Operating Manual

English

Measurement System

QuantumX Rugged DAQ

A3609-4.0_en

HBM

1 Safety instructions

Appropriate use

The QuantumX data recorders CX22-W (with WLAN) are to be used exclusively for measurement tasks and directly related control tasks within the application limits detailed in the specifications. Use for any purpose other than the above is deemed to be non-designated use.

In the interests of safety, the module should only be operated as described in the Operating Manuals. It is also essential to comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

Each time you start up the module, 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. In the event of a fault, these precautions must establish safe operating conditions.

This can be done, for example, by mechanical interlocking, error signaling, etc.

Working safely

Note

The module must not be connected directly to the power supply system. Supply voltage 10 V ... 30 V (DC).

The supply connection and all other connections must be installed in such a way that electromagnetic interference

does not adversely affect device functionality (see also “Greenline shielding design", downloadable from the Internet at http://www.hbm.com/greenline).

When devices are working in a network, these networks must be designed in such a way that malfunctions in individual nodes can be detected and shut down.

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

When the modules are working in a network, these networks must be designed in such a way that malfunctions in individual nodes can be detected and shut down.

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

General dangers of failing to follow the safety instructions

The QuantumX module is state-of-the-art and fail-safe. The modules may give rise to residual dangers if they are inappropriately installed and operated by untrained personnel.

Any person instructed to carry out installation, startup, maintenance or repair of the modules must have read and understood the Operating Manuals and in particular the technical safety instructions.

Conversions and modifications

The module must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any resultant damage.

In particular, any repair or soldering work on motherboards (replacement of components) is prohibited. When exchanging complete modules, use only original parts from HBM.

The module is delivered from the factory with a fixed hardware and software configuration. Changes can only be made within the possibilities documented in the manuals.

Qualified personnel

This device is only to be installed and used by qualified personnel strictly in accordance with the specifications and with the safety rules and regulations which follow.

Qualified persons means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function.

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

- Knowledge of the safety concepts of automation technology is a requirement and as project personnel, they must be familiar with these concepts.
- As automation plant operating personnel, they have been instructed how to handle the machinery. They are familiar with the operation of the modules and technologies described in this documentation.

- As system startup engineers or service engineers, they have successfully completed the training to qualify them to repair the automation systems. They are also authorized to activate, ground and label circuits and equipment in accordance with safety engineering standards.

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

Ambient conditions on site

- The protection class is IP65 and IP67 (dust and water).
- Please observe the permissible maximum ambient temperatures stated in the specifications.
- Extended temperature range from -35 to 80 °C (-30 to 175 °F)
- Vibration/fatigue strength up to min. 5 g for P modules
  For SomatXR:
  Vibration: 10g (450 min. between 5 … 200 Hz) per MIL-STD202G/Method 204D
- Impact resistance at 50 g for P modules.
  For SomatXR:
  Shock: 75g / 6 ms per MIL-STD202G, Method 213B)

For all modules:

- Do not expose the device to direct sunlight.
- Please observe the permissible maximum ambient temperatures stated in the specifications.

Maintenance and cleaning

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

- Before cleaning, disconnect all connections.
- Clean the housing with a soft, slightly damp (not wet!) cloth. *Never use* solvent as this could damage the labeling or the housing.
- Do not use a high-pressure cleaner for cleaning.

Note

The safety instructions described here also apply to the power pack NTX002.

2 Markings used

2.1 Symbols on the module and their meaning

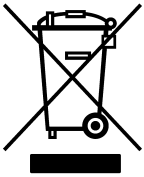
Electrostatically sensitive components

Components marked with this symbol can be damaged beyond repair by electrostatic discharge. Please observe the handling instructions for components exposed to the risk of electrostatic discharge.

Take details in the operating manual into account

CE mark

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (the Declaration of Conformity can be found on the HBM support website, www.hbm.com/support and HBMdoc).



Statutory waste disposal mark

The electrical and electronic devices that bear this symbol are subject to the European waste electrical and electronic equipment directive 2002/96/EC. The symbol indicates that the device must not be disposed of as household garbage.

2.2 The markings used in this document

Important instructions for your safety are specifically identified. It is essential to follow these instructions in order to prevent accidents and damage to property.

Symbol	Significance
CAUTION	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *can* result in slight or moderate physical injury.
Note	This marking draws your attention to a situation in which failure to comply with safety requirements *could* lead to damage to property.
Important	This marking indicates *important* information about the product or about handling the product.
Emphasis *See …*	Italics are used to emphasize and highlight text and identify references to sections, diagrams, or external documents and files.
Device -> New	Bold text indicates menu items, as well as dialog and window titles in the user interfaces. Arrows between menu items indicate the sequence in which the menus and sub-menus are called up
Sampling rate	Bold text in italics indicates inputs and input fields in the user interfaces.

3 Introduction

3.1 About the documentation

The QuantumX documentation consists of

- A printed quick start guide for initial start up
- The data sheets in PDF format
- The operating manual for the QuantumX series in PDF format
- This operating manual in PDF format
- The operating manual for the EtherCAT / Ethernet-Gateways CX27 in PDF format
- Several mounting instructions for cables, adapters and connectors in PDF format
- A comprehensive Online help with index and easy search options which is available after the installation of a software packet (e.g. MX Assistant, catman®EASY). Information about module and channel configuration can also be found here

These documents can be found:

- On the system CD supplied with the device
- After installation of the MX Assistant on the hard drive of your PC
- Up-to-date versions are always available from our Internet site at http://www.hbm.com/hbmdoc

3.2 The QuantumX Rugged DAQ series

The QuantumX Rugged DAQ series is a modular and universally applicable measurement system. The modules can be individually combined and intelligently connected according to the measurement task. The distributed operation makes it possible to position individual modules close to the measuring points, resulting in short sensor lines.

All MX modules of the QuantumX (MX...), QuantumX-P (MX...-P) and SomatXR (MX...B-R) series can be combined with one another and can be connected to a PC or to the CX22-W data recorder.

The connection interfaces on the rear are identical to Ethernet and FireWire. The MX modules of the SomatXR series offer additional functions. In principle, they can be synchronized using the Ethernet-based PTPv2 protocol (IEEE1588).

The QuantumX Rugged DAQ series currently consists of the following modules:

- *MX840A-P* Universal amplifier
  The module has 8 universal inputs and supports more than 14 transducer technologies.
- *MX411-P* Highly dynamic universal amplifier
  The module has 4 universal inputs and supports the current transducer technologies.
- *MX460-P* Frequency measuring amplifier rotation specialist
  The module has 4 digital timer inputs for connection of torque transducers (T10, T40), incremental encoders, frequency signal sources.
- *MX1609-P* Thermocouple amplifier
  The module has 16 inputs for type K thermocouples.

NOTE: This module is no longer available and has been replaced by the MX1609KB-R module.

- *MX1601-P* Universal amplifier
  The module has 16 individually configurable inputs for voltage or current measurement or for connection of current-fed piezoelectric transducers.
- *MX471-P* CAN module
  The module has 4 CAN bus nodes that can be configured for receiving and sending messages. The module support the CCP and xCP-on-CAN protocols on up to 2 channels.
  NOTE: This module is no longer available and has been replaced by the SomatXR MX1601B-R module

All modules have the following in common:

- Low voltage connection
- Configurable Ethernet interface for data communication with an operating PC
- 2 FireWire interfaces
  - For optional voltage supply (note data sheet)
  - For optional data communication with a PC
  - For synchronization of the modules
  - For internal measured data transmission
- Status LEDs to display current module status
- A factory calibration certificate is stored on each amplifier, which can be read out by the MX Assistant
- AutoBoot (module configurations are retained)

With amplifiers, the following applies for each measurement channel:

- Electrical isolation (signal inputs/outputs, voltage supply, communication)

- Configurable supply voltage for active sensors
- Support for TEDS[1*)] technology (read, write)
- Configurable sampling rate
- Configurable active digital filter (Bessel, Butterworth)
- Configurable scaling (can also be saved in TEDS)

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

3.3 Digitalization and signal path

Signal flow channel and generated signals

Each QuantumX measurement channel generates two signals.

These signals can be individually parameterized with a different data rate and filter. Parameterization is easiest to implement with the “QuantumX Assistant" software (Signal tab).

If several modules are connected together via the FireWire bus, signals can be sent in real time (isochronous), e.g. from signal source to an output (analog, CAN or EtherCAT bus) or for calculation. This isochronous real time operation is possible in parallel to the asynchronous operation. The maximum data rate here is 4.8 kHz.

The data on runtimes and the filter tables of the respective data sheets must be used for the calculation of runtimes from signal input to signal output.

1) TEDS = Transducer Electronic Data Sheet

Scaling

QuantumX Rugged DAQ supports the following scaling types:

- Two point (2-point / y=mx+b)
- Table (multi-point)
- Polynomial

The 16 channel modules MX1601-P, MX1601B-R, MX1615B-R and the modules MX411-P, MX460-P only support two point scaling.

3.4 QuantumX Rugged DAQ module synchronization

If measurement signals need to be referenced over time with each other for processing and analysis, they must be recorded synchronously.

All QuantumX modules can be synchronized among themselves. This ensures simultaneous measurement on all channels. All the analog-digital converter rates, measuring rates and bridge excitation voltages are therefore also synchronized.

3.4.1 Synchronization methods

Synchronization via FireWire

All the modules are synchronized automatically when they are connected via the FireWire cable. This is the recommended method.

No CX27 module present in the system and no external synchronization source available:

The module with the highest serial number takes over the Master function.

CX27 module present in the system and no external synchronization source available:

If a CX27 module is connected, this automatically becomes the synchronization Master. When starting the system, the system time is set once to the actual time.

If QuantumX modules alone are being used, internal synchronization is sufficient. However, if synchronous measurements are to be performed by different measurement systems, an external Master must be used for synchronization.

This is also a requirement if the QuantumX modules are a long distance away from one another and a FireWire connection would be too complex.

Synchronization with external sources

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

If several external sources are selected, the system decides according to the following priorities:

1. EtherCAT
2. IRIG-B
3. NTP

Synchronization via EtherCAT

The CX27 Gateway supports the EtherCAT “Distributed Clocks" enhancement. In an EtherCAT group, the time is distributed to all the EtherCAT nodes.

The CX27 module can be synchronized to the EtherCAT time. This will mean that all the QuantumX module clocks are synchronized to this time.

Synchronization via an NTP server

Each QuantumX module can synchronize its internal clock with an NTP server. The NTP time is distributed to the other modules via FireWire.

It is possible to achieve accuracies in the 100 µs range, although this depends on the relevant Ethernet utilization.

Modules located close together should be synchronized via FireWire.

If the synchronization source for a module is changed to NTP, the system must be restarted once. An NTP software package is included in the HBM software catman®EASY.

Parameter:

- IP address of the NTP server
- Threshold in µs, from which the time deviation to NTP time is tolerated

Further information about NTP can be found at http://www.ntp.org

Synchronization via IRIG-B

IRIG-B is a standardized time coding.

To time-synchronize the QuantumX system, the digital or analog modulated time signal is sent externally to any analog voltage input of the amplifier type MX840A-P (see assignment, Chapter 7.2.1).

The B127 format uses an analog modulation. Connection is identical to that of a 10 V voltage sensor.

The other formats are BCD-coded and must be connected analog to the sensor “Frequencies single-pole, without directional signal", see Chapter 7.8.19.

The amplifiers can acquire IRIG-B signals of type B000 to B007 and B120 to B127. All modules connected via FireWire are also automatically synchronized. The coding includes the time, year and optionally, the seconds of the day.

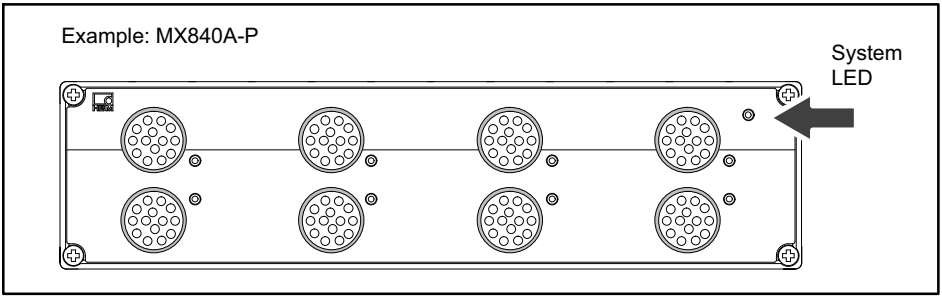
Comparison of synchronization mechanisms

Feature	FireWire	Ethernet (NTP)	EtherCAT	IRIG-B
Synchronization with other device types	QuantumX only	QuantumX Rugged DAQ MGCplus Interrogators Others	all EtherCAT nodes	all IRIG-B nodes
Max. distance between QuantumX modules	5 m (40 m with FireWire extender, 500 m via fiber optics)	100 m (Ethernet)	100 m	-
Number of modules to be synchronized	24	unlimited	CX27 required, unlimited	unlimited MX440A, MX840A required,
Synchronization accuracy	< 1 µs	100 µs to 10 ms	< 1 µs	< 1 µs
Synchronization settling time	Immediate	approx. 2 h during first start, approx. 10 min. during restart	Immediate	Immediate

Feature	FireWire	Ethernet (NTP)	EtherCAT	IRIG-B
Synchronization master	Auto 1 Quantum module	external SyncMaster, e.g. PC	external SyncMaster	external IRIG-B master
Voltage supply	< 1.5 A, looped through	-	-	-

Successful synchronization

To achieve a precise reference over time, the applicable channels must be parameterized with the same filter settings. No automatic runtime correction is carried out. The filter runtimes are shown in the data sheet. After booting and successful synchronization, the system LED shows green. If synchronization is disturbed, or not yet established, the system LED shows orange.



Time format used

Basis: 1.1.2000

Time stamp: 64 bit

32 bit seconds

32 bit fractions of a second, resolution ($1/2^{32}$)

These time stamps are appended to the measured values.

You can choose from several synchronization methods:

- Synchronizing via FireWire
- Synchronizing via EtherCAT (CX27)
- Synchronizing via NTP *(Network Time Protocol)* with FireWire
- Synchronizing via NTP without FireWire

4 Software

The supplied QuantumX System CD contains a powerful software package consisting of the MX Assistant, programming libraries for .NET/COM, TEDS Editor, FireWire driver and a program for module firmware updating. The software product catman®EASY is available as an independent product package.

4.1 MX Assistant

The HBM software “MX Assistant" offers the following functions:

System:

- Create overview (modules, Host PC)

Modules:

- Search and configuration (e.g. TCP/IP communication), naming
- Reset to factory settings
- Read factory calibration certificate
- Analysis (information, status, log file)
- Save configuration to operating PC

Channels/sensors:

- Configuration (name, connection type, TEDS, semi-automatic assignment)
- Measurement (alphanumeric display)
- Open the TEDS editor and read/write to TEDS
- Activate/deactivate isochronous operation via FireWire

Individual signals:

- Set sampling rates and filters (type, cut-off frequency)

Measured values (Scope):

- Start/Stop continuous graphic measurements (time frames, trigger, zoom)
- Basic signal analysis (X-Y cursor)
- Record measurements of individual channels

Functions and outputs:

- Generate new signals through mathematic functions (peak value, effective value, addition and multiplication, rotation)

Sensor database:

- Output signals (scaled, filtered)
- Modify and expand existing sensor databases (e.g. own sensors, dbc data files)

4.2 catman®AP

The HBM “catman®AP" software is optimally suited for the following tasks:

- Setting the communication and measurement channels (integrated, expandable sensor database plus read/write TEDS)
- Configuration of measurement or test tasks (channels, sampling rates, triggers, comments, interactions)
- Setting up virtual online calculated channels (algebra, FFT, logic, SG rosette evaluation, differential, integral, etc.)
- Setting up limit value or event monitoring (digital output activation, acoustic alarm, logbook entry)
- Individual graphic representation options (strip chart, analog meter, digital or bar display, tables, status LEDs, etc.)

- Diverse trigger- and storage options (all data, cyclic, ring buffer, long-term measurements, etc.)
- Export of measured data in current data format (catman®BIN, Excel, ASCII, DIADEM, MDF)
- Graphic analysis of acquired data
- Automation of measurement sequences (AutoSequence and EasyScript)
- Generating reports (with graphic displays, analyses, comments)

The software package consists of various modules:

- *catman®EASY – the basic package for recording measurement, visualization and storing*
- *EasyMath* for mathematical evaluation of recorded measurement data
- *AutoSequence* automates repeating measurement or analysis steps
- *EasyPlan* enables preparatory parameterization and configuration without amplifier connection
- *EasyScript* is based on current VBA standard (Visual Basic for Applications) and enables writing of own scripts for individual measurement tasks
- *EasyRoadload* Integration from Kistler RoaDyn for measuring wheel force and moment

4.3 Programming interface (API)

The abbreviation API stands for “Application Programming Interface" and designates so-called programming interfaces. Programmers can directly

access functions of other programs via APIs and use these in their own programs.

With the API you have full access to all QuantumX functions via your individually programmable software.

The API can be used in the form of programming libraries in .NET or COM technologies. The libraries allow separate applications to be created in programming languages such as C#. Functions such as communication connection, configuration of measurement channels, implementation of measurements and troubleshooting are components of the library.

The API is available for download from the HBM website. Application-based examples and practice-oriented documentation enable rapid a quick start.

4.4 Firmware update via Ethernet

You can easily check the firmware status of the modules and update them when necessary with the “QuantumX firmware update" software.

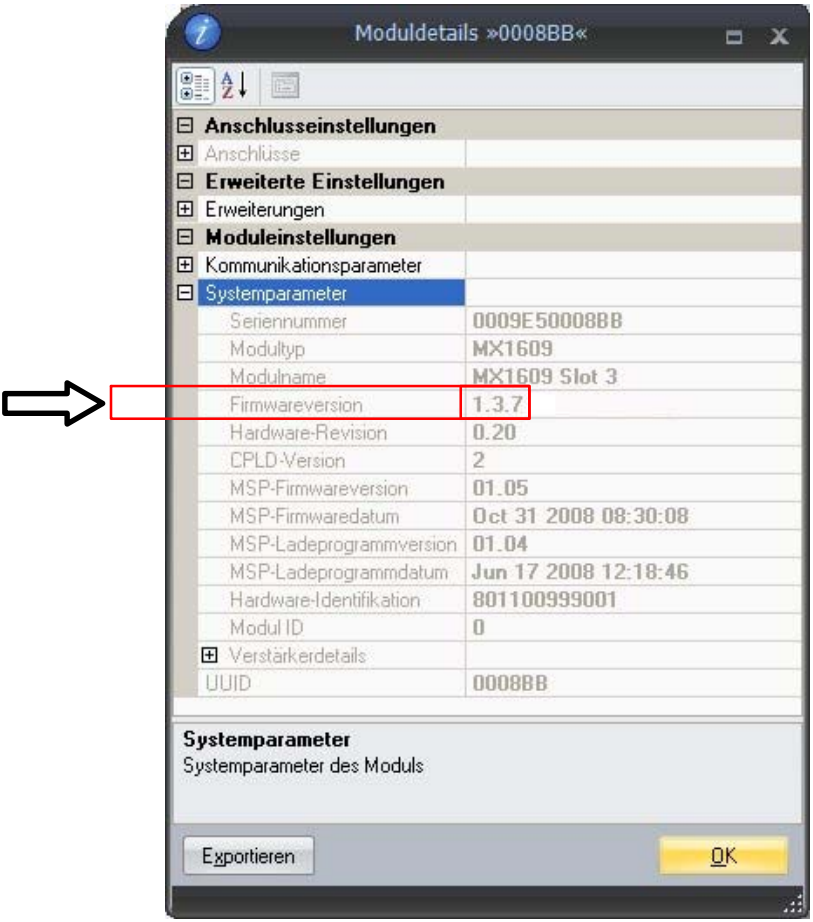
From firmware version 4, the module firmware can also be updated using MX Assistant. Always keep your software and drivers up to date.

We recommend a check and eventual updating of the firmware:

- If you want to use a new PC software package
- If you want to expand your system with new modules

You can also determine the firmware status of your modules using the QuantumX Assistant:

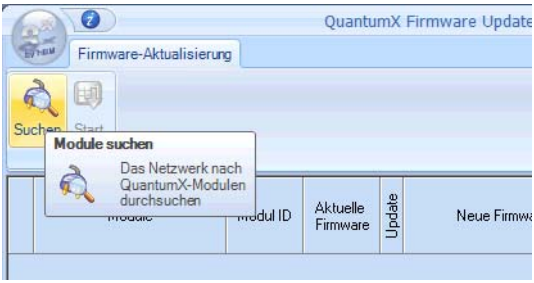
- Right-click on a **module –> Details –> System parameters**



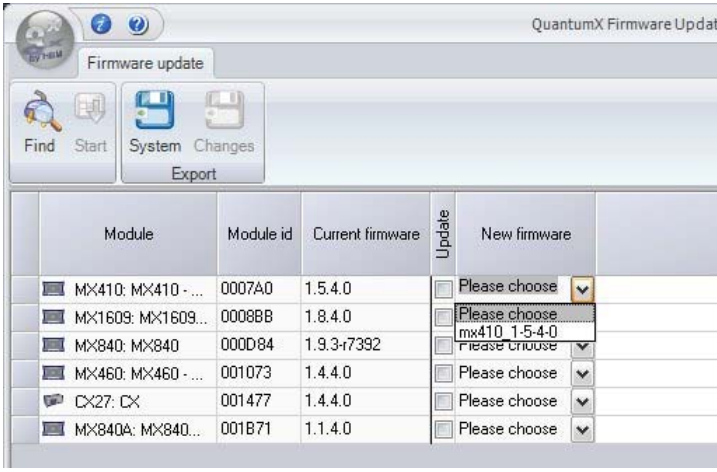
- Compare your version with the actual firmware version on the Internet under: www.hbm.com/quantumX

Implementing a firmware update:

- Download the actual firmware from the HBM website and save it in the download directory of the firmware updater (in most cases: C:ProgramsHBMQuantumX Firmware UpdateDownload)
- Download the actual software package from the HBM website
- Close all open HBM software, install the new software and start the “QuantumX Firmware Update" program
- Click on the **“Find modules"** symbol or press the function key F4



- Select the module
- Select the required version in the dropdown menu **“New firmware"**
- Activate the modules whose firmware you want to update by checking the boxes in the column “Update" and then click on the **“OK"** button



- Press the **“Start"** button and wait until the update is complete (do not interrupt the process/do not switch off the modules/do not interrupt the connection)

4.5 Sensor database / TEDS

An input channel is parameterized via an electronic data sheet or a "signal description" from the sensor database. This also applies for bus signals, e.g. CAN signals:

a) With TEDS

In the simplest case, the sensor comes with an electronic data sheet for automatic parameterization of the channel (TEDS).

TEDS stands for Transducer Electronic Data Sheet, i.e. an electronic data sheet stored in the sensor or connector. TEDS allows automatic parameterization of a

channel immediately after a sensor has been connected. Every measurement channel allows reading or writing of sensor data to the TEDS chip. The sensor database is used to describe a sensor. If a TEDS sensor is connected, this information is written.

The classical TEDS editor can optionally be used.

b) Without TEDS

In the simplest case, a generic data sheet from the sensor database can be used - e.g. for voltage, thermocouple or Pt100.

To ensure traceability of recorded measurement data, the test equipment used, e.g. a sensor or transducer's electronic data sheet should be described in detail in the sensor database or TEDS prior to channel parameterization. Sensors and transducers from HBM can be found as reference in the sensor database. This reference can be copied to your sensor database and lacking information can be added.

In general, the following parameters are important:

- Name / Designation
- Serial number
- Type / Model
- Manufacturer
- Characteristic curve (electrical, physical)
- Electrical connection (power supply/excitation voltage, wiring)

- Information (date and validity of calibration, data sheet as file, comment, etc.)

c) Can signals

In the case of CAN signals, DBC databases can be imported into the sensor database for channel parameterization with individual signals.

Chapter 7.1.3 describes TEDS in general.

5 Housing

The degree of protection given in the technical data indicates the suitability of the housings for various ambient conditions and also the protection of persons against potential risks when used. The letters *IP* (International Protection), which are always present in the designation, are followed by two digits. These indicate which degree of protection a housing offers against contact or foreign bodies (first digit) and moisture (second digit).
The QuantumX Rugged DAQ modules are available in housings with degree of protection IP67 (as per DIN EN 60529).

IP 6 7

Code index	Degree of protection against contact and foreign bodies	Code index	Degree of protection against water
6	Complete protection against contact, protection against penetration of dust	7	Immersed 1 m under water for minimum 30 minutes

Fig. 5.1 Amplifier MX840A-P

6 Connecting individual QuantumX modules with Rugged DAQ design

6.1 Connecting the supply voltage

Connect the modules to a DC voltage of 10 V ... 30 V (24V recommended). The power consumption per device can be found in the following table.

CAUTION

The following rule of thumb applies to power distribution via FireWire:
“An external voltage supply with the same voltage potential is required on every 3rd module".

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.

We recommend the installation of an uninterruptible power supply (UPS) in vehicles with battery operation between battery and module to compensate for voltage drops during start procedures.

Module	Typical power consumption, including transducer excitation (Watt)
MX840A-P	12
MX1601-P	13
MX411-P	15
MX460-P	9
MX1609-P	6

If several modules are connected to each other via *FireWire* for time-synchronous data acquisition, the supply voltage can be looped through. The power pack used must be able to provide the appropriate output.

The maximum permissible current on the FireWire connection cable is 1.5 A. The *supply connection must be repeated* if the chain is longer.

