SOMAT XR

User Manual

English

CX23-R and EX23-R

SomatXR Ultra-Rugged DAQ

X4275-3.0 en HBM:Public.

HBM

Contents

Page

Safety Information

Appropriate Use
The module and the connected transducers may be used for measurement and directly related control tasks only. Any other use is not appropriate.

To ensure safe operation, the module may only be used as specified in the operating manual. It is also essential to follow the respective legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

Each time, before starting up the modules, 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 establish safe operating conditions.

This can be done, for example, by mechanical interlocking, error signaling, limit value switches, and such.

Safety Rules
A module must not be connected directly to a power supply network. The maximum permissible supply voltage is:

CX23-R module	$10V_{DC}$ ... $30\ V_{DC}$
EX23-R module	$10V_{DC}$ ... $36\ V_{DC}$
MX modules	$10V_{DC}$ ... $30\ V_{DC}$

The supply connection, as well as the signal and sense leads, must be installed in such a way that electromagnetic interference does not adversely affect device functionality. (HBM recommendation: "Greenline shielding design," downloadable from the Internet at http://www.hbm.com/greenline.)

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

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.

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.

Conditions on Site
For all modules:

- Observe the maximum permissible ambient temperatures given in the specifications.
- Minimize device exposure to direct sunlight in hot operating environments.

Maintenance and Cleaning
The modules are maintenance-free. Please note the following when cleaning the housing:

- Before cleaning, disconnect the equipment completely.
- Clean the housing with a soft, slightly damp (not wet) cloth. Never use solvents, since these could damage the labeling on the front panel and the display.
- Do not apply high water pressure to the unit for cleaning.

General Dangers of Failing to Follow the Safety Instructions
The module is a state of the art device and, as such, is fail-safe. The module may give rise to further dangers if it is inappropriately installed and operated by untrained personnel. Any person instructed to carry out installation, commissioning, maintenance or repair of the module must have read and understood the User Manuals and in particular the technical safety instructions.

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

Working Safely
Error messages should only be acknowledged once the cause of the error is removed and no further danger exists.

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

In particular, any repair or soldering work on motherboards or 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
Qualified persons means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function. This module is only to be installed and used by qualified personnel, strictly in accordance with the specifications and the safety rules and regulations.

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, you must be familiar with these concepts.
- As automation plant operating personnel, you have been instructed how to handle the machinery and are familiar with the operation of the modules and technologies described in this documentation.
- As commissioning engineers or service engineers, you have successfully completed the training to qualify you to repair the automation systems. You are also authorized to activate, to 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.

Markings Used
The following symbols may be found on the module:

Meaning: Electrostatic sensitive device

Devices 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.

Meaning: CE mark

The CE mark enables the manufacture to guarantee that the product complies with the requirements of the relevant CE directives (the declaration of conformity is available at www.hbmdoc.com).

Meaning: Statutory waste disposal mark

National and local regulations regarding the protection of the environment and recycling of raw materials require old equipment to be separated from regular domestic waste for disposal.

For more detailed information on disposal, please contact local authorities or the dealer from whom you purchased the product.

The following symbols may be found in this manual.

WARNING
Meaning: Dangerous situation
Warns of a dangerous situation in which failure to comply with safety requirements can result in death or serious bodily injury.

CAUTION
Meaning: Potentially dangerous situation
Warns of a potentially dangerous situation in which failure to comply with safety requirements could result in bodily injury or damage to property.

NOTE
Meaning: Important information
Points out important information about the product or its handling.

1 Getting Started

1.1 SomatXR DAQ

The SomatXR Ultra-Rugged DAQ series is a modular and universally applicable measurement system. The modules of this family 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.

The SomatXR Ultra-Rugged DAQ series consists of the following modules:

- **CX23-R Data Processor**: The CX23-R hosts its own secure web-based data recorder for intuitive and easy-to-use test setup, control, monitoring and data visualization. This server-based interface supports multiple users, and the capability to define system access restrictions on a per user basis. To manage test data, the CX23-R has the capacity to perform a broad range of on-board data processing. This includes a diverse set of computed channels for defining triggers and gates for the Somat DataModes™ as well as supporting arbitrarily complex mathematical computations. The acquired test data is stored in the efficient and robust SIE file format using a high-speed SATA storage drive. In addition, the CX23-R provides direct data sourcing for six interfaces including digital inputs and outputs, three CAN ports, one GPS and one auxiliary port (AUX).
- **EX23-R PoE Switch**: The EX23-R is a ruggedized 10-port Gigabit switch that supports IEEE1588 PTPv2 transparent clock time synchronization. The EX23-R supports both IPv6 and IPv4 Internet protocols. Five ports provide Power over Ethernet (PoE) to support cameras and other low power Ethernet based data sources. This module is factory configured to work seamlessly with the CX23-R.
- **MX Modules**: The SomatXR MX modules are front end data sourcing modules that can be used as expansion modules with the CX23-R Data Processor. They are configurable to interface to a diverse range of transducers and sensors. Generic features for most MX modules include precision measurement capabilities using 24 bit ADCs, TEDS sensor support and multiple digital filtering options.

  For more information on using MX modules in a standalone system with the catmanAP and MX Assistant software applications, refer to the MX Modules User Manual.

  The following SomatXR MX modules are currently available:

  - MX1601B-R Standard Module: Up to 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE, ICP®).
  - MX1609KB-R Thermocouple Module: Up to 16 type K thermocouples (NiCrNi) for measuring temperatures.

- MX1615B-R Bridge Module: Up to 16 individually configurable inputs, including strain gage-based transducers, standardized voltage and resistance or resistance-based measurements.
- MX840B-R Universal Amplifier: Up to eight (8) universal inputs for connecting more than 16 transducer technologies.
- MX411B-R Highly Dynamic Universal Amplifier: Up to four (4) inputs, including strain gage and inductive bridges, standardized voltage and DC current sources (20 mA) or current-fed piezoelectric (IEPE, ICP®) and piezoresistive transducers.
- MX471B-R CAN Module: Up to four (4) independent CAN bus nodes electrically isolated from each other and from the power supply.

1.1.1 Module Transducer Overview

Transducer	CX23-R	MX840B-R	MX1615B-R	MX1601B-R	MX1609B-R	MX411B-R	MX471B-R	Wiring Diagram
 Strain gage, full bridge six-wire configuration		●	●			●		80
 Strain gage, half bridge five-wire configuration		●	●			●		80
 Strain gage, quarter bridge three- or four-wire configuration			●					80
 Inductive full bridge		●				●		84
 Inductive half bridge		●				●		84
 LVDT (linear variable differential transformer)		●						84
 Piezoresistive transducer		●				●		87
 Potentiometric transducer		●	●					88
 Voltage, 60 V, 10 V, 100 mV		●	● 60 V only	●		● 10 V only		89
 Current-fed piezoelectric transducer (IEPE, ICP®)		● *		● *		● *		91
 Current, 20 mA		●		●		●		92
 Resistance or resistance-based measurements		●	●					94

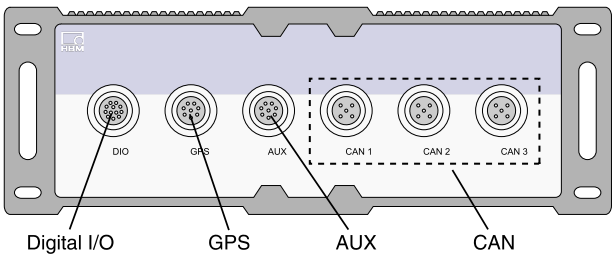
Transducer	CX23-R	MX840B-R	MX1615B-R	MX1601B-R	MX1609B-R	MX411B-R	MX471B-R	Wiring Diagram
Resistance thermometer (RTD), PT100 or PT1000		●	● PT100 only					94
Thermocouple, K-type					●			96
Digital input, static	●							97
Digital output, static	●							99
Frequency / pulse counter (timer, TTL)	○	● connectors 5-8						101
Incremental encoder (timer, TTL)	○	● connectors 5-8						101
Torque / speed		● connectors 5-8						101
CAN bus database or raw message	●	● † connector 1					● ‡ database only	107
GPS	●							
Camera, Axis network cameras	● via EX23-R							20

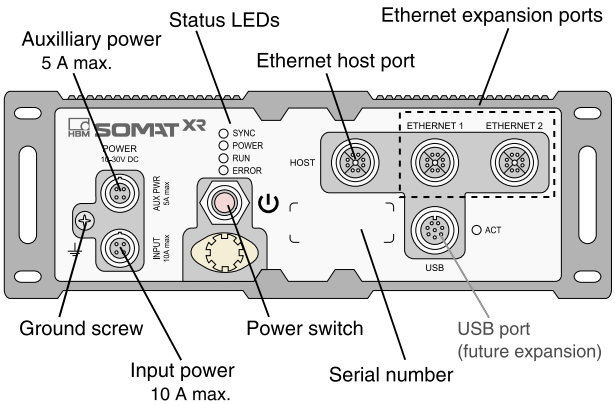
*ODU 14-pin to BNC adapter available soon.
†Not supported by the CX23-R Data Processor.
‡Including support for CCP/XCP-on-CAN.

1.2 Getting Started with the CX23-R Data Processor

The CX23-R data recorder is the central module of the rugged SomatXR family. It synchronizes all connected modules with Ethernet PTPv2, stores recorded measurement data and provides computed channels and smart data compression using Somat DataModes™. The SIE file format is used to assure data integrity and to enable configuration parameters to be retrieved. In addition, the CX23-R provides direct data sourcing for six interfaces including one DIO, three CAN, one GPS and one AUX.

The CX23-R back panel includes the input power and AUX power ports, power switch, status LEDs and Ethernet communication ports. The front panel includes the connectors for DIO, GPS, AUX and CAN data inputs.

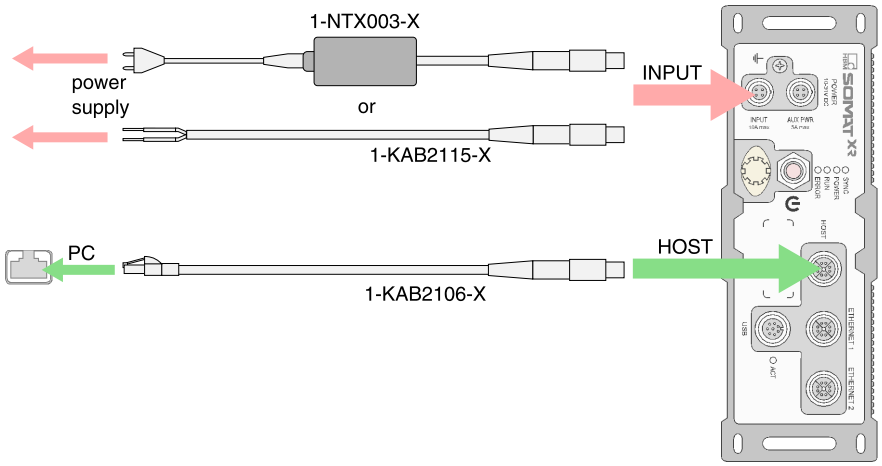




The CX23-R hosts its own secure web interface for intuitive and easy to use test setup, control, monitoring and data visualization interfaces. This server-based interface supports multiple users, and the capability to define system access restrictions on a per user basis.

1.2.1 Setting Up a Basic System

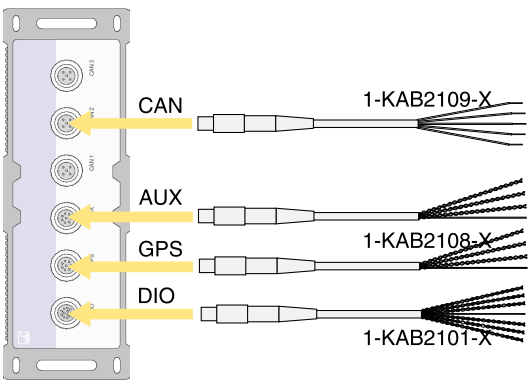
To set up a CX23-R module with basic connectivity, perform the following steps:



1. Connect the 1-KAB2115 power cable from the INPUT connector to a 10-30 V_{DC} power source. Alternatively, use the 1-NTX003 power supply.

NOTE
The green wire of the 1-KAB2115 cable must be insulated or tied to $+V_{DC}$.

2. Connect the 1-KAB2106 Ethernet cable from the HOST connector to the host PC. The host PC network settings must be compatible with the CX23-R default IP address 192.168.100.101.
3. Connect desired transducers to DIO, GPS, AUX and CAN ports using the appropriate sensor cables. Refer to the SomatXR Accessories Data Sheet for a complete list of sensor cables.



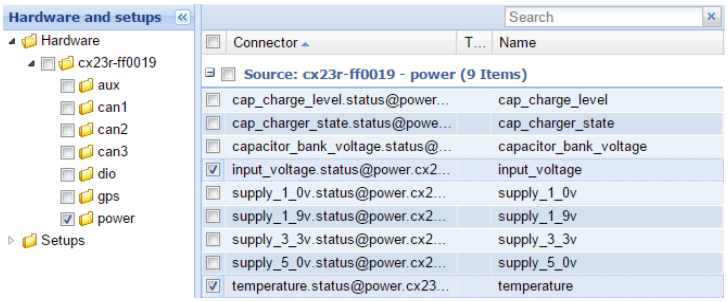
4. Wait at least five seconds after supplying power to the unit.
5. Press and release the power button. The green and blue LEDs turn on. Wait about 15 seconds for the unit to boot up.
6. Open a web browser and navigate to the default IP address 192.168.100.101. If presented with a certificate warning, choose to proceed. The CX23-R web interface is displayed.

1.2.2 Configuring and Running a Basic Test

1. Open the web-based interface at the default IP address 192.168.100.101 and navigate to the Test configuration section.

2. In the Test setups page, click the **New** button from the task pane to define a new test setup. Edit the setup name and description as desired. The default name is "test_name."

3. In the Channel setup page, click the **Add** button from the task pane. Select the desired inputs and click **OK**.

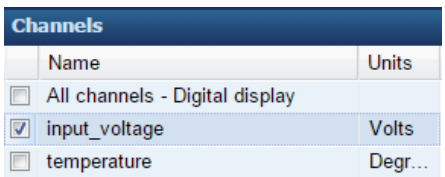


View the new channels in the All channels tab of the grid.

4. Click the **Save** button in the header or task pane to save changes.

5. Navigate to the Test and data control section.

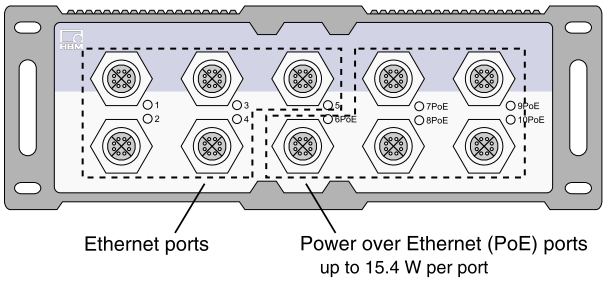
6. Click **Start** to run the test. The yellow LED flashes in the status bar of the web interface and on the unit. To view real time data, select the check boxes next to the desired channel names.

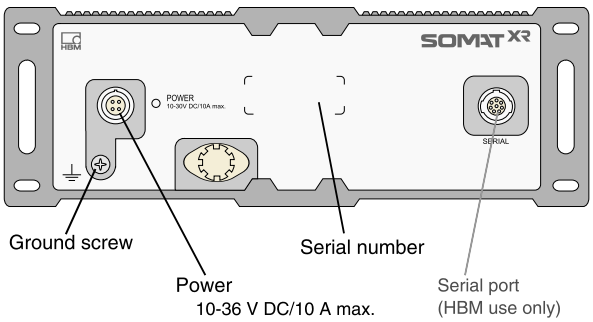


7. Click **Stop** to end the test run. To download the SIE data file, click the file name in the Test run statistics panel.

1.3 Getting Started with the EX23-R Ethernet Switch

Use the EX23-R Ethernet Switch Module to network SomatXR modules with other devices such as cameras. Use the power over Ethernet (PoE) ports to provide power to compatible network devices.





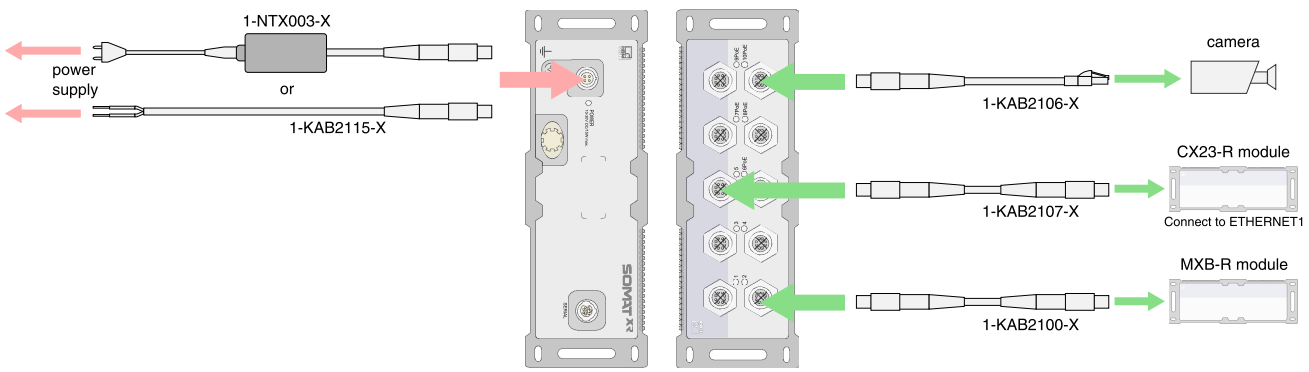
The EX23-R is designed to be used straight out of the box.

1. Connect the 1-NTX003 power supply or 1-KAB2115 power pigtail cable from the power connector on the EX23-R to a 10-36 V_{DC} power source.

NOTE
Connect only the red and black wires of the 1-KAB2115 cable.
Do NOT use a 1-KAB2110 cable to power the EX23-R from the CX23-R.

2. Connect the desired devices to the Ethernet ports using 1-KAB2100, 1-KAB2106 or 1-KAB2107 Ethernet cables, depending on the device.

CAUTION
Drawing PoE power lowers the maximum operating temperature. Please refer to the data sheet for the exact de-rating specifications.



2 Setting up the Hardware

2.1 Connecting MX Modules to a CX23-R

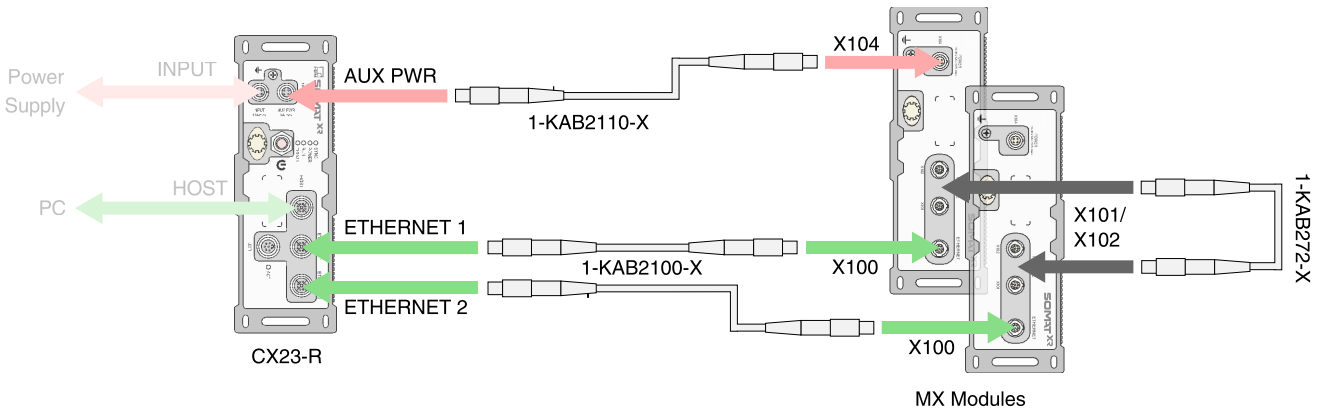
A CX23-R module can be used to control and process data from multiple MX modules to include other transducers such as voltage, current, bridge and thermocouple. MX modules can be connected directly to the CX23-R module or through one or more EX23-R Ethernet switches.

Refer to the MX Modules User Manual for more information on using MX modules.

NOTE
The CX23-R automatically configures the MX module network address and checks for firmware updates. If necessary, install new MX firmware before continuing.

CAUTION
When using FireWire to power MX modules, make sure that all modules have an Ethernet connection to the CX23-R unit or EX23-R switch. Failure to do so may cause undetected synchronization errors in all linked MX modules.

Centralized network using direct Ethernet connections



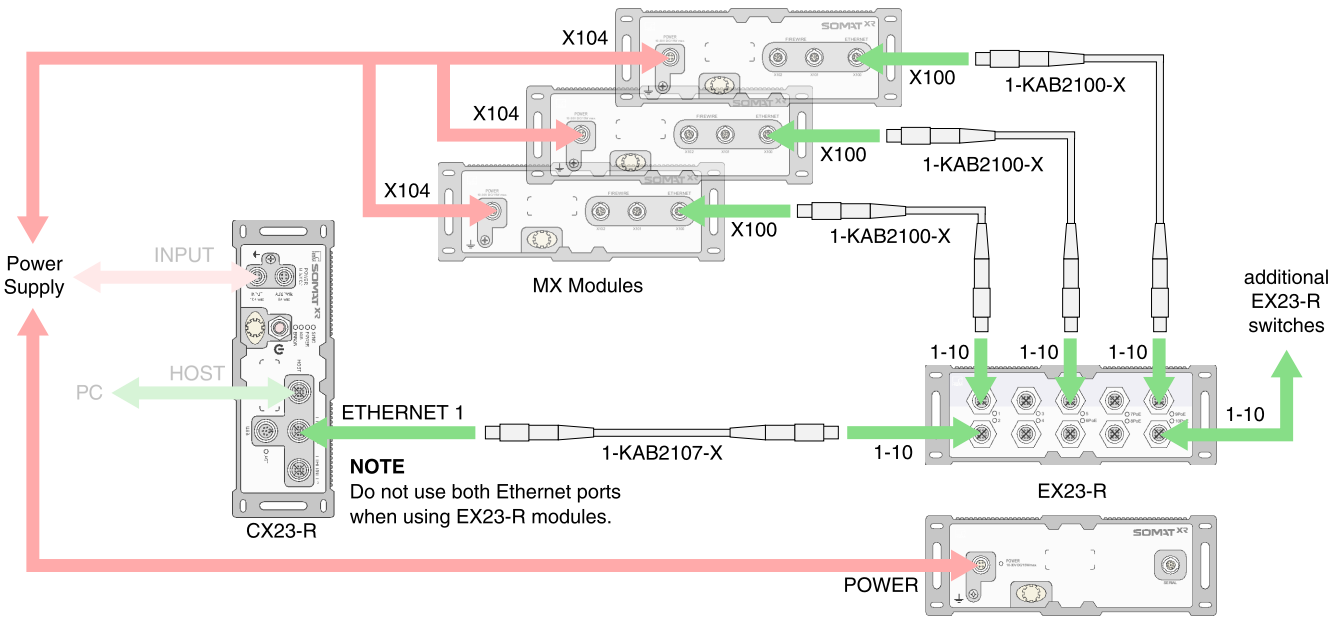
NOTE
The CX23-R AUX PWR connector can power a maximum of two MX modules.

1. To power the first MX module, connect the CX23-R AUX PWR connector to the X104 connector on the first MX module using a 1-KAB2110 cable.

CAUTION
Do not exceed 5 A current draw from the CX23-R AUX PWR connector.

2. To power the second MX module, use a 1-KAB272 cable from the X101 or X102 connector on first MX module to the X101 or X102 connector on the second MX module.
3. Connect the CX23-R ETHERNET1 and ETHERNET2 connectors to the MX module X100 connectors using KAB2100 cables. This establishes communication and synchronization between the CX23-R and MX modules.

Distributed network using EX23-R Ethernet switches



1. Connect the CX23-R, EX23-R and MX modules to a power supply.

NOTE
When designing the power system, note that increased cable lengths can produce significant voltage drops at the module connectors, especially when using PoE or powering multiple modules from one source.

NOTE
MX modules may also be powered in serial using FireWire connections. Refer to the MX Modules User Manual for details.

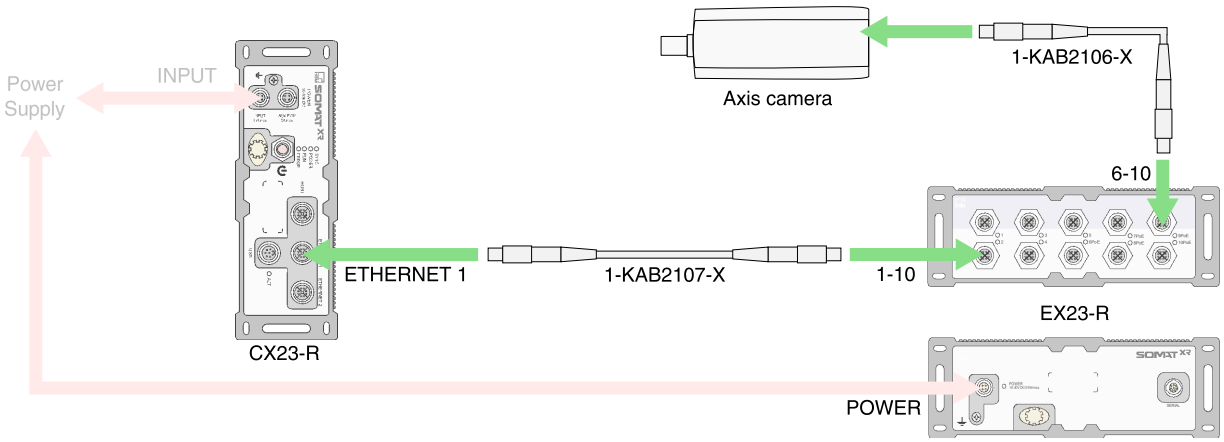
2. Use a 1-KAB2107 cable to connect the CX23-R ETHERNET1 connector to the EX23-R switch.

NOTE
For optimal data throughput performance, do not use both CX23-R Ethernet ports when using EX23-R modules.
To use multiple EX23-R modules, connect any Ethernet port on the new EX23-R module to any open EX23-R Ethernet port.

3. Use 1-KAB2100 cables to connect the MX module X100 connectors to the EX23-R switch.

2.2 Setting Up an Axis Network Camera

Somat XR offers camera input channels through the use of Axis network cameras with the EX23-R PoE Switch.



Use a 1-KAB2107 cable to connect the CX23-R ETHERNET1 connector to an open port on the EX23-R Switch. Connect the EX23-R and CX23-R modules to a power supply. Then use a 1-KAB2106 cable to connect the Axis Ethernet port to one of the EX23-R PoE ports (6-10).

Verify that the camera is detected on the network by opening the CX23-R web interface and navigating to the Hardware page of the Test Configuration section. Click on the Axis camera entry under the CX23-R module to display the camera properties including a still frame capture of the video. Click **Refresh** to recapture the frame image.

Compatible camera devices

SomatXR is compatible with the following Axis network cameras.

- Axis 211 Network Camera
- Axis M1103 Network Camera
- Axis M7001 Video Encoder
- Axis M7011 Video Encoder
- Axis P1311 Network Camera
- Axis P1344 HD Network Camera
- Axis P1346 HD Network Camera

NOTE

HBM only supports the devices listed above and assumes no risk if any other devices are used.

Resetting the camera to factory defaults

For best results or if issues exist with detecting the camera, reset the camera to

factory defaults.

1. Remove power from the camera.
2. Press and hold the control button and reapply power to the camera by connecting it to an open EX23-R PoE port (6-10).
3. After the camera status LED turns amber, release the control button.
4. Wait for the camera status LED to turn green, which indicates that the camera has been reset. This may take up to two minutes.

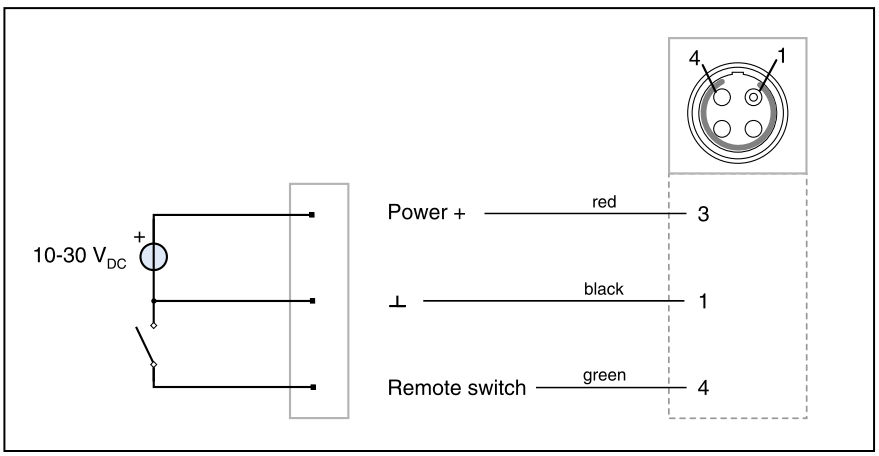
NOTE
The location of the control button and LED status indicator depends on the camera model. For information on specific models, refer to the Axis documentation.

2.3 Power Considerations

2.3.1 Setting up a Remote Power Switch

A remote power switch allows the user to control the CX23-R power state without using the power push button. This is useful in situations where the CX23-R unit is not easily accessible to the test operator.

The remote power switch acts as a three-way household switch in conjunction with the CX23-R power push button. Connect the 1-KAB2115-2 green and black wires to two contacts of a single pole, single throw contact switch with sufficient current rating (at least 10 A recommended).



NOTE
When remote switching capability is not needed, the green wire on the 1-KAB2115-2 power supply cable should be electrically isolated.

2.3.2 Powering from a Vehicle

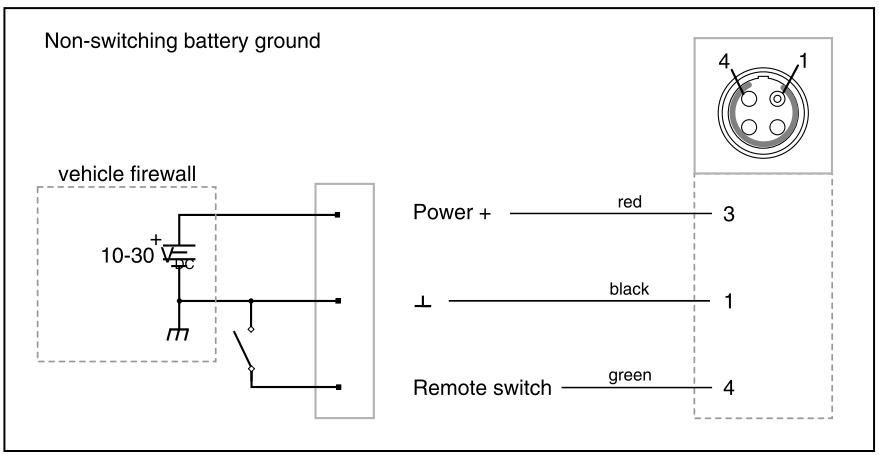
The following illustrates the recommended power connections for using a vehicle electrical system as the SomatXR system power source. The included diagrams are not intended to be complete, detailed instructions.

CAUTION
Connection to the positive power terminal without proper grounding may result in a blown fuse and/or other damage to the SomatXR system.

NOTE
When using additional cable length to make the connections, select an appropriate gauge wire to carry sufficient current (≥10 amps) and voltage (≥12 volts).

Vehicle Non-Switching Battery Ground

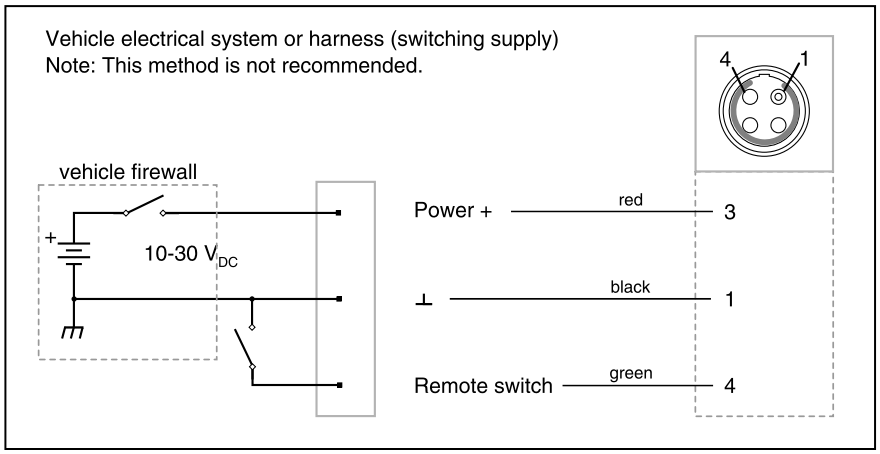
The following diagram illustrates the proper method of powering a SomatXR system with a direct connection to a vehicle battery that has a permanent ground connection to the vehicle chassis.



Vehicle Electrical System or Harness

An alternate method, shown below, uses a vehicle electrical system or harness which may be a switching supply such as an ignition or a relay type device.

CAUTION
This method, while feasible, is not recommended and cannot be guaranteed as safe. Results may include unwanted multiple runs of data, improper reboots, lost data due to multiple power cycles and improper charging of the internal battery pack.

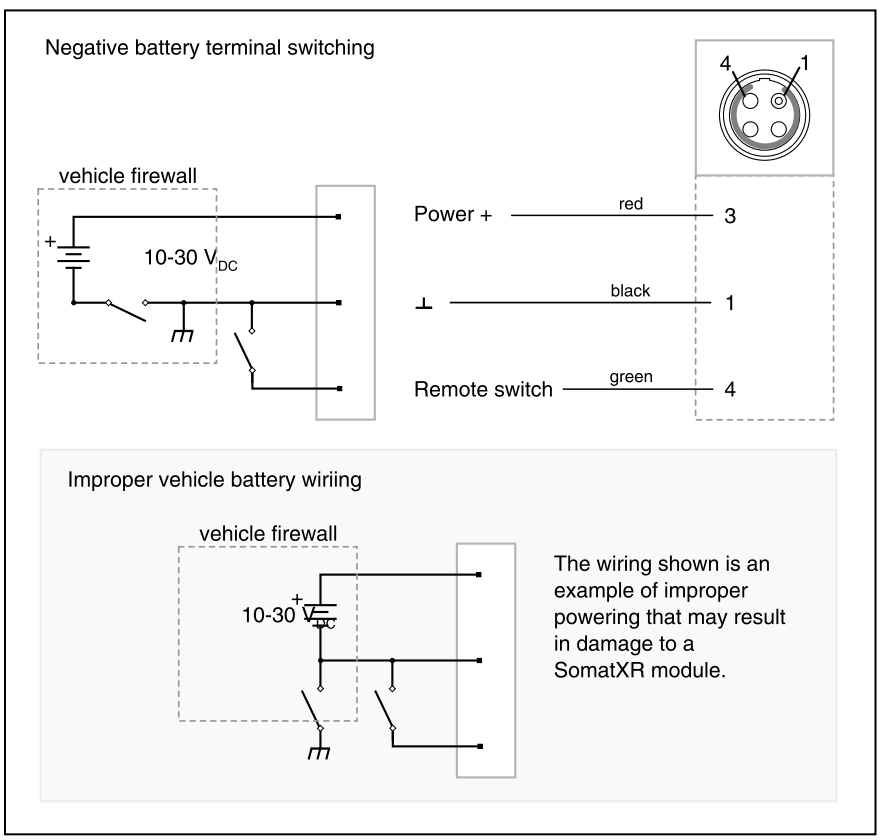


Vehicle Negative Battery Terminal Switching

For a system with a switched power system that removes the negative battery terminal from the equipment chassis ground, carefully follow the illustrated recommendation below.

