User Manual

English

eDAQ XR / eDAQ XR lite

EXRCPU / EXRLCPU

Rugged DAQ

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Safety Instructions

Appropriate use

The eDAQXR or eDAQXR-lite equipment 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 equipment 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 equipment, 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

The equipment must not be connected directly to a DC power supply network. The maximum permissible supply voltage is 36 V_{DC}. The operating range is:

EXRCPU data processor	8 V_{DC} ... 36 V_{DC}
EXRLCPU data processor	8 V_{DC} ... 36 V_{DC}
EXRBRG conditioning layer	8 V_{DC} ... 36 V_{DC}

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

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

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

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

Conditions on site

For all equipment:

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

Maintenance and cleaning

The equipment is 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 equipment is a state of the art device and, as such, is fail-safe. The equipment 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 equipment must have read and understood the User Manuals and in particular the technical safety instructions.

Remaining dangers

The scope of supply and performance of the equipment 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 equipment has been tested.

Product liability

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

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

Working safely

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

The equipment complies with the EMC standards of EN 61326-1 / EN 61326-2-x. These standards define emission limits and immunity requirements for multiple environments.

With respect to emissions, the standards contain limits for industrial (class A) and Domestic and Industrial (class B) environments. The standard herein references CISPR 11:2009+A1:2010.

With respect to immunity, the standards contain limits for electromagnetic protected (lowest requirements), general and industrial (highest requirements) environments.

The eDAQXR or eDAQXR-lite devices listed in the declaration of conformity adhere to the requirements for:

- Emissions: Class A
- Immunity: Industrial

The eDAQXR or eDAQXR-lite series and its modules are intended for use in an industrial environment. When used in residential or commercial environments, additional arrangements may be required to limit electromagnetic emissions.

Conversions and modifications

The equipment 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 equipment 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.

Symbols

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: Electric shock hazard

Devices marked with this symbol may allow improper use to result in an electric shock. Please observe handling instructions for components capable of delivering an electric shock.

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

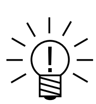
National and local regulations regarding the protection of the environment and recycling of raw materials require old equipment to be separated from regular domestic waste for disposal.

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.

Standards Declaration

Documentation

The latest versions of all eDAQXR and eDAQXR-lite documentation are available for download at www.hbm.com.

CE

Standards

Description	Unit	Value
EMC requirements	-	CE conformity test per EN 61326-1:2012
Evaluated for safety according to	-	IEC61010-1:2010
Mechanical test	-	-
Vibration	-	accord. MIL-STD202G, Method 204, Test Condition D
acceleration	m/s^2 [g]	196 [±20]
Shock	-	accord. MIL-STD202G, Method 213B, Test Condition H
acceleration	m/s^2 [g]	736 [±75]

Manufacturer's Specified Criteria: As permitted under the definition for EN 61326-1:2012 Criteria B , the permissible substitution is made that the EUT may reset or reboot with self-recovering non-user interaction in order to protect circuitry against damage and/or to protect data validity.

1 Hardware

1.1 EXRCPU/EXRLCPU

Overview

The EXRCPU and EXRLCPU are sealed, stand-alone, microprocessor-based data acquisition systems designed for portable data collection in the harshest of environments. They have leading-edge signal conditioning and a capacity to perform a broad range of on-board data processing. Engineered to be rugged and mobile, each main processor is tested to operate under demanding environmental conditions encompassing wide range thermal variations, resilience to significant vibration and shock loading and EMI immunity. Internal back-up capacitors protect each main processor from unplanned power losses or low voltage events. Hundreds of synchronous channels are possible in a single system with virtually limitless channel counts when networking multiple systems using Ethernet communications.

The main processor hosts its own secure web interface for intuitive and easy to use test setup, control, monitoring and data visualization interfaces. This server based interface supports multiple users (clients), and the capability to define and apply system access / control restrictions on a per user basis. The main processor communicates through standard 100/1000 Base-T Ethernet using IPv4 or IPv6.

The EXRCPU provides direct data sourcing for three CAN buses, one GPS module, and two digital inputs that can be used with switch controls. Three digital output lines are available to drive LEDs, relays, etc. Two GB PTPv2 compatible GB Ethernet connection ports are provided for sourcing data from MXB modules and interfacing to other EXRCPU network nodes and the EX23-R. A USB port is provided to support future functional interfaces.

The EXRLCPU provides direct data sourcing for two CAN buses, one GPS module, and two digital inputs that can be used with switch controls. Three digital output lines are available to drive LEDs, relays, etc. A GB PTPv2 compatible GB Ethernet connection port is provided for sourcing data from MXB modules and interfacing to other EXRLCPU network nodes and the EX23-R. A USB port is provided to support future functional interfaces.

Equipment

This section describes the provided equipment and the support equipment necessary to set up a system and run a test.

See Main processor mounting options for diagrams and dimensions.

Provided Equipment

The initial shipment of the respective unit contains the hardware listed below; additional hardware may be included based on options ordered.

NOTE
If any items do not arrive as expected, contact your system supplier, nearest HBM sales representative or HBM immediately.

eDAQXR EXRCPU

Order Number	Description
1-EDAQXR-32GB-2 1-EDAQXR-64GB-2	eDAQXR EXRCPU data processor layer, 32 or 64 GB memory.
1-EXR-PWR-PT-2	Power cable, 15-pin female D-Sub connector and cable ending in pigtails.
1-KAB2106-2	Ethernet patch cable (8-pin X-Code to RJ45) for connection from PC to eDAQXR host port, 2 m.
1-SAC-TRAN-MP-2-2	Three (3) transducer cables, male m8 connector to pigtail, 2 m.

eDAQXR-lite EXRLCPU

Order Number	Description
1-EDAQXRL-64GB-2	eDAQXR-lite EXRLCPU data processor layer, 64 GB memory.
1-EXR-PWR-PT-2	Power cable, 15-pin female D-Sub connector and cable ending in pigtails.
1-KAB2106-2	Ethernet patch cable (8-pin X-Code to RJ45) for connection from PC to eDAQXR-lite host port, 2 m.
1-SAC-TRAN-MP-2-2	Two (2) transducer cables, male m8 connector to pigtail, 2 m.

Support Equipment

In addition to the base processor, add-on layers and included cables, set up of the system requires an adequate power supply, a support PC and any transducers or sensors needed for testing.

Power Supply

The EXRCPU/EXRLCPU is designed to always be connected to an adequate power supply for the duration of all test runs. An example of an adequate power supply is a charged nominal 12-volt vehicle battery system that reliably supplies around 13.5 volts. Additionally, an optional Somat AC Power Supply (1-E-AC/15-2) is available.

The Somat E-AC/15 Power Supply (1-E-AC/15-2) is designed to provide 15 volts DC from a standard 120-volt AC input. This power supply has been available for the SoMat eDAQ or eDAQ-lite system and may be used with the EXRCPU/EXRLCPU.

The power supply connects to the 15-pin female D-SUB power connector on these units.

For more information on powering the EXRCPU/EXRLCPU, see Powering the eDAQXR CPU or eDAQXR-lite CPU.

Compatible power supply cables

The EXRCPU and EXRLCPU are compatible with two power supply cables (1-EXR-PWR-PT-2 and 1-EXR-PWR-IO-PT-2). See EXRCPU and EXRLCPU pin assignments(Page 21) for information about cable pins.

Compatible communication cables

The EXRCPU/EXRLCPU is compatible with several communication cables (1-KAB2100-X, 1-KAB2106-X, 1-KAB2107-X, 1-SAC-TRAN-MP-X-2 and 1-SAC-EXT-MF-X-2). See Cables(Page 24) for information about compatible cables. Refer to the SomatXR Accessories Data Sheet, available at www.hbm.com, for a list of sensor cables for EX23-R or MX modules.

Sensors

The EXRCPU, EXRLCPU, EX23-R, MX modules, eDAQ or eDAQ-lite conditioning layers support a variety of sensors for data acquisition, including several offered directly by HBM. Contact your sales representative or visit www.hbm.com for more information.

Refer to the SomatXR Accessories Data Sheet, available at www.hbm.com, for a list of accessories and cables for EX23-R or MX modules.

Connecting a main processor to power, network or modules

See Cables for optional cable diagrams.

1. Connect the 1-EXR-PWR-PT-2 power cable from the INPUT connector to a 8–36 V_{DC} power supply.

NOTE

If a switch is not connected to the red and black wires of the remote switch cable, make sure the wires are fully insulated from each other or solidly connected to each other to prevent accidentally turning the power off. If the wires are connected to each other and there is any chance of magnetic induction, do not coil the cable in a loop.

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 main processor default IP address 192.168.100.101.
3. Connect desired transducers to GPS and CAN ports using appropriate cables.
4. Wait at least five seconds after supplying power to the unit.
5. Press and release the power button. The green LED turns 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 the main processor is on a network with a DHCP server, use the HBM Device Manager (on the included USB drive) or contact your IT administrator to find out the IP address. If presented with a certificate warning, choose to proceed. The main processor web interface is displayed.

For information about navigating through the web interface, see the Interface tour (Page 206).

EXRCPU/EXRLCPU connection options

The eDAQXR and eDAQXR-liteUltra-Rugged DAQ series is a modular and universally applicable measurement system. The layers of this family can be individually combined and intelligently connected according to the measurement task.

The main processor can be connected to supported SomatXR MXB-R modules in addition to supported legacy layers for data acquisition and SIE file storage.

The following ruggedized SomatXR MX modules are currently supported in the eDAQXR and eDAQXR-lite interface:

- **eDAQXR EXRCPU**: The data processor hosts its own secure web-based data recorder for intuitive and easy-to-use test setup, control, monitoring and data visualization. The acquired test data is stored in the efficient and robust SIE file format using a high-speed solid state storage drive.
- **eDAQXR-lite EXRLCPU**: The data processor hosts its own secure web-based data recorder for intuitive and easy-to-use test setup, control, monitoring and data visualization. The acquired test data is stored in the efficient and robust SIE file format using a high-speed solid state storage drive.
- EX23-R Ethernet switch: The EX23-R is a ruggedized 10-port Ethernet switch that supports IEEE1588 PTPv2 transparent clock time synchronization. Five ports provide Power over Ethernet (PoE) to support cameras and other low power Ethernet based data sources. This module is factory configured to work seamlessly with the EXRCPU.

eDAQ layers

The following layers can be used with the EXRCPU main processor layer. See eDAQXR EXRCPU installation on eDAQ layers(Page 59) for information about installation.

eDAQ Layer	Order Number	Description
EITB	1-EITB-K-2	eDAQ Isolated Thermocouple Layer ; K-type
EITB	1-EITB-J-2	eDAQ Isolated Thermocouple Layer; J-type
ENTB	1-ENTB-2	eDAQ Non-Isolated Thermocouple Layer
EDIO	1-EDIO-B-2	eDAQ Digital I/O Layer
EBRG	1-EBRG-350-B-2	eDAQ Bridge Layer; 350-Ohm
EBRG	1-EBRG-350-AO-2	eDAQ Bridge Layer; 350-Ohm with Analog Out
EBRG	1-EBRG-120-B-2	eDAQ Bridge Layer; 120-Ohm
EBRG	1-EBRG-120-AO-2	eDAQ Bridge Layer; 120-Ohm with Analog Out
EHLS	1-EHLS-B-2	eDAQ High Level Analog Layer
EHLS	1-EHLS-AO-2	eDAQ High Level Analog Layer with Analog Out

eDAQ-lite layers

The following layers can be used with the EXRLCPU main processor layer. See eDAQXR-lite EXRLCPU installation on eDAQ-lite layers (Page 66) for information about installation.

eDAQ-lite Layer	Order Number	Description
ELNTB	1-ELNTB-2	eDAQ-lite Non-Isolated Thermocouple Layer
ELDIO	1-ELDIO-B-2	eDAQ-lite Digital I/O Layer
ELBRG	1-ELBRG-350-B-2	eDAQ-lite Bridge Layer; 350-Ohm
ELBRG	1-ELBRG-120-B-2	eDAQ-lite Bridge Layer; 120-Ohm
ELHLS	1-ELHLS-B-2	eDAQ-lite High Level Analog Layer

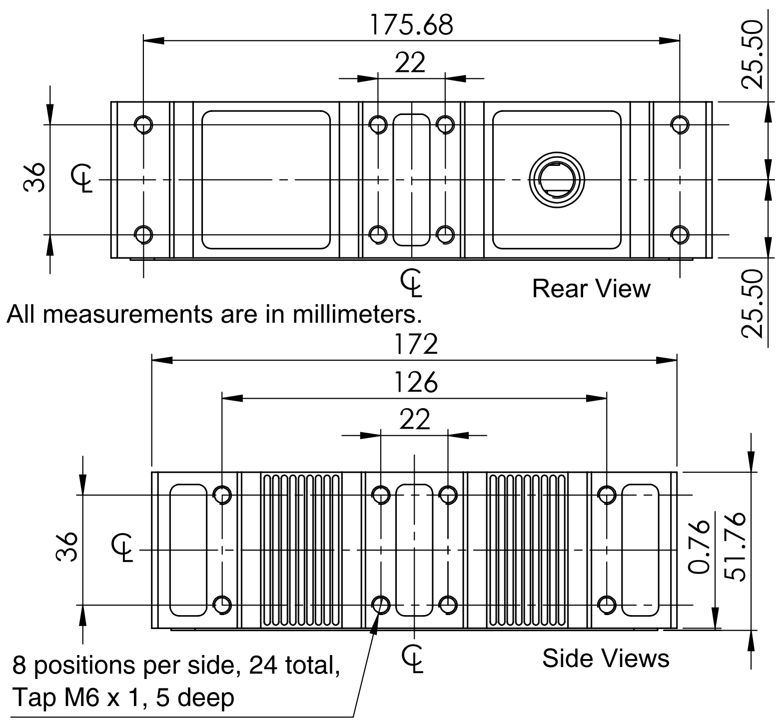
Running a test

See Setting up and running a basic test (Page 204) for more information.

1.1.1 Main processor mounting options

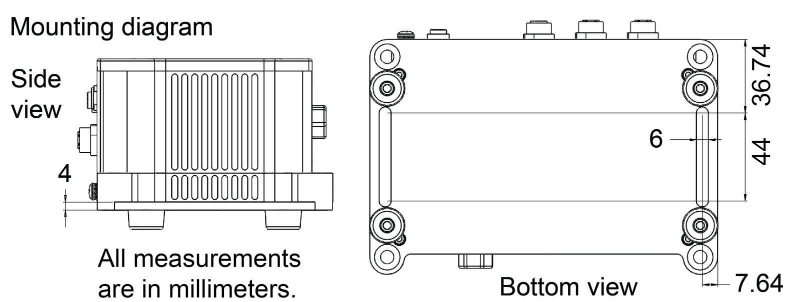
EXRCPU

There are 24 holes on the left, right and rear sides of the EXRCPU. Refer to the diagram for size and place. These tapped holes are available for mounting the EXRCPU apart from eDAQ layers or for mounting other devices on the EXRCPU.



EXRLCPU

There is a left and a right slot in the base for securing the EXRLCPU. Refer to the mounting diagram for size and place.



1.1.2 CAN, GPS and IO interfaces

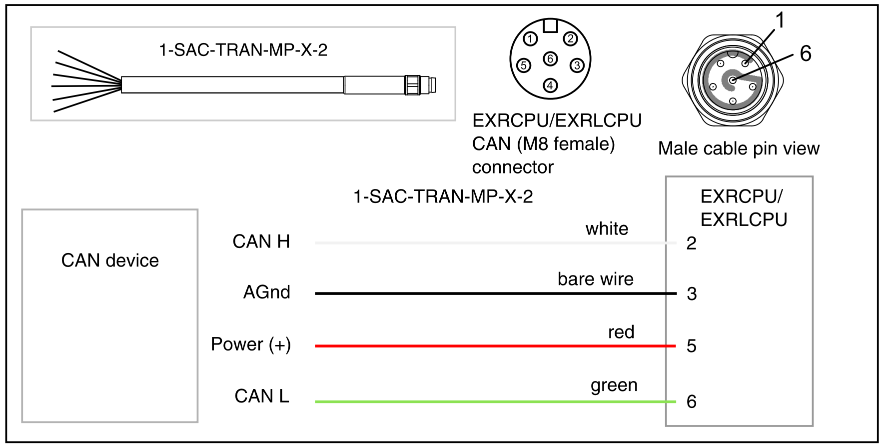
See Cables for a list of compatible cables for the ports on these CPU layers.

CAN ports (EXRCPU: CAN1, CAN2 or CAN3) or (EXRLCPU: 1 CAN 2)

The eDAQXR EXRCPU layer has three CAN ports, while the eDAQXR-lite EXRLCPU has two CAN ports.

See Databases for information about CAN device input and set up of CAN channels.

CAN device, EXRCPU/EXRLCPU

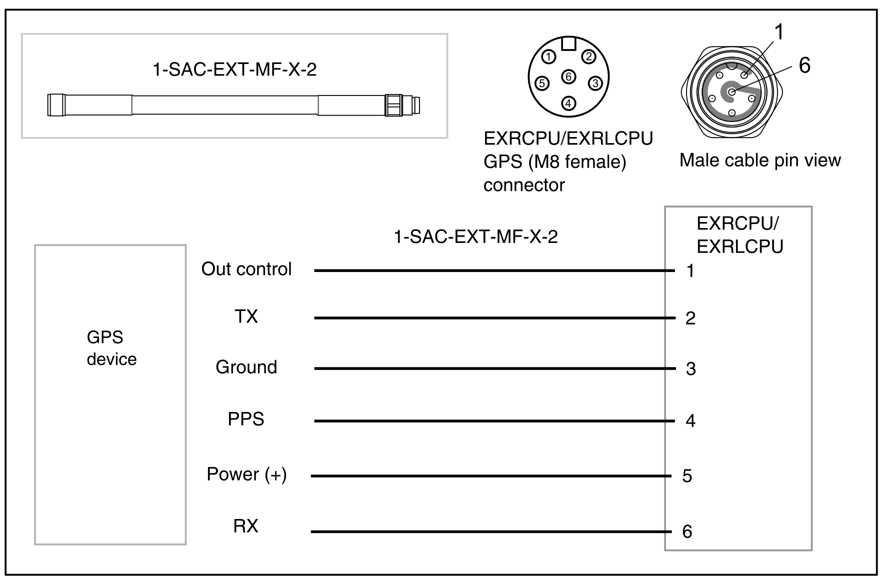


GPS port

The GPS port on these CPU layers supersedes the GPS ports on legacy conditioning layers. For example, the EXRCPU will not use the GPS port on an EDIO layer, and the EXRLCPU will not use the GPS port on an ELDIO layer with the GPS option.

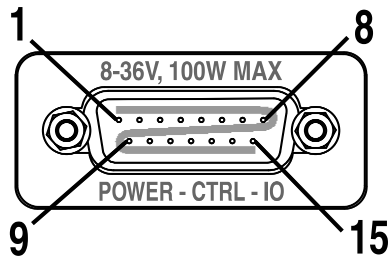
See GPS modules for more information about compatible GPS modules.

GPS, EXRCPU/EXRLCPU



IO (Input/Output) through the power connector (input D-Sub 15-pin male connector) pin assignments

Both the eDAQXR and the eDAQXR-lite CPU layers use the same IO configuration through the power/IO port. The power port on both CPU layers may use the cable 1-EXR-PWR-IO-PT-2. Seven pins are available on each power connector; there are two inputs and three outputs available.



Pin	Function	Pin	Function
1	Power (+)	9	Power (+)
2	Power (+)	10	Input 1 Ground
3	Input 1	11	Input 2 Ground
4	Input 2	12	Output 1
5	Output 2	13	Output 3
6	Remote switch	14	Remote switch Ground (-)
7	Ground (-)	15	Ground (-)
8	Ground (-)	Shell	Drain

See Setting up a remote power switch for more information.

Specifications for input and output pins on the 15-pin female D-Sub connector on the CPU layers.

Parameter	Unit	Value
Control I/O	-	2 inputs (pins 3, 4, pulled up to V_{in}, pins 10, 11 ground),
-	-	3 outputs (pins 5, 12, 13)
connector	-	female 15-pin D-Sub
output current sink	mV	350
output voltage	V	±60
output update rate	Hz	1 to 100 Hz (based on frame rate)

Limits on Input Voltages

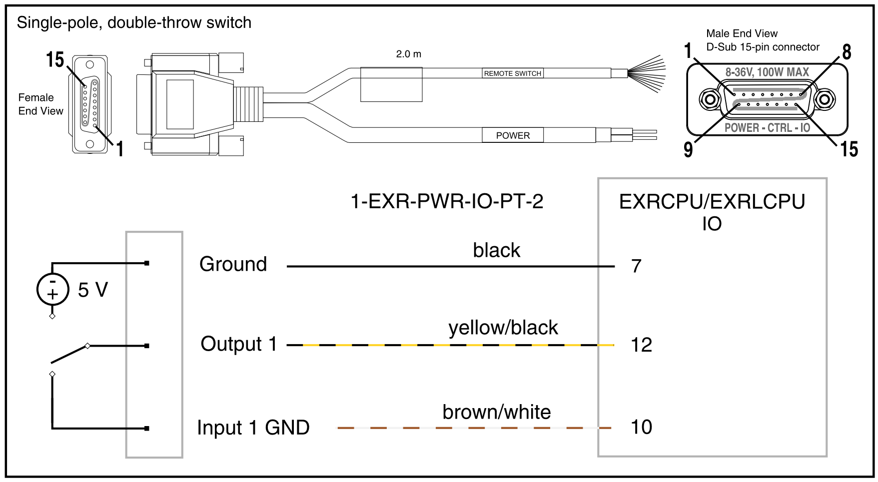
The two (2) input channels on the power/IO connector on each CPU layer are intended only for connection of a remote control switch. See Setting up a remote power switch and Remote control run mode for more information. These channels or pins are not connected to support voltage or digital input.

Wiring diagrams

Use the Power Cable (1-EXR-PWR-IO-PT-2) to wire CPU inputs.

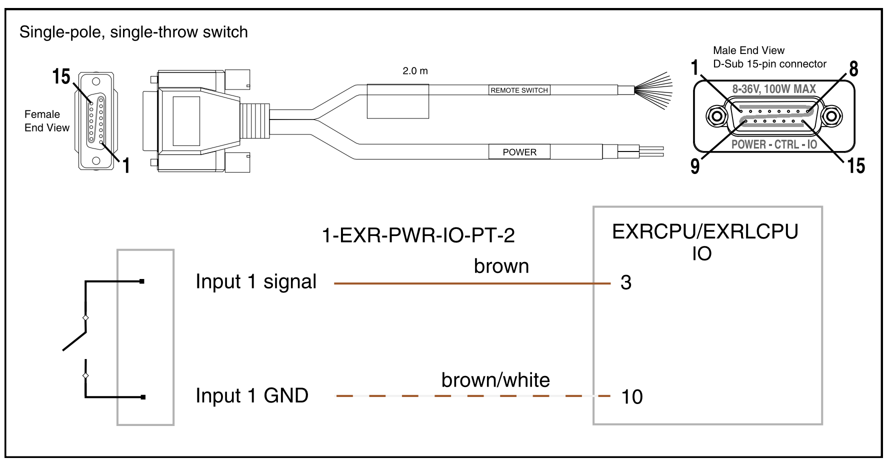
Preferred switch

Whenever possible, a single-pole, double-throw switch, wired as shown below, should be used for switched inputs. This circuit solidly switches the input line to either ground or +5 volts and prevents coupling of the input line to other digital input lines. Moving the switch to the ground side is identified as FALSE.



Alternate switch

The following diagram shows the circuit wiring for an alternate digital input involving a switch closure function. An open switch as shown is TRUE; a closed switch is FALSE. This circuit is adequate for most applications.

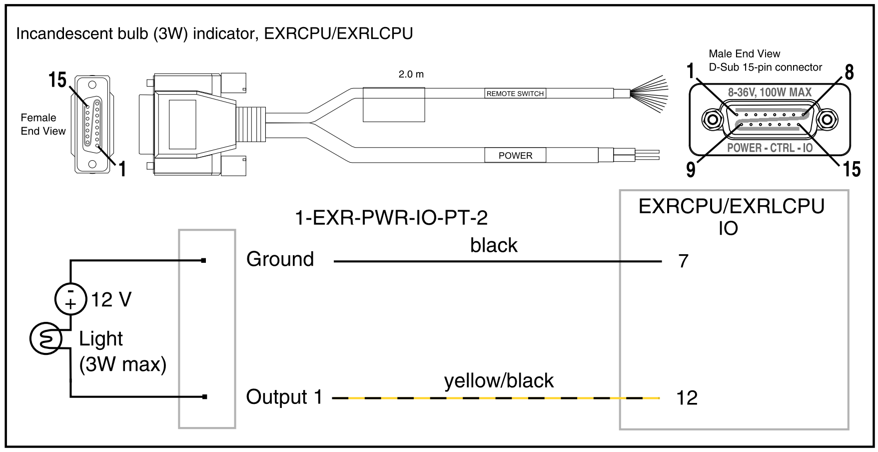


Digital output

Use the Power Cable (1-EXR-PWR-IO-PT-2) to wire CPU outputs.

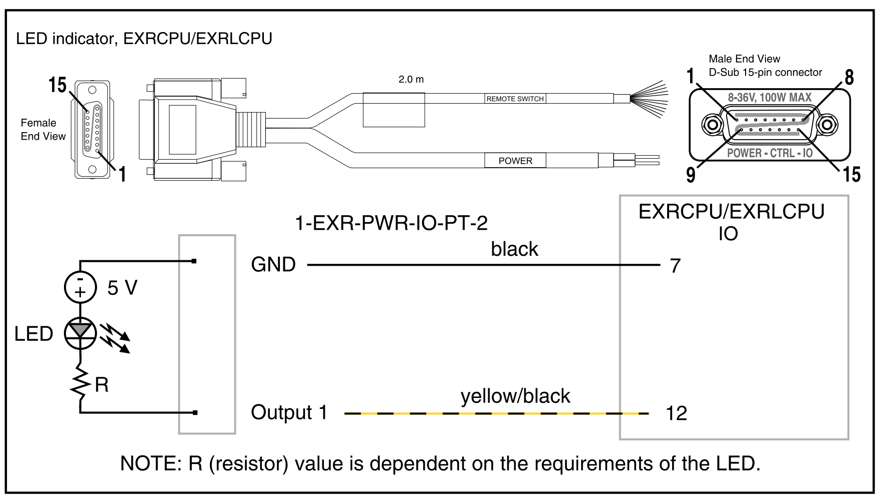
Operating a 12-volt incandescent bulb

The following diagram shows an incandescent bulb (3 watts maximum) used as an indicator in the digital output circuit. An external 12-volt DC power supply provides power for the bulb. The light turns on when the output is set to FALSE.



Operating a Light Emitting Diode (LED)

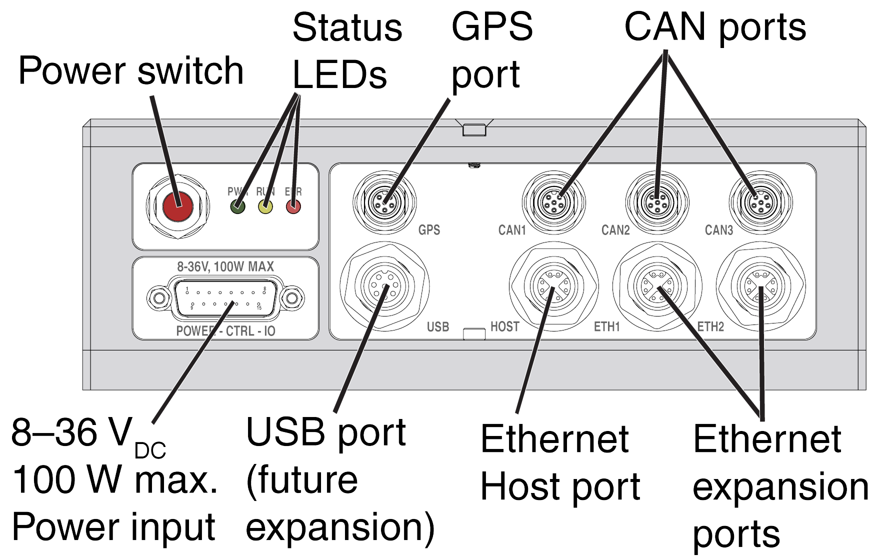
The following diagram shows the use of an LED as an indicator in the digital output circuit. An external 5-volt DC power supply provides power for the LED indicator. A FALSE output causes the diode to light. The total of all diode currents must be less than 250 mA for a CPU layer. The resistor R limits the current through the diode when the LED is on. The resistor value is dependent on the requirements of the illumination device. For more information on output current limitations, refer to the EXRCPU and EXRLCPU data sheets available at www.hbm.com.



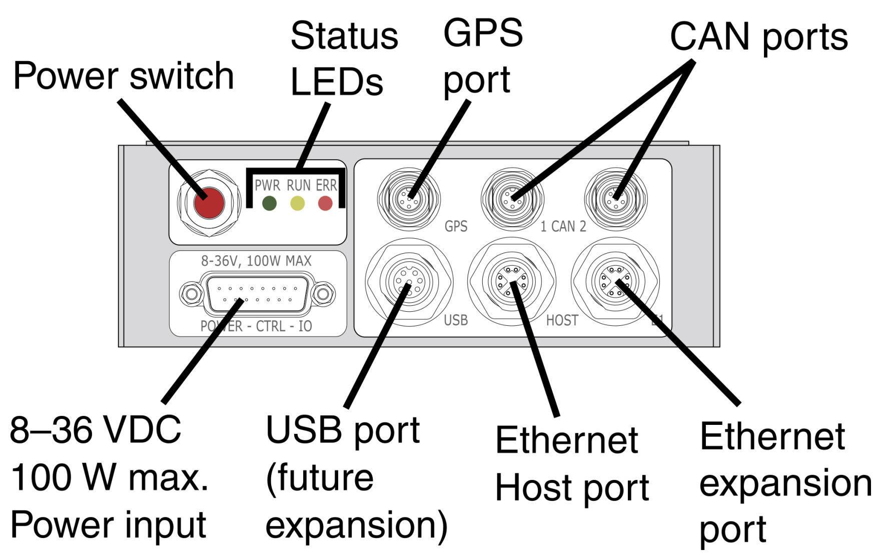
1.1.3 EXRCPU and EXRLCPU pin assignments

Please refer to other manuals for recommended cables for EX23-R or MX modules. See Cables for a list of compatible cables.

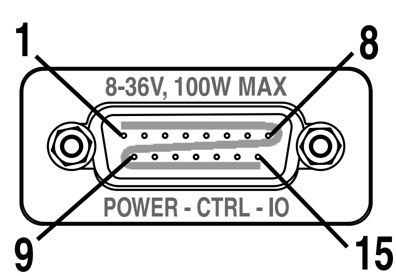
EXRCPU (Main Processor) ports



EXRLCPU (Main Processor) ports



Power connector (input D-Sub 15-pin male connector) pin assignments

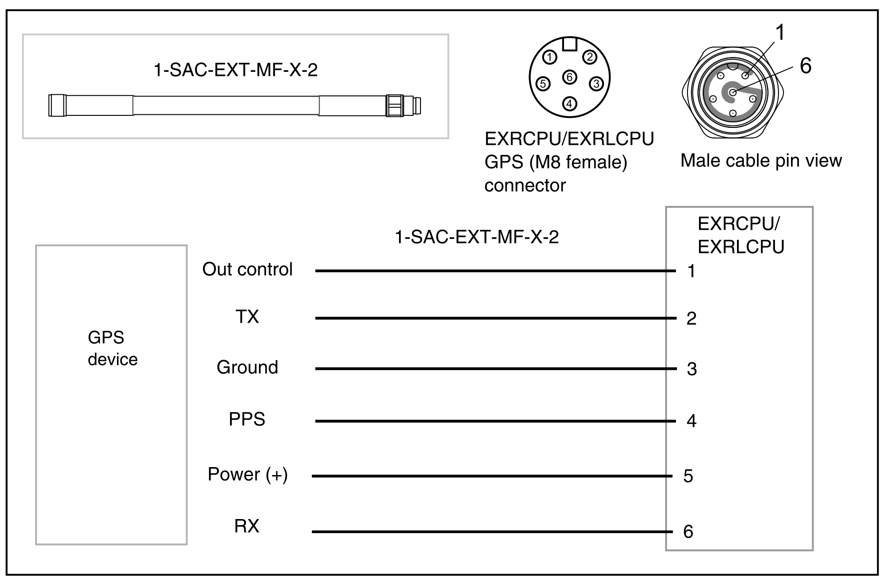


Pin	Function	Pin	Function
1	V+ (Power)	9	V+ (Power)
2	V+ (Power)	10*	Input 1 (Digital Ground)
3	Input 1	11*	Input 2 (Digital Ground)
4	Input 2	12	Output 1
5	Output 2	13	Output 3
6	Remote switch	14*	Remote switch (Digital Ground)
7*	V- (Ground)	15*	V- (Ground)
8*	V- (Ground)	Shell	Drain

* Do not connect pin 10, 11 or 14 to Frame Ground or pin 7, 8 or 15 when one of these pins is connected to Frame Ground (V-). The remote switch return (Pin 14) should never be tied to Frame Ground (V-). When using the digital I/O, pins 10 and 13 should never be tied to Frame Ground (V-).

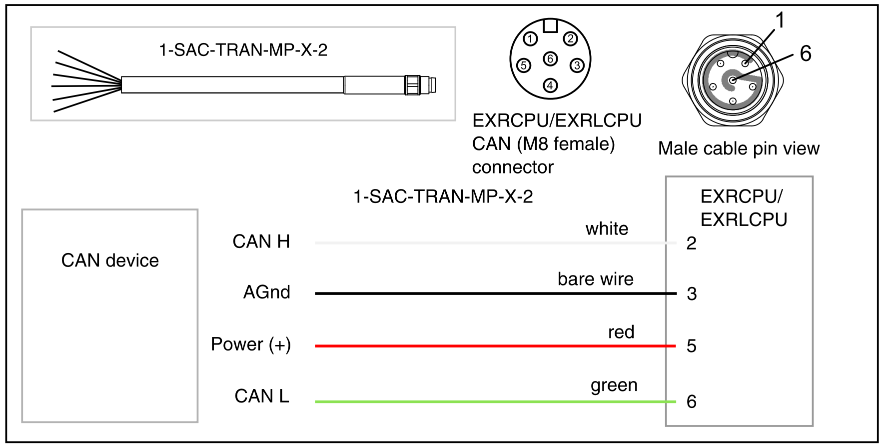
GPS port

GPS, EXRCPU/EXRLCPU



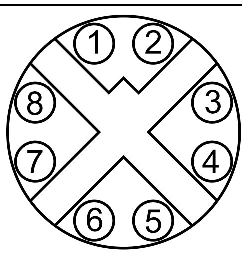
CAN ports (CAN1, CAN2 or CAN3) or (1 CAN 2)

CAN device, EXRCPU/EXRLCPU



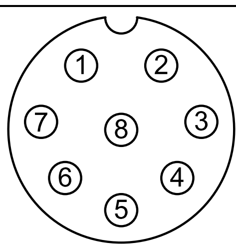
HOST / PTP / Ethernet ports (ETH1 or ETH2) or (E1)

M12 8-pin (X-code) female connector

Connector	Pin	Function	Pin	Function
	1	PTP TRX 0 P	6	PTP TRX 3 N
	2	PTP TRX 0 N	7	PTP TRX 2 N
	3	PTP TRX 1 P	8	PTP TRX 2 P
	4	PTP TRX 1 N	Shell	Chassis Ground
	5	PTP TRX 3 P		

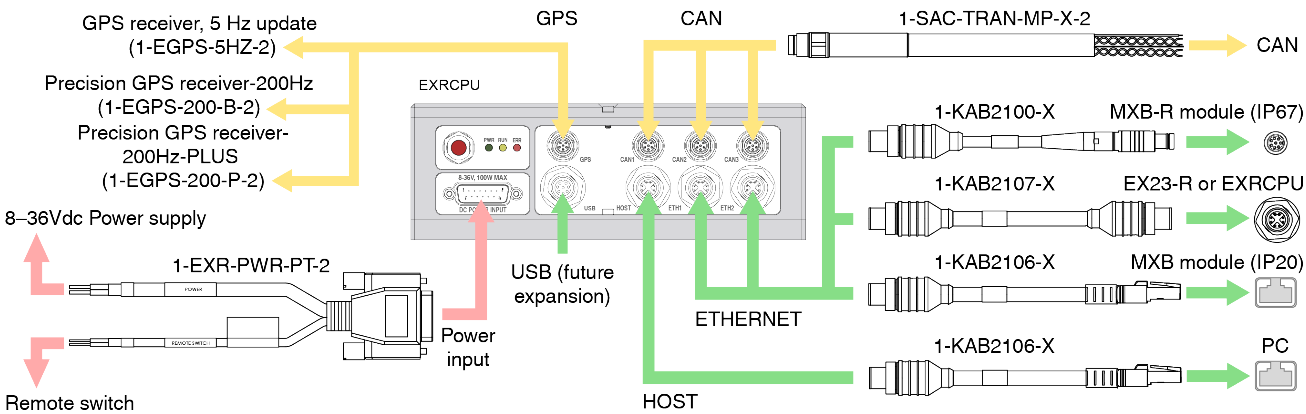
USB port

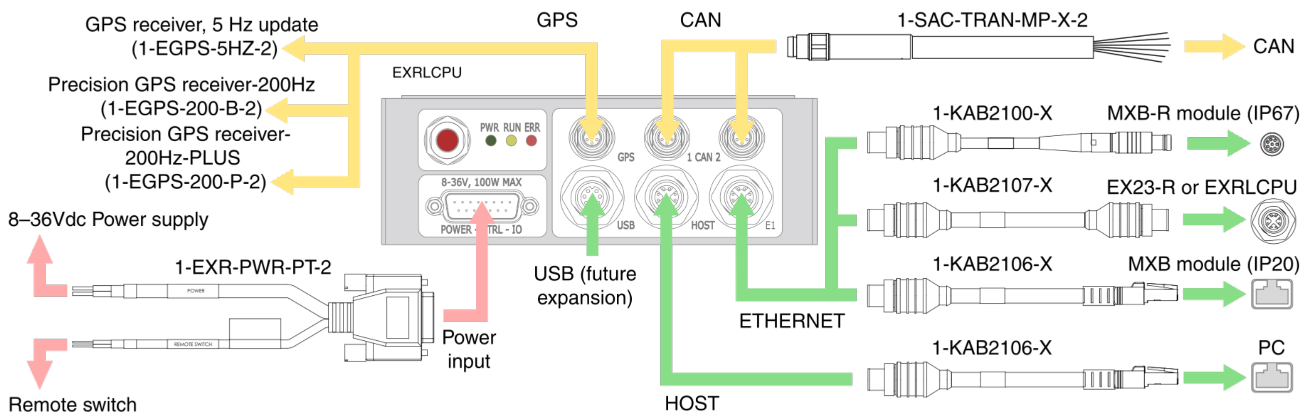
M12 8-pin female connector

Connector	Pin	Function	Pin	Function
	1	Power (+)	5	HPS RS232 RX
	2	USB DM	6	HPS RS232 TX
	3	USB DP	7	ST32 RX RS232
	4	USB GND	8	ST32 TX RS232

1.1.4 Cables

The eDAQXR EXRCPU and eDAQXR-lite EXRLCPU main processors are compatible with several communications cables. See EXRCPU and EXRLCPU pin assignments for more information about pin assignments in unit connectors.


GPS receiver, 5 Hz update
(1-EGPS-5HZ-2)
Precision GPS receiver-200Hz
(1-EGPS-200-B-2)
Precision GPS receiver-
200Hz-PLUS
(1-EGPS-200-P-2)
8–36Vdc Power supply
1-EXR-PWR-PT-2
Remote switch
GPS
CAN
EXRCPU
USB (future
expansion)
Power
input
ETHERNET
HOST
1-SAC-TRAN-MP-X-2
CAN
1-KAB2100-X
MXB-R module (IP67)
1-KAB2107-X
EX23-R or EXRCPU
1-KAB2106-X
MXB module (IP20)
1-KAB2106-X
PC


GPS receiver, 5 Hz update
(1-EGPS-5HZ-2)
Precision GPS receiver-200Hz
(1-EGPS-200-B-2)
Precision GPS receiver-
200Hz-PLUS
(1-EGPS-200-P-2)
8–36Vdc Power supply
1-EXR-PWR-PT-2
Remote switch
GPS
CAN
EXRLCPU
USB (future
expansion)
Power
input
ETHERNET
HOST
1-SAC-TRAN-MP-X-2
CAN
1-KAB2100-X
MXB-R module (IP67)
1-KAB2107-X
EX23-R or EXRLCPU
1-KAB2106-X
MXB module (IP20)
1-KAB2106-X
PC

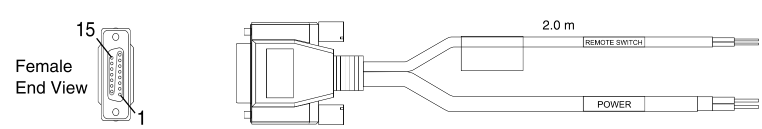
The following table lists the communications cables and their connectors.

Order Number	Description
1-EXR-PWR-PT-2	Power cable, 15-pin female D-Sub connector on cables ending in pigtails for power or remote switch, 2 m.
1-EXR-PWR-IO-PT-2	Power / IO cable, 15-pin female D-Sub connector on cables ending in pigtails for power or remote switch, 2 m.
1-KAB2100-0.4 1-KAB2100-2 1-KAB2100-5 1-KAB2107-10	Ethernet patch cable (8-pin X-Code to 8-pin X-Code) for connection EXRCPU Ethernet port to EX23-R or MX module Ethernet port (0.4, 2, 5 or 10 m).
1-KAB2106-2 1-KAB2106-5 1-KAB2106-10	Ethernet patch cable (8-pin X-Code to RJ45) for connection from PC to main processor Host port (2, 5 or 10 m).
1-KAB2107-0.4 1-KAB2107-2 1-KAB2107-5 1-KAB2107-10	Ethernet patch cable (8-pin X-Code to 8-pin X-Code) for connection main processor Ethernet port to EX23-R or MX module Ethernet port (0.4, 2, 5 or 10 m).
1-SAC-TRAN-MP-2-2 1-SAC-TRAN-MP-10-2	Transducer cable, male/pigtail (2 or 10 m).
1-SAC-EXT-MF-0.4-2 1-SAC-EXT-MF-2-2 1-SAC-EXT-MF-5-2 1-SAC-EXT-MF-10-2	Extension cable, male/female (0.4, 2, 5 or 10 m).