If several amplifiers are operated non-synchronously, they must be supplied separately.

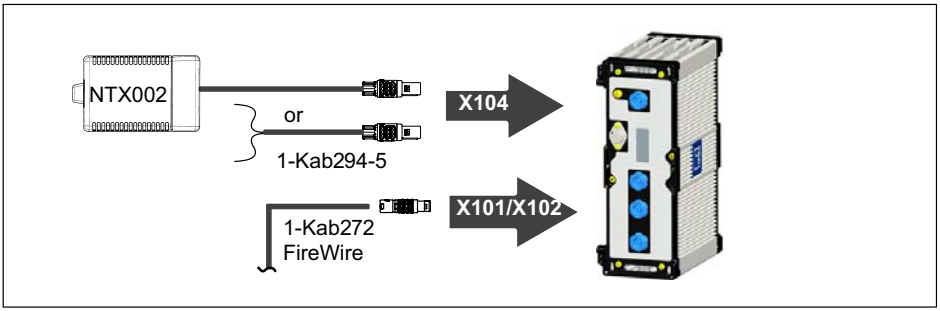


Fig. 6.1 Connecting socket for supply voltage

6.2 Connection to host PC or data recorder

6.2.1 Single Ethernet connection

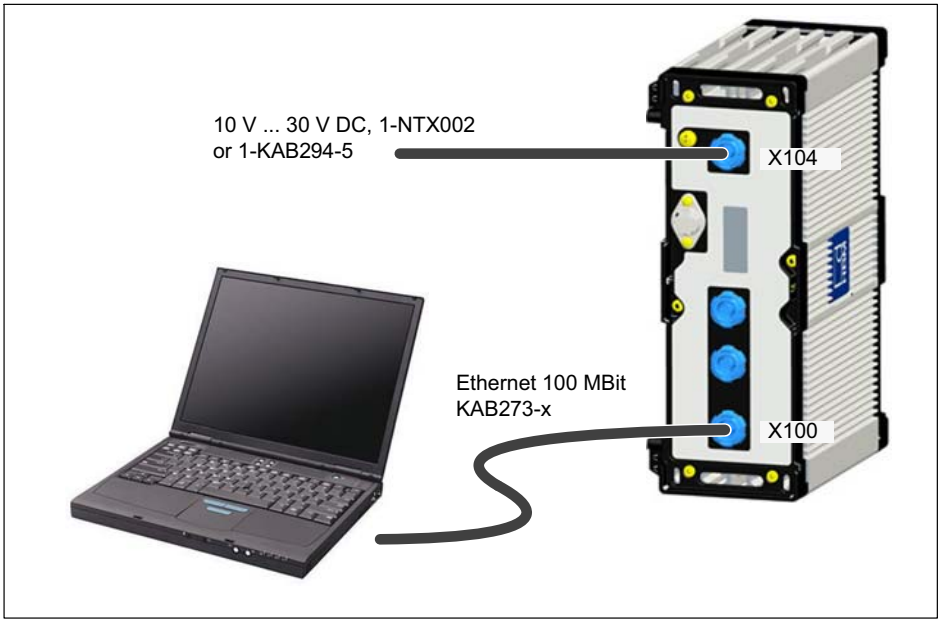


Fig. 6.2 Single Ethernet connection

Note

You must use an Ethernet crossover cable with older computers. Newer PCs/laptops have Ethernet interfaces with autocrossing function. You can also use Ethernet patch cables here.

6.2.2 Multiple Ethernet connection with NTP synchronization

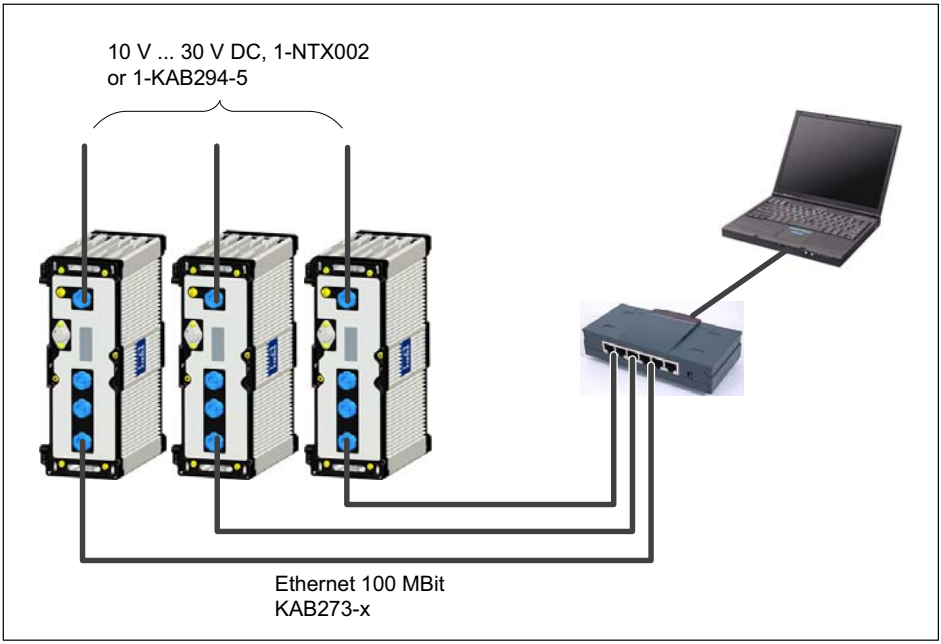


Fig. 6.3 Multiple connection via Ethernet and synchronization via NTP

Modules can be connected to the PC with standard Ethernet switches. We recommend patch cables.

With the star structure displayed here, measurement data from other modules is not lost if the Ethernet cable is broken!

6.2.3 Multiple Ethernet connection and FireWire synchronization

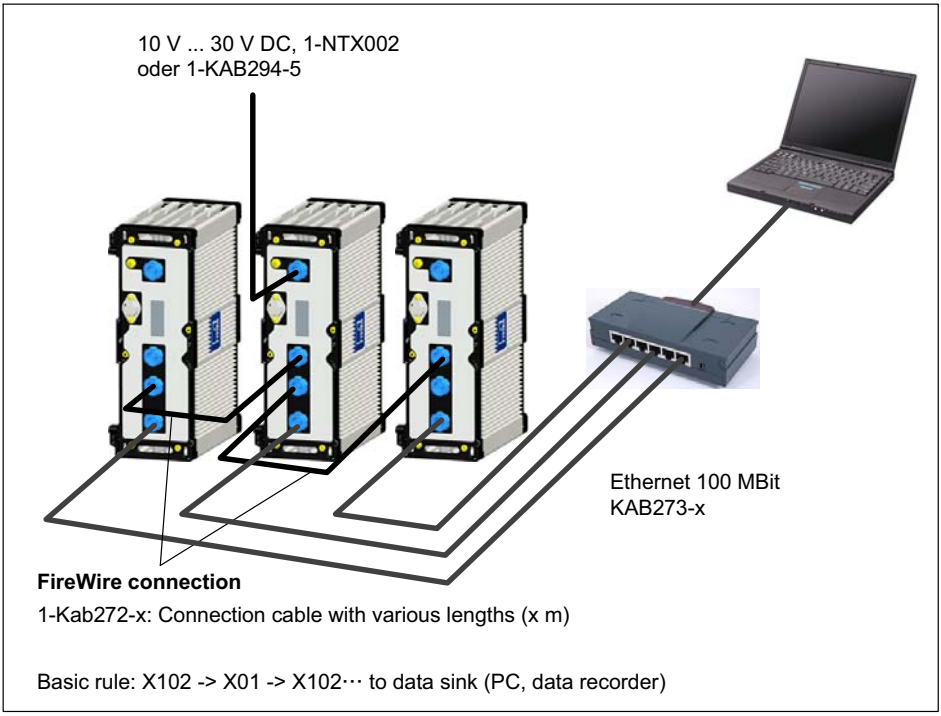


Fig. 6.4 Example of multiple connection via Ethernet with synchronization

The supply voltage for the modules is looped through FireWire in the configuration shown above (max. 1.5 A through FireWire; for power consumption of 1 module see specifications in data sheet).

Advantage of this connection structure: The other modules remain active if the Ethernet cable is broken.

6.2.4 Module connection setup via Ethernet

Direct connection with a PC (peer-to-peer)

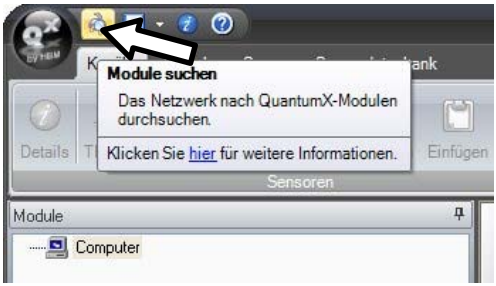
Note

Ensure that your PC has a valid IP address.

Install and start up the latest QuantumX Assistant version on your PC.

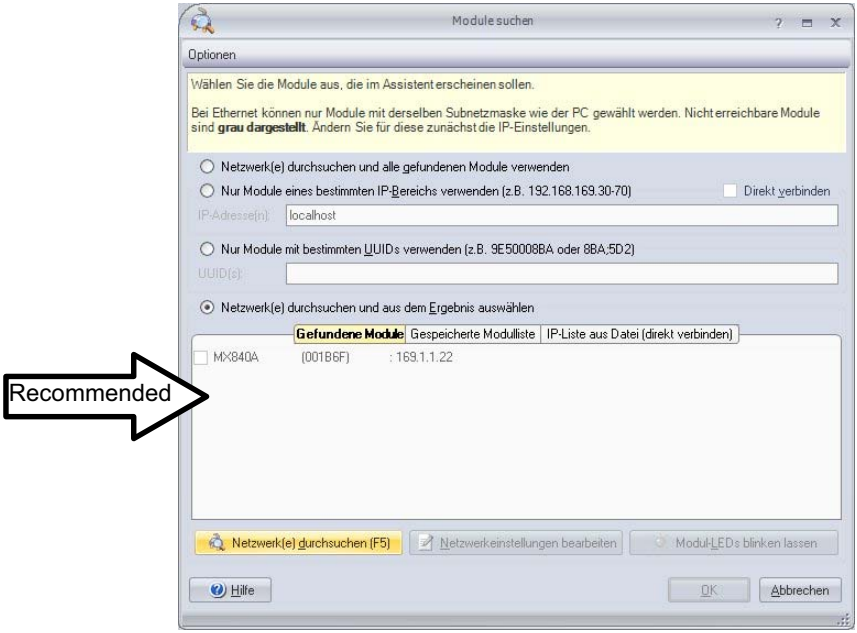
(All screenshots shown in this description display the menus in the Windows®XP operating system).

- Click on the  icon (Find modules) or press the F4 function key.



The next dialog window offers you some options for network searching. For initial setup we recommend:

- Search the entire network and select from the result



- If your modules are not displayed yet, click on the 

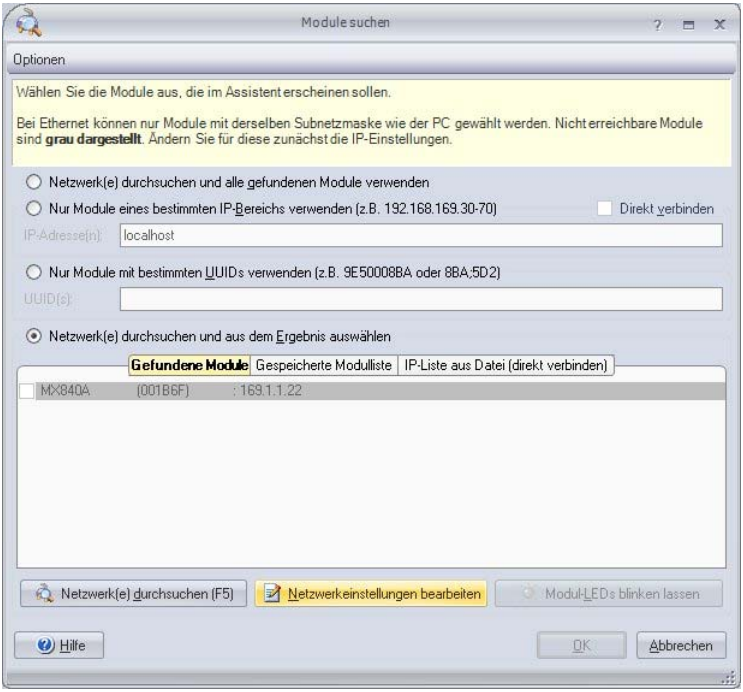
button.

Note

The network connection can be influenced by:
•An activated WiFi connection on your PC: Switch this connection off and start the network search again
•The use of a standard patch cable in a direct connection (peer-to-peer)

If the module you have selected appears in black in the list, immediate operation is possible.

If the module appears in gray in the list, mark it and click on the **“Edit network settings"** button.



- Check your settings and adjust if necessary as follows:

To configure the IP address of the module

- Activate DHCP/APIPA for automatic configuration. Please set any PC directly connected to QuantumX to DHCP as well.
- Manual configuration: Deactivate DHCP and enter the same subnet mask address as used with your PC.

Change the IP address of your module so that it permits communication (see example below)

Example:
Setting the IP address manually - module side

Settings	IP address	Subnet mask
Module before	169.1.1.22	255.255.255.0
PC / notebook	172.21.108.51	255.255.248.0
Module after	**172.21.108.1**	**255.255.248.0**

The first *three* digit groups of the PC and module IP addresses should be the same.

The subnet mask address digit groups must be identical in the module and PC!

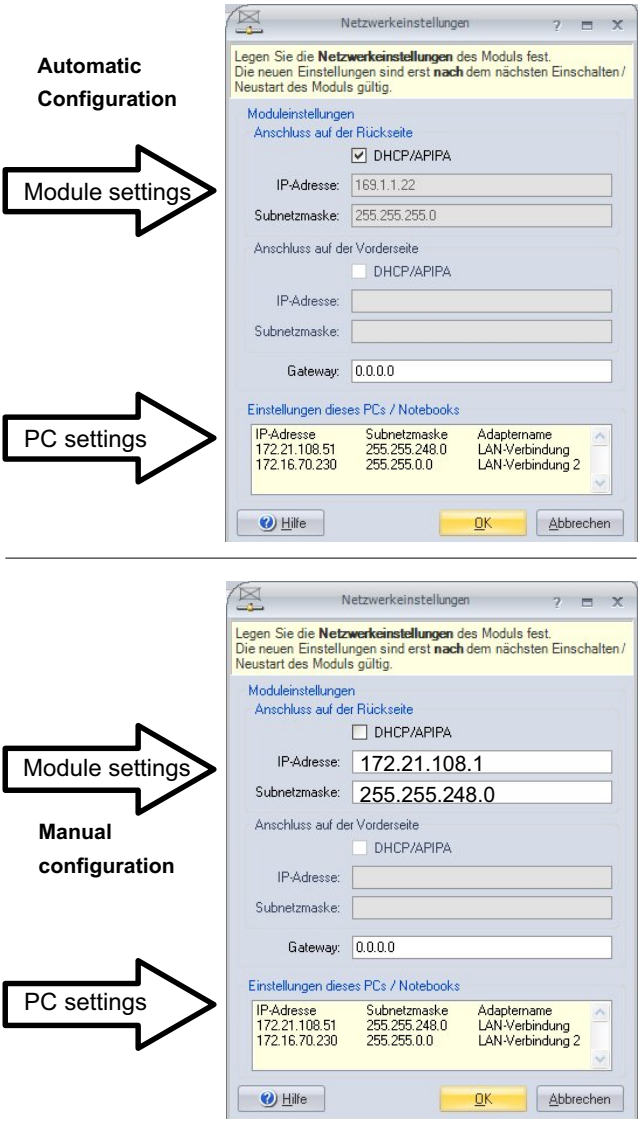
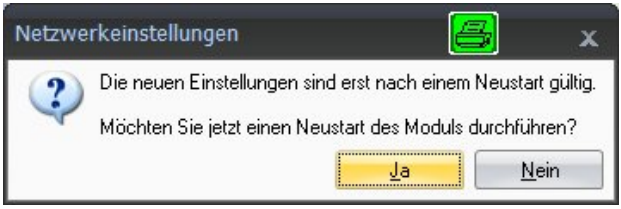


Fig. 6.5 Example of settings for a direct connection

- Click on **“OK"**
- Confirm the settings with the **“Yes"** button. The module is then restarted with the current settings.



After approx. 45 seconds click on the

button.

The system LED of the module should now light up green, if not please check your network settings again! If the network settings are OK, the module names are shown in black.

- Mark the appropriate modules by checking the relevant checkbox,
- Confirm with **“OK.”** Now everything is ready for your first measurement.

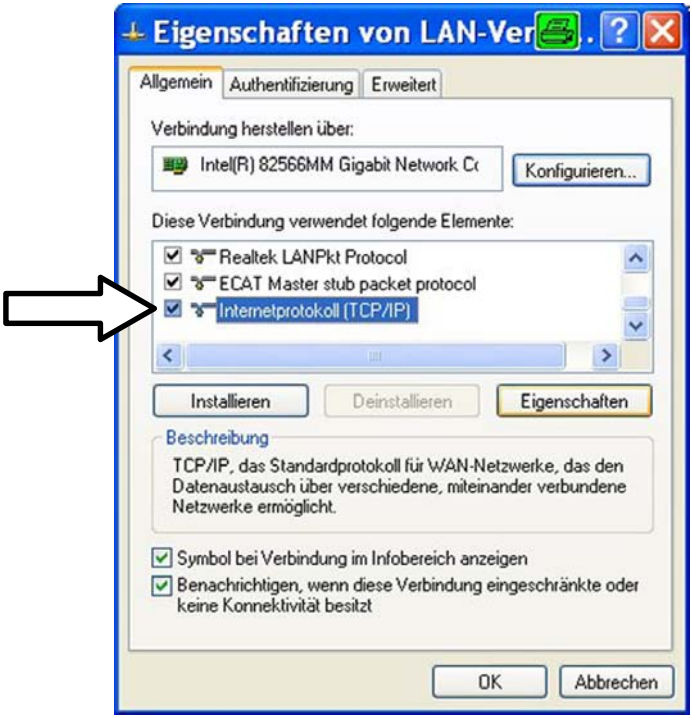
Channel configuration can be found in the online help of your software.

Ethernet settings: adjust the IP address of your PC

If you use your computer in various networks (IP address changes), but your modules have a fixed IP address, you should use the “Alternative Configuration" in the TCP/IP properties (fixed IP address and subnet mask, user-defined)!

Edit the PCs settings as follows:

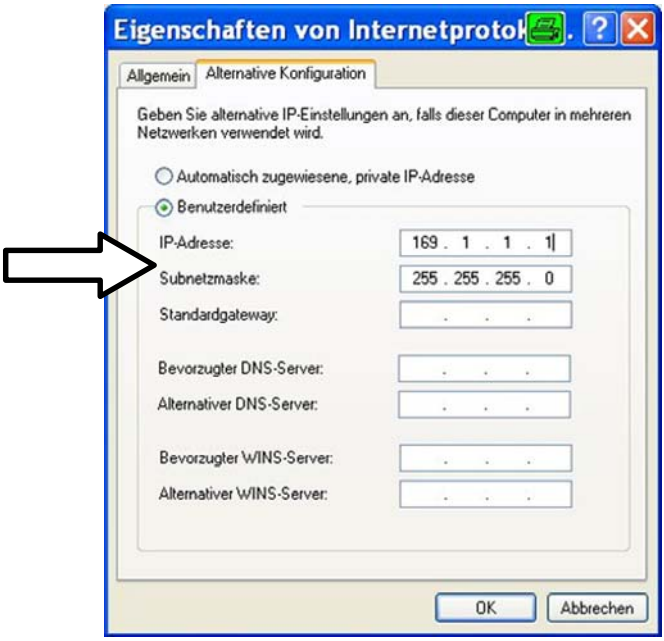
- Open the network connections (Start/Settings/Network connections).
- Right-click to mark your LAN connection and select **“Properties"** in the context menu.
- Select the **“General"** tab and mark Internet (TCP/IP) under **“This connection uses the following items"**. Click on the **“Properties"** button.



- On the **“Alternate Configuration"**, select the **“User-defined"** option and enter your data in the **“IP address"** and **“Subnet mask"** lines.

Example: Setting the IP address manually - PC side

Settings	IP address	Subnet mask
Module before	169.1.1.22	255.255.255.0
PC / notebook before	172.21.108.51	255.255.248.0
PC / notebook after	**169.1.1.1**	**255.255.255.0**

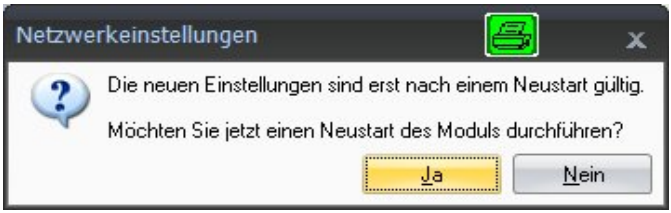


- Confirm twice with **“OK"**.

In future your computer will use the **“Alternate Configuration"** for the direct connection.

Integrating modules in an Ethernet network

- Activate the DHCP checkbox and click on **“OK"**. The following confirmation window then appears:



- Confirm the settings with the “Yes" button. The module is then restarted with the current settings.
- After approx. 45 seconds click on the 

button.

The system LED of the module should now light up green, if not please check your network settings again! If the network settings are OK, the module names are shown in black.

- Mark the appropriate modules by checking the relevant checkbox
- Confirm with **“OK"**

Channel configuration can be found in the online help of your software.

6.2.5 Firmware update via Ethernet

We recommend updating the module firmware:

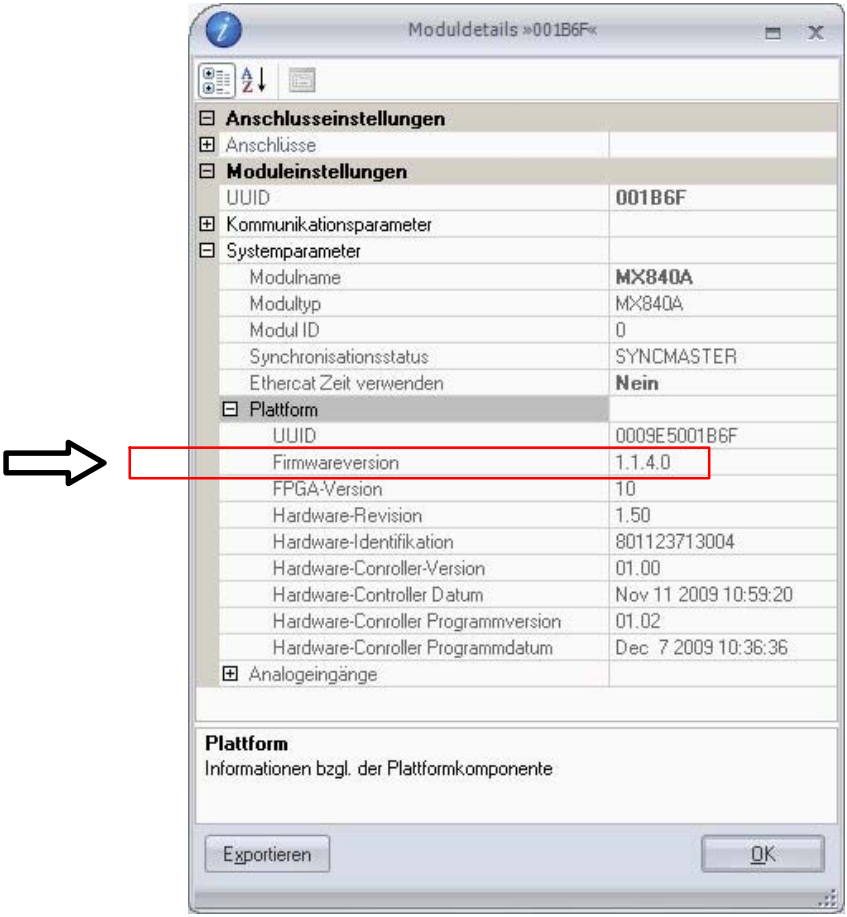
- if you want to use new HBM software
- if you want to use a new module with a different firmware version

Your PC software must also be updated

- if you want to update the firmware of your module to be able to use new functions

Use the QuantumX Assistant as follows to determine which firmware version your module is working with:

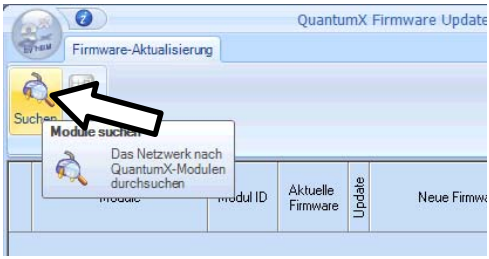
- Right-click on **Module -> Details -> System parameters**



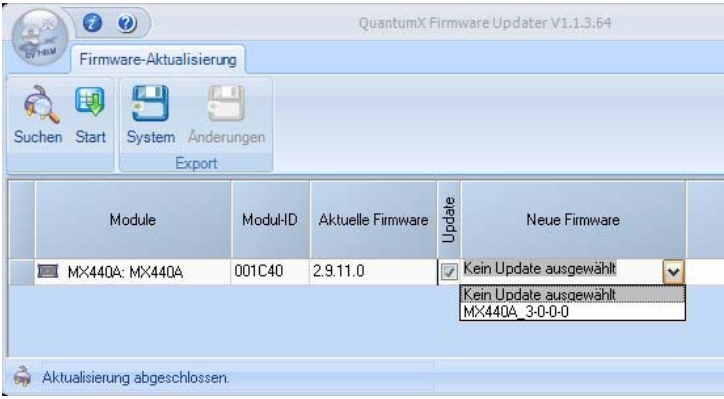
- Compare your version with the current firmware version on the Internet under: www.hbm.com/quantumX

If the firmware version number of your module is lower than the current number on the Internet, you can perform an update as follows:

- Download the current software package from the HBM website (QuantumX firmware downloader, QuantumX Assistant, etc.)
- Close all open HBM software, install the new software and start the QuantumX Firmware Updater
- Download the current firmware from the HBM website and save it in the download directory of the firmware updater (in most cases: C:Program FilesHBMQuantumX Firmware UpdateDownload)
- Click on the **“Find modules"** symbol or press the F4 function key



- Select the module
- Select the required version in the **“New firmware"** dropdown menu
- Activate the modules whose firmware you want to update by checking the boxes in the column **“Update"** and then click on the **“OK"** button



- Press the **"Start"** button and wait until the update is complete (do not interrupt the process/do not switch off the modules/do not interrupt the connection)

Note

You can update the firmware of the modules directly via FireWire and Ethernet or via the Ethernet connection of the CX27 gateway.