CAUTION

Failure to follow these suggestions may result in blown fuses and/or permanent damage to SomatXR modules. Improper powering of the unit requiring repairs by HBM technicians may be deemed as non-warranty usage, resulting in service charges.



3 Configuring the System

3.1 Configuring Network Settings

The CX23-R communicates through standard 10/100/1000 Base-T Ethernet using IPv4 or IPv6. The CX23-R hosts its own secure web interface accessed through configurable network settings. The default IP address is 192.168.100.101.

Changing the CX23-R Host Name

Navigate to the Networks page under System Configuration.

Enter a new **Host name** for the CX23-R unit and click **Save**. The system reboots with the new host name.

NOTE
Save all changes before modifying the host name. The required system reboot discards all pending changes.

Defining a Network Configuration

The CX23-R uses network configurations to determine how to boot up and communicate with the browser. Many network configurations can be defined, but only the active configuration is considered at boot time.

View and manage network configurations on the Networks page under System Configuration.

To define a new network configuration, click **New** and enter the appropriate parameters:

- **Network**: Enter a full description of the network. This is the text that displays in the networks list.
- **IP address assignment**: Set the type of IP address to either Static or Dynamic. For static assignment, enter correctly formatted IPV4 address, subnet mask, default gateway and broadcast values. Some fields are automatically populated based on the entered values, but they may be edited as necessary.
- **DNS server assignment**: For static IP assignment, manually format the Preferred and Secondary DNS servers.

Click **Save** to save the new configuration. To make the new configuration active, click the **Make active** button. The unit reboots with the new settings.

WARNING
Make sure that all entries are correct before making a network configuration active. Incorrect settings can render the system temporarily unusable and require a manual reset to default network settings.

NOTE
Save all changes before making a network configuration active. The required system reboot discards all pending changes.

Default Network Configuration and Restoring Default Settings
The unit comes factory set with the IP address 192.168.100.101. The default active network configuration is named Default Auto Set and is configured for dynamic IP address assignment (DHCP). the default network cannot be deleted.

If it becomes necessary to restore the default settings, there is a reset procedure that sets the IP address to 192.168.100.101 and makes the Default Auto Set the active network. No other network configurations are affected. To perform the reset:

1. Save all changes and ensure there are no other users on the system.
2. Switch off the CX23-R unit by pressing the power switch and wait for the unit to completely power down.
3. Press and hold the power switch.
4. When the LEDs flash, stay on and start flashing again, release the power switch.

3.2 Managing Users and Privileges

The CX23-R allows access from multiple users, each of which can be assigned a different set of privileges permitting or restricting access to the CX23-R unit.

The first step to managing users is to create one or more profiles. Profiles define what privileges can be assigned to users. For example, one profile named *Test Author* might provide access to the Test configuration and Test and data control areas of the interface and another named *Operator* might allow only controlling test runs from the Test Control page. Each profile can be assigned to multiple users. In the previous example, there might be one test author and four operators, each with their own user account and credentials.

In addition, each user has individual control over the web interface through User options which follow the user no matter the machine or browser used to log on. Select User options > **Preferences** to view User Preferences.

Adding a New Profile
Navigate to the Profiles page under System Configuration.

To create a profile, click **New**. Enter the profile name, select the desired privileges and click **Save**.

Creating a User and Assigning a Profile
Navigate to the Users page under System Configuration.

To add a new user, click **New**. Enter the desired values for the user parameters and click **Save**.

- **User name**: The user name must be unique and is case sensitive. User names cannot be changed.
- **Full name**: The user's full name to be displayed in the users list.
- **Password**: A password is required. A password can be any combination of letters, numbers or special characters and is case sensitive. The entered password is masked for security. By default, the minimum password length is

eight (8) characters. Users with appropriate privileges can change the minimum length in System Preferences . Passwords never expire.

- **Profile**: A profile that has been previously created on the Profiles page. Only one profile can be assigned to a user.

Default User and Restoring Default Credentials
The unit comes factory set with one user account and one profile with complete administrator privileges. This default user comes with the credentials:

- User name: *admin*
- Password: *password*

It is strongly recommended to change this password. The default user and profile cannot be deleted.

If an administrator's credentials are lost or forgotten, there is a reset procedure that restores the default user and profile. No other users or profiles are affected. To perform the reset:

1. Save all changes and ensure that there are no other users on the system.
2. Switch off the CX23-R unit by pressing the power switch and wait for the unit to completely power down.
3. Press and hold the power switch.
4. When the LEDs begin to flash, quickly release the power switch.

Configuring a System with No Authentication
If user control is not needed, deselect the **Authentication required** option in User section of the System Preferences. The default user must have the default password to use this setting.

3.3 Configuring MX Modules for Use with the CX23-R

The SomatXR MX modules are front end data sourcing modules that can be used as expansion modules with the CX23-R Data Processor. They are configurable to interface to a diverse range of transducers and sensors. Generic features for most MX modules include precision measurement capabilities using 24 bit ADCs, TEDS sensor support and multiple digital filtering options.

Updating MX Firmware
The CX23-R firmware always contains a copy of the latest required MX firmware version.

To update the MX firmware, navigate to the Hardware page in the Test configuration section of the CX23-R web interface. Select the MX module in the Hardware panel. Click the **Update** button in the Properties panel to start the firmware update process. Repeat the process for all connected MX modules. The CX23-R can update multiple MX modules at one time.

CAUTION
It may take several minutes for the MX module firmware update to complete. Do not disconnect power to the MX module as this may render the MX module unusable.

When the firmware update is complete, the MX module reboots. It typically takes a few minutes for the MX module to synchronize with the CX23-R. Test runs cannot be started until all MX channels used in the test setup are synchronized.

Changing the Sample Rate Domain
The MX module sample rate domain can be either Decimal or Classic and must match that of the test setup, which is based on the System Preferences when the test setup is created.

To set the module sample rate domain, navigate to the Hardware page in the Test configuration section of the CX23-R web interface. Select the MX module in the Hardware panel and set the **Sample rate domain** in the Properties panel to either Decimal or Classic. The MX module reboots automatically when this setting changes.

The sample rate domain controls the sample rates and associated digital filter types and frequencies when configuring input channels. The default setting is Decimal, which includes typical sample rates of 5000, 2500, 1000, and 500 Hz. In the Classic domain, typical nominal sample rates include 4800, 2400, 1200, and 600 Hz.

NOTE
The nominal Classic domain sample rates are used for convenience. The actual sample rates are approximately 260 ppm greater than the nominal sample rates. To find the exact sample rate, multiply the nominal sample rate by 8388608/8386425.

3.4 Configuring the EX23-R

1. Connect a PC to any open port using a 1-KAB2106 cable.
2. Open an internet browser and navigate to:
   - IP Config: 192.0.2.1/ip_config.htm
   - Firmware: 192.0.2.1/upload.htm
3. Log on using the default credentials:
   - username: *admin* password: *(blank)*

3.5 Updating Firmware

HBM regularly releases new module firmware introducing new features and providing device improvements.

Updating CX23-R Firmware
First, download the current firmware release from www.hbm.com.

There are two methods to update CX23-R firmware.

- Navigate to the Firmware page under System configuration. Click the **Browse** button and select the image file. Click **Update** to begin the firmware upgrade.
- Navigate to the Hardware page under Test configuration. Select the CX23-R module in the hardware panel and click **Update firmware** in the properties panel. Select the downloaded image file to begin the firmware upgrade.

Wait for the upgrade process to complete and the unit to reboot. Upon completion, the footer indicates the new firmware version.

CAUTION
Allow the firmware upgrade to run completely. Before upgrading, make sure that no other users are logged in and no other processes are running. Failure to do so may render all hardware unusable requiring a factory reset.

NOTE
Updating the unit firmware deletes all system log messages.

Updating MX Module Firmware
For MX modules, update the firmware on the Hardware page of the web interface. Select the MX module in the hardware panel and click **Update firmware** in the properties panel. The system updates the MX module firmware to the latest version required by the CX23-R. The CX23-R can update multiple MX modules at one time. When the firmware update is complete, the MX module reboots. It typically takes a few minutes for the MX module to synchronize with the CX23-R. Test runs cannot be started until all MX channels used in the test setup are synchronized.

CAUTION
It may take several minutes for the MX module firmware update to complete. Do not disconnect power to the MX module as this may render the MX module unusable.

4 Setting Up and Running a Test

4.1 Setting Up a Test

Set up tests in the Test Configuration section of the CX23-R web interface. Perform the following steps to set up a test.

1. Create a test setup on the Test Setup page. Test setups define the channels, computed channels and DataModes that the CX23-R captures and processes during a test run. The CX23-R can store multiple test setups. Test setups can be exported and imported on other CX23-R modules.
2. Add input channels to the test setup on the Channel Setup page based on the connected devices and imported CAN databases. For applicable transducer types, sensor parameters can be easily defined using TEDS or imported HBM sensor database files. For channels that need to be scaled, set the scaling parameters and perform experimental scaling measurements.
3. Create Computed Channels as needed to manipulate the data from transducer channels or other computed channels.
4. Create DataModes™ to store channel and computed channel data.

4.2 Configuring Input Channels

4.2.1 TEDS Sensors

To simplify input channel configuration, SomatXR MX modules support TEDS sensors.

NOTE

TEDS sensors can be programmed using HBM catman®AP or MX Assistant. For more information, refer to the software documentation.

To view the channels with TEDS sensors connected, navigate to the Hardware page in the Test configuration section. Select an MX module to display which connectors have a TEDS sensor connected.

When an MX channel with a TEDS sensor is added to the test setup, the channel parameters are configured based on the TEDS information, which is indicated by the TEDS sync icon ( ) in the *TEDS* column of the channels grid.

Channel parameters can be manually edited, which is indicated by the TEDS edited icon ( ) in the *TEDS* column. To reset the channel parameters to TEDS sensor definition, select the channel and click **Sync TEDS**.

If a TEDS sensor is connected that conflicts with an existing channel in the setup, the channel is shaded red. To use the TEDS information to configure the sensor, click the **Sync TEDS** button.

When a test is running, TEDS discovery is disabled to preclude the possibility of an TEDS edited channel being synced. When a test run stops, TEDS discovery is re-enabled which may take several seconds.

Occasionally, there are errors in TEDS information, which is indicated by the TEDS error icon ( ) in the channels grid.

4.2.2 HBM Sensor Databases

To simplify input channel configuration, the SomatXR system supports HBM sensor databases for MX modules.

Preparing an HBM Sensor Database

To import an HBM sensor database file, a .sdbx text file must be created from the standard .sdb file using the MX Assistant. To create the .sdbx file:

1. Open the MX Assistant and navigate to the Sensor database tab.
2. If the database is not already available, click **Add** and select the .sdb database file.
3. Highlight the .sdb database and click Save as. Select to save as a CX23-R database file (.sdbx) and save the file on the host machine.

Importing an HBM Sensor Database

Navigate to the Databases page in the System configuration section.

Browse for and select the .sdbx database file. The file can be located on any local or external device.

To begin the import process, click **Import**. Once imported, the new database displays in the databases list. Select the file from the list to display an overview of the database and the number of supported and unsupported sensors.

NOTE

Future CX23-R firmware versions may support more sensors. The HBM sensor database does not need to be re-imported to use newly supported sensors.

Applying Sensor Database Parameters

Navigate to the Channel Setup page of the Test configuration section and add the desired MX module input channels.

To apply sensor configurations from imported HBM sensor databases, first **expand** the Sensors panel to the left hand side of the channels grid. The Sensors panel contains the imported sensor databases and their sensor definitions. For very large databases, it may take several seconds to display the database contents for the first time.

Select the sensor definition from the Sensors panel and the desired channel or channels from the grid and click the blue arrow at the bottom of the Sensors panel to apply the definition to the selected channels. Alternately, drag and drop the sensor definition onto the desired channel.

When a sensor definition is successfully applied to a channel, this is indicated by the SDB sync icon ( ) in the *SDB* column of the channels grid. Channel parameters can be manually edited, which is indicated by the SDB edited icon ( ) in the *SDB* column. To reset the channel parameters to the applied database definition, select the channel and click **Sync SDB**.

NOTE
Sensor database parameters can be applied to TEDS sensors. However, if the channel is re-synced to its TEDS parameters, the sensor database reference is removed.

4.2.3 Vector CAN Databases

To simplify CAN channel configuration, the SomatXR system supports vector CAN databases.

Importing a Vector CAN Database
Navigate to the Databases page in the System configuration section.

Browse for and select the .dbc database file. The file can be located on any local or external device. There is an option to **Append message names to signal names**. Selecting this option appends a double colon (::) followed by the message name to the signal name on import. Duplicate signal names are made unique by appending a sequential number preceded by the pound sign (#).

To begin the import process, click **Import**. Once imported, the new database displays in the databases list. Select the file from the list to display the CAN channels.

NOTE
Only the file contents and not the actual database loads on the CX23-R device. If the system encounters an error during import, none of the file contents are imported.

Adding CAN Database Channels
Navigate to the Channel Setup page of the Test configuration section and click **Add**. In the Hardware and setups panel, select the imported CAN database under the desired CAN connector. Select the CAN channels and click **OK**.

4.3 Input Channels

4.3.1 Input Channel Generic Parameters

- **Connector**: A unique hardware identifier created by the system. To change the device or connector, select the channel and click **Change device**.
- **TEDS**: For MX module channels with TEDS Sensors connected, an icon is displayed with the TEDS status. Not in edit dialog.
- **SDB**: For MX module channels with HBM Sensor Databases applied, an icon is displayed with the SDB status. Not in edit dialog.
- **Name**: The channel name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Enter an optional detailed description of the channel.
- **Collect**: Select the Collect checkbox to write the channel data to the SIE data file during a test run.
- **Chart type**: Set the default chart type for the channel. Not in edit dialog.
- **Decimals**: Set the default decimal places for channel displays.

- **Sample rate**: Set the desired channel sample rate. If the sample rate changes, all dependent computed channels and DataModes are changed automatically.
- **Filter type**: Set the type of filter for the channel to None, Linear phase (FIR), Butterworth (FIR), Butterworth (IIR) or Bessel (IIR).
- **Filter frequency**: Set the frequency of the selected filter. The options vary based on the filter type.
- **Measurand**: Enter an optional measurement type.
- **Reading**: Current value of the channel. Show the readings by selecting the desired channels and clicking **Live update**. Not in edit dialog.
- **Data type**: The format of the channel data output. Not in edit dialog.

4.3.2 Input Channel Scaling Parameters

Before running a test, many input sensors must be scaled. Define sensor scaling parameters in Channel Setup.

To configure a channel for sensor scaling, first set the *Scaling mode* in the channel editor dialog or channel grid.

Depending on the mode selected, different scaling parameters must be specified to define the scaling line.

Sensor scaling mode	Scaling parameters
Defined slope intercept	*Slope* *Intercept*
Defined zero span	*Electrical zero* *Electrical span* *Physical span*
Defined two point	*Electrical 1* *Physical 1* *Electrical 2* *Physical 2*
Experimental two point	See Experimental Two Point Scaling
Internal shunt resistor	See Internal Shunt Resistor Scaling
Strain gage	*Strain gage factor* *Bridge factor*

Scaling parameters

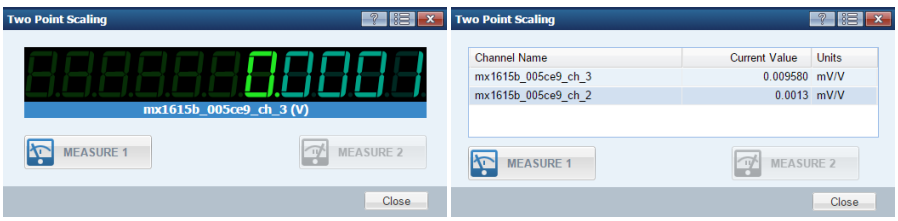
- **Scaling mode**: Set the channel scaling mode.
  - Defined slope intercept: Specify the *Slope* and *Intercept* of the scaling line.
  - Defined zero span: Specify the *Electrical zero* of the sensor scaling line. Enter both the *Electrical span* and the *Physical span*.
  - Defined two point: Specify the *Electrical 1*, *Physical 1*, *Electrical 2* and *Physical 2* points to define the scaling line.
  - Experimental two point: Use the Experimental Two Point Scaling option to define the two point parameters based on experimental measurements.

  - Internal shunt resistor: Use Internal Shunt Resistor Scaling for modules with a shunt resistor. Specify the *Shunt resistor*, *Shunt polarity* and *% Dev* parameters before starting experimental scaling.
  - Strain gage: Specify the *Strain gage factor* and *Bridge factor*.
- **Electrical units**: Electrical units of channel input.
- **Units**: Physical units of measurement for the channel.
- **Electrical 1**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Physical 1**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Electrical 2**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Physical 2**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Electrical zero**: Specify for Defined zero span scaling mode.
- **Electrical span**: Specify for Defined zero span scaling mode.
- **Physical span**: Specify for Defined zero span scaling mode.
- **Slope**: Specify for Defined slope intercept scaling mode.
- **Intercept**: Specify for Defined slope intercept scaling mode.
- **Strain gage factor**: Specify for Strain gage scaling mode.
- **Bridge factor**: Specify for Strain gage scaling mode.
- **Shunt resistor**: Specify for Internal shunt resistor scaling mode.
- **Shunt polarity**: Specify for Internal shunt resistor scaling mode.
- **% Dev**: Specify for Internal shunt resistor scaling mode.
- **Prerun zero mode**: Set to Interactive only to allow channel zeroing.
- **Prerun zero offset**: Automatically set after zeroing a channel.
- **Prerun zero target**: Specify before zeroing a channel.
- **Range min and max**: Specify the expected extreme values of the channel. May be any real number.

Experimental Two Point Scaling

Use the experimental two point scaling option to define the two point parameters based on experimental measurements.

Select the channel or channels to be scaled and click **Two Point Scaling**.



Before scaling, the system sets the scaling parameters to their experimental two point defaults. Note that the *Physical 1* and *Physical 2* values can be modified before or after the *Electrical 1* and *Electrical 2* values are measured.

Parameter	Two Point Scaling Default
Units	Electrical units
Electrical 1	0
Physical 1	0
Electrical 2	1
Physical 2	1

Click **MEASURE 1** to take the first reading (electrical 1). Then click **MEASURE 2** to take the second reading (electrical 2). Both measurements must be completed to set the channel electrical values. To restart the scaling process, close the window and click **Two Point Scaling** again. After scaling is complete, be sure to save the test setup.

NOTE
It is recommended to select the **Use system defined sensor scaling filters** option in the System Preferences to minimize the effects of noise on the accuracy of scaling measurements.

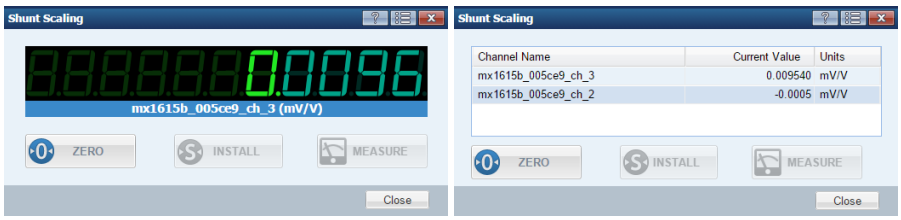
Internal Shunt Resistor Scaling
Use shunt scaling for modules with a shunt resistor.

Before starting the experimental scaling, the *Shunt resistor*, *Shunt polarity* and *% Dev* parameters must be defined. Set the *Shunt polarity* parameter to Down scale or Up scale. Specify the *% Dev* to allow the shunt deviation value to be computed correctly.

NOTE
Shunt polarity is in terms of the electrical units of mV/V. If the sensor scaling slope is negative, the shunt polarity in physical units is in the opposite direction. For example, the Up Scale option results in a negative swing in the physical units output data.

Select the channel or channels to be scaled and click **Shunt Scaling**.

NOTE
Shunt scaling is restricted to inputs without sense lines. These channels are highlighted in green to indicate that the channel is to be experimentally measured.



Before scaling, the system sets the scaling parameters to their shunt defaults. Note that the *Physical units* and *Physical span* values can be modified before or after the *Electrical zero* and *Electrical span* are measured.

Parameter	Shunt Scaling Default
Units	mV/V
Electrical zero	0
Electrical span	1
Physical span	1
Shunt deviation	blank
Excitation mode	AC 1200 Hz square
Excitation range	1.0 V for $R \leq 100\ \Omega$ 2.5 V for $R < 300\ \Omega$ 5.0 V for $R \geq 300\ \Omega$

NOTE
To optimize the scaling accuracy, the CX23-R automatically uses the AC *Excitation mode* and the largest *Excitation range* available during sensor scaling. If necessary, the excitation mode and range revert to the user-defined values after shunt scaling is completed or canceled and the channel typically requires zeroing.

Perform shunt scaling in three steps. Click **Zero** to record the unshunted values, which are used to set the zero offset. Click **Install** to install shunts as defined by the *Shunt polarity* parameter. Wait for the installed shunt readings to stabilize and then click **Measure** to record the shunted values. The recorded unshunted and shunted values are used to define the *Electrical zero* and *Electrical span* parameters. After scaling is complete, be sure to save the test setup.

NOTE
It is recommended to select the **Use system defined sensor scaling filters** option in the System Preferences to minimize the effects of noise on the accuracy of scaling measurements.

4.3.3 Analog Channels

Analog channels include Strain Gage Transducers, Inductive Transducers, Piezoresistive Transducers, Potentiometric Transducers, Voltage Sources, Current-fed Piezoelectric Transducers (IEPE, ICP®), Current Sources and Resistance-Based Measurements.

- **Input mode**: Set the analog input mode from the possible transducer types for the module. In the channel edit dialog, a wiring diagram for the selected input mode is available for reference.

NOTE
For piezoresistive bridges, use the standard Bridge full 6 wire input mode.

- **Transducer power**: Specify the unregulated transducer power voltage. The value be any real number within hardware limits.
  - For MX840B-R Universal Amplifier and MX411B-R Highly Dynamic Universal Amplifier channels, transducer power must be 5-24 V or zero.
  - For MX1601B-R Standard Module channels 1-8, transducer power must be 5-24 V or zero.
  - For MX1601B-R Standard Module channels 9-16, transducer power must be 15-30 V or zero.
- **Bridge ohms**: For Strain Gage Transducers, specify the bridge leg resistance in ohms. The value must be 90-5000 Ω. If the type is quarter bridge, the value must be 120 or 350 Ω.
- **Leadwire ohms**: For Strain Gage Transducers, specify the bridge leadwire resistance in ohms. The value may be any real number greater than or equal to zero.
- **Excitation mode**: Set the regulated excitation mode to DC or AC.
  - For MX840B-R Universal Amplifier and MX411B-R Highly Dynamic Universal Amplifier channels, the AC excitation mode is AC 4800 Hz sine.
  - For MX1615B-R Bridge Module channels, the AC excitation mode is AC 1200 Hz square.
  - For Potentiometric Transducers and 3-wire quarter bridges (regulated), the excitation mode must be DC.
  - For Inductive Transducers, the excitation mode must be AC.
  - For MX411B-R Highly Dynamic Universal Amplifier channels, FIR filters are not compatible with the AC excitation mode.
- **Excitation range**: Set the regulated excitation voltage range. The available values depend on the module.

NOTE
To optimize the scaling accuracy of bridge modes that support Internal Shunt Resistor Scaling, the CX23-R automatically uses the AC *Excitation mode* and the largest *Excitation range* available during sensor scaling. If necessary, the excitation mode and range revert to the user-defined values after shunt scaling is completed or canceled and the channel typically requires zeroing.

- **Max electrical**: Set the measuring range in mV/V. The available values depend on the module and the Excitation range.

NOTE

For the *Input mode* Bridge quarter 3 wire (no sense lines), the signal conditioner has an inherent large offset (typically, -2 mV/V for 350 Ω and -6 mV/V for 120 Ω). The CX23-R internally compensates for this offset which significantly reduces the negative limit of the measurement range.

- For 350 Ω with 5.0 V excitation, the range is reduced from -4 to -2 mV/V.
- For 350 Ω with 2.5 V excitation, the range is reduced from -8 to -6 mV/V.
- For 120 Ω with 2.5 V excitation, the range is reduced from -8 to -2 mV/V.
- For 120 Ω with 1.0 V excitation, the range is reduced from -20 to -18 mV/V.

- **Quadrature**: For Incremental encoder inputs, set to True to count in quadrature.
- **Encoder index reset**: For encoder counter inputs, set to True for inputs with a zeroing (reference) pulse.
- **Encoder index divisor**: For encoder counter inputs with a zeroing pulse, set the index divisor.

4.3.4 CAN Channels

CAN channels use Vector CAN Databases to decode specific signal values from incoming CAN messages on a CX23-R or MX471B-R CAN connector. Since database channels extract numeric signals from CAN messages, they can be plotted and used as source channels for computed channels and DataModes.

The MX471B-R supports up to 128 database channels for each CAN connector. There is no limit on the number of database channels for CX23-R CAN connectors. The CX23-R also supports active queries (SAE® J1939-21 PGN requests) on up to 75 database channels per CAN connector.

NOTE

The CX23-R also supports raw CAN Message Channels.

- **Expiration time**: Specify the time period in seconds that can elapse without data arriving on the CAN bus before data is considered stale and the output is set to the invalid value. The value may be any real number greater than zero.
- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.
- **Hardware interface**: Value is CAN.
- **Bit rate**: Set the bit rate from the drop-down list of valid values. If the CAN bit rate is changed, all channels on the same port are changed to the same bit rate value automatically.
- **Termination**: Set the state of the internal termination resistor as true or false. If the termination state is changed, all channels on the same port are changed to the same state automatically.
- **Request msg**: For CX23-R channels, value is a hexadecimal representation of the SAE® J1939-21 compliant PGN request. This value is read-only and computed based on the CAN message ID. Only applicable when the request rate is set (not *Off*).

- **Request rate**: For CX23-R channels, optionally set the rate for active query requests. When set (not *Off*), the CX23-R transmits SAE® J1939-21 compliant PGN request messages at the specified rate. Since, request messages are only requests, they may or may not be honored by the connected CAN device. Request messages are only transmitted during a test run.

4.3.5 GPS Channels

GPS channels are sourced from the GPS connector on a CX23-R module.

- **Expiration time**: Specify the time period in seconds that can elapse without data before data is considered stale and the output is set to the invalid value. The value may be any real number greater than zero.
- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.

4.3.6 Power Channels

Power channels are sourced from a CX23-R module.

- **Expiration time**: Specify the time period in seconds that can elapse without data before data is considered stale and the output is set to the invalid value. The value may be any real number greater than zero.
- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.

4.3.7 Digital Input Channels

Digital inputs are sourced from a CX23-R DIO connector.

- **Threshold mode**: Value is static.
- **Low threshold (mV):** Specify the low threshold value as an integer not less than -5000. If the low threshold value changes, all channels on the same signal input line are changed to the same value automatically.
- **High threshold (mV):** Specify the high threshold as an integer not greater than 5000 and greater than the low threshold by at least 20. If the high threshold value changes, all channels on the same signal input line are changed to the same value automatically.
- **Transducer power**: Set the transducer power mode to Off, 5 V or 12 V. If the transducer power is changed, all digital input and output channels are changed to the same mode automatically.

4.3.8 Digital Output Channels

Digital outputs are the sink channels on a CX23-R DIO connector.

- **Output mode**: Set the state of the output based on the input.
  - Set Sink Unlatched: Output is low when the input is TRUE.
  - Clear Sink Unlatched: Output is high when the input is TRUE.
  - Set Sink Latched: Output is low and stays low for the duration of the test run when the input is TRUE.
  - Clear Sink Latched: Output is high and stays high for the duration of the test run when the input is TRUE.

- **Initial state**: Set the initial state of the output at the start of each test run to High or Low.
- **Final state**: Set the final state of the output at the end of each test run to High, Low or No Action. The No Action setting value leaves the output at its last value when the test stops.
- **Transducer power**: Set the transducer power mode to Off, 5 V or 12 V. If the transducer power is changed, all digital input and output channels are changed to the same mode automatically.
- **Input channel**: Set the input channel to any Boolean (logical) channel or computed channel in the setup.

4.3.9 Temperature Channels

Temperature channels are sourced from a MX1609KB-R Thermocouple Module.

- **Sensor input mode**: Value is thermocouple.
- **Thermocouple type**: Value is K.

4.3.10 Message Channels

Message channels are sourced from CX23-R raw CAN or AUX channels. Raw channels collect incoming messages in a binary message format. Raw channels cannot be plotted or used as source channels for computed channels or DataModes, but may be viewed or extracted using offline software.

NOTE
The MX471B-R CAN module does not support raw CAN message channels. For information on database channels, refer to CAN Channels.

CAN Message Channels

- **Hardware interface**: Value is CAN.
- **Bit rate**: Set the bit rate from the drop-down list of valid values. If the CAN bit rate is changed, all channels on the same port are changed to the same bit rate value automatically.
- **Termination**: Set the state of the internal termination resistor to true or false. If the termination state is changed, all channels on the same port are changed to the same state automatically.

AUX Message Channels

- **AUX port mode**: Value is eDAQ sync.

4.3.11 Camera Channels

Camera channels are sourced from camera or video hardware connected through an EX23-R PoE Switch.

- **Frame rate**: Set the number of video frames per second to capture and write to the SIE data file.
- **Image size**: Set the image resolution in pixels of each video frame captured.
- **Image compression**: Set the percentage of compression for each video frame captured.

CAUTION
Video streaming is both CPU intensive and data intensive when using multiple cameras. Long tests can easily fill the CX23-R hard drive or a large number of channels can overload the CPU such that a test is not able to start. If either of these issues occur, reduce the image quality parameters of the camera channels.

Viewing Camera Channels in Somat InField
To be able to view camera data in InField, it is necessary to create a channel with time information and add it to a Time History. Make sure that the Time History sample rate is higher than the camera frame rate. For the maximum frame rate of 30 Hz, the Time History sample rate must be at least 100 Hz and is recommended to be 500 Hz or higher.

To view the recorded data:

1. Start InField and open the SIE file with the camera message data.
2. In the channels list, highlight the camera message channel and the time history channel and click the multiplot button.
3. In the resulting multiplot, use the cursor to scroll through the data. The image shows the camera frame at the time value of the cursor.

Consider the following when viewing camera data in InField:

- If a second cursor is enabled, the images from the camera channel are still tracked to the first cursor. Return to single cursor mode to continue scrolling through the camera frames.
- The timestamp of the image is indicated by the *x*-value on the multiplot. The timestamp is test run time. To calculate the real time, view the test start time in the metadata viewer and add the *x*-value in seconds.
- It is possible for the test not to record the full requested frame rate due to camera functionality. If the load on the network or the CX23-R module is high, the camera my drop frames to avoid a lag in the data stream.
- When scrolling through the high sample rate time history channel, the camera image repeats itself for every sample of time history data until the next camera frame in the data stream.

4.4 Computed Channels

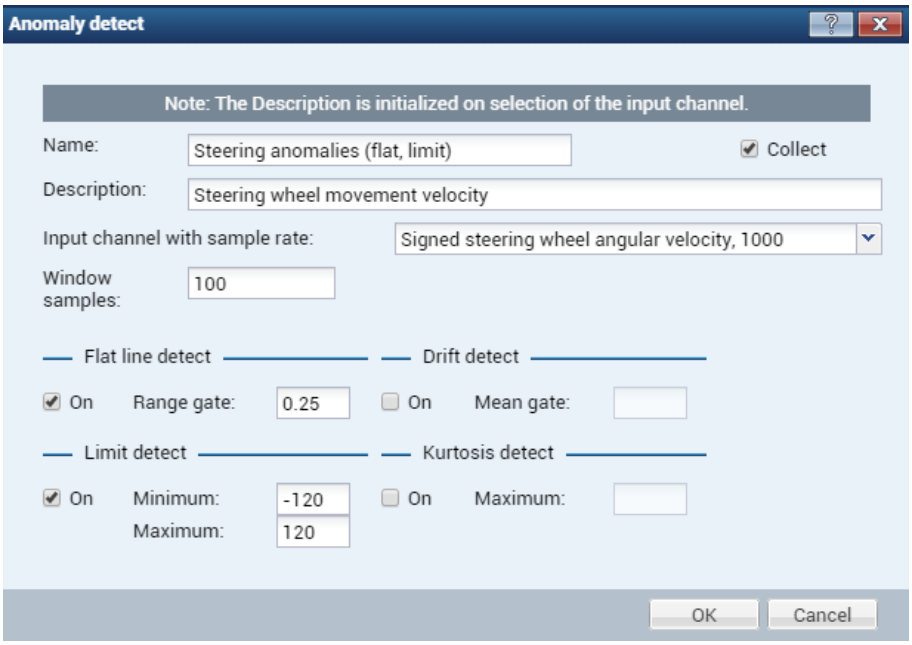
4.4.1 Computed Channel Generic Parameters

- **Name**: The computed channel name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Collect**: If checked, the channel data is written to the SIE data file during a test run.
- **Description**: Optional detailed description of the computed channel.
- **Input channel**: Select the desired input channel. In the edit dialog, the channel sample rate is displayed in Hz.
- **Measurand**: The quantity being measured or the type of measurement associated with the computed channel.
- **Units**: Physical units of measurement for the computed channel.

- **Range min and Range max**: The expected extreme values of the computed channel output.

4.4.2 Anomaly Detect

The Anomaly Detect channel generates an output marking possible anomalies in transducer or computed channel data. The channel continuously tracks the selected parameters and outputs a status for each specified window.



- **Factor**: Specify the number of input samples used to generate one output. This sets both the analysis window size and the associated output sample rate. The factor can be any positive integer greater than one.

Flat line detect

- **On**: Select to enable flat line detection.
- **Range gate**: Specify the gate for detecting a flat line anomaly. If the difference between the maximum and minimum data samples in the analysis window is less than the specified gate, the channel adds one (1) to the output.

Drift detect

- **On**: Select to enable drift detection.
- **Mean gate**: Specify the gate for detecting a drift anomaly. Drift is measured against the reference mean value of the first analysis window of each test run. If the difference between current window mean and reference mean exceeds the specified gate, the channel adds two (2) to the output.

Limit detect

- **On**: Select to enable limit detection.
- **Minimum** and **Maximum**: If any data sample in the analysis window is less than the specified minimum or greater than the specified maximum, the channel adds four (4) to the output.

Kurtosis detect

- **On**: Select to enable kurtosis detection.
- **Maximum**: Specify the maximum kurtosis value. If the kurtosis coefficient for the data in the analysis window is greater specified maximum value, the channel adds eight (8) to the output.