For the main power connector on the EXRCPU or EXRLCPU, and connecting cables, do not connect pin 10, 11 or 14 to Frame Ground (V-) or pin 7, 8 or 15 when one of these pins is connected to Frame Ground (V-). The remote switch return (Pin 14) should never be tied to Frame Ground (V-). When using the digital I/O, pins 10 and 13 should never be tied to Frame Ground (V-).

Power cable pin assignments

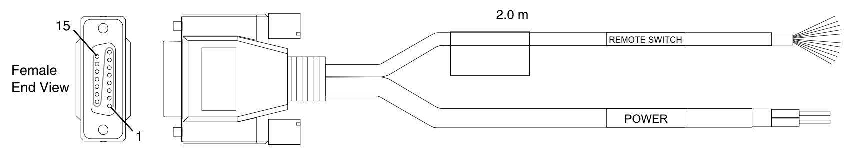
1-EXR-PWR-PT-2 Power Supply Cable, 15-pin D-Sub, female to pig tail



Pin	Function	Cable	Wire color	Wire gauge
1, 2, 9	Power (+) (8-36V)	POWER	Red	14
3	Jumpered to 4	-	-	-
4	Jumpered to 3	-	-	-
6	Remote switch	REMOTE SWITCH	Red	20
7, 8, 15	Ground (-)	POWER	Black	14
14	Remote switch (-) ground	REMOTE SWITCH	Black	20

Power and IO cable pin assignments

1-EXR-PWR-IO-PT-2 Power Supply and Control IO Cable, 15-pin D-Sub, female to pig tail

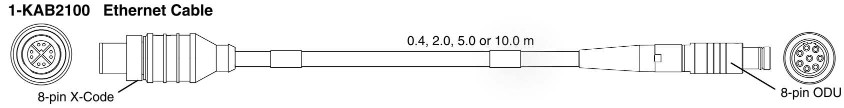


Pin	Function	Wire color	Pin	Function	Wire color
1	Power (+) (8-36V)	Red	9	Power (+) (8-36V)	Red
2	Power (+) (8-36V)	Red	10	Input 1 GND	Brown/White
3	Input 1	Brown	11	Input 2 GND	Orange/White
4	Input 2	Orange	12	Output 1	Yellow/Black
5	Output 2	Yellow	13	Output 3	Black/White
6	Remote switch	Red	14	Remote switch-ground (-)	Red/White
7	Ground (-)	Black	15	Ground (-)	Black
8	Ground (-)	Black	Shell	Drain	Drain

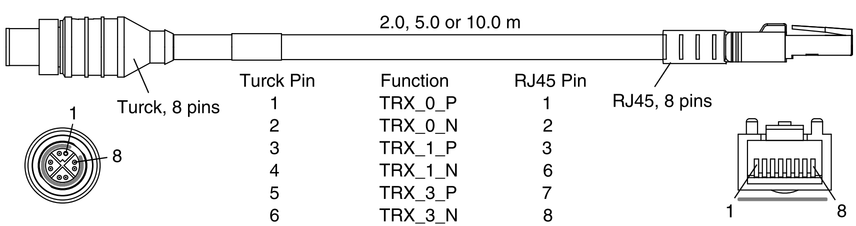
Ethernet pin assignments

Pin diagrams are shown from the pin side of the cable connector.

1-KAB2100 Ethernet Cable

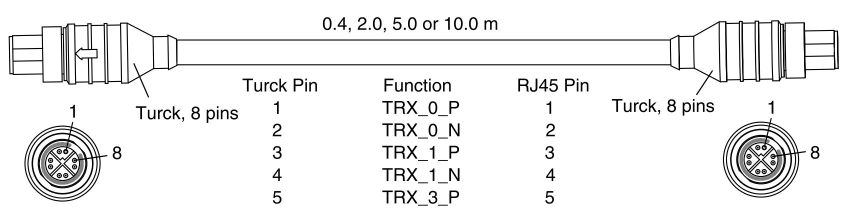


1-KAB2106-2, 1-KAB2106-5 or 1KAB2106-10, Ethernet cable



Turck Pin	Function	RJ45 Pin
1	TRX_0_P	1
2	TRX_0_N	2
3	TRX_1_P	3
4	TRX_1_N	6
5	TRX_3_P	7
6	TRX_3_N	8
7	TRX_2_N	5
8	TRX_2_P	4

1-KAB2107-0.4, 1-KAB2107-2, 1-KAB2107-5 or 1KAB2107-10, Ethernet cable

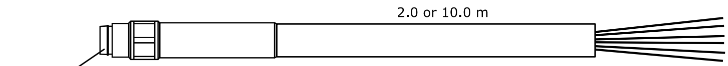


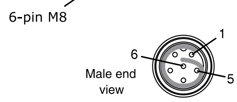
Turck Pin	Function	RJ45 Pin
1	TRX_0_P	1
2	TRX_0_N	2
3	TRX_1_P	3
4	TRX_1_N	4
5	TRX_3_P	5
6	TRX_3_N	6
7	TRX_2_N	7
8	TRX_2_P	8

CAN transducer cable pin assignments

Pin diagrams are shown from the pin side of the cable connector.

1-SAC-TRAN-MP-X-2 Transducer Cable



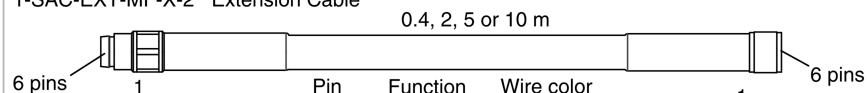


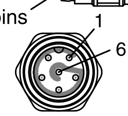
M8 Pin	Function	Wire color
1	SWC	Brown
2	CANH	White
3	AGnd	Bare wire
4	-	Black
5	Power	Red
6	CANL	Green

CAN extension cable pin assignments

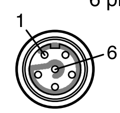
Pin diagrams are shown from the pin side of the cable connector.

1-SAC-EXT-MF-X-2 Extension Cable





Pin	Function	Wire color
1	--	Brown
--	--	--
--	--	--
2	CANH	White
3	AGnd	Bare Wire
4	--	Black
5	Power	Red
6	CANL	Green



1.1.5 Status LEDs

LED	Description
POWER (green)	
Off	Unit is off.
On	Unit is on and ready. This state is preceded by a flashing sequence of all LEDs indicating that the system is loaded.
4 Hz	Unit is shutting down, rebooting or updating firmware.
2 Hz	Unit is responding to a Flash LED command. For more information, see Hardware.
RUN (yellow)	
Off	No test run is in progress.
On	After power supply is disconnected, backup capacitors hold a charge. **Opening the CPU before the LED is off may result in damage.**
0.5 Hz	Test Setup task running.
1 Hz	Backup capacitors are charging from the connected power supply while CPU is switched off.
1 Hz	Remote control is enabled, but no Test run is in progress (with solid green LED for CPU on).
8 Hz	Test run is in progress.
ERROR (red)	
Off	No error.
On	Unit error. View the System logs for information on the error. Purge the whole log to turn off the ERROR (red) LED.
1 Hz	Low storage (less than 2 MB of storage remain).

LED sequence for loss of power event

	Green	Yellow	Red
1. Unit is shutting down due to loss of power.	2 Hz	Off	P†
2. Power restored.	On	On	On
3. Base system loaded.	On	Off	Off

LED sequence for firmware and FPGA update

	Green	Yellow	Red
Firmware and FPGA update			
1. Applying firmware update and rebooting.	4 Hz	Off	P†
2. Applying FPGA update and rebooting.	4 Hz	4 Hz	Off
Firmware update			
1. Applying firmware update and rebooting.	4 Hz	Off	P†
2. Checking FPGA.	4 Hz	4 Hz	On

† Previous state or state dependent

LED sequence for power button shut down

	Green	Yellow	Red
1. Power button pressed.	4 Hz	Off	P†
2. System shut down.	Off	Off	Off

LED sequence for power button boot up

	Green	Yellow	Red
1. Power button pressed.	On	Off	Off
2. System loaded.	S‡	S‡	S‡
3. System ready.	On	Off	P†

LED sequence for reboot from GUI

	Green	Yellow	Red
1. Reboot issued.	4 Hz	Off	P†
2. System loaded.	S‡	S‡	S‡
3. System ready.	On	Off	P†

† Previous state or state dependent

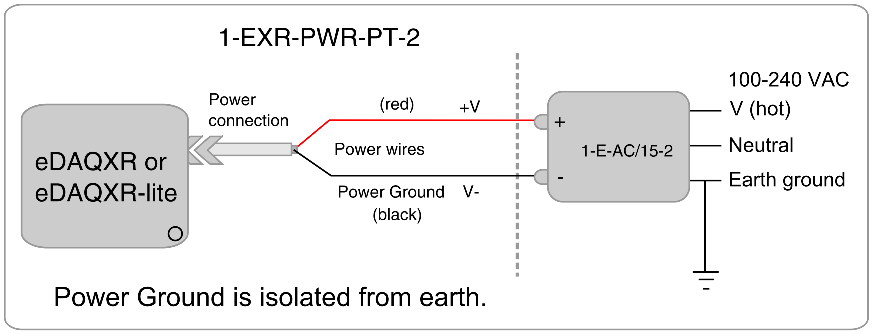
‡ Sequence with other LEDs

1.1.6 Powering the eDAQXR CPU or eDAQXR-lite CPU

CAUTION

The 1-ELBAT-2, 1-ELBAT2-2, 1-ELBAT-CE-2 or the 1-ELBAT-2-CE-2 (optional battery module attaching to the eDAQ) cannot be used with the EDAQXR system. Connecting an ELBAT to the EDAQXR will render the EDAQXR inoperable so it will need to be sent to Service for repair.

NOTE
The power input on the eDAQXR CPU is designed to be isolated. When the eDAQXR CPU with legacy eDAQ layers is not isolated from the chassis/earth ground, reverse voltage protection is compromised. Connecting only the positive side of the battery to the negative side of input power may result in an internal fault that will need factory repair. Refer to the User manual section on power and grounding for more detail.



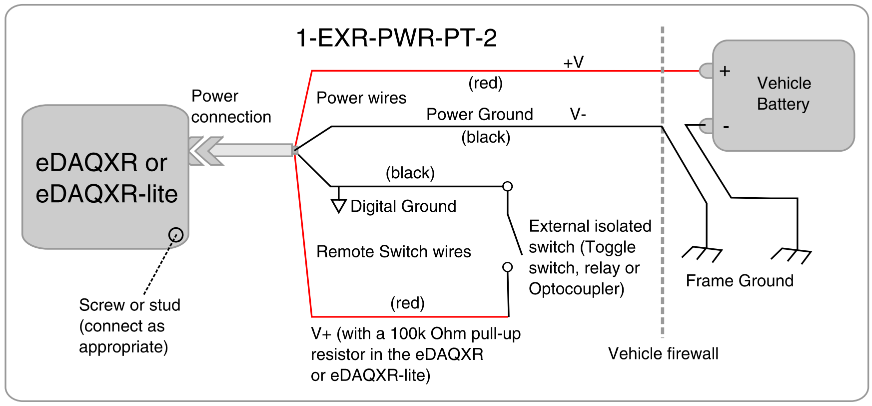
The following illustrates the recommended power connections for using a vehicle electrical system as the eDAQXR EXRCPU or eDAQXR-lite EXRLCPU system power source. The included diagrams are not intended to be complete or detailed instructions.

CAUTION
Connection to the positive power terminal without proper grounding may result in damage to the eDAQXR or eDAQXR-lite system.

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

Vehicle Frame Ground applications

The following diagram illustrates a method of powering an eDAQXR (EXRCPU) or eDAQXR-lite (EXRLCPU) system with a direct connection to a vehicle battery that has a permanent ground connection to the vehicle chassis (Frame Ground).



CAUTION

When mounted directly to the vehicle frame or when the ground stud is connect to vehicle frame the EXRCPU/EXRLCPU grounded even if the battery negative (-) is removed. For all electronics, removing battery (-) while the unit has applied voltage can cause unpredictable effects and possibly damage. It is highly recommended to always remove V+ first, no matter what the configuration. Due to the super caps backup system, transducer power can still exist without a battery (-) connected.

Careful consideration must be given to the grounding scheme when the EXRCPU is used with legacy 16-channels layers. Digital Ground, V- and stud are all connected together by the legacy layers.

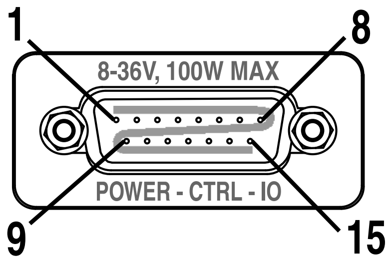
NOTE

When main power is removed, super capacitors in the eDAQXR or eDAQXR-lite become engaged to allow the unit time to save data and properly shut down. The super caps will need several seconds to recharge between cycles. If power keeps getting cycled on and off these super caps may not have enough time to charge up. Data may be affected if the super caps became prematurely depleted of energy. If the eDAQXR or eDAQXR-lite stays permanently connected to Battery power and the remote switch is used to shut off the unit, the super caps do not engage during shutdown.

Facts about the remote switch:

The remote switch is pulled up to Vehicle power (V+) through a 100k Ohm resistor inside the EXRCPU/EXRLCPU. The return is a digital ground. The connections are designed to be a dry contact between the remote switch lines. This means that only isolated switch contacts can be used with the "Remote Switch Wires". Examples would be would be a toggle switch or a mechanical relay. For an electronic solution opto coupler with an open collector output can be made to work. The remote switch return (Pin 14) should never be tied to Frame Ground (V-). When using the digital I/O pins 10 and 13 should never be tied to Frame Ground (V-).

Power connector (input D-Sub 15-pin male connector) pin assignments



Pin	Function	Pin	Function
1	V+ (Power)	9	V+ (Power)
2	V+ (Power)	10*	Input 1 (Digital Ground)
3	Input 1	11*	Input 2 (Digital Ground)
4	Input 2	12	Output 1
5	Output 2	13	Output 3
6	Remote switch	14*	Remote switch (Digital Ground)
7*	V- (Ground)	15*	V- (Ground)
8*	V- (Ground)	Shell	Drain

* Do not connect pin 10, 11 or 14 to Frame Ground (V-) or pin 7, 8 or 15 when one of these pins is connected to Frame Ground (V-).

Vehicle electrical system or harness

An alternate method to the "Remote Switch" is just to remove V+ power directly by the ignition switch or by the use of an in-line power-passing relay to the V+ of the EXRCPU or EXRLCPU. When using V+ to turn on the EXRCPU or EXRLCPU, the state of the CPU will be the last state when V+ was disconnected. For example, if the CPU was powered on when V+ was disconnected, then the CPU will power up when V+ is reconnected.

1.1.7 Setting up a remote power switch

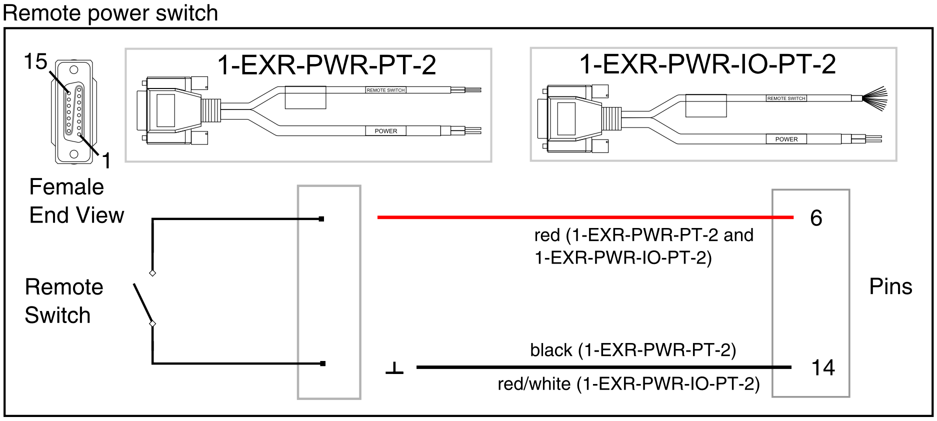
A remote power switch allows the user to control the main processor power state without using the power push button. This is useful in situations where the unit is not easily accessible to the test operator.

The remote power switch acts as a three-way household switch in conjunction with the power push button.

Connect the 1-EXR-PWR-PT-2 red and black wires of the remote switch cable to two contacts of a single pole, single throw contact switch with sufficient current rating (at least 10 A recommended). If the 1-EXR-PWR-IO-PT-2 cable is used, connect the red and red/white wires of the remote switch cable to two contacts of a single pole, single throw contact switch with sufficient current rating (at least 10 A recommended).

NOTE
If a switch is not connected to the red and black wires of the remote switch cable, make sure the wires are fully insulated from each other or solidly connected to each other to prevent accidentally turning the power off. If the wires are connected to each other and there is any chance of magnetic induction, do not coil the cable in a loop.

Remote power switch



1.2 Legacy eDAQ/eDAQ-lite layers

1.2.1 Compatible layers

eDAQXR EXRCPU main processor

- EITB isolated thermocouple layer
- ENTB non-isolated thermocouple layer
- EDIO digital input / output layer
- EBRG bridge layer
- EHLS high level analog layer

eDAQXR-lite EXRLCPU main processor

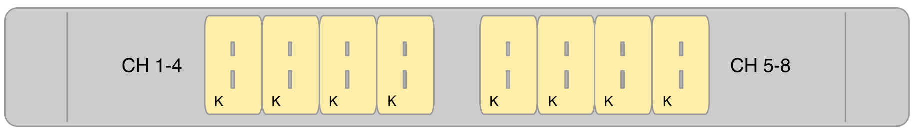
- eDAQ-lite ELNTB non-isolated thermocouple layer
- eDAQ-lite ELDIO digital input / output layer
- eDAQ-lite ELBRG bridge layer
- eDAQ-lite ELHLS high level analog layer

EITB isolated thermocouple layer

The EITB provides eight (8) channels of isolated thermocouple signal conditioning. The EITB is factory-configured for J, T, E or K type thermocouples and is operational over the full range of the thermocouple. Each channel has individual cold junction compensation and a notched filter processor that generates about seven (7) samples per second. Each channel is also isolated from the other channels to 500 volts, which allows the thermocouples to be attached to structures that have large differences in ground potential. The thermocouples are connected to the eDAQ layer using the standard Omega miniature thermocouple connectors located on the front panel.

The EITB uses the industry standard software compensation algorithm to generate the temperature data samples. The EITB first measures the cold-junction compensation (CJC) temperature and converts it to the equivalent microvolt value using a high-resolution lookup table. The EITB then subtracts the CJC equivalent microvolt value from the thermocouple's output microvolt value. The temperature is found using another high-resolution lookup table. The lookups are based on the ITS-90 Thermocouple Direct and Inverse Polynomials.

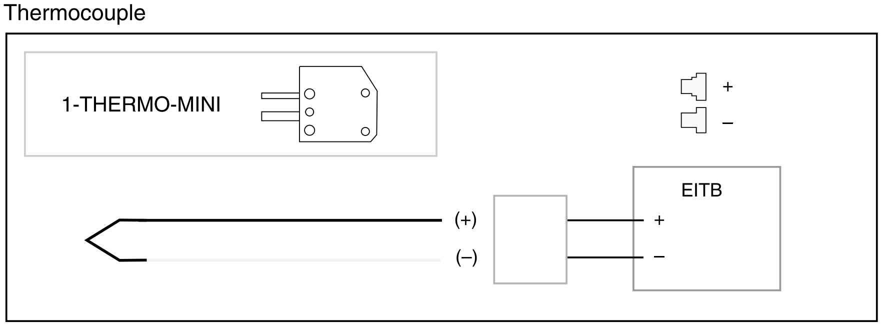
NOTE
Thermocouple leads should not exceed 30 meters in length from connector to tip.



This diagram shows the thermocouple connectors on an EITB layer configured for K-type thermocouples.

Wiring diagram

Thermocouple



ENTB/ELNTB non-isolated thermocouple layers

The ENTB provides non-isolated thermocouple inputs in two banks (A and B) of 16 channels. The ELNTB provides non-isolated thermocouple inputs in a bank of 16 channels. The ENTB/ELNTB supports the four (4) most common thermocouple types: J, K, T and E. The user-specified thermocouple type for each channel is independent of the other channels. The 16 channels of each bank share a common cold junction resulting in high channel-to-channel accuracy, which is particularly valuable when measuring thermal gradients.

Each channel uses a notched filter processor that generates about seven samples per second. Since these channels are not isolated from each other, they can only be used in applications where the individual thermocouples are electrically isolated from each other. A cold junction box is required for each bank and is connected to the ENTB/ELNTB with the cables provided using the connectors labeled “A01-A16” or

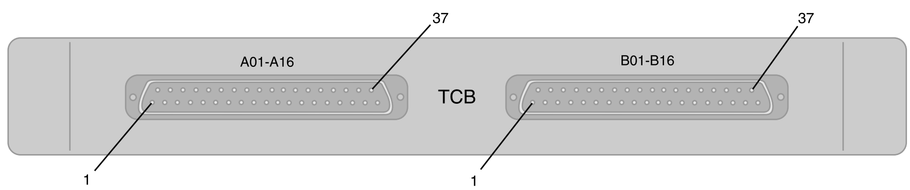
"B01-B16" located on the front panel. Each thermocouple is connected to the miniature barrier strip type paired inputs in the junction box.

The ENTB non-isolated thermocouple layer (1-ENTB-2) measures temperatures on 32 channels of non-isolated thermocouple signal conditioning through two 37-pin high density D-sub connectors of 16 channels each.

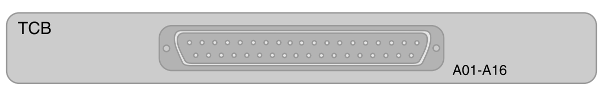
The ELNTB non-isolated thermocouple layer (1-ELNTB-2) measures temperatures on 16 channels of non-isolated thermocouple signal conditioning through a 37-pin high density D-sub connector.

The ENTB/ELNTB is compatible with the four most common thermocouple calibration types: K, J, T and E. Each channel is independently software-selectable between these calibration types. Since each bank of 16 channels share a common cold junction, the ENTB/ELNTB has excellent channel-to-channel accuracy. This is particularly useful when measuring thermal gradients.

The ENTB requires two ECJTB Cold Junction Thermocouple Boxes (sold separately) for thermocouple termination. The ELNTB requires a ECJTB Cold Junction Thermocouple Box (sold separately) for thermocouple termination.



This diagram shows the two 37-pin D-Sub connectors on an ENTB layer.



This diagram shows the 37-pin D-Sub connector on an ELNTB layer.

NOTE
Thermocouple leads should not exceed 30 meters in length from connector to tip.

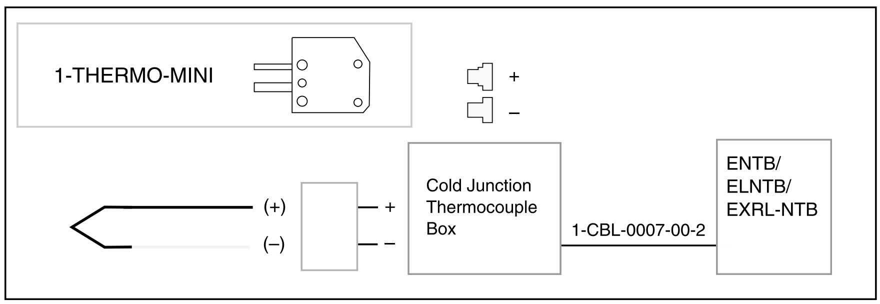
The ENTB/ELNTB uses the industry standard software compensation algorithm to generate the temperature data samples. The ENTB/ELNTB first measures the cold-junction compensation (CJC) temperature and converts it to the equivalent microvolt value using a high-resolution lookup table. The ENTB/ELNTB then subtracts the CJC equivalent microvolt value from the thermocouple's output microvolt value. The temperature is found using another high-resolution lookup table. The lookups are based on the ITS-90 Thermocouple Direct and Inverse Polynomials.

Application Note on Measuring Differential Temperatures
To measure differential temperatures using the ENTB/ELNTB layer, select two or more adjacent channels on the same bank. Use matched thermocouples for optimum differential accuracy.
Due to instrumentation noise, it is recommended that the maximum sample rate (e.g., 5 Hz for the 100 KHz MSR option) and a Smoothing Filter computed channel be used for each input channel. Using a five- or seven-tap Smoothing Filter typically reduces the instrumentation noise to below 0.2° C peak to peak (for all thermocouple types). Using more taps can further reduce the noise.
To generate the differential temperature, use a simple Signal Calculator computed channel. Use a Down Sampler computed channel to achieve the desired data storage rate.

Wiring diagram

The ENTB/ELNTB requires an ECJTB cold junction thermocouple box (1-ECJTB-K-16-2 or 1-ECJTB-2) for thermocouple termination.

Thermocouple



EDIO/ELDIO digital input/output layers

NOTE
EDIO layers must have the “DIO_V1_10_build_16.efd” firmware loaded. The firmware that supports Vehicle Bus modules on the original eDAQ (i.e., “DIO_2VBC_V1_10_build_16.efd”) is not supported in the eDAQXR.

The EDIO/ELDIO is a multifunctional layer that supports multiple digital input modes and a digital output mode. The EDIO has three (3) functionally identical banks (A, B and C). The ELDIO has one bank.

Each bank has 12 channels of digital I/O; the eight (8) channels on connectors "1-4" and "4-8" can be configured via software control for either input or output. The four (4) channels on connector "9-12" are wide range input only channels. Users must ensure that voltage inputs are within the specified limits to preclude the possibility of component damage.

Two (2) pulse counter channels are provided for each of the three (3) connectors (i.e., "1-4", "5-8", "9-12") on each bank, for a total of six (6) channels of pulse counters per bank. Pulse counter channels can be used to measure pulse width, pulse on time width, pulse counts, or to measure quadrature encoder inputs typically used to track angular or linear positions.

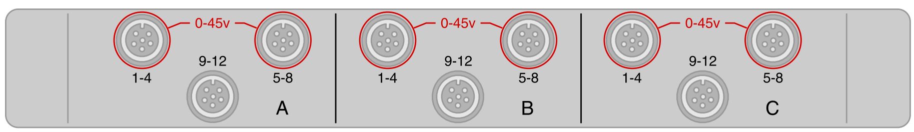
The pulse counters support pulse time period, pulse on period, pulse rate counting and quadrature decoder.

NOTE
Channels that are used for pulse counters can also be simultaneously used for Digital Input channels.

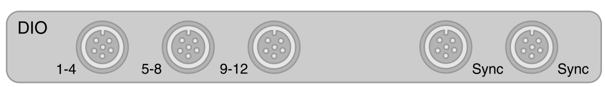
The digital input lines on each bank are sampled individually to generate logical (i.e., Boolean) data channels for triggering or other logical operations. The digital outputs are implemented as current sinks (i.e., they can only drive an output to ground). Up to 500 mA of current can be sunk on each bank. Output channels are designed to drive LED indicators, remote switches, etc.

Power to drive LEDs and other external output devices is available on each bank, and the user can select either a nominal 5 volt or a nominal 12 V output level. At either level, the DIO bank can source approximately 1 Amp.

Connect inputs, outputs, and transducers to the EDIO/ELDIO using one or more of the pins on the M8 connectors located on the front panel.



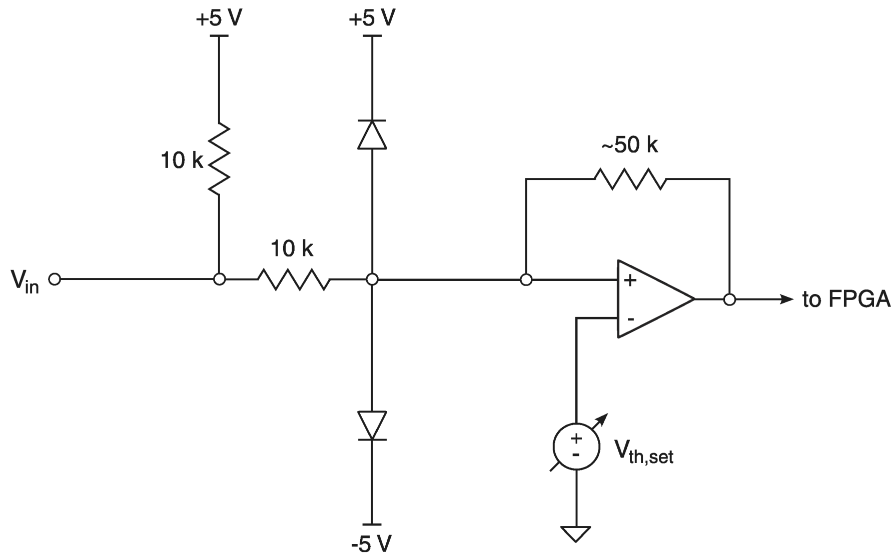
This diagram shows the M8 connectors on an EDIO layer.



This diagram shows the M8 connectors on an ELDIO layer.

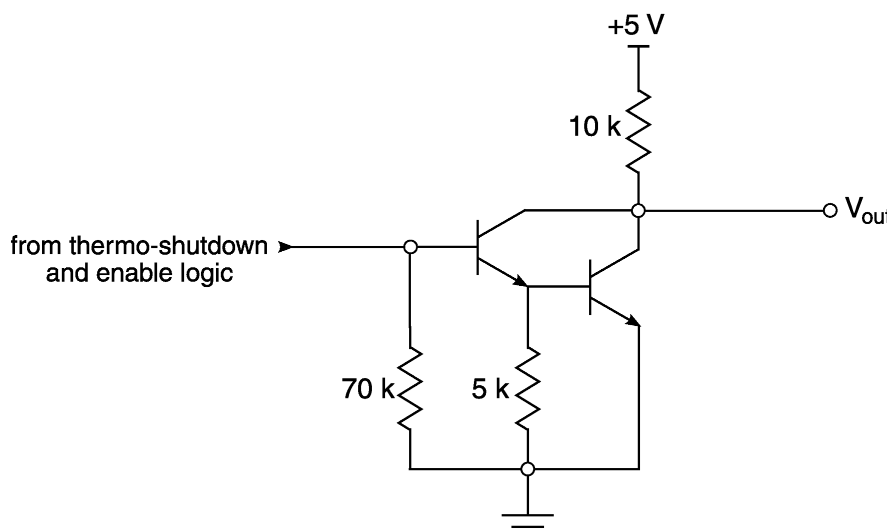
Digital Input Line Equivalent Circuit

The digital input circuitry sets the threshold voltages and determines the input as a logic 1 or 0. The input equivalent circuit is the same for all input channels.



Digital Output Line Equivalent Circuit

The output circuitry is applicable to the first two (2) connectors (channels 1–8) for each bank. Note that since the outputs share common I/O lines with the digital inputs, the lines are not allowed a DC voltage level lower than -0.3 volts.



Available Inputs and Outputs

The EDIO has digital I/O channels grouped into three (3) functionally identical banks (A, B and C). The ELDIO has one bank.

Each bank contains three connectors of four (4) digital I/O channels (i.e., bits). The eight (8) channels on connectors |1-4| and |5-8| are individually configurable to be either inputs or outputs. The four (4) channels on connector |9-12| are dedicated wide-range input channels. Each connector also provides two (2) pulse counter channels for a total of six (6) pulse counter channels per bank.

Digital Input/Output

There are 12 digital input/output lines available for each bank on the EDIO/ELDIO. Use the web interface to configure the lines on the |1-4| and |5-8| connectors as either inputs or outputs. The input lines can be sampled individually to generate logical (i.e., Boolean) data streams for triggering or other logical operations.

Use the bank configuration options to program the input threshold mode and limits for determining the Boolean state of the input channels. Connect channels using the numbered M8 connectors on the front panel of the layer.

The output lines are updated at a low rate based on the user-defined pipe frame size and are designed to drive LED indicators, remote switches, etc.

EDIO Pulse Counter

The pulse counter channels share the same input lines as the digital input/output channels. Two (2) pulse counter channels are provided on each connector (|1-4|, |5-8| and |9-12|). Pulse counter channels can measure pulse width, count pulses or used in pairs as quadrature encoder inputs typically used to track angular or linear position. Connect pulse counter channels to the EDIO/ELDIO using the numbered M8 connectors on the front panel.

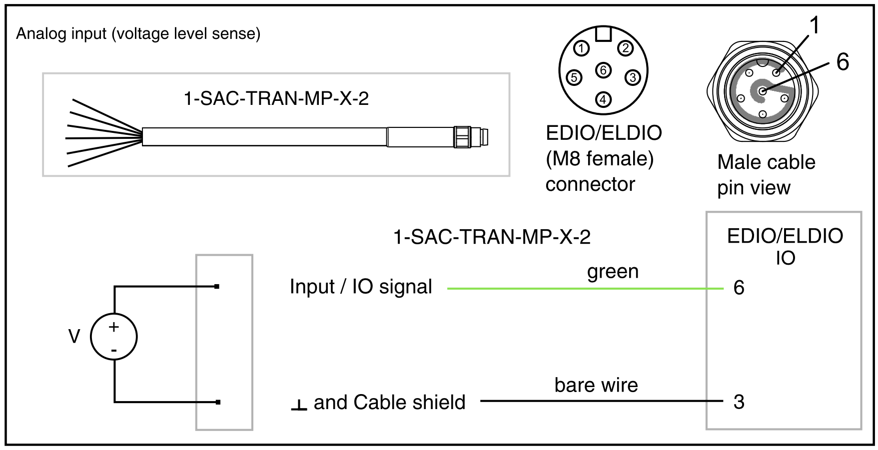
NOTE
Input bits (i.e., channels) used for pulse counters can simultaneously be used for digital input channels.

Limits on EDIO/ELDIO Input Voltages
The four (4) channels on connector |9-12| on each bank of the EDIO/ELDIO are wide range inputs that can accept steady state voltages in the range of ±45 volts. These channels can also tolerate short duration spikes up to +100 volts (as can be encountered using inductive pickup devices).
The eight (8) channels on connectors |1-4| and |5-8| on each bank of the EDIO/ELDIO are configurable as either inputs or outputs and can accept steady state voltages in the range of -0.2 to +45 volts. These channels can also tolerate short duration spikes up to +100 volts. In general, it is advised that these channels be used only with positive voltage input sources.
Exceeding the input ranges described above can result in component damage, requiring factory repair. Layer damage caused by exceeding input voltage limits is not covered by HBM warranty.

Wiring diagrams

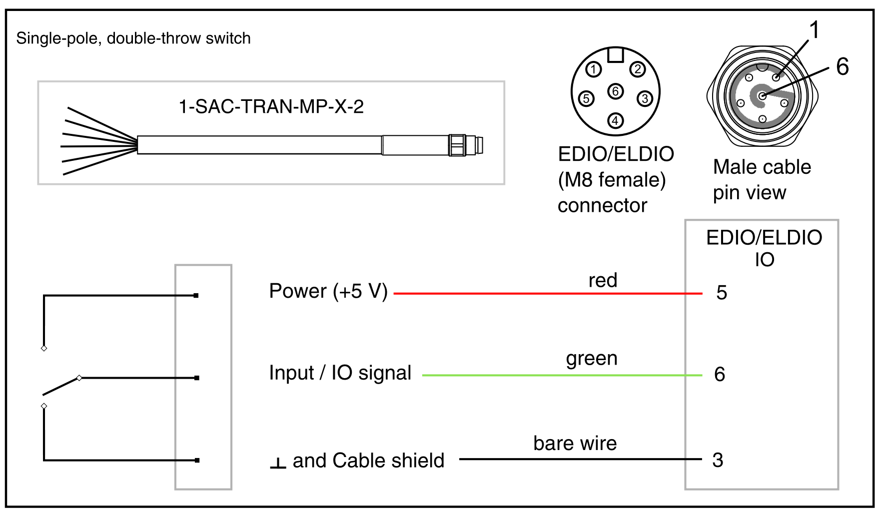
Digital input

Use the Somat SAC-TRAN-MP Transducer Cable (1-SAC-TRAN-MP-2-2 or 1-SAC-TRAN-MP-10-2) to wire EDIO/ELDIO digital inputs.



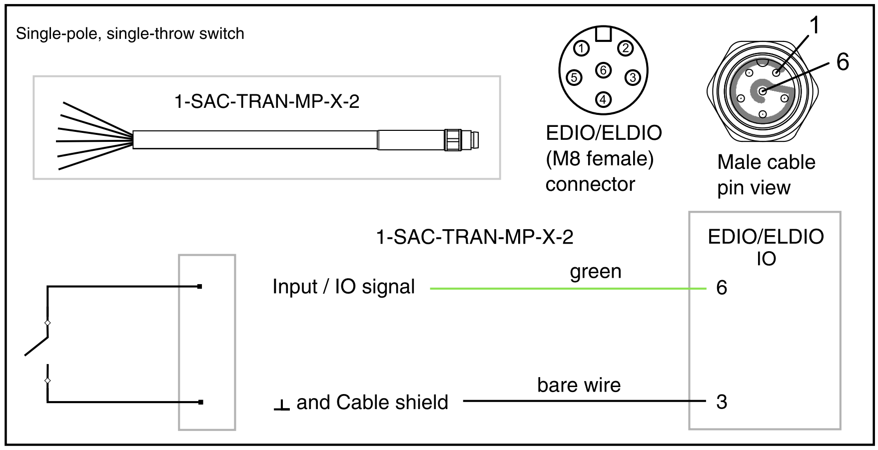
Preferred switch

Whenever possible, a single-pole, double-throw switch, wired as shown below, should be used for switched inputs. This circuit solidly switches the input line to either ground or +5 volts and prevents coupling of the input line to other digital input lines. Moving the switch to the ground side is identified as FALSE.



Alternate switch

The following diagram shows the circuit wiring for an alternate digital input involving a switch closure function. An open switch as shown is TRUE; a closed switch is FALSE. This circuit is adequate for most applications.

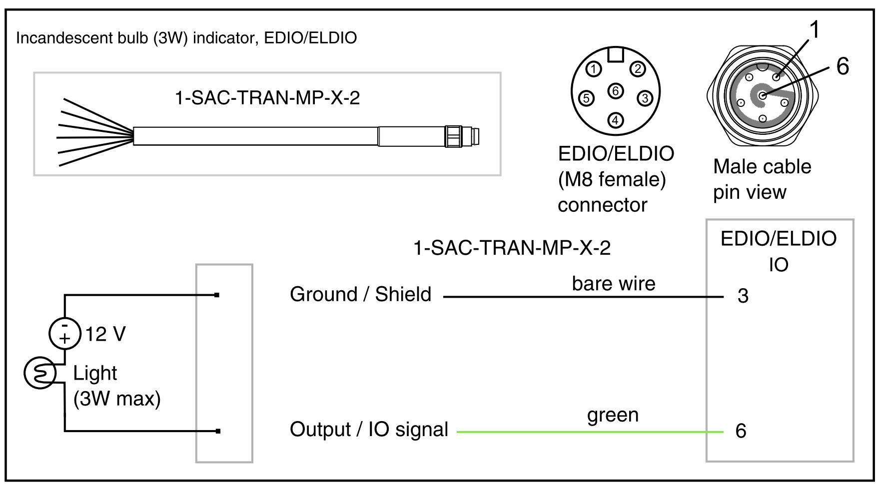


Digital output

Use the Somat SAC-TRAN-MP Transducer Cable (1-SAC-TRAN-MP-2-2 or 1-SAC-TRAN-MP-10-2) to wire EDIO/ELDIO digital outputs.

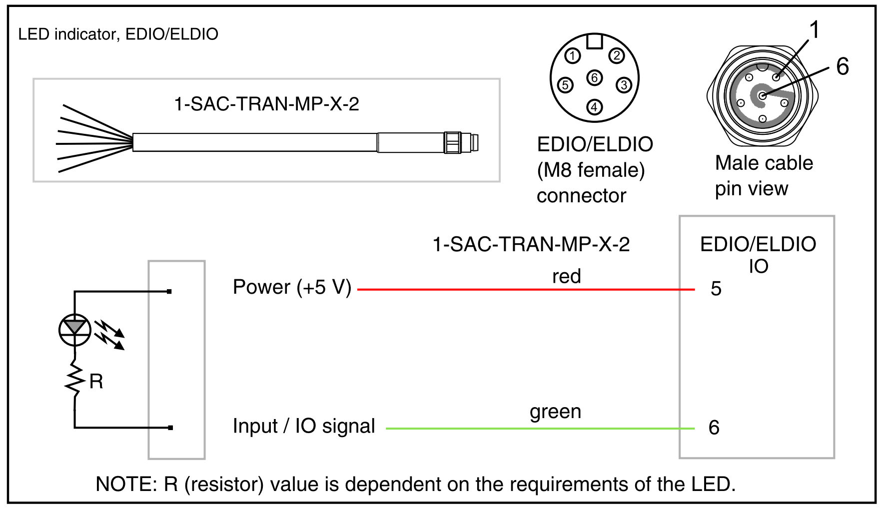
Operating a 12-volt incandescent bulb

The following diagram shows an incandescent bulb (3 watts maximum) used as an indicator in the digital output circuit. An external 12-volt DC power supply provides power for the bulb. The light turns on when the output is set to FALSE.