6.2.6 Connection via FireWire (IEEE 1394b)

General information

- Baud rate of 400 MBaud (approx. 50 MByte/s)
- Asynchronous (all nodes) or isochronous (in real time) data transmission
- Data synchronization
- Supply voltage via FireWire connection cable (max. 1.5 A)

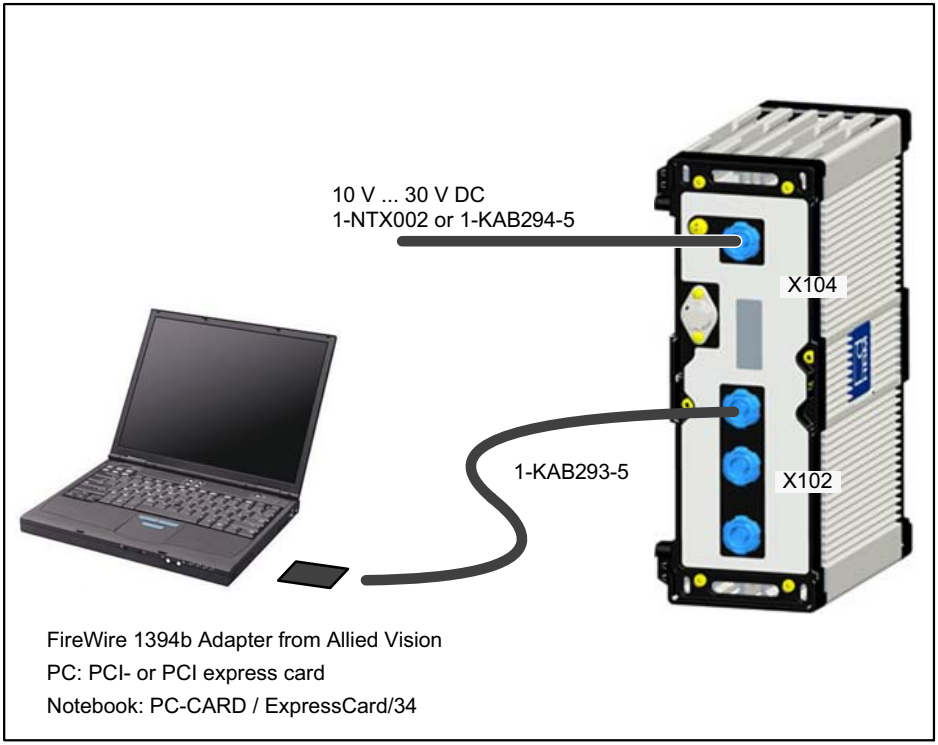


Fig. 6.6 Single FireWire connection

Note

Please check in advance whether a firmware or software update is required. Software/firmware downloads can be found on the HBM website: www.hbm.comdownloads

6.2.7 Setting up FireWire

- Integrate the FireWire PC adapter into your computer.
- Install the “t1394bus_installwizard.exe” driver wizard, available from the QuantumX system CD or catman®AP CD (target directory C:Program FilesHBMFireWire or similar). Double click to start the program.

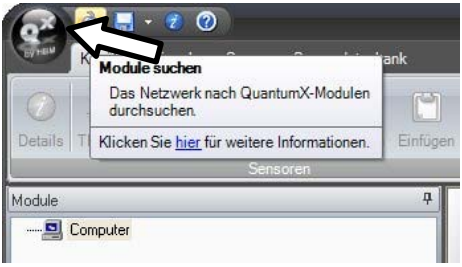
Note

For troubleshooting you can switch to the original FireWire driver with “t1394bus_installwizard.exe". After the driver is installed you will find it on your hard disk.

- After installation and configuration, connect the FireWire cable first to the PC adapter and then to the first module. Activation is confirmed acoustically by Windows.

Whenever you connect a new module to your computer via FireWire, you are prompted one time by the operating system to register the module. When you do this, please refer to the “hbm1394.sys" driver.

- Install and then start the current QuantumX Assistant on your PC.
- Click on the  icon (Find modules) or press the F4 function key.



The “Modules found" field shows all modules found via FireWire.

- If your modules are not yet displayed, mark **“Search the complete network"** and click again on the 

button.
- Mark the appropriate modules by checking the relevant checkbox
- Confirm with **“OK"**

This completes the settings for your connection. Connect your transducer now. Connection information can be found in the “QuantumX operating instructions".

Information about further channel configuration can be found in the online help of the HBM software you are using.

Note

If no modules are found via FireWire this may be caused by one of the following reasons:
-The modules have not been properly registered. Click on the FireWire driver in the systray, check the driver after the modules and reinstall it if necessary (hbm1394.sys).
-Check all connections between modules.

6.2.8 Multiple FireWire connection

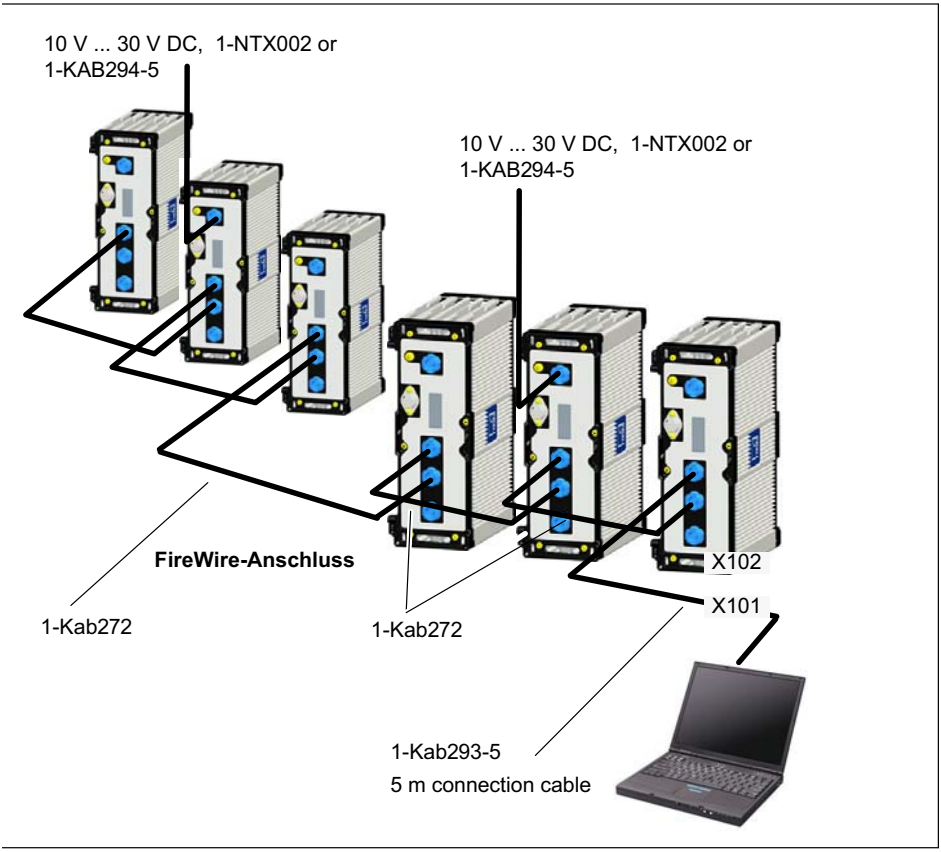


Fig. 6.7 Example of multiple connection via FireWire with synchronization

Data is transferred, modules are synchronized in timing and voltage is supplied via the FireWire connections. You can connect a maximum of 12 modules in series with each other.

Note

Different supply voltage sources need to have the same reference potential and should be in the same voltage range. Voltage drops occur as a result of cable resistance and internal protective circuits; therefore, a considerably lower supply voltage is applied to the last module in the chain. Make sure that at least 10 V is applied to the last module.

6.2.9 Output measurement signal to CAN bus (MX840A)

Measurement signals of connectors 2-8 are output to the CAN bus via connector.

Fig. 6.8 Output to CAN bus (MX840A-P, connection 1)

6.2.10 Output measurement signals to CAN bus (MX471-P)

Isochronously parameterized signals can be output.

The parameterization is permanently stored in the modules (EEPROM). To simplify parameterization on the opposite side, a CAN db (*.dbc) can be generated using the QuantumX Assistant software.

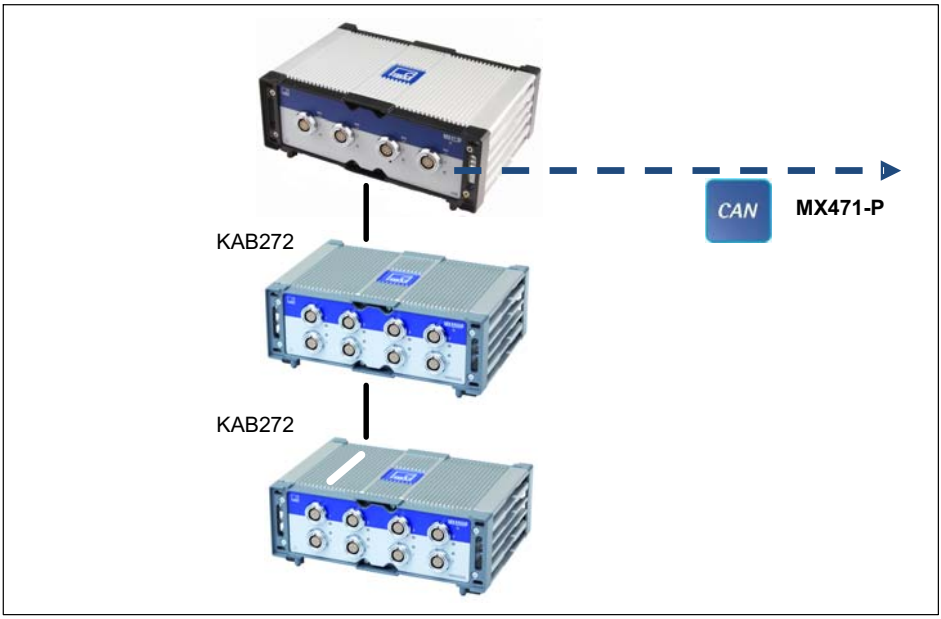


Fig. 6.9 Output to CAN bus (MX471-P, every connection)

6.2.11 Output signals in real time via EtherCAT® and in parallel via Ethernet

Each source in a QuantumX system is distributed into two signals, to which different data rate and filtering parameters can be assigned.

For example, the *first* signal of an input channel with a high data rate, e.g. acceleration sensor with 96,000 measured values per second and deactivated filter (38 kHz maximum bandwidth), can be output to PC software for analysis while the *second* signal with 4800 measured values per second and a 600 Hz filter can be output via CAN or EtherCAT®.

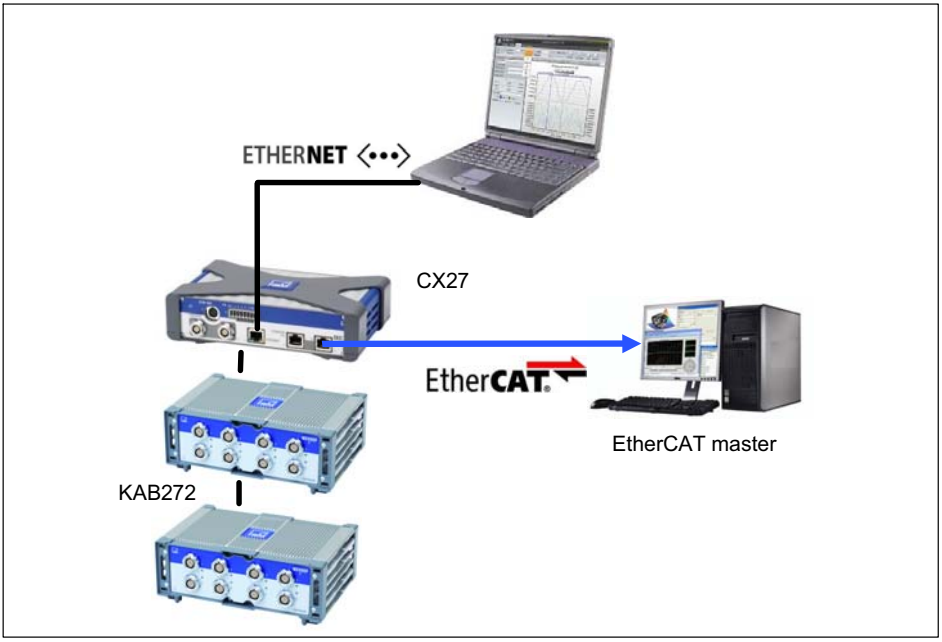


Fig. 6.10 Output in real time via EtherCAT® and in parallel via Ethernet

6.2.12 Connecting more than 12 modules

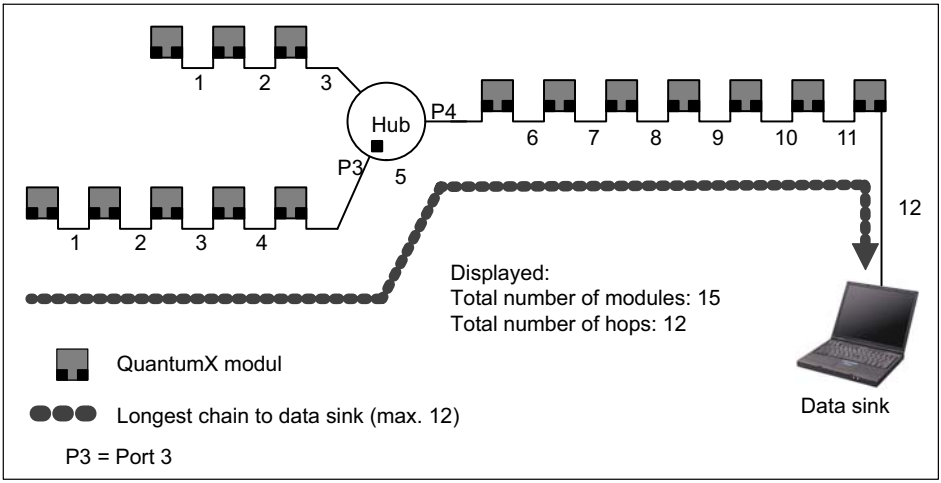


Fig. 6.11 Example of a star topology with two chains and one hub

The number of modules connected in series (daisy chain) is limited to 12. If you want to connect more modules (maximum 24), you must use hubs. Hubs are devices that connect network chains together in star configurations. This connection mode is again limited to 14 hops.

A hop is the transition from one module to another (this means n-1 hops for n QuantumX modules in a chain).

Depending on the connection situation, 1 to 2 hops are counted in one hub (*see Fig. 6.12*).

To count the total number of hops, the longest chain to the data sink must be counted (worst case).

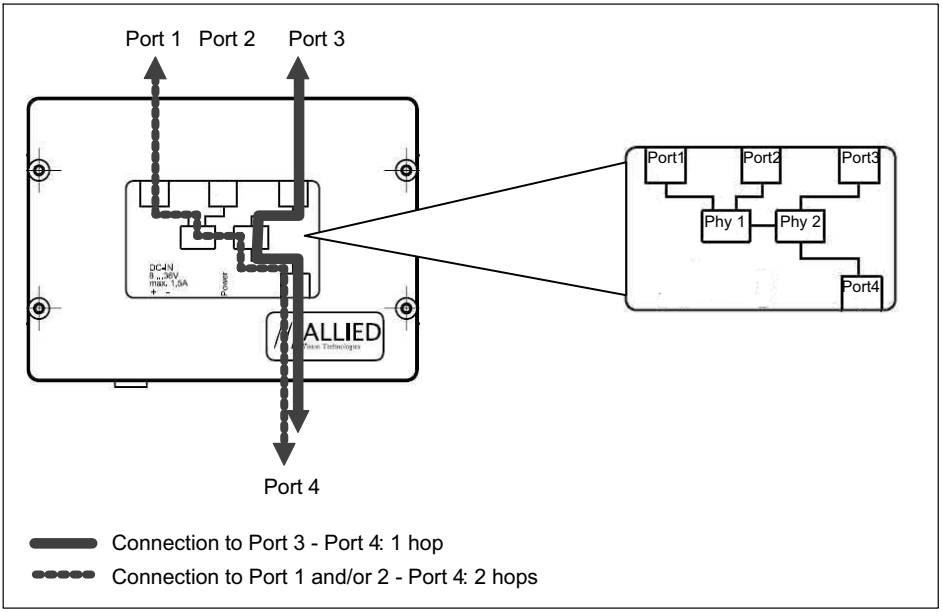


Fig. 6.12 Connection situation on the AVT 1394b hub

Note

Always connect the chain with the most modules to Port 3 or Port 4.

6.2.13 FireWire - optical connection up to 300 m

Greater distances in FireWire networks can be bridged with optohubs that enable distances of up to 300 m with the use of a fiber optical cable.

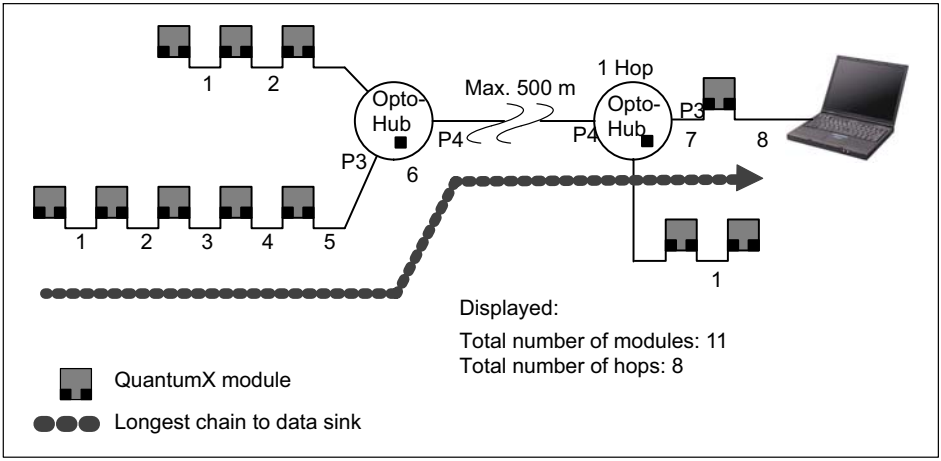


Fig. 6.13 Example of the use of optohubs

6.2.14 FireWire with optohub and fiber optical cable

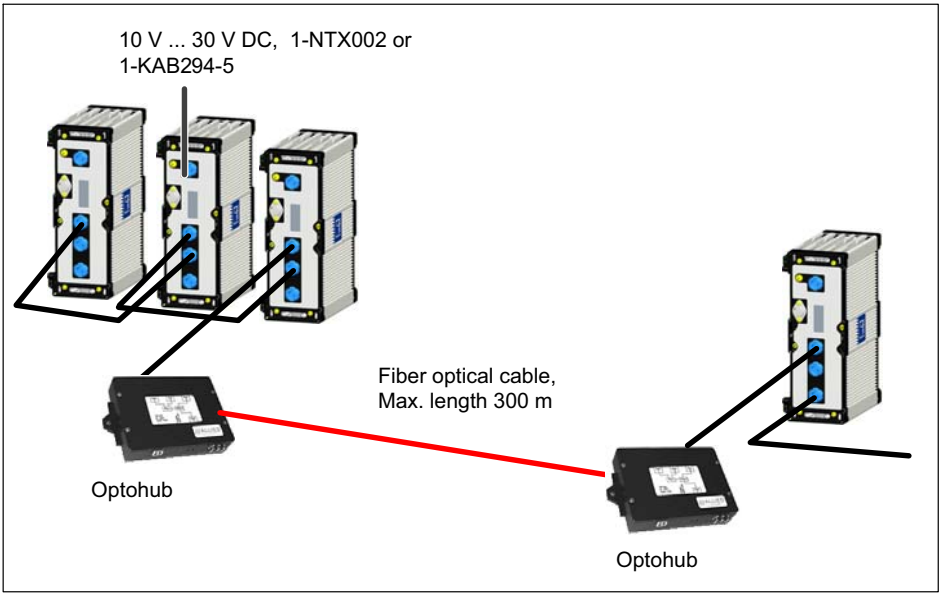


Fig. 6.14 FireWire 1394b optohubs and fiber optical cable from HBM partner Allied Vision Technologies

7 Modules and transducers

7.1 General information

7.1.1 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 measurement 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 interferences. 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.

The HBM Greenline shielding concept

The measuring chain is completely enclosed by a Faraday cage by appropriate routing of the cable shield. The cable shield is extensively connected with the transducer housing and is routed via the conductive plug to the amplifier housing. The influence of electromagnetic interferences is significantly reduced by these measures.

Note

All parts of the measurement chain (including all cable connection points such as plugs and couplings) must be surrounded by a closed EMC-proof shield. Shield junctions must represent a full contact, closed and low-impedance connection. This is the case for original HBM plug connections.
Ground connection and grounding

As the signal ground and shielding are separated in EMC-compliant cabling, the shielding can be connected at more than one point to the ground, i.e. via the transducer (metal housing) and the amplifier (housing is connected to the earth conductor).

If there are differences in potential in the measuring system, a potential compensating line must be laid (reference value: Highly flexible stranded wire, wire cross section 10 mm^2). Signal and data leads must be set up physically separated from current-carrying power lines. Ideally, cable ducts made of sheet metal with an internal partition should be used. Signal ground, earth and shielding must be laid out as separated as possible.

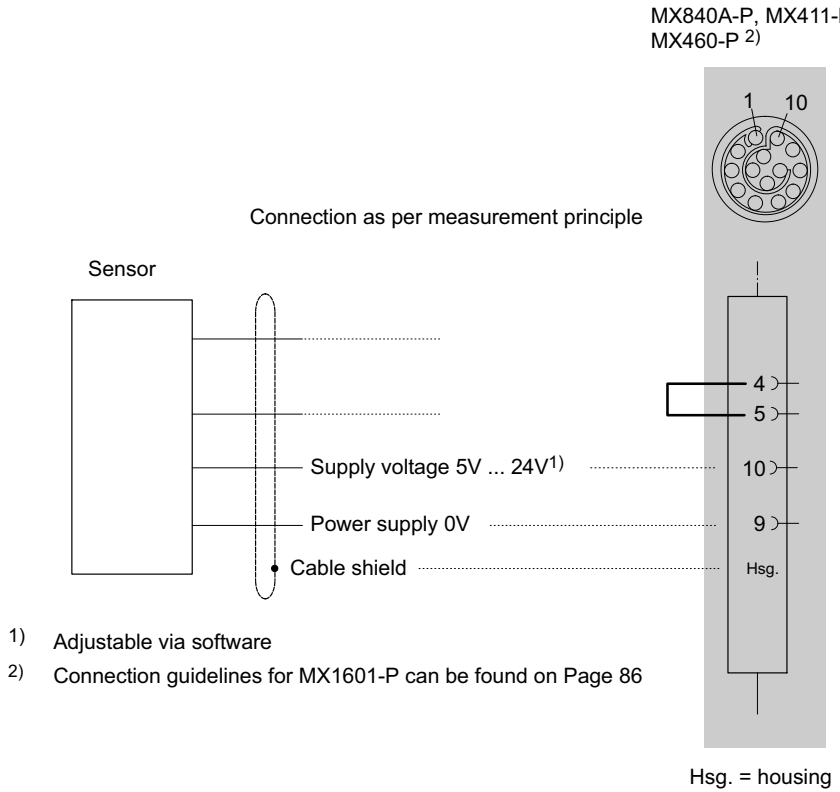
In order to minimize the influence of electromagnetic interferences and differences in potential, the signal ground and earth (or shielding) are designed to be physically separate in the HBM devices. The mains earth connector or a separate earth potential lead should serve as the earth connection as is the case for example regarding potential compensation in buildings. The earth cable should not be connected to a radiator body, water pipe or similar objects.

7.1.2 Active transducer connection

Some modules can supply active transducers with a supply voltage of 5…24 V.

When using the adjustable transducer excitation, electrical isolation from the supply voltage of the amplifier is not required.

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



1) Adjustable via software

2) Connection guidelines for MX1601-P can be found on Page 86

CAUTION

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 MX840 parameterization and can only be changed with a new parameterization. The sensor supply is switched off in the delivery condition.

7.1.3 TEDS

TEDS stands for “Transducer Electronic Data Sheet" and refers to the electronic data sheet of a transducer or sensor that is stored in a small electronic chip or appropriate module which is permanently connected to the device.

