SOMAT XR

User Manual

English

CX23-R & EX23-R

SomatXR Ultra-Rugged DAQ

HBM

X4275-1.0 en

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Safety Information

Documentation
The latest versions of all SomatXR documentation are available for download at www.hbmdoc.com.

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," that you can download 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, and such).

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 Operating 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 Introduction

1.1 SomatXR DAQ Series

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:

- **MX Modules**: The MX modules are front end data sourcing modules that can be used with the CX23-R Data Processor and the catmanAP and MX Assistant PC applications. 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. The following 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) can be connected to the MX1601B-R module.
  - **MX1609KB-R Thermocouple Module**: Up to 16 type K thermocouples (NiCrNi) can be connected to the MX1609KB-R module for measuring temperatures.
  - **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 PT100 resistance thermometer).
- **CX23-R Data Processor**: The CX23-R is the controller for the SomatXR system which encompasses all MX measurement modules and the EX23-R Ethernet expansion switch module. The CX23-R provides a web browser based graphical CX23-R web interface for system configuration and maintenance, complete test configuration definition, test setup support utilities, and test execution control and monitoring with numerous run time graphical display options. The acquired test data is stored in the efficient and robust SIE file format using a high-speed SATA Drive with storage capacity up to 64 GB and support for USB mass storage devices.
- **EX23-R Ethernet Switch Module**: 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 PoE to support cameras and other low power Ethernet based data sources. This module is factory configured to work with the CX23-R.

Module Transducer Overview

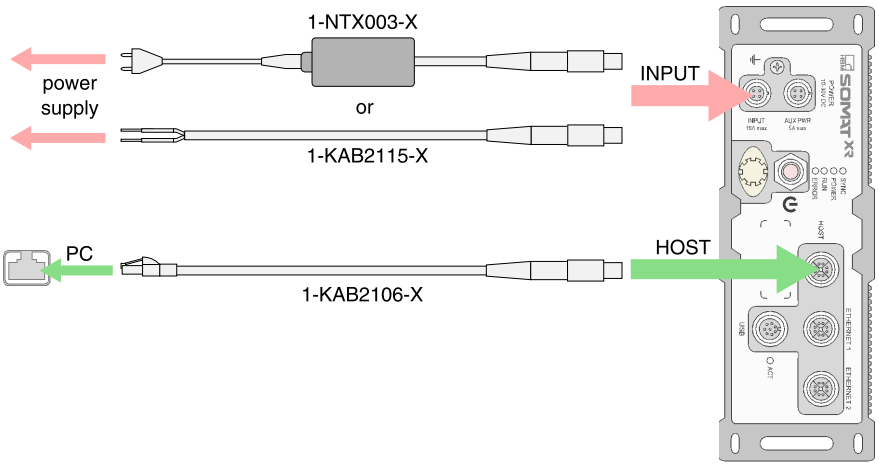
Transducer		CX23-R	MX1601B-R	MX1609B-R	MX1615B-R	Wiring Diagram
	Full-bridge strain gage six-wire configuration				●	38
	Half-bridge strain gage five-wire configuration				●	38
	Quarter-bridge strain gage three- or four-wire configuration				●	38
	Voltage 60 V, 10 V, 100 mV		●		● 60 V only	34
	Current, 20 mA		●			35
	Current-fed piezoelectric transducer, IEPE		●			37
	Resistance or resistance-based measurements				●	36
	Thermocouple, K-type			●		
	Potentiometric transducer				●	36
	PT100 resistance thermometer				●	36
	Digital input/output	●				41
	CAN bus	●				44
	GPS	●				

2 Setting Up a System

2.1 Getting Started with the CX23-R

The CX23-R back panel includes the Input Power and AUX Power ports, power switch, status LEDs and Ethernet communication ports.

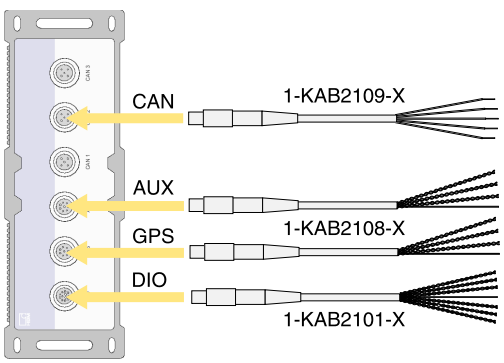
1. Connect the 1-KAB2115 power cable from the INPUT connector to a 10-30 V_{DC} power source. Alternatively, use the 1-NTX003 power supply.



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 168.192.100.101.
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.

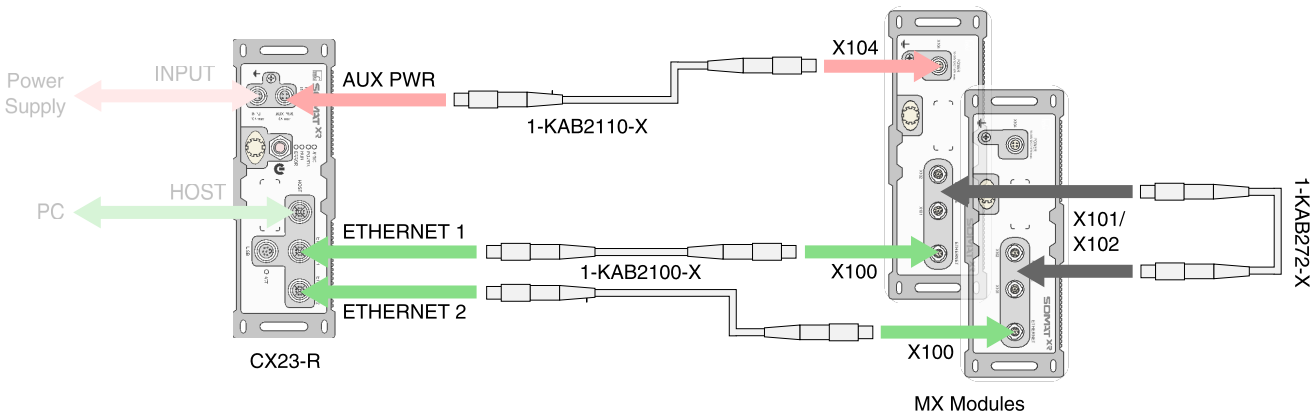
2.1.1 Connecting MX Modules

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 updates the MX module firmware, if necessary.

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.

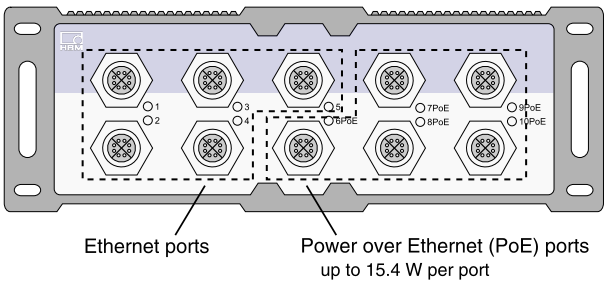
2. To power the second MX module, use a 1-KAB271 cable from the X101 or X102 connector on first MX module to the X101 or X102 connector on the second MX module.
3. Connect the CX23-R ETHERNET1 and ETHERNET2 connectors to the MX module X100 connectors using KAB2100 cables. This establishes communication and synchronization between the CX23-R and MX modules.

2.1.2 Setting Up an EX23-R

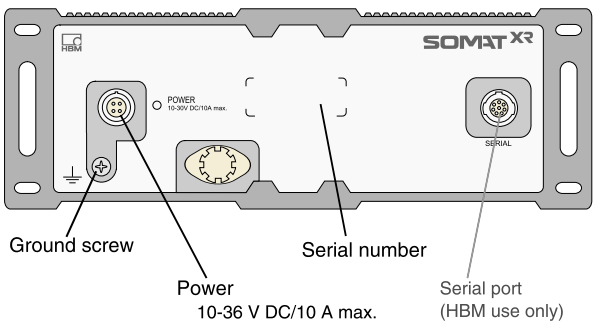
The EX23-R Power over Ethernet (PoE) Switch a standardized way with which to pass electrical power along with data on Ethernet cabling. This allows a single cable to provide both data connection and electrical power to devices.

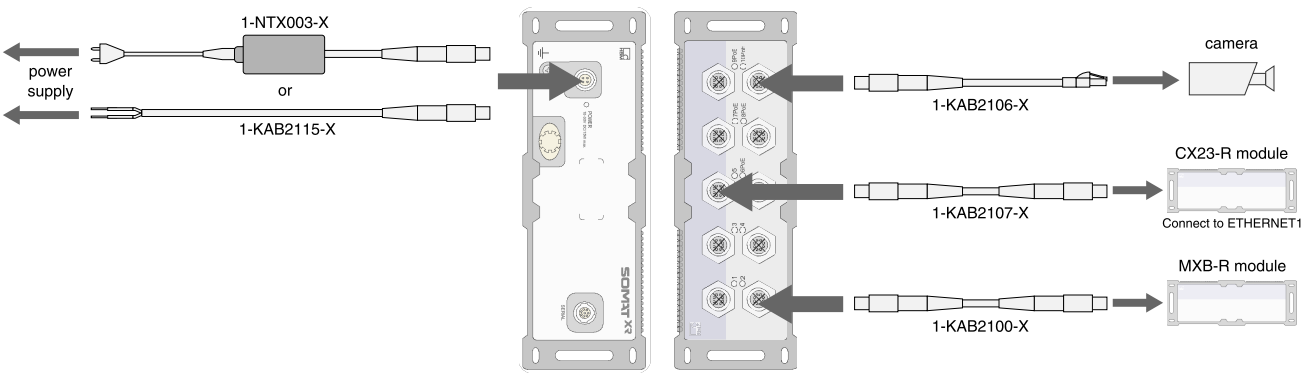
Use the EX23-R PoE Switch to network SomatXR modules with other devices such as cameras. Use the power over Ethernet ports to provide power to compatible network devices.

FRONT



BACK





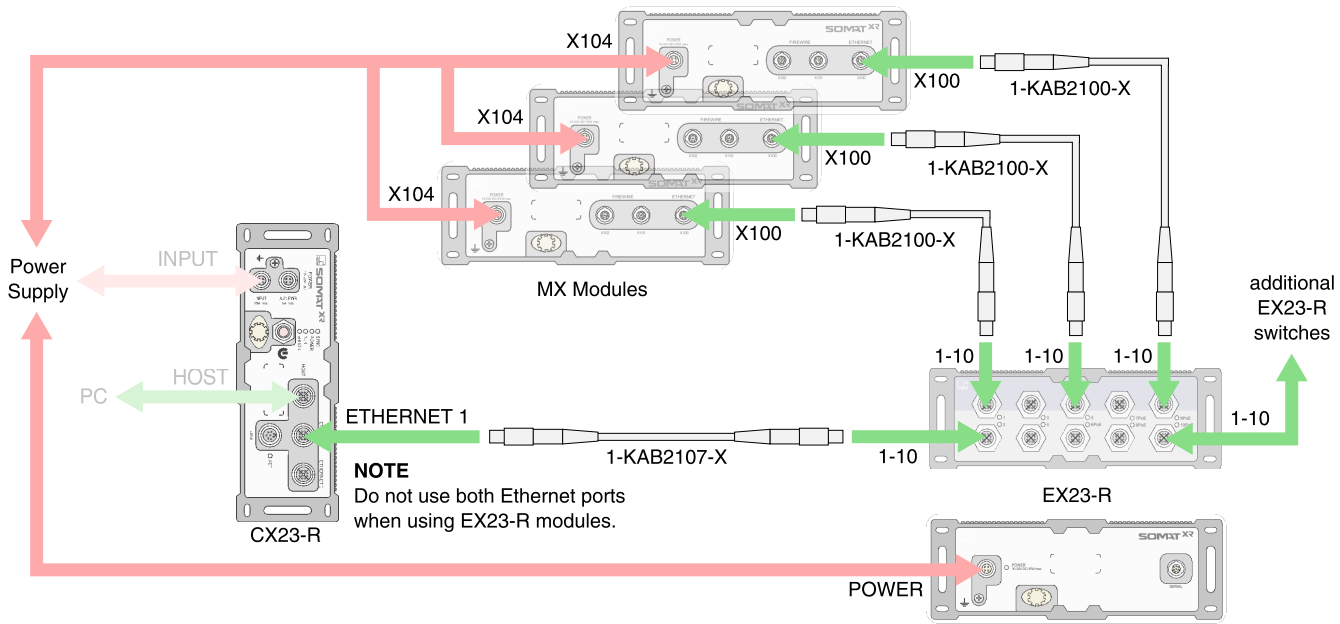
1. Connect the 1-NTX003 power supply or 1-KAB2115 power pigtail cable from the power connector on the EX23-R to a 10-36 V_{DC} power source.

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.

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 SomatXR 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.

2.1.3 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)*

2.1.4 Power Considerations

Setting up a Remote Power Switch
This allow the user to control the CX23-R power state using a remote switch instead of using the CX23-R power push button. This is useful in situations where the CX23-R is not easily accessible to the test operator.

The remote power switch acts as a “3-way household” switch in conjunction with the CX23-R power push button. It is always active and the user needs to electrically isolate the green wire on the CX23-R input power cable (1-KAB2115 cable) whenever the remote switching capability is not used.

To use the remote power switch, connect the green and black power cables to two contacts of a single pole, single throw contact switch with sufficient current rating (at least 10A recommended).

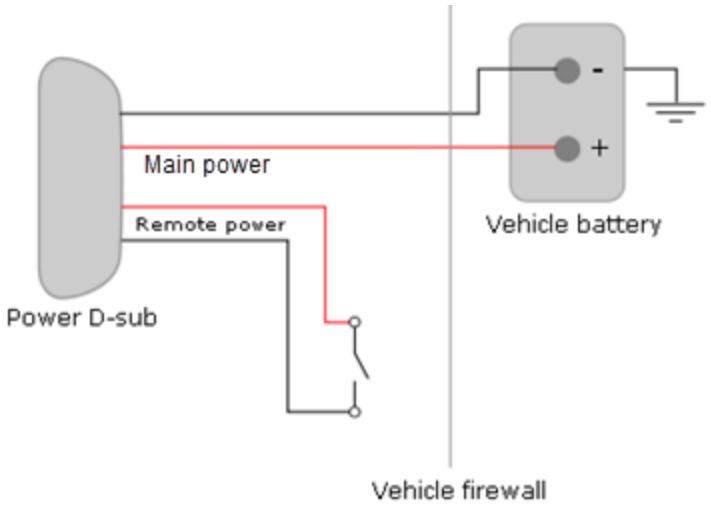
Powering the SomatXR System from a Vehicle
The following illustrates the recommended power connections for using a vehicle electrical system as the SomatXR system power source. The included diagrams are not intended to be complete, detailed instructions.

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

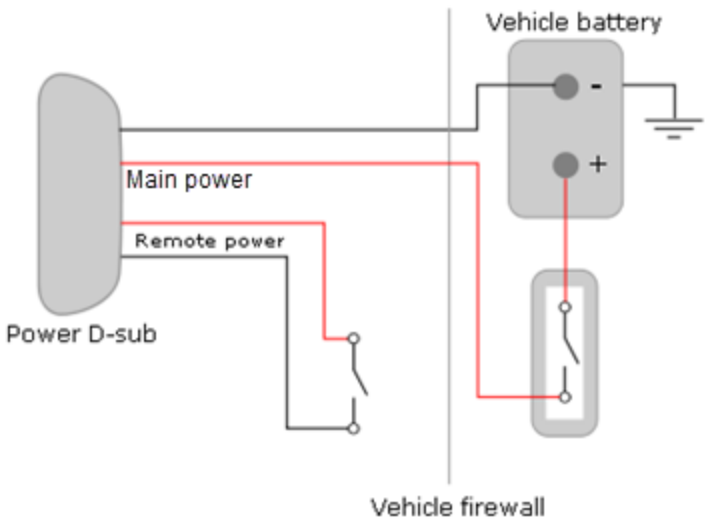
NOTE
When using additional cable length to make the connections, select an appropriate gauge wire to carry sufficient current (≥10 amps) and voltage (≥12 volts).

Refer to the following vehicle powering sections:

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.



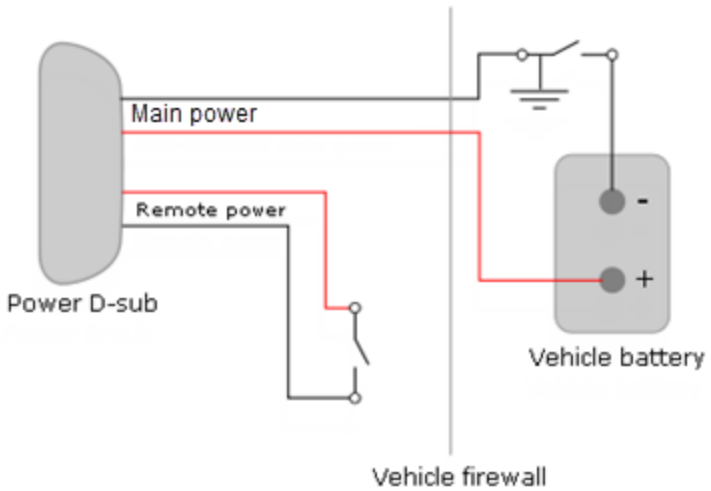
Vehicle Electrical System or Harness
An alternate method, shown below, uses a vehicle electrical system or harness which may be a switching supply such as an ignition or a relay type device. This method, while feasible, is not recommended and cannot be guaranteed as safe. Results may include unwanted multiple runs of data, improper reboots, lost data due to multiple power cycles and improper charging of the internal battery pack.



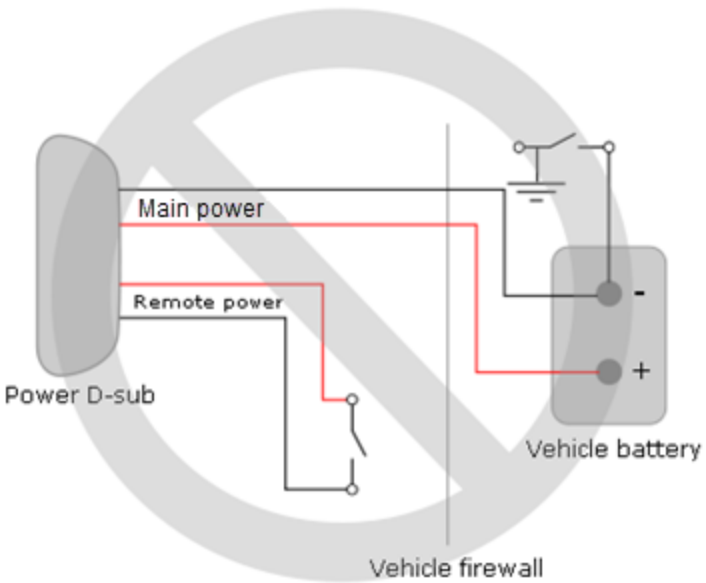
Vehicle Negative Battery Terminal Switching
For a system with a switched power system that removes the negative battery terminal from the equipment chassis ground, carefully follow the illustrated

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.



Vehicle Improper Battery Powering
The figure below shows an example of improper powering that may result in damage to a SomatXR module.



3 Controlling the System

3.1 CX23-R Web Interface

The CX23-R web interface is a web based application that runs over the https secure protocol. There must be connectivity from the client machine to the CX23-R device. This can be via a directly connected cable, or via the internet/intranet. Communication is done via a unique IP Address.

The IP Address depends on the network configuration setup. Once that IP Address is known, then we are ready to connect to the device from any of the Supported Browsers. Out of the box, the default network configuration is set to dynamic. If the CX23-R is connected to a network, any IP Address within that domain may be assigned to the CX23-R and used. If not, the default IP Address is 192.168.100.101. The URL to start the application is as follows:

https://<IP Address>/index.html. The index.html is optional. For example, if connected directly to a computer via a LAN cable, the URL might look like:

https://192.168.100.101

This starts the application and navigates you to the last place you were at. If this unit has never been used before, it navigates you to the default landing page, which will be the Hardware page of the Dashboard.

The system comes preconfigured with one user account that has all the privileges to perform any and all functions. By default, authentication is not turned on. This means that the application will not prompt for any credentials and navigate you to the state you were last in. Although no credentials were prompted for, the system automatically logs you in as the default user. This user has the following credentials:

- Username: *admin*
- Password: *password*

Both user name and password are case sensitive. You can administer these and other profiles in System Preferences.

To change the IP address or other networking parameters, navigate to System Configuration > Networks. Any changes made require a system reboot.

WARNING
Incorrect or conflicting network configurations can render the CX23-R inoperable. Please consult your network administrator for appropriate entries, or call support for assistance.

NOTE
You need to be in the correct domain to access the CX23-R. This may require change to the networking properties of your connection. See your network administrator for the proper settings.

3.1.1 Supported Browsers

The CX23-R web application supports most modern browsers, including Internet Explorer (IE11 and higher), Mozilla Firefox, Chrome, and Safari. The browser must support the following features to use the CX23-R web application:

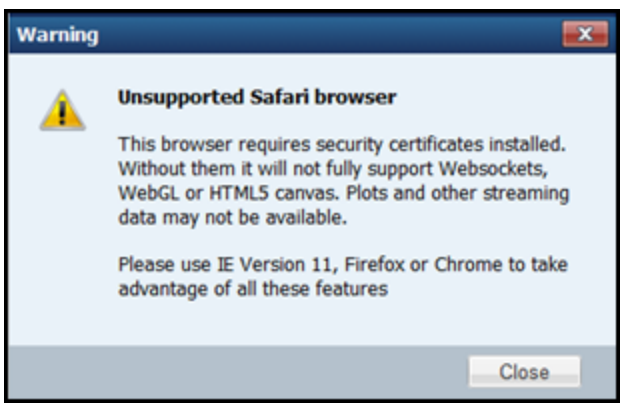
- WebSockets
- Typed arrays
- Canvas (HTML5)
- WebGL (optional)

Please refer to the browser documentation or support to ensure that it meets these requirements.

There are some known browser versions that do not support the above fully, such as Internet Explorer 10 and earlier. Should you attempt to start the CX23-R web interface using a version of Internet Explorer before 11, you will be greeted with the following alert:

The CX23-R web interface runs over a secure socket layer which generally requires a signed certificate. Unfortunately, the firmware does not ship with any certificate. The Safari browser will not allow a web socket connection to be established under these circumstances. Any information relying on web sockets will not be served to the client. This means that plots and running test statistics may not be available from Safari browsers.

If you attempt to start the CX23-R web interface from a Safari browser, you will be greeted with the following alert:



Be advised that while these browsers are not supported and plotting/statistics may not be available, most other functionality continue to work. If you do not need these features for a given session, you can ignore these warnings.

3.2 Managing Users

Access to the web interface is controlled by managing profiles and users.

The system comes factory set with one user account with the default credentials:

- Username: *admin*
- Password: *password*
- Profile: *Administrator*

It is strongly recommended that this account be changed/deleted and new accounts created with stronger passwords and appropriate profiles.

NOTE
If user control is not needed, deselect the Authentication required option in the System Preferences. Make sure that the default user exists with the default credentials to use this setting.

Profiles define what privileges can be assigned to users. For more about adding and managing profiles, see Profiles.

Grant system access by creating users and assigning them profiles. For more information about adding and managing users, see Users.

Each user has individual control over their environment through the User Preferences. These preferences follow the user no matter what machine or browser is used to log on.

User Passwords

The only restriction imposed on the password is the length. By default, the minimum length of any password being created is eight (8) characters. This can be changed within the System Preferences by users with appropriate privileges.

There exists a master password reset process that recreates the default user and profiles should an administrator's credentials be lost or forgotten. To perform a master reset, do the following:

1. Make sure all work has been saved and there are no other users on the system.
2. Switch off the CX23-R unit by pressing the power button.
3. Wait until the unit has completely switched off.
4. Press and hold the power button. All LEDs will turn on.
5. After about 5 seconds, the LEDs on the front panel will start to flash.
6. At this time, release the power button.

3.3 Configuring the Network Settings

Configure all network settings from the Networks page, including changing the module IP address and host name.

Manually Reset to Factory Defaults

The network configuration can always be reset to factory defaults using the following procedure:

1. Make sure that all unsaved work has been saved and that no other users are on the system.
2. Switch off the CX23-R unit by pressing the power button. Wait till the unit has completely switched off.
3. Press and hold the power button. All LEDs will turn on.
4. After about 5 seconds, the LEDs on the front panel will start to flash for a couple of seconds and then stop. Do not release the power button yet.
5. The LEDs will once again start to flash after another 5 seconds for a second time.
6. At this time, release the power button.

The system restarts and the default IP address settings are restored. The default IP address is 192.168.100.101.

3.4 Setting Up a Test

Setting up a test is done in the Test Control section of the web interface. Perform the following steps to successfully set up a test configuration.

1. Add or import a test setup. (Setup Maintenance)
2. Add transducer channels to the test setup based on the connected hardware modules. (Channel Setup)
3. Set the sensor scaling for the transducer channels as needed. (Sensor Scaling)
4. Create computed channels as needed to manipulate the data from transducer channels or other computed channels. (Computed Channels)
5. Create Data Modes to store the channel data. (Data Modes)
6. Save the current setup.

3.5 Running a Test

Running a test is done in the Test Control section of the web interface.

During a test run, live data can be viewed from the Test Control page or from the Displays page in the Dashboard section.

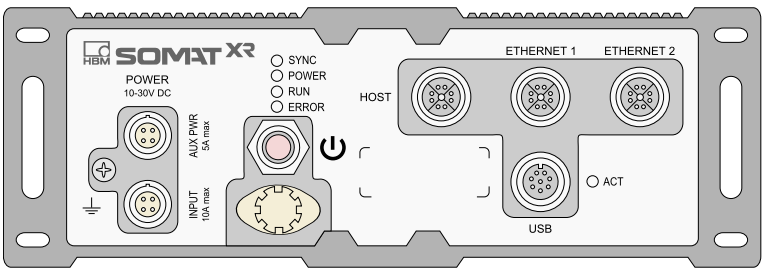
As the test runs, the system writes the test data to the specified SIE data file. Manage and download the data files after a test run from the SIE Data page in the Dashboard section. There is currently no ability to view SIE data in the web application. To view the data, download the file and open it in an SIE file reader application such as Catman or Infield.

4 Modules

4.1 CX23-R Data Processor

4.1.1 CX23-R Input and Output Channels

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



Transducer		Wiring Diagram
	Digital input/output	41
CAN	CAN bus	44
	GPS	

DIO Channels

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

The DIO input lines 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 ±V to a resolution of 20 mV. The -3 dB bandwidth is 4 MHz, with start of attenuation roll off at nominally 1 MHz.

The DIO outputs 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).

GPS Channels

The GPS port uses an RS232 serial port with additional control lines to communicate to Somat EGPS modules (full firmware support currently limited to 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.

AUX Channels
The AUX port is configurable to support a variety of custom interfaces. Currently, not supported.

CAN Channels
The three CAN ports 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 import of CAN databases in the Vector DBC file format.

Each port provides an internal termination resistor that can be switched in or out under user control. 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.

