HBK
HOTTINGER BRÜEL & KJÆR

ENGLISH

Operating Manual

MX Modules

SomatXR Rugged DAQ

www.hbm.com/start

HBM

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1 SAFETY INSTRUCTIONS

Intended use

The module and the transducers connected to it must only be used for measurements and directly related control and regulation tasks. Use for any purpose other than the above is deemed improper use.

In the interests of safety, the module must only be used as described in the operating manual. When the module is in use, it is essential to comply with the applicable legal and safety requirements for the relevant application. The same applies to the use of accessories.

Before starting up the module for the first time, you must first run a project planning and risk analysis that takes into account all the safety aspects of automation technology. This particularly concerns personal and machine protection.

Additional safety precautions must be taken in plants where malfunctions could cause major damage, loss of data or even personal injury. If an error occurs, these precautions ensure that safe operating conditions are established.

This can be achieved, for example, through mechanical interlocking, fault messages, limit value switches, and similar things.

Safety requirements

Notice

A module must not be directly connected to a power supply system. The permissible supply voltage range is 10 … 30 V_{DC}.

The supply voltage connection as well as the signal and sense leads must be installed in such a way that electromagnetic interference does not adversely affect device functionality (recommendation: HBK "Greenline Shielding Design", download from www.hbm.com or www.hbkworld.com).

Automation equipment and devices must be covered over in such a way that adequate protection or locking against unintentional actuation is provided (e.g. access checks, password protection, etc.).

In the case of devices that run in a network, the network design must be such that errors in individual nodes can be detected and remedied.

Safety precautions must be taken both in terms of hardware and software, so that a line break or other interruptions to signal transmission, e.g. via the bus interfaces, do not cause undefined states or loss of data in the automation device.

Conditions at the installation site

For all modules:

- Observe the maximum permissible ambient temperatures specified in the technical data.
- Make sure that the device is exposed to as little direct sunlight as possible in hot operating environments.

Maintenance and cleaning

The modules are maintenance-free. Note the following points when cleaning the housing:

- Before cleaning, disconnect the module from all connections.
- Clean the housing with a soft, slightly damp (not wet!) cloth. You should never use solvents, as they could damage the label on the front panel, and damage the display.
- Do not subject the device to high water pressure while cleaning.

The following modules include a battery to buffer the memory contents, and guarantee uninterrupted operation of the time base:

- CX22B-R: BR2330A/FAN (soldered)

Only trained and qualified personnel authorized by HBK may change batteries.

General dangers of failing to follow the safety instructions

The module is a state of the art device and as such is fail-safe. The module may give rise to residual dangers if it is inappropriately installed and operated by untrained personnel. Any person instructed to carry out installation, start-up, maintenance or repair of the module must have read and understood the operating manual and in particular the technical safety instructions.

Residual dangers

The scope of supply and performance of the module covers only a small area of measurement technology. In addition, planners, installers and operators should plan, implement and manage the safety features of the test and measuring equipment in such a way as to minimize residual dangers. Existing regulations must be complied with at all times. The residual dangers associated with test and measuring equipment must be indicated. After making settings and carrying out activities that are password-protected, you must make sure that any controls that may be connected remain in safe condition until the switching performance of the module has been tested.

Product liability

In the following cases, the protection provided for the device may be adversely affected. Liability for equipment functionality passes to the operator when:

- The device is not used in accordance with the operating manual.
- The device is used outside the field of application described in this chapter.

- The operator makes unauthorized changes to the device.

Working safely

Error messages should not be confirmed until after the cause of the error is removed and there is no further danger.

The devices comply with the EMC standards EN61326-1/EN61326-2-x. The standards applied contain definitions of limit values and test levels for multiple environments.

In terms of emission (EME), the requirements for industrial environments (Class A) and household/laboratory environments (Class B) must be met. The standard here references to CISPR 11:2009+A1:2010.

Regarding immunity to interference, requirements for controlled electro-magnetic environments (lowest requirements), general environments and industrial environments (highest requirement) must be met.

SomatXR modules listed in the declaration of conformity meet the requirements for:

- Emission: Class A
- Immunity to interference: Industrial environment

The SomatXR series and the individual modules are designed essentially for use in an industrial environment. When used in residential and commercial applications, additional measures may be necessary to limit emission.

Conversions and modifications

The module must not be modified in its design or safety features without our express consent. Any modifications made shall exclude liability on our part for resulting damage.

In particular, any repair or soldering work on motherboard, or replacement of components, is prohibited. When exchanging complete modules, use only genuine parts from HBK.

The module is delivered from the factory with a fixed hardware and software configuration. Changes may only be made within the options documented in the instructions.

Qualified personnel

Qualified persons means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function. This module may only be used by qualified personnel in accordance with the specifications and in compliance with the safety requirements and regulations.

This includes people who meet at least one of the three following criteria:

- The safety concepts of automation technology are assumed to be known. The project personnel must be familiar with these concepts.

- The personnel operating the automation equipment must have been instructed in the handling of the machines, and be familiar with use of the modules and of the technologies described in this documentation.
- The commissioning engineers and service technicians must have successfully completed training that qualifies them to repair automation systems. They are also authorized to commission, ground and label circuits and equipment in accordance with safety engineering standards.

It is also essential to comply with the legal regulations and safety rules applicable to the application concerned during use. The same applies to the use of accessories.

2 MARKINGS USED

2.1 Markings used in this document

Important instructions for your safety are highlighted. Following these instructions is essential in order to prevent accidents and damage to property.

Symbol	Meaning
DANGER	This marking warns of an *imminently threatening* dangerous situation in which failure to comply with safety requirements *will* result in death or extremely serious physical injury.
WARNING	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *could* result in death or serious physical injury.
CAUTION	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *could* result in slight or moderate physical injury.
Notice	This marking draws your attention to a situation in which failure to comply with safety requirements *could* lead to property damage.
Important	This marking draws your attention to *important* information about the product or about handling the product.
Tip	This marking indicates tips for use or other information that is useful to you.
Information	This marking draws your attention to information about the product or about handling the product.
Emphasis *See …*	Italics are used to emphasize and highlight text and identify references to sections of the manual, diagrams, or external documents and files.
Device -> New	Bold text indicates menu items, as well as dialog and window headings in the program environment. Arrows between menu items indicate the sequence in which the menus and sub-menus are called up
Sample rate	Bold text in italics indicates inputs and input fields in the user interfaces.

2.2 Symbols on the device

Caution

Indicates that care must be taken when operating the device, and the instructions in the operating manual must be followed when using the module.

Warning of hot surfaces

Indicates that the marked item may be hot, and should not be touched without taking precautions.

CE mark

By the CE mark the manufacturer indicates that the product complies with the requirements of the relevant EC directives.

The NTX001 international medical power supply unit has other markings on it such as VDE, UL, PSE (Japan). The electro-magnetic compatibility of the unit has been tested according to IEC 61326.

UKCA mark

By the UKCA mark the manufacturer indicates that the product complies with the requirements of the relevant UK regulations.

Marking in accordance with the requirements of SJ/T 11364-2014 and SJ/T 11363-2006 ("China RoHS-2")

Marking for products containing hazardous substances in quantities above the maximum concentrations.

Statutory waste disposal marking

In accordance with national and local environmental protection and material recovery and recycling regulations, old devices that can no longer be used must be disposed of separately and not with normal household garbage.

Electrostatically sensitive components

Components marked with this symbol can be damaged beyond repair by electrostatic discharge. Please observe the handling instructions for electrostatic sensitive devices.

Connection to functional ground

You can use this connection to integrate the module into your functional grounding, where necessary, so that interference currents are diverted and no interfering signals are fed in.

3 INTRODUCTION

3.1 SomatXR DAQ

The SomatXR series is a rugged data acquisition system of modular design that is universally applicable for measurements of any kind. The modules in this family can be combined and intelligently interconnected specific to the measurement task. Distributed operation makes it possible to position individual modules close to the measuring points, resulting in short sense leads.

The SomatXR series includes the following available MX modules:

- *MX840B-R universal module*: Eight (8) universal inputs for connecting more than 16 transducer technologies, including one port for acquiring CAN messages.
- *MX1615B-R bridge module*: 16 individually configurable inputs, including for strain gage transducers, standardized voltages, ohmic resistances or resistance-based measurements.
- *MX1601B-R standard module*: 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE).
- *MX1609KB-R thermocouple module* and *MX1609TB-R thermocouple module*: 16 thermocouples of type K (Ni-CrNi) or 16 thermocouples of type T (Cu-CuNi) for temperature measurements.
- *MX411B-R high dynamic range universal module*: Four (4) inputs including strain gage and inductive bridges, standardized voltage (10 V) and DC (20 mA) sources, or current-fed piezoelectric (IEPE, ICP®) and piezoresistive transducers.
- *MX460B-R frequency/counter module*: Up to four (4) digital inputs for measuring digital pulses up to 1 MHz (speed, torque, angular position, displacement, PWM in general). CX23-R/eDAQXR support is limited in the following respects. Mathematical functions are not supported. Interactive zeroing of the "crankshaft" sensors is not possible/supported.
- *MX471C-R CAN-FD modules*: Four (4) independent CAN/CAN-FD bus nodes, galvanically isolated from each other and from the power supply. The module can also be used as a FireWire-to-Ethernet gateway to connect multiple FireWire-inter-connected SomatXR modules to a PC via Ethernet.

The SomatXR series includes the following MX modules that are no longer available:

- *MX471B-R CAN module*: Four (4) independent CAN bus nodes, galvanically isolated from each other and from the power supply.
- *MX590B-R pressure sensing module*: Up to five (5) pressure inputs for direct acquisition of relative and absolute pressures using TEDS technology for each connection.

The SomatXR series includes the following CX modules:

- *CX22B-R data recorder*: The CX22B-R comes with the pre-installed catman® Easy software package for test parameterization, visualization, and data analysis in the field. The acquired test data is stored on the integrated solid state drive (SSD).

Information

For details on the CX22B-R, refer to the separate CX22B-R operating manual.

- *CX27C-R Industrial Ethernet Gateway*: The gateway is used to integrate other SomatXR modules into the fieldbuses, such as EtherCAT® or Profinet. The module can also be used as a FireWire-to-Ethernet gateway in order to connect multiple SomatXR modules to a PC.

Information

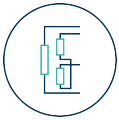
For details on the CX27C-R, refer to the separate CX27C-R operating manual.

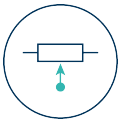
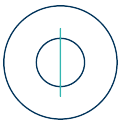
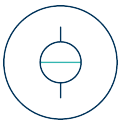
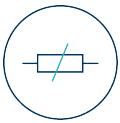
3.2 Overview of modules and transducers

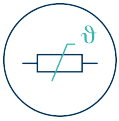
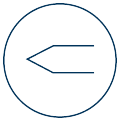
Information

The modules highlighted in gray in the following table are no longer available.

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	Strain gage full bridge, 6-wire configuration	●	●			●					69
	Strain gage half bridge, 5-wire configuration	●	●			●					69

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	Strain gage quarter bridge, 3- or 4-wire configuration	●[1) 3-wire only]	●			●[1) 3-wire only]					69
	Inductive full bridge	●				●					73
	Inductive half bridge	●				●					73
	LVDT (linear variable differential transformer)	●									73
	Piezoresistive transducer	●				●					76

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	Potentiometer	●	●								77
	Voltage, 60 V, 10 V, 100 mV	●	● 60 V only	●		● 10 V only					78
	Current-fed piezoelectric transducer (IEPE, ICP®)	●[2)]		●[2)]		●[2)]					80
	Current, 20 mA	●		●		●					82
	Resistance or resistance-based measure-ments	●	●								84

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	Resistance thermometer PT100 or PT1000	●	● PT100 only								84
	Thermocouple	●3)			● Type K or T						86
	Frequency/ pulse counter (timer, TTL)	● Chan-nels 5-8					●				88
	Incremental encoder (timer, TTL)	● Chan-nels 5-8					●				88
	Torque/ rotational speed	● Chan-nels 5-8					●				88

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	Passive inductive encoder						●				99
	Pulse width modulation						●				100
	Crank wheel sensor						●				105
	SSI protocol	● Chan-nels 5-8									98
	CAN bus	● Chan-nel 1						●[4]	●[4]		102

Transducer		MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	MX590B-R	Circuit diagram
	CAN-FD bus								●4)		102
	Absolute pressure sensor (gas/ liquid)									●	104
	Relative pressure sensor (gas/ liquid)									●	104

1) Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2.
2) ODU 14-pin to BNC 1-KAB430-0.3 adapter can optionally be used.
3) Adapters 1-SCM-R-TCK-2 for type K, 1-SCM-R-TCE-2 for type E, 1-SCM-R-TCT-2 for type T, and 1-SCM-R-TCJ-2 for type J.
4) Includes support for CCP/XCP-on-CAN (not in conjunction with CX23-R).

3.3 About the documentation

The SomatXR documentation includes:

- Printed Quick Start Guide.
- SomatXR series operating manuals in PDF format.
- Various data sheets for SomatXR modules and accessories.
- Various mounting instructions (in PDF format) for cables, adapters and connectors.
- Comprehensive online help and user-friendly search options available after installing the Windows PC software (e.g. MX Assistant, catman®EASY).

These documents can be found:

- In the QuantumX/SomatXR system package at www.hbm.com/start.
- On your PC's hard disk, after installing the MX Assistant.
- Updated versions are always available at www.hbm.com or www.hbkworld.com.

3.4 MX modules

All SomatXR MX modules can be combined with MX modules of the QuantumX series (MX...) and the QuantumX-P series (MX...-P), and connected to the CX22 data recorder and the CX27 Ethernet and EtherCAT gateway. There are some restrictions when using the SomatXR CX23-R data recorder and the CPU layers of the eDAQXR and eDAQXR-lite series (see relevant operating manual).

The modules of the SomatXR series also offer additional functions. They can fundamentally be synchronized via the Ethernet-based PTPv2 protocol (IEEE1588) or FireWire, and offer the "Decimal" option in addition to the "HBM Classic" sample rate domain.

All MX modules have a similar rear panel with a mains power connection, two FireWire ports, and an Ethernet port. Gateway modules such as the CX27C-R and MX471C-R provide an additional Ethernet port on the front.

Features of the MX modules

All MX modules have the following common features:

- Low voltage connection
- Configurable Ethernet port for data communication with an operating PC
- Two FireWire ports
  - For synchronization of the modules
  - For internal measurement data transmission
  - For optional power supply (refer to data sheet)
  - For optional data communication with a PC
- Status LEDs indicating the current module status

- A working standard calibration certificate is stored on each measuring amplifier, and can be read out via the MX Assistant.
- Autoboot (module configurations are retained)

Measuring amplifiers have the following features for each channel:

- Galvanic isolation
  - Signal inputs for power supply and communication
  - Mutual signal inputs (except MX1615B-R)
- Configurable power supply for active sensors
- Support for TEDS technology (read, write)
- Configurable sample rate
- Configurable active digital filter (Bessel, Butterworth, linear-phase, or off)
- Configurable scaling (can also be stored in the TEDS)

Sensors assigned using the sensor database can be calibrated via the channel and written back into the sensor database.

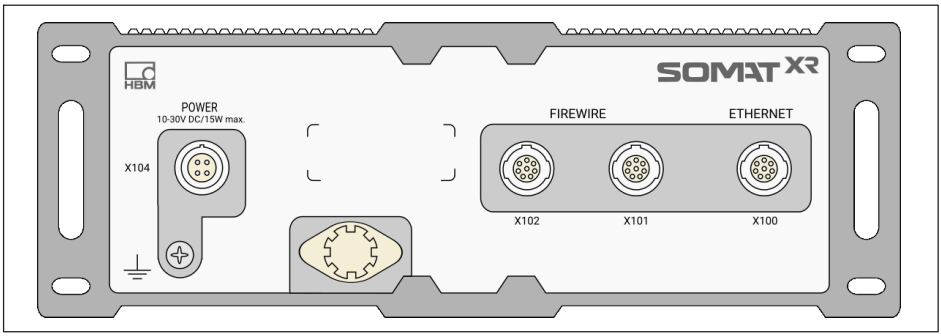
4 SYSTEM SETUP

A SomatXR system can be set up in various ways:

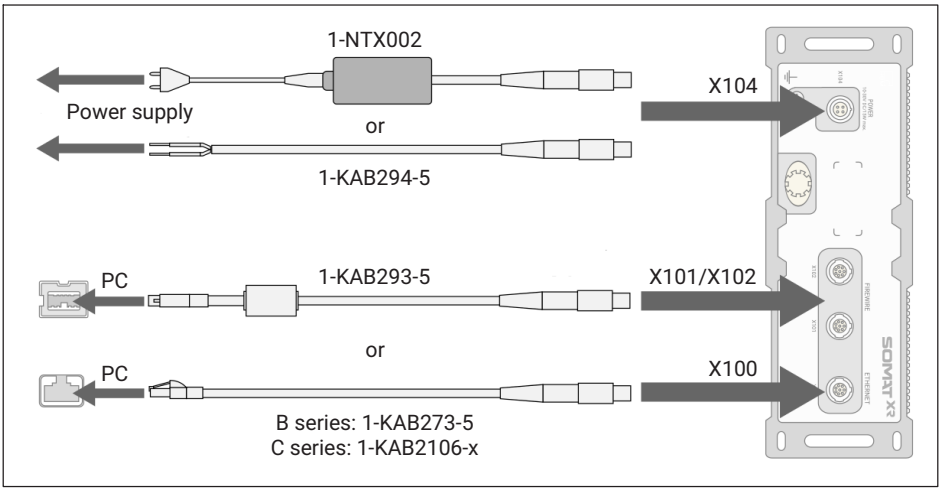
- MX modules connected to a host PC (explained in this manual)
- MX modules connected to a data recorder (SomatXR CX22B-R or QuantumX CX22B, eDAQXR CPU layer or eDAQXR-lite CPU layer) (explained in the relevant recorder manuals)
- MX modules connected to a gateway (SomatXR CX27C-R, QuantumX CX27B or CX27C) (explained in the relevant gateway manuals)

4.1 First steps with the MX module

All MX modules have a similar rear panel with a mains power connection, two FireWire ports, and an Ethernet port. B series modules have a 100 Mbit Ethernet connector with an 8-pin ODU socket, while C series modules have a 1 Gbit Ethernet connector with an 8-pin M12 socket (X-coded).



First connect a 10 V to 30 V DC voltage source (24 V recommended) to the X104 power supply connector. Use the 1-NTX002 plug-in power supply unit or the 1-KAB294-W-5 mains cable. Connect the host PC to the module's Ethernet (X100) or FireWire (X101 or X102) port. Use Ethernet cable 1-KAB273-5 (B series) or 1-KAB2106-x (C series) or FireWire cable 1-KAB293-5.



For more information on connecting the module to a host PC, see *section 4.4* and *section 4.5*.

SomatXR MX modules can be used as stand-alone devices or in a network with centralized control, data synchronization and common power supply via FireWire. For more information on interconnecting modules, see *section 4.5 "Connecting multiple modules to the host PC"* and *section 4.6 "Module synchronization"*.

Finally, connect the sensors you need. For tips on connecting transducers, see section *4.7 "Connecting transducers"*.

Notice

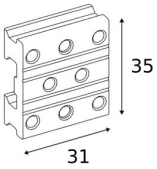
It is not possible to install additional modules in the SomatXR system during operation (not hot-pluggable). To add new modules to the network, disconnect the modules from the power supply.

4.2 Mechanical mounting of the modules

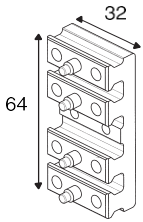
For information on equipment available for mounting SomatXR modules and accessories, visit www.hbm.com or www.hbkworld.com.

Order No.	Item	Description
1-CASELINK	Installation parts	Four (4) elements for mechanical connection
1-CASELINK-RUG-2	Installation parts	Four (4) robust elements for mechanical connection
1-CASEMOUNT	Mounting brackets	Two (2) mounting brackets included for panel mounting: 1-CASELINK
1-CASEMOUNT2-2	Mounting brackets	Two (2) mounting brackets with 1-CASELINK-RUG-2 for two (2) modules
1-CASEMOUNT3-2	Mounting brackets	Two (2) mounting brackets with 1-CASELINK-RUG-2 for three (3) modules
1-CASEMOUNT-UMB-2	Mounting element	SomatXR universal mounting element for GPS, UPS, access point, camera, etc.

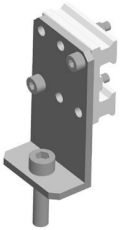
1-CASELINK



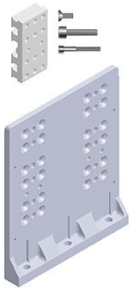
1-CASELINK-RUG-2



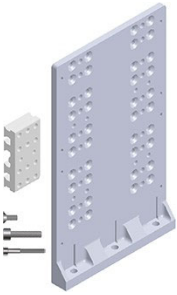
1-CASEMOUNT



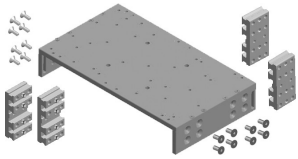
1-CASEMOUNT2-2



1-CASEMOUNT3-2



1-CASEMOUNT-UMB-2



4.2.1 Caselinks (1-CASELINK or 1-CASELINK-RUG-2)

A set of caselinks consists of four (4) elements to connect two (2) SomatXR modules. Set screws (M5) are included with the mounts to secure them to the modules.

4.2.2 Casemounts (1-CASEMOUNT, 1-CASEMOUNT2-2 or 1-CASEMOUNT3-2)

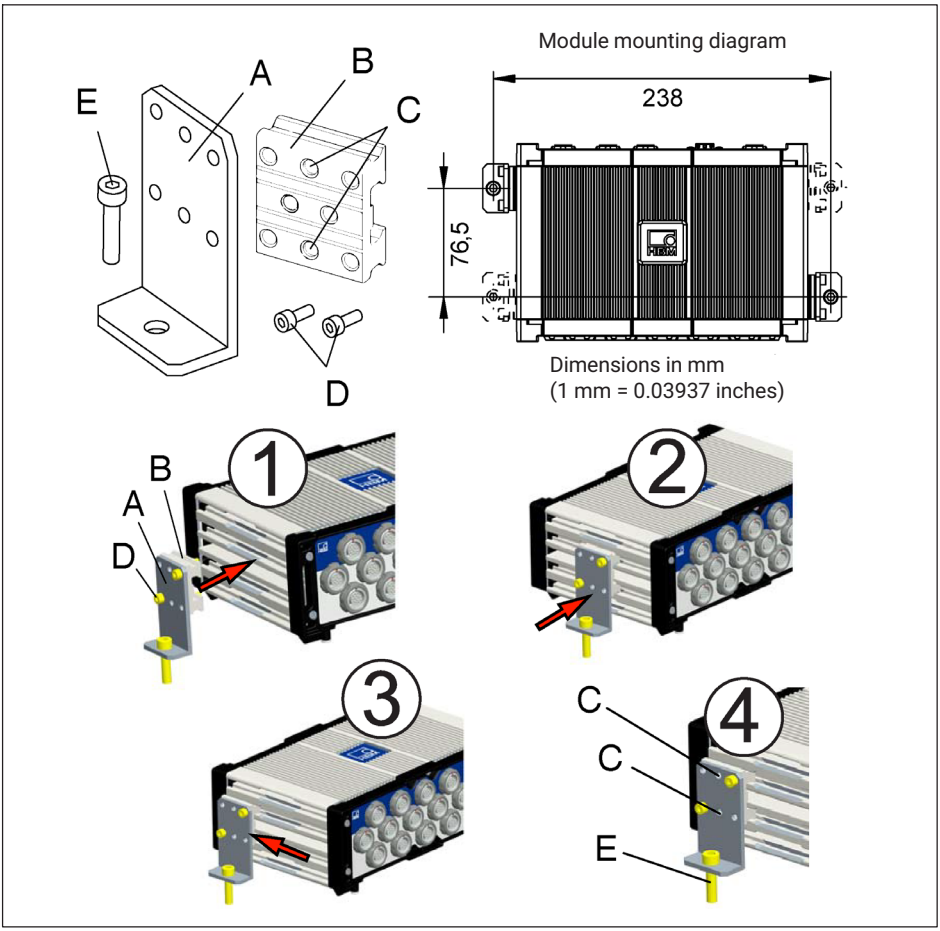
- Use 1-CASEMOUNT to mount one module
- Use 1-CASEMOUNT2-2 to mount two modules
- Use 1-CASEMOUNT3-2 to mount three modules

Set screws (M5) and flat screws are included to secure the housing brackets and mounts to the modules. For more information, refer to the data sheets at www.hbm.com or www.hbkworld.com.

Notice

HBK recommends mounting modules individually in environments subject to strong vibration. Individually mounted SomatXR modules are vibration- and shock-resistant in accordance with MIL-STD-202G. Top modules of stacked configurations may exceed vibration and shock specifications in environments subject to strong vibration. Make sure that the mounted modules do not exceed the vibration and shock specifications (see module data sheets).

1-CASEMOUNT

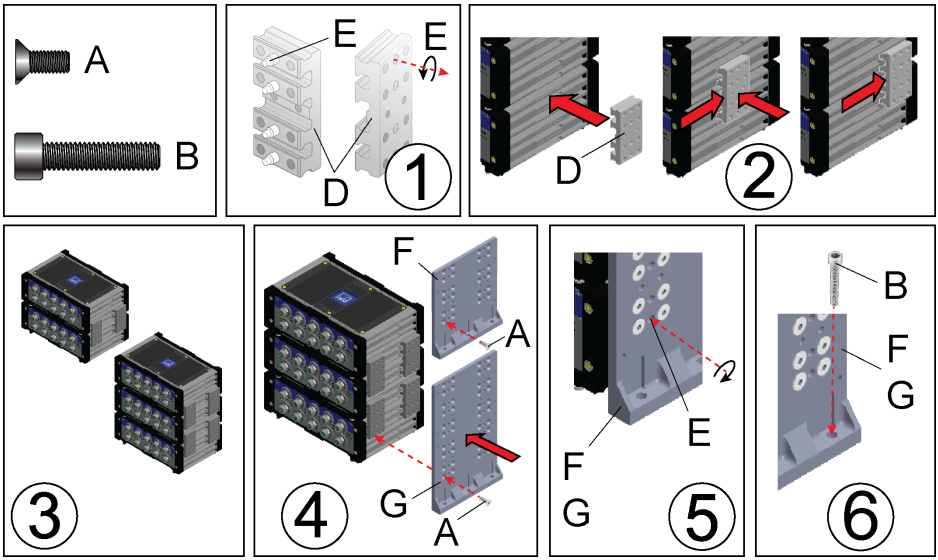


Instructions

The casemounts have been pre-assembled. The mounting diagram is not to 1: 1 scale. The dimensions can be used as a guide for tapping the holes.

1. Insert a housing ring (B) into the slots on the side of a module. Install the two (2) case clips on opposite corners of the module, as shown in the mounting diagram.
2. Make sure the caselink fully engages in the slots on the side of the module.
3. Move the housing ring into the module slots to align the hole in the mount (A) with the tapped hole in the mounting surface.
4. Tighten the two (2) M5 set screws (C) in each caselink. Tighten the two (2) M6 screws (E) holding the mounts to the mounting surface.

1-CASEMOUNT2-2 and 1-CASEMOUNT3-2



Instructions

Assemble the module tower completely before threadlocking the cross-head (Phillips) screws.

1. Apply a serviceable (blue) threadlocker to the four (4) M5 set screws (E) in each caselink (D). Use a 2.5 mm Allen wrench to turn the set screws back into the caselink before installing the caselink on a module.
2. Connect two (2) stacked modules by inserting two (2) caselinks (D) into the slots at each end of the modules.

3. A set of four (4) caselinks can hold two (2) stacked modules together. Kit 1-CASE-MOUNT2-2 contains 1-CASELINK-RUG-2 for two (2) modules. Kit 1-CASEMOUNT3-2 contains 1-CASELINK-RUG-2 for three (3) modules.
4. First attach the mounts (F or G) to the connecting elements (CASELINK) using the M5 countersunk screws and a #2 Phillips screwdriver. Then apply a serviceable thread-locker, and tighten all screws firmly with the screwdriver.
5. Tighten the fastening screws (E) in each caselink using a 2.5 mm Allen wrench. Tighten the screws with a torque of 3.6 Nm.
6. Install the mounts (F or G) on the modules, and verify the dimensions before drilling and tapping the holes (M6 18-8 1.0 pitch). The mounting diagram below is not to 1: 1 scale. The dimensions can be used as a guide for tapping the holes. The mounting holes around the mounts are slightly oversized to allow for mounting tolerances. Apply appropriate threadlocker to the M6 screws (B), and insert through the three (3) holes in each mount (F or G) and into the tapped holes. Tighten the screws with a torque of 6.1 Nm (54 in-lbs).