In addition, valuable meta-data such as calibration data are delivered providing important information for the traceability of measurements or tests. The electronic data sheet can be located in the transducer housing, in the inseparable cable or connector plug.

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

Transducer information stored in the TEDS data memory:

- The physical unit of the measured quantity (N for force, for example) and its measuring range
- The unit of the electrical output signal (mV/V for bridge transducers, for example)
- The linear characteristics as the relation between the measured quantity and the electrical signal
- If applicable, the requisite excitation and electrical power supply of the transducer

Additional information, that could be read out using relevant software, for example:

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

The amplifiers in the QuantumX series are capable of reading the transducer information stored in the data sheet and automatically converting it into amplifier

settings to enable rapid and safe measurement operation.

The electronic data sheet is read automatically as soon as the transducer is connected to the device. The electrical bridge between two pins in the plug serves as the “transducer identification". The amplifier switches automatically to the configured measurement mode after the digital identification mode.

The TEDS data can also be read in via a software command, e.g. with catman®AP.

QuantumX Rugged DAQ supports several options for reading and writing TEDS data:

- It is possible to access a TEDS module via two separate cable wires (“one-wire circuit") or retrofit TEDS in the transducer connector.
- Amplifiers with direct connection of IEPE transducers support TEDS Version 1.0.
- A special TEDS module is integrated in some HBM transducers, this can transmit the TEDS data via the feedback line of a sensor (patented “zero-wire circuit").
  The amplifier switches to the measurement mode after the digital communication (data mode). These transducers include the force transducer U93 for example.
- Thermocouple amplifiers with RFID chips on the transducer connector support the TEDS technology in order to, e.g. connect the measuring point electronically with the transducer.

The data sheet of each amplifier includes further specifications with regards to TEDS, e.g. the maximum possible cable length to the transducer. If TEDS is not

used, the possible cable length can be significantly longer.

Note

Further information about TEDS topics can be found on the HBM Internet pages: http://www.hbm.com/teds

Retrofitting TEDS in transducer connectors

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

The following figure shows the retrofitting of TEDS in a plug.

HBM recommends the TEDS module (1-wire® EEPROM) DS24B33 from Dallas Maxim. Minimum requirements to read and write this chip are firmware version 1.21.16 / 2.21.16 and TEDS Editor version 3.3.

7.1.4 Autocalibration / Autoadjustment

Measurement channels with full/half bridge mode are cyclically calibrated during the runtime following the start of the module. This mechanism improves long-term stability (ageing) and also the short-term stability of an amplifier if there are temperature fluctuations at the site of the measuring device.

The *autocalibration* briefly interrupts measurement and - in place of the measured values from the transducer - sends signals from an internal calibration source to the AD converter (zero and reference signal).

The MX840A-P amplifiers have *autoadjustment*.

These amplifiers have a second measurement circuit in the full/half bridge measurement mode, which measures in parallel to the input circuit and implements a calibration cycle in a 30 second rhythm. This ensures long-term and short-term stability in this circuit. The accuracy of the calibration channel is therefore transferred to the measurement channel with a patented process.

This allows the modules to achieve a high stability without having to cyclically freeze the measured value.

Autoadjustment is switched on the default settings. The cyclical calibration can be briefly deactivated via the QuantumX Assistants and via catmanEASY®.

7.2 MX840A-P universal amplifier

The universal amplifier MX840A-P provides 8 universal channels for connecting amplifiers, sensors or CANbus.

The amplifier can be connected to the CANbus via Connection 1, whereby up to 128 signals can be recorded or the digitalized measurement data of the module can be cyclically transmitted.

Connections 5 to 8 provide digital timer inputs.

Transducer socket: 14-pin ODU

Connectable MX840A-P transducers

	Transducer type	Connection sockets	See Page
	SG full bridge	1 ... 8	95
	Inductive full bridge	1 ... 8	96
	SG half bridge	1 ... 8	98
	Inductive half bridge	1 ... 8	99
	LVDT	1 ... 8	101
	Voltage	1 ... 8	106, 107
	Current	1 ... 8	109
	Current-fed piezoelectric transducer (IEPE, ICP®)	1 ... 8	102
	Piezoresistive transducer	1 ... 8	97
	Ohmic resistor	1 ... 8	112
	Potentiometer	1 ... 8	100

	Transducer type	Connection sockets	See Page
	Resistance thermometers PT100, PT1000	1 ... 8	113
min⁻¹	Incremental encoder	5 ... 8	from 116

Connectable MX840A-P transducers (continued)

	Transducer type	Connection sockets	See Page
SSI	SSI protocol	5 ... 8	122
f	Frequency measurement, pulse counting	5 ... 8	from 116
	Torque/speed	5 ... 8	117, 118
CAN	CANbus	1	126

7.2.1 MX840A-P pin assignment

So that insertion or removal of a transducer connection can be unmistakably identified, Pin 4 and Pin 5 in the connector plug must be bridged! If this bridge is missing, no measurement values will be recorded at the connection!

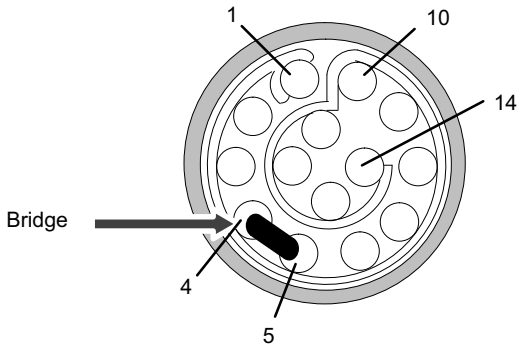


Fig. 7.1 Pin arrangement of connection plug, view from the solder side

Pin	Connection
1	Bridge excitation voltage (-), 0°-reference pulse (zeroing pulse) (-)
2	Bridge excitation voltage (+), 0°-reference pulse (zeroing pulse) (+)
3	Voltage input 10 V (+), 60 V (+)
4	Signal ground
5	Always connect with Pin 4! (Plug-in detection)
6	Current input ±20 mA (+)
7	Measurement signal (+), potentiometer measurement signal (+), voltage input 100 mV (+), f_1(-)-signal differential, SSI data (-)
8	Measurement signal (-), f_1(+)-signal differential, SSI data (+)
9	Active sensor supply 5 ... 24 V (0 V)
10	Active sensor supply 5 ... 24 V (+)
11	Sense lead (-), f_2(-)-signal differential, CAN-High, SSI clock (-)

Pin	Connection
12	Sense lead (+), f_2(+)-signal differential, CAN-Low, SSI clock (+)
13	TEDS (-), ground frequency measurement
14	TEDS (+)

7.2.2 MX840A-P status display

The front panel of the universal amplifier has a system LED and 8 connection LEDs. The system LED indicates the status of the device, the connection LEDs the states of the individual connections.

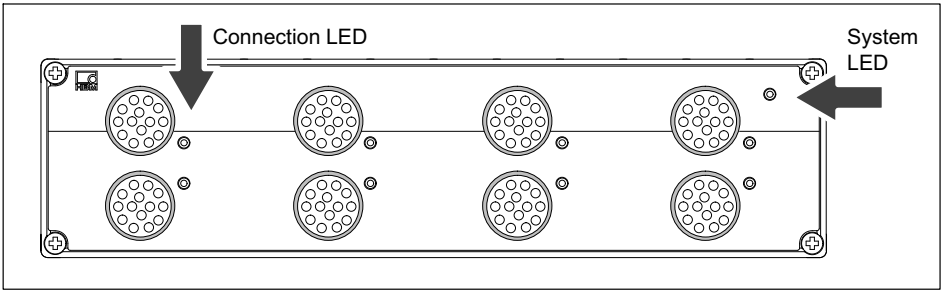


Fig. 7.2 MX840-P front view

System LED	
Green	Error-free operation
Orange	System is not ready, boot procedure running
Flashing orange	Download active, system is not ready
Red	Error
Connection LEDs	
All LEDs are orange	Boot procedure running (system is not ready)

All LEDs are flashing orange	Firmware download active (system is not ready)
Orange	Connection newly assigned, transducer identification running (calibration)
Green	Error-free operation
Flashing green (5s), then green	TEDS data being read in
Flashing orange (5s), then green	Manual configuration ongoing (ignore TEDS)
Red	No sensor connected Channel error (incorrectly parameterized, connection error, invalid TEDS data)
CAN LEDs	
Green	CANbus activated, CAN data can be received
Orange	CANbus in “WARNING" state, CAN data received but bus is occasionally disturbed; buffer overflow, individual data lost
Red	CANbus in “ERROR" or “BUS-OFF" state, CAN data cannot be received or processed

General rule: Brief flashing →TEDS identified (green: is used, orange: is not used).

7.3 MX411-P highly dynamic universal amplifier

You can connect up to four transducers to the highly dynamic universal amplifier MX411-P. Transducers are connected via a 14-pin ODU device socket.

All measuring channels are electrically isolated from one another and from the mains. When using the adjustable transducer excitation, electrical isolation from the supply voltage of the amplifier is not required.

Connectable MX411-P transducers

	Transducer type	Connection sockets	See Page
	SG full bridge	1 ... 4	95
	Inductive full bridge	1 ... 4	96
	Inductive half bridge	1 ... 4	99
	SG half bridge	1 ... 4	98
	Voltage	1 ... 4	106, 107
	Current	1 ... 4	109
	Current-fed piezoelectric transducer (IEPE, ICP®)	1 ... 4	102
	Piezoresistive transducer	1 ... 4	97

7.3.1 MX411-P pin assignment

So that insertion or removal of a transducer connection can be unmistakably identified, Pin 4 and Pin 5 in the connector plug must be bridged! If this bridge is missing, no measurement values will be recorded at the connection!

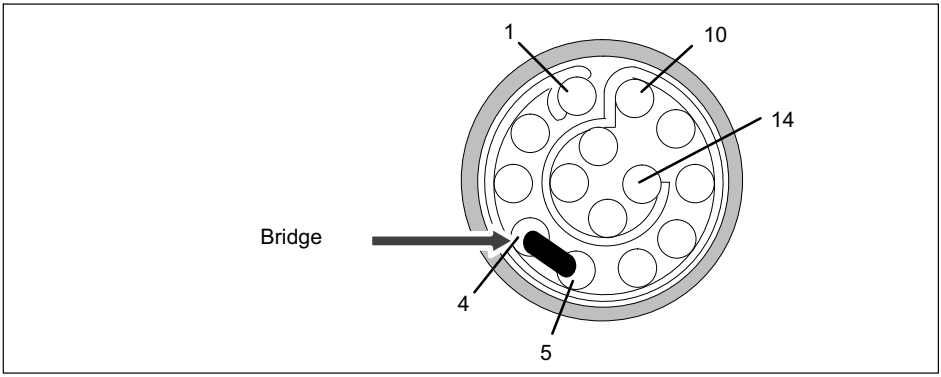


Fig. 7.3 Pin arrangement of connection plug, view from the solder side

Pin	Connection
1	Bridge excitation voltage (-)
2	Bridge excitation voltage (+)
3	Voltage input 10 V, IEPE (+)
4	Signal ground
5	Always connect with Pin 4! (Plug-in detection)
6	Current input ±20 mA (+)
7	Measurement signal (+)
8	Measurement signal (-)
9	Active sensor supply (-)
10	Active sensor supply (+)
11	Sense lead (-)
12	Sense lead (+)
13	TEDS (-)
14	TEDS (+)

7.3.2 MX411-P status display

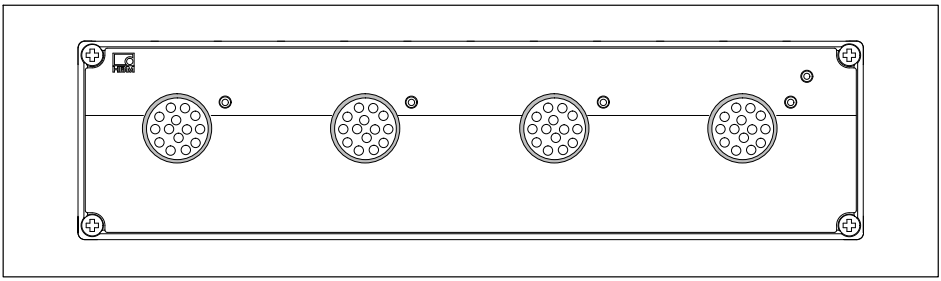


Fig. 7.4 MX411-P front view

System LED	
Green	Error-free operation
Orange	System is not ready, boot procedure running
Flashing orange	Download active, system is not ready
Red	Error
Connection LEDs	
All LEDs are orange	Boot procedure running (system is not ready)
All LEDs are flashing orange	Firmware download active (system is not ready)
Orange	Connection newly assigned, transducer identification running (calibration)
Green	Error-free operation
Flashing green (5s), then green	TEDS data being read in
Flashing orange (5s), then green	Manual configuration ongoing (ignore TEDS)
Red	No sensor connected Channel error (incorrectly parameterized, connection error, invalid TEDS data)
Red	Overload of sensor supply

General rule: Brief flashing →TEDS identified (green: is used, orange: is not used).

7.4 MX460-P frequency measuring amplifier

You can connect up to four transducers to the frequency measuring amplifier MX460-P. Transducers are connected via a 14-pin ODU device socket. All measuring channels are electrically isolated from one another and from the mains. When using the adjustable transducer excitation, electrical isolation from the supply voltage of the amplifier is not required.

Connectable MX460-P transducers

	Transducer type	Connection sockets	See Page
	Torque/speed	1 ... 4	117, 118
	Frequency measurement, pulse counting	1 ... 4	from 116
	Pulse width, pulse duration, period duration (PWM)	1 ... 4	125
	Passive inductive encoder	1 ... 4	123
	Incremental encoder	1 ... 4	from 116

7.4.1 MX460-P pin assignment

So that insertion or removal of a transducer connection can be unmistakably identified, Pin 4 and Pin 5 in the connector plug must be bridged! If this bridge is missing, no measurement values will be recorded at the connection!

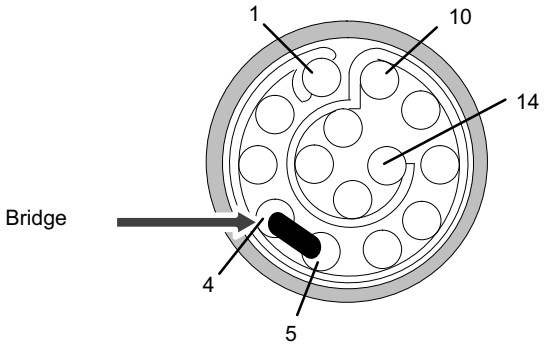


Fig. 7.5 Pin arrangement of connection plug, view from the solder side

Pin	Connection
1	Reference pulse 0° (zeroing pulse) (-)
2	Reference pulse 0° (zeroing pulse) (+)
3	f_1 AC+ (for passive inductive transducers)
4	Reference voltage V_{ref} (2.5 V)
5	Always connect with Pin 4! (Plug-in detection)
6	No function
7	Frequency input f_1 (-)
8	Frequency input f_1 (+)
9	Active sensor supply 5 ... 24 V (-)
10	Active sensor supply 5 ... 24 V (+)

Pin	Connection
11	Frequency input f_2 (-)
12	Frequency input f_2 (+)
13	TEDS (-), signal ground
14	TEDS (+)

7.4.2 MX460-P status display

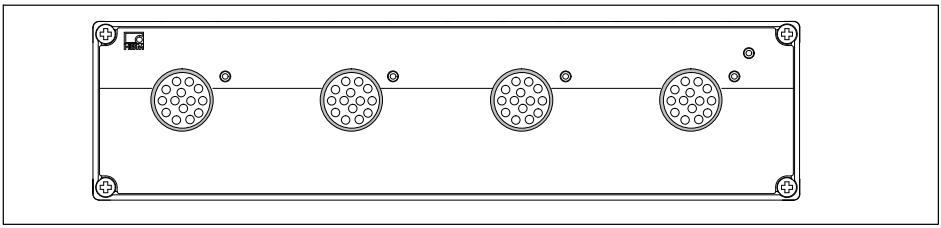


Fig. 7.6 MX460-P front view

System LED	
Green	Error-free operation
Orange	System is not ready, boot procedure running
Flashing orange	Download active, system is not ready
Red	Error
Connection LEDs	
All LEDs are orange	Boot procedure running (system is not ready)
All LEDs are flashing orange	Firmware download active (system is not ready)
Orange	Connection newly assigned, transducer identification running (calibration)
Green	Error-free operation
Flashing green (5s), then green	TEDS data being read in

Flashing orange (5s), then green	Manual configuration ongoing (ignore TEDS)
Red	No sensor connected Channel error (incorrectly parameterized, connection error, invalid TEDS data)

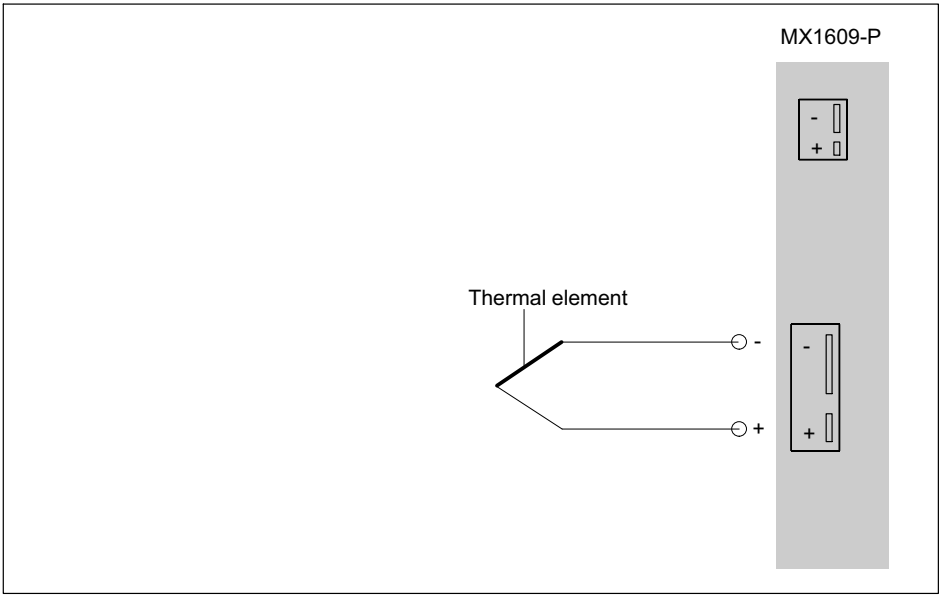
General rule: Brief flashing →TEDS identified (green: is used, orange: is not used).

7.5 MX1609-P thermocouple amplifier

Up to 16 type K thermocouples (Ni-CrNi) can be connected to the module MX1609-P for measuring temperatures.

Connectable MX1609-P transducers

	Transducer type	Connection sockets
	Thermocouple type K	1 ... 16



Type	Thermocouple material 1 (+)	Thermocouple material 2 (-)
K	Nickel-chrome (color code green)	Nickel-aluminum (color code white)

7.5.1 Thermocouple with TEDS functionality (RFID)

Measuring point identification

An RFID[1)] chip in or on the thermocouple plug ensures wireless transducer identification through the amplifier. RFID technology enables contactless reading and writing of data such as the precise measuring point or the required physical unit (°C or °K). The data are input with the TEDS Editor provided by HBM. They are then written

1) RFID = Radio Frequency Identification: Method for communication between transponder and read/write device with magnetic fields or electromagnetic waves.

onto the RFID chip via a corresponding RFID transponder in the amplifier.

The chip is reusable and works without batteries.

Rescaling

The MX1609-P has a rescaling function. Errors from thermocouples or installation situations can be minimized using a table that converts values from degree °C to degree °C.

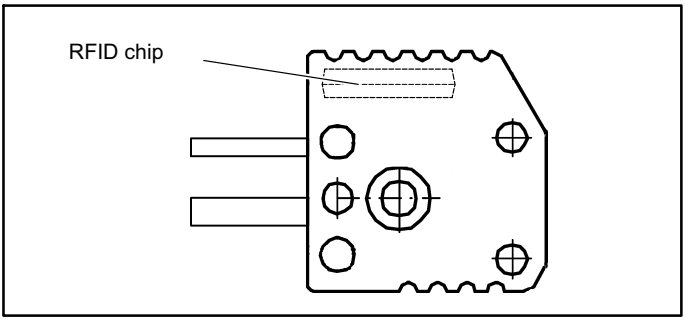
The MX1609-P can process maximum 64 value pairs. 14 value pairs can be stored in the TEDS template “Calibration Table" if no additional optional templates are used.

This function delivers the best results when the ambient temperature of the MX1609-P, and therefore the temperature of the cold junction, is kept constant.

Conditions for using RFID chips for measuring point identification:

- All channels can read/write via RFID
- The neighboring channel must not be occupied in the MX1609-P during writing
- Maximum distance chip to housing: 1 mm
- For self-assembly: Check position of chip on plug

Thermocouple plug with integrated RFID chip from HBM



The chip for measuring point identification is already integrated in the HBM THERMO-MINI.

7.5.2 MX1609-P status display

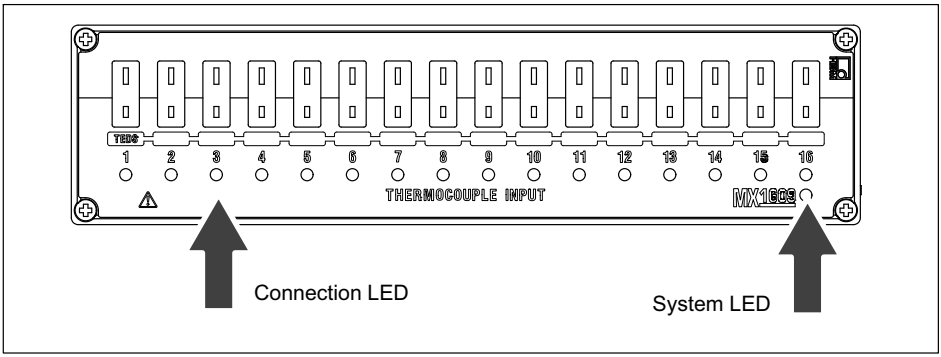


Fig. 7.7 MX1609-P front view

System LED	
Green	Error-free operation
Orange	System is not ready, boot procedure running

Flashing orange	Download active, system is not ready
Red	Error
Connection LEDs	
All LEDs are orange	Boot procedure running (system is not ready)
All LEDs are flashing orange	Firmware download active (system is not ready)
Orange	Connection newly assigned, transducer identification running (calibration)
Green	Error-free operation (“Ignore TEDS" or “if available" set, channel is manually configured)
Flashing green (5s), then green	Error-free operation (“Use TEDS" or “if available" set and TEDS data valid)
Red	No sensor connected Channel error (incorrectly parameterized, connection error, invalid TEDS data)
Red	Overload of sensor supply

General rule: Brief flashing →TEDS identified (green: is used, orange: is not used).

7.6 MX1601-P amplifier

You connect up to 16 freely configurable inputs for voltage (10 V, 100 mV) or current (20 mA) or current-fed piezoelectric sensors (IEPE) to the MX1601-P.

Transducers are connected via an 8-pin Odu sockets. This module has been replaced by the SomatXR MX1601B-R module with 14-pin ODU.

All measuring channels are electrically isolated from one another and from the mains. When using the adjustable transducer excitation, electrical isolation from the supply voltage of the amplifier is not required.

Connectable MX1601-P transducers

	Transducer type	Connection sockets	See Page
	Voltage	1 ... 16	106, 107
	Current	1 ... 16	109
	Current-fed piezoelectric transducer (IEPE, ICP®)	1 ... 16	102

7.6.1 MX1601-P pin assignment

So that insertion or removal of a transducer connection can be unmistakably identified, Pin 2 and Pin 5 in the connector plug must be bridged! If this bridge is missing, no measurement values will be recorded at the connection!

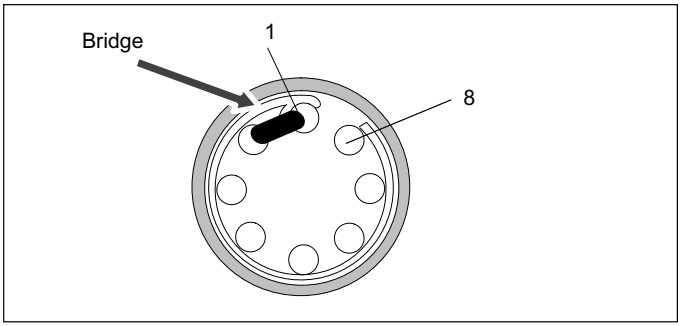


Fig. 7.8 Pin arrangement of connection plug, view from the connection side

Pin	Connection
1	Always connect with Pin 2! (Plug-in detection)
2	Signal ground
3	Voltage input 10 V (+), 100 mV (+), IEPE (+)
4	Current input 20 mA (+)
5	TEDS (-), internally bridged on pin 2 (signal ground)
6	Active sensor supply (-)
7	Active sensor supply (+)
8	TEDS (+)
Shielding	Housing (shield connection)

Note

The adjustable transducer excitation between 5 ... 24 V is only available on channels 1 ... 8. Channels 9 ... 16 output the supply voltage (10 ... 30 V) minus approx. 1 V. A current of max. 30 mA can be consumed, the current limitation switches the transducer excitation off if current consumption is higher.

7.7 MX471-P CAN module

The MX471-P module provides four independent CAN bus nodes that are all electrically isolated from each other and power supply.

Connectable MX471-P buses

	Type	Connector sockets / nodes	See page
CAN	CAN bus (high-speed CAN)	1 ... 4	126

Connected devices are not directly addressed during data transmission on a CAN bus. A unique identifier denotes the contents of a message (e.g. rotational speed or engine temperature).