4.1.2 CX23-R Status LEDs

Sync (Blue)

Off	Unit is stand alone (no PTPv2 connections).
On	Unit is PTPv2 slave.
2 Hz	Unit is PTPv2 master.
1 Hz	Unit is PTPv2 master synchronized to GPS time.

Power (Green)

Off	Unit is off.
On	Unit is on.
4 Hz	Unit is shutting down.
2 Hz	Locate mode. for more information.

Test (Yellow)

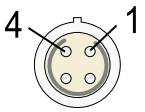
Off	No test run in progress.
4 Hz	Test run in progress.

Alarms (Red)

Off	No error.
On	Unit error.
1 Hz	User alert.

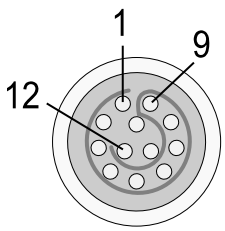
NOTE
See the System Logs for more information on user alerts and unit errors. Viewing the log file usually turns the red LED off. However, some alarms persist until the user takes required actions (deleting one or more SIE files when the SATA storage space is full).

4.1.3 CX23-R INPUT PWR and AUX PWR Pin Assignments



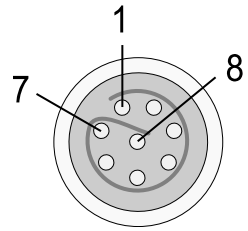
PIN	Description	Wire Color
1	Power in -	Black
2	Single wire data	White
3	Power in +	Red
4	Remote switch	Green

4.1.4 CX23-R DIO Pin Assignments



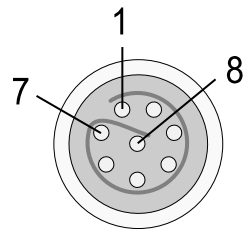
PIN	Description	Wire Color
1	Ground	Black/Red
2	Power	Red
3	Ground	Black/White
4	Input 1	White
5	Ground	Black/Green
6	Input 2	Green
7	Ground	Black/Blue
8	Input 3	Blue
9	Ground	Black/Yellow
10	Output 2	Yellow
11	DIO Cable Detect	Black/Brown (shorted to 1 in cable)
12	Output 1	Brown

4.1.5 CX23-R GPS Pin Assignments



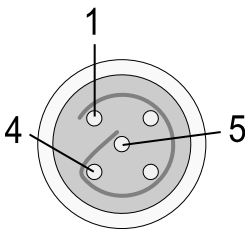
PIN	Description	Wire Color
1	GPS Transmit	White
2	Out Control	Brown
3	GPS Receive	Green
4	GPS Cable Detect	shorted to 7 in cable
5	GPS PPS	Gray
6	Input Control	Pink
7	Ground	Black
8	Power	Red

4.1.6 CX23-R AUX Pin Assignments



PIN	Description	Wire Color
1	Sample Clock Positive	White
2	VBM INTR	Brown
3	VBM Transmit	Green
4	VBM Cable Detect	shorted to 7 in cable
5	VBM Receive	Gray
6	Sample Clock Negative	Pink
7	Ground	Black
8	Power	Red

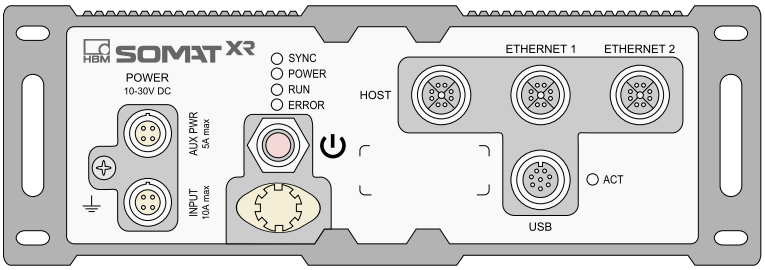
4.1.7 CX23-R CAN Pin Assignments



PIN	Description	Wire Color
1	Ground	Yellow
2	Power	Red
3	Ground	Black
4	CAN H	White
5	CAN L	Blue

4.1.8 CX23-R Input and Output Channels

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



Transducer		Wiring Diagram
	Digital input/output	41
CAN	CAN bus	44
	GPS	

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

The DIO input lines 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 ±V to a resolution of 20 mV. The -3 dB bandwidth is 4 MHz, with start of attenuation roll off at nominally 1 MHz.

The DIO outputs 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).

GPS Channels
The GPS port uses an RS232 serial port with additional control lines to communicate to Somat EGPS modules (full firmware support currently limited to 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.

AUX Channels
The AUX port is configurable to support a variety of custom interfaces. Currently, not supported.

CAN Channels
The three CAN ports 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 import of CAN databases in the Vector DBC file format.

Each port provides an internal termination resistor that can be switched in or out under user control. 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.

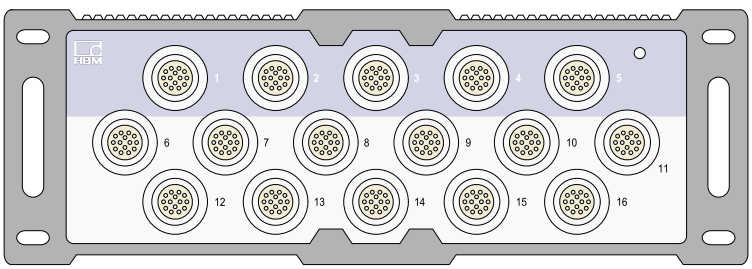
4.2 MX Modules

4.2.1 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) can be connected to the MX1601B-R module.

Transducer		Wiring Diagram
	Voltage 60 V, 10 V, 100 mV	34
	Current, 20 mA	35
	Current-fed piezoelectric transducer, IEPE	37

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.

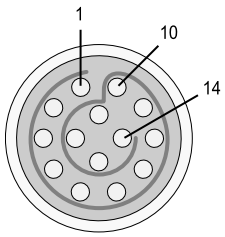


Status LEDs

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

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



Pin	Connection
1	--
2	--
3	Voltage input 60 V (+), 10 V (+), 100 mV (+), IEPE (+)
4	Signal ground
5	--
6	Current input 20 mA (+)
7	--
8	--
9	Active sensor supply (-)
10	Active sensor supply (+)
11	--
12	--
13	TEDS (-)
14	TEDS (+)
Shield	Shield

NOTE
Bridge connection between pins 4 and 5 is necessary for voltage sensor compatibility.Bridge connection between pins 1 and 11 is needed for voltage sensor compatibility when cable is also used with MX1615B-R modules.

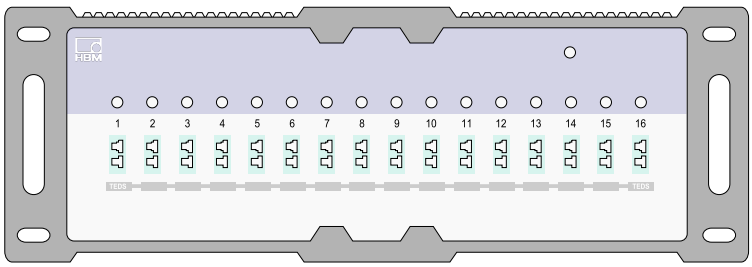
The adjustable transducer excitation between 5 and 24 volts is only available on channels 1 through 8. These channels can draw a maximum of 0.7 W per channel or 2 W total.

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.

4.2.2 MX1609KB-R Thermocouple Module

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

Transducer	
	Thermocouple, K-type



Status LEDs

The following table gives the descriptions for all LED states.

System LED	Connection 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

Thermocouple with TEDS functionality (RFID)
Measuring point identification

An RFID chip in or on the thermocouple plug ensures wireless transducer identification through the amplifier. RFID technology enables contactless reading and writing of data such as the precise measuring point or the required physical unit (°C or °K). It is written onto the RFID chip via a corresponding RFID transponder in the amplifier.

The chip is reusable and works without batteries.

Rescaling

The MX1609KB-R has a rescaling function. Errors from thermocouples or installation situations can be minimized using a table that converts values from degree C to degree C.

The MX1609KB-R can process maximum 64 value pairs. 14 value pairs can be stored in the TEDS template “Calibration Table" if no additional optional templates are used.

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

Conditions for using RFID chips for measuring point identification

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

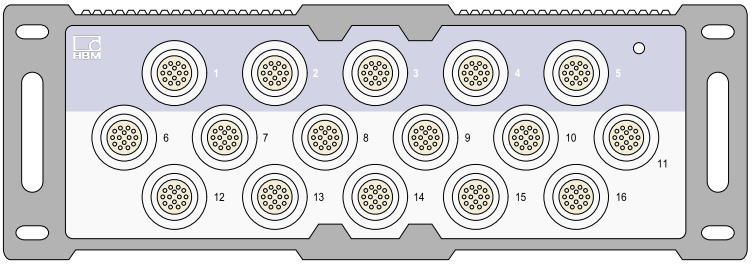
4.2.3 MX1615B-R Bridge Module

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. PT100 resistance thermometer).

Transducer		Wiring Diagram
	Full-bridge strain gage six-wire configuration	38
	Half-bridge strain gage five-wire configuration	38
	Quarter-bridge strain gage three- or four-wire configuration	38
	Voltage 60 V	34
	Resistance or resistance-based measurements	36
	Potentiometric transducer	36
	PT100 resistance thermometer	36

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.



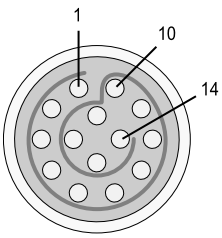
Status LEDs

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

MX1615B-R Pin Assignments

Connect sensors via the 14-pin ODU MINI-SNAP connectors.



Pin	Connection
1	Excitation (-)
2	Excitation (+)
3	Voltage input 60 V (+)
4	Signal ground
5	--
6	--
7	Measurement signal (+)
8	Measurement signal (-)
9	--
10	--
11	Sense (-)
12	Sense (+)
13	TEDS (-)
14	TEDS (+)
Shield	Shield

NOTE
Pin assignment is different for quarter bridge (Quarter-bridge strain gage, four-wire configuration and Quarter-bridge strain gage, three-wire configuration), Resistance and PT100 Resistance Thermometer inputs. For more information, refer to the wiring diagrams.

NOTE
Bridge connection between pins 1 and 11 is necessary for voltage sensor compatibility.Bridge connection between pins 4 and 5 is needed for voltage sensor compatibility when cable is also used with MX1601B-R.

4.3 EX23-R Power over Ethernet (PoE) Switch

4.3.1 EX23-R Status LEDs

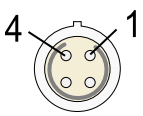
Power LED	Description
Off	Power input not in range
On	Unit is powered
Flashing (2 Hz)	Power error
Flashing (8 Hz)	Firmware update

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

4.3.2 EX23-R Input Power Pin Assignments



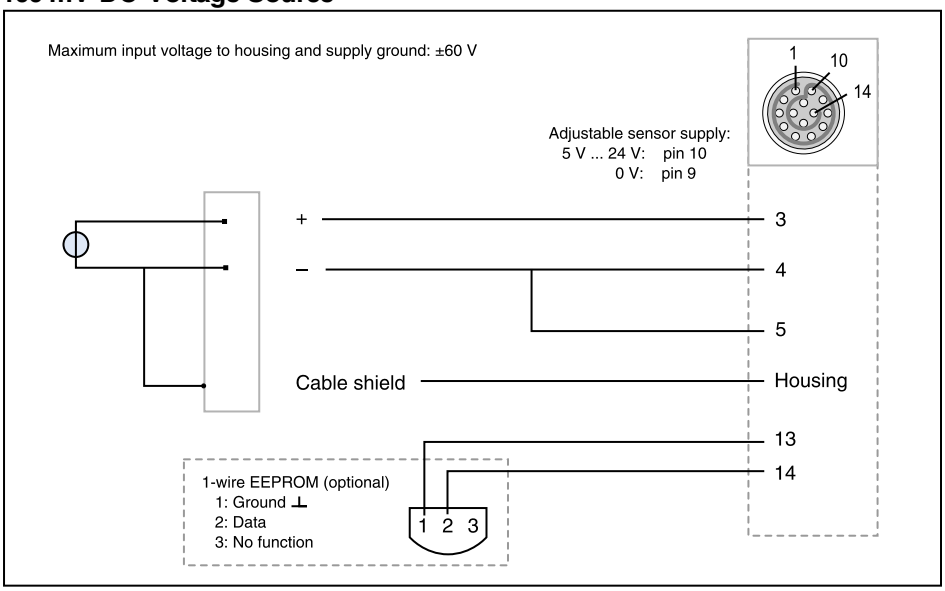
PIN	Description	Wire Color
1	Power in -	Black
2	Single wire data	White
3	Power in +	Red
4	Remote switch	Green

5 Inputs

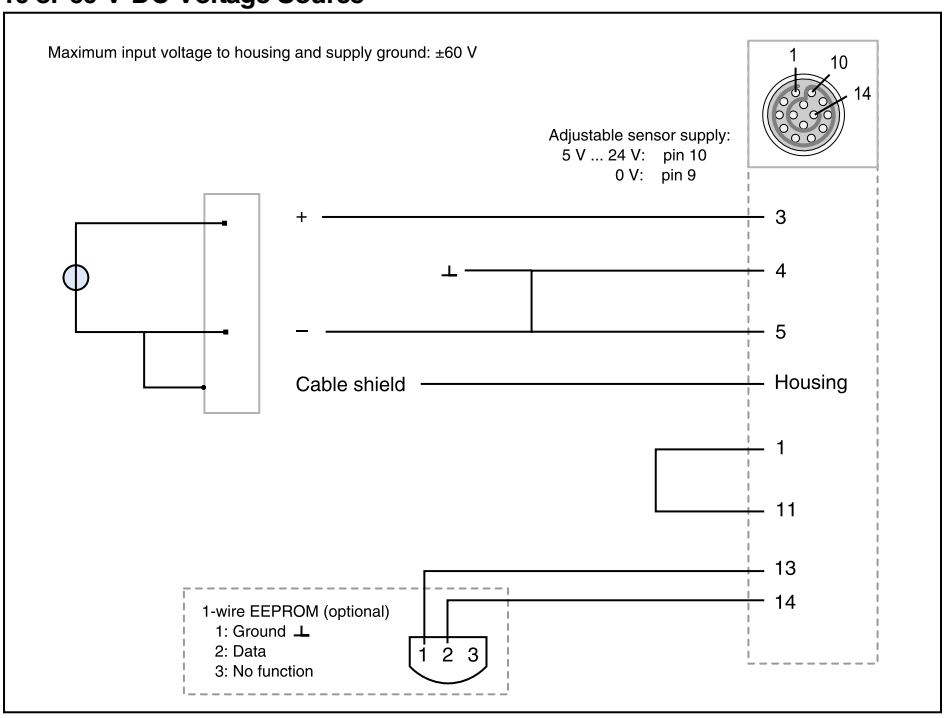
5.1 DC Voltage Sources

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Voltage 60 V, 10 V, 100 mV		●		● 60 V only

5.1.1 100 mV DC Voltage Source



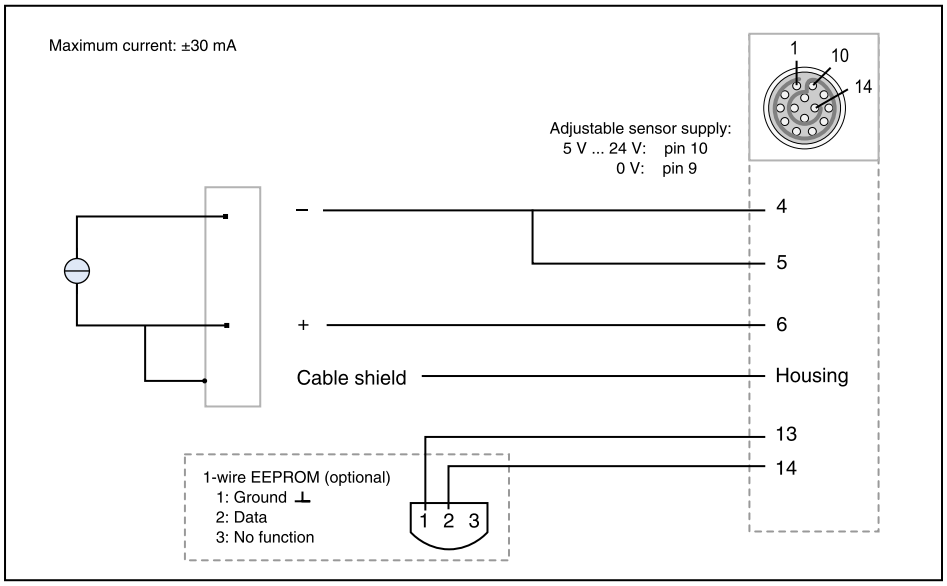
5.1.2 10 or 60 V DC Voltage Source



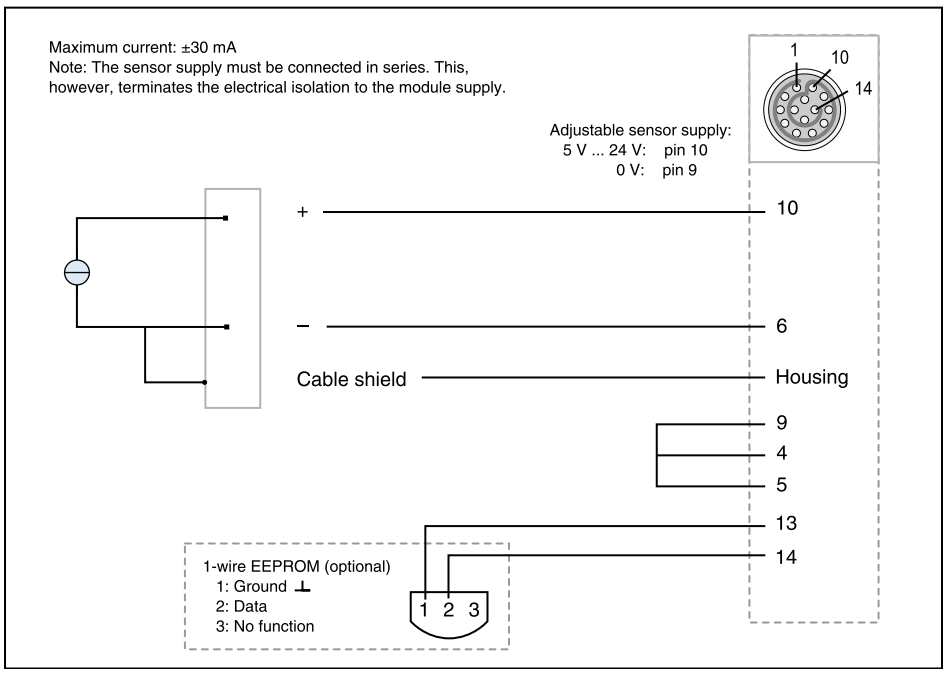
5.2 DC Current Sources

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Current, 20 mA		●		

5.2.1 20 mA DC Current Source



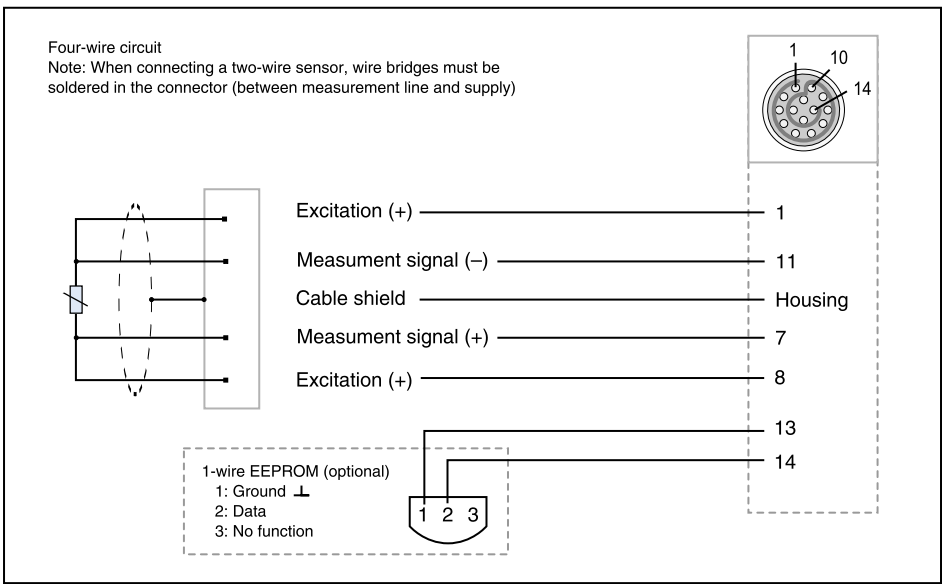
5.2.2 20 mA Current-fed DC Current Source



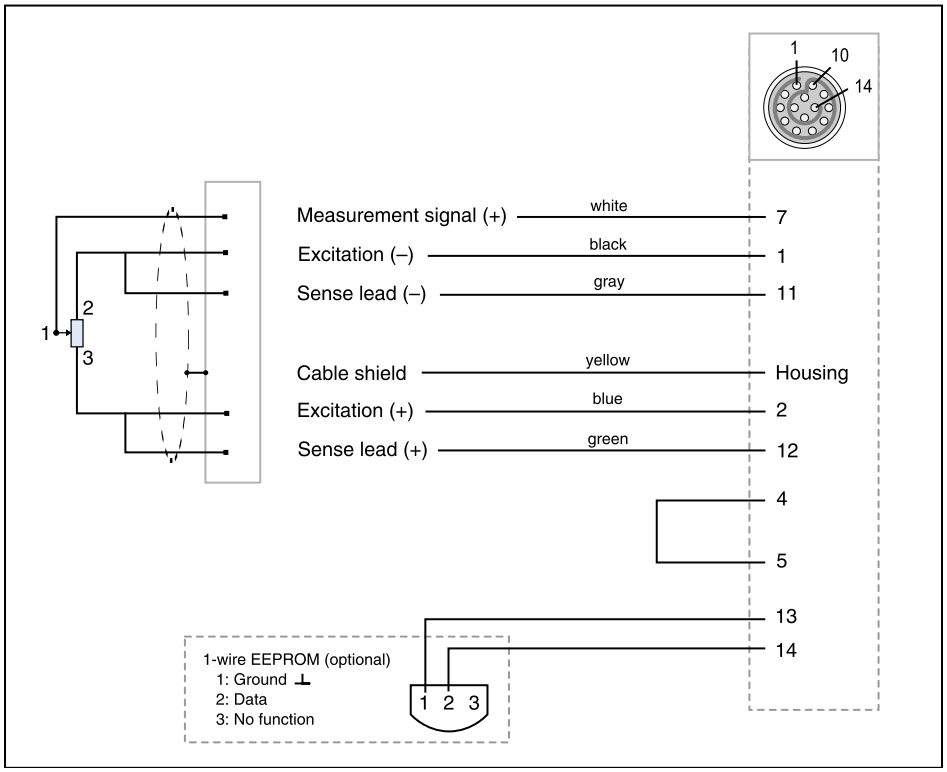
5.3 Resistance-Based Measurements

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Resistance or resistance-based measurements				●
Potentiometric transducer				●
PT100 resistance thermometer				●

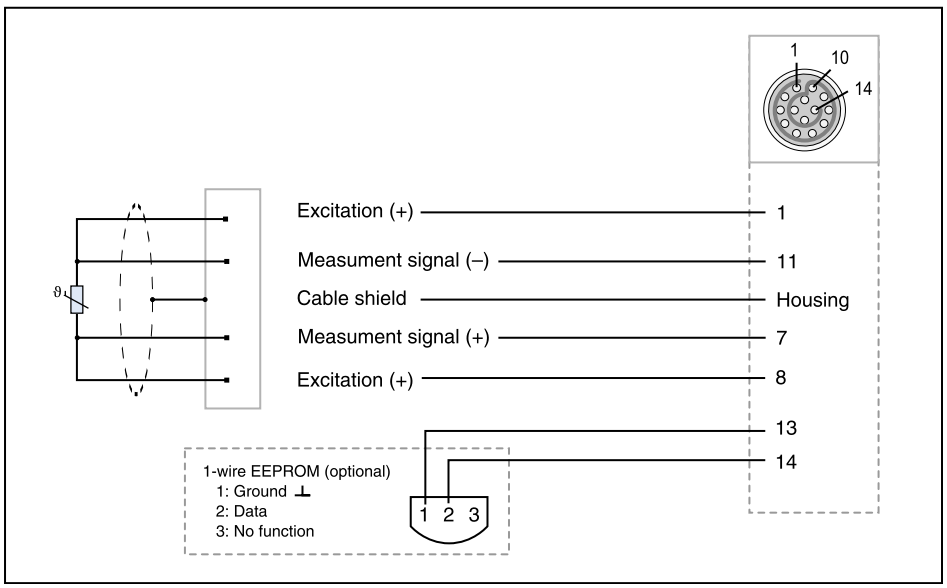
5.3.1 Resistance



5.3.2 Potentiometric Transducer



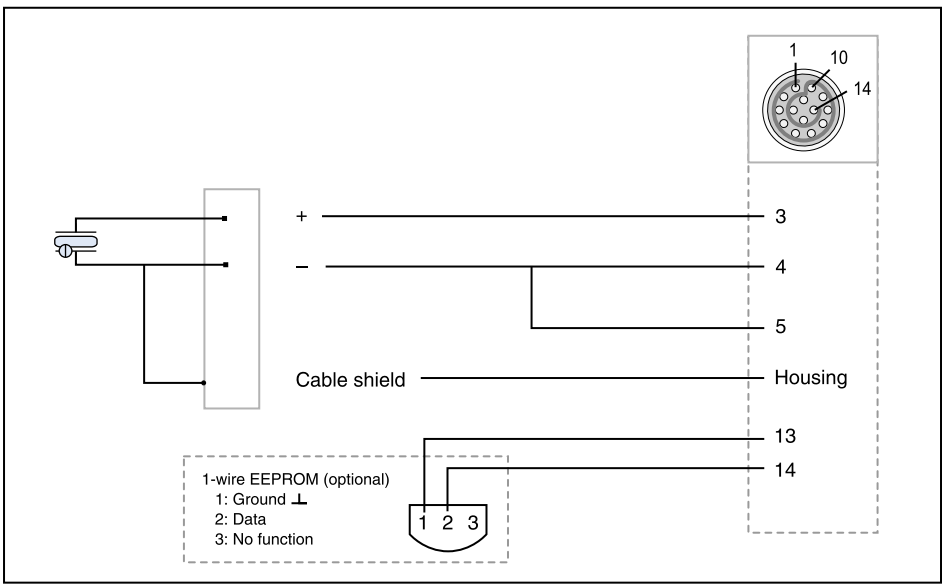
5.3.3 PT100 Resistance Thermometer



5.4 Current-fed Piezoelectric Transducers

Current-fed piezoelectric transducers are supplied with a constant current of 5.5 mA and output a voltage signal to the amplifier. This type of transducer is also called an IEPE or ICP® transducer. IEPE is short for Integrated Electronics Piezo Electric. ICP® is a registered trademark of the company PCB Piezotronics.