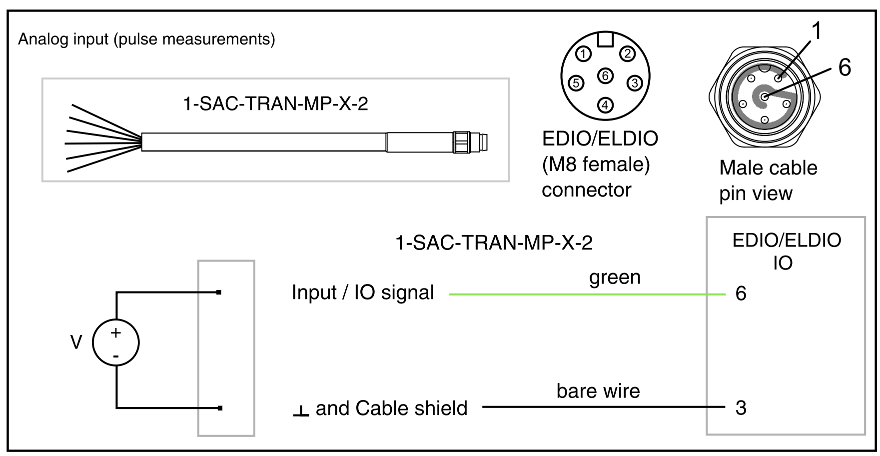


Operating a Light Emitting Diode (LED)

The following diagram shows the use of an LED as an indicator in the digital output circuit. A FALSE output causes the diode to light. The total of all diode currents must be less than 250 mA for an EDIO/ELDIO bank. The resistor R limits the current through the diode when the LED is on. The resistor value is dependent on the requirements of the illumination device. For more information on output current limitations, refer to the EDIO and ELDIO data sheets available at www.hbm.com.



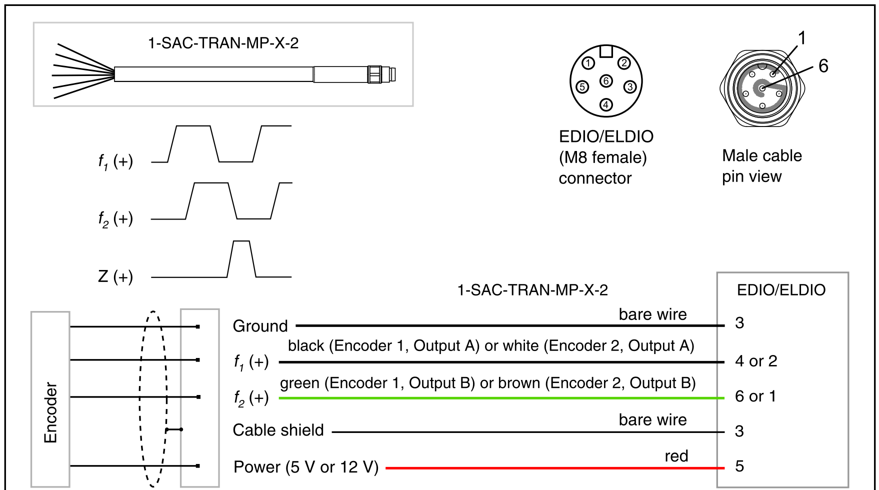
Pulse counters



Encoders

Single-ended, open collector

Encoder, single-ended, open collector

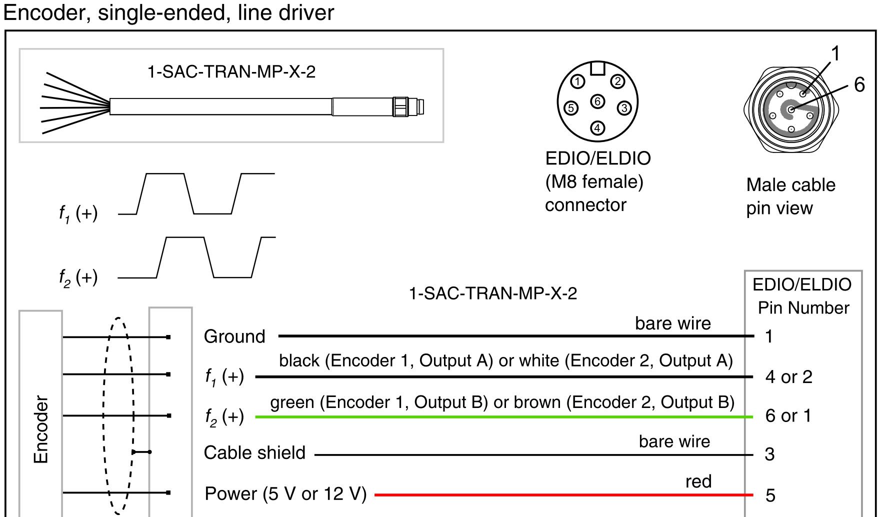


$A = f_1(+)$; $B = f_2(+)$

Pin	Wire color	Quadrature encoder usage
1	Brown	Encoder 2, Output B
2	White	Encoder 2, Output A
3	Bare wire	Return
4	Black	Encoder 1, Output A
5	Red	Power
6	Green	Encoder 1, Output B

Line driver encoders

Encoder, single-ended, line driver

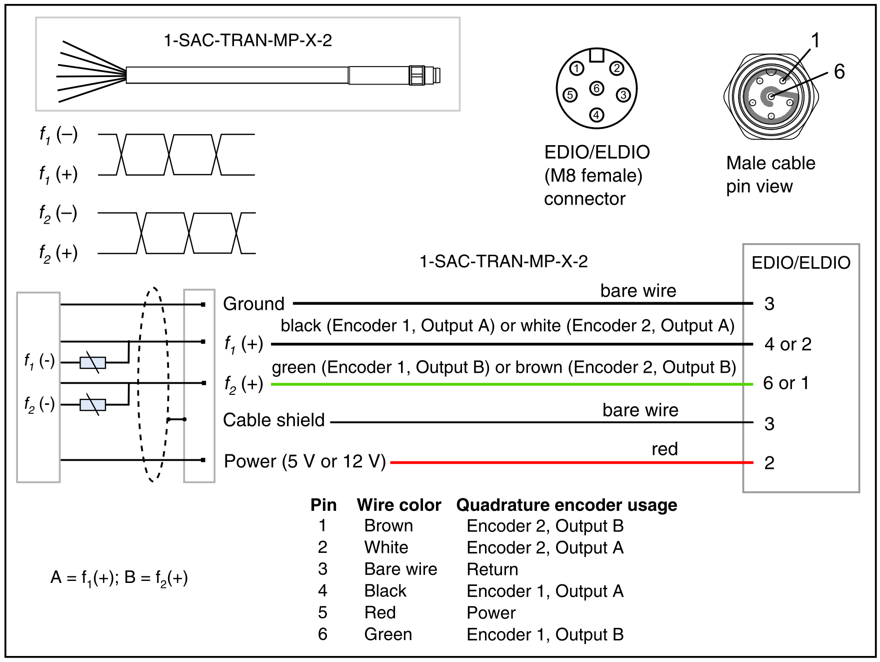


$A = f_1(+)$; $B = f_2(+)$

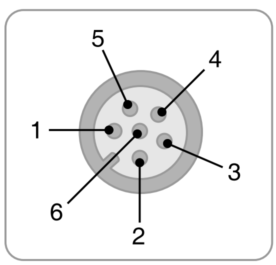
Pin	Wire color	Quadrature encoder usage
1	Brown	Encoder 2, Output B
2	White	Encoder 2, Output A
3	Bare wire	Return
4	Black	Encoder 1, Output A
5	Red	Power
6	Green	Encoder 1, Output B

For applications requiring long cable runs or more than 200K pulses per second, use the differential wiring diagram below placing the 120-ohm termination as close to the input as possible to dampen reflections.

Encoder, differential, line driver



Cable pinouts for EDIO inputs



The following table lists the pinouts for the SAC-TRAN-MP cable when used for EDIO/ELDIO inputs. The I/O pin depends on the bank connector (i.e., |1-4|, |5-8| or |9-12|).

NOTE

The quadrature encoder outputs as specified are for default signal polarity which assigns the positive direction to clockwise rotation. To reverse polarity, interchange encoder outputs A and B.

Pin	Function	Wire color	Quad encoder use
1	I/O 4, 8 or 12	Brown	Encoder 2, output B
2	I/O 3, 7 or 11	White	Encoder 2, output A
3	GND/Shield	Bare wire	Return
4	I/O 1, 5 or 9	Black	Encoder 1, output A
5	Power	Red	Power
6	I/O 2, 6 or 10	Green	Encoder 1, output B

A = f_1(+); B = f_2 (+)

EBRG/ELBRG bridge layers

The EBRG/ELBRG bridge layers offer simultaneously sampled low-level differential analog inputs through independent connectors. These are extremely versatile layers. The layers work with both amplified and unamplified transducers including: strain gauges, accelerometers, pressure transducers, load cells and other general analog signals. The layers provide excellent strain gage conditioning with support for quarter-, half- and full-bridge configurations. Automatic balancing and gain settings, as well as software selectable sample rates, excitation, and digital filtering simplify set up of a strain channel. There are several calibration options including defined value, external and multipoint calibrations as well as shunt calibrations with embedded software tools. The layers also provide four shunt calibration resistors per channel with software selectable shunt direction for either upscale (-Sig to -Ex) or downscale (-Sig to +Ex) calibrations.

The EBRG supports 16 input signals. The ELBRG supports 4 input signals.

The layers support full- and half-bridge types with resistance ranges from 100 to 10000 Ohm, and quarter-bridges with resistance of either 120 or 350 Ohm (as a factory installed option). A set of internal shunt resistors (50, 100, 200, and 500 kOhm) is available for sensor scaling and test setup sanity checks.

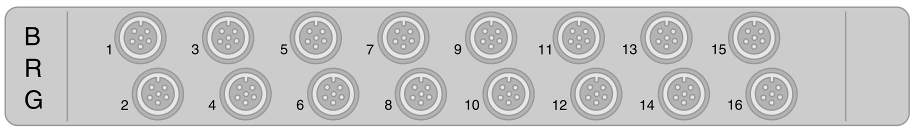
Some other features are itemized as follows.

a. Differential inputs provided for the analog input signals.
b. The EBRG has synchronous sampling with other EHLS, EBRG and EDIO layers. The ELBRG has synchronous sampling with other ELHLS, ELBRG and ELDIO layers.
c. Completely flexible configuration of filter type, filter pass bandwidth, and sample rate on a per channel basis.
d. For EBRG layer models 02 and above, an optional analog output sub board is available to provide high level analog output signals for each channel.
e. For EBRG layer models 02 and above, the excitation is provided on 4 channel Bank basis (i.e., the excitation voltage for Bank 1 [channels 1-4] can be selected independent of the excitation voltages selected for the other three (3) Banks).

Connect transducers to the EBRG/ELBRG individually using the M8 connectors located on the front panel.

Each independent channel contains programmable transducer power, an eight-pole Butterworth analog guard filter, a 16-bit A/D converter, software selectable digital filtering and output sample rate options of up to 100 kHz.

The EBRG/ELBRG layer supports full- and half-bridge types with a resistance from 100 to 10000 ohms and quarter-bridges with a resistance of either 120 or 350 ohms. All bridge configurations are accomplished using programmable switches, however, the quarter-bridge choice of 120- or 350-Ohm completion resistor is a factory installed option. A set of internal shunt resistors with selectable shunt direction is available for calibration purposes.

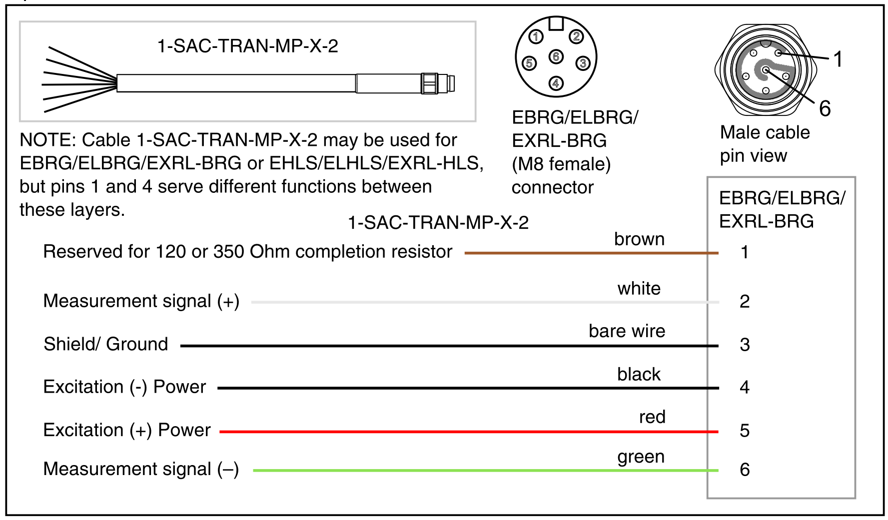


The diagram shows the M8 connectors on the EBRG layer.

The diagram shows the M8 connectors on the ELBRG layer.

Wiring diagrams

Input

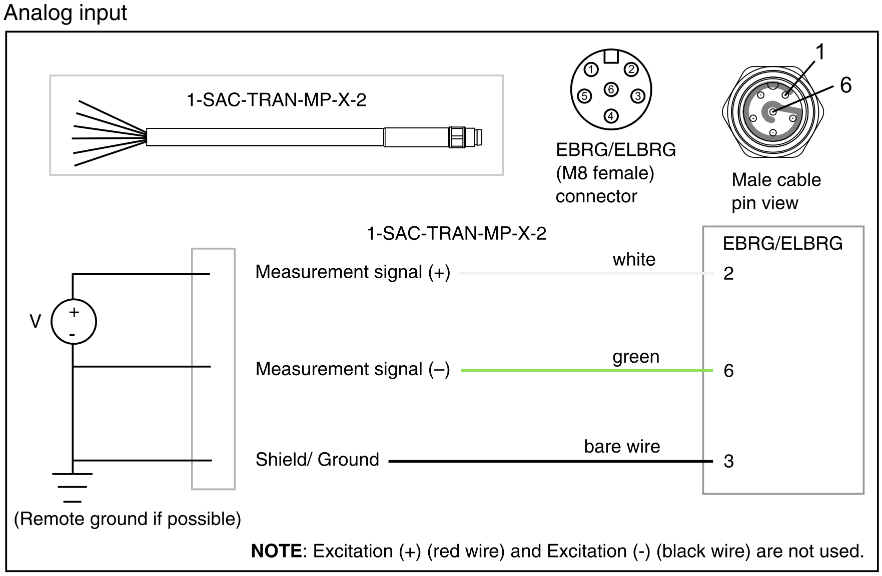


Analog input

Use the Somat SAC-TRAN-MP Transducer Cable (1-SAC-TRAN-MP-2-2 or 1-SAC-TRAN-MP-10-2) to wire EBRG/ELBRG analog inputs.

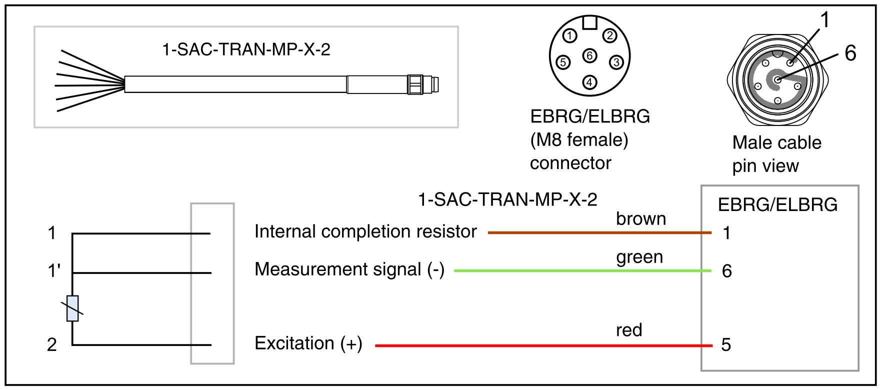
NOTE
Do not use this wiring diagram for EHLS/ELHLS channels.

Analog input

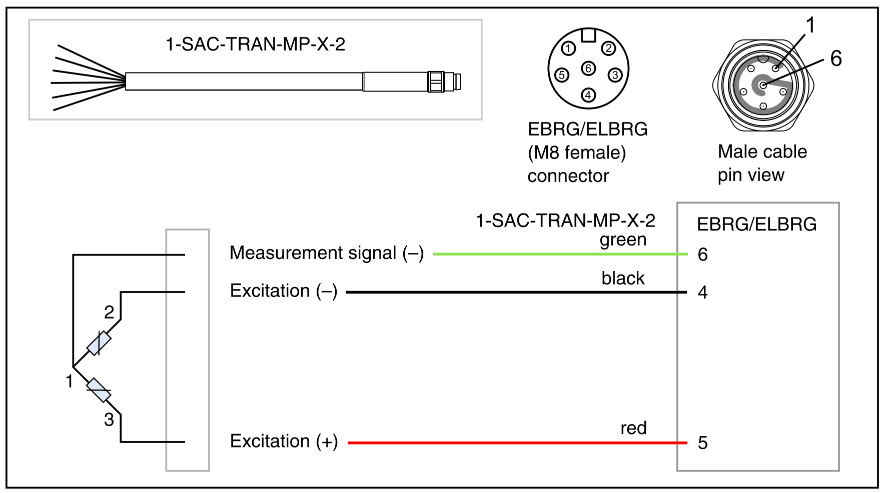


Strain gages

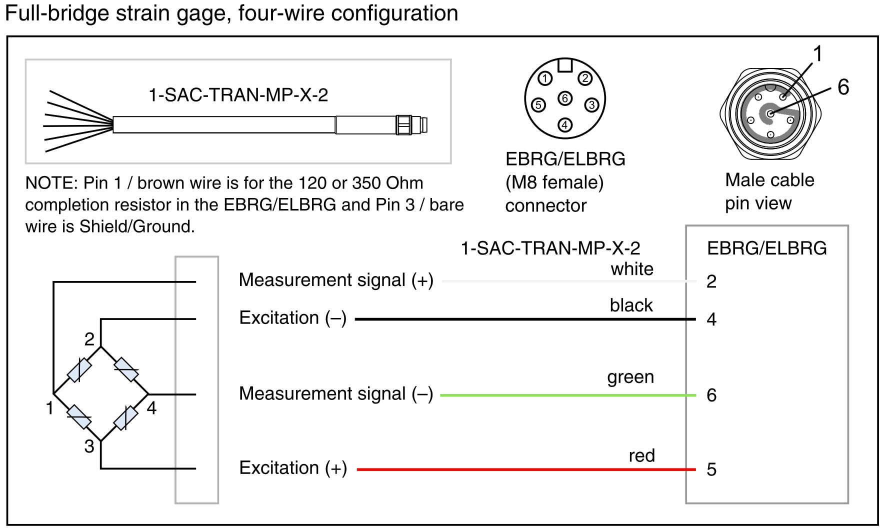
Quarter-bridge strain gage, three-wire configuration



Half-bridge strain gage, three-wire configuration

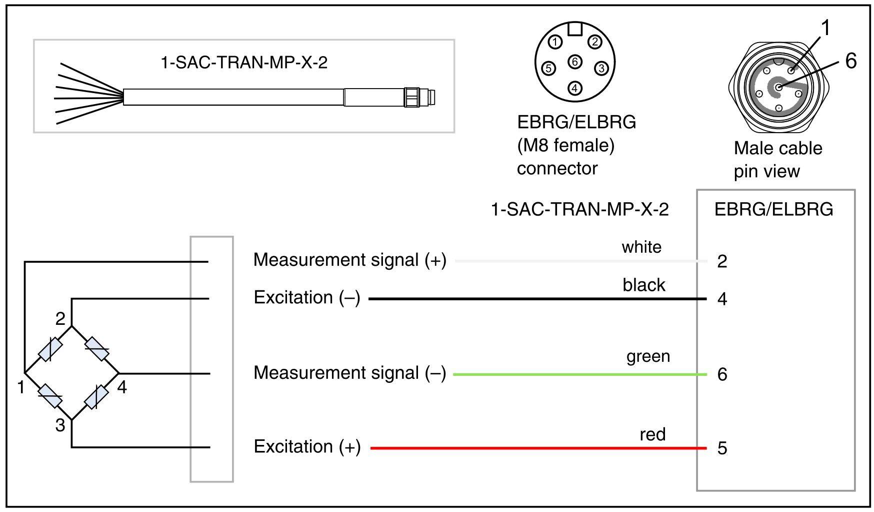


Full-bridge strain gage, four-wire configuration

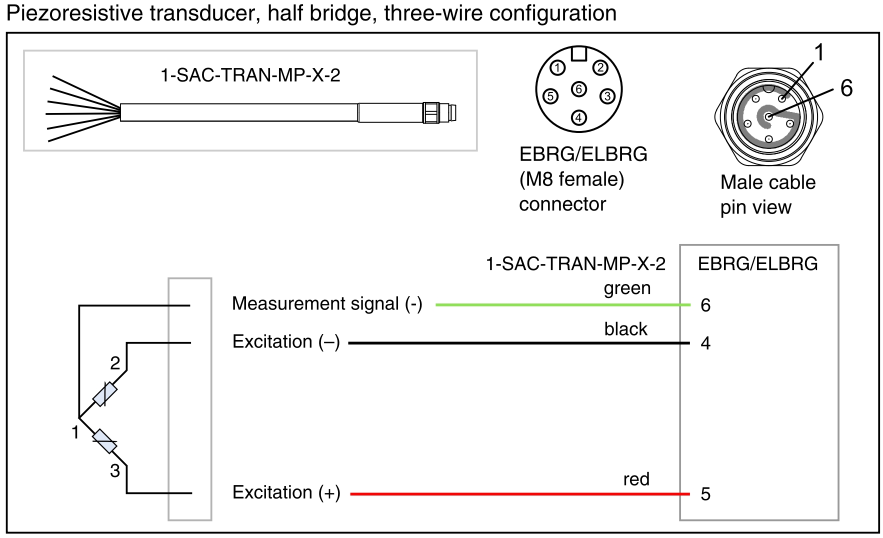


Piezoresistive transducers

Piezoresistive transducer, full bridge, four-wire configuration

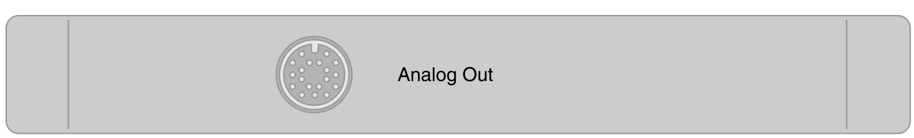


Piezoresistive transducer, half bridge, three-wire configuration



Analog Output

The EBRG is available with an optional analog output function to provide high level analog output signal for each channel. Outputs are filtered analog output signals that can be used in the creation of time-domain lab durability tests. Each output channel is associated with the corresponding (like-numbered) input channel on the EBRG board. Connect the analog outputs to the EBRG through the Analog Output connector on the back panel shown in the diagram below.



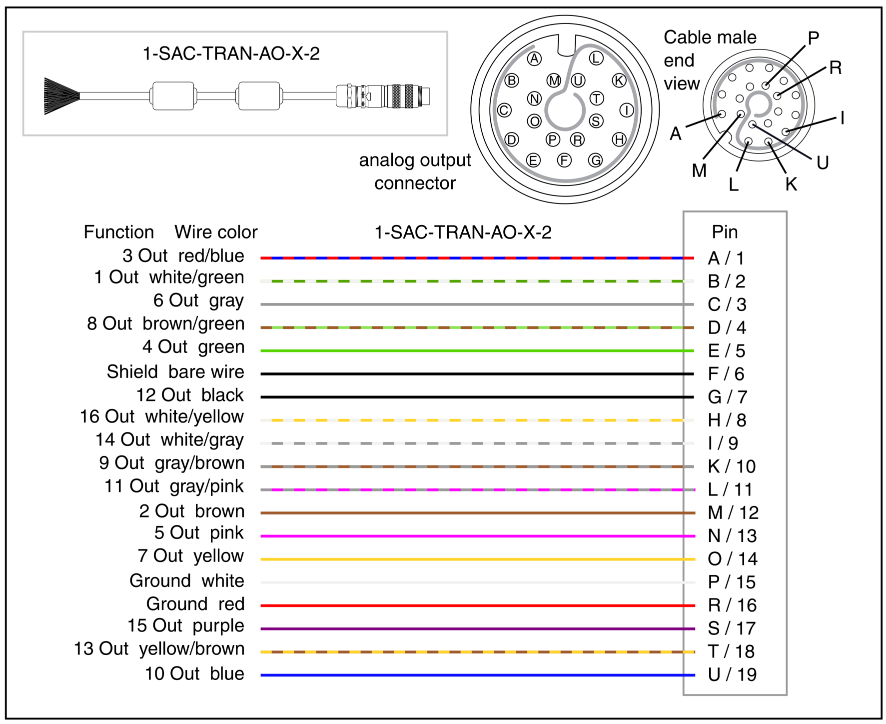
This diagram shows the analog out connector on the back panel of an EBRG layer.

The outputs are generated from a D/A converter implemented as a unity gain follower to the A/D converter. The eDAQXR/eDAQXR-lite uses the non-inverting unity gain follower by default. Select the Analog output inversion option in the test setup configuration to use the inverting unity gain follower when the channel calibration slope is negative.

NOTE

The EBRG uses a nominal ±2-volt A/D converter. However, do not assume that the user-defined full-scale values are even approximately equivalent to ±2 volts for any particular channel. This is primarily because the eDAQXR automatically provides a minimum over range protection of 1% and the eDAQXR can set gains only at certain discrete values resulting in actual over range protection that is sometimes significantly larger than 1%.

Analog output



EHLS/ELHLS high level analog layers

The EHLS/ELHLS High Level Simultaneously Sampled (High Level SS) layer is a high performance layer that supports multiple adapter modules to extend the range of supported transducers. The layer supports powered inputs with configurable full scale ranges from +/-64 mV up to +/-74.9 V.

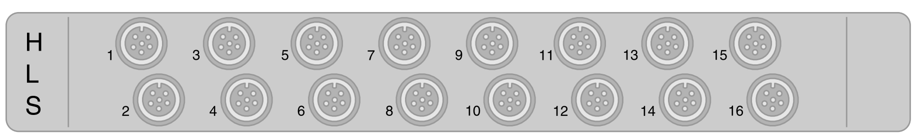
The EHLS board conditions each of the 16 input signals by means of programmable excitation circuitry, an eight (8) pole Butterworth analog guard filter, programmable amplifier gain and offset, 16-bit analog to digital converter sampling at 100000 S/s in the Decimal sample rate domain (or 98304 S/s in the Binary domain). The EHLS features simultaneous sampling for all 16 channels, programmable digital filters, and the output sample rate achieved by means of multiple stages of combined down sampling / digital filtering.

The ELHLS board conditions each of the 4 input signals by means of programmable excitation circuitry, an eight (8) pole Butterworth analog guard filter, programmable amplifier gain and offset, 16-bit analog to digital converter sampling at 100000 S/s in the Decimal sample rate domain (or 98304 S/s in the Binary domain). The ELHLS features simultaneous sampling for all 4 channels, programmable digital filters, and the output sample rate achieved by means of multiple stages of combined down sampling / digital filtering.

Some other features are itemized as follows.

a. Differential inputs provided for the analog input signals.
b. EHLS has synchronous sampling with other EHLS, EBRG and EDIO layers. ELHLS has synchronous sampling with other ELHLS, ELBRG and ELDIO layers.
c. The EHLS provides 400 milliwatts of transducer power supply with an adjustable supply voltage of 3–28 volts for every channel, adjustable only in 1 V increments. The ELHLS provides 400 milliwatts of transducer power supply with an adjustable supply voltage of 4–15 volts for every channel, adjustable only in 1 V increments. Use the transducer power supplies in parallel for larger loads.
d. Isolated analog output signal for each channel.
e. Completely flexible configuration of filter type, filter pass bandwidth, and sample rate on a per channel basis.
f. IEPE adapter module and Smart modules that support resistive bridge and thermocouple sensors.

Connect transducers to the EHLS/ELHLS individually using the M8 connectors located on the front panel.



This diagram shows the 16 M8 connectors on an EHLS layer.

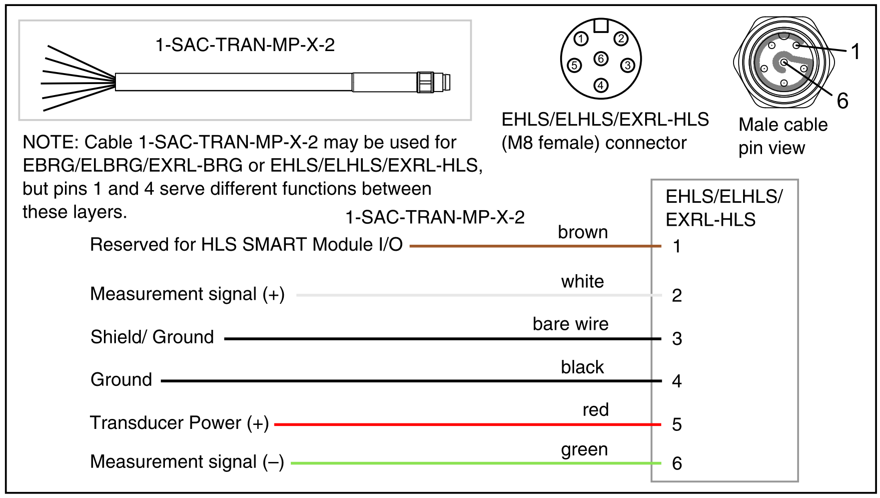
This diagram shows the 4 M8 connectors on an ELHLS layer.

Each independent channel contains programmable transducer power, an eight-pole Butterworth analog guard filter, a 16-bit A/D converter, software selectable digital filtering and output sample rate options of up to 100 kHz.

NOTE
The analog guard filters on the EHLS/ELHLS channels result in some gain amplification for high frequency inputs.

Wiring diagrams

Input

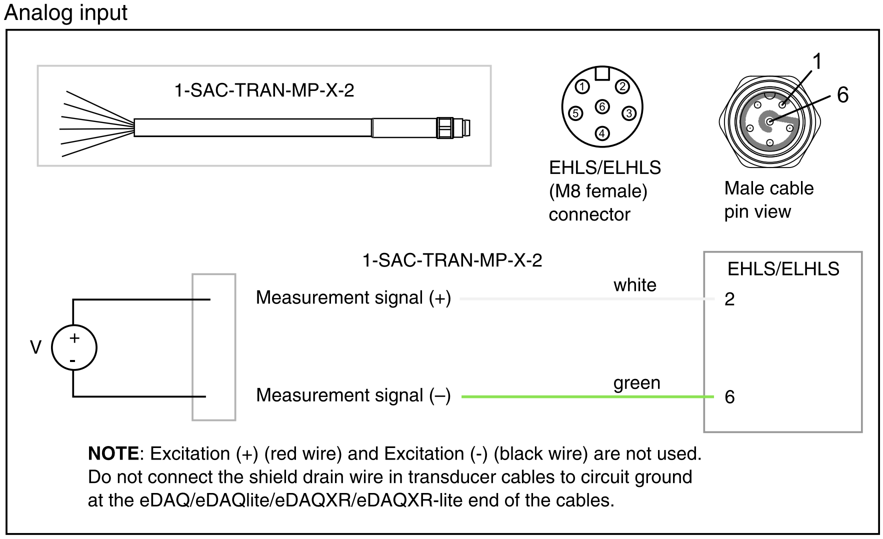


EHLS/ELHLS Analog input

Use the Somat SAC-TRAN-MP Transducer Cable (1-SAC-TRAN-MP-2-2 or 1-SAC-TRAN-MP-10-2) to wire EHLS/ELHLS analog inputs.

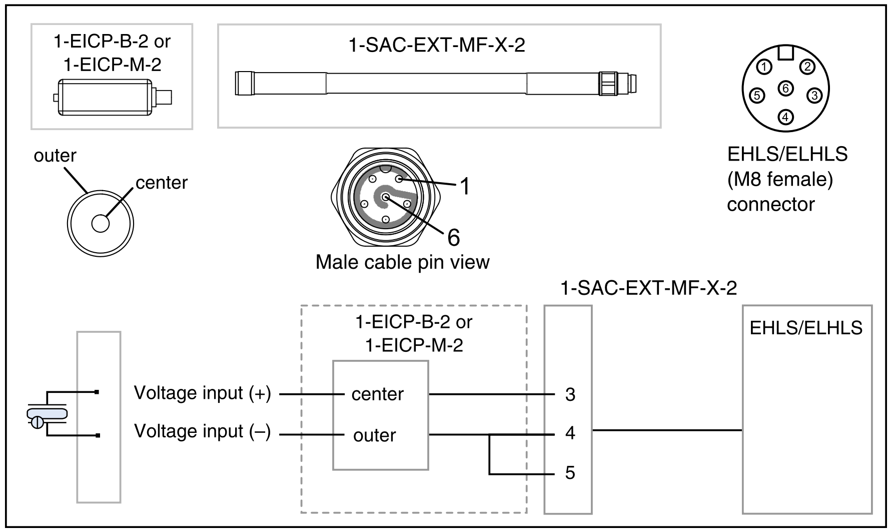
NOTE
Do not use this wiring diagram for EBRG or ELBRG channels.

Analog input



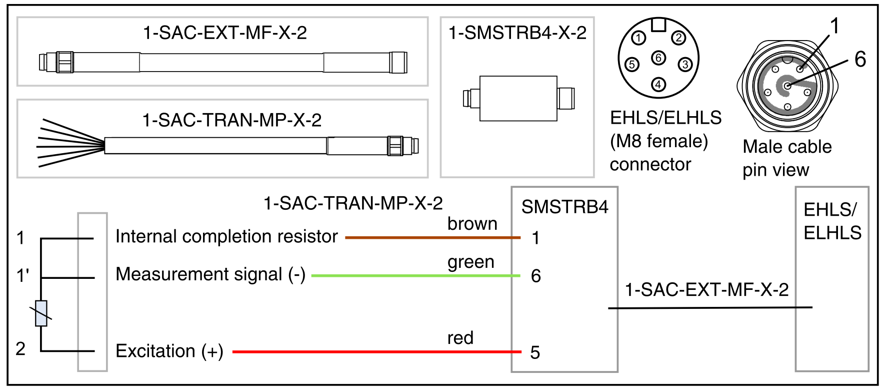
Current-fed piezoelectric transducer (IEPE) input with adapter

Current-fed piezoelectric transducer (IEPE) with adapter

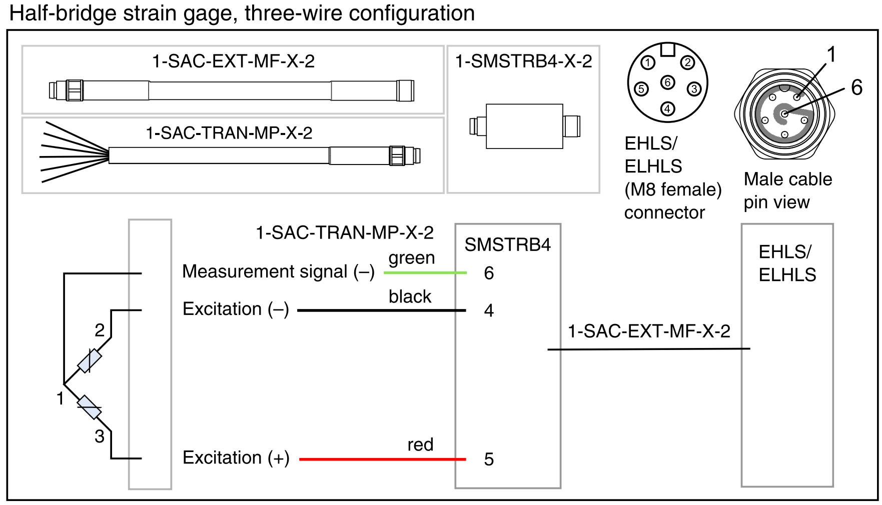


Strain gages

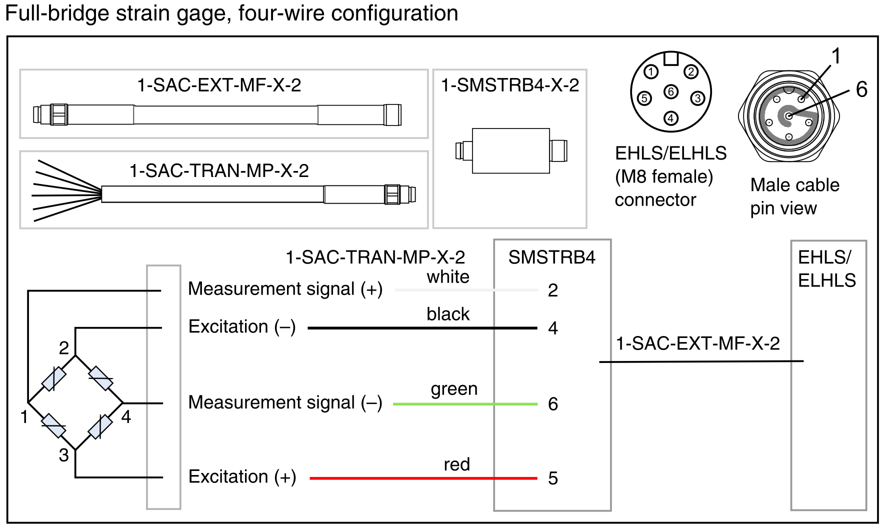
Quarter-bridge strain gage, three-wire configuration



Half-bridge strain gage, three-wire configuration

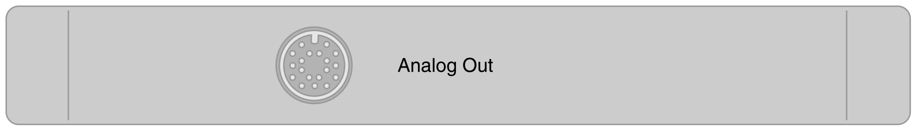


Full-bridge strain gage, four-wire configuration



Analog Output

The EHLS is available with an optional analog output function to provide high level analog output signal for each channel. Outputs are filtered analog output signals that can be used in the creation of time-domain lab durability tests. Each output channel is associated with the corresponding (like-numbered) input channel on the EHLS board. Connect the analog outputs to the EHLS through the Analog Output connector on the back panel shown in the diagram below.



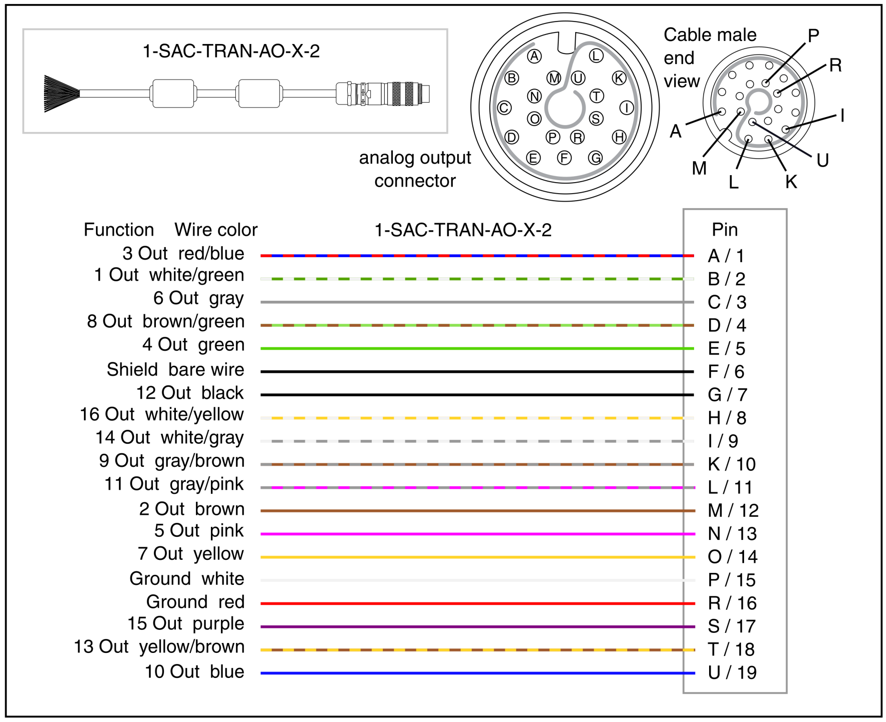
This diagram shows the analog out connector on the back panel of an EHLS layer.

The outputs are generated from a D/A converter implemented as a unity gain follower to the A/D converter. The EHLS uses the non-inverting unity gain follower by default. Select the Analog output inversion option in the test setup configuration to use the inverting unity gain follower when the channel calibration slope is negative.

NOTE

The EHLS uses a nominal ±2-volt A/D converter. However, do not assume that the user-defined full-scale values are even approximately equivalent to ±2 volts for any particular channel. This is primarily because the eDAQXR automatically provides a minimum over range protection of 1% and the eDAQXR can set gains only at certain discrete values resulting in actual over range protection that is sometimes significantly larger than 1%.

Analog output



eDAQ and eDAQ-lite layer wiring diagrams

See EITB isolated thermocouple layer (Page 34) for wiring diagrams and supporting information for this layer.

See ENTB/ELNTB non-isolated thermocouple layers (Page 35) for wiring diagrams and supporting information for this layer.

See EDIO/ELDIO digital input/output layers (Page 37) for wiring diagrams and supporting information for this layer.

See EBRG/ELBRG bridge layers (Page 46) for wiring diagrams and supporting information for this layer.

See EHLS/ELHLS high level analog layers (Page 51) for wiring diagrams and supporting information for this layer.