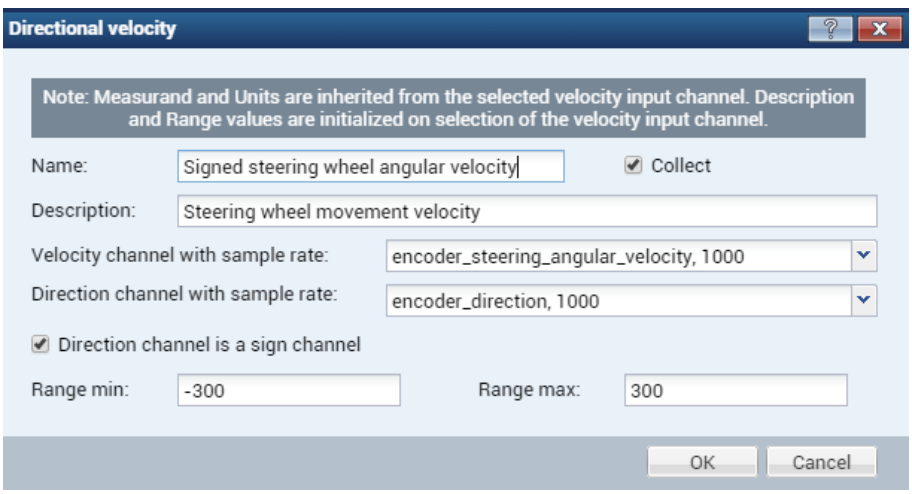
The following equation is used to calculate the kurtosis coefficient, K:

$$K = \frac{n \sum_{i=1}^{n} (x_i - \bar{x})^4}{\left(\sum_{i=1}^{n} (x_i - \bar{x})^2 \right)^2}$$

where, n is the number of data samples in the analysis window and $\bar{x}$ is the mean of the data samples in the analysis window.

4.4.3 Directional Velocity

The Directional Velocity computed channel generates a signed velocity output from two input channels. One input channel is the unsigned velocity and the second input channel is a position channel to set the sign of the output value.



- **Velocity channel**: Select the desired velocity input channel. In the edit dialog, the channel sample rate is displayed in Hz.
- **Direction channel**: Select the desired direction channel. In the edit dialog, the channel sample rate is displayed in Hz.

NOTE

When viewing the All computed channels tab, the **Input channel** is the velocity channel. To display both input channels, view the Directional velocity tab.

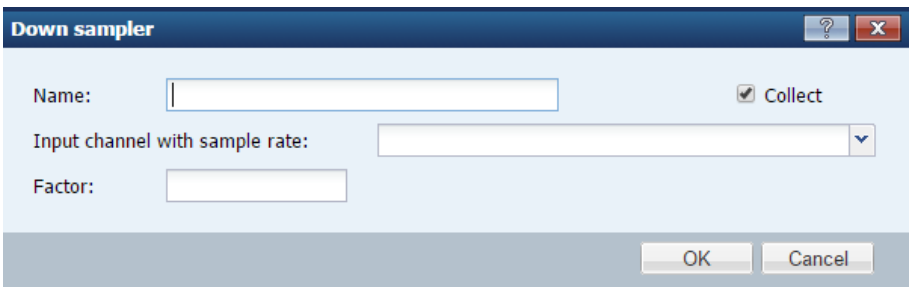
- **Direction channel is a signed channel**: Select this option if the direction input channel is a signed channel. In this case the direction channel values should be either -1 or +1. Deselect this option if the direction channel is a position channel and the signs must be determined from positional data values.

In this case, if the current position channel sample is greater than the previous sample, the output is set to positive. If the current position channel sample is less than the previous sample, the output is set to negative. If they are equal, the sign remains at its current value.

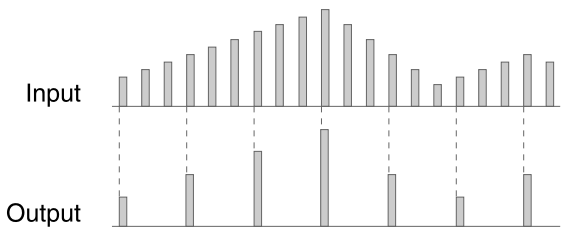
Example: Rotary encoder
The Directional Velocity computed channel is designed to generate a signed angular velocity output channel for a rotary encoder. In this example, the velocity channel is typically the A or B signal lines from a DIO frequency channel. The direction channel is typically either a DIO quadrature direction channel for a signed channel, or a DIO quadrature count channel for a position channel.

4.4.4 Down Sampler

The Down Sampler channel reduces the number of samples taken from the input channel by a user-defined factor, simulating a lower sample rate and decreasing the amount of memory needed data storage.



- **Factor**: Enter an integer greater than zero as the down sample factor. This has the effect of decreasing the sample rate by this factor. The following example has a factor of 3.

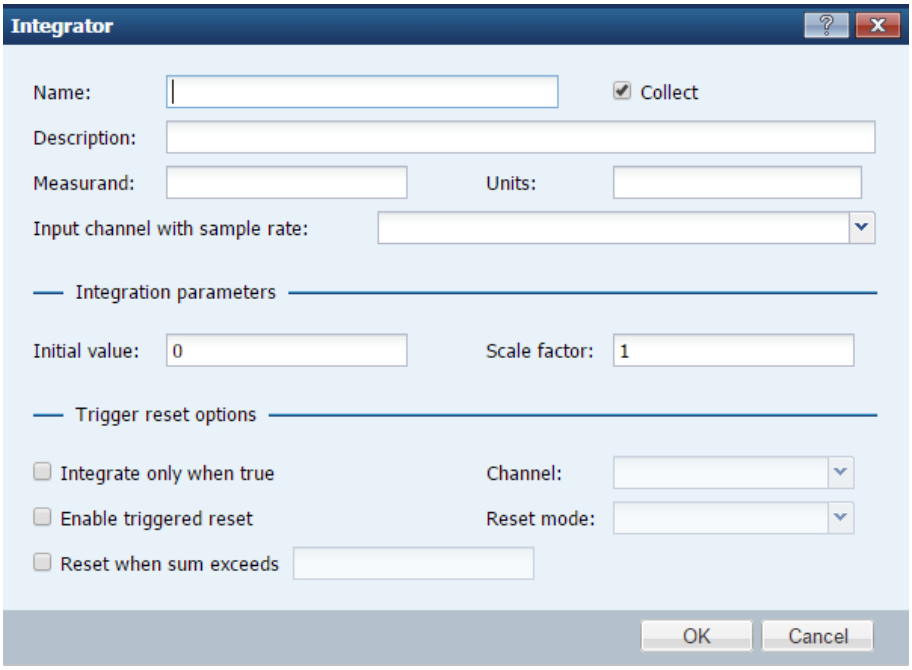


4.4.5 Integrator

The Integrator computed channel generates an output that is the integral of the input channel.

As long as the integrator is not reset or suppressed, each output sample is the cumulative sum of the current and all previous input samples multiplied by the scale factor and added to the initial value.

A logical trigger channel can reset the integrator or suppress integration. The integrator can also reset when exceeding a user-defined value.



Integration parameters
Enter the desired **Initial value** and **Scale factor**. Setting the scale factor to the sample period results in the time integral of the input channel.

Trigger reset options
Select the **Integrate only when true** option and set the trigger **Channel** to suppress integration when the trigger channel is FALSE.

Select the **Enable triggered reset** option to reset the integrator to the initial value when the trigger channel satisfies the condition set by the **Reset mode**. The available trigger reset modes are below.

- **When true**: Reset when the trigger channel is TRUE.
- **On false - true edge**: Reset when the trigger channel transitions from FALSE to TRUE.
- **After true - false edge**: Reset on the sample after the trigger channel transitions from TRUE to FALSE. If the Integrate only when true option is not selected, then the output sample after the TRUE to FALSE edge is the sum of the initial value and the scaled input sample.

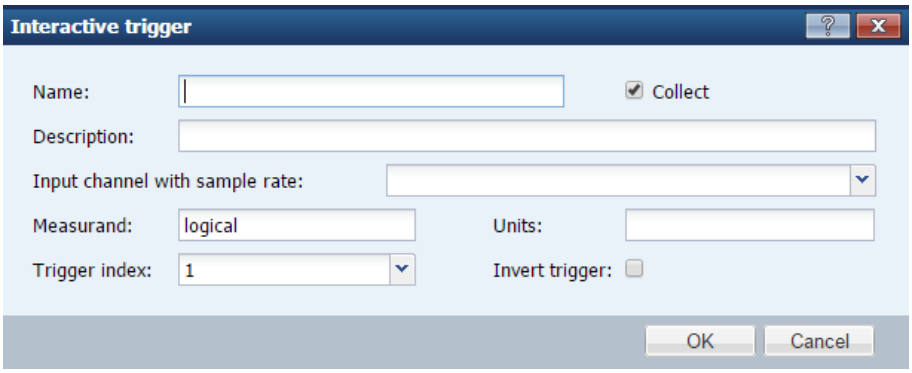
NOTE
When using the Integrate only when TRUE option, the reset mode is limited to After TRUE - FALSE Edge.

Select the **Reset when sum exceeds** option to reset the integrator to the initial value when the absolute value of the integrator sum exceeds the specified value.

4.4.6 Interactive Trigger

The Interactive Trigger channel provides a means to trigger Data Modes and other computed channels directly from the Test Control page. The system supports up

to eight Interactive Triggers.



Set the **Trigger index** from 1 to 8.

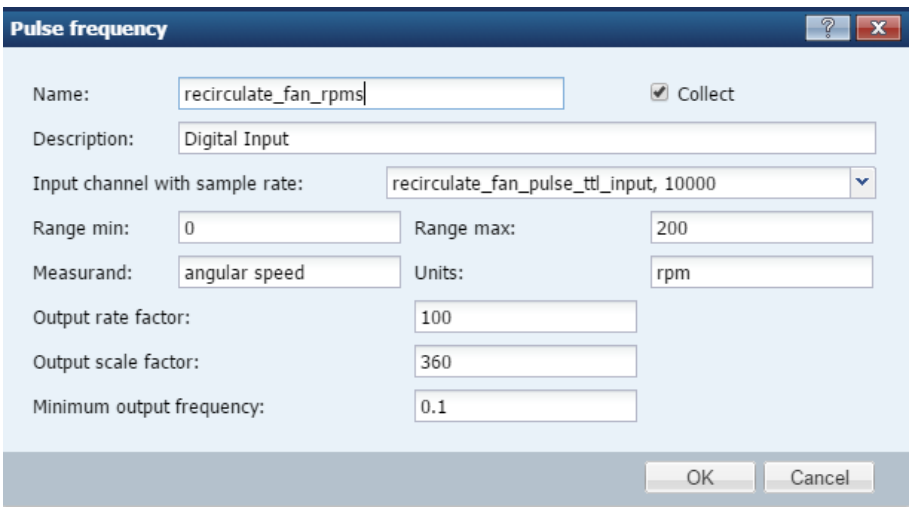
Select the **Invert trigger** option to reverse the logic of the trigger.

4.4.7 Pulse Frequency

The Pulse Frequency computed channel is designed to measure pulse frequencies, primarily in conjunction with Digital Input Channels. The system scans the logical input channel for falling edge and rising edge transitions. The pulse period is updated based on the time between rising-to-rising edges and falling-to-falling edges.

NOTE

The pulse counter frequency output is also update if the time period since the last set of edges exceeds the current output. This results in improved results as the pulse trains slows or stops.



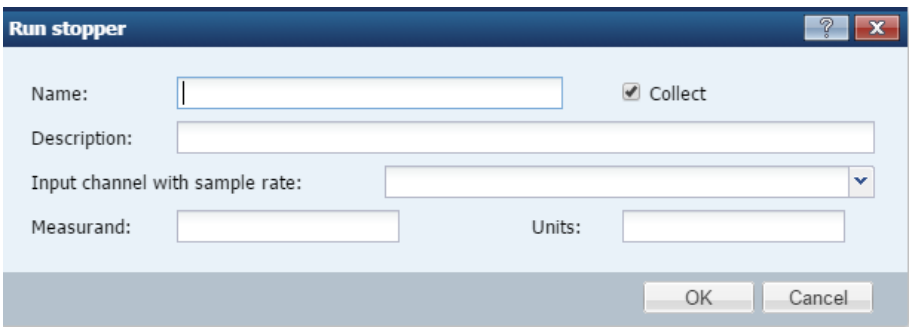
- **Output rate factor**: Specify the down sample factor that determines the output channel sample rate. For example, for an input channel with a sample rate of 10000 Hz and an Output rate factor of 1000, the output channel sample rate is 10 Hz. The value must be an integer of 10 or greater.

- **Output scale factor**: Specify the scale factor to convert the output data from Hz to the desired physical units. The Output scale factor cannot be zero.
- **Minimum output frequency**: Specify the minimum frequency, *f*, of the output channel between 0.001 and 1.0 Hz. If a new pulse is not detected within the period of 1/*f*, the output value is set to *f*. The value remains at *f* until the detected pulse period is less 1/*f*. For example, if the minimum output frequency is 0.1 Hz and the input channel is a 50 Hz pulse train that suddenly stops, the pulse counter output remains at 50 Hz until a new pulse frequency is detected or until 10 seconds (1/*f*) have elapsed; at that point, the output value is set to 0.1 Hz. This minimum output frequency is also the initial output value until the first pulse is detected.

NOTE
The accuracy of the pulse frequency measurements depends on only the sample rate of the input channel. For example, using an input channel sampled at 2000 Hz provides 1% accuracy of a 20-Hz pulse signal and 0.1% of a 2-Hz pulse signal. As a general rule, the input sample rate should be 100 times the maximum expected pulse frequency to provide 1% or better accuracy of the entire pulse frequency range.

4.4.8 Run Stopper

The Run Stopper channel stops a test run when the logical input channel becomes TRUE.



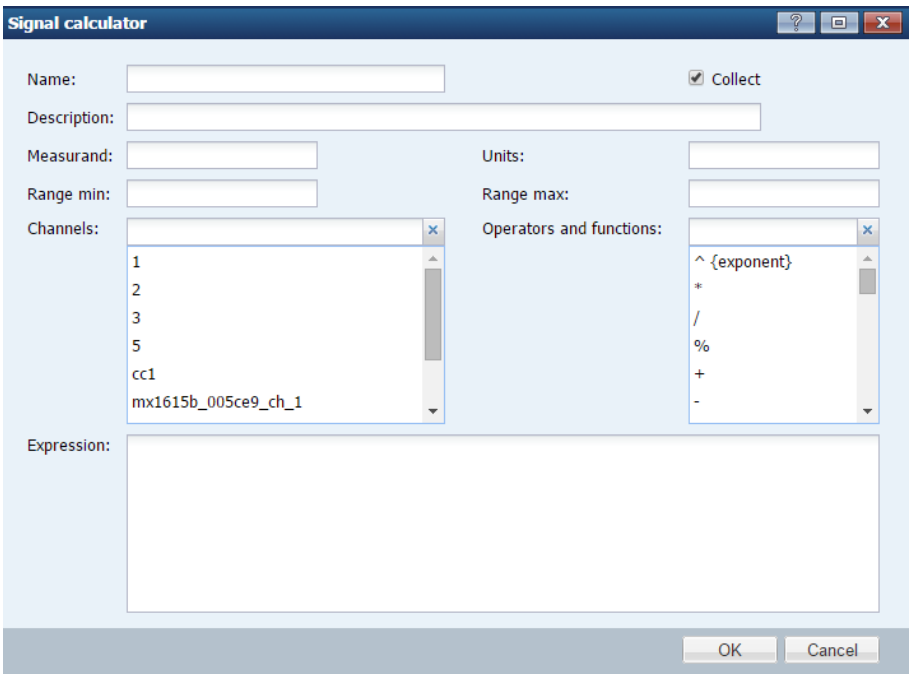
NOTE
Because the input channel is processed in frames that can be buffered, the test run does not stop immediately but typically stops within a fraction of a second after the input channel becomes TRUE. In the worst case, assume that several seconds could elapse before the test run stops.

Application Note: Stopping a test after a defined time period
To stop a test run after a defined time period:

1. Add a Time Channel with the name `elapsed_time`.
2. Add a Signal Calculator channel with the expression `elapsed_time >= 600`, where 600 seconds is the desired test run duration.
3. Add a Run Stopper channel with the Signal Calculator channel as the input channel.

4.4.9 Signal Calculator

Use the Signal Calculator computed channel to create logical, arithmetic or trigonometric expressions combining other channels, functions and constants.



All input channels to a single Signal Calculator channel must have the same sample rate, which also determines the computed channel sample rate.

Double-click or drag and drop a channel or operator to add it to the expression. Alternatively, build the expression using keyboard entry. All operators and referenced input channels are case sensitive.

NOTE
If using drag and drop to select channels and functions, the item is dropped at the current position of the cursor.

Functions

Category	Operator	Syntax	Return
Logical	>	*a* > *b*	TRUE if *a* is greater than *b*; else FALSE
	>=	*a* >= *b*	TRUE if *a* is greater than or equal to *b*; else FALSE
	<	*a* < *b*	TRUE if *a* is less than *b*; else FALSE
	<=	*a* <= *b*	TRUE if *a* is less than or equal to *b*; else FALSE
	==	*a* == *b*	TRUE if *a* is equal to *b*; else FALSE
	!=	*a* != *b*	TRUE if *a* is not equal to *b*; else FALSE
	!	!*a*	TRUE if *a* is FALSE; else FALSE
	&&	*a* && *b*	TRUE if *a* and *b* are TRUE; else FALSE
	||	*a* || *b*	TRUE if either *a* or *b* are TRUE; else FALSE
Arithmetic	^	*a* ^ *b*	*a* raised to the power of *b*
	*	*a* * *b*	The product of *a* and *b*
	/	*a* / *b*	The quotient of *a* and *b*
	%	*a* % *b*	The modulus of *a* and *b*
	+	*a* + *b*	The sum of *a* and *b*
	-	*a* - *b*	The difference of *a* and *b*
	fabs	fabs(*a*)	The absolute value of *a*
	sqrt	sqrt(*a*)	The square root of *a*
	log	log(*a*)	The natural logarithm of *a*
	log10	log10(*a*)	The base-10 logarithm of *a*
	exp	exp(*a*)	The exponential function of *a*
	sgn	sgn(*a*)	-1 for *a* < 0, 1 for *a* > 0, 0 for *a* = 0
	float	float(*a*)	Logical channel *a* converted to floating point
	floor	floor (*a*)	The largest integer less than *a*
	ceil	ceil(*a*)	The smallest integer greater than *a*
Trigonometric (all angles in radians)	sin	sin(*a*)	The sine of *a*
	cos	cos(*a*)	The cosine of *a*
	tan	tan(*a*)	The tangent of *a*
	asin	asin(*a*)	The arcsine of *a* in the range [-PI/2, PI/2]
	acos	acos(*a*)	The arccosine of *a* in the range [0, PI]
	atan	atan (*a*)	The arctangent of *a* in the range [-PI/2, PI/2]

Application Note: Piecewise Linear Relationships

In the following example, the desired output of the Signal Calculator channel *y* is defined as follows, based on the value of the input channel *x*.

$$y = \begin{cases} 2.1x + 100, & x > 100 \\ 2.2x + 90, & 50 < x \leq 100 \\ 2.3x + 80, & 0 < x \leq 50 \\ 2.4x + 70, & x \leq 0 \end{cases}$$

The first step is to define the required set of logical channels as follows:

s1: x>100

s2: x>50 && x<=100

s3: x>0 && x<=50

s4: x<=0

The second step is to define the required set of arithmetic channels as follows:

y1: 2.1*x+100

y2: 2.2*x+90

y3: 2.3*x+80

y4: 2.4*x+70

The third step is to define the final channel *y* as follows:

y: y1*float(s1) + y2*float(s2) + y3*float(s3) + y4*float(s4)

NOTE

It is not necessary to define intermediate variables and it is less efficient from a processing point of view when intermediate variables are not used more than once in the set of computed channels. However, intermediate variables have been used above to clarify the general approach.

4.4.10 Smoothing Filter

The Smoothing Filter computed channel generates an output that is a smoothed representation of the input without generating any phase lead or lag.

NOTE

The Smoothing Filter can result in loss of data significance if not used properly. It is provided primarily for digital pulse counter inputs .In general, it should not be used for analog input channels with digital anti-aliasing filters.

Specify the **Filter Length** as an odd number between 3 and 201 samples. The filter is a simple boxcar filter where each output sample is the linear average across the filter length.

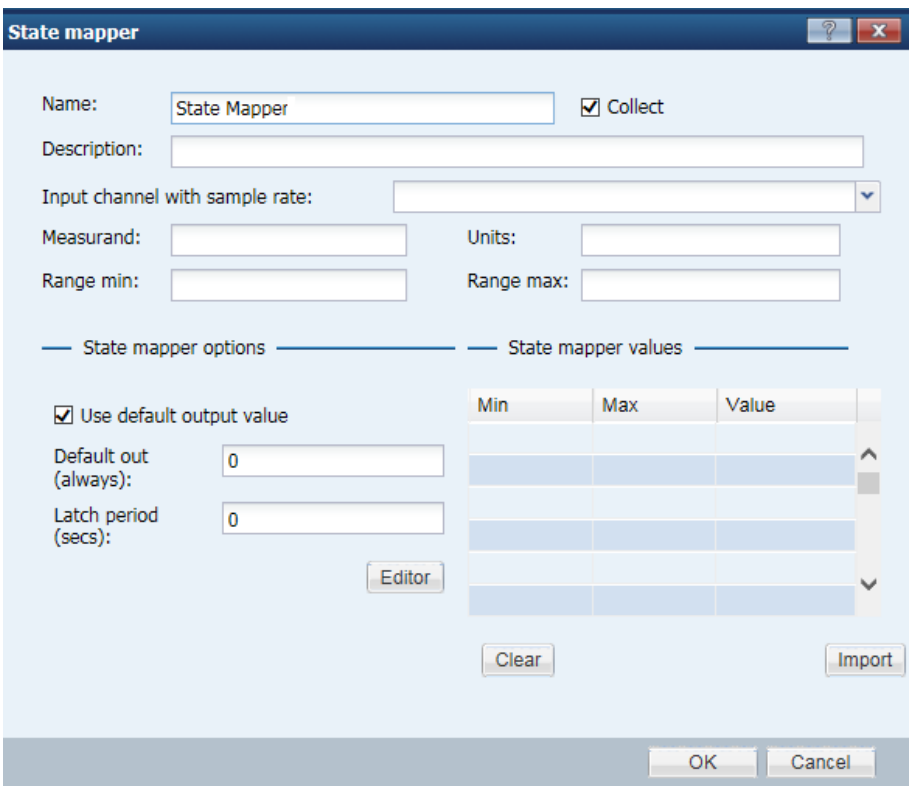
For example, for a filter length of five, the filter averages the current sample, the two samples before, and the two samples after. Note that the channel backfills the initial output samples with the first fully filtered output value. For example, if the filter length is nine, the first four output samples are assigned the same value as the fifth output sample value.

4.4.11 State Mapper

The State Mapper channel maps the input channel into a discrete state output channel based on a set mapping conditions.

NOTE

The State Mapper channel can consume significant CX23-R computational resources depending on the sample rate and the number of mapping conditions defined.



State mapper options

Select the **Use default output value** to output a default value when the input channel does not meet any of the mapping conditions. If not selected, the output remains in its existing state.

Enter a **Default out** value for the output. The channel outputs the default value if the first input sample does not meet any mapping conditions. When using the

default out option, the channel outputs the default value throughout the test run if the input does not meet any mapping conditions.

Enter the **Latch Period** in seconds that the input channel must consistently the mapping conditions before the output state switches. The latch period is similar to a duty cycle on the output state preventing the output state from switching for at least this period of time. This feature can eliminate state switching transients in the output channel data stream. If the latch period is zero, the output state switches on each sample.

State mapper values
A state mapper condition consists of Min, Max and Value numbers. When the input is greater than or equal to the Min and less than the Max, the channel outputs the specified Value. The system supports up to 32 mapping conditions. There are several methods to define the state mapper conditions.

The default method is using the **Grid**. Each row represents one condition with Min, Max and Value fields.

Click **Editor** to change to the text editor input method. In the text editor, each line represents one condition with the Min, Max and Value entries separated by at least one space.

Switching between these two input methods retains all entered conditions which are reformatted appropriately.

Alternatively, click **Import** to import previously created state mapper conditions from an ASCII file. Each line of the ASCII file represents one condition with the Min, Max and Value entries separated by a space or tab. Importing state mapper conditions deletes any manually entered values. The conditions are shown in the grid or text editor after import.

Click **Clear** to clear all state mapper values.

Example: Angular Position

Consider mapping an input channel that generates angular position in the range of 0 to 360 degrees to an output channel that specifies which 60-degree sector the input channel is in. Use the following mapping conditions where *x* is the input and *y* is the output.

$$y = \begin{cases} 1, & 0 \le x < 60 \\ 2, & 60 \le x < 120 \\ 3, & 120 \le x < 180 \\ 4, & 180 \le x < 240 \\ 5, & 240 \le x < 300 \\ 6, & 300 \le x < 360 \end{cases}$$

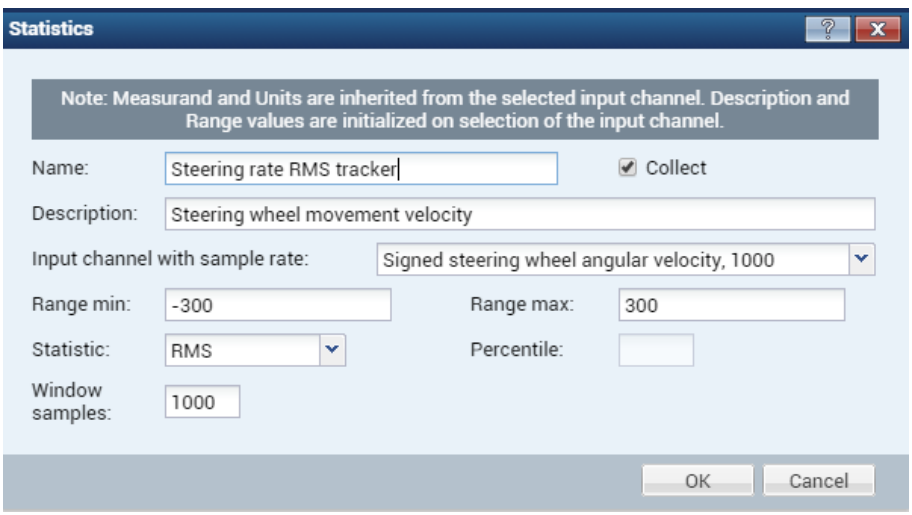
Enter the values as shown below for the grid and text editor interfaces:

Min	Max	Value
0	60	1
60	120	2
120	180	3
180	240	4
240	300	5
300	360	6

```
0 60 1
60 120 2
120 180 3
180 240 4
240 300 5
300 360 6
```

4.4.12 Statistics

The Statistics channel generates statistical output data from source transducer or computed channel input data.



- **Statistic**: Select one of six available statistical modes.
- **Percentile**: For the Xth percentile mode, specify the X value as an integer between 0 and 100. The output is the value at the Xth percentile of the sample window. If necessary, an output value is interpolated between the input values that border the exact Xth percentile. Note that an X value of 0 returns the minimum input value and an X value of 100 returns the maximum input value.

- **Window samples**: Specify the number of input samples, n, used to generate one output sample. This sets the analysis window size and associated output sample rate. Specify any positive integer greater than one.

Statistics algorithms

The following equations define the algorithms used to compute the statistical values where n is the specified number of window samples.

Mean

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Standard deviation

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

RMS (root mean square)

$$x_{rms} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2}$$

Kurtosis

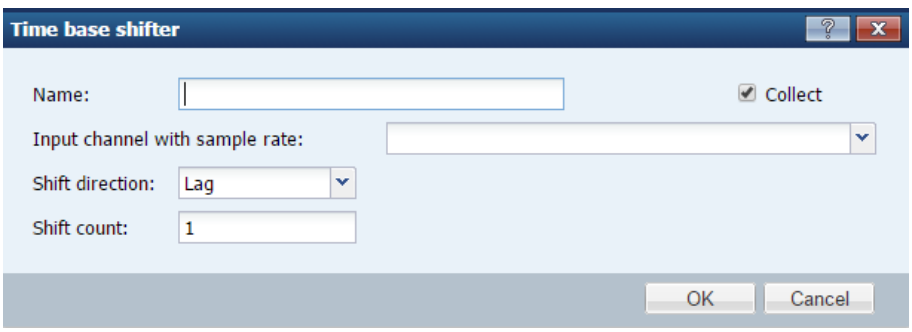
$$K = \frac{n\sum_{i=1}^{n}(x_i - \bar{x})^4}{\left(\sum_{i=1}^{n}(x_i - \bar{x})^2\right)^2}$$

Skewness

$$g_1 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^3}{\sqrt{\frac{1}{n}\left(\sum_{i=1}^{n}(x_i - \bar{x})^2\right)^3}}$$

4.4.13 Time Base Shifter

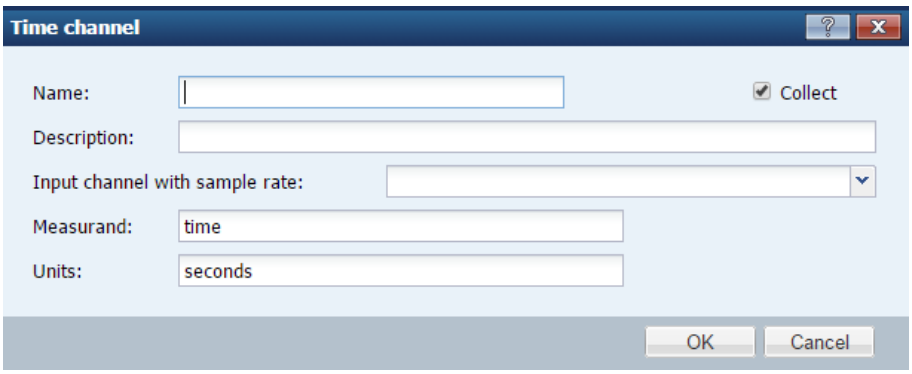
The Time Base Shifter channel generates an output channel that either leads or lags the selected input channel by a user-defined number of samples.



- **Shift direction**: Set the output to either lag or lead the input channel.
- **Shift count**: Enter the desired shift amount, *n*, from 1 to 1000 samples. Note that the channel fills the first *n*+1 output samples with the initial value of the input channel.

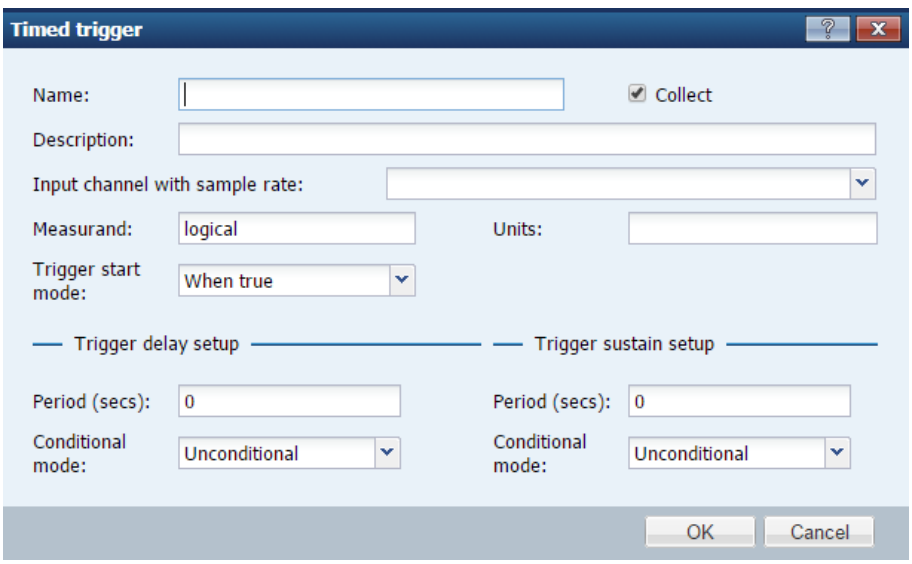
4.4.14 Time Channel

The Time Channel provides a time base channel for use with other computed channels or for storage in the Time History DataMode. For each sample in the selected input channel, the channel outputs the corresponding elapsed time in seconds since the start of the test run. The first sample is at zero seconds.



4.4.15 Timed Trigger

The Timed Trigger channel generates a logical output based on a logical input and user-defined timing parameters.



The input channel must be a logical channel.

Select the **Trigger start mode** from the options below.

- **When true**: Start when the input channel is TRUE.
- **On false - true edge**: Start when the input channel transitions from FALSE to TRUE.
- **After true - false edge**: Start on the sample after the input channel transitions from TRUE to FALSE.

Trigger delay setup

Specify the delay **Period** in seconds. The delay period is the time after the trigger start that the output channel is set.

Select the delay **Conditional mode** to set the output channel state based on the behavior of the input channel during the delay period. The available conditional modes are below.

- **Unconditional**: Set the output to TRUE regardless of the input channel.

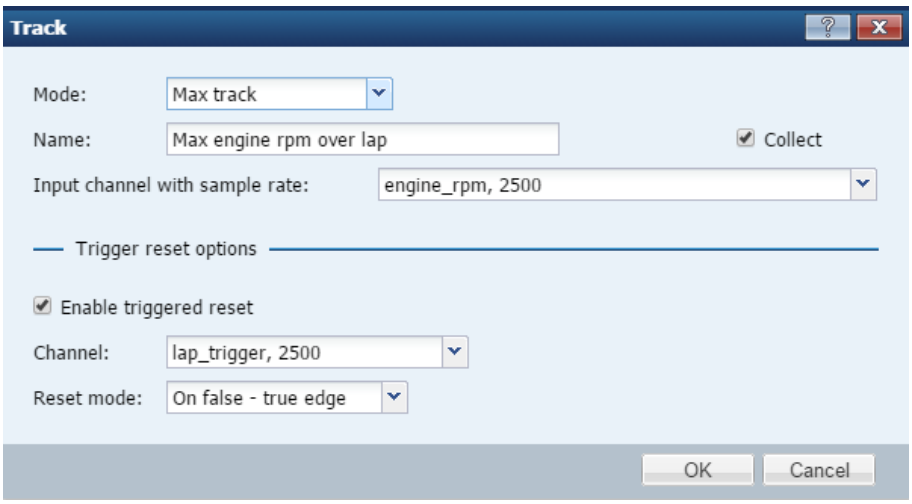
Trigger sustain setup
Specify the sustain **Period** in seconds. The sustain period is the duration that the output channel is set. At the end of the sustain period, the output value is set to FALSE and the system waits for the next trigger start condition.

Select the sustain **Conditional mode** to set the output channel state based on the behavior of the input channel during the sustain period. The available conditional modes are below.

- **Unconditional**: Set the output to TRUE for the duration of the sustain period regardless of the input channel.

4.4.16 Track

The Track computed channel generates an output channel that tracks the minimum value, maximum value or range of the input channel. A logical trigger channel can be used to reset the tracker.



Set the **Mode** to Min track, Max track or Range track.

