RACK). Furthermore, for both housing types there is a module variant for 48 V vehicle electrical systems (with the module name suffix "-48V") and a variant for 12 V vehicle electrical systems (without suffix).

The plug-in modules are equipped with backplane slot connectors according to DIN 41612 with very low impedance high current contacts. They achieve an active load patch resistance of less than 5 mΩ (for currents over 100 mA). A matching 19" rack solution is available that has a backplane with high-current capable contacts and push-in IDC type connectors.

Reference

Technical Specs IHR 531
(desktop device)

Technical Specs IHR-R 534
(plug-in module for 19" IHR-RACK)

Technical Specs IHR-RACK 537

Pin configuration of the signal connection 611
Pin configuration of the standard CAN bus DSUB-9 578

CAN Termination IHR-R, IHR-48V-R 46

IHR-RACK pin configuration (power supply, CAN and signal connection 591

Note IHR-RACK

The power supply of the 19" IHR module housing with up to seven IHR-R, IHR-48V-R plug-in modules is to be connected exclusively to slot 1, see fig. slot 1 591.

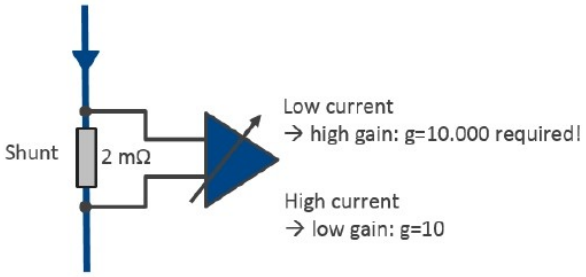
9.6.2.1 Current measurement

In the measurement of current using a measuring resistor, the choice of shunt represents a crucial decision and also a limitation. While it must be large enough to supply significant voltage signals that aren't drowned out by noise and disturbance variables, the power dissipation that increases quadratically with the working current imposes hard limits. For a desired maximum working current (measuring range) of 50 A, the selected shunt may not be greater than 2 mΩ, because it is then already converting 5 W – the limit for a device if it is still to be handy. At this upper operating point it supplies a scanty 100 mV which, however, is still well manageable and can be processed cleanly after adequate pre-amplification, for instance by means of a 1 V ADC with 24-bit resolution. However, if one desires at the same time a measurement resolution of, for example, 50 nA with this configuration, in order to measure leakage currents, for instance, it soon becomes clear that the limits of physics are well exceeded here. Levels of 2 mΩ × 50 nA = 0.1 nV definitely have no chance to prevail over noise and parasitic thermovoltages, etc., even if they were to be "inflated" with an additional gain of, for example, a factor of 1000 to 0.1 µV (fig. a). The pre-gain must therefore be generated from the shunt itself.

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a) Fixed Shunt, limited by ***power dissipation***!

i.e. max. 2 mΩ, 50 A → 5W (I^2*R)

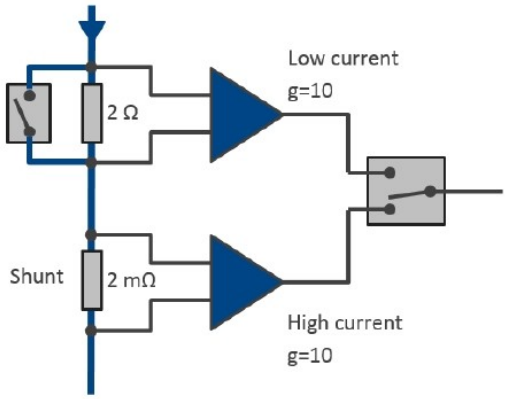


Voltage levels:

High current: 2 mΩ * 50 A = 100mV → ***g=10***, 1V ADC

Low current: 2 mΩ * 50nA = ***0.1 nV*** → g=10.000 for 1µV signal !

b) „Gain" through adapted shunt (1:1000)

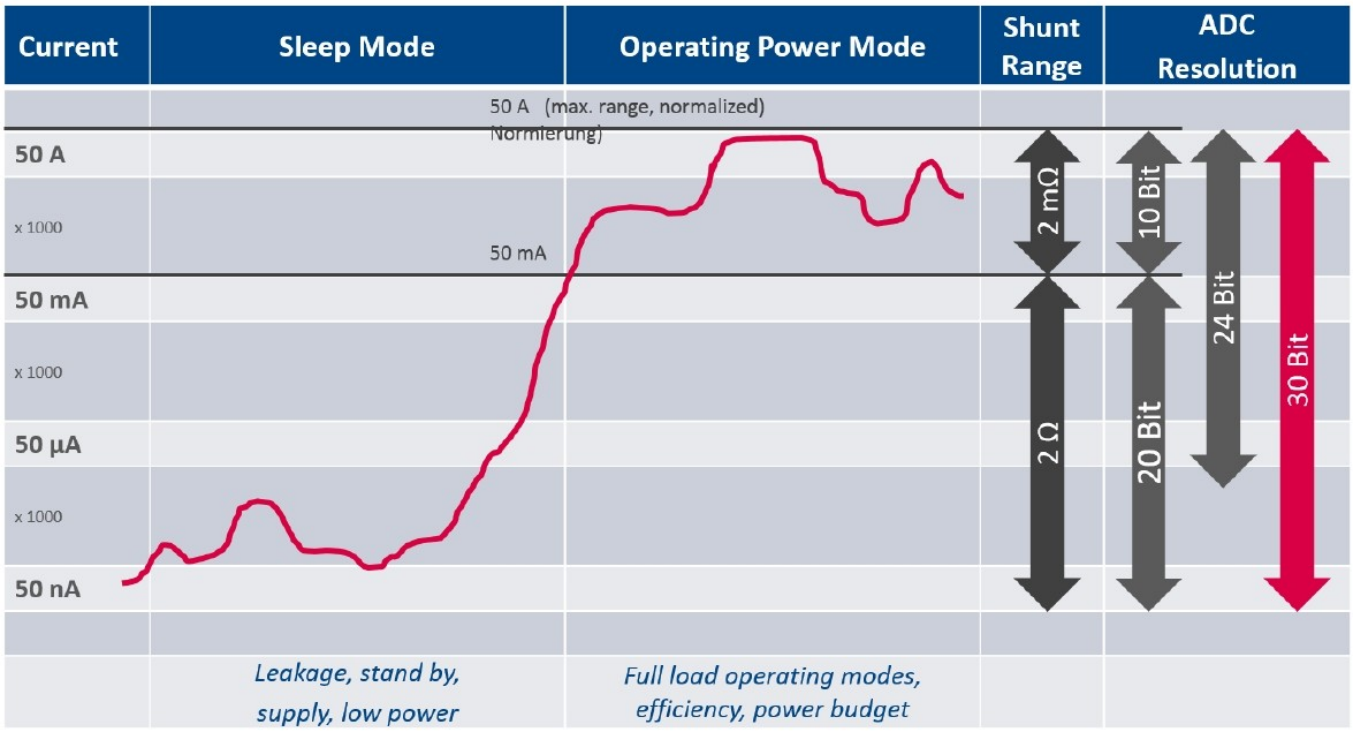


Voltage levels:

High current: 2 mΩ * 50 A = 100mV → ***g=10***, 1V ADC

Low current: 2 Ω * 50nA = ***100 nV*** → still manageable!

c) Resulting range dynamics



That can be implemented by a second serial shunt as shown in fig. b): This shunt's resistance of 2 Ω is higher by a factor of 1000 (shunt gain), but is only active at low currents. It is dynamically bypassed as soon as higher working currents threaten to overload it.

Figure c) outlines how, with this combination, a total range dynamics of about 30 bits can be achieved, i.e. a ratio of maximum measuring range to minimum resolution of 1:1 billion (10^9). For comparison: using a balance with the corresponding measuring range, you could measure a mosquito weighing 2 mg and then an elephant weighing 2 tonnes (= 2×10^9 mg).

Thus, the basic principle is already outlined: the heart of the measuring module from imc is formed by the measuring current path, in which a low-impedance 2 mΩ shunt designed for the maximum current is always active. A second, high-impedance 2 Ω shunt in series can still cleanly capture even the smallest currents, but is dynamically bypassed by means of fast switches as soon as the present working current exceeds a threshold of

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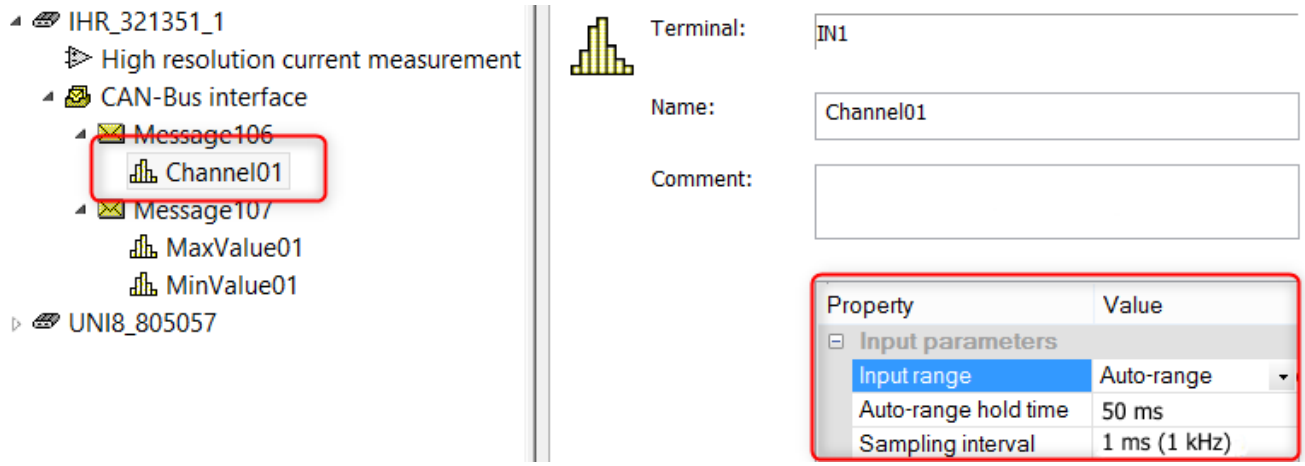
around 100 mA. The voltages across both shunts are measured by a 30 kS/s ADC with 24-bit resolution and correctly selected, scaled and calibrated by a processor. Output data is delivered via CAN bus with selectable data rates of between 1 Hz and 1 kHz. Output variables, apart from mean values, are also minimum and maximum values within the selected output interval. These are derived on the basis of the internal data rate of 30 kHz.

Warning No reverse polarity protection

Pay attention to the correct polarity when connecting for current measurement. The CANSAS YOUR is not designed for negative currents and may destroy the device in case of high currents.

9.6.2.2 Settings possibilities

Channel settings for the main channel



IHR: Settings dialog for the channel

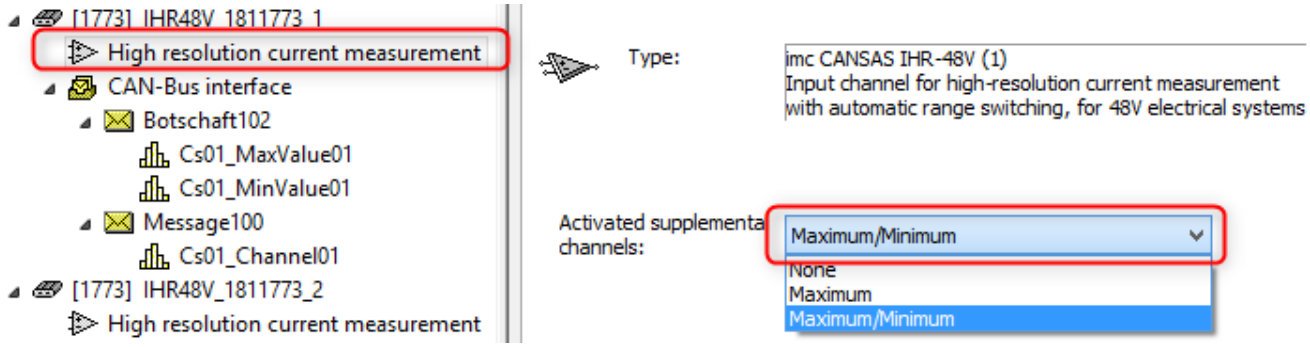
Automatic switching

The automatic switching is performed for values of "*Sampling interval*" from 1 s to a maximum of 1 ms. On the input side, the readings are captured at 30 kHz. These values are **averaged** over the sampling interval specified and outputted on the CAN bus at that sampling rate. Switching from the large input range occurs after a specified hold time "*Auto-Range hold time*".

"*High current (fixed-range)*" measurement range

If the measurement range is set to "*High current (fixed range)*" at longer sampling intervals also, then applications involving **PWM**-controlled loads are also possible. With such signals, the automated switching would not respond quickly enough and may cause feedback to the current source.

Supplemental channels (Amplifier page)



IHR: Settings dialog for the channel

In addition to the **averaged** values of the **main channel**, it is possible to generate additional **supplemental channels**. The amplifier determined the ***Maximum***- and/or ***Minimum values*** in the *Sampling interval*. The necessary messages and channels are created automatically when the list is selected (see image).

9.6.3 SENT: Gateway from SENT to the CAN-Bus

The imc CANSAS-SENT module has inputs to accommodate eight SENT sensors. The signals are captured by the SENT sensors and transmitted on the CAN-Bus. This means that the module represents a manifold gateway from SENT to the CAN-Bus.

Reference

Technical Specs: imc CANSAS-SENT 557

The device conforms to the standard SAE J2716 of 2007, 2008, 2010 and 2016, which specifies the SENT protocol. SENT stands for Single Edge Nibble Transmission for Automotive Applications.

Highlights:

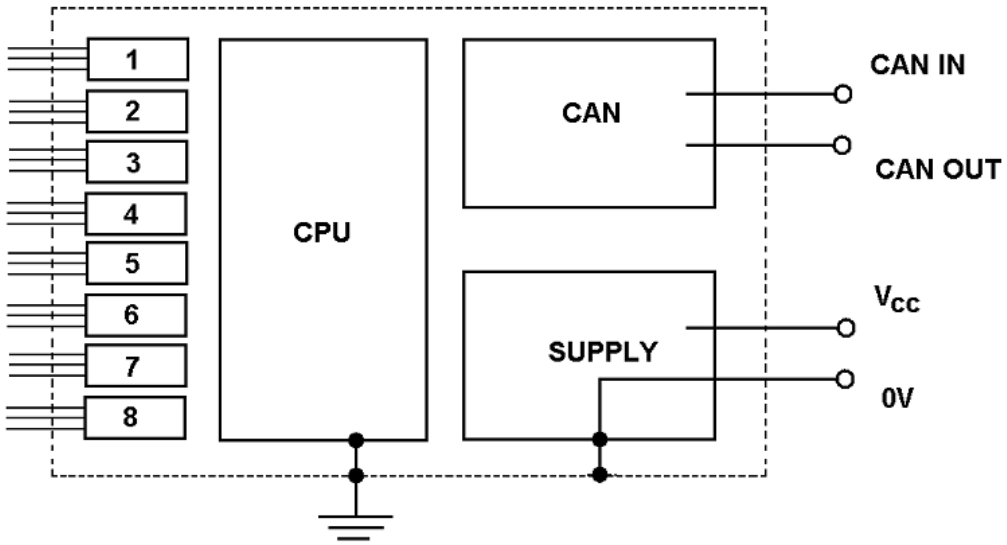
- The imc CANSAS-SENT module can be used with any sensor having a SENT output. Sensor having a SENT output are used in the automotive industry, e.g. as a Hall sensor, pressure sensor, steer angle sensor, throttle valve position sensor or air mass sensor.
- imc CANSAS-SENT is suited to any application requiring the integration of SENT sensors into an existing CAN-bus measurement setup, especially in test stands, on board test vehicles and in sensor technology testing.
- For best results, imc CANSAS-SENT can be supplemented with other imc CANSAS modules and such data acquisition devices as imc BUSDAQ.
- Software:
  Parameterization of the module is accomplished via the CAN-Bus by means of the imc CANSAS software as of Version 1.8. Each of the 8 SENT inputs can be configured separately. The CAN-Bus configuration can be freely adjusted, as with all imc CANSAS modules.
- The 8 SENT inputs are isolated both mutually and from the chassis/ground. Each input is designed for connection of a SENT sensor. The sensor's power is supplied in conformity to SAE J2716 (5 V with max. 20 mA).

  Note

  The SAE J2716 standard of APR2016 allows a maximum of 50 mA supply current. The integrated sensor supply in the imc CANSAS SENT module can provide only 20 mA according to the technical data sheet 557. This corresponds to the standard up to SAE J2716 of 2010. An external power supply must be used if transmitters are used that absorb more than 20 mA.
- The CANSAS-SENT module has one status LED on its front panel for each SENT input.
- One special feature is interference-free signal tapping.

9.6.3.1 Operating modes, isolation

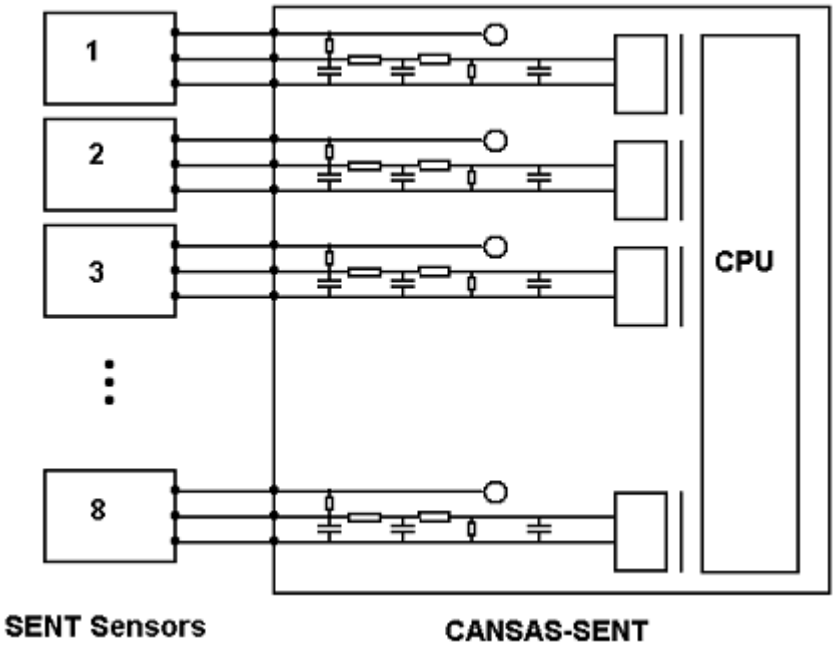
The following block diagram illustrates the module's overall isolation scheme:



As is clearly shown, the CAN terminal and the 8 input circuits (Blocks 1..8 at the left) are isolated both mutually and from the rest of the module, which in turn consists of module's (not the sensors') power supply unit, its CPU and the chassis, which are all at the same voltage level and have a common ground.

The chassis itself is grounded. The Minus-pole of the module's power supply is connected with the chassis.

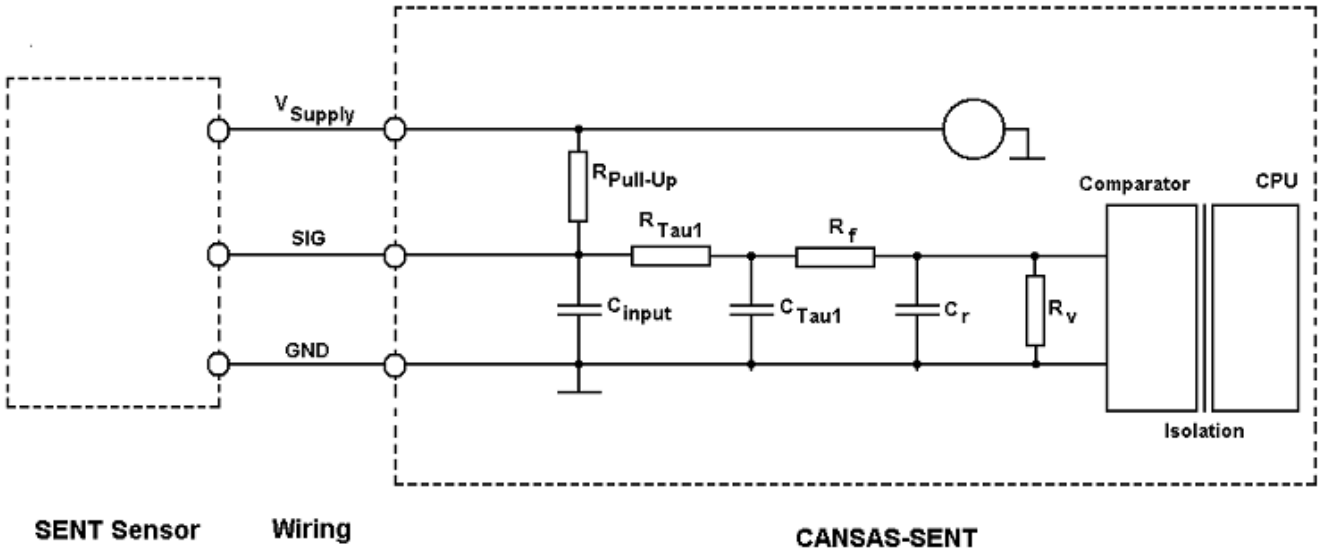
The imc CANSAS-SENT module has 8 inputs. One SENT-sensor can be connected at each input. Each individual input is equipped with its own circuit. All inputs are mutually isolated, and each has its own (and thus consequently isolated) power supply voltage. This eliminates the possibility of sensors interfering with each other's signals.



The diagram above illustrates an 8-fold arrangement in standard operating mode.

9.6.3.1.1 Standard operation

A SENT sensor is connected exclusively to one imc CANSAS-SENT module (not simultaneously to another device). The SENT sensor is supplied with power by the CANSAS-SENT module. The CANSAS-SENT module contains the input circuit defined in the standard SAE J2716.

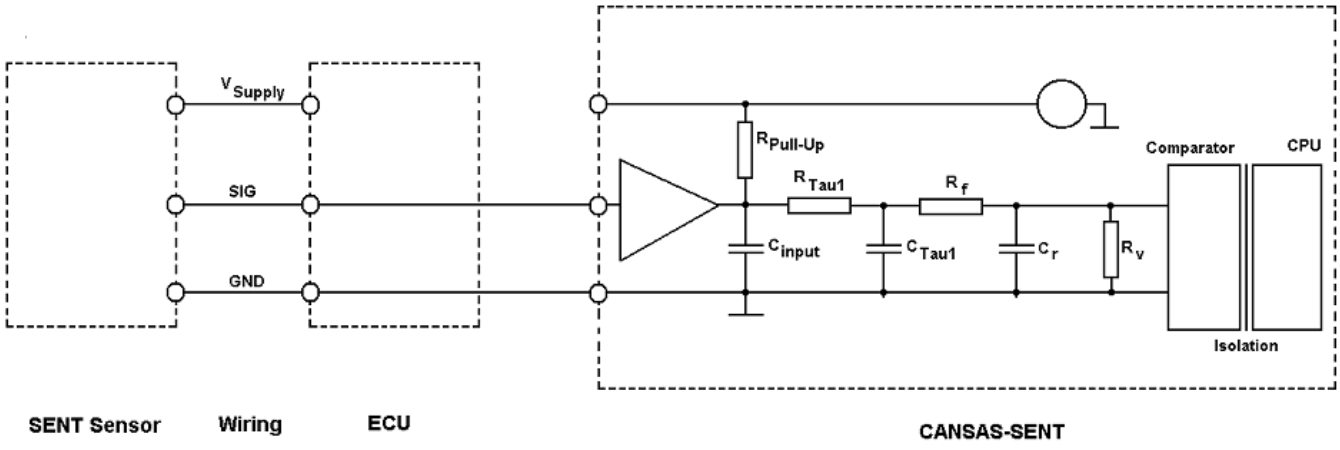


The sensor is connected with the imc CANSAS module via three lines, GND (ground), SIG (sensor signal output) and V_{Supply} (supply voltage). imc CANSAS thus also provides the sensor's power voltage. V_{Supply} is a CANSAS-SENT module output, while SIG is a CANSAS-SENT module input. GND is the particular sensor's specific ground (reference voltage level) line which is referenced to the supply voltage V_{Supply} and the signal lead SIG.

9.6.3.1.2 Interference-free signal tapping

A SENT sensor to be used for measuring with imc CANSAS-SENT may already be installed and wired up. In that case, the SENT sensor is connected with another device which has the input circuitry conformant to SAE J2716 and which already supplies the SENT sensor. On board a vehicle, this other device is typically a control unit, such as the Engine Control Unit (ECU). This setup is the basis of the following examples.

If the sensor is already being operated with the ECU, then according to SAE J2716, it is not permitted to simply connect an additional SENT input circuit in parallel. Otherwise, there would be 2 parallel pull-up resistors and the resulting input impedance may be too low. Therefore, in interference-free tapping, the signal is tapped at high impedance, which avoids affecting the signal. This makes it possible to use the CANSAS-SENT module even with a SENT sensor used for closed-loop engine control purposes.



In this arrangement, the SENT sensor is connected with an ECU for closed-loop control purposes, and is supplied with power by the ECU. Additionally, the imc CANSAS-SENT module is connected. Since the sensor is already supplied with power from the ECU, it may not also be connected with any additional voltage source. The sensor's input V_{Supply} is not connected with the imc CANSAS module. The CANSAS module's output V_{Supply} remains open and unused. The ground line (GND) as well as the signal line (SIG) must be connected between the sensor and imc CANSAS module. The CANSAS input circuit is changed from standard operation: an impedance converter ensures that there is no (significant) feedback to the SENT-sensor from the input circuit's RC network for smoothing the signal edges. In consequence, the SENT-sensor is not additionally impeded either by capacitance or ohmic resistance. The ground appearing in the block diagram is referenced to only one SENT-sensor input. The entire input circuitry for each sensor is isolated.

Warning

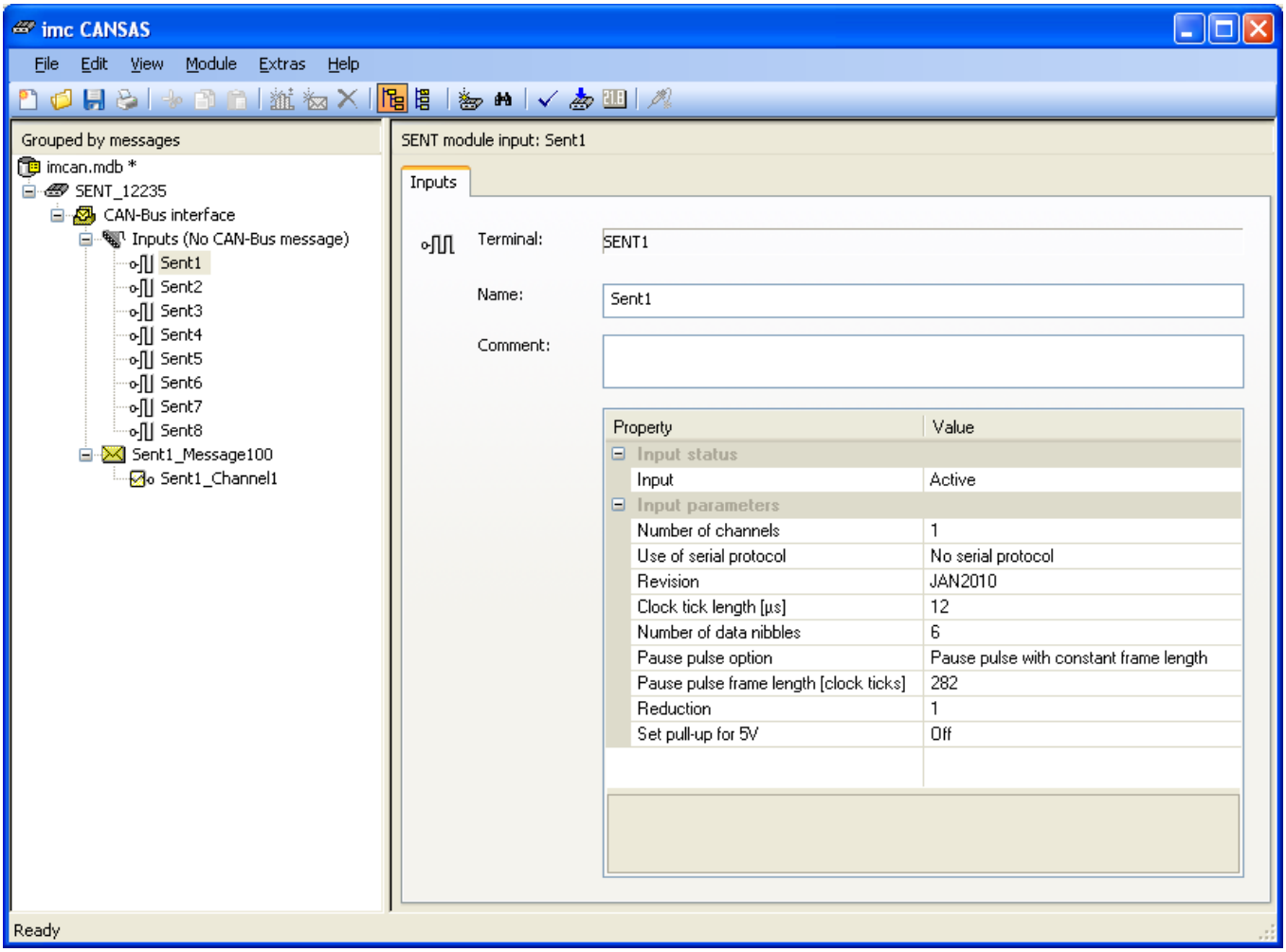
Interference-free tapping is parameterized separately for each channel. Only after completion of parameterization, is the impedance converter in effect. For this reason, it is important for the imc CANSAS module to be configured appropriately before wiring up the setup or activating the ECU.

9.6.3.2 Parameterization

Each of the imc CANSAS-SENT module's 8 inputs can be parameterized separately. It is possible to configure either FAST- or SLOW channels at each of the inputs. A FAST-channel obtains its signal values directly from the SENT message's data nibbles. A SLOW-channel is formed from a sequence of SENT-messages by means of a serial protocol.

Multiple-selection across different inputs is easy to use if multiple sensors of the same type are connected. Each FAST-channel itself can also be parameterized separately. For SLOW-channels, there are no adjustable parameters.

9.6.3.2.1 Parameterizing the SENT inputs



Input

Active: The input is in use. A SENT-sensor is connected at this input. Messages from the sensor are evaluated, CAN-messages are composed.

Passive: The input is ignored and not evaluated. No CAN-messages are composed.

Number of channels

The amount of FAST-channels to be configured for this sensor. Adjustable from 1 to 4. The FAST-channels contain the sensor's actual measurement values (e.g. the pressure measured by a pressure sensor). They are generated from the SENT message's 6 data nibbles. Depending on the amount set here, the corresponding amount of FAST-channels are created.

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Status Channel

Off: The Status channel is deactivated; there is none. The message with the FAST-channels is only transmitted if the SENT message's CRC is valid.

On: The Status channel is activated. A corresponding channel (which can not be parameterized) is created. The Status channel's values are unsigned and are 9 bits wide.

Channel structure:

Bit	Definition
0..3	1. Nibble of the SENT message: Status and Communication nibble
0	Reserved for specific application
1	Reserved for specific application
2	Serial data message bits
3	Message start
4..7	CRC of message
8	= 1 CRC of message valid = 0 CRC of message invalid

Attention! The message with the FAST channels is transmitted after each SENT message, even if the SENT message's CRC is not valid. However, in such a case be absolutely certain to observe bit 8 of the Status channel, since if the CRC is invalid, all of the CAN-message's other bits can also be incorrect!

Example: The value 472 is transmitted in the Status channel. This corresponds to 1D8H. Thus, Message start is set to 1; the CRC is DH = 13 and CRC valid = 1. All others are 0.

Use of serial protocol

No serial protocol: There is no serial protocol in the SENT message. Or, there is one, but it is not to be evaluated.

Short serial protocol (8 Bit): The sensor uses the short serial message format. Its data field is 8 bits wide.

Enhanced serial protocol (12 Bit): The sensor uses enhanced serial message format. The configuration with a 12-bit data filed is used.

Enhanced serial protocol (16 Bit): The sensor uses enhanced serial message format. The configuration with a 16-bit data filed is used.

If a serial protocol is set, a CAN message is generated which contains both the serial protocol's data field and its message-ID. The corresponding channels in the CAN message are called _SerialControl (message.ID) and _SerialData (data field).

If the setting for this parameter does not fit the actually received SENT messages, the following adaptation is performed: if the data filed is actually wider than configured, the top bits are truncated. If the data field is actually smaller than configured, the top bits are stuffed with zeroes. If a serial protocol is defined, but none is actually received in the SENT messages, then no corresponding CAN messages are generated. If the serial protocol is not configured, but actually received in the SENT messages, it is ignored.

If a CRC error occurs in the evaluation of the serial protocol transferred in the SENT messages, the serial protocol affected is rejected and not transmitted on the CAN-bus.

Revision

APR2007

FEB2008

JAN2010

APR2016

The various revisions of the standard SAE J2716. This entry is important because, for instance, the calculation of the CRC may differ between the individual revisions. The particular revision will be selected according to which the SENT-sensor is specified.

Clock tick length

Specifies the time interval in µs. 3.0 µs ≤ Clock tick length ≤90.0 µs

Number of data nibbles

The sensor transmits this many data nibbles (1..6). Here, only the data nibbles are counted. In total, the sensor always transmits 2 more nibbles.

Pause pulse option

No pause pulse: no pause pulse is included in the transmission.

Pause pulse: a pause pulse (an additional stuffing pulse after the CRC nibble) is included in the transmission.

Pause pulse with constant frame length: a pause pulse is included in the transmission. This causes the entire transmission duration to have a fixed length. The subsequent parameter "Pause pulse frame length" specifies the exact value.

Pause pulse frame length

Frame length, expressed in clock ticks. For 6 data nibbles, the number is in the range 282…922. This parameter is only available if the Pause pulse option is set to the value "Pause pulse with constant frame length".

Reduction

1…1000. The frequency of CAN-messages with FAST channels is reduced by this factor. It is generally set to 1, so that one corresponding CAN-message is sent for each SENT-message. But for cases where the traffic on the CAN-bus is too high or if a lower transfer frequency is desirable for some reason, a value > 1 can be selected. E.g. for a value of 10, only every 10th SENT-message is converted to a CAN-message. Nevertheless, all SENT-messages are always evaluated, for instance in order to extract the SLOW channels.

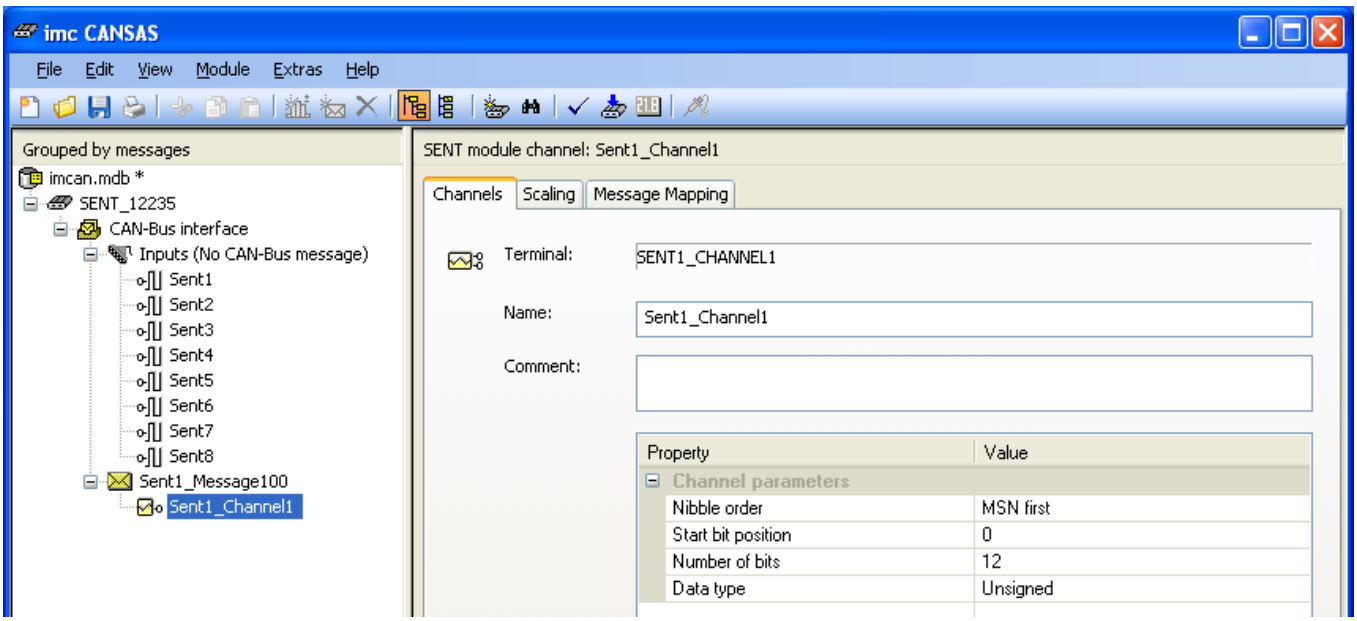
Interference-free signal tapping

Off, On: see the description of operating modes above 453.

Attention! Making the wrong selection can lead to damage to the connected devices!

9.6.3.2.2 Parameterizing the FAST-channels

From each SENT-input (= connected SENT-sensor), it is possible to extract FAST-channels to be transmitted on the CAN-bus.



The FAST-channel is formed by extracting a number from a SENT-message's data nibbles, which is then put into a CAN-message.

Nibble order

The order in which the nibbles are arranged, which together form a number.

MSN first: most significant nibble first. The nibble with the highest value is transmitted before the nibbles of lower value.

LSN first: least significant nibble first: The nibble with the lowest value is transmitted before the nibbles of higher value.

See the examples further below.

Start bit position

The bit position from which onward the number's first bit is transmitted. All 6 data nibbles are imagined as ordered in succession, resulting in a sequence of 6*4 = 24 bits. A nibble's highest-value bit is considered the nibble's first bit. The first among the 24 bits has bit position 0, the last has bit position 23.

Thus, the data nibble's most significant bit has bit position 0, that of the 2nd data nibble the bit position 4. And the first data nibble's least significant bit has bit position 3, that of the 2nd data nibble the bit position 7.

See the examples further below.

Number of bits

The number in the SENT-message is this many bits wide. With CANSAS, the amount can be between 1 and 16 (theoretically up to 24).

See the examples further below.

Data type

What is the number's data type?

Signed: signed integer in two's complement. E.g. for 8-bit width, the value range -128 ..127

Unsigned: unsigned integer. for example: for 8-bit width, the value range 0..255

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9.6.3.2.3 FAST-channel examples: Nibble order, Start bit position

The following examples conform to the nomenclature presented in Appendix A of the standard SAE J2716 of JAN2010. As an example, FAST-channels with the names Channel 1 and Channel 2 are extracted from the SENT-message. xxx denotes data from other channels.

The examples illustrate how the parameters Nibble order, Start bit position and Number of bits are used.

Example 1 as per SAE J2716 JAN2010, A.1 Dual throttle position sensors

	Nibble order	Start bit position	Number of bits
Channel 1	MSN first	0	12
Channel 2	LSN first	12	12

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
Channel 1 Data [11]	2^{11}	Channel 1 MSN [3]	Data 1
Channel 1 Data [10]	2^{10}	Channel 1 MSN [2]	
Channel 1 Data [9]	2^{9}	Channel 1 MSN [1]	Channel 1 MSN
Channel 1 Data [8]	2^{8}	Channel 1 MSN [0]	
Channel 1 Data [7]	2^{7}	Channel 1 MidN [3]	Data 2
Channel 1 Data [6]	2^{6}	Channel 1 MidN [2]	
Channel 1 Data [5]	2^{5}	Channel 1 MidN [1]	Channel 1 MidN
Channel 1 Data [4]	2^{4}	Channel 1 MidN [0]	
Channel 1 Data [3]	2^{3}	Channel 1 LSN [3]	Data 3
Channel 1 Data [2]	2^{2}	Channel 1 LSN [2]	
Channel 1 Data [1]	2^{1}	Channel 1 LSN [1]	Channel 1 LSN
Channel 1 Data [0]	2^{0}	Channel 1 LSN [0]	
Channel 2 Data [3]	2^{3}	Channel 2 LSN [3]	Data 4
Channel 2 Data [2]	2^{2}	Channel 2 LSN [2]	
Channel 2 Data [1]	2^{1}	Channel 2 LSN [1]	Channel 2 LSN
Channel 2 Data [0]	2^{0}	Channel 2 LSN [0]	
Channel 2 Data [7]	2^{7}	Channel 2 MidN [3]	Data 5
Channel 2 Data [6]	2^{6}	Channel 2 MidN [2]	
Channel 2 Data [5]	2^{5}	Channel 2 MidN [1]	Channel 2 MidN
Channel 2 Data [4]	2^{4}	Channel 2 MidN [0]	
Channel 2 Data [11]	2^{11}	Channel 2 MSN [3]	Data 6
Channel 2 Data [10]	2^{10}	Channel 2 MSN [2]	
Channel 2 Data [9]	2^{9}	Channel 2 MSN [1]	Channel 2 MSN
Channel 2 Data [8]	2^{8}	Channel 2 MSN [0]	

The example above also applies for an alternative from A.5 Pressure.