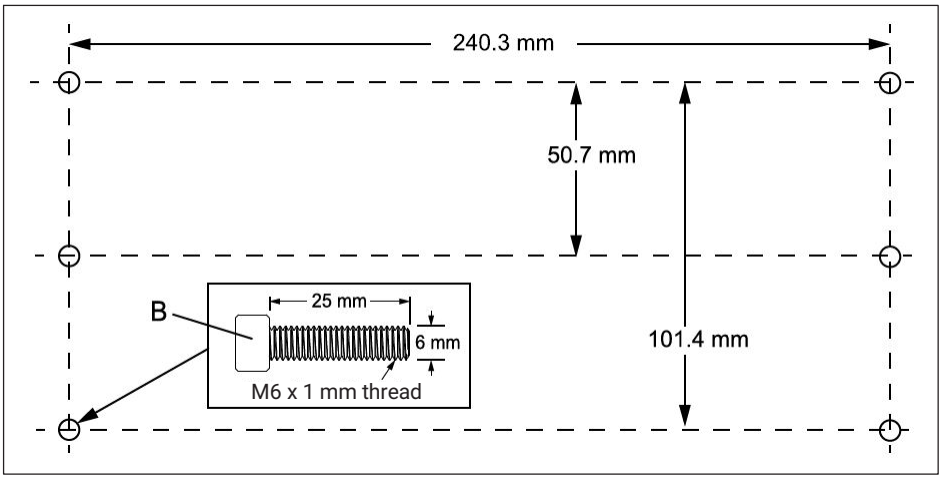
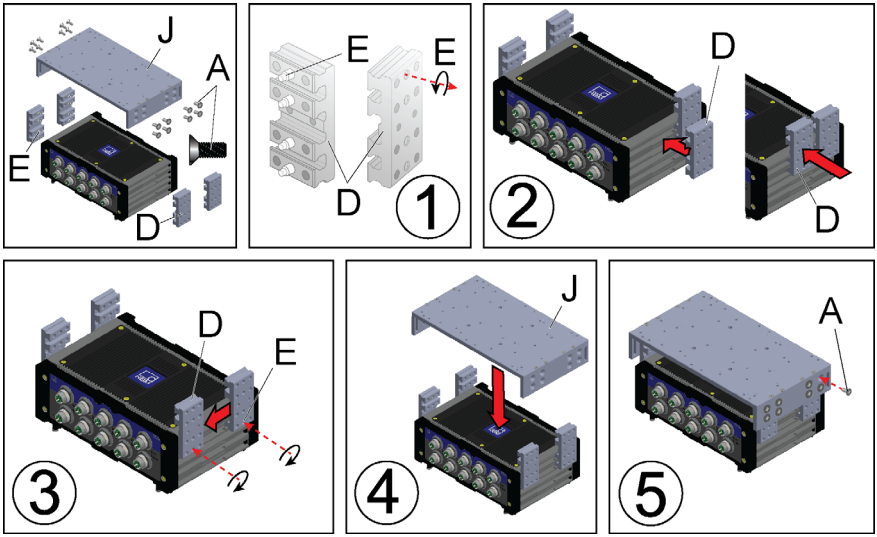


Fig. 4.1 1-CASEMOUNT2-2 and 1-CASEMOUNT3-2 Diagram for mounting brackets

4.2.3 Universal mount (1-CASEMOUNT-UMB-2)

This mount can be used in conjunction with the 1-CASEMOUNT2-2 or 1-CASEMOUNT3-2 kits. For more information, refer to the data sheet at www.hbm.com or www.hbkworld.-com.

This universal mount supports a variety of commercial products that possibly do not meet the system's vibration specifications. Care must be taken not to exceed the module specifications in the data sheet when adding accessories to the stack.



Instructions (typical use case)

Assemble the module tower completely before threadlocking the cross-head (Phillips) screws.

1. Apply a serviceable (blue) threadlocker to the four (4) M5 set screws (E) in each caselink (D). Use a 2.5 mm Allen wrench to turn the fastening screws back into the caselinks before attaching the caselinks to a module.
2. Insert two caselinks (D) into the slots at each end of the SomatXR module.
3. Tighten the fastening screws (E) in each caselink on the module using a 2.5 mm Allen wrench. Tighten the screws with a torque of 3.6 Nm.
4. Align the mount (J) with the housing halves on the module.
5. First mount the mounting brackets (J) to the connecting elements (CASELINK) using the M5 countersunk screws and a #2 Phillips screwdriver. Then apply a serviceable threadlocker, and tighten all screws firmly with the screwdriver.

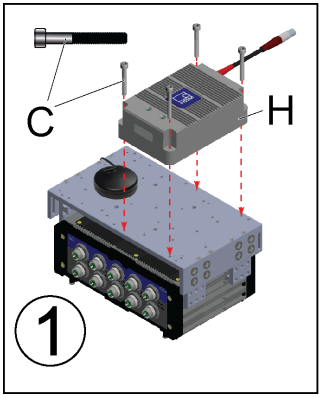
Optional device installation on the universal mount

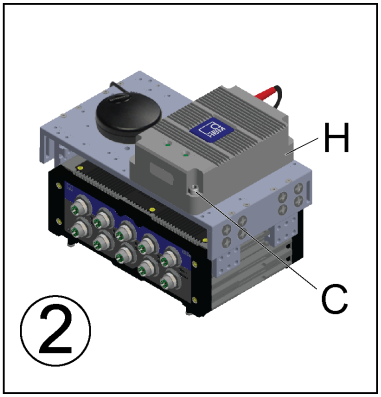
Only one MOXA AWK-4121, 1-EGPS200-B-2, 1-EGPS200-P-2 or Sierra Wireless PinPoint X or XT unit will fit on the universal mount.

The following equipment can be installed on the universal mount:

1. Sierra Wireless AirLink GX450 **and** 1-EGPS-5HZ-2 **or** Axis camera
2. ACKSYS WLg-xROAD / N **or** / NP **and** 1-UPX002-2 **or** 1-EGPS-5HZ-2 **or** Axis camera
3. Two (2) 1-UPX002-2 units
4. 1-UPX002-2 **and** ACKSYS WLg-xROAD / N **or** / NP **or** 1-EGPS-5HZ-2 **or** Axis camera

5. Axis camera **and** L-Com BT-CAT6P1HP-48W
6. L-Com BT-CAT6P1HP-48W **and** PoE Power injector power supply unit (Axis camera mounted separately)





Example of accessory mounting:
Installing a UPX series uninterruptible power supply unit

Each UPX kit contains four (4) SO-227-1002109 (M4) screws for installing the uninterruptible power supply unit to a mount.

1. Attach a UPX unit (H) to a universal mount using a serviceable threadlocker, four (4) M4 screws (C), and a 3 mm Allen wrench.
2. Apply a suitable threadlocker, and tighten the screws (C) with a torque of 1.8 Nm (16 in-lbs), otherwise the screws may loosen and damage the thread of the mounts.

Notice

Mount other devices on the universal mount using the appropriate screws and threadlockers. Some devices, such as the 1-EGPS-5HZ-2 and MOXA AWK-4121, must be fitted on the mount before the mount is installed on a SomatXR module. Tighten the screws firmly so as to avoid vibration loosening the screws and damaging the device thread.

Notice

Before attaching an accessory to a universal mount, make sure that the maximum vibration and shock specifications of the accessory are not exceeded.

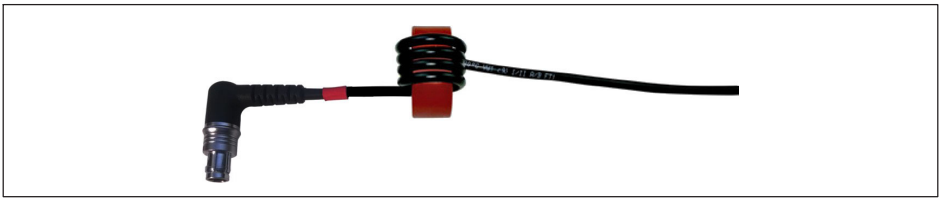
4.3 Power supply considerations

Notice

Defects in the module cannot be excluded if a supply voltage > 30 V is used. If the supply voltage drops below 10 V, the modules switch off.

Electromagnetic compatibility

The SomatXR series and the individual modules are designed essentially for use in an industrial environment. When used in residential and commercial applications, additional measures may be necessary to limit emission. An example would be where the power supply is provided by a battery. Wrap the supply cable (1-KAB294-W-5) four times around the included toroidal core as shown below.



When using the NTX002 or NTX003 power supply units, the system conforms to the EN61326 Class B standard (domestic/laboratory environments) without the procedure shown.

Power supply by FireWire

If multiple modules are interconnected via FireWire for synchronized data acquisition, the power supply can be looped through. The power pack used must be able to provide the appropriate output. The maximum current allowed on the FireWire connecting cable is 1.5 A. In a longer chain, the supply must be fed in repeatedly.

Notice

For power distribution via FireWire, an external power supply with the same voltage potential is required at every third module.

Where multiple measuring amplifiers are run unsynchronized, they must be supplied individually.

Notice

It is not possible to install additional modules in the SomatXR system during operation (not hot-pluggable). To add new modules to the network, disconnect the modules from the power supply.

Uninterruptible power supply

When running on a vehicle battery, we recommend installing an uninterruptible power supply unit (UPS) between the battery and the module to compensate for voltage drops during starting. For this purpose HBK offers the 1-UPX002-2, which is capable of supplying up to three MX modules with uninterrupted power.

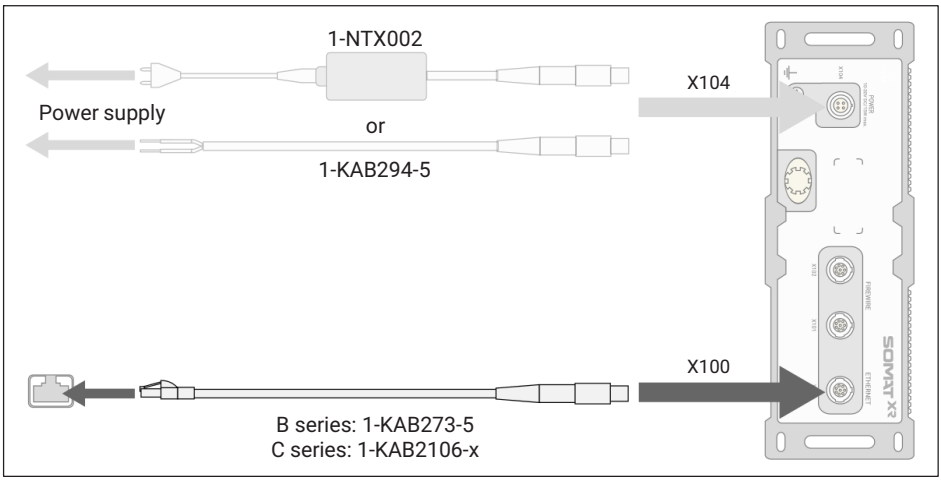
When using the UPX002 unit, connect the power supply to the input connector using a 1-KAB2115-2 cable. Connect the UPX002 output cable to the X104 power supply connection on the MX module.

For more information on UPX002 features, refer to the 1-UPX002-2 data sheet.

4.4 Connecting a single module to the host PC

Single connection via Ethernet

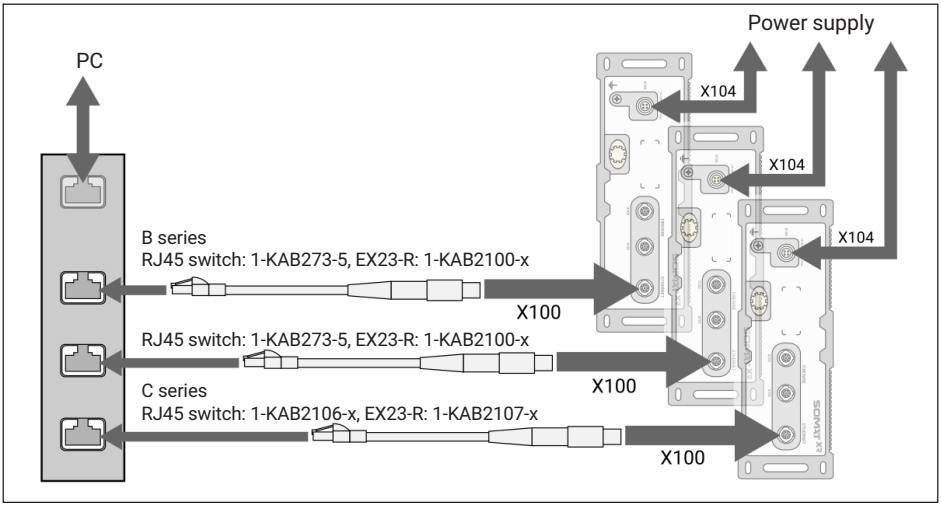
To connect a module to the host PC via Ethernet, simply connect the appropriate Ethernet cable to the module's X100 port and the PC's Ethernet port.



4.5 Connecting multiple modules to the host PC

Multiple connection via Ethernet with PTP or NTP synchronization

Modules can be connected to the PC with standard Ethernet switches. For PTP, the Ethernet switch must comply with that standard. All modules should be powered separately.



For more information on PTP and NTP synchronization, see section *4.6 "Module synchronization"*.

Multiple connection by FireWire (with CX27C-R or MX471C-R)

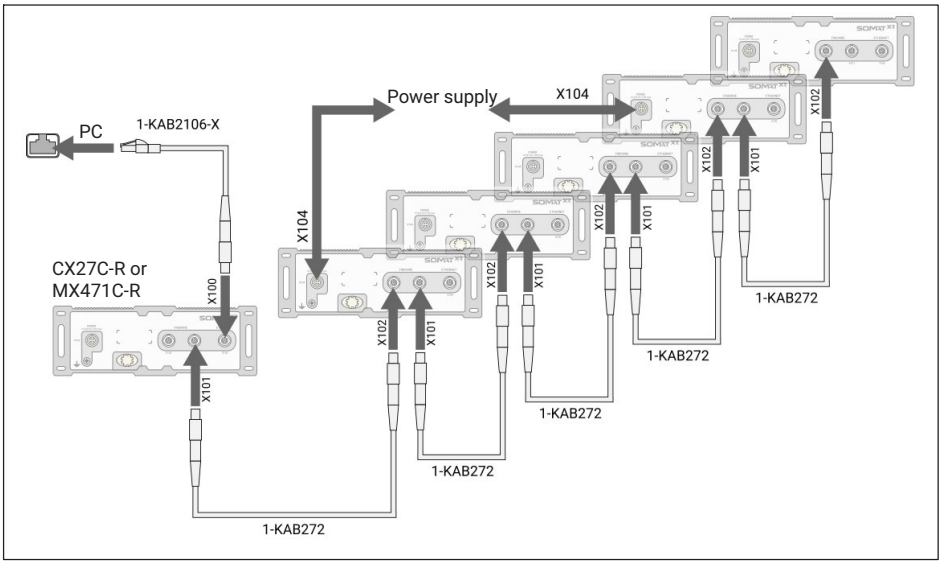
Data is transferred, modules are synchronized, and voltage is supplied via the FireWire ports. A maximum of 12 modules can be connected in series. In the last module (must be the CX27C-R or MX471C-R) all signals are routed to Ethernet, and sent to the connected PC.

Notice

Different voltage sources must have the same reference potential, and should be in the same voltage range.

Important

Cable resistances and internal protective circuitry cause voltage drops to occur, so the last module in the chain is provided with a significantly lower supply voltage. Make sure that at least 10 V is still connected to the last module.



Important

From source to sink, the connection between the modules must always run from FireWire port X102 to X101 on the next module.

Multiple connection by FireWire (without CX27C-R or MX471C-R)

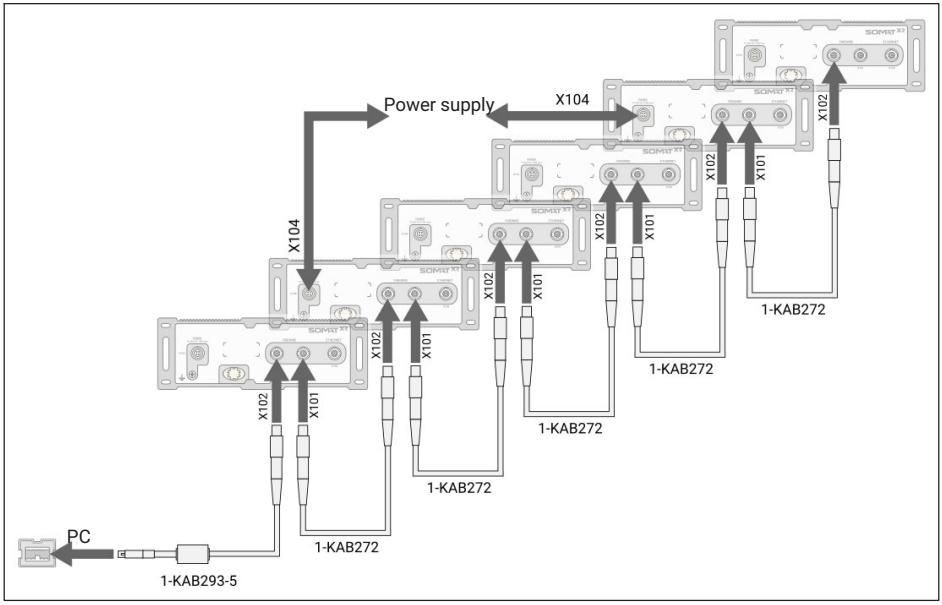
Data is transferred, modules are synchronized, and voltage is supplied via the FireWire ports. A maximum of 12 modules can be connected in series.

Notice

Different voltage sources must have the same reference potential, and should be in the same voltage range.

Important

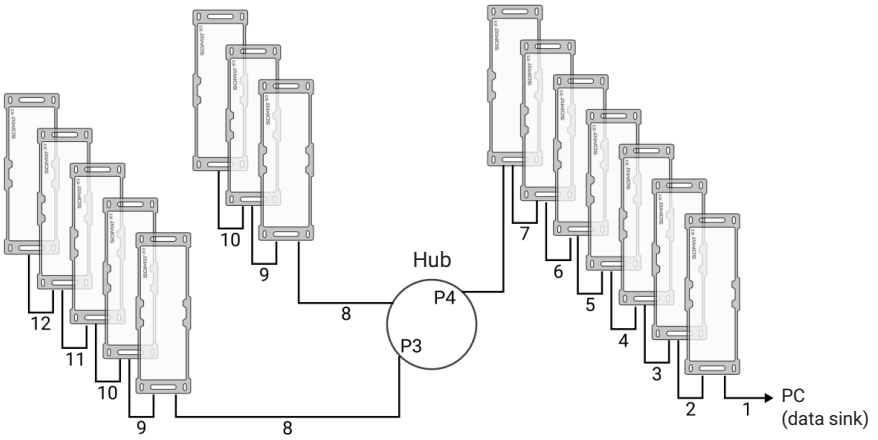
Cable resistances and internal protective circuitry cause voltage drops to occur, so the last module in the chain is provided with a significantly lower supply voltage. Make sure that at least 10 V is still connected to the last module.



Important

From source to sink, the connection between the modules must always run from FireWire port X102 to X101 on the next module.

To connect up to 24 modules, use a hub. Hubs are devices that interconnect network chains in a star configuration. This connection method is in turn limited to 14 hops. A hop is the transition from one module to another (this means n-1 hops for n modules in a chain). Depending on the connection situation, 1 to 2 hops are counted in one hub. The determining factor for the total number of hops is the longest chain to the data sink (worst case).

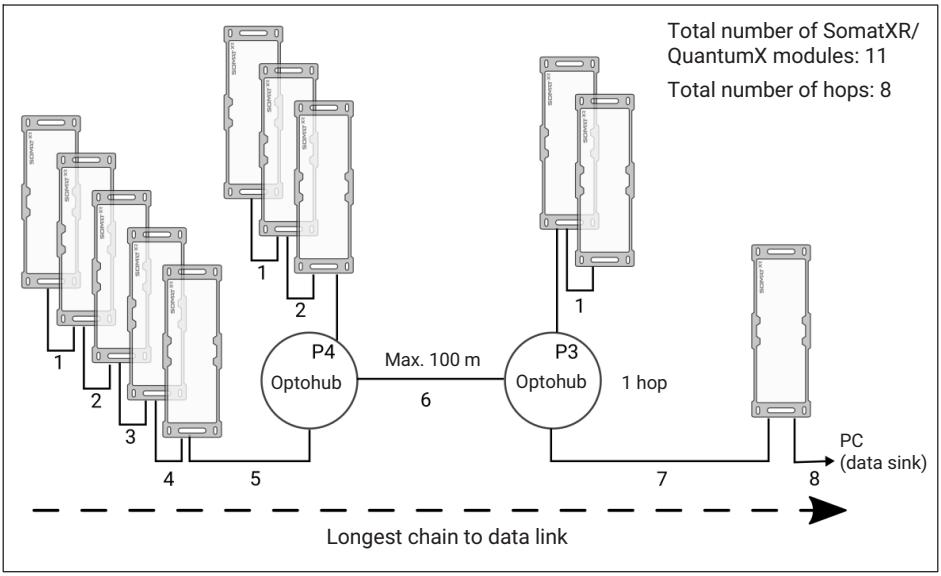


Total number of modules: 15
Longest chain to data sink: 12

Distances of more than 5 meters in FireWire networks can be bridged with Optohubs, which allow distances of up to 100 meters when using a fiber-optic cable. Distances of more than 100 meters significantly reduce the number of hops as follows:

- <100 m Fiber-optic cable: 11 hops
- 100 - 200 m Fiber-optic cable: 7 hops
- 200 - 250 m Fiber-optic cable: 5 hops
- 250 - 300 m Fiber-optic cable: 3 hops

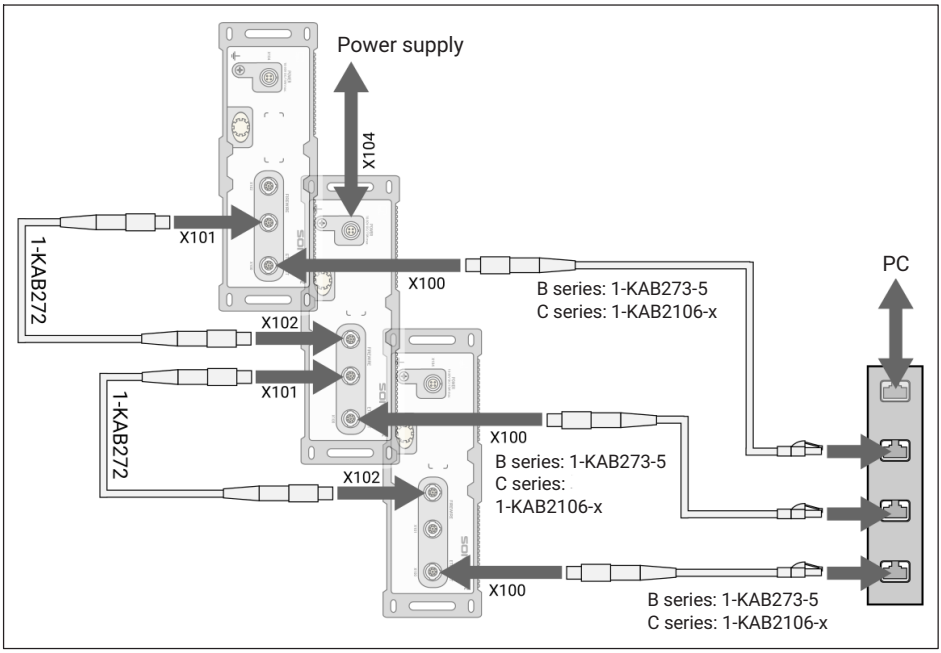
Another advantage (in addition to a wide module distribution and the associated short sense leads) is fully isolated data communication between different system components, for example to suppress the electromagnetic interference of high overhead line voltages in rail traffic.



Multiple connection via Ethernet with FireWire synchronization

In the configuration shown below, the power supply to the modules is looped through via FireWire (max. 1.5 A via FireWire; for the power consumption of a module refer to the data sheet).

This connection configuration offers the advantage that, in the event of a break in the Ethernet cable, the remaining modules remain active.



Important

If modules are interconnected in a subnet via Ethernet and FireWire, it is sufficient to set one module to PTP synchronization. The other modules are then automatically synchronized to the PTP module via FireWire. Even if all modules are set to PTP, the system detects the FireWire connection, and uses it to synchronize the subnet.

4.6 Module synchronization

In order to link measurement signals by time for processing and analysis, their acquisition must be synchronized.

All SomatXR modules can be synchronized with each other. This ensures simultaneous measurement on all channels. All the analog-to-digital converter rates, sample rates and bridge excitation voltages are also synchronized as a result.

In order to establish exact synchronization, the channels concerned must be parameterized with the same filter settings. There is no automatic phase delay correction. The phase delays of the filters are specified in the data sheet. After booting and successful synchronization, the system LED is lit green. If synchronization is disturbed, or not yet established, the system LED is lit orange.

Time stamps are added to the measured values in the following format:

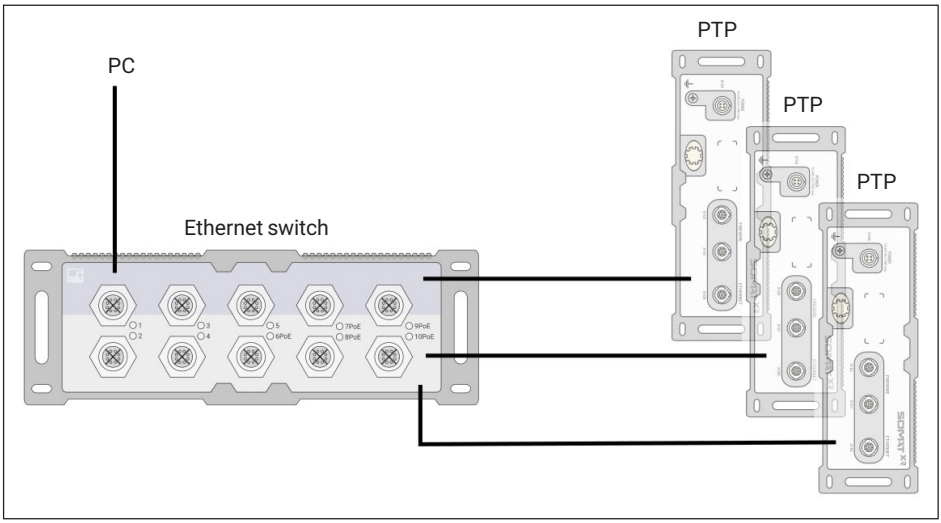
- Basis: 1.1.2000
- Time stamp: 64-bit
- 32-bit Seconds
- 32-bit Fractions of a second

Overview of synchronization methods

Feature	FireWire	Ethernet PTPv2	Ethernet NTP	EtherCAT®
Synchronization with other devices	QuantumX	QuantumX (B and C series) MGCplus (CP52) eDAQXR eDAQXR-lite	Quantum X MGCplus Other	All EtherCAT® nodes
Maximum distance between modules	5 m (40 m with FireWire extender, 500 m via fiber-optic cable)	100 m	100 m	100 m
Number of modules	24	Unlimited	Unlimited	Unlimited (CX27C-R needed)
Accuracy	< 1 µs	< 1 µs	< 10 ms	< 1 µs
Settling time	Immediate	Immediate	Approx. 2 h on first start, approx. 10 min. on restart	Immediate
Master	MX module	External PTP time server MX module CX23-R EXR-CPU EXRL-CPU	External sync master	External sync master
Power supply	1.5 A, looped through	None	None	None

Synchronization via Ethernet PTP or NTP

Each SomatXR module can accurately and reliably synchronize its internal clock with PTP (Precision Time Protocol). This is done by a multiple Ethernet connection via an Ethernet switch (e.g. EX23-R).



To enable PTP synchronization, all modules must be set to PTP (via MX Assistant or catman).

The master clock serving as the reference in a network is automatically selected by a master clock algorithm. This allows the use of a grandmaster clock, as it is automatically selected as the main clock. If there is no grandmaster clock, one module automatically assumes the role of the clock generator.