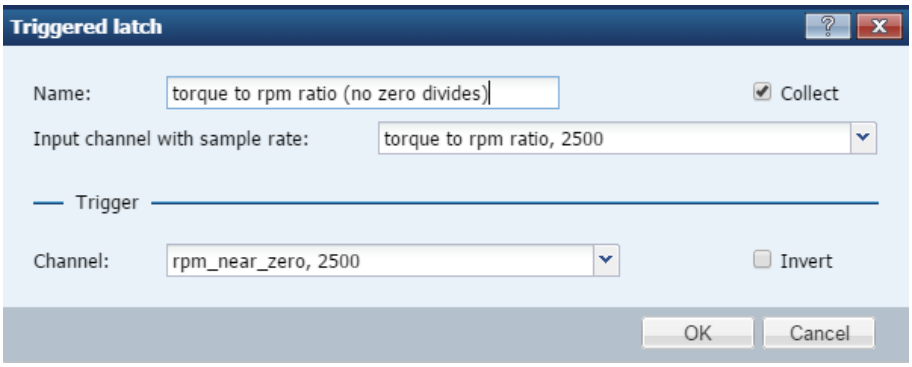
Trigger reset options
Select the **Enable triggered reset** option to reset the tracker when the trigger **Channel** satisfies the condition set by the **Reset mode**. The available trigger reset modes are below.

- **When true**: Reset when the trigger channel is TRUE.
- **On false - true edge**: Reset when the trigger channel transitions from FALSE to TRUE.
- **After true - false edge**: Reset on the sample after the trigger channel transitions from TRUE to FALSE.

For Min track and Max track modes, resetting the tracker sets the output to the current sample value. For the Range track mode, resetting the tracker sets the output to zero.

4.4.17 Triggered Latch

The Triggered Latch computed channel generates an output channel that latches the previous input channel data value when triggered.



Select the trigger **Channel** to use to trigger the data latch.

By default, the channel latches the input data value when the trigger channel transitions from FALSE to TRUE and holds this data value until the trigger channel transitions from TRUE to FALSE. When the trigger channel is FALSE, the channel outputs the same value as the input channel.

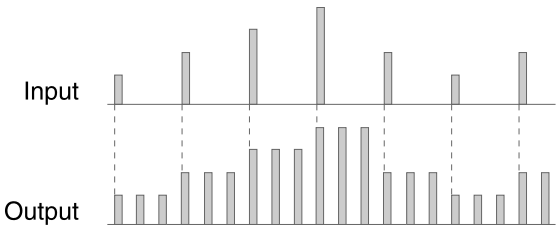
NOTE
If the trigger channel is initially TRUE, the channel outputs a system defined value of zero until the trigger channel transitions to FALSE.

Select the **Invert** option to reverse the logic of the trigger.

4.4.18 Up Sampler

The Up Sampler channel increases the number of samples taken from the input channel by a user-defined factor, enabling correlation of input data with that of a channel with a higher sample rate on a point-for-point basis. Each input channel sample repeats a number of times during the interval between the first sample and the next one based on a conversion factor value.

- **Factor**: Enter an integer greater than zero as the up sample factor. This has the effect of increasing the sample rate by the product of this factor. The following example has a factor of 3.



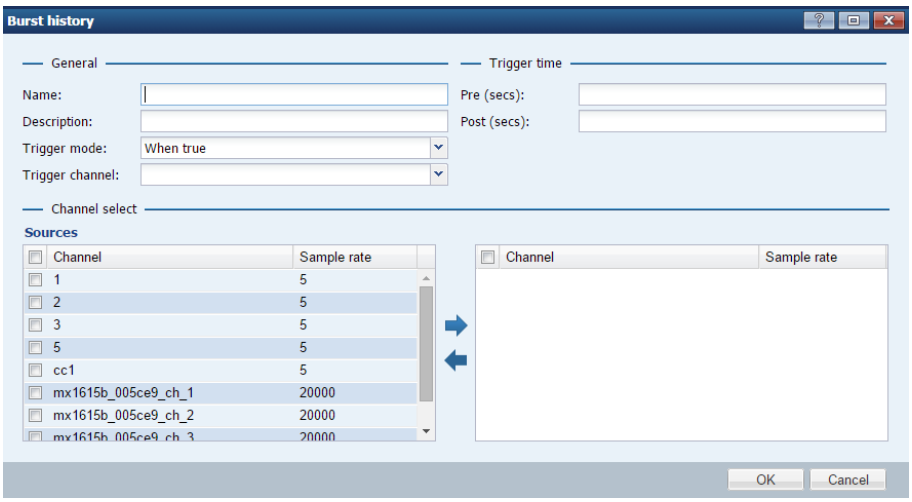
4.5 DataModes

4.5.1 DataMode Generic Parameters

- **Name**: Each DataMode must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Optional detailed description of the DataMode.
- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data sampling is always on from the start of the test.
  - **Trigger**: Data sampling starts when the trigger channel becomes TRUE and runs until the end of the data stream.
  - **Gate**: Data sampling occurs if and only if the trigger channel is TRUE.
  - **One shot**: Take a single data sample when the trigger channel transitions from FALSE to TRUE or if the trigger channel is TRUE on the first sample of any run.
- **Trigger channel**: Specify the trigger input when using a trigger option other than Always on. The trigger channel must have the same sample rate as the input channels.
- **Channel select**: From the channels list, select the desired input channels for the DataMode. Select channels either by dragging and dropping into the list on the right or by clicking the arrow buttons.

4.5.2 Burst History

The Burst History DataMode stores one or more bursts of data when a user-defined triggering event occurs. The Burst History DataMode is useful for characterizing rare events at high data sampling rates. The system uses a circular buffer to allow storage of data both before and after the specified trigger.



Trigger Time

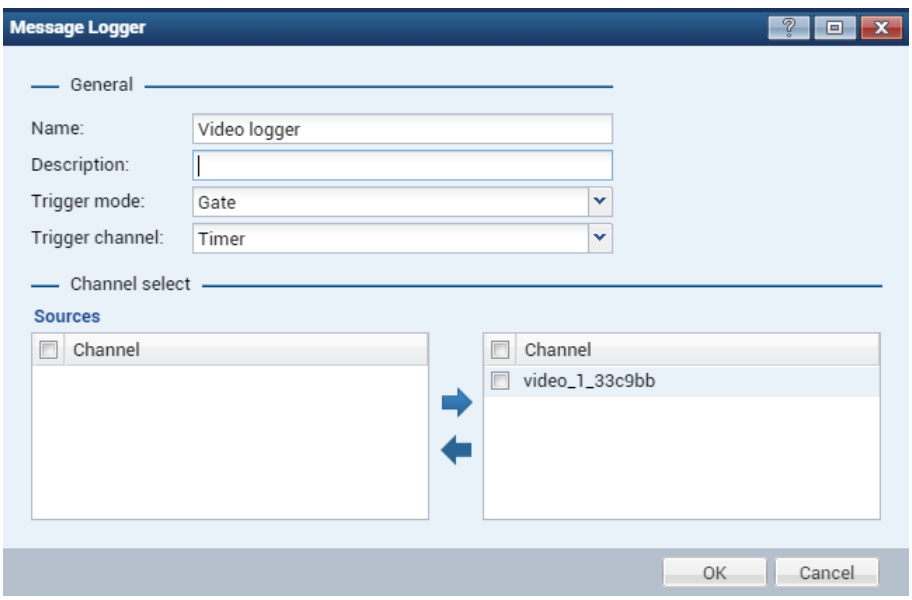
Specify the **Pre** trigger time, which is the period of time in seconds of data sampling before the trigger.

Specify the **Post** trigger time, which is the period of time in seconds of data sampling after the trigger.

NOTE
The total number of samples stored is the sum of the post-trigger and pre-trigger samples plus one, since the trigger sample is always stored.

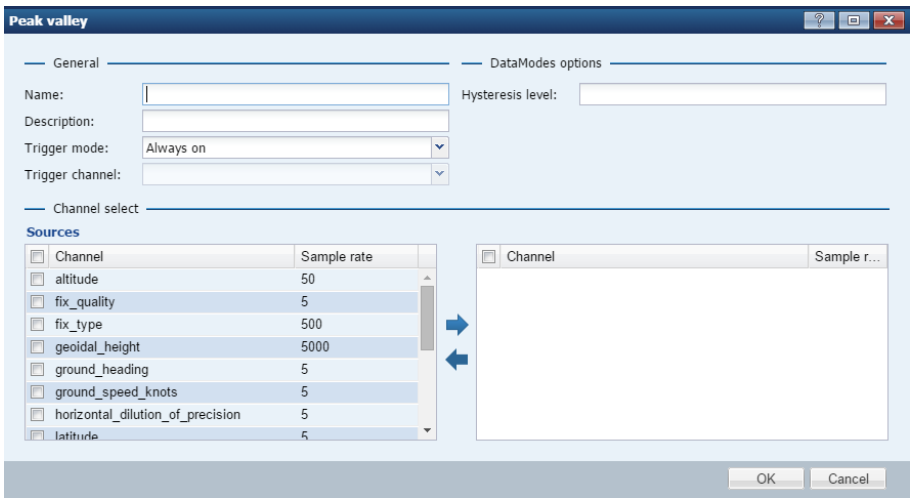
4.5.3 Message Logger

The Message Logger Data Mode stores one or more message or video channels in the output data file.



4.5.4 Peak Valley

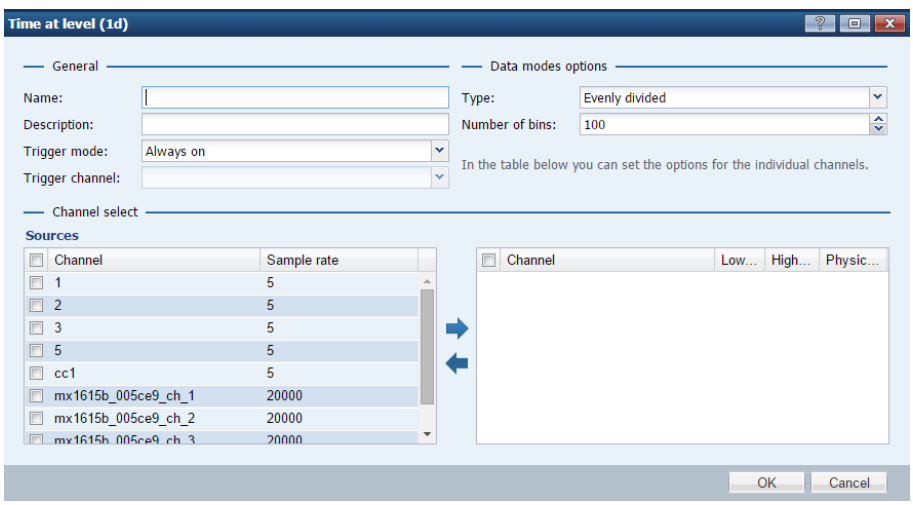
The Peak Valley DataMode stores multiple channels of peak and valley sequences in the output data file. The system acquires peaks and valleys from triggered or un-triggered time history data streams using the user-defined hysteresis value and the peak-valley processing algorithm.



Specify the **Hysteresis** level for the peak-valley processing algorithm.

4.5.5 Time at Level (One Dimensional)

The Time at Level (1D) DataMode stores one-dimension Time at Level histograms in the output data file. Specify multiple input channels to generate multiple one-dimensional Time at Level data channels.



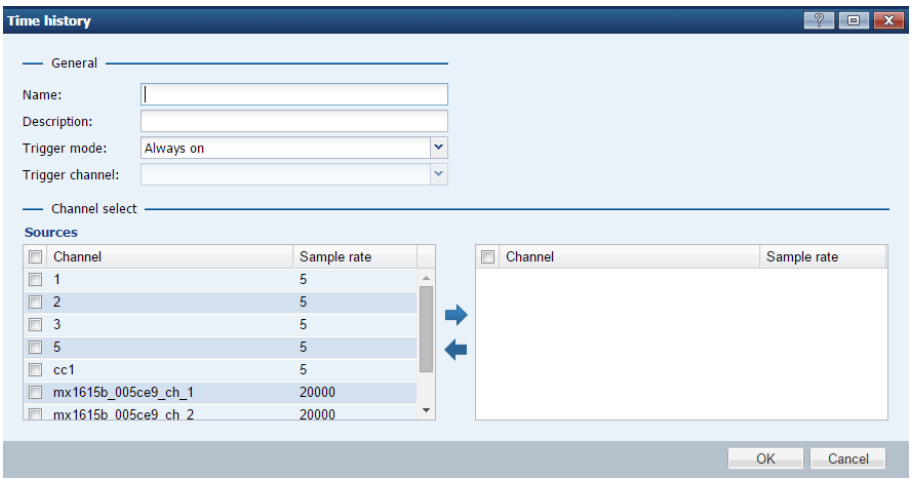
Enter the desired **Number of bins** for the Data Mode. The total number of bins is this specified number plus two for underflow and overflow bins. The default number of bins is 100.

In the Channel select section, enter the desired **Low bound** and **High bound** for each selected input channel.

NOTE
If the range min and max parameters are defined for an input channel, those values are used as the default Low bound and High bound values.

4.5.6 Time History

The Time History Data Mode stores multiple channels of triggered or un-triggered time history data streams in the output data file.



4.6 Running a Test

Running a test and displaying live data is done from the Test Control page of the Test and data control section.

As the test runs, the system writes the test data to the specified SIE data file. Manage and download the data files after a test run from the SIE Data page in the Test and data control section.

There is currently no ability to view SIE data in the web application. To view the data, download the file and open it in an SIE file reader application such as catman®AP or Infield.

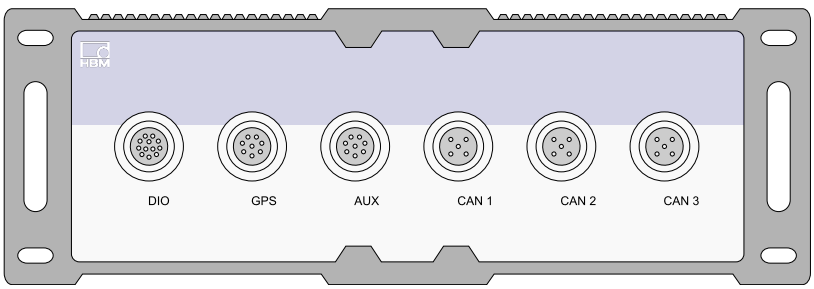
5 SomatXR Hardware

5.1 CX23-R Data Processor

5.1.1 CX23-R Inputs and Outputs

The CX23-R data processor provides connections for sourcing input data channels through six connectors - one digital input/output, one GPS and three CAN.

Transducer	CX23-R	Wiring Diagram
Digital input, static	●	97
Digital output, static	●	99
CAN bus database or raw message	●	107
GPS	●	
Camera, Axis network cameras	● via EX23-R	20



DIO Channels

The DIO connector provides pin connections for three sensor input lines, two current sinking output lines, one power output line and individual shield/ground connections for all five input and output lines.

Digital Input Channels have an input impedance of 10 KΩ, are over-voltage protected up to ±70 V and support user-defined static upper and lower thresholds in the range of ±5 V to a resolution of 20 mV. The -3 dB bandwidth is 4 MHz, with start of attenuation roll off at nominally 1 MHz.

Digital Output Channels can sink 350 mA to ground and are over-voltage protected up to ±60V. They are designed to drive LEDs, relays and other indicators and control at maximum update rates of 20 Hz nominally.

The DIO power supply provides power up to 3 W at user-selectable voltages of 5 V or 12 V (within ±5% accuracy).

CAN Channels

The three CAN connectors support CAN Channels and are functionally identical and functionally independent. The CAN ports are ISO 11898 CAN 2.0(A&B)

compliant and support J1939 (limited to 8 byte data payloads). The CX23-R supports importing Vector CAN Databases.

Each connector provides a switchable internal termination resistor. Each port provides passthrough power (from the CX23-R power supply source) limited to 1 A current draw. This can be used to power CAN devices such as the SomatCR 1609 CAN temperature measuring module.

The CX23-R supports baud rates of 1000K, 800K, 667K, 500K, 400K, 250K, 125K, 100K, 50K and 41.6K bps.

GPS Channels

The GPS connector supports GPS Channels and uses an RS232 serial port with additional control lines to communicate with the Somat EGPS-5HZ module. The CX23-R processes standard NMEA formatted GPS messages to provide navigation and time channels at 5 Hz update rates.

5.1.2 CX23-R Status LEDs

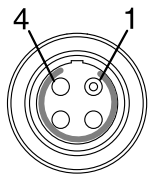
LED	Description
SYNC (blue) †	
On	Sample clock is synchronized to PTP source.
4 Hz	Sample clock is synchronized to GPS source.
1 Hz	Sample clock is not externally regulated.
POWER (green)	
Off	Unit is off.
On	Unit is on.
4 Hz	Unit is shutting down.
2 Hz	Unit is responding to a Flash LED command. For more information, see Hardware.
RUN (yellow)	
Off	No test run is in progress.
4 Hz	Test run is in progress.
ERROR (red)	
Off	No error.
On	Unit error.
1 Hz	User alert.

† The SYNC (blue) LED provides status for the CX23-R module only. The LED provides no information on the status of connected MX modules. The sync status of each connected MX module is provided in the Properties panel of the Hardware page.

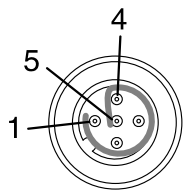
NOTE

Refer to System Logs for information on errors and alerts. Certain LEDs persist until the required action is taken, such as deleting the SIE files if SATA Drive is full.

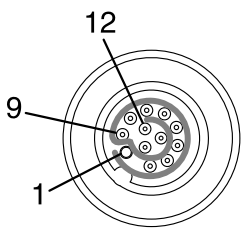
5.1.3 CX23-R INPUT PWR and AUX PWR Pin Assignments

Connector	PIN	Description	Wire Color (1-KAB2115-2)
 *pin side of cable*	1	Ground	Black
	2	-	-
	3	Power in/out +	Red
	4	Remote switch	Green

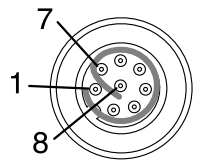
5.1.4 CX23-R CAN Pin Assignments

Connector	PIN	Description	Wire Color (1-KAB2109-2)
 *pin side of cable*	1	CAN Ground	Yellow
	2	CAN Power 10-30 V	Red
	3	Ground	Black
	4	CAN_H	White
	5	CAN_L	Blue

5.1.5 CX23-R DIO Pin Assignments

Connector	PIN	Description	Wire Color (1-KAB2101-02)
 *pin side of cable*	1	Ground *jumper to pin 11*	Black/Red
	2	DIO 5 V or 12 V	Red
	3	Ground	Black/White
	4	Input 1	White
	5	Ground	Black/Green
	6	Input 2	Green
	7	Ground	Black/Blue
	8	Input 3	Blue
	9	Ground	Black/Yellow
	10	Output 2	Yellow
	11	Ground cable detect *jumper to pin 1*	Black/Brown
	12	Output 1	Brown

5.1.6 CX23-R GPS Pin Assignments

Connector	Pin	Description	Wire Color (1-KAB2108-2)
 *pin side of cable*	1	GPS transmit	White
	2	Out control	Brown
	3	GPS receive	Green
	4	Ground cable detect *jumper to pin 7*	-
	5	GPS PPS	Gray
	6	Input control	Pink
	7	Ground	Black
	8	Power +	Red

5.2 EX23-R PoE Switch

5.2.1 EX23-R Status LEDs

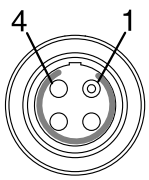
Power LED	Description
Off	Power input not in range
On	Unit is powered
Flashing (2 Hz)	Power error
Flashing (8 Hz)	Firmware update

Several issues can cause a power error:

- Over temperature
- Over voltage or over current input power
- Internal power supply not working

Ethernet LED	Description
Off	No link
Green	Gigabit link is up
Orange	10 or 100 Mb link is up

5.2.2 EX23-R POWER Pin Assignments

Connector	PIN	Description	Wire Color (1-KAB2115 -2)
 *pin side of cable*	1	Ground	Black
	2	-	-
	3	Power in +	Red
	4	Remote switch	Green

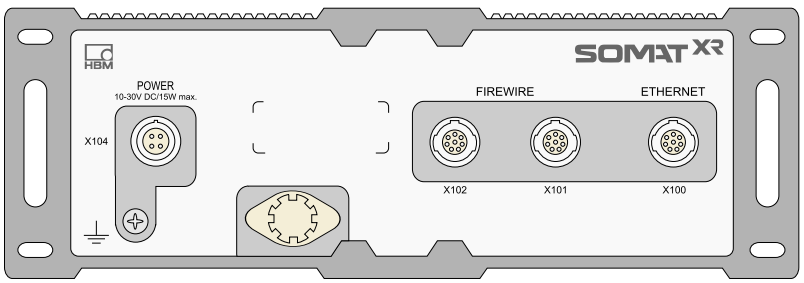
5.3 MX Modules

The SomatXR MX modules are front end data sourcing modules that can be used as expansion modules with the CX23-R Data Processor. They are configurable to interface to a diverse range of transducers and sensors. Generic features for most MX modules include precision measurement capabilities using 24 bit ADCs, TEDS sensor support and multiple digital filtering options.

MX modules can be connected to a CX23-R module directly or through one or more EX23-R Ethernet switches. For more information on setting up a system with MX modules, see Connecting MX Modules to a CX23-R.

All MX modules can also be combined with MX modules of the QuantumX (MX...) and QuantumX-P (MX...-P) series and can be connected to the CX22-W data recorder and the CX27 Ethernet and EtherCAT gateway. For more information on using MX modules in a standalone system with the catmanAP and MX Assistant software applications, refer to the MX Modules User Manual.

Each MX module has a similar back panel with a power connector, two FireWire connectors, and one Ethernet connector.



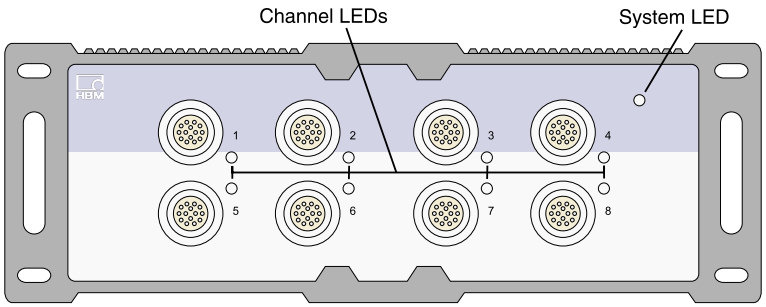
5.3.1 MX840B-R Universal Amplifier

Up to eight (8) universal inputs can be connected to the MX840B-R module compatible with more than 16 transducer technologies.

Transducer	MX840B-R	Wiring Diagram
 Strain gage, full bridge six-wire configuration	●	80
 Strain gage, half bridge five-wire configuration	●	80
 Inductive full bridge	●	84
 Inductive half bridge	●	84
 LVDT (linear variable differential transformer)	●	84
 Piezoresistive transducer	●	87
 Potentiometric transducer	●	88
 Voltage, 60 V, 10 V, 100 mV	●	89
 Current-fed piezoelectric transducer (IEPE, ICP®)	● *	91
 Current, 20 mA	●	92
 Resistance or resistance-based measurements	●	94
 Resistance thermometer (RTD), PT100 or PT1000	●	94
 Frequency / pulse counter (timer, TTL)	● connectors 5-8	101
 Incremental encoder (timer, TTL)	● connectors 5-8	101
 Torque / speed	● connectors 5-8	101
 CAN bus	● † connector 1	107

*ODU 14-pin to BNC adapter available soon.
†Not supported by the CX23-R Data Processor.

Status LEDs

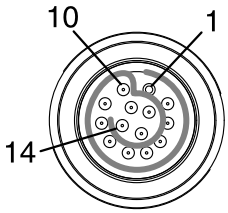


The following table gives the descriptions for all LED states.

System LED	Description
Green	System is error free
Red	System error
Orange	System is not ready; boot procedure is running
Orange flashing	System is not ready; download is active

Channel LED	Description
Green	Channel is ready
All orange	Boot procedure is running
All orange flashing	Download is active
Orange	Connection is newly assigned; transducer identification is running
Green flashing, then green	TEDS data is being read
Orange flashing, then green	Manual configuration; ignore TEDS
Red	No sensor connected; channel error (incorrect parameterization, connection error, invalid TEDS data)

MX840B-R Pin Assignments
Connect sensors via the 14-pin ODU MINI-SNAP connectors.

Connector	Pin	Connection	Wire Color (1-KAB183 or 1-KAB184)
 *pin side of cable*	1	Excitation (-) Zeroing pulse (-)	Black
	2	Excitation (+) Zeroing pulse (+)	Blue
	3	Voltage input 10 V (+), 60 V (+)	White/Black
	4	Signal ground *jumper to pin 5*	Red/Black
	5	Ground cable detect *jumper to pin 4*	Pink/Black
	6	Current input 20 mA (+)	Yellow/Black
	7	Measurement signal (+) Voltage input 100 mV (+) f_1 (-)	White
	8	Measurement signal (-) f_1 (+)	Red
	9	Active sensor supply 5...24 V (0 V)	Brown
	10	Active sensor supply 5...24 V (+)	Yellow
	11	Sense (-) f_2 (-)	Grey
	12	Sense (+) f_2 (+)	Green
	13	TEDS (-) Ground frequency measurement	Grey/Black
	14	TEDS (+)	Green/Black
	Shield	Shield	--

NOTE
Connection between pins 4 and 5 is necessary for all transducers. Note that the sensor connector must have a connection between pins 1 and 11 for compatibility with the MX1615B-R module.

5.3.2 MX1615B-R Bridge Module

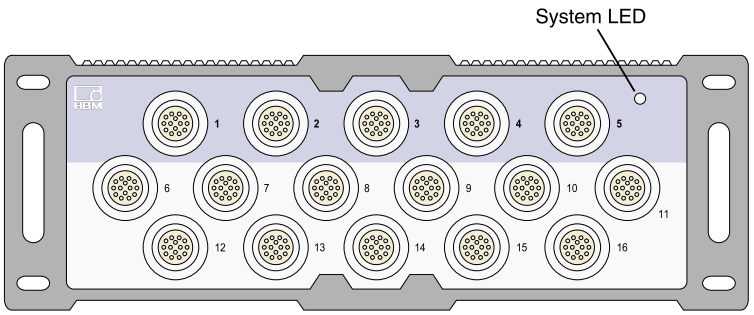
Up to 16 individually configurable inputs can be connected to the MX1615B-R, including strain gage-based transducers, standardized voltage and resistance or resistance-based measurements (for example, a PT100 resistance thermometer).

Transducer	MX1615B-R	Wiring Diagram
Strain gage, full bridge six-wire configuration	●	80
Strain gage, half bridge five-wire configuration	●	80
Strain gage, quarter bridge three- or four-wire configuration	●	80
Potentiometric transducer	●	88
Voltage, 60 V	●	89
Resistance or resistance-based measurements	●	94
Resistance thermometer (RTD), PT100	●	94

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

The measurement channels are electrically isolated from the power supply and the interfaces. When TEDS or T-ID is used, the measurement channel is automatically parameterized after connection.

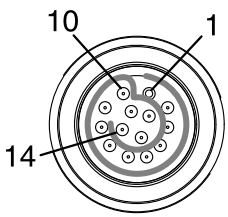
Status LED



The following table gives the descriptions for all LED states.

System LED	Description
Green	System is error free
Red	System error
Orange	System is not ready; boot procedure is running
Orange flashing	System is not ready; download is active

MX1615B-R Pin Assignments
Connect sensors via the 14-pin ODU MINI-SNAP connectors.

Connector	Pin	Connection	Wire Color (1-KAB183 or 1-KAB184)
 *pin side of cable*	1	Excitation (-) *jumper to pin 11*	Black
	2	Excitation (+)	Blue
	3	Voltage input 60 V (+)	White/Black
	4	Signal ground	Red/Black
	5	--	Pink/Black
	6	--	Yellow/Black
	7	Measurement signal (+)	White
	8	Measurement signal (-)	Red
	9	--	Brown
	10	--	Yellow
	11	Sense (-) *jumper to pin 1*	Grey
	12	Sense (+)	Green
	13	TEDS (-)	Grey/Black
	14	TEDS (+)	Green/Black
	Shield	Shield	--

NOTE
Pin assignment is different for Quarter-bridge strain gages, Resistance and Resistance Thermometer (RTD) inputs. For more information, refer to the wiring diagrams.

NOTE
Connection between pins 1 and 11 is necessary for all MX1615B-R transducers. Note that the sensor connector must have a connection between pins 4 and 5 for compatibility with other MX modules.

5.3.3 MX1601B-R Standard Module

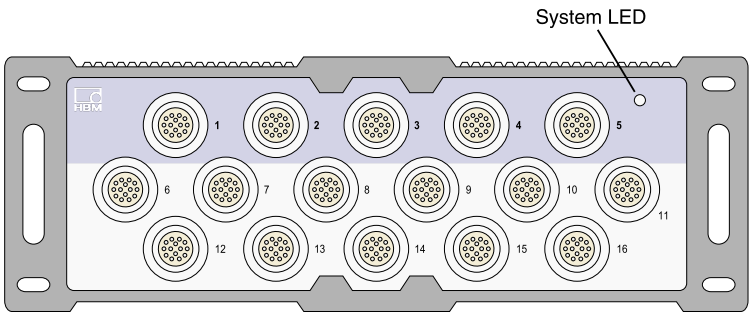
Up to 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE, ICP®) can be connected to the MX1601B-R module.

Transducer	MX1601B-R	Wiring Diagram
Voltage, 60 V, 10 V, 100 mV	●	89
Current-fed piezoelectric transducer (IEPE, ICP®)	● *	91
Current, 20 mA	●	92

*ODU 14-pin to BNC adapter available soon.

All measuring channels are electrically isolated from one another and from the power. When using transducer excitation, electrical isolation from the supply voltage of the amplifier is rescinded.

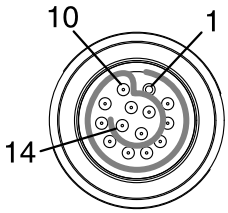
Status LED



The following table gives the descriptions for all LED states.

System LED	Description
Green	System is error free
Red	System error
Orange	System is not ready; boot procedure is running
Orange flashing	System is not ready; download is active

MX1601B-R Pin Assignments
Connect sensors via the 14-pin ODU MINI-SNAP connectors.

Connector	Pin	Connection	Wire Color (1-KAB183 or 1-KAB184)
 *pin side of cable*	1	--	Black
	2	--	Blue
	3	Voltage input (+), IEPE (+)	White/Black
	4	Signal ground *jumper to pin 5*	Red/Black
	5	Ground cable detect *jumper to pin 4*	Pink/Black
	6	Current input 20 mA (+)	Yellow/Black
	7	--	White
	8	--	Red
	9	Active sensor supply (-)	Brown
	10	Active sensor supply (+)	Yellow
	11	--	Grey
	12	--	Green
	13	TEDS (-)	Grey/Black
	14	TEDS (+)	Green/Black
	Shield	Shield	--

NOTE
Connection between pins 4 and 5 is necessary for all transducers. Note that the sensor connector must have a connection between pins 1 and 11 for compatibility with the MX1615B-R module.

The adjustable transducer excitation between 5 and 24 volts is only available on channels 1 through 8. These channels can draw a maximum of 0.7 W per channel or 2 W total.

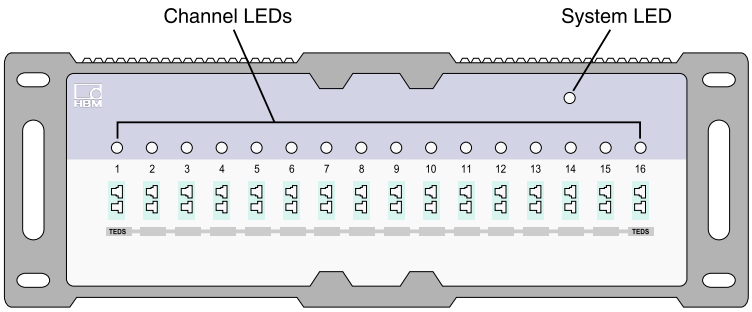
Channels 9 through 16 output the supply voltage (10 ... 30 V) minus approximately one volt. A maximum current of 30 mA per channel or 75 mA total can be consumed. The current limitation switches the transducer excitation off if current consumption is higher.

5.3.4 MX1609KB-R Thermocouple Module

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

Transducer	MX1609B-R	Wiring Diagram
Thermocouple, K-type	●	96

Status LEDs



The following table gives the descriptions for all LED states.

System LED	Channel LED	Description
Green	--	System is error free
Red	--	System error
Orange	Orange	System is not ready; boot procedure is running
Orange flashing	Orange flashing	System is not ready; download is active
--	Green	Connection is error free
--	Green flashing	TEDS data is valid (LED flashes for 5 s)
--	Orange	Transducer identification/sensor scaling is running
--	Red	No sensor connected Channel error (incorrectly parametrized, connection error, invalid TEDS data) Overload of sensor supply

5.3.5 MX411B-R Highly Dynamic Universal Amplifier

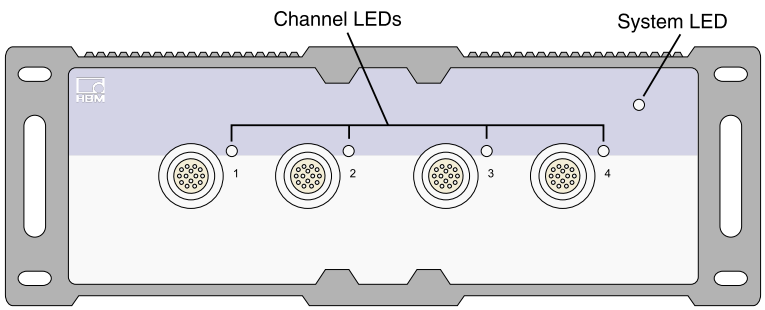
Up to four (4) electrically isolated inputs can be connected to the MX411B-R module, including strain gage and inductive bridges, standardized voltage and DC current sources (20 mA) or current-fed piezoelectric (IEPE, ICP®) and piezoresistive transducers.

Transducer	MX411B-R	Wiring Diagram
Strain gage, full bridge six-wire configuration	●	80
Strain gage, half bridge five-wire configuration	●	80
Inductive full bridge	●	84
Inductive half bridge	●	84
Piezoresistive transducer	●	87
Voltage, 10 V	●	89
Current-fed piezoelectric transducer (IEPE, ICP®)	● *	91
Current, 20 mA	●	92

*ODU 14-pin to BNC adapter available soon.

The measurement channels are electrically isolated from each other and from the power supply. When using the adjustable transducer excitation, electrical isolation from the supply voltage is not required.

Status LEDs

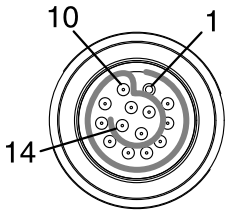


The following table gives the descriptions for all LED states.

System LED	Description
Green	System is error free
Red	System error
Orange	System is not ready; boot procedure is running
Orange flashing	System is not ready; download is active

Channel LEDs	Description
Green	Channel is ready
All orange	Boot procedure is running
All orange flashing	Download is active
Orange	Connection is newly assigned; transducer identification is running
Green flashing, then green	TEDS data is being read
Orange flashing, then green	Manual configuration; ignore TEDS
Red	No sensor connected; channel error (incorrect parametization, connection error, invalid TEDS data); overloaded sensor supply

MX411B-R Pin Assignments
Connect sensors via the 14-pin ODU MINI-SNAP connectors.