1.2.2 Compatible layer addressing

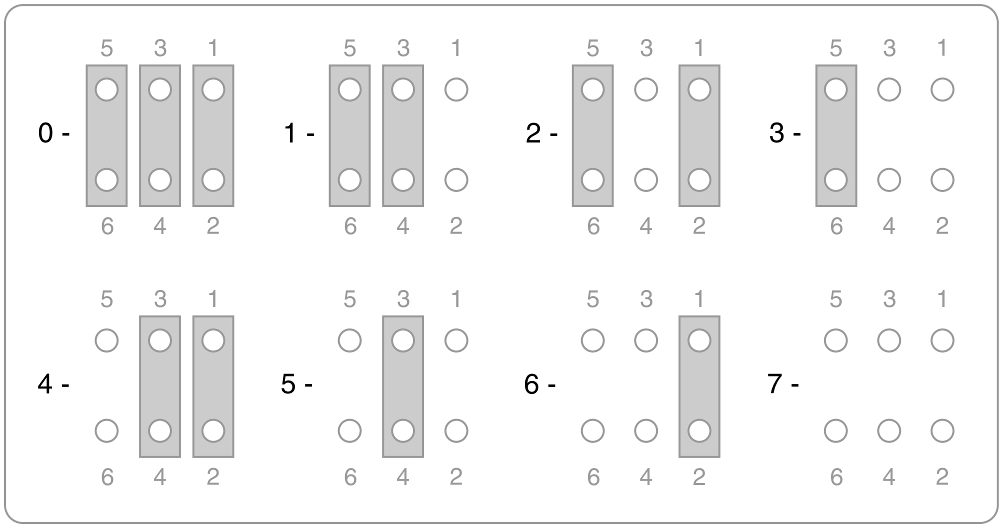
Before assembling a stack of layers, install jumpers correctly on each layer to establish a unique address for each layer when it is connected to a main processor.

Layer Addressing

The eDAQ or eDAQXR-lite stack is configured at the factory with the layer address jumpers properly set.

Follow the guidelines below to reconfigure a stack.

On all compatible layers except the main processor, there is a set of three jumper locations used to assign a physical layer address. Each jumper location consists of two associated pins labeled 1-2, 3-4 or 5-6 where pins 1-2 represent the least significant digit and pins 5-6 represent the most significant in a three-digit binary number. A jumpered pair results in a logical 0. An illustration of all possible logical addresses follows.



All layer address jumper sets are on the side of the bus connector receptacle (i.e., opposite the side with the bus connector bare pins). The jumper is labeled JP1.

eDAQXR EXRCPU stacking order

To access eDAQ conditioning layers, an eDAQXR EXRCPU must be installed on the top of a layer stack using the eDAQ adapter assembly (1-EXR-E-ADT-2). See eDAQXR EXRCPU installation on eDAQ layers (Page 59) for instructions.

There can be only one main processor in a stack.

A unique hardware ID for each layer is displayed in the web interface. For all layer types that can appear more than once in an eDAQ stack, the hardware IDs have numbered suffixes starting with 1 and are assigned starting with the layer that has the lowest layer address. For example, if there are two EBRG layers in the stack with layer addresses 3 and 4, the layer with address 3 is referenced as Brg_1, and the layer with address 4 is referenced as Brg_2.

The convention for assembling the legacy eDAQ layer stack for an eDAQXR is consistent with the convention used for the eDAQ. For the eDAQXR, this means that the hardware ID suffix decreases as the layer is positioned further away from the EXRCPU layer. In the example above, the EBRG addressed at 3 with hardware ID of Brg_1 is furthest from the EXRCPU layer. It is advised that this convention be followed.

eDAQXR-lite EXRLCPU stacking order

To access eDAQ-lite conditioning layers, an eDAQXR-lite EXRCPU must be installed on the bottom of a layer stack. See eDAQXR-lite EXRLCPU installation on eDAQ-lite layers (Page 66) for instructions.

There can be only one main processor in a stack.

A unique hardware ID for each layer is displayed in the web interface. For all layer types that can appear more than once in an eDAQ-lite stack, the hardware IDs have numbered suffixes starting with 1 and are assigned starting with the layer that has the lowest layer address. For example, if there are two ELBRG layers in the stack with layer addresses 3 and 4, the layer with address 3 is referenced as Brg_1, and the layer with address 4 is referenced as Brg_2.

The convention for assembling the legacy eDAQ-lite layer stack for an eDAQXR-lite is consistent with the convention used for the eDAQ-lite. For the eDAQXR-lite, this means that the hardware ID suffix increases as the layer is positioned further away from the main processor layer. In the example above, the ELBRG addressed at 3 with hardware ID of Brg_1 is closest to the main processor layer. It is advised that this convention be followed.

1.2.3 eDAQXR EXRCPU installation on eDAQ layers

NOTE

Before disconnecting your legacy eDAQ MPB layer, update the firmware of conditioning layers to the proper firmware levels.

If there is a DIO layer present, the firmware cannot be the 2VBC firmware. Check the firmware version via the web browser. If the firmware version number starts with DIO_2VBC, you must reflash the firmware to normal DIO firmware before installing the eDAQXR. Both firmware versions are included in the eDAQ firmware files on the user's computer (normally located at "C:/Program Files (x86)/SoMat/eDAQ Firmware").
Make sure the stack does not contain eDAQ legacy layers ELLB, EHLB or an ECOM layer. These layers are not supported by the eDAQXR. The eDAQXR EXRCPU supports only EDIO, EBRG, EHLS, ENTB and EITB layers.

The power input on the eDAQXR CPU is designed to be isolated. When the eDAQXR CPU with legacy eDAQ layers is not isolated from the chassis/earth ground, reverse voltage protection is compromised. Connecting only the positive side of the battery to the negative side of input power may result in an internal fault that will need factory repair. Refer to the User manual section on power and grounding for more detail.

The 1-ELBAT-2, 1-ELBAT2-2, 1-ELBAT-CE-2 or the 1-ELBAT-2-CE-2 (optional battery module attaching to the eDAQ) cannot be used with the EDAQXR system. Connecting an ELBAT to the EDAQXR will render the EDAQXR inoperable so it will need to be sent to Service for repair.

CAUTION
The person performing the installation should read this document in its entirety prior to performing any steps. If any portion of the installation process is not clear or the user is not comfortable performing the required sequence of actions, contact HBM Customer Service. Undertaking addition of new layers to an eDAQ stack by someone other than an HBM technician is done at the customer's own risk. Damage to the stack can occur and is the sole responsibility of the customer. If this risk is unacceptable, contact HBM Customer Service and request an RMA for installation of an eDAQXR EXRCPU on eDAQ layers.

Adding an EXRCPU to eDAQ layers

The interface for installing an EXRCPU on eDAQ layers (1-EXR-E-ADT-2) (B) (including six (6) 30mm screws) may be purchased separately from the EXRCPU. The interface is included in EXRCPU kits 1-EXR-E-32GB-2 and 1-EXR-E-64GB-2. See the EXRBRG Quick Start Guide for eDAQXR layer installation instructions on an EXRCPU.

Required tools: #1 Phillips screw driver and 2.5mm ball hex driver (SO-123-1003006)

CAUTION
Failure to comply with safety requirements could result in bodily injury or damage to property. Only disassemble layers in ESD safe conditions. Install only one data processor layer on an eDAQ layer stack. Do not install an EXRCPU on the interface before installing the interface on an eDAQ layer. Interface screw holes are only accessible before the EXRCPU is installed on the interface. High retention power connectors are used, therefore EXRCPU installation and removal may require some added force.

NOTE
An EXRCPU can support eight connected eDAQ layers. Every layer in an eDAQ stack must have a unique address (set using appropriate jumpers). If not, the eDAQXR web interface may not show the connected layers.

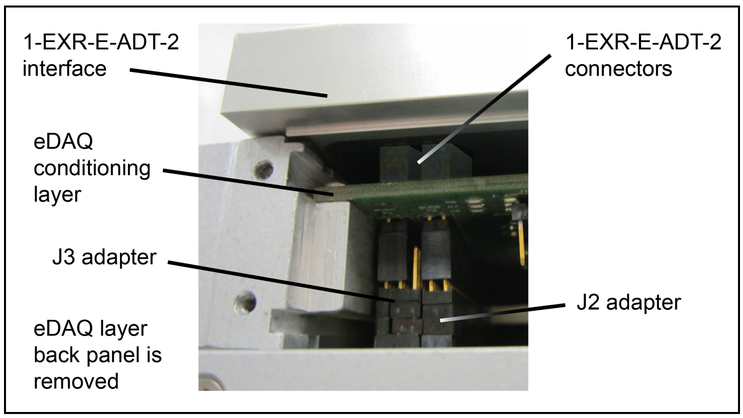
CAUTION
Backup capacitors of the EXRCPU charge while power is supplied. After power supply is removed, the EXRCPU lights the yellow LED until the charge depletes. Opening the CPU while the capacitors are charged exposes voltage potentials. Any object shorting these voltages could damage the EXRCPU.

See Compatible layer addressing (Page 57) for more information about correctly installing jumpers on a compatible eDAQ conditioning layer for a unique layer address.

1. Remove the CPU layer from an eDAQ stack. Disassemble a stack from the top down, due to alternating screw positions in the rings. See Adding legacy eDAQ layers to a stack for more detailed information about assembling legacy eDAQ layers in a stack.

2. Install a base (A) (without a battery) under the bottom eDAQ conditioning layer using six (6) screws. An optional base kit (1-EBASE-EXRCPU-2), including six (6) 30mm screws, is sold separately.

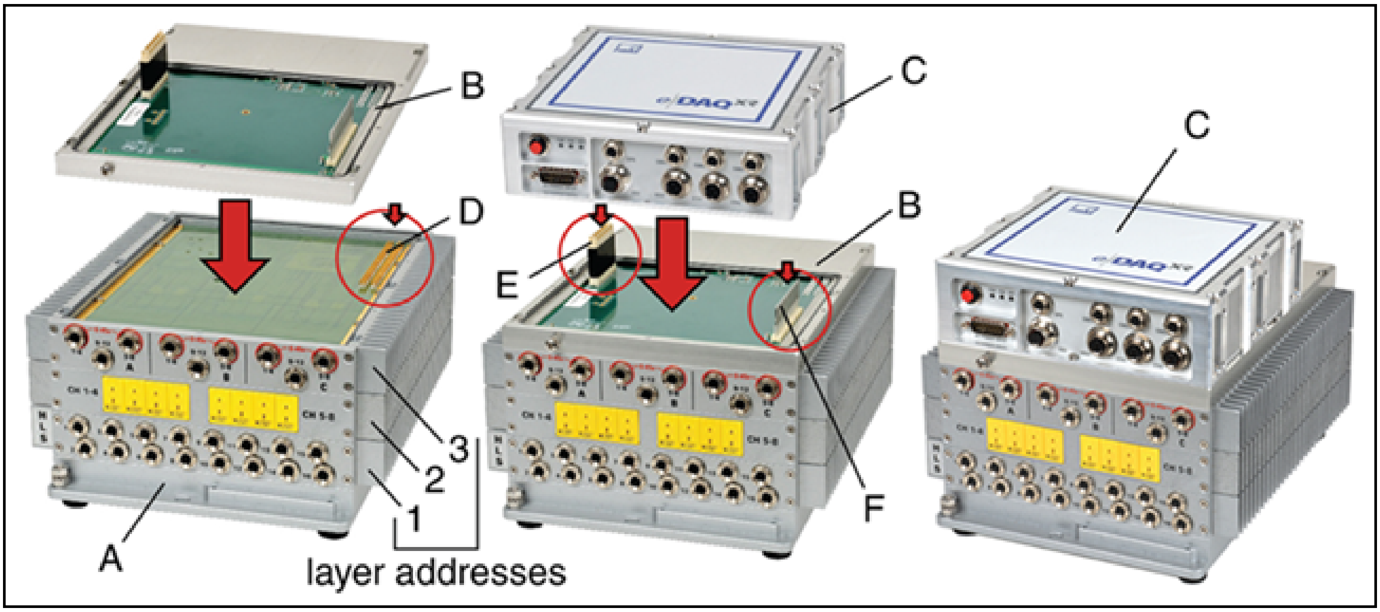
3. Make sure each layer is set with a unique address using appropriate jumpers. Make sure jumper addresses ascend from low to high (1, 2, 3...) under the EXRCPU (C). The layer with the lowest address (1) is the greatest distance from the EXRCPU. Install the eDAQ layers on the top of the stack using six (6) screws each.



4. Carefully align the pins (D) and connectors and install the interface (1-EXR-E-ADT-2) (B) on the top eDAQ conditioning layer using six (6) 30mm screws. There are connectors, not adapters, between the interface and the top eDAQ conditioning layer.

5. Carefully align the pins (F) and connectors (E) and install the EXRCPU (C) on the interface (B) using eight (8) M3 8mm screws. Plastic tabs on the connector (E) are easily broken off by mishandling.

6. Connect the EXRCPU (C) to an 8–36 V_{DC} power supply using the power cable (1-EXR-PWR-PT-2). The system is now ready for use.



NOTE

To retain the ball hex driver (SO-123-1003006) with the EXRCPU, install the M6 12mm screw low and center on the back of the EXRCPU.

Slide the driver under the screw and wedge the handle against the top of the lower case.

1.2.4 Adding legacy eDAQ layers to a stack

See eDAQXR EXRCPU installation on eDAQ layers for instructions about installing an eDAQXR CPU on an assembled legacy eDAQ conditioning layer stack.

CAUTION

Read through this section in its entirety prior to performing any steps. If any portion of the installation process is not clear or is not comfortable to perform, ship the CPU and layers to HBM customer service for the installation. If done improperly, the addition of new layers can cause damage to the eDAQXR system and any damage is the sole responsibility of the customer.

CAUTION
Before disconnecting your legacy eDAQ MPB layer, update the firmware of conditioning layers to the proper firmware levels.

If there is a DIO layer present, the firmware cannot be the 2VBC firmware. Check the firmware version via the web browser. If the firmware version number starts with DIO_2VBC, you must reflash the firmware to normal DIO firmware before installing the eDAQXR. Both firmware versions are included in the eDAQ firmware files on the user’s computer (normally located at “C:/Program Files (x86)/SoMat/eDAQ Firmware”).

Make sure the stack does not contain eDAQ legacy layers ELLB, EHLB or an ECOM layer. These layers are not supported by the eDAQXR. The eDAQXR EXRCPU supports only EDIO, EBRG, EHLS, ENTB and EITB layers.

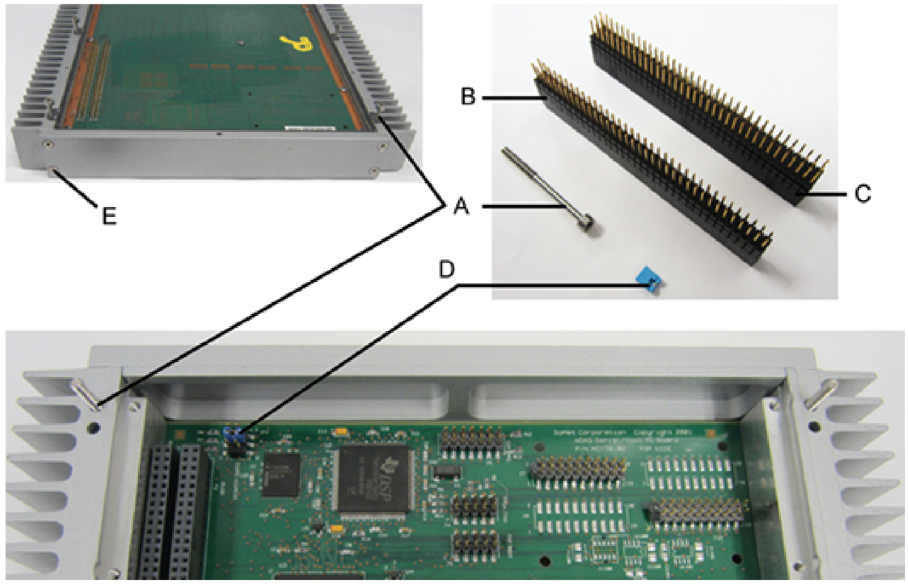
CAUTION
Failure to comply with safety requirements could result in bodily injury or damage to property.
Only disassemble layers in ESD safe conditions.
There cannot be more than one CPU in a stack.
If building up a stack with legacy conditioning layers, always remove J2 and J3 connector adapters from the lowest layer above the base. Failure to remove these adapters may allow them to fall from the connectors and cause damage to the layer.
Backup capacitors of the EXRCPU charge while power is supplied. After power supply is removed, the EXRCPU lights the yellow LED until the charge depletes. Opening the CPU while the capacitors are charged exposes voltage potentials. Any object shorting these voltages could damage the EXRCPU.

Adding a layer requires an eDAQ stack, the desired eDAQ layer, a #1 Philips head screwdriver and a 2.5-mm hex driver.

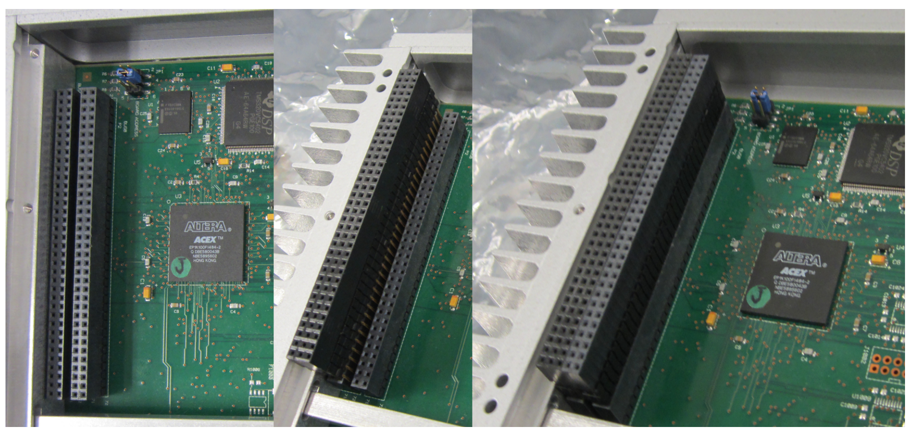
Install a base (without a battery) under the bottom eDAQ conditioning layer using six (6) screws. An optional base kit (1-EBASE-EXRCPU-2), including six (6) 30mm screws, is sold separately.

To add a layer to an eDAQ stack:

1. Power down the CPU and disconnect the power supply.
2. Remove the screws, eDAQXR EXRCPU and interface (1-EXR-E-ADT-2) from the eDAQXR stack or the eight screws and top plate from the eDAQ stack.



3. To remove layer to reach a specific location within the stack, remove the six (6) HM3x30MM-Custom (A) from the side rails of the layer and then remove the layer. Note: The screws may be loosened from a layer and left in the removed layer as alignment guides for layer connection. Remove layers as needed to get access to the desired position within the stack.



4. Install the J2x36-.635MF100 (B) and the J3x36-.635MF100 (C) onto the bus connectors of a board (on the underside near the JP1 layer address pins), as shown in the picture above. The third row of the J3x36-.635MF100 connector (C) should be placed as a spacer in between the rows of bus pins (i.e. no pins making connection). A J3 and a J2 are recommended because using two J2 adapters can tilt, contributing to misalignment. Be sure that the pins are properly aligned and that the connectors sit down onto the board. Improperly aligned bus pins will damage the boards. Gently tilt a J2 or J3 adapter left and right to remove it from a board, because rocking the adapter from end to end may bend pins.

5. Set the layer address for a board using the blue J1x2F jumpers (D) installed on the underside of the layer. The jumper pins are located opposite the serial number and near the layer connectors. For more information on eDAQ layer addresses, see Compatible layer addressing.
6. To ensure alignment is correct, remove the four (4) HM3x12MM-FHNY screws (E) from the back panel of the eDAQ layer. Remove the back panel to provide a clear view for aligning the bus pins. Be careful not to damage or tear the gasket.
7. Align the bus connectors of the new layer with the bus pins of the layer below. The pins must be aligned correctly. Improper alignment damages the layer on power-up.
8. Press the board and ring onto the eDAQ stack. Use care not to put undue strain on the board. Repeat for each layer as necessary until all layers are attached.
9. Replace the back panel and start the four (4) HM3x12MM-FHNY screws (E).
10. Place the six (6) HM3x30MM-Custom (A) (or HM3x40MM-CS, used on the lowest layer into a base) into the holes and start all of them before tightening any single screw down. Note: The ring should match up with the stack and be flush on all sides. Make sure to start all the screws and then tighten the four (4) back panel screws (E) and the six (6) ring screws (A). The gasket should compress and the metal enclosures should be very close, if not touching.
11. Repeat steps above for adding each additional layer until a complete stack is assembled.

1.2.5 eDAQXR-lite EXRLCPU installation on eDAQ-lite layers

NOTE
Before disconnecting your eDAQ-lite CPU layer, update the firmware of legacy conditioning layers to current firmware levels.

NOTE: ELCOM and GPS on ELDIO are not supported by the eDAQXR-lite CPU.

- ELCOM – Not supported
- ELDIO – V1.9 (GPS not supported)
- ELHLS – V1.1
- ELNTB – V1.0
- ELBRG – V1.2

Keep standoffs with each conditioning and main processor layer. Some layers have unique standoffs.

The power input on the eDAQXR-lite CPU is designed to be isolated. Connecting the minus side of the input power to signal ground may result in an internal fault that will need factory repair. Refer to the User manual section on power and grounding for more detail.

The 1-ELBAT-2, 1-ELBAT2-2, 1-ELBAT-CE-2 or the 1-ELBAT-2-CE-2 (optional battery module attaching to the eDAQ-lite) cannot be used with the 1-EDAQXRL-64-2 system. Connecting an ELBAT to the 1-EDAQXRL-64-2 will render the 1-EDAQXRL-64-2 inoperable so it will need to be sent to Service for repair.

CAUTION
The person performing the installation should read this document in its entirety prior to performing any steps. If any portion of the installation process is not clear or the user is not comfortable performing the required sequence of actions, contact HBM Customer Service. Undertaking addition of new layers to an eDAQ-lite stack by someone other than an HBM technician is done at the customer's own risk. Damage to the stack can occur and is the sole responsibility of the customer. If this risk is unacceptable, contact HBM Customer Service and request an RMA for installation of an eDAQXR-lite EXRLCPU on eDAQ-lite layers.

Adding an eDAQXR-lite main processor to eDAQ-lite layers

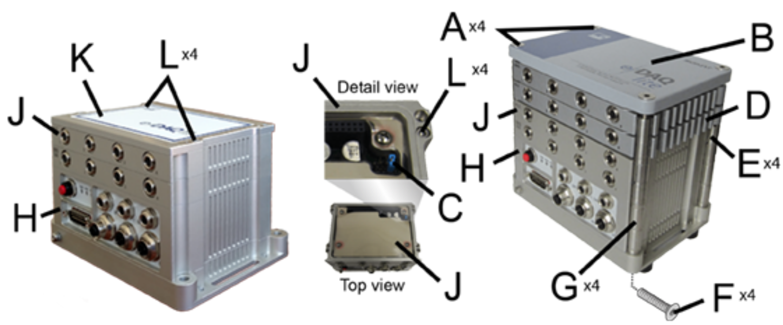
Required tools: #1 flat blade screw driver and 2.5mm ball hex driver (SO-123-1003006)

CAUTION
Failure to comply with safety requirements could result in bodily injury or damage to property. Only disassemble layers in ESD safe conditions. Install only one data processor layer on an eDAQ-lite layer stack.

NOTE
An eDAQXR-lite main processor can support eight connected eDAQ-lite layers. Every layer in an eDAQ-lite stack must have a unique address (set using appropriate jumpers). If not, the eDAQXR-lite web interface may not show the connected layers.

CAUTION
Backup capacitors of the EXRLCPU charge while power is supplied. After power supply is removed, the EXRLCPU lights the yellow LED until the charge depletes. Opening the CPU while the capacitors are charged exposes voltage potentials. Any object shorting these voltages could damage the EXRLCPU.

See Compatible layer addressing (Page 57) for more information about correctly installing jumpers on a compatible eDAQ-lite conditioning layer for a unique layer address.



1. Turn off the eDAQ-lite main processor using the power switch and disconnect the power supply from the power connector.
2. Remove four (4) flat-head screws (A) and the lid (B) from the top of the eDAQ-lite stack.

NOTE
One O-ring or gasket must be present under each legacy layer and the legacy eDAQ-lite lid. Newer, CE-compliant layers contain an O-ring installed in a groove on the bottom of the layer or lid. Older, non-CE-compliant layers use a foam gasket and have no groove. Be careful to use only one correct O-ring or gasket. Some layers have unique standoffs. Keep standoffs with each layer.

3. Remove conditioning layers from the eDAQ-lite stack for use with the eDAQXR-lite main processor (H).
4. Make sure each layer is set with a unique address using appropriate jumpers (C). Make sure jumper addresses ascend from low to high (1, 2, 3...) over the main processor. The layer with the lowest address (1) is the closest to the main processor.

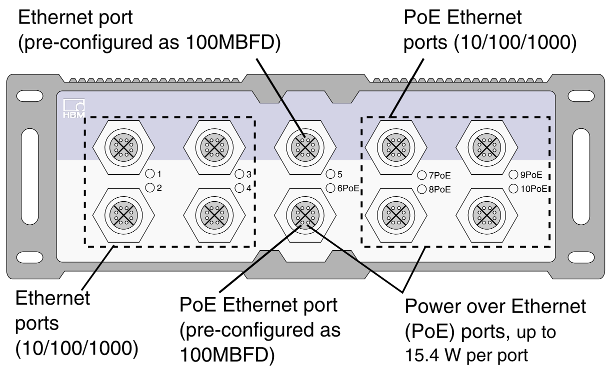
NOTE
If legacy and New-design layer rings are in a stack, the IP rating for the devices may be impacted. Always install standoffs (E) when using legacy layers in a stack.

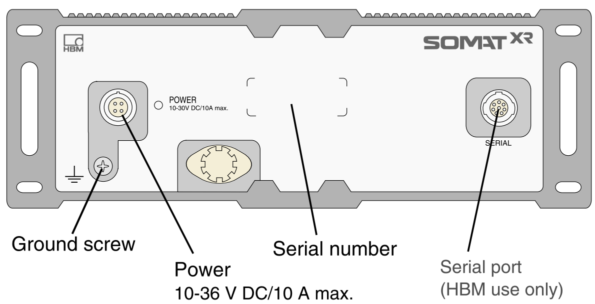
5. **Legacy layers** (D) **only**: Install the four (4) standoffs (G (SO-257-1003660)) on the eDAQXR-lite base using four (4) flat head screws (F). Before installing a legacy layer ring, install four (4) guiding standoffs (E) using a flat blade screwdriver.
   New-design layers (J) **only**: Install four (4) screws (L) in each conditioning layer using the hex driver (SO-123-1003006). Alternate screw positions between layers.
   Mixed layers stack (D and J): First install New-design layers (J) on the eDAQXR-lite using hex head screws (L) and the hex driver (SO-123-1003006). Install the four (4) standoffs (G) on the eDAQXR-lite base using four (4) flat head screws (F), then install standoffs (E) and legacy conditioning layers (D).
6. Carefully align the pins and connectors and install a layer on the stack. Use care not to put undue strain on each layer. Repeat for each layer as necessary until all layers are attached.
7. Be careful not to scratch the lid. **Legacy layers** (D) **only or Mixed layers stack** (D and J): Install the lid (B) on the stack using four (4) screws (A), the standoffs (E and G) and screws (F).
   New-design layers (J) **only**: Install the lid (K) using four (4) screws (L) and the hex driver.
8. Connect the eDAQXR-lite main processor to an 8–36 V_{DC} power supply using the power cable (1-EXR-PWR-PT-2).
9. The system is now ready for use.

New-design layer rings may be installed on legacy ELBRG, ELDIO, ELHLS and ELNTB printed circuit boards. The New-design ring and captive screws provide an improved seal with the eDAQXR-lite CPU. Conditioning layer boards in new-design rings are available for purchase as 1-EXRL-BRG-120-2, 1-EXRL-BRG-350-2, 1-EXRL-DIO-B-2, 1-EXRL-HLS-2 or 1-EXRL-NTB-2.

1.3 EX23-R Ethernet switch

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





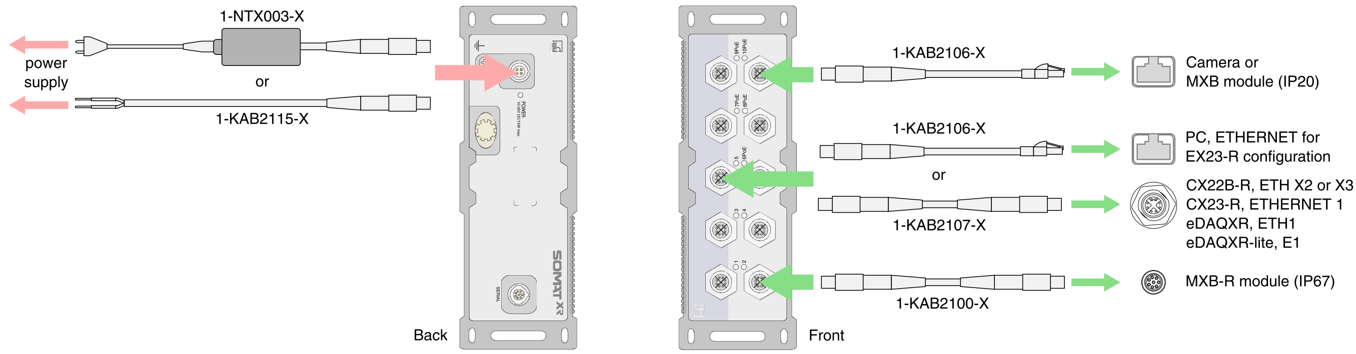
The EX23-R is designed to be used straight out of the box.

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

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

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.



See Configuring the EX23-R for steps to configure an EX23-R.

1.3.1 EX23-R status LEDs

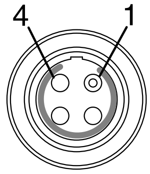
Power LED	Description
Off	Power input not in range
On	Unit is powered
Flashing (2 Hz)	Power error
Flashing (8 Hz)	Firmware update

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

1.3.2 EX23-R POWER pin assignments

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

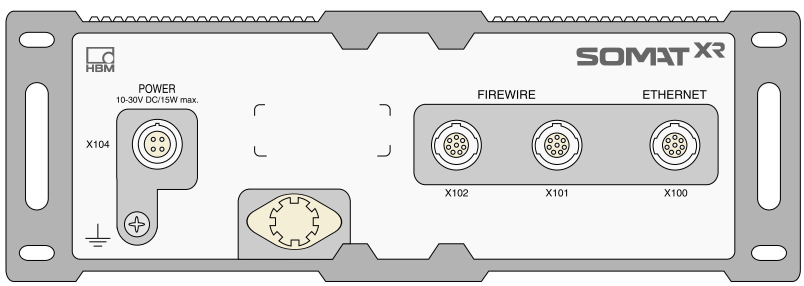
1.3.3 Configuring the EX23-R

The EX23-R is set up to be used straight out of the box. Making changes to settings is not recommended. However, if you need to change any settings, please follow these instructions:

1. Connect a PC to any open EX23-R port using a 1-KAB2106 cable.
2. Open an internet browser and navigate to: IP Config: 192.0.2.1/ip_config.htm or Firmware: 192.0.2.1/upload.htm
3. Log on using the default credentials: username: *admin* password: *(blank)*

NOTE
To reset to factory defaults, jumper port 1 to port 2 using a 1-KAB2107 cable and power cycle the unit. Reset to factory defaults will cause ports to auto negotiate. However, Ports 5 and 6 must be manually configured to 100Mb full duplex (status LED will be orange) for reliable PTP function. Contact HBM Customer Service for assistance with manual configuration.

1.4 MXB modules



MXB modules can be connected to an EXRCPU/EXRLCPU layer directly or through one or more EX23-R Ethernet switches. For more information on setting up a system with MXB modules, see Connecting MXB modules to an EXRCPU/EXRLCPU.

The data processor is designed to use Ethernet based PTPv2 protocol (IEEE1588) for time and data synchronization with MX modules and other peripherals. FireWire connections between MX modules are available and useful to simplify power distribution. When FireWire connections are used, timing and data synchronization between MX modules may or may not be based on the FireWire protocol.

CAUTION
All MXB modules in the system must have an Ethernet connection (either directly to the data processor or indirectly through an EX23-R). Connecting an MXB module to any other MXB module using FireWire without both having an Ethernet connection to the data processor can result in acquired data not being synchronized to the data processor on one or more MXB modules.

Decimal sample rates and Linear Phase FIR and Butterworth FIR digital filters that match the sample rates and digital filters in the eDAQ are available. However, the MXB modules do not phase align the Linear Phase FIR filters as the eDAQ does (i.e., the phase delay of the MXB Linear Phase FIR filters is dependent on the sample rate and digital filter characteristics). In addition, a comprehensive set of Butterworth IIR and Bessel IIR digital filters are available for use with the Decimal sample rates. The data processor also supports the traditional (Classic) HBM sample rates and IIR digital filters.

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

Available QuantumX modules
For more information about a QuantumX module, download the current manual from www.hbm.com/daq-support. The following non-ruggedized modules are currently supported in the CX23-R/EXRCPU/EXRLCPU interface:

- **MX1601B Standard Module (Universal Amplifier)**: Up to 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE, ICP®). This module is functionally equivalent to the MX1601B-R in laboratory environments.
- **MX1609KB Thermocouple Amplifier**: Up to 16 type K thermocouples (Ni-CrNi) for measuring temperatures. This module is functionally equivalent to the MX1601B-R in laboratory environments.
- **MX1609TB Thermocouple Amplifier**: Up to 16 type T thermocouples (Cu-CuNi) for measuring temperatures. This module is functionally equivalent to the MX1601B-R in laboratory environments.
- **MX1615B Bridge Module (Strain Gage Amplifier)**: Up to 16 individually configurable inputs, including strain gage-based transducers, standardized voltage and resistance or resistance-based measurements. This module is functionally equivalent to the MX1601B-R in laboratory environments with the following exceptions – 15V input mode instead of 60V input mode, one positive swing (upscale polarity) shunt resistor only, shunt scaling is not supported.
- **MX471B CAN Module**: The module has 4 CAN bus nodes that can be configured for receiving messages.
- **MX471C-R CAN FD Module** : Up to four (4) independent CAN / CAN FD bus nodes electrically isolated from each other and from the power supply. The module can also be used as a gateway to connect to multiple SomatXR modules via FireWire and to a PC via Ethernet.
- **MX878B Analog Output Module**: Up to 8 analog output channels with +/-10V range that can be sourced from any MX module channel that is connected via FireWire. CX23-R/eDAQXR support is limited to an input follower mode where each analog output channel follows the defined input data source using the following scaling. The user defined Range max parameter value for the source MX channel maps to +10V analog output voltage; the user defined Range min

parameter value maps to -10V analog output voltage. The nominal data skew between the analog output and the source input to the associated MX module channel is nominally 3 milliseconds when no digital filters are used.

- **MX840B Universal Module**: Up to eight (8) universal inputs for connecting more than 16 transducer technologies. This module is functionally equivalent to the MX840B-R in laboratory environments with the following exception – one positive swing (upscale polarity) shunt resistor only.
- **MX460B Frequency / Counter Module**: Up to four (4) digital inputs to measure digital pulses up to 1 MHz (speed, torque, angle position, displacement, PWM in general). This module is functionally equivalent to the MX460B-R in laboratory environments. CX23-R/eDAQXR support is limited in the following aspects. Math functions are not supported. Interactive zeroing of the “crank shaft” sensors is not supported.

1.4.1 Connecting MXB modules to an EXRCPU/EXRLCPU

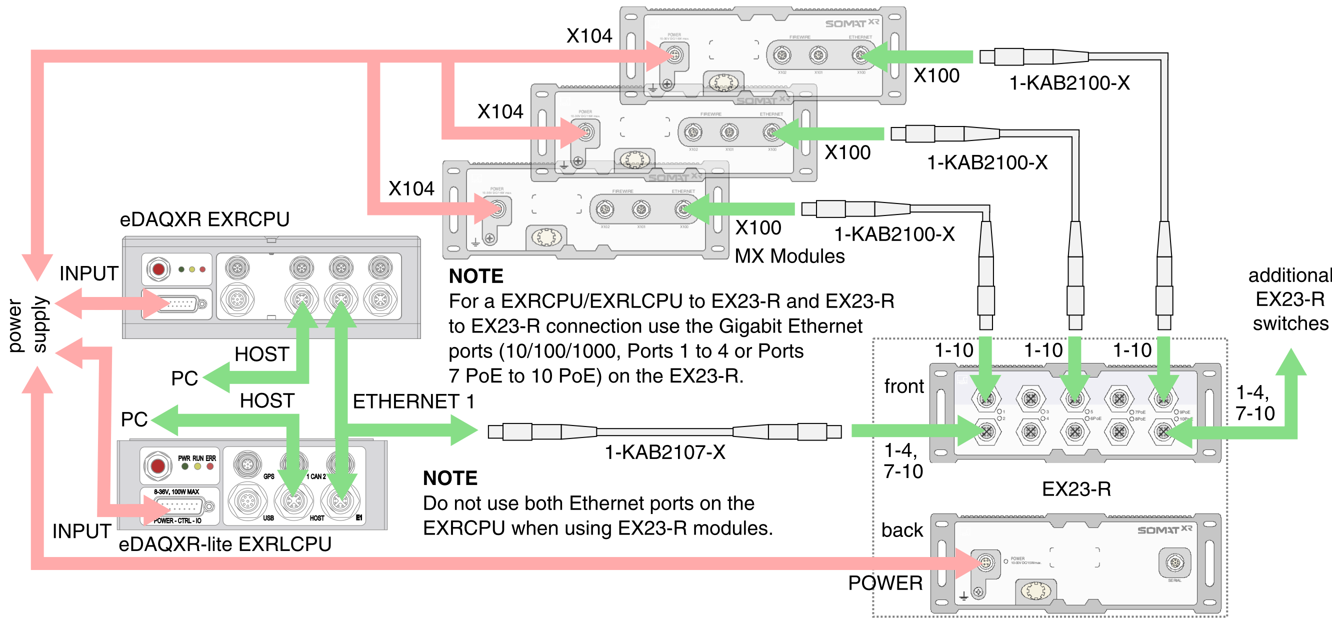
An EXRCPU/EXRLCPU can be used to control and process data from multiple MXB modules to include other transducers such as voltage, current, bridge and thermocouple. MX modules can be connected directly to the EXRCPU/EXRLCPU or through one or more EX23-R Ethernet switches.

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

NOTE
The EXRCPU/EXRLCPU automatically configures the MX module network address and checks for firmware updates. If necessary, install new MX firmware before continuing. **Do not reboot the EXRCPU/EXRLCPU when MX firmware updates are in progress.**

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

Distributed network using EX23-R Ethernet switches



1. Connect the EXRCPU/EXRLCPU layer, EX23-R modules and MX modules to a power supply.

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

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

2. Use a 1-KAB2107 cable to connect the EXRCPU ETH 1 or EXRLCPU E1 connector to the EX23-R switch, as shown in the diagram.

NOTE
For optimal data throughput performance, do not use both EXRCPU 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.

NOTE
For a EXRCPU/EXRLCPU to EX23-R and EX23-R to EX23-R

connection use the Gigabit Ethernet ports (10/100/1000, Ports 1 to 4 or Ports 7PoE to 10 PoE) on the EX23-R.

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

MX module firmware update process
Do not reboot the EXRCPU/EXRLCPU when MX firmware updates are in progress.

1.4.2 MX840B-R universal module

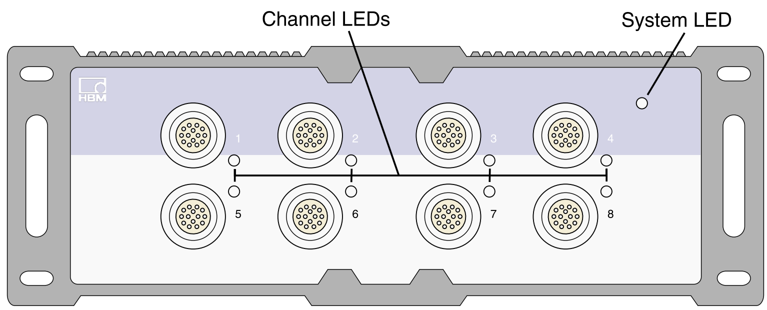
Up to eight (8) universal inputs can be connected to the MX840B-R module compatible with more than 16 transducer technologies.

Transducer	MX840B-R	Wiring diagram
Strain gage, full bridge six-wire configuration	●	97
Strain gage, half bridge five-wire configuration	●	97
Strain gage, quarter bridge three- or four-wire configuration	●* 3-wire only	97
Inductive full bridge	●	101
Inductive half bridge	●	101
LVDT (linear variable differential transformer)	●	101
Piezoresistive transducer	●	104
Potentiometric transducer	●	105
Voltage, 60 V, 10 V, 100 mV	●	107
Current-fed piezoelectric transducer (IEPE, ICP®)	●†	108
Current, 20 mA	●	109
Resistance or resistance-based measurements	●	111
Resistance thermometer (RTD), PT100 or PT1000	●	111
Thermocouple	●‡	113
Frequency / pulse counter (timer, TTL)	● connectors 5-8	115
Torque / speed	● connectors 5-8	115

Transducer		MX840B-R	Wiring diagram
	SSI protocol	● connectors 5-8	115
CAN	CAN bus database or raw message	● connector 1	126

* Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2. † Use ODU 14-pin to BNC adapter 1-KAB430-0.3. ‡ Use thermocouple adapter 1-SCM-R-TCK-2 for K-type, 1-SCM-R-TCE-2 for E-type, 1-SCM-R-TCT-2 for T-type and 1-SCM-R-TCJ-2 for J-type.

Status LEDs



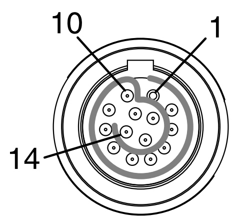
The following table gives the descriptions for all LED states.