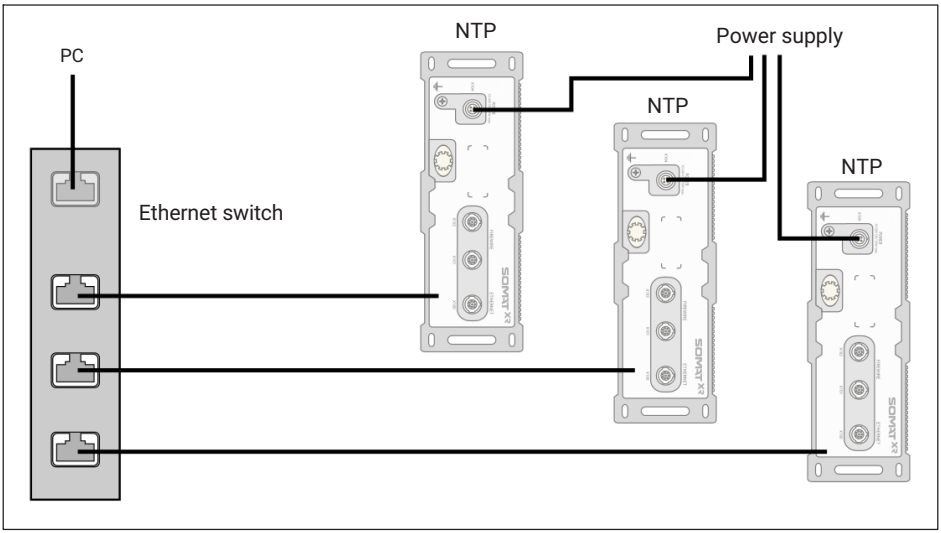
To avoid loss of synchronization quality in networks under heavy load, we recommend using special PTP switches. To compensate for the delay in the network, the switches should support a transparent clock with either E2E (end-to-end) or P2P (peer-to-peer). The transport protocol can be either IPv4 or IPv6.

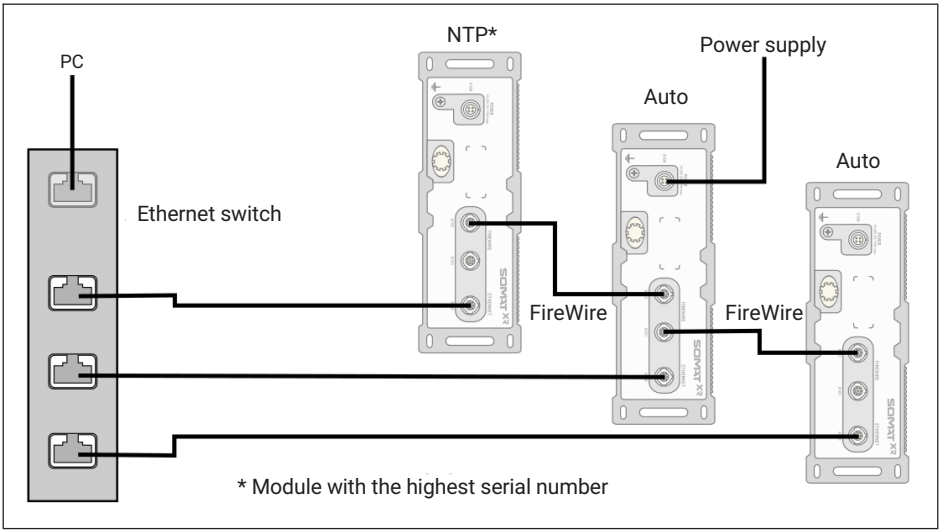
Synchronization via Ethernet NTP

Each SomatXR module can synchronize its internal clock with an NTP server. The NTP time is distributed to all other modules via an Ethernet switch or via FireWire. Modules that are close to each other should be synchronized via FireWire, if available.

Accuracies of 1 ms or better can be achieved, depending on the network load, and whether a dedicated NTP master is used.

An NTP software package is included in HBK's catman®EASY software.





Synchronization via FireWire

If only SomatXR or QuantumX MX modules located close to each other (less than 5 meters apart) are used, we recommend using FireWire connections for synchronization. All modules are automatically synchronized when connected via the FireWire cable.

For more information on FireWire connections, see section *4.5 "Connecting multiple modules to the host PC"*.

In a standard configuration, the module with the highest serial number takes on the master function. If a CX27 module or an external synchronization source is connected, the module or external source automatically becomes the synchronization master. At system startup, the system time is set once to the current time.

If only SomatXR and QuantumX MX modules are used, internal synchronization is sufficient. However, if measurements are to be performed synchronously with different systems, synchronization via an external master is required. This requirement also applies where MX modules are set up very far apart from each other, and a FireWire connection would be too costly.

If an external synchronization source is set, the module with the best synchronization quality automatically becomes the master, and synchronizes all connected modules via FireWire.

Other synchronization methods

- EtherCAT®: For time synchronization via EtherCAT®, a SomatXR CX27C-R or QuantumX CX27C Industrial Ethernet gateway is required. For more details on this, refer to the gateway operating manual.
- IRIG-B: IRIG-B is a standardized time coding. It can only be used in combination with an MX840B(-R) module.

4.7 Connecting transducers

Shielding design

Sources of interference can cause electromagnetic fields which can induce interference voltages inductively or capacitively via the connection cable and device housing in the measuring circuit and therefore interfere with the device function. It must be ensured that the devices used in the system also do not transmit any electromagnetic interference. Electromagnetic compatibility (EMC), which encompasses both the required electromagnetic interference immunity (EMI) and the permissible electromagnetic interference emissions (EME), has become increasingly important over the years.

In the HBK Greenline shielding design concept, the measurement chain is completely enclosed in a Faraday cage by suitable routing of the cable shield. The cable shield is extensively connected with the transducer housing, and is routed via the conductive plug connector to the amplifier housing. These measures significantly reduce the effects of electromagnetic interference.

Notice

All parts of the measurement chain (including all cable connection points such as plugs and couplings) must be enclosed in an EMC shield. Shield junctions must provide a full-contact, closed, low-impedance connection. This is the case with original HBK plug connections.

Ground connection and grounding

Since EMC-compliant wiring requires the signal ground and shielding to be separated, the shielding can also be connected to ground at more than one point, for example via the transducers (metallic housing) and the amplifier (housing connected to protective conductor).

In case of potential differences in the measurement system, a potential equalization line must be installed (recommended value: highly flexible stranded wire, wire cross-section 10 mm^2). Signal and data cables must be routed so that they are physically separated from live power lines. Ideally, cable ducts made of sheet metal with an internal partition should be used. When doing so, the signal ground, chassis ground and shielding should be kept separate as far as possible.

In order to minimize the effects of electromagnetic interference and differences in potential, the signal ground and chassis ground (or shielding) in HBK devices are designed to be as far apart as possible. The ground connection should be the protective conductor of the mains or a separate ground potential line, as is the case for potential equalization in buildings, for example. Avoid connecting the ground line to a radiator, water pipe, or similar objects.

Active transducer connection

Some modules can supply active transducers with a bridge excitation voltage of 5 to 24 V.

When using the adjustable transducer excitation voltage, galvanic isolation from the supply voltage of the measuring amplifier can be eliminated.

The maximum permissible power consumption is 700 mW per channel, but not more than 2 W in total. If the power consumption exceeds 700 mW on one channel, the transducer excitation voltage of that channel switches off. If the power consumption exceeds a total of 2 W, the device may switch off.

Notice

Check the correct voltage setting when connecting a sensor. Too high a voltage can destroy the sensor. The voltage value is a part of the MX module's parameterization, and is only changed on a new parameterization. When shipped, the sensor supply is switched off.

4.7.1 TEDS

The acronym TEDS stands for "Transducer Electronic Data Sheet", and refers to the electronic data sheet of a transducer or sensor, which is stored inseparably connected in a small electronic chip or in a relevant module. The TEDS may be located in the transducer housing, in the non-separable cable, or in the connector plug.

The TEDS enables automatic parameterization of a channel as soon as a sensor is connected. Each measurement channel can read or write sensor data from or to the TEDS chip. The sensor descriptions are stored in the sensor database. When a TEDS sensor is connected, this information is written. In addition, valuable metadata such as calibration data is provided, which is important information in terms of the traceability of measurements or tests.

Information

The function and working method of TEDS are defined in standard IEEE1451.4.

Transducer information stored in the TEDS chip:

- Physical unit of the measured quantity (e.g. "N" for force) and its measuring range
- Unit of the electrical output signal (e.g. "mV/V" for bridge transducers)
- Linear characteristic as relationship between measured quantity and electrical signal
- Where necessary, bridge excitation, or supply of electric power to the transducer

Additional information that can be read out using appropriate software:

- Transducer manufacturer, type, serial number, etc.
- Calibration date, recalibration interval, calibrator's initials, etc.

The measuring amplifiers of the SomatXR series are able to read out the transducer information stored in the electronic data sheet and automatically convert it into

the correct amplifier settings so as to enable quick and secure measuring.

The electronic data sheet is read automatically as soon as the transducer is connected to the device. Transducer identification is provided by the electrical bridge between two pins in the plug. After the digital identification mode, the measuring amplifier automatically switches to the configured measuring mode.

The TEDS data can also be read in by a software command, using catman®/AP for example.

The SomatXR rugged data acquisition system offers multiple options for reading or writing TEDS data:

- It is possible to address a TEDS module via two separate wires ("one-wire" configuration), or to retrofit the TEDS in the transducer connection.
- Measuring amplifiers with directly connected IEPE transducers support TEDS version 1.0.

- Some transducers from HBK have a special TEDS module integrated, which can transmit the TEDS data via the feedback line of a sensor (patented "zero-wire" configuration).
- Thermocouple and pressure sensing modules with RFID chips on the transducer connection port support TEDS technology.

Information

For more information on TEDS visit http://www.hbm.com/teds.

Important

If you are using a TEDS calibration table for non-linear transducer scaling, make sure that the TEDS chip has been written with the HBM TEDS Editor version 3.4.0.6 or higher, catman® version 3.4.1 or higher, or the QuantumX/MX Assistant version 2.6.R1 or higher.

Retrofitting TEDS in the transducer connection

The IEEE standard 1451.4 defines a generally recognized method by which sensors can be identified. The sensor is identified by the relevant data sheet, which is stored in electronic form in the sensor, in the cable or in the plug on a 1-wire EEPROM (TEDS – "Transducer Electronic Data Sheet"). The amplifier communicates with this EEPROM via the serial 1-wire interface, reads out the data sheet, and makes the corresponding amplifier settings.

HBK recommends the following TEDS modules from Analog Devices/Maxim:

- DS24B33: Five included in HBK's 1TEDS-PAK
- DS28E07: Five included in HBK's 1-TEDS-PAK-B

4.8 Digitization and signal path

Each SomatXR measurement channel generates two signals. The signals can be parameterized individually with different sample rates and filters. The easiest way to set the parameters is to use the "MX Assistant" software.

If multiple modules are interconnected via FireWire, the signals can be sent in real time (isochronously), such as from a signal source to an output (analog, CAN, or Industrial Ethernet: EtherCAT® or PROFINET).

This isochronous real-time mode can run in parallel with asynchronous operation. The maximum sample rate here is 4.8 kHz.

The SomatXR rugged data acquisition system supports the following scaling methods:

- Two-point scaling (y=mx+b)
- Table scaling (MX840B-R, MX411B-R and MX460B-R only)
- Polynomial scaling (MX840B-R. MX411B-R and MX460B-R only)

5 DRIVING A SYSTEM

5.1 SomatXR CX22B-R / QuantumX CX22B data recorder

The data recorder is shipped with the pre-installed catman Easy DAQ software packages. For details on a system with the CX22B-R, refer to the data recorder documentation.

5.2 eDAQXR and eDAQXR-lite CPU layers

The CPU layers use their own secure web interface for data acquisition. For details on eDAQXR and eDAQXR-lite systems with SomatXR satellites, refer to the CPU layer documentation.

5.3 PC software

SomatXR modules can also be used with a PC or laptop running data acquisition software instead of a data recorder or CPU layer. The QuantumX/SomatXR system package includes a powerful software suite consisting of the HBM Device Manager, the MX Assistant, and the FireWire driver. The catman®Easy/AP software is available as a stand-alone package. All software packages, as well as the latest QuantumX/SomatXR firmware and drivers, can be found on the website (www.hbm.com/start).

5.3.1 HBM Device Manager

The HBM Device Manager is a software tool that, among other capabilities, lists all SomatXR modules found on the network. This feature is also included in the MX Assistant and in catman®Easy/AP.

5.3.2 MX Assistant

The MX Assistant software provides the following features:

- System:
  - Create overview (modules, host PC)
- Modules:
  - Find and configure (TCP/IP communication), name
  - Reset to factory default settings
  - Read out working standard calibration certificate
  - Analyze (information, status, log file)
  - Save configuration on operating PC
  - Firmware updates
- Channels/sensors:
  - Configure (name, connection type, TEDS, semi-automatic assignment)

  - Measure (alphanumeric display)
  - Read from/write to TEDS
  - Enable/disable isochronous mode via FireWire
  - Modify and extend existing sensor databases (e.g. own sensors, dbc data files), save database in CX23-R readable format (sdbx)
  - Assign sensor input signals to CAN, EtherCAT® or PROFINET
- Single signals:
  - Set sample rates and filters (type, cut-off frequency)
  - Measured values (scope)
  - Start/stop graphical measurements (time frame, trigger, zoom)
  - Simple signal analyses (X-Y cursor)
  - Record measurements of individual channels
- Functions and outputs:
  - Generate new signals by mathematical functions (peak value, RMS, addition and multiplication, rotation)

5.3.3 catman®Easy/AP

catman®Easy

catman Easy is the basic version that includes online and offline configuration, online visualizations, and online math functions, as well as recording functions. catman Easy can be combined with two different add-on modules:

- EasyMath: Mathematical module and autosequencing for catman Easy.
- EasyScript: Free VBA programming in measurement and analysis mode.

catman®AP

catman AP extends the full functionality of the catman Easy software package with powerful modules, including:

- GNSS/GPS data visualization on maps
- Video recording
- Integration of wheel force sensors
- Parallel recording
- Cloud data streaming

catman®PostProcess

catman PostProcess provides various post-process tools for processing, analyzing and reporting your results, including:

- Curve operations (peak detection, cutting and smoothing data, removing peaks)

- Mathematical functions (e.g. strain gage rosette calculation, electric power calculation)
- Data visualization
- Video playback
- Statistics and classifications (e.g. rainflow, dwell time)
- Data export and reporting

5.3.4 Programming interface (API) of the MX module

The abbreviation API stands for "Application Programming Interface", and designates so-called programming interfaces. APIs allow programmers to directly access functions of other programs and use them in their own programs.

With the API you have full access to all functions of the MX module through custom programmable software.

The API can be used in the form of programming libraries in .NET technologies. The libraries allow you to create your own applications in programming languages such as C#. Components of the library include functions such as communication setup, configuration of inputs and outputs, starting and stopping data acquisition, and error handling.

For more information on the HBM common API, please visit www.hbm.com or www.hbkworld.com. Application-oriented examples and practical documentation enable a quick start.

5.4 Updating firmware

Updating module firmware is recommended in the following cases:

- When using a new PC software package for the first time
- When adding new modules to the system

With the MX Assistant or catman® you can conveniently check the firmware status of the modules, and update it if necessary. For more information, refer to the software's online help.

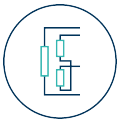
Notice

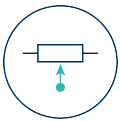
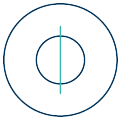
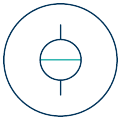
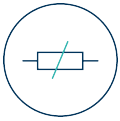
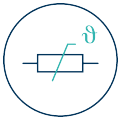
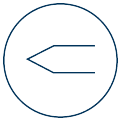
A firmware update may take a few minutes. The module must not be restarted or disconnected from the power supply while the update is running. Otherwise there is a risk that the module may be no longer accessible.

6 MODULES

6.1 MX840B-R universal module

The MX840B-R module has eight (8) universal inputs compatible with more than 16 transducer technologies.

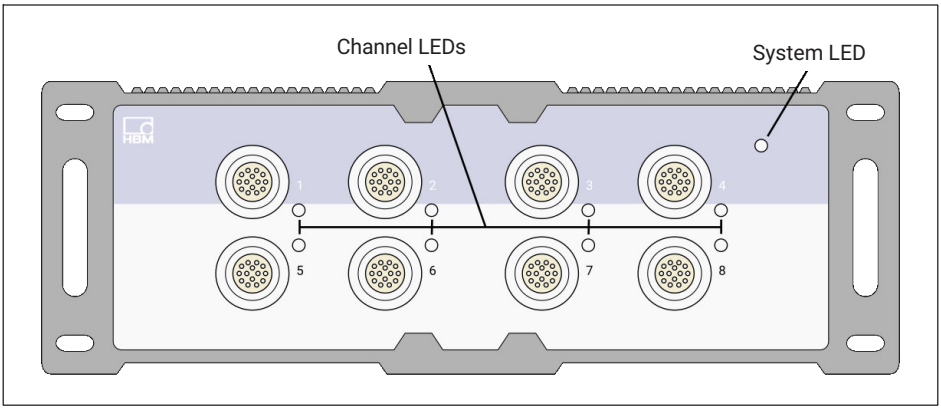
Transducer		MX840B-R	Circuit diagram
	Strain gage full bridge, 6-wire configuration	•	69
	Strain gage half bridge, 5-wire configuration	•	69
	Strain gage quarter bridge, 3- or 4-wire configuration	•[1)] 3-wire only	69
	Inductive full bridge	•	73
	Inductive half bridge	•	73
	LVDT (linear variable differential transformer)	•	73
	Piezoresistive transducer	•	76

Transducer		MX840B-R	Circuit diagram
	Potentiometer	•	77
	Voltage	•	78
	Current-fed piezoelectric transducer (IEPE, ICP®)	•[1]	80
	Current, 20 mA	•	82
	Resistance or resistance-based measurements	•	84
	Resistance thermometer PT100 or PT1000	•	84
	Thermocouple	•[2]	86
	Frequency/pulse counter (timer, TTL)	• Channels 5-8	88
	Torque/rotational speed	• Channels 5-8	88

Transducer		MX840B-R	Circuit diagram
SSI	SSI protocol	• Channels 5-8	98
CAN	CAN bus	• Channel 1	102

1) ODU 14-pin to BNC 1-KAB430-0.3 adapter can optionally be used.
2) Adapters 1-SCM-R-TCK-2 for type K, 1-SCM-R-TCE-2 for type E, 1-SCM-R-TCT-2 for type T, and 1-SCM-R-TCJ-2 for type J.

Status LEDs



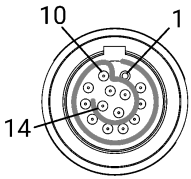
The following tables contain the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Red	System error
Orange	System not ready; booting
Flashing orange	System not ready; downloading

Channel LED	Description	Description (connection 1, CAN bus)
Green	Channel ready	CAN bus activated, CAN data can be received
All Orange	Booting	
All flashing orange	Downloading	
Orange	Connection reassigned; transducer identification in progress	CAN data received, but intermittent interference on bus; buffer overflow; loss of some data
Flashing green, then green	TEDS data being read	
Flashing orange, then green	Manual configuration; TEDS is ignored	
Red	No sensor connected; channel error (parameterization not correct, connection error, invalid TEDS data)	CAN bus error; CAN interface in "Bus OFF" state; CAN data cannot be received or processed

6.1.1 Pin assignment MX840B-R

Connect sensors via the 14-pin ODU MINISNAP connectors.

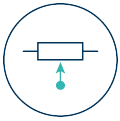
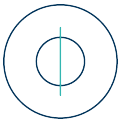
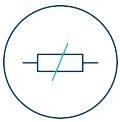
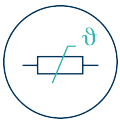
Connection	Pin	Connection	Wire color (1-KAB183 or 1-KAB184)
 Plug end of cable	1	Bridge excitation voltage (-) Zeroing pulse (-)	Black
	2	Bridge excitation voltage (+) Zeroing pulse (+)	Blue
	3	Voltage input 10 V (+), 60 V (+)	White/black
	4	Signal ground Bridge to pin 5	Red/black
	5	Ground cable detection Bridge to pin 4	Pink/black
	6	Current input 20 mA (+)	Yellow/black
	7	Measurement signal (+) Voltage input 100 mV (+) f_1 (–)	White
	8	Measurement signal (-) f_1 (+)	Red
	9	Active sensor supply 5...24 V (0 V)	Brown
	10	Active sensor supply 5...24 V (+)	Yellow
	11	Sense lead (-) f_2 (–) CAN H	Gray
	12	Sense lead (+) f_2 (+) CAN L	Green
	13	TEDS (-) Measurement of natural frequency CAN ground	Gray/black
	14	TEDS (+)	Green/black
	Cable shield	Cable shield	--

Important

Pins 4 and 5 must be bridged for all transducers. To ensure compatibility with the MX1615B-R module, pins 1 and 11 of the sensor connector must be bridged.

6.2 MX1615B-R bridge module

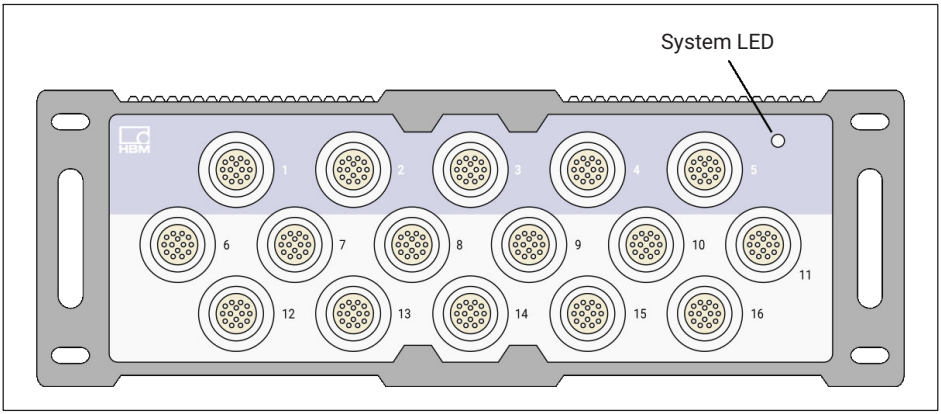
The MX1615B-R module has 16 individually configurable inputs, including for strain gage transducers, standardized voltages, resistances, resistance-based measurements, and resistance thermometers.

Transducer		MX1615B-R	Circuit diagram
	Strain gage full bridge, 6-wire configuration	•	69
	Strain gage half bridge, 5-wire configuration	•	69
	Strain gage quarter bridge, 3- or 4-wire configuration	• 3-wire only	69
	Potentiometer	• 60 V only	77
	Voltage, 60 V	•	78
	Resistance or resistance-based measurements	•	84
	Resistance thermometer Pt100	• PT100 only	84

The MX1615B-R can provide the bridge excitation voltage as a constant direct voltage (DC) or square wave carrier frequency of 1200 Hz (AC) with an amplitude of 0.5 V, 1 V, 2.5 V or 5 V.

The measuring channels are galvanically isolated from the power supply and the interfaces. When using TEDS or T-ID, the measurement channel is automatically parameterized after connecting.

Status LED

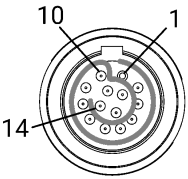


The following table contains the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Red	System error
Orange	System not ready; booting
Flashing orange	System not ready; downloading

6.2.1 Pin assignment MX1615B-R

Connect sensors via the 14-pin ODU MINISNAP connectors.

Connection	Pin	Connection	Wire color (1-KAB183 or 1-KAB184)
 Plug end of cable	1	Bridge excitation voltage (-) Bridge to pin 11	Black
	2	Bridge excitation voltage (+)	Blue
	3	Voltage input 60 V (+)	White/black
	4	Signal ground	Red/black
	5	-	Pink/black
	6	-	Yellow/black
	7	Measurement signal (+)	White
	8	Measurement signal (-)	Red
	9	-	Brown
	10	-	Yellow
	11	Sense lead (-) Bridge to pin 1	Gray
	12	Sense lead (+)	Green
	13	TEDS (-)	Gray/black
	14	TEDS (+)	Green/black
	Cable shield	Cable shield	--

Important

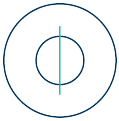
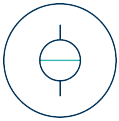
The pin assignment for strain gage transducer, resistor and resistance thermometer (RTD) inputs differs. For more information, refer to the circuit diagrams.

Important

Pins 1 and 11 must be bridged for all MX1615B-R transducers. To ensure compatibility with other MX modules, pins 4 and 5 of the sensor connector must be bridged.

6.3 MX1601B-R standard module

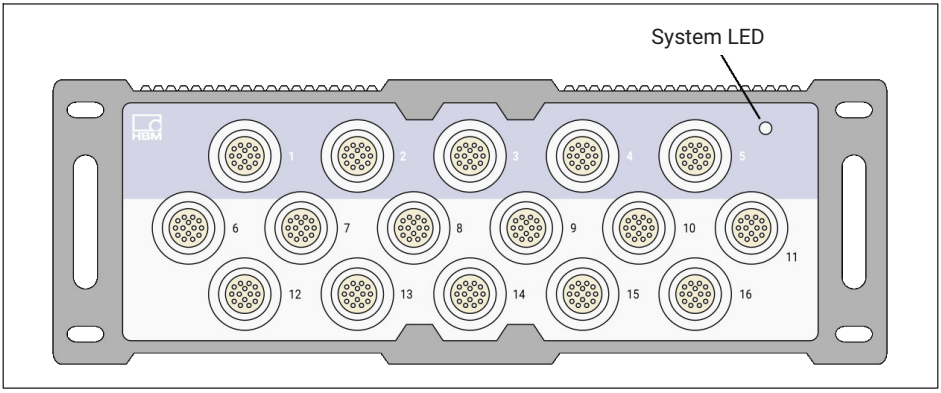
The MX1601B-R module has 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE, ICP®).

Transducer		MX1601B-R	Circuit diagram
	Voltage	•	78
	Current-fed piezoelectric transducer (IEPE, ICP®)	•[1)]	80
	Current, 20 mA	•	82

1) ODU 14-pin to BNC 1-KAB430-0.3 adapter can optionally be used.

All measurement channels are galvanically isolated from each other and from the power supply. When using the adjustable transducer excitation voltage, galvanic isolation from the supply voltage of the measuring amplifier can be eliminated.

Status LED

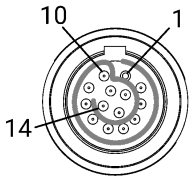


The following table contains the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Red	System error
Orange	System not ready; booting
Flashing orange	System not ready; downloading

6.3.1 Pin assignment MX1601B-R

Connect sensors via the 14-pin ODU MINISNAP connectors.

Connection	Pin	Connection	Wire color (1-KAB183 or 1-KAB184)
 Plug end of cable	1	-	Black
	2	-	Blue
	3	Voltage input (+), IEPE (+)	White/black
	4	Signal ground Bridge to pin 5	Red/black
	5	Ground cable detection Bridge to pin 4	Pink/black
	6	Current input 20 mA (+)	Yellow/black
	7	-	White
	8	-	Red
	9	Active sensor supply (-)	Brown
	10	Active sensor supply (+)	Yellow
	11	-	Gray
	12	-	Green
	13	TEDS (-)	Gray/black
	14	TEDS (+)	Green/black
	Cable shield	Cable shield	--

Important

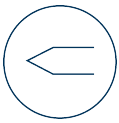
Pins 4 and 5 must be bridged for all transducers. To ensure compatibility with the MX1615B-R module, pins 1 and 11 of the sensor connector must be bridged.

The transducer supply, adjustable between 5 V and 24 V, is only available on channels 1 to 8. The power consumption of these channels is a maximum of 0.7 W per channel, or 2 W in total.