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Current-fed piezoelectric transducer, IEPE		●		

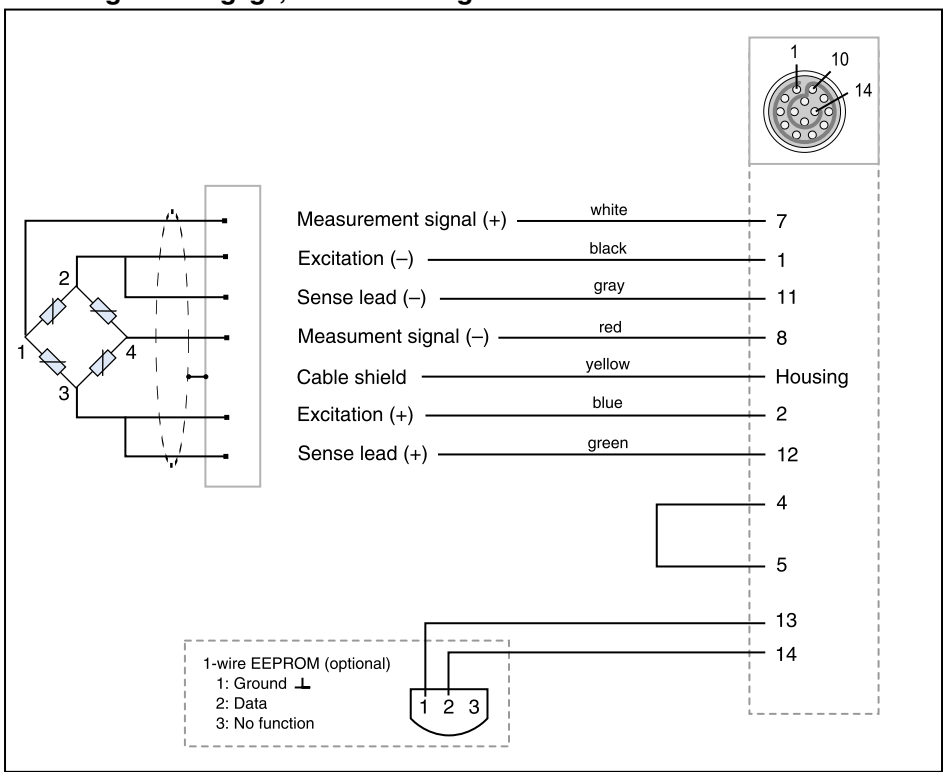


NOTE
IEPE transducers with TEDS version 1.0 are supported.

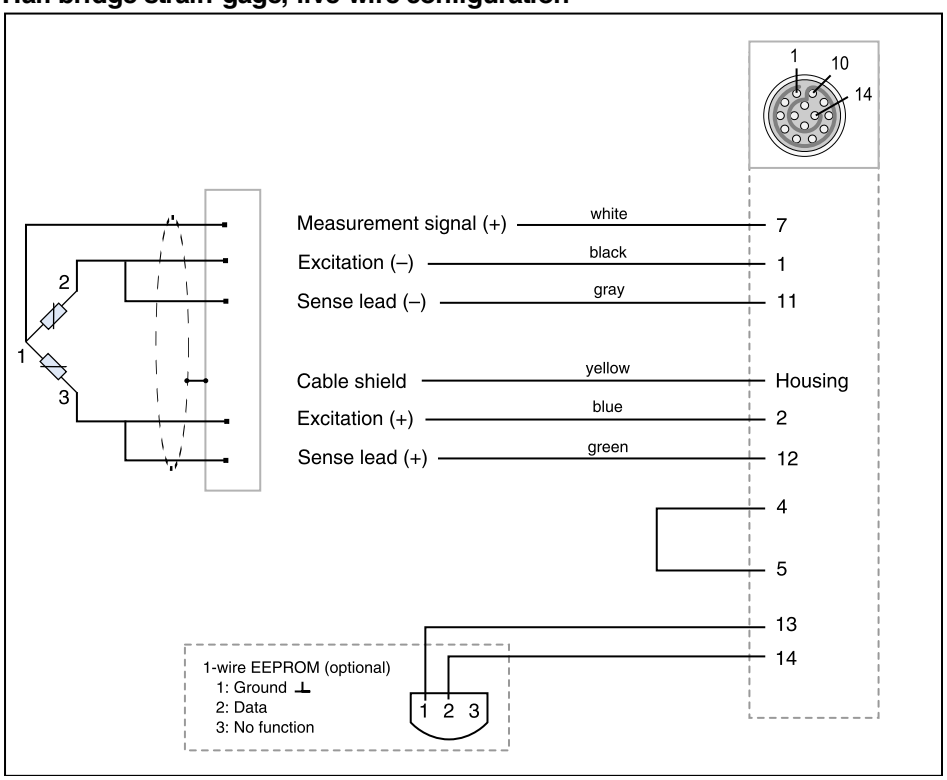
5.5 Strain Gage Transducers

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Full-bridge strain gage six-wire configuration				●
Half-bridge strain gage five-wire configuration				●
Quarter-bridge strain gage three- or four-wire configuration				●

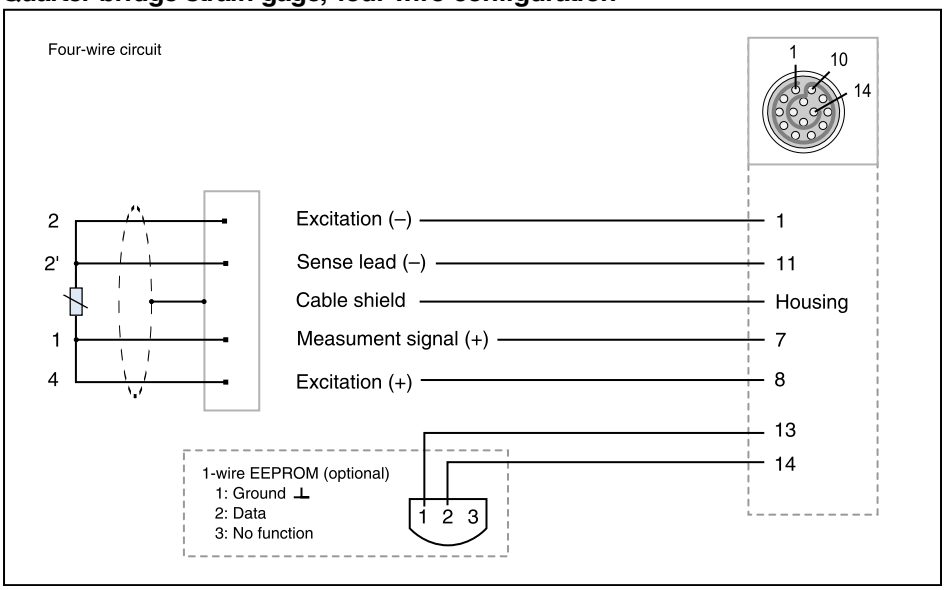
5.5.1 Full-bridge strain gage, six-wire configuration



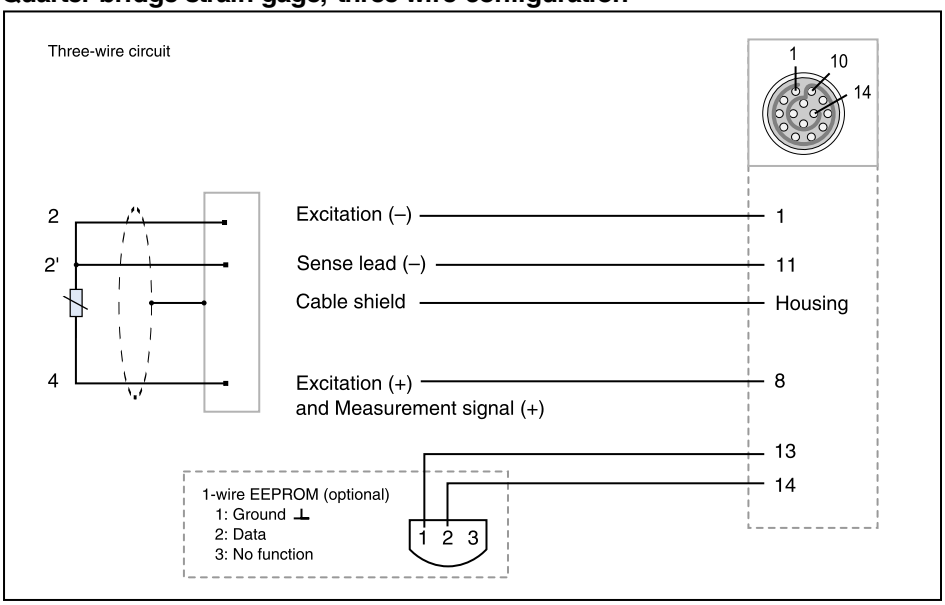
5.5.2 Half-bridge strain gage, five-wire configuration



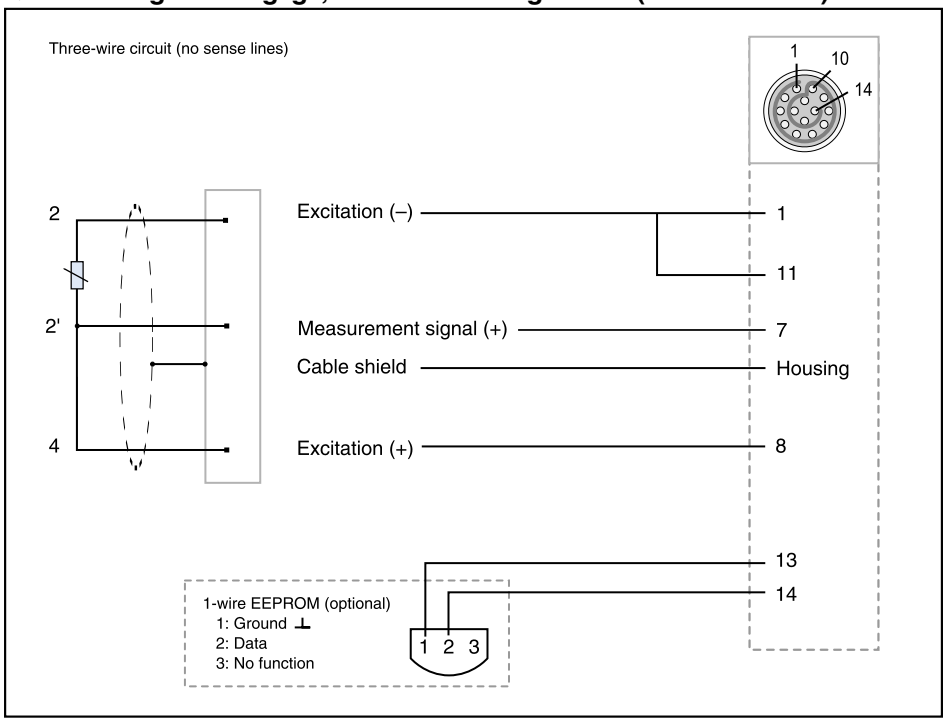
5.5.3 Quarter-bridge strain gage, four-wire configuration



5.5.4 Quarter-bridge strain gage, three-wire configuration



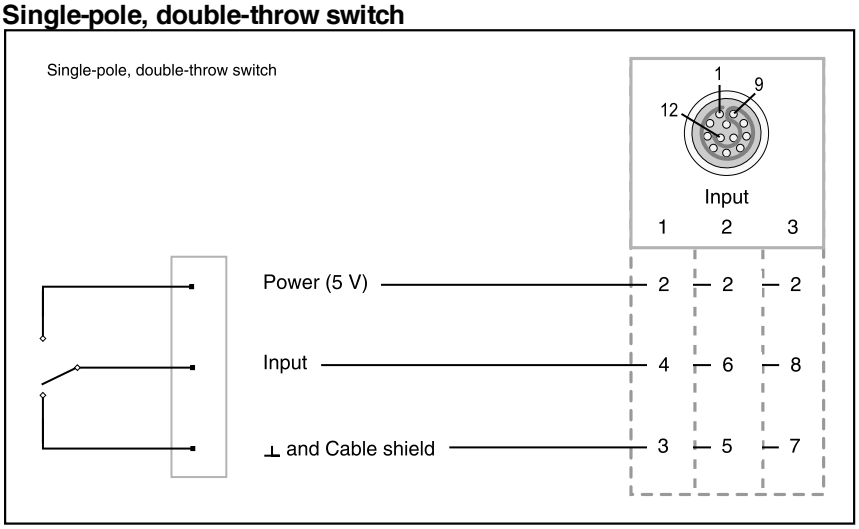
5.5.5 Quarter-bridge strain gage, three-wire configuration (no sense lines)



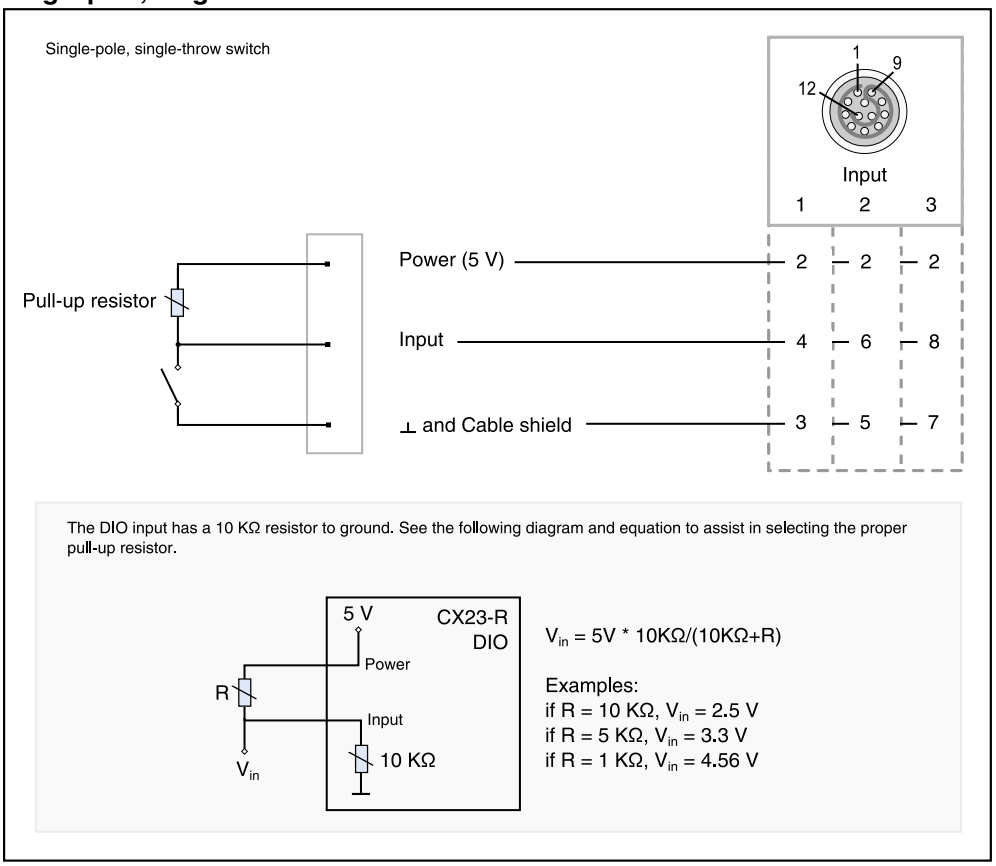
5.6 Digital Inputs

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Digital input/output	●			

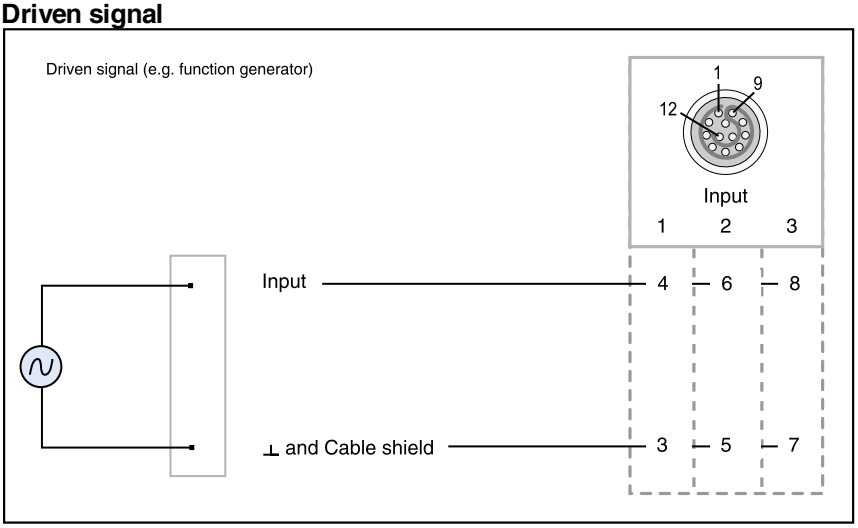
5.6.1 Single-pole, double-throw switch



5.6.2 Single-pole, single-throw switch



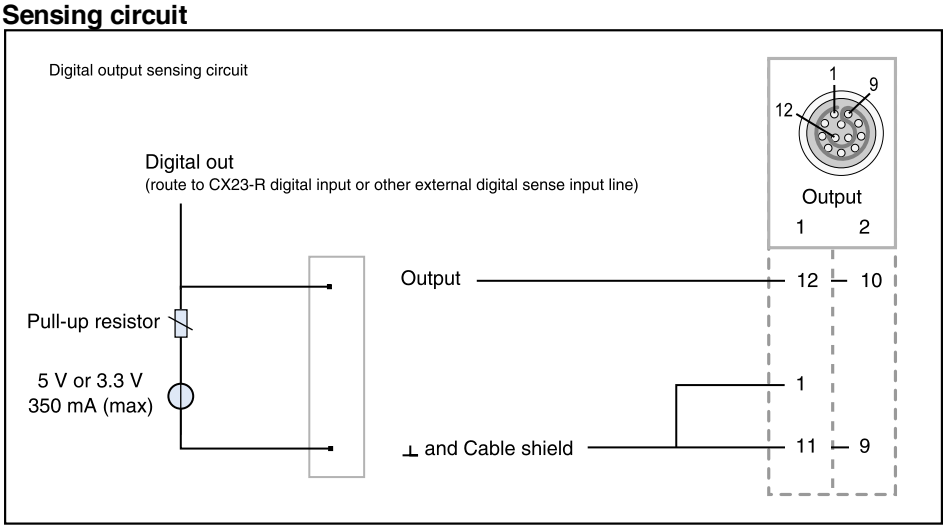
5.6.3 Driven signal



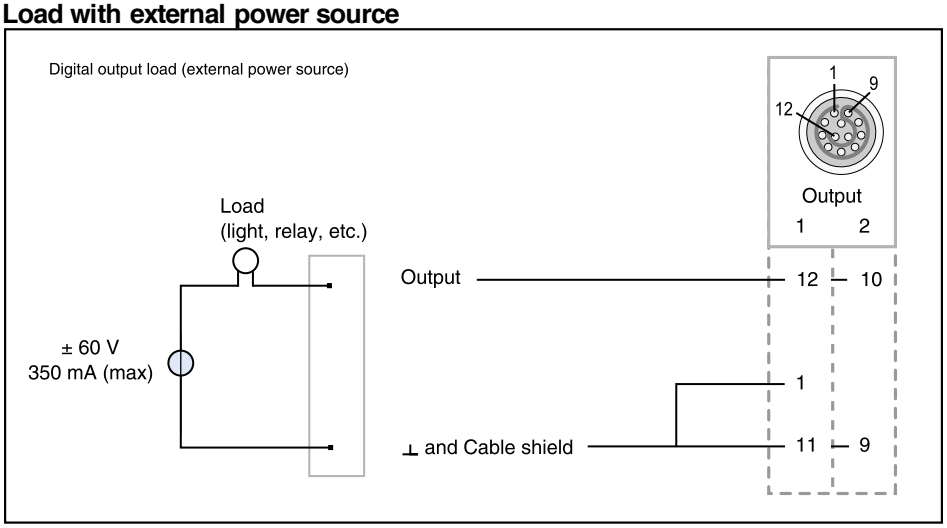
5.7 Digital Outputs

Transducer	CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
Digital input/output	●			

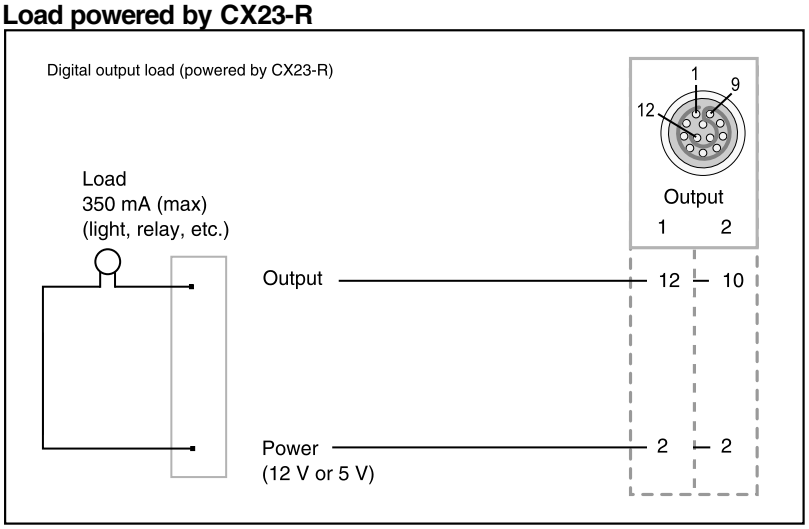
5.7.1 Sensing circuit



5.7.2 Load with external power source



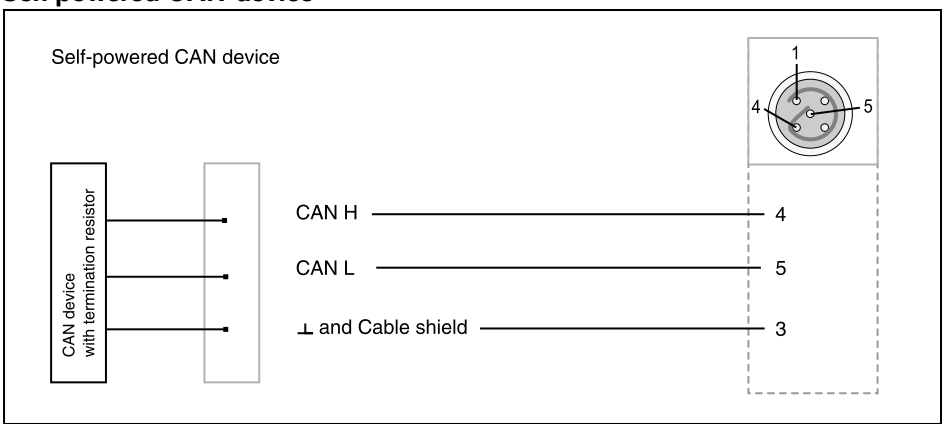
5.7.3 Load powered by CX23-R



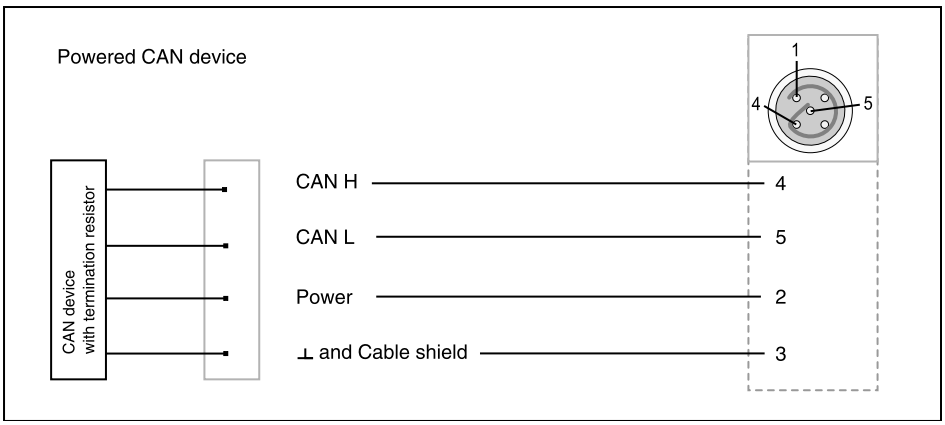
5.8 CAN Devices

Transducer		CX23-R	MX1601B-R	MX1609B-R	MX1615B-R
CAN	CAN bus	●			

5.8.1 Self-powered CAN device



5.8.2 Powered CAN device



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

NOTE
The CX23-R has an internal completion resistor between CAN H and CAN L that can be enabled or disabled with software.

6 CX23-R Web Interface Description

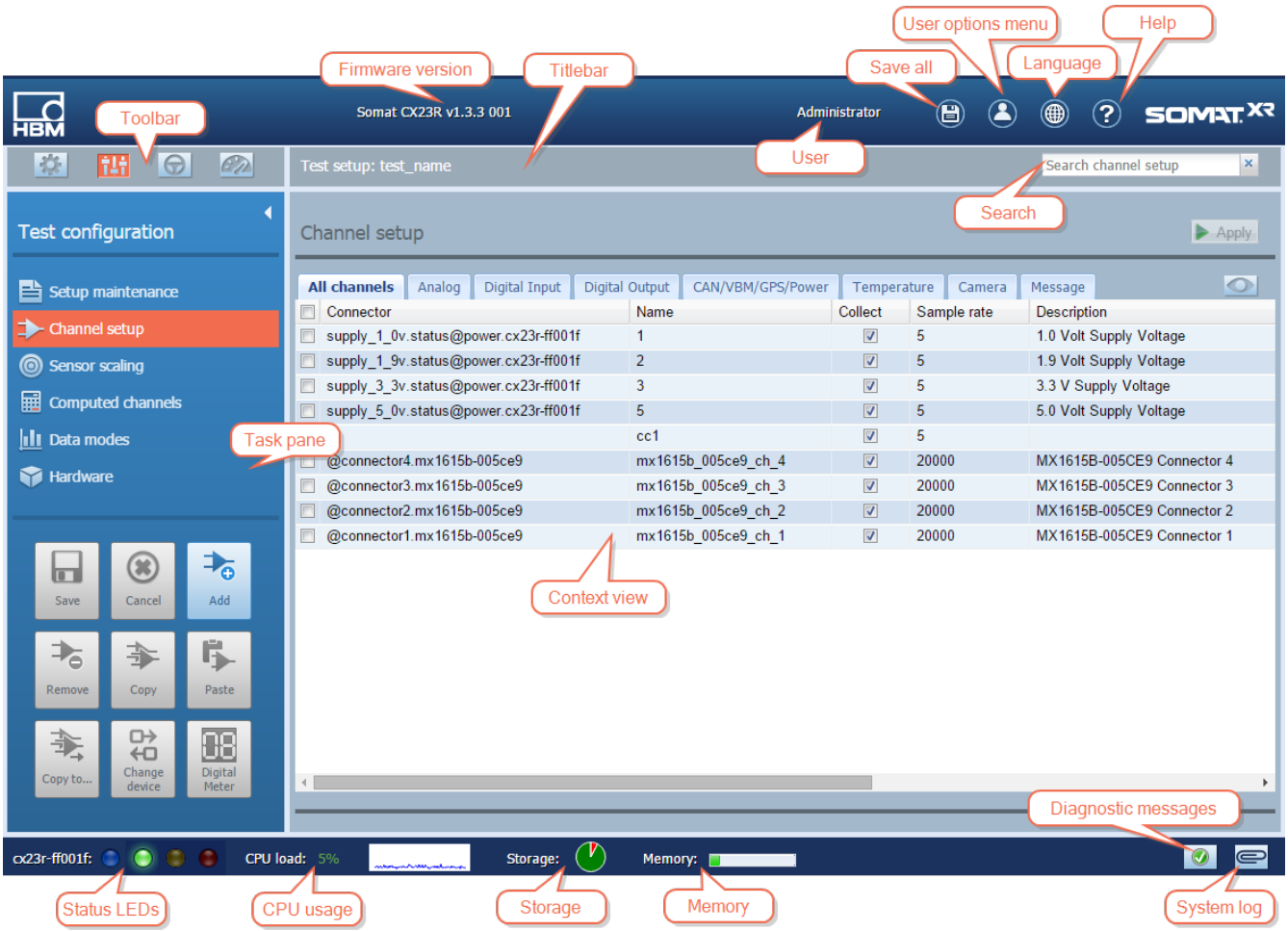
6.1 Log on

Enter your **User name** and **Password** to log on to the system. Both the user name and password are case sensitive.