The identifier also signifies the priority of the message.

Message = identifier + signal + additional information

Device connected to the bus = node

Each node on the MX471-P can be parameterized either as a receiver or as transmitter (gateway).
Parameterization as receiver is described in section 7.7.3.
Parameterization as transmitter is described in section 7.
The online help that comes with the respective software package provides detailed information about parameterization.

Note

To ensure normal operation, the CAN bus needs to be terminated at both ends, and only there, using appropriate termination resistors.
A 120-ohm termination resistor can be individually connected in the module by software. Termination is also required when short cables with low bit rates are used.

Please refer to the data sheet for the relation between bit rate and maximum bus line length.

The configuration of a node is retained after switching the modules off and on.

For decoding signals at a rate greater than 2000/s, please set up signal inputs 1 to 8 on the MX471-P. The signal buffers of these signal inputs have been expanded accordingly.

7.7.1 MX471-P pin assignment

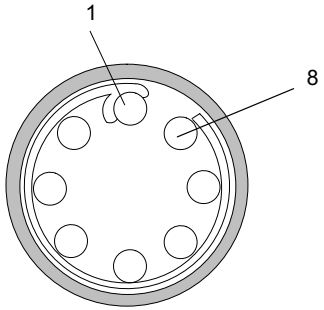
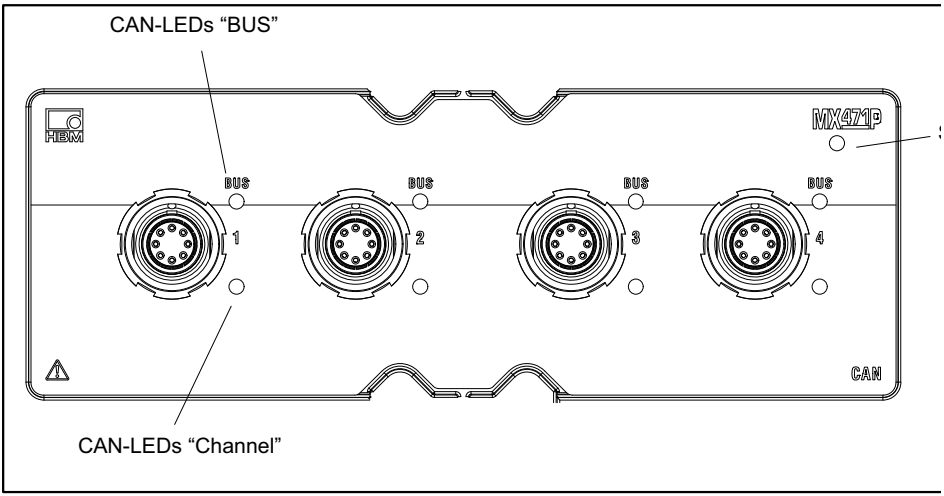


Fig. 7.9 Pin arrangement of connector plug, view from the solder side

Transducer socket: 14-pin ODU

Pin	Connector
1	CAN Low
2	CAN High
3	GND
Shield	Housing (shild connection)

7.7.2 LEDs status display



System LED

Green	Error-free operation
Yellow	System is not ready, boot procedure running
Flashing yellow	Download active, system is not ready
Red	Error, faulty synchronization

CAN LEDs (BUS)

Green flickering	Bus is error-free and activity on CAN
Constant green	Bus is error-free and no activity on CAN
Yellow flickering	Intermittent bus errors (warning) and activity on CAN
Constant yellow	Intermittent bus errors (warning) and no activity on CAN
Red on	Bus error, CAN interface in “Bus-OFF” status

CAN LEDs (channel):

Constant green	Channel is ready for operation
Flashing yellow	Firmware1 download active
Yellow on	Boot process running
Red on	Channel has errors

Ethernet LED:

Green on	Ethernet link status is OK
Flashing yellow	Ethernet data transmission ongoing

7.7.3 Receiving CAN messages

To be able to receive CAN messages, the node must be able to identify the relevant messages. This can be done directly on the node or, in a reproducible way, by previously generated messages in the sensor database. Individual messages can be linked to the node by dragging from the sensor database and dropping them where required.

CAN databases type *.dbc can also be read into the sensor database. If no CAN database is available, it can also be created. Editors for this purpose are provided by different companies.

Received CAN messages are instantly “time-stamped" in measurement mode. This enables directly acquired measured quantities and CAN messages to be acquired and analyzed in parallel and synchronously in the entire system.

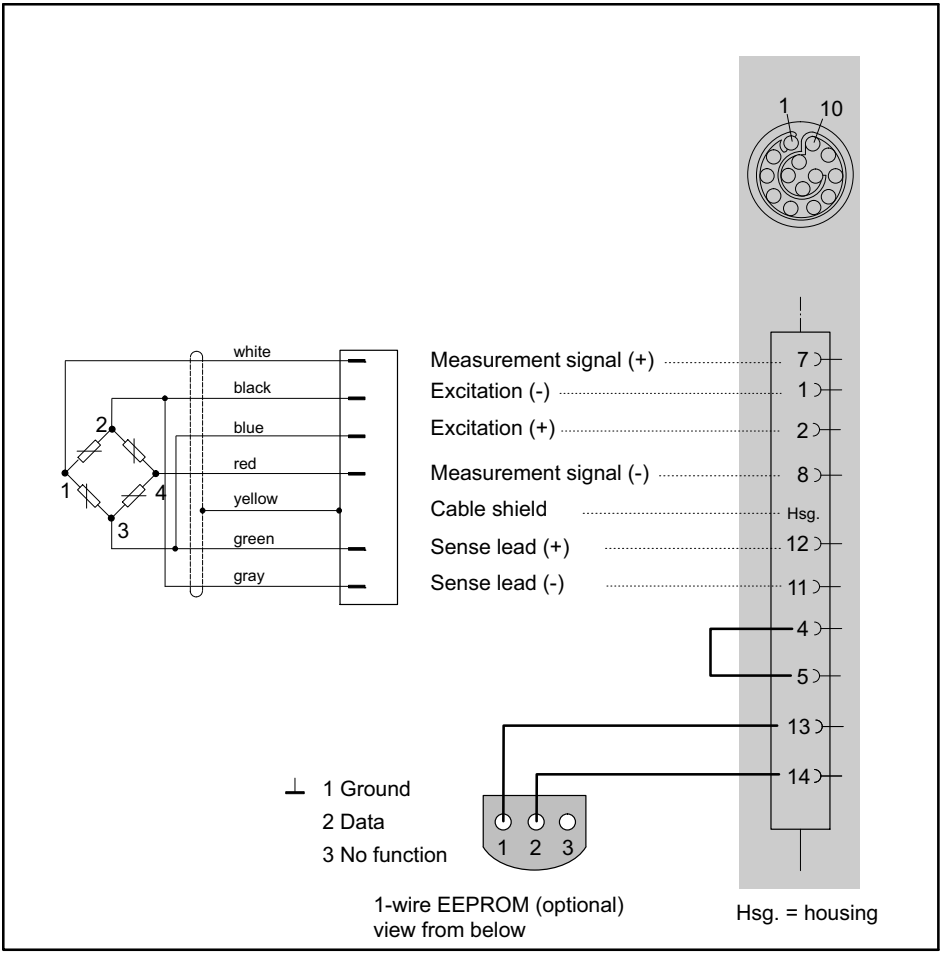
Note

The MX471-P is not a traditional data logger that logs the complete CAN data stream on the bit level. The parameterized node "listens" on the CAN bus and extracts the signals from the relevant CAN messages to transmit them as measured values.

7.8 Transducer connection

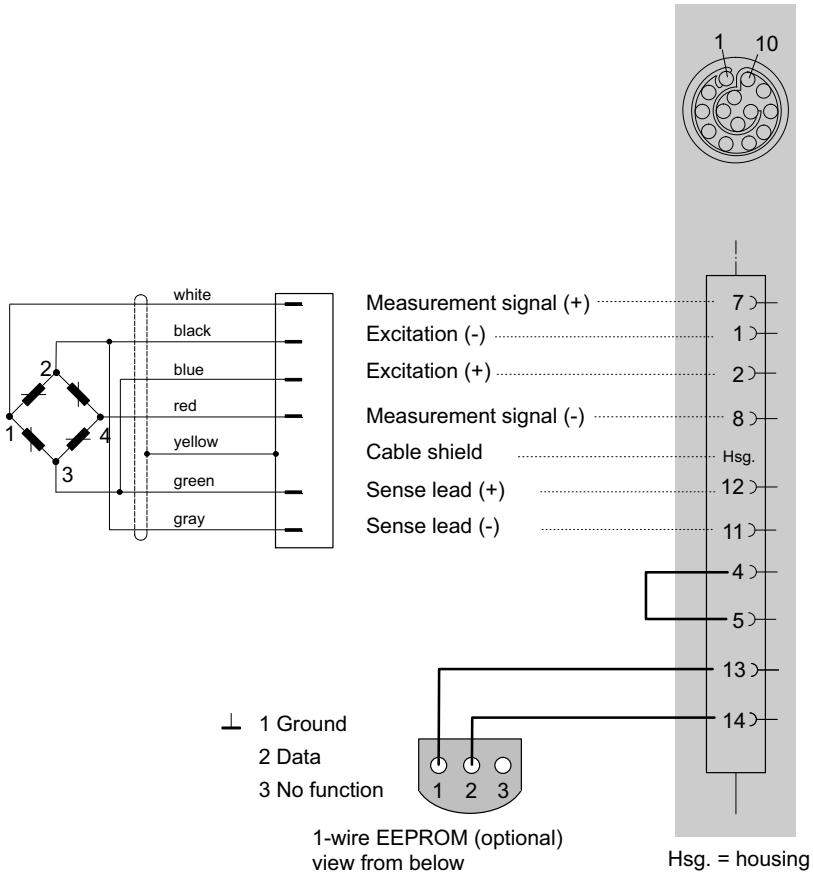
7.8.1 Full bridge, SG

Supported by the following modules: MX840B-R, MX411B-R, MX1615B-R



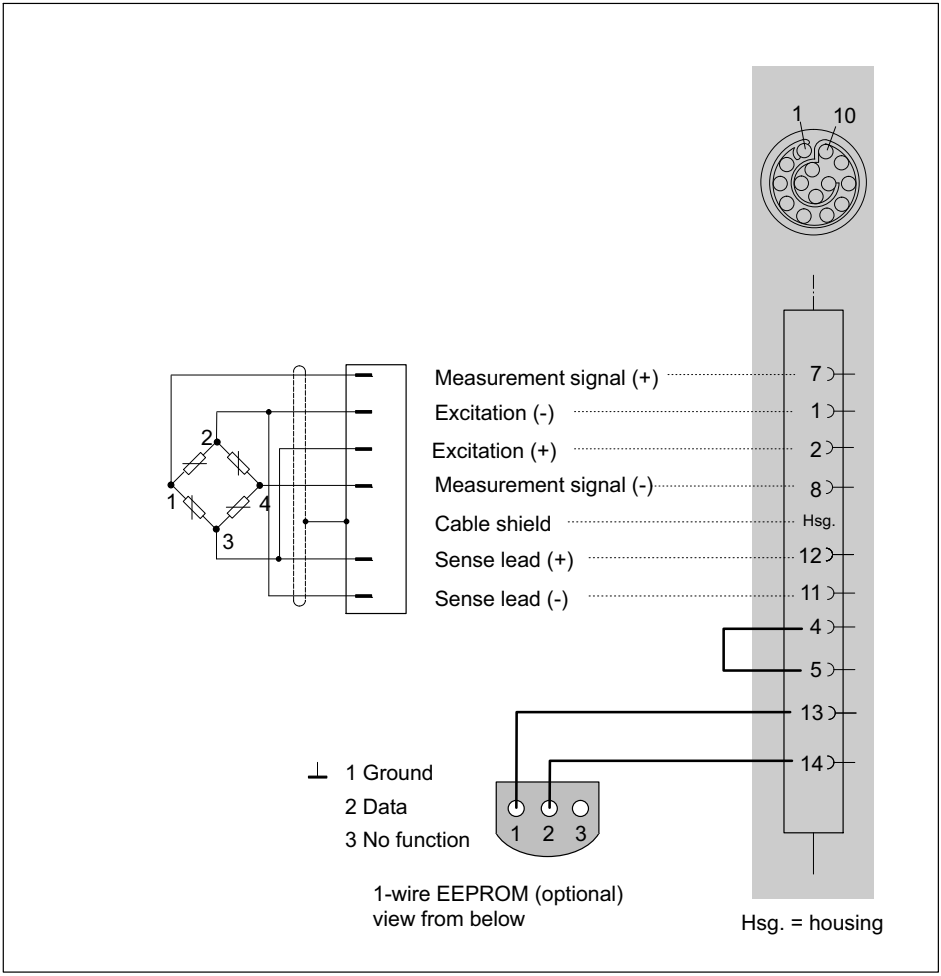
7.8.2 Full bridge, inductive

Supported by the following modules: MX840B-R, MX411B-R



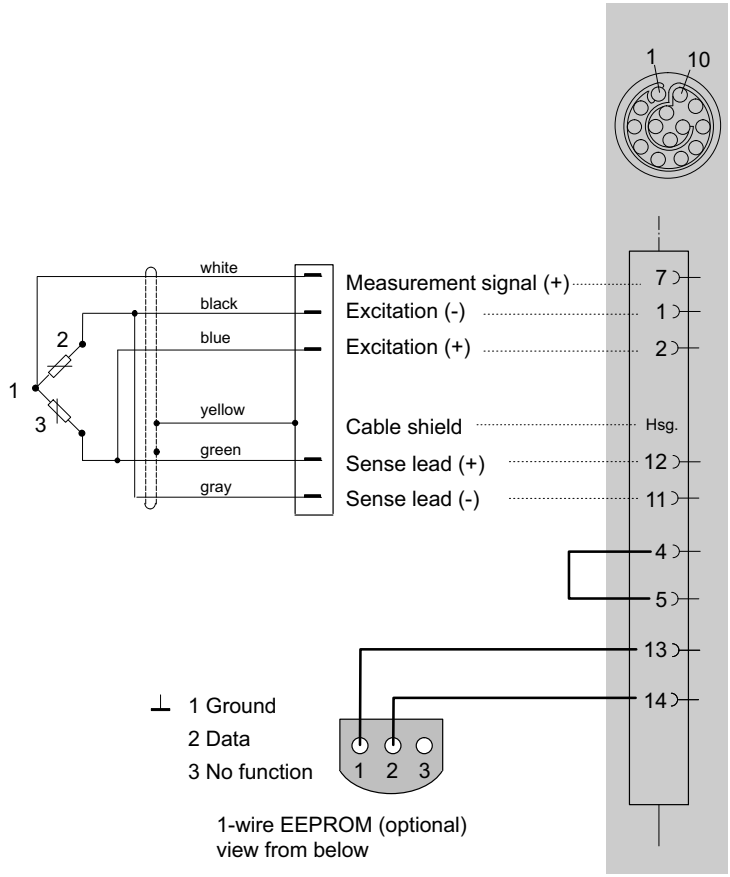
7.8.3 Full bridge, piezoresistive

Supported by the following modules: MX840B-R, MX411B-R



7.8.4 Half bridge, SG

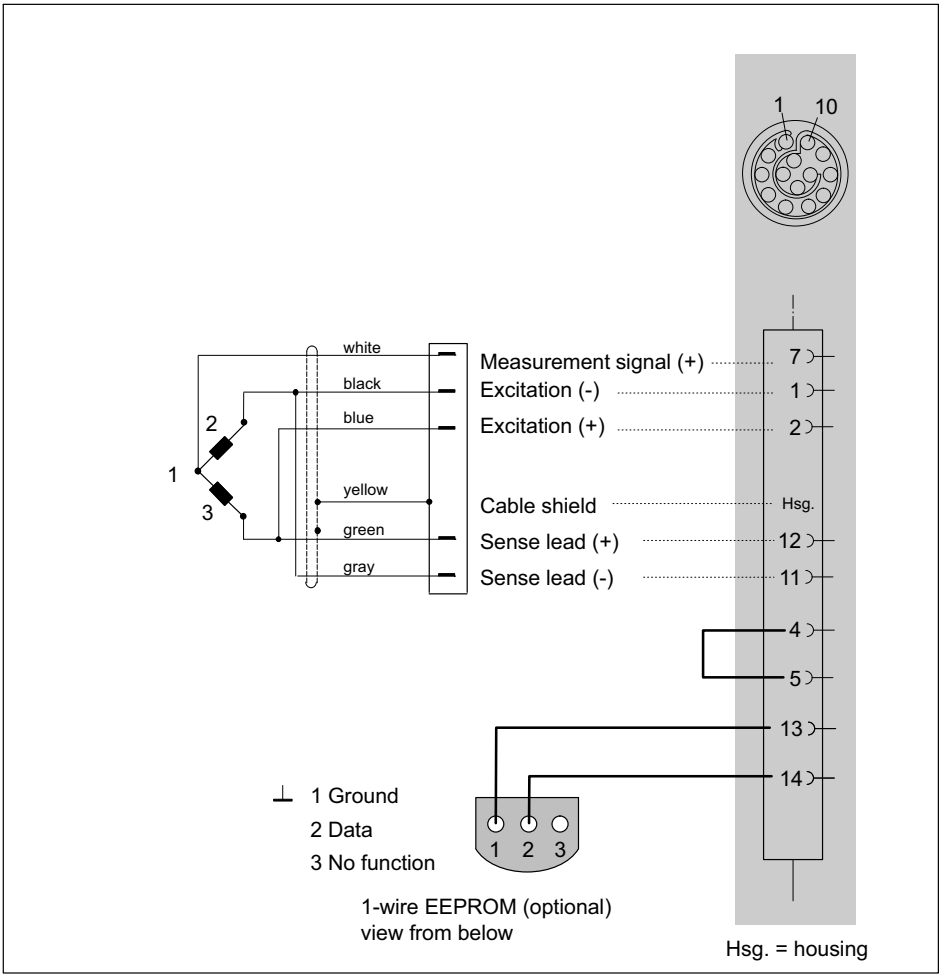
Supported by the following modules: MX840B-R, MX411B-R, MX1615B-R



Hsg. = housing

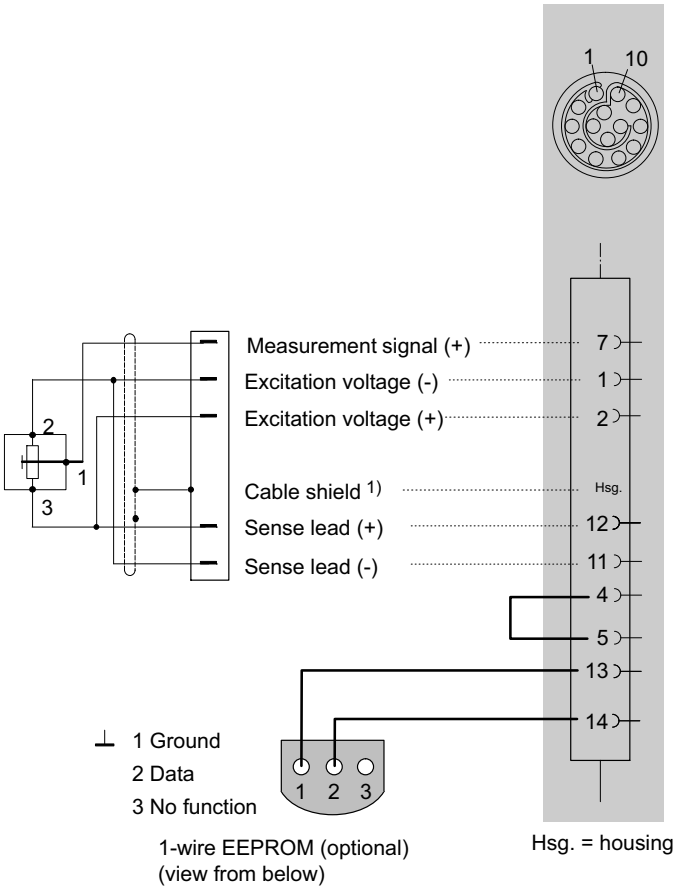
7.8.5 Half bridge, inductive

Supported by the following modules: MX840B-R, MX411B-R



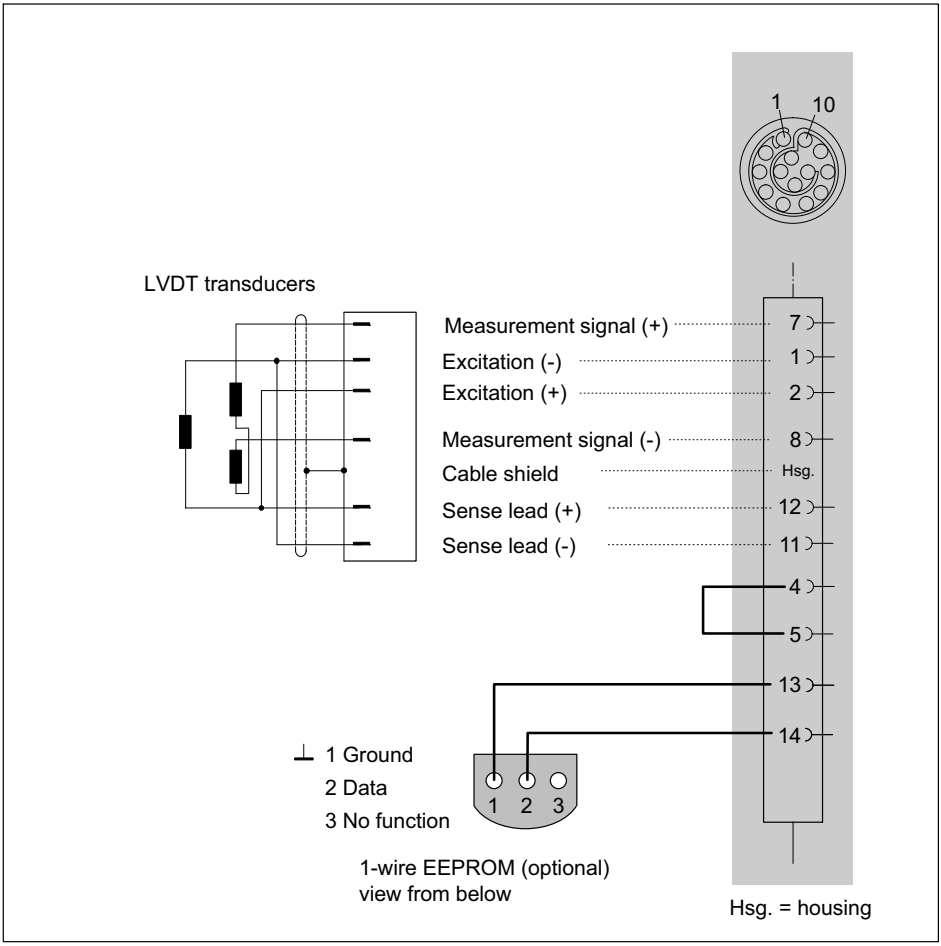
7.8.6 Potentiometric transducer

Supported by the following modules: MX840B-R, MX1615B-R



7.8.7 LVDT transducers

Supported by the following modules: MX840B-R



7.8.8 Current-fed piezoelectric transducer

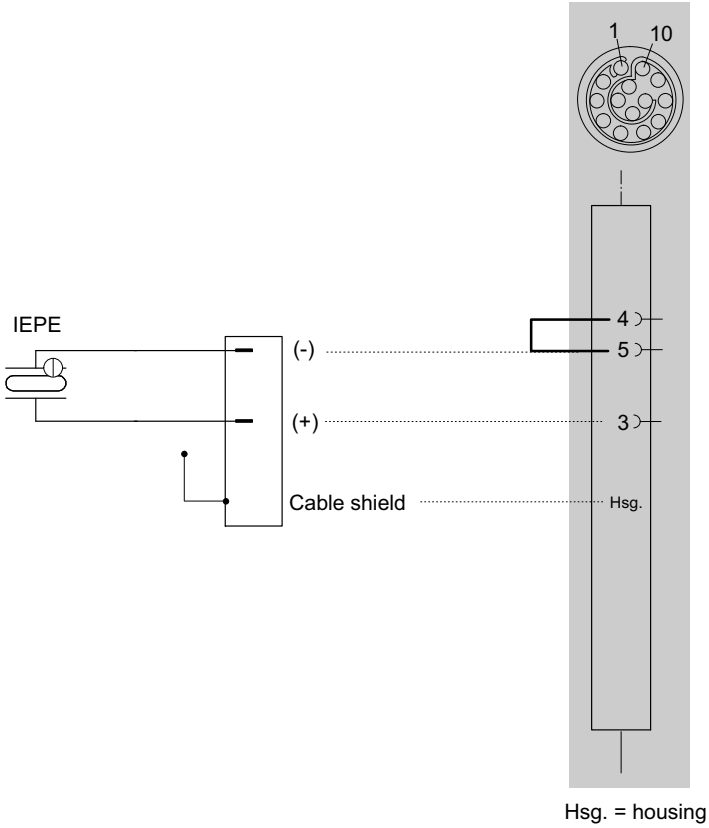
Current-fed piezoelectric transducers are supplied with a constant current of e.g. 5.5 mA and output a voltage signal to the amplifier. This type of transducer is also called an IEPE or ICP® transducer.

IEPE is short for “Integrated Electronics Piezo Electric"

ICP® is a registered trademark of the company “PCB Piezotronics".