Example 2 as per SAE J2716 JAN2010, A.2 Mass Air flow sensors, 16 bit MAF

	Nibble order	Start bit position	Number of bits
Channel 1	MSN first	0	16
Channel 2	LSN first	16	8

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
Channel 1 Data [15]	2^{15}	Channel 1 MSN [3]	Data 1
Channel 1 Data [14]	2^{14}	Channel 1 MSN [2]	
Channel 1 Data [13]	2^{13}	Channel 1 MSN [1]	Channel 1 MSN
Channel 1 Data [12]	2^{12}	Channel 1 MSN [0]	
Channel 1 Data [11]	2^{11}	Channel 1 MidMSN [3]	Data 2
Channel 1 Data [10]	2^{10}	Channel 1 MidMSN [2]	
Channel 1 Data [9]	2^{9}	Channel 1 MidMSN [1]	Channel 1 MidMSN
Channel 1 Data [8]	2^{8}	Channel 1 MidMSN [0]	
Channel 1 Data [7]	2^{7}	Channel 1 MidLSN [3]	Data 3
Channel 1 Data [6]	2^{6}	Channel 1 MidLSN [2]	
Channel 1 Data [5]	2^{5}	Channel 1 MidLSN [1]	Channel 1 MidLSN
Channel 1 Data [4]	2^{4}	Channel 1 MidLSN [0]	
Channel 1 Data [3]	2^{3}	Channel 1 LSN [3]	Data 4
Channel 1 Data [2]	2^{2}	Channel 1 LSN [2]	
Channel 1 Data [1]	2^{1}	Channel 1 LSN [1]	Channel 1 LSN
Channel 1 Data [0]	2^{0}	Channel 1 LSN [0]	
Channel 2 Data [3]	2^{3}	Channel 2 LSN [3]	Data 5
Channel 2 Data [2]	2^{2}	Channel 2 LSN [2]	
Channel 2 Data [1]	2^{1}	Channel 2 LSN [1]	Channel 2 LSN
Channel 2 Data [0]	2^{0}	Channel 2 LSN [0]	
Channel 2 Data [7]	2^{7}	Channel 2 MSN [3]	Data 6
Channel 2 Data [6]	2^{6}	Channel 2 MSN [2]	
Channel 2 Data [5]	2^{5}	Channel 2 MSN [1]	Channel 2 MSN
Channel 2 Data [4]	2^{4}	Channel 2 MSN [0]	

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Example 3 as per SAE J2716 JAN2010, A.2 Mass Air flow sensors, 14 bit MAF

	Nibble order	Start bit position	Number of bits
Channel 1	MSN first	0	14
Channel 2	LSN first	14	10

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
Channel 1 Data [13]	2^{13}	Channel 1 MSN [3]	Data 1
Channel 1 Data [12]	2^{12}	Channel 1 MSN [2]	
Channel 1 Data [11]	2^{11}	Channel 1 MSN [1]	Channel 1 MSN
Channel 1 Data [10]	2^{10}	Channel 1 MSN [0]	
Channel 1 Data [9]	2^{9}	Channel 1 MidMSN [3]	Data 2
Channel 1 Data [8]	2^{8}	Channel 1 MidMSN [2]	
Channel 1 Data [7]	2^{7}	Channel 1 MidMSN [1]	Channel 1 MidMSN
Channel 1 Data [6]	2^{6}	Channel 1 MidMSN [0]	
Channel 1 Data [5]	2^{5}	Channel 1 MidLSN [3]	Data 3
Channel 1 Data [4]	2^{4}	Channel 1 MidLSN [2]	
Channel 1 Data [3]	2^{3}	Channel 1 MidLSN [1]	Channel 1 MidLSN
Channel 1 Data [2]	2^{2}	Channel 1 MidLSN [0]	
Channel 1 Data [1]	2^{1}	Channel 1, 2 LSN [3]	Data 4
Channel 1 Data [0]	2^{0}	Channel 1, 2 LSN [2]	
Channel 2 Data [1]	2^{1}	Channel 1, 2 LSN [1]	Channel 1, 2 LSN
Channel 2 Data [0]	2^{0}	Channel 1, 2 LSN [0]	
Channel 2 Data [5]	2^{5}	Channel 2 MidN [3]	Data 5
Channel 2 Data [4]	2^{4}	Channel 2 MidN [2]	
Channel 2 Data [3]	2^{3}	Channel 2 MidN [1]	Channel 2 MidN
Channel 2 Data [2]	2^{2}	Channel 2 MidN [0]	
Channel 2 Data [9]	2^{9}	Channel 2 MSN [3]	Data 6
Channel 2 Data [8]	2^{8}	Channel 2 MSN [2]	
Channel 2 Data [7]	2^{7}	Channel 2 MSN [1]	Channel 2 MSN
Channel 2 Data [6]	2^{6}	Channel 2 MSN [0]	

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Example 4 as per SAE J2716 JAN2010, A.3 Single Secure

	Nibble order	Start bit position	Number of bits
Channel 1	MSN first	0	12
Channel 2	LSN first	12	8
Inverted Copy	MSN first	20	4

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
Channel 1 Data [11]	2^{11}	Channel 1 MSN [3]	Data 1
Channel 1 Data [10]	2^{10}	Channel 1 MSN [2]	
Channel 1 Data [9]	2^{9}	Channel 1 MSN [1]	Channel 1 MSN
Channel 1 Data [8]	2^{8}	Channel 1 MSN [0]	
Channel 1 Data [7]	2^{7}	Channel 1 MidN [3]	Data 2
Channel 1 Data [6]	2^{6}	Channel 1 MidN [2]	
Channel 1 Data [5]	2^{5}	Channel 1 MidN [1]	Channel 1 MidN
Channel 1 Data [4]	2^{4}	Channel 1 MidN [0]	
Channel 1 Data [3]	2^{3}	Channel 1 LSN [3]	Data 3
Channel 1 Data [2]	2^{2}	Channel 1 LSN [2]	
Channel 1 Data [1]	2^{1}	Channel 1 LSN [1]	Channel 1 LSN
Channel 1 Data [0]	2^{0}	Channel 1 LSN [0]	
Counter Data [7]	2^{7}	Counter MSN [3]	Data 4
Counter Data [6]	2^{6}	Counter MSN [2]	
Counter Data [5]	2^{5}	Counter MSN [1]	Counter MSN
Counter Data [4]	2^{4}	Counter MSN [0]	
Counter Data [3]	2^{3}	Counter LSN [3]	Data 5
Counter Data [2]	2^{2}	Counter LSN [2]	
Counter Data [1]	2^{1}	Counter LSN [1]	Counter LSN
Counter Data [0]	2^{0}	Counter LSN [0]	
Inverted Copy Data [3]	2^{3}	Inverted Copy MSN [3]	Data 6
Inverted Copy Data [2]	2^{2}	Inverted Copy MSN [2]	
Inverted Copy Data [1]	2^{1}	Inverted Copy MSN [1]	Inverted Copy MSN
Inverted Copy Data [0]	2^{0}	Inverted Copy MSN [0]	

The example above is also applicable for A.4 Single Sensors and an alternative from A.5 Pressure.

Example 5

	Nibble order	Start bit position	Number of bits
Channel 1	MSN first	0	8

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
Channel 1 Data [7]	2^7	Channel 1 MSN [3]	Data 1 Channel 1 MSN
Channel 1 Data [6]	2^6	Channel 1 MSN [2]	
Channel 1 Data [5]	2^5	Channel 1 MSN [1]	
Channel 1 Data [4]	2^4	Channel 1 MSN [0]	
Channel 1 Data [3]	2^3	Channel 1 LSN [3]	Data 2 Channel 1 LSN
Channel 1 Data [2]	2^2	Channel 1 LSN [2]	
Channel 1 Data [1]	2^1	Channel 1 LSN [1]	
Channel 1 Data [0]	2^0	Channel 1 LSN [0]	
…	…	…	…

Example 6

	Nibble order	Start bit position	Number of bits
Channel 2	LSN first	4	8

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
xxx		xxx [3]	Data 1 xxx
xxx		xxx [2]	
xxx		xxx [1]	
xxx		xxx [0]	
Channel 2 Data [3]	2^3	Channel 2 LSN [3]	Data 2 Channel 2 LSN
Channel 2 Data [2]	2^2	Channel 2 LSN [2]	
Channel 2 Data [1]	2^1	Channel 2 LSN [1]	
Channel 2 Data [0]	2^0	Channel 2 LSN [0]	
Channel 2 Data [7]	2^7	Channel 2 MSN [3]	Data 3 Channel 2 MSN
Channel 2 Data [6]	2^6	Channel 2 MSN [2]	
Channel 2 Data [5]	2^5	Channel 2 MSN [1]	
Channel 2 Data [4]	2^4	Channel 2 MSN [0]	
…	…	…	…

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Example 7

	Nibble order	Start bit position	Number of bits
Channel 2	MSN first	5	8

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
xxx		xxx [3]	Data 1
xxx		xxx [2]	
xxx		xxx [1]	xxx
xxx		xxx [0]	
xxx		xxx, Channel 2 MSN [3]	Data 2
Channel 2 Data [7]	2^7	xxx, Channel 2 MSN [2]	
Channel 2 Data [6]	2^6	xxx, Channel 2 MSN [1]	xxx, Channel 2 MSN
Channel 2 Data [5]	2^5	xxx, Channel 2 MSN [0]	
Channel 2 Data [4]	2^4	Channel 2 MidN[3]	Data 3
Channel 2 Data [3]	2^3	Channel 2 MidN [2]	
Channel 2 Data [2]	2^2	Channel 2 MidN [1]	Channel 2 MidN
Channel 2 Data [1]	2^1	Channel 2 MidN [0]	
Channel 2 Data [0]	2^0	Channel 2 LSN, xxx [3]	Data 4
xxx		Channel 2 LSN, xxx [2]	
xxx		Channel 2 LSN, xxx [1]	Channel 2 LSN,
xxx		Channel 2 LSN, xxx [0]	xxx
…	…	…	…

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Example 8

	Nibble order	Start bit position	Number of bits
Channel 2	MSN first	7	3

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
xxx		xxx [3]	Data 1
xxx		xxx [2]	
xxx		xxx [1]	xxx
xxx		xxx [0]	
xxx		xxx, Channel 2 MSN [3]	Data 2
xxx		xxx, Channel 2 MSN [2]	
xxx		xxx, Channel 2 MSN [1]	xxx, Channel 2
Channel 2 Data [2]	2^2	xxx, Channel 2 MSN [0]	MSN
Channel 2 Data [1]	2^1	Channel 2 LSN, xxx [3]	Data 3
Channel 2 Data [0]	2^0	Channel 2 LSN, xxx [2]	
xxx		Channel 2 LSN, xxx [1]	Channel 2 LSN,
xxx		Channel 2 LSN, xxx [0]	xxx
…	…	…	…

Example 9

	Nibble order	Start bit position	Number of bits
Channel 2	LSN first	5	8

Sensor data	Bit weight	SENT Nibble Bits	SENT Nibble
S&C [3] Serial Data Channel		S&C [3]	Status and communication
S&C [2] Serial Data Channel		S&C [2]	
S&C [1] Reserved for specific application		S&C [1]	
S&C [0] Reserved for specific application		S&C [0]	
xxx		xxx [3]	Data 1
xxx		xxx [2]	
xxx		xxx [1]	xxx
xxx		xxx [0]	
xxx		xxx, Channel 2 LSN [3]	Data 2
Channel 2 Data [2]	2^2	xxx, Channel 2 LSN [2]	
Channel 2 Data [1]	2^1	xxx, Channel 2 LSN [1]	xxx, Channel 2
Channel 2 Data [0]	2^0	xxx, Channel 2 LSN [0]	LSN
Channel 2 Data [6]	2^6	Channel 2 MidN[3]	Data 3
Channel 2 Data [5]	2^5	Channel 2 MidN [2]	
Channel 2 Data [4]	2^4	Channel 2 MidN [1]	Channel 2 MidN
Channel 2 Data [3]	2^3	Channel 2 MidN [0]	
Channel 2 Data [7]	2^7	Channel 2 MSN, xxx [3]	Data 4
xxx		Channel 2 MSN, xxx [2]	
xxx		Channel 2 MSN, xxx [1]	Channel 2 MSN,
xxx		Channel 2 MSN, xxx [0]	xxx
…	…	…	…

9.6.3.2.4 Scaling the FAST-channels

The scaling of the FAST channels is accomplished by means of the Scaling page, as described in the chapter Operation 453.

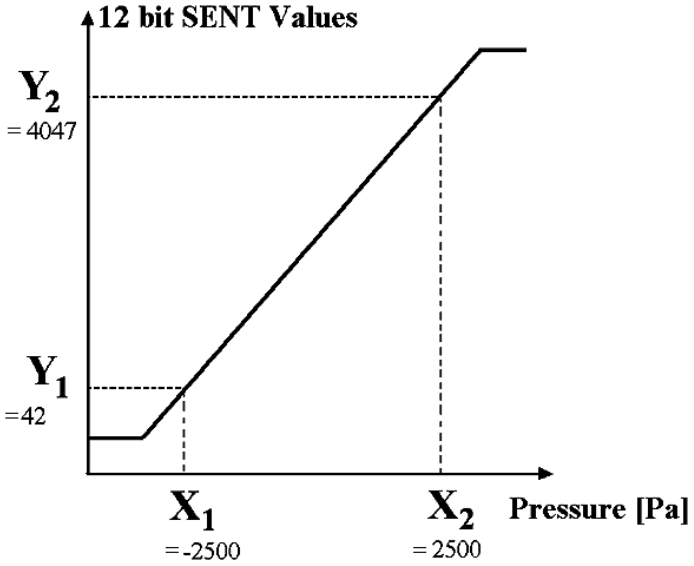
Each respective channel in the CAN-message is assigned the appropriate scaling according to the entries made. In this way, the integer value from the SENT message is correctly interpreted as physical units.

Note that on the Scaling page the designations X1, Y1, … are reversed from the order in the other imc CANSAS modules in conformity to the nomenclature in SAE J2716, according to which, X1 and X2 designate two physical values and Y1, Y2 represent the corresponding integer values from the SENT message.

The resulting channel scaling in the CAN message can be viewed on the page "Message Mapping".

Example:

The following diagram shows the scaling of the data in conformity to SAE J2716 of JAN2010:

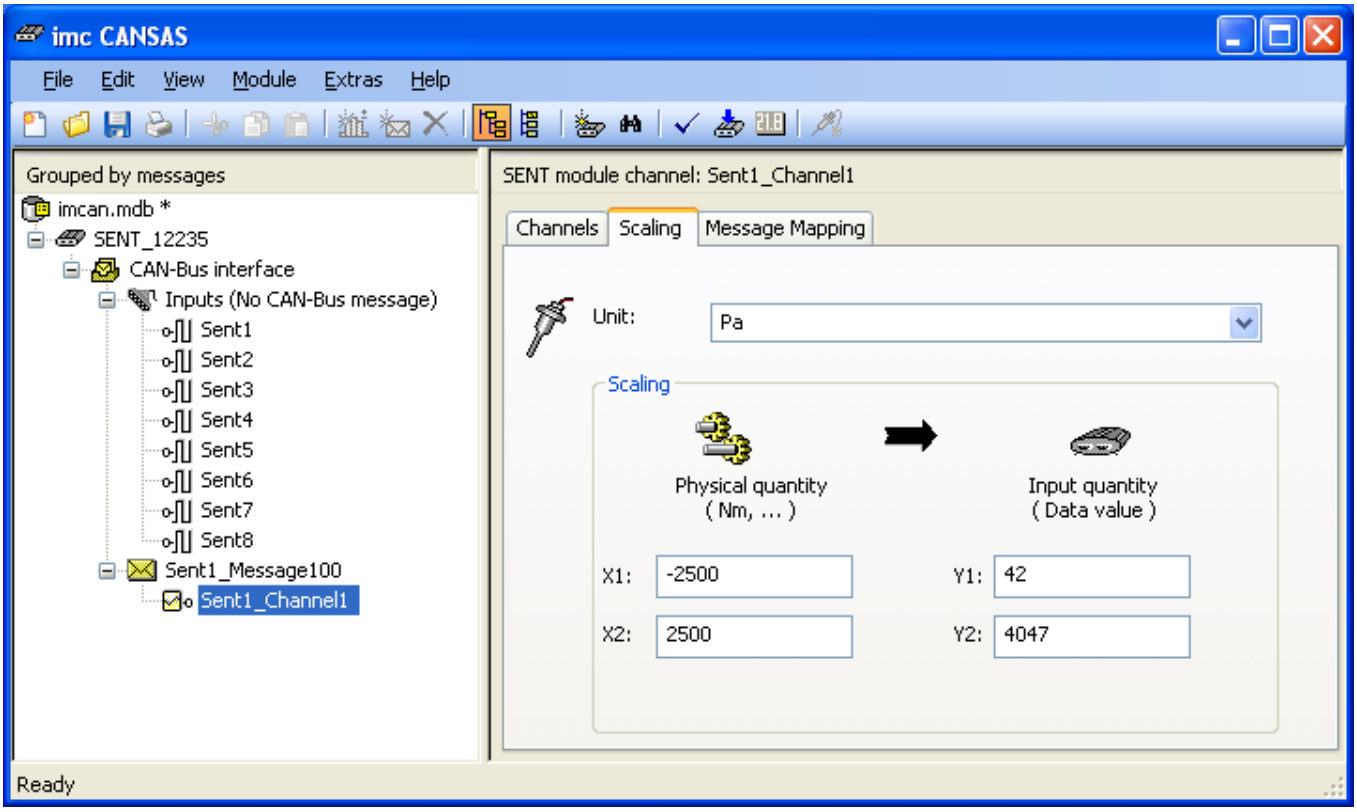


A relative pressure sensor has this characteristic curve:

12 bit SENT Values	Pressure [Pa]
42	-2500
4047	2500

This means, for instance, that the 12-bit integer 4047 transmitted in a SENT message corresponds to a pressure of 2500 Pa.

The following picture shows the scaling in the imc CANSAS GUI:



9.6.3.3 Format the CAN messages

For each SENT input, there is a CAN message containing all FAST channels. 1..4 FAST-channels can be configured. The FAST channels are obtained from the SENT message's 6 data nibbles. The CAN message is as large as all the extracted channels strung together. If, for instance, two channels (one with 12 bits, one with 8 bits) are extracted from the SENT message, then the CAN message is 20 = 8 + 12 bit long. The CAN message is sent immediately after arrival and verification of the SENT message. The CAN message's clock rate is derived from the clock rate at which the SENT messages are received. If the Status channel is activated, it is also appended to the CAN message with a width of 9 bits. The order of the channels in the CAN messages is always set automatically.

Note

The CAN message contains not simply a consecutive string of the 6 data nibbles, because a nibble order of LSN first produces a bit sequence which the typical CAN-Bus decoders are not able to evaluate.

For each SENT input, there is a CAN message containing the content of the Serial Protocol (SLOW channels). This CAN message is only generated if a Serial Protocol has been parameterized. The message structure is fixed. Initially the SLOW-channel's message-ID is positioned in the CAN message with a constant width of 16 bits. This channel's name, for instance, is Sent1_SerialControl for the 1st input. This channel is followed by the content of the SLOW channel, which is either 8, 12, or 16 bits wide, depending on the Serial Protocol's configuration. The CAN message is sent once a complete Serial Protocol data package has been constructed and verified. For this purpose, it is necessary for the CRC of the individual SENT messages to have been transmitted correctly, as well as that a sufficiently long series of SENT messages was transmitted, and also that the CRC via a serial communication media was transmitted correctly. This channel's name, for instance, is Sent1_SerialData for the 1st input.

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9.6.3.4 Timing of the CAN message

The timing of the CAN messages is primarily determined by the SENT sensors. Following completed reception and verification of a SENT messages, the CAN message is constructed and is thus ready for transmission on the CAN-bus. The intended sending time for the CAN message to one SENT sensor is independent of the sending time for the CAN message to a different SENT sensor. However, since in the case of conflicts, multiple CAN messages can not be transmitted simultaneously but only sequentially, the order of the CAN messages in time are mutually affected due to the limited capacity of the CAN-bus. In particular, of very many sensors are connected, there will be an appreciable delay. The imc CANSAS-SENT module transmits the CAN messages in the order of their respective intended sending times, or according to the order of the incoming SENT messages.

The module can send a maximum of about 5 CAN messages per 1ms. The limit depends to a certain degree mainly on the amount and complexity of FAST channels which have been parameterized. The CAN-bus' Baud rate must be set sufficiently higher to provide adequate transmission capacity on the bus.

9.6.3.5 Demands on the CAN-Bus

Example of demands on CAN capacities:

2 sensors are to be operated at a CANSAS-SENT module. Each delivers one SENT message every 3ms. Each sensor has a (14-bit) pressure channel and a (10-bit) temperature. Also, the Serial Protocol is to be evaluated.

On the CAN-bus, Standard-IDs are used at a Baud rate of 1 MBit/s.

The CAN message for a FAST channel has 14+10 = 24 bits of content. The module sends 2 such messages within 3ms.

The evaluation of the Serial Protocol Channels occurs after 16 FAST messages. Thus, every 3ms*16=48ms, one SLOW message per sensor is generated. The SLOW message has 16 (control) + 8 (data) = 24 bits of content. The module sends 2 such messages within 48 ms.

Total bus capacity demands for 47 bit overhead:

Message per 1 s	Total bits per message	Total bits in 1 s
2 * 1s / 3ms	47 + 24	47333
2 * 1s / 48ms	47 + 24	2958
	Sum	50291

CAN-Bus capacity demands = 50291 [bit / s] / 1000000 [bit / s]= 0.050 = 5.0%

If the CAN-bus is overburdened, it is possible to use the parameter "Reduction".

Note that the CAN-bus is not working at 100% capacity.

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9.6.3.6 Overloading the CAN-Bus

Since the imc CANSAS SENT module generates its CAN messages at the clock rate of the incoming SENT messages, a sufficiently high rate of SENT messages can cause overloading of the CAN-Bus. In particular, of the CAN messages are sent consecutively without any pause. In that case, other CAN-Bus subscribers having higher CAN-IDs (and correspondingly lower priority) may not succeed in sending their messages. That also occurs in the PC which configures the CANSAS. For instance, if the Master and Slave IDs are set to 2032 and 2033, respectively, they have bottom priority. So the PC itself is no longer able to communicate with the module via the CAN-bus. In consequence, there will be error messages upon any attempt to find or configure the CANSAS module.

Remedy:

- The CANSAS-module is configure with Master-ID = 2, Slave-ID = 3. These are the recommended CAN-IDs even for the Standard-Rack mode frequently used in CANSAS.
- The Baud rate should be set sufficiently high in any case.
- For sensors with a known high message rate, the parameter "Reduction" can be used.
- It may also help not to have all of the module's 8 inputs switched to active at once.

9.6.3.7 Special functions

If lines with SENT inputs are selected in the tree diagram on the left side of the GUI, then the tree's context menu contains an item for importing a SENT description file. From this file, the SENT input's settings are imported. If any detailed information on SLOW channels are also available, these are also saved (although not displayed). If imc CANSAS is used together with imc DEVICES or imc STUDIO, then the SLOW channel settings are applied. The validity of the SLOW channels is established on the basis of conditions for the SLOW channels' message-ID.

9.6.3.8 LEDs

A continuously flashing green LED indicates that the module is ready. When it flashes cyclically, the module has a power supply. Its CPU is working correctly.

For each channel there is one Status-LED

Display	Significance
LED off	No SENT sensor is connected, either no signal edges received, or too few which match the timing configured.
LED green	Consistent SENT messages received
LED flashing green	CRC of the SENT message incorrect

9.6.3.9 Pin configuration

DSUB-15 plug (female) IN 1..4 for inputs 1..4 and IN 5..8 for inputs 5..8.

Please find here the pin configuration. 612

10 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 Precautions for operation 19) 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.

The specifications always refer to the respective product. For peripheral components, the specifications of these peripheral components must also be observed. This applies in particular to safety-relevant properties.

Reference

Technical Specs 500 of the imc CANSAS*flex* (CANFX) modules
Technical Specs 473 of the imc CANSAS*fit* (CANFT) modules
Technical Specs 568 of the imc µ-CANSAS modules

10.1 CANFT

Properties and highlights of the CANFT modules

CAN bus:

- Configurable Baud-rate (max. 1 Mbit/s)
- Default configuration ex-factory: Baud rate=500 kbit/s and IDs: Master=2, Slave=3
- Galvanically isolated

Sampling rates and synchronization:

- Configurable CAN data rate
- Simultaneous sampling of all module's channels

Power supply:

- Wide range supply input, see technical specs 474
- LEMO.0B.305 sockets (IN / OUT) in conjunction with CAN bus signals

Onboard signal processing (depending on module type):

- Anti-Aliasing Filter (AAF) automatically adapted to the output rate
- Multi functional status LED, global or channel-wise (depending on module type)

Power consumption:

Module	Power consumption		Remarks
	Value typ.	min. / max.	
CANFT/DI-16	1.4 W @ 12 V	2.8 W	
CANFT/ENC-6	1.8 W @ 12 V	3.8 W	sensor supply not loaded
CANFT/T-10	1.3 W @ 12 V	1.6 W	
CANFT/UTI-6	1.8 W @ 12 V 6 W @ 12 V	<7.3 W	sensor supply not loaded sensor supply loaded
CANFT/HISO-T-8	1.6 W	<2.5 W	
CANFT/HISO-UT-6	1.9 W	<3.2 W	sensor supply not loaded sensor supply loaded
CANFT/HISO-HV-4	1.5 W	<1.8 W	

Operating conditions

No degree of protection class (IP code) is defined for the CANFT modules in the HISO series. The operating conditions that apply to the modules in the HISO series can be found in the following chapters, e.g. chapter HISO-UT-6 487.

The following technical data applies to CANFT modules that do not belong to the HISO series, e.g. UTI-6, T-10:

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP65	dust- and splash water proof (if closed, see CANFT Click-mechanism 34)
Operating temperature range	-40°C to +125°C	internal condensation temporarily allowed
Pollution degree	2	
Dimensions (L x W x H)	153 x 40 x 53 mm	including mounting flanges and click mechanism

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Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage		7 V to 50 V DC 9.5 V to 50 V DC	after power up upon power up
Power supply options	CAN/Power cable or via adjacent module		LEMO.0B, 5-pin module connector (click mechanism)

Max. number of modules for direct coupling (block size with click mechanism)		
Parameter	**Value**	**Remarks**
Max. number of modules	8	limited by termination of internal CAN bus backbone (click junction)
Pass through power limits for directly connected modules (click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	4 A	at 25 °C current rating of click connector
	-20 mA/K·ΔT_a	derating with higher operating temperatures T_a $\Delta T_a = T_a$ -25 °C
Max. power	48 W at 12 V DC 96 W at 24 V DC	equivalent pass through power at 25 °C typ. DC vehicle voltage AC/DC power adaptor and installations
	24 W at 12 V DC 48 W at 24 V DC	at +125 °C, Exception: with HISO-T-8 at +105 °C and with HISO-UT-6 at 85 °C

Available power for supply of additional modules via CAN-cable (LEMO.0B, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6.5 A	at 25 °C current rating of LEMO.0B connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-15 mA/K·ΔT_a	derating with higher operating temperatures T_a $\Delta T_a = T_a$ -25 °C
Max. power	78 W at 12 V DC 156 W at 24 V DC	equivalent pass through power at 25 °C typ. DC vehicle voltage AC/DC power adaptor and installations
	60 W at 12 V DC 120 W at 24 V DC	at +125 °C, Exception: with HISO-T-8 at +105 °C and with HISO-UT-6 at 85 °C

Unless otherwise indicated, the technical specs given are valid for all CANFT modules.

Reference

CANFT Click-mechanism 34

10.1.1 CANFT/DI-16

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Inputs	16	8 isolated groups of 2-bit channel
Measurement modes	voltage mode switch mode	configurable for each group separately
Interconnections	compatible connector type	recommended connector:
CAN / Supply	5-pin LEMO.0B	
Measurement input	7-pin LEMO.1B	LEMO.FEG.1B.307
Module connector	Click-connection (covering caps)	for the supply and system bus (CAN) of directly connected modules without further cables

Sampling rate		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	output rate of the CAN-Bus data, for all 16 inputs of the module

Differential input		
Parameter	**Value**	**Remarks**
Input configuration	differential	the common reference of a group is the respective -IN terminal
Isolation strength	±150 V	to system ground (housing) and between groups (tested at: 200 V)
Input voltage level	TTL, 24 V	configurable for each group separately
Overvoltage protection	±70 V	long-term, test voltage ±100 V (60 s) in voltage mode, only diff. voltages >-22 V are permitted in switch mode
Input impedance	2 MΩ	
Switch mode		measured between +IN and -IN of a channel
no-load voltage	max. 4 V	
short-circuit current	max. 800 µA	
Thresholds		
TTL (5 V)	1.4 V (±400 mV)	0 < 1 V, 1 > 1.8 V
24 V	8.1 V (±800 mV)	0 < 7.3 V, 1 > 8.9 V
switch mode	18 kΩ (±10 kΩ)	low-impedance contact at input = High

Reference

Module description CANFT/DI-16 248

Power supply, power consumption, max. number of modules and operating conditions 473

LEMO pin configuration:

measuring input 603

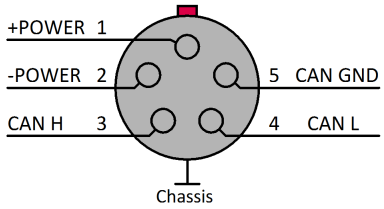
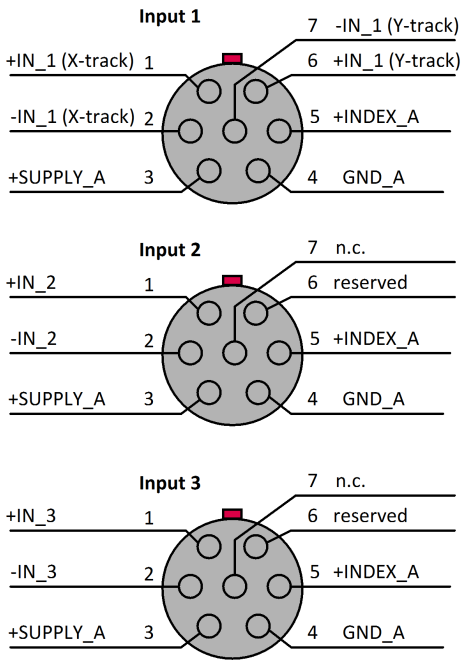
CAN / power supply 582

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10.1.2 CANFT/ENC-6

General

Input, measurement mode		
Parameter	**Value**	**Remarks**
Channels	6	2 isolated groups: each with 3 channels, additional index track and sensor supply
Measurement modes	RPM (rotational speed)	
	angle	differential, summarized, absolute (0..360°, with zero-impulse)
	velocity	
	displacement	differential, integrated with zero-impulse
	frequency	
	time	individually selectable edge for start/stop condition
	event-counter	differential, integrated
	PWM	
	missing tooth	RPM with interpolation of 1 or 2 missing teeth
Signal encoder types	single-track encoder	without direction detection; with / without zero-pulse; usable on inputs 1 to 6; all relevant modes
	dual-track encoder	with direction detection; with / without zero-pulse; 4-slope evaluation (quadrature) usable on inputs 1Y & 4Y
Zero-pulse (reference position)	separate index signal	fully conditioned index track for each group of 3 channels
Signal conditioning	differential amplifier filter detection threshold hysteresis	individually for all 6 channels

Connections		
Parameter	**Value**	**Remarks**
Inputs CAN / power supply Measurement input	compatible socket type LEMO.0B 5-pin LEMO.1B 7-pin	recommended plug FEG.0B.305 FEG.1B.307
LEMO pin configuration CAN and power supply:		
Measuring input:		

Pin	input 1, 4	input 2,3 5,6	
1	+IN (X)	+IN	inputs 1...3: isolated group A with INDEX_A, SUPPLY_A, GND_A
2	-IN (X)	-IN	
3	+SUPPLY	+SUPPLY	inputs 4...6: isolated group B with INDEX_B, SUPPLY_B, GND_B
4	GND	GND	
5	+INDEX	+INDEX	for inputs 1, 4 apply: also for dual-track encoder (X, Y),
6	+IN (Y)	reserved	
7	-IN (Y)	n.c.	INDEX: single-ended connection (reference: GND_A/B)

Note: Since the Index-signal can only be applied at one terminal per group, the pins allocated to the index track on the other two terminals must remain unconnected. In order to prevent picking up interference or additional damping of the signal due to cable capacitance, no unconnected lines should be connected to the open pins either.

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Sampling rate, Bandwidth, Filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	individual per channel configurable
Analog bandwidth	2 MHz	analog signal conditioning, -3 dB
Time resolution	10 ns 100 MHz clock	clock frequency of the counter for primary time measurement
Stability of primary oscillator	<100 ppm Ageing <5 ppm / year	100 MHz oscillator over full temperature range
Output format	16/32 Bit Integer	individual per channel configurable

Isolation		
Parameter	**Value**	**Remarks**
Isolation		no individual isolation of the channels among each other, but isolation of the channel groups among each other
CAN-bus	±60 V	test voltage: ±300 V (10 s)
power supply input	±60 V	test voltage: ±300 V (10 s)
analog input and sensor supply	±60 V	
channel-to-channel	±60 V	between channel groups
Isolated channel groups	2	each group with 3 channels, index and sensor supply; groups isolated among each other

Measurement mode

Analog Signal conditioning			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Number of fully conditioned input tracks	10		2 isolated groups with 3 channels each, 1 out of 3 is equipped with XY-tracks (quadrature), additional index track
Input configuration	differential single-ended		all x- and y-tracks index-track (reference: GND_A/B)
Input-voltage range	±12 V ±50 V		linear range max range
Overvoltage protection	±60 V		permanently
Input coupling	DC		
Input impedance	170 kΩ 8..10 kΩ		diff., linear range (±12V) with ±50 V input voltage
Common mode input voltage	max. ±20 V		referenced to GND_A/B
CMRR	70 dB 60 dB	50 dB 50 dB	DC, 50 Hz 10 kHz
Analog bandwidth	2 MHz		-3 dB
Analog filter	bypass (without filter) 20 kHz, 2 kHz, 200 Hz		configurable individually per channel Butterworth, 2. order
Detection threshold	-12 V to + 12 V		individually configurable for each channel identical for XY tracks
Hysteresis	min. 100 mV		configurable individually per channel
Switching delay	500 ns		signal: 100 mV square wave

Sensor supply				
Parameter	**Value**			**Remarks**
Configuration options	2 selectable settings 5 V / 12 V			selectable for each 3-channel-group (A/B): SUPPLY_A/B; groups galvanically isolated
Output voltage	voltage +5 V +12 V	current 100 mA 42 mA	power 0.5 W 0.5 W	total consumption for each 3-channel-group (A/B)
Short-circuit protection	unlimited duration			to output voltage reference ground (GND_A/B)
Accuracy of output voltage	2%			at terminals, no load over the entire temperature range

Module description CANFT/ENC-6 251.

Power supply, power consumption, max. number of modules and operating conditions 473

10.1.3 CANFT/HISO-T-8

General

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Inputs	8	
Measurement mode	temperature measurement by thermocouple	
Supported sensors	Thermocouple type K	
Connector / socket	compatible socket type	recommended plug
CAN / power supply	LEMO.0B 5-pin	FEG.0B.305
Grounding / potential compensation	M4	
Measuring input	LEMO Redel 2P, 8-pin, Code B	
Module connector	Click-connection (protected)	for the supply and system bus (CAN) of directly connected modules without further cables

Sampling rate, Bandwidth, Filter			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate		≤100 Hz	output rate of CAN bus data, configurable, individually per channel
Bandwidth	15 Hz		-3 dB; CAN output data rate = 100 Hz; anti-aliasing filter (AAF)
	2.5 Hz		0.1 dB
Filter			digital Filter
Type	low pass		
Characteristic	Butterworth, Bessel, Moving averaging (sinc), anti-aliasing filter		individual selectable; averaging and AAF: adapted automatically, according to selected output rate
Cut-off frequency	1 Hz to 200 Hz		
Order	2nd and 8th		selectable low pass filter
Anti-aliasing filter	Cauer 8th order with $f_{cut\text{-}off} = 0.4 \cdot f_s$		f_s: CAN output data rate and $f_s \geq 1$ Hz
Resolution	24 Bit		data output: 32 Bit FLOAT or 16 Bit INT

Isolation		
Parameter	**Value**	**Remarks**
Isolation	galvanically isolated	to system ground
CAN bus	±60 V	
power supply input	±60 V	
channel	1000 V	channel to channel, channel to CAN, channel to module power supply
measurement category	1000 V CAT I 600 V CAT II 300 V CAT III	working voltage according EN 61010-1, EN 61010-2-030, EN 60664-1
test voltage		according EN 61010-1, EN 60664-1
	4.4 kV RMS, 60 s	AC voltage test
	8 kV 1.2/50 µs	surge voltage test each measuring connector against chassis and all other inputs
pollution degree	2	according EN 61010-1, EN 60664-1

Coupling		
Parameter	**Value**	**Remarks**
Input coupling	DC	
Input configuration	isolated	differential

Status-LED		
Parameter	**Value**	**Remarks**
Power-LED (PWR)	bicolor	
green	power active	
Status-LED	multicolor	overall status of module
green	normal operating, run	
blue	init, etc.	
blue/orange	firmware update	
yellow	prepare configuration	
red	error	
Channel-Status-LED	bicolor	status for each channel
off	channel passive	
green	channel active	
red	over-range error	signal exceeding nominal range by 5 %

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Measurement Mode

Thermocouple measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sensor	Thermocouple type K		DIN EN 60854 [1]
Input range	-200 °C to +1300 °C -100 °C to 250 °C		output format: 16 Bit INT or FLOAT [2] output format: 16 Bit INT
Overvoltage protection	±200 V		protection of electronics against differential signal voltage
Input coupling	DC		
Input configuration	isolated		differential
Measurement error -200 °C to -150 °C -150 °C to -50 °C **-50 °C to 500 °C** 500 °C to 1300 °C Impact of the sensor impedance	 0,4 K 0,2 K **0,1 K** 0,3 K 0.0002 % / Ω · R_{TC}	 ±1,3 K ±0,7 K **±0,7 K** ±0,9 K	 of reading; resistance of sensor R_{TC} [3]
Drift	 + 0.0009 %/K · ΔT_a 0.02 K/K · ΔT_a		T = -150 °C to 1300 °C T_a = -20 °C to 90 °C of reading $\Delta T_a = \lvert T_a$ -25 °C$\rvert$
IMRR (Isolation mode rejection ratio)	0.003 K/V		50 V; 50 Hz; R_{TC} = 100 Ω thermocouple
Noise	0.01 K_{rms}		average filter 100 ms output format: FLOAT; -100 °C to 250 °C

Operating and environmental conditions

Parameter	Value	Remarks
Operating temperature range	-40°C to +105°C	internal condensation temporarily allowed (pollution degree 2)
Pollution degree	2	according DIN EN 61010-1, DIN EN 60664-1
External mechanical stress	IK07	
Shock- and vibration resistance	IEC 61373, IEC 60068-2-27 IEC 60062-2-64 category 1, class A and B	
Dimensions (L x W x H)	approx. 153 x 70 x 75 mm	including mounting flanges and click
Weight	approx. 0.7 kg	

1 Based on "International Temperature Scale of 1990" (ITS-90) For reasons of compatibility with older products, the range in the user interface is -270°C to 1370°C.