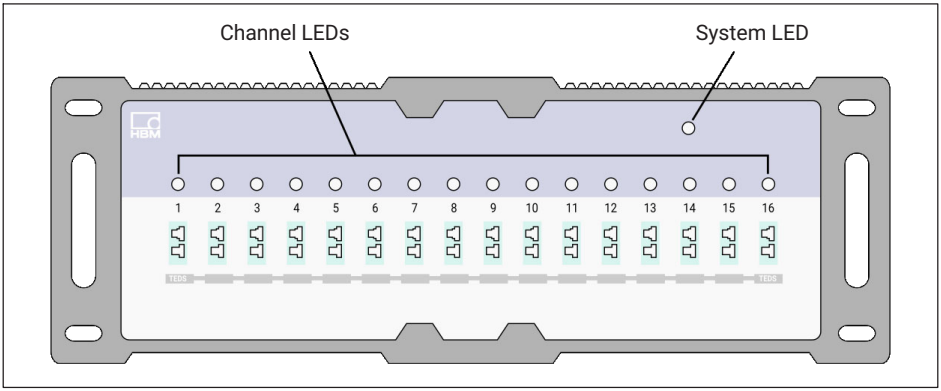
On channels 9 to 16 the output is equal to the supply voltage (10 ... 30 V) minus approximately one volt. The maximum current consumption is 30 mA per channel, or 75 mA in total. At a higher current consumption, the transducer supply is switched off by the current limiter switches.

6.4 MX1609KB-R thermocouple module

Up to 16 type K (NiCrNi) thermocouples can be connected to the MX1609KB-R module for temperature measurements.

Transducer		MX1609KB-R	Circuit diagram
	Thermocouple	• Type K only	86

Status LEDs



The following table contains the descriptions for all LED states.

System LED	Channel LED	Description
Green	-	Error-free operation
Red	-	System error
Orange	Orange	System not ready; booting

System LED	Channel LED	Description
Flashing orange	Flashing orange	System not ready; downloading
--	Green	Connection is error-free
--	Flashing green	TEDS data is valid (LED flashes for 5 s)
--	Orange	Transducer identification/sensor scaling in progress
--	Red	No sensor connected

Thermocouple with TEDS functionality (RFID) measuring point identification

An RIFD chip in or on the thermocouple connector ensures wireless transducer identification by the measuring amplifier. RFID technology enables contactless reading and writing of data, such as the exact measuring point or the desired physical unit (°C or K). It is written to the RFID chip via a corresponding RFID transponder in the measuring amplifier.

The chip is reusable, and works without batteries.

The MX1609KB-R has a rescaling function. A table that converts values can be used to minimize thermocouple or installation errors.

The MX1609KB-R can process maximum 64 value pairs. In the TEDS

"Calibration Table" template, 14 pairs of values can be stored, provided no additional optional templates are used.

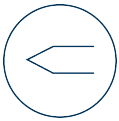
This function delivers the best results when the ambient temperature of the MX1609KB-R, and therefore the temperature of the cold junction, is kept constant.

Conditions for using RFID chips for measuring point identification

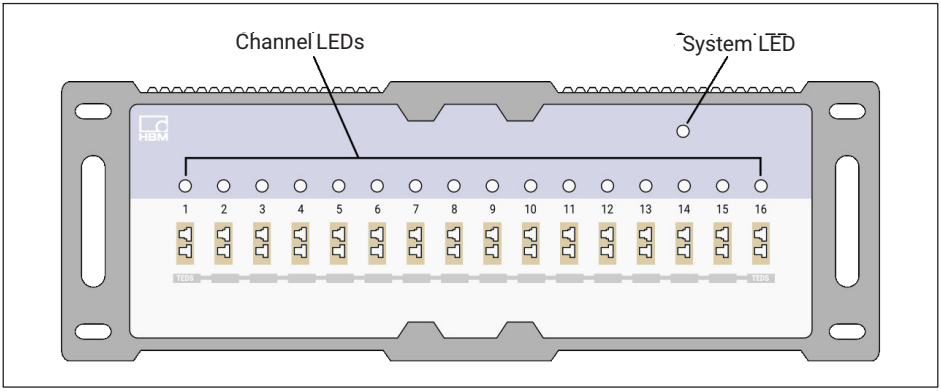
- All channels can read and write via RFID.
- The adjacent channel must not be in use during writing.
- Maximum distance from chip to housing: 1 mm
- For self-assembly: Check position of chip on plug.

6.5 MX1609TB-R thermocouple module

Up to 16 type T (Cu-CuNi) thermocouples can be connected to the MX1609TB-R module for temperature measurements.

Transducer		MX1609TB-R	Circuit diagram
	Thermocouple	• Type T only	86

Status LEDs



The following table contains the descriptions for all LED states.

System LED	Channel LED	Description
Green	-	Error-free operation
Red	-	System error
Orange	Orange	System not ready; booting
Flashing orange	Flashing orange	System not ready; downloading
--	Green	Connection is error-free
--	Flashing green	TEDS data is valid (LED flashes for 5 s)
--	Orange	Transducer identification/sensor scaling in progress
--	Red	No sensor connected

Thermocouple with TEDS functionality (RFID) measuring point identification

An RIFD chip in or on the thermocouple connector ensures wireless transducer identification by the measuring amplifier. RFID technology enables contactless reading and writing of data, such as the exact measuring point or the desired physical unit (°C or K). It is written to the RFID chip via a corresponding RFID transponder in the measuring amplifier.

The chip is reusable, and works without batteries.

The MX1609TB-R has a rescaling function. A table that converts values can be used to minimize thermocouple or installation errors.

The MX1609TB-R can process maximum 64 value pairs. In the TEDS

"Calibration Table" template, 14 pairs of values can be stored, provided no additional optional templates are used.

This function delivers the best results when the ambient temperature of the MX1609TB-R, and therefore the temperature of the cold junction, is kept constant.

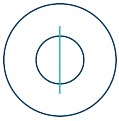
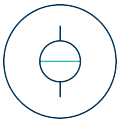
Conditions for using RFID chips for measuring point identification

- All channels can read and write via RFID.
- The adjacent channel must not be in use during writing.
- Maximum distance from chip to housing: 1 mm
- For self-assembly: Check position of chip on plug.

6.6 MX411B-R high dynamic range universal module

The MX411B-R module has four (4) galvanically isolated inputs, including for strain gage and inductive bridges, standardized voltage (10 V) and DC current (20 mA) sources, or current-fed piezoelectric (IEPE, ICP®) and piezoresistive transducers.

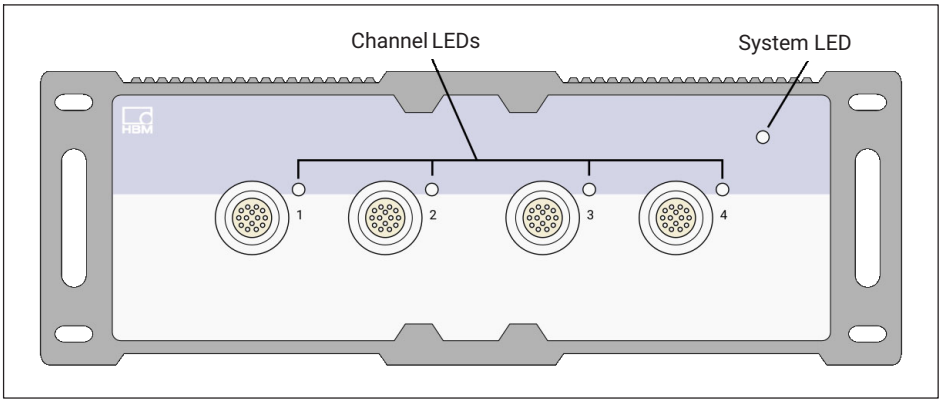
Transducer		MX411B-R	Circuit diagram
	Strain gage full bridge, 6-wire configuration	•	69
	Strain gage half bridge, 5-wire configuration	•	69
	Strain gage quarter bridge, 3- or 4-wire configuration	•[1)] 3-wire only	69

Transducer		MX411B-R	Circuit diagram
	Inductive full bridge	•	73
	Inductive half bridge	•	73
	Piezoresistive transducer	•	76
	Voltage	•	78
	Current-fed piezoelectric transducer (IEPE, ICP®)	•[2]	80
	Current, 20 mA	•	82

[1] Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2.
[2] ODU 14-pin to BNC 1-KAB430-0.3 adapter can optionally be used.

The measurement channels are galvanically isolated from each other and from the power supply. When using the adjustable transducer excitation voltage, galvanic isolation from the supply voltage of the measuring amplifier can be eliminated.

Status LEDs



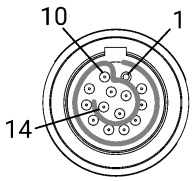
The following tables contain the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Red	System error
Orange	System not ready; booting
Flashing orange	System not ready; downloading

Channel LEDs	Description
Green	Channel ready
All orange	Booting
All flashing orange	Downloading
Orange	Connection reassigned; transducer identification in progress
Flashing green, then green	TEDS data being read
Flashing orange, then green	Manual configuration; TEDS is ignored
Red	No sensor connected; channel error (parameterization not correct, connection error, invalid TEDS data); transducer excitation voltage overload

6.6.1 Pin assignment MX411B-R

Connect sensors via the 14-pin ODU MINISNAP connectors.

Connection	Pin	Connection	Wire color (1-KAB183 or 1-KAB184)
 Plug end of cable	1	Bridge excitation voltage (-)	Black
	2	Bridge excitation voltage (+)	Blue
	3	Voltage input 10 V (+), IEPE (+)	White/black
	4	Signal ground Bridge to pin 5	Red/black
	5	Ground cable detection Bridge to pin 4	Pink/black
	6	Current input 20 mA (+)	Yellow/black
	7	Measurement signal (+)	White
	8	Measurement signal (-)	Red
	9	Active sensor supply (-)	Brown
	10	Active sensor supply (+)	Yellow
	11	Sense lead (-)	Gray
	12	Sense lead (+)	Green
	13	TEDS (-)	Gray/black
	14	TEDS (+)	Green/black
	Cable shield	Cable shield	--

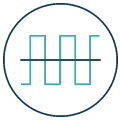
Important

Pins 4 and 5 must be bridged for all transducers. To ensure compatibility with the MX1615B-R module, pins 1 and 11 of the sensor connector must be bridged.

6.7 MX460B-R frequency/counter module

Up to four (4) digital inputs can be connected to the MX460B-R for measuring digital pulses up to 1 MHz (speed, torque, angular position, displacement, PWM in general). CX23-R/eDAQXR support is limited in the following respects. Mathematical functions are not supported. Interactive zeroing of the "crankshaft" sensors is not supported.

You can connect up to four measurement transmitters to the MX460B-R frequency module. Transducers are connected via a 14-pin ODU device socket. All measurement channels are galvanically isolated from each other and from the power supply. When using the adjustable sensor supply, the galvanic isolation from the supply voltage of the amplifier is eliminated.

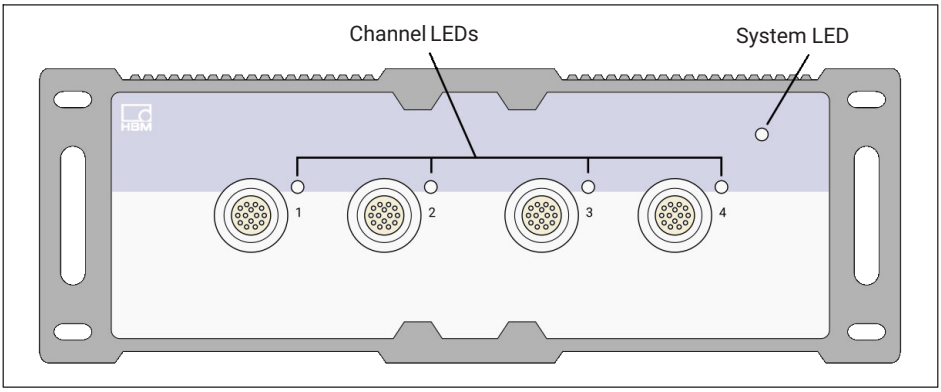
Transducer		MX840B-R	Circuit diagram
	Frequency/pulse counter (timer, TTL)	•	88
	Incremental encoder (timer, TTL)	•	88
	Torque/rotational speed	•	88
	Passive inductive encoder	•	99
	Pulse width modulation	•	100

Notice

The MX460B-R can supply sensors with a constant DC voltage of 5 to 24 V. Always check the encoder data sheet for the maximum supply voltage. A 12 volt sensor supply to a 5 volt encoder might damage it.

When using TEDS or T-ID, the measurement channel is automatically parameterized after connecting.

Status LEDs



The following tables contain the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Red	System error
Orange	System not ready; booting
Flashing orange	System not ready; downloading

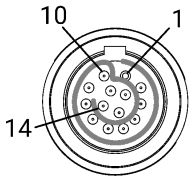
Channel LEDs	Description
Green	Channel ready
All orange	Booting
All flashing orange	Downloading
Orange	Connection reassigned; transducer identification in progress
Flashing green, then green	TEDS data being read
Flashing orange, then green	Manual configuration; TEDS is ignored
Red	No sensor connected; channel error (parameterization not correct, connection error, invalid TEDS data)

Rule of thumb: Brief flash means TEDS detected (green: in use; orange: not in use).

6.7.1 Pin assignment MX460B-R

Pins 4 and 5 in the connector plug must be bridged so that the connection or disconnection of an encoder can be unmistakably detected! If this bridge is missing, no measurement values will be recorded on the connection!

Connect sensors via the 14-pin ODU MINISNAP connectors.

Connection	Pin	Connection	Wire color (1-KAB183 or 1-KAB184)
 Plug end of cable	1	Bridge excitation voltage (-) Zeroing pulse (-)	Black
	2	Bridge excitation voltage (+) Zeroing pulse (+)	Blue
	3	f1 AC+ (for passive inductive transducers)	White/black
	4	Signal ground (reference voltage V_{ref} (2.5 V) Bridge to pin 5	Red/black
	5	Plug-in detection Bridge to pin 4	Pink/black
	6	Not in use	Yellow/black
	7	Frequency input f_1 (-)	White
	8	Frequency input f_1 (+)	Red
	9	Active sensor supply 5…24 V (0 V)	Brown
	10	Active sensor supply 5…24 V (+)	Yellow
	11	Frequency input (-) f2 (-)	Gray
	12	Frequency input (+) f2 (+)	Green
	13	Signal ground, TEDS (-)	Gray/black
	14	TEDS (+)	Green/black
	Cable shield	Cable shield	--

Important

Pins 4 and 5 must be bridged for all transducers. To ensure compatibility with the MX1615B-R module, pins 1 and 11 of the sensor connector must be bridged.

6.8 MX471-R CAN module

6.8.1 MX471B-R CAN module

The MX471B-R module has four (4) independent CAN bus nodes.

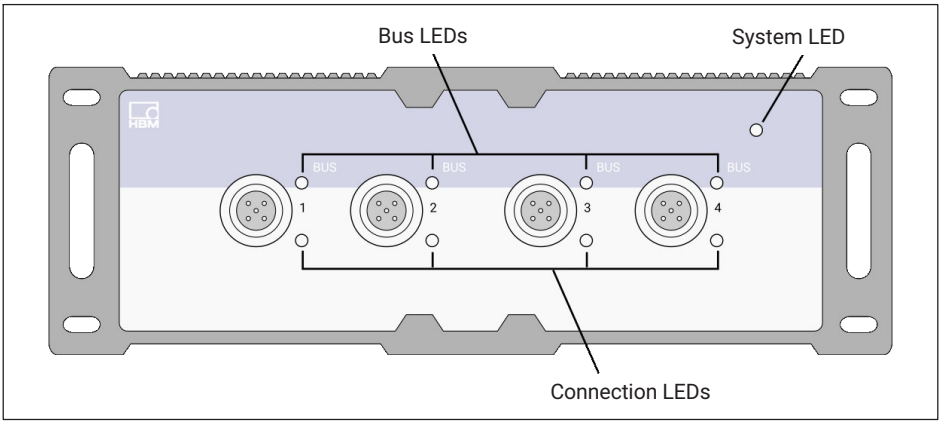
Transducer		MX471B-R	Circuit diagram
CAN	CAN bus	•[1)]	102

1) Includes support for CCP/XCP-on-CAN (not in conjunction with CX23-R).

All CAN bus nodes are galvanically isolated from each other and from the power supply.

The MX471B-R supports classic bit rates up to 1 Mbit/s. For information on the relationship between the bit rate and the maximum length of the bus line, refer to the MX471B-R data sheet.

Status LEDs



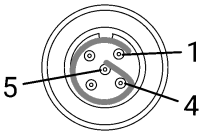
The following tables contain the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Yellow	System not ready; booting

System LED	Description
Flashing yellow	System not ready; downloading
Red	System error; synchronization error

Bus LEDs	Description
Flickering green	Bus error-free, activity on CAN
Green	Bus error-free, no activity on CAN
Flickering yellow	Intermittent bus error (warning); activity on CAN
Yellow	Intermittent bus error (warning); no activity on CAN
Red	Bus error; CAN interface in "Bus OFF" state

Connection LEDs	Description
Green	Channel ready - no errors
Yellow	Bus warning - intermittent or permanent errors
Flashing yellow	Firmware update in progress
Red	Bus error - data loss; reduce number of decoded and/or sent messages
Flashing red	Bus OFF - no receiving or sending possible

Connection	Pin	Connection	Wire color (1-KAB2109-2)
 Plug end of cable	1	CAN_SHLD (directly connected to housing potential, capacitively coupled to GND)	Yellow
	2	-	Red
	3	CAN-GND (ground/0V/V-)	Black
	4	CAN H (dominant high)	White
	5	CAN L (dominant low)	Blue

6.8.2 MX471C-R CAN-FD module

Four (4) independent CAN/CAN-FD bus nodes can be connected to the MX471C-R. The module can also be used as a gateway to connect multiple SomatXR modules (interconnected by FireWire) to the PC via an Ethernet cable.

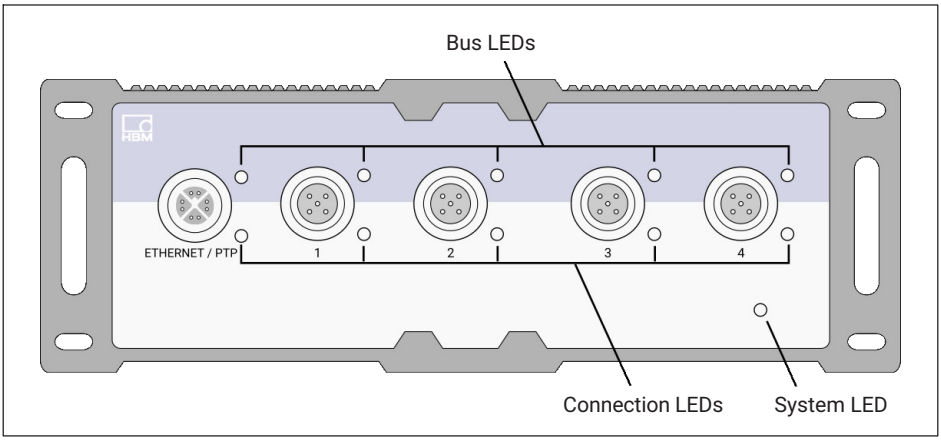
Transducer		MX471C-R	Circuit diagram
CAN	CAN bus	•[1)]	102
CAN[FD]	CAN-FD bus	•[1)]	102

1) Includes support for CCP/XCP-on-CAN (not in conjunction with CX23-R).

All CAN bus nodes are galvanically isolated from each other and from the power supply.

The MX471C-R supports classic bit rates up to 1 Mbit/s and CAN-FD rates up to 4 Mbit/s. For information on the relationship between the bit rate and the maximum length of the bus line, refer to the MX471C-R data sheet.

Status LEDs



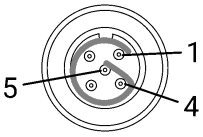
The following tables contain the descriptions for all LED states.

System LED	Description
Green	Error-free operation
Orange	System not ready; booting
Flashing orange	System not ready; downloading
Red	System error; synchronization error

Bus LEDs	Description
Flickering green	Bus error-free, activity on CAN
Green	Bus error-free, no activity on CAN
Flickering orange	Intermittent bus error (ERROR PASSIVE); activity on CAN
Orange	Intermittent bus error (ERROR PASSIVE); no activity on CAN
Red	Bus error; CAN interface in "Bus OFF" state

Connection LEDs	Description
Green	Channel ready - no errors
Orange	Data loss - intermittent or permanent errors
Flickering orange	Firmware update in progress
Red	Module overload - reduce number of decoded and/or sent messages
Flickering red	Bus off - no receiving or sending possible

Pin assignment MX471C-R

Connection	Pin	Connection	Wire color (1-KAB2109-2)
 Plug end of cable	1	CAN_SHLD (directly connected to housing potential, capacitively coupled to GND)	Yellow
	2	-	Red
	3	CAN-GND (ground/0V/V-)	Black
	4	CAN H (dominant high)	White
	5	CAN L (dominant low)	Blue

Important

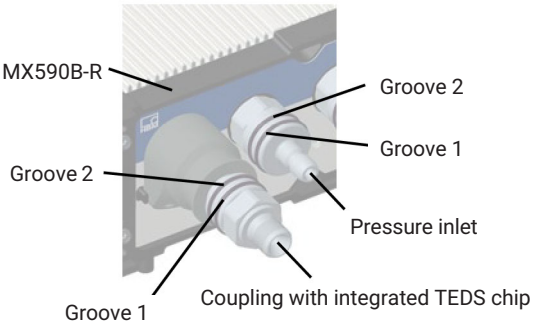
According to EMC requirements, pin 1 can be connected to the shield of the CAN cable. Integrating the MX471C-R module into the potential equalization is strongly recommended.

6.9 MX590B-R pressure sensing module

Up to five (5) pressure inputs for direct acquisition of relative and absolute pressures using TEDS technology for each connection.

Transducer		MX471C-R	Circuit diagram
	Absolute pressure sensor (gas/liquid)	•	104
	Relative pressure sensor (gas/liquid)	•	104

Configurable with up to five (5) single pressure transducers, with pressure measurement: absolute up to 10 bar; relative up to 25 bar. A module can be ordered with 5 different pressure ranges selected from those listed below.



Measuring range	Groove 1, color	Groove 2, color	Order code
0 ... 4 bar absolute	Blue	Blue	A
0 ... 6 bar absolute	Green	Green	B
0 ... 10 bar absolute	Yellow	Yellow	C

Measuring range	Groove 1, color	Groove 2, color	Order code
-0.5 ... +0.5 bar relative	Red	Black	D
0 ... +1.6 bar relative	Black	Black	E
-1 ... +2.5 bar relative	Blue	Brown	K
-1 ... +4 bar relative	Red	Blue	F
-1 ... +10 bar relative	Blue	Yellow	G
-1 ... +16 bar relative	Orange	Orange	H
0 ... +25 bar relative	Brown	Brown	I
Empty (blind panel)	-	-	0

Status LEDs

System LED	Description
Green	Error-free operation
Orange	System not ready; booting, not synchronized
Flashing orange	System not ready; downloading
Red	Serious hardware fault. The module must be sent to HBK for recovery.

Notice

If the maximum pressure of the coupling (value stored in the TEDS chip) is higher than the maximum pressure of the transducer (value permanently stored in the module), the channel LED flashes red. In this case, there is a risk that the pressure transmitter will be permanently destroyed.

Channel LEDs	Description
Flashing red	Serious hardware fault. The module must be sent to HBK for recovery.
Flashing red	Pressure transmitter defective. The module must be sent to HBK for recovery.
Red	Limit exceeded. When TEDS needed: No TEDS yet found.
Orange	Channel is being prepared.
Flashing green, 5 s	TEDS data being read.
Flashing orange, 5 s	TEDS detected, but the data is not being used (Ignore TEDS selected).

Channel LEDs	Description
Green	When TEDS being used: Maximum pressure outside TEDS data matches maximum pressure of transmitter.
Flashing continuously green	When TEDS being used: Maximum pressure outside TEDS data lower than maximum pressure of transmitter.
Flashing continuously red	When TEDS being used: Maximum pressure outside TEDS data higher than maximum pressure of transmitter. **DANGER - risk of pressure transmitter being permanently destroyed.**

Inputs

Each pressure transmitter is equipped with a self-sealing inlet, made of stainless steel or aluminum depending on the nominal pressure range. Matching couplings:
Walther precision, type LP-004. HBK couplings 1CONS3006T (aluminum, FKM seal) and 1CONS3007T (stainless steel, FFKM seal) are equipped with an RFID chip for the TEDS data set. After attaching a coupling, the content of the TEDS chip is read (RFID technology).

Pressure couplings (available separately)

Ordering number	Description	Material	Pressure seal	Nominal pressure range	Connection	TEDS
1-CON-S3006T	Pressure coupling	Aluminum	FKM	< 10 bar	M12 x 1.5 (external thread)	From RFID
1-CON-S3007T	Pressure coupling	Stainless steel	FFKM	≥ 10 bar	M12 x 1.5 (external thread)	From RFID

TEDS programming

The couplings are shipped with a blank TEDS chip, and must be programmed by the user. To program the TEDS chip, make sure that you have installed the TEDS Editor (see QuantumX system CD, setups\obsolete\TEDS_Setup.exe).

1. Run the MX Assistant.
2. Search for the MX590B-R, and connect to the module.
3. Make sure that you have selected "Use TEDS if available" in the Channel tab for the channel on which you want to program the TEDS chip.
4. Connect the coupling to the relevant channel. The channel LED flashes.

5. Select "Open TEDS in HBM TEDS Editor" from the TEDS context menu.
6. Once the TEDS chip content is available for the TEDS Editor, set "Maximum pressure", "Pressure type" and "Channel name" to the desired values.
7. Click "Save and activate TEDS", and close the TEDS Editor.

7 TRANSDUCER CONNECTION

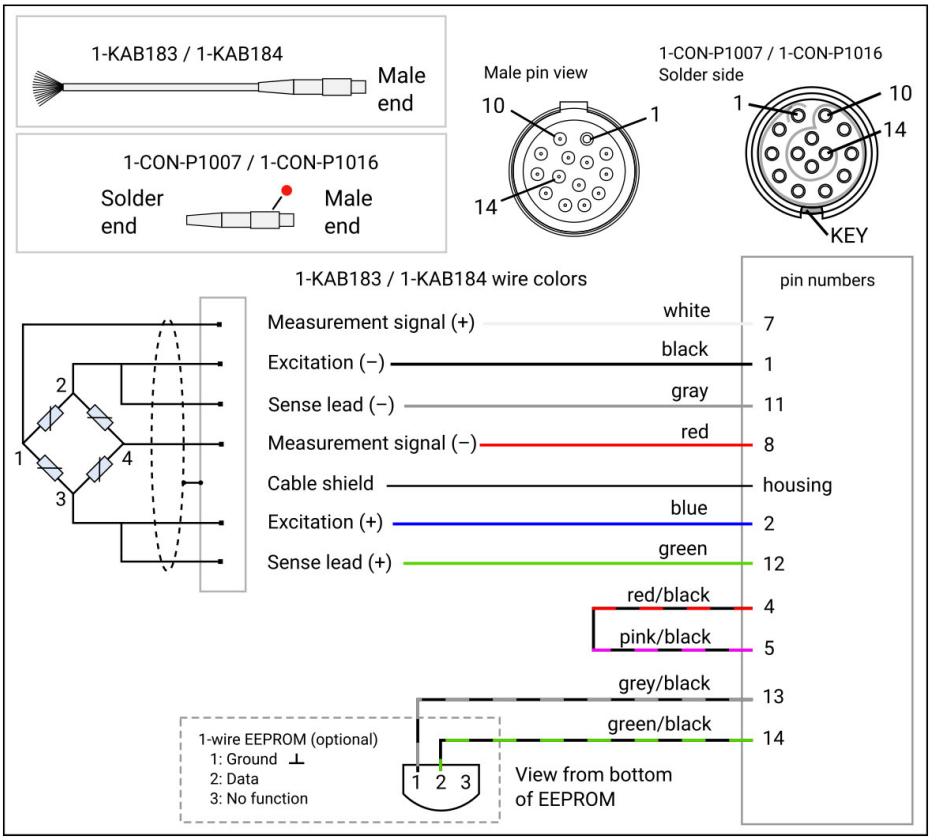
7.1 Strain gage transducers

Transducer		MX840B-R	M1615B	MX411B-R
	Strain gage full bridge, 6-wire configuration	•	•	•
	Strain gage half bridge, 5-wire configuration	•	•	•
	Strain gage quarter bridge, 3- or 4-wire configuration	•[1)] 3-wire only	•	•[1)] 3-wire only

1) Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2.