Supported by the following modules:

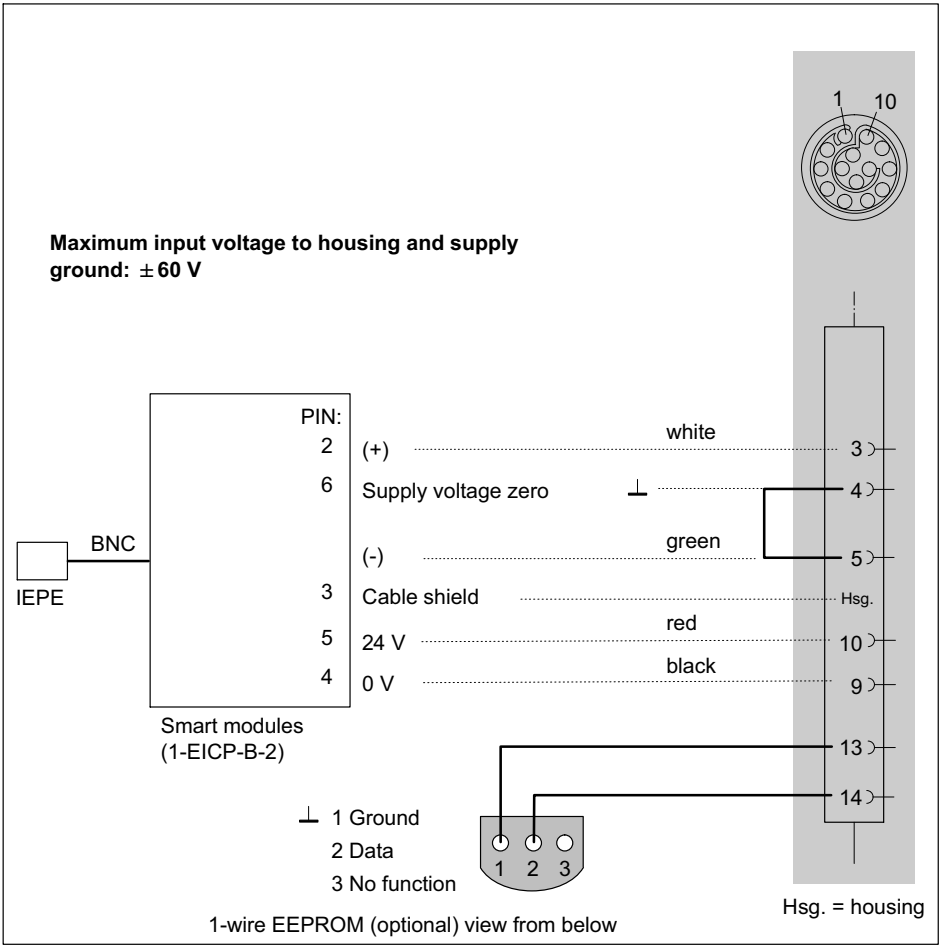
- MX411B-R
- MX1601B-R
- MX840B-R with 10 V analog input and 24 V excitation via a smart module



Note

IEPE transducers with TEDS version 1.0 are supported.

Wiring diagram MX840B-R with external Smart module



Accessories for the connection of the Smart modules:

Designation	Description	Order no.
Smart module	External signal conditioning module supplied with 24 V, supplies IEPE with constant current (BNC socket) and outputs a standardized voltage signal ± 10 V	1-EICP-B-2
Connection cable	Cable between Smart module and SubHD plug	1-SAC-EXT-MF-x-2 (x = length in meters)
Device connector	QuantumX Rugged DAQ connector	1-CON-P1007

Retrofitting TEDS Chip in transducer connectors when using the Smart module

TEDS data stored directly in the IEPE transducer cannot be read by the Smart module. TEDS can be retrofitted in the QuantumX Rugged DAQ connector so that the Smart module can be read in and the channel settings automated according to the IEPE transducer.

Settings can be implemented via the TEDS Editor.

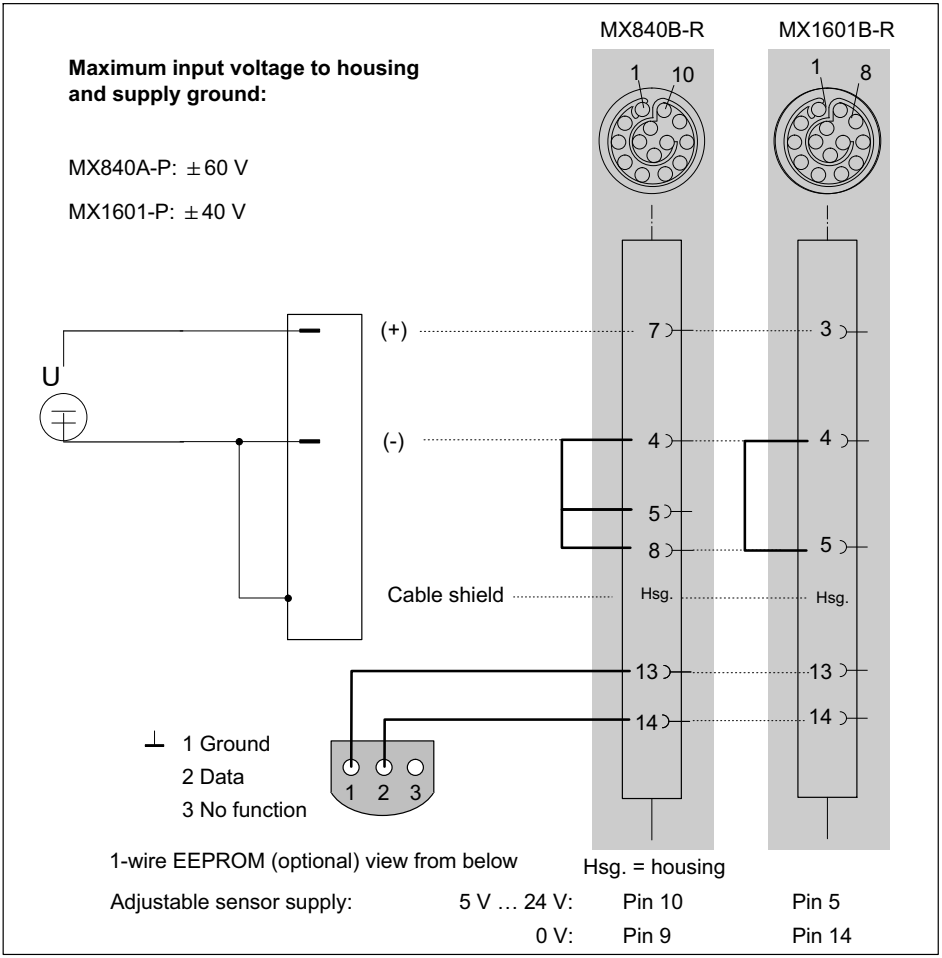
- TEDS-specific requirements:
  - “High Level Voltage Output Sensor"
  - Physical Measurand: Acceleration (m2/s or g)
  - Electrical range: standard +/- 10 V
  - Power requirements: required
- Complete the data sheet according to the transducer
- Excitation level: 24 V nominal

CAUTION

Changing the IEPE transducer on the Smart module can lead to incorrect device settings.

7.8.9 DC voltage sources 100 mV

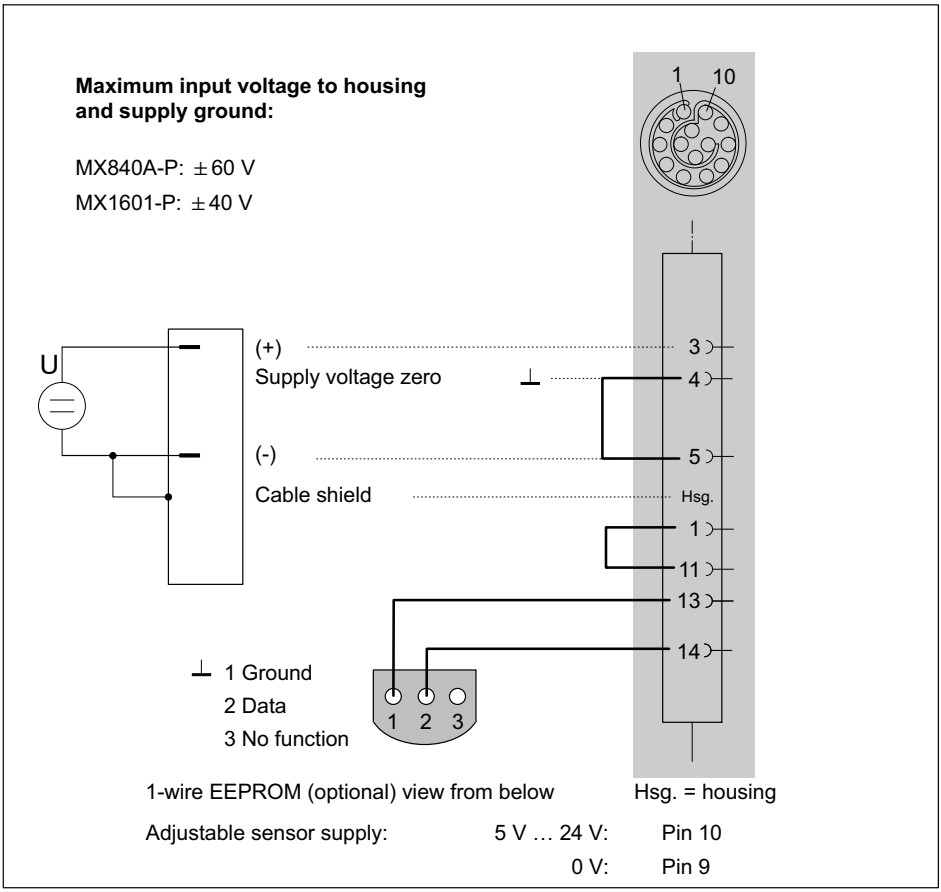
Supported by the following modules: MX840B-R, MX1601B-R



7.8.10 DC voltage sources 10 V or 60 V range

Voltage ranges supported by the measuring amplifiers:

10 V and 60 V:	MX840B-R, MX1601B-R
10 V:	MX411B-R
60 V:	MX1615B-R

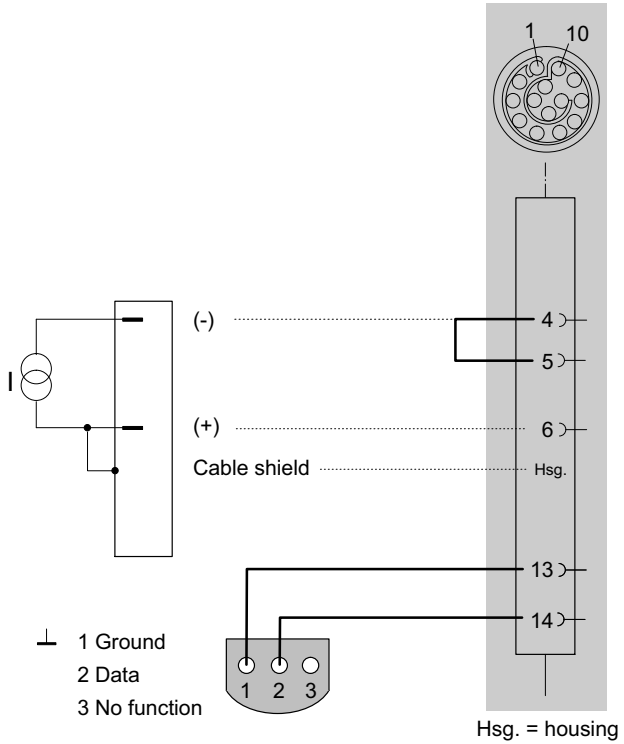


MX840B-R: You can select two measuring ranges (10 V or 60 V), depending on the parameterization.

Incorrect parameterization will not cause the destruction of the amplifier.

7.8.11 DC current sources 20 mA

Supported by the following modules: MX840B-R, MX411B-R, MX1601B-R



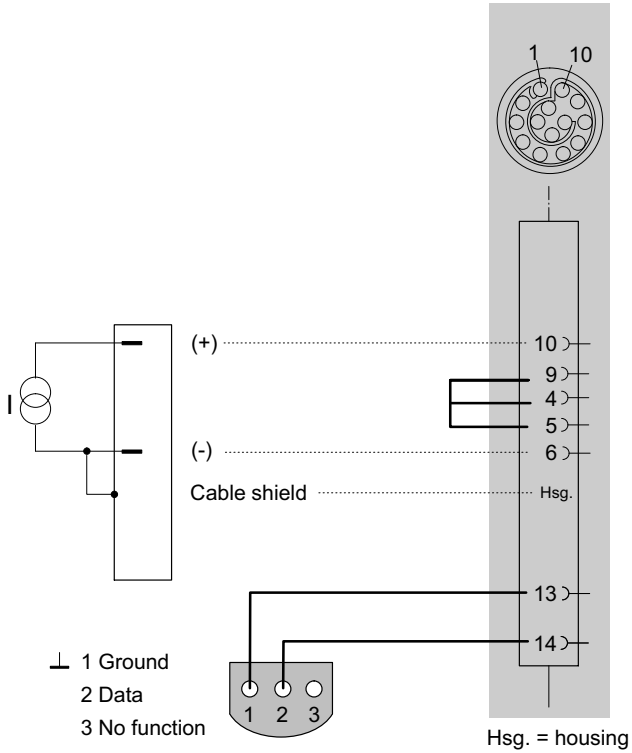
1-wire EEPROM (optional) view from below

Adjustable sensor supply:	5 V … 24 V:	Pin 10
	0 V:	Pin 9

Maximum current ±30 mA

7.8.12 DC current sources 20 mA - current-fed

Supported by the following modules: MX840B-R, MX411B-R, MX1601B-R



1-wire EEPROM (optional) view from below

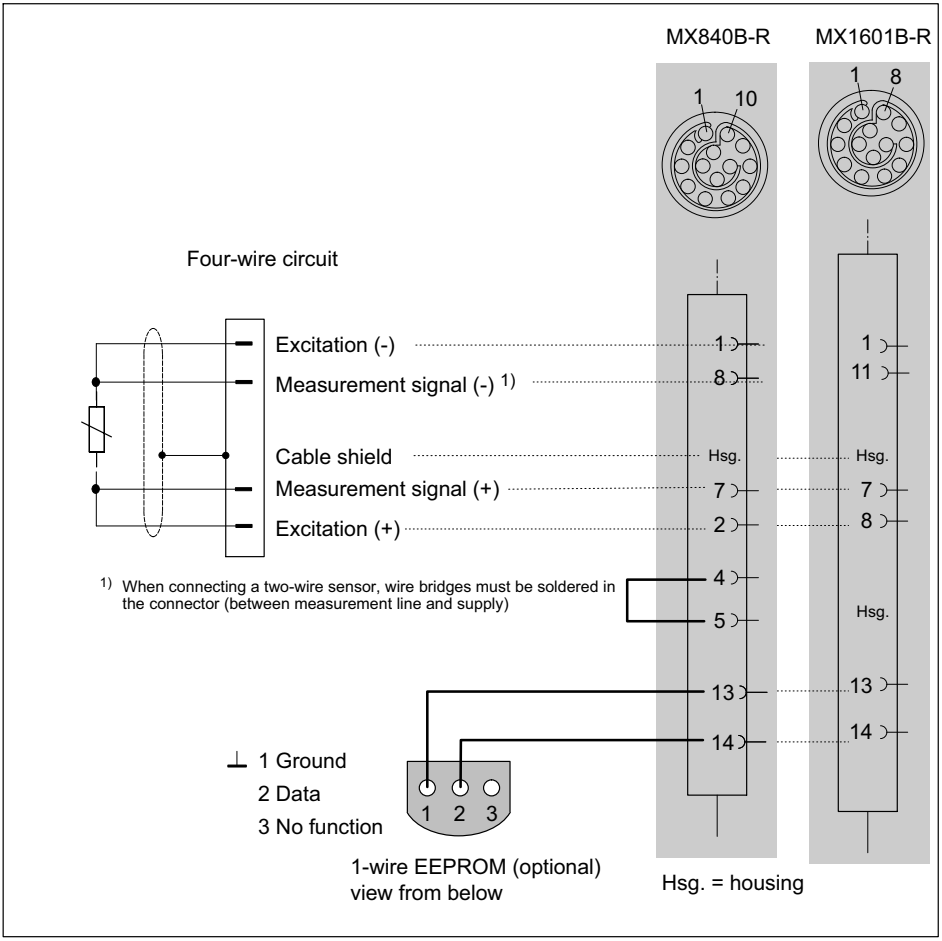
Adjustable sensor supply:	5 V … 24 V:	Pin 10
	0 V:	Pin 9

Maximum current ±30 mA

The sensor supply must be connected in series. This however terminates the electrical isolation to the module supply.

7.8.13 Resistance

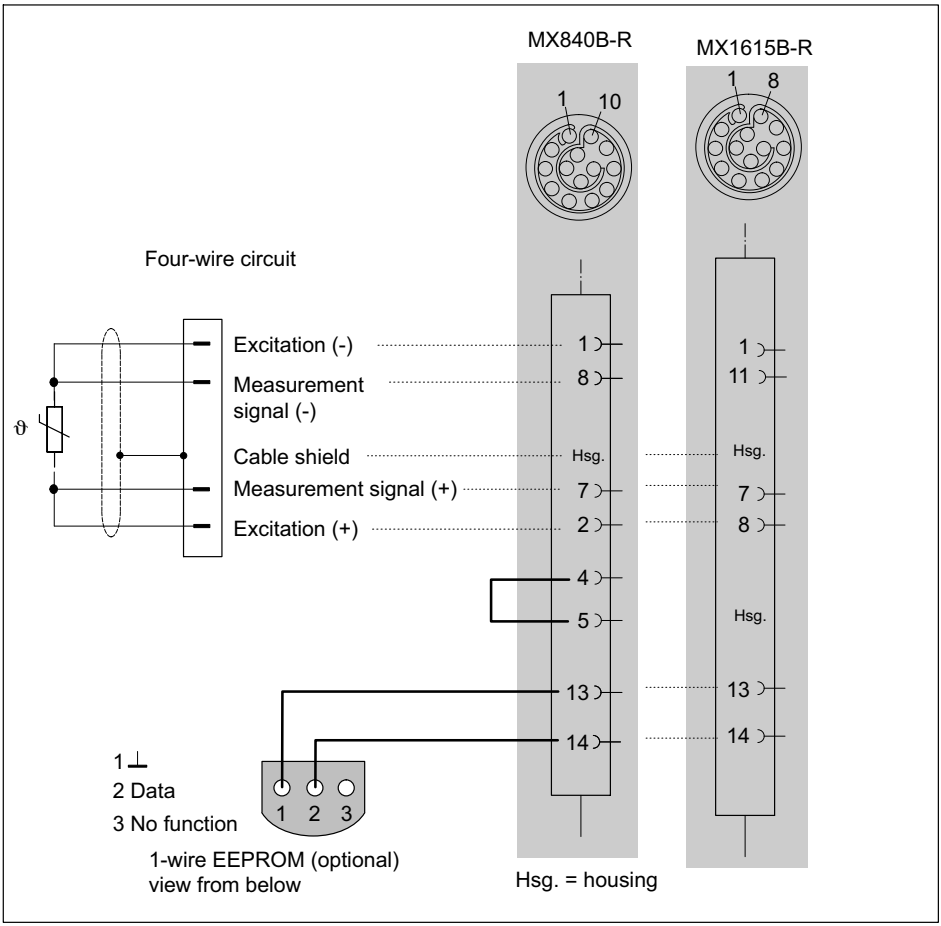
Supported by the following modules: MX840B-R, MX1615B-R



7.8.14 Resistance thermometers Pt100, Pt1000

Supported by the following modules:

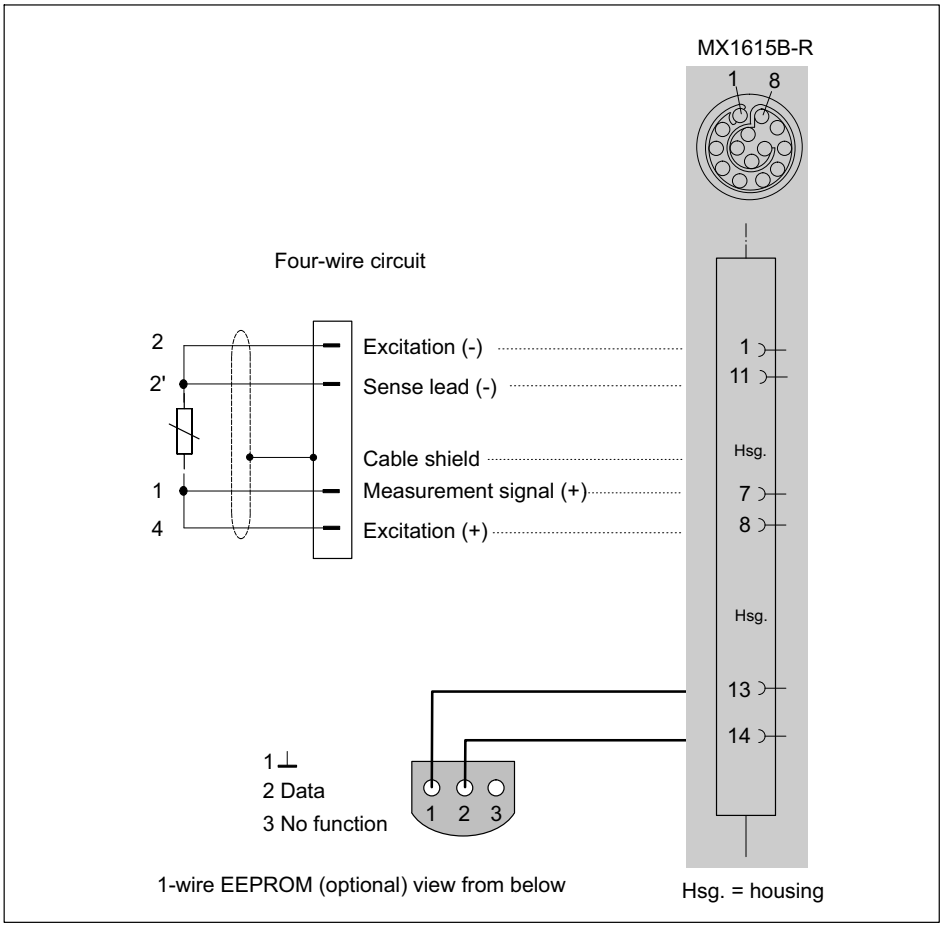
Pt100 / Pt1000: MX840B-R, MX1615B-R



7.8.15 Quarter bridge SG, 4-wire

Supported by the following modules:

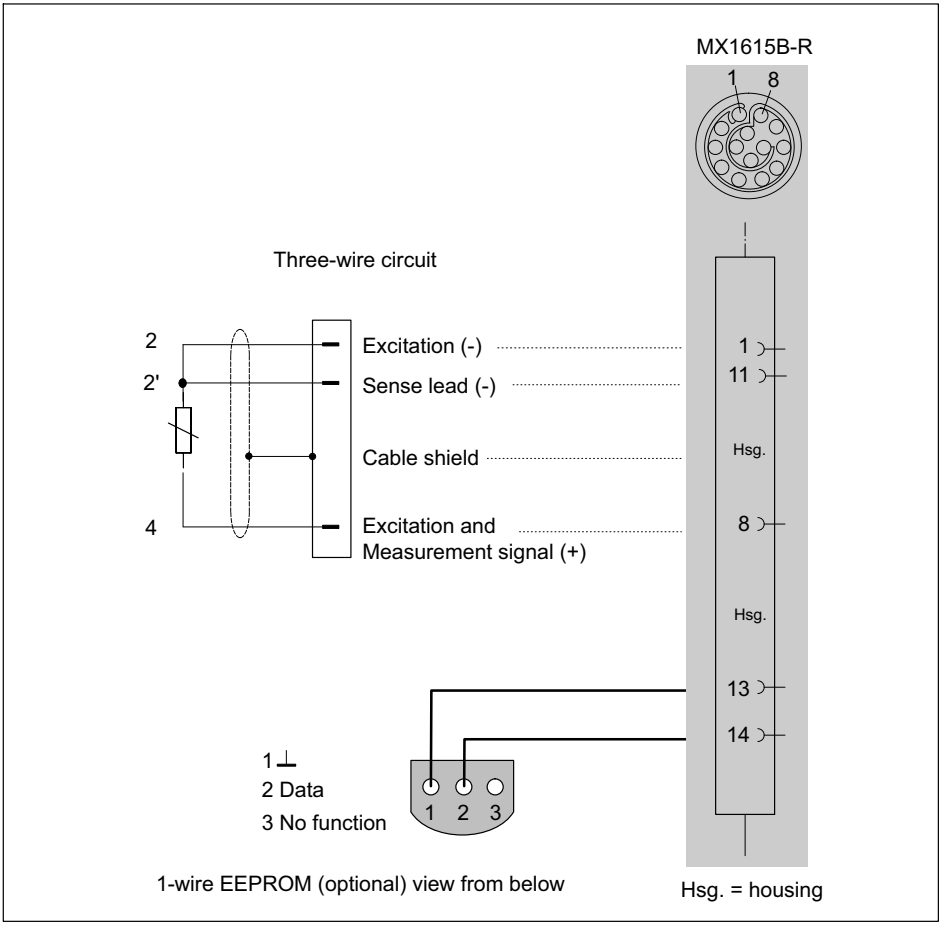
MX1615B-R



7.8.16 Quarter bridge SG, 3-wire

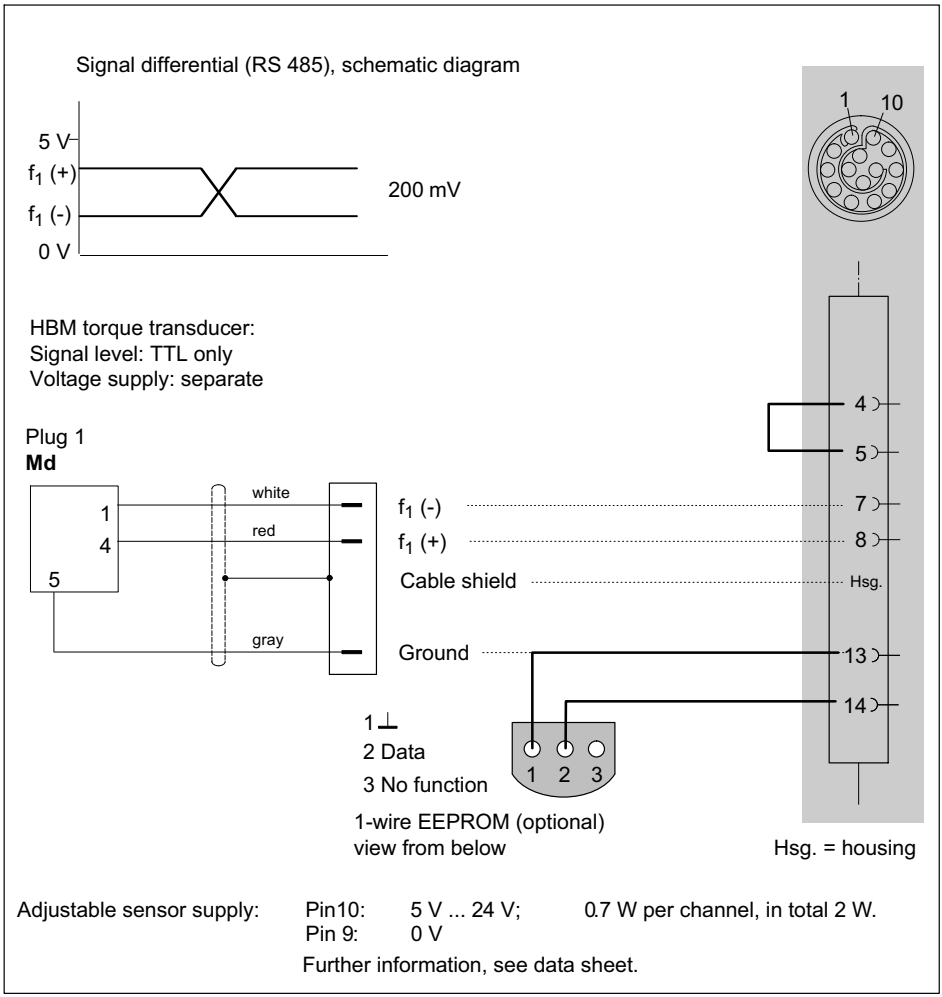
Supported by the following modules:

MX1615B-R



7.8.17 Frequency, differential, without directional signal

Supported by the following modules: MX840B-R, MX460B-R



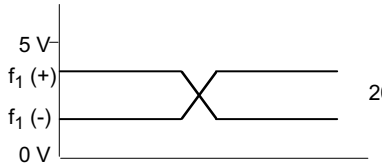
Adjustable sensor supply: Pin10: 5 V ... 24 V; 0.7 W per channel, in total 2 W.
Pin 9: 0 V

Further information, see data sheet.