3 The specific cable resistance of NiCr/Ni (IEC-Standard) is approx. 0.5 Ω · mm^2/m.
(e.g. diameter = 0.8 mm; length = 3 m; resistance = 6 Ω)

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10.1.4 CANFT/HISO-UT-6

General

Inputs, measurement mode		
Parameter	**Value**	**Remarks**
Inputs	6	differential, analog
Measurement mode	voltage measurement voltage measurement active sensors (5 V) resistance measurement temperature sensor PT100/PT1000	 e.g. MEMS acceleration sensors series imc AC 4-wire
Connector / socket	compatible socket type	recommended plug
CAN / power supply	LEMO.0B 5-pin	FEG.0B.305
Grounding / potential compensation	M4	
Measuring input	LEMO Redel 2P, 8-pin, Code C	
Module connector	Click-connection (protected)	for the supply and system bus (CAN) of directly connected modules without further cables

Sampling rate, Bandwidth, Filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	CAN output data rate; configurable, individually per channel
Bandwidth	0 Hz to 400 Hz	-3 dB; CAN output data rate = 1 kHz; anti-aliasing filter (AAF)
Filter		digital filter
Characteristic	Moving average, Butterworth, Bessel, anti-aliasing filter	individual selectable; averaging and AAF: adapted automatically, according to selected output rate
Cut-off frequency	1 Hz to 200 Hz	-3 dB, in 1 - 2 - 5 steps
Order	2nd and 8th	selectable low pass filter
Anti-aliasing filter	Cauer 8th order with $f_{cut\text{-}off} = 0.4 \cdot f_s$	f_s: CAN output data rate $f_s \geq 1$ Hz
Resolution	24 Bit	data output: 32 Bit Float or 16 Bit Integer

Isolation		
Parameter	**Value**	**Remarks**
Isolation	galvanically isolated	to system ground
CAN-Bus	±60 V	
power supply input	±60 V	
channel	1000 V	channel to channel, channel to CAN, channel to module power supply
measurement category	1000 V CAT I 600 V CAT II 300 V CAT III	working voltage according EN 61010-1, EN 61010-2-030, EN 60664-1
test voltage		according EN 61010-1, EN 60664-1
	4.4 kV RMS, 60 s	AC voltage test
	8 kV 1.2/50 µs	surge voltage test each measuring connector against chassis and all other inputs
pollution degree	2	according EN 61010-1, EN 60664-1

Coupling		
Parameter	**Value**	**Remarks**
Input coupling	DC	
Input configuration	isolated	differential

Status-LED		
Parameter	**Value**	**Remarks**
Power-LED 	bicolor	
green	power active	
Status-LED 	multicolor	overall status of module
green	operating, run	
blue	init, firmware update etc.	
yellow	prepare configuration	
red	error	
Channel-Status-LED	bicolor	status for each channel
off	channel passive	
green	channel active	
red	over-range error	signal exceeding nominal range by 5 %

Sensor supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Output voltage	+5 V		arbitrary for each channel
Error of output voltage		-2 % to +10 %	
Output current	8 mA	>7 mA	
Output power per channel		34 mW	
Capacitive load	0 to 1 mF		
Output impedance	30 Ω		

Measurement modes

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±100 V, ±50 V, ±25 V, ±10 V, ±5 V, ..., ±25 mV		
Max. Over Voltage	±200 V		differential input voltage
Input impedance	1 MΩ 20 MΩ	±1% ±1%	measurement ranges ≥±5 V measurement ranges ≤±2.5 V
Gain error		0.02% + 0.002%/K·ΔT_a	of reading $\Delta T_a = \lvert T_a - 25°C \rvert$
Offset error		0.02% or 10 µV + 0.001%/K·ΔT_a	of range, sensor supply voltage = 0 V whichever is greater $\Delta T_a = \lvert T_a - 25°C \rvert$
IMRR (Isolation mode rejection ratio)	 -125 dB -152 dB		50 Hz measurement ranges ≥±5 V measurement ranges ≤±2.5 V
Noise	 75 μV_{rms} 1.6 μV_{rms} 1 μV_{rms} 0.7 μV_{rms}		sampling rate = 1 kHz; filter = AAF; resolution = 32 bit float; ranges: 100 V, ..., 5 V 2.5 V 1 V 500 mV, ..., 25 mV

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Resistance measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	100 kΩ, 50 kΩ, 25 kΩ, 10 kΩ, ..., 100 Ω		50 Ω .. 10 Ω on request
Gain error		 0.02% 0.002%/K·ΔT_a	of the measured value ΔT_a=|T_a -25°C|
Offset error		 0.01% 0.003%/K·ΔT_a	of range range = 100 kΩ to 100 Ω ΔT_a=|T_a -25°C|

SNR	
	-82 dB
	
	-100 dB
	
	-104 dB
			bandwidth = 400 Hz; filter = AAF
			range = 100 kΩ;
			signal: 1%..100% of range
			range = 10 kΩ;
			signal: 1%..100% of range
			range = 1 kΩ

RTD measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Temperature sensors	Resistance Temperature Detectors (RTDs) PT100, PT1000		4-wire configuration
Input range	-200°C to 850°C -50°C to 150°C		output format: 16 Bit INT or FLOAT output format: 16 Bit INT
Overvoltage protection	±60 V		
Supply Current	0.88 mA 0.7 mA		PT100; P_{dis}<0.3 mW PT1000; P_{dis}<1.9 mW
Measurement error			
-200°C to 0°C	0.001 K	0.05 K	
0°C to 100°C	0.001 K	0.1 K	
100°C to 300°C	0.002 K	0.18 K	
300°C to 500°C	0.003 K	0.25 K	
500°C to 850°C	0.006 K	0.4 K	
Noise, SNR	 0.005 K_{rms} <1 LSB		average filter 100 ms output format: Float; 850°C output format: 16 Bit Integer; 850°C

Operating conditions

Parameter	Value	Remarks
Operating temperature range	-40°C to +85°C	internal condensation temporarily allowed (pollution degree 2)
Pollution degree	2	according DIN EN 61010-1, DIN EN 60664-1
External mechanical stress	IK07	
Shock- and vibration resistance	IEC 61373, IEC 60068-2-27 IEC 60062-2-64 category 1, class A and B	
Dimensions (L x W x H)	approx. 153 x 70 x 75 mm	including mounting flanges and click mechanism
Weight	approx. 0.7 kg	

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10.1.5 CANFT/HISO-HV-4

General

Inputs, measurement mode		
Parameter	**Value**	**Remarks**
Inputs	4	differential, analog
Measurement mode	voltage measurement	
Connector / socket	compatible socket type	recommended plug
CAN / power supply	LEMO.0B 5-pin	LEMO FEG.0B.305
Grounding / potential compensation	M4	
Measuring input	4 mm safety laboratory sockets	4 mm safety laboratory plugs
Module connector	Click-connection (protected)	for the supply and system bus (CAN) of directly connected modules without further cables

Sampling rate, Bandwidth, Filter			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate	≤1 kHz		CAN output data rate; configurable, individually per channel
Bandwidth	0 Hz to 400 Hz		-3 dB; CAN output data rate = 1 kHz; anti-aliasing filter (AAF)
Filter			digital filter
Cut-off frequency	1 Hz to 200 Hz		-3 dB, in 1 - 2 - 5 steps
Characteristic	Moving average, Butterworth, Bessel, anti-aliasing filter		individual selectable; averaging and AAF: adapted automatically, according to selected output rate
Order	8th		low pass filter
Anti-aliasing filter	Cauer 8th order with $f_{cut\text{-}off} = 0.4 \cdot f_s$		f_s = CAN output data rate ≥ 1 Hz
Resolution	24 Bit		data output: 32 Bit Float or 16 Bit Integer

Isolation		
Parameter	**Value**	**Remarks**
Isolation	galvanically isolated	to system ground
CAN-Bus	±60 V	
power supply input	±60 V	
channel	1000 V	channel to channel, channel to CAN, channel to module power supply
measurement category		working voltage according to EN 61010-1, EN 61010-2-30
	1000 V CAT II 600 V CAT III 300 V CAT IV	
test voltage		according EN 61010-1
	5.4 kV RMS	AC voltage test
	9.6 kV 1.2/50 µs	surge voltage test
pollution degree	2	according EN 61010-1, EN 60664-1

Coupling		
Parameter	**Value**	**Remarks**
Input coupling	DC	
Input configuration	isolated	differential

Status-LED		
Parameter	**Value**	**Remarks**
Power-LED	bicolor	
green	power active	
Status-LED	multicolor	overall status of module
green	normal operating, run	
blue	init, etc.	
blue/orange	firmware update	
yellow	prepare configuration	
red	error	
Channel-Status-LED	bicolor	status for each channel
off	channel passive	
green	channel active	
red	over-range error	signal exceeding nominal range by 5 %

Reference

CANFT/HISO-HV-4 description 279

Measurement mode

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±1500 V, ±1000 V, ±500 V, ±250 V, ±100 V, ±50 V		
Max. Over Voltage	±2000 V		overload of differential measurement input
Input impedance	20 MΩ || 4 pF	±2%	
Gain error		0.05% + 0.005%/K·ΔT_a	of reading $\Delta T_a = \lvert T_a - 25°C \rvert$
Offset error		0.05% + 0.0005%/K·ΔT_a	of range $\Delta T_a = \lvert T_a - 25°C \rvert$
IMRR (Isolation mode rejection ratio)	84 dB		50 Hz
Noise, SNR	 121 dB 115 dB 115 dB 115 dB 108 dB 102 dB		sampling rate = 1 kHz; filter = AAF; resolution = 32 bit Float; ranges: 1500 V 1000 V 500 V 250 V 100 V 50 V

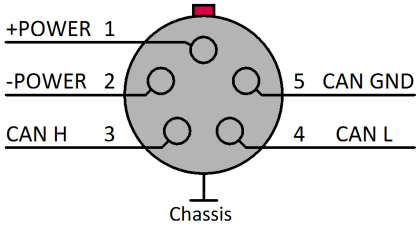
Operating conditions

Parameter	Value	Remarks
Operating temperature range	-40°C to +85°C	internal condensation temporarily allowed (pollution degree 2)
Pollution degree	2	according DIN EN 61010-1, DIN EN 60664-1
External mechanical stress	IK08	
Shock- and vibration resistance	IEC 61373, IEC 60068-2-27 IEC 60062-2-64 category 1, class A and B	
Weight	approx. 0.7 kg	
Dimensions (L x W x H)	approx. 153 x 72 x 73 mm	including mounting flanges and click mechanism

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10.1.6 CANFT/T-10

General

Inputs, measurement mode		
Parameter	**Value**	**Remarks**
Inputs	10	
Measurement mode	temperature measurement	thermocouple measurement
Connector / socket	compatible socket	recommended plug
Measuring input	miniature thermocouple terminal socket 2-pin, female	miniature thermocouple terminal connector 2-pin, male
CAN / power supply	LEMO.0B 5-pin	FEG.0B.305
		
Module connector	Click-connection (covering caps)	For the supply and system bus of directly connected modules without further cables.

Sampling rate, Bandwidth			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate		≤100 Hz	configurable, individually per channel
Bandwidth	33 Hz 5 Hz		-3 dB 0.1 dB
Resolution	24 Bit		output format: 16 Bit INT or 32 Bit FLOAT

Isolation			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation	galvanically isolated		
CAN-Bus	±60 V		test voltage: ±300 V (10 s)
power supply input	±60 V		test voltage: ±300 V (10 s)
analog input	±60 V		test voltage: ±300 V (10 s)
channel-to-channel	±60 V		test voltage: ±300 V (10 s)

Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage		7 V to 50 V DC 9.5 V to 50 V DC	operating upon power up under conditions of IP65 (humidity): max. 35 V
Power consumption	1.3 W	1.6 W	max. at input voltage 50 V
Power supply options	CAN/Power cable or via adjacent module		LEMO.0B, 5-pin module connector (click mechanism)

Status-LED		
Parameter	**Value**	**Remarks**
Power-LED	bicolor	
green	power active	
Status-LED	multicolor	overall status of module
green	operating, run	
blue	init, firmware update etc.	
yellow	prepare configuration	
red	error	
Channel-Status-LED	bicolor	
off	channel passive	
green	channel active	channel number (1..10) lights up and indicates individual channel status
red	sensor break / over-range error	

Measurement mode

Temperature measurement - thermocouple, module variant: CANFT/T-10[-TYP]			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement mode	thermocouple type K, J, T, N type K, J, T, E, L, N, C, S, R		 fix-variant: T-10-K, T-10-J, T-10-T, T-10-N universal variant: T-10 (UNI) max. 2 types simultaneously in the same configuration
Input ranges	-270 °C to +1370 °C -210 °C to +1200 °C -270 °C to +400 °C -270 °C to +950 °C -200 °C to +900 °C -270 °C to +1300 °C 0 °C to +2320 °C -50 °C to +1760 °C -50 °C to +1760 °C		type K type J type T type E type L type N type C (W5Re/W26Re) type S type R output format: 16 Bit INT or 32 Bit FLOAT
	-100°C to +250°C		additional for all variants, output format: 16 Bit INT
Input coupling	DC		
Input configuration	differential, isolated		
Input impedance		>850 kΩ	
Measurement error	±0.25 K	±0.5 K	-150°C up to upper measurement limit at 25°C
Measurement error type S, type R	±0.5 K	±1.0 K	+500 °C up to the upper measurement limit at 25 °C
Deviation of cold junction compensation module variant: T-10-K, T-10-T, T-10-J, T-10-N module variant: T-10 (UNI)		 ±0.25 K ±0.5 K ±0.5 K ±0.75 K	 operating temperature -20°C to +105°C other operating temperatures operating temperature -20°C to +105 °C other operating temperatures
Drift	±8 ppm/K·ΔT_a +60 nV/K·ΔT_a		relating to the measured thermo voltage $\Delta T_a = \lvert T_a - 25°C \rvert$
Noise	1.6 μV_{rms}		max. bandwidth
Common Mode Rejection Ration CMRR	140 dB		

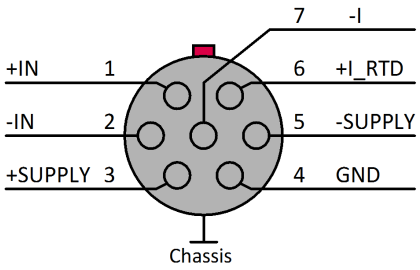
Reference

Module description CANFT/T-10 262.
Power supply, power consumption, max. number of modules and operating conditions 473
LEMO pin configuration: CAN / power supply 582

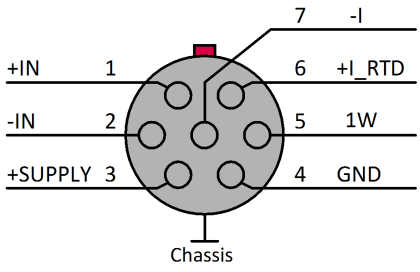
10.1.7 CANFT/UTI-6

General

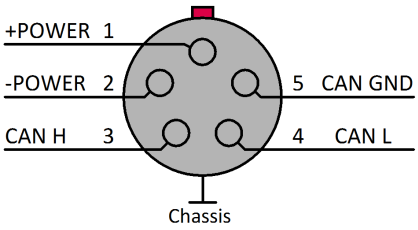
Inputs, measurement mode			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Inputs	6		
Measurement mode	voltage current resistance temperature PT100/PT1000		 4-wire
Connector / socket	compatible socket type		recommended plug
CAN / power supply	LEMO.0B 5-pin		FEG.0B.305
Measuring input	LEMO.1B 7-pin		FEG.1B.307
LEMO pin configuration	measuring input		CAN / power supply
Module connector	Click-connection (covering caps)		for the supply and system bus (CAN) of directly connected modules without further cables
TUID Transducer Unique Identifier	similar to IEEE 1451.1 TEDS		with CANFT/UTI-6-TEDS; read only single wire interface: 1W



UTI-6-SUP



UTI-6-TEDS



Sampling rate, Bandwidth, Filter			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate		≤1 kHz	CAN output rate of the CAN-Bus data, individually per channel
Bandwidth	0 Hz to 400 Hz		CAN output rate: 1 kHz, AAF Filter
Filter			
Type	low pass		
Characteristic	Butterworth, Bessel, averaging filter (sinc), AAF		individual selectable; mean and AAF: adapted automatically, according to selected output rate
Cut-off frequency	1 Hz to 200 Hz		-3 dB, 1 - 2 - 5 steps
Order	2nd and 8th		selectable low pass filter
Anti-aliasing filter	Cauer 8th order with $f_{cut-off} = 0.4 \cdot f_s$		f_s: output rate, for $f_s \geq 1$ Hz
Resolution	24 Bit		output: 32 Bit Float or 16 Bit Integer

Reference

LEMO pin configuration:

measuring input 602
CAN / power supply 582

Please find in the following chapter the technical specs of the operating conditions and the power consumption 473.

Please find here the description of the UTI-6 264

Isolation		
Parameter	**Value**	**Remarks**
Isolation	galvanically isolated	to case (CHASSIS) and between functional units
CAN-Bus	±60 V	test voltage: ±300 V (10 s)
power supply	±60 V	test voltage: ±300 V (10 s)
Analog input channels	±60 V	analog input and sensor supply
Channel-to-channel	±60 V	

Sensor supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Output voltage UTI-6-SUP	±15 V, ±12 V, ±10 V, ±7.5 V, ±5 V, ±4 V, ±3.5 V, ±3.3 V, ±3 V, ±2.5 V		referenced to GND; arbitrary for each channel
Output voltage UTI-6-TEDS	+15 V, +12 V, +10 V, +7.5 V, +5 V, +4 V, +3.5 V, +3.3 V, +3 V, +2.5 V		referenced to GND; arbitrary for each channel
Short-Circuit-Proof	unlimited duration		protection for module and each channel
Error of output voltage		±2% 0.01%/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Max. Output current	150 mA		
Output power per channel per module		 0.5 W 0.4 W 2 W	 bipolar supply with symmetric load unipolar supply or asymmetric load
Output impedance	0.6 Ω		

Measurement modes

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±60 V, ±50 V, ±25 V, ±10 V, ±5 V, ±2.5 V, ±1 V to ±25 mV		
Max. Over Voltage	±200 V		differential input voltage
Input coupling	DC		
Input impedance	1 MΩ 20 MΩ	±1% ±1%	measurement ranges ≥±5 V or device off measurement ranges ≤±2.5 V
Gain error	 0.008% + 0.0004%/K·ΔT_a	 0.02% + 0.001%/K·ΔT_a	of reading $\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Offset error	 0.003% + 0.00006%/K·ΔT_a	 0.02% or 10 µV + 0.001%/K·ΔT_a	of range whichever is greater $\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Noise	 75 μV_{rms} 1.8 μV_{rms} 1.2 μV_{rms} 0.8 μV_{rms}		sampling rate = 1 kHz; filter = AAF; resolution = 32 bit float; ranges: 60 V, ..., 5 V 2.5 V 1 V 500 mV, ..., 25 mV

Current measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±20 mA		

Current measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overload	±100 mA		
Input coupling	DC		
Input impedance	25 Ω	±1%	
Gain error		0.02% + 0.002%/K·ΔT_a	of the measured value ΔT_a=|T_a -25°C|; with T_a = ambient temperature
Offset error		2 µA + 4 nA/K·ΔT_a	of range ΔT_a=|T_a -25°C|; with T_a = ambient temperature
Noise	30 nA_{rms}		bandwidth = 400 Hz; filter = AAF

Resistance measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	100 kΩ, 50 kΩ, 25 kΩ, 10 kΩ, ..., 100 Ω		
Overvoltage protection	±30 V		
Input coupling	DC		
Gain error		0.02% + 0.002%/K·ΔT_a	of the measured value ΔT_a=|T_a -25°C|; with T_a = ambient temperature
Offset error		0.01% + 0.003%/K·ΔT_a	of range ΔT_a=|T_a -25°C|; with T_a = ambient temperature

SNR	
	-82 dB
	
	-100 dB
	
	-104 dB
			bandwidth = 400 Hz; filter = AAF
			range = 100 kΩ;
			signal: 1%..100% of range
			range = 10 kΩ;
			signal: 1%..100% of range
			range = 1 kΩ

RTD measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Temperature Sensors	Resistance Temperature Detectors (RTDs) PT100, PT1000		4-wire configuration
Input range	-200°C to 850°C -50°C to 150°C		output format: 16 Bit INT or FLOAT output format: 16 Bit INT
Overvoltage protection	±60 V		
Input coupling	DC		
Supply Current	0.88 mA 0.7 mA		PT100; P_{dis}<0.3 mW PT1000; P_{dis}<1.9 mW
Measurement error PT100, PT1000 -200°C to 0°C 0°C to 100°C 100°C to 300°C 300°C to 500°C 500°C to 850°C	 0.001 K 0.001 K 0.002 K 0.003 K 0.006 K	 0.05 K 0.1 K 0.18 K 0.25 K 0.4 K	
Noise, SNR	0.005 K_{pk-pk} -117 dB <1 LSB		100 ms sampling rate, average filter output format: Float; 850°C output format: 16 Bit Integer; 850°C

Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage		7 V to 50 V DC 9.5 V to 50 V DC	operating upon power up under conditions of IP65 (humidity): max. 35 V
Power consumption	1.8 W @ 12 V 6 W @ 12 V	<7.3 W	sensor supply not loaded sensor supply loaded
Power supply options	CAN/Power cable or via adjacent module		LEMO.0B, 5-pin module connector (click mechanism)

Please find here the description of the UTI-6 264
Please find in the following chapter the technical specs of the operating conditions of the CANFT module series and the power consumption 473.

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10.2 CANFX

Properties and capabilities

CAN bus:

- Configurable Baud rate (max. 1 Mbit/s)
- Default configuration ex-factory: Baud rate=125 kbit/s and IDs: Master=2, Slave=3
- Galvanically isolated
- Built-in terminator resistance, manually switchable

Sampling rates and synchronization:

- Configurable CAN data rate
- Simultaneous sampling of all module's channels, as well as across multiple modules
- Synchronization of multiple modules as well as to a global CAN-logger: based on CAN messages (no Sync signal required)

Power supply:

- Galvanically isolated power supply input
- DC 10 V to 50 V
- LEMO.0B connector (2-pin); alternative power supply via CAN connector (DSUB-9)

On-board signal processing:

- "Virtual channels": integrated signal processor (DSP) for online processing. Data reduction, filtering, scaling, calculations, threshold monitoring, etc.
- Programmable multi-functional status-LED, supporting linkage to virtual channels

Heartbeat-message:

- Configurable with cyclical "life-sign", e.g. for integrity check purposes in test rigs
- Contains checksum for configuration and serial number, e.g. for consistency monitoring (checking of whether the correct module is still being used, for instance in installations undergoing maintenance)

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Shock resistance	40 g (pk over 5 ms)	
Operating temperature range	-40°C to +85°C	unless otherwise indicated in the data sheet of your module

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		imc CANSAS*flex* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a - 25°C$
Max. power		Equivalent pass through power at 25°C
	96 W at 12 V DC 192 W at 24V DC	typ. DC vehicle voltage AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-30 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a - 25°C$
Max. power		Equivalent pass through power at 25°C
	72 W at 12 V DC 144 W at 24 V DC	typ. DC vehicle voltage AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C

Unless otherwise indicated, the technical specs given are valid for all CANFX modules.

Reference

CANFX Click-mechanism 39

10.2.1 C8

Channels, measurement modes, terminal connection		
Parameter	**Value**	**Remarks**
Inputs	8	
Measurement modes DSUB	voltage measurement current measurement temperature measurement thermocouples PT100	voltage plug (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) thermo plug (ACC/DSUBM-T4)
Measurement modes LEMO	voltage measurement current measurement RTD	with external shunt
Measurement mode Thermocouple terminal socket (-2T)	thermocouple type-K	miniature thermocouple terminal
Measurement mode BNC (-BNC)	voltage measurement	
Terminal connection	2x DSUB-15 / 4 channels or 8x BNC or 8x 2-pin thermocouple terminal sockets 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)	inputs only for voltage measurement only for type K thermocouple measurement CAN (in / out), supply (alternatively) supply
Terminal connection for SL Inputs CAN (in / out) inputs CAN (in / out) DC power supply	 2 x DSUB-15/ 4 channels 2x DSUB-9 8x 7-pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	 CANSAS-SL-C8-D, (-SUPPLY) power supply (alternatively) CANSAS-SL-C8-L, (-SUPPLY) power supply (alternatively) for all SL models

Sampling rate, bandwidth		
Parameter	**Value**	**Remarks**
Sampling rate	≤100 Hz	per channel
Bandwidth	20 Hz 10 Hz	-3 dB (voltage measurement) -3 dB (temperature measurement)

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation CAN-Bus power supply input analog input	 ±60 V ±60 V no isolation		output to case (CHASSIS) nominal; testing voltage:300 V (10 s) nominal; testing voltage:300 V (10 s) analog reference ground:CHASSIS
Overvoltage protection	 ±250 V	±80 V	permanent channel to chassis <1 ms

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV … ±5 mV		
Input impedance	1 MΩ 492 kΩ 79 kΩ	±1% >135 kΩ >75 kΩ	differential ±60 V to ±2 V ±1 V to ±50 mV ±20 mV to ±5 mV
Gain error	0.01%	≤0.05% ≤0.02% ≤0.05%	of reading ±60 V to ±200 mV ±100 mV to ±20 mV ±10 mV to ±5 mV
Gain drift	5 ppm/K·ΔT_a	±20 ppm/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; ambient temperature T_a
Offset error	0.005% 0.005% 0.02%	≤0.05% ≤0.01% ≤0.06%	of input range ±60 V to ±200 mV ±100 mV to ±20 mV ±10 mV to ±5 mV
Offset drift	±4 µV/K ±0.07 µV/K	<±12 µV/K <±0.16 µV/K	±60 V to ±2 V ±1 V to ±5 mV
Common mode voltage ±50 V to ±2 V ±1 V to ±5 mV	 50 V 2 V	 <30 V <1 V	with differential input voltage: ±50 V ±1 V
Common mode rejection ratio (CMRR) ±60 V to ±2 V ±1 V to ±5 mV ±1 V to ±5 mV	 70 dB 120 dB 100 dB	 >54 dB >100 dB	common mode test voltage ±50 V ±1 V with C8-BNC variant
Noise	51 nV_{rms} 305 nV_{pkpk}		range ±5 mV, sampling rate 100 Hz, R_{source} = 50 Ω

Temperature measurement - thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement mode	J, T, K, E, N, S, R, B		
Measurement range	-50°C to 400°C -50°C to 150°C -270°C to 1370°C		type K
Resolution	0.025 K 0.0031 K		type K -270°C to 1370°C -50°C to 150°C
Error thermocouples	±0.2 K	<±0.5 K	types J, T, K, E, L (for all other types, the voltage measurement error applies)
drift	±0.02 K/K·ΔT_a		$\Delta T_a = \lvert T_a - 25°C \rvert$ ambient temperature T_a
Error of cold junction compensation		<±0.15 K <±0.5 K	 C8-2T

Temperature measurement - thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Drift of cold junction	±0.001 K/K·ΔT_j		$\Delta T_j = \lvert T_j - 25°C \rvert$; cold junction T_j
Input impedance	100 kΩ		differential
Signal-noise ratio		>85 dB	bandwidth 10 Hz

Temperature measurement - RTD (PT100)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement range	-200°C to 850°C, -50°C to 150°C		resolution: ≈0.016 K,≈0.003 K
Error		<±0.2 K <±0.1 K <±0.05%	-200°C to 850°C, four-wire connection -50°C to 150°C, four-wire connection corresponding resistance
Drift		±0.01 K/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$ ambient temperature T_a
PT100 sensor feed	625 µA		
Input impedance	20 MΩ	±1%	differential

Optional sensor supply (CAN-xx-SUPPLY)				
Parameter	**Value**			**Remarks**
Configuration options	7 selectable settings			
Output voltage	voltage	current	net power	set globally for all channels of a module
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Isolation				
standard	non isolated			output to case (CHASSIS)
optional, upon request	isolated			nominal rating: 50 V, test voltage (10 sec): 300 V
Short-circuit protection	unlimited duration			to output voltage reference ground
Accuracy of output voltage				at terminals, no load
	<0.25% (typ.) / <0.5% (max.)			25°C; 2.5 V to 24 V
	<0.9% (max.)			over entire temperature range
Max. capacitive load	>4000 µF			2.5 V to 10 V
	>1000 µF			12 V, 15 V
	>300 µF			24 V

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Supply voltage	10 V to 50 V DC		
Power consumption		<2.5 W	

Module description C8 281 and please observe CANFX specific Specs 500, e.g. power supply options

10.2.2 CI8

Channels, Measurement modes		
Parameter	**Value**	**Remarks**
Channels	8	
Measurement modes DSUB	voltage measurement current measurement temperature measurement thermocouples temperature measurement PT100 temperature measurement PT1000 resistance measurement current fed sensors	voltage plug (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) thermo plug (ACC/DSUBM-T4) only with standard variant only with PT1000 variant not supported with PT1000 variant IEPE/ICP expansion plug (ACC/DSUB-ICP4)
	temperature measurement PT100	CANFX/L-CI8-PT CI8-PT variant does not support thermocouple or current measurement
Measurement modes LEMO and ITT Veam (-L, -V)	voltage measurement current measurement temperature measurement PT100 / PT1000 resistance measurement	 PT1000 variant upon request not supported with PT1000 variant
Measurement mode Thermocouple terminal socket (-2T)	thermocouple type-K	miniature thermocouple terminal
Measurement modes Phoenix-plug (-PH)	voltage measurement RTD (PT100) in 4-wire-configuration	
Measurement mode BNC (-BNC)	voltage measurement	

Sampling rate, bandwidth, filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel
Bandwidth	440 Hz	-3 dB without lowpass filter
Filter cutoff frequency filter characteristic	1/6 of sampling rate	digital lowpass, Butterworth, Bessel 2.order
TEDS - Transducer Electronic DataSheets	conformant to IEEE 1451.4 Class II MMI	esp. with ACC/DSUBM-TEDS-xx (DS2433)
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 TPDOs in INT16, INT32, and FLOAT	

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation:	galvanically isolated		channel to case (housing, CHASSIS, case) and channel-to-channel
CAN-Bus	±60 V		nominal; testing voltage: 300 V (10 s)
power supply input	±60 V		nominal; testing voltage: 300 V (10 s)
analog input	±60 V		nominal; testing voltage: 300 V (10 s)
Overvoltage protection	±60 V		differential input voltage (continuous)
	ESD 2 kV		human body model
	transient protection: automotive load dump ISO 7637		R_i=30 Ω, t_d=300 µs, t_r<60 µs
Input coupling	DC		
Input configuration	differential, isolated		galvanically isolated to System-GND (case, CHASSIS)
Input impedance	6.7 MΩ		ranges ≤±2 V)
	1 MΩ		ranges ≥±5 V an device powered-down
	50 Ω		with shunt-plug (ACC/DSUBM-I4) respectively current input (-L, -V)
Input current			
operating conditions		1 nA	at operating conditions
on overvoltage condition		1 mA	$\|V_{in}\|$ >5 V on ranges <±5 V or device powered-down
Auxiliary supply			for IEPE/ICP plug
voltage	5 V	±5%	independent of optional
available current	>0.26 A	>0.2 A	sensor supply, short circuit proof
internal resistance	1.0 Ω	<1.2 Ω	power per DSUB-plug

Voltage measurement				
Parameter	**Value typ.**	**min. / max.**	**Remarks**	
Input ranges	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV, ±50 mV, ±20 mV			
Gain error	<0.025%	<0.05%	of the measured value, at 25°C	
Gain drift		0.0006%/K·ΔT_a	ranges ≤±2 V	over full temperature range
		0.005%/K·ΔT_a	ranges ≥±5 V ΔT_a=|T_a –25°C|	
Offset error	0.02%	0.05%	of range	
Offset drift		0.00025%/K·ΔT_a	over full temperature range	
Non-linearity	<40 ppm	<60 ppm	range ±10 V	
Input voltage noise	7.2 μV_{rms}		range ±20 mV	sampling rate 1 kHz, R_{source} = 0 Ω
	36 μV_{pkpk}			
IMR (isolation mode rejection)	>145 dB (50 Hz)		range ≤±2 V	R_{source} = 0 Ω
	>70 dB (50 Hz)		range ≥±5 V	
Channel isolation	>1 GΩ, <40 pF		channel-to-ground / protection ground	
	>1 GΩ, <10 pF		channel-to-channel	

Voltage measurement				
Parameter	**Value typ.**	**min. / max.**	**Remarks**	
Channel isolation (crosstalk) channel-to-channel	>165 dB (50 Hz) >92 dB (50 Hz)		range ≤±2 V range ≥±5 V	R_{source}≤100 Ω

Current measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Current input ranges	±20 mA, ±10 mA		
Shunt impedance	50 Ω		DSUB variant: shunt-plug LEMO/ITT Veam variant: internal shunt
Gain error	<0.07% <0.025%	<0.15% <0.05%	DSUB variant LEMO/ITT Veam variant
Offset error		2.4 µA	
Offset drift		0.00025%/K·ΔT_a	over full temperature range

Temperature measurement - thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement mode	R, S, B, J, T, E, K, L, N		
Measurement range	-50°C to 400°C -50°C to 150°C -270°C to 1370°C		type K
Resolution	0.063 K (1/16K)		
Measurement error		<±1.0 K	type K
Temperature drift	±0.02 K/K·ΔT_a		ΔT_a= |T_a-25°C| ambient temperature T_a
Error of cold junction compensation temperature drift	 ±0.001 K/K·ΔT_j	<±0.15 K <±0.5 K	ACC/DSUBM-T4 variant CI8-2T ΔT_j= |T_j-25°C| cold junction temperature T_j

Temperature measurement – RTD (PT100/ PT1000)		
Parameter	**Value**	**Remarks**
Measurement modes	PT100 PT1000	standard variant special variant only: PT1000 instead of PT100 mode
Measurement range	-50°C to +150°C -200°C to +850°C	
Resolution	0.063 K (1/16 K)	
Measurement error	<±0.2 K <±0.05%	–200°C to +850°C, 4-wire connection corresponding resistance
Temperature drift	±0.01 K/K· ΔT_a	ΔT_a=|T_a-25°C|; ambient temp. T_a
Sensor feed (PT100 and resistance measurement)	250 µA	
Sensor feed (PT1000 variant)	50 µA	special variant PT1000

Resistance measurement		
Parameter	**Value**	**Remarks**
Measurement range	1 kΩ, 500 Ω, 250 Ω, 150 Ω	for variant with DSUB-15 sockets: max. usable range 500 Ω (limited voltage swing of reference current source) with PT1000 variant there is no resistance measurement available
Measurement error	0.06 Ω <0.05%	4-wire measurement plus of reading
Temperature drift	±0.004 Ω/K· ΔT_a	$\Delta T_a=\lvert T_a-25°C\rvert$; ambient temp. T_a

Optional sensor supply (CAN-xx-SUPPLY)				
Parameter	**Value**			**Remarks**
Configuration options	7 selectable settings			
Output voltage	voltage	current	net power	set globally for all channels of a module
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Isolation standard optional, upon request	non isolated isolated			output to case (CHASSIS) nominal rating: 50 V, test voltage (10 sec): 300 V
Short-circuit protection	unlimited duration			to output voltage reference ground
Accuracy of output voltage	<0.25% (typ.) / <0.5% (max.) <0.9% (max.)			at terminals, no load 25°C; 2.5 V to 24 V over entire temperature range
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V to 10 V 12 V, 15 V 24 V

Power supply	Value	Remarks
Input supply voltage	10 V to 50 V DC	
Power consumption	<5.5 W <10 W	without supply with optional supply

Reference

Module description CI8 289

Please find CANFX specific Specs here 500, e.g. power supply options and the click mechanism

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10.2.3 DAC8

Parameter	Value	Remarks
Channels	8	each channel configurable separately
Operation mode	voltage source current source	suitable plug for both modes: ACC/DSUBM-DAC4
Output range	-10 V to +10 V 0 mA to 20 mA	min. load: 1 kΩ for voltage mode max. load: 250 Ω for current mode
Sampling rate	5 kHz (max.)	per channel
Analog bandwidth	5 kHz	-3 dB
Resolution	16 bit 15 bit	as voltage source as current source
Accuracy deviation	<0.1%	of the output range
Output value upon power-up	0 V	
Isolation CAN Bus power supply analog outputs	 ±60 V ±60 V no isolation	to CHASSIS nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 300 V (10 s) analog reference ground: CHASSIS
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 RPDOs in INT16, INT32, and FLOAT	

Power supply		
Parameter	**Value (typ./max.)**	**Remarks**
Supply voltage	10 V to 50 V DC	
Power consumption	6 W (typ.)	12 V supply, 23°C
Operating temperature	-20°C to 85°C	

Reference

Please find here the DAC8 module description 301, the DAC8 terminal connections 307 and please observe the CANFX specific Specs 500, e.g. power supply options and the click mechanism

10.2.4 DCB8

Inputs, Measurement modes		
Parameter	**Value**	**Remarks**
Inputs	8	
Measurement modes DSUB	voltage measurement current measurement bridge measurement strain gauge	 ACC/DSUBM-I2 half-, quarter- and full bridge
LEMO	voltage measurement current measurement bridge measurement strain gauge	 half-, quarter- and full bridge
Terminal connection	4x DSUB-15 or 8x LEMO	2 channels per plug 1 channel per plug

Sampling rate, Bandwidth, Filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel, output rate on the CAN-Bus
Bandwidth	200 Hz	-3 dB; Filter OFF
	190 Hz	-3 dB; with AAF-filter
Resolution	16 Bit	internal 24 bit processing output rate: 16 bit Integer
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	
TEDS - Transducer Electronic Data Sheets	conformant to IEEE 1451	ACC/DSUBM-TEDS-xxx

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation: CAN-Bus power supply input analog inputs	 ±60 V ±60 V no isolation		to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) analog reference ground: CHASSIS
Overvoltage protection	±40 V		long term
Input coupling	DC		
Input configuration	differential		
Input impedance	20 MΩ 9.5 MΩ	±1%	differential when Power OFF

Parameter	Value	Remarks
Supply voltage	10 V to 50 V DC	
Power consumption	4 W to 18 W	
Operating temperature	-40°C to 85°C	

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	±10 V, ±5 V, ±2 V, ±1 V... ±5 mV		
Gain error	0.02%	≤0.05%	of reading
Gain drift	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	ΔT_a=|T_a-25°C| ambient temperature T_a
Offset error	0.02%	≤0.05% ≤0.1% ≥0.15%	of range, in ranges: >±50 mV ≤±50 mV ±5 mV
Offset drift	±0.06 µV/K·ΔT_a	±0.3 µV/K·ΔT_a	ΔT_a=|T_a-25°C| ambient temperature T_a
Common mode rejection ranges ±10 V to ±50mV ±20 mV to ±5mV	 92 dB 120 dB	 >84 dB >100 dB	common mode test voltage: ±10 $V_=$
Noise (RTI)	0.4 μV_{rms} 14 nV/√Hz		bandwidth 0.1Hz to 200 Hz (RTI)

Bridge measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Bridge measurement modes	full-, half bridge quarter bridge		 5 V bridge excitation voltage only
Bridge input ranges	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ... ±0.5 mV/V ... ±1 mV/V ... ±2 mV/V		bridge excitation voltage: 10 V 5 V 2.5 V
Gain error	0.02%	≤0.05%	of reading
drift	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	ΔT_a=|T_a –25°C| ambient temperature T_a
Offset	0.01%	≤0.02%	of input range after automatic bridge balancing
drift	+16 nV/V/K·ΔT_a	+0.2 µV/V/K·ΔT_a	ΔT_a=|T_a –25°C| ambient temperature T_a
Bridge excitation voltage	10 V 5 V 2.5 V		not with quarter bridge measure
min. bridge impedance max. bridge impedance	120 Ω, 10 mH full bridge 60 Ω, 5 mH half bridge 5 kΩ		
Internal quarter-bridge completion	120 Ω		optional 350 Ω
Cable resistance for bridges (without return line)	<6 Ω <12 Ω <24 Ω		10 V excitation 120 Ω 5 V excitation 120 Ω 2.5 V excitation 120 Ω

Built-in DCB8 Sensor Supply				
Parameter	**Value**			**Remarks**
Configurations options	7 ranges			
Output voltage	Voltage +2.5 V +5.0 V +7.5 V +10 V +12 V +15 V +24 V	Current 580 mA 580 mA 400 mA 300 mA 250 mA 200 mA 120 mA	Net power 1.5 W 2.9 W 3.0 W 3.0 W 3.0 W 3.0 W 2.9 W	set globally
Short circuit protection	unlimited duration			to reference ground of the output voltage
Output voltage accuracy [1]	<0.25% (typ.) <0.5% (max.) <0.9% (max.)			at terminal plugs, no load 25°C; 2.5 V to 24 V 25°C; 2.5 V to 24 V over entire temperature range
Compensation of cable resistances	measurement mode: bridge measurement, strain gauge 3-wire circuit: single sense wire: sensing of return line only (–VB: supply ground) voltage drops dynamically monitored and numerically compensated			provided for 2.5 V, 5 V and 10 V. prerequisites: 1) symmetrical feed and return lines differing cable length for individual channels allowed
Compensation of cable resistances	measurement mode: voltage measurement with adjusted supply 3-wire circuit: single sense wire: sensing of return line only (–VB: supply ground) physical adjustment of voltage (+VB)			provided for 5 V prerequisites: 1) symmetrical feed and return lines, 2) identical wires for all channels, 3) representative measurement at channel [1] special operation mode: only for an operation with special sensors with a sensitivity depends in a certain extent on the exact value of the supply (especially "Nippon DENSO")
Efficiency	min. 40% typ. 55% typ. 50%			2.5 V 5 V, ..15 V 24 V
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V to 10 V 12 V, 15 V 24 V

[1] The precision of the bridge measurement is not affected by actual precision of the bridge supply. The current value of the bridge supply is continuously monitored and compensated.