Connector	Pin	Connection	Wire Color (1-KAB183 or 1-KAB184)
 *pin side of cable*	1	Excitation (-)	Black
	2	Excitation (+)	Blue
	3	Voltage input 10 V (+), IEPE (+)	White/Black
	4	Signal ground *jumper to pin 5*	Red/Black
	5	Ground cable detect *jumper to pin 4*	Pink/Black
	6	Current input 20 mA (+)	Yellow/Black
	7	Measurement signal (+)	White
	8	Measurement signal (-)	Red
	9	Active sensor supply (-)	Brown
	10	Active sensor supply (+)	Yellow
	11	Sense lead (-)	Grey
	12	Sense lead (+)	Green
	13	TEDS (-)	Grey/Black
	14	TEDS (+)	Green/Black
	Shield	Shield	--

NOTE
Connection between pins 4 and 5 is necessary for all transducers. Note that the sensor connector must have a connection between pins 1 and 11 for compatibility with the MX1615B-R module.

5.3.6 MX471B-R CAN Module

Up to four (4) independent CAN bus inputs can be connected to the MX471B-R module.

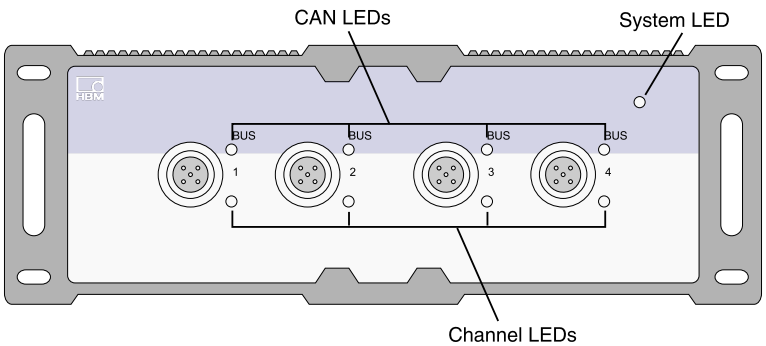
Transducer	MX471B-R	Wiring Diagram
CAN bus	● ‡	107

‡ Including support for CCP/XCP-on-CAN.

Each CAN bus node is electrically isolated from each other and from the power supply.

The MX471B-R supports baud rates of 1000K, 800K, 667K, 500K, 400K, 250K, 125K, 100K, 50K, 20K and 10K bps. Please refer to the MX471B-R Data Sheet for the relationship between bit rate and maximum bus line length.

Status LEDs



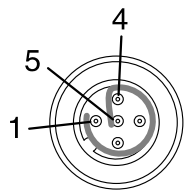
The following tables give the descriptions for all LED states.

System LED	Description
Green	System is error free
Yellow	System is not ready; boot procedure is running
Yellow flashing	System is not ready; download is active
Red	System error; faulty synchronization

CAN LEDs (BUS)	Description
Green flickering	Bus is error free; activity on CAN
Green	Bus is error free; no activity on CAN
Yellow flickering	Intermittent bus errors (warning); activity on CAN
Yellow	Intermittent bus errors (warning); no activity on CAN
Red	Bus error; CAN interface in Bus OFF status

Channel LEDs	Description
Green	Channel is ready
Yellow	Boot procedure is running
Yellow flashing	Download is active
Red	Channel has errors

MX471B-R Pin Assignments

Connector	PIN	Description	Wire Color (1-KAB2109-2)
 *pin side of cable*	1	CAN Ground	Yellow
	2	--	Red
	3	Ground	Black
	4	CAN H	White
	5	CAN L	Blue

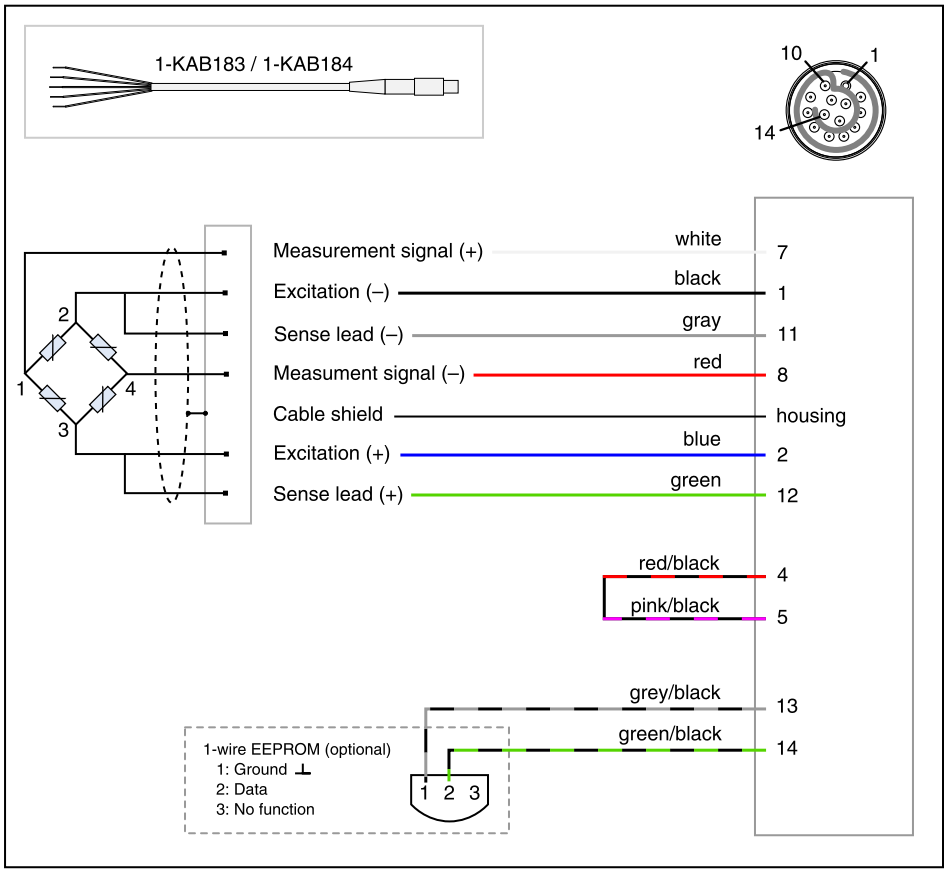
5.4 Inputs and Wiring Diagrams

5.4.1 Strain Gage Transducers

Transducer	MX840B-R	MX1615B-R	MX411B-R
Strain gage, full bridge six-wire configuration	●	●	●
Strain gage, half bridge five-wire configuration	●	●	●
Strain gage, quarter bridge three- or four-wire configuration		●	

Full-bridge strain gage

Full-bridge strain gage, six-wire configuration

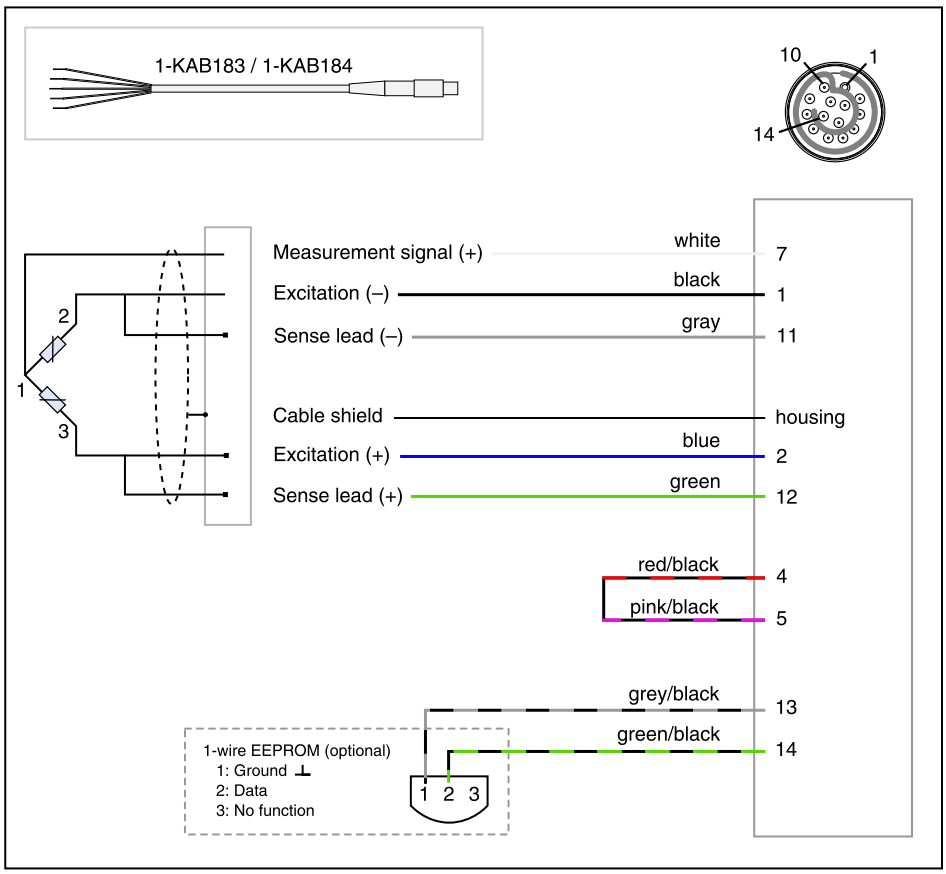


NOTE

For full four-wire bridge configurations, a connection between the sense lead and excitation lines must be made in the connector.

Half-bridge strain gage

Half-bridge strain gage, five-wire configuration

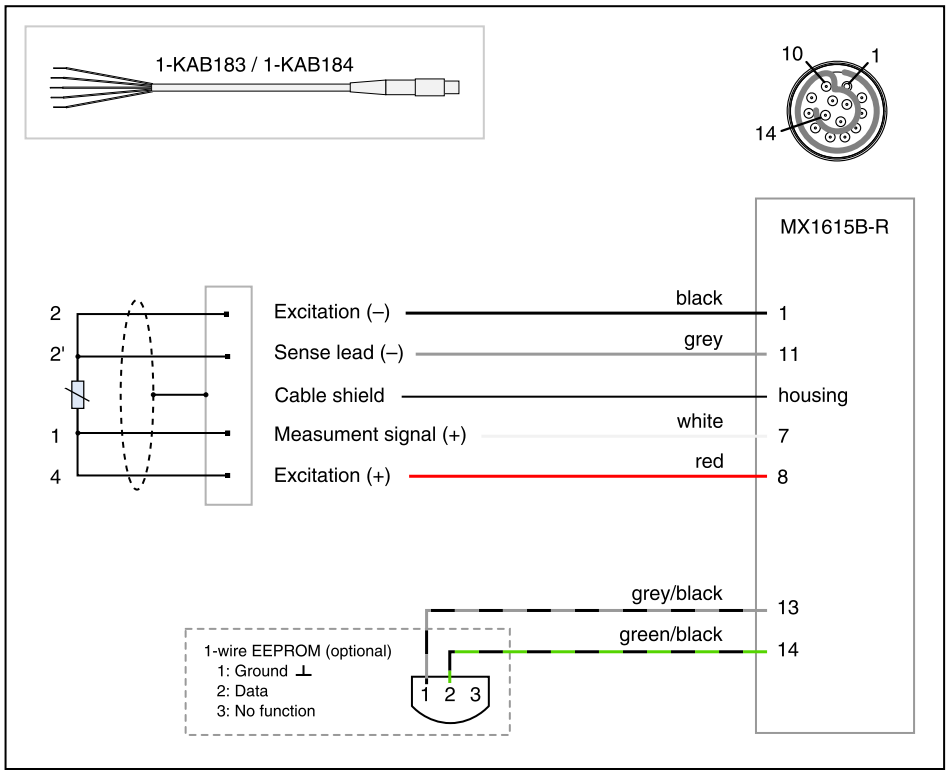


NOTE

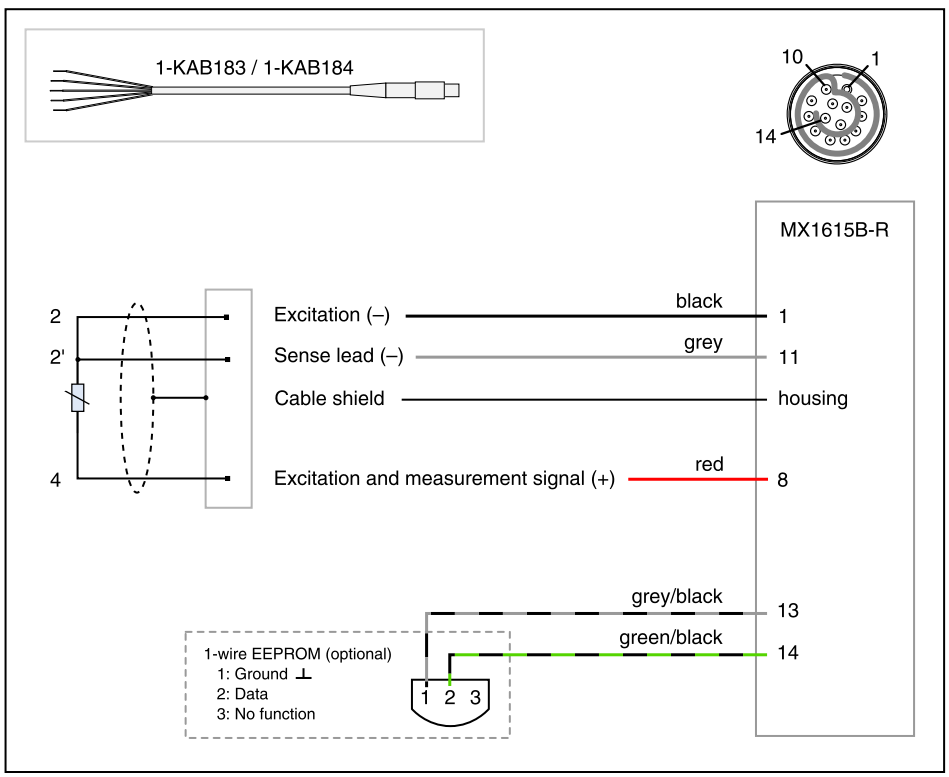
For half three-wire bridge configurations, a connection between the sense lead and excitation lines must be made in the connector.

Quarter-bridge strain gages

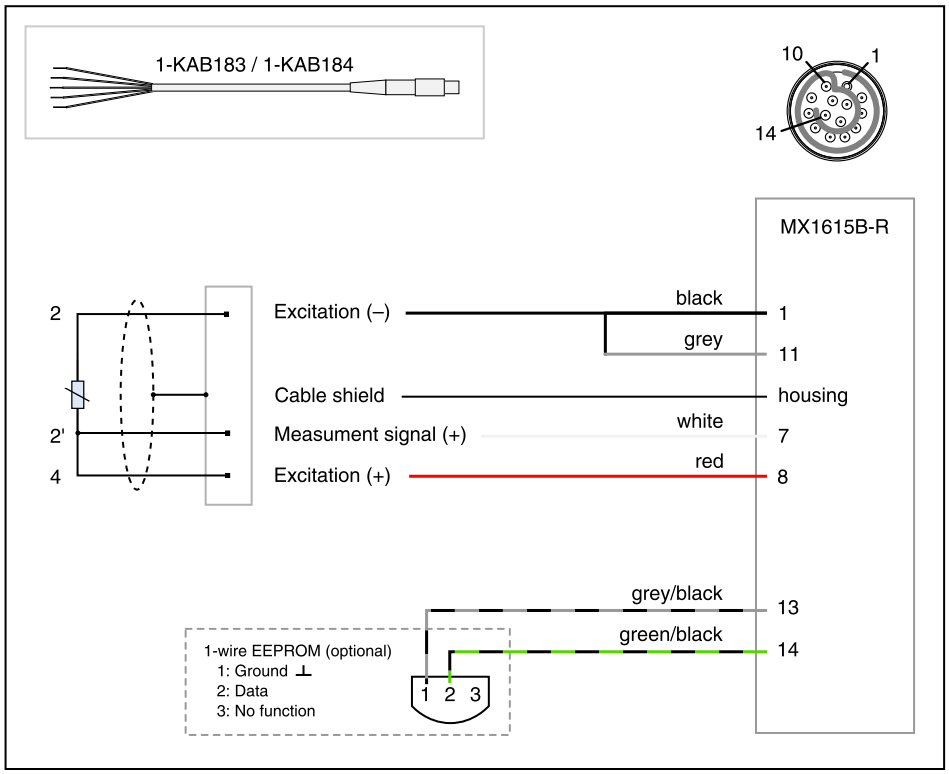
Quarter-bridge strain gage, four-wire configuration



Quarter-bridge strain gage, three-wire configuration



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

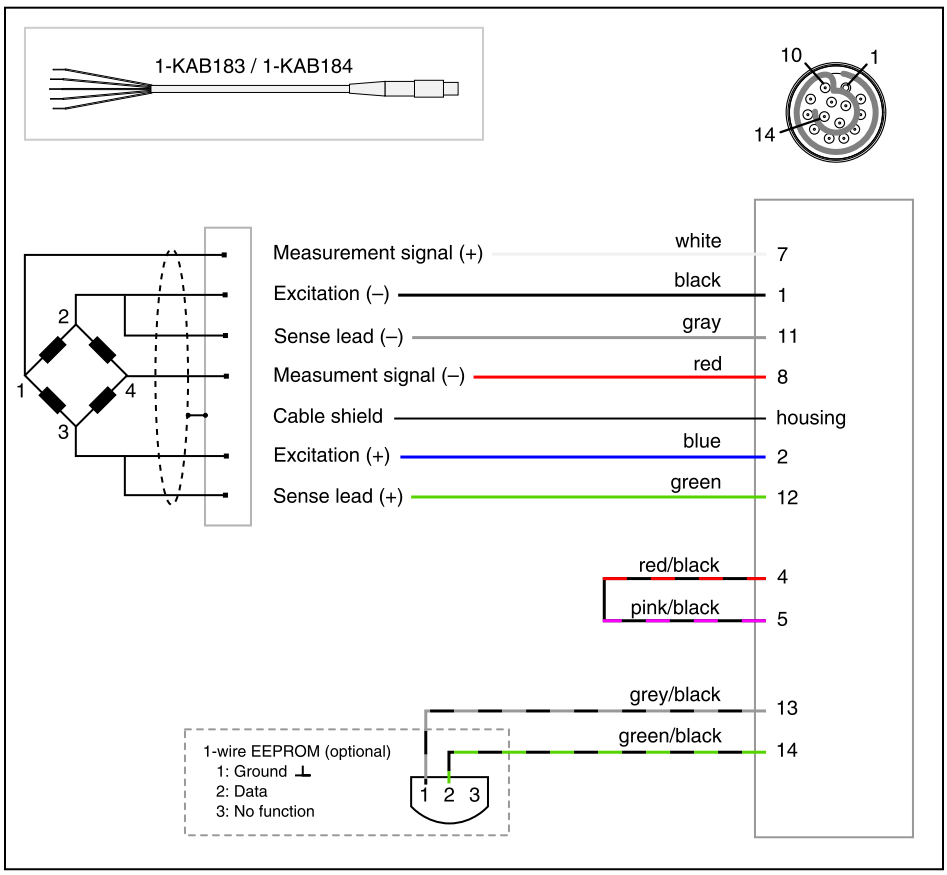


5.4.2 Inductive Transducers

Transducer	MX840B-R	MX411B-R
Inductive full bridge	●	●
Inductive half bridge	●	●
LVDT (linear variable differential transformer)	●	

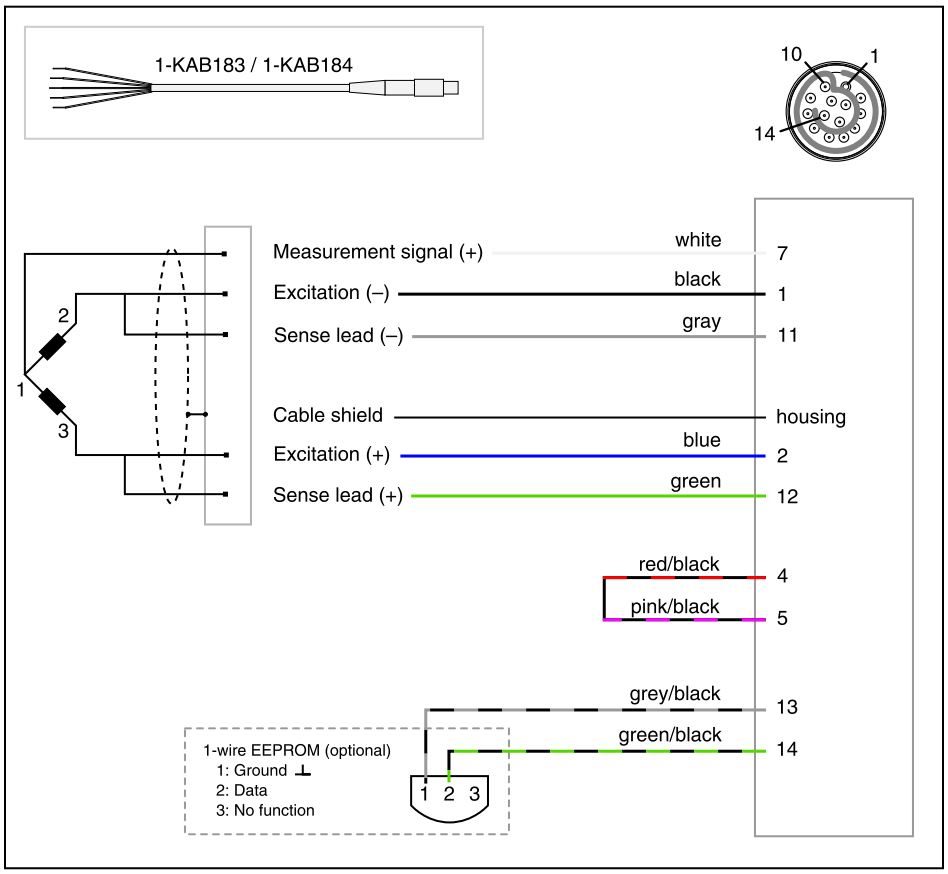
Inductive full-bridge

Inductive full-bridge, six-wire configuration



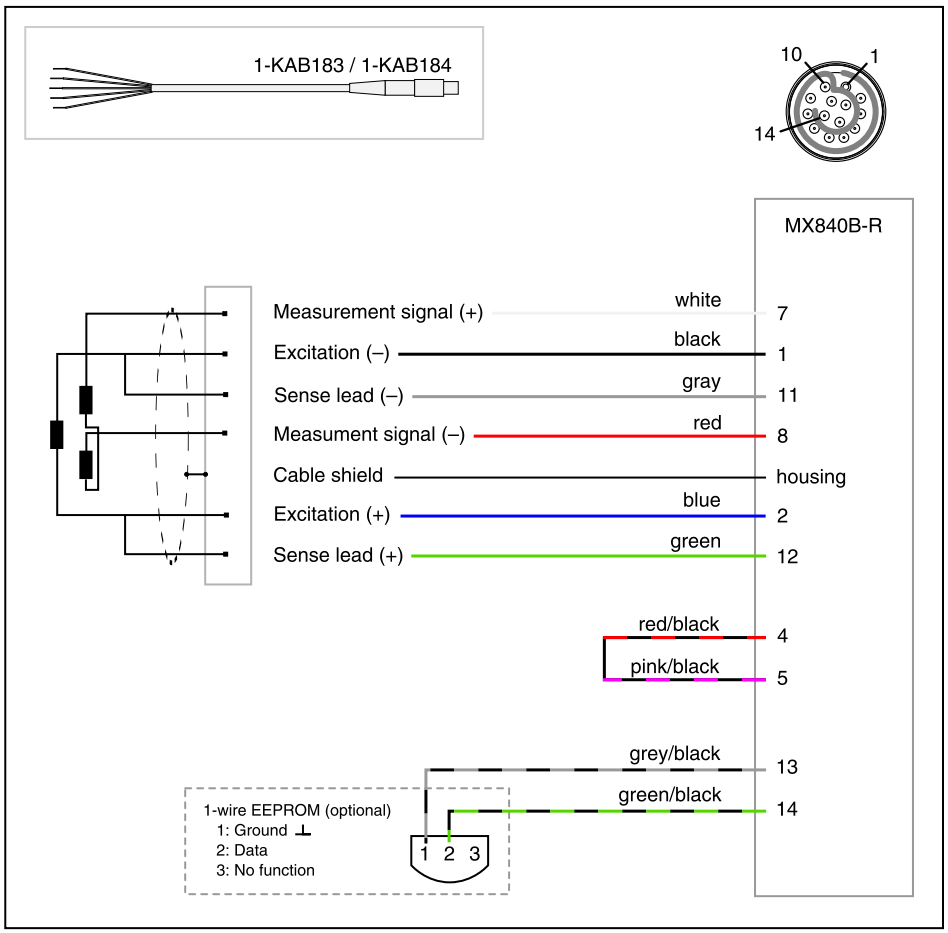
Inductive half-bridge

Inductive half-bridge, five-wire configuration



Linear variable differential transformer (LVDT)

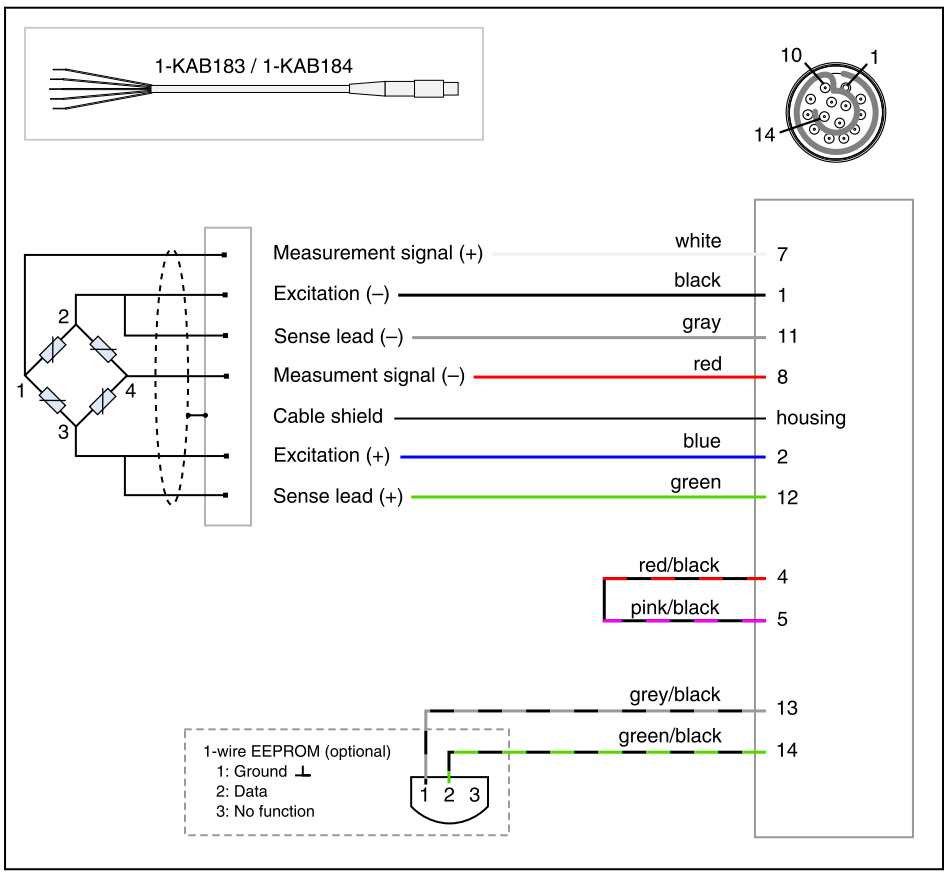
Linear variable differential transformer (LVDT)



5.4.3 Piezoresistive Transducers

Transducer	MX840B-R	MX411B-R
Piezoresistive transducer	●	●

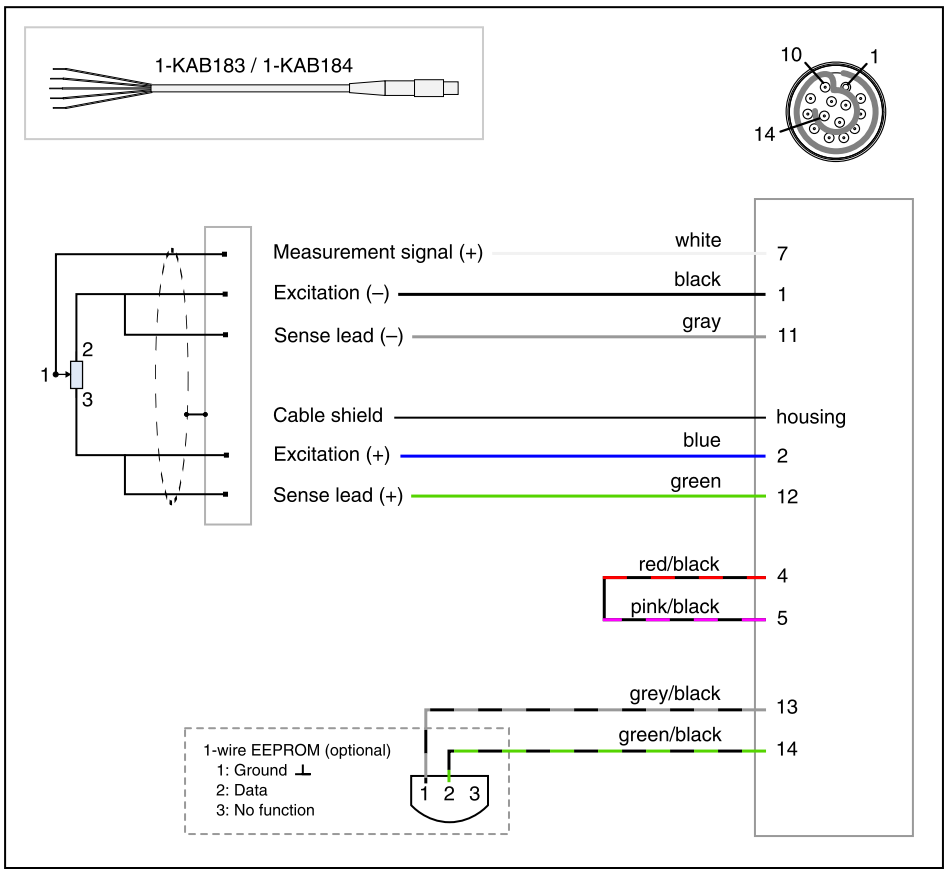
Piezoresistive full bridge, six-wire configuration



5.4.4 Potentiometric Transducers

Transducer	MX840B-R	MX1615B-R
Potentiometric transducer	●	●

Potentiometric transducer

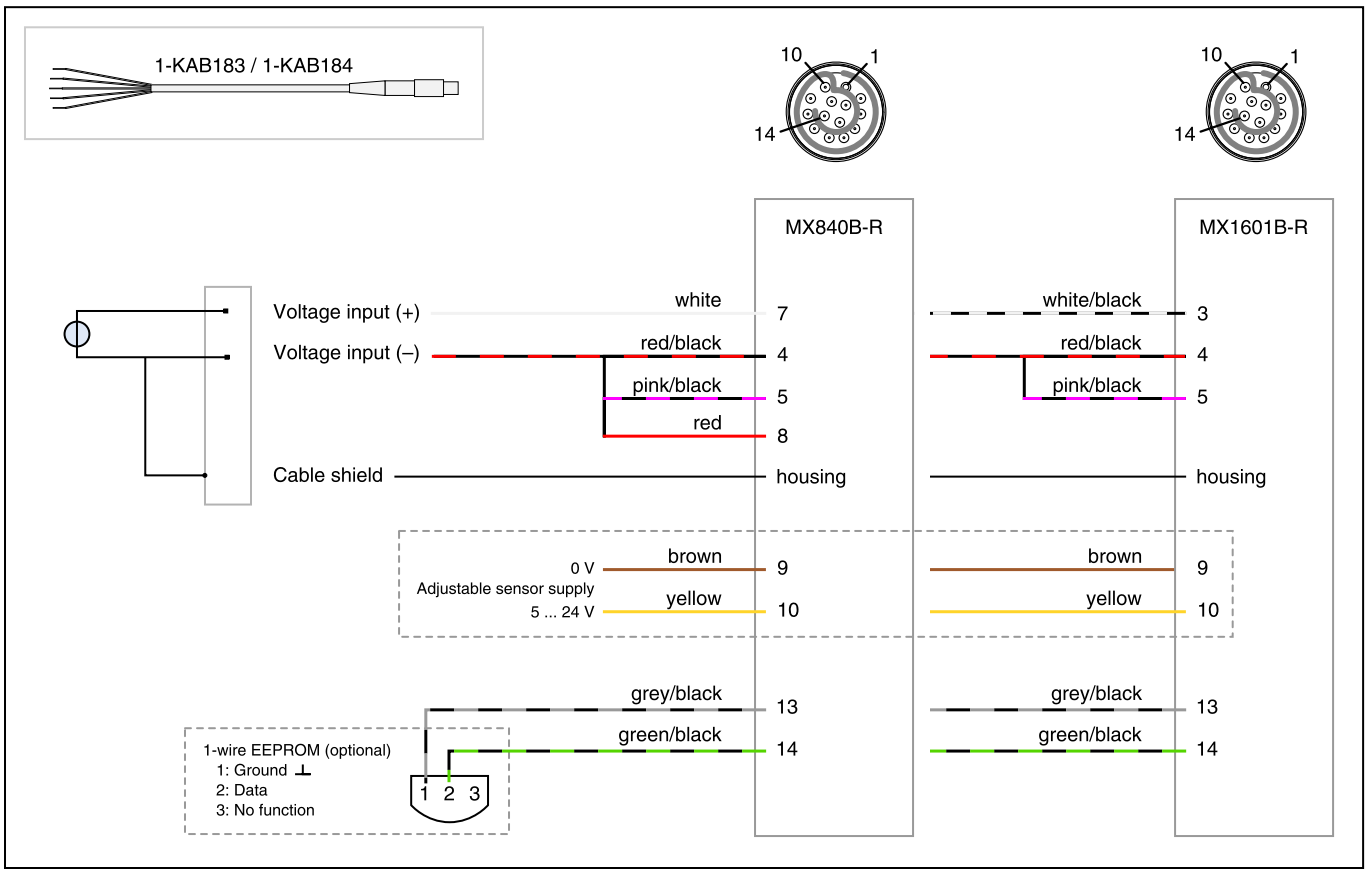


5.4.5 Voltage Sources

Transducer	MX840B-R	MX1615B-R	MX1601B-R	MX411B-R
Voltage, 60 V, 10 V, 100 mV	●	● 60 V only	●	● 10 V only

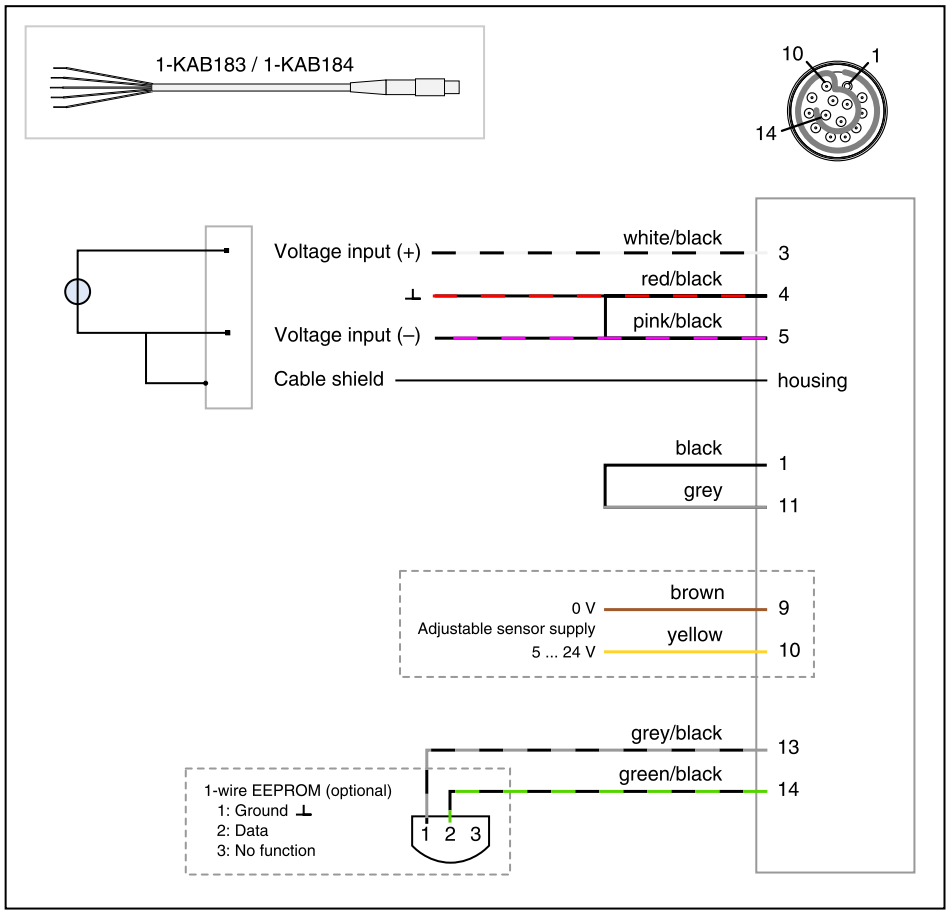
100 mV DC Voltage Source

Voltage, 100 mV



10 or 60 V DC Voltage Source

Voltage, 10 or 60 V



NOTE
Maximum input voltage to housing and supply ground is ±60 V.