Click the button to make the password visible. Check the **Keep me logged on** option to have the browser remember your credentials for 30 days.

If user authentication is not configured, using the browser refresh button will log you in as the default user.

6.2 Tour of the Workspace

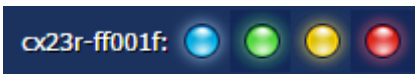


Header

HBM Logo		Opens up the HBM Website if connectivity permits.

Firmware Version	Currently installed firmware version.	
User	Full name of the currently logged in user.	
Save All	Save all pending changes. When changes are pending, the icon is **orange**.	
User Options Menu		Open the user menu to Header, set **User Preferences**,or Log Off.
Language	Change the interface language.	
Help	Open the online help system.	

Footer

Status LEDs		• **CX23-R hardware identifier**: The internal identifier given to the CX23-R. Defaults to cx23r-<serial number>. • **Status LEDs**: sync, power, test and error. These mirror the LEDs on the device. See CX23-R Status LEDs for more information.
CPU Usage		The most current CPU load reading and a chart of the last 60 readings. Mouse over the chart to show data points. The digital reading will be green for < 80%, yellow for 80-89% and red for >= 90%
Storage		Used and available storage on the CX23-R internal SATA Drive. The red slice shows the used storage and the green slice shows the available storage. 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.
System Logs		Display the **System Logs** page.

Diagnostic Messages

When on a test configuration page, the Diagnostic Messages button is on the far right of the status bar. The icon indicates the highest level message of the current test being configured. A **green check** indicates that there are no diagnostic messages. Hover over the button to display the number and types of messages.

Click the button to display all the diagnostic messages. Click on individual messages to navigate to the specific part of the setup causing the message. There are three types of diagnostic messages:

	Informational message. These are friendly reminders or additional information to help configure setups. They have no impact on test runs.
	Warning. This indicates a possible error. Warnings may or may not cause problems with the test engine. They may also indicate configuration inconsistencies or ambiguities. Users should investigate these warnings carefully and take any action if necessary. Depending on system preferences, a test run may or may not be started with warning level errors.
	Error. These are errors that prevent a test run from being started.

Diagnostic messages are recalculated upon completion of individual values. In the case of a spreadsheet interface, re-validation takes place only after the cell is completed and focus moves away from that cell. While the cell is considered to be in edit mode, no validations take place.

Upon a cell changing, the setup as a whole is validated. All channels are iterated and the rules applied at every level. If any defaults or rippling of data due to a change in a cell, then this will be done before the validation process starts. If the validation finds any errors or messages, it highlights the appropriate cell/rows and adds a message to the diagnostic messages list. If existing errors have been addressed and no longer need to display, the color and the message will be removed from the list.

Toolbar

On the left of the toolbar are four buttons to navigate to the main sections of the interface. Note that not all these may be visible depending on profiles.

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, sensor scaling, computed channels, and data modes • Set channel sensor scaling based on signal measurements
Test Control	• Control and monitor test runs • Create, configure and display real time charts
Dashboard	• View all hardware • Create, configure and display real time charts • Manage SIE data files

Titlebar
Name of current test within Test configuration or the name of the selected/running setup in Test control; otherwise, it is blank.

Context Sensitive Search Bar	 The context sensitive search bar is on the far right of the Titlebar. Use the search bar to filter lists or grid entries on the page.

Task Pane
The Task Pane is on the left side of each main section. In general, the task pane contains a menu of available subsections and a group of applicable 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.

Context View
The content of this panel is sensitive to the Toolbar option and the Task Pane option selected. It could be a grid, as in the Channel setup or it could be charts, as in Test control. It is basically a sandbox where any widgets that are appropriate may be rendered here. See the relevant context help for what to expect here.

6.2.1 Header

Change Password

Use the Change Password dialog to change the current logged in user's password at any time. There is no expiration of passwords, nor are there any complicated rules regarding passwords. The user setting determines the password's strength.

Length is the only restriction imposed on the password. By default, the minimum length of passwords being created/changed is eight (8) characters. Authorized users can change this in the System Configuration User preferences.

NOTE

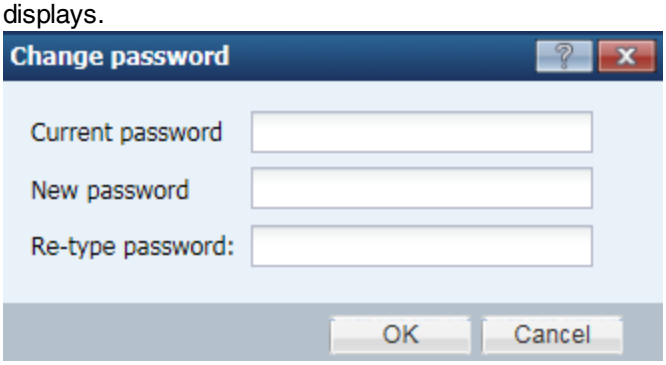
All usernames and passwords are case sensitive. All passwords in this dialog are masked for security.

To successfully change a user's password, the logged in user must supply their current password. This password must match exactly the existing password. Then they must supply the new password – twice. Both new passwords must be identical. Should any password fail any validation, the password will not change.

The user's password changes when all validations pass and they click **OK**. The current session remains active and the user remains logged in, but future logins require that the new password. Click **Cancel** to close this dialog with no change in password.

The length of the passwords will only be validated once – when created or changed. Thereafter, the length is no longer be validated. So, if the minimum length of a password is changed in the System Configuration, existing passwords will not be affected - shorter than minimum passwords will still be valid. However, next time they change, they must honor the minimum password length for a successful password change.

Select **Change password** from User options. The Change password dialog displays.



Enter the necessary data and click **OK**. Click **Cancel** to close this dialog with out changing your password.

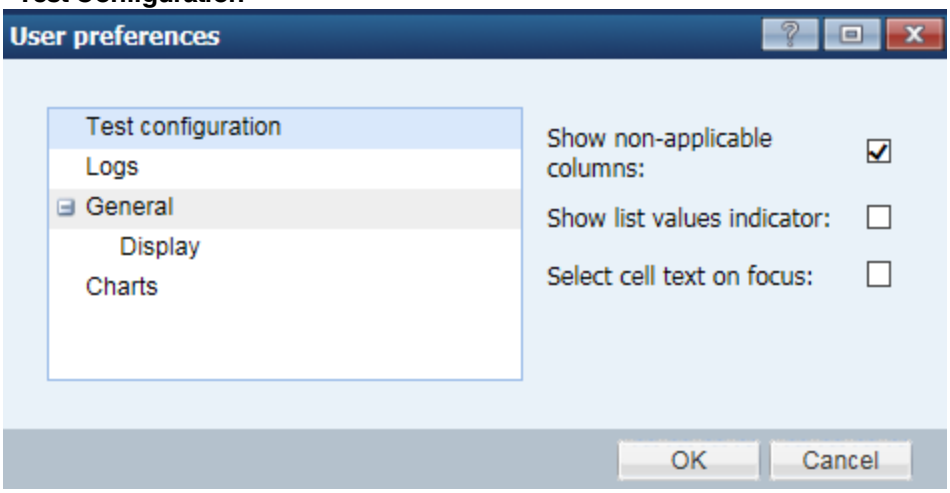
The system never forces you to change your password, and passwords never expire, regardless if they are used or not.

Enter your current password and new password twice to change your password. Passwords are case sensitive and may need to have a minimum number of characters depending on the system settings.

User Preferences

All user preferences take effect immediately and persist indefinitely or until they are changed or removed. Preferences follow the user, not the session, browser or machine. Select User options > **Preferences** to view User Preferences.

Test Configuration

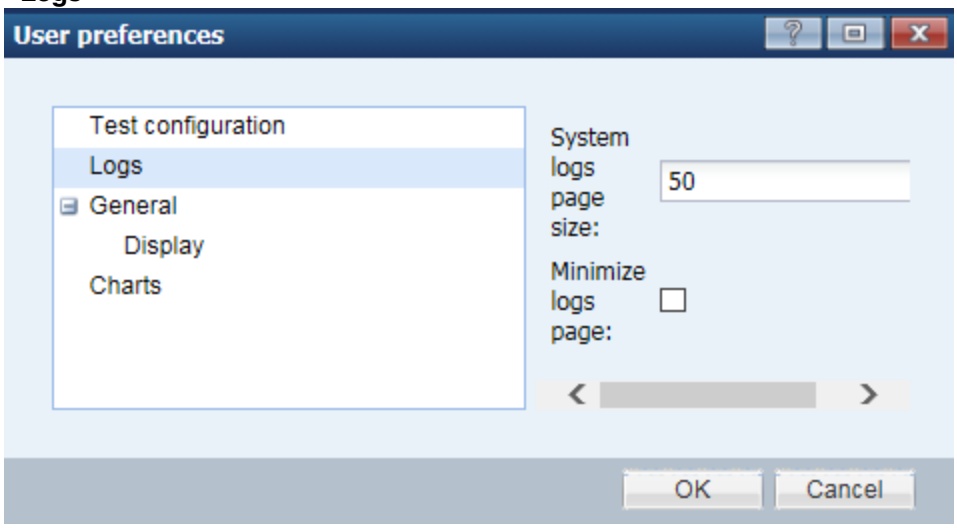


Deselect the **Show non-applicable columns** option to hide columns in the Spreadsheet Interface that are not applicable to the current context. When selected, these cells display as "N/A."

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

Select the **Select cell text on focus** to automatically select all the text in an editable cell when it gains focus. Use this setting when replacing cell values instead of appending text to existing cell values.

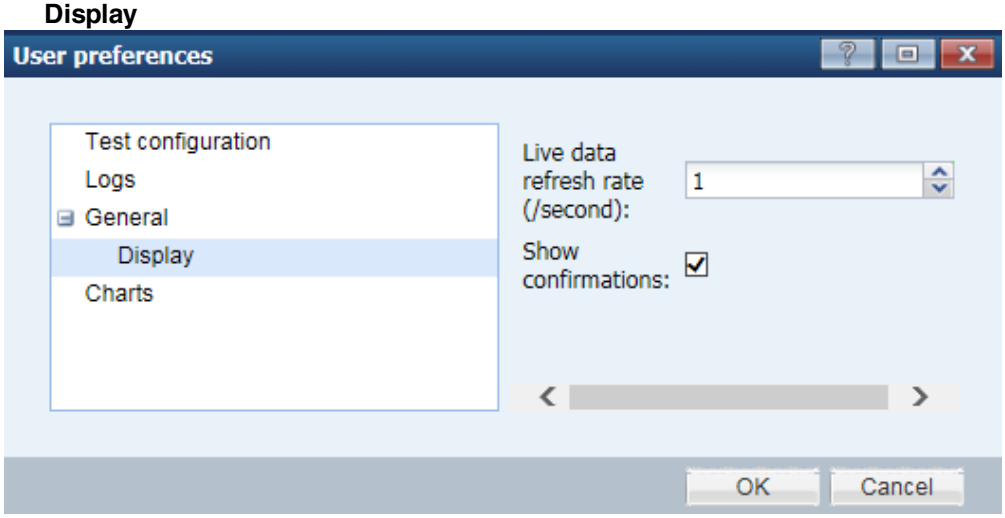
Logs



In the **System logs page size**, enter a value between 1-1000 to limit the number of log entries per page. The default value is 50.

Select the **Minimize log page** option to open the log panel as a smaller display. When deselected, the log page opens as a full page.

Display

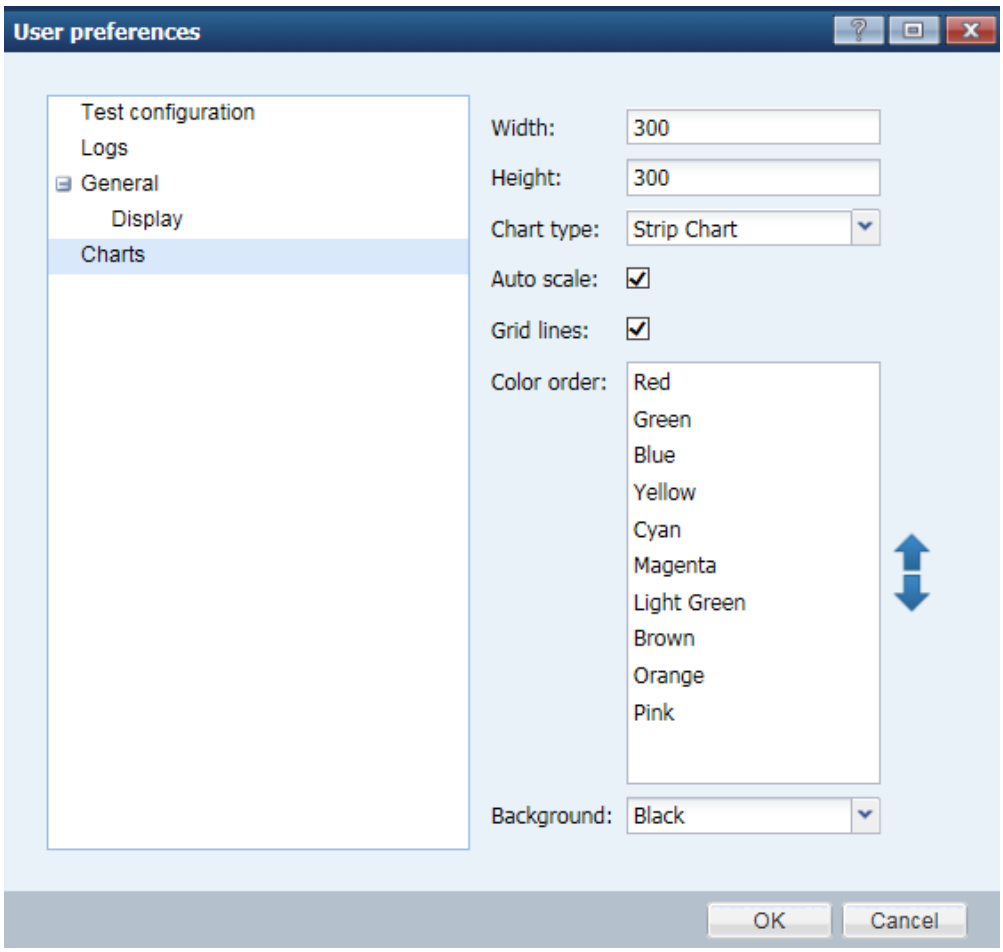


The **Live data refresh rate** is the rate that live data refreshes including the hardware panel and channel panel when a digital display test is running. Set the refresh rate between 0 and 10 times per second. A value of zero causes no updates to take place. If live data values are not required, it 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.

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

Charts



Change the charts settings to define the default characteristics of new charts in the test control or dashboard displays windows.

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

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

Select a **Chart type** of Strip Chart, Gauge or Digital. The default is Strip Chart.

For a Strip Chart, select the **Auto scale** option 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.

For a Strip Chart, select the **Grid lines** option to show grid lines. When deselected, the grid lines are not displayed.

For a Strip Chart, arrange the **Color order** to determine the order in which colors are assigned to added channels. Drag and drop or use the arrows to re-order the colors.

For a Strip Chart, select a **Background** color of black or white. The default is white.

6.2.2 Footer

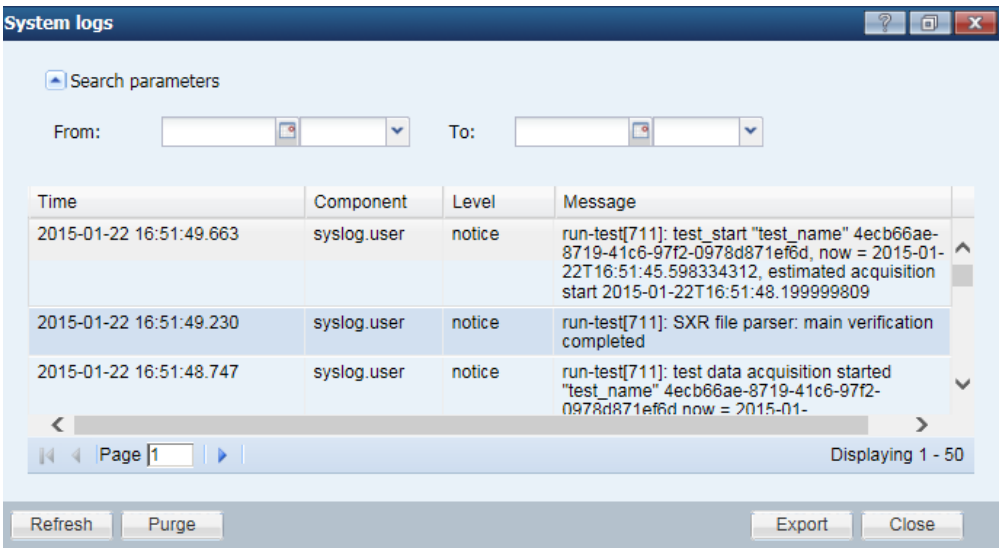
Diagnostic Messages
There are three types of diagnostic messages:

	Informational message. These are friendly reminders or additional information to help configure setups. They have no impact on test runs.
	Warning. This indicates a possible error. Warnings may or may not cause problems with the test engine. They may also indicate configuration inconsistencies or ambiguities. Users should investigate these warnings carefully and take any action if necessary. Depending on system preferences, a test run may or may not be started with warning level errors.
	Error. These are errors that prevent a test run from being started.

Diagnostic messages are recalculated upon completion of individual values. In the case of a spreadsheet interface, re-validation takes place only after the cell is completed and focus moves away from that cell. While the cell is considered to be in edit mode, no validations take place.

Upon a cell changing, the setup as a whole is validated. All channels are iterated and the rules applied at every level. If any defaults or rippling of data due to a change in a cell, then this will be done before the validation process starts. If the validation finds any errors or messages, it highlights the appropriate cell/rows and adds a message to the diagnostic messages list. If existing errors have been addressed and no longer need to display, the color and the message will be removed from the list.

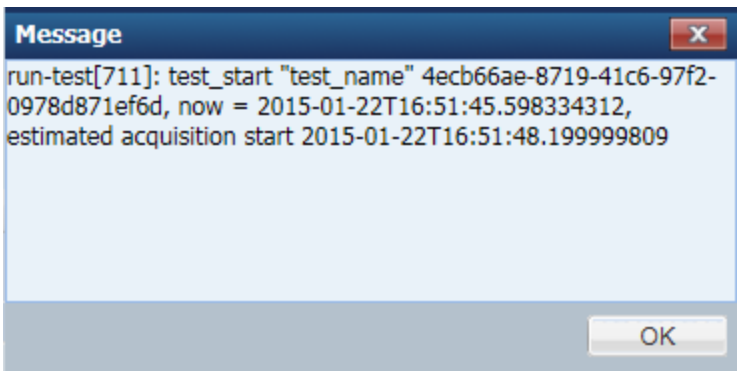
System Logs
The system log contains many of the system level messages for various tasks, events and exceptions encountered. The log is particularly helpful for support purposes, but may be useful to authorized users.



NOTE
The log shows only those messages considered most useful to a typical user. Though not displayed, all other log entries are considered when exporting or purging entries.

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
By default, the system displays 50 entries, you can change this setting User Preferences.

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.

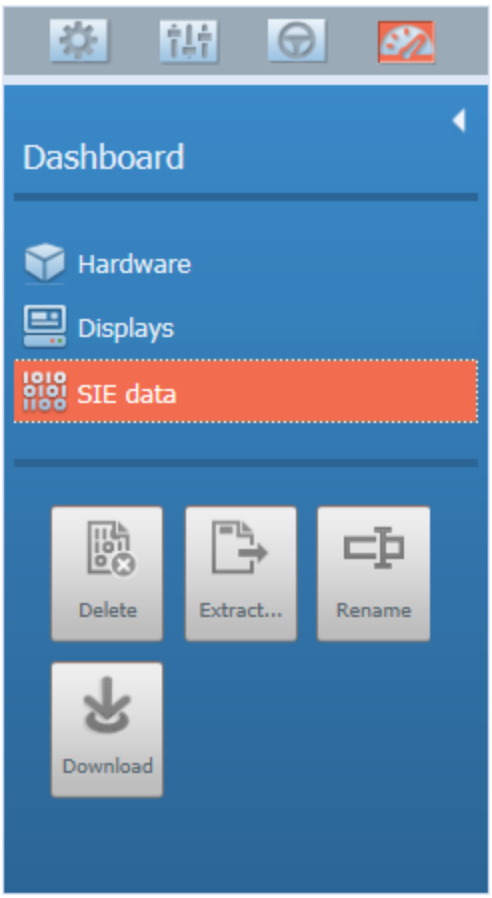
Purging the system log
Click **Purge** to delete all log entries from the system. To specify which entries to purge, use the date and time filters first.

Export Log File

Enter the desired file name and click Export.

6.2.3 Task Pane

The Task Pane on the left that controls the operations to perform on the form to the right.



The Task Pane contains widgets appropriate to the current page. This is generally not a navigation pane, but more of an action/task pane. You can select and operate on items using available components.

Typical entries you see in a Task Pane are:

Menu Options
A list of different options related to the active page. Only one option can be current. As you select the options, the form to the right renders content as specified by the option you select. The current option is denoted by an orange background. This list is different depending on a users permission levels.

Buttons
There could be a series of buttons in a “Tile” style format. These too are context sensitive and may display, enable or disable according to the option you select and/or the state of the panel on the right side.

Miscellaneous widgets
It is possible to see a variety of different widgets in this pane at the same time. You can use widgets to select entries or display lists.

This Task Pane is always visible by default and has a fixed size. It shrinks and grows vertically depending on the browser window and the options shown. Horizontally, it is always the same width but you can resize it. It can be “minimized”. Click the **arrow icon** on the top right hand corner of the task pane to minimize it. Once minimized, an expand icon appears allowing you to maximize it. This icon is typically on the top left corner of the main panel.

In a minimized state, no content for the task pane is shown. To maximize the pane, click the **maximize** icon. The maximize/minimize state of the task pane is remembered for the current panel and its state redisplays in future sessions.

The task pane does not honor the search bar. Regardless of what you enter, the toolbar’s search box will not effect in the task pane.

6.3 Spreadsheet Interface

You use a spreadsheet interface when dealing with multiple rows that share common columns and is targeted towards meeting the needs and features of the CX23-R.

The spreadsheet allows you to see many rows and columns at once and navigate using the keyboard or mouse. Spreadsheets can be read-only or editable. They can be filtered, sorted, and configured different ways.

This section documents features available when using certain spreadsheets. Some forms may impose restrictions or rules on what can and cannot be done within a spreadsheet. The topic is a general overview on how to interact with spreadsheets and what their behavior is. The spreadsheet interface is nothing more than a smart grid with intelligence built in relative to the context in which it is being used.

6.3.1 Anatomy of a spreadsheet

A spreadsheet (grids) consists of rows and columns. The intersection of rows and columns is a cell. A cell can contain any value that can be visually represented. This includes different rendering types such as text, combo boxes/lists, check

boxes, or buttons. Regardless of what the contents of cells, the operations that can be performed on the spreadsheet is common.

Spreadsheets always have columns, which have column headings (titles). The headings are in a human readable form and subject to localization. The language chosen determines exactly what heading displays. The behavior and navigation will always be the same regardless of what the column names or titles.

There are no row numbers in spreadsheets. Usually all interaction is by column name and row selection. Since rows can be filtered or sorted, the row numbers will never remain the same. For these reasons, numbers are not shown.

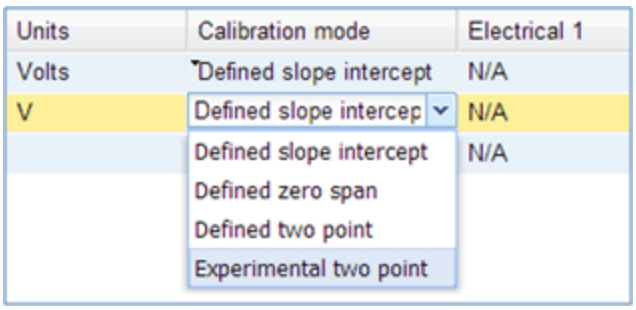
To aid in the visualization of rows within a spreadsheet, they are **zebra** stripped. Odd positioned rows are a light blue color while even positioned rows are a darker blue. The mouse-over color of a row changes to gray when the mouse cursor hovers over a row (read-only). When you it becomes the current row and changes to a medium blue color. The only exception to these colors is when the row contains Diagnostic Messages during setup configuration.

Spreadsheets can be editable and read-only. Editable spreadsheets allow you to manually edit individual cells. Depending on the renderer used, and what rules are allowed for that cell, the interface for the edit may be slightly different. But, you can change the cell values.Editable spreadsheets can change their size dynamically. You can insert or delete rows.

Read-only spreadsheets generally are static in size and contents. You cannot edit these and generally you cannot add or delete rows.

For example:

Editable spreadsheet



Read-only spreadsheet

Name	Description	Message ID
CITC16_00001_T08	CITC16_00001_T08	0x00000202
CITC16_00001_T05	CITC16_00001_T05	0x00000202
CITC16_00001_T13	CITC16_00001_T13	0x00000204
CITC16_00001_T15	CITC16_00001_T15	0x00000204

Spreadsheets are used when large volumes of similar structured rows are to be displayed and/or manipulated. They are used extensively in the CX23-R CX23-R web interface to display rows for users, profiles, networks, and channels.

When a spreadsheet is initially rendered, it is organized in a predefined way as deemed appropriate for typical use cases. However, you can customize spreadsheets. Depending on what is organized and where it is organized, the customizations made may actually persist. This means that the next time the same spreadsheet is rendered, it remembers the last settings and honors them. For example, the Channel Setup interface spreadsheet remembers all customizations made.

For spreadsheets where you can perform row operations, a “selection” column is automatically inserted. This is usually the very first column. This column has no heading text, but does have a “Select All” check box to select all or none by toggling the header check box. This column cannot be hidden, sorted, resized, or filtered. It operates exactly the same way in all the places where it is defined.