Reference

Module description DCB8 308 and
please observe the CANFX specific Specs 500, e.g. power supply options and the click mechanism

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10.2.5 DI16

Parameter	Value	Remarks
Inputs	16 digital inputs	Common reference ground for each 2-channel-group. Each 2-channel-group isolated to other groups as well as to power supply and CAN-Bus.
Input voltage range	TTL or 24 V	software-configurable
Sampling rate	max. 10 kHz	
Input configuration	differential	isolated to power supply and channel-to-channel
Input current	< 0.8 mA	current source drive (min. current 0.1 mA)
Switching threshold 5 V operation (TTL) 24 V operation	 V_{Lmax} = 0.8 V; V_{Hmin} = 2.0 V V_{Lmax} = 5.0 V; V_{Hmin} = 8.0 V	 typ. 1.7 V ±200 mV typ. 6.7 V ±300 mV

General		
Parameter	**Value**	**Remarks**
Isolation: CAN-Bus power supply input digital inputs	 ±60 V ±60 V ±60 V	to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Overvoltage protection	±60 V	differential input voltage
CAN-Bus	defined as per ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2"	supports 4 PDOs in INT16, INT32, and FLOAT

Reference

Module description DI16 315 and
please observe the CANFX specific Specs 500, e.g. power supply options as well as the click mechanism

10.2.6 DO16

Parameter	Value			Remarks
Channels	16			Each 8-channel-group isolated to the other group as well as to power supply and CAN-Bus. No isolation within bank. Separate voltage supply for each bank of 8 channels
Configuration options	Open-Drain Totem-Pole			configurable independently for each 8-bit channel group
Max. output level	5 V max. 30 V			internal supply external supply
Output current	High-level:	15 mA 22 mA	5 V signals 24 V signals	
	Low-level:	700 mA		Low-level: <0.4 V
Power-up default	High-impedance High			configured as Open-Drain configured as Totem-Pole
Switching time	100 µs			
Externally available power supply	5 V / 30 mA per connector			available in addition to the output stages

General	Value	Remarks
Isolation: CAN-Bus power supply input digital outputs	 ±60 V ±60 V ±60 V	to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
CAN-Bus	defined as per ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	

Terminal connections	Value	Remarks
Terminal connection	2x DSUB-15 PHOENIX spring cage terminal block	CANSAS(-L)-DO16 outputs CANSAS-K-DO16 outputs
Rear Side	2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	CAN (in/out) Supply
Terminal connection (SL)	2x DSUB-15	outputs
Rear Side	2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	CAN (in/out), supply (alternatively) Supply
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 41 x 128 x 145 mm 38 x 112.5 x 152 mm	CANSAS-DO16 CANSAS-L-DO16 CANSAS-K-D016 (8HP) CANSAS-SL-DO16-D
Weight	300 g	

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Parameter	Value typ.	min. / max.	Remarks
Operating temperature	-40°C to 85°C		
Input supply voltage	10 V to 50 V DC		
Power consumption	4 W		

Reference

Module description DO16 318 and
please observe the CANFX specific Specs 500, e.g. power supply options as well as the click mechanism

10.2.7 DO8R, DO16R

Parameter	Value	Remarks
Relais	8 16	DO8R DO16R
Contact-Configuration	toggle	"IN" = "ON" (logical signal 1) "IN" = "OFF" (logical signal 0)
Power-Up Default	OFF	defined state at module startup: logical 0
Relay specs		
Switching voltage	max. 125 V (AC) max. 110 V (DC)	
Switching current	max. 1 A at 30 V (DC) max. 0.3 A at 125 V (AC) min. 10 µA at 10 mV (DC)	 min. current flow required to maintain low contact resistance
Switching power	max. 30 W at 30 V (DC) max. 37.5 W at 125 V (AC)	
Switching time	<30 ms	

General	Value	Remarks
Isolation:		to CHASSIS
CAN-Bus	±60 V	nominal; testing: 300 V(10 s)
Power supply input	±60 V	nominal; testing: 300 V(10 s)
CAN-Bus	defined by ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA®DS 404V1.2" supports 1 RPDO in INT16, INT32, and FLOAT	

Parameter	Value	Remarks
Supply voltage	10 V to 50 V DC	
Power consumption	4 W (typ.)	12 V supply, 23°C
Operating temperature	-40°C to 85°C	

Reference

Module description DO8R, DO16R 321 and
please observe the CANFX specific Specs 500, e.g. power supply options as well as the click mechanism

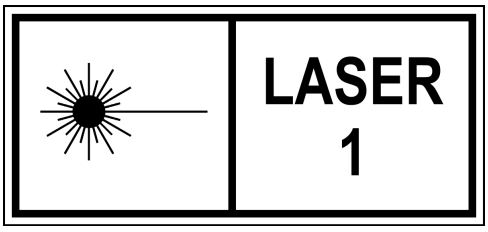
10.2.8 FBG-T8

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Inputs	8	8 independent fiber-optic inputs for one sensor per channel
Measurement modes	temperature temperature measurement with balancing	with suitable fiber-optic FBG sensors
Compatible sensors	imc FBG-Temp fiber-type: SMF 28	type FBG (properties: see fiber-optic FBG parameters)
Connectors	fiber optic connector type E2000 / APC	
Sensor characteristics	non-linear	fifth order polynomial, characteristic calculation by device firmware
Sensor parameterization	individual parameters of the sensor characteristic curve	software support for entering individual calibration parameters (according to the calibration certificate of the sensor)
Calibration cycle of the device	annually	recommended service cycle

Sampling rate, bandwidth, filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel; output rate of the CAN bus data, individually configurable per channel. Aliasing free thanks to analog filtering
Bandwidth	100 Hz (-3 dB)	8th-order Bessel filter, at 1 kHz sampling rate
Filter		digital filter
Type	low-pass	
Characteristic	averaging filter (sinc), AAF	at output rates <1 kHz: adapted automatically, according to selected output rate
Cut-off frequency	$0.44 \cdot f_s$	-3 dB, sinc characteristic f_s: output rate, for 1 Hz ≤ f_s < 1 kHz
Resolution	24 bit ADC	output on CAN bus: 32 bit Float or 16 bit Integer

Fiber-optic FBG parameter		
Parameter	**Value**	**Remarks**
Wavelength measuring range	1549 ... 1553 nm	calibrated range
Laser source	laser class 1 <10 mW (typ. 1 mW)	
Compatible fiber types	SMF 28	single-mode, Faser-Bragg grating (FBG) sensors
Sensor reflectivity	50 ... 90 %	of the sensor
Full width at half maximum	400 … 700 pm	FWHM
Side lobe suppression	>15 dB	SLRS

Measurement accuracy			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Absolute measurement accuracy	±30 pm		operating temperature: 23°C (±3 °C) in conjunction with sensor "imc FBG-Temp": corresponds ±3 °C with sensor sensitivity of approx. 10 pm / °C
Temperature drift	±10 pm		over the entire specified operating temperature range Describes an ***additional*** deviation of the displayed measured value during operation of the device under varying environmental conditions.
Reproducibility	typ. 15 pm	max. 30 pm	Is already ***included*** in the total absolute measurement accuracy. Comprises polarization-related effects as part of overall accuracy. Related to, for example: • movement and deformation of the cable (fiber) • plug-in cycles of the fiber connector
Noise	<1.3 pm		rms



CANFDX/FBG-T8 works with class 1 lasers, which means that the device is safe during normal operation. Nevertheless, looking directly into the beam of the Class 1 laser device may cause irritation to your eyesight. This is possible, for example, if the protective cover has been removed or if the device has been damaged in such a way that laser radiation can be released.

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20 E2000 fiber optic connectors provide integrated protective covers. Plug-on protective covers for unused input sockets E2000
Operating temperature range	-5°C to +75°C	without condensation
Calibrated operating range	-5°C to +60°C	with specified temperature drift
Storage temperature	-40°C to +85°C	
Pollution degree	2	
Shock and vibration resistance	IEC 61373, IEC 60068-2-27 IEC 60062-2-64 Category 1, class A and B MIL-STD-810 Rail Cargo Vibration Exposure U.S. Highway Truck Vibration Exposure	
Weight	820 g	
Dimensions	70.6 x 110 x 146.5 mm	W x H x D

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption	3 W	<4 W	
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSAS*flex* or imc CANSAS*fdx* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	96 W at 12 V DC 192 W at 24V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-30 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	72 W at 12 V DC 144 W at 24 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C

Reference

Module description FBG-T8 323

10.2.9 HISO8

Parameter	Value	Remarks
Channels	8	HV isolated analog channels for high common mode voltage
Measurement modes HISO8-L	 voltage measurement current measurement (20 mA) PT100, PT1000 measurement resistance measurement	
HISO8-4L	voltage measurement PT100, PT1000 measurement resistance measurement	
CANFX/L-HISO8-T-2L/-8L	thermocouples type-K	
Terminal connection	high-voltage proof connectors	assembled, ready-made plugs and cables, both suitable and high voltage proof, available as accessories
inputs	8x 5-pin LEMO.1P REDEL 4x 8-pin LEMO.2P REDEL 2x 8-pin LEMO.2P REDEL 8x 2-pin LEMO.2P REDEL	1 channel per plug, HISO8-L 2 channels per plug, HISO8-4L 4 channels per plug, HISO8-T-2L 1 channel per plug, HISO8-T-8L

Sampling rate, bandwidth, filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel
Bandwidth	440 Hz	-3 dB
Filter type characteristics HISO8-L/-4L HISO8-T-2L/-8L	 low pass Butterworth and Bessel 2nd order, 1st to 4th order, averaging filter averaging filter	digital filter individually selectable; cut-off frequency = 1/6 of the sampling rate
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2"	support of 4 TPDOs in INT16, INT32, and FLOAT

Temperature measurement - Thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Mode	thermocouples type K		
Measurement ranges	-50°C to 150°C -50°C to 400°C -270°C to 1370°C		
Resolution	0.025 K		16-bit
Measurement error		±0.5 K	type K, range -150°C to the upper limit of the measurement range, at 25°C
Temperature drift	±0.02 K/K·ΔT_a		$\Delta T_a = \lvert T_a - 25°C \rvert$ ambient temperature T_a
Error of cold junction compensation Drift of cold junction compensation	 ±0.001 K/K·ΔT_j	<±0.5 K	HISO8-T-2L/-8L $\Delta T_j = \lvert T_j - 25°C \rvert$ cold junction temp. T_j

Temperature measurement - PT100, PT1000			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement ranges	-200°C to +850°C -50°C to +150°C		
Resolution	0.016 K 0.003 K		range -200°C to +850°C (16-bit) range -50°C to +150°C (16-bit)
Measurement error	<±0.25 K <±0.05%		range -200°C to +850°C, 4-wire config. additionally the resistance value of the displayed temperature
Temperature drift	±0.01 K/K·ΔT_a		ΔT_a=|T_a-25°C| ambient temperature T_a
Sensor feed	250 µA		individual current supply, isolated

Voltage measurement	Value typ.	min. / max.	Remarks	
Measurement ranges	±100 V, ±50 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV, ±50 mV, ±20 mV			
Gain error	<0.02%	<0.05%	of the measured value, at 25°C	
Gain drift		15 ppm/K 50 ppm/K	ranges ≤±2 V ranges ≥±5 V	over full temperature range
Offset error	0.02%	≤0.05% ≤0.08%	of range, at 25°C ranges >±50 mV ranges ≤±50 mV	
Offset drift	0.3 µV/K·ΔT_a 10 µV/K·ΔT_a	0.6 µV/K·ΔT_a 30 µV/K·ΔT_a	ranges ≤±2 V ranges ≥±5 V ΔT_a=|T_a-ambient temp T_a	
Non-linearity	<120 ppm		±10 V input range	
Signal noise		2 μV_{rms} 12 μV_{pkpk}	bandwidth 0.1 Hz to 440 Hz range ±20 mV R_{source} = 0 Ω	

Current measurement with internal shunt			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement ranges	±10 mA, ±20 mA		
Shunt-resistance	50 Ω		internal
Gain error	<0.07%	<0.15%	of the measured value, at 25°C
Offset error	0.02%	≤0.05%	of range
Non-linearity	<120 ppm		

Resistance measurement	Value	Remarks
Measurement range	0 Ω to 1000 Ω, 0 Ω to 500Ω, 0 Ω to 250 Ω, 0 Ω to 150 Ω	individual current supply, isolated
Measurement error	0.06 Ω <0.05%	4-wire measurement plus of reading
Temperature drift	±0.004 Ω/K· ΔT_a	ΔT_a=|T_a-25°C|; ambient temp. T_a

General				
Parameter	**Value typ.**	**min. / max.**	**Remarks**	
Isolation: (common mode)			conforming DIN EN 61010-1:2010-07 and DIN EN 61010-2-030:2011-07 channel / channel channel / CAN channel / supply channel / housing	
General				
Pollution degree	2			
test voltage to system ground and between channels	3000 V		1 min	
Automotive				
Working voltage	800 V 1131 V		AC/DC peak	
Additional transient, overvoltage	500 V			
Main power supply grid				
Measurement category	CAT II			
Assessment voltage	300 V			
Overvoltage protection			differential input permanent transient e.g. automotive load dump	
	±100 V ±600 V			
	ESD 2 kV		human body model	
IMR (isolation mode rejection)	>140 dB (50 Hz) >90 dB (50 Hz)		ranges ≤±2 V ranges ≥±5 V	R_{source} = 0 Ω
Channel isolation	>1 GΩ, <40 pF >1 GΩ, <10 pF		against system ground / housing channel-to-channel	
Crosstalk	>165 dB (50 Hz) >90 dB (50 Hz)		ranges ≤±2 V ranges ≥±5 V	R_{source} ≤100 Ω
Input coupling	DC			
Input configuration	differential, isolated		isolated from system ground (housing, CHASSIS, function ground)	
Input impedance	6.7 MΩ 1 MΩ		ranges ≤±2 V ranges ≥±5 V	
Input current				
normal		1 nA	under operating conditions	
at overload		1 mA	$\|V_{in}\|$ >5 V or deactivated	

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption	4 W	5.5 W	

Reference

Module description: HISO8 399, please find further CANFX specific Specs here 500, e.g. power supply

10.2.10 HISO-HV4

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Channels	4	HV-isolated analog channels
Measurement mode	voltage measurement up to 800 V	rated voltage of isolation: max. 800 V AC_{RMS} max. 800 V DC permanent
Terminal connection	safety banana jacks 4 mm	

Sampling rate, bandwidth, filter		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel
Bandwidth	440 Hz	-3 dB
Filter type characteristics	 low pass Butterworth and Bessel 2nd order, 1st to 4th order, averaging filter	digital filter individually selectable; cut-off frequency = 1/6 of sampling rate

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement ranges	±800 V, ±500 V, ±200 V, ±100 V, ±50 V, ±20 V, ±10 V		rated voltage of isolation: max. 800 V AC_{RMS} max. 800 V DC permanent linear operation and valid measurement output (e.g. transients): up to 960 V
Gain error	<0.02 %	<0.05 %	of the measured value, at 25°C
Gain drift		50 ppm/K	over full temperature range
Offset error	0.02 %	≤0.05 %	of range, at 25°C
Offset drift		1.5 mV/K	
Non-linearity	<120 ppm		
Signal noise		1 mV_{rms} 6 mV_{pkpk}	bandwidth 0.1 Hz to 440 Hz R_{source} = 0 Ω

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General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Isolation			conforming to IEC 61010-1:2010-07 and IEC 61010-2-030:2011-07 channel / channel channel / CAN channel / supply channel / housing
General			
Pollution degree	2		
Test voltage to system ground	3000 V		1 min.
Automotive			
Working voltage	800 V 1131 V		AC/DC peak
Additional transient overvoltage	500 V		
Mains circuits (power supply)			
Measurement category	CAT II		
Rated voltage	300 V		
Overvoltage protection	±1500 V ESD 2 kV		differential input protection against damage of the electronics by overvoltage (e.g. transients) human body model
IMR (isolation mode rejection)	>70 dB (50 Hz)		
Channel isolation	>1 GΩ >1 GΩ		against system ground / housing channel-to-channel
Crosstalk	>72 dB (50 Hz)		
Input coupling	DC		
Input configuration	differential, isolated		isolated from system ground (housing, CHASSIS, functional earth)
Input impedance	10 MΩ		

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption	4 W	5,5W	

Reference

Module description: HISO-HV4 397

Please find further CANFX specific Specs here 500, e.g. power supply options and the click mechanism

10.2.11 HISO-T-8-2L

General

Parameter	Value	Remarks
Inputs	8	
Measurement mode	temperature measurement by thermocouple	
Supported sensors	Thermocouple type K	
Connector / socket	compatible socket type	recommended plug
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302, multicoded 2 notches, for optional individually power supply
Grounding / potential compensation	M4	
Measuring input	LEMO Redel 2P, 8-pin, Code B	4-channel sensor cable are available separately as accessories, see data sheet
CAN	DSUB-9	CAN IN (male) / CAN OUT (female)
Module connector	via locking slider	for the supply and system bus (CAN) of directly connected modules without further cables

Sampling rate, Bandwidth			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sampling rate		≤100 Hz	configurable, individually per channel
Bandwidth	15 Hz 2.5 Hz		-3 dB; CAN output data rate = 100 Hz; anti-aliasing filter (AAF) 0.1 dB
Resolution	24 Bit		data output: 32 Bit FLOAT or 16 Bit INT

Status-LED		
Parameter	**Value**	**Remarks**
Power-LED		
green	power active	
Status-LED	overall status of module	
green	normal operating, run	
blue	init, etc.	
blue/orange	firmware update	
yellow	prepare configuration	
red	error	
Channel-Status-LED	status for each channel	
off	channel passive	
green	channel active	
red	over-range error	signal exceeding nominal range by 5 %

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Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage		7 V to 50 V DC 9.5 V to 50 V DC	after power up upon power up
Power consumption	1.6 W	<2.2 W	

Isolation

Parameter	Value	Remarks
Isolation	galvanically isolated	
CAN bus	±60 V	to system ground
power supply input	±60 V	to system ground
channel of each connection socket		according EN 61010-1, EN 61010-2-030, EN 60664-1
working voltage	1000 V_{AC}, 1400 V_{DC}	to CAN, power supply and channels of another connection socket
	1000 $V_{AC/DC}$	to channels of the same connection socket
measurement category	300 V CAT III, 600 V CAT II	to CAN, power supply and channels of another connection socket
test voltage	8 kV 1,2/50 µs 4,4 kV RMS, 60 s	to CAN, power supply and channels of another connection socket
	3 kV RMS, 60 s	between channels of the same connection socket
Pollution degree	2	

Note

The specifications of the cables used must always be considered in the application.

Measurement Mode

Thermocouple measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Sensor	Thermocouple type K		DIN EN 60854 [1]
Input range	-270 °C to 1370 °C -100 °C to 250 °C		output format: 16 Bit INT or FLOAT [2] output format: 16 Bit INT
Overvoltage protection	±200 V		
Input coupling	DC		
Input configuration	isolated		differential
Measurement error -200 °C to -150 °C -150 °C to -50 °C **-50 °C to 500 °C** 500 °C to 1300 °C Impact of the sensor impedance	 0.4 K 0.2 K **0.1 K** 0.3 K 0.0002 % / Ω · R_{TC}	 ±1.3 K ±0.7 K **±0.7 K** ±0.9 K	 of reading; resistance of sensor R_{TC} [3]
Drift	+ 0.0009 %/K · ΔT_a 0.02 K/K · ΔT_a		T = -150 °C to 1300 °C T_a = -20 °C to 90 °C of reading $\Delta T_a = \lvert T_a - 25\ °C \rvert$
IMRR (Isolation mode rejection ratio)	0.003 K/V		50 V; 50 Hz; R_{TC} = 100 Ω thermocouple
Noise	0.01 K_{rms}		average filter 100 ms output format: FLOAT; -100 °C to 250 °C

1 Based on "International Temperature Scale of 1990" (ITS-90)

2 The listed measuring ranges can only be selected via CANSAS (via devices in group A or via PC dongle). In imc STUDIO (via devices in group B), only the large measuring range and only float are available.

3 The specific cable resistance of NiCr/Ni (IEC-Standard) is approx. 0.5 Ω · mm^2/m.
(e.g. diameter = 0.8 mm; length = 3 m; resistance = 6 Ω)

Reference

Module description: HISO8 399, please find further CANFX specific Specs here 500, e.g. power supply

10.2.12 IGN

Parameter	Value (typ. / max.)	Remarks
Inputs	1 1 1 1	ignition signal crankshaft sensor reference signal camshaft signal inputs isolated from CAN-Bus, supply and mutually.
Sampling rate (CAN output)	1 Hz to 200 Hz	Output rate, averaging interval
Time resolution of measurement	333 ns	counter frequency 3 MHz (primary sampling rate)
Input pulse frequency	max. 600 kHz	
RPM range	100 to 20000 RPM	
Ignition angle range	-100 to 100 degrees	
Adjustable signal delay	max. 10 ms	
Crankshaft sensor	36-1, 36-2, 60-1, 60-2, 36+1, 24-1 2 to 3600 cogs 1 pulse	with missing cog sensor with zero impulse sensor with 1 pulse per revolution
Camshaft sensor	Freely editable pattern with 1..20 signal edges per camshaft revolution	use is optional, for an automatic cylinder recognition
Resolution ignition angle	0.1° 0.01°	on display on CAN
Resolution RPM	1 RPM 0.5 RPM	on display on CAN
Input configuration	differential	configurable 5 V pull-up resistor
Input impedance	1 MΩ	
Input voltage range	±40 V	differential
Switching threshold	-40 V to +40 V	individually adjustable per channel
Hysteresis	0 V bis 40 V	individually adjustable per channel
Common mode input voltage	max. ±60 V	
Overvoltage protection	±100 V	long-term
Analog bandwidth	500 kHz	-3 dB (full power)
Gain uncertainty	<1%	23°C
Offset	<1%	23°C
Integrated Snapshot-mode	20 kHz to 3 MHz	high resolution analog sampling and output of all input channels especially for diagnostic assistance
Resolution of the analog primary data	12 Bit	
Frequency stability	<100 ppm	aging <±5 ppm / year

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Analog output			
Parameter	**Value (typ. / max.)**		**Remarks**
Range	-10 V to +10V 0 V to 10 V		ignition signal -100° to +100° RPM 0 to 10000 RPM
Load current	±10 mA / channel (max.)		
Gain uncertainty	<±5 mV	<±10 mV	-30° - 85°C
Offset uncertainty	<±2 mV	<±4 mV	-30° - 85°C
Digital outputs			
Level	TTL		representation of all input signals

General		
CAN-Bus	defined by ISO 11898	
Isolation: CAN-Bus analog input	 ±60 V ±60 V	to case(CHASSIS) nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 100 V (10 s)
Sensor supply	+12 V (max 100 mA) +5 V (max 200 mA)	Reference: GND
Display	2 lines 0.2 s, 0.5 s, 1 s	alphanumerical frame rate
Supply voltage	10 V to 30 V DC	
Power consumption	4 W (typ.)	12 V supply, 23°C
Operating temperature	-30°C to 85°C	typically, display can be read in temperatures above 15°C
Dimensions (W x H x D)	205 x 115 x 45 mm	imc CANSAS-IGN
Weight	800 g	
Connection terminals	4xBNC 1x DSUB-15 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	inputs outputs CAN (in / out) power supply

Module description IGN 424

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10.2.13 IHR(-48V)

Parameter	Value	Remarks
Inputs	2	
Terminals front panel measurement connections	 banana sockets 4 mm push-in terminals 0,75 mm² ... 16 mm²	 SPT 16/1-V-10,0
Terminals rear panel CAN Supply	 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	 CAN (in/out), power supply alternatively
Output values	 current (mean value) current (peak values)	Default name: Channel01 MaxValue / MinValue
Output type	CAN	

Sampling rate, Bandwidth		
Parameter	**Value**	**Remarks**
Sampling rate	30 kHz 1 Hz, 10 Hz, 100 Hz, 1 kHz	internal primary, per channel output rate (CAN) for all output values of each channel
Bandwidth	output rate · 0.4	-3 dB
Filter characteristic	Sinc	Sinc-Filter (block averaging)
Resolution	30 Bit	nominal measurement range / minimum measured value resolution (ADC)

General	CAN/IHR	CAN/IHR-48V	Remarks
Max. load voltage	15 V	60 V	working voltage of the load circuit; load circuit will be opened in case of overload via electronic fuse operating threshold overvoltage protection (TVS)
Isolation	galvanic isolation of all 3 circuits: supply, channel and CAN against each other		All 3 circuits are mutually isolated so that their potentials are safely separated at all common board voltages.
Isolation voltages Nominal all routes (channel, CAN, housing) Test voltage Channel - Housing Channel - Channel CAN - Housing	 70 V DC 500 V DC 700 V_{RMS} 450 V_{RMS}		 permanently 1 min

CAN		
Parameter	**Value**	**Remarks**
Baud rate	125 kbit/s, 250 kbit/s, 500 kbit/s, 1000 kbit/s	set by imc CANSAS software
CAN messages Number of identifier structure and mapping Identifier No.	 2 or 4 fixed freely configurable	 max. 2 CAN messages per channel
Default settings Baud rate Identifier	 125 kbit/s Master-ID= 2032, Slave-ID= 2033	power on with reset plug
Scaling factor	$36.379 \cdot 10^{-9}$	current, output format 32 Bit Integer

Current measurement			
Parameter	**12 V systems (CAN/IHR)**	**48 V systems (CAN/IHR-48V)**	**Remarks**
Input parameter	current		only positive direction, no inverse-polarity protection
Measurement range nominal	 0 to +30 A	 0 to +10 A	automatic range-switching continuous operation
Overload protection	reversible electronic fuse		interruption of the load circuit, automatic reset
Tripping characteristic of electronic fuse	 30 A to 60 A 60 A to 78 A as of 78 A	 10 A to 20 A 20 A to 26 A as of 26 A	detection of indicated current for a maximum duration of: 60 s 1 s immediately
Reset of the electronic fuse	automatically after 60 s		
Max. allowed current rating	limited by thermal load capacity		relevant parameters: average continuous current, temporary peaks, operating temperature
Max. peak current at at 5 A continuous current at 30 A continuous current	 78 A 54 A		temporary peaks at 25°C at 40°
For 48 V systems Max. peak current at at 1.7 A continuous current at 10 A continuous current		 26 A 18 A	 temporary peaks at 25°C at 40°
Shunt	2 Ω 2 mΩ		Kelvin sensing for both shunts High-Current-Range
Switching times	<1 µs <1 ms		2 Ω —> 2 mΩ 2 mΩ —> 2 Ω
Switching threshold Hysteresis	100 mA (typ.) 80 mA (typ.) 20 mA (typ.)		2 Ω —> 2 mΩ 2 mΩ —> 2 Ω
Resolution	36 nA		

Current measurement			
Parameter	**12 V systems (CAN/IHR)**	**48 V systems (CAN/IHR-48V)**	**Remarks**
Load circuit resistance	<10 mΩ	<20 mΩ	at 20°C and min. 100 mA
Gain error	<1%		of respective value
Gain drift	<40 ppm/°K		
Offset error	±200 nA		
Offset drift	30 ppm/°K + 20 nA/°K		
Noise	200 nA (pkpk)		output rate: 1 Hz
Status LED normal operation tripped electronic fuse	 LED on LED off		

Power supply of the module		
Parameter	**Value**	**Remarks**
Supply voltage	9 V to 32 V DC	
Power consumption	 3 W at 10 V supply 5.4 W at 32 V supply	both channels

Operating conditions		
Parameter	**Value**	**Remarks**
Operating environment	dry, non corrosive environment within specified temperature range	
Rel. humidity	80% up to 31°C, above 31°C: linear declining to50%	according IEC 61010-1
Operating altitude	up to 2000 m	
Ingress protection rating	IP20	
Pollution degree	2	
Operating temperature	5°C to 40°C	without condensation
Dimensions	81 x 112.5 x 202 mm	W x H x D
Weight	1.7 kg	

10.2.14 IHR(-48V)-R

Parameter	Value	Remarks
Inputs	2	
Terminals DIN41612	Harting male & female multi-point connectors	for the plug-in backplane CAN/IHR-RACK
Terminals measurement connections Supply, CAN-Bus	 4x spring-loaded terminal: 0.75 mm^2 ... 16 mm^2 spring-loaded terminal: 0.14 mm^2 ... 0.5 mm^2	at the rear panel of the CAN/IHR-RACK
Output values	current (mean value) current (peak values)	Default name: Channel01 MaxValue / MinValue
Output type	CAN	

Sampling rate, bandwidth		
Parameter	**Value**	**Remarks**
Sampling rate	30 kHz 1 Hz, 10 Hz, 100 Hz, 1 kHz	per channel / internal primary output rate (CAN) for all output values of each channel
Bandwidth	output rate · 0.4	-3 dB
Filter characteristic	Sinc	Sinc-Filter (Block averaging)
Resolution	30 Bit	nominal measurement range / minimum measured value resolution (ADC)

General			
Parameter	**CAN/IHR-R**	**CAN/IHR-48V-R**	**Remarks**
Max. load voltage	15 V	60 V	working voltage of the load circuit; load circuit will be opened in case of overload via electronic fuse operating threshold overvoltage protection (TVS)
Isolation	galvanic isolation of all 3 circuits: supply, channel and CAN against each other		All 3 circuits are mutually isolated so that their potentials are safely separated at all common board voltages.
Isolation voltage Nominal All (supply, channel and CAN) Test voltage Channel - housing Channel - Channel CAN - housing	 70 V DC 500 V_{rms} 700 V_{rms} 450 V_{rms}		 working voltage 1 min

CAN		
Parameter	**Value**	**Remarks**
Output format	32 Bit Integer	
Scaling factor	$36.379 \cdot 10^{-9}$	current

CAN in flexible mode (all DIP switches of the backplane ON)		
Parameter	**Value**	**Remarks**
Baud rate	125 kbit/s, 250 kbit/s, 500 kbit/s, 1000 kbit/s	via imc CANSAS configurable
CAN messages Number of base addresses Installation and config. Identifier no.	 2 or 4 fix free configurable	configurable via imc CANSAS max. 2 CAN messages per channel with/without additional channels including Master-ID/Slave-ID, e.g. 2/3 or 2032/2033

CAN in RACK-mode (DIP switches coding via backplane)		
Parameter	**Value**	**Remarks**
Baud rate	500 kbit/s	fix, not changeable
CAN messages Number of base addresses Installation and config. Identifier no.	 2 fix fix	 2 CAN messages per channel fixed rules coded via DIP switches
Default settings Identifier	 Master-ID=2, Slave-ID=3	not changeable
Address allocation	automatic 1 base address per module	base address for each slot can be configured via DIP switch

Current measurement	**Value**		
	12 V system	**48 V system**	
Parameter	**CAN/IHR-R**	**CAN/IHR-48V-R**	**Remarks**
Input variable	current		only one current direction
Measurement range Nominal	 0 to +30 A	 0 to +10 A	automatic range-switching permanent operation
Overload protection	reversible electronic fuse		Load circuit separated by electronic fuse, automatic Reset
Trigger-Characteristic of the electronic fuse	30 A to 60 A 60 A to 78 A as of 78 A	10 A to 20 A 20 A to 26 A as of 26 A	max. dwell time until triggering: 60 s 1 s immediately
Reset electronic fuse	automatically after 60 s		
Max. allowable current	limited by thermal load capacity		relevant parameters: mean continuous current, short-time peaks, operating temperature
Max. peak current at 5 A continuous current at 30 A continuous current	 78 A 54 A	 26 A 18 A	short-time peaks at 25°C at 40°

Current measurement	Value		
	12 V system	48 V system	
Parameter	**CAN/IHR-R**	**CAN/IHR-48V-R**	**Remarks**
Shunt	2 Ω, 2 mΩ		Kelvin sensing for both shunts High-Current-Range
Switching times	<1 µs <1 ms		2 Ω —> 2 mΩ 2 mΩ —> 2 Ω
Switching threshold Hysteresis	100 mA (typ.) 80 mA (typ.) 20 mA (typ.)		2 Ω —> 2 mΩ 2 mΩ —> 2 Ω
Resolution	36 nA		
Path resistance	<10 mΩ	<20 mΩ	at 20°C and min. 100 mA
Gain uncertainty	<1%		of respective value
Gain drift	<40 ppm/°K		
Offset uncertainty	±200 nA		
Offset drift	30 ppm/°K + 20 nA/°K		
Noise (current-mean value)	200 nA (pkpk)		output rate: 1 Hz
Status LED normal operation trigger electronic fuse	 LED on LED off		

Power supply of the module		
Supply voltage	9 V to 36 V DC	
Power consumption	3 W at 10 V supply 5.4 W at 36 V supply	both channels
Temperature range	5°C to 40°C	
Dimension (W x H x D)	60.62 x 129 x 162.5 mm (12 TE)	DIN 41612 with front panel
Weight	approx. 500 g	

10.2.15 IHR-RACK

Slots, connections		
Parameter	**Value**	**Remarks**
Slots	7	
Terminals DIN41612	Harting male & female multi-point connectors	
Terminals Backplane		
Current	4x spring-loaded terminals: 0.75 mm^2 ... 16 mm^2	2 current-connections per channel (SPT 16/1-V-10,0)
CAN Power supply	spring-loaded terminals: 0.14 mm^2 ... 0.5 mm^2	

CAN		
Parameter	**Value**	**Remarks**
Address allocation	8 bits on DIP switch	The IDs for the plug-in modules are assigned with formulas.

General		
Parameter	**Value**	**Remarks**
Temperature range	5°C to 40°C	
Dimensions (W x H x D)	482.4 x 132 x 187.8	without handles

Reference

Pin configuration 591

10.2.16 INC4

Input, measurement mode		
Parameter	**Value**	**Remarks**
Inputs	4 + 1 (9 tracks)	4 channels with 2 tracks (X, Y) each 1 index channel, all fully conditioned inputs isolated from CAN-Bus and supply, but not mutually
Measurement modes	RPM (rotational speed) angle velocity displacement time frequency PWM event-counter	 differential, integrated, absolute (0°..360°) differential, integrated between selectable edges duty cycle differential, integrated
Signal encoder types	single-track encoder	without direction detection; with / without zero-pulse; usable on inputs 1 to 4; all relevant modes
	dual-track encoder	with direction detection; with / without zero-pulse; 4-slope evaluation (quadrature) usable on inputs 1Y & 4Y
Zero-pulse (reference position)	separate index signal	fully conditioned index track commonly used for 4 channels The connection for the zero-pulse is only led out at CON1.
Signal conditioning	differential amplifier filter detection threshold hysteresis	individually for all channels

Sampling rate, bandwidth, CAN-Bus		
Parameter	**Value**	**Remarks**
Sampling rate (CAN output)	1 kHz / channel (max.)	
Time resolution	33 ns 32 MHz clock	clock frequency of the counter for primary time measurement
Stability of primary oscillator	<100 ppm aging <5 ppm / year	
Resolution of data	16 bit	
CAN-Bus	defined by ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	

General		
Parameter	**Value**	**Remarks**
Isolation		to CHASSIS
CAN-Bus	60 V	nominal; testing: 300 V (10 s)
power supply input	60 V	nominal; testing: 300 V (10 s)
analog input	no isolation	analog reference ground: CHASSIS
Sensor supply	+5 V (±200 mV), 20 mA (max.)	Reference: GND

Analog signal conditioning		
Parameter	**Value**	**Remarks**
Input configuration	differential single-end	all x- and y-tracks index-track
Input voltage range (differential)	±10 V ±30 V	linear range maximum, outside of linear range: max. non-linearity error: 300 ns
Overvoltage protection	±60 V	permanently
Input impedance	100 kΩ	
Common mode input voltage	max. ±30 V	
CMRR	70 dB (typ.), 50 dB (min.) 60 dB (typ.), 50 dB (min.)	DC, 50 Hz 10 kHz
Analog bandwidth	500 kHz	-3 dB (full power)
Analog filter	bypass (without filter), 20 kHz, 2 kHz, 200 Hz	configurable (globally for all channels) Butterworth, 2nd order
Switching threshold	-8 V to +10 V	globally configurable in 0.1 V steps
Hysteresis	0.3 V to 4 V	globally configurable in 0.1 V steps
Gain error	<1%	
Offset	<1%	

Optional sensor supply (CANFX/xx-SUPPLY)				
Parameter	**Value (typ. / max.)**			**Remarks**
Configuration options	7 selectable settings			
Output voltage	voltage	current	net power	set globally for all channels of a module
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Short-circuit protection	unlimited duration			to output voltage reference ground
Output voltage accuracy	<0.25% (typ) / <0.5% (max.) <0.9% (max.)			at terminal plugs, no load 25°C; 2.5 V to 24 V over entire temperature range
Capacitive load (max.)	>4000 µF >1000 µF >400 µF			2.5 V to 10 V 12 V, 15 V 24 V

Power supply imc CANSAS*classic*		
Parameter	**Value**	**Remarks**
Supply voltages	10 V to 50 V DC	
Sensor supply voltage at CAN/x-INC4-xx-**SUPPLY**	+2.5 V to +24 V	technical specs: Sensor supply module
Power consumption	4 W (typ.)	12 V supply, 23°C

Operating conditions and terminal connections of imc CANSAS*classic* modules		
Parameter	**Value**	**Remarks**
Operating temperature	-40°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 41 x 128 x 145 mm 38 x 112.5 x 152 mm 38 x 112.5 x 152 mm	CANSAS-INC4 CANSAS-L-INC4, -L-INC4-V CANSAS-C-INC4 (8TE) CANSAS-SL-INC4-L CANSAS-SL-INC4-D
Weight	300 g	
Terminal connection Rear side	2x DSUB-15 4x ITT VEAM 2x DSUB-9 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	Inputs: -INC4, -L-INC4 -L-INC4-V(-SUPPLY) -K-INC4 CAN (in / out), supply (alternatively) power supply
Terminal connection (SL) inputs CAN (in/out)	 2x DSUB-15 2x DSUB-9	 CANSAS-SL-INC4-D power supply (alternatively)
inputs CAN (in/out) power supply	4x 7-pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	only CANSAS-SL-INC4-L power supply (alternatively) for all SL models

The following statements apply to the imc CANSAS*flex* INC4 modules.

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Operating temperature range	-40°C to 85°C	internal condensation temporarily allowed

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption	4 W 8 W		INC4 INC4-SUPPLY
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSAS*flex* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	96 W at 12 V DC 192 W at 24V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-30 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	72 W at 12 V DC 144 W at 24 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C

Module description INC4 331

10.2.17 P8

Parameter	Value	Remarks
Inputs	8	8 pressure fittings
Measurement modes	absolute pressure relative pressure	
Sampling rate	1 kHz (max.)	per channel
Resolution	16 Bit	

Pressure measurement			
Parameter	**Measurement error**		**Remarks**
Measurement ranges (working range, valid values)	ranges depending on selected sensor type CANFX/P-SEN-xx		-30 °C to +85 °C mounting position horizontal (schematic) [1]
Absolute pressure			Sensor type, calibrated range
0.1 bar to 25.0 bar	<0.2 %	<50 mbar	A25(-F), > 0.5 bar
0.1 bar to 10.0 bar	<0.2 %	<20 mbar	A10(-F), > 0.5 bar
0.1 bar to 6.0 bar	<0.2 %	<12 mbar	A6(-F), > 0.5 bar
0.1 bar to 3.5 bar	<0.2 %	<7 mbar	A3.5(-F), > 0.5 bar
0.1 bar to 1.2 bar	<0.1 % abs.	<1.2 mbar	A1.2(-F), > 0.5 bar
Internal barometer	<0.1 % abs.	<1.2 mbar	
Relative pressure	related to span (abs. ranges)		Sensor type, calibrated range
calculation with int. barometer			
-0.9 bar to +24.0 bar	< 0.2 %	< 51 mbar	A25(-F), > -0.5 bar
-0.9 bar to +9.0 bar	< 0.2 %	< 21 mbar	A10(-F), > -0.5 bar
-0.9 bar to +5.0 bar	< 0.25 %	< 13.2 mbar	A6(-F), > -0.5 bar
-0.9 bar to +2.5 bar	< 0.25 %	< 8.2 mbar	A3.5(-F), > -0.5 bar
-0.9 bar to +0.2 bar	< 0.6 %	< 2.4 mbar	A1.2(-F), > -0.2 bar
Relative pressure			Sensor type, calibrated range
Relative pressure sensor			R5(-F), > -0.3 bar
-0.9 bar to +5 bar	< 0.3 %	< 13.2 mbar	R0.3(-F), > -0.3 bar
-0.3 bar to +0.3 bar	< 0.3 %	< 1.8 mbar	temperature range on request

Medium hookup	Value	Remarks
Non-leak-free	NW5 or 7,2, stainless steel, fluorine rubber (FPM, FKM) designed for gases, oils, water NW5, brass, butadiene acrylonitrile rubber (NBR) designed for gases	
Leak-free [2]	quick-release fittings NW5, stainless steel, perfluorine rubber (FFKM) designed for gases, fuels, oils, water NW5, chrome-plated brass (FFKM) designed for fuels	
Mating cycles	1000	with regular lubrication

1 Due to the effect of gravity on the oil column in its internal barometer, the sensors' high sensitivity can lead to offset errors if its position is changed. (For measurements of relative pressure, this can be compensated using the Tare function)

2 Leak-free signifies that the fitting come with a valve which closes automatically when the tube is disconnected (useful for liquids).