Strain gage full bridge, 6-wire configuration

Full-bridge strain gage, six-wire configuration

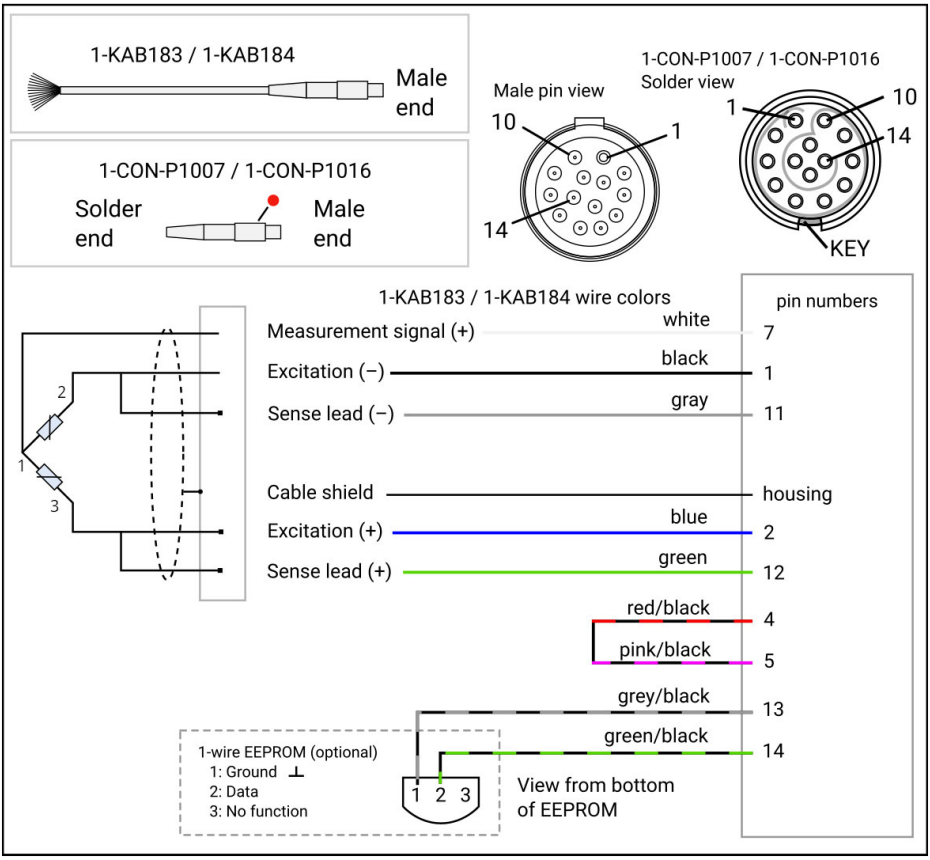


Tip

For full bridges in a four-wire configuration, a connection must be made in the connector between the sense leads and the respective excitation voltage leads.

Strain gage half bridge, 5-wire configuration

Half-bridge strain gage, five-wire configuration

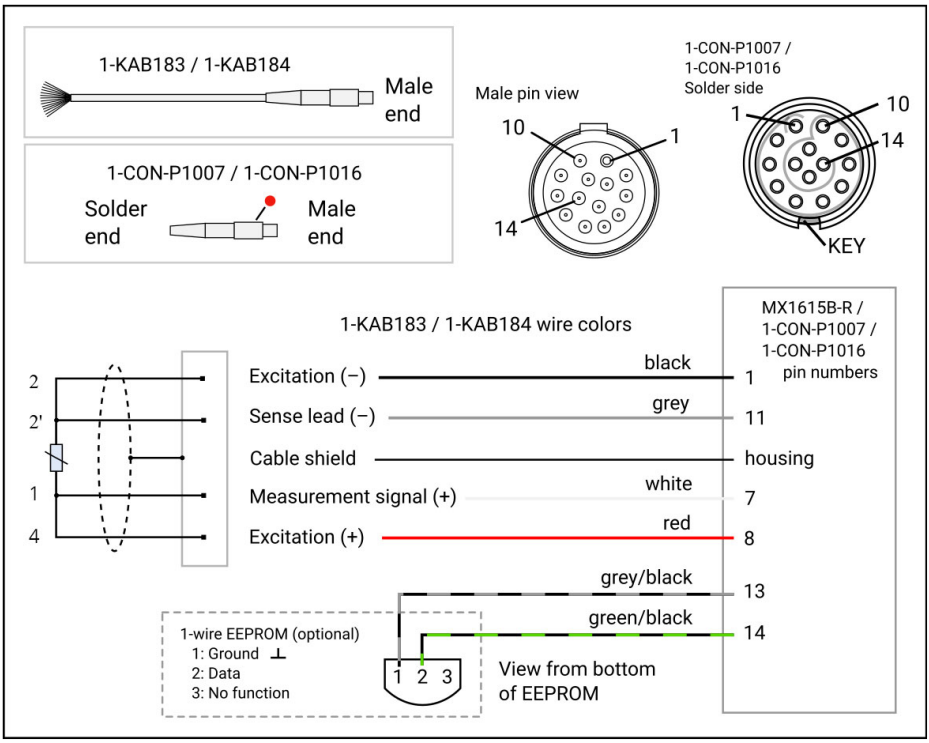


Tip

For half bridges in a three-wire configuration, a connection must be made in the connector between the sense leads and the respective excitation voltage leads.

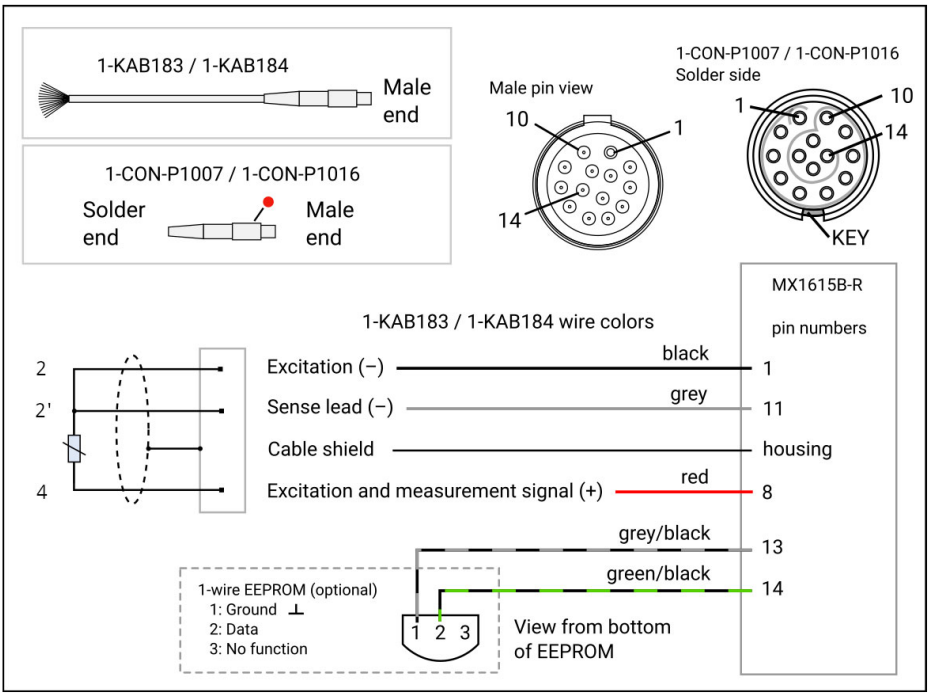
Strain gage quarter bridge, 4-wire configuration

Quarter-bridge strain gage, four-wire configuration



Strain gage quarter bridge, 3-wire configuration with sense lead

Quarter-bridge strain gage, three-wire configuration

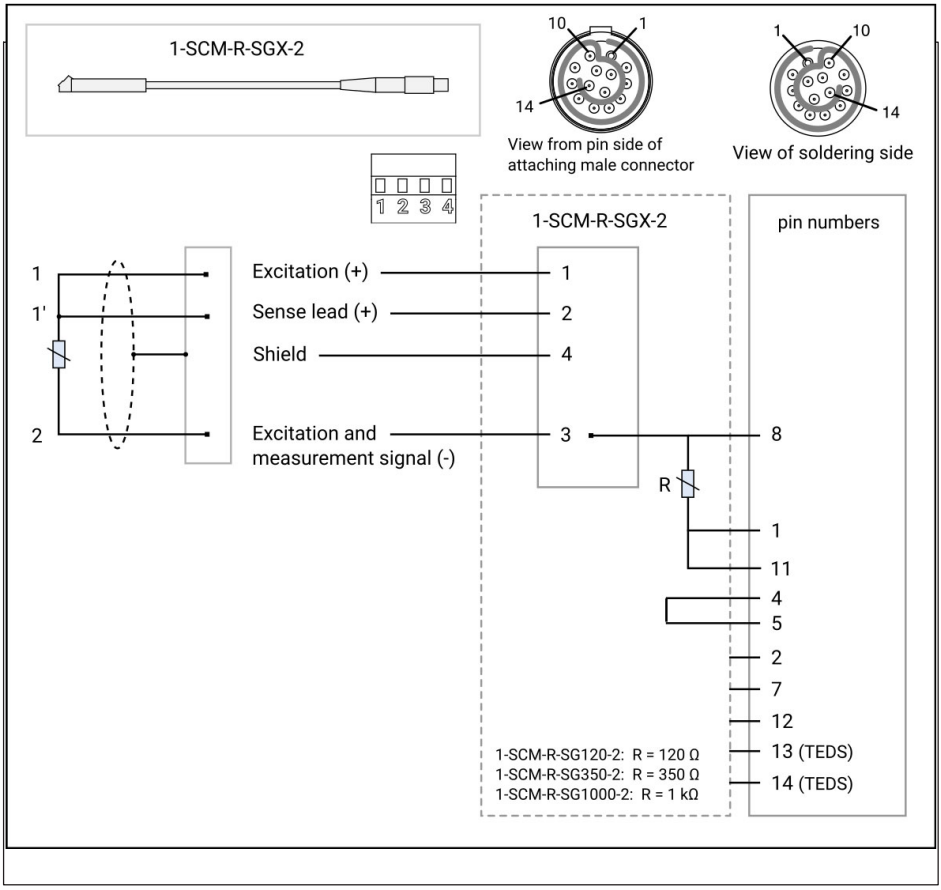


Information

This circuit configuration can be used with the CX23-R data recorder, catman®AP, or the MX Assistant. In the CX23-R, it supports upscaling by means of a shunt.

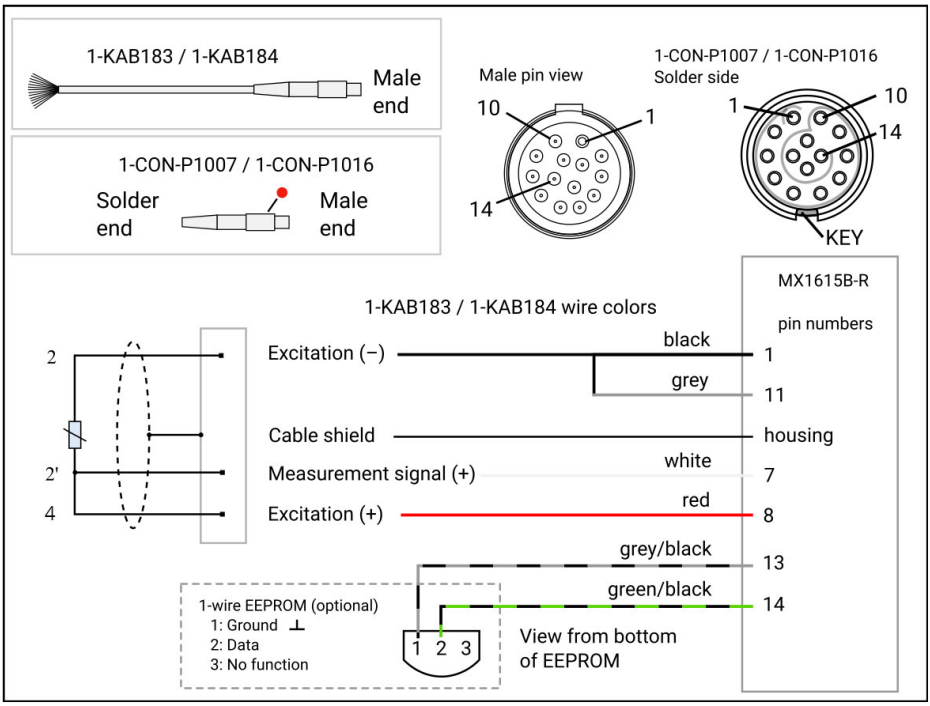
Strain gage quarter bridge, 3-wire configuration with supplementary adapter

Quarter-bridge strain gage, three-wire configuration, with completion adapter



Strain gage quarter bridge, 3-wire configuration without sense lead

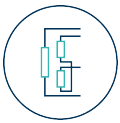
Quarter-bridge strain gage, three-wire configuration (no sense lines)



Information

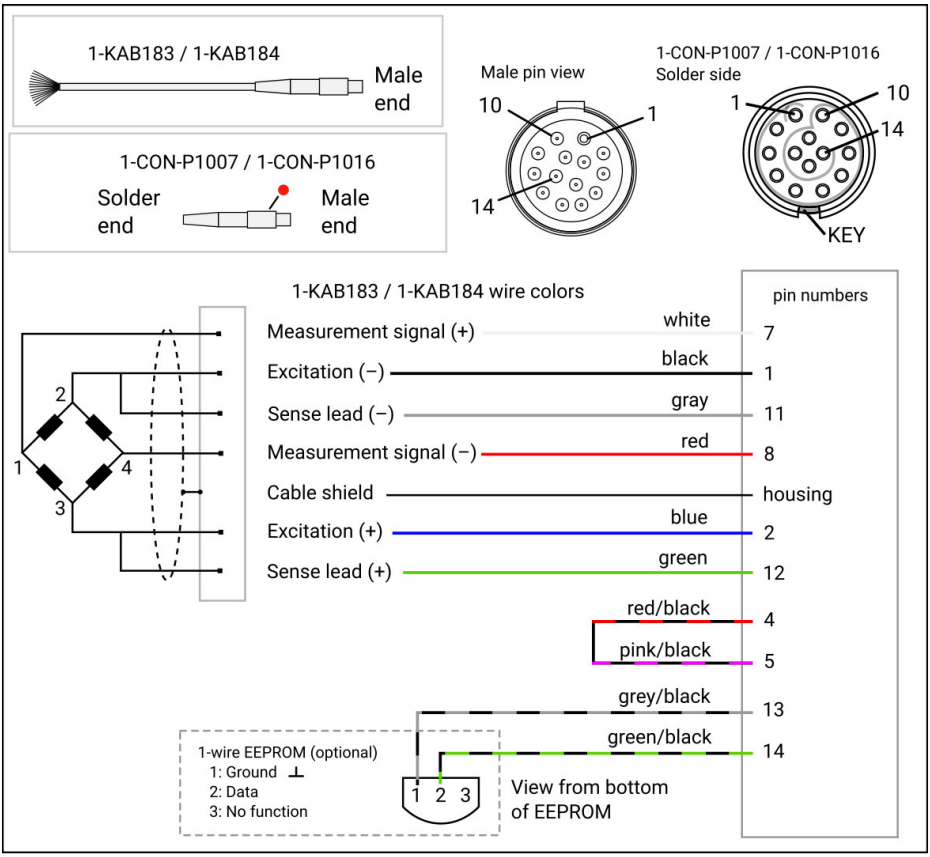
This circuit configuration can only be used with the CX23-R data recorder. It supports downscaling by means of a shunt.

7.2 Inductive transducers

Transducer		MX840B-R	MX411B-R	Circuit diagram
	Inductive full bridge	•	•	73
	Inductive half bridge	•	•	73
	LVDT (linear variable differential transformer)	•		73

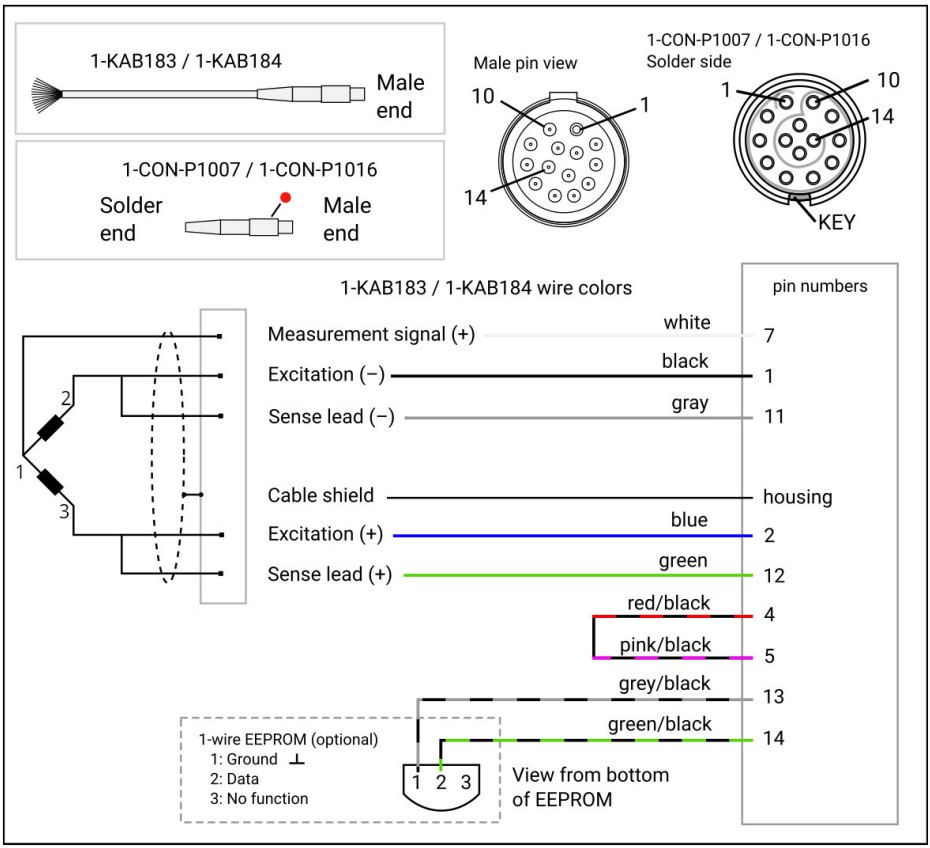
Inductive full bridge, 6-wire configuration

Inductive full-bridge, six-wire configuration

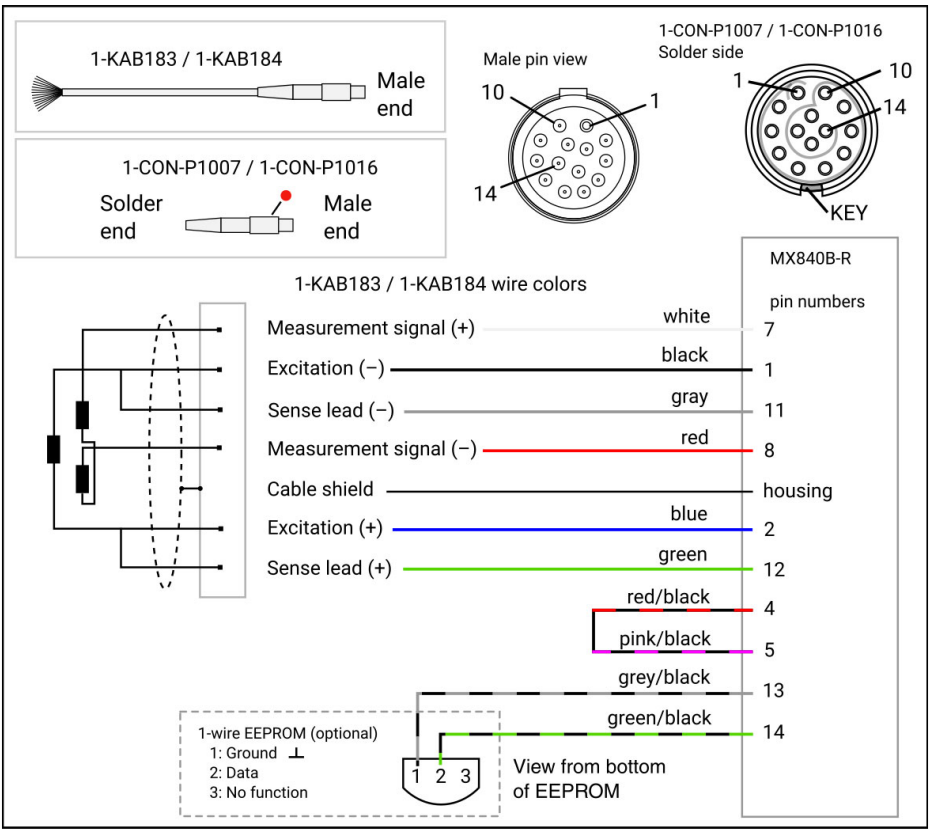


Inductive half bridge, 5-wire configuration

Inductive half-bridge, five-wire configuration



Linear variable differential transformer (LVDT)

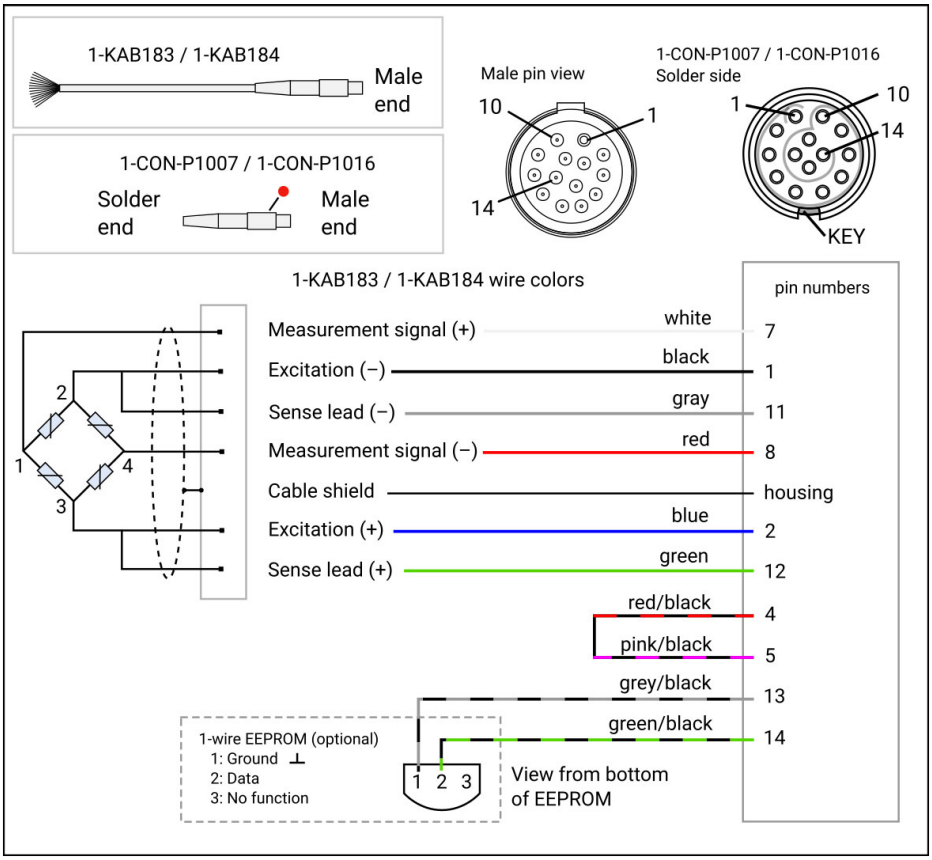


7.3 Piezoresistive transducers

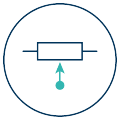
Transducer		MX840B-R	MX411B-R	Circuit diagram
	Piezoresistive transducer	•	•	76

Piezoresistive full bridge, 6-wire configuration

Piezoresistive full bridge, six-wire configuration

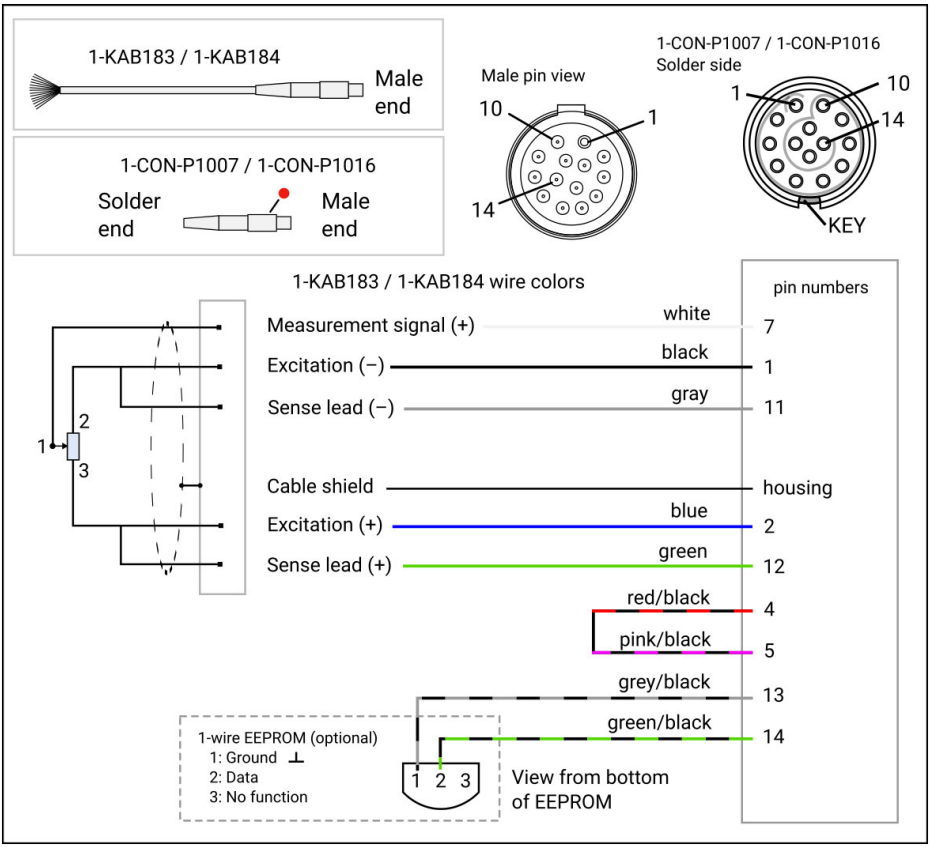


7.4 Potentiometric transducers

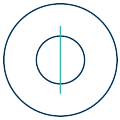
Transducer		MX840B-R	MX1615B-R	Circuit diagram
	Potentiometer	•	•	77

Potentiometric transducer

Potentiometric transducer

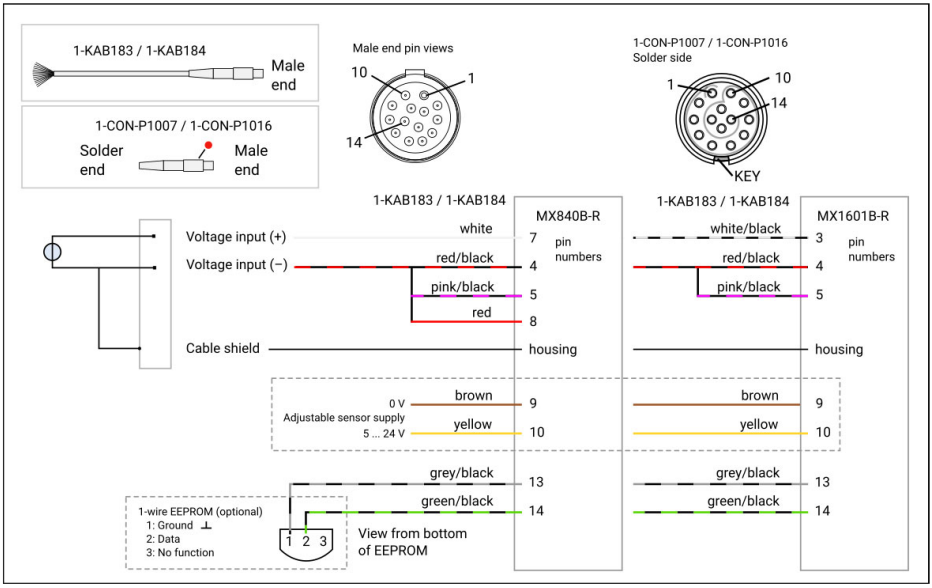


7.5 Voltage sources

Transducer		MX840B-R	MX1615B	MX411B-R	Circuit diagram
	Voltage	•	•	•	78

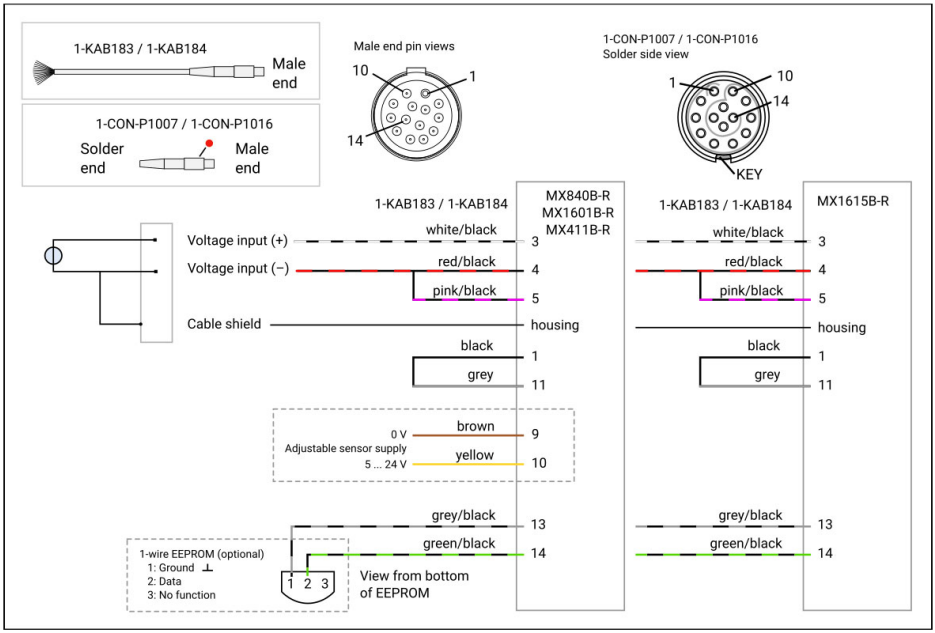
100 mV DC voltage source

Voltage, 100 mV



10 or 60 V DC voltage source

Voltage, 10 or 60 V



Notice

Maximum input voltage against housing and supply ground: ±60 V

Important

To ensure compatibility with the MX1615B-R module, pins 1 and 11 must be bridged.
To ensure compatibility with all other MX modules, pins 4 and 5 must be bridged.