NOTE
A connection between pins 1 and 11 is necessary for compatibility with the MX1615B-R module. A connection between pins 4 and 5 is necessary for compatibility with all other MX modules.

NOTE
The MX1615B-R module does not provide an adjustable sensor supply.

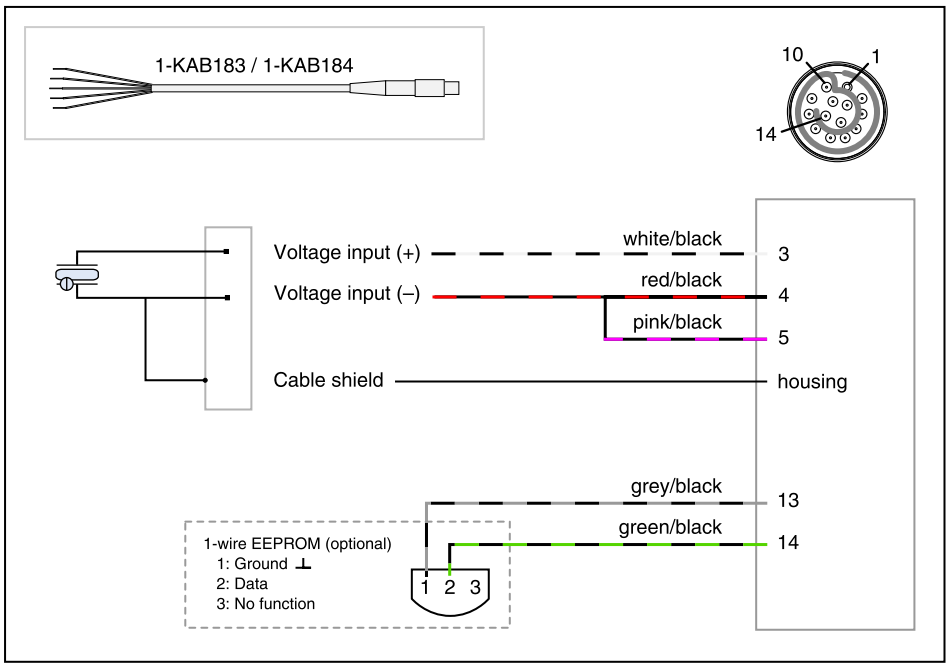
5.4.6 Current-fed Piezoelectric Transducers (IEPE, ICP®)

Current-fed piezoelectric transducers are supplied with a constant current 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.

Transducer	MX840B-R	MX1601B-R	MX411B-R
Current-fed piezoelectric transducer (IEPE, ICP®)	● *	● *	● *

*ODU 14-pin to BNC adapter available soon.

Current-fed piezoelectric transducer (IEPE)



NOTE

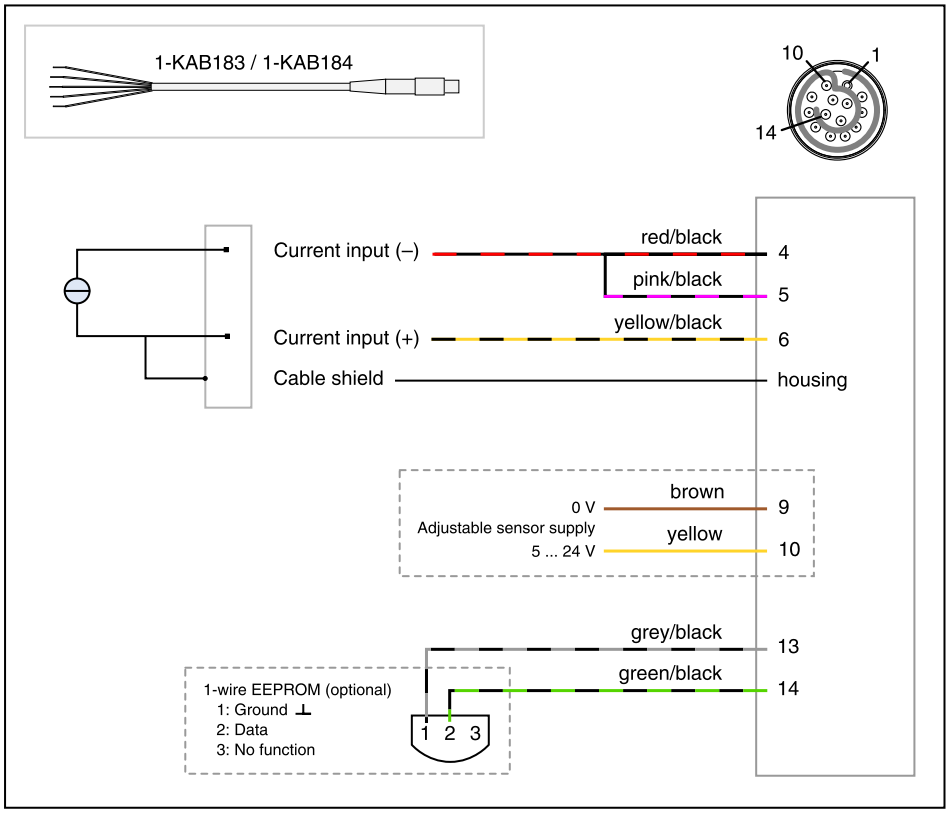
IEPE transducers with TEDS version 1.0 are supported.

5.4.7 Current Sources

Transducer	MX840B-R	MX1601B-R	MX411B-R
Current, 20 mA	●	●	●

20 mA DC Current Source

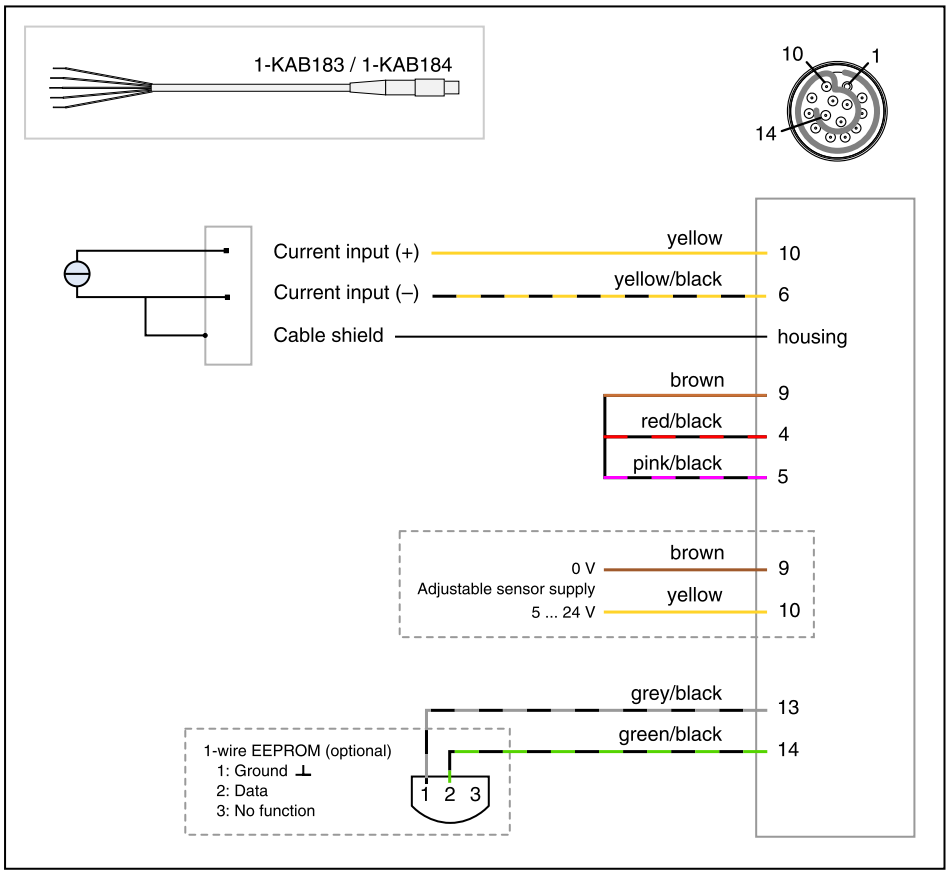
Current, 20 mA



NOTE
Maximum current is ±30 mA.

20 mA Current-fed DC Current Source

Current, 20 mA current-fed



NOTE
Maximum current is ±30 mA.

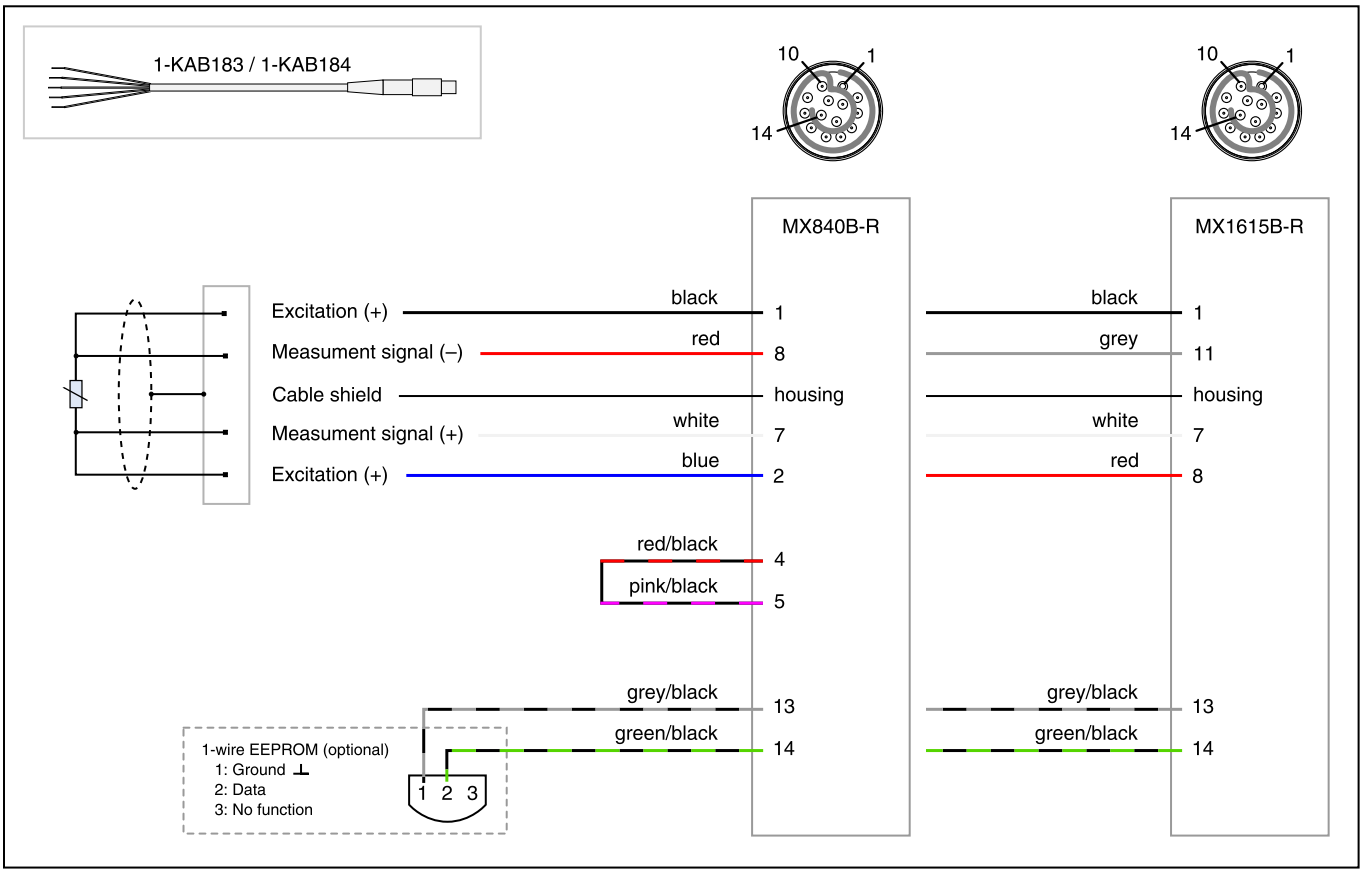
NOTE
The sensor supply must be connected in series. This, however, terminates the electrical isolation to the module supply.

5.4.8 Resistance-Based Measurements

Transducer	MX840B-R	MX1615B-R
Resistance or resistance-based measurements	●	●
Resistance thermometer (RTD), PT100 or PT1000	●	● PT100 only

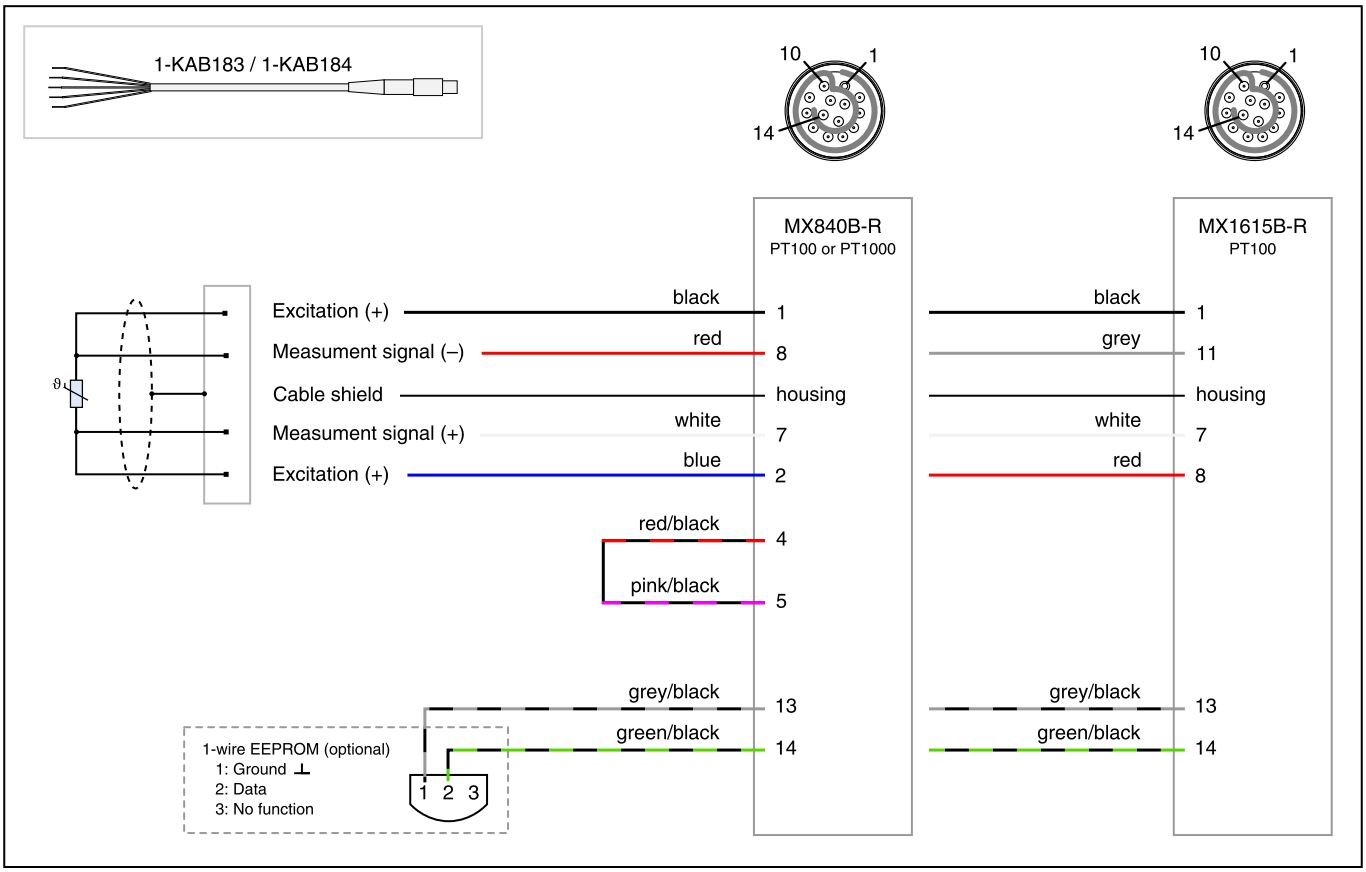
Resistance

Resistance, four-wire circuit



Resistance Thermometer (RTD)

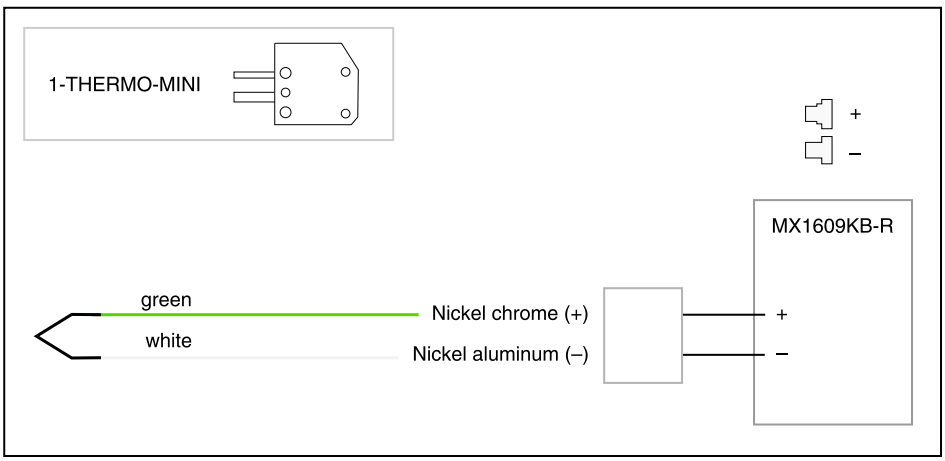
Resistance thermometer



5.4.9 Thermocouples

Transducer	MX1609B-R
Thermocouple, K-type	●

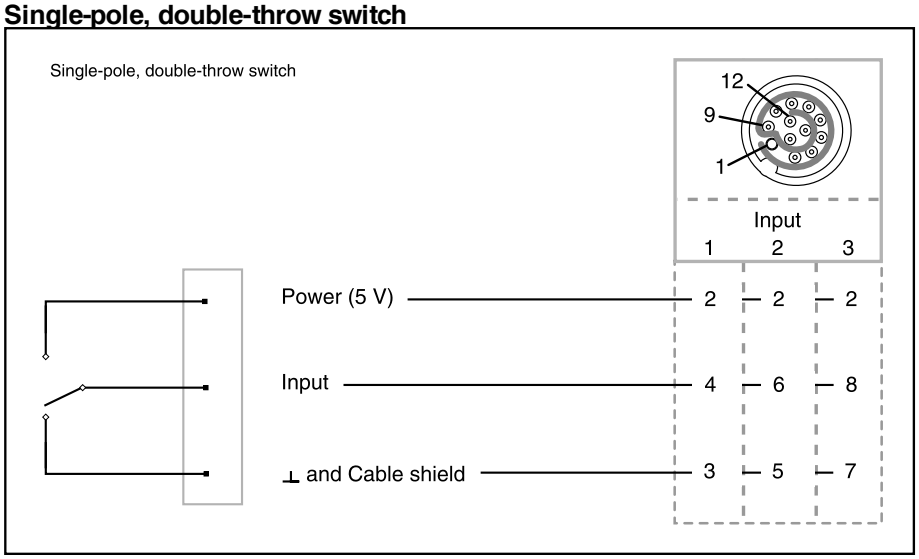
Thermocouple, K-type



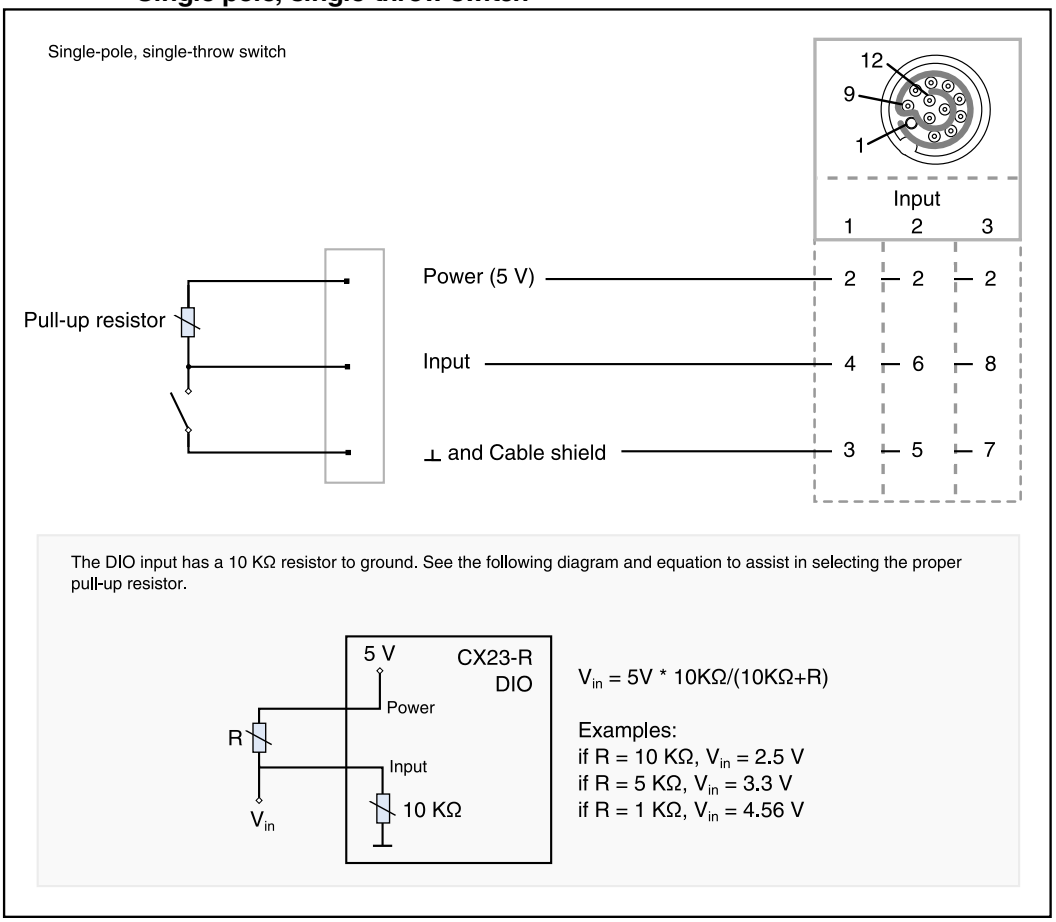
5.4.10 Digital Inputs

Transducer	CX23-R
Digital input, static	●

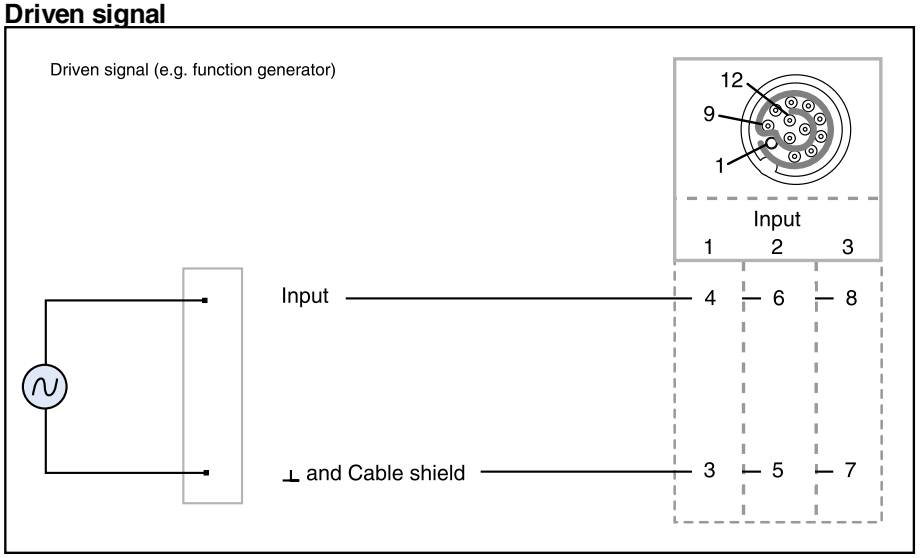
Single-pole, double-throw switch



Single-pole, single-throw switch



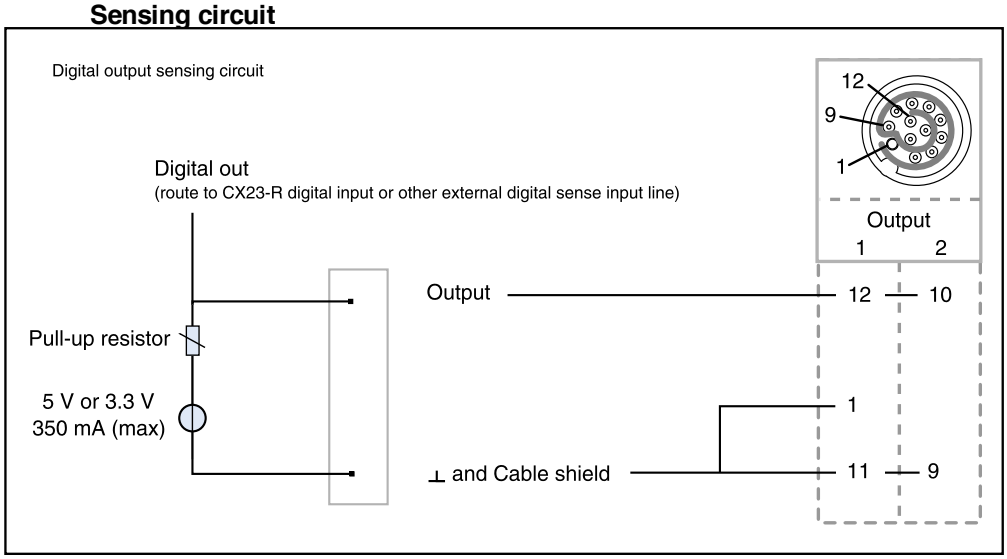
Driven signal



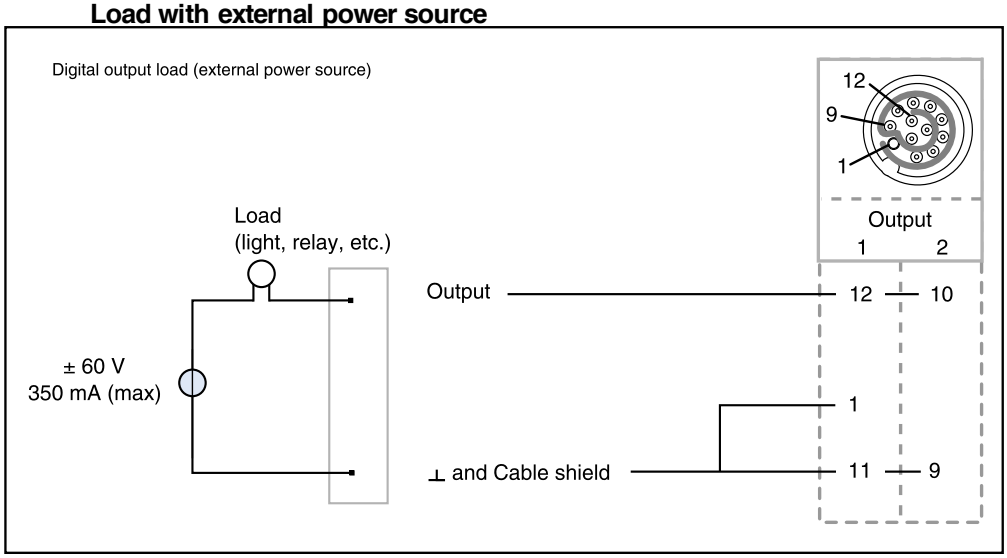
5.4.11 Digital Outputs

Transducer	CX23-R
Digital output, static	●

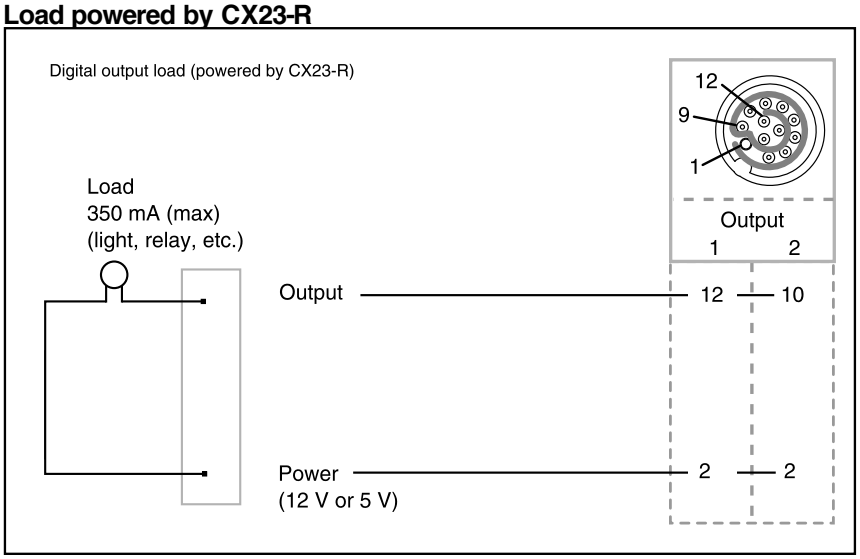
Sensing circuit



Load with external power source



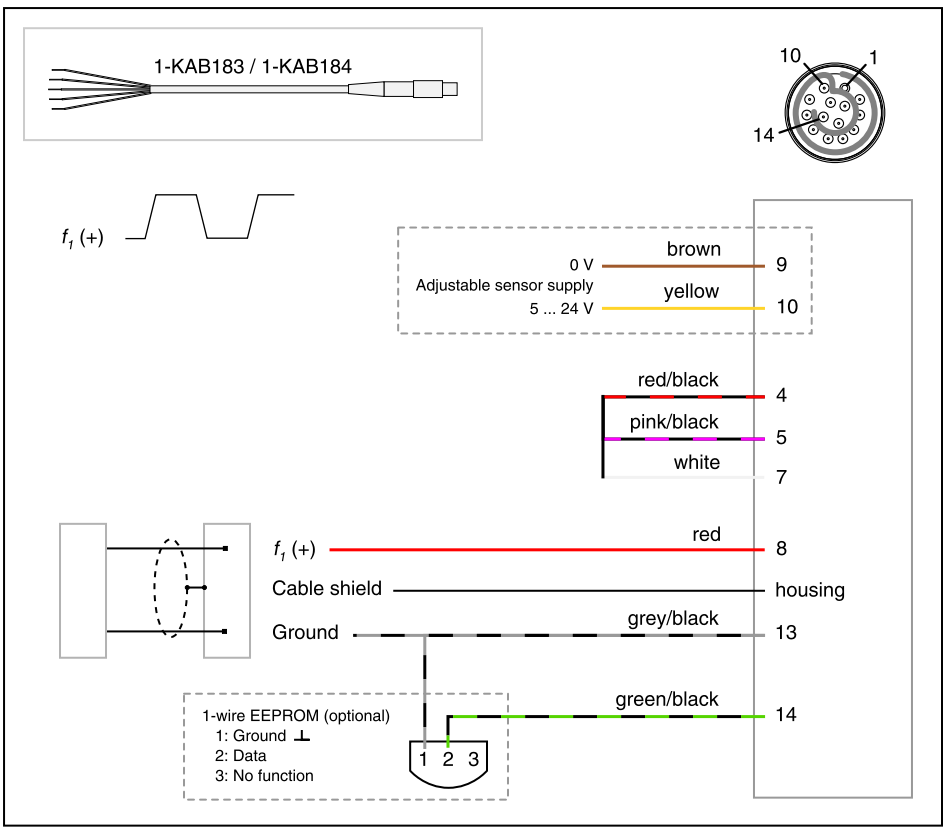
Load powered by CX23-R



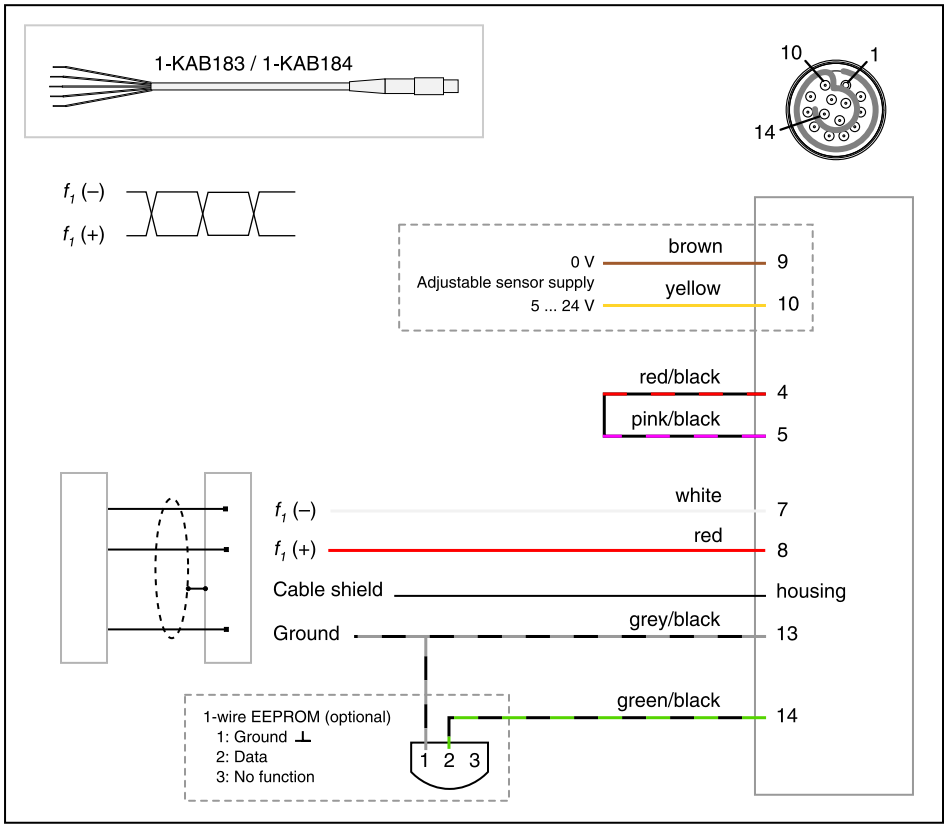
5.4.12 Digital Timer Inputs

Transducer	CX23-R	MX840B-R
Frequency / pulse counter (timer, TTL)	○	● connectors 5-8
Incremental encoder (timer, TTL)	○	● connectors 5-8
Torque / speed		● connectors 5-8