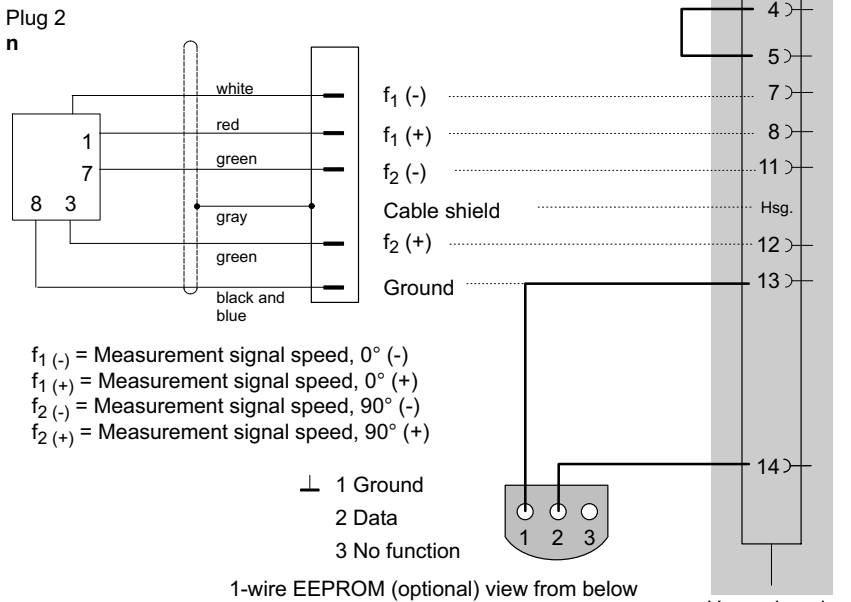
7.8.18 Frequency, differential, with directional signal

Supported by the following modules: MX840B-R, MX460B-R

Differential signal (RS 485); schematic diagram



HBM torque transducer:
Signal level: TTL only
Voltage supply: separate

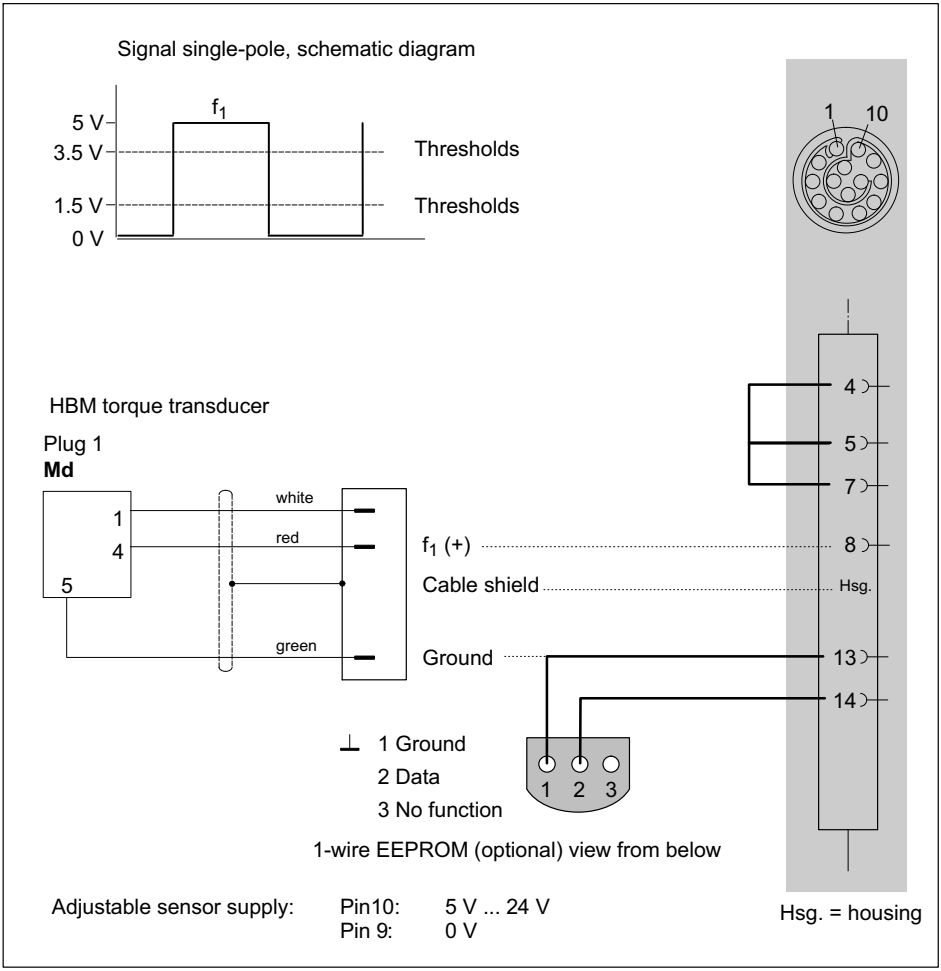


$f_{1\,(-)}$ = Measurement signal speed, 0° (-)
$f_{1\,(+)}$ = Measurement signal speed, 0° (+)
$f_{2\,(-)}$ = Measurement signal speed, 90° (-)
$f_{2\,(+)}$ = Measurement signal speed, 90° (+)

Adjustable sensor supply: Pin10: 5 V ... 24 V; 0.7 W per channel, in total 2 W.
Pin 9: 0 V
Further information, see data sheet.

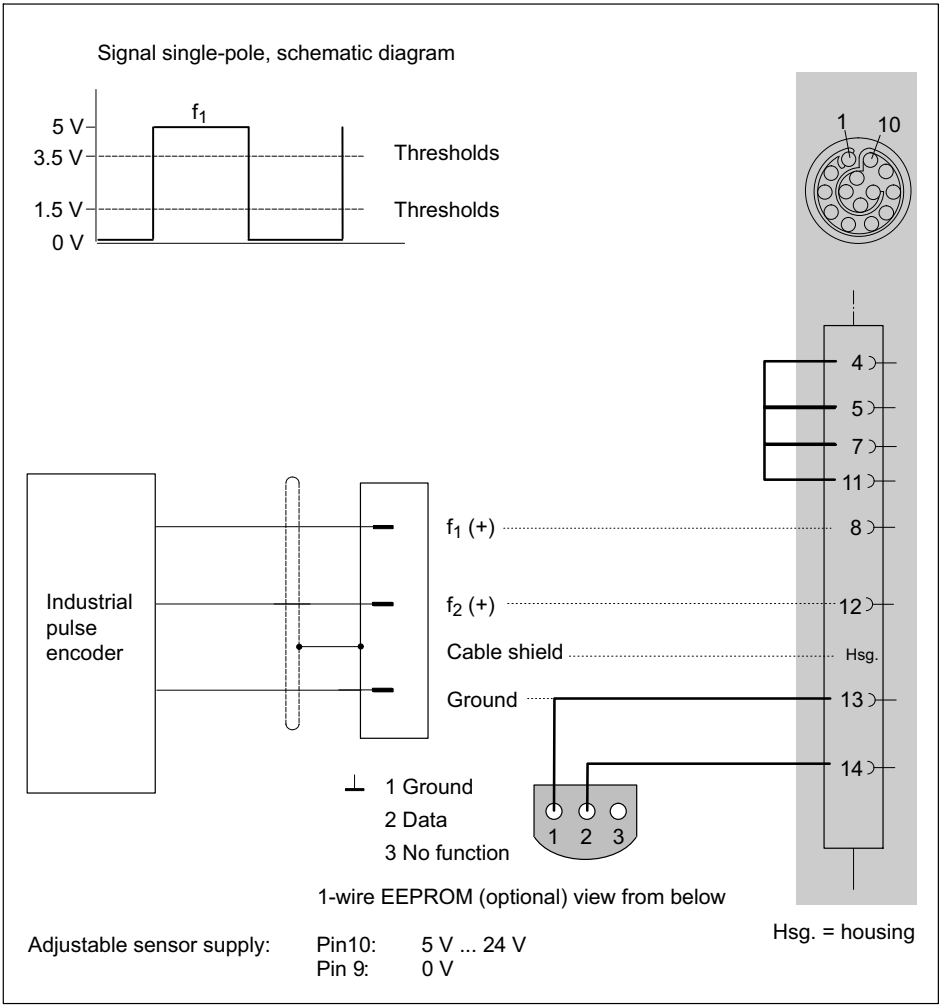
7.8.19 Frequency, single-pole, without directional signal

Supported by the following modules: MX840B-R, MX460B-R



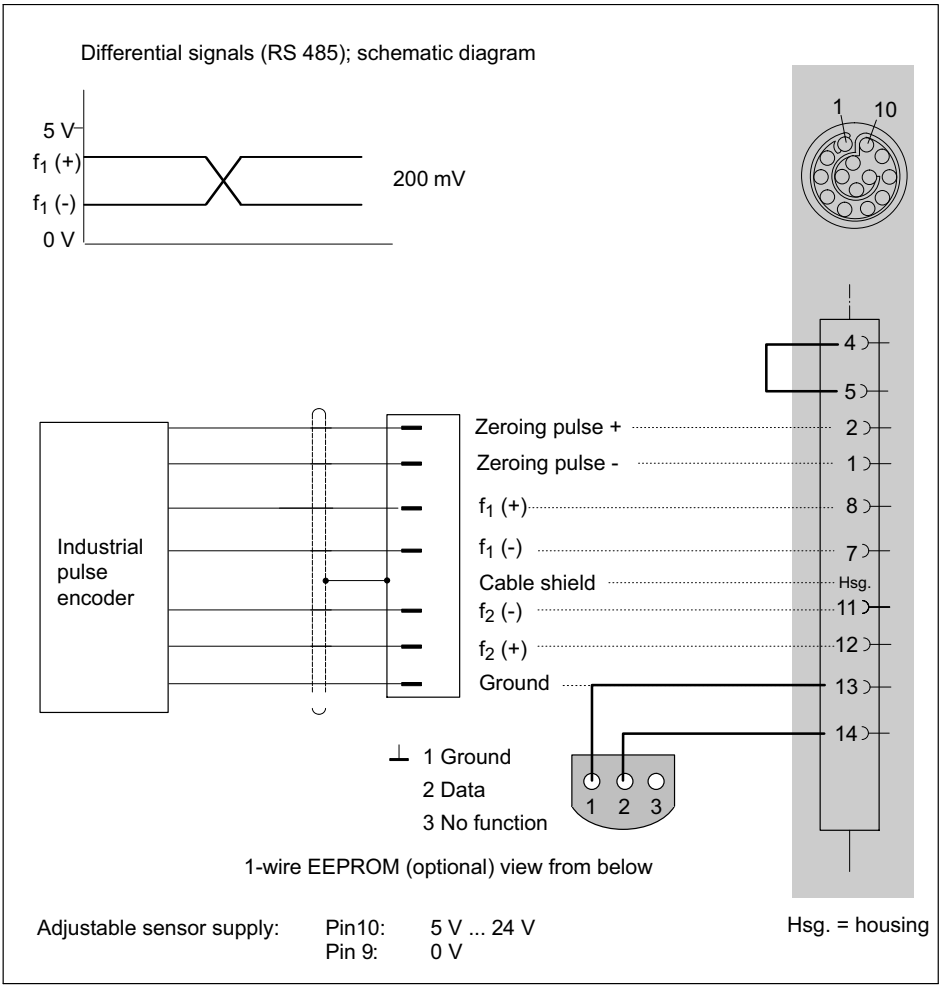
7.8.20 Frequency, single-pole, with directional signal

Supported by the following modules: MX840B-R, MX460B-R



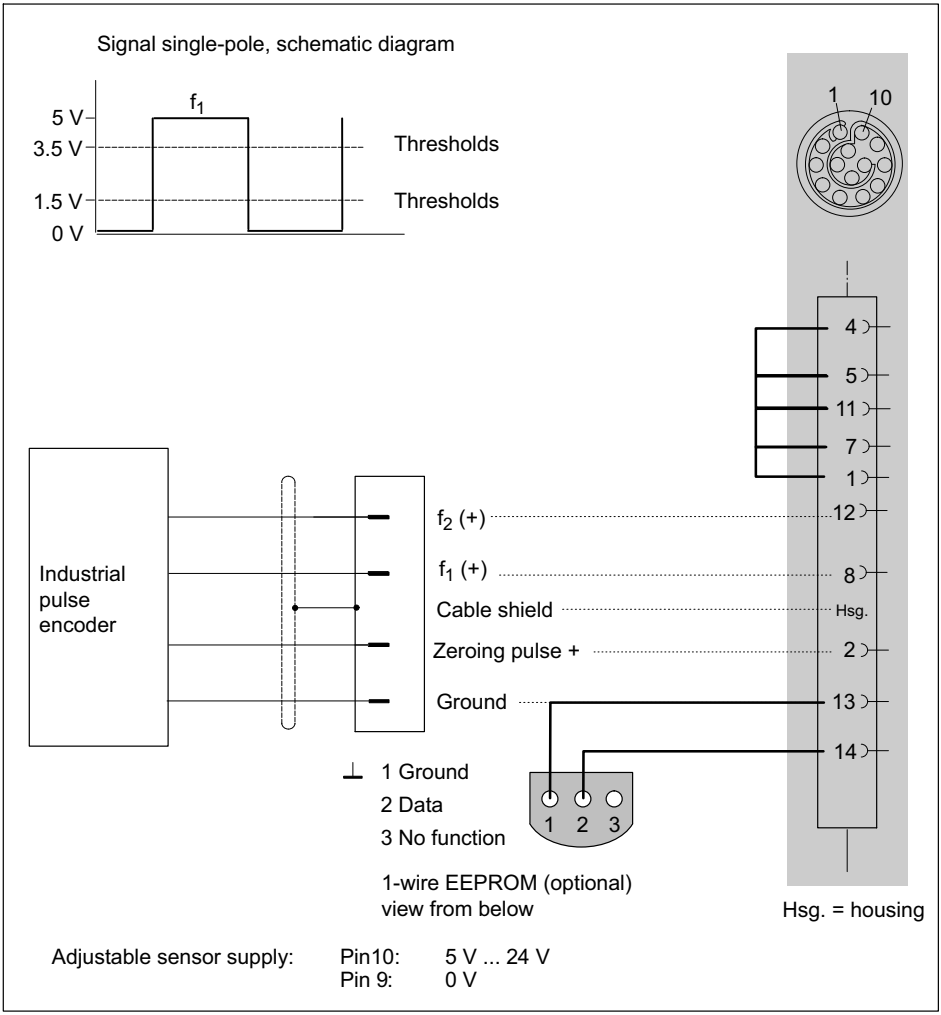
7.8.21 Encoder and pulse encoder, differential

Supported by the following modules: MX840B-R, MX460B-R



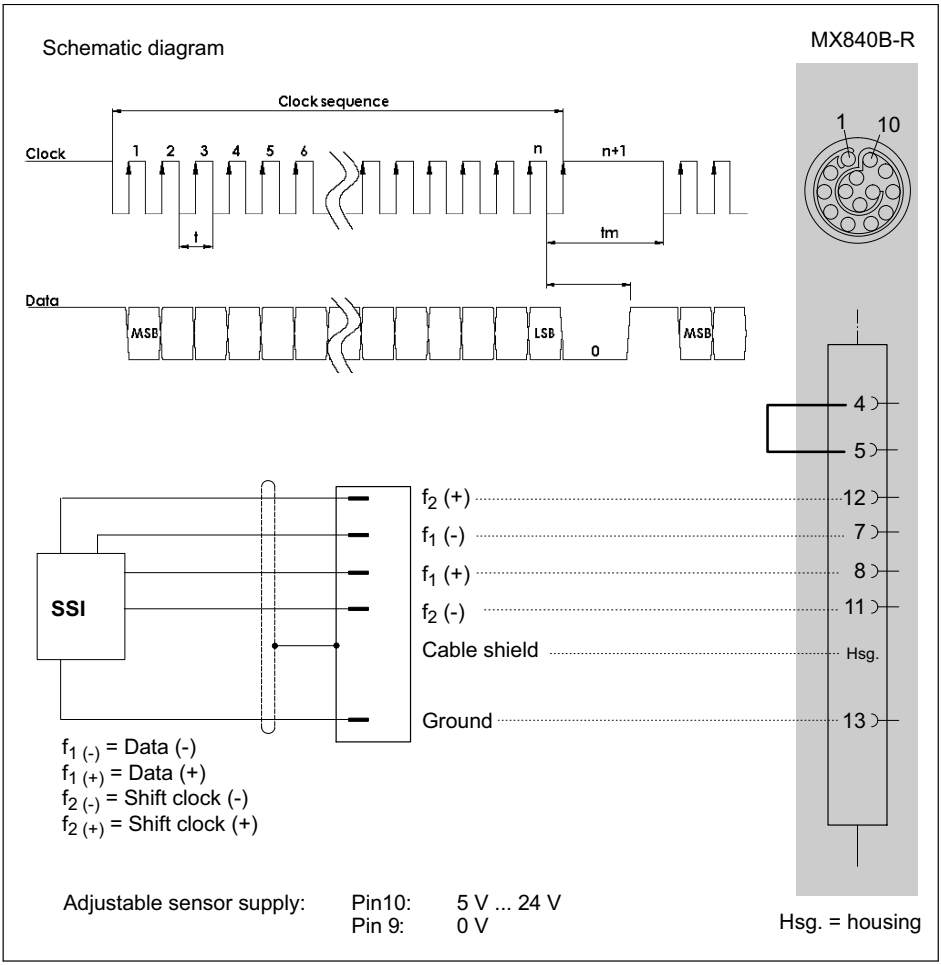
7.8.22 Encoder and pulse encoder, single-pole

Supported by the following modules: MX840B-R, MX460B-R



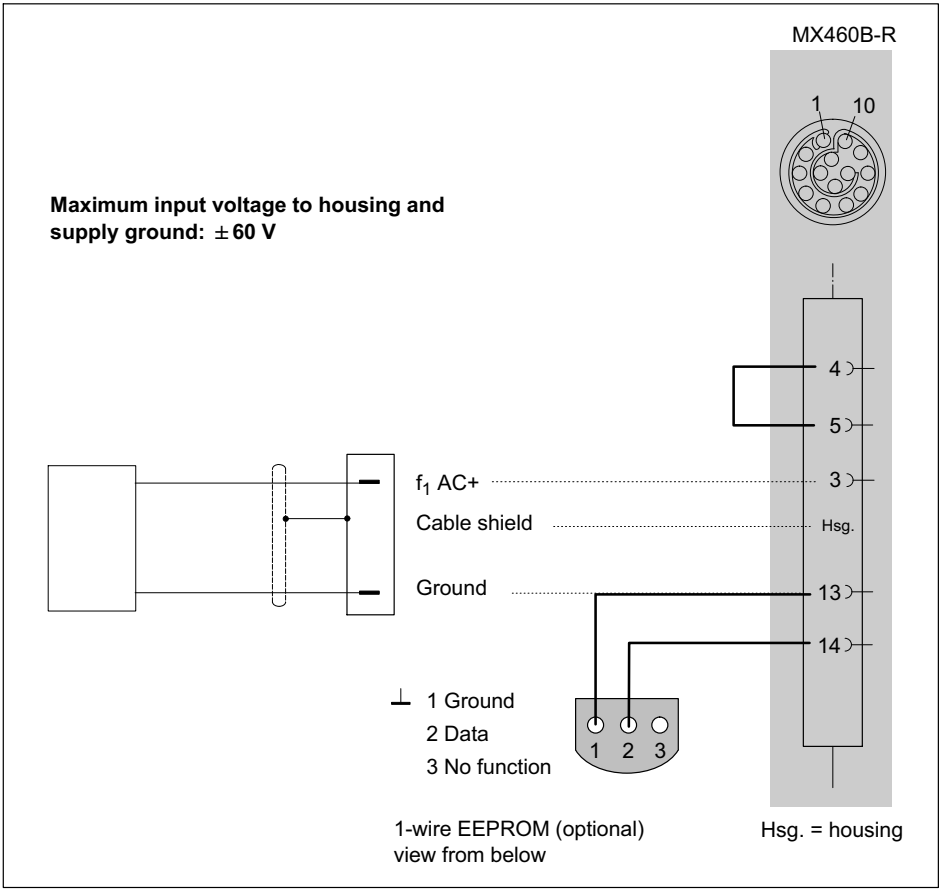
7.8.23 SSI protocol

Supported by the following modules: MX840B-R



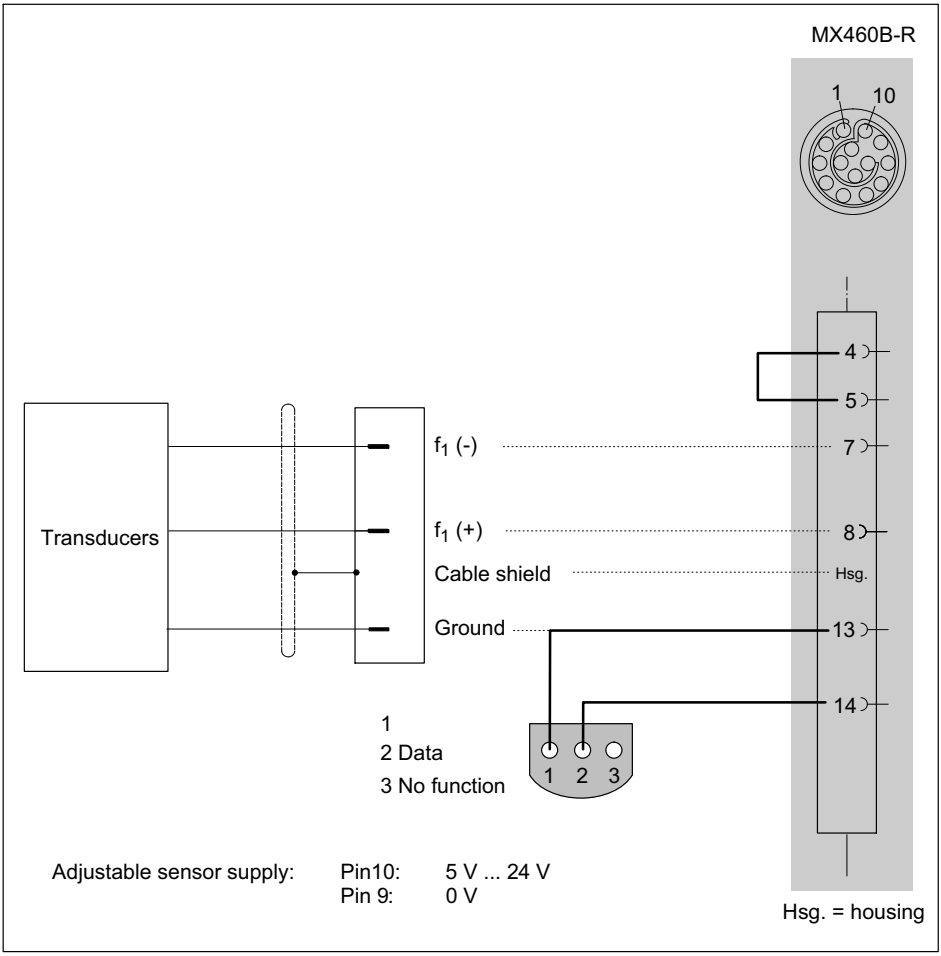
7.8.24 Passive inductive encoder

Supported by the MX460B-R module.