Information

The MX1615B-R module does not provide an adjustable transducer excitation voltage.

7.6 Current-fed piezoelectric transducers (IEPE, ICP®)

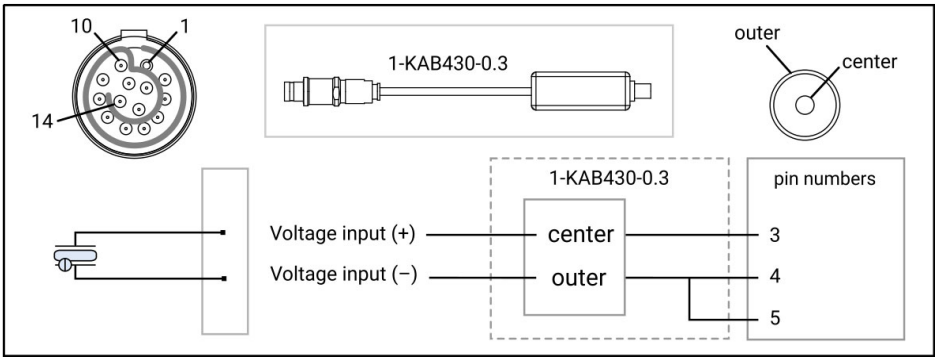
Current-fed piezoelectric transducers are supplied with a constant current, and deliver a voltage signal to the measuring amplifier. Transducers of this type are also called IEPE or ICP® transducers. IEPE is short for "Integrated Electronics Piezo Electric". ICP® is a registered trademark of PCB Piezotronics.

Transducer		MX840B-R	MX1601B-R	MX411B-R	Circuit diagram
	Current-fed piezoelectric transducer (IEPE, ICP®)	•[1)]	•[1)]	•[1)]	80

[1)] ODU 14-pin to BNC 1-KAB430-0.3 adapter can optionally be used.

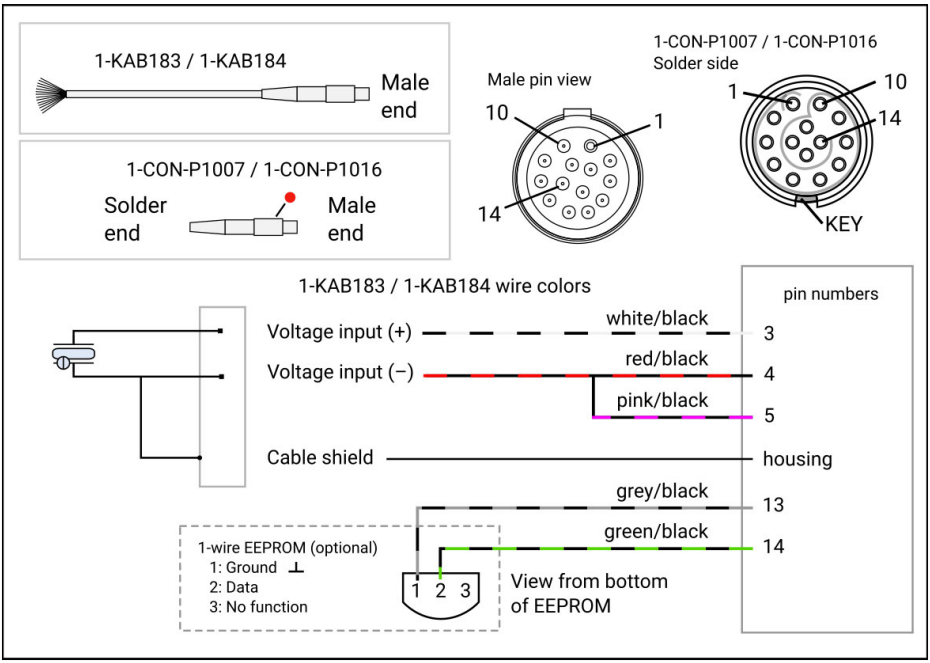
Current-fed piezoelectric transducer (IEPE) with adapter

Current-fed piezoelectric transducer (IEPE) with adapter



Current-fed piezoelectric transducer (IEPE)

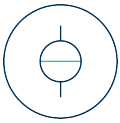
Current-fed piezoelectric transducer (IEPE)



Information

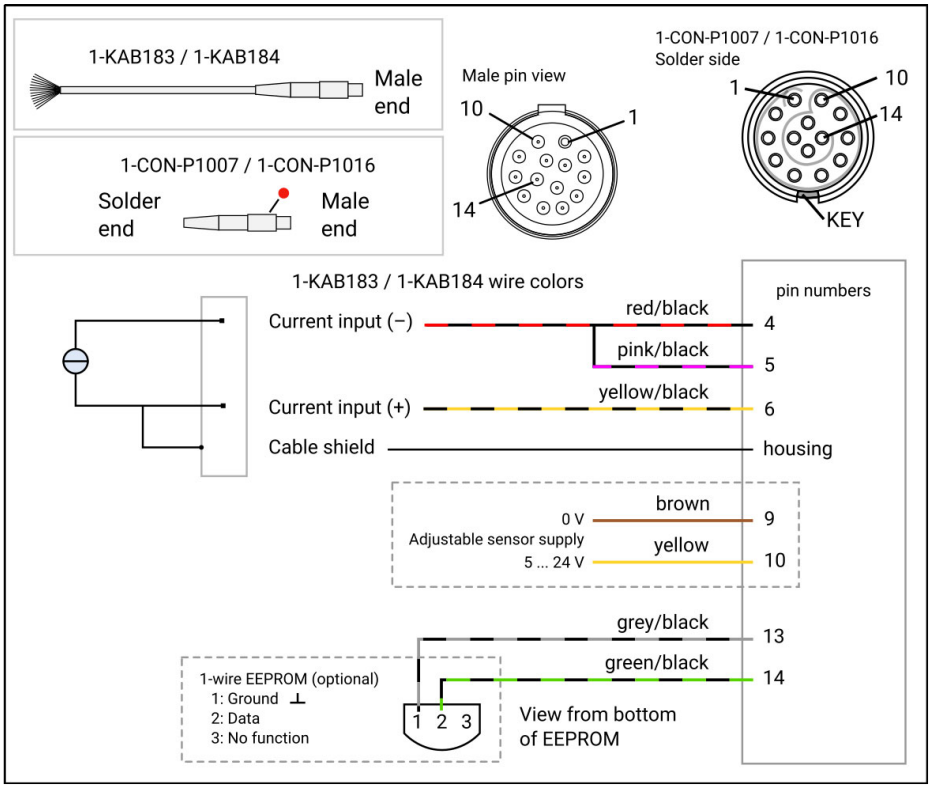
IEPE transducers with TEDS version 1.0 are supported.

7.7 Current sources

Transducer		MX840B-R	MX1601B-R	MX411B-R	Circuit diagram
	Current, 20 mA	•	•	•	82

20 mA DC current source

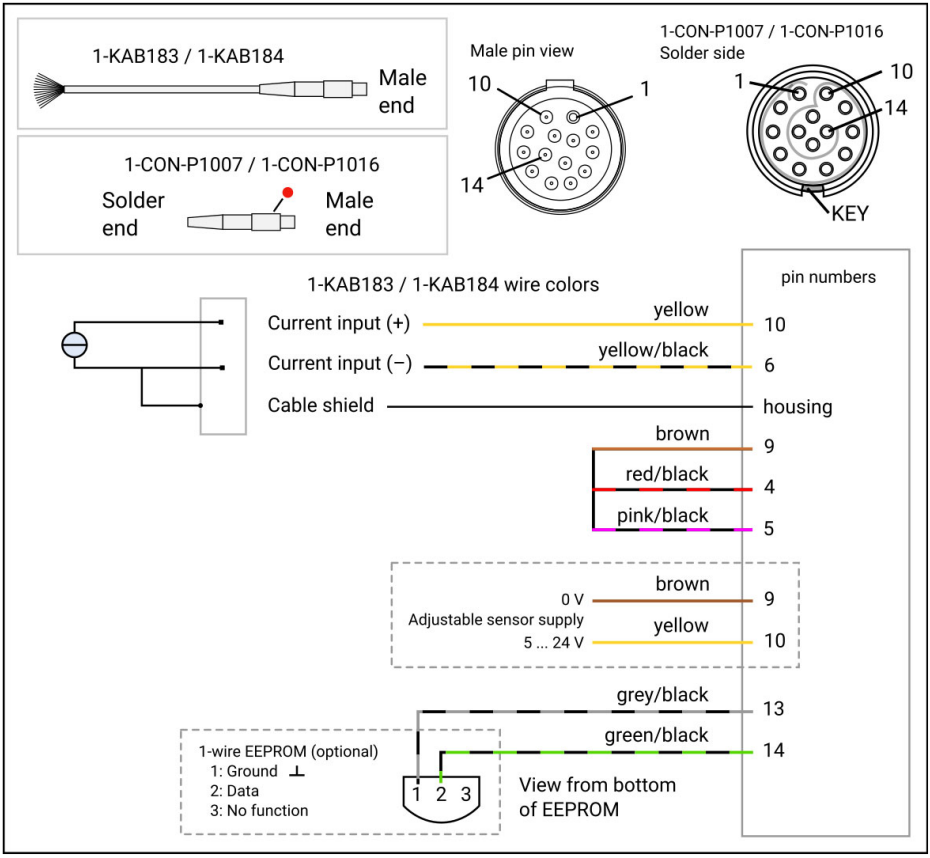
Current, 20 mA



Notice

Maximum current: ±30 mA.

Voltage-fed 20 mA DC current source



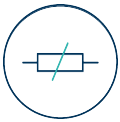
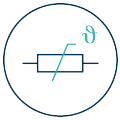
Notice

Maximum current: ±30 mA.

Information

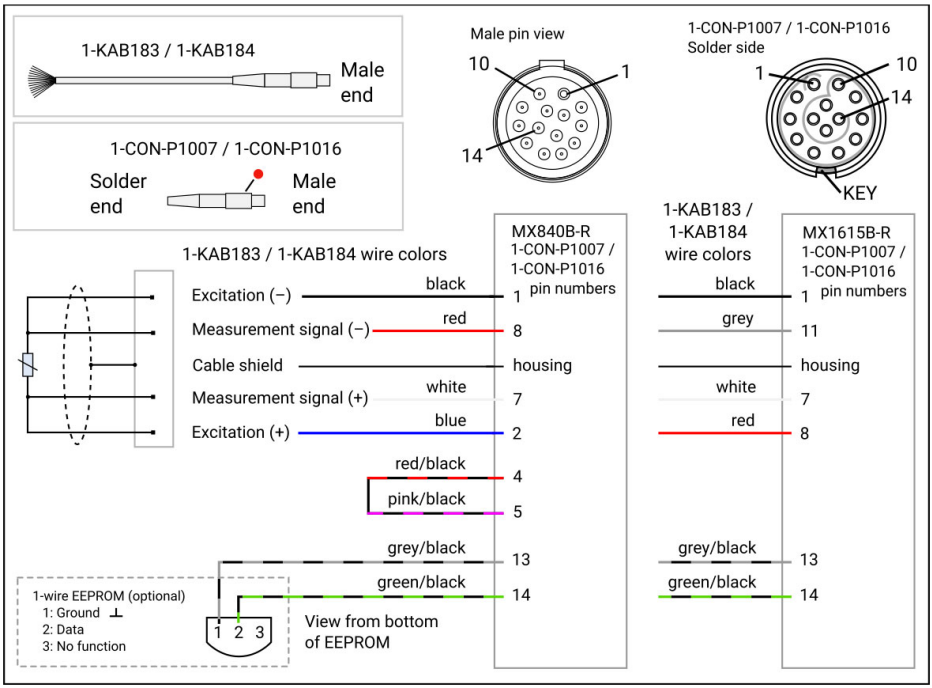
The transducer excitation voltage must be connected in series. However, this eliminates the galvanic isolation from the module supply.

7.8 Resistance-based measurements

Transducer		MX840B-R	MX1615B-R	Circuit diagram
	Resistance or resistance-based measurements	•	•	84
	Resistance thermometer PT100 or PT1000	•	• PT100 only	84

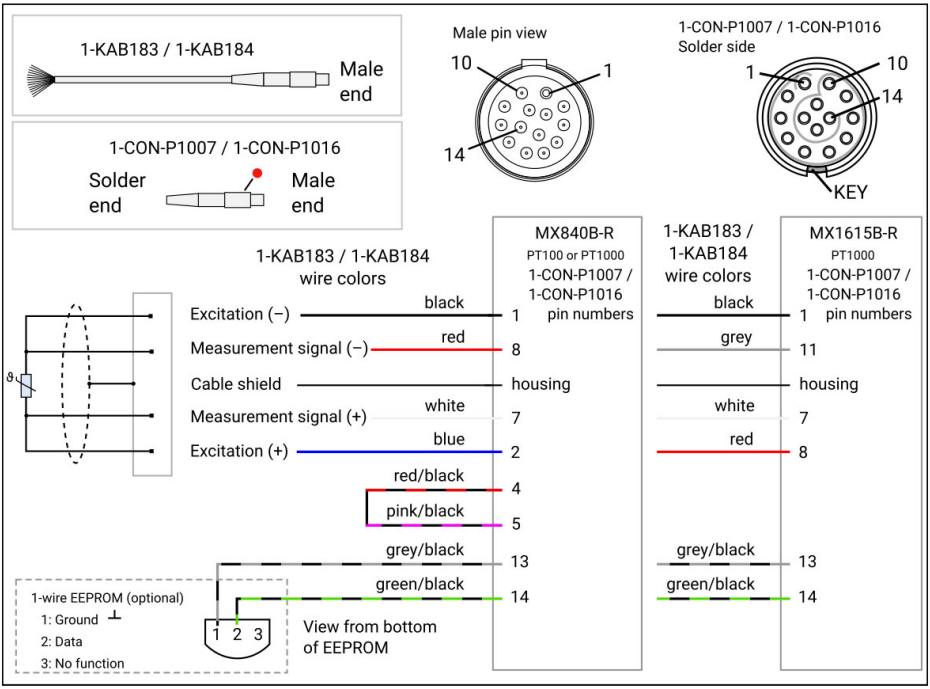
Resistance

Resistance, four-wire circuit

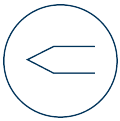


Resistance thermometers (RTD)

Resistance thermometer



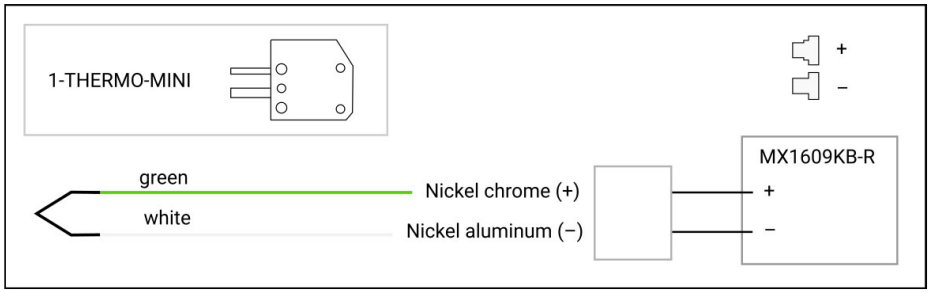
7.9 Thermocouples

Transducer		MX840B-R	M1609KB-R	MX1609TB-R
	Thermocouple	•[1)]	• Type K only	•

1) Adapters 1-SCM-R-TCK-2 for type K, 1-SCM-R-TCE-2 for type E, 1-SCM-R-TCT-2 for type T and 1-SCM-R-TCJ-2 for type J.

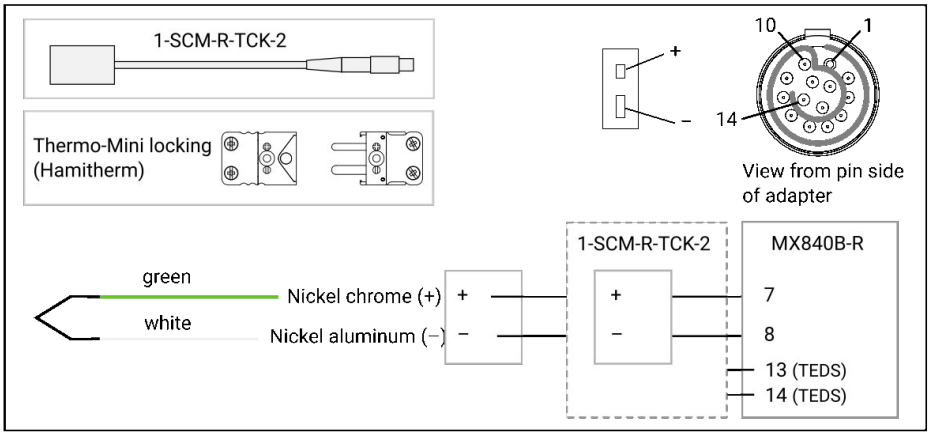
Thermocouple, type K

Thermocouple, K-type



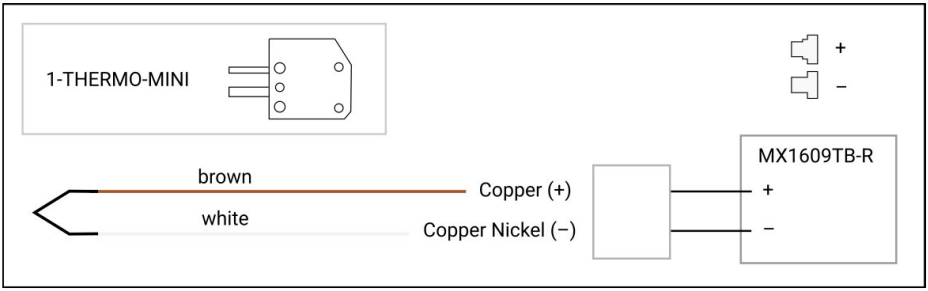
Thermocouple, type K with adapter

Thermocouple, K-type, with adapter



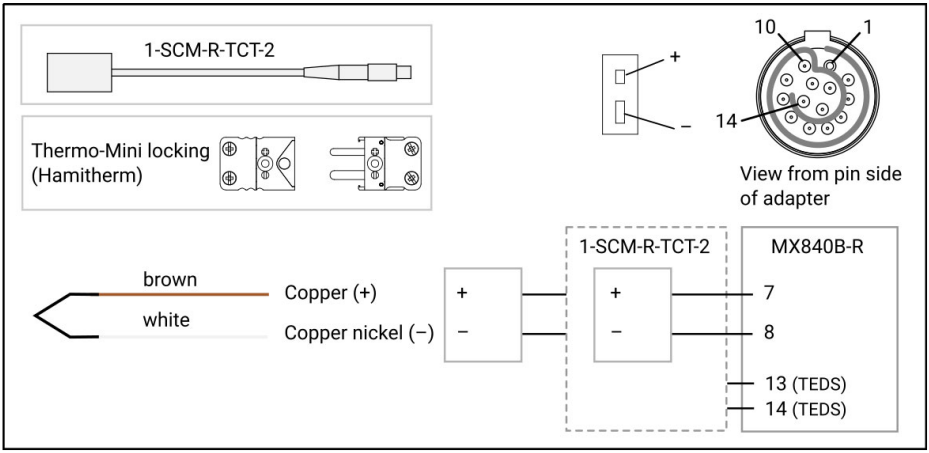
Thermocouple, type T

Thermocouple, T-type



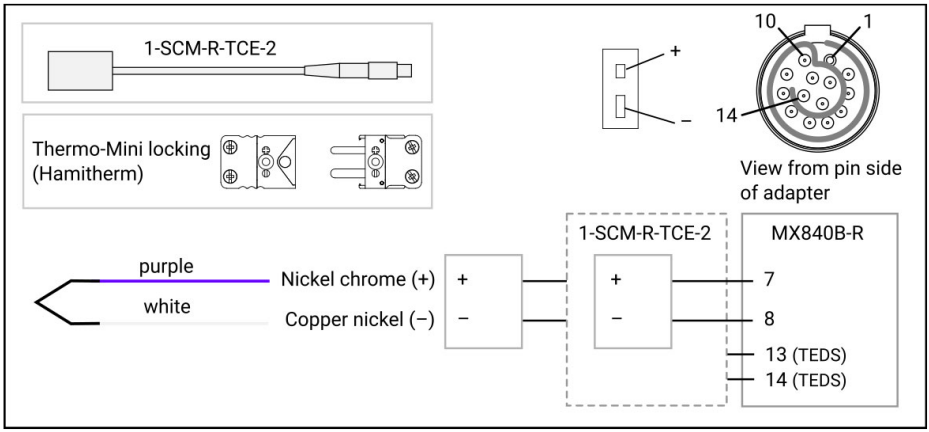
Thermocouple, type T with adapter

Thermocouple, T-type, with adapter



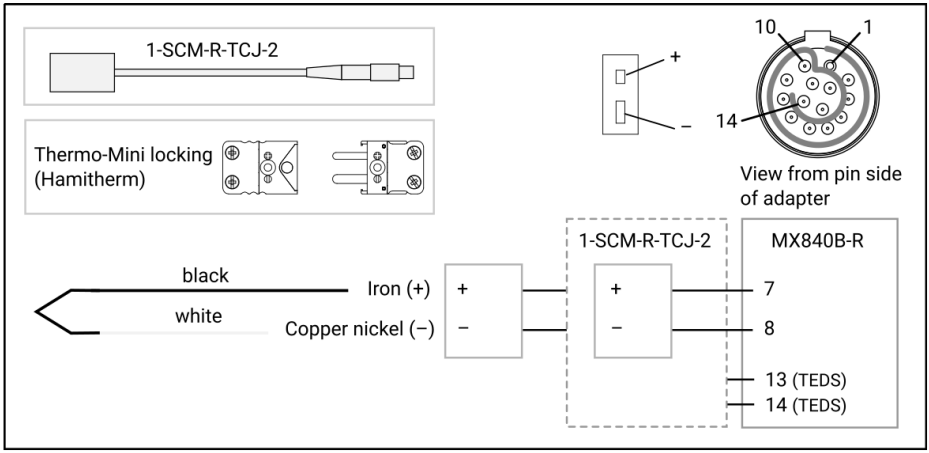
Thermocouple, type E with adapter

Thermocouple, E-type, with adapter

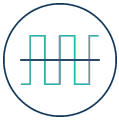


Thermocouple, type J with adapter

Thermocouple, J-type, with adapter

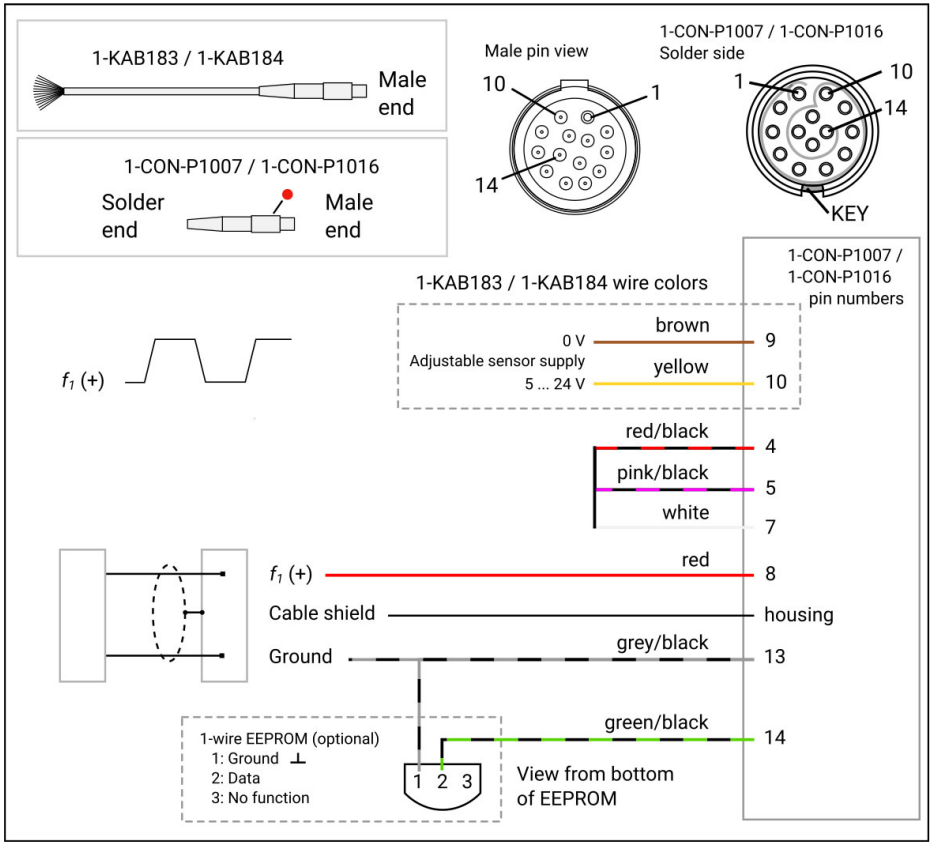


7.10 Digital inputs

Transducer		MX840B-R	MX460B-R
	Frequency/pulse counter (timer, TTL)	• Channels 5-8	•
	Incremental encoder (timer, TTL)	• Channels 5-8	88
	Torque/rotational speed	• Channels 5-8	•
	SSI protocol	• Channels 5-8	