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Overload limits			
Parameter	**min.**	**max.**	**Remarks**
Input ranges 0.1 bar to 25.0 bar 0.1 bar to 10.0 bar 0.1 bar to 6.0 bar 0.1 bar to 3.5 bar 0.1 bar to 1.2 bar ±0.3 bar	 +0.5 bar -0.5 bar	 TBD +15 bar TBD +5 bar +1.5 bar +0.5 bar	sensor types CANFX/P-SEN-xx A25(-F) A10(-F) A6(-F) A3.5(-F) A1.2(-F) R0.3(-F) (Relative pressure transducer)
Temperature of medium	0°C to +100°C Perfluorine rubber (FFKM) -15°C to +100°C Fluorine rubber (FPM, FKM) 0°C to +100°C butadiene acrylonitrile rubber (NBR)		The upper limits are determined by the pressure sensors. Sealings not used in standard models

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Operating temperature range	-30°C to 85°C	internal condensation temporarily allowed
Operating altitude	up to 3000 m up to 1500 m	when using direct sensor readings only when deriving rel. pressure using internal barometer
Dimensions	111.3 x 110 x 146.5 mm	W x H x D

Remarks:

- Accuracy ratings pertain to settled state of thermal equilibrium.
- If the module is subjected to accelerations, the inertia will cause measurement errors with the sensitive sensors.
- Module description P8 338

10.2.18 PWM8

Parameter	Value	Remarks
Channels	8 (2 x 4 channels)	4-channel-group isolated to the other group as well as to supply and CAN-bus. No isolation within a channel-group. Separate voltage supply for both 4-channel-groups.
Output configuration	Open-Drain output TTL-output	Each channel has one open-drain and one TTL-output.
PWM frequency	30 Hz to 30 kHz	TTL-output common setting for each channel-group
Time resolution of PWM	≥31.3 ns	counter frequency 32 MHz
Resolution	 31.3 ns 62.5 ns 125 ns 250 ns 500 ns	at selected PWM-frequency 30 kHz to 470 Hz 460 Hz to 240 Hz 230 Hz to 120 Hz 110 Hz to 60 Hz 55 Hz to 30 Hz
Duty cycle	0% to 100%	
Output level (max.)	TTL: 5 V Open-Drain: <30 V	internal supply external supply
Externally usable supply	5 V/ 30 mA	per channel-group (VCC_1_4 and VCC_5_8)
Output current	TTL (High-level): <10 mA TTL (Low-level): <10 mA Open-Drain (Low-level): <1400 mA	
Switching time	TTL: <6 ns / 16 ns Open-drain: <10 µs / 20 µs	typ / max on / off
CAN-Bus	defined as per ISO 11898	
Isolation CAN-Bus supply analog output	 ±60 V ±60 V ±60 V	to housing (Chassis) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)

Reference

Module description PWM8 352

10.2.19 SC16

Parameter	Value	Remarks
Channels	16	4x DSUB-15 with each 4 channels
Measurement mode (DSUB) CANSAS-SC16, CANSAS-L-SC16, CANSAS-K-SC16	voltage measurement current measurement temperature measurement: thermocouple, RTD (PT100)	standard plug (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) thermo plug (ACC/DSUBM-T4)
Measurement mode (SL DSUB) CANSAS-SL-SC16-D CANSAS-SL-SC16-L-SUPPLY	voltage measurement	
Measurement mode (SL LEMO) CANSAS-SL-SC16-L, CANSAS-SL-SC16-L-SUPPLY	voltage RTD (PT100) current	 with external shunt
Measurement mode Thermocouple terminal socket (-2T) CANSAS-L-SC16-2T, CANSAS-L-SC16-2T-Y, CANSAS-K-SC16-2T CANSAS-K1-SC16-2T, CANSAS-K1-SC16-3T CANSAS-K-SC16-2T	thermocouple type-K thermocouple type-K thermocouple type-K thermocouple type-K thermocouple type-K thermocouple type-K thermocouple type-K thermocouple type-T	miniature thermocouple terminal article number: 1050397 (yellow plug) article number: 1050332 article number: 1050333

Sampling rate, Bandwidth, CANopen®, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	max. 500 Hz (2 ms) / channel	maximum allowable input signal frequency: 100 Hz The data rates 500 Hz and 200 Hz are based on a slower working sampling rate and will be interpolated.
Sampling rate, temperature	max. 1 Hz (1 s) / channel	recommended maximum for optimized noise reduction; filter: 12 Hz (-3 dB); -60 dB @ 50 Hz no restrictions for input signal frequency (except for narrow band 0.5 Hz to 12 Hz)
Bandwidth with compensation filter	28 Hz sampling rate / 7	at sampling rate 500 Hz (2 ms), 200 Hz (5 ms) 100 Hz (10 ms) to 2 Hz (500 ms)
Resolution	16 bit	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	in CANopen® mode: max. 100 Hz (10 ms) / channel
TEDS - Transducer Electronic DataSheets	conformant to IEEE 1451.4 Class II MMI	ACC/DSUBM-TEDS-xxx

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
Block isolation CAN-bus DC supply input	±60 V ±60 V		each function block to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Max. common-mode input voltage	±40 V		analog input to case (CHASSIS) nominal rating
Channel isolation	±40 V ±15 V		max. voltage between any two arbitrary input pins of different channels; max. fault protection for specified accuracy
Overvoltage protection	±40 V		differential channel input voltage (long-term)
Input configuration	DC, differential		isolated to: case, supply and CAN-bus
Input impedance (static)	10 MΩ 50 Ω		voltage mode current mode (Shunt plug)
Input current static dynamic on overvoltage condition	 2 nA (typ.) 0.2 mA (typ.) 20 nA (typ.) 0.1 µA	 25 nA (max.) 20 mA (max.) 2 µA (max.) 1 µA	dynamic input currents: (scanner/multiplexer) settled current at time of sampling peak dynamic input current (typ. @100 mV, max. @10 V) average dynamic input current (typ. @100 mV, max. @10 V) $\|V_{in}\|$ >15 V; or device powered-down
Noise 	 25 mV $_{pk-pk}$ 0.5 K $_{pk-pk}$ 6 mV $_{pk-pk}$	 5 µV $_{rms}$ 0.08 K $_{rms}$ 	sampling rate: 2 ms, R_s = 50 Ω range ±100 mV thermocouple type K sampling rate: 1 s, R_s = 50 Ω
Max. source impedance	5 kΩ		of sensor or signal source
Max. cable length (signal-input)	200 m		100 pF / m
Crosstalk (channel to channel)	< -105 dB		60 Hz, source impedance R_s = 100 Ω, range ±100 mV
CMRR / IMR	100 dB (50 Hz)		Common-Mode reference: case (CHASSIS) all other channels: CHASSIS

Voltage measurement			
Parameter	**Value (typ.)**	**min. / max.**	**Remarks**
Range	±10 V, ±5 V ±2 V, ±1 V ±500 mV, ±200 mV, ±100 mV		
Gain Error	<0.025 %	<0.05 %	at 25°C
Gain drift	30 ppm/K (typ.)	60 ppm/K (max.)	
Offset	<0.02 %		over entire temperature range
Linearity error	<50 ppm		range ±10 V

Current measurement with shunt connector			
Parameter	**Value (typ.)**	**min. / max.**	**Remarks**
Range	±40 mA, ±20 mA, ±10 mA, ±4 mA, ±2 mA		
Shunt impedance	50 Ω		
Gain Error	<0.075 %	<0.15 %	at 25°C
Offset	<0.02 %		over entire temperature range

Temperature measurement - Thermocouples			
Parameter	**Value (typ.)**	**min. / max.**	**Remarks**
Measurement modes	R, S, B, J, T, E, K, L, N		
Measurement range	-200°C to +1200°C		type: R, S, B, J, T, E, K, L, N (max. one type per configuration)
Temperature error	±0.2 K	<±0.5 K	-150 °C to max range type: J, T, K, E, L (for other types: see uncertainties of voltage measurements) at sampling rate ≥1 s with imc plug ACC/DSUBM-T4 also apply for SC16-2T-x variant
Drift	±0.02 K/K·ΔT_a		ΔT_a=|T_a -25°C|; ambient temp: T_a
Error of cold junction Compensation		<±0.15 K <±0.5 K	with imc plug ACC/DSUBM-T4 with thermo socket SC16-2T-x
Drift of cold junction	±0.001 K/K·ΔT_j		ΔT_j = |T_j -25°C| cold junction T_j

Temperature measurement - RTD measurement (PT100)			
Parameter	**Value (typ.)**	**min. / max.**	**Remarks**
Measurement range	-200°C to +850°C		mixed configuration with thermocouples supported; Use of thermo-plug provides complete set of terminals for full 4-wire connection scheme; reference current: 410 µA, int. calibrated
Measurement error		<±0.2 K <±0.05 %	-200°C to 850°C, four-wire connection plus percentage of reading (corresponding to equivalent resistance value)
Drift		±0.01 K/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a

Optional sensor supply (CAN-xx-SUPPLY)				
Parameter	**Value**			**Remarks**
Configuration options	7 selectable settings			
Output voltage	voltage	current	net power	set globally for all channels of a module
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Isolation				
standard	non isolated			output to case (CHASSIS)
optional, upon request	isolated			nominal rating: 50 V, test voltage (10 sec): 300 V
Short-circuit protection	unlimited duration			to output voltage reference ground
Accuracy of output voltage	<0.25% (typ.) / <0.5% (max.) <0.9% (max.)			at terminals, no load 25°C; 2.5 V to 24 V over entire temperature range
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V to 10 V 12 V, 15 V 24 V

Operating conditions			
Parameter	**typ.**	**min. / max.**	**Remarks**
Supply voltage	10 V to 50 V DC		
sensor supply voltage (optional)	2.5 V to 24 V		technical specs Sensor supply module
Power requirements:	2.6 W (typ.)	<3.0 W (max.) <7 W	12 V DC, over full temperature range with SUPPLY option (xx-SUPPLY)
Operating temperature	-40°C to 85°C		
Dimensions (W x H x D), weight	55 x 111 x 90 mm; 300 g 55 x 111 x 145 mm; 850 g 41 x 128 x 145 mm; 500 g 81 x 128 x 145 mm 78 x 112.5 x 152 mm 58 x 112.5 x 152 mm 55 x 111 x 90 mm 55 x 111 x 145 mm 58 x 112.5 x 152 mm 78 x 112.5 x 152 mm		CANSAS-SC16 CANSAS-L-SC16, -L-SC16-2T CANSAS-K-SC16, -K(1)-SC16-2T CANSAS-K1-SC16-3T CANSAS-SL-SC16-L CANSAS-SL-SC16-D with optional sensor supply CANSAS-SC16-SUPPLY CANSAS-L-SC16-SUPPLY CANSAS-SL-SC16-L-SUPPLY CANSAS-SL-SC16-D-SUPPLY
Terminal connection	4x DSUB-15 16x 2-pol. TK-connector		inputs CANSAS-SC16 only for thermocouple type K
	2x DSUB-9		CAN (in / out), power supply (alternatively)
	PHOENIX (MC 1,5 /4STF-3,81)		DC power supply
Terminal connection SL	4x DSUB-15 16x LEMO (HGG.1B.307)		inputs CANSAS-SL-SC16-**D**(-SUPPLY) CANSAS-SL-SC16-**L** (-SUPPLY)
	2x DSUB-9 2x 10-pin LEMO (HGA.1B.310		power supply (alternatively) CANSAS-SL-SC16-**D**(-SUPPLY) CANSAS-SL-SC16-**L** (-SUPPLY)
	1x 6-pin LEMO (HGA.1B.306)		power supply (for all SL models)

Module description SC16 356

10.2.20 SCI8, SCI16

Channels, Measurement modes		
Parameter	**Value**	**Remarks**
Channels SCI16 SCI8	 16 8	 4x DSUB-15 with each 4 channels 2x DSUB-15 with each 4 channels
Measurement mode DSUB	 voltage measurement current measurement temperature measurement: thermocouple, RTD (PT100)	 voltage plug (ACC/DSUBM-U4) shunt plug (ACC/DSUBM-I4) thermo plug (ACC/DSUBM-T4)
Measurement mode LEMO	 voltage measurement ≤60 V RTD (PT100) current measurement	 with internal shunt
Measurement mode Thermocouple terminal socket (-2T)	thermocouple type-K	miniature thermocouple terminal
terminal socket (-2T-T)	thermocouple type-T	miniature thermocouple terminal
terminal socket (-2T-J)	thermocouple type-J	miniature thermocouple terminal
Measurement mode BNC	 voltage measurement ≤60 V	

Sampling rate, Bandwidth, CANopen®, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate SCI16 SCI8	 max. 500 Hz (2 ms) / channel max. 1 kHz (1 ms) / channel	max. allowable input signal frequency: 100 Hz 150 Hz The data rates 500 Hz and 200 Hz are based on a slower working sampling rate and will be interpolated.
Sampling rate, Temperature SCI16 SCI8	 max. 1 Hz (1 s) / channel max. 2 Hz (500 ms) / channel	recommended maximum for optimized noise reduction; filter: 12 Hz (-3 dB); -60 dB @ 50 Hz no restrictions for input signal frequency (except for narrow band 0.5 Hz to 12 Hz); All channels with the same sampling rate.
Bandwidth SCI16 SCI8	 23 Hz sampling rate / 7 42 Hz sampling rate / 7	with compensation filter, at sampling rate 500 Hz (2 ms), 200 Hz (5 ms) 100 Hz (10 ms) to 2 Hz (500 ms) 1 kHz (1 ms), 500 Hz (2 ms) 200 Hz (5 ms) to 5 Hz (200 ms)
Resolution	16 bit	

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Sampling rate, Bandwidth, CANopen®, TEDS		
Parameter	**Value**	**Remarks**
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	SCI16: in CANopen® mode: max. 100 Hz (10 ms) / channel SCI8: in CANopen® mode: max. 200 Hz (5 ms) / channel
TEDS - Transducer Electronic Data Sheets	conformant to IEEE 1451.4 Class II MMI	ACC/DSUBM-TEDS-xxx

General			
Parameter	**Value (typ. / max)**		**Remarks**
Block isolation CAN-bus DC supply input	 ±60 V ±60 V		each function block to case (CHASSIS) nominal rating; tested: 300 V (10 s) nominal rating; tested: 300 V (10 s)
Max. common-mode input voltage	±60 V		analog input to case (CHASSIS) nominal rating; tested: 300 V (10 s)
Channel isolation:	±60 V		max. voltage between any two arbitrary input pins of different channels; for specified accuracy nominal rating testing: 300 V (10 s)
Overvoltage protection	±60 V		differential channel input voltage (long-term)
Input configuration	DC, differential		isolated to: case, supply and CAN-bus
Input impedance (static)	10 MΩ 1 MΩ 50 Ω		voltage mode ≤10 V voltage mode ≥20 V current mode (Shunt plug)
Input current: static dynamic on overvoltage condition	 1.5 nA (typ.) 0.1 mA (typ.) 10 nA (typ.)	 15 nA (max.) 1.5 mA (max.) 1 µA (max.) 1.5 mA	dynamic input currents: (scanner/multiplexer) settled current at time of sampling peak dynamic input current (typ. @100 mV, max. @10 V) average dynamic input current (typ. @100 mV, max. @10 V) $\|V_{in}\|$ >17 V in range ≤±10 V
Noise	 25 μV_{pk-pk} 10 mV_{pk-pk} 0.5 K_{pk-pk} 6 μV_{pk-pk}	 5 μV_{rms} 2 mV_{rms} 0.08 K_{rms}	sample rate: 2 ms, R_s = 50 Ω range ±100 mV range ±20 V thermocouple type K sample-rate: 1 s, R_s = 50 Ω
Source impedance	5 kΩ		of sensor or signal source
Cable length (signal-input)	200 m		100 pF / m
Crosstalk (channel to channel	< -105 dB		60 Hz, source impedance R_s = 100 Ω, range ±100 mV
CMRR / IMR	100 dB (50 Hz)		Common-Mode reference: case (CHASSIS) all other channels: CHASSIS

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV		
Gain error	<0.025%	<0.05%	at 25°C with voltage plug
Gain drift	30 ppm/K 50 ppm/K	60 ppm/K 90 ppm/K	range ≤±10 V range ≥±20 V
Offset error	<0.02%		over entire temperature range
Linearity error	<50 ppm		range ±10 V

Current measurement with shunt plug			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±40 mA, ±20 mA, ±10 mA, ±4 mA, ±2 mA		
Shunt impedance	50 Ω		
Gain error	<0.075%	<0.15%	at 25°C
Offset error	<0.02%		over entire temperature range

Temperature measurement - Thermocouple			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Measurement mode	R, S, B, J, T, E, K, L, N		(max. one type per configuration)
Range	-50°C to +1760°C -50°C to +1760°C -45°C to +1820°C -210°C to +1200°C -270°C to +400°C -270°C to +1000°C -270°C to +1240°C -200°C to +900°C -270°C to +1300°C		type R type S type B type J type T type E type K type L type N
Temperature error	±0.2 K	<±0.5 K	-150 °C to max range type: J, T, K, E, L (other types: uncertainties of voltage measurements apply) sample rate SCI16: ≥1 s respectively SCI8: ≥0.5 s with imc plug ACC/DSUBM-T4 also apply for SCI8(16)-2T variant
Drift	±0.02 K/K·ΔT_a		ΔT_a= |T_a-25°C| ambient temperature T_a
Error of cold junction compensation		<±0.15 K <±0.5 K	with imc plug ACC/DSUBM-T4 with SCI8(16)-2T-x (thermo socket)
Drift of cold junction	±0.001 K/K·ΔT_j		ΔT_j = |T_j -25°C| cold junction T_j

Temperature measurement - RTD (PT100)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Range	-200°C to +850°C		mixed configuration with thermocouples supported; Use of thermo-plug provides complete set of terminals for full 4-wire connection scheme; reference current: 410 µA, int. calibrated
Gain error		<±0.2 K <±0.05%	-200°C to 850°C, four-wire connection plus percentage of reading
Drift		±0.01 K/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$ ambient temperature T_a

Optional sensor supply (CAN-xx-SUPPLY)				
Parameter	**Value**			**Remarks**
Configuration options	7 selectable settings			
Output voltage	voltage	current	net power	set globally for all channels of a module
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Isolation standard optional, upon request	non isolated isolated			output to case (CHASSIS) nominal rating: 50 V, test voltage (10 sec): 300 V
Short-circuit protection	unlimited duration			to output voltage reference ground
Accuracy of output voltage	<0.25% (typ.) / <0.5% (max.) <0.9% (max.)			at terminals, no load 25°C; 2.5 V to 24 V over entire temperature range
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V to 10 V 12 V, 15 V 24 V

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption			
SCI8	2.8 W	<3.3 W <7 W	without supply with optional supply
SCI16	4 W	<4.6 W <8 W	without supply with optional supply

Operating conditions and terminal connections of the module		
Parameter	**Value**	**Remarks**
Operating temperature	-40°C to 85°C	
Dimensions (W x H x D), weight	55 x 111 x 90 mm, ca. 500 g 35 x 111 x 90 mm, ca. 330 g	CANSAS-SCI16 CANSAS-SCI8
	55 x 111 x 145 mm, ca. 850 g 35 x 111 x 145 mm	CANSAS-L-SCI16, L-SCI16-2T CANSAS-L-SCI8
	41 x 128 x 145 mm, ca. 500 g	CANSAS-K-SCI8(16), K-SCI8-2T, -K-SCI8-BNC (=3HE/8TE)
	81 x 128 x 145 mm	CANSAS-K-SCI16-2T -K-SCI16-BNC (=3HE/16TE)
	58 x 112.5 x 152 mm	CANSAS-SL-SCI8-L
	78 x 112.5 x 152 mm	CANSAS-SL-SCI16-L
	38 x 112.5 x 152 mm	CANSAS-SL-SCI8-D
	58 x 112.5 x 152 mm	CANSAS-SL-SCI16-D
		with optional sensor supply
	55 x 111 x 90 mm 55 x 111 x 90 mm	CANSAS-SCI16-SUPPLY CANSAS-SCI8-SUPPLY
	55 x 111 x 145 mm 55 x 111 x 145 mm	CANSAS-L-SCI16-SUPPLY CANSAS-L-SCI8-SUPPLY
	41 x 128 x 145 mm, ca. 500 g	CANSAS-K -SCI8(16)-SUPPLY (=3HE/8TE)
	58 x 112.5 x 152 mm 78 x 112.5 x 152 mm	CANSAS-SL-SCI8-L-SUPPLY CANSAS-SL-SCI16-L-SUPPLY
	58 x 112.5 x 152 mm 78 x 112.5 x 152 mm	CANSAS-SL-SCI8-D-SUPPLY CANSAS-SL-SCI16-D-SUPPLY
Terminal connection	4x DSUB-15 2x DSUB-15	inputs (CANSAS-SCI16) inputs (CANSAS-SCI8)
	8(16)x 2-pin Thermo-plug	thermocouples type-K (CANSAS-X-2T)
	8(16)x BNC	inputs (CANSAS-K-SCI8(16)-BNC)
	2x DSUB-9	CAN (in / out), power supply (alternatively)
	PHOENIX (MC 1,5 /4STF-3,81)	DC power supply
Terminal connection for SL		inputs
	2(4)x DSUB-15	CANSAS-SL-SCI8(16)-**D**(-SUPPLY)
	8(16)x LEMO (HGG.1B.307)	CANSAS-SL-SCI8(16)-**L**(-SUPPLY)
		CAN (in / out) power supply (alternatively)
	2x DSUB-9 2x 10-pin LEMO (HGA.1B.310)	CANSAS-SL-SCI8(16)-D(-SUPPLY) CANSAS-SL-SCI8(16)-L(-SUPPLY)
	1x 6-pin LEMO (HGA.1B.306)	DC power supply

The following statements only apply to the imc CANSAS*flex* modules:

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Operating temperature range	-40°C to 85°C	internal condensation temporarily allowed

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSAS*flex* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a - 25°C$
Max. power	96 W at 12 V DC 192 W at 24V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor and installations
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Module description SCI8, SCI16 356

10.2.21 SENT

Parameter	Value typ.	min. / max.	Remarks
SENT standard	SAE J2716 (2007, 2008, 2010, 2016)		completely compatible
SENT input	8 respectively for pins V_{Supply}, signal input (SIG) and GND		Isolated individually from each other and from CHASSIS
Supply voltage for the SENT sensor	5 V	4.85 V to 5.15 V	at 20°C individually for each sensor no general short-circuit protection. However, one supply may be short-circuited for a short time.
Supply current of the SENT sensor		20 mA	according SENT-Norm I_{out} (Receiver power supply requirements)
CAN bus	defined in accordance with ISO 11898 up to 1 Mbit/s		terminal connection isolated to power supply / CHASSIS of the CANSAS module; as per CiA® Draft Standard 102 Version 2.0
LEDs	8 1		Status indicator Power
Isolation CAN bus SENT-inputs	 ±60 V ±60 V		to system ground nominal; tested 300 V (10 s) nominal; tested 300 V (10 s)
Overvoltage protection of the SENT input	±60 V	 -0.3 V to 0.3 V + V_{Supply}	signal input (SIG) to GND transient overvoltage pulses long-term, continuous
Power consumption	5.5 W		24 V DC, 20°C
Shock resistance	50 g pk over 5 ms		without plug
Weight	400 g		
Dimensions (B x H x T)	38 x 111 x 90 mm		
Supply voltage		10 V to 50 V DC	
Operating temperature		-40°C to 85°C	condensation allowed
Terminal connection	PHOENIX (MC 1,5/4STF-3,81)		power supply
	2x DSUB-15		8 SENT inputs
	2x DSUB-9		CAN (IN / OUT), power supply (alternatively)

SENT-input configuration options			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Serial protocol	short enhanced (12 bit) enhanced (16 bit) without protocol		
Clock Tick length		1 to 90 µs	resolution in steps of 0.1 µs
Number of data nibbles		1 to 6	
Pause Pulse Option	npp: no pause pulse pp: pause pulse ppc: pause pulse with constant frame length		
Pause pulse frame length		147 to 922 Ticks	expressed in clock ticks
CRC	✓		is verified
Reduction		1 to 100	A number of FAST channel samples will create and output one single CAN message.
Number of FAST-channels		1 to 4	per SENT-inputs
Nibble order	MSN first LSN first		set separately for each FAST-channel
Start bit position		0 to 23	set separately for each FAST-channel
Number of bits		1 to 16	set separately for each FAST-channel
Data type	signed integer unsigned integer		set separately for each FAST-channel
Scaling	linear scaling possible		
Status-Channel	4+4+1 bit		CRC, communication-nibble, CRC-Valid bit
Passive monitoring	yes / no		Parameterized separately for each input; tapped without power supply or feedback
CAN-message rate		5000 / s	fully compatible

The following specs only apply to the imc CANSAS*flex* SENT

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Operating temperature range	-40°C to 85°C	internal condensation temporarily allowed

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption		<5.5 W	
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSAS*flex* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a - 25°C$
Max. power	96 W at 12 V DC 192 W at 24V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-30 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a - 25°C$
Max. power	72 W at 12 V DC 144 W at 24 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C

Module description: SENT 452

10.2.22 UNI8

Channels, Measurement modes		
Parameter	**Value**	**Remarks**
Channels	8	
Measurement modes DSUB	voltage measurement voltage measurement with adjusted supply current measurement resistance measurement thermocouples (mounted with and without contact to GND) bridge-sensor bridge: strain gauge PT100 in 3- and 4-wire configuration	 internal shunt (single-ended) or with shunt connector (ACC/DSUBM-I2) plug with built-in cold-junction compensation (CJC) ACC/DSUBM-UNI2 half-, quarter- and full bridge the "protect" variant does not support the 3-wire configuration
Measurement modes LEMO and ITT Veam	voltage measurement voltage measurement with adjusted supply current measurement resistance measurement thermocouples (mounted with and without contact to GND) bridge-sensor bridge: strain gauge PT100 in 3- and 4-wire configuration	 internal shunt (single-ended) plugs with built-in cold-junction compensation (CJC) ACC/TH-LEM-150, CAN/UINST-PT100 (ITT VEAM) half-, quarter- and full bridge

Sampling rate, Bandwidth, CANopen®, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤1 kHz	per channel, output rate on the CAN-bus
Bandwidth	200 Hz	-3 dB; Filter OFF
	190 Hz	-3 dB; with AAF-filter
Resolution	16 bit	internal 24 bit processing output format: 16 bit Integer
TEDS - Transducer Electronic Data Sheets	conformant to IEEE 1451 Class II MMI	ACC/DSUBM-TEDS-xxx
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	

General		
Parameter	**Value**	**Remarks**
Isolation CAN-Bus power supply input analog input	 ±60 V ±60 V no isolation	referred to case (CHASSIS) nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 300 V (10 s) analog reference ground: CHASSIS
Overvoltage protection	±80 V	permanent, channel to chassis
Input coupling	DC	
Input configuration	differential	
Input impedance	1 MΩ 20 MΩ	measurement ranges: >±10 V measurement ranges: ≤±10 V

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V... ±5 mV		
Gain error	0.02%	0.05%	of measured value, 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%	percentage of range, in specified ranges: >±50 mV range ≤±50 mV range ±5 mV range
Offset drift	±60 µV/K·ΔT_a ±0.06 µV/K·ΔT_a	±100 µV/K·ΔT_a ±0.3 µV/K·ΔT_a	>±10 V ≤±10 V $\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
CMRR Common mode rejection ratio	 62 dB 92 dB 120 dB	 >46 dB >84 dB >100 dB	DC and f≤60 Hz range ±50 V... ±20 V range ±10 V... ±50 mV range ±20 mV... ±5 mV
Noise	0.4 μV_{rms} 14 nV/√Hz		(RTI) bandwidth 0.1 Hz to 200 Hz

Current measurement with shunt plug			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 mA, ±20 mA, ±10 mA, ,.., ±1 mA		
Shunt impedance	50 Ω		external shunt plug ACC/DSUBM-I2
Over load protection		±60 mA	permanent
Input configuration	differential		with 50 Ω impedance in shunt plug
Gain error	0.02%	0.06% 0.1%	of reading plus error of 50 Ω shunt
Gain drift	20 ppm/K·ΔT_a	95 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 measurement range, at 25°C
Offset drift	±0.05 nA/K·ΔT_a	±0.5 nA/K·ΔT_a	$\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature

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Current measurement with internal shunt			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 mA, ±20 mA, ±10 mA, ,.., ±1 mA		
Shunt impedance	120 Ω		internal (only the 120 Ω variant)
Over load protection		±60 mA	permanent
Input configuration	single-ended		internal current backflow to -VB
Gain error	0.02%	0.06%	of reading
Gain drift	20 ppm/K·ΔT_a	95 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 measurement range, at 25°C
Offset drift	±0.05 nA/K·ΔT_a	±0.5 nA/K·ΔT_a	$\Delta T_a=\lvert T_a$ -25°C$\rvert$; with T_a = ambient temperature

The 350 Ω variant (1/4 bridge completion) does not support current measurement with internal shunt.
Alternatively an external shunt can be used. For the DSUB-15 variant an appropriate shunt plug is available: ACC/DSUBM-I2

Bridge measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Modes	DC		
Measurement modes	full-, half bridge quarter bridge		 max. 5 V bridge excitation voltage
Input ranges bridge excitation voltage: 10 V bridge excitation voltage: 5 V bridge excitation voltage: 2.5 V	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ... ±0.5 mV/V ... ±1 mV/V ... ±2 mV/V		
Bridge excitation voltage	10 V 5 V 2.5 V		not for quarter bridge measurement
Internal quarter-bridge completion	120 Ω		optional 350 Ω
Input impedance	20 MΩ	±1%	differential, full bridge
Gain error	0.02%	0.05%	of the measured value, 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	0.01%	0.02%	of input range after automatic bridge balancing
Offset drift	16 nV/V/K·ΔT_a	0.2 µV/V/K·ΔT_a	$\Delta T_a=\lvert T_a$ -25°C$\rvert$; with T_a = ambient temperature
Allowable cable impedance "one way" not including return line		<8 Ω <16 Ω <24 Ω	10 V bridge voltage 120 Ω 5 V bridge voltage 120 Ω 2.5 V bridge voltage 120 Ω

Temperature measurement - Thermocouples			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	J, T, K, E, N, S, R, B, L		resolution: approx. 0.1 K
Measurement error	≤1 K		specification of the error applies only to: DSUB CJC PT1000 ACC/DSUBM-UNI2 LEMO CJC PT100 ACC/TH-LEM-150 ITT VEAM CJC PT100 CAN/UNIST-PT100 sensor type K at 20°C over total temperature range
Input impedance	20 MΩ	±1%	differential

Temperature measurement - RTD-measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	-200°C to 850°C		resolution: approx. 0.02 K
Measurement error		<±0.2 K <±0.05% +0.01 K/K·ΔT_a	4-wire measurement of reading (corresponding resistance) $\Delta T_a = \lvert T_a - 25°C \rvert$; with T_a = ambient temperature
Sensor feed	1.23 mA		

Resistance measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input range	0 Ω to 800 Ω		
Gain error		≤0.15%	of the measured value, at 25°C
Offset error		≤0.05%	of measurement range

Built-in UNI8 Sensor Supply				
Parameter	**Value**			**Remarks**
Configurations options	7 ranges			
Output voltage	Voltage	Current	Net power	set globally
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 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	
Short circuit protection	unlimited duration			to reference ground of the output voltage
Output voltage accuracy [1]	<0.25% (typ.) <0.5% (max.) <0.9% (max.)			at terminal plugs, no load 25°C; 2.5 V to 24 V 25°C; 2.5 V to 24 V over entire temperature range
Compensation of cable resistances	measurement mode: bridge measurement, strain gauge 3-wire circuit: single sense wire: sensing of return line only (-VB: supply ground) voltage drops dynamically monitored and numerically compensated			provided for 2.5 V, 5 V and 10 V. prerequisites: 1) symmetrical feed and return lines differing cable length for individual channels allowed
Compensation of cable resistances	measurement mode: voltage measurement with adjusted supply 3-wire circuit: single sense wire: sensing of return line only (-VB: supply ground) physical adjustment of voltage (+VB)			provided for 5 V. prerequisites: 1) symmetrical feed and return lines, 2) identical wires for all channels, 3) representative measurement at Channel 1 special operation mode: only for an operation with special sensors with a sensitivity depends in a certain extent on the exact value of the supply (especially "Nippon DENSO")
Efficiency	min. 40% typ. 55% typ. 50%			2,5 V 5 V, ..15 V 24 V
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V, ..10 V 12 V, 15 V 24 V

[1] The precision of the bridge measurement is not affected by actual precision of the bridge supply. The current value of the bridge supply is continuously monitored and compensated.

Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Supply voltage	10 V to 50 V DC		
Power consumption	5 W (typ.)	8 W (max.) 14 W (max.)	 including supply for external sensors (over total temperature range)
Operating temperature	-40°C to 85°C		

Terminal connections of the imc CANSAS classic modules		
Parameter	**Value**	**Remarks**
Terminal connection CANSAS-K, -L	8x 7-pin ITT VEAM or 8x 7-pin LEMO or 4x DSUB-15	 2 channels per plug
	2x DSUB-9	CAN (in / out), supply (alternatively)
	PHOENIX (MC 1.5/4STF-3.81)	power supply
Terminal connection CANSAS-SL	8x 7-pin ITT VEAM or 8x 7-pin LEMO (HGG.1B.307) or 4x DSUB-15	 2 channels per plug
	2x DSUB- 9 or 2x 10-pin LEMO (HGA.1B.310)	CAN (in / out), supply (alternatively) CAN (in / out), supply (alternatively)
	1x 6-pin LEMO (HGA.1B.306)	power supply
Dimensions (W x H x D)	 75 x 111 x 145 mm 81 x 128.4 x 145 mm 58 x 112.5 x 152 mm	without plugs CANSAS-L CANSAS-K CANSAS-SL
Weight	approx. 900 g	

The following statements only apply to the **imc CANSAS*flex*** UNI8 modules.

Terminal connections		
Parameter	**Value**	**Remarks**
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	**Value**	**Remarks**
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20
Operating temperature range	-40°C to 85°C	internal condensation temporarily allowed

Power supply			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input supply voltage	10 V to 50 V DC		
Power consumption	5 W	8 W 14 W	 including supply for external sensors (over total temperature range)
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSAS*flex* or imc BUSDAQ*flex*

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	**Value**	**Remarks**
Max. current	8 A	at 25°C current rating of the click connector
	-50 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	96 W at 12 V DC 192 W at 24V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	**Value**	**Remarks**
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	-30 mA/K·ΔT_a	Derating with higher operating temperatures T_a, $\Delta T_a = T_a$ –25°C
Max. power	72 W at 12 V DC 144 W at 24 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C

Module description UNI8 372

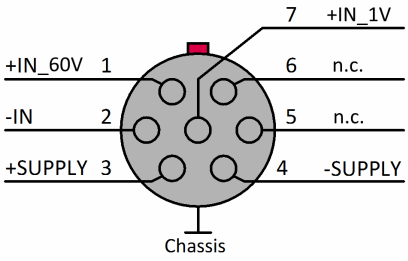
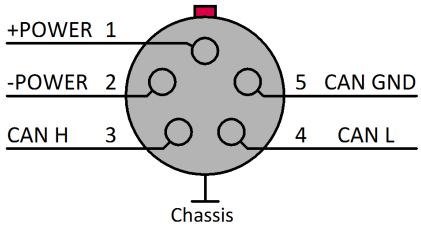
10.3 µ-CANSAS

10.3.1 µ-CANSAS-V1

Parameter	Value typ.	min. / max.	Remarks
Channels	1		
Measurement modes	voltage measurement voltage with divider		Input +IN_1V, -IN_COM Input +IN_60V, -IN_COM
Sampling rate	2 kHz		
Analog bandwidth	840 Hz		-3 dB
AD-conversion	24 Bit		
CANopen® Mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 PDO in INT16, INT32, and FLOAT		
Input ranges	±1 V, ±500 mV, ±200 mV, ±100 mV ±60 V, ±20 V, ±10 V ±5 V, ±2 V		Input +IN_1V Input +IN_60V
Sensor supply	5 V, 10 V		max 210 mW, short-circuit-protected: 1 s
Isolation	60 V / 500 V		long-term / 10 s
Max. sustainable voltage	40 V / 100 V 100 V		Input +IN_1 V long-term / 1 s Input +IN_60 V long-term
Input configuration	DC, differential		Isolation to: case, power supply and CAN-Bus
Input impedance	5 MΩ 10 kΩ 900 kΩ		Input +IN_1 V Input +IN_1 V upon overvoltage, or deactivated Input +IN_60 V
Gain error	<0.05%		of measured value
Gain drift	2 ppm/K 3.5 ppm/K	10 ppm/K 30 ppm/K	ranges ≤±1 V ranges ≥±2 V
Offset	0.01%		of measured value
Offset drift	0.8 µV/K 4.4 µV/K	2 µV/K 20 µV/K	ranges ≤±1 V ranges ≥±2 V
Noise	1.6 μV_{rms} 115 μV_{rms}		range ±100 mV range ±2 V sampling rate: 2 kHz, R_{source} _q = 0 Ω
IMR (isolation mode rejection)	>120 dB (50 Hz) >100 dB (50 Hz)		ranges ≤±1 V ranges ≥±2 V R_{source} = 0 Ω
Sensor supply	5 V, 10 V		max. 210 mW, short-circuit proof 1 s
Accuracy of sensor supply	<5%		over entire temperature range

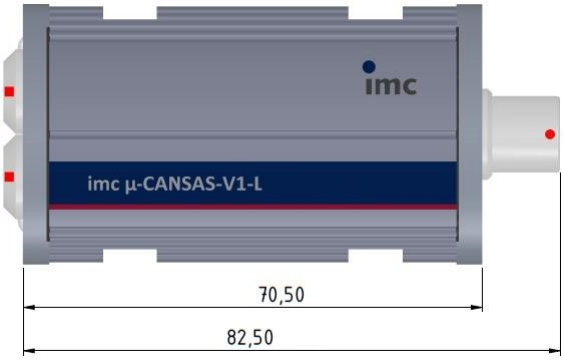
Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Power supply		9 V to 50 V DC	
Power consumption	1 W	1.5 W	

Operating conditions		
Parameter	**Value**	**Remarks**
Operating temperature	-40°C to 120°C	CAN/µ-V1-L/AS
Dimensions (W x H x D) with / without terminal connection	 40 x 20 x 82.5 / 70,5 mm 40 x 20 x 104 / 60 mm	 CAN/µ-V1-L CAN/µ-V1-AS
Weight	0.1 kg 0.08 kg	CAN/µ-V1-L CAN/µ-V1-AS

Parameter	**Value**	**Remarks**
Terminal connection		
CAN / Supply	2x LEMO 5-pin type: HGG.0B.305 1x 6-pin Autosport type: AS208-35PA	CAN/µ-V1-L CAN IN und OUT CAN/µ-V1-AS CAN OUT
Measurement input	1x LEMO 7-pin type: HGG.1B.307	CAN/µ-V1-L
LEMO pin configuration	input CAN/µ-V1-L, LEMO.1B: 	CAN / supply; CAN/µ-B1-L, LEMO.0B: 

Dimensions

imc µ-CANSAS-V1-L



Modulbeschreibung µ-CANSAS-V1 403

10.3.2 µ-CANSAS-T1

Parameter	Value typ.	min. / max.	Remarks
Channels	1		
Measurement modes	Thermocouples type: B, E, J, K, N, R, S, T		Input: +IN_1V, -IN_COM
Sampling rate / channel	100 Hz		
Analog bandwidth	20 Hz		-3 dB
AD-conversion	24 Bit		
Isolation	60 V / 500 V		long-term / 10 s
Max. sustainable voltage	40 V / 100 V		long-term / 1 s
Input configuration	DC, differential		isolation to: frame, power supply and CAN-Bus
Input impedance	5 MΩ 10 kΩ		Input: +IN Input: +IN upon overvoltage, or deactivated
Diagnostics	open sensor detection		data output upon detected wiring error: lower end full scale (negative)
Measurement error	<±0.6 K		Type: J, T, K, E (for all other types, the voltage measurement uncertainties apply; see Technical Specs µ-CANSAS-V1)
Temperature drift	±0.024 K/K·ΔT_a		ΔT_a= |T_a -25°C| ambient temperature T_a
Error of cold junction compensation	<±0.3 K		tightly sealed screw connection
Drift of cold junction	±0.005 K/K ΔT_j		ΔT_j = |T_j -25°C| cold junction temp. T_j

Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Power supply		9 V to 50 V DC	
Power consumption	1 W	1.5 W	

Operating conditions		
Parameter	**Value**	**Remarks**
Operating temperature	-40°C to 120°C	
Dimensions (W x H x D) with / without terminal connection	 40 x 20 x 82.5 / 70,5 mm 40 x 20 x 104 / 60 mm	 CAN/µ-T1-L CAN/µ-T1-AS
Weight	0.1 kg 0.08 kg	CAN/µ-T1-L CAN/µ-T1-AS

Terminal connection	Value	Remarks
CAN / Supply	2x LEMO 5-pin type: HGG.0B.305 1x 6-pin Autosport type: AS208-35PA	CAN/µ-T1-L CAN IN und OUT CAN/µ-T1-AS CAN OUT
Measurement input	1x 8-pin Phoenix strip terminal	(MPT0,5/8)

Module description µ-CANSAS-T1 411

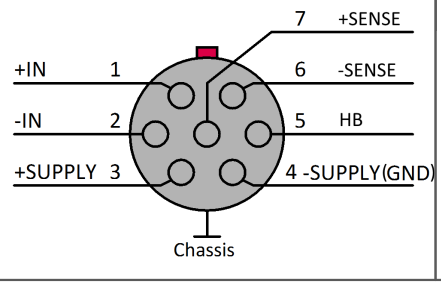
10.3.3 µ-CANSAS-B1

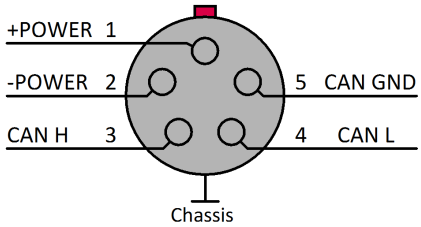
Parameter	Value	Remarks
Channel	1	
Measurement modes	full bridge half bridge	
Sampling rate	2 kHz	
Analog bandwidth	840 Hz	-3 dB
AD-conversion	24 Bit	
CANopen® Mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 PDO in INT16, INT32, and FLOAT	CANopen® not with CAN/µ-H-B1-2.5V
Input ranges	±200 mV/V, ±100 mV/V, ±50 mV/V, ±20 mV/V, ±10 mV/V, ±5 mV/V, ±2 mV/V,±1 mV/V ±0,5 mV/V	 not with variant with bridge supply = 2.5 V
Bridge supply	5 V DC 2.5 V DC	max 210 mW, short-circuit protection variant: CAN/µ-H-B1-2.5V
Isolation	60 V / 500 V	long-term / 10 s
Input overvoltage protection	40 V / 100 V	long-term / 1 s
Min. bridge impedance	120 Ω	I_{max} =42 mA
Input impedance	5 MΩ 10 kΩ	operating mode upon overvoltage or deactivated (power down)
Gain error	<0.1%	of measured value
Offset error	<2 µV/V <0.02% <0.08%	after bridge balancing for ranges: <±10 mV/V of selected range, for ranges ±200 mV/V to ±10 mV/V with electrically controlled environments in cases of HF interference with unshielded installations (applies for variant µ-CAN-H-B1(-2.5V), only)
Offset drift	0.04 µV/V/K	
Noise	0.32 $\mu V/V_{rms}$ 0.64 $\mu V/V_{rms}$	full bridge, full bandwidth variant: bridge supply 2.5 V

Power supply of the module			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Power supply		9 V to 50 V DC	
Power consumption	1 W	1.5 W	