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

Channel LED	Description	Description (Connector 1, CAN bus)
Green	Channel is ready	CAN bus activated, CAN data can be received
All orange	Boot procedure is running	
All orange flashing	Download is active	
Orange	Connection is newly assigned; transducer identification is running	CAN data received but bus is occasionally disturbed; buffer overflow; individual data loss
Green flashing, then green	TEDS data is being read	
Orange flashing, then green	Manual configuration; ignore TEDS	
Red	No sensor connected; channel error (incorrect parameterization, connection error, invalid TEDS data)	CAN bus error; CAN interface in Bus OFF state; CAN data cannot be received or processed

MX840B-R pin assignments

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



pin side of cable

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

NOTE

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

1.4.3 MX1615B-R bridge module (strain gage amplifier)

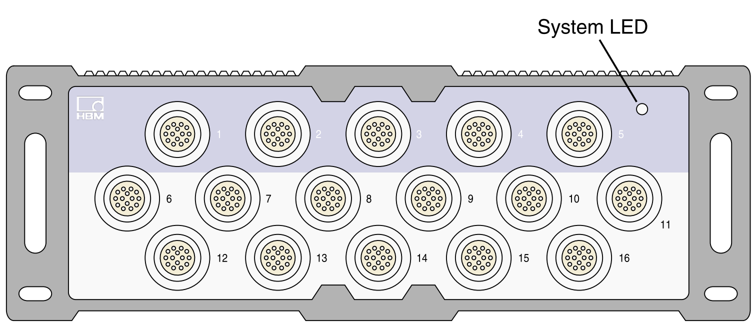
Up to 16 individually configurable inputs can be connected to the MX1615B-R, including strain gage-based transducers, standardized voltage and resistance or resistance-based measurements (for example, a PT100 resistance thermometer).

Transducer	MX1615B-R	Wiring diagram
Strain gage, full bridge six-wire configuration	●	97
Strain gage, half bridge five-wire configuration	●	97
Strain gage, quarter bridge three- or four-wire configuration	●	97
Potentiometric transducer	●	105
Voltage, 60 V	● 60 V only	107
Resistance or resistance-based measurements	●	111
Resistance thermometer (RTD), PT100	● PT100 only	111

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

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

Status LED

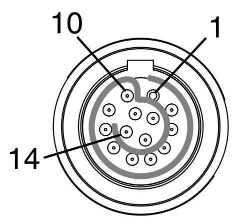


The following table gives the descriptions for all LED states.

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

MX1615B-R pin assignments

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

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

NOTE

Pin assignment is different for Inputs and wiring diagrams, Resistance-based measurements and Resistance-based measurements inputs. For more information, refer to the wiring diagrams.

NOTE

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

1.4.4 MX1601B-R standard module (universal amplifier)

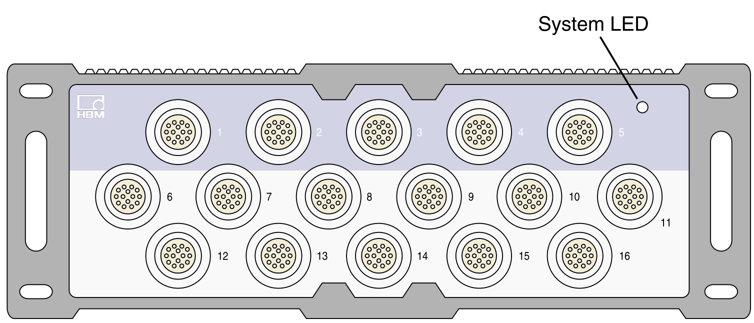
Up to 16 configurable inputs for DC voltage sources (60 V, 10 V, 100 mV), DC current sources (20 mA) or current-fed piezoelectric transducers (IEPE, ICP®) can be connected to the MX1601B-R module.

Transducer	MX1601B-R	Wiring diagram
Voltage, 60 V, 10 V, 100 mV	●	107
Current-fed piezoelectric transducer (IEPE, ICP®)	●†	108
Current, 20 mA	●	109

† Use ODU 14-pin to BNC adapter 1-KAB430-0.3.

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

Status LED

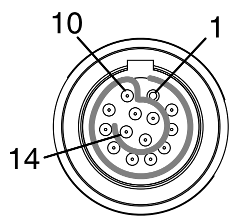


The following table gives the descriptions for all LED states.

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

MX1601B-R pin assignments

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



pin side of cable

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

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

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

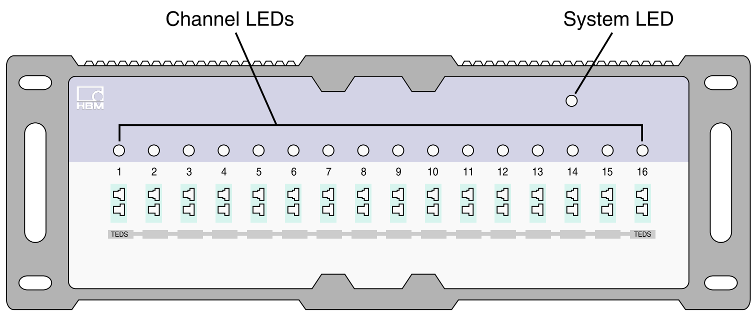
Channels 9 through 16 output the supply voltage (10 ... 30 V) minus approximately one volt. A maximum current of 30 mA per channel or 75 mA total can be consumed. The current limitation switches the transducer excitation off if current consumption is higher.

1.4.5 MX1609KB-R Thermocouple Amplifier

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

Transducer	MX1609KB-R	Wiring diagram
Thermocouple	● K-type only	113

Status LEDs



The following table gives the descriptions for all LED states.

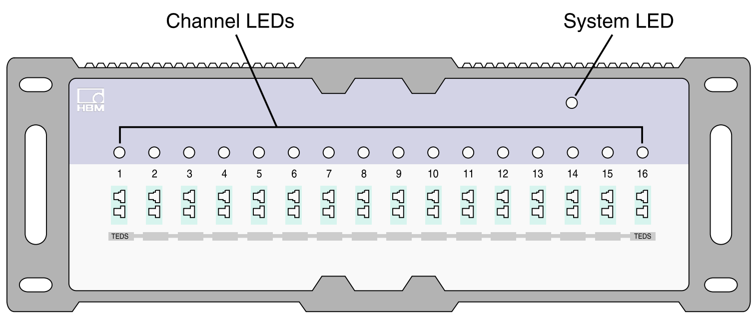
System LED	Channel LED	Description
Green	--	System is error free
Red	--	System error
Orange	Orange	System is not ready; boot procedure is running
Orange flashing	Orange flashing	System is not ready; download is active
--	Green	Connection is error free
--	Green flashing	TEDS data is valid (LED flashes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

1.4.6 MX1609TB-R Thermocouple Amplifier

Up to 16 thermocouple type T (Cu-CuNi) can be connected to the MX1609TB-R module for measuring temperatures.

Transducer	MX1609TB-R	Wiring diagram
Thermocouple	● T-type only	113

Status LEDs



The following table gives the descriptions for all LED states.

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

1.4.7 MX411B-R highly dynamic universal module

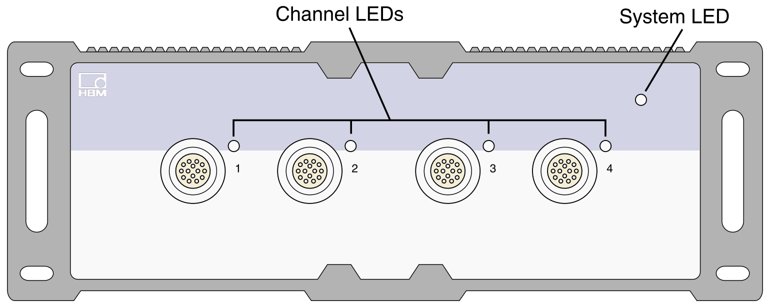
Up to four (4) electrically isolated inputs can be connected to the MX411B-R module, including strain gage and inductive bridges, standardized voltage and DC current sources (20 mA) or current-fed piezoelectric (IEPE, ICP®) and piezoresistive transducers.

Transducer	MX411B-R	Wiring diagram
Strain gage, full bridge six-wire configuration	●	97
Strain gage, half bridge five-wire configuration	●	97
Strain gage, quarter bridge three- or four-wire configuration	●* 3-wire only	97
Inductive full bridge	●	101
Inductive half bridge	●	101
Piezoresistive transducer	●	104
Voltage, 10 V	● 10 V only	107
Current-fed piezoelectric transducer (IEPE, ICP®)	●†	108
Current, 20 mA	●	109

* Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2. † Use ODU 14-pin to BNC adapter 1-KAB430-0.3.

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

Status LEDs



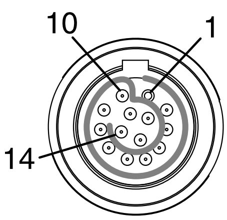
The following table gives the descriptions for all LED states.

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

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

MX411B-R pin assignments

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



pin side of cable

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

NOTE

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

1.4.8 MX460B-R frequency / counter module

Up to four (4) digital inputs may be connected to the MX460B-R, to measure digital pulses up to 1 MHz (speed, torque, angle position, displacement, PWM in general). CX23-R/EXRCPU/EXRLCPU support is limited in the following aspects. Math functions are not supported. Interactive zeroing of the "crank shaft" sensors is not supported.

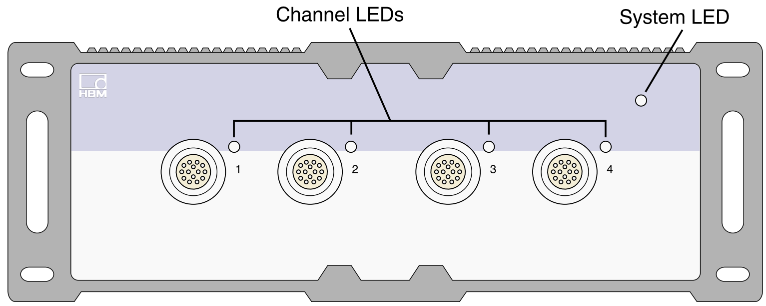
You can connect up to four transducers to the frequency measuring amplifier MX460B-R. Transducers are connected via a 14 -pin ODU device socket. All measuring channels are electrically isolated from one another and from the mains. When using the adjustable sensor supply, electrical isolation from the supply voltage of the amplifier is rescinded.

Transducer	MX460B-R	Wiring diagram
Frequency / pulse counter (timer, TTL)	●	115
Incremental encoder (timer, TTL)	●	115
Torque / speed	●	115
Passive inductive encoder	●	123
PWM - Pulse width, pulse duration, period duration	●	124
Crank wheel sensor	●	131

CAUTION
The MX460B can supply sensors with a constant DC voltage of 5 to 24 volts. Always check encoder data sheet for maximum supply voltage. Supplying a sensor supply of 12 volts to a 5-volt encoder may damage it.

When TEDS or T-ID is used, the measurement channel is automatically parameterized after connection.

Status LED



The following table gives the descriptions for all LED states.

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

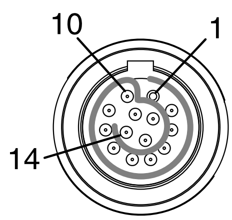
Channel LED	Description
Green	System is error free
All LEDs are orange	System is not ready; boot procedure is running
Orange flashing	System is not ready; download is active
Orange	Connection newly assigned, transducer identification running (calibration)
Flashing green (5 seconds), then green	TEDS data being read in
Flashing orange (5 seconds), then green	Manual configuration ongoing (ignore TEDS)
Red	System error

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

MX460B-R pin assignments

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

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

Connector	Pin	Connection	Wire Color (1-KAB183 or 1-KAB184)
 *pin side of cable*	1	Reference pulse 0° (zeroing pulse) (-)	Black
	2	Reference pulse 0° (zeroing pulse) (+)	Blue
	3	f_1 AC+ (for passive inductive transducers)	White/Black
	4	Reference voltage Vref (2.5 V) *jumper to pin 5*	Red/Black
	5	Plug-in detection *jumper to pin 4*	Pink/Black
	6	No function	Yellow/Black
	7	Frequency input f_1 (-)	White
	8	Frequency input f_1 (+)	Red
	9	Active sensor supply 5...24 V (0 V)	Brown
	10	Active sensor supply 5...24 V (+)	Yellow
	11	Frequency input f_2 (-)	Grey
	12	Frequency input f_2 (+)	Green
	13	Signal ground, TEDS (-)	Grey/Black
	14	TEDS (+)	Green/Black
	Shield	Shield	--

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

1.4.9 MX471-R modules

MX471B-R CAN module

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

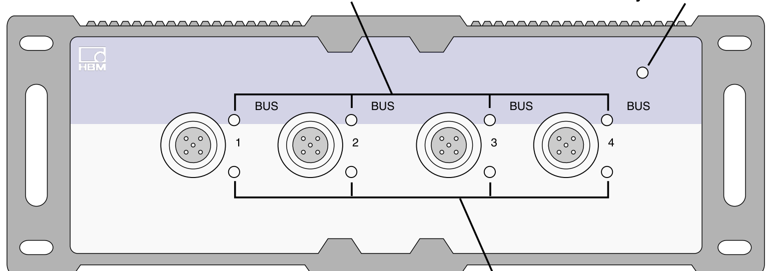
Transducer		MX471B-R	Wiring diagram
CAN	CAN bus database or raw message	●§ database only	126

§ Including support for CCP/XCP-on-CAN (not in combination with CX23-R).

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

The MX471B-R supports classical bit rates up to 1 Mbit/s. Please refer to the MX471B-R Data Sheet for the relationship between bit rate and maximum bus line length.

Status LEDs



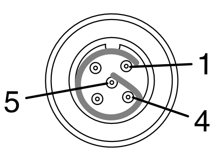
The following tables give the descriptions for all LED states.

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

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

Connector LEDs	Description
Green	Channel is activated - no errors or failure
Orange	BUS warning - intermittent or permanent failure
Orange flashing	Firmware update in progress
Red	BUS error - data is lost, reduce number of decoded and/or transmitted signals
Red flashing	BUS off - no transmission or receiving possible

MX471B-R pin assignments

<table>
<tr><th>Connector</th><th>PIN</th><th>Description</th><th>Wire color (1-KAB2109-2)</th></tr>
<tr><td rowspan="5">

pin side of cable</td><td>1</td><td>CAN_SHLD (direct connected to chassis potential, capacitively coupled to GND)</td><td>Yellow</td></tr>
<tr><td>2</td><td>--</td><td>Red</td></tr>
<tr><td>3</td><td>CAN_GND (Ground / 0V / V-)</td><td>Black</td></tr>
<tr><td>4</td><td>CAN_H (dominant high)</td><td>White</td></tr>
<tr><td>5</td><td>CAN_L (dominant low)</td><td>Blue</td></tr>
</table>

NOTE

According to EMC requirements, Pin 1 can be connected to the shield of the CAN cable. The integration of the module MX471B-R in the potential equalization is highly recommended.

MX471C-R CAN / CAN FD Module

Up to four (4) independent CAN / CAN FD bus inputs can be connected to the MX471C-R module.

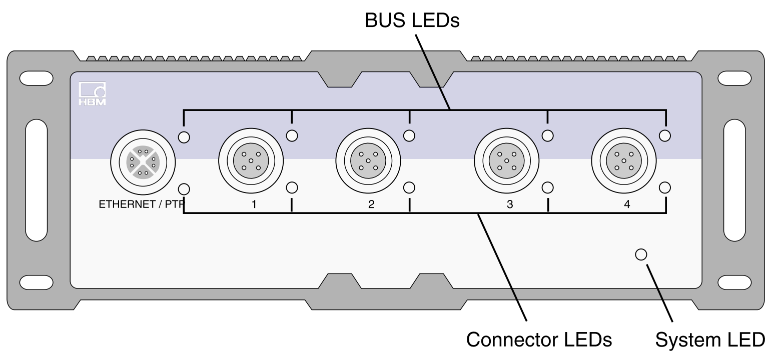
Transducer		MX471C-R	Wiring diagram
CAN	CAN bus database or raw message	● § database only	126
CAN FD	CAN FD bus	●	126

§ Including support for CCP/XCP-on-CAN (not in combination with CX23-R).

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

The MX471C-R supports classical bit rates up to 1 Mbit/s and CAN FD rates up to 4 Mbit/s. Please refer to the MX471C-R Data Sheet for the relationship between bit rate and maximum bus line length.

Status LEDs



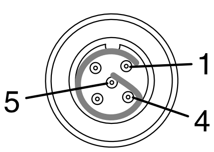
The following tables give the descriptions for all LED states.

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

BUS LEDs	Description
Green flashing	Bus is error free; activity on CAN
Green	Bus is error free; no activity on CAN
Orange flashing	Intermittent bus errors (ERROR PASSIVE); activity on CAN
Orange	Intermittent bus errors (ERROR PASSIVE); no activity on CAN
Red	CAN interface in Bus OFF state

Connector LEDs	Description
Green	Channel is activated - no errors or failure
Orange	Intermittent or permanent failure - data is lost
Orange flashing	Firmware update in progress
Red	Module in overload - reduce number of decoded and/or transmitted messages
Red flashing	BUS off - no transmission or receiving possible

MX471C-R pin assignments

Connector	PIN	Description	Wire color (1-KAB2109-2)
 *pin side of cable*	1	CAN_SHLD (direct connected to chassis potential, capacitively coupled to GND)	Yellow
	2	--	Red
	3	CAN_GND (Ground / 0V / V-)	Black
	4	CAN_H (dominant high)	White
	5	CAN_L (dominant low)	Blue

NOTE
According to EMC requirements, Pin 1 can be connected to the shield of the CAN cable. The integration of the module MX471C-R in the potential equalization is highly recommended.

NOTE
Details about CAN and CAN FD can be found in the separate QuantumX / SomatXR CAN manual.

1.4.10 Inputs and wiring diagrams

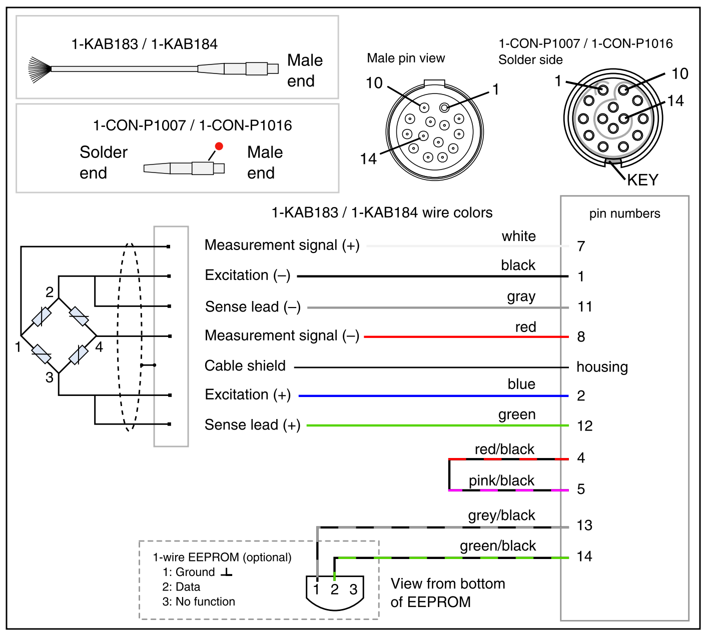
Strain gage transducers

Transducer	MX840B-R	MX1615B-R	MX411B-R
Strain gage, full bridge six-wire configuration	●	●	●
Strain gage, half bridge five-wire configuration	●	●	●
Strain gage, quarter bridge three- or four-wire configuration	●* 3-wire only	●	●* 3-wire only

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

Full-bridge strain gage

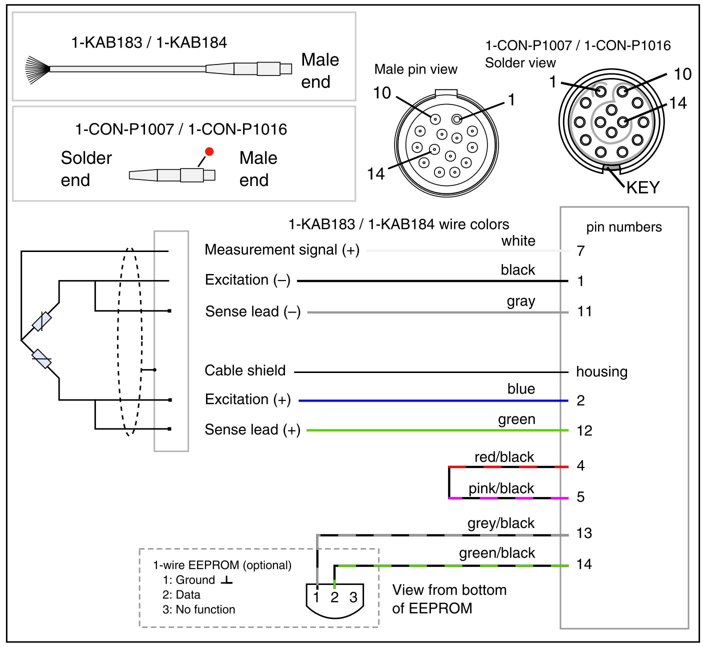
Full-bridge strain gage, six-wire configuration



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

Half-bridge strain gage

Half-bridge strain gage, five-wire configuration

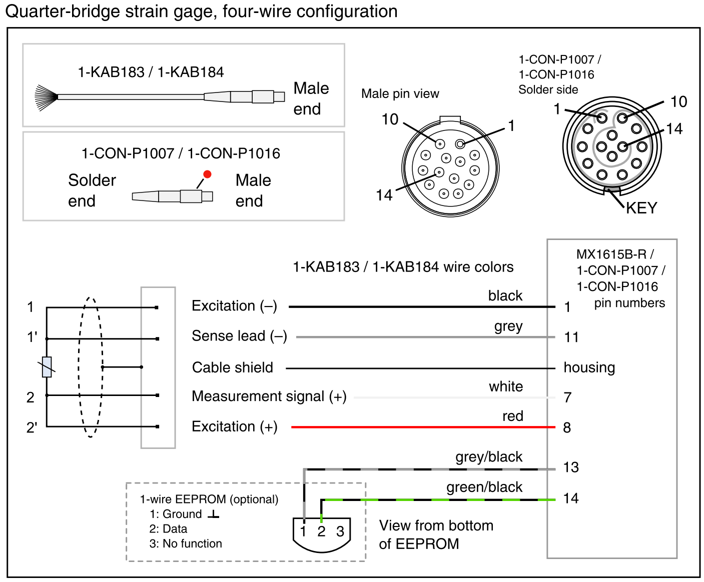


NOTE

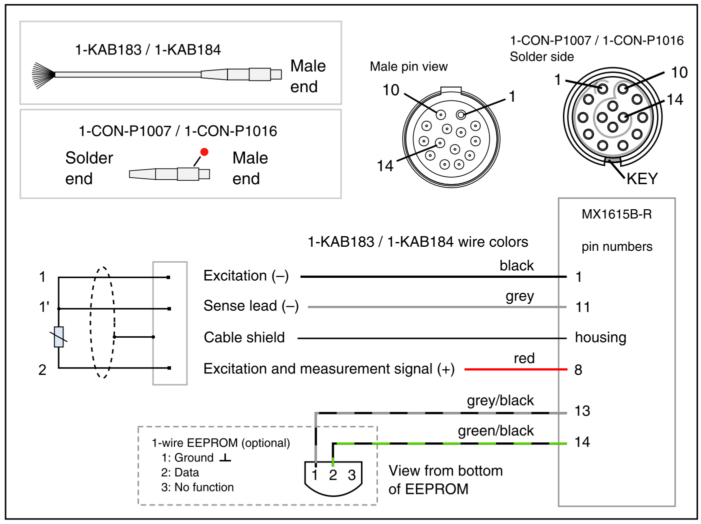
For half three-wire bridge configurations, a connection between the sense lead and excitation lines must be made in the connector.

Quarter-bridge strain gages

Quarter-bridge strain gage, four-wire configuration

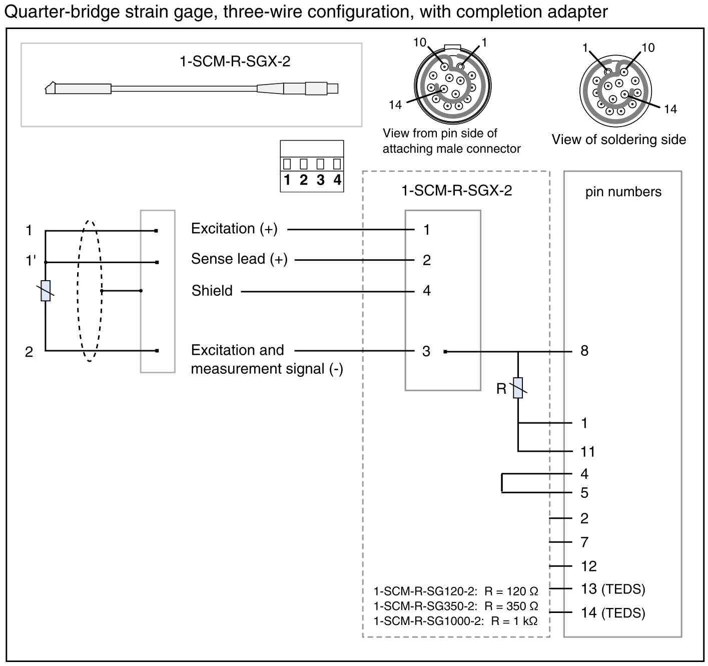


Quarter-bridge strain gage, three-wire configuration

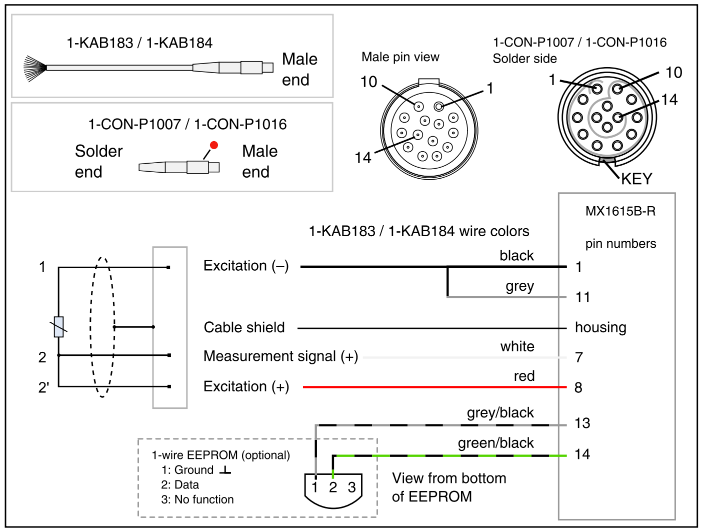


> **NOTE**
> The quarter-bridge, three-wire configuration with sense line can be used with the EXRCPU, catman®AP or MX Assistant, which support up scale shunting.

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



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



NOTE

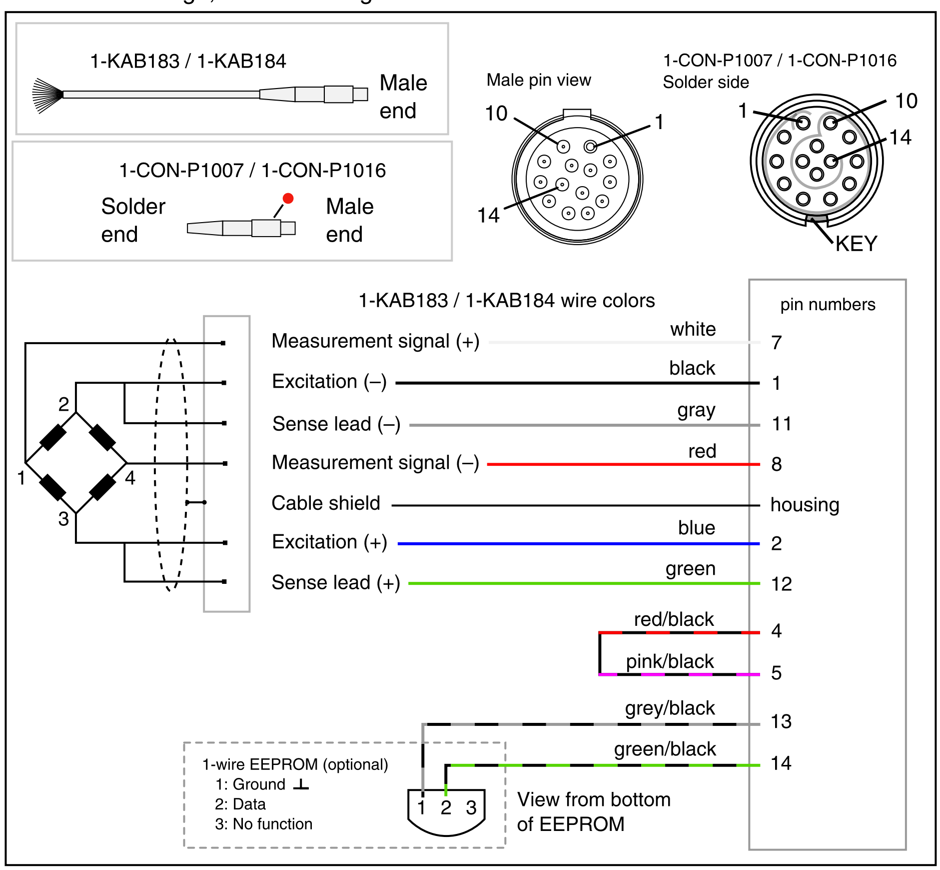
The quarter-bridge, three-wire configuration without sense lines can be used only with the EXRCPU, which supports down scale shunting. It is not supported by catman®AP or MX Assistant.

Inductive transducers

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

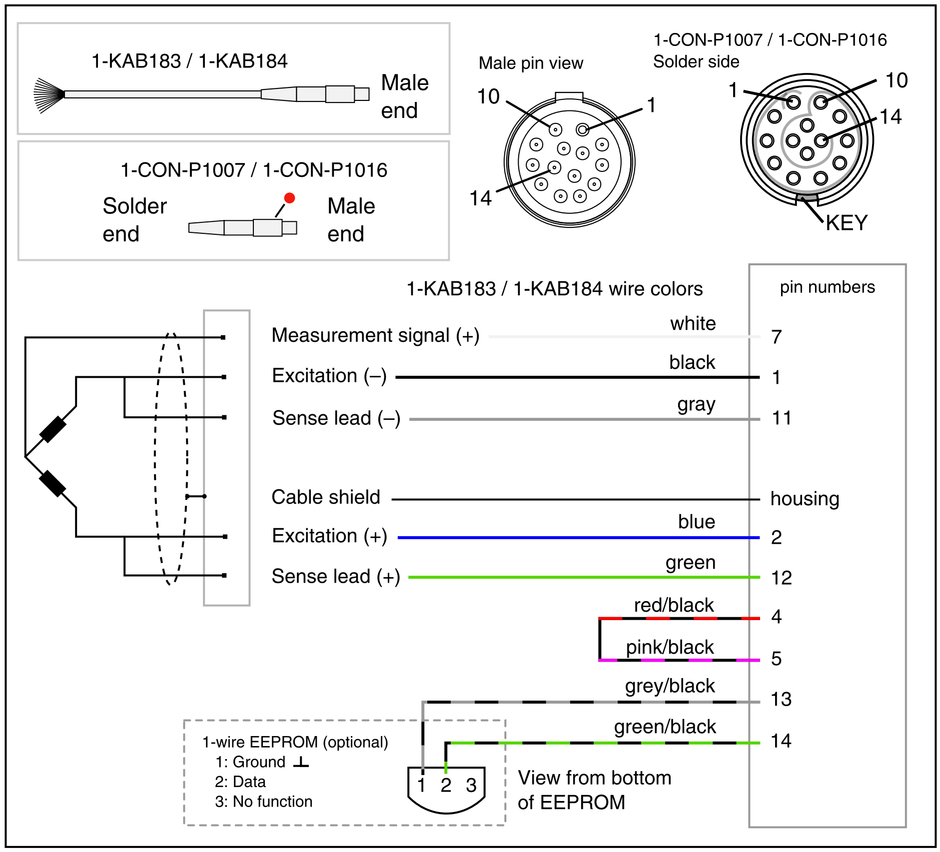
Inductive full-bridge

Inductive full-bridge, six-wire configuration



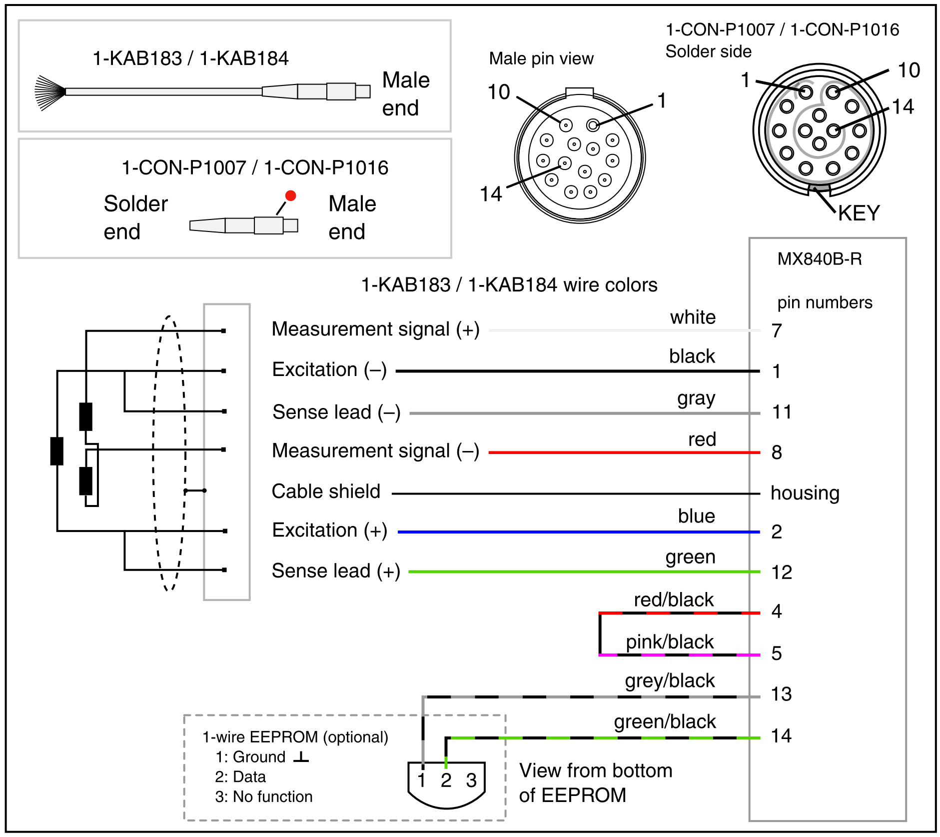
Inductive half-bridge

Inductive half-bridge, five-wire configuration



Linear variable differential transformer (LVDT)

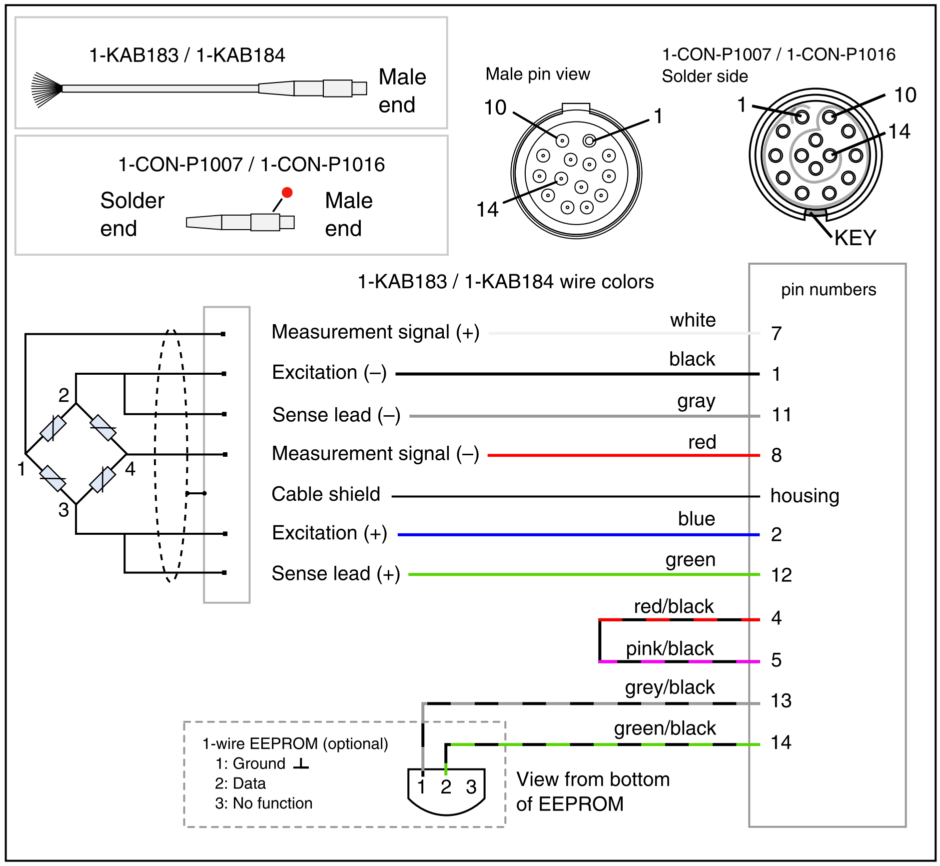
Linear variable differential transformer (LVDT)



Piezoresistive transducers

Transducer	MX840B-R	MX411B-R
Piezoresistive transducer	●	●

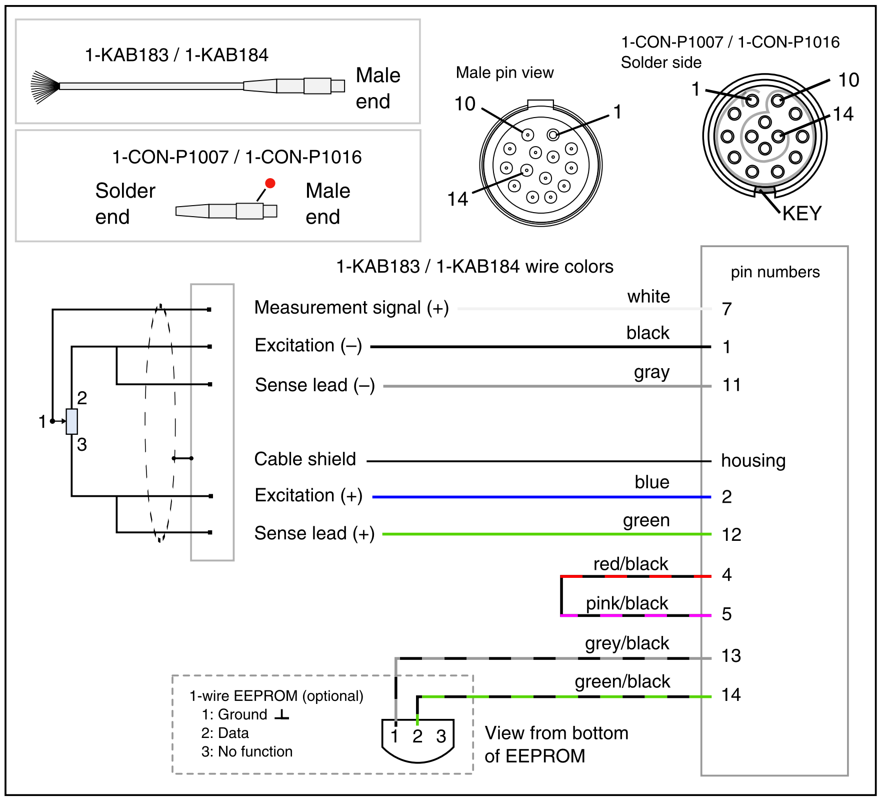
Piezoresistive full bridge, six-wire configuration



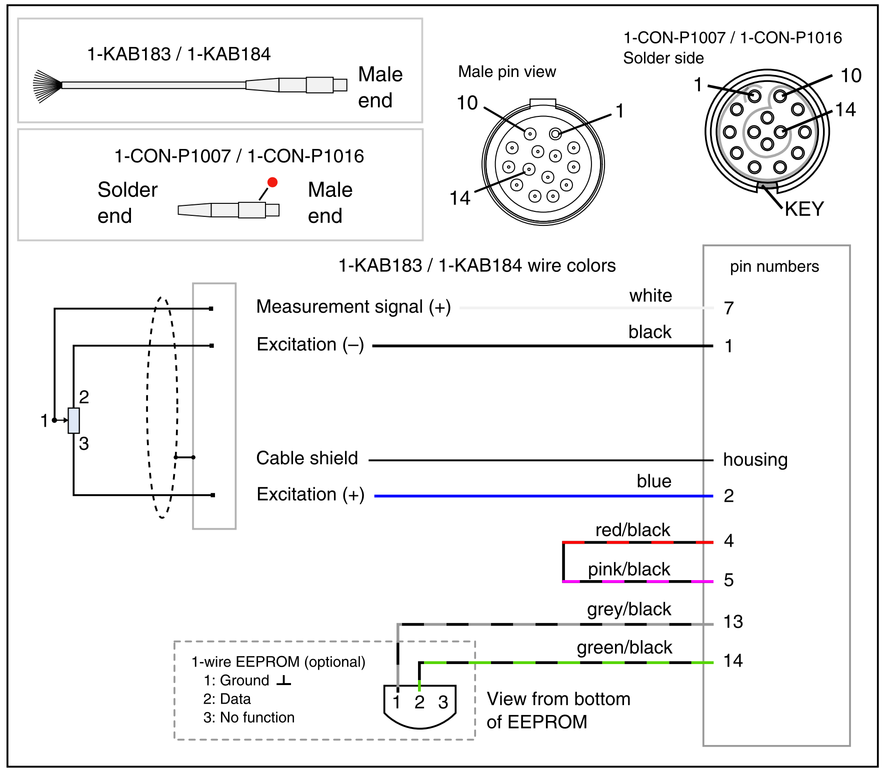
Potentiometric transducers

Transducer	MX840B-R	MX1615B-R
Potentiometric transducer	●	●

Potentiometric transducer



Potentiometric transducer (3 wire)

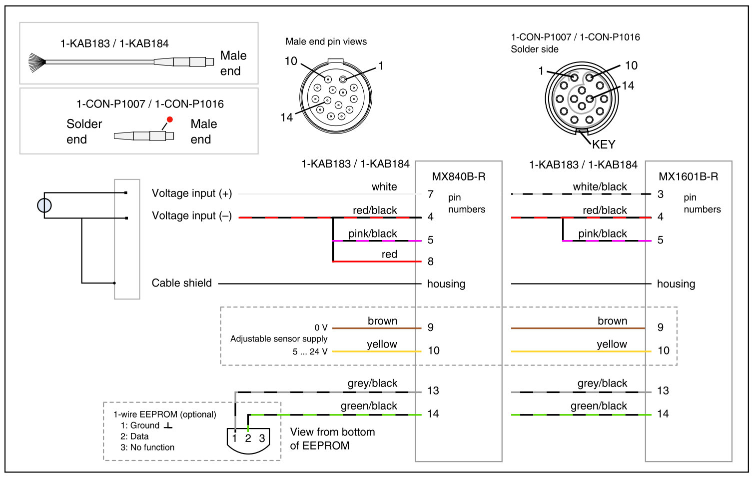


Voltage sources

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

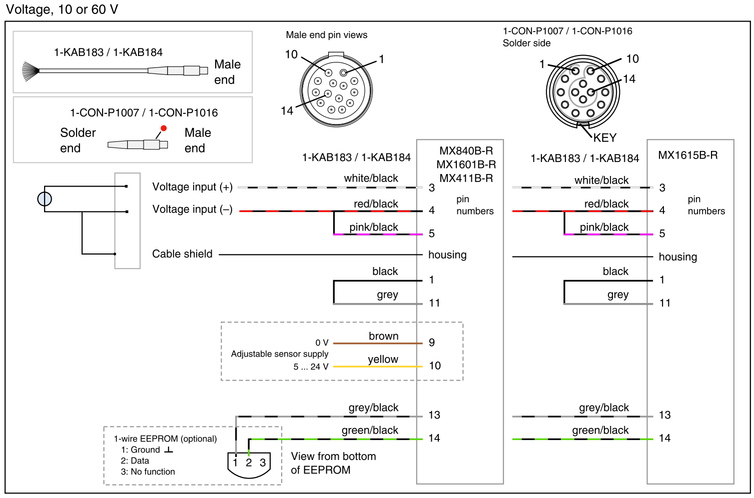
100 mV DC Voltage Source

Voltage, 100 mV



10 or 60 V DC Voltage Source

Voltage, 10 or 60 V



NOTE

Maximum input voltage to housing and supply ground is ±60 V. A connection between pins 1 and 11 is necessary for compatibility with the MX1615B-R module. A connection between pins 4 and 5 is necessary for compatibility with all other MX modules. The MX1615B-R module does not provide an adjustable sensor supply.