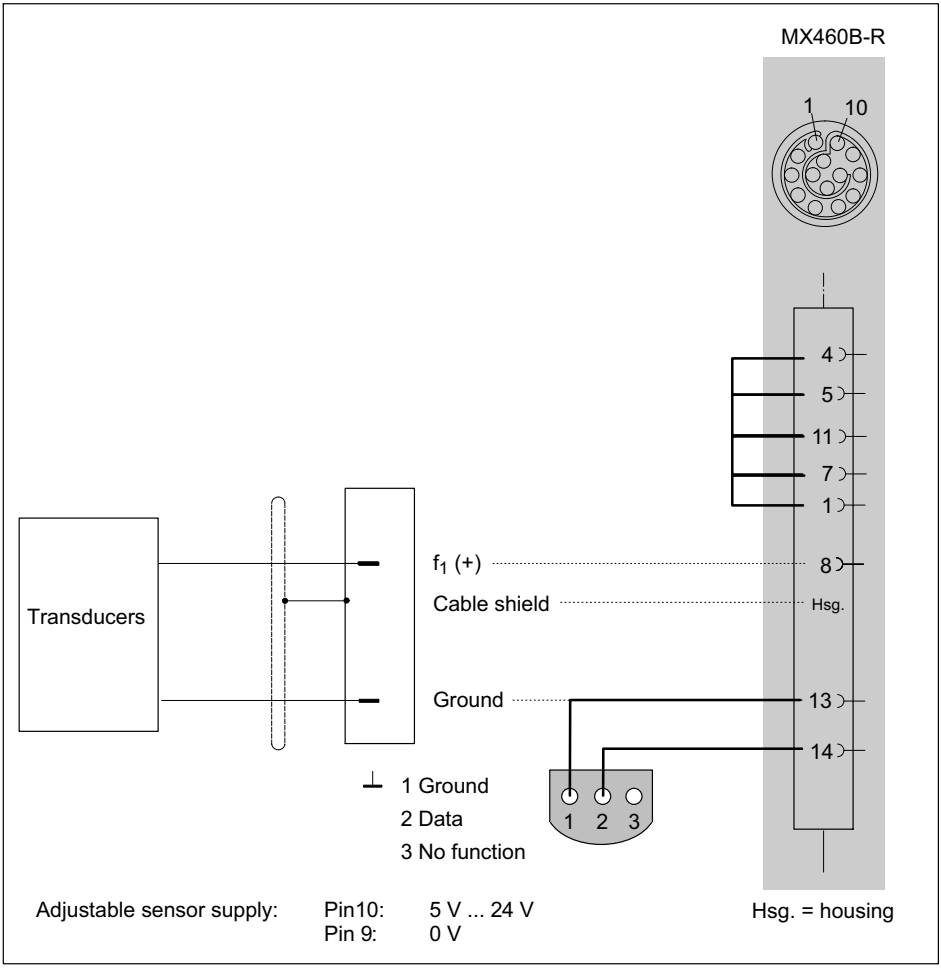
7.8.25 PWM - Pulse width, pulse duration, period duration

Supported by the following modules: MX460B-R



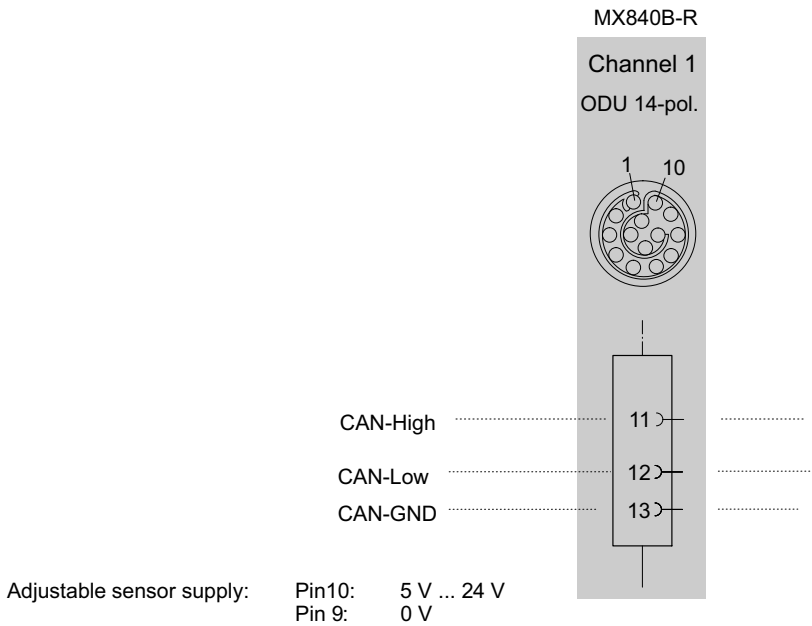
7.8.26 PWM - Pulse width, pulse duration, period duration, single-pole

Supported by the following modules: MX460B-R



7.8.27 CANbus

CAN messages can be acquired with the following modules: Channel 1 from MX840B-R. CAN messages can be acquired and sent with the following modules: MX840B-R (only module-internal measured quantities). A dbc data file can be generated using the QuantumX assistant.



Note

Ensure correct termination with termination resistors is made, as shown in following figure. The MX840B-R does not have any internal termination.

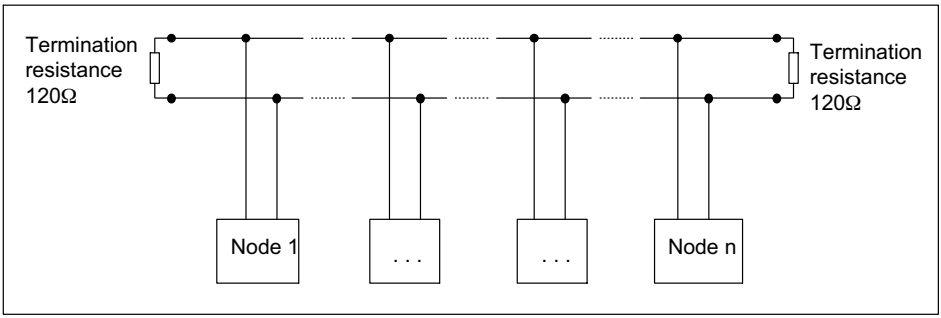


Fig. 7.10 Bus termination resistors

8 Functions and outputs

8.1 MX471-P

The MX471-P module ensures a high-performance connection between a CAN bus network and the QuantumX system.

Four CAN interfaces are available, all working independently of each other.

The CAN bus enables signals to be input to the measurement system and output as PDO (Process Data Object).

CAN output

The modular QuantumX data acquisition system can be individually assembled. IEEE1394b FireWire enables quantities measured using amplifiers or computed values to be transmitted to specific modules in real time (isochronous signals).

For example, to send a measured temperature as a “Process Data Object” (PDO) over the CAN bus via a specific node of the MX471-P, the temperature signal can simply be dragged and dropped onto the node. Parameterization is then performed automatically. The CAN message needs to be completed in the corresponding dialog.

A parameterized MX471-P node is able to send any signals or measured quantities cyclically as CAN messages.

The CAN messages are sent to the CAN bus at the data rate set for the source signal. With a data rate > 4800 Hz, the transmission rate is limited. The transmission rate on

the CAN bus can generally be reduced with a configurable divider.

For bus parameterization, the baud rate must be specified via software and it may be necessary to activate a termination resistor (bus termination).

Parameterizing the CAN message requires:

- Defining an identifier (decimal CAN-ID) and the corresponding format (11 or 29 bits)
- A divider to reduce the transmission rate, if required

Signals are sent using the 4-byte float format.

When parameterization of the node has been completed, a type *.dbc CAN database can be generated. This database makes configuring a receiver node easier.

Additional protocols

The MX471-P module supports the following protocols on up to 2 channels:

- CAN Calibration Protocol (CCP)
- eXtended Calibration Protocol (xCP-on-CAN)

These protocols are commonly used in the automotive industry to communicate with parameter sets/signal lists from electronic control equipment.

The first step for parameterization of the individual MX471-P channels requires the CANape software tool from Vector Informatik. Based on an available control device description file (*.a2l), CANape generates a signal description file (*.dbc) which is transferred to the channel using the QuantumX Assistant tool and parameterizes the respective CAN node. Seed&Key encryption technology is supported.

Note

Generally both message types (standard/extended) can be used in a CAN network.
There is no analysis of Sync or Remote-Frames messages.
The four CAN nodes are handled with equal priority.
A node parameterized as sender works as an autonomous gateway and no longer requires a connection to a PC.
SDOs are not supported, and therefore the MX471-P cannot be considered as a CANopen slave.
The states of individual nodes are displayed directly at the relevant connection point.

CAUTION

If a CAN node uses an incorrect baud rate for transmission over the bus, all data transmission on the bus may fail.

9 FAQ

Subject

QuantumX Rugged DAQ in an (Ethernet) network and device scanning with catman®Easy/AP

Question/Problem

I connected a QuantumX Rugged DAQ amplifier via a network cable and started the catman®EASY/AP software, but I am not getting a connection to the amplifier. Even though the network address of the QuantumX Rugged DAQ is entered in the scan options, the program says:

"The device scan cannot find any connected devices. …“

What might be causing this, how can I set up a connection to QuantumX Rugged DAQ ?

Reply/Solution

First of all, check carefully whether the network address of the QuantumX Rugged DAQ amplifier is in the same subnet as the PC and whether this IP address is correctly entered in the scan options of catman®Easy/AP. If this is the case, the following factors may also prevent the QuantumX Rugged DAQ from being located in the network:

- The Windows® firewall. This can block the connection during device scanning and should be switched off temporarily for the duration of the measurement. The settings for the firewall can be found under **Control panel –> Security center –> "Windows Firewall"**.
- Wireless network adapters (WLAN). These can, depending on the configuration, take priority in

operating the network and thereby disturb the wired network scan. If a WLAN adapter is present on the notebook or laptop, it must be deactivated.

- The firewall of an installed VPNClient. This can also disturb a network scan. For example, the setting **"Stateful Firewall (Always On)"** is activated by default in the CISCO VPN Client. This should be temporarily deactivated for the QuantumX Rugged DAQ device scan.
- A virus scanner can also possibly block the network scan due to its properties. It should therefore be temporarily deactivated.
- If the PC settings will not permit a scan via a network area at all (e.g. for security reasons), it is still possible to connect a device manually with a selected configuration. This setting can be found in the **"Scan options"** as the option **"Add device manually"**.

Please note that administrator rights under Windows® may be necessary for some of these settings.

Question/Problem

How can I check whether the amplifier is physically connected correctly with the network cable and can actually be reached via my PC?

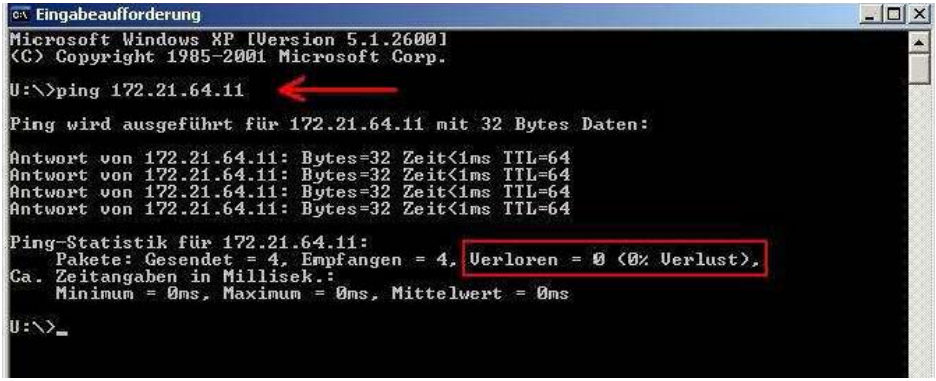
Reply/Solution

This can be easily checked with the help of a Windows® function. Please open the Windows® entry prompt (**Start –> Programs –> Accessories –> entry prompt**) and enter the following at Prompt C:>:

ping xxx.xxx.xxx.xxx *(ENTER)*

The xxx.xxx.xxx.xxx represents the IP address of your QuantumX Rugged DAQ device. If correctly connected,

the device will reply positively. An example is shown in the following screenshot:



If you connect a QuantumX Rugged DAQ directly 1:1 to the PC, a "crossover patch cable" must be used as the network cable.

If no module appears, there are several possible causes. Check the following points and then repeat the search.

General reasons

- Is the QuantumX Rugged DAQ module switched on and is the module LED lit up green?
- Is the interface cable connected?
- Have you activated the correct interface or correct interface adapter?
- Check the scan options in the dialog Find modules (Where do I find the scan options?).

If you are using the Ethernet interface

- Have you used the correct Ethernet cable (Ethernet Switch with standard cable or direct connection with crossed cable)?

- Is your Ethernet switch working correctly?

  If you are not operating any other devices on the switch with which you can check the function, try to set up a direct connection between the PC and the QuantumX Rugged DAQ module.

- Could your firewall be responsible for blocking the UDP scan?

  Try deactivating the firewall or enable the TCP ports via 1000 for your PC and 5001 for the IP address of the QuantumX Rugged DAQ. Also refer to Changing the Ethernet interface parameters of the QuantumX Rugged DAQ

- If a WLAN is also active in your PC, you must test whether the module can be found when you temporarily switch off the WLAN (just for the search period). With some WLAN configurations, problems can occur across all interfaces during a scan.

- If your PC has several Ethernet interfaces, limit the search to the interface which is connected to the module: Scan options in the dialog Find modules (Where do I find the scan options?).

- If you want to use the QuantumX Rugged DAQ module in a larger network, please contact your network administrator. There are a series of options in administrated networks to limit or completely prevent data transmission between individual subscribers. Administrative enabling may also be necessary here.

Possible examples and their effects with regards to the connection of PC and QuantumX Rugged DAQ via Ethernet

1. No server in the network, the PC has no address (DHCP) and the QuantumX Rugged DAQ module is set to DHCP/APIPA (factory setting)

When using Windows XP or higher, temporary addresses are used by the PC and QuantumX Rugged DAQ module, connection can be made.

2. No server in the network, the PC has no setting or uses DHCP, the QuantumX Rugged DAQ module has a permanent address

   No connection can be set up with this combination.

3. DHCP server in the network, the PC has a permanent address or uses DHCP, the QuantumX Rugged DAQ module has a permanent address

   A connection can normally only be set up when the PC and QuantumX Rugged DAQ module addresses lie in the same subnet, i.e. the IP address may only have different digit groups where a 0 is present in the subnet mask. Also refer to Changing the Ethernet interface parameters of the QuantumX Rugged DAQ

4. DHCP server in the network, the PC and the QuantumX Rugged DAQ module use DHCP

   Connection can be made.

10 Accessories

Module accessories

Voltage supply		
Article	**Description**	**Order no.**
AC/DC power supply unit	Input: 100-240 V AC (±10%); 1.5 m cable with international plug set Output: 24 V DC, Max. 1.25 A; 2 m cable with plug for IP67 modules	1-NTX002
Connector / Voltage supply	Connector / Voltage supply QuantumX (module in protection class IP65)	1-CON-P1001
Voltage supply cable (ODU-IP68)	Connector (ODU-IP68, 4 pin) for QuantumX Rugged DAQ voltage supply with 5 m cable and exposed wires;	1-KAB294-5
Mechanical		
Installation parts	4 elements for mechanical connection of Rugged DAQ modules	1-CASELINK
Carrying handle	Hinged carrying handle and 4 screw feet for Rugged DAQ modules	1-CASECARRY
FireWire		
FireWire cable (module to module)	FireWire cable connector between QuantumX Rugged DAQ modules (lengths: 0.2m/2 m/5 m); Fitted both ends with appropriate plugs. Note: The cable can be used to optionally supply connected QuantumX Rugged DAQ modules with voltage (max. 1.5 A, from source to last acceptor).	1-KAB272-0.2 1-KAB272-2 1-KAB272-5

Hub to module connection cable 3 m	FireWire cable connector between hub and QuantumX Rugged DAQ modules (lengths: 3 m); Fitted both ends with appropriate plugs. Note: The cable can be used to optionally supply connected QuantumX Rugged DAQ modules or hub with voltage (max. 1.5 A, from source to last acceptor).	1-KAB276-3
PC to module connection cable 3 m	FireWire connection cable between QuantumX Rugged DAQ module and PC FireWire interface (ODU-IP68, 8 pin FireWire 1394b, 5 m); Note: QuantumX modules cannot be supplied with voltage via this cable.	1-KAB293-5
FireWire ExpressCard	FireWire IEEE1394b ExpressCard/34 for connection of QuantumX Rugged DAQ amplifiers to notebook or PC (via ExpressCard- adapter)	1-IF002
SCM-FW FireWire Extender	Two elements to extend FireWire connection up to 40 m Additionally required: 2 x 1-KAB272-x and Industrial Ethernet cable (M12, CAT5e/6, up to 30 m). Connection via KAB293-5 not possible.	1-SCM-FW
Ethernet		
Ethernet cable (ODU-IP68, RJ45, 5 m)	Ethernet patch cable between PC and QuantumX Rugged DAQ module, 5 m, fitted both sides with appropriate plugs.	1-KAB273-5
Ethernet patch cable (ODU-IP68, M12, 5 m)	Ethernet patch cable, one end ODU-IP68, other end M12 plug, 5 m	1-KAB295-5
Transducer side		

Connector (ODU-IP68, 8 pin)	1 pcs. Connector, 8 pin, ODU-IP68	1-CON-P1006
Connector (ODU-IP68, 14 pin)	1 pcs. Connector, 14 pin, ODU-IP68	1-CON-P1007

MX1609-P accessories

Article	Description	Order no.
Bag with 10 mini thermocouple plugs, incl. RFID for thermocouples type K	Bundle, comprising 10 x mini thermocouple plugs with integrated RFID chip for measuring point detection for the MX1609-P thermocouple measuring amplifier of the QuantumX family; type K: NiCr-NiAl, RFID integrated, green, male	1-THERMO-MINI

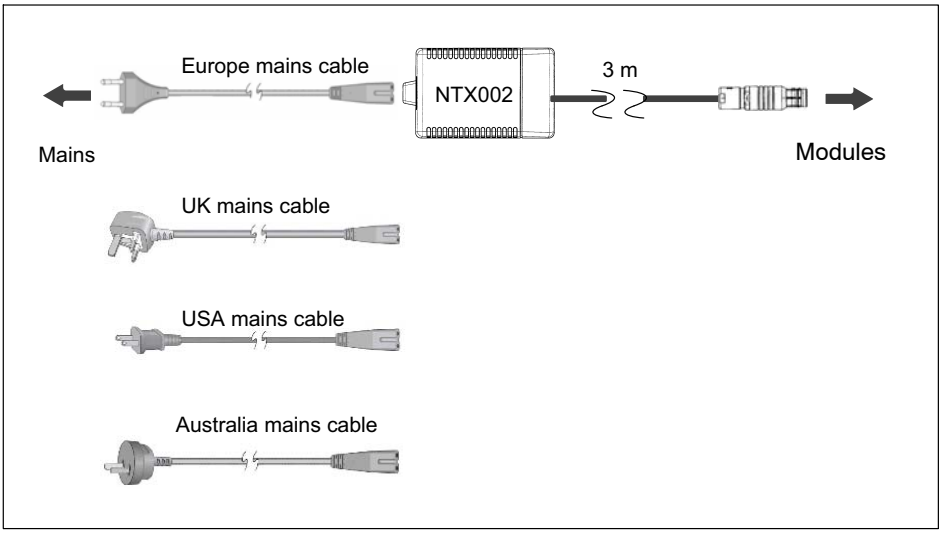
Accessories for the connection of the Smart modules

Article	Description	Order no.
Smart module	External signal conditioning module supplied with 24 V, supplies IEPE with constant current (BNC socket) and outputs a standardized voltage signal ± 10 V	1-EICP-B-2
Connection cable	Cable between Smart module and SubHD plug	1-SAC-EXT-MF-x-2 (x = length in meters)
Device connector	QuantumX Rugged DAQ connector	1-CON-P1007

10.1 System accessories

10.2 Voltage supply

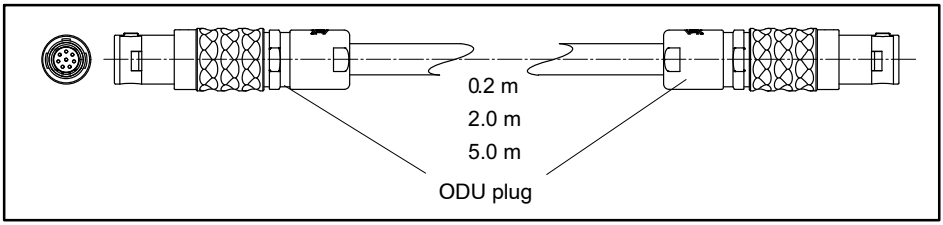
10.2.1 Power pack NTX002



Order No.: 1-NTX002

10.3 FireWire

10.3.1 FireWire cable (module to module; IP68)



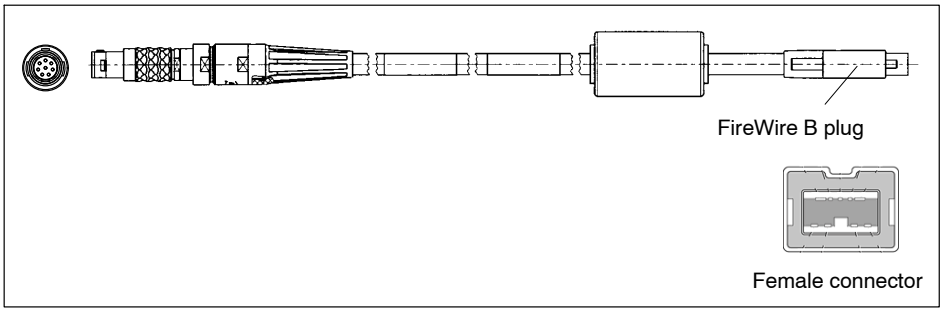
Order No.:

1-KAB272-2 (Length 2 m)

1-KAB272-0.2 (Length 0.2 m)

1-KAB272-5 (Length 5 m)

10.3.2 Connection cable



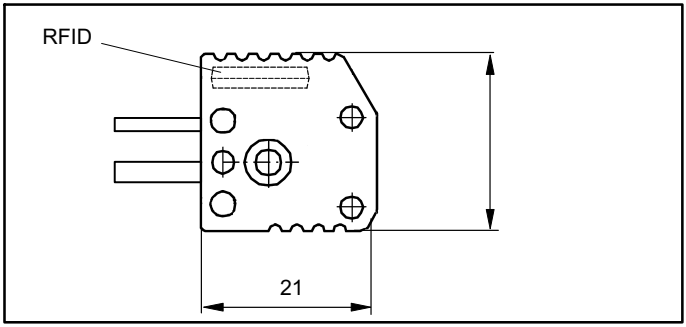
Order number:

1-KAB293-5 (Length 5 m)

1-KAB276-3 (Length 3 m, like KAB293-5 but with attached voltage supply cable)

10.4 MX1609-P accessories

10.4.1 Thermo-connector with integrated RFID chip



Connectors for thermocouple amplifiers:

MX1601-P: Type K

Package unit: 10 mini connectors for thermocouples type K

Order number : 1-THERMO-MINI

11 Support

Headquarters world-wide

Europe
Hottinger Baldwin Messtechnik GmbH:
Im Tiefen See 45, 64293 Darmstadt, Germany
Tel. +49 6151 8030, Fax +49 6151 8039 100
E-mail: info@hbm.com
www.hbm.com

North and South America
HBM, Inc., 19 Bartlett Street, Marlborough, MA 01752, USA
Tel. +1 800 578 4260 / +1 508 624 4500,
Fax +1 508 485 7480
E-mail: info@usa.hbm.com

Asia
Hottinger Baldwin Measurement (Suzhou) Co., Ltd.
106 Heng Shan Road, Suzhou 215009, Jiangsu, VR China
Tel. (+86) 512 682 477 76, Fax (+86) 512 682 593 43
E-mail: hbmchina@hbm.com.cn

Up to date addresses of representatives can also be found on the Internet under:
www.hbm.com/Contact/International sales offices

Hottinger Baldwin Messtechnik GmbH
Im Tiefen See 45 · 64293 Darmstadt · Germany
Tel. +49 6151 803-0 · Fax: +49 6151 803-9100
E-Mail: info@hbm.com · www.hbm.com

measure and predict with confidence

A3609-4.0_en 7-2001.3609