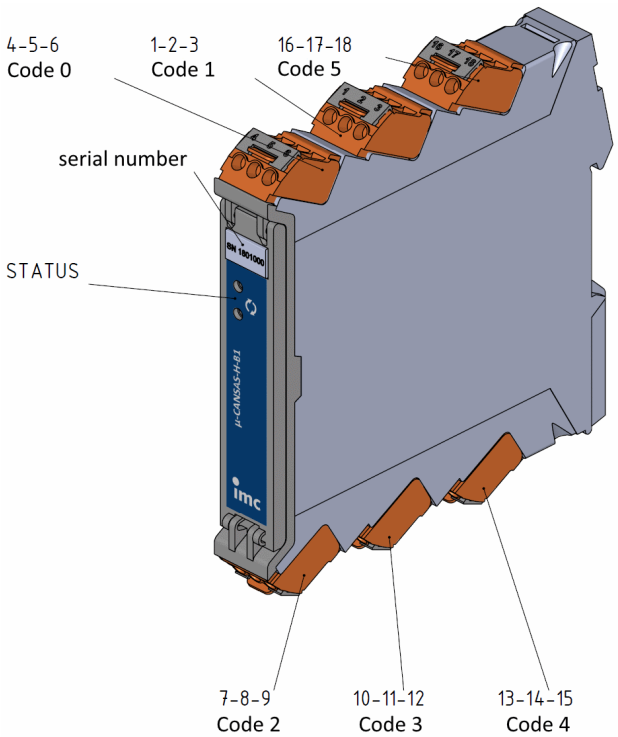
Operating conditions		
Parameter	**Value**	**Remarks**
Operating temperature	-40°C to 120°C -20°C to 85°C	CAN/µ-B1-L/AS CAN/µ-H-B1(-2.5V)
Dimensions (W x H x D) with / without terminal connection	 40 x 20 x 82.5 / 70.5 mm 40 x 20 x 104 / 60 mm 17.5 x 120 x 114 mm	 CAN/µ-B1-L CAN/µ-B1-AS CAN/µ-H-B1(-2.5V)
Weight	0.1 kg 0.08 kg	CAN/µ-B1-L CAN/µ-B1-AS

Parameter	**Value**	**Remarks**
Terminal connection		
CAN / Supply	2x LEMO 5-pin type: HGG.0B.305 1x 6-pin Autosport type: AS208-35PA plugable terminal block (Weidmüller)	CAN/µ-B1-L CAN IN and OUT CAN/µ-B1-AS CAN OUT CAN/µ-H-B1(-2.5V)
Measurement input	1x LEMO 7-polig Typ: HGG.1B.307 plugable terminal block (Weidmüller)	CAN/µ-B1-L CAN/µ-H-B1(-2.5V)
LEMO pin configuration	input CAN/µ-B1-L, LEMO.1B:	CAN / supply CAN/µ-B1-L, LEMO.0B:





Plugable terminal block (Weidmüller)



Terminal block	Pin	configuration
upper block	1	CAN High
middle	2	CAN GND
code 1	3	CAN Low
upper block	4	+SUPPLY
front	5	-SUPPLY
code 0	6	CAN Reset
block below	7	+SENSE
front	8	+VB
code 2	9	+IN
block below	10	-IN
middle	11	-VB
code 3	12	-SENSE
block below	13	-IN
back	14	HB
code 4	15	n.c.
upper block	16	CAN High
back	17	CAN GND
code 5	18	CAN Low

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Please find here the µ-CANSAS-B1 module description 413

10.4 Synchronization line

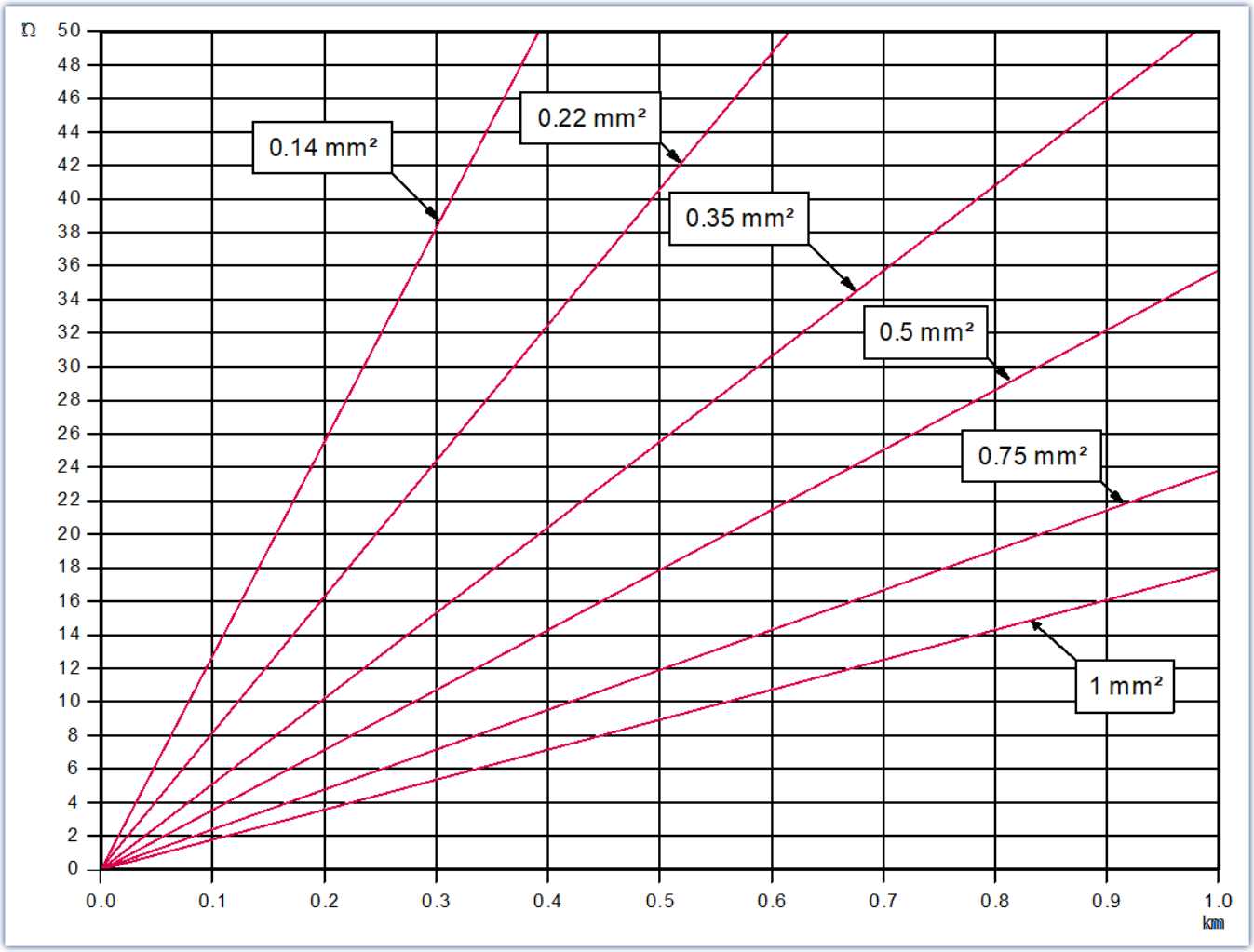
Technical specs of the imc CANSAS modules' synchronization line

Parameter	Value (typ. / max)		Test conditions
High-level output voltage ("Master mode")	4,75 V	5,5 V	
Low-level output voltage ("Master mode")		0,55 V	@ I = 25 mA
High-level output current ("Master mode")		25	
High-level Input Voltage ("Slave mode")	4,0 V		
Low-level Input Voltage ("Slave mode")		0,8 V	
input leakage current		100 µA	
sync-frequency	1 Hz		±100ppm

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10.5 Tables and diagrams

10.5.1 Cable resistance as function of length and cross-section



Nomogram to determine cable resistance as function of one way distance and cross-section of copper cables

10.6 Accessories

10.6.1 DSUB-screw terminals for measurement inputs

All plugs listed below are 15-pin DSUB plugs made for direct connection to the measurement inputs of your imc CANSAS module (CON1, CON2). For attaching the lines/wires having 1 mm^2 cross section, there are screw terminals inside the plug enclosure.

Measurement	Comments	Order code
Voltage	voltage measurement with 4 differential channels	ACC/DSUBM-U4
Current	current measurement (0..40 mA) with 50 Ω (0.1%) shunt equipped for 4 differential channels	ACC/DSUBM-I4
Thermocouples	Direct connection of 4 thermocouples. In the terminal connector, an isothermal plate and a PT100 for cold junction compensation are built in.	ACC/DSUBM-T4
PT100	connection of 4 PT100 measurement resistors	ACC/DSUBM-T4
Measurement bridges	bridge measurement for two channels with e.g. UNI8	ACC/DSUBM-B2
Incremental counter inputs	connection of 4 incremental encoders e.g. INC4 connection of 4 incremental encoders with current signal	ACC/DSUBM-ENC4 ACC/DSUBM-ENC4-IU
Analog outputs	4 analog output channels for e.g. DAC8	ACC/DSUBM-DAC4
Digital inputs	8 digital inputs for connection to e.g. DI16	ACC/DSUBM-DI2-8
Digital outputs	8 digital outputs for connection to e.g. DO16	ACC/DSUBM-DO8
Relay outputs	four relays for connection to e.g. DO8R	ACC/DSUBM-REL4
PWM8	4 digital outputs for connection to PWM8 modules	ACC/DSUBM-PWM4

Reference

Pin configuration, see chapter Pin configuration 592

Note

For a complete overview of the accessories, please refer to the price list. In the data sheet of the respective module you will find the accessories that are compatible with the module.

10.6.2 FBG-Temp s / xs / xxs

General		
Parameter	**Value**	**Remarks**
Measurement mode	temperature	
Compatible measurement devices	imc CANSAS*fdx*-FBG-T8	8-channel fiber-optic interrogator; measurement module with CAN output
Technology	Fiber Bragg Grating glass-fiber, single-mode type SMF 28	
Connector	fiber optic connector type E2000 / APC	plug E2000 with locking mechanism and integrated protective cover
Sensor characteristics	individually parameterized sensor characteristics	5th order polynomial, individual calibration certificate
Sensitivity	9.5 pm/K (6.13 ppm/K)	typical linear sensitivity at 23 °C
Thermal response time	<0.1 s	T_90 (settling to 90 %)
Operating temperature range	-40 °C … +220 °C	usable measurement range
Calibrated operating range	-40 °C … +190 °C	for specified accuracy
Temperature range for storage, installation and assembly	-40 °C … +250 °C	tolerated by the sensor without irreversible damage (connector E2000: up to +85°C)

Fiber-optic FBG parameter		
Parameter	**Value**	**Remarks**
Bragg wavelength λ_0	1550 nm ±0.5 nm	
Reflectivity	70 % ±20	
Full width at half maximum	400 … 700 pm	FWHM
Side lobe suppression	>15 dB	SLRS

Measurement accuracy		
Parameter	**Value**	**Remarks**
Absolute measurement accuracy	±0.7 °C	when using the individual calibration parameters (certificate). Comprises the accuracy and reproducibility of the individually calibrated sensor characteristic curve. Applies to the entire specified measurement range

Mechanics		
Parameter	**Value**	**Remarks**
Mounting	glue crimping encapsulation	Methacrylat glue (MMA) e.g. "ERGO 1665" Cyanoacrylat glue e.g. "Scotch-Weld SF100"
Maximum load	50 kg	
Dimensions Length Active part Diameter	 32 ± 2 mm 12 ± 2 mm below tip 1.35 ± 0.2 mm	of the sensor with PEEK shrink tubing active FBG grating at sensor tip
Encapsulation	glass capillary PEEK shrink tubing	
Min. allowed bending radius	 5 mm ≤ 1 turn 10 mm ≤ 10 turns	at the passive fiber; max. 1 turn with minimum radius
Sensor cable diameter	0.9 ± 0.03 mm	sheating of the fiber on full length ("buffer"): PEEK, light brown
Cable length	900 ± 100 mm	with connector type E2000 / APC; extendable with E2000 coupling and optical patch cables
Pressure resistance	20 km above sea level	max. height
Fluid resistance	non-aggressive liquid and gaseous media (e.g., water, oil, diesel, petrol...)	other media upon request

Isolation		
Parameter	**Value**	**Remarks**
Technology	glass fiber based, metal free	completely insensitive to electromagnetic fields and interference
Isolation properties Resistance per unit length Isolation voltage	 277 GΩ/m 30 kV	

Reference Configuration

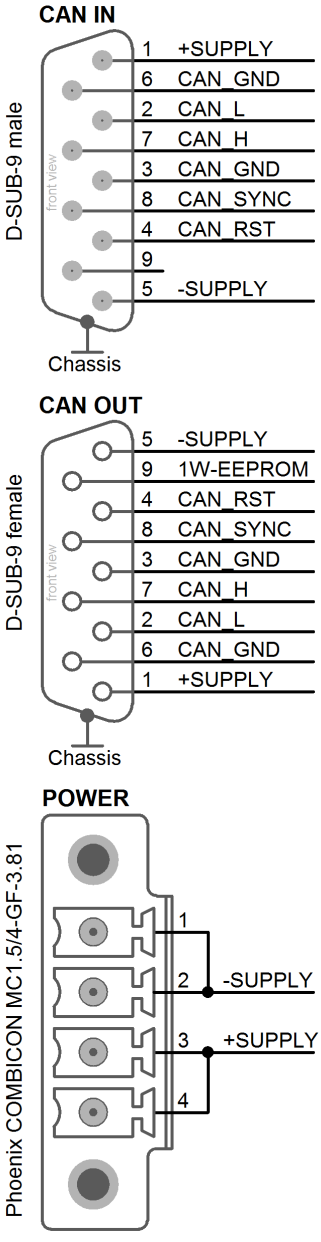
Please find here a detailed description for the configuration of the sensors: "Sensor imc FBG-Temp 326"

11 Pin configuration

11.1 CAN bus connectors

imc µ-CANSAS modules are equipped with Autosport 581 or LEMO connectors 582.
imc CANSAS*fit* modules are equipped with LEMO 0B connectors 582.

11.1.1 Standard module with DSUB-9



The following overview shows the pin configuration of the CAN bus sockets (CAN IN and CAN OUT).

You can find a general CAN bus description in the CAN bus description 43.

PIN	Signal	CiA description	Use in imc CANSAS
1	+CAN_SUPPLY	--	**imc CANSAS-specific:** + imc CANSAS voltage supply. The module can be supplied via this plug (and pin 5).
2	CAN_L	dominant low bus line	connected as per CiA®
3	CAN_GND	CAN ground	connected as per CiA®. CAN bus reference GND
4	CAN_RST	--	**imc CANSAS-specific:** imc CANSAS Reset (for startup with reset plug). The reset plug has a shortcut to pin 3 (GND).
5	-CAN_SUPPLY	--	**imc CANSAS-specific:** - imc CANSAS voltage supply (negative pole of supply / 0 V).
6	GND	CAN Ground	connected to pin 3, as per CiA®
7	CAN_H	dominant high bus line	connected as per CiA®
8	CAN_SYNC	--	**imc CANSAS-specific:** additional line for a sync signal (1 Hz). Generally 5 V to CAN Ground. Is pulled to CAN-Ground by the master during synchronization according to its clock.
9	1Wire EEPROM	--	**imc CANSAS-specific:** EEPROM information about mounting position (when used in a rack)
	Information **only at female CAN-OUT** plug P212. Pin 9 at male CAN-IN plug is "not connected".		
	Pin 9 is the positive pin of the EEPROM. The corresponding minus-pole must be connected to the chassis/shield (10/11) of the DSUB-plug.		
	The EEPROM is not inside the module, but can be connected externally.		

The two 9-pin sockets are connected 1:1 so that all connections except for pin 9 are connected through to the next imc CANSAS module.

Warning Safety note

No voltage may be applied to **pin 9** of the DSUB-9 (female) socket, as this **will destroy the imc module**. In contrast, modules from Vector, such as the VN 1630, use DSUB pin 9 for the VB+ A supply line.

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11.1.1.1 CAN bus wiring

Unless 9-line cables are used for the CAN bus, observe the following: pins 2 and 7 are absolutely necessary for transfer on the CAN bus. The CAN bus ground is also necessary. This may not be obvious, but consider that differentially transmitted signals require a reference, for which reason a line connected to the CAN bus ground must also be included. Either pin 3 or pin 6 can be used for this purpose. Situations can also arise in which the CAN-ground is not needed: for instance, in a vehicle, where it is possible to access Chassis potential anywhere, instead of using a line to pin 3. In this case, Chassis simply replaces the line to pin 3. Other lines can be included as required, for example a synchronization line or supply line.

Note also when using DSUB-plugs and the cables that there is a maximum current which DSUB-plugs can carry. This particularly applies to the DSUB-plugs on the imc CANSAS-modules and the internal connection of all of this plug's pins. The current should not exceed approx. 1 A. It may be necessary to use a correspondingly high supply voltage for the modules, or the separate green terminal for the supply.

Under no circumstances may a voltage be applied to pin 9, as this pin is reserved for the slot detection of the modules for rack operation. A voltage applied to this pin will destroy the module.

Check the cross-sections of the cables. The CAN cables supplied as standard with 9-pin DSUB plugs are not designed to handle large currents.

11.1.1.2 Notes for the use of CANcabs

Problem: Pins 4 and 9 are used in imc CANSAS for Reset and OneWire EEPROM. When a CANcabs extra cable from any of the companies Vector, dSPACE or KVASER is used, it results in duplicate pin assignment, since these pins are also used in those cases.

Remedy: The contacts Pin 4 and Pin 9 in the CAN connector must be disconnected from their leads to the CANcabs! This applies to the following CANcabs:

Pin	251 1050	251opto 1050opto DNopto	251 fiber	1041 opto	252 1053 1054	1054 opto	10011 opto	5790c (single wire)	5790c opto
1									
2	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	N.C.	N.C.
3	GND	VGND	VGND	VGND	GND	VGND	VGND	GND	VGND
4	RL	N.C.	N.C.	Split	RL	N.C.	RL	R100	R100
5	Shield								
6									
7	CAN High								
8									
9	N.C.	N.C.	VB+ 6-36V	VB+ optional 11-18V	N.C.	VB+ optional 11-18V	VB+ optional 16-32V	V_Batt	VB+ optional 11-18V

RL: reserved, may not be connected

11.1.1.3 Specification of components used

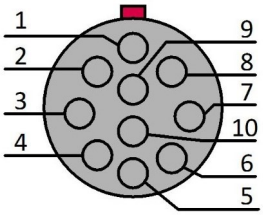
In imc CANSAS, the following components are used for the CAN-connection. Use this as a reference for the purpose of especially critical applications, e.g. in connection with bit-timing.

CAN-Controller: DSP TMS320LF2407A (Texas Instruments)
Oscillator Type: SG8002JFPCM-10M Hz (Epson, crystal oscillator, 10 MHz, -40 +85°C,±100 ppm);
CAN transceiver: PCA82C250 (Philips)
Slope resistor: 1 kΩ

11.1.2 CANSAS-SL with LEMO

The following overview shows the pin configuration of the CAN bus sockets (CAN IN and CAN OUT) of the imc CANSAS-SL housings. The differences to the standard imc CANSAS modules are described here.
A general description of the CAN bus can be found in Chapter "Startup" 43 of this documentation.

11.1.2.1 CAN bus pin configuration and contact wiring



LEMO.HGA.1B.310 (10-pin), view on top of the socket

PIN	Signal	CiA®-description	Use in imc CANSAS
1	CAN_HIGH	dominant high bus line	connected as per CiA®
2	CAN_LOW	dominant low bus line	connected as per CiA®
3	CAN_GND	CAN Ground	connected as per CiA®. CAN bus reference ground.
4	CAN_RST_STECK		imc CANSAS-specific: imc CANSAS Reset (for startup with Reset plug). The Reset plug has a shortcut to PIN 3 (GND).
5	CAN_SYNC		imc CANSAS-specific: additional wire for a sync signal (1 Hz) generally 5 V to CAN Ground
6	CAN_GND	CAN Ground	connected to Pin 3, as per CiA®
7, 8	+CAN_SUPPLY		imc CANSAS-specific: + pin for imc CANSAS power supply (+10 V..+50 V)
9, 10	-SUPPLY		imc CANSAS-specific: - pin for power supply (negative pole respectively 0 V)

Both 10-pin sockets are directly connected. In that way all circuit points can be connected through to the next imc CANSAS module.

Unless 10-line cables are used for the CAN bus, observe the following: Pins 1 and 2 are absolutely necessary for the transfer on the CAN bus. The CAN bus ground is also necessary. This may not be obvious, but consider that differentially transmitted signals require a reference, for which reason a line connected to the CAN bus ground must also be included. Either Pin 3 or Pin 6 can be used for this purpose. Situations can also arise in which the CAN-ground is not needed: for instance, in a vehicle, where it is possible to access Chassis potential anywhere, instead of using a line to Pin 3. In this case, Chassis simply replaces the line to Pin 3. Other lines can be included as required, for example a synchronization line or supply line.

Note

Note also when using LEMO-plugs and the cables that there is a maximum current which LEMO-plugs can carry. This particularly applies to the LEMO-plugs on the imc CANSAS-modules and the internal connection of all of this plug's pins. The current should not exceed approx. 4.5 A. It may be necessary to use a correspondingly high supply voltage for the modules, or the separate terminal for the supply. Also give regard to the cables' cross-sections.

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11.1.3 µ-CANSAS with Autosport or LEMO

Below is the pin configuration of the imc µ-CANSAS modules' CAN bus connector. Connections of -AS modules are made via 6-pin Autosport terminals 581 of the type AS208-35SA (CAN IN) and AS208-35PA (CAN OUT). Special tools exist for the purpose of assembling the Autosport connectors. Connections of µ-CANSAS-XX-L modules are made via 5-pin LEMO terminals 582 of the type HGG.0B.305. For a general description of the CAN bus refer to CAN bus description 43.

Note Default configuration

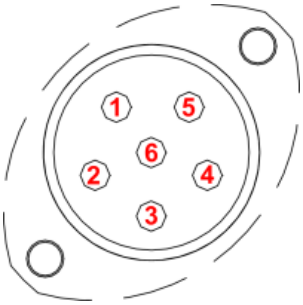
Per default imc µ-CANSAS modules imc µ-CANSAS-V1, imc µ-CANSAS-T1 and imc µ-CANSAS-B1 come **without an internal terminator resistor**.

If the modules with integrated terminating resistor were ordered, you do not need any additional terminators. In this case such a module can only be used as the last module in the CAN bus, since it necessarily terminates the CAN bus.

11.1.3.1 CAN bus pin configuration and contact wiring

11.1.3.1.1 Autosport (µ-CANSAS-XX-AS)

PIN	Signal	CiA® description	Use in imc CANSAS
1	+CAN_SUPPLY	dominant high bus line	imc CANSAS-specific: + pin for µ-CANSAS power supply
2	-SUPPLY		imc CANSAS-specific: - pin for power supply (negative pole respectively 0 V)
3	CAN_LOW	dominant low bus line	connected as specified by CiA®
4	CAN_HIGH	dominant high bus line	connected as specified by CiA®
5	CAN_RESET		imc CANSAS-specific: imc CANSAS Reset. Must be jumpered with CAN_GND for a reset.
6	CAN_GND	CAN Ground	Connected as per CiA®. CAN bus reference ground



6-pin Autosport terminal type AS208-35 view on the socket

Pins 3 and 4 are absolutely necessary for transmission on the CAN bus, as well as the CAN bus ground. According to specifications, the differential signals require a reference, for which reason a CAN bus ground connection is also needed. For this purpose pin 6 can be used. There are situations where the CAN ground is not necessary: for example, on board vehicles, if instead of a line to pin 6 it is possible to make contact with anywhere on the chassis. In that case, the chassis is a substitute for the line to pin 6.

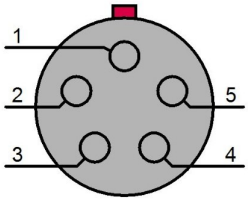
Other lines can be used for the purpose if necessary, for instance the power supply line.

Note

When using Autosport plugs and cables, that there is a limit on the maximum current through the Autosport-plug. The current should not exceed approx. 5 A. An accordingly high power supply voltage for the modules may need to be used. Check the cross-section of the cables.

11.1.3.1.2 LEMO 0B plug (µ-CAN-x1-L)

PIN	Signal	CiA® description	Use in imc CANSAS
1	+CAN_SUPPLY	dominant high bus line	imc CANSAS-specific: + pin for imc CANSAS voltage supply
2	-SUPPLY		imc CANSAS-specific: - pin of imc CANSAS power supply (minus contact: 0 V)
3	CAN_HIGH	dominant high bus line	connected as specified by CiA®
4	CAN_LOW	dominant low bus line	connected as specified by CiA®
5	CAN_GND	CAN Ground	connected as per CiA®, CAN bus reference ground
CHASSIS			cable shielding



5-pin LEMO terminal type HGG.0B.305

view on the socket

Pins 3 and 4 are absolutely necessary for transmission on the CAN bus, as well as the CAN bus ground. According to specifications, the differential signals require a reference, for which reason a CAN bus ground connection is also needed. For this purpose pin 5 can be used. There are situations where the CAN ground is not necessary: for example, on board vehicles, if instead of a line to pin 5 it is possible to make contact with anywhere on the chassis. In that case, the chassis is a substitute for the line to pin 5. Other lines can be used for the purpose if necessary, for instance the power supply line.

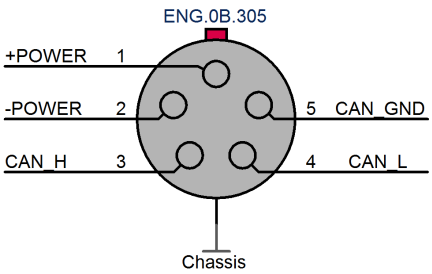
Note when using LEMO plugs and cables, that there is a limit on the maximum current through the LEMO-plug. An accordingly high power supply voltage for the modules may need to be used. Check the cross-section of the cables.

11.1.4 CANFT with LEMO

The following overview shows the CAN IN and CAN OUT that are also used for the power supply.

Note Default configuration

- Per default imc CANSAS*fit* modules come without an internal terminator resistor.
- Pin 3 and pin 4 are absolutely necessary for transmission on the CAN bus, as well as the CAN bus ground. According to specifications, the differential signals require a reference, for which reason a CAN bus ground connection is also needed. For this purpose pin 5 can be used. There are situations where the CAN ground is not necessary: for example, on board vehicles, if instead of a line to pin 5 it is possible to make contact with anywhere on the chassis. In that case, the chassis is a substitute for the line to pin 5.



view on the socket

- When using LEMO plugs and cables, please note that the maximum current through the LEMO-plug is limited. It may be necessary to use a higher supply voltage for the modules.

11.2 Power Supply

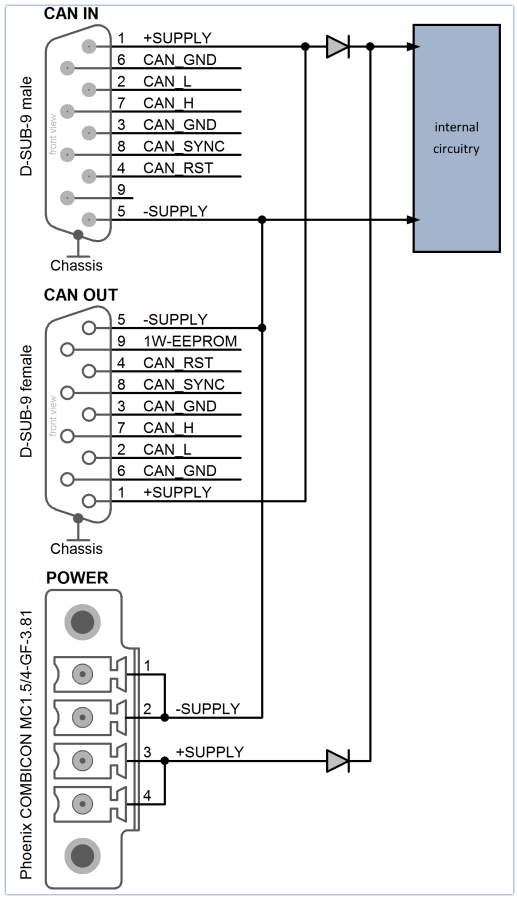
With regard to EN 61326-1 and EN 61010-1, the DC supply inputs are not specified for connection to a DC mains supply. DC networks are particularly extensive supply installations in the industrial sector. For these, increased safety margins are assumed for expected transient overvoltages in the event of a fault. This is comparable to the safety categories CAT II..IV in AC mains voltage systems.

11.2.1 CANSAS

There are two possibilities for supplying imc CANSAS modules with power:

- via the green Phoenix-jack labeled "POWER",
  or
- via the CAN bus (+SUPPLY / -SUPPLY).

Supplying power via the CAN bus connectors has the advantage that it can be conducted further down the CAN bus through the module and thus drive a cascade of modules as the sole supply.



Phoenix - socket

pin (front view)	**name**	**remarks**
1 (left)	-SUPPLY	0 V
2	-SUPPLY	0 V
3	+SUPPLY	+10 V...+50 VDC*
4 (right)	+SUPPLY	+10 V...+50 VDC*

* for all types build from 2010. Before 9 V to 32 V.
(See identification plate of the module also.)

Notes

- Note that the cumulative current for all connected devices flows through the CAN bus power supply lines. Since DSUB plugs are nominally designed to take 1 A rated current per pin, a maximum of three imc CANSAS modules should be supplied via the CAN bus connection (with 12 V supply voltage and approx. 4 W consumption per module, 1 A cumulatively flows in the 3 modules). If commercially available 9pin DSUB-cables are used, which tend to have high impedance, voltage loss in the lines must be taken into consideration (the input voltage measured at the module must not be less than 9 V!). To avoid that problem, choose a higher voltage, e.g. 24 V.
- Note when arranging the power supply that the starting current is greater than the long-term current. Also observe the remarks on CAN bus wiring above.
- The imc CAN bus connectors made for imc devices do not meet imc CANSAS module specs, but can under certain circumstances be modified by imc to do so. Please contact our customer support 10 if interested.

11.2.2 CANSAS-SL

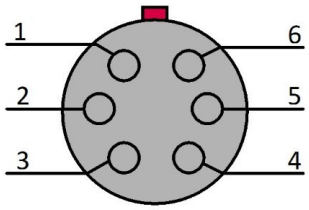
There are two possibilities for supplying imc CANSAS-modules with power:

- via the 6-pin LEMO socket labeled "POWER", or
- via the CAN bus (+SUPPLY / -SUPPLY).

Supplying power via the CAN bus-connectors has the advantage that it can be conducted further down the CAN bus through the module and thus drive a cascade of modules as the sole supply.

LEMO - socket

LEMO Pin (front view)	Name	Remarks	color of wire
1 (left)	+SUPPLY	+10 V...+50VDC	red
2	+SUPPLY	+10 V...+50VDC	
3	-SUPPLY	0 V	black
4 (right)	-SUPPLY	0 V	
5	---	n.c.	
6	---	n.c.	



6-pin LEMO (HGA.1B.306)

Notes

- Note that the cumulative current for all connected devices flows through the CAN bus power supply lines. Since LEMO plugs are nominally designed to take 2A rated current per pin, a maximum of 12 imc CANSAS modules should be supplied via the CAN bus connection (with 12 V supply voltage and approx. 4 W consumption per module, 1 A cumulatively flows in the 3 modules). If commercially available 10-pin LEMO-cables are used, which tend to have high Ohm-counts, voltage loss in the lines must be taken into consideration (the input voltage measured at the module must not be less than 10 V!). To avoid that problem, choose a higher voltage, e.g. 24 V.
- The connectors at the 6-pin LEMO socket and those for the CAN bus are not connected internally but are separated from each other by diodes. Therefore, make sure that the imc CANSAS module is supplied with power via only one of the two possible ways!
- The DC-supply inputs on the device itself (LEMO-socket) are galvanically isolated, i.e. isolated from the housing! If a imc CANSAS-SL is powered by an isolated DC-voltage source (e.g., battery), use the shielding of the supply plug or CAN bus plug to ground the device.
- Also, all signal leads to imc CANSAS-SL must be shielded and the shielding grounded (electric contact between the shielding and the plug housing).
- Note when arranging the power supply that the starting current is greater than the long-term current. Also observe the remarks on CAN bus wiring above.
- The imc CAN bus connectors made for imc devices do not meet imc CANSAS-module specs, but can under certain circumstances be modified by imc to do so. Please contact our customer support 10 if interested.

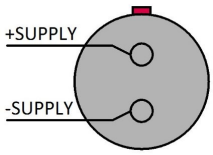
11.2.3 µ-CANSAS

The imc µ-CANSAS modules are supplied via the CAN bus terminals +SUPPLY and -SUPPLY (see image in previous section for pin configuration 582). The permitted supply voltage range for the imc µ-CANSAS modules is: **9 V to 50 V DC**.

Notes

- Be aware that the total current of all connected devices flows through the CAN bus supply lines. When a commercially available 6-pin cable is used, the voltage drop along the supply lines must additionally be taken into consideration, since they have relatively high resistance (the input voltage, measured at the module, may not be less than 9 V). So, to avoid problems select a higher power supply voltage, e.g. 24 V.
- When dimensioning the current supply, note that the power-on current is higher than the long-term current. Also make note of the information presented above on the CAN bus' wiring.
- imc devices' CAN bus terminals are not rated for the supply of imc CANSAS modules, but under certain circumstances they can be modified at imc for this purpose. If interested, please contact our customer support 10.

11.2.4 CANFX



The +Pin is marked with a red dot.

The imc CANSAS*flex* modules can be powered by a DC supply voltage which is supplied via a 2-pole **LEMO.EGE.0B compatible socket** (multicoded 2 notches). The permissible supply voltage range is: **10 V to 50 V**.

Note

Alternatively it is possible to supply the imc CANSAS*flex* module via a CAN-plug (DSUB-9) or via a clicked module connection.

11.2.5 CANFT

The imc CANSAS*fit* modules are supplied via the CAN bus terminals +POWER and -POWER (see image in previous section for pin configuration 582). The permitted supply voltage range for the imc CANSAS*fit* modules is: **7 V to 50 V DC**.

Notes

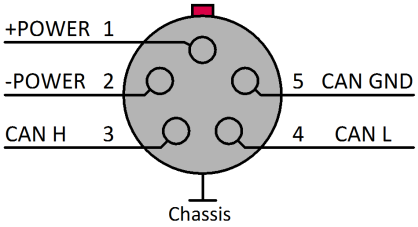
- Be aware that the total current of all connected devices flows through the CAN bus supply lines. When a commercially available cable is used, the voltage drop along the supply lines must additionally be taken into consideration, since they have relatively high resistance (the input voltage, measured at the module, may not be less than 7 V). So, to avoid problems select a higher power supply voltage, e.g. 24 V.
- When dimensioning the current supply, note that the power-on current is higher than the long-term current. Also make note of the information presented above on the CAN bus' wiring.

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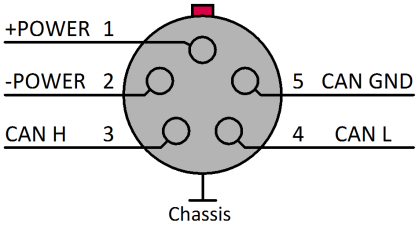
Cable for CAN and power supply for imc CANSAS*fit* modules



LEMO plug 0B, 5-pin

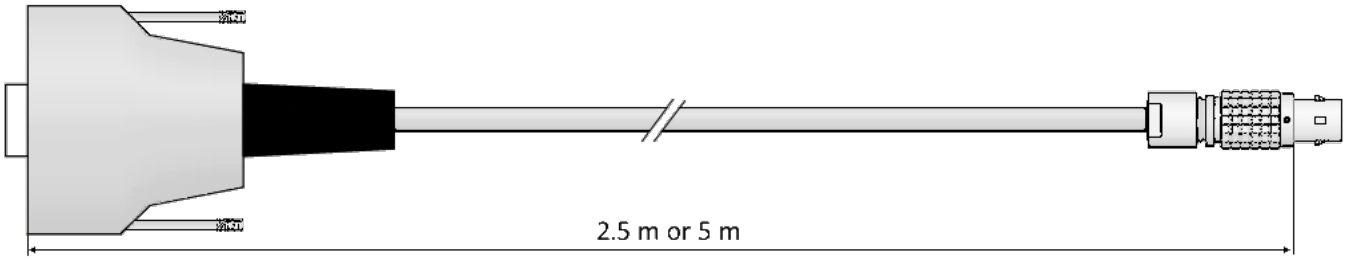


LEMO plug 0B, 5-pin



Order code	cable length	cross section	article no.
ACC/CABLE-LEMO-LEMO-1M	1 m	signal wire: 0.14 mm^2 supply wire: 0.25 mm^2	13500228
ACC/CABLE-LEMO-LEMO-2M5	2.5 m		13500229
ACC/CABLE-LEMO-LEMO-5M	5 m		13500259

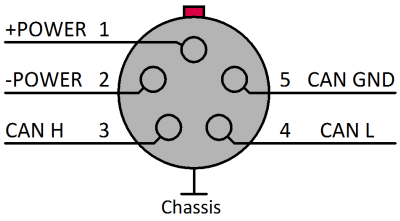
Cable for CAN and power supply for imc CANSAS*fit* and µ-CANSAS modules



DSUB-9, 9-pin

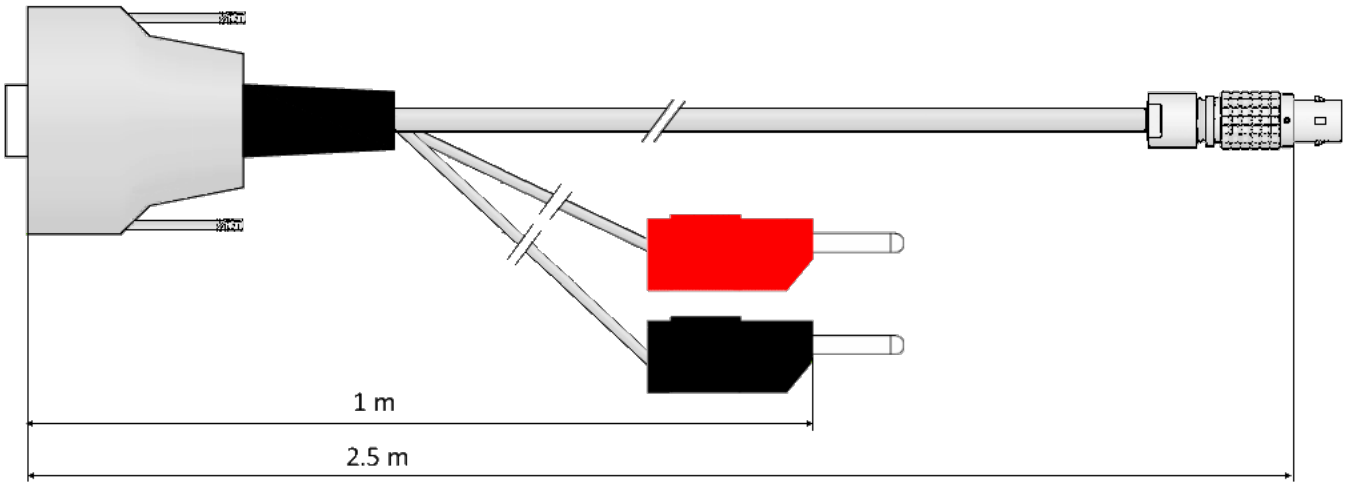
Pin	Signal
1	+POWER
2	CAN L
3	CAN GND
5	-POWER
7	CAN H

LEMO plug 0B, 5-pin



Order code	cable length	cross section	article no.
ACC/CABLE-LEMO-DSUB-2M5	2.5 m	signal wire: 0.14 mm^2 supply wire: 0.25 mm^2	13500230
ACC/CABLE-LEMO-DSUB-5M	5 m		13500258

Cable for CAN and power supply for imc CANSAS*fit* and µ-CANSAS modules (Y-cable)



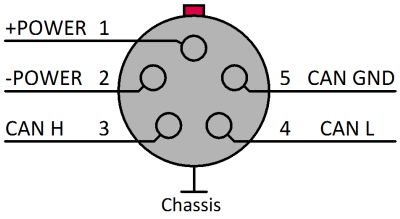
DSUB-9, 9-pin

Pin	Signal
2	CAN L
3	CAN GND
7	CAN H
Pin 1, 4, 5, 6, 8 and 9 are n.c.	

banana, 4 mm

BAN-plug	
red	+POWER
black	-POWER
minimum 0.5 mm^2 -40°C to 125°C	

LEMO plug 0B, 5-pin

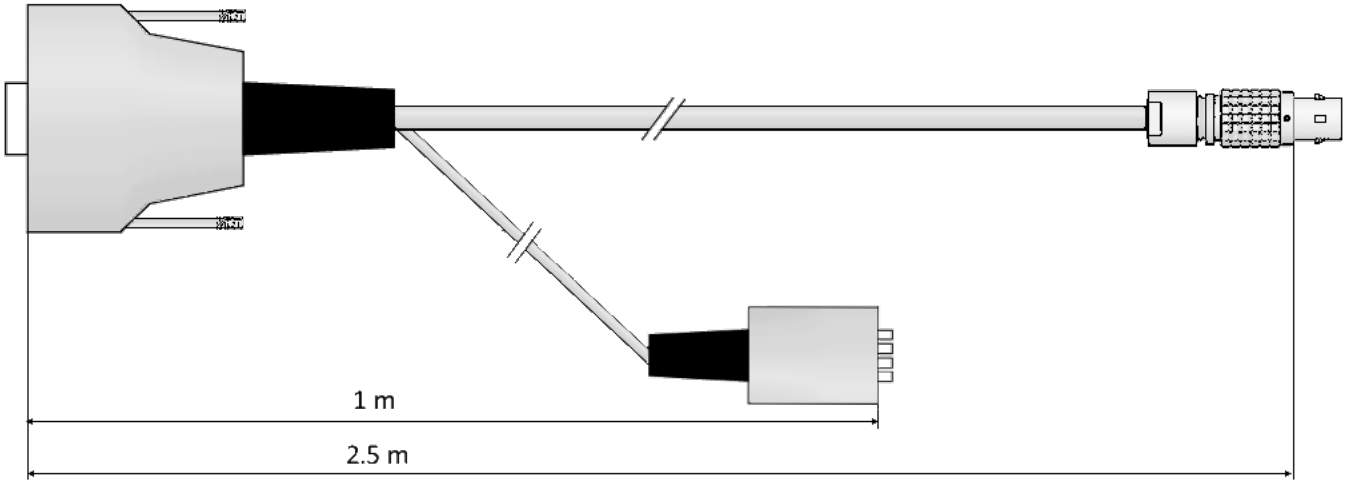


Order code	cable length	cross section	article no.
ACC/CABLE-LEMO-DSUB-BAN-2M5	2.5 m	signal wire: 0.14 mm^2 supply wire: 0.25 mm^2	13500231
ACC/CABLE-LEMO-DSUB-BAN-5M	5 m		13500269

With the Y-cables +POWER, -POWER are not connected to the DSUB-9 pins (*pin 1, 5 are n.c.*).