6.3.2 Interaction with a spreadsheet

The following lists all customizations you can perform on a spreadsheet. Interactions happen at the row, column, or cell level.

Resize column width

Column widths are initially predefined by the application when they are first rendered. You are free to change the size. To do this, “grab” the right side handle of the column header with the mouse and drag it to the required size. A thin vertical black line guides you to the new position.

If the value in a cell (including the header) cannot fit into the allocated width of the column, then ellipses (…) display for part of the value that cannot be shown. This is just a rendering visualization and is not part of the real value of that cell.

Order spreadsheet by column

By default, a spreadsheet is not ordered. The rows display in the order the application deems appropriate. You have the ability to re-order the entire spreadsheet by any column that permits ordering.

To order in column ascending order, click the heading of the column by which you want to sort. A small upward pointing arrow displays in the column header to indicate that row is sorted ascending. Click the column header again and it toggles to descending, reversing the direction of the arrow. You can repeat this process any number of times.

NOTE

Once user ordering has taken place, it is not possible to remove the sorting and revert back to its original rendered order. You need to re-select, re-render, or restart the form.

The sorting algorithm of the spreadsheets is aware of the type of values contained in columns and the order honors that type. Numerical values order numerically and date columns order by date.

Sometimes, it does not make any sense ordering a column – like a column for check boxes. In this case, ordering that column is inhibited.

Besides clicking the column header to sort,you can also mouse-over the right of the column header to reveal a drop-down menu where sorting.

Hide/Show columns
The columns shown in a spreadsheet are those that the application sees fit to show. You can customize the columns you do want to see and those that do not interest you. For those of no interest, select to "hide". The column still exists, contains values, and persists, they are just not shown at that particular time.

To hide and show individual columns, navigate the mouse to the right of the column header where a drop-down context menu displays. Use the menu option for Columns. Navigate to the right of that option and a list of all currently available columns displays. You can select or unselect columns you require. Selections made reflect immediately in the underlying spreadsheet.

There are two restrictions to selecting and unselecting columns:

1. There must always be at least one visible column
2. You cannot select columns that are not in the list

Click outside the columns list to close it.

Move rows
Where permissible, you can move rows within a spreadsheet. For single row moves, click and drag the row to the desired location. For multiple row moves, select each row be checking the Select check box and drag the entire selection to the desired location. The rows move in the order selected. If the rows where checked in the order 3, 2, 5, 1 and dragged to the end of the list, then that is the order they will be moved to the end: 3, 2, 5 and 1.

To aid in exactly where the moved rows will be dropped, a dotted blue line displays as you hover the mouse cursor over the rows while dragging is taking place. This dotted line determines the drop location. It will either be before a certain row, or after a certain row. While this is taking place, a text with the number of rows being moved displays.

NOTE
There is no keyboard support for performing row move operations.

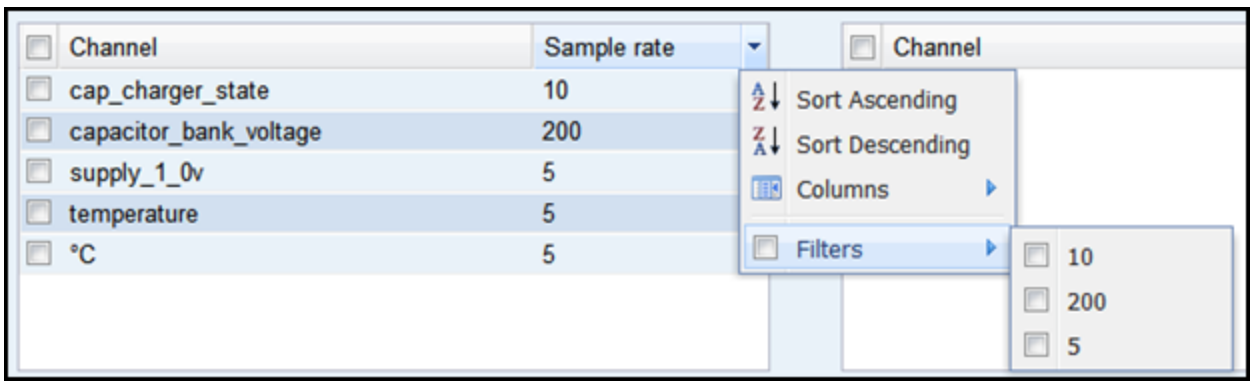
NOTE
You cannot initiate a drag operation by clicking on the selection check box. You must click on any other part of the row for the drag operation to start. Use the selection check box for selection as cannot use it from which to drag .

Filter rows by columns
Some columns allow the selection and/or filtering or rows as defined. Click the down arrow to the right of the column header and the context menu displays a Filters option. You can turn on and off Filters by clicking the Filters check box, or

drill down further to select specific filtering.

The filtering interface may be different for different columns. Where appropriate, a specific renderer may be used. For example, filtering for a name may be a text field, whereas filtering for sample rates may be a pick list .

Once you apply a filter by column, that column's header text displays in bold italics.



Row actions

Some spreadsheets allow you to use the right-click context menu. This is a short-cut that generally simulates the checking of a row and performing an operation. If appropriate, when you right-click a row, a context menu display the actions that you perform. Selecting an option to perform that action.

The operations you can perform on rows are usually denoted by buttons in the Task Pane. This is a good guide to tell if you can use right-click short cuts.

NOTE

The right-click context menu displays and applies to a single row only. This is the row the mouse was on when it was clicked. It is not possible to operate on multiple rows using this method.

Navigation

For read-only spreadsheets, navigation and access to individual cells is not permitted. It is not possible to traverse the spreadsheet by cells. The only way to navigate is to use the horizontal and vertical scroll bars to reposition the viewing area.

Editable spreadsheets offer greater navigational abilities. Not only can you reposition the viewing area, you can navigate at the cell level. Navigating to a cell in an editable spreadsheet has two modes: In-Focus and Out-Focus.

In-Focus means that the cell has focus and you can change the value. Usually this is indicated by the mouse cursor in the field or by the existing value being automatically selected. This happens when you click that cell with your mouse, or when you navigate away from editing a cell to another editable cell.

Out-Focus means the cell has focus and you can edit it, but you are not currently in edit mode. This displays by a solid light blue box over the entire cell. This

usually occurs when you navigate away from a non-editable cell to another cell using the keyboard. You can click that cell or press Enter to start editing that cell.

You can perform navigation using the mouse or the keyboard. The keyboard navigation includes:

Keyboard	Description
Arrow up	If in a read-only cell, position to the same cell in the previous row. If no previous row, stay where you are. If in an editable row, move within the renderer in that cell. For example, if the renderer is an edit box, do nothing. If the renderer is a list, navigate that list.
Arrow down	If in a read-only cell, position to the same cell in the next row. If no next row, stay where you are. If in an editable row, move within the renderer in that cell. For example, if the renderer is an edit box, do nothing. If the renderer is a list, navigate that list.
Arrow left	If in a read-only cell, position to the previous cell in the same row. If no previous cell, go to the last cell in the previous row. If in an editable cell, move the cursor to the left of the existing value. If already positioned to the left most character of that field, move to the previous cell.
Arrow right	If in a read-only cell, position to the next cell in the same row. If no next cell, go to the first cell in the next row. If in an editable cell, move the cursor to the right of the existing value. If already positioned to the right most character of that field, move to the next cell.
Tab	Go to the next cell. If no next cell in that row, go to the first cell in the next row. Keep the same focus mode you were last in. If in Out-Focus mode, the next cell will be in Out-Focus mode. If in In-Focus mode, the next cell will be in In-Focus mode.
Shift Tab	Go to the previous cell. If no previous cell in that row, go to the last cell in the previous row. Keep the same focus mode you were last in. If in Out-Focus mode, the next cell will be in Out-Focus mode. If in In-Focus mode, the next cell will be in In-Focus mode.
Home	Go to the first page in the spreadsheet.
End	Go to the last page in the spreadsheet.
Page Up	Go to the first row of the spreadsheet.
Page Down	Go to the last row of the spreadsheet.
Enter	For read-only spreadsheets - nothing. Switch between In-Focus and Out-Focus.

Cell Editing

For spreadsheets that allow editing, you can edit individual cells using any renderer that the application makes available. Currently, you can edit:

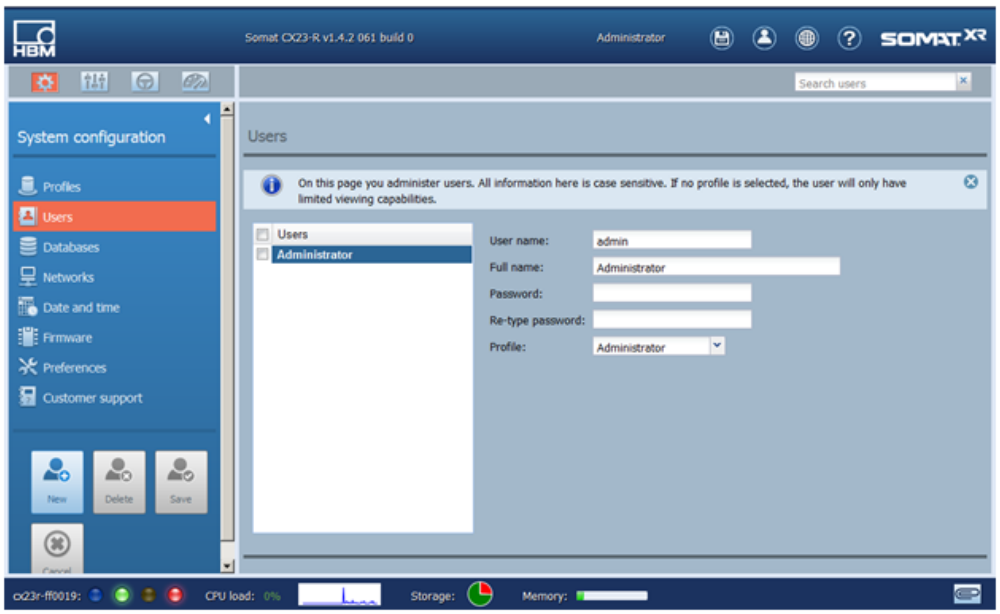
- **TextField**: Single line text editor
- **Combo List**: List where you can select one option
- **Editable Combo Box**: List where you can select one option, but you can enter a value outside that list
- **Check Box**: A box that denotes if it has been checked or not
- **No Editor**: This cell has been restricted from any input

It is very common that when a cell changes, certain rules and validations will be applied to it to make sure that it is a valid value. These rules only act on the cell when editing is complete. The completion of a cell edit is defined by when the cell loses the In-Focus mode, such as when you press Enter or when navigating away from this cell. This is the only time the edit is considered complete. Attempting to save changes before a cell is considered complete may result in that cell not being saved. It would be good practice to press Tab upon the completion of any cell edits.

When an editable text field cell gains focus, the selection of that cell's value is determined by a User Preferences "Select cell text on focus". If this preference is set (checked), the entire cell's text is automatically selected and any input replaces all the selected text. If this preference is not set, no text is selected and the editor cursor is positioned to the end of the text in that cell.

6.4 System Configuration

The Profiles, Users, and Networks maintenance panels share a similar interface for adding, changing, and deleting records.



A list to the right of the Task Pane shows all records that exist for the selected menu option. The list has the appropriate name and you can be resize it horizontally. Resizing of the list is not persisted and the screen reverts to the

default size the next session. The current record highlights with a solid blue band. This list displays the description in alphabetical ascending order.

The **Search** filter at the top right of the toolbar applies to the entries in the list. The list shrinks and grows as you change search criteria. The current record always displays, regardless if it matches the search filter or not.

You edit new or existing entries on the right side of this page (sandbox). Manipulation of data in the sandbox directly controls other parts, such as buttons on the header as well as the Task Pane. As soon as changes are made, the appropriate buttons are enabled or disabled. Every keystroke edit, mouse edit, or pasting constitute a change. If you make any changes since the last save, the record is considered "dirty". You must save a dirty record before navigating away.

You can **Delete** records at any time. Select the check boxes next to the names to delete multiple records. Once you delete, there is no way to restore them other than manually re-entering them.

These buttons are context sensitive and disable and enable as the context changes. If an option has no significance or is out of context, it is not available. Buttons include:

New
New record. This is not enabled if there is a record in the middle of a change. When selected, it displays a panel of all the fields appropriate for the record you are creating.These fields will be blank unless there is a default. There will not be a current record while in "new record" mode, so there is no a blue band in the list of records. Once you save the record, it becomes the current record display the blue band.

Delete
Deletes the record(s) you select. Select the records check box next to the item you require. You can only delete records you select. If you do not select any records, the **Delete** button is not enabled.

If user preferences state that confirmations are required, then a confirmation dialog displays before the delete takes place. You can cancel or confirm the delete.

Once deleted, the record drops off the list and the first record in the list becomes the current record. If there are no records, there is no current record and only the New button is available.

Save
This saves any changes made to a new or existing record. The **Save** button is active only if you have made changes. If the application deems that nothing has changed, this button is not available.

If there are any validations to perform, they occur. If errors are found, they display and you need to correct before continuing. No persistence takes place until you satisfy all validations.

Cancel
Undo any changes to this record since the last update (Save). Use this when you

want to **Cancel** and revert the field's values to their last saved state and not save your changes. A confirmation dialog displays stating that you will lose any changes.

Should any changes made require that a reboot take place, a reboot button displays in the Task Pane. When these changes are made, the application automatically prompts to reboot the CX23-R. You can continue or choose to cancel and reboot manually. Note that there must be no other pending changes when a reboot is requested. If so, there will be a confirmation stating this.

6.4.1 Profiles

Profiles define what privileges can be assigned to users. Profiles can be created, updated and removed at any time.

Creating a Profile

To create a profile, click **New** in the Task Pane. Enter the desired values for the parameters and click **Save**.

- **Profile**: Enter a full description of the profile. This is the text that displays in the profiles list.
- **Hardware control**: If checked, users can add and control hardware on Hardware pages.
- **Test configuration:** Select if users can view, edit or have no access to test configuration. This includes Setup Maintenance, Channel Setup, Computed Channels and Data Modes.
- **Test control**: Select if users can view, start and stop tests, have full access to or have no access to Test Control.
- **SIE data files**: Select if users can view, rename/delete, download/upload, have full access to or have no access to SIE Data.
- **System configuration**: Select which system configuration pages users can access - Users and Profiles, Databases, Networks, CX23-R Firmware, System Preferences, or Customer Support.

Editing a Profile

To edit a profile, select the profile from the profiles list and change the parameters. Click **Save** in theTask Pane. 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** in the Task Pane.

If a profile is deleted, the profile is removed for all users. A user with no profile is given minimal access to the application and can only view the dashboard Hardware and Displays pages.

NOTE

The last administrator profile cannot be deleted. An administrator profile is a profile that contains the privileges to maintain users and profiles.

6.4.2 Users

The users page is where all users in the system are maintained. Users can be created, updated and removed at any time.

Factory default settings include one default user with a username of 'admin' and a password of 'password'. This can be changed or removed any time if it is not required.

NOTE
The default user should not be removed if user authentication is not required as set in System Preferences.

Adding a New User

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

- **User name**: Each user must have a unique user name. User names are case sensitive. Once a user is created, its user name cannot be changed.
- **Full name**: Enter the full name of the user. This is the text that is displayed in the users list.
- **Password**: A password is needed for the authentication process and must be supplied. Enter the desired password and then re-type the password exactly. A password can be any combination of letters, numbers or special characters. Passwords are cases sensitive and masked for security. There is no limit to how long the password can be, but an authorized user can configure the minimum required password length in the System Preferences.
- **Profile**: An optional profile assigned to the user. This must be a profile that has been previously created on the Profiles page. Only one profile can be selected per user. If no profile is selected, the user is given minimal access to the application and can only view the dashboard Hardware and Displays pages.

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.

To update the user password, the password must be re-typed exactly to be successfully changed.

Deleting a User

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

NOTE
The last administrator profile cannot be deleted. An administrator profile is a profile that contains the privileges to maintain users and profiles.

6.4.3 Databases

Use the Database page to import external databases. Databases are a set of predefined channels for predefined types of hardware or connectors. Currently

SomtXR supports CAN databases. Only users with the “Databases” privileges can to import, edit, and delete databases.

All databases already imported display in the Databases list. This is a tree like interface where databases are grouped by their hardware type. You can navigate around existing databases simply by clicking the database name (or type). The current database displays with a solid blue band over the name. To the right of the list, the database contents display.

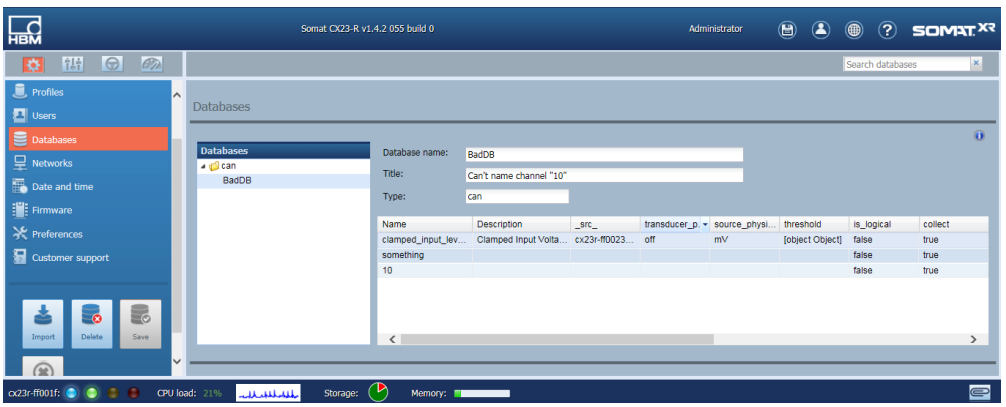
Databases are very similar to setup configurations as far as structure goes. They have summary information that contains fairly static information describing the database, as well as a list of channels with configuration parameters. This panel shows the database contents using a typical read-only Spreadsheet Interface style.

You can change some of the database’s static information including the database name and title. The name must conform to the standard setup name rules. This means that it cannot include any of the following characters: '"', '"', '\t', '/', '\', '|', ','

The content for the database varies depending on the type you select. Different hardware contains different parameters that can be configured. Different data from one database may not be the same as another. What is constant is that they all have summary information as well as channel and parameter data. The spreadsheet interface is very generic that knows nothing about the channels it contains. There are no special rules or logic in the rendering of this table. Columns are created and display as they exist in the imported database.

The Task Pane contains four buttons to administer databases – Import, Delete, Save, and Cancel

Previously imported databases display in the databases list. Click **Databases** and click the database name to display the contents.



You cannot change databases directly and all information displays in the content panel as read-only. You can edit channels during test configuration.

Importing a Database

You can import a database file from any local or external device, such as a thumb drive. In any case, the file must be visible from the client machine. Once imported, the new database displays in the list under the appropriate hardware type.

To import a database, click **Import** in the Task Pane. Browse for and select the database file and click **Import**. Once imported, the new database displays in the databases list.

NOTE
Only the contents of the file (configuration) and not the actual database loads on the CX23-R device.

See help on Import Database for more information.

Deleting a Database
To delete a database, select the desired database and click **Delete**. If user preferences state that confirmations are required, confirm the delete at the prompt.

Once deleted, the first database in the list becomes the current database. You cannot restore a databases you delete but must re-import the file. However, you lose any changes made to the summary information and need to manually edit it.

Save
Click **Save** if you made any changes to the database name or title. Save makes all changes to the current database permanent.

Cancel
Click **Cancel** to revert any changes made to the current database back to its last state (as it existed before you made any changes). A prompt displays to indicate the changes made will be lost if you choose to continue.

Once you make changes to a database configuration, you must save the information before navigating away from that database record. If attempting to navigate away while unsaved changes exist, a warning message displays. Continuing from here will not save the changes and they will be lost.

Import Database
Click the **Import** button from the **Databases** form in System Configuration. Use the Database page to create a new database file based on the contents of the local file you select.

Click **Browse** to activate the file chooser. The file chooser varies from one browser to another, but they all enable you to select a file from the local machine or network.

The file name chosen must be in UTF-8 format. The extension name of the file is not used and could be anything. However, the system will only recognize files in the dbc standard formats.

When importing databases, an option is provided to instruct the importer on how to construct the signal name. Allowing extended names will prepend the description to the name, while not allowing extended names will leave the signal name as is. A double colon (::) will be inserted between the description and the signal name if extended names is selected. All signal names must be unique. If duplicate signal

names are encountered, they will be made unique by appending sequential number preceded by the pound sign (#).

After you select a file, click the Import button. This triggers the import process which reads the file, validates the format, and creates the database configuration exactly as defined.

Should there be any problems with the file, or should the content not be in the correct format or type, an error message displays and the import aborts. Should this be the case, no import takes place and no new database is created. Either the process completes in its entirety, or the process does nothing. The system will never create a partial database configuration file.

Upon the successful import of a database file, the database tree contains the newly imported database. If no database edits are pending, the imported database becomes the current database.

If warning errors occur in the import process, The System Logs the issues and an informational dialog displays.

6.4.4 Networks

Network configurations determine how the CX23-R boots up and how it communicates with the browser. You can define many network configurations at any one time, but only the active configuration is considered at boot time.

Changing the CX23-R Host Name

Change the CX23-R host name on the networks configuration page. There can only be one host name assigned for each CX23-R device.

Defining a New Network Configuration

Click **New** in the Task Pane and define the new configuration. Enter the appropriate parameters:

- **Network**: Enter a full description of the network. This is the text that displays in the networks list.
- **Active indicator**: There must be one and only one active network configuration. The factory bootstrap process creates one default configuration that uses dynamic addressing from a DNS server. If this fails, the system sets the IP address to the default 192.168.100.101.
- **IP address assignment**: Select the type of IP address. This can be either Static or Dynamic. For static assignment, enter correctly formatted IPV4 or IPV6 address, Subnet mask, Default gateway, and Broadcast values. The Broadcast value automatically calculates if you provide a valid IP address and subnet mask.
- **DNS server assignment**: Manually format the Preferred DNS Server and Secondary DNS. These settings are only applicable for static IP address assignment.

Click **Save** to save the new configuration. To make the new configuration the active network configuration, check the active indicator on the new configuration and unchecked for all other configurations. Then click **Reboot**.

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

Modifying a Network Configuration
To edit the parameters of an existing network configuration, select the configuration from the networks list and change the parameters as necessary. Then click **Save**. If modifying the current active network, click **Reboot** to apply the changes.

Deleting a Network Configuration
To delete an existing network configuration, select the configuration from the networks list and click **Delete**. You cannot delete either the current active network configuration nor the default network configuration.

NOTE
The status of a network configuration is only accurate if the system is rebooted upon changing it. If not, then it will only represent what will be active when the system is rebooted. It does not indicate the active network currently used by the system in the event it was changed.

6.4.5 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 time according to a connected GPS device or the host PC. Alternatively, manually set the date and time by typing in the desired values or using the calendar widget.

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

Click the **Update** button in the Task Pane to validate and save these settings. The new time and date are immediately changed in the device.

6.4.6 CX23-R Firmware

The Firmware page provides the interface to upgrade device firmware to the newest version.

Updating Firmware
To update the CX23-R firmware, download the image file from www.hbm.com.

After download, click the **Browse** button and select the image file. Click **Update** in the Task Pane to begin the firmware upgrade.

CAUTION
During a firmware upgrade, allow the process 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.

During the upgrade process, no navigation is available. Once complete, the use of the application can resume. The header updates to reflect the new version of the firmware.

6.4.7 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 the change need to log out and log back in for the settings to take effect.

System
Specify the **Sample rate domain** as either Decimal or Classic. The sample rate domain controls the sample rates and associated digital filter types and frequencies when configuring input channels. This setting determines the sample rate domain for new test setups, which you cannot change. The default setting is Decimal, which includes typical sample rates of 5000, 2500, 1000, and 500 Hz. In the HBM 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 8388608/8388608.

NOTE
Select the applicable **Aux connector mode** - VBM, Sync Clock or ECM - to specify what type of hardware is connected to the CX23-R auxiliary port.

Select the default **Bridge shunt 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.

NOTE
You cannot change the default polarity for the 3-wire quarter bridge configurations.

In the **Exception Handling** section, set the **Max number of test restarts on error resets**. If a test unexpectedly ends or the CX23-R loses power during a test

run, the system attempts to rerun the test after a restart. Enter a value between 0 and 5. If the value is zero, the system does not attempt a test restart.

Click **Download certificate** to download the calibration certificate as a PDF file.

User
Select the **Authentication required** option 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 credentials have not been changed from the factory settings.

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.

Select the **Default language** for each new user. Once logged in, users may change the interface language at any time.

Test
Select the **Allow test run if warnings exist in setup** option to start a test run when warnings are present. If deselected, test runs do not start until warnings are resolved.

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.

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

6.4.8 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 nature and potentially destructive nature.

There are two options available:

Download customer support package
This takes a snapshot of the state of the system at a point in time. It creates a package that you can send 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.

All users are able to generate this support package.

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.

Once you click this option, a warning dialog displays advising the user of the consequences. At this point in time, the user can cancel out of this process, or continue.

If the user chooses to continue, a customer support package generates and a dialog displays. The package contains a snapshot of all the databases that you are about to delete. It is critical that allow this download to continue and the file downloaded to a place for safekeeping. It is the only means to be able to revert the action about to be performed.

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.

At this stage, the user again has the option not to continue with the deleting of the databases. Should the user decide to continue, the databases id deleted and a reboot occurs.

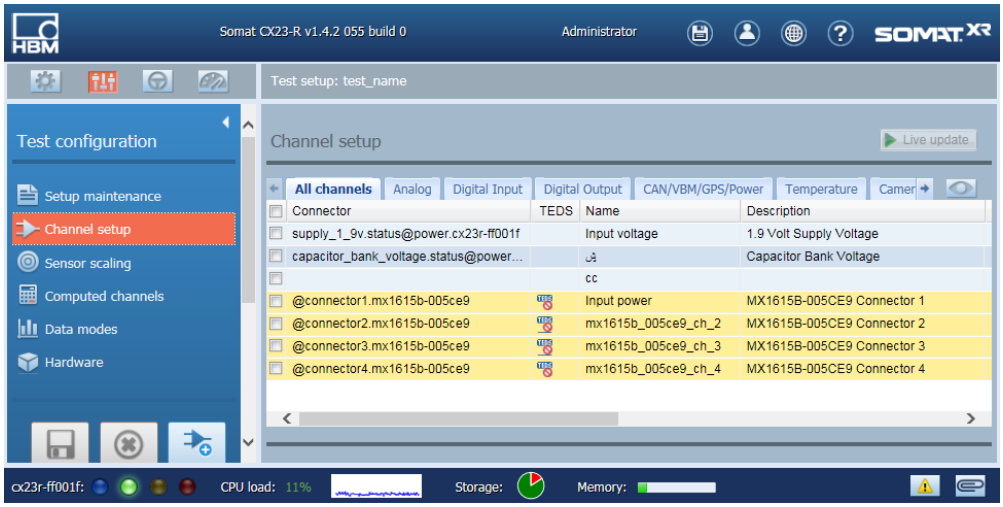
NOTE
At this time, the state of the CX23-R is almost set to factory settings. All users, profiles, system and user preferences, setups, and configurations have been deleted. The only user available is the default ‘admin’ user. The only network configuration is the default dynamic configuration.