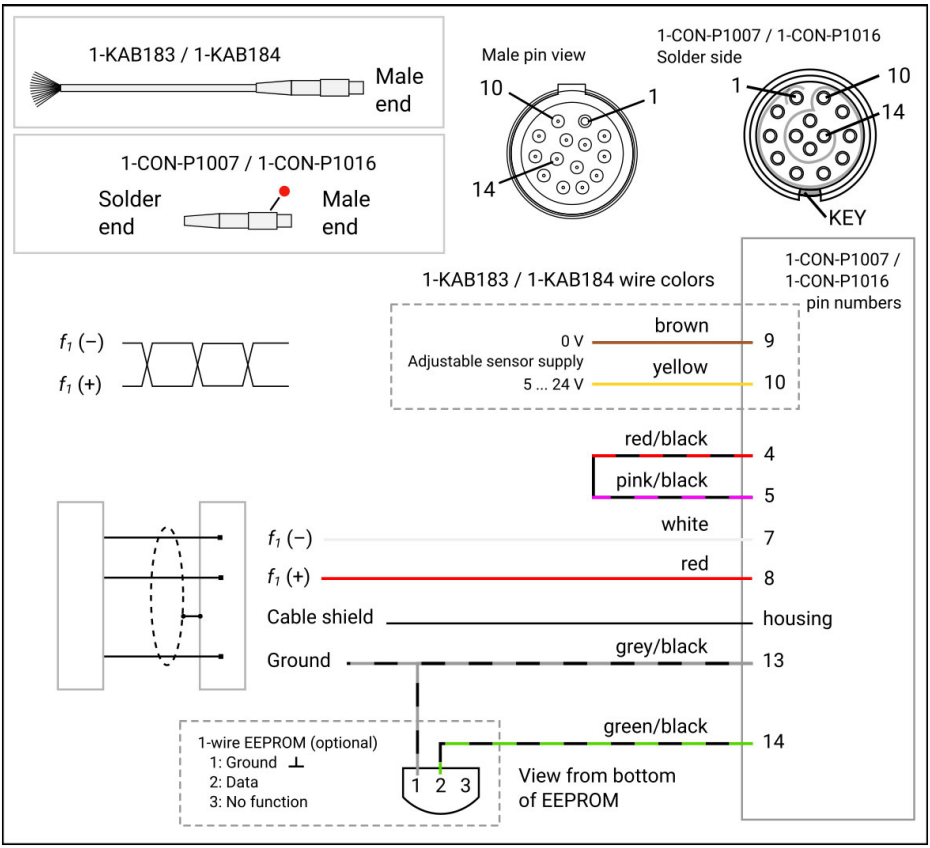
Frequency/pulse counter

Frequency, single-ended

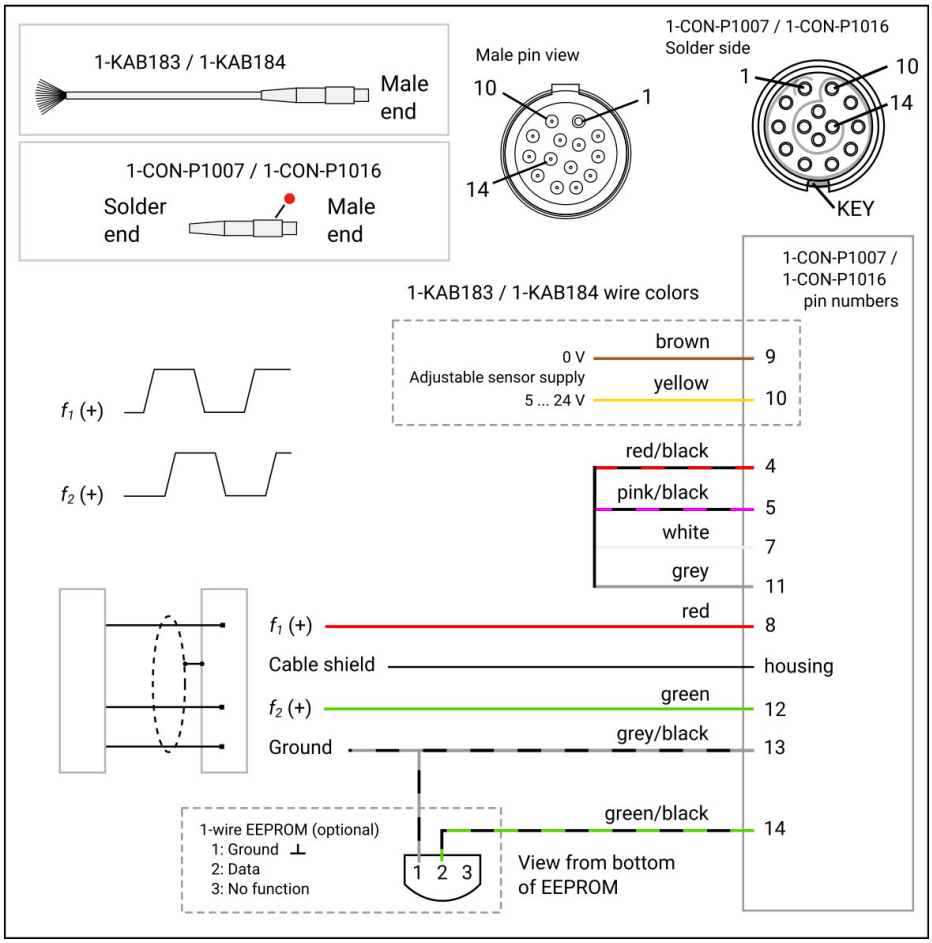


Frequency, differential

Frequency, differential

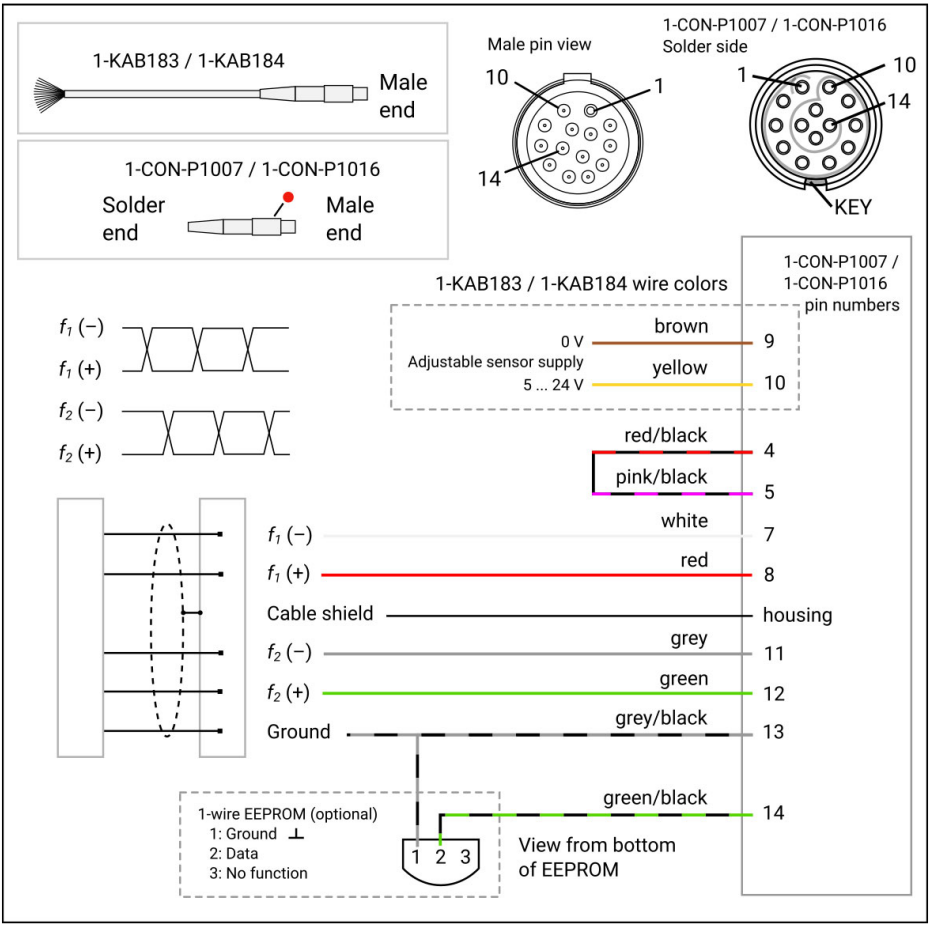


Frequency, single-ended, directional



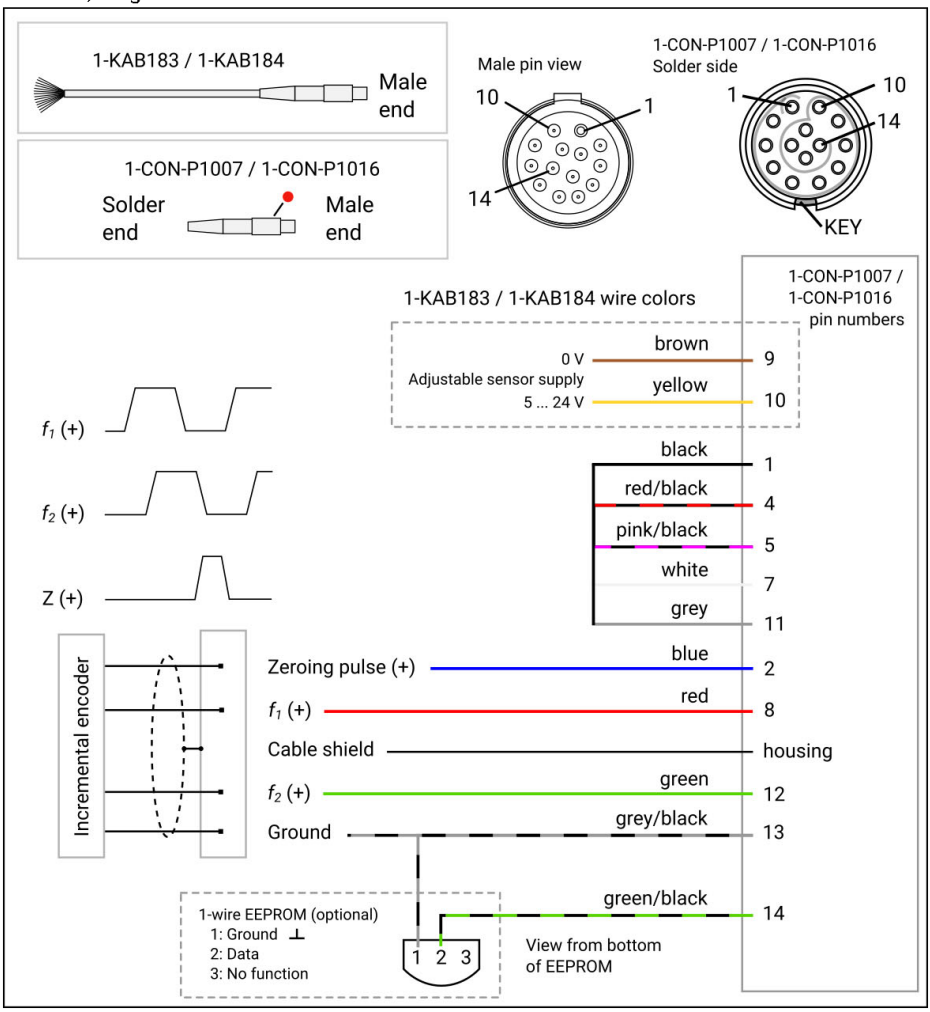
Frequency, differential, directional

Frequency, differential, directional



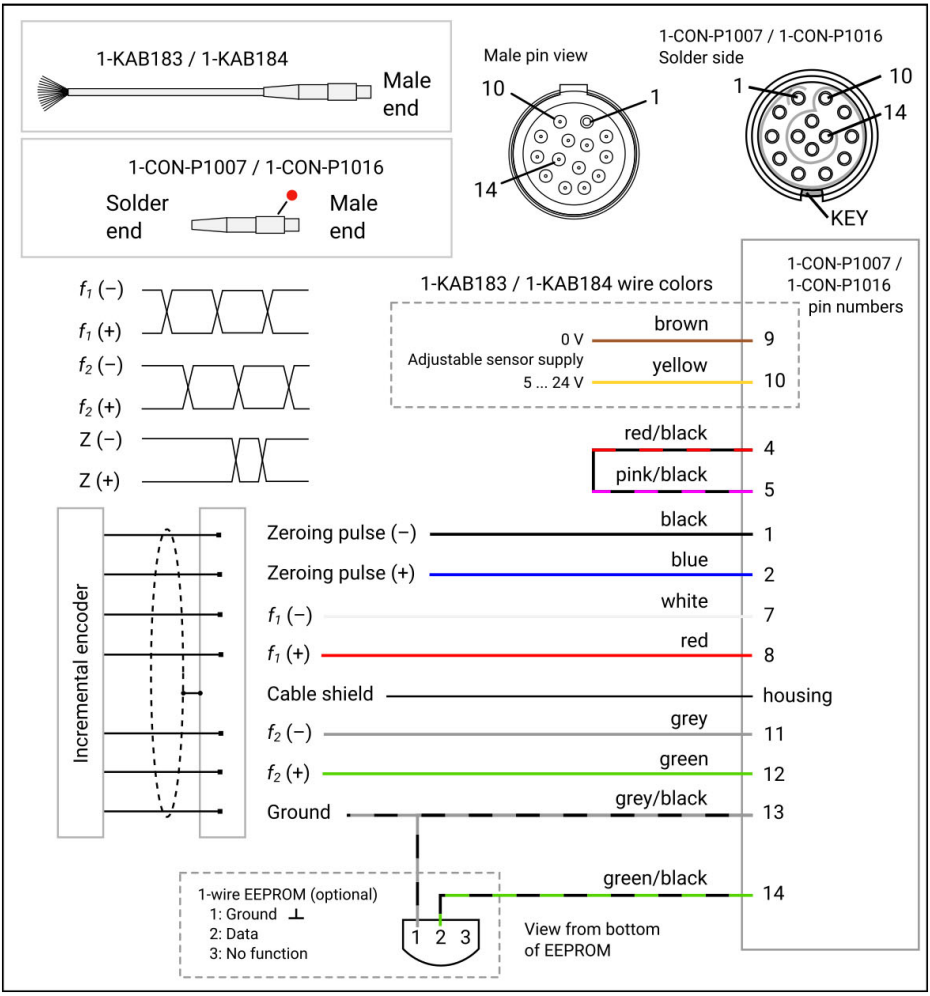
Incremental encoder

Encoder, single-ended



Encoder, differential

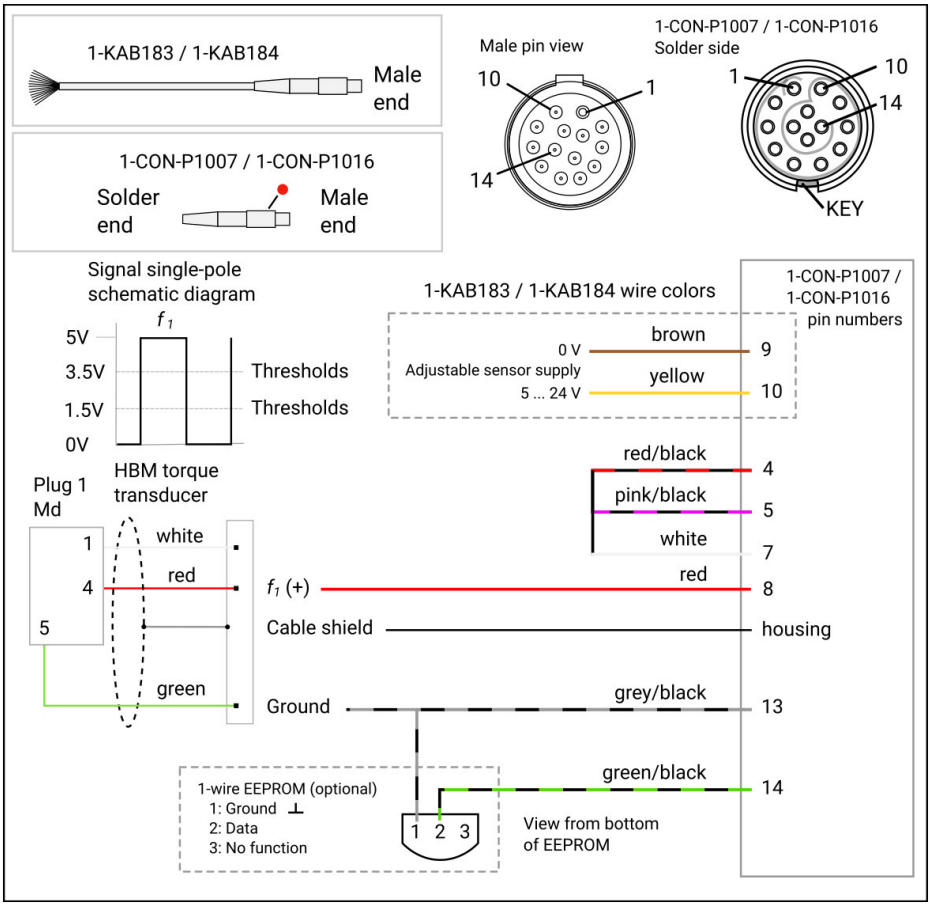
Encoder, differential



Torque/rotational speed (HBM torque transducer)

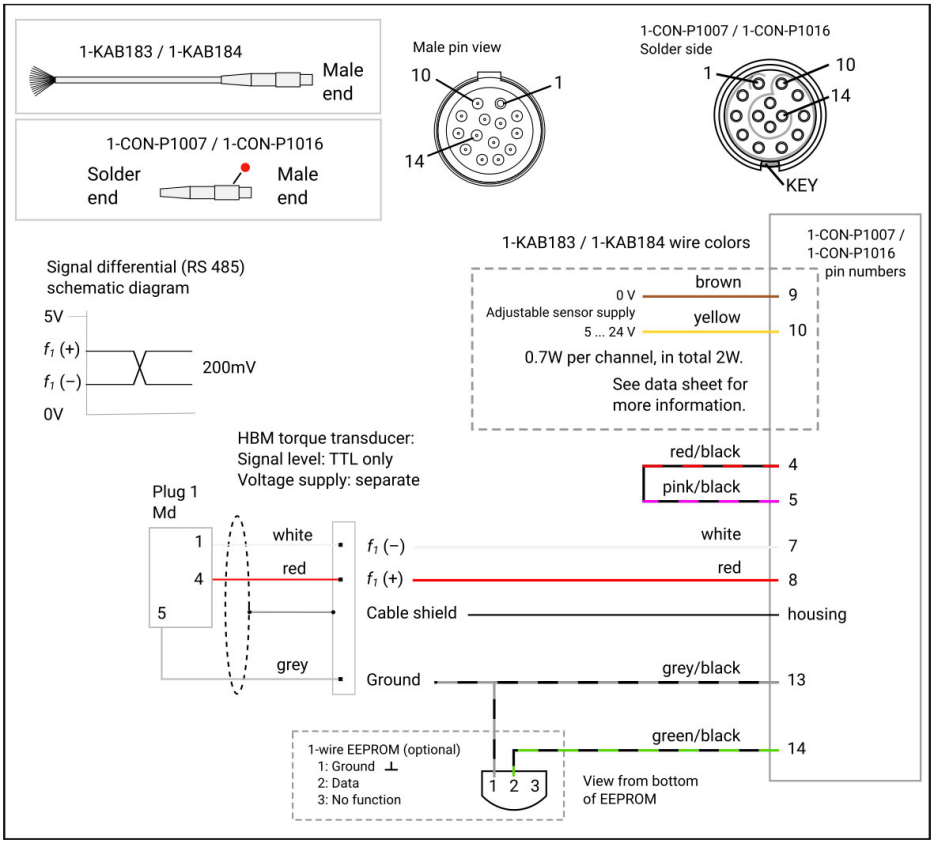
Frequency, single-pole, without direction signal

Frequency, single-ended



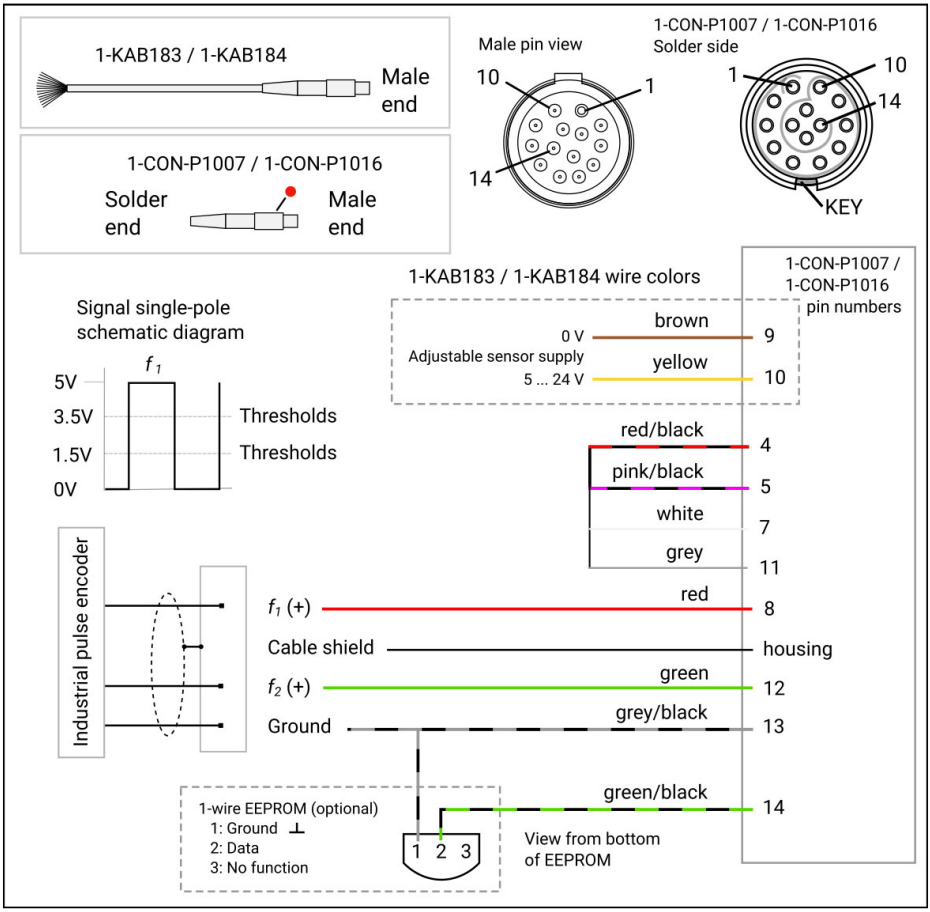
Frequency, differential, without direction signal

Frequency, differential



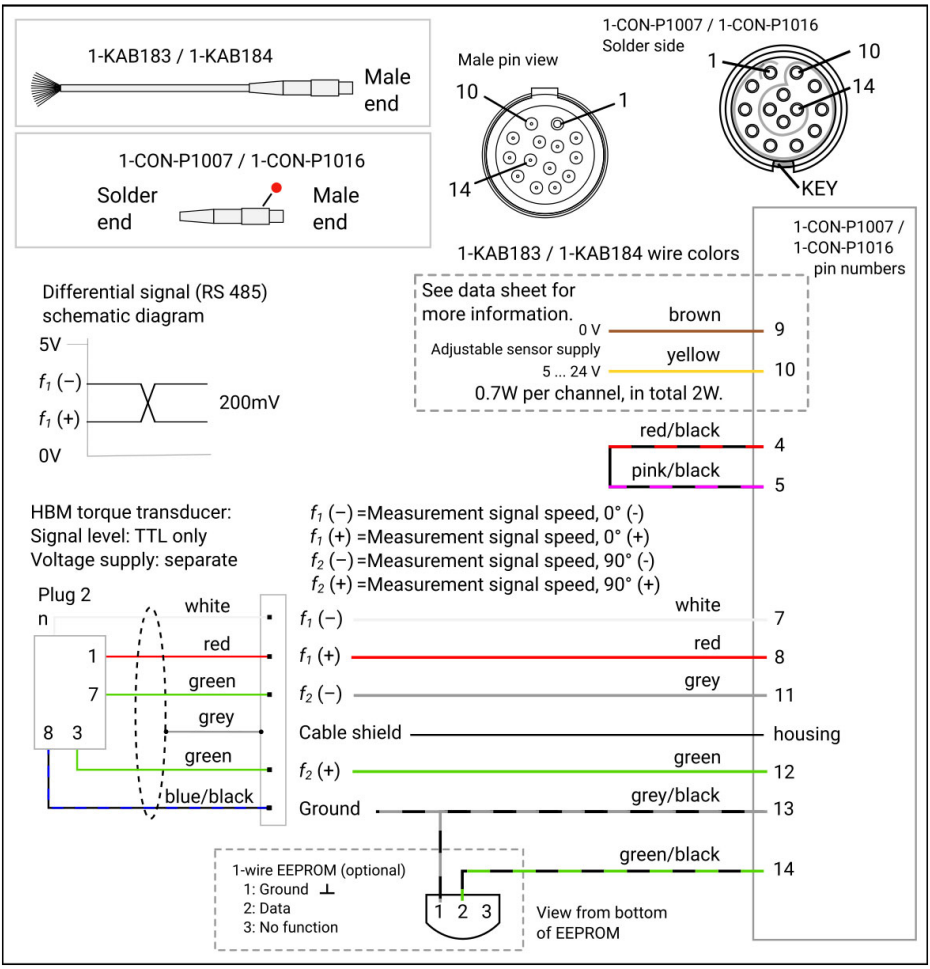
Frequency, single-pole, with direction signal

Frequency, single-ended, directional



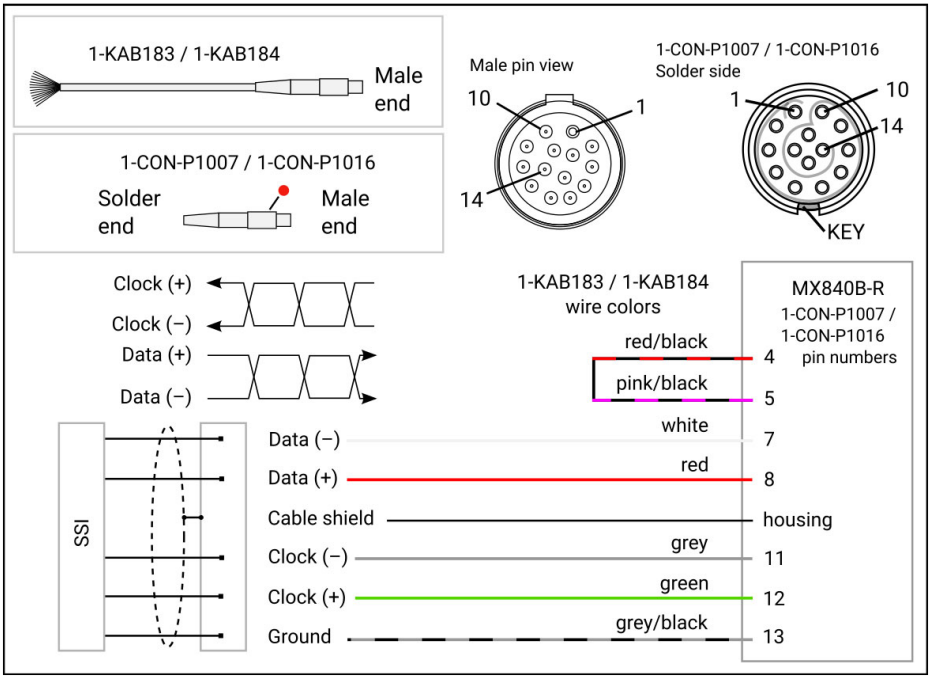
Frequency, differential, with directional signal

Frequency, differential, directional



Absolute value encoder (SSI protocol)