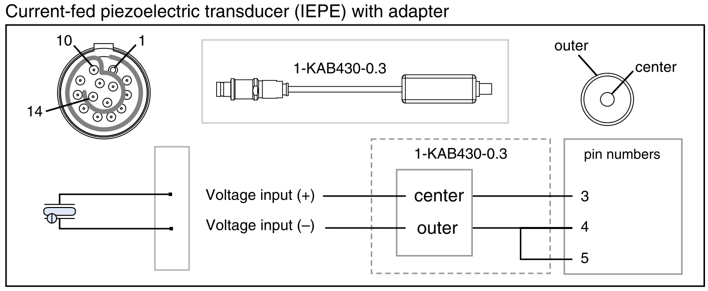
Current-fed piezoelectric transducers (IEPE, ICP®)

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

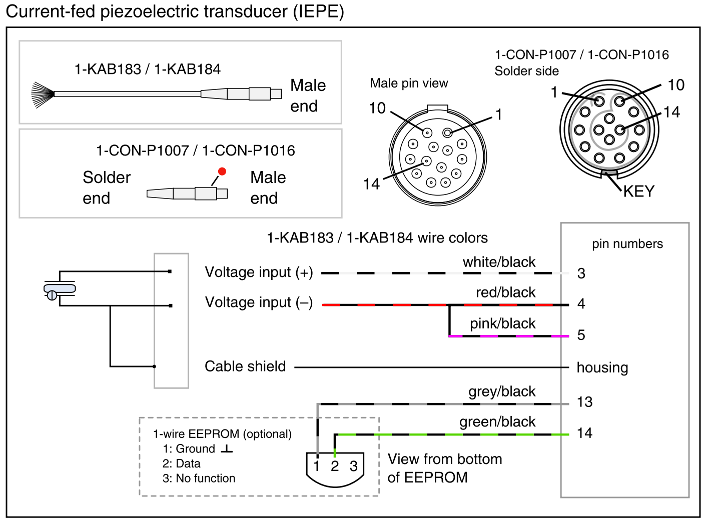
Transducer	MX840B-R	MX1601B-R	MX411B-R
Current-fed piezoelectric transducer (IEPE, ICP®)	●†	●†	●†

† Use ODU 14-pin to BNC adapter 1-KAB430-0.3.

Current-fed piezoelectric transducer (IEPE) with adapter



Current-fed piezoelectric transducer (IEPE)



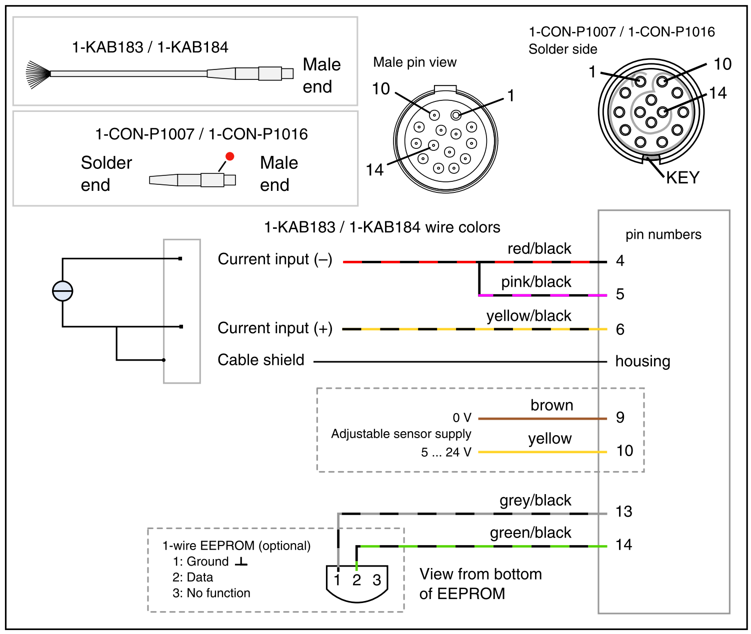
NOTE
IEPE transducers with TEDS version 1.0 are supported.

Current sources

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

20 mA DC Current Source

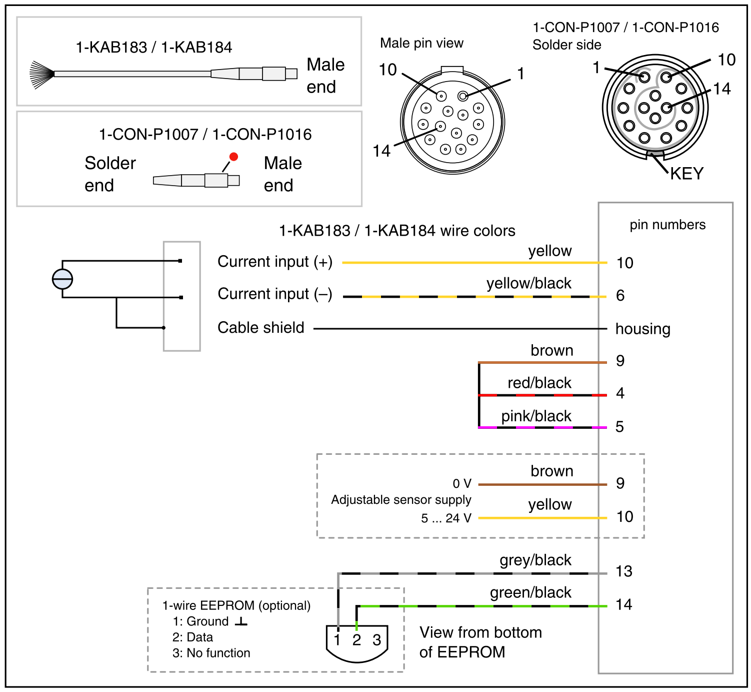
Current, 20 mA



NOTE
Maximum current is ±30 mA.

20 mA Current-fed DC Current Source

Current, 20 mA current-fed



NOTE
Maximum current is ±30 mA.

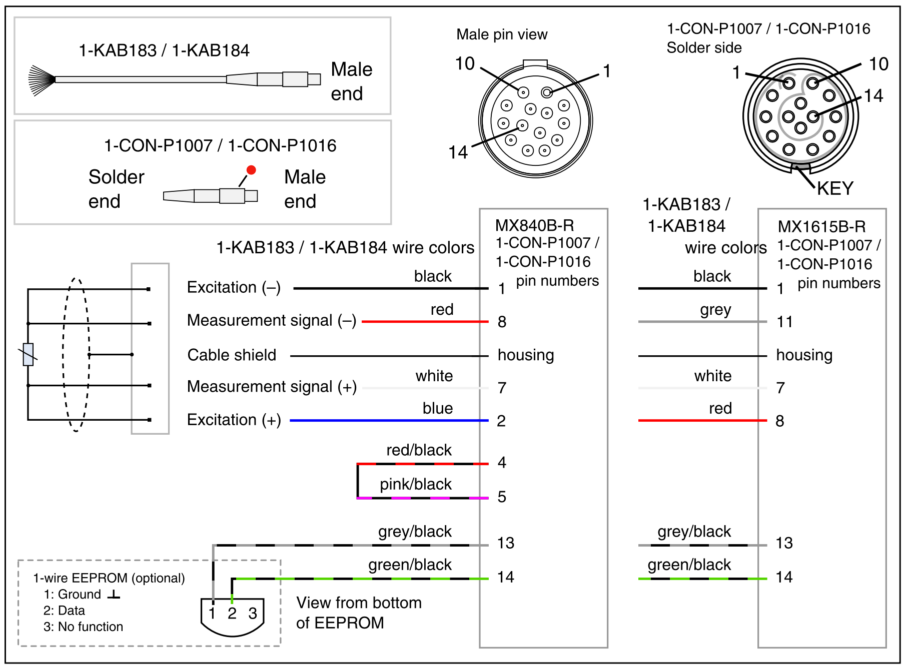
NOTE
The sensor supply must be connected in series. This, however, terminates the electrical isolation to the module supply.

Resistance-based measurements

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

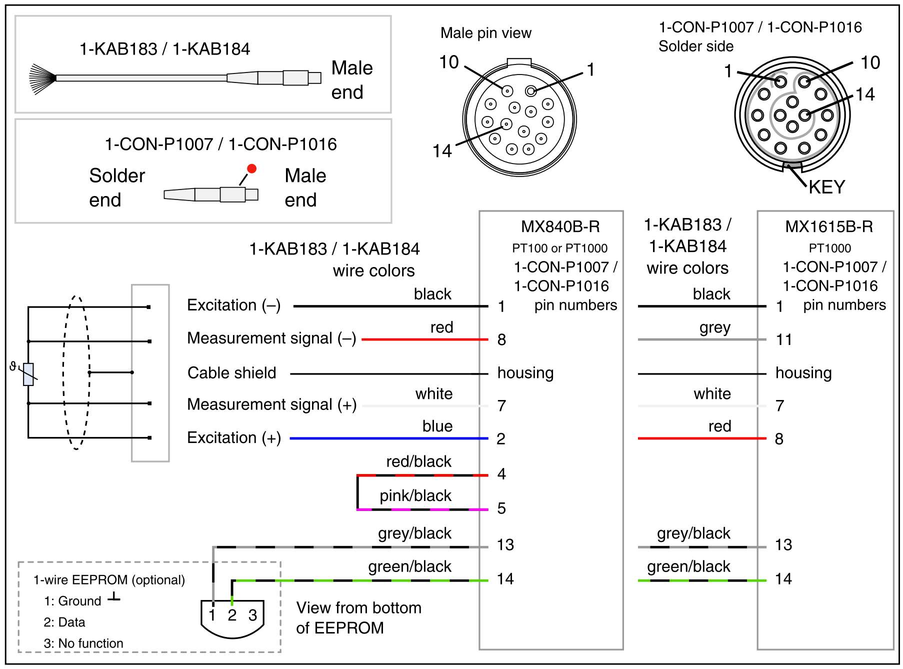
Resistance

Resistance, four-wire circuit



Resistance Thermometer (RTD)

Resistance thermometer

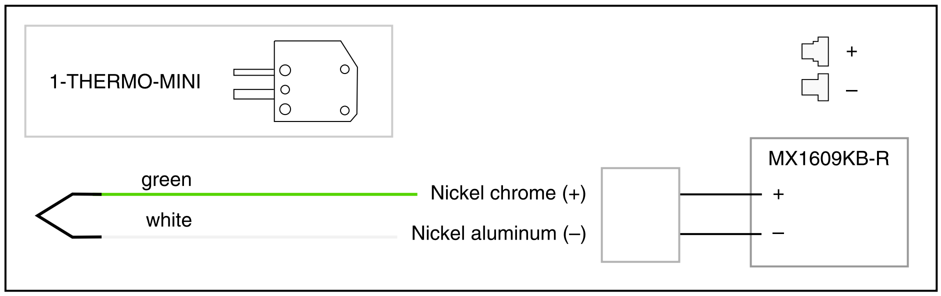


Thermocouples

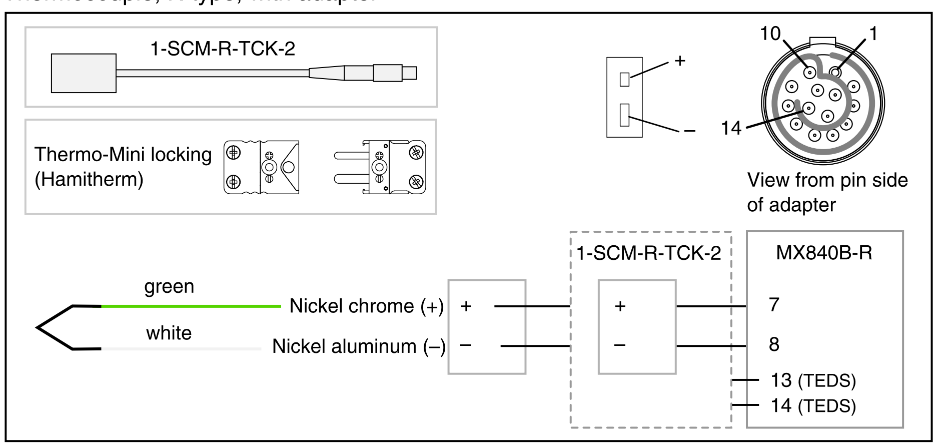
Transducer	MX840B-R	MX1609KB-R	MX1609TB-R
Thermocouple	●‡	● K-type only	● T-type only

‡ Use thermocouple adapter 1-SCM-R-TCK-2 for K-type, 1-SCM-R-TCE-2 for E-type, 1-SCM-R-TCT-2 for T-type and 1-SCM-R-TCJ-2 for J-type.

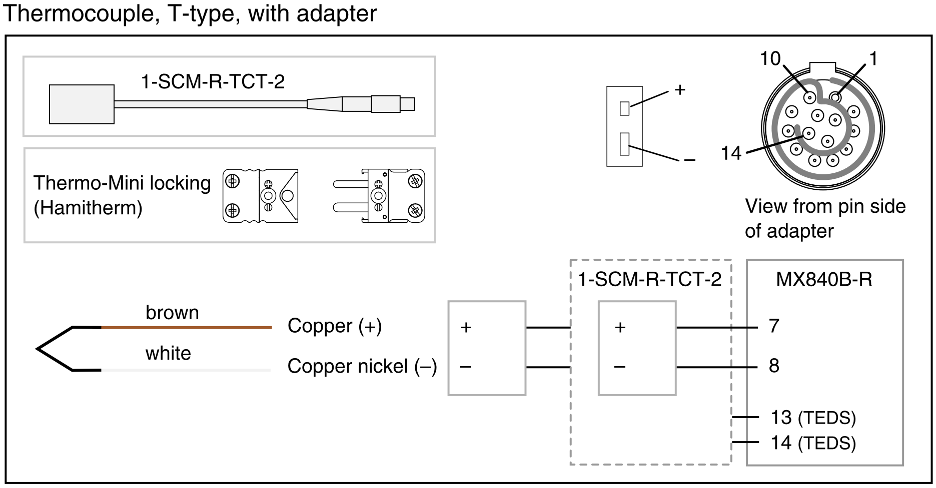
Thermocouple, K-type



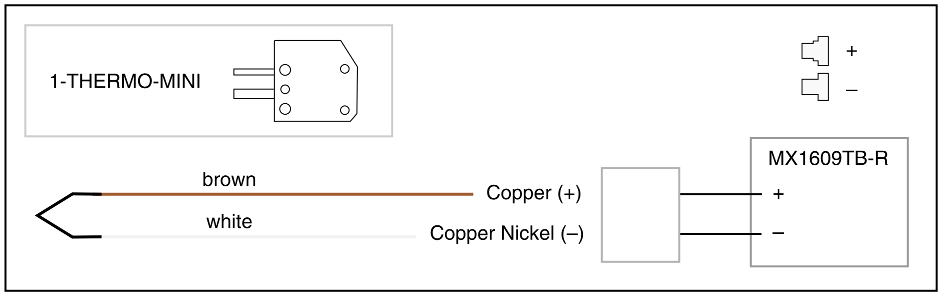
Thermocouple, K-type, with adapter



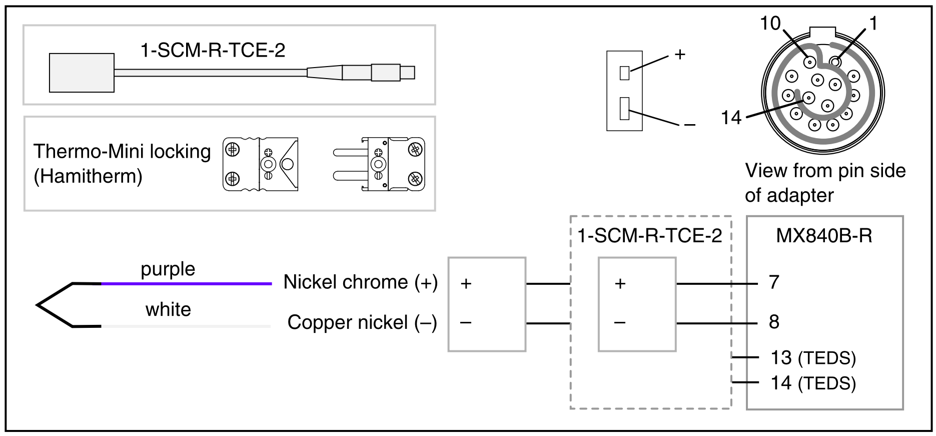
Thermocouple, T-type, with adapter



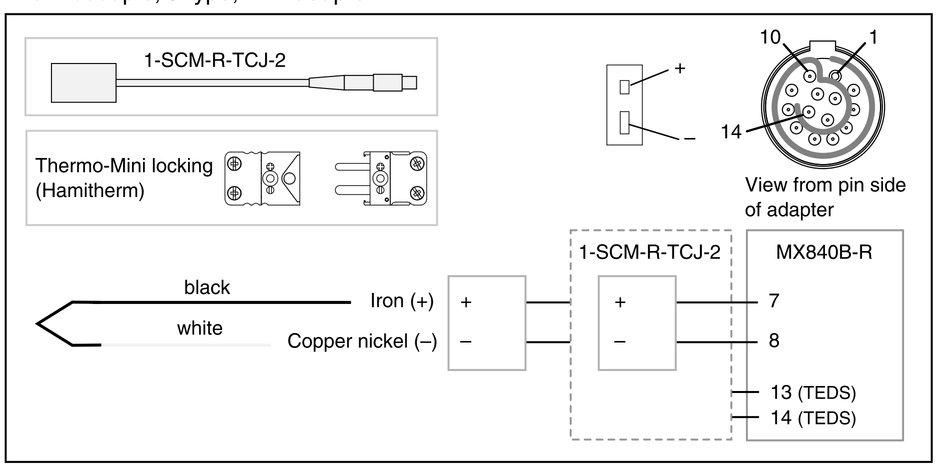
Thermocouple, T-type



Thermocouple, E-type, with adapter



Thermocouple, J-type, with adapter

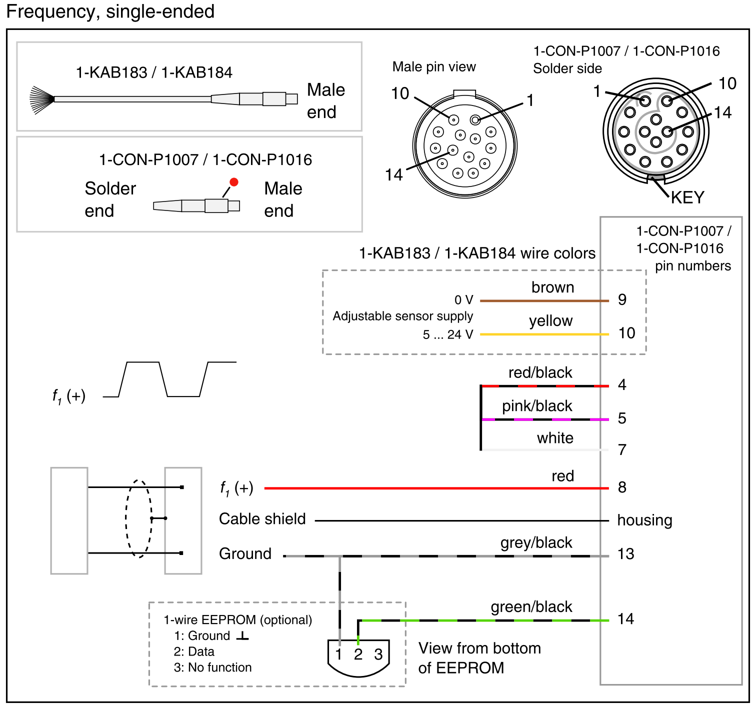


Digital timer inputs

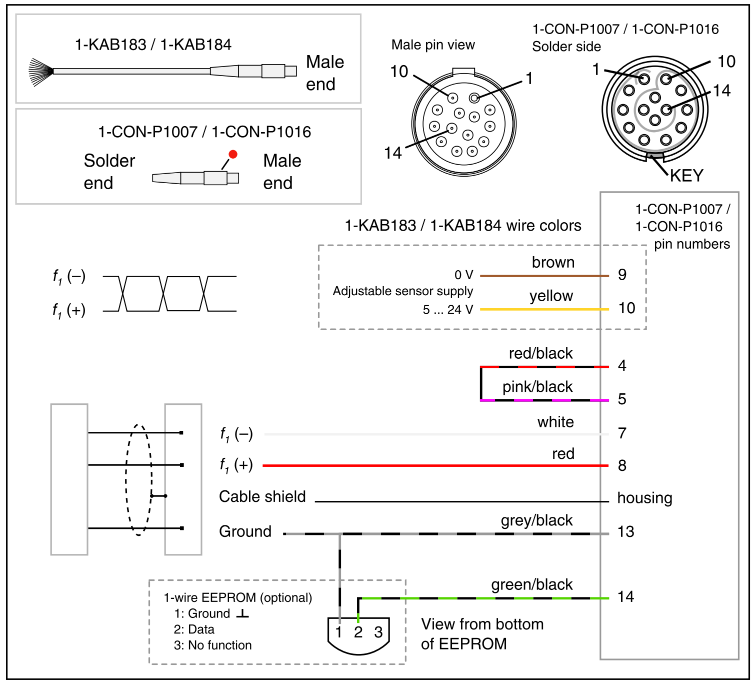
Transducer	MX840B-R	MX460B-R
Frequency / pulse counter (timer, TTL)	● connectors 5-8	●
Incremental encoder (timer, TTL)	● connectors 5-8	●
Torque / speed	● connectors 5-8	●
SSI protocol	● connectors 5-8	

Frequency / pulse counter

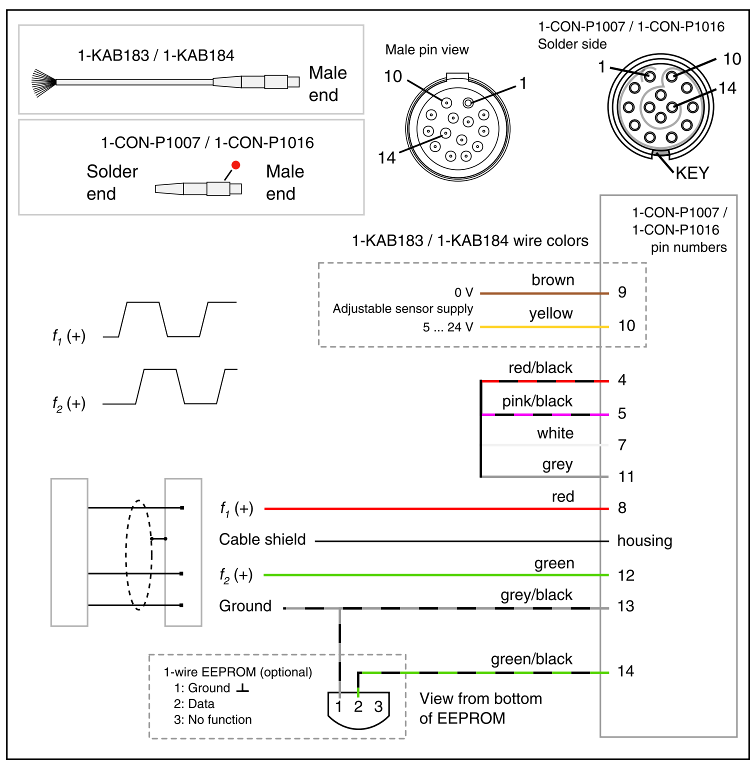
Frequency, single-ended



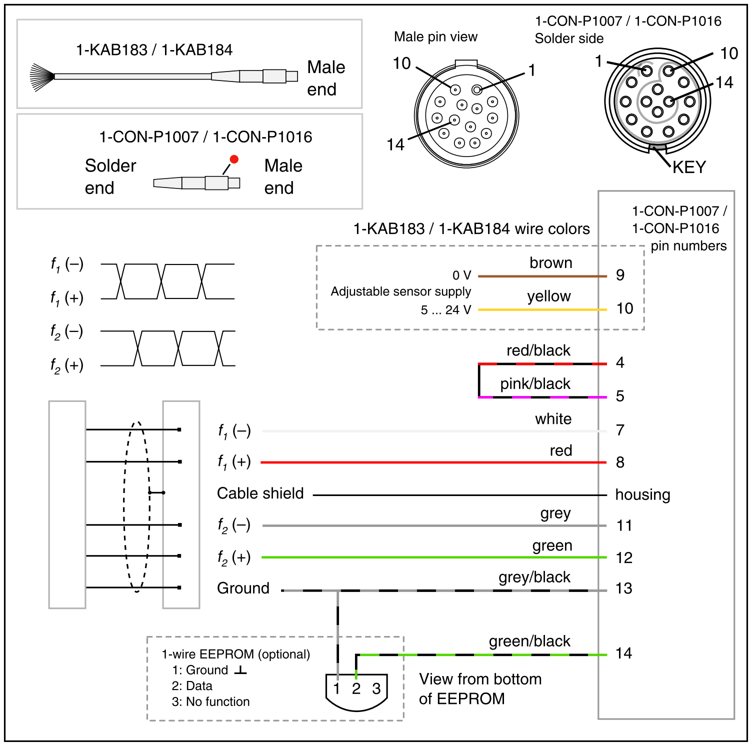
Frequency, differential



Frequency, single-ended, directional

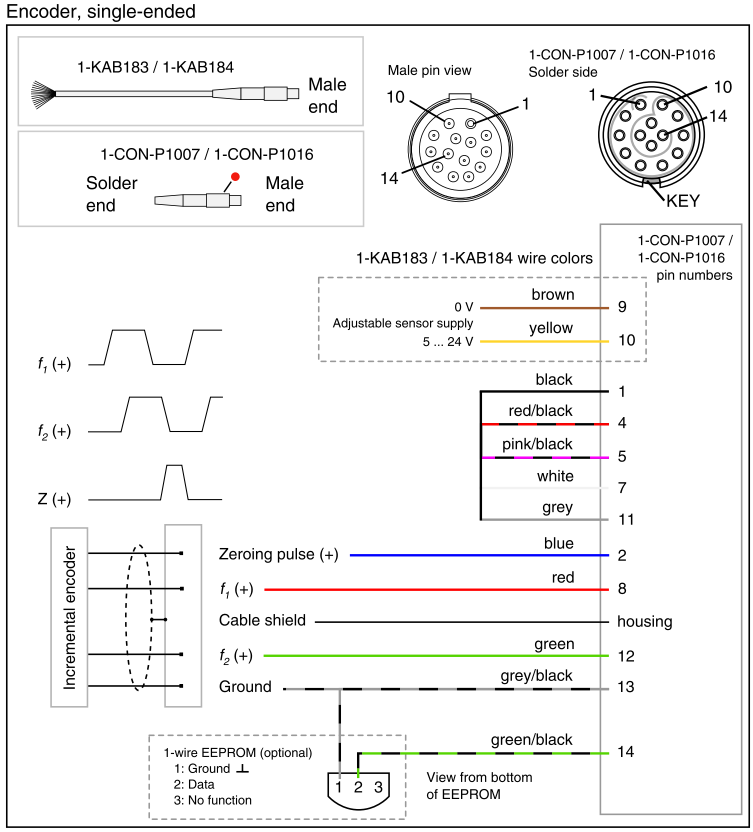


Frequency, differential, directional

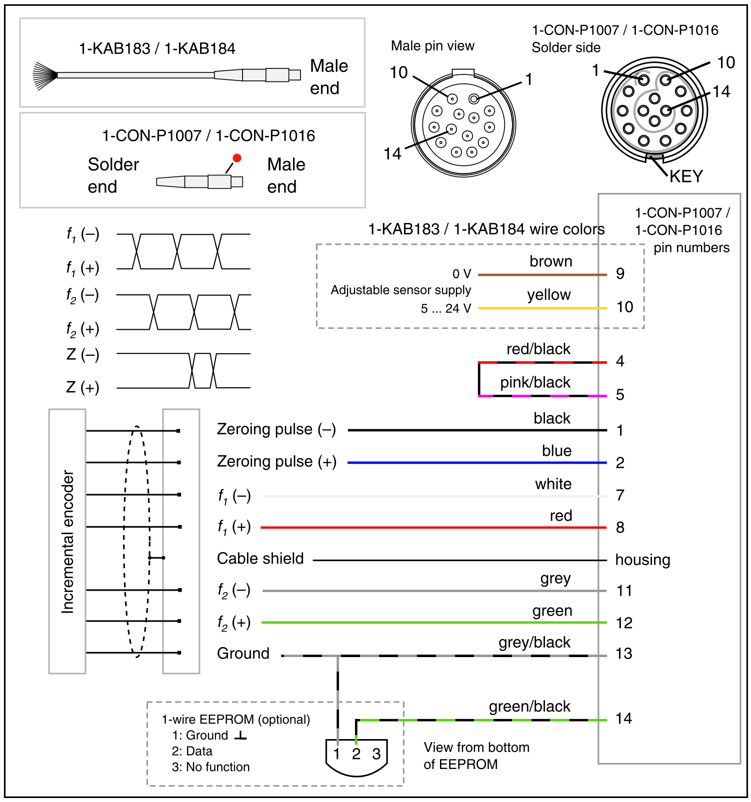


Incremental encoder

Encoder, single-ended

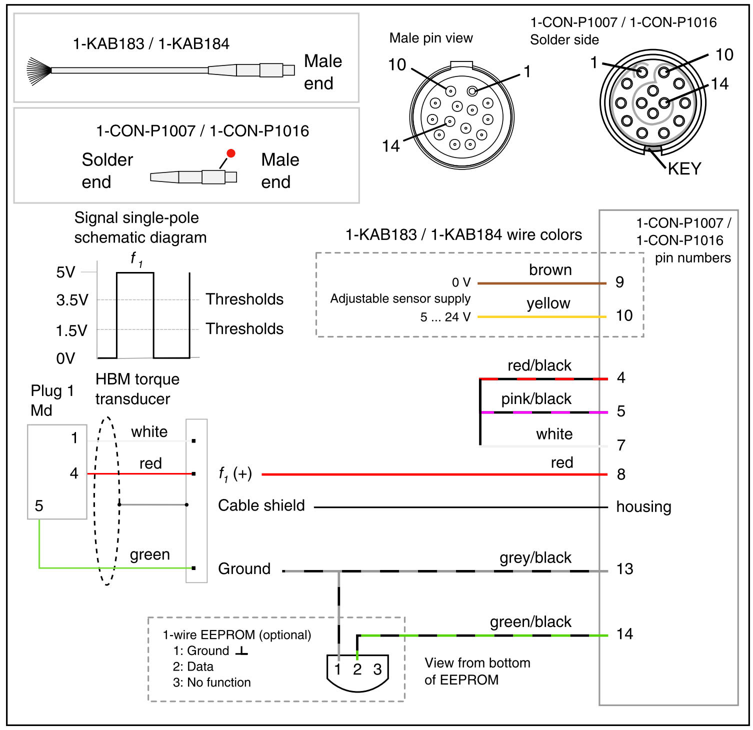


Encoder, differential

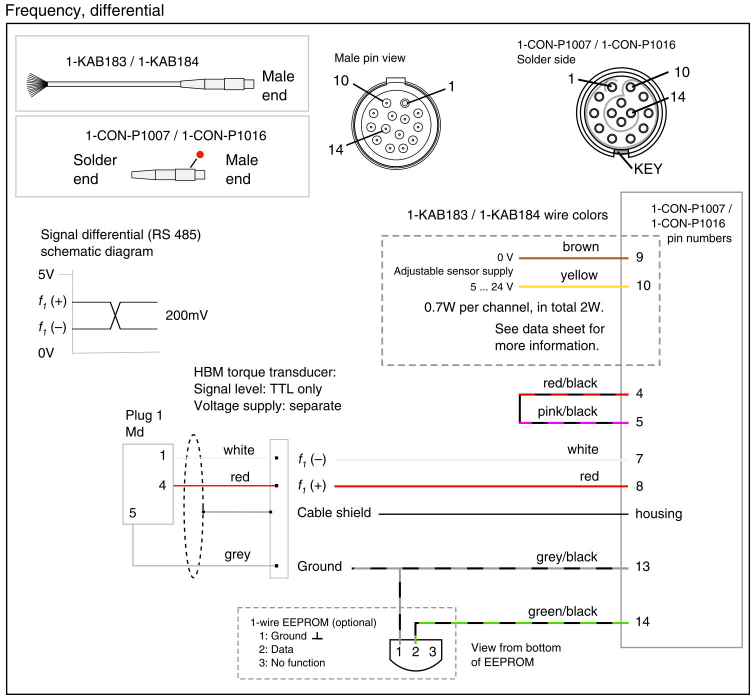


Torque / Speed (HBM torque transducers)

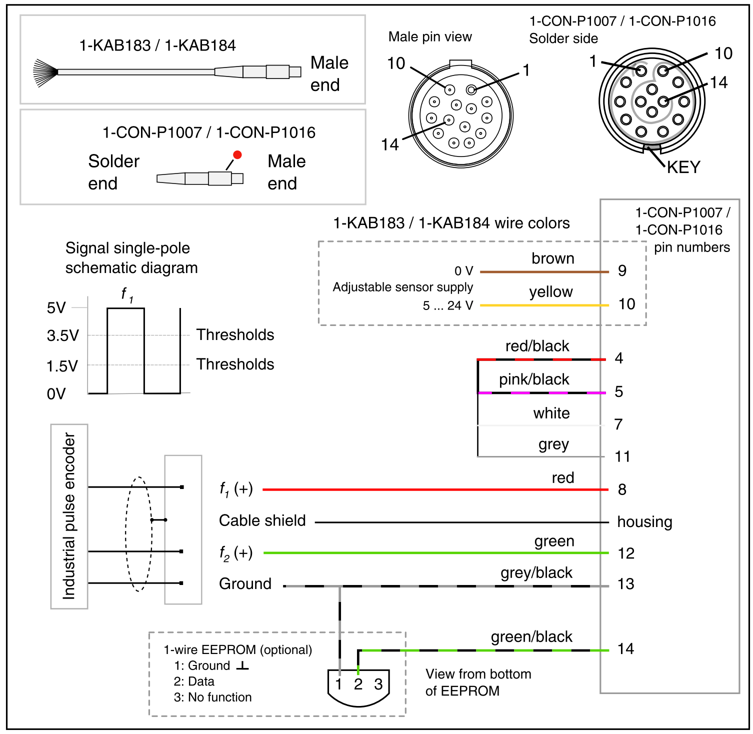
Frequency, single-ended



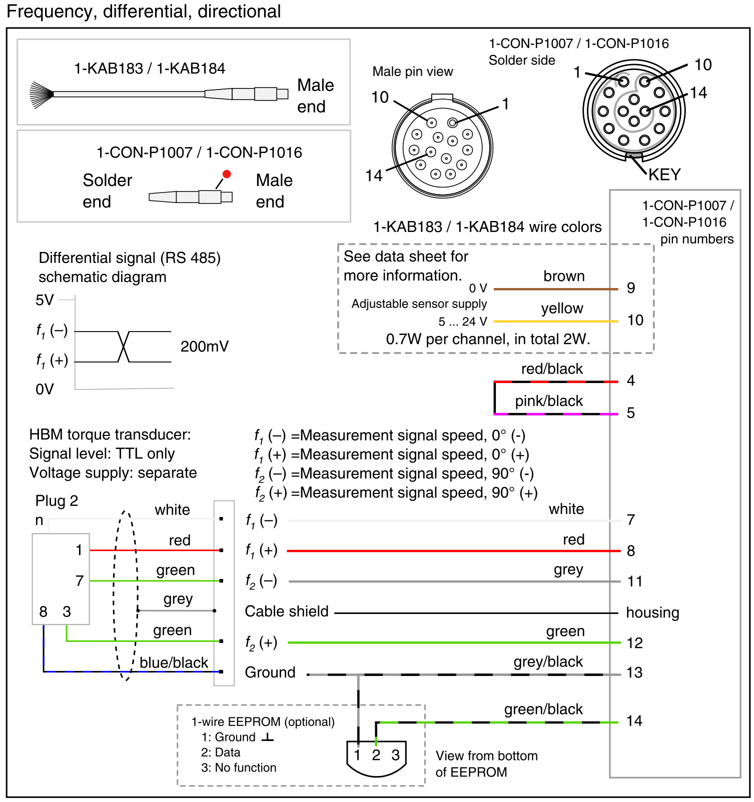
Frequency, differential



Frequency, single-ended, directional

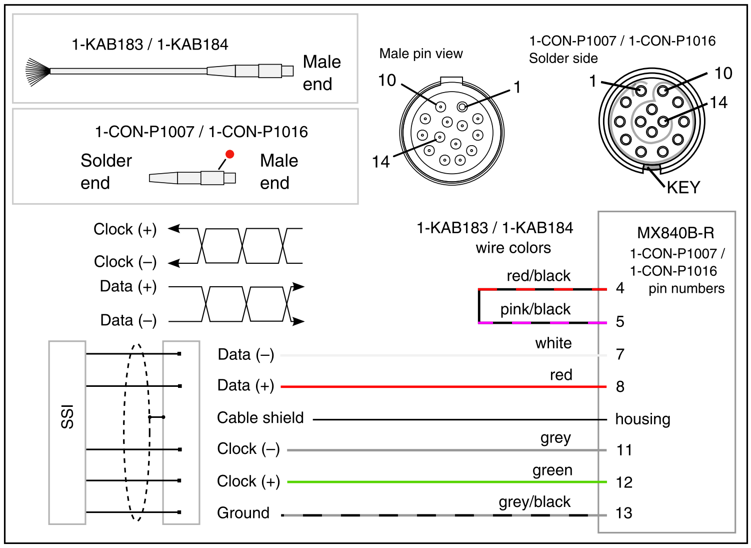


Frequency, differential, directional



Absolute value encoder (SSI protocol)