Other cable lengths are also available on request.

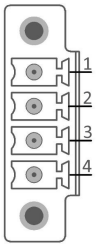
Cable for CAN and power supply for imc CANSAS*fit* and µ-CANSAS modules



DSUB-9, 9-pin

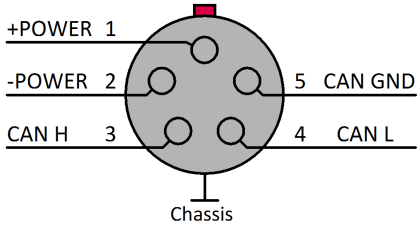
Pin	Signal
2	CAN L
3	CAN GND
7	CAN H
Pin 1, 4, 5, 6, 8 and 9 are not connected (n.c.)	

Phoenix, 4-pin



IMC 1,5/4-STGF-3,81	
Pin	Signal
1	not connected
2	-POWER
3	+POWER
4	not connected

LEMO plug 0B, 5-pin

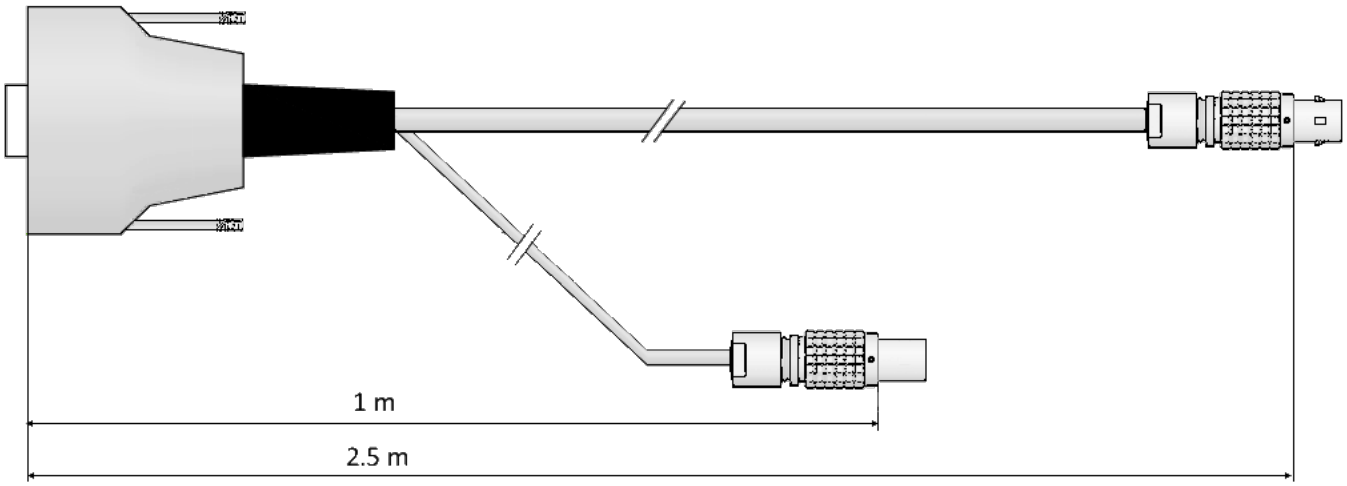


Order code	cable length	cross section	article no.
ACC/CABLE-LEMO-DSUB-PHOE-2M5	2.5 m	signal wire: 0.14 mm^2 supply wire: 0.25 mm^2	13500261

Cable for CAN and power supply for imc CANSAS*fit* modules: compatible with AC/DC power adaptor LEMO.1B

a) Variant for 15 V / 24 V power adaptor (e.g. CRPL/AC-ADAPTER-60W-1B, article no. 13500368)

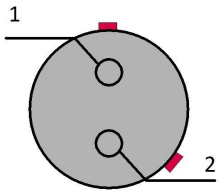
b) Variant for 48 V power adaptor (ACC/AC-ADAP-48-150-1B, article no. 13500148)



DSUB-9, 9-pin

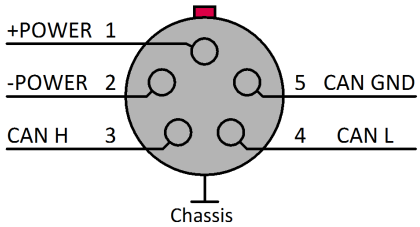
Pin	Signal
2	CAN L
3	CAN GND
7	CAN H
Pin 1, 4, 5, 6, 8 and 9 are n.c.	

LEMO connector 1B female, 2-pin



LEMO G/E-coded	
Pin	Signal
1	+POWER
2	-POWER

LEMO plug 0B, 5-pin



Order code	cable length		article no.
ACC/CABLE-LEMO-DSUB-LEMO-1B	2.5 m	for 15 V / 24 V power adaptor (e.g. CRPL/AC-ADAPTER-60W-1B): **G-coded**	13500368
ACC/CABLE-LEMO-DSUB-LEMO-1BE	2.5 m	only for 48 V power adaptor (ACC/AC-ADAP-48-150-1B): **E-coded**	13500296

cross section valid for both cables, signal: 0.14 mm^2 and power supply wires: 0.25 mm^2

imc CANSAS*fit* Power-Set			
Order code	cable length		article no.
CANFT/POWER-P	2.5 m	Power adaptor (AC/DC adaptor) 24 V, 60 W, cable for CAN and power, LEMO.0B to DSUB-9, power input via PHOENIX	12100023
CANFT/POWER-L24	2.5 m	Power adaptor (AC/DC adaptor) 24 V, 60 W, cable for CAN and power, LEMO.0B to DSUB-9, power input via LEMO.1B	12100044
CANFT/POWER-L48	2.5 m	Power adaptor (AC/DC adaptor) 48 V, 150 W, cable for CAN and power, LEMO.0B to DSUB-9, power input via LEMO.1B	12100045

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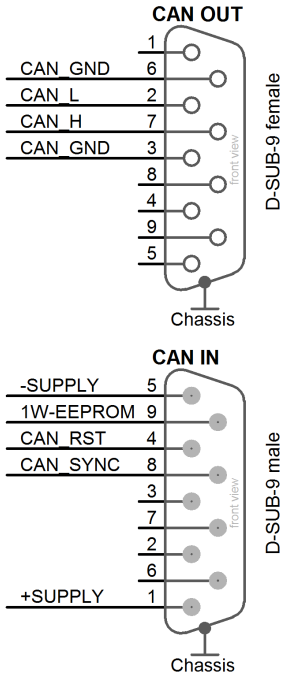
11.3 19" RACK

The 19" subrack is only for accommodating up to 10 imc cassette modules with 8 HP (horizontal pitches), having built-in slot recognition.

Parameter	CAN/19BGT	CAN/19BGT-D	CAN/19BGT-MMH	CANFX/RACK
for imc CANSAS housing	CANSAS-K cassette	CANSAS-L alu-profile	CANSAS-L alu-profile	CANFX-L housing
Slot: level (tier) / position	10	10	10	10
Connection Supply	LEMO.2B 2-pin 10 .. 36 V / <100 VA pin 1 (red point): +Supply pin 2: -Supply	LEMO.2B 2-pin 10 .. 36 V / <100 VA	XH pol (4-pin) 10 .. 36 V / <100 VA pin 1+2: +Supply pin 3+4: -Supply	Phoenix (4-pin) MC 1.5/4STF-3.81 10 .. 50 V DC
Connection CAN	DSUB-9 m/w			
Drop down locking mechanism	no	yes	yes	no
Side panel	angular	angular	round	angular
Contact pin for grounding	no	yes	yes	yes
imc article number	10500069	10500141	10500320	12500094
Included accessories	CAN-Bus terminator (10500028), LEMO.FGG.2B plug for power supply (13500024) and modem cable for extended temperature range		-	CAN/POWER-PLUG (10500024)
Weight				2 kg
Dimension rack (W x H x D)	483 x 133 x 180 mm			

Slot recognition

imc RACKs are equipped with an integrated slot recognition. There is an EPROM for each slot integrated in the Backplane of the RACK. The imc CANSAS software is able to interpret the content of this EPROM. Using multiple RACKs it is possible to define for each RACK a level number ("X", see slot: level (tier) / position). The module's exact position in a specific RACK can be guaranteed.

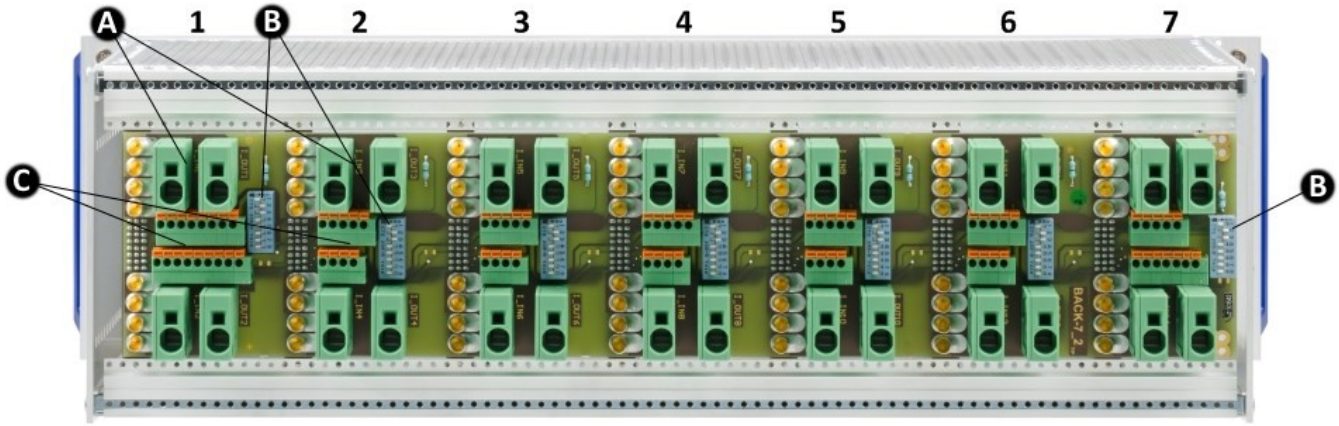


Pin configuration - 19" RACK CAN IN and CAN OUT

PIN	CAN IN	CAN OUT	Remarks
1	+SUPPLY	n.c.	
2	n.c.	CAN_L	dominant low bus line
3	n.c.	CAN_GND	CAN Ground, CAN-Bus reference ground
4	CAN_RST	n.c.	
5	-SUPPLY	n.c.	
6	n.c.	CAN_GND	verbunden mit Pin 3
7	n.c.	CAN_H	dominant high bus line
8	CAN_SYNC	n.c.	imc specific: Additional line for a sync signal (1 Hz).
9	1Wire EEPROM	n.c.	

IHR-RACK

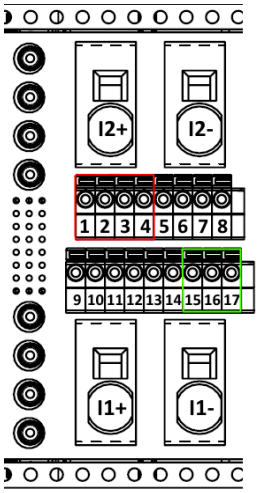
The 19" rack (CAN/IHR RACK, article no. 10500452) is per standard equipped with a backplane with high-current capable "push-in" displacement terminals for up to seven IHR plug-in modules. **The power supply** of the measurement technology itself (rack and modules) is uniformly designed **9-32 V DC** and **is exclusively provided via** the terminals at **slot 1**.



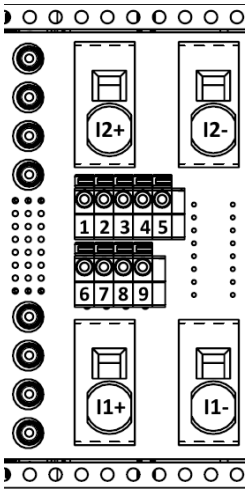
rear view with slot numbering 1 to 7

Legend: A: power connectors B: DIP Switch C: spring-loaded terminals, for CAN and power supply

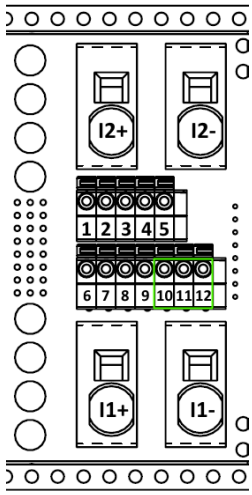
Slot 1



Slot 2 to 6



Slot 7



Pin configuration: spring-loaded terminals

Pin	Slot 1		Slot 2..6	Slot 7
1	-SUPPLY	power supply of the entire IHR-RACK including modules only via slot 1	—	—
2	+SUPPLY		—	—
3	-SUPPLY		—	—
4	+SUPPLY		—	—
5..9	—		—	—
10	—			CAN H
11	—			CAN L
12	—			CAN GND
13..14	—			
15	CAN H			
16	CAN L			
17	CAN GND			

Please find notes for the CAN termination 46 in the chapter "*connecting the terminators*".

11.4 Signal connection

Note General

Channels whose signal is to be measured must always be connected to a sensor or at least shorted at the input. Open inputs can cause the amplifier to be overmodulated, which can lead to interference or measurement uncertainty on the other channels. In such cases, the values of the technical specifications may not be reached.

11.4.1 Modules with DSUB-15

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.

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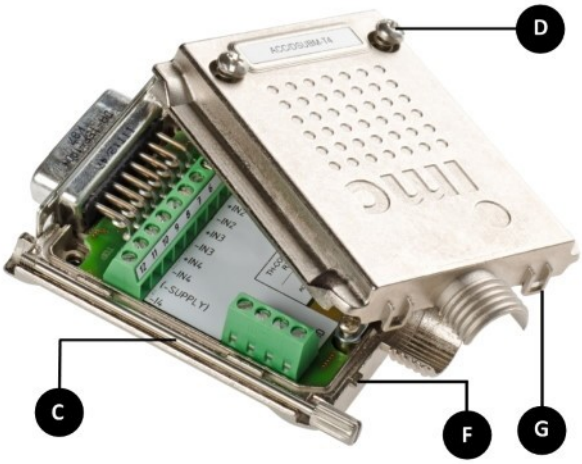
For devices with DSUB-15 connection technology, the convenient imc terminal plugs for solderless screw terminal connection are available as optional accessories.

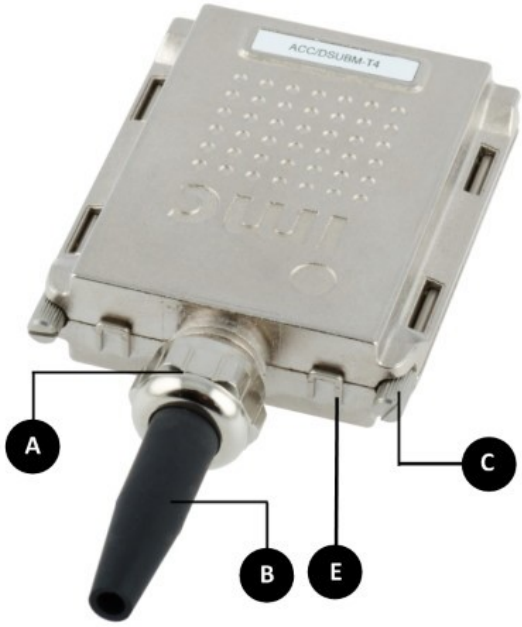


ACC/DSUBM-xxx: snap the nose into the slot

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

11.4.1.1 ACC/DSUBxx plugs

Plastic

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

Metal connector

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 sensor supply of the module is equipped with option ±15 V, then this pin = -15 V

Plastic Metal connector

ACC/DSUB-		ACC/DSUBM-		B2	B1	U4	UD4
DSUB Pin	Terminal	DSUB Pin	Terminal	BRIDGE	BRIDGE	VOLTAGE	SC16 V.-DEVIDER
9	1	9	1	+VB1	+SENSE1	(RES.)	
2	2	2	2	+IN1	+VB1	+IN1	+IN1
10	3	10	3	-IN1	+IN1	-IN1	-IN1
3	4	3	4	-VB1	-IN1	(+SUPPLY)	(+SUPPLY)
11	5	11	5	[+SENSE1_1/4B1]	-VB1	+IN2	+IN2
4	6	4	6	-SENSE1		-IN2	-IN2
12	7	12	7	+VB2		(-SUPPLY)	(-SUPPLY)
5	8	5	8	+IN2		+IN3	+IN3
13	9	13	9	-IN2		-IN3	-IN3
6	10	6	10	-VB2		(GND) *	(GND)
14	11	14	11	[+SENSE2_1/4B2]	+5V	+IN4	+IN4
7	12	7	12	-SENSE2	GND	-IN4	-IN4
15	14	15	15	GND	HB	(GND)	
8	17	8	18	+5V	CAL	(+5V)**	
	13		13				
	18		14				
	15		16	CHASSIS	CHASSIS	CHASSIS	CHASSIS
	16		17	CHASSIS	CHASSIS	CHASSIS	CHASSIS

[ ] : if SEN SUPPLY with option ±15V, then this pin = -15V

[ ] : 1/4 Bridge with UNI8, DCB8

* if the SEN SUPPLY of the module is equipped with option ±15 V, then this pin 6 is the reference

** not with C8

Plastic

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

Metal connector

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

* if SEN SUPPLY with option ±15 V, then this pin 6 is reference

Plastic Metal connector

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

Plastic Metal connector

ACC/DSUB-		ACC/DSUBM-		ENC4, ENC4-IU	DO-8	DAC4	PWM	REL4	DI2-8
DSUB Pin	Terminal	DSUB Pin	Terminal	INC.-ENCODER	DIGITAL OUT	ANALOG OUT	TTL PULSE	RELAIS	DIGITAL IN
9	1	9	1	+INA	BIT1		PWM1_OPDRN	IN1	+IN1
2	2	2	2	-INA	BIT2	DAC1	PWM2_OPDRN	IN2	+IN2
10	3	10	3	+INB	BIT3	AGND	PWM1_TTL	IN3	-IN1/2
3	4	3	4	-INB	BIT4		PWM2_TTL	IN4	+IN3
11	5	11	5	+INC	BIT5	DAC2	PWM3_OPDRN	OFF1	+IN4
4	6	4	6	-INC	BIT6	AGND	PWM4_OPDRN	OFF2	-IN3/4
12	7	12	7	+IND	BIT7		PWM3_TTL	OFF3	+IN5
5	8	5	8	-IND	BIT8	DAC3	PWM4_TTL	OFF4	+IN6
13	9	13	9	+INDEX		AGND		ON1	-IN5/6
6	10	6	10	-INDEX				ON2	+IN7
14	11	14	11	+5V	HCOM	DAC4	+5V	ON3	+IN8
7	12	7	12	GND *	LCOM	AGND	GND	ON4	-IN7/8
15	14	15	15	(-SUPPLY)	LCOM		GND	(GND)	LEVEL
8	17	8	18	(+SUPPLY)	OPDRN			(+5V)	LCOM
	13		13						
	18		14						
	15		16	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS
	16		17	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS

* ENC4: INDEX only at first socket (CON1)

** OPDRN is reserved and is not to be connected

11.4.1.2 TEDS plugs

Plastic

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

Metal connector

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 *
4	6	-SENSE1
5	7	+IN2
13	8	-IN2
14	9	I2_1/4B2 *
7	10	-SENSE2
12	11	+VB2
6	12	-VB2
15	15	TEDS_GND
8	18	(+5V)
	13	TEDS2
	14	TEDS1
	16	CHASSIS
	17	CHASSIS

* if SEN SUPPLY with option ±15 V, then this pin is = -15 V

Plastic

ACC/DSUB-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	14	GND	TEDS2
8	17	+5V	TEDS3
	13	TEDS1	TEDS1
	18	TEDS2	TEDS4
	15	CHASSIS	CHASSIS
	16	TEDS_GND	TEDS_GND

Metal connector

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

* if the SEN SUPPLY of the module is equipped with option ±15 V, then this pin 6 = -SUPPLY and Pin 12 the reference

[ ] : 1/4 Bridge with UNI8 and DCB8

** not for imc CANSAS C8

Plastic

ACC/DSUB-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	14	TEDS2	TEDS_GND
8	17	TEDS3	(+5V)
	13	TEDS1	TEDS1
	18	TEDS4	TEDS2
	15	CHASSIS	CHASSIS
	16	TEDS_GND	CHASSIS

Metal connector

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	

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Plastic

ACC/DSUB-TEDS-		T4
DSUB	Terminal	TH-COUPLE/RTD
9	1	+IREF
2	2	+IN1
10	3	-IN1
3	4	
11	5	+IN2
4	6	-IN2
12	7	
5	8	+IN3
13	9	-IN3
6	10	-IREF
14	11	+IN4
7	12	-IN4
15	14	TEDS2
8	17	TEDS3
	13	TEDS1
	18	TEDS4
	15	CHASSIS
	16	TEDS_GND

Metal connector

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

11.4.1.3 CI8-PT

The terminal connection of the CANFX/L-CI8-PT (1250000) is optimized for a 4-wire PT-measurement with individual soueces.

Signal	DSUB Pin
+I_PT1	9
+IN1	2
-IN1	10

Signal	Pin
+I_PT3	12
+IN3	5
-IN3	13

+I_PT2	3
+IN2	11
-IN2	4

+I_PT4	6
+IN4	14
-IN4	7

-I_PT1..4	15

(+5V)	8

One pin (solder cup) for common contacting of all 4 individual return conductors.

Note Software minimum requirement / measurement modes

Operation of the CANFX/L-CI8-PT module requires at least imc CANSAS software version 2.2 R2. A thermocouple measurement and a current measurement are not supported.

11.4.2 Modules with DSUB-9

imc CANSAS-K-INC4				
DSUB Pin	**CON1**	**CON2**	**CON3**	**CON4**
1	+IN1X	+IN2X	+IN3X	+IN4X
6	-IN1X	-IN2X	-IN3X	-IN4X
2	+IN1Y	+IN2Y	+IN3Y	+IN4Y
7	-IN1Y	-IN2Y	-IN3Y	-IN4Y
3	+INDEX [2]	+INDEX	+INDEX	+INDEX
8	-INDEX	-INDEX	-INDEX	-INDEX
4	NC	NC	NC	NC
9	GND	GND	GND	GND
5	+5V	+5V	+5V	+5V

[2] *The incremental counter inputs have a common index track, which is connected in parallel to the other inputs in each DSUB.*

11.4.3 Modules with ITT VEAM

Round socket: ITT-VEAM (MIL-C-26482)

ITT VEAM	-UNI8	-L-CI8-V-(SUPPLY*)
A	+IN	+IN
B	-IN	-IN
C	+SUPPLY	(+SUPPLY)
D	-SUPPLY	GND (-SUPPLY)
E	TEDS	TEDS (OneWire)
F	SENSE/ RTD current source	I_PT (RTD current source)
G	Quarter bridge completion, Sense-lead for RTD 3-wire configuration	+I (positive measurement input for current measurement)

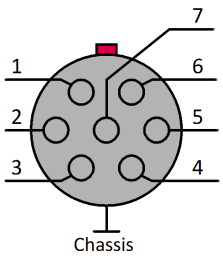
* sensor supply voltages available with optional sensor supply module

CAN/L-UNI8	CAN/L-CI8-V	CAN/L-CI8-V-SUPPLY
1050051	1050293	1050364

imc CANSAS -L-DO8R-V, -L-DI16-V, -L-DAC8-V, -L-PWM8-V

ITT VEAM	-L-DO8R-V	-L-DI16-V	-L-DAC8-V	L-PWM8-V
A	IN	+IN		PWM Open Drain
B	ON	-IN		
C	OFF		OUT	Vcc
D			GND	GND
E				
F				PWM TTL
G	CHASSIS	CHASSIS	CHASSIS	CHASSIS

11.4.4 Modules with LEMO



The imc CANSAS modules of the housing model SL which are equipped with LEMO connectors have certain limitations regarding measurement possibilities. The exact limitations are stated in the technical data sheet of the respective module.

Figure shows: view on the LEMO.1B socket

11.4.4.1 DCB8, UNI8 and INC4

PIN	-DCB8	-UNI8
1	+IN	+IN
2	-IN	-IN
3	+SUPPLY	+SUPPLY
4	-SUPPLY (GND)	-SUPPLY (GND)
5	TEDS (OneWire)	TEDS (OneWire)
6	SENSE	SENSE/PT100 current source*
7	Quarter bridge completion	Quarter bridge completion / Sense for PT100 3-wire

-INC4-L(-SUPPLY*)
+IN X
-IN X
+SUPPLY
-SUPPLY (GND)
+INDEX
+IN Y
-IN Y

*Note that when measuring with thermocouple, a **PT100 must be integrated in the plug as cold junction compensation**. In addition, the ACC/TH-LEM-150 connector is available as an accessory: a LEMO. 1B lug with integrated cold junction compensation.

* - reference of +INDEX is -SUPPLY
- Sensor supply voltage 5 VDC/ 100 mA (optional 300 mA)
- other sensor supply voltages available with optional supply

11.4.4.2 C8, CI8, SCI8, SCI16, SC16

LEMO PIN	-C8-L-(SUPPLY*)	-CI8-L-(SUPPLY*)	-SCI8-L	-SCI16-L	-SC16-L
1	+IN	+IN	+IN	+IN	+IN
2	-IN	-IN	-IN	-IN	-IN
3	(+SUPPLY)	(+SUPPLY)	+SUPPLY	+SUPPLY	+SUPPLY
4	GND (-SUPPLY)	GND (-SUPPLY)	-SUPPLY (GND)	-SUPPLY (GND)	-SUPPLY (GND)
5	n.c.	TEDS (OneWire)	TEDS (OneWire)	TEDS (OneWire)	TEDS (OneWire)
6	PT100 current source				
7	+I (positive measurement input for current measurement)				

* sensor supply voltage with optional sensor supply module

11.4.4.3 µ-CAN-B1-L and µ-CAN-V1-L

LEMO Pin	µ-CAN-B1-L
1	+IN
2	-IN
3	+SUPPLY
4	-SUPPLY (GND)
5	HB
6	-SENSE
7	+SENSE

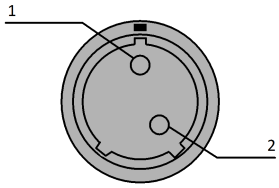
LEMO Pin	µ-CAN-V1-L
1	+IN_60V with divider (MR: 2 to 60 V)
2	-IN
3	+SUPPLY
4	-SUPPLY
5	n.c.
6	n.c.
7	+IN_1V without divider (MR: 0.1 to 1 V)

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Note Manufacture of measuring cables

To ensure that the working voltages specified for the channel isolation are reliably maintained, the cores must not be stripped too far during the manufacture of the measuring cables. The isolation of the cores must reach up to the solder cups. For a shielded cable, the exposed cable shield must be completely removed. As a rule, only suitable cables with sufficient isolation should be used.

11.4.4.4 HISO8-T-8L

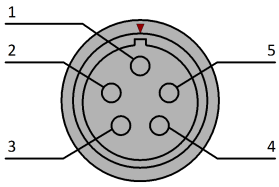


view on the LEMO.2P socket

LEMO PIN	Signal 1 to 8 / Material
1	+IN / NiCr
5	-IN / Ni

Separate imc document with specs for the recommended cables: TD_ACC-CABLE-HV-T.en
www.imc-tm.com/download-center/product-downloads/imc-cansas/data-sheets → **accessories**

11.4.4.5 HISO8-L

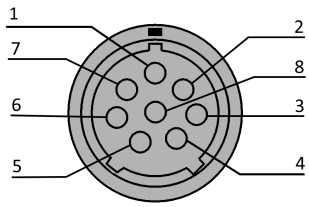


view on LEMO.1P socket

LEMO PIN	HISO8-L
1	+IN
2	-IN
3	+I
4	+PT
5	-PT

Separate imc document with specs for the recommended cables: TD_ACC-CABLE-HV-L1P.en
www.imc-tm.com/download-center/product-downloads/imc-cansas/data-sheets → accessories

11.4.4.6 HISO8-4L



view on the LEMO.2P socket

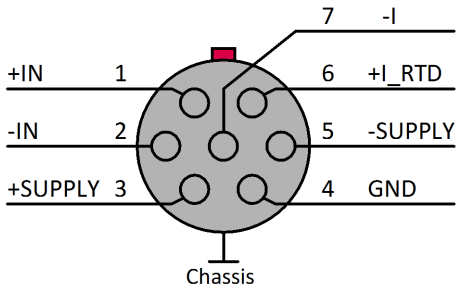
PIN	Channel 1	Pin	Channel 2
1	+IN1	5	+IN2
2	-IN1	6	-IN2
3	+I1	7	+I2
4	-I1	8	-I2

Reference

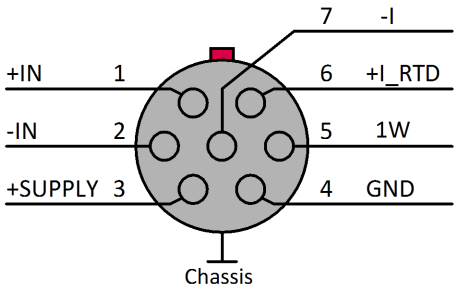
Please find here a description of the HISO8. 397

Separate imc document with specs for the recommended and compatible cable: TD_ACC-CABLE-2HV.en
www.imc-tm.com/download-center/product-downloads/imc-cansas/data-sheets → accessories

11.4.4.7 UTI-6



CANFT/UTI-6-SUP

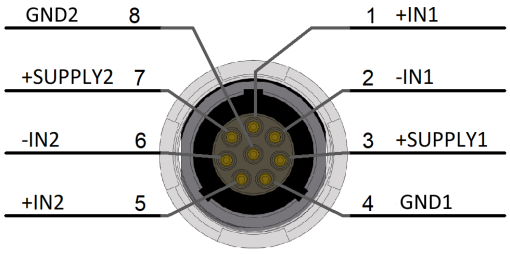


CANFT/UTI-6-TEDS

Reference

- Please find here the description 264
- Technical Specs 495

11.4.4.8 HISO-UT-6



LEMO Redel 2P, 8-pin, Code C
(view on top of the socket)

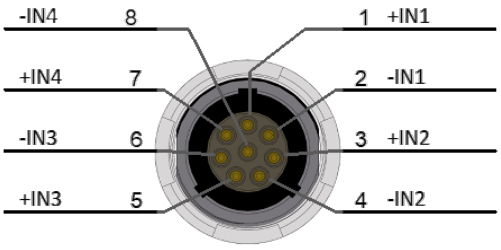
Reference

- Please find here the CANFT/HISO-UT-6 description. 277
- Technical Specs CANFT/HISO-UT-6 483

- Separate imc document with specs for the recommended and compatible cables: TD_ACC-CABLE-2HV.en

www.imc-tm.com/download-center/product-downloads/imc-cansas/data-sheets → accessories

11.4.4.9 HISO-T-8 (CANFT), HISO8-T-2L and HISO-T-8-2L (both CANFX)



LEMO Redel 2P, 8-pin, Code B
(view on top of the socket)

Reference

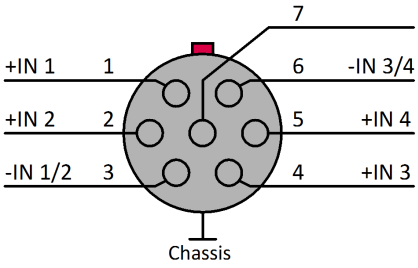
- Please read: CANFT/HISO-T-8 276 CANFX/HISO-T-8-2L 397
- Specs: CANFT/HISO-T-8 480 CANFX/HISO-T-8-2L 526
- Please read: CANFX/HISO8-T-2L 397
  Specs: CANFX/HISO8-T-2L 521

- Separate imc document with specs for the recommended and compatible cable: TD_ACC-CABLE-HV-T.en

www.imc-tm.com/download-center/product-downloads/imc-cansas/data-sheets → accessories

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11.4.4.10 DI-16



view on LEMO.1B terminal

Pin	input 1 - 4 (5-8, 9-12, 13-16)	8 isolated groups with 2 channels each 2 groups with 4 channels per terminal
1	+IN 1	isolated group A IN 1
2	+IN 2	isolated group A IN 2
3	-IN 1/2	isolated group A GND 1/2
4	+IN 3	isolated group B IN 1
5	+IN 4	isolated group B IN 2
6	-IN 3/4	isolated group B GND 1/2
7	n.c.	

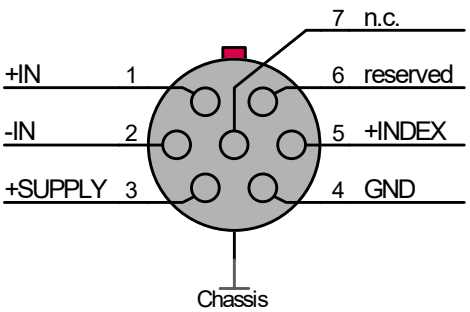
Reference

- Please find here the description 248
- Technical Specs CANFT/DI-16 475

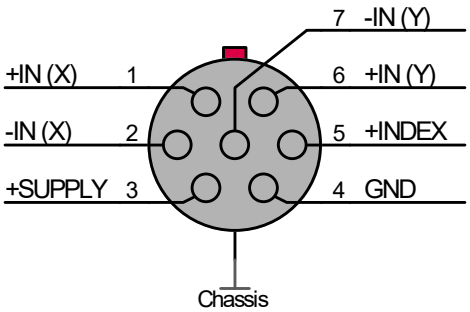
11.4.4.11 ENC-6

Pin	input 1, 4	input 2, 3, 5 und 6	inputs 1...3: isolated group A with INDEX_A, SUPPLY_A, GND_A inputs 4...6: isolated group B with INDEX_B, SUPPLY_B, GND_B for inputs 1, 4 apply: also for dual-track encoder (X, Y) INDEX: single-ended connection (reference: GND_A/B)
1	+IN (X)	+IN	
2	-IN (X)	-IN	
3	+SUPPLY	+SUPPLY	
4	GND	GND	
5	+INDEX	+INDEX	
6	+IN (Y)	reserviert	
7	-IN (Y)	n.c.	

Single-track encoder



Dual-track encoder



Reference

- Please find here the description 251
- Technial specs CANFT/ENC-6 476

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11.4.5 Modules with Phoenix terminal block (-PH)

11.4.5.1 CI8-PH

Signal	Pin	for channel
+PT	1	IN1, IN3, IN5, IN7
+IN	2	
-IN	3	
-PT	4	
+PT	5	IN2, IN4, IN6, IN8
+IN	6	
-IN	7	
-PT	8	

11.4.5.2 DI16-PH

Signal	left terminal block	right terminal block	Signal
1+	+IN 1 (BIT 1)	+IN 9 (BIT 9)	9+
1-	-IN 1 (BIT 1)	-IN 9 (BIT 9)	9-
2+	+IN 2 (BIT 2)	+IN 10 (BIT 10)	10+
2-	-IN 2 (BIT 2)	-IN 10 (BIT 10)	10-
3+	+IN 3 (BIT 3)	+IN 11 (BIT 11)	11+
3-	-IN 3 (BIT 3)	-IN 11 (BIT 11)	11-
4+	+IN 4 (BIT 4)	+IN 12 (BIT 12)	12+
4-	-IN 4 (BIT 4)	-IN 12 (BIT 12)	12-
5+	+IN 5 (BIT 5)	+IN 13 (BIT 13)	13+
5-	-IN 5 (BIT 5)	-IN 13 (BIT 13)	13-
6+	+IN 6 (BIT 6)	+IN 14 (BIT 14)	14+
6-	-IN 6 (BIT 6)	-IN 14 (BIT 14)	14-
7+	+IN 7 (BIT 7)	+IN 15 (BIT 15)	15+
7-	-IN 7 (BIT 7)	-IN 15 (BIT 15)	15-
8+	+IN 8 (BIT 8)	+IN 16 (BIT 16)	16+
8-	-IN 8 (BIT 8)	-IN 16 (BIT 16)	16-
5 VDC	Sen-Supply	Sen-Supply	5 VDC
5 VDC	Sen-Supply	Sen-Supply	5 VDC
Ground	GND	GND	Ground
CHASSIS	CHASSIS	CHASSIS	CHASSIS

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11.4.5.3 DO16-PH

Signal	left terminal block	right terminal block	Signal
1+	BIT 1	BIT 9	9+
1-	LCOM 1	LCOM 2	9-
2+	BIT 2	BIT 10	10+
2-	LCOM 1	LCOM 2	10-
3+	BIT 3	BIT 11	11+
3-	LCOM 1	LCOM 2	11-
4+	BIT 4	BIT 12	12+
4-	LCOM 1	LCOM 2	12-
5+	BIT 5	BIT 13	13+
5-	LCOM 1	LCOM 2	13-
6+	BIT 6	BIT 14	14+
6-	LCOM 1	LCOM 2	14-
7+	BIT 7	BIT 15	15+
7-	LCOM 1	LCOM 2	15-
8+	BIT 8	BIT 16	16+
8-	LCOM 1	LCOM 2	16-
OD 1	NC	NC	OD 2
GND 1	LCOM 1	LCOM 2	GND 2
5 V 1	HCOM1	HCOM2	5 V 2
GND 1	LCOM 1/CHASSIS	LCOM 2/CHASSIS	GND 2

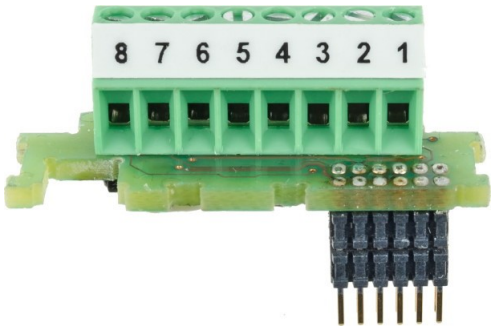
11.4.5.4 DO8R-PH

socket	1	2	3	4	5	6	7	8
IN	IN1	IN2	IN3	IN4	IN5	IN6	IN7	IN8
ON	ON1	ON2	ON3	ON4	ON5	ON6	ON7	ON8
OFF	OFF1	OFF2	OFF3	OFF4	OFF5	OFF6	OFF7	OFF8
CHASSIS	-	-	-	CHASSIS	-	-	-	CHASSIS

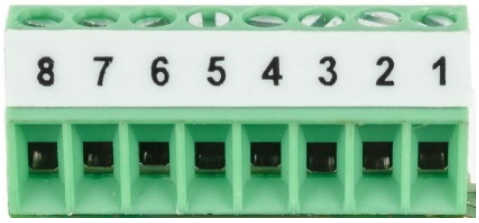
Function	label version Phoenix (-Ph)	label version DSUB
closed in idle state (normally closed)	NC	ON
opened in idle state (normally open)	NO	OFF
common reference (common)	COM	IN

11.4.5.5 µ-CANSAS Phoenix strip terminal

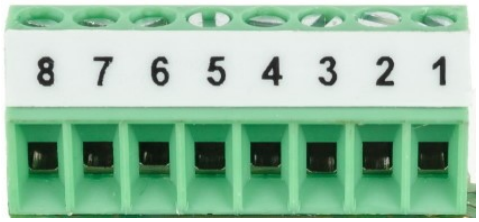
Pin configuration of the Phoenix strip terminal for imc µ-CANSAS-V1-AS

Phoenix MPT0,5/8	Pin	Signal
 *8-pin Phoenix strip terminal*	8	+IN with divider (MR 2..60V)
	7	+IN without divider (MR 0,1..1V)
	6	-IN_COM
	5	reserved
	4	-SUPPLY
	3	+SUPPLY
	2	reserved
	1	reserved

Pin configuration of the Phoenix strip terminal for imc µ-CANSAS-B1-AS

Phoenix MPT0,5/8	Pin	Signal
 *8-pin Phoenix strip terminal*	8	reserved
	7	+IN
	6	-IN_COM
	5	HB
	4	-SUPPLY
	3	+SUPPLY
	2	-Sense
	1	+Sense

Pin configuration of the Phoenix strip terminal for imc µ-CANSAS-T1-AS

Phoenix MPT0,5/8	Pin	Signal
 *8-pin Phoenix strip terminal*	8	reserved
	7	+IN
	6	-IN_COM
	5	reserved
	4	reserved
	3	reserved
	2	reserved
	1	reserved

11.4.5.5.1 Mounting instructions

Within a imc µ-CANSAS module there is a Phoenix strip terminal (model: MPT0.5/8) for connecting signals. This strip terminal is located on a connector junction which can be detached from the front of the module. The cable grommet is a *UNI EMC* screwed cable gland of model *UNI ENTSTÖR DICHT* from the company Pflitsch. When threading the cable, please adhere to the manufacturer's instructions. The following section explains step-by-step how to access the connector junction and how to make the necessary connections.

Step 1: Unfasten the grounding bolt and the **outer** Torx screw from the housing face.



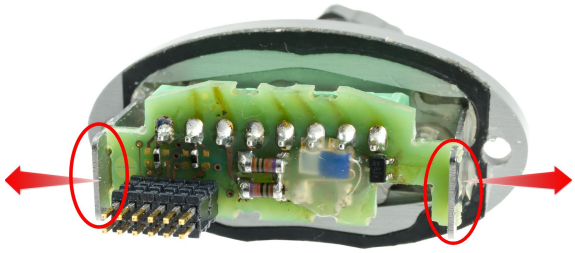
Warning

The two inner screws must not be loosened, see photo.

Step 2: Carefully pull the housing face out until the connections are exposed.