Upon a restart, the user is automatically logged in with the default admin username.

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

6.5 Test Configuration

This toolbar option encapsulates everything to create and administer setup configuration file. You can for view, create, maintain, scale, export, and delete setup configurations.



The Task Pane contains all the options required including:

- **Setup Maintenance**: Create, save, delete, import, and export setups.
- **Channel Setup**: Add, change, copy, and delete channels as well as digital displays.
- **Sensor Scaling**: Perform Sensor scaling on selected channels.
- **Computed Channels**: Administer computed channel.
- **Data Modes**: Administer data modes.
- **Hardware**: View network hardware and control it.

Available options to view depend on privileges the user has been granted. If the user has absolutely no user privileges in test configuration, this toolbar option will not be available for selection.

6.5.1 Setup Maintenance

This is the starting point for creating, modifying, and deleting setup configurations. The Setups panel displays a list of the current setup configurations.

The summary editor for the selected setup is to the right of the list. The **Setup name** is mandatory and must be unique. The **Title**, **Author** and **Summary** fields are optional. Set the **Test start delay**, which is the time from when the test is requested to when it starts, between 0 and 17 seconds. The sample rate domain is displayed but cannot be changed.

The Test engine frame rate in Hz allows tests to run at maximum performance levels based on the channel sample rates defined in the setup. Select a test engine frame rate value from the list. The default is 5.

Creating a Test Setup

There are several ways to create a test setup.

- **New**: Click **New** in the Task Pane to create a new test setup with default values. The new setup appears in the setups list as *test_name*.
- **Save As**: Click **Save As...** to duplicate the current test setup under a new name. It is not possible to replace an existing setup.

- **Import**: 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
Check the box next to a single setup or multiple setups and click **Delete** to permanently delete the setup(s) from the device. You cannot recover a deleted setup.

Exporting a Test Setup
Select a setup and click **Export** to save the setup to the local machine. You can only select one file to export. Currently, only the.sxr format is supported. This is a text file containing setup configuration in a json format. Exported setups may be imported to another device as is or after modification.

Save setup configuration as...
Enter a new setup name and click **Save**.

Import test configuration
Click the **Browse** button to select the test configuration to be imported and click **Import**. The format must be valid json and the syntax valid setup configuration.

Export test configuration
Enter the desired file name and click **Export** to save the file to the local machine. Currently, only .sxr format is supported. This is a text file containing setup configuration in a json format.

6.5.2 Channel Setup

The Channel Setup page provides the interface to add, modify, and remove input channels of all types. View all channels in the selected setup or filter by channel type using the grid tabs.

Adding Input Channels
There are two options to add an input channel.

- Click **Add** in the Task Pane to add a new blank channel.
- Click **Copy to...** to duplicate an existing channel. This copies the parameters from the existing channel and pastes them into the selected new channels.

You can add channels from a number of sources. These sources are arranged in a tree style component that you can be expand and collapse to the desired level. Select the check box at any branch level to show the available channels at and below that level.

NOTE
You must select the check box next to the channel for functions to be available.

This tree contains the different types of sources from which to select channels:

- **Hardware**: Discovered hardware and databases on the network.
- **Setups**: Existing setup configurations on the connected device.

As you select source branches, their available channels display in alphabetical order (by connector) and grouped by source. Only unique and available channels display. If a channel has already been selected, does not display.

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

Copying Channel Properties
To copy the properties from one input channel and paste them into another channel of the same type, select the channel to copy and click **Copy** in the Task Pane.

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.

To paste the copied parameters into a different input channel, select the target channel and click **Paste**. You can only past parameters into channels of the same type. For example, you cannot paste DIO parameters into analog channels.

Changing Device Hardware
You can change the hardware to which a group of channels connects. This is useful if you import a setup configuration file from a different device or if you use the same setup after swapping hardware.

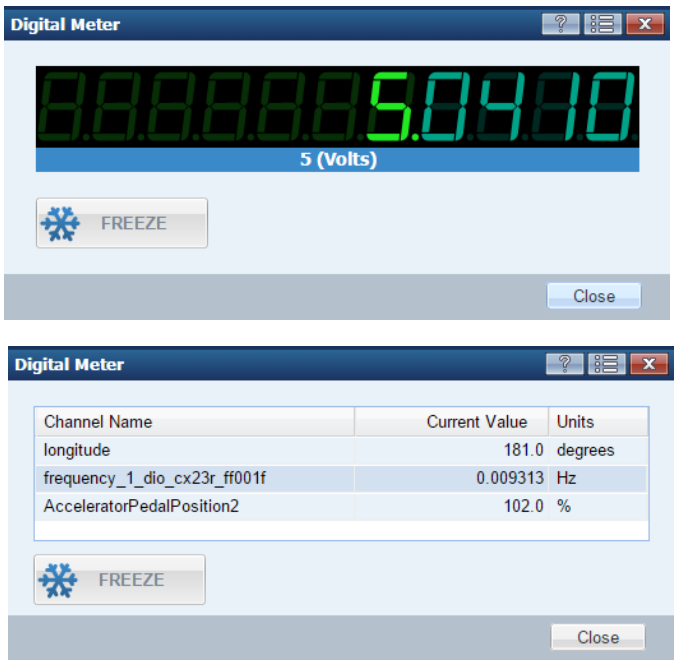
To change the device, select a single channel or multiple channels and click **Change device**.

The dialog displays a list of the hardware that you can change. Click **Change device** and enter or select a value in the New Device column and click **OK**. For CAN channels, you can change the CAN connector.

NOTE
In most cases, you cannot change the connector using this process. Instead, remove the channel and re-add it using the correct connector.

CAUTION
Attempting to supply inappropriate values for the device name results in errors 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**.You cannot display Digital meters while a test is running.



Select Channels
You can add channels from a number of sources. These sources are arranged in a tree style component that you can be expand and collapse to the desired level. Select the check box at any branch level to show the available channels at and below that level.

NOTE
You must select the check box next to the channel for functions to be available.

This tree contains the different types of sources from which to select channels:

- **Hardware**: Discovered hardware and databases on the network.
- **Setups**: Existing setup configurations on the connected device.

As you select source branches, their available channels display in alphabetical order (by connector) and grouped by source. Only unique and available channels display. If a channel has already been selected, does not display.

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

Copy Select
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.

Change Device
The dialog displays a list of the hardware that you can change. Click **Change device** and enter or select a value in the New Device column and click **OK**. For

CAN channels, you can change the CAN connector.

NOTE
In most cases, you cannot change the connector using this process. Instead, remove the channel and re-add it using the correct connector.

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

6.5.3 Sensor Scaling

Before a test can be started, most channels must have the sensor scaling defined. These channels are displayed in the sensor scaling grid for easy navigation and editing. To configure a channel for sensor scaling, supply a **Sensor scaling mode**.

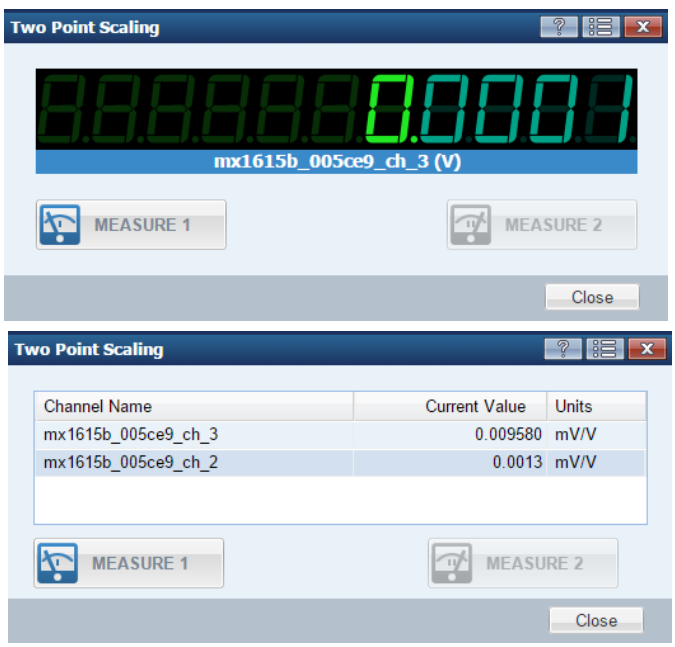
Defined Slope Intercept
Specify the **Slope** and **Intercept** of the scaling line.

Defined Zero Span
Specify the **Slope** 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.

Experimental Two Point

Select the channel or channels and click **Two Point Scaling** in the Task Pane. The system sets Electrical 1 and Physical 1 to zero, Electrical 2 and Physical 2 to one, Intercept to zero, and Physical units to the Electrical Units value.



Initially, the readout displays the current reading of the channel(s), as per the parameters defined, but with the following experimental two point scaling defaults:

- Physical units and output units will be set to the electrical units
- Electrical 1 and physical 1 will be set to 0
- Electrical 2 and physical 2 will be set to 1
- The scaling zero intercept will be set to 0

There are two buttons, labeled **MEASURE 1** and **MEASURE 2**, that capture the two readings. These readings will be populated into the electrical 1 and 2 respectively.

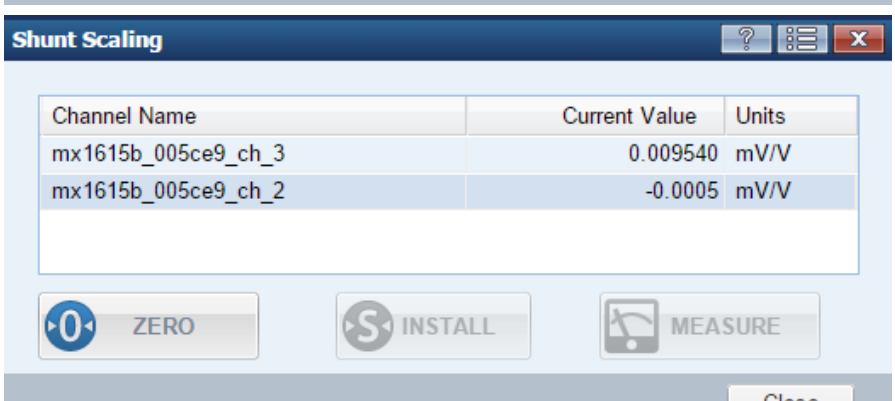
The first measurement will need to be taken before the second one can be taken. Once they are both selected, exiting the dialog will automatically update the setup configuration with these two values. Not completing the entire process, or canceling out will not perform the measurements and will revert any and all experimental values to their original values.

Once the first measurement is taken, the second one can be taken. It is not possible to read the first measurement again with restarting the scaling from the beginning. Either cancel out of the scaling, or complete it and restart it again. There are no limits to how many times the scaling process can be started/completed.

Internal Shunt Resistor

Set the **Shunt polarity** to Down scale or Up scale.

Select the channel or channels and click **Shunt Scaling** in the task pane. The system sets Physical span to one, Electrical zero to zero, Electrical span to one, Intercept to zero, and Physical units to mV/V.



Initially, the readout will display the current reading of the channel(s), as per the parameters defined, but with the following shunt scaling defaults:

- Physical units and output units will be set to “mV/V”
- Physical span will be set to 1
- Electrical zero and electrical span 0 and 1 respectively
- The scaling zero intercept will be set to 0
- The shunt deviation will be initially set to blank
- The excitation mode will be set to AC 1200 Hz square
- The excitation range will be 2.5 v for bridge resistance < 300 Ohm, else 5.0 v

There are three buttons, labeled **ZERO**, **INSTALL** and **MEASURE**. When the test is initially started, all shunts will be removed, the current readings displayed, and the zero button enabled. The install and measure will be grayed out at this time.

The user will select the zero button as the first step in completing the shunt scaling. It will proceed to collect readings for these unshunted values for all channels selected. These unshunted values will then be used to set the zero offset and re-start another test with these new parameters. Once the test has started, the readings should be close to zero.

At this time, the Install button will be enabled as well as the **ZERO** button. The user can repeat the balance or proceed to install shunts by clicking the install button. If the install button is pressed, the shunts will be installed as per the polarity defined on each channel. The zero and install buttons will be disabled and the measure button will be enabled.

It is recommended that the user wait until such time that the installed shunts readings stabilize before selecting to measure. The shunts will cause a spike that results in “ringing” of the readings due to the signal conditioner front end filtering and digital filtering. This can easily be seen in the digital readout display. At that time, the measure button can be clicked.

Now that shunts have been installed and readings stabilized, the measure button can be clicked to record the shunted values. These unshunted and shunted values measured will populate the electrical zero and electrical span respectively in the setup configuration. The prerun balance offset will be set to zero.

The shunt deviation can then be computed.

Strain Gage
Specify the **Strain gage factor** and **Bridge factor**.

Internal
Internal control.

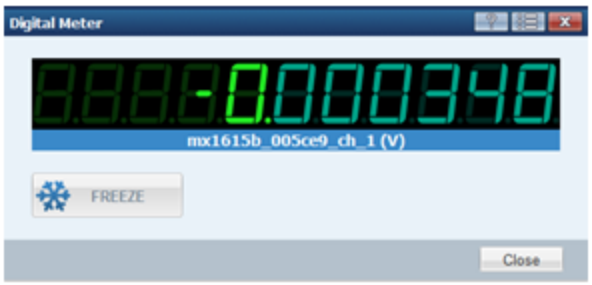
Copying Sensor Scaling Properties
It is possible to copy the properties from one input channel and paste them into another channel of the same type. To do this, select the channel to be copied and click **Copy**. Select the parameter to be copied and click **OK**.

To paste the copied parameters into a different channel, select the target channel and click **Paste**.

Single Channel Digital Meter

The sensor scaling single channel digital meter displays the current value of the selected channel including:

- **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.
- **Control**: Open the Shunt Control dialog.



There is also an option to **Freeze** the readings at their current values.

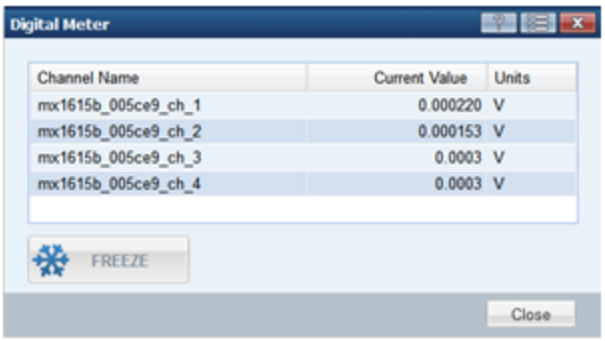
NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Multi-Channel Digital Display

The sensor scaling multi-channel digital meter displays the current values of the selected channels including:

- **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.
- **Control**: Open the Shunt Control dialog.



There is also an option to **Freeze** the readings at their current values.

NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

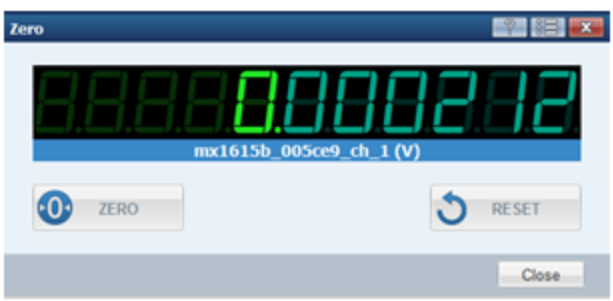
NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Single Channel Zero

Use this dialog to display and adjust the pre-run balance offset, so that the reading will be as close as possible to the pre-run zero target. By default, the zero target is set to zero, but it can be changed to reflect any value.

The sensor scaling single channel digital meter displays the current value of the selected channel including:

- **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.
- **Control**: Open the Shunt Control dialog.



Initially, the readout will display the current reading of the channel(s), as per the parameters defined. This reading can then be fine-tuned by applying the **ZERO** button. The display will respond by performing the following:

- Read the current reading
- Stop the currently running test
- Apply the reading to the prerun balance offset
- Restart another test with newly updated parameters

The display now should read pretty close to zero (or whatever the target value is set to).

There is also a **RESET** button. This will simply clear any previous zero scaling previously performed. In effect, it will set the **RESET** prerun balance offset to zero and restart a new test with that value. The display should then read the normal value again.

The **ZERO** and buttons can be pressed as many times as desired. There is no restriction in the order or number of times they can be applied.

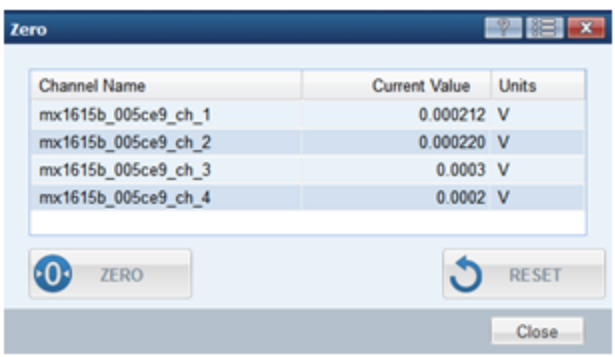
NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Multi-Channel Zero
Use this dialog to display and adjust the pre-run balance offset, so that the reading will be as close as possible to the pre-run zero target. By default, the zero target is set to zero, but it can be changed to reflect any value.

The sensor scaling multi-channel digital meter displays the current values of the selected channels including:

- **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.
- **Control**: Open the Shunt Control dialog.



Initially, the readout will display the current reading of the channel(s), as per the parameters defined. This reading can then be fine-tuned by applying the **ZERO** button. The display will respond by performing the following:

- Read the current reading
- Stop the currently running test
- Apply the reading to the prerun balance offset
- Restart another test with newly updated parameters

The display now should read pretty close to zero (or whatever the target value is set to).

There is also a **RESET** button. This will simply clear any previous zero scaling previously performed. In effect, it will set the **RESET** prerun balance offset to zero and restart a new test with that value. The display should then read the normal value again.

The **ZERO** and buttons can be pressed as many times as desired. There is no restriction in the order or number of times they can be applied.

NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Single Channel Shunt Scaling
For MX1615B-R modules where the scaling mode is shunt resistor, this dialog will be used to perform shunt scaling. Furthermore, we are currently restricting shunt scaling to the no sense lines input modes. For these channels, the row will be highlighted in green to indicate that the channel is to be experimentally measured. This is just an informational message and has not impact on validations or test runs.

The sensor scaling single channel digital meter displays the current value of the selected channel including:

- **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.
- **Control**: Open the Shunt Control dialog.

Initially, the readout will display the current reading of the channel(s), as per the parameters defined, but with the following shunt scaling defaults:

- Physical units and output units will be set to “mV/V”
- Physical span will be set to 1
- Electrical zero and electrical span 0 and 1 respectively
- The scaling zero intercept will be set to 0
- The shunt deviation will be initially set to blank
- The excitation mode will be set to AC 1200 Hz square
- The excitation range will be 2.5 v for bridge resistance < 300 Ohm, else 5.0 v

There are three buttons, labeled **ZERO**, **INSTALL** and **MEASURE**. When the test is initially started, all shunts will be removed, the current readings displayed, and the zero button enabled. The install and measure will be grayed out at this time.

The user will select the zero button as the first step in completing the shunt scaling. It will proceed to collect readings for these unshunted values for all channels selected. These unshunted values will then be used to set the zero offset and re-start another test with these new parameters. Once the test has started, the readings should be close to zero.

At this time, the Install button will be enabled as well as the **ZERO** button. The user can repeat the balance or proceed to install shunts by clicking the install button. If the install button is pressed, the shunts will be installed as per the polarity defined on each channel. The zero and install buttons will be disabled and the measure button will be enabled.

It is recommended that the user wait until such time that the installed shunts readings stabilize before selecting to measure. The shunts will cause a spike that results in “ringing” of the readings due to the signal conditioner front end filtering and digital filtering. This can easily be seen in the digital readout display. At that time, the measure button can be clicked.

Now that shunts have been installed and readings stabilized, the measure button can be clicked to record the shunted values. These unshunted and shunted values measured will populate the electrical zero and electrical span respectively in the setup configuration. The prerun balance offset will be set to zero.

The shunt deviation can then be computed.

NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

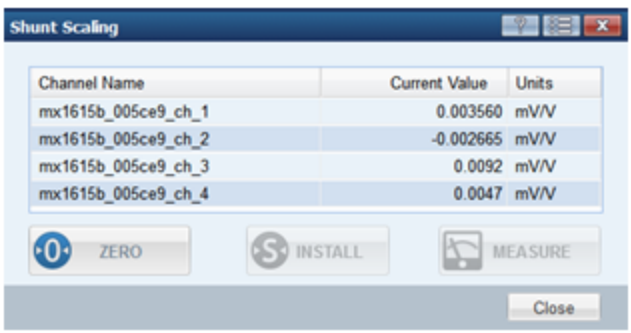
NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Multi-Channel Shunt Scaling

For MX1615B-R modules where the scaling mode is shunt resistor, this dialog will be used to perform shunt scaling. Furthermore, we are currently restricting shunt scaling to the no sense lines input modes. For these channels, the row will be highlighted in green to indicate that the channel is to be experimentally measured. This is just an informational message and has not impact on validations or test runs.

The sensor scaling multi-channel digital meter displays the current values of the selected channels including:

- **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.
- **Control**: Open the Shunt Control dialog.



Initially, the readout will display the current reading of the channel(s), as per the parameters defined, but with the following shunt scaling defaults:

- Physical units and output units will be set to “mV/V”
- Physical span will be set to 1
- Electrical zero and electrical span 0 and 1 respectively
- The scaling zero intercept will be set to 0
- The shunt deviation will be initially set to blank
- The excitation mode will be set to AC 1200 Hz square
- The excitation range will be 2.5 v for bridge resistance < 300 Ohm, else 5.0 v

There are three buttons, labeled **ZERO**, **INSTALL** and **MEASURE**. When the test is initially started, all shunts will be removed, the current readings displayed,

and the zero button enabled. The install and measure will be grayed out at this time.

The user will select the zero button as the first step in completing the shunt scaling. It will proceed to collect readings for these unshunted values for all channels selected. These unshunted values will then be used to set the zero offset and re-start another test with these new parameters. Once the test has started, the readings should be close to zero.

At this time, the Install button will be enabled as well as the **ZERO** button. The user can repeat the balance or proceed to install shunts by clicking the install button. If the install button is pressed, the shunts will be installed as per the polarity defined on each channel. The zero and install buttons will be disabled and the measure button will be enabled.

It is recommended that the user wait until such time that the installed shunts readings stabilize before selecting to measure. The shunts will cause a spike that results in “ringing” of the readings due to the signal conditioner front end filtering and digital filtering. This can easily be seen in the digital readout display. At that time, the measure button can be clicked.

Now that shunts have been installed and readings stabilized, the measure button can be clicked to record the shunted values. These unshunted and shunted values measured will populate the electrical zero and electrical span respectively in the setup configuration. The prerun balance offset will be set to zero.

The shunt deviation can then be computed.

NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Single Channel Two Point Scaling
Use this dialog to display and adjust the electrical 1 and electrical 2 values of any channel where the scaling mode is experimental two point. For these channels, the row will be highlighted in green to indicate that the channel is to be experimentally measured. This is just an informational message and has not impact on validations or test runs.

The sensor scaling single channel digital meter displays the current value of the selected channel including:

- **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.
- **Control**: Open the Shunt Control dialog.

Initially, the readout displays the current reading of the channel(s), as per the parameters defined, but with the following experimental two point scaling defaults:

- Physical units and output units will be set to the electrical units
- Electrical 1 and physical 1 will be set to 0
- Electrical 2 and physical 2 will be set to 1
- The scaling zero intercept will be set to 0

There are two buttons, labeled **MEASURE 1** and **MEASURE 2**, that capture the two readings. These readings will be populated into the electrical 1 and 2 respectively.

The first measurement will need to be taken before the second one can be taken. Once they are both selected, exiting the dialog will automatically update the setup configuration with these two values. Not completing the entire process, or canceling out will not perform the measurements and will revert any and all experimental values to their original values.

Once the first measurement is taken, the second one can be taken. It is not possible to read the first measurement again with restarting the scaling from the beginning. Either cancel out of the scaling, or complete it and restart it again. There are no limits to how many times the scaling process can be started/completed.

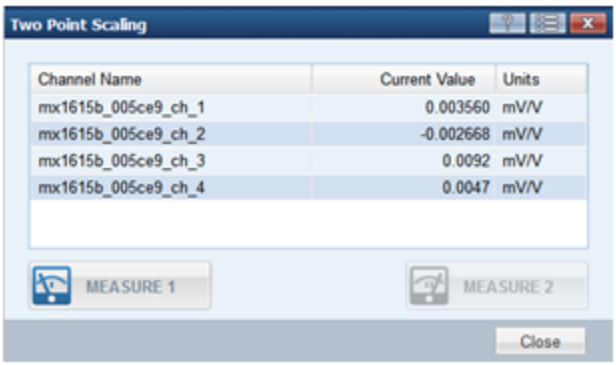
NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

Multi-Channel Two Point Scaling
Use this dialog to display and adjust the electrical 1 and electrical 2 values of any channel where the scaling mode is experimental two point. For these channels, the row will be highlighted in green to indicate that the channel is to be experimentally measured. This is just an informational message and has not impact on validations or test runs.

The sensor scaling multi-channel digital meter displays the current values of the selected channels including:

- **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.
- **Control**: Open the Shunt Control dialog.



Initially, the readout displays the current reading of the channel(s), as per the parameters defined, but with the following experimental two point scaling defaults:

- Physical units and output units will be set to the electrical units
- Electrical 1 and physical 1 will be set to 0
- Electrical 2 and physical 2 will be set to 1
- The scaling zero intercept will be set to 0

There are two buttons, labeled **MEASURE 1** and **MEASURE 2**, that capture the two readings. These readings will be populated into the electrical 1 and 2 respectively.

The first measurement will need to be taken before the second one can be taken. Once they are both selected, exiting the dialog will automatically update the setup configuration with these two values. Not completing the entire process, or canceling out will not perform the measurements and will revert any and all experimental values to their original values.

Once the first measurement is taken, the second one can be taken. It is not possible to read the first measurement again with restarting the scaling from the beginning. Either cancel out of the scaling, or complete it and restart it again. There are no limits to how many times the scaling process can be started/completed.

NOTE
For the meter to show accurate readings, the system starts a background test run for the duration of the digital display. No other digital displays or test runs can be started.

NOTE
MX modules output overflow values when no suitable connector is found. This is represented by a series of "+" characters on the display.

6.5.4 Computed Channels

Computed channels are data channels derived from one or more input channels or from previously defined computed channels. The computed channel grid displays all computed channels that have already been defined for the current setup. Several types of computed channels supported:

- Signal Calculator
- Integrator
- Up Sampler
- Down Sampler
- Time Base Shifter
- Time Channel
- Interactive Trigger
- Timed Trigger
- State Mapper
- Smoothed Filter

These have their own tab view. Within each of these tabs, only computed channels of that type are visible.

Adding a Computed Channel
There are two options to add a computed channel.