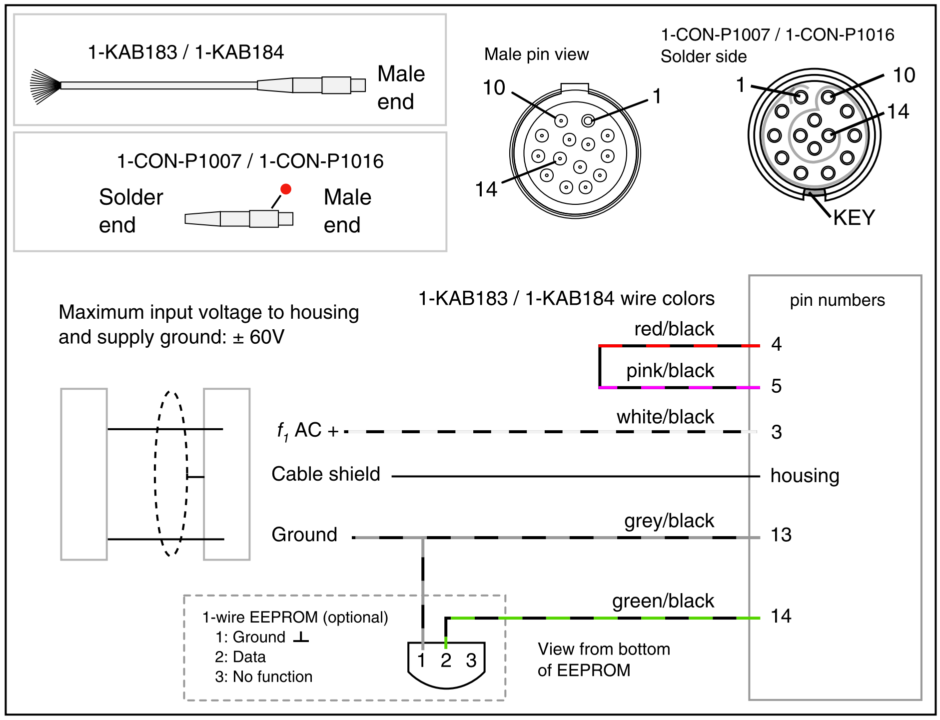
SSI Protocol



Passive inductive encoder

Transducer	MX460B-R
Passive inductive encoder	●

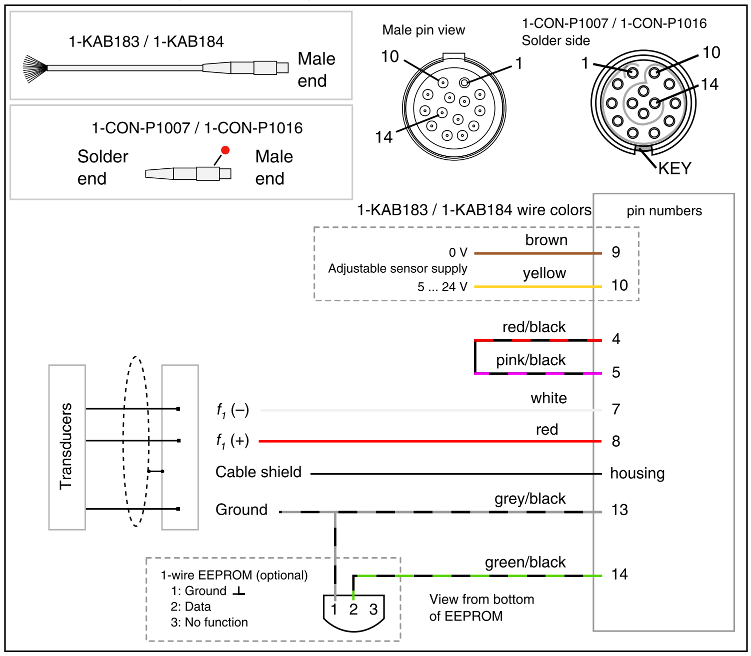
Passive inductive encoder



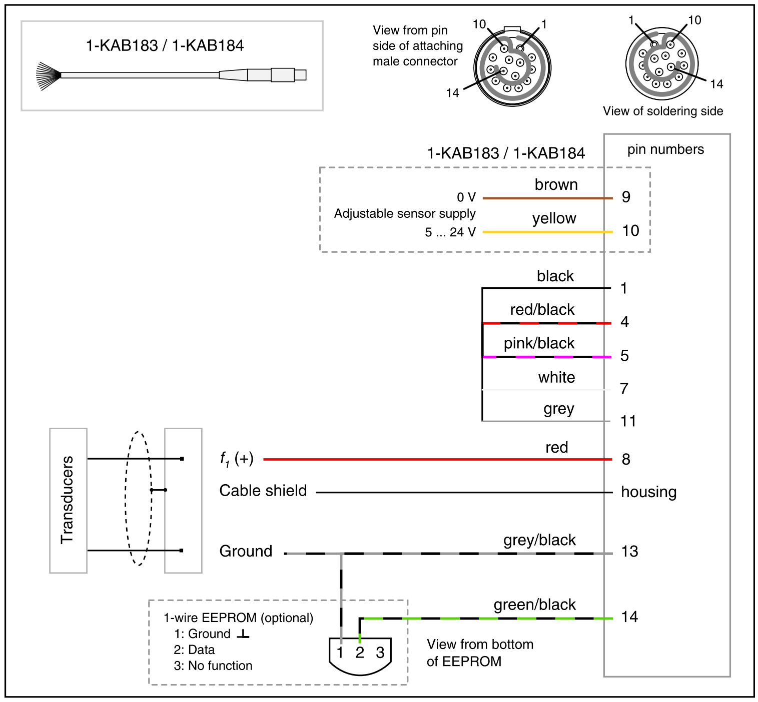
Pulse width, pulse duration, period duration (PWM)

Transducer	MX460B-R
PWM - Pulse width, pulse duration, period duration	●

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



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



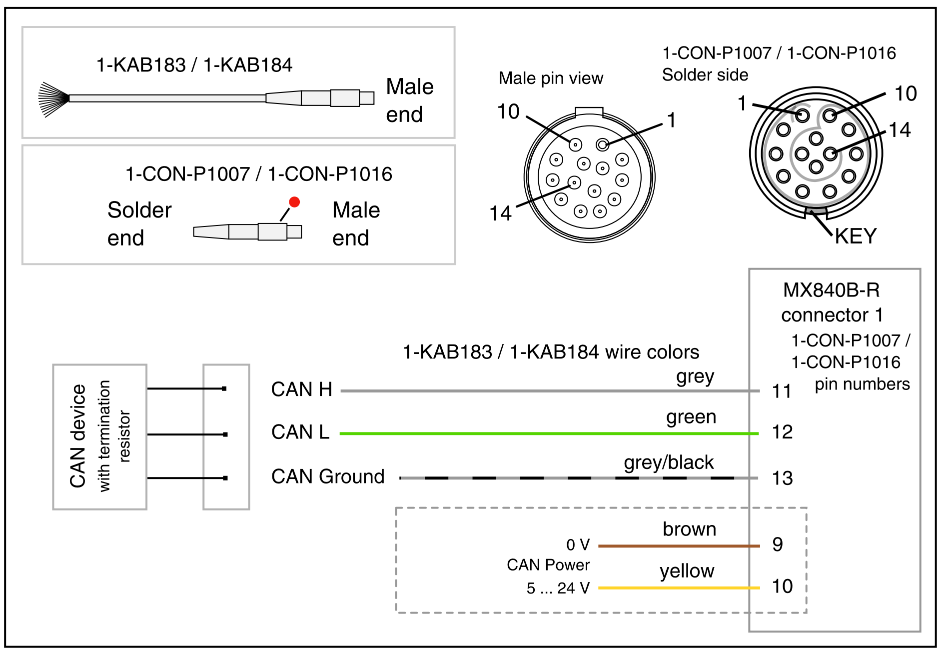
CAN devices

Transducer	MX840B-R	MX471B-R	MX471C-R
CAN — CAN bus database or raw message	● connector 1	●§ database only	●§ database only
CAN FD — CAN FD bus			●

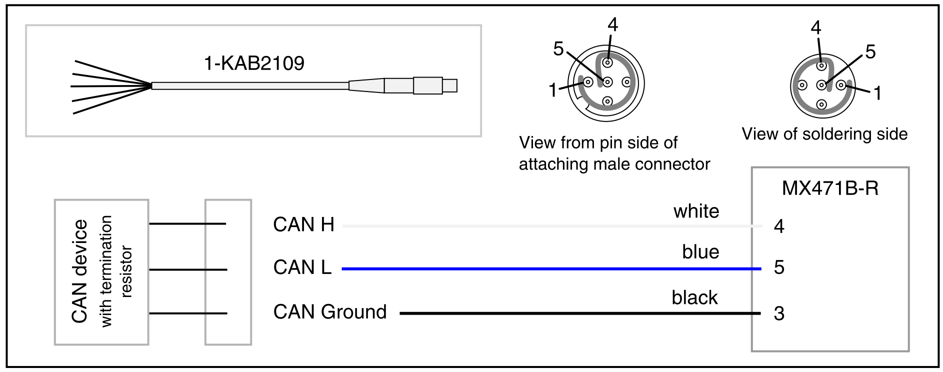
§ Including support for CCP/XCP-on-CAN (not in combination with CX23-R).

NOTE
To ensure normal operation, the CAN bus needs to be terminated at both ends using appropriate termination resistors. The MX471B-R, MX471C-R and MX840B-R provide internal completion resistors between CAN H and CAN L that can be enabled or disabled individually with software.

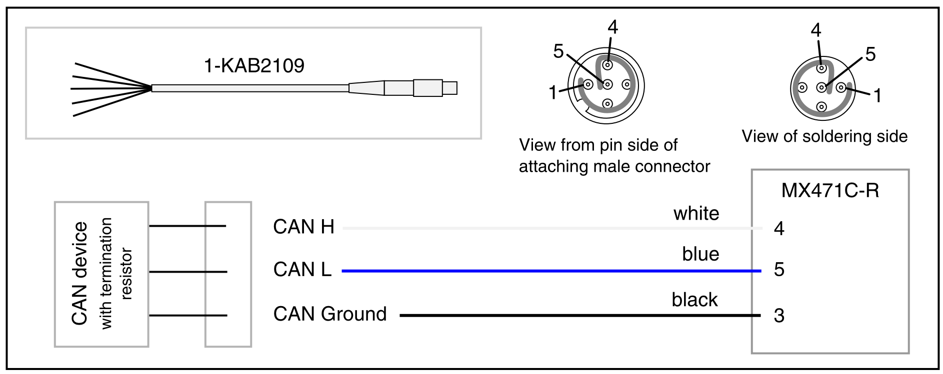
CAN device, MX840B-R



CAN device, MX471B-R



CAN / CAN FD device, MX471C-R

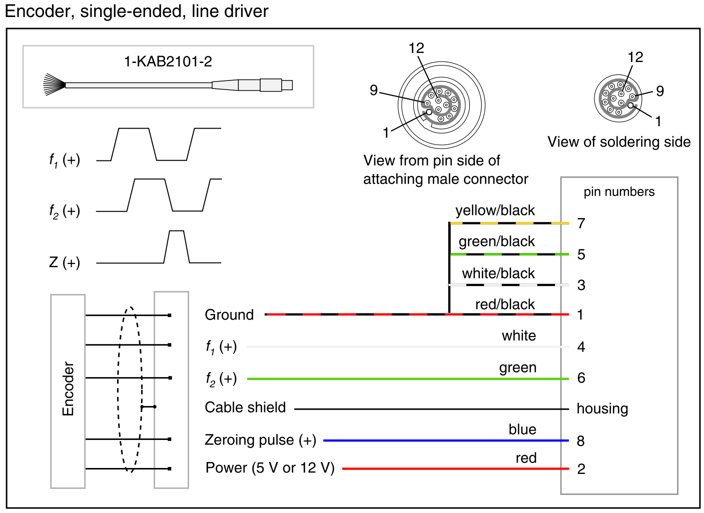


Transducer	MX840B-R
Incremental encoder (timer, TTL)	● connectors 5-8

Notes on wiring encoder inputs:

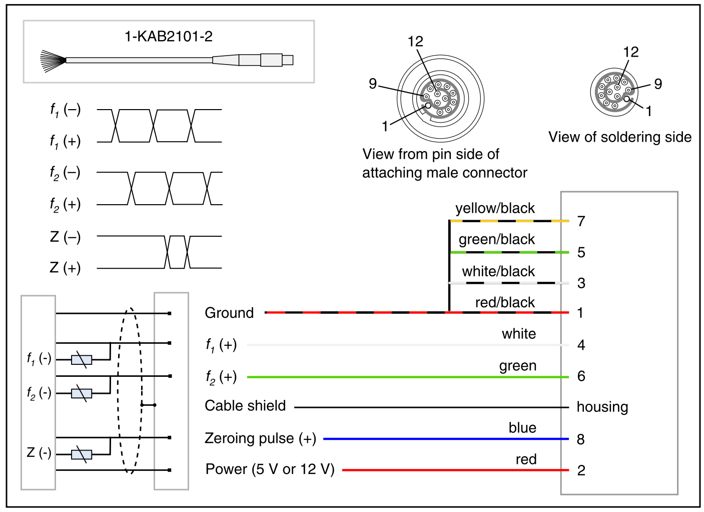
- Always check encoder data sheet for maximum supply voltage. Supplying 12-volt transducer power to a 5-volt encoder may damage it.
- Transducer power is limited to 3 W. Check encoder data sheet to ensure the encoder and any necessary pull-up resistors use less than 3 W total.
- If using a differential encoder in a single-ended (ground referenced) configuration, connect only the positive inputs (f_1(+), f_2(+) and Z(+)) or only the negative inputs (f_1(-), f_2(-) and Z(-)).
- Check encoder data sheet for output low and high voltages and set thresholds accordingly.

Encoder, single-ended, line driver

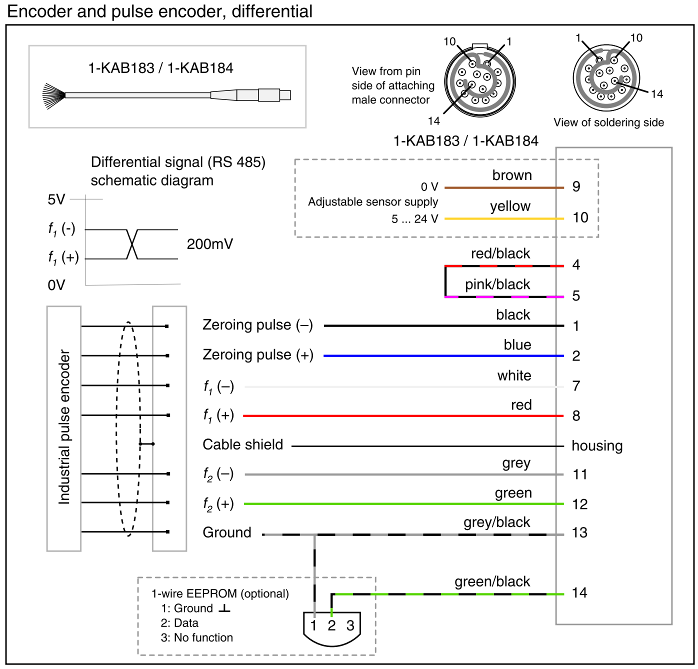


For applications requiring long cable runs or more than 200K pulses per second, use the differential wiring diagram below. Place the 120-Ohm termination as close to the input as possible to dampen reflections.

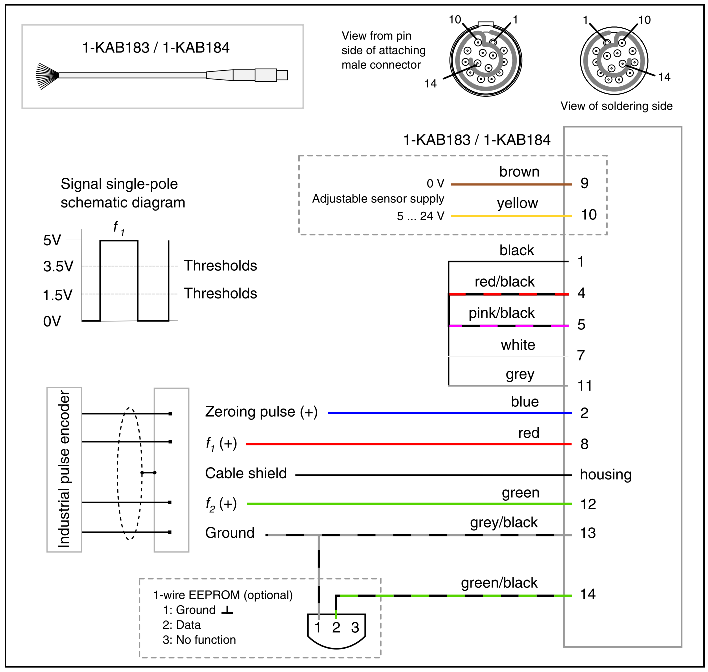
Encoder, differential, line driver



Encoder and pulse encoder, differential



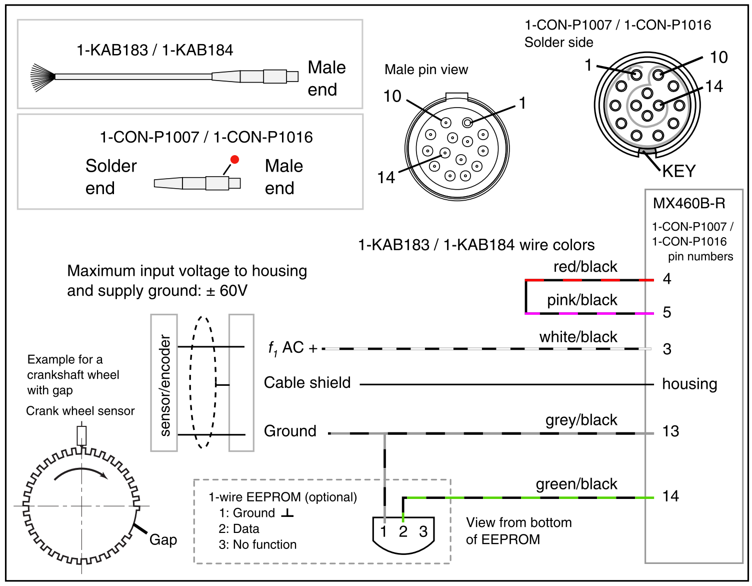
Encoder and pulse encoder, single-pole



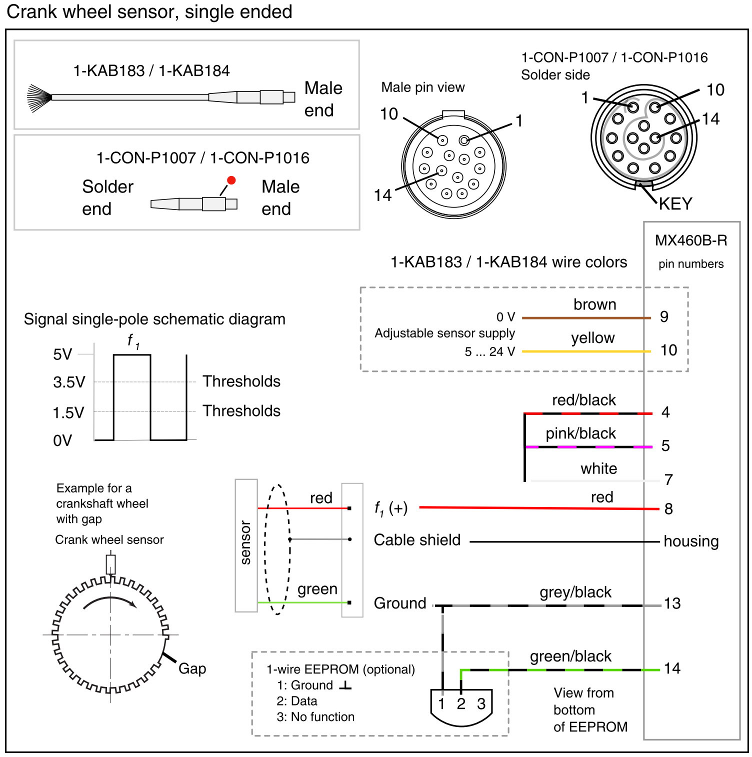
Crank wheel sensors

Transducer	MX460B-R
Crank wheel sensor	●

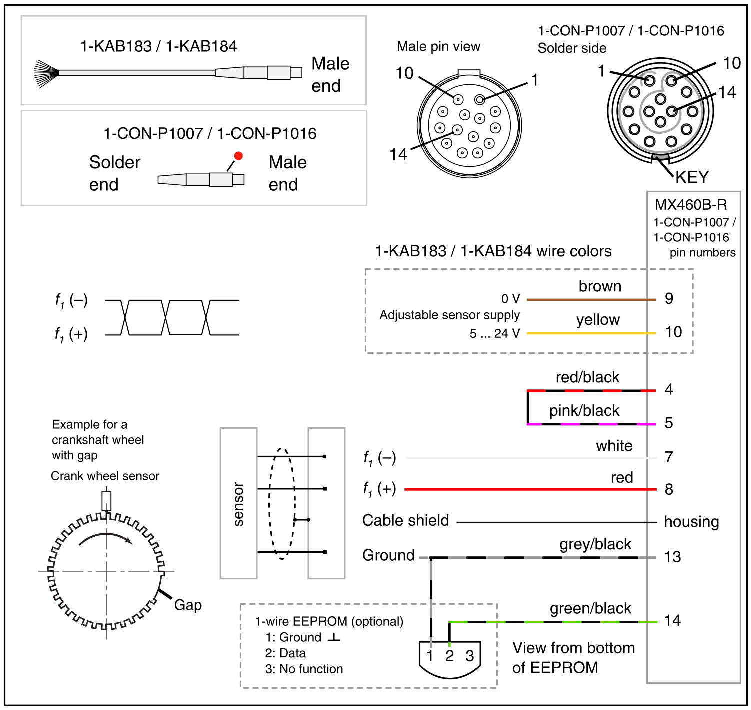
Passive inductive encoder, crank wheel



Crank wheel sensor, single ended



Crank wheel sensor, differential



1.4.11 Module transducer overview

Transducer	MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	Wiring diagram
Strain gage, full bridge six-wire configuration	●	●			●				97
Strain gage, half bridge five-wire configuration	●	●			●				97
Strain gage, quarter bridge three- or four-wire configuration	●* 3-wire only	●			●* 3-wire only				97
Inductive full bridge	●				●				101
Inductive half bridge	●				●				101
LVDT (linear variable differential transformer)	●								101
Piezoresistive transducer	●				●				104
Potentiometric transducer	●	●							105
Voltage, 60 V, 10 V, 100 mV	●	● 60 V only	●		● 10 V only				107
Current-fed piezoelectric transducer (IEPE, ICP®)	●†		●†		●†				108
Current, 20 mA	●		●		●				109
Resistance or resistance-based measurements	●	●							111

Transducer	MX840B-R	MX1615B-R	MX1601B-R	MX1609KB-R MX1609TB-R	MX411B-R	MX460B-R	MX471B-R	MX471C-R	Wiring diagram
Resistance thermometer (RTD), PT100 or PT1000	●	● PT100 only							111
Thermocouple	●‡			● K-type or T-type respectively					113
Frequency / pulse counter (timer, TTL)	● connectors 5-8					●			115
Incremental encoder (timer, TTL)	● connectors 5-8					●			115
Torque / speed	● connectors 5-8					●			115
Passive inductive encoder						●			123
PWM - Pulse width, pulse duration, period duration						●			124
Crank wheel sensor						●			131
SSI protocol	● connectors 5-8								115
CAN bus database or raw message	● connector 1						●§ database only	●§ database only	126
CAN FD bus								●	126

* Use quarter bridge adapter 1-SCM-R-SG1000-2, 1-SCM-R-SG120-2 or 1-SCM-R-SG350-2. † Use ODU 14-pin to BNC adapter 1-KAB430-0.3. ‡ Use thermocouple adapter 1-SCM-R-TCK-2 for K-type, 1-SCM-R-TCE-2 for E-type, 1-SCM-R-TCT-2 for T-type and 1-SCM-R-TCJ-2 for J-type. § Including support for CCP/XCP-on-CAN (not in combination with CX23-R).

1.5 GPS modules

GPS channels are sourced from the GPS connector on the CX23-R/EXRCPU/EXRLCPU. EGPS-200, EGPS-200-Plus and Garmin GPS modules are supported. See GPS channels and www.hbm.com for more information.

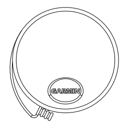
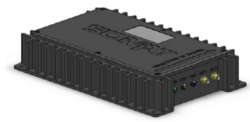
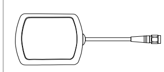
The Garmin GPS (model GPS18X-5Hz) module requires the 5 Vdc power option and draws about 0.5 W. EGPS-200 and EGPS-200-Plus modules require the 12 Vdc power option and draw about 2.4 W. On boot up of the main processor, the power is always set to 5 Vdc.

With the power option set to 5 Vdc, the EGPS-200 and EGPS-200-Plus modules operate in a minimal mode that is sufficient to send a message to the processor allowing it to identify the module. When the processor receives this message, it switches to the 12 Vdc power mode.

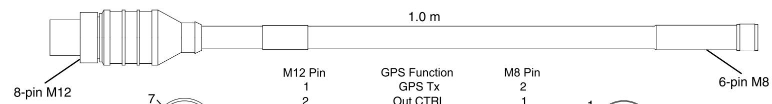
CAUTION
The Garmin module will be instantly destroyed if it is connected to the GPS connector with the 12 Vdc power option selected! As such, always power off the main processor before connecting a Garmin GPS if an EGPS-200 or EGPS-200-Plus module was previously connected.

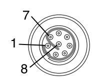
Cables and accessories

Order Number	Description
1-EGPS-5HZ-2	5 Hz GPS receiver (for use on CX23-R, also order KAB2102-1 in addition)(for an extension cable to EXRCPU/EXRLCPU, also order 1-SAC-EXT-MF-X-2 in addition)
1-EGPS-200-B-2	Precision GPS receiver, Includes (1) Trigger Cable (1-SAC-GPSTRIG-2) and (1) GPS Antenna (1-EGPS-200-ANT-2) (also order a 1-KAB2102-1 to connect to CX23-R) (also order a 1-SAC-EXT-MF-X-2 to connect to EXRCPU/EXRLCPU)
1-EGPS-200-P-2	Precision GPS receiver PLUS Package - IMU and RTK Measurements, Includes (1) Trigger Cable (1-SAC-GPSTRIG-2), (2) GPS Antennas (1-EGPS-200-ANT-2) and (1) Dual Antenna Template (1-EGPS-200-TEM-2) (also order a 1-KAB2102-1 to connect to CX23-R) (also order a 1-SAC-EXT-MF-X-2 to connect to EXRCPU/EXRLCPU)
1-EGPS-200-ANT-2	Antenna for EGPS-200-B-2 or EGPS-200-P-2
1-KAB2102-1	GPS/AUX adapter cable (8-pin M12 to 6-pin M8) 1m.
1-SAC-GPSTRIG-2	Trigger cable for EGPS-200-B-2 or EGPS-200-P-2
1-EGPS-200-TEM-2	Dual Antenna Template for EGPS-200-P-2
1-SAC-EXT-MF-0.4-2 1-SAC-EXT-MF-2-2 1-SAC-EXT-MF-5-2 1-SAC-EXT-MF-10-2 1-SAC-EXT-MF-15-2	Extension Cable - Male/Female Connectors (0.4, 2, 5, 10 or 15 m)

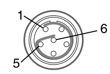
1-EGPS-5HZ-2	1-EGPS-200-B-2	1-EGPS-200-P-2	1-EGPS-200-ANT-2
			

1-KAB2102-1 GPS/AUX Adapter

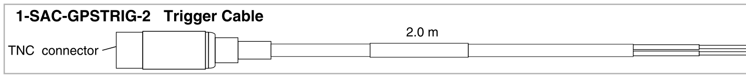




M12 Pin	GPS Function	M8 Pin
1	GPS Tx	2
2	Out CTRL	1
3	GPS Rx	6
4 (jumper to pin 7)	GND cable detect	3
5	GPS PPS	4
6	NC	-
7	Ground	-
8	Power +	5



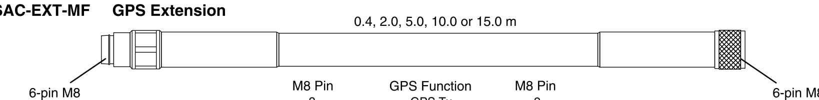
1-SAC-GPSTRIG-2 Trigger Cable

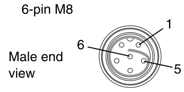


Function	Wire color
Shield	Brown
Conductor	White

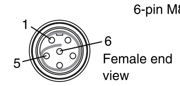
1-EGPS-200-TEM-2 GPS Antenna Template

1-SAC-EXT-MF GPS Extension





M8 Pin	GPS Function	M8 Pin
2	GPS Tx	2
1	Out CTRL	1
6	GPS Rx	6
3	GND cable detect	3
4	GPS PPS	4
5	NC	5



EGPS-200 operation and installation

Overview

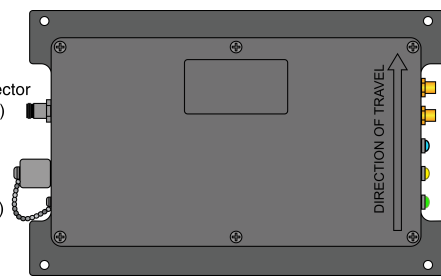
The EGPS-200 is primarily designed for ground vehicle testing applications. It provides a set of high accuracy vehicle speed output channels (raw 2D, raw 3D, and combined speed). An inertial motion unit (IMU) provides tri-axial (i.e., x-axis, y-axis and z-axis) acceleration output channels. The combined speed channel is computed using the acceleration data combined with the enhanced GPS sourced raw2D and raw3D speed data. In proving grounds test environments where there is a clear view of most of the sky, combined speed accuracy of 0.05 km/hr can typically be achieved for vehicle speeds of 5 km/hr or greater. Speed data can easily be integrated to provide high accuracy distance-travelled data using the Integrator Computed channel.

The EGPS-200 provides the standard GPS receiver time and location fix data with accuracy comparable to GPS receivers in its class – typically within 3 meters or better for latitude and longitude, and 6 meters or better for altitude. GPS position fixes use the latest processing techniques to eliminate jumps in position when the satellite constellation changes, while avoiding any lag in positional update when the unit moves. Note that the EGPS-200 raw speed channels data are computed using either the Doppler shift of the satellites, or the carrier phase of the GPS signal, and as such speed accuracy is not limited by the accuracy of the GPS position fix data.

The EGPS-200 also provides a TTL level trigger input that can be used as a trigger channel in any of the Computed channels such as the Integrator or a DataMode™ that support triggers. This is particularly significant for vehicle testing application such as brake testing, determination of zero-to-speed acceleration marks, etc.

All data channels output from the EGPS-200 are time stamped to ensure data integrity and provide tight synchronization with eDAQ analog and digital channels (acquired from the Bridge, High Level SS, and Digital layers). Typical data synchronization is within a few milliseconds.

The EGPS-200 Plus provides real time kinematic (RTK) channel data and an advanced IMU relative to the EGPS-200 Base product. This IMU provides enhanced tri-axial accelerometer channels and tri-axial gyroscope channels. The RTK option provides pitch, roll, and yaw rate channel data via the IMU gyroscopes, and instantaneous pitch and yaw data sourced from the dual GPS antennae system. This supports the acquisition of quasi real time nominal accuracy vehicle slip and squat data using simple Computed channels.



Cable connection and status LEDs diagram (Top view of 1-EGPS-200-P-2 shown)

EGPS-200 Status LEDs

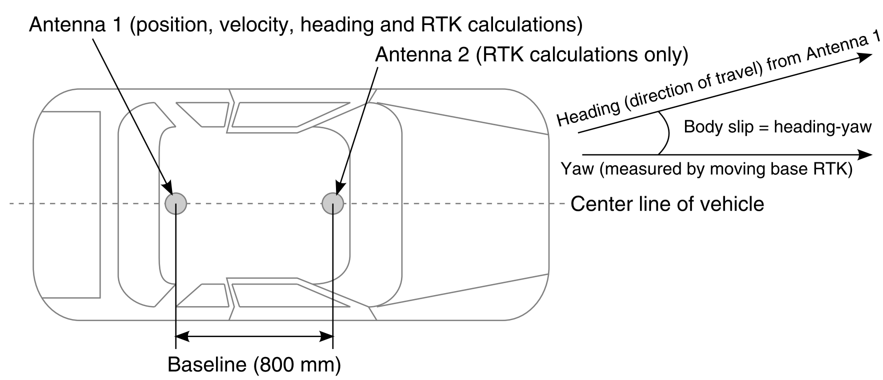
LED	Description
PWR (green) shows power and PPS lock status	
Off	Unit is not powered.
On	Turns on immediately after 12 volt power is applied to the unit, which is typically several seconds after the connected CPU is powered up.
1Hz	PPS lock is attained.
STAT (yellow) shows GPS signal status	
Off	Unit is not powered.
1Hz	Unit has acquired enough satellites to get a GPS position fix (i.e., after the fix_quality channel is 1 or higher).
On	For the EGPS-200 Plus (1-EGPS-200-P-2) only, RTK lock is attained.
TRIG (blue) shows input from the TRIG connector	
Off	No connection to the trigger input connector, so trigger channel is pulled high (internally).
On	Connection to trigger input connector and the trigger channel input is pulled down to logic 0, when the two wires of the trigger cable pigtail (1-SAC-GPSTRIG-2) are connected to each other.

The EGPS-200 has been developed and optimized for vehicle testing applications in proving grounds quality environments where there is a consistently clear view of most of the sky from horizon to horizon. In such environments, high accuracy combined speed and integrated distance measurements are routinely attainable. Furthermore, short term interruptions of a clear view of the sky (such as passing under an overpass structure) are well tolerated with little or no sacrifice to this high accuracy. However, high accuracy (or even nominal accuracy) measurements are not attainable in environments such as urban areas with high rise buildings, rural areas with dense / tall trees lining the road, canyons in hilly / mountainous areas, etc. Users must be aware of this constraint and plan their vehicle testing programs accordingly.

To obtain maximum EGPS-200 data accuracy and integrity, it is essential that the GPS antennae and the EGPS-200 unit be properly mounted in the test vehicle. The EGPS-200 units require a 3.3V active antenna which must be mounted in a position giving a good view of the sky. The antennae (1-EGPS-200-ANT-2) supplied with the EGPS-200 unit are adequate for most EGPS-200 testing applications. However, for the most demanding applications, the user may want to consider procuring the highest quality antennae available. These are typically larger in size (and typically quite expensive).

EGPS-200 (1-EGPS-200-B-2) Base unit: The single antenna lead is connected to the ANT connector. Mounting the antenna on the top of the vehicle is recommended. The user should be careful not to crush the antenna lead – for example when a vehicle window or door is closed.

EGPS-200 (1-EGPS-200-P-2) Plus unit: Following is a diagram that illustrates the recommended antennae mounting on a test vehicle.

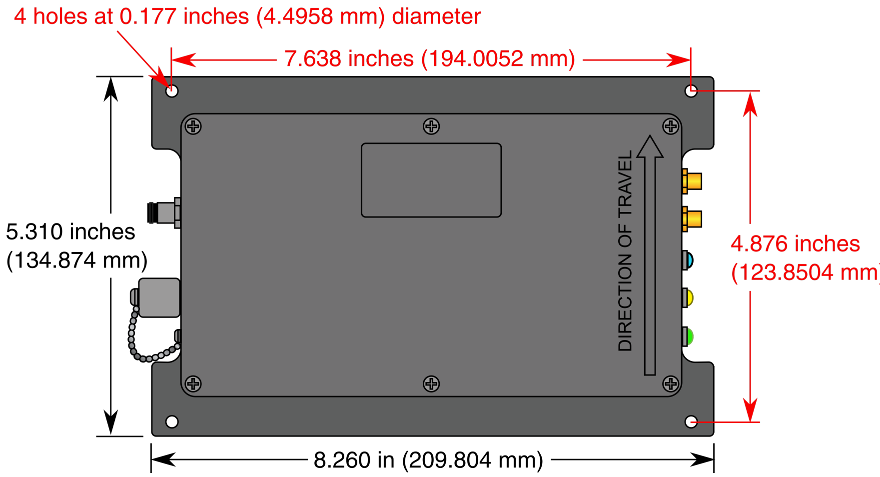


- It is strongly recommended that the two antennas be mounted on the roof of the vehicle. The (primary GPS measurements) antenna that is connected to ANT1 must be to the rear of the (RTK measurements) antenna that is connected to ANT2.
- The distance between the two antennae should be as close as possible to the RTK baseline distance of 800 millimeter. The magnetic mounting dual antenna template (1-EGPS-200-TEM-2) is provided to facilitate this. Small deviations on the order of a few millimeters can be tolerated with fairly insignificant loss of accuracy for the RTK channels.

- The antennae should be mounted parallel to the direction of travel center line. This will minimize the difference between the heading channel data and the rtk_ yaw channel data when there is no vehicle slip.
- The antennae should be mounted so that both are the same distance above the ground. This will minimize the difference between the gradient channel data and the rtk_pitch channel data when there is no vehicle squat (dive).
- Both antennas should be mounted directly to the metal roof of the vehicle. The metal under the antenna acts as a “ground plane” for the antenna. This is important for optimal satellite signal acquisition. Do not use adhesive tapes or any other material to hold the antennae in place - some adhesive tapes completely block acquisition of the GPS signals.
- To avoid any possible damage to the car paintwork, clean the metal to remove any dirt or grime before mounting the antenna. This also reduces the possibility that the antenna will move when the vehicle experiences high acceleration rates or encounters strong wind gusts.
- The antennas should be mounted so the antenna cables point in the same direction – for example mount the antennae such that both cables exit towards the rear of the test vehicle.
- Both antennas must be of the same make and model. This is critical for acquiring accurate differential GPS data for the RTK channels.

Requirements and recommendations for mounting EGPS-200 units are as follows:

- Due to the relatively small size of the EGPS-200 unit, mounting it in the test vehicle at the optimal orientation can be somewhat challenging. However, for acquisition of the combined speed, acceleration and gyroscope channels (1-EGPS-200-P-2 only), it is important to make a concerted effort to mount the unit per the following recommendations.
  - The unit should be mounted such that the “direction of travel” arrow on the EGPS-200 lid is parallel to the direction of travel center line, and points to the forward direction.
  - The unit should be mounted such that the XY plane of the unit is parallel to the ground plane. One way to check this is to verify that the X and Y axis accelerometers are centered at zero g’s when the vehicle is parked on flat ground.
  - Ideally, the unit should be mounted such that it sees the same IMU accelerations and angular displacements as the (typically roof mounted) antennae. While this may not be feasible in all situations, it is critical that the unit be rigidly secured to the vehicle chassis to minimize the differences between what the GPS antennae sense and what the IMU senses.
  - Before using the EGPS-200 for formal test data acquisition, the user is strongly advised to perform some check out tests to verify proper antennae and EGPS-200 unit installation.



Mounting diagram (Top view of 1-EGPS-200-P-2 shown)

1.6 Accessory devices

1.6.1 Setting up a wireless host device

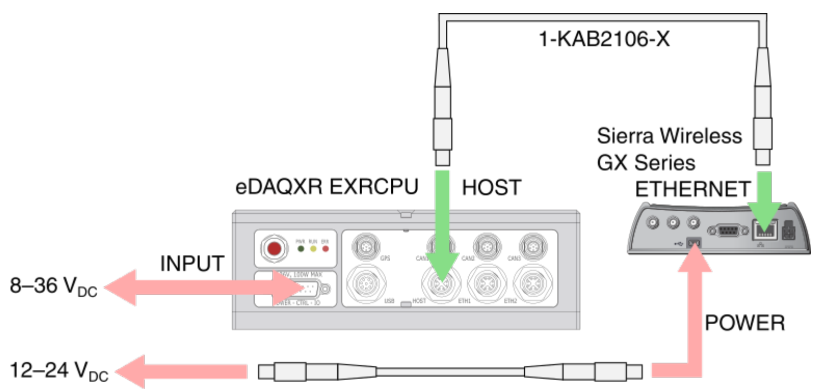
HBM offers a wireless solution for the eDAQXR and eDAQXR-lite system using the Sierra Wireless GX Series, MOXA AWK-4121 or ACKSYS WLg-xROAD devices.

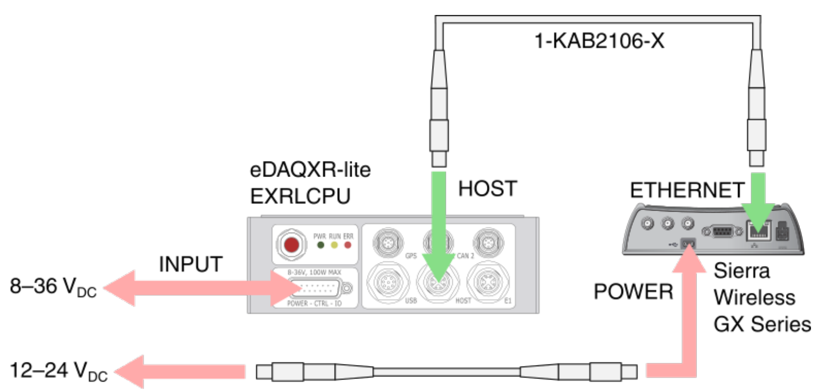
SIERRA WIRELESS GX Series gateway

The Sierra Wireless GX Series cellular gateway is capable of 4G LTE network connection. A wireless account and SIM card must be obtained from a wireless service provider. The gateway connects to the main processor through Ethernet ports, so the unit can be remotely controlled by a web-enabled computer through the cellular network.

Connecting the gateway to a main processor

Refer to Sierra Wireless documentation for setting up a SIM card from a 4G LTE service provider and gateway software.





1. Connect an antenna to the Sierra Wireless gateway.
2. Refer to Sierra Wireless documentation for connecting the gateway to a power source.
3. Connect the EXRCPU/EXRLCPU to a 8–36V_{DC} power supply.
4. Connect a 1-KAB2106-2 cable between the EXRCPU/EXRLCPU HOST port and the Ethernet port on the Sierra Wireless gateway.

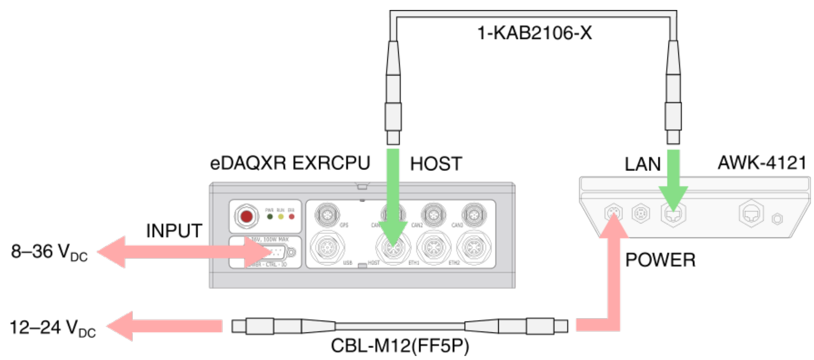
Configuring the gateway

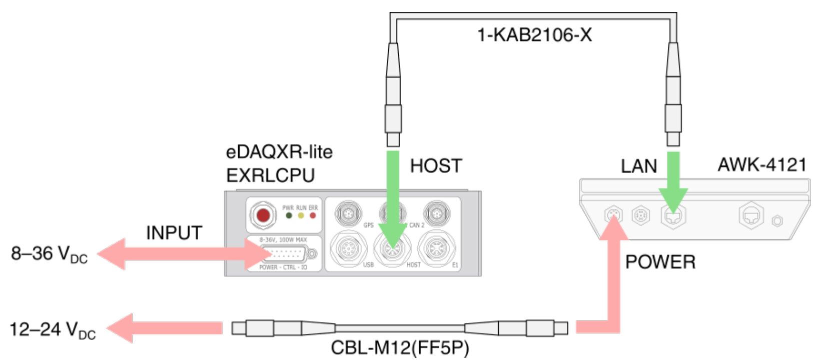
1. Set up your Sierra Wireless gateway as instructed by your service provider.
2. In a web browser, navigate to the IP address provided by a wireless service provider to open the eDAQXR/eDAQXR-lite web interface.
3. In some configurations you may need to change security settings in your browser to access the eDAQXR/eDAQXR-lite web interface. Please see the User Manual for more information.