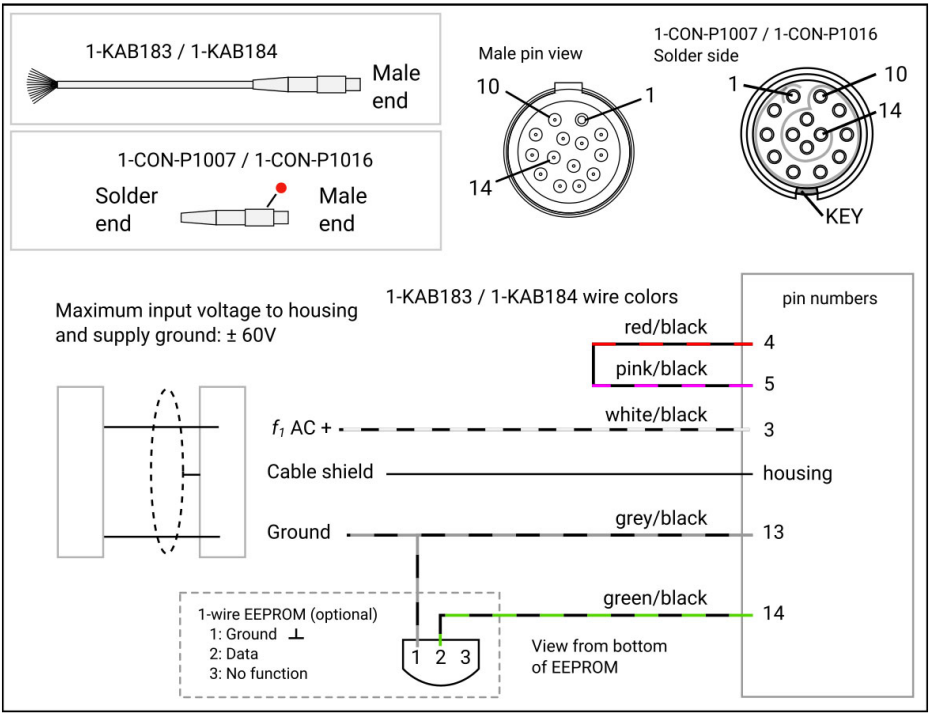
SSI Protocol



7.11 Passive inductive encoder

Transducer		MX460B-R
	Passive inductive encoder	•

Passive inductive encoder

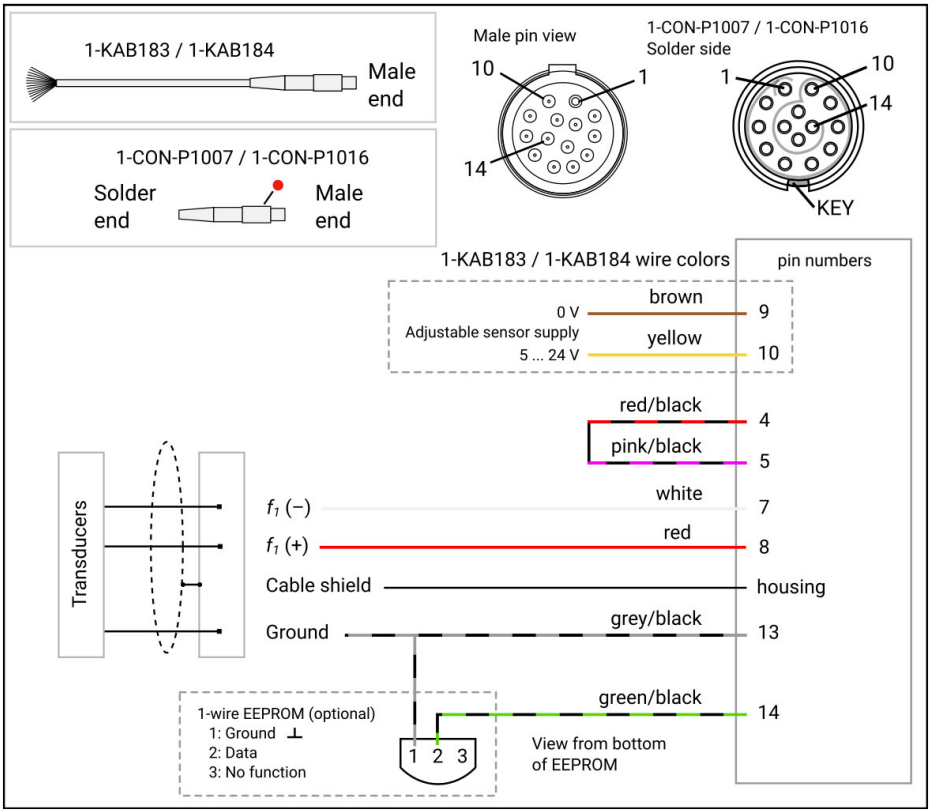


7.12 Pulse width modulation (PWM)

Transducer		MX460B-R
	Pulse width modulation	•

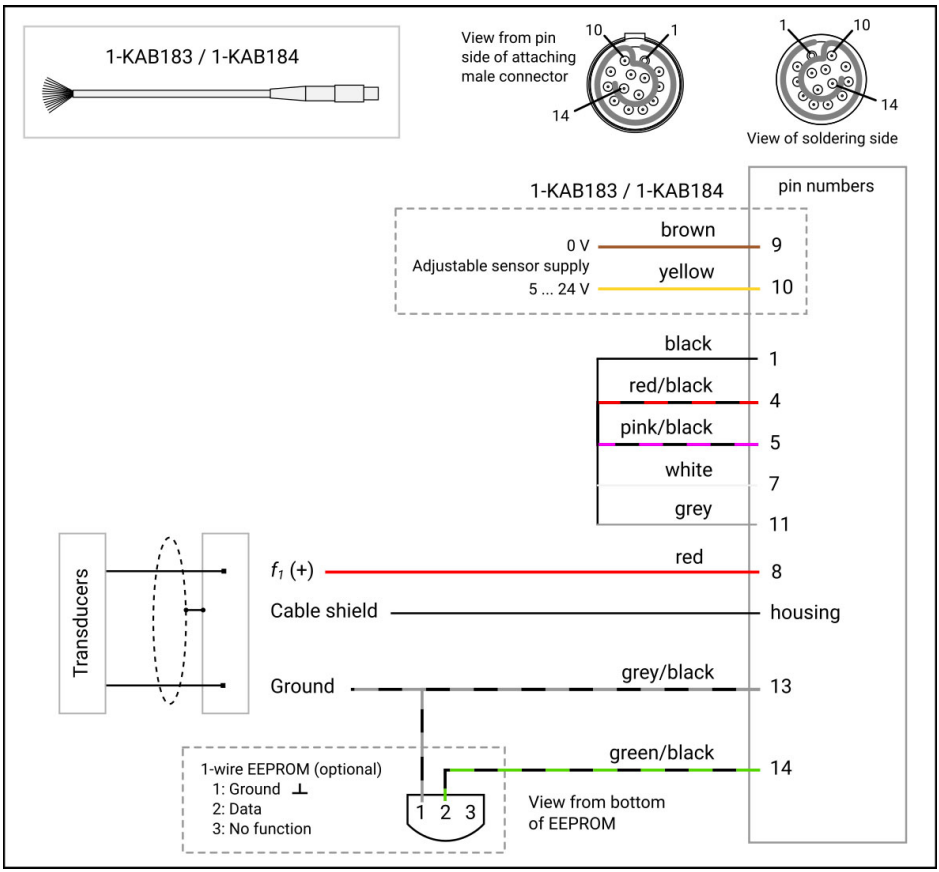
Transducer
Pulse width modulation - pulse width, pulse duration, period duration, differential

PWM - Pulse width, pulse duration, period duration, differential



Transducer
Pulse width modulation - pulse width, pulse duration, period duration, single-ended

PWM - Pulse width, pulse duration, period duration, single-ended



7.13 CAN bus

Transducer		MX840B-R	MX471B-R	MX471C-R
CAN	CAN bus	•	•[1)]	•[1)]
CAN FD	CAN-FD bus			•[1)]

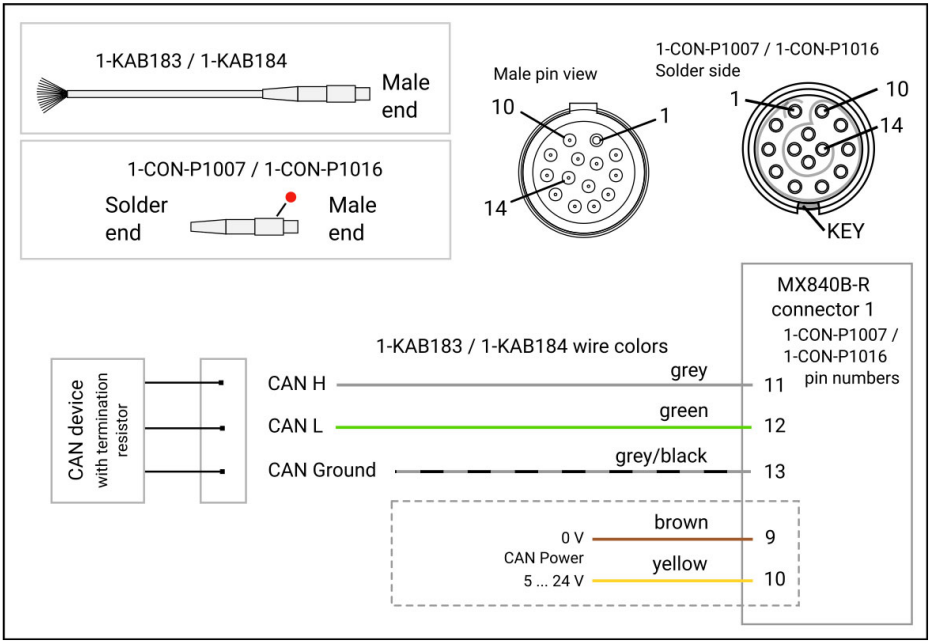
[1)] Includes support for CCP/XCP-on-CAN (not in conjunction with CX23-R).

Tip

To ensure trouble-free operation, the CAN bus must be terminated at both ends with suitable termination resistors. The MX471B-R, MX471C-R and MX840B-R modules have internal completion resistors between CAN H and CAN L, which can be individually activated or deactivated with the software.

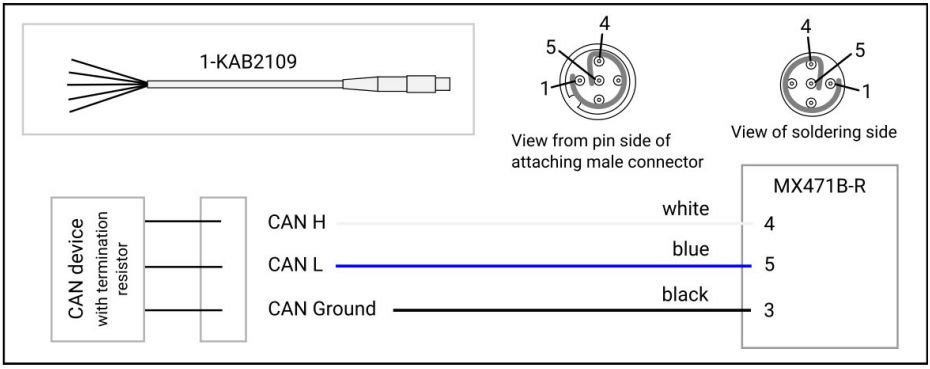
CAN bus, MX840B-R

CAN device, MX840B-R



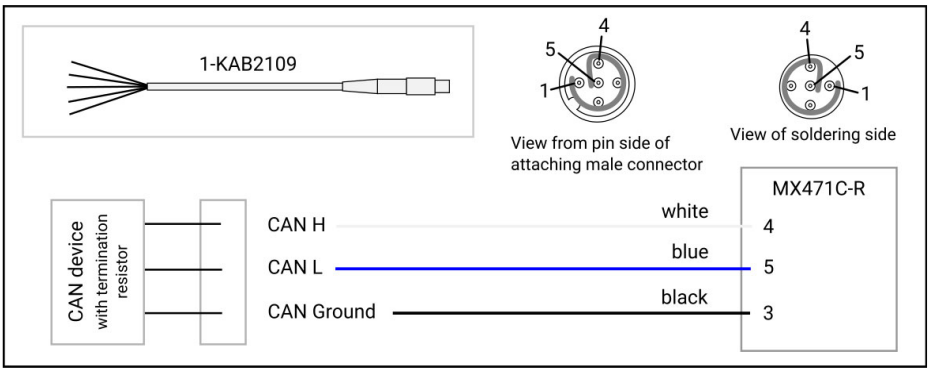
CAN bus, MX471B-R

CAN device, MX471B-R



CAN/CAN-FD bus, MX471C-R

CAN / CAN FD device, MX471C-R



7.14 Direct pressure sensor

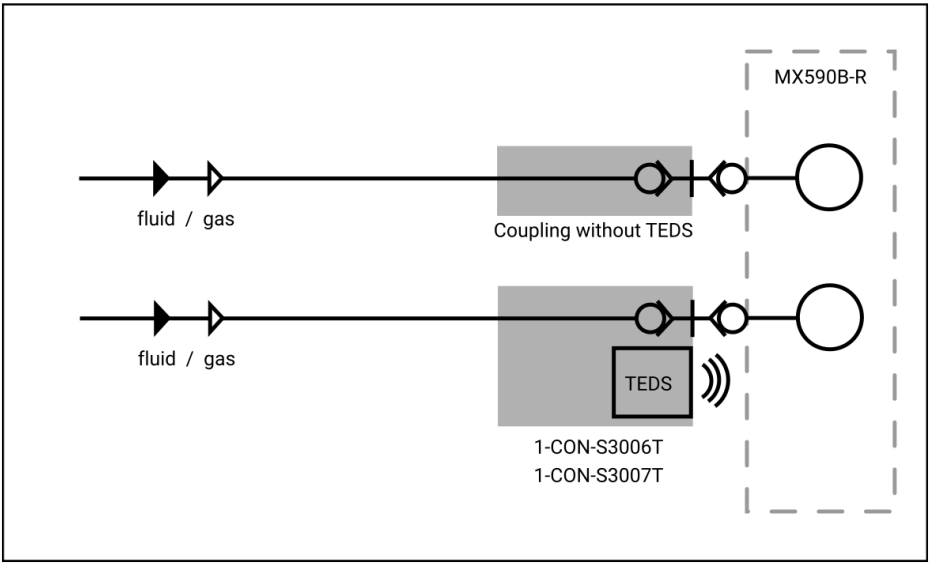
Transducer		MX590B-R
	Absolute pressure sensor (gas/liquid)	•
	Relative pressure sensor (gas/liquid)	•

Information

Differential pressure sensors (gas/liquid) are not supported.

Pressure, MX590B-R

Pressure, MX590B-R

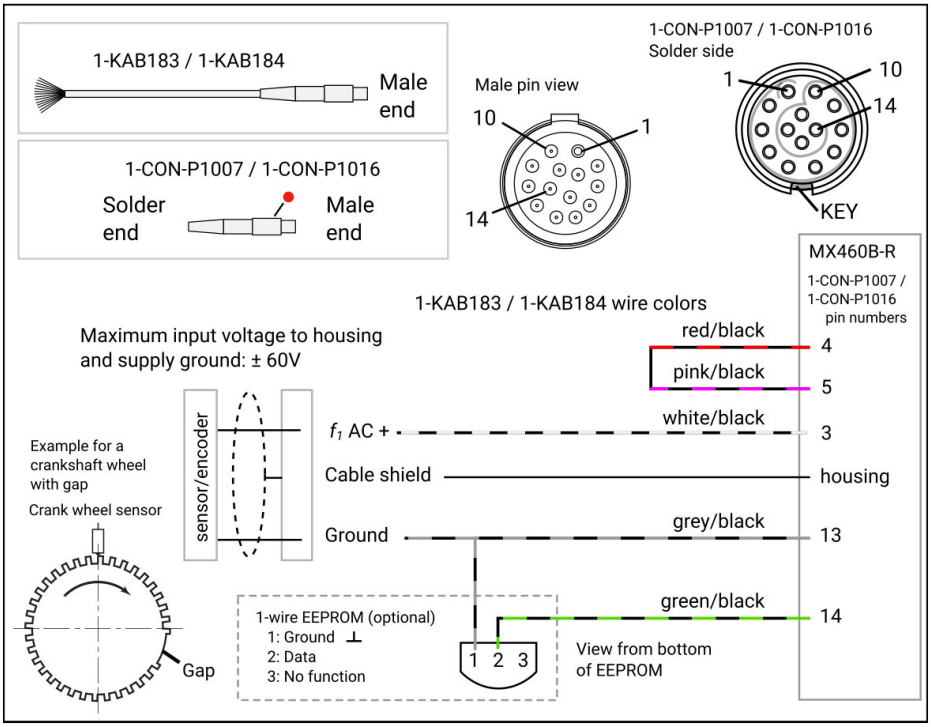


7.15 Crank wheel sensors

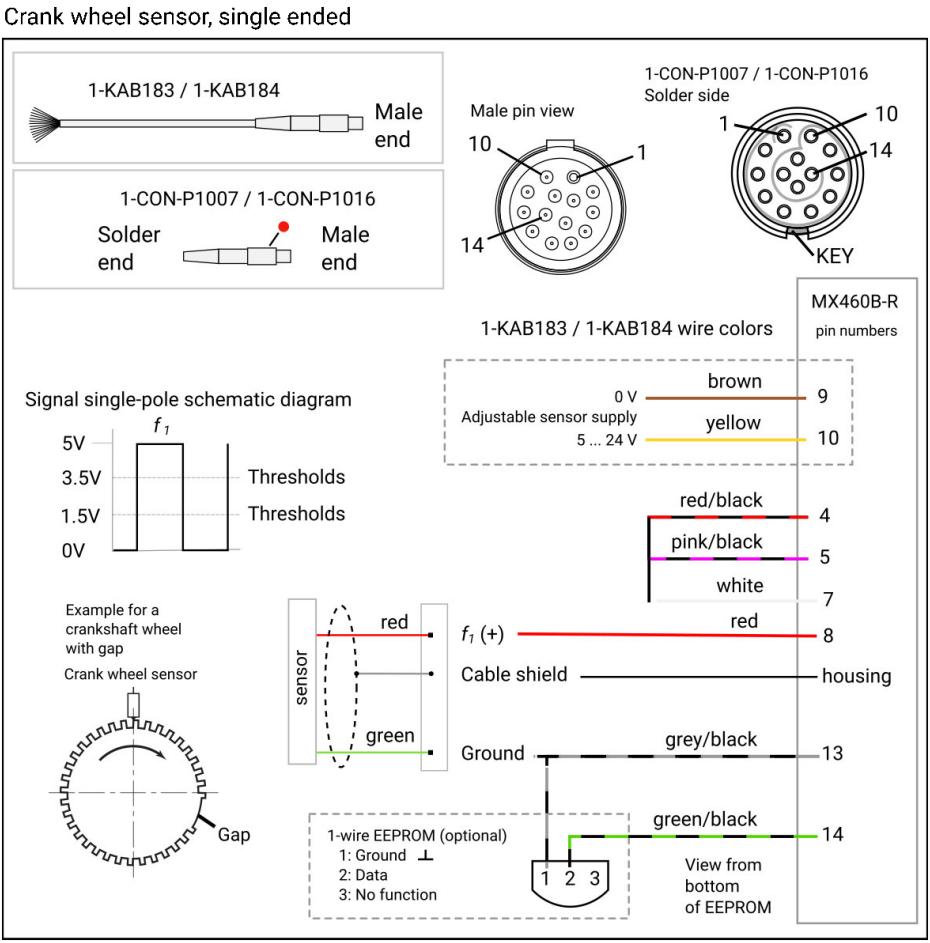
Transducer		MX460B-R
	Crank wheel sensor	•

Passive inductive encoder, crank wheel

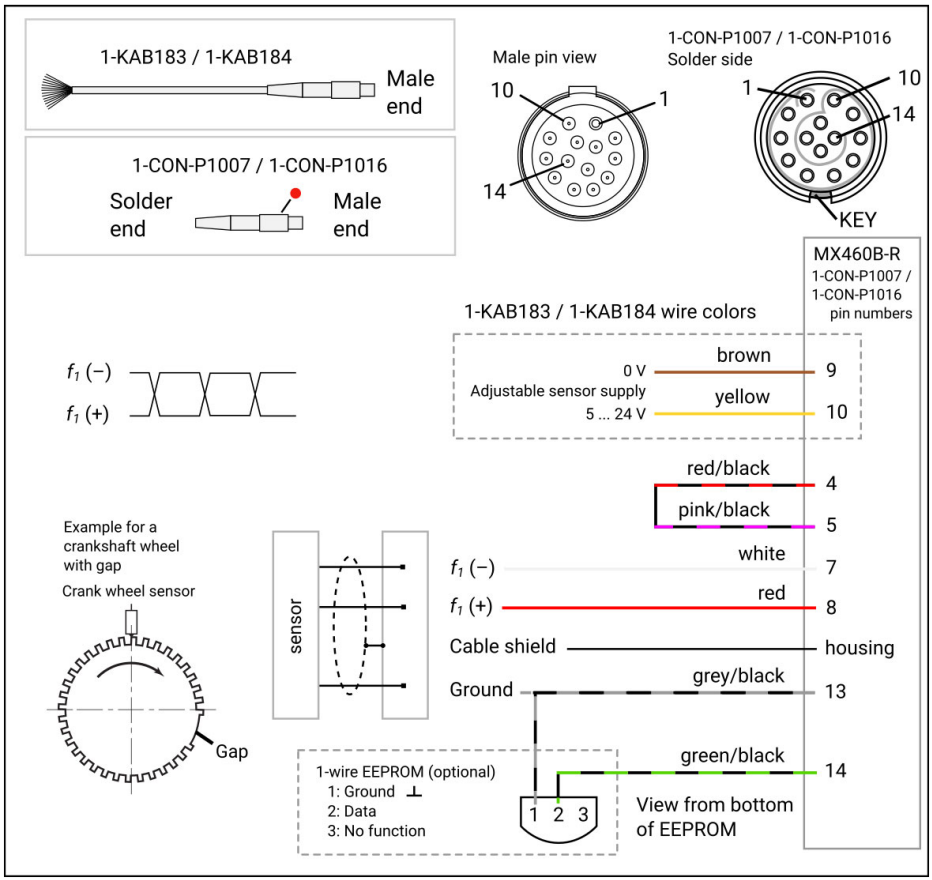
Passive inductive encoder, crank wheel



Crank wheel sensor, single-ended



Crank wheel sensor, differential

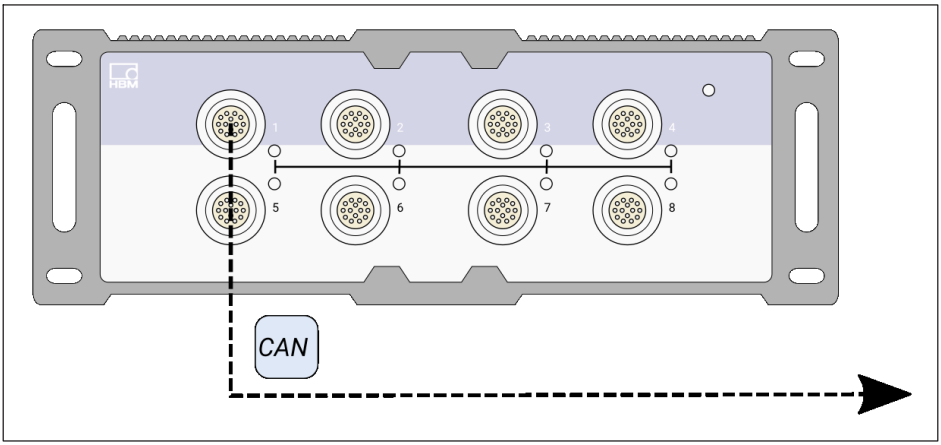


8 OUTPUTS OF THE MX MODULES

8.1 Output of measurement signals to the CAN bus

8.1.1 MX840B-R

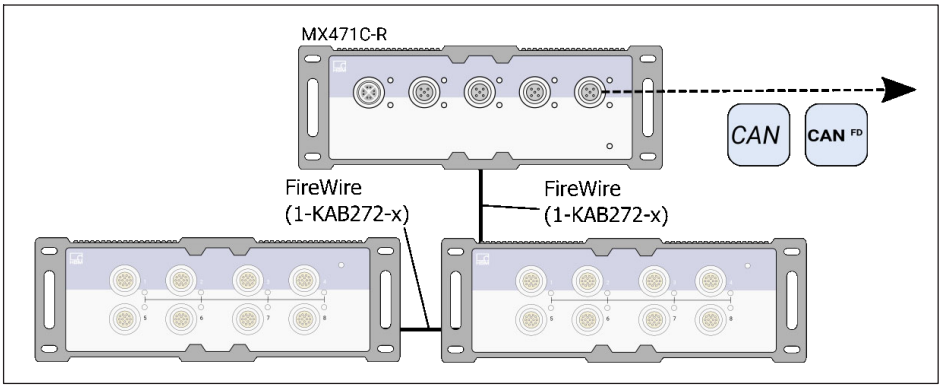
The MX840B-R universal module offers the facility to output channels 2 to 8 to the CAN bus (channel 1). This mode is fully configured in the MX Assistant.



8.1.2 MX471B-R/MX471C-R

The two modules MX471B-R and MX471C-R offer the facility to output measurement signals or the real time calculated signal to the CAN bus. This gateway mode is normally used in test cells or mobile measurement for connection to a central CAN-based data logger.

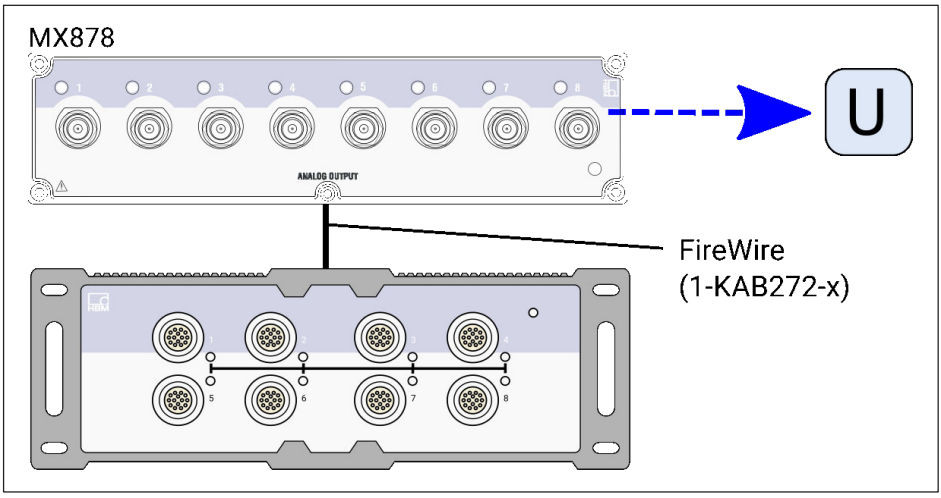
This mode is fully configured in the MX Assistant. The signals to be transmitted must be parameterized isosynchronously (in real time), and then assigned to the respective CAN interface. The parameterization is permanently stored in the modules (EEPROM).
To simplify integration at the opposite end (e.g. logger/test cell), the MX Assistant can generate a database of CAN signals (.dbc).



8.2 Real-time signal output

8.2.1 MX878B

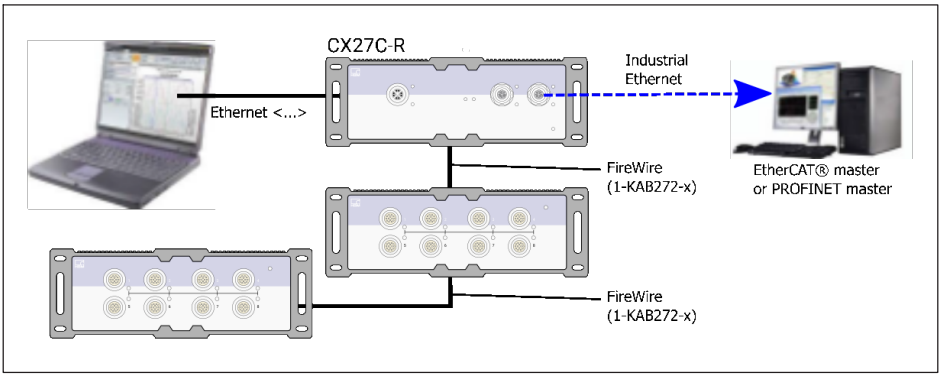
The QuantumX MX878B analog output module provides up to eight analog voltage outputs for measured sensor values and channel calculations in real time. This mode is configured with the CX23-R data recorder, the catman® software, or the MX Assistant. All other MX modules must be connected via FireWire, and the signals to be transmitted must be parameterized isosynchronously (in real time) and then assigned to the respective analog voltage output. The parameterization is permanently stored in the modules (EEPROM). The maximum sample rate is limited to 5 kHz. Harmonic signals up to approximately 500 Hz can be mapped outstandingly well.



8.2.2 CX27C-R via Industrial Ethernet (EtherCAT® or PROFINET) and acquisition via Ethernet

Each source of an MX module is split into two signals that can be assigned different sample rates and filter parameters.

For example, the first signal of an input channel may have a high sample rate (e.g. an accelerometer at 100 kS/s) and a filter disabled for analysis, while the second signal may have a lower sample rate (e.g. 5 kS/s) and is outputted via EtherCAT® or PROFINET.



9 CHANGE HISTORY

Version	Date	Notes
1.0	08/2014	First version
2.0	02/2015	CX23-R and EX23-R
3.0	10/2015	Modules MX840B-R, MX411B-R and MX471B-R
3.1	10/2015	Minor updates
4.0	11/2015	Electromagnetic compatibility
5.0	04/2016	Sensor adapter, UPX-002, outputs
5.1	06/2018	Mechanical mounting of modules, KAB430 IEPE, MX460B-R and MX590B-R modules, view from solder side
6.0	08/2018	MX1609TB-R
6.1	10/2018	Correction of solder side views, new notes (add modules)
7.0	08/2019	MX471C-R, CX27C-R, CANFD bus, diagrams for soldering 1CON-P1007 and 1CON-P1016 connectors and Phillips screws on mounting brackets
7.1	11/2019	Thermocouple adapters, T type and J type for MX840B-R and -1 ... 2.5 bar relative for MX590B-R
7.2	12/2019	Minor updates
8.0	11/2023	Transfer to HBK design, and minor updates.

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