- Click **Add** and select the type of computed channel if prompted.
- Select the desired channel and click **Copy to...** to duplicate an existing computed channel.

Enter or edit the appropriate parameters and click **OK**. Once created, you can use it by itself or you can incorporate it as part of other computed channels.

Many parameters are common across all computed channels and may include:

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.

- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate 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.

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.

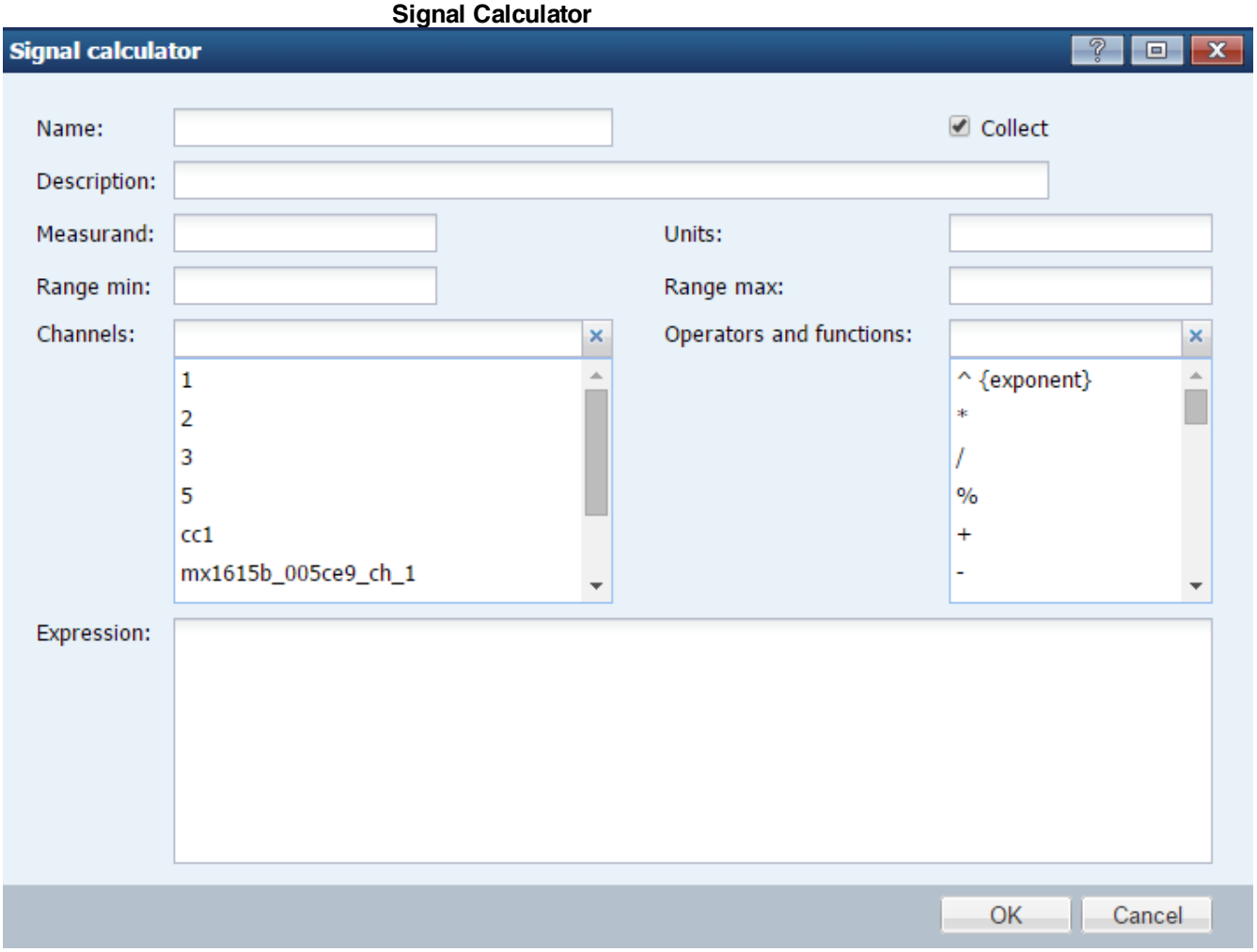
Copying Computed Channel Properties
To copy the properties from one computed channel and paste them into another computed channel, select the channel to be copied and click **Copy**.

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.

Click **Paste** to paste the copied parameters into a different computed channel.

Removing a Computed Channel
Select the desired computed channel and click **Remove**. You cannot recover removed channels.

Signal Calculator



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

Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.
- **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.

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/operators, the item will be dropped at the current position of the cursor and not where the mouse pointer is.

The output is 64-bit float and either arithmetic (floating point) or logical (Boolean) depending on the expression.

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

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*)	*a* in floating point data type
	floor	floor (*a*)	The largest integer less than *a*
	ceil	ceil(*a*)	The smallest integer greater than *a*

Category	Operator	Syntax	Return
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*.

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

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

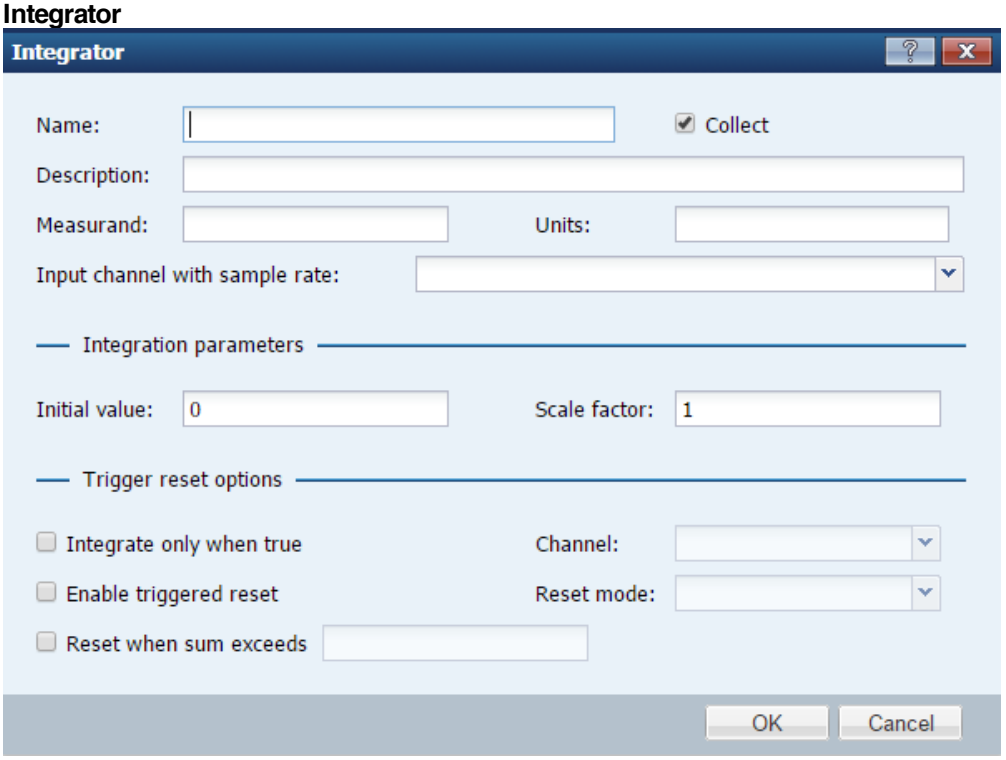
The third step is to define the final channel *y* as follows:

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.

Integrator



The Integrator computed channel generates an output that is the integral of the input channel. The output data type is 64-bit float.

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.

Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate 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.

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 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.

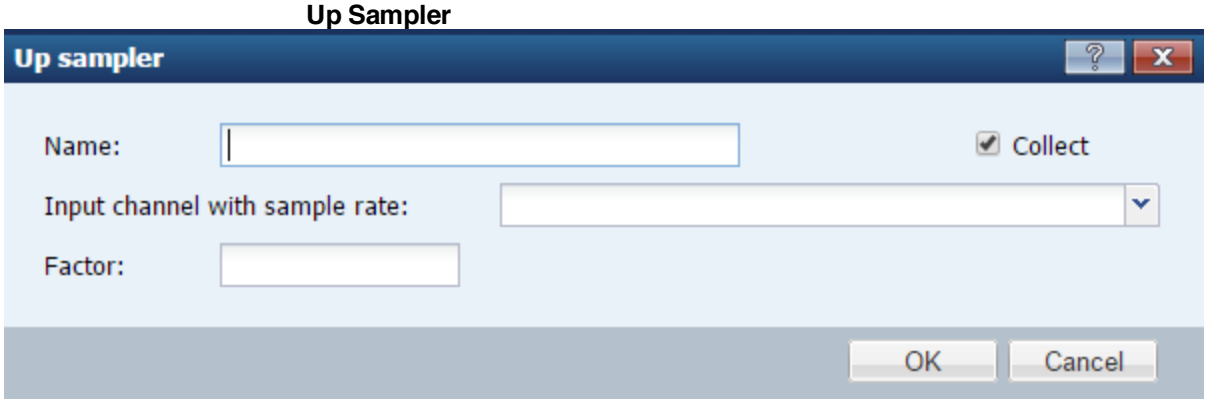
- **When true**: Reset when the trigger channel is TRUE.
- **On false - true edge**: Reset when the trigger channel transitions from FALSE to TRUE.
- **After true - false edge**: Reset on the sample after the trigger channel transitions from TRUE to FALSE. If the Integrate only when true option is not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

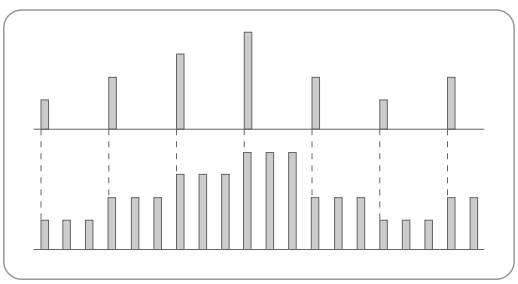
NOTE

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.

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.

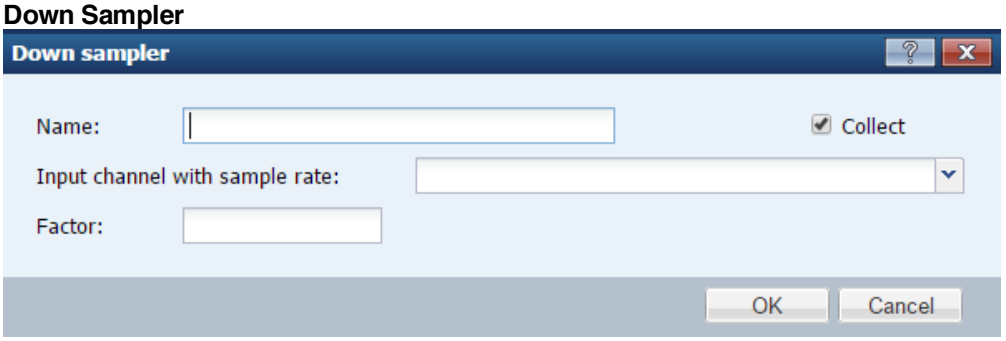
Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate in Hz.

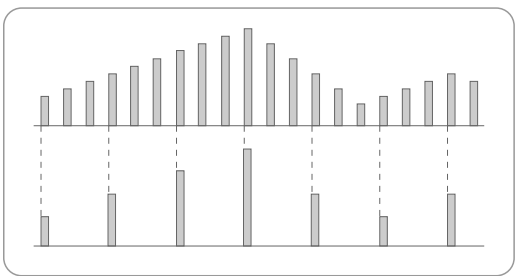
Enter an integer greater than zero for the desired up sample **Factor**.This has the effect of increasing the sample rate by the product of this factor.

The output data type is the same data type as the input channel.

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.



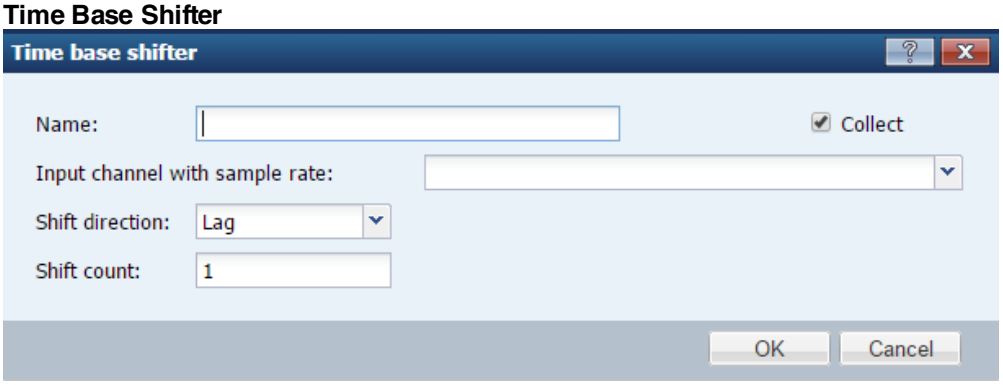
Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate in Hz.

Enter an integer greater than zero for the desired down sample **Factor**.This has the effect of reducing the sample rate by the division of this factor.

The output data type is the same as the input data type.

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. The output data type is the same data type as the input channel.

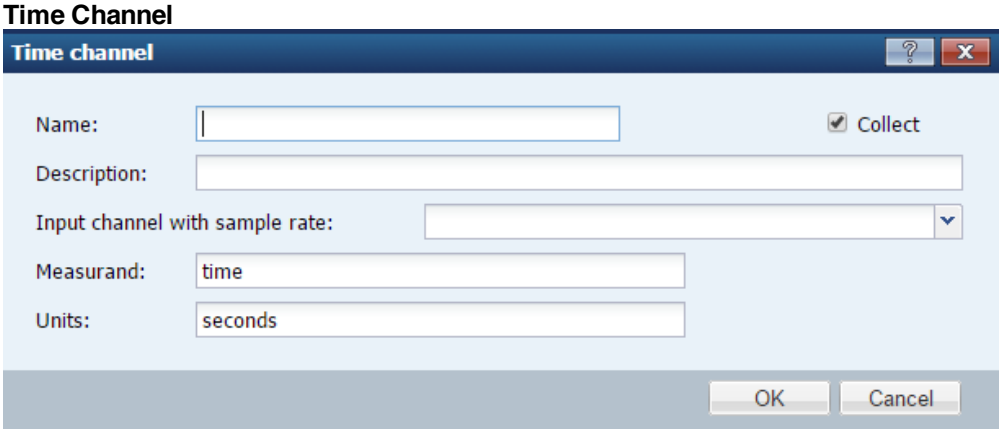
Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate in Hz.

Set the **Shift Direction** to either lag or lead the input channel. Enter the desired **Shift Count** from 1 to 1000 samples.

Note that the channel fills the first *n*+1 output samples with the initial value of the input channel.

Time Channel

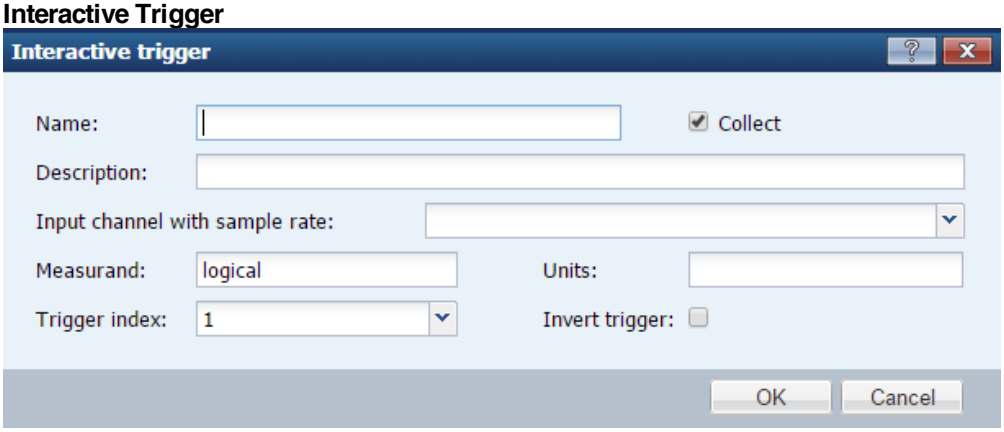


The Time Channel provides a time base channel for use with other computed channels or for storage in the Time History Data Mode. For each data sample in the selected input channel, the channel outputs the corresponding elapsed time in seconds since the start of the test run. The first sample is at zero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

Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate 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.

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. The output data type is 64-bit float (logical).

For more information on using interactive triggers during a test run, see Interactive triggers.

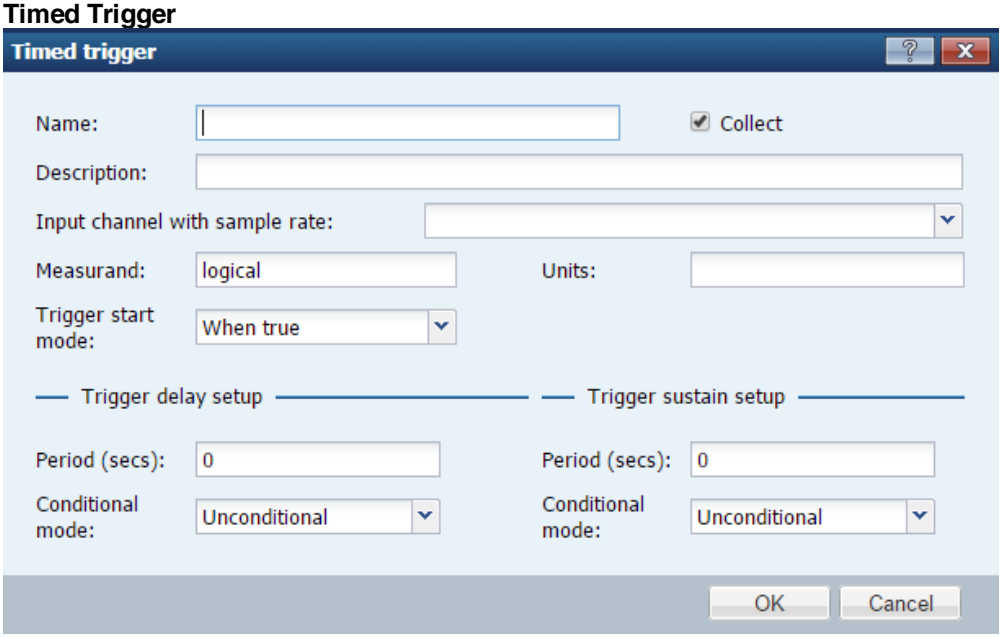
Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate 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.

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

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

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 an existing input or computed logical channel.

Common Parameters

- **Name**: Each computed channel must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>'). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must remove them manually if no longer required.
- **Description**: Optional detailed description of the computed channel.
- **Input channel with sample rate**: Select the desired input channel. Each input channel display its sample rate 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.

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.

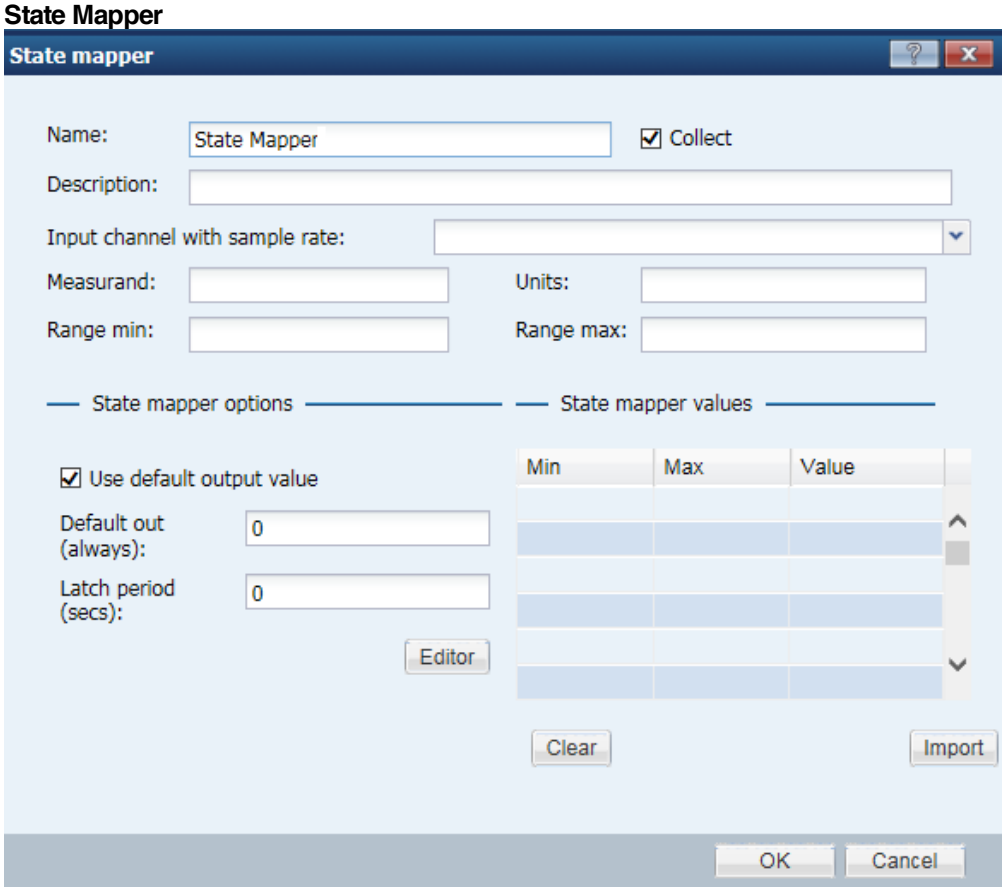
- **Unconditional**: Set the output to TRUE regardless of the input channel.

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.

State Mapper



The State Mapper channel maps the input channel into a discrete state output channel based on a set mapping conditions. Define each mapping condition in terms of a minimum input value, a maximum output value, and the associated output state value. The number of mapping conditions must be 32 or less.

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

Common Parameters
Name: Each computed channel must have a unique name and contain valid characters (single and double quotes not permitted). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must manually remove if no longer required.

Input Channel with sample rate: Input channel (any non-sink channel).

Measurand: 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 max: Expected extreme values of computed channel.

Use default output value: Default output option 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.

Default out (always): Default value for the output. The channel outputs the value if the first input sample does not meet any mapping conditions. Also, when using default out, the channel outputs the default value throughout the test run when the input does not meet any mapping conditions.

Latch Period (secs): Time in seconds that the input channel must consistently map to the same output state 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 0.0, then the output state switches on each sample.

State Mapper Values: Define the state mapper conditions. There are several interfaces to enter this information.

- Grid
- Editor
- ASCII File

The toggle button enables you to switch between interfaces when entering state mapper values. No matter which interface you are in, switching keeps what you have already entered and reformats it according to the new interface you select.

By default, use a Spreadsheet Interface (grid) to enter the mapping conditions. There are 32 rows allocated to enter all the conditions. Each row contains three units: Min, Max, and Value that represent a condition. Click **Editor** to switch to a free format text editor.

In the text editor interface, you can edit the state mapper conditions in a simple text editor where the respective values for a condition display on a single line. Separate each value by at least one space. There is no limit to the number of conditions you can enter, but anything over 32 creates an error and you need to fix it. Click **Grid** to switch to the grid interface.

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

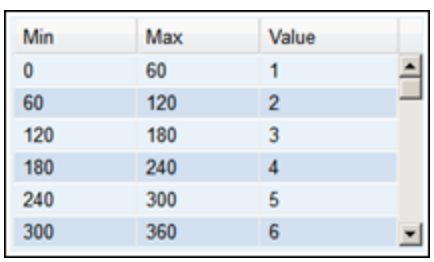
To maintain backwards compatibility with the TCE interface, click **Import** to open the browser's file chooser where you can select a previously saved/created file. This is an ASCII file where each line must represent a condition and contain three values separated by space or tab. The three values are Min, Max, and Values in that order.

State Mapper Example: Angular Position
Consider mapping an input channel that generates angular position in the range of 0 to 360 degrees into 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.

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

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

The grid interface for the above conditions:

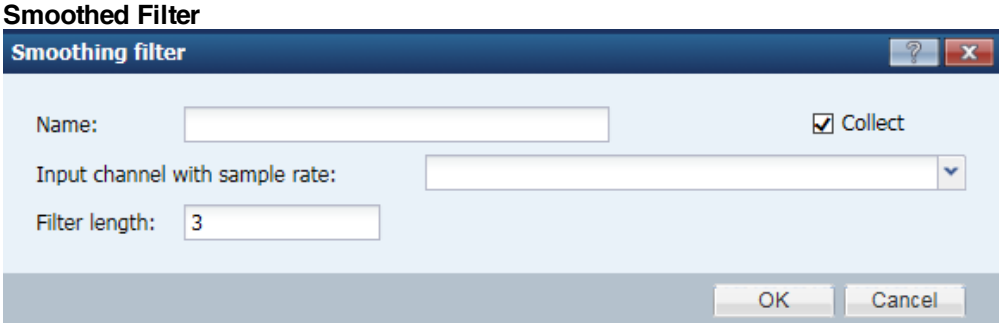


The editor interface:

The ASCII file contents looks similar to those in the editor, but the spaces could be tabs.

No matter which editor is chosen, the results are the same. Any row where all the fields (Min, Max, and Value) are blank are ignored.

Smoothed Filter



The Smoothed Filter channel generates an output channel that is a smoothed representation of the input channel without generating any phase lead or lag. The filter is a simple boxcar filter where each output sample is the linear average of a user-specified number of input samples.

For example, for a tap count 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 tap count is nine, the first four output samples are assigned the same value as the fifth output sample value.

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

Common Parameters
Name: Each computed channel must have a unique name and contain valid characters (single and double quotes not permitted). If changed, all references to the channel change automatically. If removed, all references to the channel remain and you must manually remove if no longer required.

Input channel with sample rate: The input channel (any non-sink channel).

Filter Length: Specify the length of the boxcar filter. The number must be an odd number between 3 and 201.

6.5.5 Data Modes

Data Modes determine how the CX23-R stores and displays test data. A Data Mode definition consists of a list of input channels, triggering conditions, and other parameters specific to the Data Mode. The Data Mode grid displays all Data Modes that have already been defined for the current setup. Several types of Data Modes are supported:

- Time at Level (One Dimensional)
- Time History
- Burst History

Adding a Data Mode

There are two options to add a Data Mode.

- Click **Add**and select the Data Mode type to create new blank Data Mod.
- Select the Data Mode type and click Click **Copy to...**to duplicate an existing Data Mode.

Enter or edit the parameters and click **OK** to create the Data Mode. Once created, you can use the Data Mode by itself or incorporate it as part of other computed channels.

Many parameters are common across all Data Modes including:

- **Name**: Each Data Mode must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Optional detailed description of the computed channel.
- **Trigger mode**: Select one of four available triggering options. Triggering provides a to eliminate undesired segments of the input data stream before it is processed by the Data Mode.
  - **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 Data Mode. Select channels either by dragging and dropping into the list on the right or by using the arrow buttons.

Editing a Data Mode

Select the desired Data Mode in the grid and click the **Edit** button in the Task Pane to edit the channel parameters using the Data Mode dialog. Alternately, edit the Data Mode parameters directly in the channel grid.