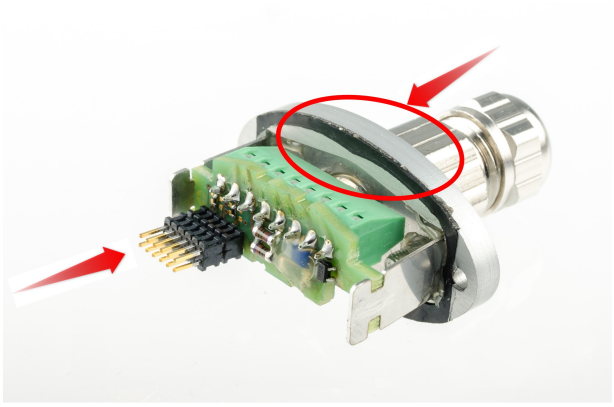


Step 3: Detach the connector junction with its Phoenix strip terminal from the housing face by gently bending the clamping brackets at the sides outward.

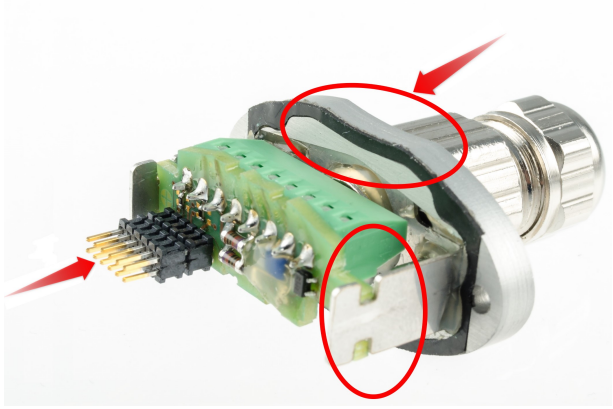


Step 4: Feed the cable through the gland in accordance with the manufacturer's instructions and connect the leads according to the pin configuration for connector pins 606.

Step 5: Re-attach the connector junction into its former position by means of the clamping brackets. Gently tug the cable back outwards through the gland in order to straighten out the individual leads, to prevent them from possibly becoming bent or stuck. When installing the connector junction, ensure that it is not positioned upside down. The recess in the profile of the housing face is an indication of whether the connector junction is installed correctly.



Correct connection junction position



Incorrect connection junction position

Step 6: Check that the cable and leads are not under strain or tension and then close the cable gland, which is designed for cables of 4 – 6 mm in diameter. If the cable used is thinner, then its diameter in the section passing through the gland must be made correspondingly wider by means of heat-shrinkable tubing.



Step 7: Carefully insert the housing face into the housing. Make absolute certain that the housing and its face are attached together in the correct position. This can be ascertained on the basis of the grooves in the connector junction's plate which are shaped to accommodate the guide rails inside the housing (see photos below). Also, the correct position is distinguished by the recess in the profile of the housing face, which fits over one side of the housing.



Correct position

Incorrect position

Step 8: Once the housing face is placed flush on the housing, the module can be closed tight with the Torx screws.

Possible troubleshooting:

If the front of the case (the inside) is not completely inside the case (see the "incorrect position" photo), the back can also be loosened to look for the problem.

11.4.6 Modules with fiber optic connector

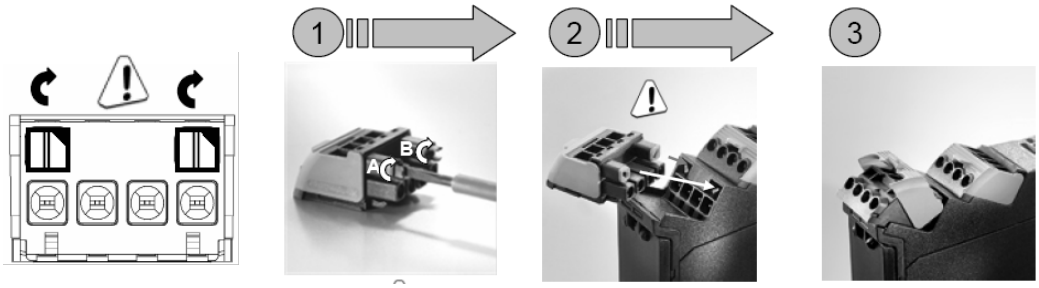
The FBG sensors from imc are equipped with the robust E2000/APC connector technology. This has an integrated protective cap on the sensor and measuring equipment side, such that the fiber optic is protected against dust and dirt. As soon as the connector is plugged into the socket, the cap opens automatically. A locking mechanism prevents the connector from coming loose accidentally after connection. The E2000/APC fiber optic extensions can be used to extend the sensor cables.



Reference

Please observe the module description 323 imc CANSAS*fdx* FBG-T8 and Notes on usage 324 of fiber optic connectors.

11.4.7 Terminal block (Weidmüller)

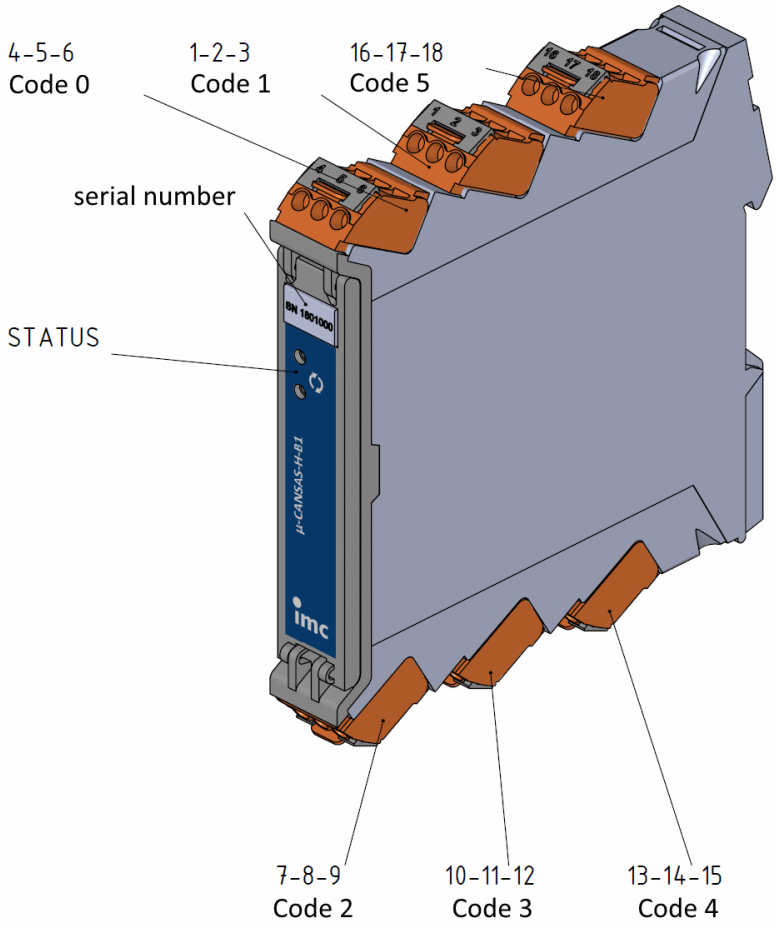


The coding of this terminal block is done by imc!

Note

Each terminal block will be coded by imc ex-factory in a way that each block can only be connected to the corresponding plug (female). This makes sure that a incorrect connection is not possible at all.

11.4.7.1 µ-CAN-H-B1, µ-CAN-H-B1-2.5V



Terminal block	Pin	Configuration
upper block	1	CAN High
middle	2	CAN GND
Code 1	3	CAN Low
upper block	4	+SUPPLY
front	5	-SUPPLY
Code 0	6	CAN Reset
block below	7	+SENSE
front	8	+VB
Code 2	9	+IN
block below	10	-IN
middle	11	-VB
Code 3	12	-SENSE
block below	13	-IN
back	14	HB
Code 4	15	n.c.
upper block	16	CAN High
back	17	CAN GND
Code 5	18	CAN Low

Note

µ-CAN-H-B1 modules, delivered **after October 2016**, are equipped with **6 terminal blocks**!
µ-CAN-H-B1 modules, delivered before October 2016, are equipped with only 4 terminal blocks!

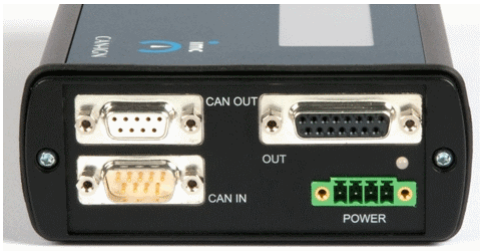
Which terminal blocks?
Upper terminal blocks: middle and front - Code 1 and 0
Terminal blocks below: middle and front - Code 2 and 3

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11.4.8 IGN



CANSAS-IGN: BNC inputs



CANSS-IGN: CAN-connector and analog/digital outputs

4 isolated BNC sockets for
4 isolated input channels:

- SPARK: connector for the ignition signal
- ANGLE: connector for the crankshaft sensor
- REF: If an incremental encoder is used as the crankshaft sensor, the incremental encoder's zero-output is connected here.
- CAM: The camshaft sensor is only connected to this input in the case of Monitoring of Selected Cylinders. This returns one pulse per revolution of the camshaft.

Uniform conditioning is provided for all 3 signals: voltage isolation, bandwidth approx. 600 kHz, 40 V input range.

This terminal provides the analog and digital outputs and auxiliary power supply. The outputs and power supply are not isolated against the module's power supply.

Pin	Signal	Reference
1	TTL1 (Spark)	Pin 9
2	TTL2 Crankshaft	Pin 10
3	TTL3 (Ref)	Pin 11
4	TTL4 (CAM)	Pin 12
5	+5 V (max. 200 mA)	Pin 13
6	+12 V (max. 100 mA)	Pin 13
7	DAC1 AngleOut (ignition angle)	Pin 15
8	DAC2 SpeedOut (RPMs)	Pin 15
9, 10 11, 12	Digital Ground 0 V	
13	Ground 0 V	
14	not connected	
15	Analog Ground 0 V	

11.4.9 IHR

The CAN/IHR (article no. 10500398) and the CAN/IHR-48V (article no. 10500398) measuring module is equipped on the front panel with laboratory sockets 4 mm (banana) and with spring terminals 0.75 mm²...16 mm². On the back of the measuring module (desktop device) the standard connection technology 578 is available.

The IHR plug-in module (the CAN/IHR-R, article no. 10500450 and the CAN/IHR-48V-R, article no. 10500451) for the 19" IHR RACK has no connectors on the front panel. The measurement connections have to be connected on the rear side of the plug-in module and with the backplane of the IHR-RACK.

Reference

Please find here the 19" IHR RACK description 591.

11.4.10 SENT

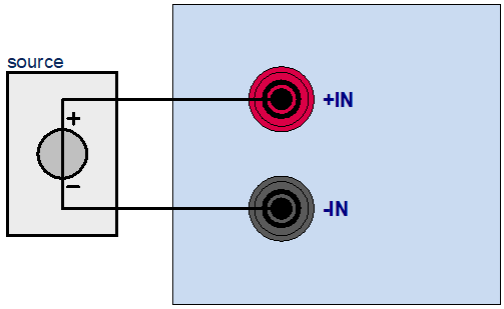
DSUB-15 plugs (female): IN 1..4 for inputs 1..4 and IN 5..8 for inputs 5..8.

Pin	plug (female) IN 1..4	plug (female) IN 5..8
1	imc internal use, service departure not for common use.	
2	V Supply (5 V) Input 1	V Supply (5 V) Input 5
3	SIG Signal Input 2	SIG Signal Input 6
4	GND Input 2	GND Input 6
5	V Supply (5 V) Input 3	V Supply (5 V) Input 7
6	SIG Signal Input 4	SIG Signal Input 8
7	GND Input 4	GND Input 8
8	Not used	Not used
9	SIG Signal Input 1	SIG Signal Input 5
10	GND Input 1	GND Input 5
11	V Supply (5 V) Input 2	V Supply (5 V) Input 6
12	SIG Signal Input 3	SIG Signal Input 7
13	GND Input 3	GND Input 7
14	V Supply (5 V) Input 4	V Supply (5 V) Input 8
15	Not used	Not used

Reference

Please find here the description of the module 452.

11.4.11 HISO-HV-4



Reference

CANFT/HISO-HV-4 description 279, Technical Specs 488

Index

"

"?"- menu (Help) 56

µ

µ-CAN-B1-L
LEMO 600
µ-CANSAS
blinking codes 221
CAN bus connectors 581
connection instructions for Phoenix terminal block 606
µ-CANSAS-B1 419
bridge balancing 416
bridge balancing upon power-up 417
bridge balancing via the CAN-bus 417
bridge measurement 414
CANopen 413
connector 421
filter 419
in the measurement window 418
sampling interval 419
Technical Specs 571
µ-CANSAS-B1-AS
Phoenix terminal block 606
µ-CANSAS-H-B1
DIN-Rail mounting 422
plug und unplug the terminal block 422
µ-CANSAS-T1 412
CANopen 411
connector 412
filter 412
sampling interval 412
technical specs 570
temperature measurement 412
µ-CANSAS-T1-AS
Phoenix terminal block 606
µ-CANSAS-V1 408, 409
10V supply voltage 408
5V supply voltage 408
balance 405
CANopen 403
connector 410
filter 409
sampling interval 409
Technical spec 568
voltage measurement 404
zero adjusting 404
µ-CANSAS-V1-AS
Phoenix terminal block 606
µ-CAN-V1-L
LEMO 600

1

19" RACK 590

2

2-point-scaling 100

A

absolute pressure 339
Absolute Value 145
ACC/DSUBM-SENT4 612
ACC-terminals 594
acquisition modules
CI8 137
DCB8 137
HISO8 137
activating balance via CAN-bus
µ-CANSAS-V1 406
Addition 143
adjustment 10
adjustment of supply
UNI8 388
after unpacking 20
air pressure 339
allow overmodulation CI8 298
analog connections
CANSAS 33
analog outputs
DAC8 305
angle
ENC-6 256
Angle (differential, abs, sum) 201
Angle measurement
Incremental counters 201
anti-aliasing
C8 286
P8 341
UNI8 390
assembly of the ITT-VEAM plug 242
assembly of the sensor clip 241
Assignment 146
automatic scan-mode 91
Auto-Range (IHR) 450

B

balancing
DCB8 311
UNI8 378
balancing upon power-up

balancing upon power-up
µ-CANSAS-V1 405
Balancing values 311
Band-pass filter 146
bandwidth
C8 286
DCB8 314
P8 341
UNI8 389, 390
barometer 146, 339
baud rate 37
before starting 20
bit timing 579
Bit-wise AND 147
Bit-wise NOT 147
Bit-wise OR 148
Bitwise XOR 149
Blinkcodes
CANFT/DI-16 250
blinking code
configuration 218
fault condition (classic/flex) 219
Reset-plug 218
standard operation (classic/flex) 218
blinking codes
µ-CANSAS 221
CANSASclassic/flex 218
CANSASfit 221
ENC-6 260
FBG-T8 222
synchronization 218
T-10 263
UNI8 222
UTI-6 273
Block circuit diagram
CANFT/DI-16 249
block diagram
DAC8 305
DI16 316
DO8R/DO16R 321
block-measurement (scanner) 211
bridge balancing 190
µ-CANSAS-B1 416
bridge balancing via the CAN-bus
µ-CANSAS-B1 417
bridge channels
UNI8 376
bridge measurement 182
DCB8 308
bridge measurement cable compensation
DCB8 310
UNI8 378
burst-mode 211
Bus-activation 43
Bus-off error 116
Button status 149
byte order 68
CANSASfit 247

C

C8 281, 502, 594
anti-aliasing 286
bandwidth 286
current measurement 282
DSUB15 288
Fahrenheit 283
filter 286
Fischer round plugs 288
frequency response 286
round plugs 288
RTD (Pt100) 283
sensor supply 285
shielding 288
temperature measurement 283
thermocouples 283
voltage measurement 282
cable
CAN bus 579
CAN bus at SL housings 580
cable compensation
UNI8 378
cable resistance 574
Cables 12
cables' cross-sections
CAN bus 579
CAN bus at SL housings 580
Calculated output signals 207
calculating the output signal
DAC8 304
calibration 10, 106
coming 226
overdue 228
reminder 226
calling the software 53
CAN
connection for the PC 33
connection to CANSAS 33
CAN bus
cable 579
cable at SL housings 580
cables' cross-sections 579
cables' cross-sections at SL housings 580

CAN bus
components 579
pin configuration 578
pin configuration at SL housings 580
CAN bus connectors 578
µ-CANSAS 581
SL housing 580
CAN bus wiring 579
SL housings 580
CAN-1 protocol 126
CAN-assistent 24
CANboardXL 26
CANboardXL pxi- 26
CAN-Bus
synchronization 126
wiring 44
CAN-Bus description 43
CAN-Bus interface 24, 65
CANcabs 579
CANcardX 26
CANcaseXL 26
CAN-Controller 579
CANFT
general specifications 473
power consumption 473
CANFT/DI-16
Blinkcodes 250
Block circuit diagram 249
Message mapping 250
CAN-message 206
CAN-nodes 48
CANopen 49, 76, 280
µ-CANSAS-B1 413
µ-CANSAS-T1 411
µ-CANSAS-V1 403
CI8 289
DAC8 301
DI16 315
DO8R/DO16R 321
INC4 331
LEDs 49
limitations 49
SC16, SCI16, SCI8 356
virtual channels 49
CANpari 26
CANSAS
analog connections 33
in a rack 117
CANSAS software 37
CANSASfit
blinking codes 221
byte order 247
DI-16 248
Intel (byte order) 247
LED 247
message mapping 247
Motorola (byte order) 247
power supply 585
Properties 246
T-10 262
CANSASfit (CANFT) 37
CANSASflex
click together 39
magnetic fields 39
power supply 585
CBA 82
CE 12
CE Certification 10
Certificates 10
Change requests 10
channel mapping
ENC-6 260
channel name 68
Characteristic 151
characteristic curves 238
User-defined UNI8 389
choice of current or voltage signals on 8 analog 301
CI8 294, 594
CANopen 289
current measurement 293
filter 299
ground reference 294
imc-Thermopulg 294
isolated voltage channels 289
overmodulation 298
PT100 294
resistance measurement 297
RTD (Pt100) 289, 294
sensor supply 297
specification 289
technical spec 505
temperature measurement 289, 294
voltage measurement 289
voltage measurement with zero balancing 290
CiA 43
CiA DS 301 V4.0.2 49
CiA DS 404V1.2 49
cleaning 23
clock of messages (DBC export) 108
coldjunction compensation 181
C8 283
thermocouples 283, 294

color-coding thermocouples 180
Combination mode 192
comparator
ENC-6 260
INC4 333
comparator conditioning
Incremental counter 197
Comparison 152
configure IGN 433
connection
DCB8 314
UNI8 390
connection instructions for µ-CANSAS
Phoenix terminal block 606
Connector
µ-CANSAS-B1 421
µ-CANSAS-B1-L 421
µ-CANSAS-H-B1 421
µ-CANSAS-H-B1-2.5V 421
Constant Channel 153
Constant Digital Channel 153
Control menu 57
Conversion to Float 153
Counter 191
coupling (P8) 348
crimps 395
cumulative measurements 194
current (differential)
UNI8 380
current meas.
UNI8 381
current meas.ground ref.
UNI8 380
current measurement
C8 282
CI8 293
SC16, SCI16, SCI8 357
Customer support
Tech support 10

D

DAC8 139, 301
analog outputs 305
block diagram 305
calculating the output signal 304
CANopen 301
dimensions 307
linking the output signal to a CAN-message 302
message mapping 303
module outputs the user's 301
specification 301
data acquisition 126
data formats 133
data sheet (TEDS) 121
data transfer rate 47
data type 68
database 113
DBC 82
DBC export options 108
DCB8 510, 594
balancing 311
bandwidth 314
bridge measurement sense 310
connection 314
Description 308
initial unbalance 310
LEMO plug 600
sensor supply 313
shunt calibration 311
voltage measurement 312
voltage measurement with zero-adjusting (tare) 313
voltage source at a different fixed potential 313
voltage source with ground reference 312
voltage source without ground reference 312
DCB8 PROTECT 396
DCF77
synchronity 126
default operation type IGN 429
delay
SC16, SCI16, SCI8 371
synchronity 126
delay times 214
description
ENC-6 251
DI16 138, 513
block diagram 316
CANopen 315
DSUB-15 317
ITT VEAM 317
Phoenix terminal block 317
sampling interval 317
specification 315
DI-16
LEMO 603
DI-16 CANSASfit 248
DI16-Ph
Phoenix terminal block 604
differential measurement procedures 194
Digital inputs 206, 315
digital output
modules 209
digital outputs 206, 318

Dimensions
DAC8 307
DIN 61010-1 216
DIN-EN-ISO-9001 10
display IGN 428
distance
ENC-6 258
Distance (differential, abs, sum) 201
Distance measurement
Incremental counters 201
Division 145
DO16 514
Phoenix terminal block 605
specification 318
DO16R 209
DO8R 209
Phoenix 605
DO8R, DO16R 140
DO8R, -DO16R 516
DO8R/DO16R
block diagram 321
CANopen 321
DSUB15 322
ITT VEAM 322
Phoenix terminal block 322
specification 321
Starting 322
double samples 48
double shielding 217
Driver-software for the PC 24
dSPACE interface cards 29
DSUB15
C8 288
DO8R/DO16R 322
INC4 337
PWM8 354
SC16, SCI16, SCI8 362
UNI8 393
DSUB-15
DI16 317
IGN 611
DSUB9
INC4 337
DSUB-screw terminals 575
dual-track encoder 199, 333

E

edge (incremental counter) 202
Edit 55
copy 87
Cut 87
Delete 89
New 88
Paste 88
Rename 88
Undo 87
Elastic modulus 189
ElektroG 12
EMC 11
ENC-6
angle 256
blinking codes 260
channel mapping 260
comparator 260
description 251
distance 258
encoders 259
events 253
frequency 255
hysteresis 260
LEMO 603
measurement modes 252
modes 259
PWM 257
RPM 253
RPM with missing tooth 254
speed 255
Technical Specs 476
threshold 260
time 259
velocity 255
ENC-6-SUPPLY 261
encoder modes
INC4 331
encoders
ENC-6 259
energy sources 14
ESD warning 20
Event counting 154
events
ENC-6 253
Events counting 191
Incremental counters 201
exchanging sensor information 240
Exp. RMS 154
expand all branches/Collapse all branches 90
expert setting 65
export 113
configuration 82
export dialog 84
Extended Identifier 65
Extra 56

Extract bit from word 155
extracted directly from a CAN message or derived 301
Extras - interface 104

F

FAST channels (SENT) 468
FAST-channel 456
FBG-T8
  Balancing temperature 326
  blinking codes 222
  CaliData 326
  cleaning stylus 324
  configuration 326
  connection 324
  Description 323
  entering coefficients 327
  input range 326
  linearization 326
  linearization (polynomial) 328
  measuring principle 323
  notes on usage 324
  polynom 326
  protective caps 324
  Service channels 329
  with imc SENSORSse of coefficients 328
FCC 12
features and modules 223
Fiber Bragg Grating 323
File 55
  close 86
  export 82
  import 82
  new 81
  open... 81
  page preview 83
  print 83
  print setup... 86
  save 82
  save as... 82
filter 211
  µ-CANSAS-B1 419
  µ-CANSAS-T1 412
  µ-CANSAS-V1 409
  C8 286
  CI8 299
  P8 341
  SC16, SCI16, SCI8 366
  UNI8 390
  UTI-6 271
Find me... 56
firmware update 106
firmware-version 63
Fischer (C8) 288
Fixed analog value 155
Fixed digital value 155
Fixed Scaling 156
Fixed Value Range 156
frequency 205
  ENC-6 255
Frequency determination 157
frequency response
  C8 286
from received CAN-messages or specified 301
Full bridge
  µ-CANSAS-B1 415
  DCB8 309
  UNI8 376
full bridge: 4 active strain gauges 188
full bridge: general 186
full bridge: half bridge - shear strain 188
full bridge: Poisson full bridge (strain gauges adjacent branches) 187
full bridge: Poisson full bridge (strain gauges opposed branches) 187
full bridge: WSG 186
functions (e.g. squarewave, sawtooth etc.) by 301
Functions' Reference 142
fuse
  ext. supply (incremental counter) 333

G

general Safety 19
General terms and conditions 10
Greater 158
Greatest value 158
ground reference 285
grounding 216
Guarantee 10, 11
guarding 122

H

Half bridge
  µ-CANSAS-B1 415
  DCB8 309
  UNI8 377
half bridge: 1 active and 1 passive starin gauge 186
half bridge: 2 sctive strain gauges 185
half bridge: general 184
half bridge: Poisson 185
half bridge: strain gauge 184
Hardware requirements 24
hardware-version 63
heartbeat 76, 122, 124

Help - Info about CANSAS... 110
High-pass filter 159
HISO 397
HISO-T-8
  Technical Specs 480
HISO-UT-6-3L
  Technical Specs 483
Hotline
  Tech support 10
hysteresis
  (ENC-6) 260
  INC4 333
Hysteresis-Filter 159

I

IEEE P1451 /1 230
IEEE1451 339
IGN 424, 529, 611
  configure 433
  default operation type 429
  description 424
  display 428
  inputs (BNC) 446
  LEDs 428
  offset adjustment 443
  outputs (DSUB9) 446
  parameterization 433
  snapshot operation mode 430
IHR 448
  Auto-Range 450
  settings 450
  signal connection 611
  supplemental channels 450
imc CANSASfit
  attachment mechanism 34
  max. number of modules per block 35
  power supply options 35
  termination 38
imc CANSASflex
  connection options 41
  power supply options 41
imc CANSAS-SENT module 452
imc SENSORS 120
imc STUDIO 24
imcansas.exe 53
imCanUsb 26
imcLanguageSelector 53
imc-Thermoplug 283
  C8 283
import 113
  sensor -data 236
  sensor information 238
INC4 538
  CANopen 331
  comparator 333
  DSUB15 337
  DSUB9 337
  DSUB-9 (CANSAS-K-INC4) 599
  hysteresis 333
  ITT VEAM 337
  LEMO (SL) 337
  measurement quantities 331
  sensors with current signals 334
  specification 331
  threshold 333
incremental counter
  block diagram 198
  combined measurement 205
  comparator conditioning 197
  edge 202
  index signal 333
  index track 333
  max. number of pulses per rev. 201
  maximum input range 197
  quadrature encoder 333
  sampling rate 191
  scaling 197
  sensors 333
  single-track encoder 333
  start edge 202
  stop edge 202
  supply voltage 333
  SYNC 333
  time measurement 202
  track (X,Y) 333
  zero marker pulse 333
index-channel 199
Industrial safety 17
Industrial safety regulation 17
initial unbalance
  DCB8 310
  UNI8 378
input
  (BNC) IGN 446
  channel properties 68
input impedance
  DCB8 312
  UNI8 372
Input/output stage 68
installation 24
integer-arithmetic 134
integrate a new module 91

integrating CANSAS software in imc STUDIO 24
Integration of SENT sensors 452
Intel-format 68
interface 104
interface cards 26
Inverse 145
inversion of the CANSAS DO16 logic 320
invert output (DO16) 320
ISO / DIS 11898 43
ISO-9001 10
isolated thermocouple
UNI8 382, 385
isolation 216
isolation - concept
SC16, SCI16, SCI8 364
isolation voltage 217
ITT VEAM
DI16 317
DO8R/DO16R 322
INC4 337
PWM8 354
ITT VEAM with Pt100 inside of connector
UNI8 395
ITT-VEAM (MIL-C-26482)
UNI8 393
Ixxat 26
interfaces 29
USB-to-CAN FD 29
USB-to-CAN II 29

K

keep balancing values 106
K-factor 189
KVASER 26
KVASER (FAQ) 28

L

language setting 53
Leads 12
LED 136
µ-CANSAS 221
blinking codes (CANSASclassic/flex) 218
CANopen 49
CANSASfit 221, 247
fault condition (classic/flex) 219
FBG-T8 222
IGN 428
SENT 471
standard operation (classic/flex) 218
UNI8 222
UTI 497
LED-Flash 160
LEMO
DI-16 250
ENC-6 261
LEMO (SL)
INC4 337
LEMO connector
pin configuration 600
LEMO pin configuration
C8, CI8, SCI8, SCI16, SC16 600
LEMO plug
µ-CAN-B1-L 600
µ-CAN-V1-L 600
DCB8 600
ENC-6 603
INC4 600
UNI8 600
LEMO Stecker
DI-16 603
LEMOSA
UNI8 394
Lesser 161
Liability restrictions 11
limitations (CANopen) 49
Limited Warranty 10
linearization
FBG-T8 328
linking the output signal to a CAN-message
DAC8 302
literature (CAN-Bus) 43
Logical AND 162
Logical NOT 162
Logical OR 163
Logical XOR 163
Lower Value 161
Low-pass filter 164

M

maintenance 10, 23
Master
synchronization 126
max. number of channels 37
Maximum 165
maximum input range
INC-channels 197
MDB database 113
mean value 165, 211
means of the module's computational capacities. 301
measured substances (P8) 348
measurement mode
temperature 179

measurement modes
ENC-6 252
Measurement modes for incremental counter inputs 191
Median Filter 165
message 67
message mapping 206
µ-CANSAS-B1 418
µ-CANSAS-T1 412
µ-CANSAS-V1 408
CANFT/DI-16 250
CANSASfit 247
DAC8 303
messages
clock (DBC export) 108
Minimum 166
Minus sign 144
missing tooth 200
ENC-6 254
modes
ENC-6 259
modification of the baud rate 118
module 56
check configuration 97
configure... 98
database 61
find selections... 96
integrating assistant 91
measure... 99
sensors 102
two-point-scaling 100
module tree 59, 77
modules cannot be found 91
Module-status word 166
Monoflop 167
Motorola-format 68
Multiplication 144

N

name 68
new module integration 91
nipples (P8) 348
Nippondenso
Sensor 388
Norm SAE J2716 2007, 2008, 2010 and 2016 452

O

offset 68
adjustment IGN 443
open file 113
Open sensor detection 359
Operating personnel 16
operating software 118
output modules 139
output rate 211
output signal 206
Output Status on LED 168
Output status word 169
outputs (DSUB9) IGN 446
outputs. The desired output signals can either be 301
overmodulation CI8 298

P

P1451.4 230
P8 137, 338
anti-aliasing 341
balancing 345
barometer 346
barometer readings 346
Built-in error recognition 347
filter 341
Maintenance 347
measurement mode 344
module integration 342
permanent damage at pressure sensors 340
pressure sensor 339
Read-in of sensor data 342
sampling interval 341
specification 338
parameterization IGN 433
permanent damage at pressure sensors (P8) 340
phase
synchronity 126
phaseshift
CANSAS modules 126
Phoenix
DO8R 605
DO8R-Ph 605
socket 583
Phoenix terminal block
µ-CANSAS-B1-AS 606
µ-CANSAS-T1-AS 606
µ-CANSAS-V1-AS 606
connection instructions für µ-CANSAS 606
DI16 317
DI16-Ph 604
DO16 605
DO8R/DO16R 322
pin configuration
µ-CAN-H-B1 610
µ-CAN-H-B1-2.5V 610
ACC/DSUB TEDS 596

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pin configuration
ACC-terminals 594
CAN bus 578
CAN bus at SL housings 580
ITT VEAM socket 599
LEMO connector 600
LEMO plug DCB8, UNI8 600
LEMO plug DI-16 603
LEMO plug ENC-6 603
SENT 471
supply 583
supply at µ-CANSAS 585
supply at SL housing 584
Plug & Measure 230, 241
Poisson full bridge 187
Poisson half bridge 185
Poisson's ratio 189
Power consumption
CANFT modules 473
power supply 583
µ-CANSAS 585
CANSASfit 585
CANSASflex 585
SL housing 584
pressure measurement (P8) 338, 340
coupling 348
measured substances 348
nipples 348
pressure terminals 348
pressure sensor (P8) 339
pressure terminals (P8) 348
print dialog 84
print setup dialog 86
Probe-breakage recognition
µ-CANSAS-T1 412
T-10 263
UNI8 387
Probe-breakage recognition (SCxx)
switch on/off 360
Product improvement 10
Properties
µ-CANSAS 280
CANSASclassic 280
CANSASfit 246
CANSASflex 280
properties dialog 60
properties of modules 62
PT100 180, 284, 358
SC16, SCI16, SCI8 357
type LEMO 284, 295, 359
UNI8 386
PT100 in 2 wire config
UNI8 386
PT100 in 3 wire config
UNI8 386
PT100 in 4 wire config
UNI8 386
Pulse Sequence Encoder 170
pulse time 203
pulse width modulation 352
pulses number max. 201
PWM
ENC-6 257
PWM mode (INC4) 204
PWM8 139
CANopen 352
delay time 354
DSUB15 354
frequency 352
ITT VEAM 354
scaling 353
specification 352
T_process 354
technical spec 545

Q

Quality Management 10
quarter bridge
120 Ohm WSG 184
DCB8 310
UNI8 377
WSG 184

R

rack
maintenance 118
operating 117
slot identification 117
read sensor-Eprom 240
read/write sensors 64
readable configuration 106, 111
recognition of sensor by means of wire jumpers
UNI8 392
Rectangle function 171
relative pressure 339
Remote Frames (RTR) 43
repair 10
Resampling 171
Reset-plug
ACC/CANFT-RESET 114
blinking code 218
CAN/RESET 114

resistance measurement
CI8 297
UNI8 388
Restriction of Hazardous Substances 12
RMS 172
RoHS 12
round plugs
C8 288
round plugs ITT-VEAM (MIL-C-26482)
UNI8 393
round plugs LEMOSA
UNI8 394
round plugs ZF LEMO
UNI8 394
RPM 205
ENC-6 253
RPM with missing tooth
ENC-6 254
RTD
UNI8 386
RTD (Pt100) 284, 358
C8 283
SC16, SCI16, SCI8 357
type LEMO 284, 295, 359

S

SAE J2716 452
sampling
synchron 126
sampling interval 141, 211
µ-CANSAS-B1 419
µ-CANSAS-T1 412
µ-CANSAS-V1 409
DI16 317
P8 341
SC16, SCI16, SCI8 363
UNI8 390
sampling rate 211
Incremental counter 191
saving imported sensor information 237
Sawtooth 172
SC16 594
technical specs 546
SC16, SCI16, SCI8
CANopen 356
current measurement 357
delay 371
DSUB15 362
filter 366
isolation - concept 364
PT100 357
RTD (Pt100) 357
sampling rates 363
sensor supply 362
specification 356
thermocouple measurement 358
voltage measurement 357
scale input channel 68
scaling 68
Incremental counter 197
scaling for strain analysis 189
scaling: strain gauges 189
scan-mode (automatic) 91
scanner concept 211
schematic
imc thermo plug 182
T4 182
Schmitt-Trigger 173
SCI16 594
technical spec 551
SCI8 594
technical spec 551
SCxx module
Probe-breakage recognition switch on/off 360
sense
DCB8 310
UNI8 378
sensor
pressure 339
sensor database 234, 238
sensor information 237
sensor recognition (TEDS) 102, 121
sensor supply
C8 285
CI8 297
DCB8 313
ENC-6-SUPPLY 261
SC16, SCI16, SCI8 362
UTI-6 272
sensor supply module
UNI8 389
sensor-database 237
SENT 612
block diagram 453
FAST channels 459, 468
iming of the CAN-messages 470
inputs 456
pin configuration 471
Status-LED 471
technical spec 557
SENT-message 456
SENT-output 452

SENT-Protocol 452
SENT-Sensors 452
service 23
  Tech support 10
service and maintenance 10
Service channels
  FBG-T8 329
service check 10
settings (IHR) 450
SETUP.EXE 24
shielding
  C8 288
Short circuit status 173
shunt calibration
  DCB8 311
  UNI8 378
simultaneous, sampling 126
Sine 174
single shielding 217
single-track encoder 199
SL housing
  CAN bus connectors 580
Slave
  synchronization 126
Slope Limiting 174
slot info 64
SLOW-channel 456
Smoothing based on 2 values 174
Smoothing based on 3 values 175
snapshot operation mode IGN 430
software installation 24
soldering 396
special functions 76, 126
Special hazards 17
specification
  CI8 289
  DAC8 301
  DI16 315
  DO16 318
  DO8R/DO16R 321
  INC4 331
  P8 338
  SC16, SCI16, SCI8 356
speed 205
  ENC-6 255
SQRT 175
square 1s signal 126
Standard Deviation 176
start edge (incremental counter) 202
Starting (DO8R/DO16R) 322
status bar 76
Status word 150
stop edge (incremental counter) 202
strain gauge 182
strain gauge: scaling 189
strain gauges 183
Subtraction 143
summation INC
  resetting 195
supplemental channels (IHR) 450
supply
  pin configuration 583
  pin configuration at µ-CANSAS 585
  pin configuration at SL housing 584
  SENT sensors 454
supply voltage
  µ-CANSAS-V1 408
  incremental counter 333
Symbols 13
synchronization 76, 126
  blinking codes 218
  incremental counter 333, 334
synchronization line 573

T

T-10
  blinking codes 263
  Probe-breakage recognition 263
  Technical Specs 491
  Temperature measurement 262
T-10 CANSASfit 262
table of chemical resistance (P8) 348
Tech support 10
Technical spec
  µ-CANSAS-V1 568
  CI8 505
  DAC8 509
  DCB8 510
  DO16 514
  DO8R, DO16R 516
  IGN 529
  INC4 538
  PWM8 545
  SCI16 551
  SCI8 551
  SENT 557
Technical Specs
  µ-CANSAS-B1 571
  µ-CANSAS-T1 570
  C8 502
  DI16 513
  ENC-6 476

Technical Specs
general 472
HISO-T-8 480
HISO-UT-6-3L 483
SC16 546
T-10 491
UNI8 560
UTI-6 495
TEDS 230, 236, 596
blinking codes UNI8 222
CI8 289
data sheet 121
sensor recognition 121
transducer recognition 121
Telephone numbers
Tech support 10
temperatur characteristic curve
How to select? 179
temperature meas.
UNI8 382
temperature measurement 179
µ-CANSAS-T1 412
C8 283
CI8 289, 294
FBG-T8 323
T-10 262
temperature table 179
Terminal IGN 611
terminator
by CANFX-modules 42
CAN-Interface activated by software 42
Terminator in µ-CANSAS 46
terminator in data logger 45
Terminator in IHR-48V-R 46
Terminator in IHR-R 46
terminators 44
thermo plug 181
schematic 182
thermocouple
UNI8 382
thermocouple measurement 285
C8 283
CI8 294
SC16, SCI16, SCI8 358
thermocouple with ground reference 285
thermocouples 179
thermocouples color-coding 180
Third output module 73
This imc CANSAS- 301
threshold
ENC-6 260
INC4 333
time
ENC-6 259
Time determination 177
Time measurement 192, 202
time offset 126
time shift 126
toolbar 58
transducer recognition (TEDS) 121
transfer all values 209
transfer value after editing 209
transporting CANSAS 23
Triangle 178
troubleshooting 22, 50
TTL
synchronity 126
two-point-scaling 100

U

UNI8 137, 594
Adjustment of supply 388
Anti-aliasing 390
Assembly instructions for ITT VEAM with PT100 inside of connector 395
Balancing 378
Bandwidth 389, 390
Bridge measurement 376
Bridge measurement sense 378
Cable compensation 378
characteristic curves 389
Connection 390
Current meas. ground ref. 380
Current meas. with var. supply 381
Description 372
DSUB15 393
Filter 390
Full bridge 376
Half bridge 377
ICP and thermocouple 385
Initial unbalance 378
Isolated thermocouple 385
Isoliertes Thermoelement 382
ITT-VEAM (MIL-C-26482) 393
LEMO plug 600
LEMOSA 394
Probe-breakage recognition 387
PT100 (RTD) - meas. 386
PT100 in 2 wire config 386
PT100 in 3 wire config 386
PT100 in 4 wire config 386
Quarter bridge 377
Recognition of sensor by means of wire jumpers 392

UNI8 137, 594
Resistance measurement 388
Round plugs ITT-VEAM (MIL-C-26482) 393
Round plugs LEMOSA 394
Round plugs ZF LEMO 394
Sampling interval 390
Sense 378
Sensor supply module 389
Shunt calibration 378
technical specs 560
TEDS: blinking codes 222
Temperature meas. 382
Thermocouple 382
Thermocouple with ground ref. 382
Thermocouple without ground ref. 385
voltage measurement 372
Voltage measurement: with zero-adjusting (tare) 375
Voltage source with CMR 374
Voltage source with ground reference 373
Voltage source without ground reference 373
ZF LEMO 394
UNI8 PROTECT 396
User-defined characteristic curves UNI8 389
UTI-6 264
blinking codes 273
Current measurement 267
Filter 271
LEMO measuring input 602
Resistance measurement 268
RTD measurement 269
sensor supply 272
Technical Specs 495
voltage measurement 265

V

Vector 26
driver package 20.30.5 30
driver package 24.10.0 30
interface cards 30
velocity
ENC-6 255
version
firmware 63
hardware 63
View 56
adjust 90
group by 90
split 89
status bar 89
toolbar 89
virtual channels 74, 130
CANopen 49
properties 74
voltage balancing via measurement window
µ-CANSAS-V1 407
voltage measurement
µ-CANSAS-V1 404
C8 282
CI8 289
DCB8 312
SC16, SCI16, SCI8 357
UNI8 372
UTI-6 265
voltage measurement with zero balancing
CI8 290

W

Warranty 10
Waste on Electric and Electronic Equipment 12
watchdog 122
WEEE
Restriction of Hazardous Substances 12
Weidmueller
pin configuration 610
wiring
CAN bus 579
CAN bus at SL housings 580
write sensor-Eprom 240

X

XML 82
XML format 113

Z

zero adjusting
µ-CANSAS-V1 404
zero marker pulse
incremental counter 333
zero pulse 199
ZF LEMO
UNI8 394

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