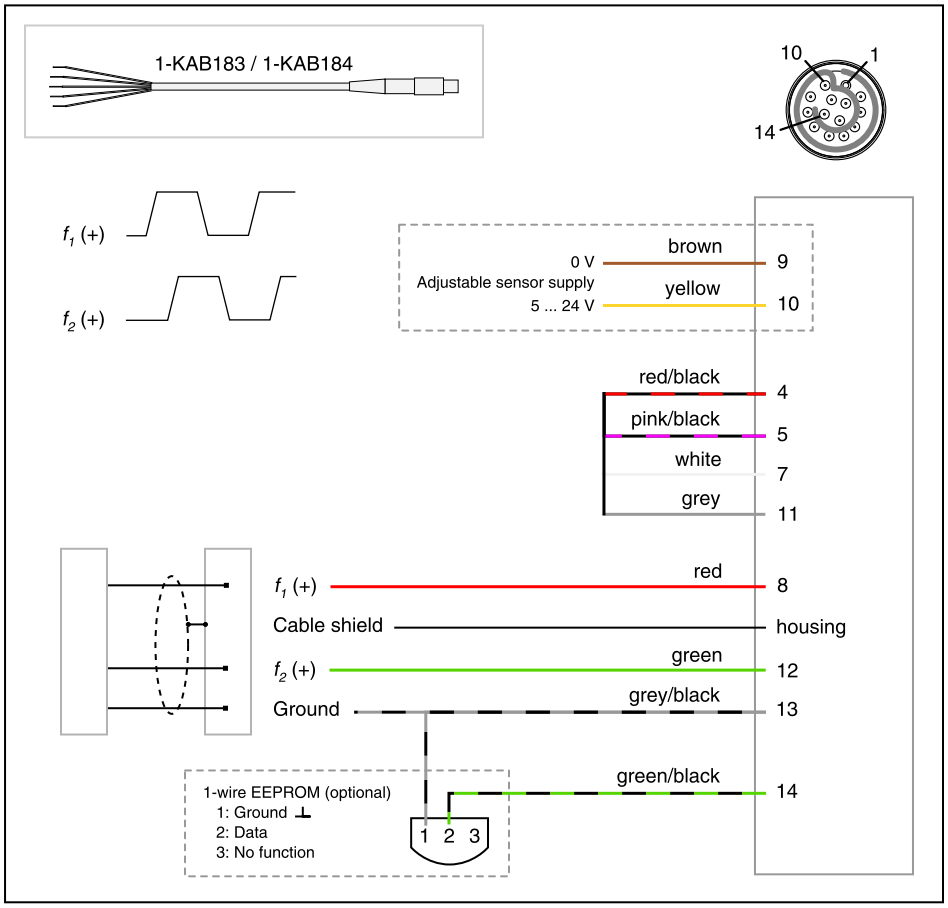
Frequency, single-ended



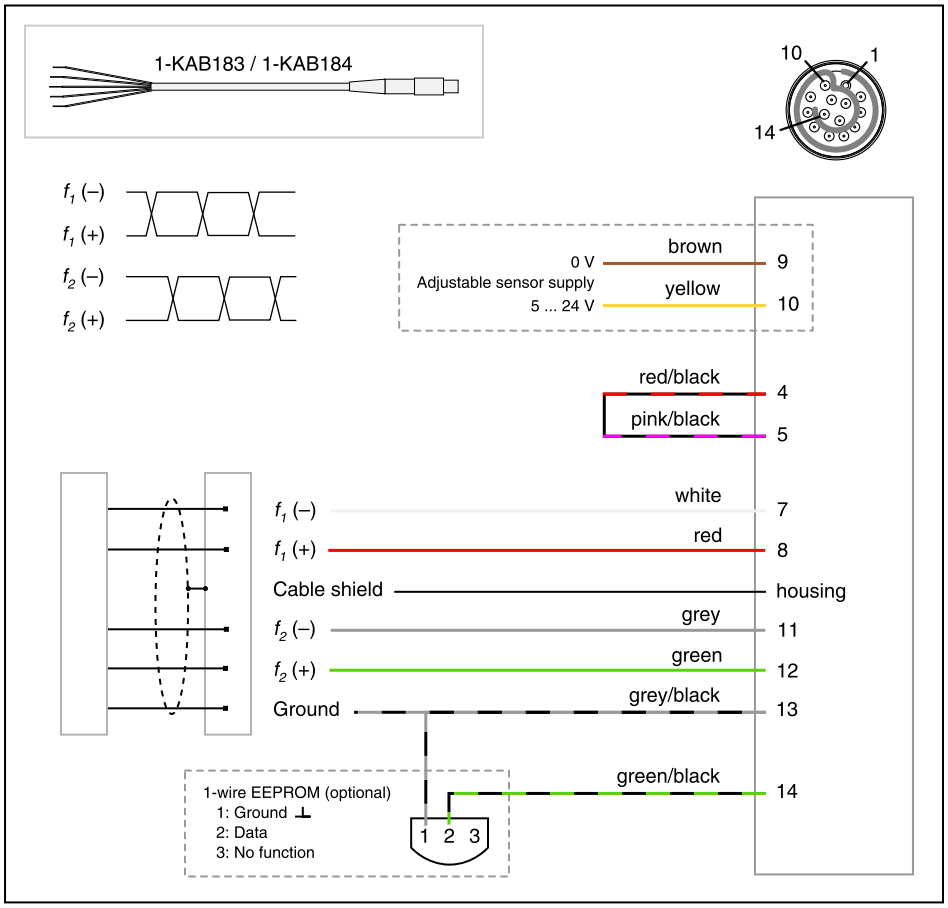
Frequency, differential



Frequency, single-ended, directional

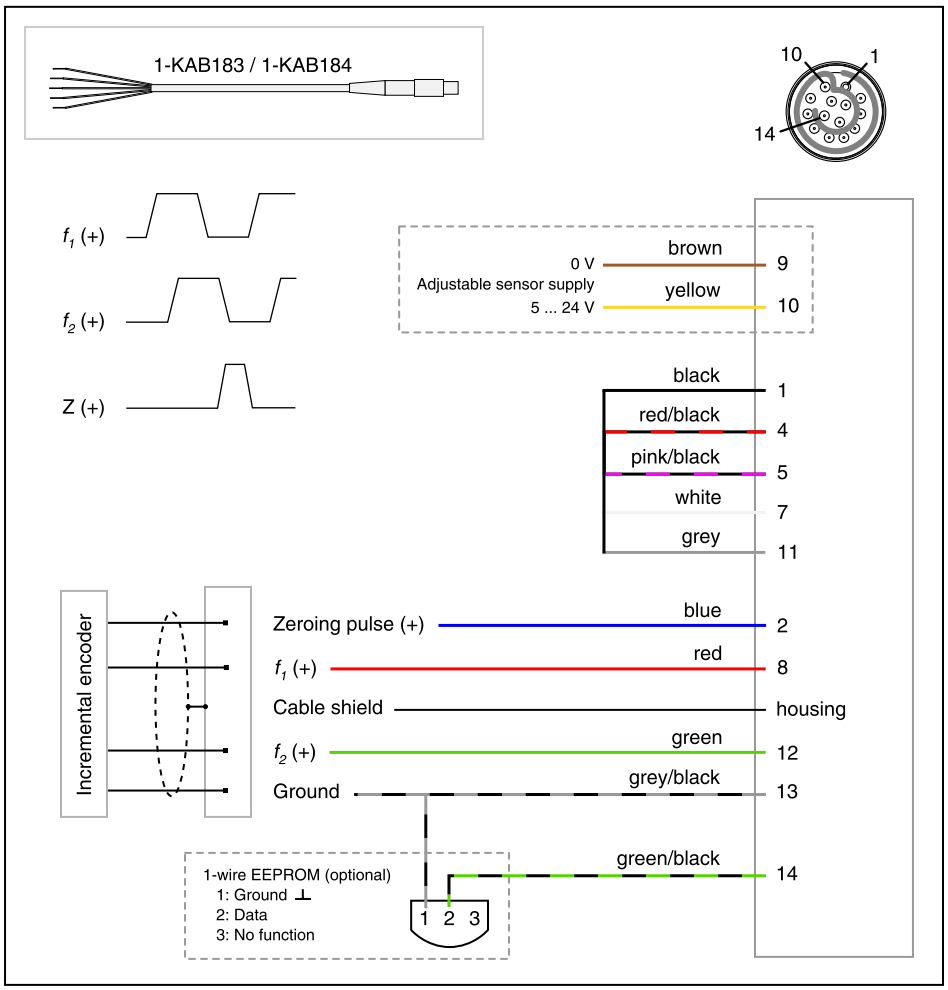


Frequency, differential, directional

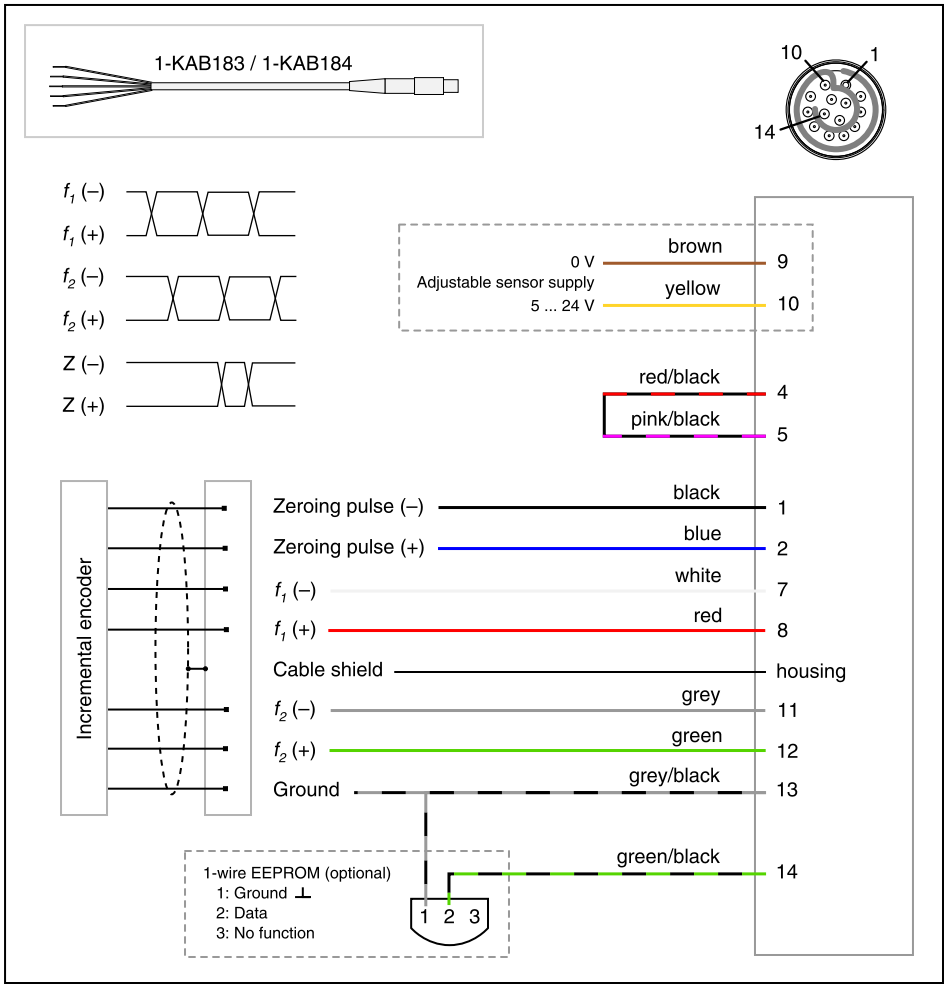


Incremental encoder

Encoder, single-ended



Encoder, differential



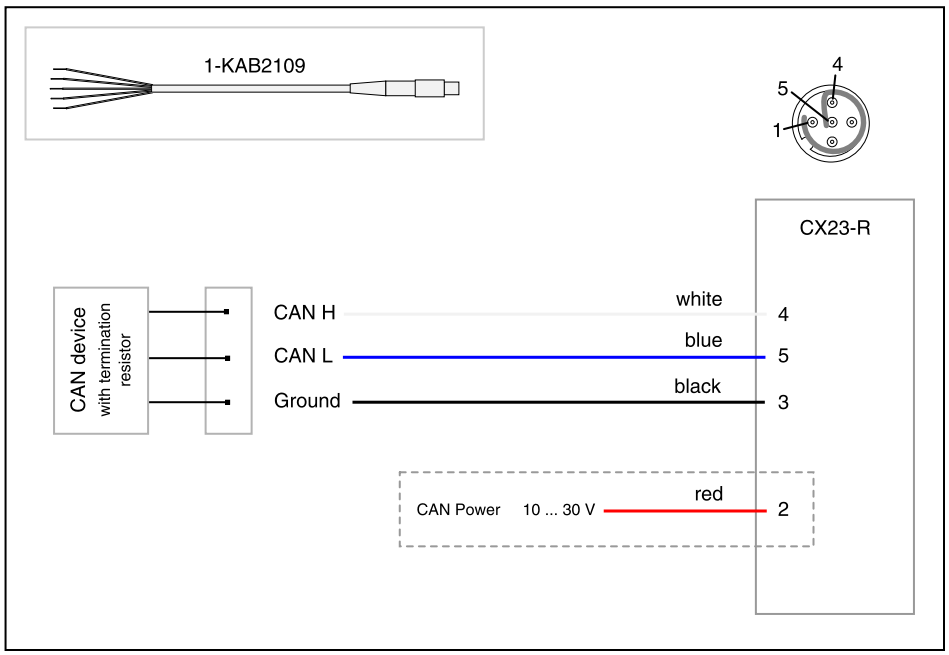
5.4.13 CAN Devices

Transducer	CX23-R	MX840B-R	MX471B-R
CAN CAN bus	●	● † connector 1	●

† Not supported by the CX23-R Data Processor.

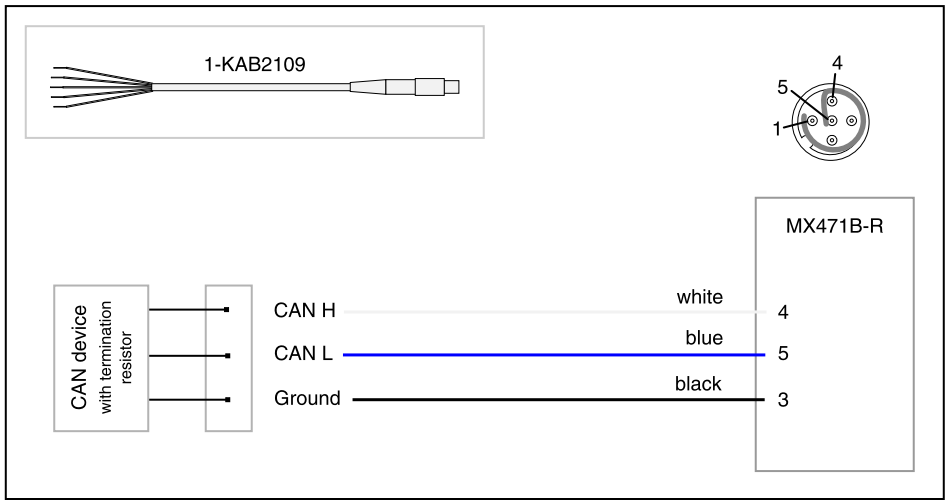
NOTE
To ensure normal operation, the CAN bus needs to be terminated at both ends using appropriate termination resistors. The CX23-R,MX471B-R and MX840B-R provide internal completion resistors between CAN H and CAN L that can be enabled or disabled individually with software.

CAN device, CX23-R



NOTE
The optional CAN power provided by the CX23-R is 1 A limited and the same voltage as the input to the CX23-R.

CAN device, MX471B-R



6 CX23-R Web Interface

6.1 Supported Browsers

The CX23-R web application supports most modern browsers, including Internet Explorer (IE11 and higher), Mozilla Firefox, Chrome and Safari (Safari 8 for OS X or iOS 7).

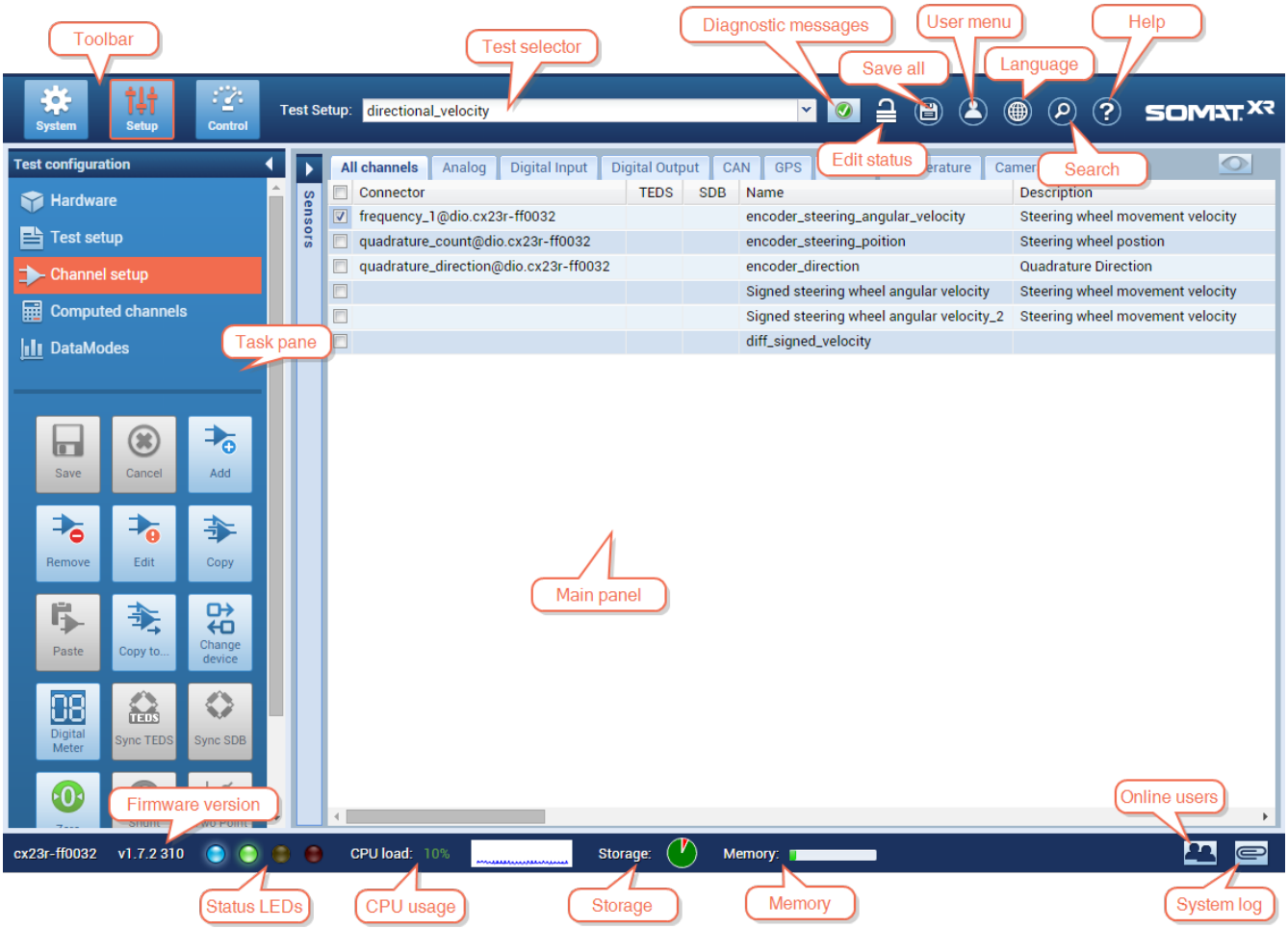
Browsers must support the following features to use the CX23-R web application. Please refer to browser documentation or support to ensure that these requirements are met.

- WebSockets
- Typed arrays
- Canvas (HTML5)
- WebGL (optional)

NOTE
By default, the CX23-R web application runs on an HTTP connection (port 80). It is recommended instead to use a secure HTTPS connection (port 443).

NOTE
Safari requires a signed certificate for running secure socket layers. Any information relying on web sockets, such as charts and test statistics, may not be available without special certificate configuration.

6.2 Tour of the Workspace



NOTE
Not all of the workspace features may be visible depending on User Privileges.

Task pane

The task pane is on the left hand side of the window. In general, the task pane contains a menu of available pages and action buttons. The task pane may be **minimized** to allow more space for the main panel. The state of the task pane is remembered separately for each section and for future sessions.

Main panel

The main panel displays the page selected in the task pane. This is the primary working area and may contain a Grid Interface.

Header

Toolbar

The toolbar contains buttons to navigate the main sections of the interface.

	System configuration • Manage profiles and users • Import databases • Set up networks • Configure system date and time • Update firmware • Set system preferences • Customer support tasks
	Test configuration • Manage test setups and hardware • Create and edit input channels, computed channels, and DataModes • Set channel sensor scaling based on signal measurements
	Test and data control • Control and monitor test runs • Create, configure and display real time charts • Manage SIE data files

Test selector

In the Test configuration section, use the test selector to select the test setup to edit. In the Test and data control section, use the test selector to select the test to run.

To the right of the selector are test indicators.

Diagnostic messages	One of four icons indicating the highest level message for the current test. Hover over the icon to display the number and types of messages. Click to display the Diagnostic Messages window.  No messages  Information  Warning  Error
Edit status (Test configuration section only)	 Test is unlocked and can be edited.  Test is locked and cannot be edited.  Test has been edited and not saved.

Menu

	Save all	Save all pending changes. When changes are pending, the icon is **orange**.
	User menu	Open the user menu to Change Password, set User Preferences, or Log Off.
	Language	Change the interface language.
	Search	Open the **search bar** to filter lists or grid entries in the main panel. When a search is active, the icon is **orange**.
	Help	Open the online help system.

Status bar

Host name		Host name of the connected device.
Firmware version		Currently installed firmware version.
	LEDs	A mirror of the CX23-R Status LEDs on the connected device.
	CPU load	The most current CPU load reading and a chart of the last 60 readings. Mouse over the chart to display data points.

	Storage	Used (red) and available (green) storage on the CX23-R internal SATA Drive. Mouse over the pie chart to display the percentages.
	Memory	Amount of memory being used by the CX23-R with respect to its total memory. Mouse over the bar to display the percentage being used.
	Online users	Click to display a list of the users currently logged in to the system.
	System logs	Click to display the System Logs page. The icon turns **red** when an error or alert exists and the red status LED is lit.

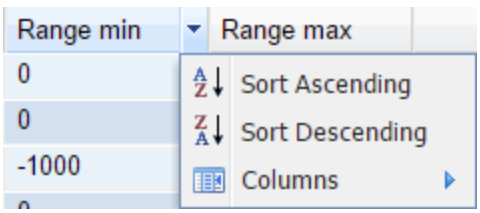
6.2.1 Grid Interface

Many pages contain a grid interface to list channels or connectors and their properties. Cells within the grid can contain editable text, combo lists, check boxes, buttons or read-only values.

Edit a cell value by clicking on the cell or by using the keyboard directional and tab keys to navigate to the cell.

For most grids, select a row by checking the box in the first column. Perform actions on single rows by right clicking on a row and selecting an action.

Grids can be filtered using **search**. Columns can be sorted or hidden from the column header menu.



Rows can be manually sorted by dragging them where desired. To move multiple rows at one time, select the rows desired and then click and drag. The rows move to the new location in the order that they were selected.

Most columns can be resized by dragging the column border and reordered by dragging the column header. These grid configurations are user specific and are remembered for future sessions.

6.2.2 System Logs

The system log contains many of the system level messages for various tasks, events and exceptions encountered. The log is particularly helpful for support purposes, but may be useful to authorized users.

The system always displays log entries in reverse chronological order. Each entry contains the following information:

- **Time**: System date and time the entry was written into the log.
- **Component**: System-level module where the log event took place.
- **Level**: The severity of the event. Possible values are notice, warning or error.

- **Message**: The content of the log entry. Double-click the entry to view the full, non-truncated message ().

NOTE
Updating the unit firmware deletes all system log messages.

Filtering the system log
Enter values in any or all of the **From and To** date and time fields. Click **Refresh** to request the log entries in the selected range. The specified range not only affects the displayed entries, but also determines which entries are exported or purged.

Exporting the system log
Click **Export**, enter the file name and click **Export** to save the exported entries to the local machine. To specify which entries to export, use the date and time filters first.

NOTE
The system log window shows only messages considered most useful to a typical user. Though not displayed, all log entries are included when exporting or purging the log file.

Purging the system log
Click **Purge** to delete all log entries from the system. To specify which entries to purge, use the date and time filters first.

NOTE
The system log window shows only messages considered most useful to a typical user. Though not displayed, all log entries are included when exporting or purging the log file.

6.2.3 User options

User Preferences
Each user can change the user preferences to individually customize the web interface.

Select User options > **Preferences** to view User Preferences.

All user preferences take effect immediately and persist until they are changed or removed. Preferences follow the user, not the session, browser or machine.

Exporting User Preferences
User preferences can be exported to be loaded into other CX23-R systems or to restore preferences after a system reset.

To export user settings, click **Export** in User preferences. Enter a file name for the preferences file and click **Export**. To load a saved preferences file, click **Import** in User preferences and select the saved file.

Test Configuration
Show non-applicable columns: Deselect to hide columns in the Grid Interface

that are not applicable to the current channels or selected parameters. When selected, these cells display as "N/A."

Show list values indicator: Select to show which entries in a grid view are defined from a list of valid values. When deselected, the indicator is hidden.

Select cell text on focus: Select to automatically select all the text in an editable grid cell when it gains focus. Use this setting to replace cell values instead of append text to existing cell values.

Logs
System logs page size: Specify a value between 1-1000 to limit the number of entries per page in the System Logs. The default value is 50.

Minimize log page: Select to open the System Logs panel as a smaller display. When deselected, the log panel opens as a full page. The setting is overridden by the minimize and maximize button on the panel itself.

Display
Live data refresh rate: Specify the rate that live data refreshes, including the hardware panel and channel panel when a digital display test is running. A value of zero causes no updates to take place. If live data values are not required, it is highly recommended to set the refresh rate to zero to avoid large overheads for tests with a large number of channels.

NOTE
If a channel sample rate is less than the refresh rate, the value is only updated at the lower sample rate.

Show confirmations: Deselect to hide confirmation dialog boxes. This is recommended only for advanced users.

Decimal point handling
Default number of decimals: Set the default number of decimal places shown on digital meters. There are several options for overriding the default value.

- For channels with *Range min* and *Range max* values defined, select the **Use significant digits when Range min/max values are defined** option and set the **Significant digits** to automatically set the number of decimals based on the defined values. For example:
  - With **Significant digits** set to 5 and a channel defined with a *Range min* of -5 kN and a *Range max* of 5 kN, the digital meter displays four decimal places (e.g. 2.3593, 0.3247).
  - With **Significant digits** set to 5 and a channel defined with a *Range min* of -5000 N and a *Range max* of 5000 N, the digital meter displays one decimal place (e.g. 2359.3, 324.7).
- To override the number of decimals on a per channel basis, set the *Decimals* parameter in the Channel Setup grid.
- To override the number of decimals on a Single Channel Digital Meter, set the number of decimal places from the chart menu.

Status bar configuration
Select an item to display it in the status bar. Deselect an item to hide it from the status bar.

	Host name	Host name of the connected device.
	LEDs	A mirror of the CX23-R Status LEDs on the connected device.
	CPU load	The most current CPU load reading and a chart of the last 60 readings. Mouse over the chart to display data points.
	Storage	Used (red) and available (green) storage on the CX23-R internal SATA Drive. Mouse over the pie chart to display the percentages.
	Memory	Amount of memory being used by the CX23-R with respect to its total memory. Mouse over the bar to display the percentage being used.

Charts
Change the charts settings to define the default characteristics of new charts in the Test Control page.

Width: Enter a value of 200 pixels or more. The default is 300.

Height: Enter a value of 200 pixels or more. The default is 300.

Chart type: Select Strip Chart, Analog Meter or Digital Meter as the default type for new charts added to the Test Control charts panel. The default is Strip Chart.

Strip Chart Settings
Auto scale: Select to automatically scale the y-axis based on the current and past data points. When deselected, the y-axis is defined by the min and max values supplied in the channel configuration. Depending on the min and max values, the chart may still opt to auto scale.

Grid lines: Select to show strip chart grid lines. When deselected, the grid lines are not displayed.

Color order: Arrange the colors to determine the order in which colors are assigned to new channels. Drag and drop or use the arrows to re-order the colors.

Background: Select either black or white as the background color for new strip charts. The default is white.

Changing User Password
To change the current user password, select **Change password** from User options.

Enter the current and new passwords and click **OK**.

A password can be any combination of letters, numbers or special characters and is case sensitive. The entered password is masked for security. By default, the minimum password length is eight (8) characters. Users with appropriate privileges can change the minimum length in System Preferences . Passwords never expire.

Use the new password to sign in to future sessions.

6.3 System configuration

6.3.1 Profiles

Profiles define the set of privileges can be assigned to users. Profiles can be created, updated and removed at any time. Changing or removing a profile assigned to a user affects new sessions only; existing sessions are unaffected until the user logs out.

User Privileges

Hardware control	
☐ Unselected	View only access to Hardware
☑ Selected	Add and control Hardware
Test configuration	
None	No access to Test Configuration pages
View	View only access to all Test Configuration pages
Edit	Full access to all Test Configuration pages and functions
Test control	
None	No access to Test Control
View	View and manipulate charts in Test Control
Start/Stop	Start and stop test runs in Test Control
All	Access to all Test Control functions
SIE data files	
None	No access to SIE Data
View	View SIE Data files list
Rename/Delete	Rename and delete SIE Data files
Download/Extract	Download and extract SIE Data files
All	Rename, delete, download and extract SIE Data files
Logs control	
None	No access to System Logs
View	View and export System Logs
Purge	View, export and purge System Logs
System configuration	
Users and profiles	Manage Users and Profiles
Databases	Import Databases
Networks	Manage Networks
Firmware	Update Firmware

Preferences	Set System Preferences
Customer support	Download support packages and release notes from Customer Support

Creating a Profile
To create a profile, click **New**. Enter the profile name, select the desired privileges and click **Save**.

Editing a Profile
To edit a profile, select the profile from the profiles list and change the parameters. Click **Save** to apply the changes. Changes apply to new sessions only; existing sessions are unaffected until the user logs out.

Deleting a Profile
To delete a profile, select the desired profile and click **Delete**.

A deleted profile is removed for all users.

NOTE
The default administrator profile cannot be deleted.

6.3.2 Users

The CX23-R allows access from multiple users, each of which can be assigned a different set of privileges permitting or restricting access to the CX23-R unit. Users can be created, updated and deleted at any time.

The unit comes with one default user with a user name of *admin* and a password of *password*. It is recommended to change the admin password for greater security.

Adding a New User
To add a new user, click **New**. Enter the desired values for the user parameters and click **Save**.

- **User name**: The user name must be unique and is case sensitive. User names cannot be changed.
- **Full name**: The user's full name to be displayed in the users list.
- **Password**: A password is required. A password can be any combination of letters, numbers or special characters and is case sensitive. The entered password is masked for security. By default, the minimum password length is eight (8) characters. Users with appropriate privileges can change the minimum length in System Preferences . Passwords never expire.
- **Profile**: A profile that has been previously created on the Profiles page. Only one profile can be assigned to a user.

Updating a User
To update user information, simply select the user from the users list and edit the parameters. Click **Save** to apply the changes.

Deleting a User
To delete a user, simply select the user from the users list and click **Delete**.

NOTE
The default user *admin* cannot be deleted.

6.3.3 Networks

The CX23-R uses network configurations to determine how to boot up and communicate with the browser. Many network configurations can be defined, but only the active configuration is considered at boot time.

Defining a New Network Configuration
To define a new network configuration, click **New** and enter the appropriate parameters:

- **Network**: Enter a full description of the network. This is the text that displays in the networks list.
- **IP address assignment**: Set the type of IP address to either Static or Dynamic. For static assignment, enter correctly formatted IPV4 address, subnet mask, default gateway and broadcast values. Some fields are automatically populated based on the entered values, but they may be edited as necessary.
- **DNS server assignment**: For static IP assignment, manually format the Preferred and Secondary DNS servers.

Click **Save** to save the new configuration. To make the new configuration active, click the **Make active** button. The unit reboots with the new settings.

WARNING
Make sure that all entries are correct before making a network configuration active. Incorrect settings can render the system temporarily unusable and require a manual reset to default network settings. See Configuring Network Settings for the reset procedure.

NOTE
Save all changes before making a network configuration active. The required system reboot discards all pending changes.

Changing the Active Network Configuration
Select the desired configuration from the networks list and click the **Make active** button. The unit reboots with the new network settings.

WARNING
Make sure that all entries are correct before making a network configuration active. Incorrect settings can render the system temporarily unusable and require a manual reset to default network settings. See Configuring Network Settings for the reset procedure.

NOTE
Save all changes before making a network configuration active. The required system reboot discards all pending changes.

Modifying a Network Configuration
To edit the parameters of an existing network configuration, select the desired configuration from the networks list and edit the parameters as necessary. Click **Save** to save the changes. If modifying the active network, the system may need to reboot to apply the changes.

WARNING
Make sure that all entries are correct before modifying the active network configuration. Incorrect settings can render the system temporarily unusable and require a manual reset to default network settings. See Configuring Network Settings for the reset procedure.

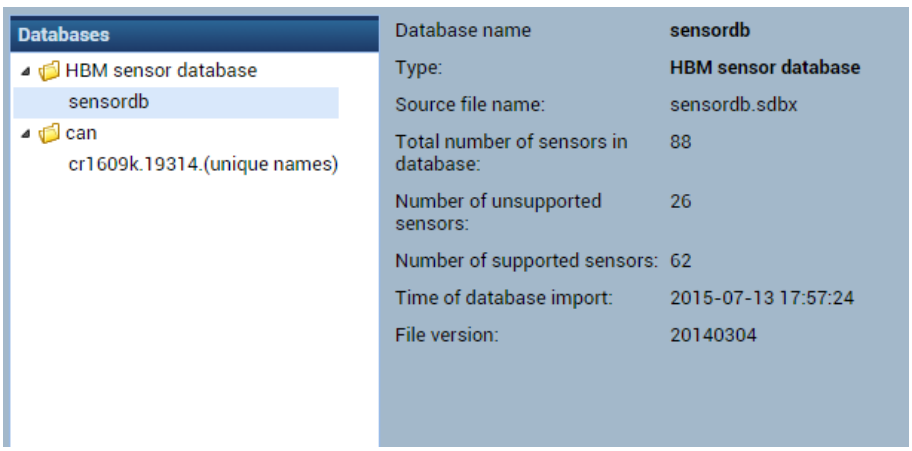
NOTE
Save all changes before modifying the active network configuration. The required system reboot discards all pending changes.