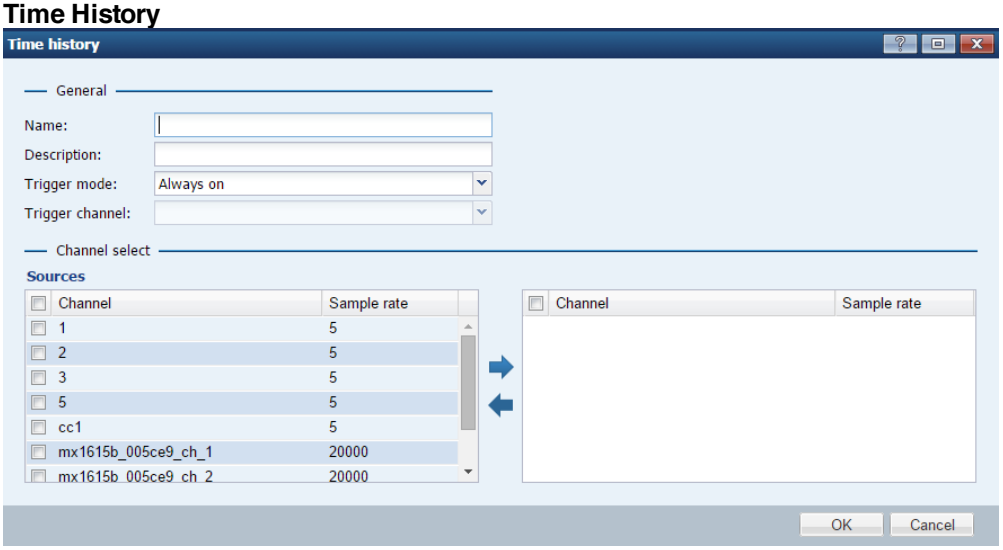
Removing a Data Mode
Select the desired Data Mode in the grid and click the **Delete** button. Removed Data Modes cannot be recovered.

Data Mode Memory Consumption

Defined Data Modes 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:

Data Mode	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

Time History



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

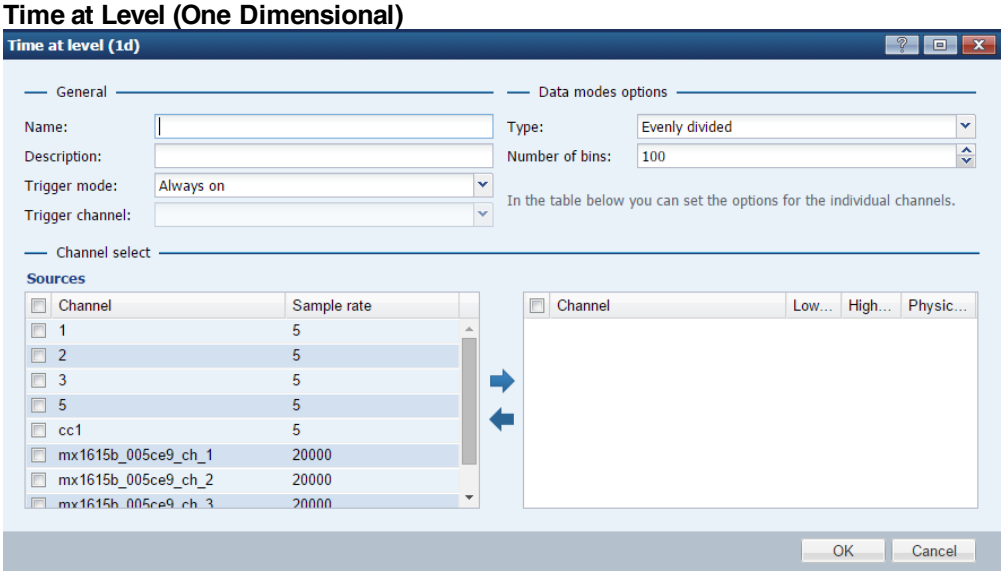
Common Parameters

- **Name**: Each Data Mode must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Optional detailed description of the computed channel.
- **Trigger mode**: Select one of four available triggering options. Triggering provides a to eliminate undesired segments of the input data stream before it is processed by the Data Mode.
  - **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 Data Mode. Select channels either by dragging and dropping into the list on the right or by using the arrow buttons.

Time at Level (One Dimensional)



The Time at Level (1D) Data Mode 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.

Common Parameters

- **Name**: Each Data Mode must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Optional detailed description of the computed channel.
- **Trigger mode**: Select one of four available triggering options. Triggering provides a to eliminate undesired segments of the input data stream before it is processed by the Data Mode.
  - **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.

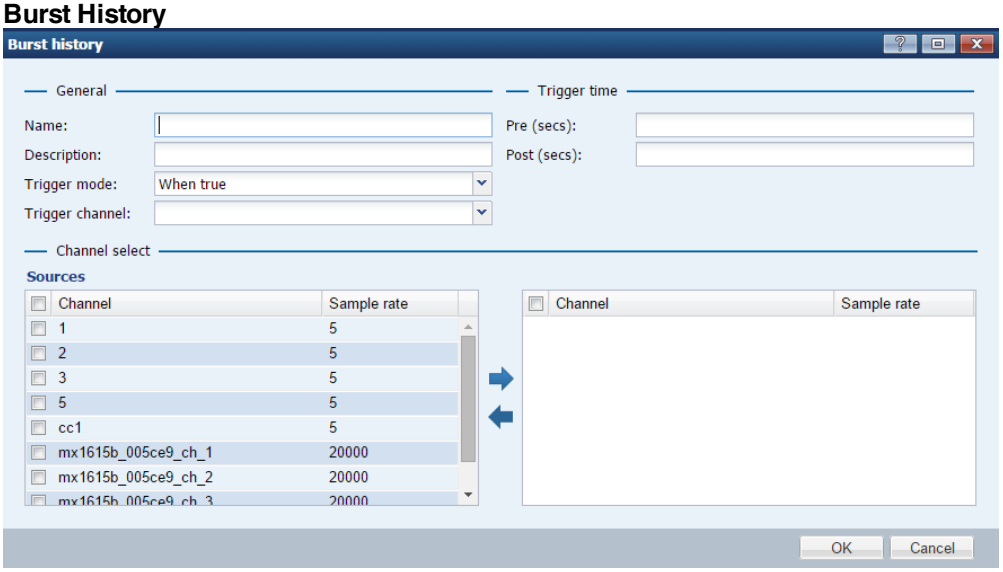
- **Trigger channel**: Specify the trigger input when using a trigger option other than Always on. The trigger channel must have the same sample rate as the input channels.
- **Channel select**: From the channels list, select the desired input channels for the Data Mode. Select channels either by dragging and dropping into the list on the right or by using the arrow buttons.

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.

Burst History



The Burst History Data Mode stores one or more bursts of data when a user-defined triggering event occurs. The Burst History Data Mode is useful for characterizing rare events at high data sampling rates. The CX23-R uses a circular buffer to allow storage of data both before and after the specified trigger.

Common Parameters

- **Name**: Each Data Mode must have a unique name and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<', '>').
- **Description**: Optional detailed description of the computed channel.

- **Trigger mode**: Select one of four available triggering options. Triggering provides a to eliminate undesired segments of the input data stream before it is processed by the Data Mode.
  - **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 Data Mode. Select channels either by dragging and dropping into the list on the right or by using the arrow buttons.

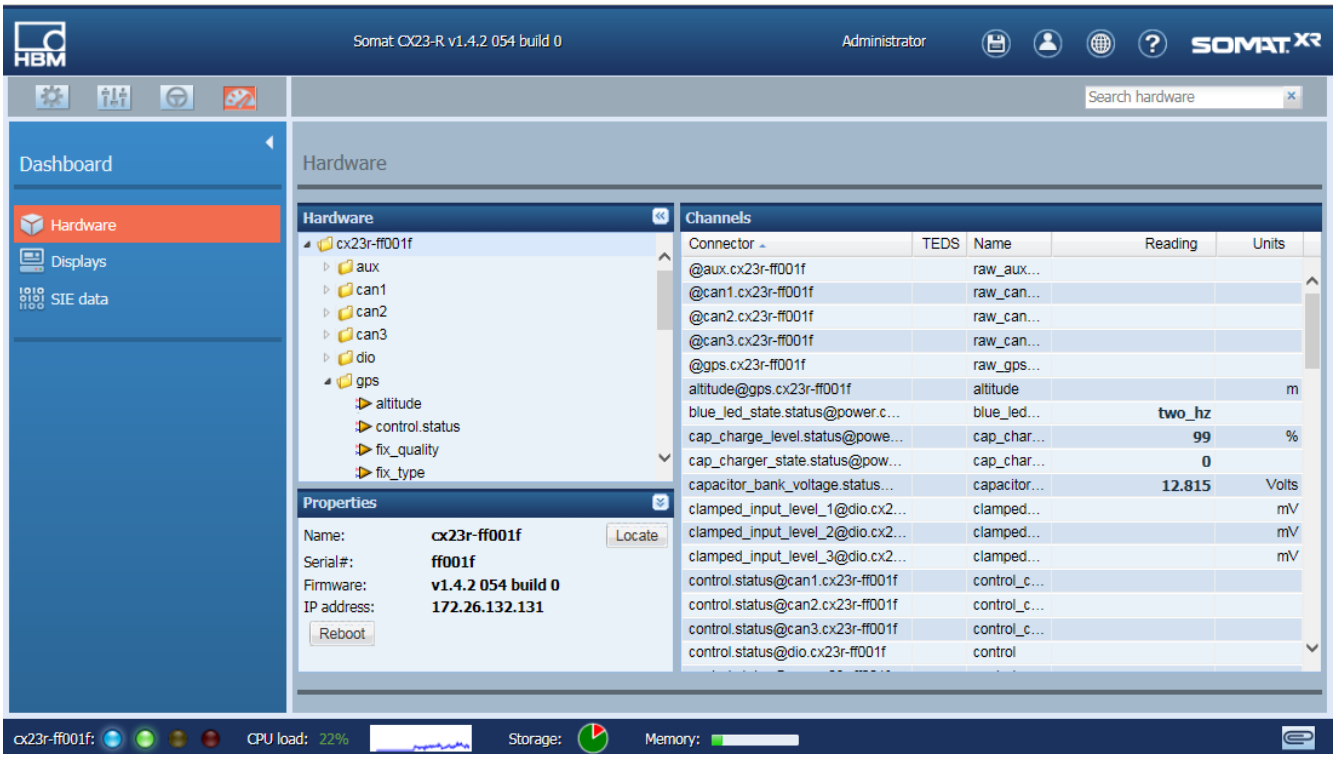
Trigger Time

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.

6.5.6 Hardware



You can display the Hardware pane via the Test Configuration or the Dashboard panels. You can resize Hardware sections to maximize viewing areas.

Hardware
Hardware displays the topology of the network in a tree-like component displaying all the different hardware and channels the discovery process found. The tree depth is limited to only three levels. These levels are Host, Hardware, and Channel.

- **Host**: A physical unit or device. Typically a CX23-R or MX module.
- **Hardware**: Usually a connector or board/layer
- **Channel**: Internal or external channel

Not all hardware discovered has these levels. For example, a SATA Drive will not contain any channels.

Click the arrow icon next to the appropriate level to collapse or expand the levels (branches) on the tree. By default, all levels are collapsed when the Hardware tree is initially rendered. But when you expand branches and position within the tree, the state remains as the default the next time a new session starts. A black arrow pointing bottom right indicates that the branch is expanded, while a white arrow pointing right indicates the branch is collapsed.

Navigate the Hardware tree with the mouse or keyboard:

- **Arrow Up**: Move to the previous item
- **Arrow Down**: Move to the next item
- **Arrow Left**: Collapse the current item
- **Arrow Right**: Expand the current item

The tree display is a dynamic component. Depending on the discovery process, Hardware branches and leaves can disappear or appear at any time as you disconnect or reconnect hardware or networks go down and up. The Hardware tree display changes to reflect this situation. Hardware such as SATA hard drives constantly update their space availability as it changes.

The current position in the tree displays with a blue colored bar over the item. When you select an item, the other sections (Properties and Channels) change their content to display that information.

You can minimize the Hardware section. The entire Hardware section, including Properties, minimizes to make additional space for other sections. Click the **double left arrows** on the Hardware section header. Once minimized, no information regarding these sections is visible. However, they can still change dynamically. Click **Maximize** in the toolbar section to redisplay the full sections.

Properties
Properties displays context sensitive information on the type of hardware you select. The level you select determines exactly what appears. For individual modules, such as a CX23-R or MX module, the following information displays:

- **Name**: Internal name of the hardware.
- **Serial#**: Serial number of the hardware.
- **Firmware**: Firmware version deployed to the hardware.
- **IP Address**: Displays if the hardware has an IP address.
- **Locate**: Ability to physically identify the actual hardware by requesting it to flash one of its LEDs. Click and the corresponding hardware's LED flashes. At the same time, the Locate button changes to Stop. The LED continues to flash until you click Stop.

For the CX23-R, the green LED flashes at a frequency of 2Hz until you click Stop or restart the device.

Sample Rate Domain

You can view and change the MX module's current Sample Rate Domain setting. There are two settings: **Decimal** and **Classic**. If this setting changes, the MX module uses the configuration setting, and a prompt to reboot the MX module occurs. If you do not exercise the reboot option, manually reboot the MX module.

MX modules

- **Sample rate domain**: Displays the data domain rate setting the MX module is currently in. Users with hardware control privileges can change this option via the combo box entry. Upon changing this value, the MX module automatically reboots. Click the Reboot button to manually reboot the MX module.

- **Firmware update**: Updates the MX module's firmware to the latest version as expected by the CX23-R. This is an automatic update in that there is no firmware file to upload first. The file should already exist on the CX23-R. Click Firmware update to display firmware update procedures and pitfalls. If allowed to continue, the firmware on the MX updates and the MX reboots. It may take several minutes after the reboot for the quantum to be running and in a synchronized state. No test runs are allowed to start that contain channels for MX modules that are not synchronized.

Currently, the MX modules that use the CX23-R and EX23-R are:

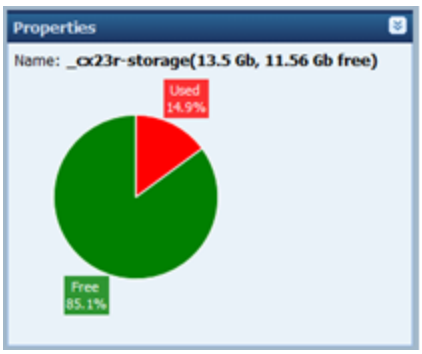
- MX1601B-R
- MX1609B-R
- MX1615B-R

Storage devices

The Properties frame displays the following Storage devices information:

- **Name**: The internal name of the channel

Graphical representation of the used/available space



You can minimize this section. Unlike the Hardware section, only the Properties section minimizes. Press the down arrows button on the header to minimizes it, and press the up arrows button maximize it.

Channels

This is the main section in the Hardware display and occupies all remaining space on the page. You can only resize this section and cannot minimize it. The interface is a read-only Spreadsheet Interface and many of the spreadsheet features are available.

The entire content of this section is dedicated to displaying the channels contained in the branch of the Hardware tree you select. This could be all the channels on a single device or an individual channel. You can select one channel or an entire branch of channels.

Click an individual channel row to select it. The branch of the Hardware tree where this channel appears automatically expands and positions itself to this channel. Also, the Properties section displays properties for this channel. All other channels are omitted from the Channels display.

Default columns that display are:

- **Connector**: Internal identifier of the channel. This is system generated and will always be unique.
- **TEDS**: Icon depicting the TEDS applicability of this channel for MX modules. Currently not supported.
- **Name**: Default internal name of the channel. This can change during test configuration. There is no limitation to the length of this name. Should the name not fit into the cell, the Name wraps and makes the cell bigger (maximum of 2000 characters).
- **Reading**: Live data reading of the sensor connected to this channel. Depending on the channel, this may or may not show any readings. Some channels require a test be running before live readings display.
- **Units**: Signal unit of measure for this channel.

Double-click any single row to display the reading in a dialog box where you can copy it to the cut and paste buffer.

Add Hardware

The default values reflect the hardware selected in the hardware pane. Enter or modify the connector or channel fields as desired. Very little validation is performed on the supplied values to make hardware addition as flexible as possible; be sure to supply correct values and formats.

A connector or channel value is required and must be unique. Attempting to assign a duplicate value simply updates the existing connector or channel. A connector value should be in the form *connector.device* and channel value should be in the form *channel@ connector.device*.

The name, description and category are optional, though it is strongly recommended to select a proper category when creating channels.

Click the Save button when finished to add or modify the selected hardware and update the hardware panel accordingly. Clicking the Close button aborts any hardware changes.

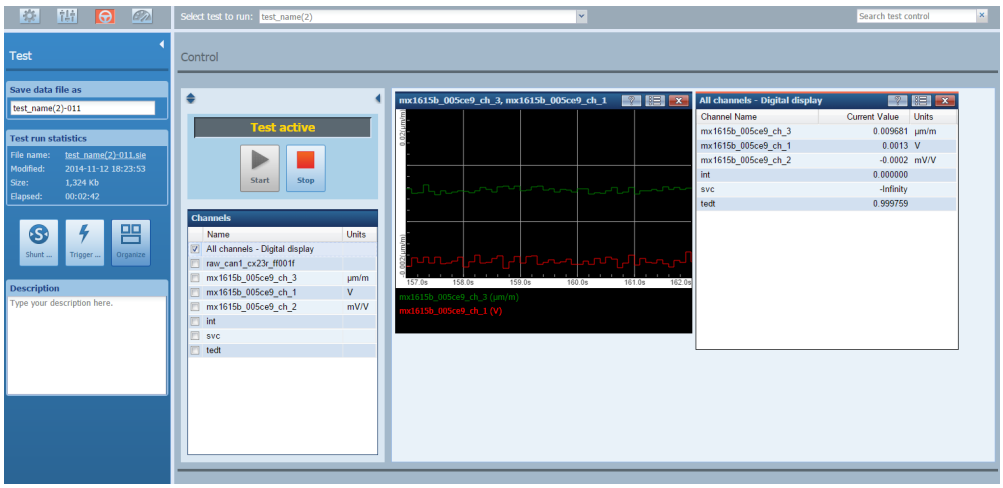
Cloning hardware is extremely easy using this dialog. Simply select the desired hardware entry and click Add Hardware. This populates the dialog with the current values which can be changed as needed.

NOTE

It is possible to add channels only. In this case, the connector is automatically added by the application. Although the hardware discovery process always adds the connector before adding the channel, adding channels manually bypasses this step.

6.6 Test Control

Select the desired test from the drop-down list in the titlebar.



Running a Test

Before starting a test run, enter test run information in the Task Pane. Once a test is running, you cannot change this information.

If defined, the Test Duration parameter determines the duration of the test run in seconds, after which time the test run automatically stops. Show or hide this parameter in the Test section of the System Preferences.

The start a test run, select the test and click **Start**. To stop the current test run, click **Stop**.

The user starting the test run need not be the same user stopping the same test run.

During the test run, the test control status bar shows that a test is active and the following run statistics display in the task pane:

- **File Name**: SIE data file name in the Task Pane. If no name was given, defaults to the setup name (with optional unique sequential number). Click the file name to download the 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. For the first 100K, the units will be bytes (b), thereafter Kilobytes (Kb). Mouse over the field to see the exact file size in bytes at that point in time.
- **Elapsed**: Total elapsed running time for the current test run from when it started running (t = 0).

Installing Shunts

If any MX1615B-R bridge channels exist and the shunt control option is selected, click **Shunt...**.

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

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

Note that all shunt resistors are removed when you start 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
If any Interactive Trigger computed channels exist, click **Trigger...**.

To control a trigger, use the check box by the trigger index. A check indicates a TRUE state. 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 grayed.

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

Viewing Live Displays
The displays panel provides for the display of the live data for the channels in the selected test. A test must be running to view displays. To add a display, select the desired channels from the Channels list. The charts may be re-sized, repositioned, and configured as needed. To automatically organize the display windows, click **Organize**. This toggles between cascade and tile modes. The available display types are:

- Strip Chart Display
- Digital Meter Display
- All channels - Digital display
- Analog Meter Display

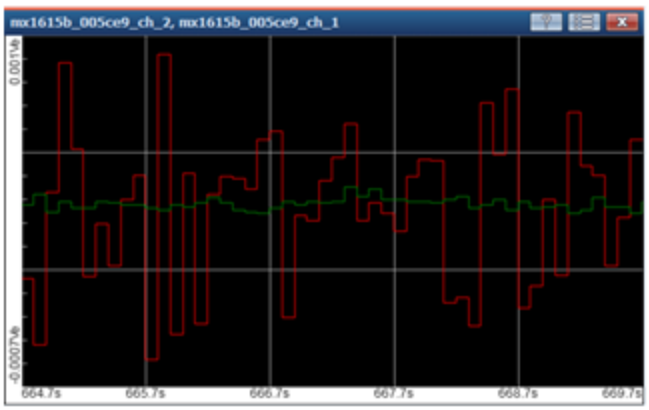
Click a chart to modify its display properties. Set user specific display defaults in User Preferences.

6.6.1 Strip Chart Display

The strip chart is a graphic representation of the data points for the channel or channels you select including:

- **Freeze Strip Chart**: Check the box to pause the chart. Uncheck the box to resume live readings.
- **Properties**: Configure the y-axis, x-axis and grid characteristics of the chart. (Strip Chart Properties)
- **Show legend**: Show the channel names and colors.
- **Chart Type**: An option available only when multiple channels exist in a chart. This gives options to configure the axes of the chart a number of ways.
  - **Single**: Display of channels using a single y-axis inheriting the properties of the first channel added to the chart.
  - **Stacked**: Display each channel stacked vertically on top of each other with their own customizable y-axis, but sharing a common x-axis.

- **Multiple**: Display one y-axis for each channel to the horizontal left and all the channels to the right.



Strip Chart Properties

Y-Axis
Scaling

- **Automatic**: The system determines the best upper and lower values based on current and past readings (default).
- **From hardware**: Use the min and max values specified in the test setup. If these are not specified in the test setup, the system uses automatic scaling.
- **Fixed**: Enter the min and max values.

Formatter

- **Decimal**: Decimal format up to two decimal places.
- **Scientific**: Scientific notation.

X-Axis
Time window

Specify a span time in milliseconds of the display. Note that a value too large could cause performance issues.

Formatter

Specify the format of the x-axis time labels.

Grid
Select whether to show or hide the chart gridlines.

6.6.2 Digital Meter Display

The single channel digital meter displays the current value of the selected channel. There are several options available from the menu.

- **Freeze Readout**: Check the box to pause the reading at its current value. Uncheck to resume live readings.
- **Decimals:** Select the number of decimal places to show or select scientific notation for extremely large or small values.

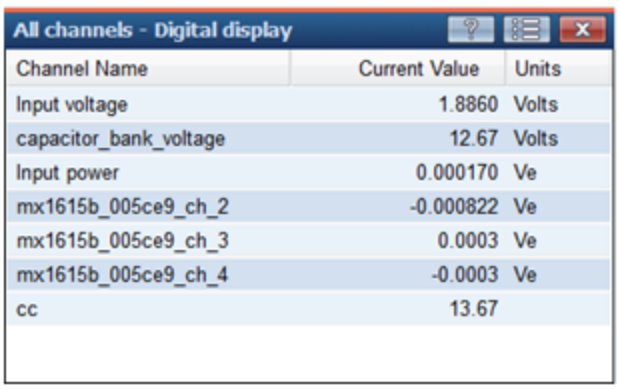
- **Update rate**: Select the rate at which the display refreshes at 1, 2, 5 or 10 times per second. Note that in cases where the channel sample rate is less than the selected update rate, the display refreshes at the lower sample rate.

This display is a fixed size and you cannot it.

6.6.3 All channels - Digital display

The all channels digital meter displays the current values of the test channels in a grid. There are several options available from the menu.

- **Freeze Readout**: Check the box to pause the channel readings at their current values. Uncheck to resume live readings.
- **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.



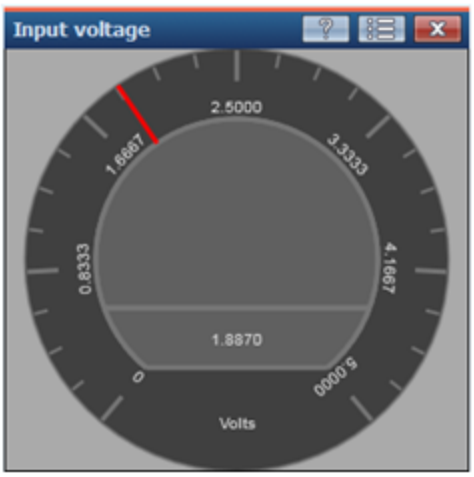
Channel Name	Current Value	Units
Input voltage	1.8860	Volts
capacitor_bank_voltage	12.67	Volts
Input power	0.000170	Ve
mx1615b_005ce9_ch_2	-0.000822	Ve
mx1615b_005ce9_ch_3	0.0003	Ve
mx1615b_005ce9_ch_4	-0.0003	Ve
cc	13.67	

NOTE
This display can only support a maximum of 32 channels.

6.6.4 Analog Meter Display

The analog gauge meter is a graphic representation of the most current data point for the selected channel. There are several options available from the menu:

- **Freeze Gauge**: Check the box to pause the reading at its current value. Uncheck the box to resume live readings.
- **Properties**: Specify the range values of the display. (Analog Meter Properties)
- **Decimals:** Select the number of decimal places to show or select scientific notation for extremely large or small values.



Analog Meter Properties
Range labels

Specify the min and max values of the analog display.

6.6.5 Shunt Control

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

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

Note that all shunt resistors are removed when you start 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.

6.6.6 Interactive triggers

To control a trigger, use the check box by the trigger index. A check indicates a TRUE state. 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 grayed.

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

6.7 Dashboard

6.7.1 Displays

The displays panel provides for the display of the live data for the channels in the selected test. A test must be running to view displays. To add a display, select the desired channels from the Channels list. The charts may be re-sized, repositioned, and configured as needed. To automatically organize the display

windows, click **Organize**. This toggles between cascade and tile modes. The available display types are:

- Strip Chart Display
- Digital Meter Display
- All channels - Digital display
- Analog Meter Display

Click a chart to modify its display properties. Set user specific display defaults in User Preferences.

The configured chart arrangements persist for the duration of the running test and the selected setup. You can stop the test and the charts remain open. All state and configuration parameters remain and are in effect should you restart the same test. The charts will be removed if you select a different setup or a change is made to the current setup. While the charts are displayed with no test running, the configuration menus are inhibited, as is the ability to resize strip charts.

6.7.2 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** from the Task Pane.

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 Test Configuration from SIE File

Select the check box next to the desired file and click **Extract** to extract text where it appears. Click **Export test configuration** to export the associated setup configuration as a json formatted .sxr file to the local machine.

Rename SIE File
Enter a new file name and click **Save**.

Export SIE
Click **Export test configuration** to export the associated setup configuration as a json formatted .sxr file to the local machine.

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