Deleting a Network Configuration
To delete an existing network configuration, select the configuration from the networks list and click **Delete**. The active network and default network configurations cannot be deleted.

6.3.4 Databases

Databases are sets of pre-defined channels for hardware or connectors. The SomatXR system supports Vector CAN and HBM sensor databases.

The Database page displays all imported databases in a tree view and the summary data and channels of the selected database (). The summary contains some editable fields while the list of channels is always read-only. The channel list columns may be different depending on the database contents.



Importing a Database
To import a database, click **Import**.

The SomatXR system supports Vector CAN database files (.dbc) and HBM sensor database files (.sdbx).

Vector CAN Database Files (.dbc)
Browse for and select the .dbc database file. The file can be located on any local or external device. There is an option to **Append message names to signal names**. Selecting this option appends a double colon (::) followed by the message name to the signal name on import. Duplicate signal names are made unique by appending a sequential number preceded by the pound sign (#).

To begin the import process, click **Import**. Once imported, the new database displays in the databases list. Select the file from the list to display the CAN channels.

NOTE
Only the file contents and not the actual database loads on the CX23-R device. If the system encounters an error during import, none of the file contents are imported.

HBM Sensor Database Files (.sdbx)
Browse for and select the .sdbx database file. The file can be located on any local or external device. For information on converting standard .sdb files to CX23-R compatible .sdbx files, see HBM Sensor Databases.

To begin the import process, click **Import**. Once imported, the new database displays in the databases list. Select the file from the list to display an overview of the database and the number of supported and unsupported sensors.

NOTE
Future CX23-R firmware versions may support more sensors. The HBM sensor database does not need to be re-imported to use newly supported sensors.

Deleting a Database
To delete a database, select the desired database and click **Delete**. Deleted databases cannot be restored.

6.3.5 Firmware

HBM regularly releases new CX23-R firmware introducing new features and providing device improvements. Download the current firmware release from www.hbm.com.

Click the **Browse** button and select the image file. Click **Update** to begin the firmware upgrade.

Wait for the upgrade process to complete and the unit to reboot. Upon completion, the footer indicates the new firmware version.

CAUTION
Allow the firmware upgrade to run completely. Before upgrading, make sure that no other users are logged in and no other processes are running. Failure to do so may render all hardware unusable requiring a factory reset.

NOTE
Updating the unit firmware deletes all system log messages.

6.3.6 Date and time

The Date and time page provides the interface to reset the CX23-R date and time. Choose to use the current date and time according to a connected GPS device or the host PC. Alternatively, manually set the date and time by selecting the desired values.

NOTE
The CX23-R exclusively uses UTC time. Therefore, it is necessary to convert to UTC time when setting the date and time manually.

When any value is changed, the system date and time are immediately updated.

6.3.7 System Preferences

System preferences apply to all users of the system. Whenever possible, the changes take effect immediately for the user making the changes. Other users already logged in at the time of the change need to log out and log back in for the settings to take effect.

System

- **Sample rate domain**: Set the domain to either Decimal or Classic. This setting determines the sample rate domain for new test setups, which cannot be changed. The sample rate domain controls the sample rates and associated digital filter types and frequencies when configuring input channels. The default setting is Decimal, which includes typical sample rates of 5000, 2500, 1000, and 500 Hz. In the Classic domain, typical nominal sample rates include 4800, 2400, 1200, and 600 Hz.

NOTE
The nominal Classic domain sample rates are used for convenience. The actual sample rates are approximately 260 ppm greater than the nominal sample rates. To find the exact sample rate, multiply the nominal sample rate by 8388608/8386425.

- **TEDS enabled**: Select to enable TEDS features for MX modules.
- **Bridge shunt polarities**: Set the default polarities for MX1615B-R bridge channels when installing shunts with a test run in progress or when using the shunt resistor sensor scaling mode. Select either Up scale for positive shunt polarity or Down scale for negative shunt polarity for each bridge configuration.

NOTE
The 3-wire quarter bridge modes support only one shunt polarity.

- **Exception Handling**: Specify the **Max number of test restarts on error resets** as a value between 0 and 5. If a test stops on a critical error, the system reboots and attempts to restart the test as long as the "test restart counter" is not zero. The counter is set to the **Max number of test restarts on error resets** value when starting a test run from the Test Control page and is decremented on each test restart attempt initiated from an error reset.

NOTE
Power failures and user-initiated reboots are not error resets. The system always restarts an interrupted test when either of these events occurs.

- **Calibration certificate**: Click the **Download certificate** button to download the calibration certificate as a PDF file.

User

- **Authentication required**: Select to display the login dialog at the start of a session. If deselected, the default user is automatically logged in. This option is only applicable if the default user password has not been changed from the factory settings.
- **Minimum password length**: Specify a minimum password length for new users and future password changes. Existing passwords for current users do not need to conform to this length.
- **Default language**: Set the default language for each new user. Once logged in, users may change the interface language at any time.

Test

- **Allow test run if warnings exist in setup**: Select to start a test run when warnings are present. If deselected, test runs do not start until warnings are resolved.
- **Display test duration prompt**: Select the Display test duration prompt option to ask for a test duration at the start of each test run. If specified, the test run automatically stops when the duration time elapses.
- **Allow editing other setups during test runs**: Select to allow users to edit test setups while a different test setup is running. A currently running test is never able to be edited. If deselected, all test setups are locked and cannot be edited during a test run.

NOTE
A **lock icon** to the right of the Test selector indicates that the current test is not editable.

- **Test engine frame rate default**: Set the default rate in Hz at which the CX23-R test engine processes data packets for new test setups. The factory default

value of 5 Hz is recommended for most testing applications. Take the following into account when setting the test engine frame rate.

- Digital Output Channels are always updated at the test engine frame rate.
- The latency of the real time displays is a function of the test engine frame rate. For example, at 5 Hz, the latency is at least 0.2 seconds; at 20 Hz, the latency is at least 0.05 seconds.
- In general, increasing the test engine frame rate minimally increases the CPU load. For example, a channel sampled at 100 Hz is more efficient to process at five frames of 20 data samples than at 20 frames of five data samples. However, this is not important unless the test is running near 100% CPU load.

Sensor Scaling
Select the **Use system defined sensor scaling filters** option to use the system defined sensor scaling sample rates and digital filters for zeroing and experimental sensor scaling for MX1601B-R and MX1615B-R channels. The sample rates and filters are a function of the sample rate domain as defined in the table below. If deselected, the system uses user-defined sample rates and digital filters.

Sample rate domain	Sample rate	Filter type	Filter frequency
Decimal	100 Hz	FIR Butterworth	15 Hz
Classic	50 Hz	IIR Butterworth	10 Hz

6.3.8 Customer Support

Customer support exposes features and functions that support staff typically uses to debug and fix anomalies that can render the CX23-R inoperable. Only use these functions as directed due to their sensitive and potentially destructive nature.

Download customer support package
The customer support package is a snapshot of the state of the system at a point in time. This package can be sent to customer support for further analysis, debugging, and addressing. This package is an archive zipped file containing all internal databases, system information, messages, status, and disk usage.

It is recommended that this be downloaded and sent to customer support when requested. The support staff have the tools and knowledge to open, interpret, and fix any issues found.

Delete databases
This option deletes all internal databases within the CX23-R. Because of its destructive nature, only those users with the highest security level are granted access to this area. Only perform this when instructed by customer support and when a recovery strategy exists. Make sure to save all pending changes and that no other users are on the system before executing this option.

Before deleting the databases, the system generates a customer support package. The package contains a snapshot of all the databases that are being deleted. It is critical that allow this download to complete and to save the file in a

safe location as it is the only means available to revert the system back to its state before the deletion.

NOTE
Depending on the size of the databases, this may take from several seconds to several minutes to complete. Please allow this to complete before continuing.

All users, profiles, system and user preferences, and test setups and configurations are deleted. The system reboots with the default auto network settings and logs in the default admin user.

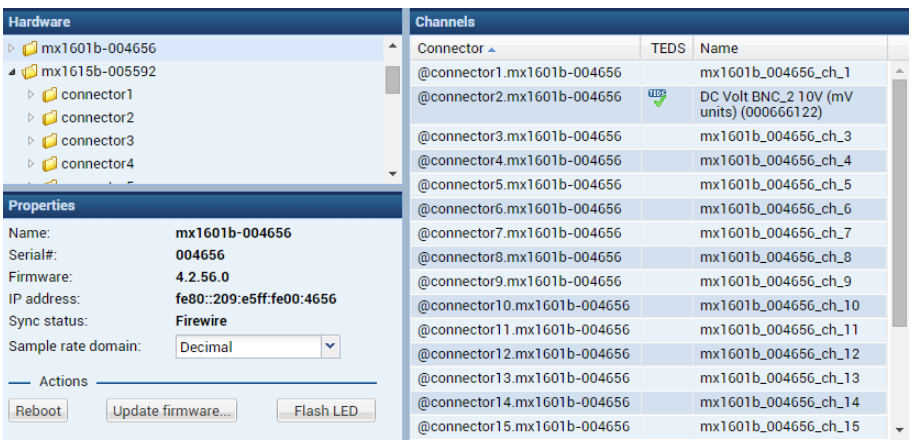
NOTE
SIE files from previous test runs are not removed as part of the database delete process and these remain in their current location.

Release notes
Download a PDF of the current firmware release notes.

6.4 Test configuration

6.4.1 Hardware

The Hardware page displays the system hardware, properties and available channels. All panels can be resized.



The Hardware panel displays the topology of the network with the CX23-R module and connected MX modules at the top level. Connectors, channels and other devices appear under their top-level modules. Branches appear or disappear as hardware is connected or disconnected. The hardware tree can be navigated using the mouse or directional keys.

NOTE
Connected EX23-R modules are not shown. Devices such as cameras connected directly to an EX23-R appear under the CX23-R module. MX modules connected to an EX23-R appear as top level devices.

The Channels panel shows a list of the channels under the selected device or connector in a read-only grid. The grid displays basic channel information including whether the channel has a TEDS sensor connected. Click on a channel row to automatically select the channel in the hardware panel.

Select a device, connector or channel in the Hardware panel to display its properties in the Properties panel. Displayed properties may include:

- **Name**: Internal name of the device, connector or channel.
- **Serial#**: Serial number of the device.
- **Firmware**: Firmware version installed on the device.
- **IP Address**: IP address of the device.
- **Sync status**: For MX modules, the module synchronization status.
- **Sample rate domain**: For MX modules, set the domain to either Decimal or Classic. The MX module reboots automatically when this setting changes. For more information, see Changing the Sample Rate Domain.
- **Reading**: The current status reading for channels such as CX23-R power and system channels.
- **Actions**
  - **Flash LED**: Click to identify a CX23-R or MX module by flashing one of its LEDs. For a CX23-R module, the green POWER LED flashes at 2 Hz. Click **Stop flashing** to resume normal LED behavior. Normal behavior is also resumed when a module is rebooted.
  - **Reboot**: Click to shut down and restart a device.
  - **Update firmware**: Click to update CX23-R or MX module firmware. For detailed information, see Updating Firmware.

6.4.2 Test Setup

Test setups define the channels, computed channels and DataModes that the CX23-R captures and processes during a test run. The Test setup page displays the parameters of the current setup configuration.

Test selector

Select the test setup using the test selector in the header.

Test Setup Parameters

- **Setup name**: The setup name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Title**: Enter an optional title of the test setup.
- **Author**: Enter an optional author of the test setup. The author defaults to the logged in user.
- **Summary**: Enter an optional detailed summary of the test setup.

- **Test start delay**: Specify the test start delay time in seconds. The default value of zero is the recommended setting in general. Non-zero delay times may be desired in the following scenarios.
  - Some sensors such as IEPE sensors require significant time to stabilize after excitation is applied.
  - For some sensor configurations, MX modules can start sending data before the signal conditioner circuitry is fully stabilized causing data to be tagged as "overflow data".

NOTE
These scenarios may be circumvented by zeroing the sensors before starting a test run. However, for test runs automatically restarted on power cycles in particular, consider increasing the start delay time to allow the sensors or signal conditioners to stabilize.

- **Sample rate domain**: The sample rate domain is read-only and based on the System Preferences when the test setup is created. The sample rate domain cannot be changed once the setup is created.
- **Test engine frame rate** : Set the rate in Hz at which the CX23-R test engine processes data packets. Set the default value for new test setups in the System Preferences. The factory default value of 5 Hz is recommended for most testing applications. Take the following into account when setting the test engine frame rate.
  - Digital Output Channels are always updated at the test engine frame rate.
  - The latency of the real time displays is a function of the test engine frame rate. For example, at 5 Hz, the latency is at least 0.2 seconds; at 20 Hz, the latency is at least 0.05 seconds.
  - In general, increasing the test engine frame rate minimally increases the CPU load. For example, a channel sampled at 100 Hz is more efficient to process at five frames of 20 data samples than at 20 frames of five data samples. However, this is not important unless the test is running near 100% CPU load.

Creating a Test Setup
There are several methods to create a test setup.

- Click **New** to create a new test setup with default values. The new setup appears in the setups drop down list as *test_name*.
- Select an existing test setup and click **Save As...** to duplicate the setup under a new name. It is not possible to replace an existing setup.
- Click **Import** to load a previously exported setup file or a manually created text file from the local machine. The format must be a valid json and the syntax a valid setup configuration. If a setup with the same name already exists, then a unique number is appended to the name.

Deleting a Test Setup
To permanently delete a setup from the device, select the desired test setup and click **Delete**. Deleted test setups cannot be recovered.

Exporting a Test Setup

To save a test setup to the local machine, select the desired setup and click **Export**. The setup is saved as a .sxr text file containing the setup configuration in a json format. Exported setups may be imported to another device as is or after modification. Only one test setup can be exported at a time.

6.4.3 Channel Setup

Input channels define what transducer and sensor data should be captured in a test run. Available input channels depend on the connected hardware and imported databases. The channel Grid Interface displays the channels defined for the current setup. Some columns, indicated by color shading, have dependent columns. Click the column header to show or hide its dependents.

The All channels view displays generic and scaling parameters for all defined channels including Computed Channels.

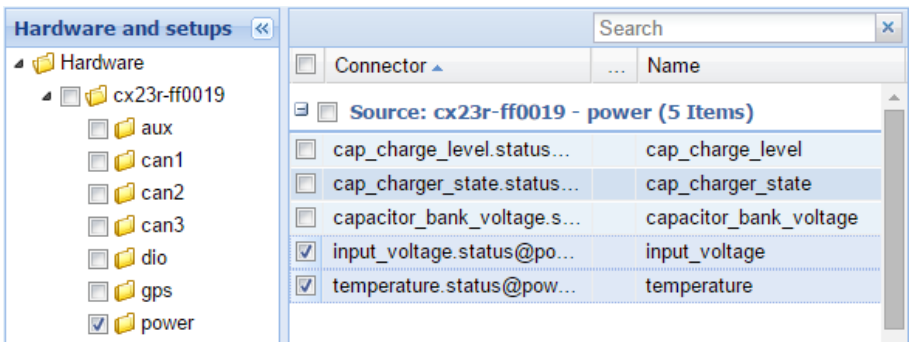
Each channel type has its own tab view which displays the specific parameters for channels of that type.

Adding an input channel

There are two methods to add an input channel.

- Click **Add** to add a new blank channel.
- Duplicate the parameters of an existing channel by selecting a channel and clicking **Copy to...**.

Select the desired channels from discovered hardware on the network, including imported databases, or existing setup configurations on the connected device.



Select the check box next to a source branch to display its available channels. The channels are displayed in alphabetical order (by connector) and grouped by source. A channel already added to the test setup is not displayed. When using **Copy to...**, only applicable channels are displayed.

To add a channel to the setup, select the check box next to the channel or group of channels and click **OK**.

Editing an input channel

Select the desired channel and click **Edit** to edit the channel parameters using the edit channel dialog.

Alternately, edit input channel parameters directly in the channel grid. Select the All channels tab to edit generic parameters and the channel type tab to edit channel specific parameters.

If a channel name is changed, all references to the channel from computed channels or DataModes change automatically.

Applying TEDS sensor parameters
To simplify input channel configuration, SomatXR MX modules support TEDS sensors. When an MX channel with a TEDS sensor is added to the test setup, the channel parameters are configured based on the TEDS information, which is indicated by the TEDS sync icon ( ) in the *TEDS* column of the channels grid.

Channel parameters can be manually edited, which is indicated by the TEDS edited icon ( ) in the *TEDS* column. To reset the channel parameters to TEDS sensor definition, select the channel and click **Sync TEDs**.

Applying sensor database parameters
To apply sensor configurations from imported HBM sensor databases, first **expand** the Sensors panel to the left hand side of the channels grid. The Sensors panel contains the imported sensor databases and their sensor definitions. For very large databases, it may take several seconds to display the database contents for the first time.

Select the sensor definition from the Sensors panel and the desired channel or channels from the grid and click the blue arrow at the bottom of the Sensors panel to apply the definition to the selected channels. Alternately, drag and drop the sensor definition onto the desired channel.

When a sensor definition is successfully applied to a channel, this is indicated by the SDB sync icon ( ) in the *SDB* column of the channels grid. Channel parameters can be manually edited, which is indicated by the SDB edited icon ( ) in the *SDB* column. To reset the channel parameters to the applied database definition, select the channel and click **Sync SDB**.

NOTE
Sensor database parameters can be applied to TEDS sensors. However, if the channel is re-synced to its TEDS parameters, the sensor database reference is removed.

Defining sensor scaling properties
To configure a channel for sensor scaling, first set the *Scaling mode* in the channel editor dialog or channel grid.

Depending on the mode selected, different scaling parameters must be specified to define the scaling line.

Sensor scaling mode	Scaling parameters
Defined slope intercept	*Slope* *Intercept*
Defined zero span	*Electrical zero* *Electrical span* *Physical span*
Defined two point	*Electrical 1* *Physical 1* *Electrical 2* *Physical 2*
Experimental two point	See Experimental Two Point Scaling
Internal shunt resistor	See Internal Shunt Resistor Scaling
Strain gage	*Strain gage factor* *Bridge factor*

Copying channel properties
To copy the properties from one channel to another, select the channel to be copied and click **Copy**.

Select the parameters to copy. The parameters depend on the selected channel type. In addition, parameters hidden in the grid view do not display in the copy dialog. Click **OK** to copy the selected parameters.

Select the target channel and click **Paste** to paste the copied parameters into the selected channel. Only parameters that exist in the target channel are pasted. For example, DIO parameters cannot be pasted into analog channels.

Changing device hardware
Sometimes it is useful to change the hardware to which a group of channels connects. For example, after importing setup configuration file, using the same setup after swapping hardware or moving a transducer to another connector.

To change the device or connector, select a single channel or multiple channels and click **Change device**.

To change the device, enter or select a value in the New Device column. To change the channel connector, select a value in the New connector column. Click **OK** to save the changes.

CAUTION
Attempting to supply inappropriate values for the device name results in an error and prevents the test from running.

Viewing the digital meter
To view a digital display of the current channel values, select one or more channels and click **Digital Meter**.

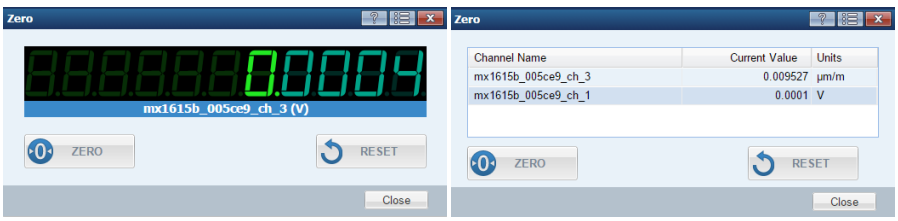
Click **Freeze** to pause the readings at the current values.

NOTE
Digital meters cannot be displayed while a test is running.

Zeroing channels
Zeroing a channel adds an offset, making the pre-run channel value as close as possible to the *Prerun zero target*. The default zero target is zero.

After setting the *Prerun zero target*, select one or more channels and click **Zero**.

NOTE
The *Prerun zero mode* must be set to Interactive only for a channel to be zeroed. By default, only bridge-type channels are set to this mode. Other channel types must be set manually if zeroing is required.



Click **ZERO** to offset the readings to the *Prerun zero target*. The offset is recorded in the *Prerun zero offset* parameter. Click **RESET** to clear any previous zero offsets. After zeroing is complete, be sure to save the test setup.

NOTE
It is recommended to select the **Use system defined sensor scaling filters** option in the System Preferences to minimize the effects of noise on the accuracy of scaling measurements.

6.4.4 Computed Channels

Computed channels are data channels derived from one or more input channels or other computed channels. The computed channel grid displays all computed channels defined for the current setup.

Each computed channel type has its own tab view. Within each of these tabs, only computed channels of that type are visible. Tabs are automatically made visible when computed channels are created.

Available computed channels:

- Anomaly Detect
- Directional Velocity
- Down Sampler
- Integrator
- Interactive Trigger
- Pulse Frequency
- Run Stopper

- Signal Calculator
- Smoothing Filter
- State Mapper
- Statistics
- Time Base Shifter
- Time Channel
- Timed Trigger
- Track
- Triggered Latch
- Up Sampler

Adding a Computed Channel

There are two options to add a computed channel.

- Click **Add** to create a new blank computed channel. If adding from the All computed channels tab, select the type of computed channel to add. If adding from another tab, the new computed channel is the same type as the selected tab. Define all necessary parameters and click **OK**.
- Duplicate an existing channel by selecting a channel and clicking **Copy to...**. The new channel must be given a unique name. Edit any other parameters as necessary and click **OK**.

Once created, a channel can be used on its own or as an input to other computed channels.

Editing a Computed Channel

Select the desired computed channel and click **Edit** to edit the channel parameters using the computed channel dialog.

Alternately, edit the computed channel parameters directly in the channel grid. Select the All computed channels tab to edit generic parameters and the channel type tab to edit channel specific parameters.

If the computed channel name is changed, all references to the channel from other computed channels or DataModes change automatically.

Copying Computed Channel Properties

To copy the properties from one channel to another, select the channel to be copied and click **Copy**. Select the parameters to copy. The parameters depend on the selected channel type. In addition, parameters hidden in the grid view do not display in the copy dialog. Click **OK** to copy the selected parameters.

Select the target channel and click **Paste** to paste the copied parameters into the selected channel. Only parameters that exist in the target channel are pasted.

Removing a Computed Channel

Select the desired channel and click **Remove**. Channels referenced by other computed channels or DataModes cannot be removed. Computed channels cannot be recovered after removal.

Viewing the Digital Meter
To view a digital display of the current channel values, select one or more channels and click **Digital Meter**.

Click **Freeze** to pause the readings at the current values.

NOTE
Digital meters cannot be displayed while a test is running.

6.4.5 DataModes™

DataModes determine how the CX23-R stores and displays test data. A DataMode definition consists of a list of input channels, triggering conditions, and other parameters specific to the DataMode. The DataMode grid displays all DataModes that have already been defined for the current setup.

Each DataMode type has its own tab view. Within each of these tabs, only DataModes of that type are visible. Tabs are automatically made visible when DataModes are created.

Available DataModes:

- Burst History
- Message Logger
- Peak Valley
- Time at Level (One Dimensional)
- Time History

Adding a DataMode
There are two options to add a DataMode.

- Click **Add** to create a new blank DataMode. If adding from the All DataModes tab, select the type of DataMode to add. If adding from another tab, the new DataMode is the same type as the selected tab. Define all necessary parameters and click **OK**.
- Duplicate an existing DataMode by selecting a DataMode and clicking **Copy to...**. The new DataMode must be given a unique name. Edit any other parameters as necessary and click **OK**.

Editing a DataMode
Select the desired DataMode in the grid and click **Edit** to edit the channel parameters using the DataMode dialog.

Alternately, edit the DataMode parameters directly in the channel grid. Select the All DataModes tab to edit common parameters and the DataMode type tab to edit specific parameters.

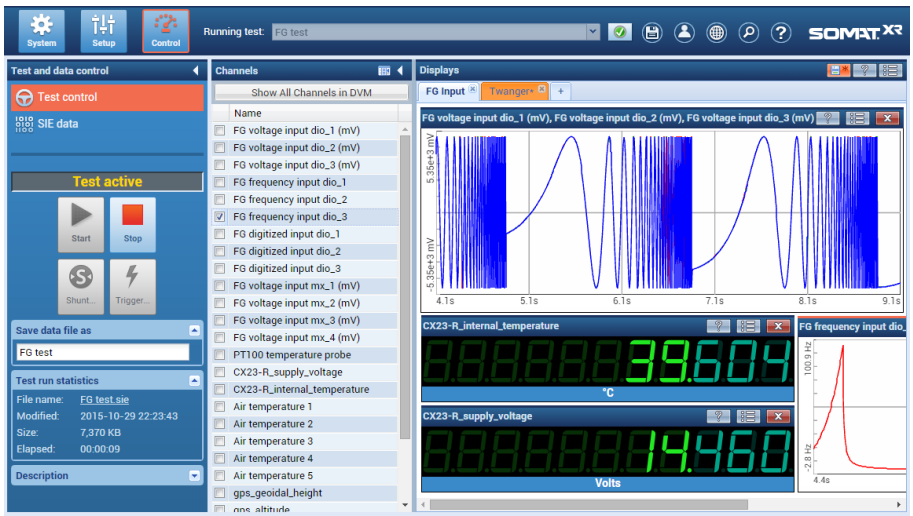
Removing a DataMode
Select the desired DataMode and click **Delete**. DataModes cannot be recovered after deletion.

DataMode Memory Consumption
Defined DataModes determine the rate at which the CX23-R consumes memory. There is some overhead for storing the test setup file and other system files, but typically these files require much less than 1 MB for most large channel count test setups and proportionately less for tests with fewer channels. Excluding this overhead, the CX23-R consumes raw data storage memory as detailed below:

DataMode	Data Type	Memory Consumption
Sequential	32-bit float	4 bytes per data point per channel
	64-bit float	8 bytes per data point per channel
Histogram	64-bit unsigned	8 bytes per bin per channel

6.5 Test and data control

6.5.1 Test Control



Preparing a Test
Before starting a test run, select the desired test using the test selector in the header.

Enter a data file name and description in the task bar panels. This information is optional cannot be changed once a test is running.

Optionally, enter a time in seconds in the Select Test Duration task bar panel. This parameter determines the duration of the test run, after which time the test automatically stops. Show or hide this parameter in the Test section of the System Preferences.

Running a Test
To start the selected test, click **Start**. A running test is indicated by the flashing yellow LED in the status bar and on the device. To stop the current test run, click **Stop**.

Any user with privileges can stop a test run. The user who started the test need not be the same user who stops the test.

During the test run, the following run statistics display in the task pane:

- **File Name**: SIE data file name. If no name was given, the file name defaults to the setup name (with optional unique sequential number). Click the file name to download the SIE file to the local machine.
- **Modified**: System date/time stamp of the last update to the SIE file.
- **Size**: Current size of the SIE file. After the first 100 Kb, the units are displayed in kilobytes (Kb). Mouse over the field to see the exact file size in bytes.
- **Elapsed**: Total elapsed time in seconds for the current test run.

Viewing Live Data
The Displays panel provides for the display of live channel data.

To create the first chart, select the desired channels from the Channels list. To add a new chart, drag a channel onto an empty area of the Displays panel. Add channels to an existing chart by dragging a channel onto the chart window or by clicking the chart window and selecting channels from the Channels list. To add a digital meter containing all test channels, click the Show All Channels in DVM button at the top of the Channels list.

Managing Displays
The Displays window can contain many different display configurations, each with its own named tab. Different display configurations allow for a variety of chart types, sizes, locations and channels. To manage displays, open the displays menu by clicking the menu button () or right clicking in the Displays panel.

To save a configuration, click Save Display in the Display menu. The save all configurations click the save button (). Configurations can also be saved under a new name (Save Display As...) which adds a tab to the Displays window. To delete a configuration, click the "x" on the configuration tab. To add a blank configuration, click the plus (+) tab to the right of the configuration tabs.

Display configurations can be created and modified at any time.

Chart Types

- Strip Chart: Plot of one or multiple channel values over time.
- Single Channel Digital Meter: Digital display of a single channel value.
- Multi-Channel Digital Meter: Tabular display of multiple channel values.
- Analog Meter: Analog gauge display of single channel value.

Installing Shunts
Shunt control allows installation and removal of shunt resistors during a test run. If the current test contains one or more applicable channels , click **Shunt...**.

To install a shunt, select **Normal** or **Opposite** shunt mode.

NOTE
The **Normal** mode is based on the System Preferences **Bridge shunt polarities** parameter unless the bridge channel is configured to use the internal shunt resistor scaling mode. In this case, the **Normal** mode is the polarity defined in the sensor scaling configuration.

NOTE
Shunt polarity is in terms of the electrical units of mV/V. If the sensor scaling slope is negative, the shunt polarity in physical units is in the opposite direction. For example, the Up Scale option results in a negative swing in the physical units output data.

To remove a shunt, select **Remove shunt**.

All shunt resistors are removed at the start of a new test or new display mode.

NOTE
The Shunt Control dialog can remain open while still navigating the web application and closes automatically at the end of the test run.

Controlling Interactive Triggers
Interactive triggers provide a means to manually trigger computed channels and Data Modes during a test run. Set up interactive triggers through the Interactive Trigger computed channel.

If the current test contains an Interactive Trigger computed channel, click **Trigger...**.

Select a trigger index to set the trigger to TRUE. To invert the trigger logic, select the Invert trigger parameter when adding or editing the computed channel. Triggers not defined in the test setup are disabled.

NOTE
The Trigger Control dialog can remain open while still navigating the web application and closes automatically at the end of the test run.

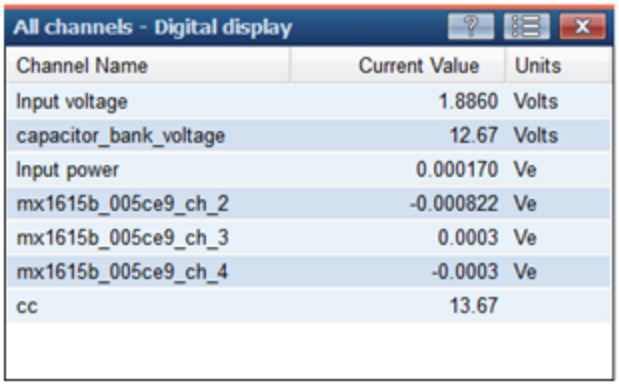
Single Channel Digital Meter
The single channel digital meter displays the current value of the selected channel in a fixed-sized display.

There are several options available from the menu:

- **Freeze Digital Meter**: Select to pause the data display. Deselect to resume live data.

- **Decimals**: Select the number of decimal places to show or select scientific notation for extremely large or small values.
- **Update rate**: Select the rate at which the display refreshes at 1, 2, 5 or 10 times per second. Note that in cases where the channel sample rate is less than the selected update rate, the display refreshes at the lower sample rate.

Multi-Channel Digital Meter
When multiple channels or all channels are selected, the digital meter displays the current values of the channels in a grid.

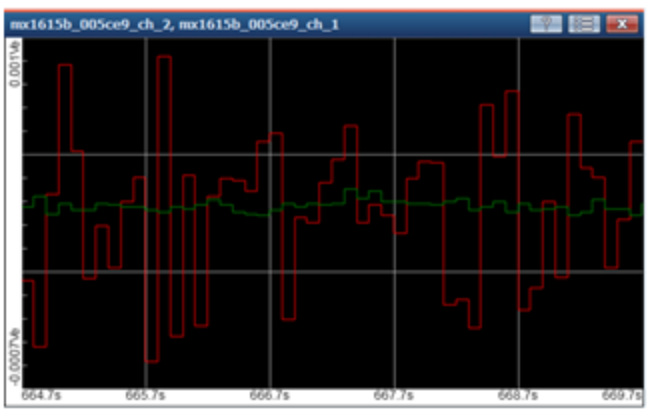


NOTE
This display supports a maximum of 32 channels.

There are several options available from the menu:

- **Freeze Digital Meter**: Select to pause the data display. Deselect to resume live data.
- **Update rate**: Select the rate at which the display refreshes at 1, 2, 5 or 10 times per second. Note that in cases where the channel sample rate is less than the selected update rate, the display refreshes at the lower sample rate.

Strip Chart
The strip chart is a graphic representation of the data points for the channel or channels selected. Change default strip chart options, such as background color and grid display, in User options.



There are several options available from the menu:

- **Freeze Strip Chart**: Select to pause the data display. Deselect to resume live data.
- **Properties**: Configure the y-axis, x-axis and grid Strip Chart Properties.
- **Show legend**: Show the channel names and colors.
- **Chart Type**: For a chart with multiple channels, configure the display of the y-axes.
  - **Single** (default): Display a single y-axis inheriting the properties of the first channel added to the chart.
  - **Stacked**: Display channels stacked vertically, each with a customizable y-axis.
  - **Multiple**: Display a customizable y-axis for each channel in the chart.

Analog Meter
The analog meter is a graphic representation of the most current data point for the selected channel.

There are several options available from the menu:

- **Freeze Analog Meter**: Select to pause the data display. Deselect to resume live data.
- **Properties**: Specify the Min and Max values of the analog meter.
- **Decimals**: Select the number of decimal places to show or select scientific notation for extremely large or small values.

6.5.2 SIE Data

The SIE data pane displays all SIE data files stored on the connected device.

The SIE files are identified using the file name supplied during the test run. If no name is supplied, the name of the setup is used. A red test name indicates that test is currently running.

Downloading SIE Data Files
The easiest way to download an SIE file to the local machine is to click its file name. Alternately, select the check box next to the desired files and click **Download**.

NOTE
It is good practice to ensure that the complete file has been downloaded. To do this, compare the file size of the downloaded file to the size of the listed SIE file. Mouse over the **Size** entry in the grid to show the exact file size in bytes.

Renaming SIE Data Files
Select the check box next to the file and click **Rename**. Enter a new file name and click **Save**.

Deleting SIE Data Files
Select the check box next to a single file or multiple files and click **Delete** to remove the file or files from the connected device. Depending on how many files are selected, the process may take several minutes. Deleted files cannot be recovered; it is recommended to download files off the device prior to deleting them.

Extracting Data from SIE File
Several types of data and information can be extracted from SIE files including the test setup, hardware information and raw channel data.

Select the check box next to the desired SIE file and click **Extract**.

Click the desired extraction option.

Export test configuration
Enter the desired file name and click **Export**. A json formatted .sxr text file containing setup configuration is saved to the local machine.

Extract hardware information
Enter the desired file name and click **Export**. A json formatted .sxri text file containing hardware information is saved to the local machine.

Extract raw data
Select the desired raw message or video channel. Optionally, enter a test start time and duration in seconds for the extracted data. Click **Extract** to save the data file to the local machine.

For raw message channels, the extracted data is downloaded in a text file named *extracted-data.txt*.

For video channels, a .jpg image of each frame is named with its time stamp, placed in a folder named for the camera serial number and downloaded in a tarball file named *extracted-data.tgz*.

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