MOXA AWK-4121 access point

The MOXA AWK-4121 is an industrial 802.11 ab/b/g IP68 Wireless AP/Bridge/Client. MOXA offers many antenna options to fit various applications, and comes standard with two omni-directional antennas (5/3 dBi, N-type male, 2.4/5 GHz).

Connecting the access point to an EXRCPU/EXRLCPU





1. Connect an antenna to the access point.
2. Connect the AWK-4121 POWER connector to a 12–24 V_{DC} power source. The unit ships with a field wire-able power plug. A one-meter power cable (CBL-M12 (FF5P)/Open-100 IP67) is sold separately by MOXA.
3. Connect the EXRCPU/EXRLCPU to a 8–36V_{DC} power supply.
4. Use a 1-KAB2106-X cable to connect the EXRCPU/EXRLCPU HOST port to the AWK4121 LAN port.

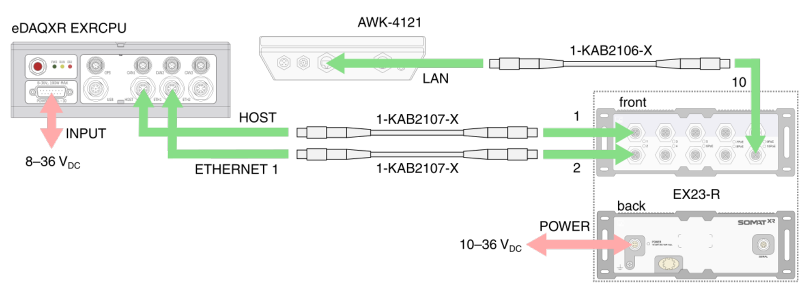
Configuring the access point

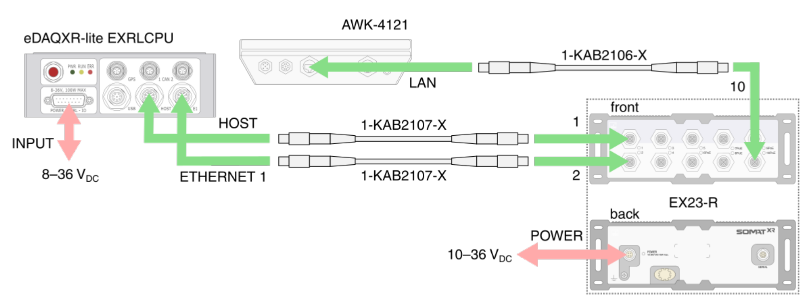
Assign an IP address to the access point compatible with your network by following the setup instructions in access point documentation. The EXRCPU/EXRLCPU default IP address is 192.168.100.101.

Configuring an EX23-R Switch for connecting the access point
To effectively use Power over Ethernet, bandwidth and security (to avoid broadcasting packets to other ports), set up the EX23-R to have two virtual local area networks (VLANs).

1. Connect a computer with an Ethernet card to a powered EX23-R using a 1-KAB2106-X cable.
2. Set the computer to a unique IP address in subnet 192.0.2.XXX, with the subnet mask 255.255.255.0.
3. Log in using the default username `admin` and no password.
4. In the menu, select Configuration>Private VLANs>PVLAN Membership.
5. Click Add New Private VLAN.
6. Set VLAN 1 to ports 1 and 10.
7. Set VLAN 2 to ports 2 through 9.
8. Click Save.
9. Exit the web interface.
10. Disconnect the computer from the EX23-R.
11. Connect the EX23-R to the access point and the EXRCPU/EXRLCPU as shown in Connecting the access point for Power over Ethernet.

Connecting the access point for Power over Ethernet (PoE)
This powers the access point by PoE (IEEE 802.3af) and allows use of virtual networks.





1. Use a 1-KAB2106-X cable to connect the AWK-4121 LAN port to EX23-R 10PoE port.
2. Connect the EX23-R module and EXRCPU/EXRLCPU to a power supply.

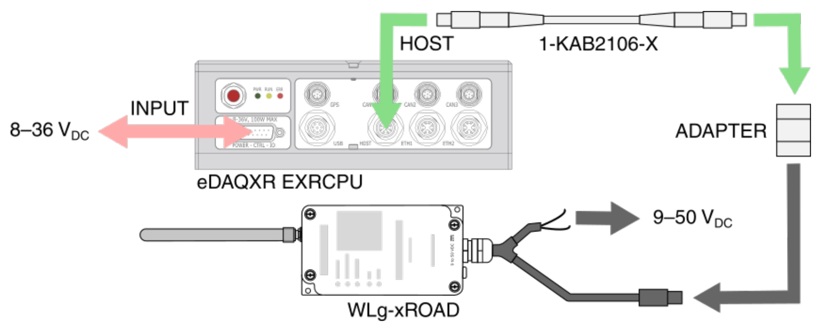
3. Install a cap (A-CAP-M12M-M, sold separately by MOXA) on the AWK-4121 POWER connector.
4. Use a 1-KAB2107-X cable to connect the EXRCPU/EXRLCPU HOST port to EX23-R 1 port.
5. Use a 1-KAB2107-X cable to connect the EXRCPU/EXRLCPU ETHERNET port to EX23-R 2 port.

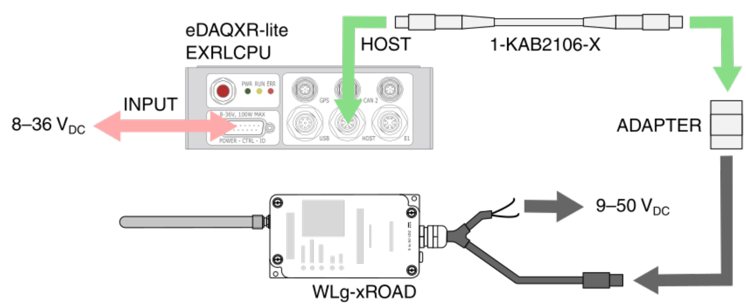
ACKSYS WLg-xROAD/N or WLg-xROAD/NP access point

The ACKSYS WLg-xROAD access point is an industrial 802.11 a/b/g/h IP65 Wireless AP/Bridge/Repeater. The WLg-xROAD/N and WLg-xROAD/NP access points come with an antenna and two meters of cabling connected to the access point and terminating in an RJ45 Ethernet connector. Only the WLg-xROAD/NP access point can operate with Power over Ethernet (PoE, IEEE 802.3af).

Connecting the access point to an EXRCPU/EXRLCPU

The ACKSYS WLg-xROAD/N and ACKSYS WLg-xROAD/NP access points can be connected directly to the EXRCPU/EXRLCPU, but the access points require connection to a 9–50 V_{DC} power source.





1. Connect an antenna to the access point.
2. Connect the wires of the WLg-xROAD power cord to a 9–50 V_{DC} power source. Refer to ACKSYS documentation for more information.
3. Connect the EXRCPU/EXRLCPU to a 8–36V_{DC} power supply.
4. Connect the access point RJ45 (Ethernet) connector to a 1-KAB2106-X cable using an RJ45 adapter (purchased separately) appropriately sealed for your application.

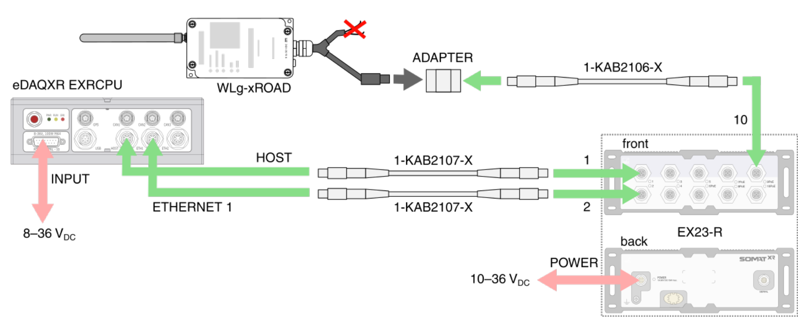
5. Connect the 1-KAB2106-X cable to the HOST port on an EXRCPU/EXRLCPU.

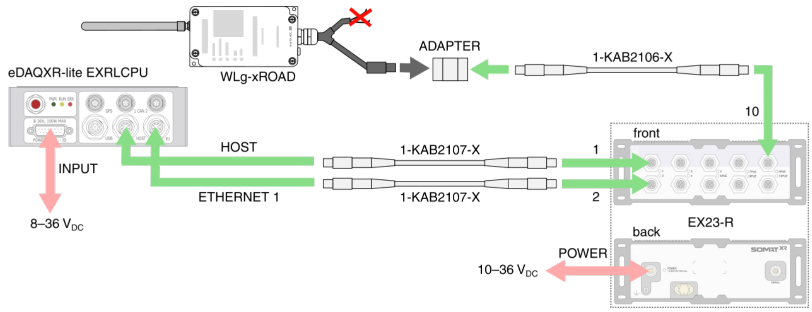
Configuring the access point
Assign an IP address to the access point compatible with your network by following the setup instructions in access point documentation. The EXRCPU/EXRLCPU default IP address is 192.168.100.101.

Configuring an EX23-R Switch for connecting the access point
To effectively use Power over Ethernet, bandwidth and security (to avoid broadcasting packets to other ports), set up the EX23-R to have two virtual local area networks (VLANs).

1. Connect a computer with an Ethernet card to a powered EX23-R using a 1-KAB2106-X cable.
2. Set the computer to a unique IP address in subnet 192.0.2.XXX, with the subnet mask 255.255.255.0.
3. Log in using the default username `admin` and no password.
4. In the menu, select Configuration>Private VLANs>PVLAN Membership.
5. Click Add New Private VLAN.
6. Set VLAN 1 to ports 1 and 10.
7. Set VLAN 2 to ports 2 through 9.
8. Click Save.
9. Exit the web interface.
10. Disconnect the computer from the EX23-R.
11. Connect the EX23-R to the access point and the EXRCPU/EXRLCPU as shown in Connecting the access point for Power over Ethernet.

Connecting the WLg-xROAD/NP access point for Power over Ethernet (PoE)
This powers the WLg-xROAD/NP access point by PoE and allows use of virtual networks. The ACKSYS WLg-xROAD/N cannot be powered by PoE.

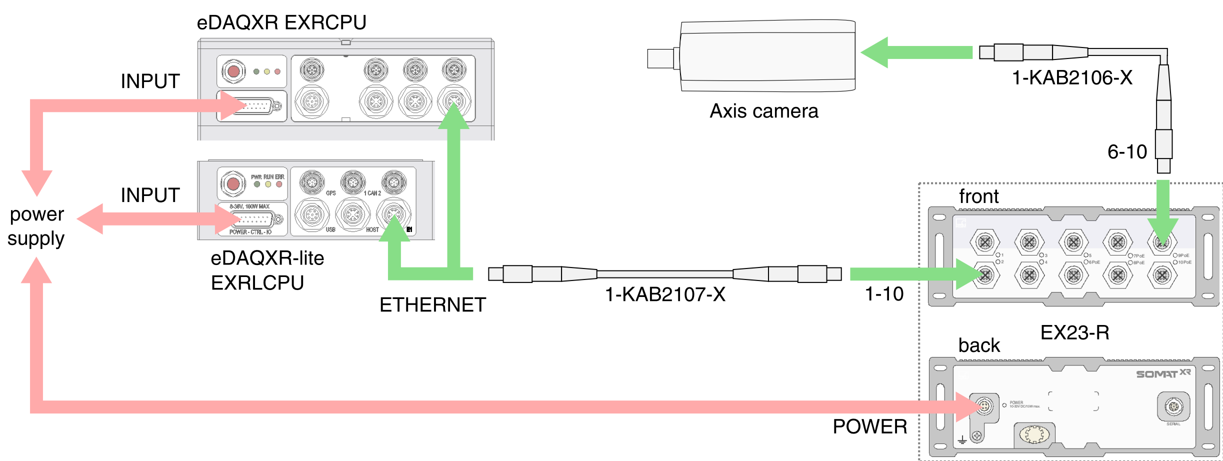




1. Connect the access point's RJ45 connector to an RJ45 adapter (purchased separately) appropriately sealed for your application.
2. Use a 1-KAB2106-X cable to connect the adapter to EX23-R 10PoE port.
3. Install caps on the WLg-xROAD power wires.
4. Connect the EX23-R module and EXRCPU/EXRLCPU to a power supply.
5. Use a 1-KAB2107-X cable to connect the EXRCPU/EXRLCPU HOST port to EX23-R 1 port.
6. Use a 1-KAB2107-X cable to connect the EXRCPU/EXRLCPU ETHERNET port to EX23-R 2 port.

1.6.2 Setting up an Axis network camera

The eDAQXR EXRCPU and eDAQXR-lite EXRLCPU offer camera input channels through the use of Axis network cameras with the EX23-R PoE Switch.



eDAQXR EXRCPU/eDAQXR-lite EXRLCPU

Use a 1-KAB2107 cable to connect the EXRCPU/EXRLCPU ETHERNET connector to an open port on the EX23-R Switch. Use a 1-KAB2106 cable to connect the Axis Ethernet port to one of the EX23-R PoE ports (6-10).

Web interface

Verify the camera is detected on the network by opening the EXRCPU or EXRLCPU web interface and navigating to the Hardware page of the Test Configuration section.

Expand the desired module to find the camera channel entry. Click the eye icon ( ) to open the preview window.

The Video channel preview shows the video stream from the selected camera channel.

Click **Freeze** to pause the video.

Click **Rotate** to rotate the video display counter-clockwise by degree increments supported by the video device. Please refer to video device manufacturer's documentation for video image rotation, which may be limited to 180 or 90 degree increments.

See Video display for viewing and controlling a video channel. In Test configuration, a camera channel's parameters may be edited in the Single channel editor.

Compatible camera devices
eDAQXR and eDAQXR-lite are compatible with the following Axis network cameras.

- Axis 211 Network Camera
- Axis M1103 Network Camera
- Axis M1124 Network Camera
- Axis M7001 Video Encoder
- Axis M7011 Video Encoder
- Axis P1311 Network Camera
- Axis P1357 Network Camera
- Axis P1344 HD Network Camera
- Axis P1346 HD Network Camera
- Axis Q1775 Network Camera
- Axis P1214-E HD Network Camera

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

Resetting the camera to factory defaults
For best results or if issues exist with detecting the camera, reset the camera to factory defaults.

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

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

2 System operation

2.1 Configuring EXRCPU and EXRLCPU network settings

The EXRCPU and EXRLCPU communicate through standard 100/1000 Base-T Ethernet using IPv4 or IPv6. Each main processor hosts its own secure web interface accessed through configurable network settings. The default IP address is 192.168.100.101.

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

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

To define a new network configuration, click **New**. Select **Static** or **Dynamic** as desired.

Select **Static** and enter the appropriate parameters:

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

Select **Dynamic - Obtain IP address configurations automatically (DHCP)** (Dynamic Host Configuration Protocol), to get information such as an IP address, subnet mask and default gateway. If on a network with a DHCP server, use the HBM Device Manager (on the included USB drive) or contact your IT administrator to find out the IP address. If presented with a certificate warning, choose to proceed.

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

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

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

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

2.2 Personal computer support applications

Support applications for the main processor may be run on a personal computer (PC). These applications may be downloaded from the HBM website (www.hbm.com/daq-support).

XR Download Manager

This software enables SIE file manipulation in a main processor from a connected PC. SIE files from a main processor can be downloaded, opened, extracted or deleted.

Installing XR Download Manager

1. Save the XR Download Manager executable (*.exe) file to the computer from the USB flash drive delivered with the main processor or from the www.hbm.com website.
2. Double-click the file icon to install XR Download Manager.
3. Respond to installation dialogs to put an icon shortcut on the computer desktop.
4. Run the program by double-clicking the XR Download Manager icon on the desktop.

XR Emulator

This software emulates the web interface, without connection to a main processor. A user can explore the web interface and control a virtual CX23-R, eDAQXR or eDAQXR-lite (depending on the version of the XR Emulator downloaded and installed), up to the point of running a test. The XR Emulator cannot run a test, but it can export a test setup (*.sxr file). A main processor can import the setup and run the test from a matching Emulator.

Installing the XR Emulator

1. Download the XR Emulator executable (*.exe) file to the computer from the USB flash drive delivered with the eDAQXR or from the www.hbm.com website.
2. Double-click the file icon to install the XR Emulator.
3. Respond to installation dialogs to put an icon shortcut on the computer desktop.
4. Run the program by double-clicking the XR Emulator icon on the desktop.

2.3 Managing users and privileges

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

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

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

Adding a new profile

Navigate to the Profiles page under System Configuration.

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

Creating a user and assigning a profile

Navigate to the Users page under System Configuration.

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

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

Default user and restoring default credentials

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

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

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

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

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

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

2.4 Configuring MX modules for use

The SomatXR MXB modules are front end data sourcing modules that can be used with the EXRCPU/EXRLCPU or the catmanAP and MX Assistant software 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. All MXB modules have a similar back panel with a power connector, two FireWire connectors and one Ethernet connector.

Updating MX firmware
The EXRCPU/EXRLCPU firmware always contains a copy of the latest required MX firmware version.

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

CAUTION
It may take several minutes for the MX module firmware update to complete. **Do not reboot the CPU when MX firmware updates are in progress.** Do not disconnect power to the MX module as this may render the MX module unusable.

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

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

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

The sample rate domain controls the sample rates and associated digital filter types and frequencies that are available when configuring input channels. If Binary sample rate domain is chosen, the list of test engine frame rates to choose from will be 102.4, 51.2, 25.6, 12.8, 5.12, 2.56, 1.28. The default setting is Decimal, which includes typical sample rates of 5000, 2500, 1000 and 500 S/s. In the Classic domain, typical nominal sample rates include 4800, 2400, 1200 and 600 S/s.

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

2.5 Updating main processor firmware

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

First, download the current firmware release from www.hbm.com/daq-support.

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

NOTE
Updating the unit firmware deletes all system log messages.

There are two methods to update firmware.

- Navigate to the Firmware page under System configuration. Click the **Browse** button and select the image file. Click **Update** to begin the firmware upgrade. The update can take several minutes.
- Navigate to the Hardware page under Test configuration. Click **Update firmware** in the **control menu** of the layer. Select the downloaded image file to begin the firmware upgrade.

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

NOTE
In a networked system of units, there is an option to update all units at the same time. This not only saves time, it ensures that all units are running the same firmware version. It is strongly recommended that this option be used.

2.6 Managing test input and output

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

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

See Setting up and running a basic test and Test control for more information about performing a test.

2.6.1 Configuring TEDS sensors

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

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

TEDS sensors are shown in both the Hardware and Input channels pages.

- **Hardware page**: Expand an MX module. The connectors with TEDS sensors connected are indicated by the TEDS sync icon ( ).
- **Input channels page**: Click **Add** and select an MX module from the hardware list. The connectors with TEDS sensors connected are indicated by the TEDS sync icon ( ).

NOTE
When a new MX module is connected or rebooted, the system runs through a TEDS discovery process indicated by the TEDS discovery icon ( ). This may take several seconds.

When a channel is added to a connector with a TEDS sensor connected, the channel parameters are configured based on the TEDS information. Channel parameters can be manually edited, which is indicated by the TEDS edited icon ( ). If a TEDS sensor is connected or disconnected that conflicts with an existing channel in the setup, the channel is shaded red.

To reset the channel parameters to the TEDS sensor definition, navigate to the Input channels page, select the channel and click **TEDS...**. In the TEDS options dialog window presented, select the **Sync TEDS** option and click OK.

In some situations, the user interface will identify TEDS conflicts that the user will want to resolve by not resetting channel parameters to the TEDS sensor definition. In this situation, select the **Resolve TEDS conflict** option and click OK.

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

2.6.2 TEDS conflicts

After a channel has been added to the test configuration, a TEDS conflict error can occur if a TEDS sensor is removed, or if a new or different TEDS sensor is connected. In these situations, the user interface provides two options to clear the error status.

Most often, the user will want to use the "Sync TEDS" option to use the TEDS parameterization or ignore the fact that a TEDS sensor has been removed. However, in some cases, this is not desired. Because of this, the option to "Resolve TEDS conflict" is available to ignore the TEDS parameterization and keep the current channel parameterization.

2.6.3 Configuring SMART modules

To simplify input channel configuration, the web interface supports SMART modules on an EHLS layer. Query smart modules using the module **control menu** in Test configuration > Hardware.

Strain and Thermocouple SMART modules are shown in both the Hardware and Input channels pages.

- **Hardware page**: Expand an eDAQ layer. The connectors with SMART modules are indicated by the type of module in the SM column, such as SMSTRB (strain) or SMITC (thermocouple).

- **Input channels page**: Click **Add** and select an EHLS layer from the hardware list. The connectors with SMART modules are indicated by the type of module in the SM column, such as SMSTRB or SMITC.

2.6.4 Vector CAN databases

To simplify CAN channel configuration, the eDAQXR, eDAQXR-Lite and CX23-R systems support Vector CAN databases. See Databases (Page 234) for importing instructions. Also see Editing database channel parameters (Page 156) for more information.

Adding CAN database channels

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

Editing database channel parameters

NOTE

The current offering is for advanced users who understand CAN sufficiently to generate a valid CAN database file. Channel parameters currently have limited validations.

NOTE

Edited CAN databases can be exported in a simplified Vector CAN DBC file format. This is provided primarily for portability from one eDAQXR, eDAQXR-lite or CX23-R device to another. The exported DBC file is not guaranteed to be usable by Vector applications (e.g., CANalyzer, CANape, etc.). The user interface does not validate all user edits that can result in the Vector applications rejecting the exported DBC file. For example, in Vector applications, a Signal or Message name is only valid using letters, numbers and underscores (_).

Database channel content may be edited using the spreadsheet grid cells, or by using the Single channel editor dialog window invoked by clicking on the Edit button in the task pane.

Single channel editor for CAN database channels

Right click on a channel and select **Edit** from the dropdown menu.

A dialog shows editable parameters.

- **Name:** Typically, this is the Channel name and also the Vector CAN DBC file Signal name. However, if the database was imported using the option to prepend the Message name to the Signal name using a delimiter, channels that are edited (or added) must conform to this name format. To be compatible with Vector applications, use only letters, numbers and underscores (_).
- **Message ID:** Enter a valid value in hexadecimal format limited to 29 bit significance.
- **Description:** There are no restrictions on user input for this.

- **Message name:** This must be consistent across all channels that have the same Message ID. To be compatible with Vector applications, use only letters, numbers and underscores (_).
- **Message ID:** Enter a valid value in hexadecimal format limited to 29 bit significance. The user interface provides limited validations on this value.
- **Mask:** Use FFFFFFFF by default. For advanced users, enter an appropriate value in hexadecimal format in the range of 0 to FFFFFFFF. See CAN channels **> Technical Note: CAN Message ID Masking** for more information.
- **Bit start, Bit length:** The user must provide valid values. Basic validations are performed (e.g., the sum of the Bit start and Bit length currently cannot exceed 64 for Intel data formats or 71 for Motorola data formats).
- **Offset, Scale:** The user must provide valid values. The Scale cannot be 0.0.
- **Min, Max:** The user must provide valid values. The only validation is that the Max exceed the Min. However, the user should consider the following. These values are used to set the Range Min/Max parameters when a CAN channel is added to an SXR test. It is recommended that they be set to the actual maximum and minimum values based on the Data format, Scale and Offset values for integer data formats. For example, if the Data format is an Unsigned 16, Max is computed as 32767.0 * Scale + Offset, and Min is computed as -32768.0 * Scale + Offset.
- **Units:** There are no restrictions on user input for this. To be compatible with Vector applications, use only letters, numbers and underscores (_).
- **Data format:** Select from the Data format pull down (SLSB, UMSB, ULSB, SMSB, FMSB or FLSB). For more information, see Table 2, CAN data type parameters in SIE file metadata.
- **Invalid value:** There are no restrictions on this value. However, it is currently advised that this be set to the Max or Min value for channels that use any of the integer Data format options, assuming the Max or Min value is defined using the recommendation provided above.
- **Request msg:** This field is optional and allows the user to specify a CAN message to transmit. When used, the field should consist of 8 hexadecimal digits specifying the CAN message ID, followed by 0, 2, 4, ... or 16 hexadecimal digits specifying the CAN message data bytes. The high-order bit of the CAN message ID specifies a 29-bit "extended" CAN frame. Valid message IDs range from "00000000" to "000007ff" (11-bit frames) and from "80000000" to "9fffffff" (29-bit frames).
  This field is often used to specify a message that should be used to poll an ECU (a connected CAN device) for a parameter value, but can be used for any purpose.
  If a "Request msg" is not set, and the user selects a "Request rate" other than "Off" for an Input Channel, the UI will automatically populate the "Request msg" field with an SAE® J1939.21 "Request" message formed from the channel's message ID (treated as a PGN).

Mode dependent channels/signals are supported for Basic signal multiplexing. Extended multiplexing is not supported (i.e., there can be only one Multiplexor channel/signal for any given Message ID). The user interface validates this limitation. The following parameters can viewed/edited in the Single channel editor only.

- **Mode dependent type:** Select the radio button to define the channel as a Multiplexor channel/signal or a Multiplexed channel/signal when applicable.

If the channel is a Multiplexor channel/signal, there are no other associated parameters. If the channel is a Multiplexed channel/signal, the following parameters are required.

- **Mode bit start, Mode bit length, Mode data format:** All three of these parameter values must be the same as the Bit start, Bit Length, Data format values defined for the Multiplexor channel/signal. The user interface validates this requirement. The reason these parameters are required is that the system does not require that the Multiplexor channel exist in the database or the SXR channel set; however, it must exist in the database channel set to be able to export the database to a Vector CAN DBC file.
- **Mode value:** Enter the Multiplexor value used to identify that the CAN message is providing data for this specific Multiplexor channel/signal. The user interface validates this value. It must be a non-negative integer in the range of the Multiplexor signal. For example, if the Multiplexor signal is Unsigned 8 bit, then it must be in the range of 0 to 255, and if the Multiplexor signal is Signed 8 bit, then it must be in the range of 0 to 127.

CCP channels/signals are supported to a limited (introductory) degree for the eDAQXR and eDAQXR-lite only. CAN databases with any CCP channels/signals cannot be exported.

- **Protocol:** This is a read only, temporary identifier used to denote that the channel is a sourced channel, such as CCP. The value shown has no meaning for users.

When editing is completed, click **OK**. The information entered in the dialog will show in the spreadsheet grid cells.

Data capture functionality is provided to allow users to view and analyze raw CAN message streams. This is useful when CAN messages available in the actual message stream are not yet defined in the CAN database.

Data capture requires configuration of the following 4 settings. After defining all of these settings, click the **Apply** button.

- **Bit rate:** Select among the ten available rates (1000000, 80000, 666667, 500000, 400000, 250000, 125000, 100000, 50000 or 41670). This is the bit rate of the CAN channel source.
- **Termination:** This is determined by the requirements of the CAN channel source (True or False). Select True or False, based on the source of the channel and the connection to the network. If neither True nor False allow data capture, the Bit rate setting may be incorrect or there are other issues.
- **Module:** If the XR unit is part of a networked system, select the desired XR unit.
- **Port:** Select CAN 1, CAN 2 or CAN 3 (only CAN 1 and CAN 2 on the eDAQXR-lite). The CAN channel is connected to this port.

To capture data, enter a value in the **Time** field up to 7200 seconds to capture all messages in that time period, or enter a value in the **Number** field up to 10000 to capture that number of messages. Click on the **Capture** button to start the capture.

NOTE
If values are entered for both fields, the capture will stop when either limit is satisfied. If no value is entered in the **Time** or **Number** field, 10000 messages may be captured. To stop capture before either limit is reached, click the **Close** button. After capture, the number of captured samples shows in parentheses after **Value** at the top of the column.

Captured data can viewed, searched, filtered and exported.

- Pull down menus allow the **Time** or **Value** column to be hidden (one must stay visible) and contents sorted (ascending or descending).
- To find data among captured samples, enter text in the **Search** field. Search field content is highlighted in the message **Time** and **Value** fields.
- To filter data, enter text in the **Filter** field. Only the message rows with matching text in the **Time** or **Value** fields is shown. Clear the **Filter** field to see all captured message rows. At the top of the **Value** column, the number of filtered message shows in parentheses with the number of captured messages, such as (173/3004).
- To export data, select message rows with the mouse or keyboard and click the **Export** button. Selected messages are saved as a tab delimited Text file to facilitate using Microsoft Excel (named `capture.txt` unless renamed by the user). The number of messages exported shows in parentheses at the top of the text document. Note that search results are not highlighted in the exported file.

2.6.5 eDAQ CAN databases

To simplify CAN channel configuration, the eDAQXR, eDAQXR-Lite and CX23-R systems support eDAQ CAN databases in a .txt format. See Databases (Page 234) for importing instructions.

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

2.6.6 HBM sensor databases

To simplify input channel configuration, the SomatXR/eDAQXR system supports HBM sensor databases for MX modules. See Databases (Page 234) for importing instructions.

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

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

Applying sensor database parameters

Navigate to the Input channels or Hardware pages of the Test configuration section.

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

Drag and drop the sensor definition from the Sensors panel onto the desired channel.

When a sensor definition is successfully applied to a channel, this is indicated by the SDB sync icon ( ). Channel parameters can be manually edited, which is indicated by the SDB edited icon ( ).

NOTE

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

2.6.7 Input channels

Input channel generic parameters

Many parameters are common across all channels and are displayed in the All channels tab:

- **Connection**: A unique hardware identifier created by the system.
- **TEDS**: For MX module channels with **TEDS sensors** connected, an icon is displayed with the TEDS status. Not in edit dialog. See Configuring TEDS sensors for more information.
- **SDB**: For MX module channels with HBM sensor databases applied, an icon is displayed with the SDB status. Not in edit dialog.
- **SM**: For Smart modules connected to a channel, a status is displayed. Not in edit dialog.
- **Reading**: Current value of the channel. Show the readings by selecting the desired channels and clicking **Live update**. Not in edit dialog.
- **Units**: For most channel types, the user can enter the physical units as desired; however, for some channel types (i.e., most temperature channels, and any bridge channel that uses the Strain gage scaling mode), the user can only select an option provided in the drop down list box.

- **Name**: The channel name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<' and '>'). Invalid channel names are 'true' and 'false' (case sensitive).
- **Description**: Enter an optional detailed description of the channel.
- **Sample rate**: Select the desired channel sample rate. If the sample rate changes, all dependent computed channels and DataModes™ are changed automatically.
- **Measurand**: Enter an optional measurement type.
- **Input mode**: Select the digital input mode from the options presented. In the channel edit dialog, a wiring diagram for the selected input mode is available for reference.
- **Data type**: The format of the channel data output (read only).
- **Collect**: Select the Collect checkbox to write the channel data to the SIE data file during a test run.
- **Filter type**: For applicable channels, select the type of filter for the channel to None, Linear phase (FIR), Butterworth (FIR), Butterworth (IIR) or Bessel (IIR).
- **Filter frequency**: Set the frequency of the selected filter. The options vary based on the filter type.
- **Decimals**: Select the default decimal places for channel displays. Use the “Auto” option to apply the settings defined in the User Preferences. See **User preferences > General > Decimal point handling** for more information.
- **Network node**: A CPU serial number shows for a module or camera channel's network node.
- **Custom column information**: For each column to be used, enter a unique name for the column header. Select either the “Text” or the “Numeric” sorting option.
- **Range min / Range max**: Enter the desired full scale range min and max values in physical (engineering) units. For all channels, they are used as the default min and max bounds for histogram DataModes. For EBRG and EHLS channels, they are used to set the programmable gain and D/A offset to maximize the resolution of the data.
- **Alarm min / Alarm max**: Enter the desired values for min and/or max alarms as a physical units value or as a % of Range min/max value.
- **Warning min / Warning max**: Enter the desired values for min and/or max warnings as a physical units value or as a % of Range min/max value.

Input channel scaling parameters

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

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

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

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

- **Scaling mode**: Set the channel scaling mode.
  - **Defined slope intercept**: Specify the *Slope* and *Intercept* of the scaling line.
  - **Defined zero span**: Specify the *Electrical zero* of the sensor scaling line. Enter both the *Electrical span* and the *Physical span*.
  - **Defined two point**: Specify the *Electrical 1*, *Physical 1*, *Electrical 2* and *Physical 2* points to define the scaling line.
  - **Experimental two point**: Use the Experimental two point scaling option to define the two point parameters based on experimental measurements.
  - **Internal shunt resistor**: Use internal shunt resistor scaling for applicable modules with a shunt resistor. Specify the *Shunt resistor* and *Shunt polarity* parameters before starting experimental scaling. (Note that *% Dev* is the percent deviation from the ideal shunt voltage swing for Internal shunt resistor scaling mode. This is set by the system and is read only.) See the topics Define known shunt (Page 167) and Equivalent strain calculator (Page 167) for more information about these shunt scaling tools for calculating *Physical span*.

NOTE
To calculate the equivalent Physical span from the known physical span associated with a known shunt resistance, open the single channel editor and click **Define Known Shunt** and enter the known values. To calculate the Physical span for equivalent strain, open the single channel editor and click **Equivalent Strain** and enter the known values.

  - **Defined sensitivity factor**: Specify the Sensitivity which is typically defined in the data sheet for bridge sensors (e.g., PSI per mV/V, Newton per mV/V, etc.). The Defined sensitivity factor is available for all channels that support Defined slope intercept scaling mode. Note that this scaling mode is equivalent to the Defined slope intercept mode, where the Slope is equal to the Sensitivity and the Intercept is equal to 0.

  - **Strain gage**: Specify the *Strain gage factor* and *Bridge factor*.

- **Sensitivity factor**: Specify the Sensitivity which is typically defined in the data sheet for bridge sensors (e.g., PSI per mV/V, Newton per mV/V, etc.). The sensitivity factor is available for all channels that support Defined slope intercept scaling mode.
- **Electrical units**: Electrical units of channel input. The defined sensor scaling is used to convert data from Electrical units to Physical units.
- **Calibration date**: When using the channel calibration dates and locks option, the UTC calibration date (yyyy-mm-ddThh:mm:ss) is shown when the channel is calibrated. See Calibration options for more information.
- **Units**: Physical units of measurement for the channel.
- **Electrical 1**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Physical 1**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Electrical 2**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Physical 2**: Specify for Defined two point scaling mode. Automatically set after Experimental two point scaling.
- **Electrical zero**: Specify for Defined zero span scaling mode.
- **Electrical span**: Specify for Defined zero span scaling mode.
- **Physical span**: Specify for Defined zero span scaling mode.
- **Slope**: Specify for Defined slope intercept scaling mode.
- **Intercept**: Specify for Defined slope intercept scaling mode.
- **Strain gage factor**: Specify for Strain gage scaling mode.
- **Bridge factor**: Specify for Strain gage scaling mode.
- **Shunt resistor**: Specify for Internal shunt resistor scaling mode.
- **Shunt polarity**: Specify for Internal shunt resistor scaling mode.
- **% Dev**: Percent deviation from the ideal shunt voltage swing for Internal shunt resistor scaling mode. This is set by the system and is read only.
- **Range min and max**: Specify the expected extreme values of the channel. These parameters are most significant for the EBRG and EHLS layer channels because they are used to set the signal conditioner gains and offset. For other channel types, they are less significant. However, for all channel types, they are used as defaults for the histogram bounds in applicable data modes, and they can also be used as default y-axis limits for strip chart displays.
- **Warning and Alarm min and max**: Specify the desired values for warning and alarm thresholds.
  - Enter a real number that defines the level in physical units, or a real number followed by the ‘%’ character that defines the level as a percent of Range max or min, or leave the cell blank to inhibit the warning or alarm.
  - The percent value must be in the range of 0% to 120%.

- The % of Range max is independent of Range min and vice-versa. For example, if Range max is set to 1000 and Range min is set to -500 and 90% is used for both alarm levels, the alarms trip when the data value becomes > 900 or <-450. If the user changes the Range min to -600, the Min alarm threshold changes to -540. However, the Max alarm threshold does not change (i.e., it is still 900).
- The values of the warnings and alarms, in terms of real numbers, must satisfy the following condition for all defined parameters:
  Min alarm threshold < Min warning threshold < Max warning threshold < Max alarm threshold.
- A min or max warning will show a yellow background for the numbers.
- A min or max alarm will show a red background for the numbers.

- **Max electrical**: This field is applicable to MXB modules only. It is used to set the signal conditioner gain and resultant measurement range.

Input channel zero parameters

- **Zero mode**: Select one of the following options.
  - **Not applicable:** Zeroing is not allowed.
  - **Interactive only:** Interactive zeroing is allowed.
  - **Normal Test Starts:** Zeroing is done automatically on every normal test start. Interactive zeroing is allowed.

NOTE

Normal test start is defined as a test started using the web browser user interface, or a test started using the remote control switch when the Remote control run mode is in use. For tests that use the Cyclic test run mode, only the test started in the user interface is applicable; test cycles started automatically after the previous test cycle are not applicable. Tests restarted on power cycles or error resets are not applicable.

- **Zero target**: Specify the physical value desired for the zero task. Typically, this is 0.0, but not always. For example, this parameter may be set to 1.0 (g) for an accelerometer that senses the force of gravity. In this example, the zero task would result in the channel data being offset so that the current reading is 1.0.
- **Zero offset**: Automatically set after zeroing a channel. The user can edit this, but that is not generally advised.

Calculate lead wire resistance

Experimental calculation of lead wire resistance is available for all bridge channel types on the legacy eDAQ layers (i.e., for EBRG/ELBRG bridge channels and EHLS/ELHLS SMSTRB bridge channels). This is also available on the eDAQXR EXRBRG bridge channels.

For the EXRBRG bridge modes that use the sense lines, lead wire resistance is generally not a factor since the sense lines automatically do the compensation. However, this is not the case when the Internal shunt resistor scaling mode is used. As such, lead wire resistance calculations are available only when the Internal shunt resistor scaling mode is used with the bridge modes that use the sense lines.

The system can accurately calculate the lead wire resistance if and only if the bridge resistances are all equal and accurately known, and the resistances of all of the relevant lead wires are equal. The lead wire that runs to the +Sig bridge node is not relevant to lead wire resistance compensation; however, all of the others (i.e., the lead wires that run to the +Ex, -Ex, and -Sig bridge connections) are relevant.

To use this method, the Bridge type and Bridge resistance fields must be defined correctly. Note that it is recommended that the Excitation be set as high as possible to produce the most accurate results; however, this is not a critical factor. Based on experiments using 350 Ohm bridges, the differences in the calculated resistances differ by less than 0.05 Ohms depending on the use of 5V or 10V excitation.

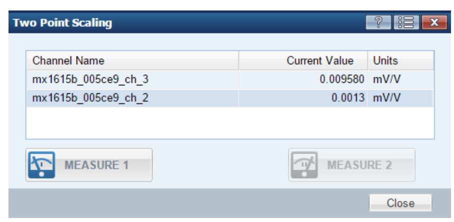
The user only needs to ensure that the transducer is stable (e.g., unloaded) then click **Lead Wire Resistance** in the Setup task pane or the Lead Wire Resistance button in the Edit channel dialog. The system will then run both Up scale and Down scale shunt experiments using the smallest shunt resistor available (i.e., the nominal 50K Ohm resistor for all legacy eDAQ layer channels) to optimize the calculation accuracy.

This is somewhat of a time consuming process. The user interface will report the calculated lead wire resistance values resulting from both the Up scale and Down scale shunt experiments. Normally, these two values should be very nearly equal (i.e., having a difference of ±0.1 Ohm or less). If this is not the case, then one of the requirements for using this tool has most likely been violated.

Experimental two point scaling

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

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



When this task starts, the GUI displays some temporary parameter settings in the grid interface. These can be ignored as the user defined settings are restored later. The Units, Physical 1 and Physical 2 values can be modified before or after the Electrical 1 and Electrical 2 values are measured.

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

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

Internal shunt resistor scaling

Use shunt scaling for applicable eDAQXR/eDAQXR-lite layers and MX modules.

Before starting the shunt scaling task, define all pertinent parameters for the bridge configuration, including the Shunt resistor and Shunt polarity.

Note that the *% Dev* parameter is a read only parameter that is automatically updated after the shunt scaling task is completed. The *% Dev* is the calculated percent deviation from the ideal shunt span based on the bridge type, bridge resistance, lead wire resistance and shunt resistance. In brief, it provides feedback to the user on the accuracy of the shunt scaling experiment.

NOTE
Shunt polarity is based on electrical units scaling (i.e., mV/V scaling). If the sensor scaling slope is negative, the shunt polarity in output units is in the opposite direction. For example, the Up Scale option would result in a negative swing in the output data.

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

When this task starts, the GUI displays some temporary parameter settings in the grid interface. These can be ignored as the user defined settings are restored later. The *Units* and *Physical span* values can be modified before or after the *Electrical zero* and *Electrical span* are measured.

NOTE
For the MX1615B-R module only, to optimize the scaling accuracy, the CX23-R/eDAQXR/eDAQXR-lite automatically uses the AC Excitation mode and the largest Excitation range available during sensor scaling. If necessary, the Excitation mode and range revert to the user-defined values after shunt scaling is completed or canceled. In this situation, the channel requires zeroing and the GUI prompts the user to do this.

Perform shunt scaling in three steps:

1. Click **Zero** to record the unshunted values, which are used to set the zero offset.
2. Click **Install** to install shunts.
3. Wait for the installed shunt readings to stabilize, then click **Measure** to record the shunted values. The recorded unshunted and shunted values are used to define the *Electrical zero* and *Electrical span* parameters. After scaling is complete, be sure to save the test setup.

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

Shunt scaling tools

Define known shunt and **Equivalent strain calculator** are shunt scaling tools available only when the internal shunt resistor scaling mode is selected.

Define known shunt

The define know shunt option calculates the equivalent *Physical span* from a known shunt.

Enter the known shunt resistance and equivalent physical value and click **OK**.

This shunt tool allows the user to define a calibration step consisting of the selection of any one of the FCS shunt resistors along with the corresponding equivalent engineering value based on another Known Shunt calibration (an example of a Known Shunt calibration is that a 33.2 KOhm shunt produces a 2200 lb output). The equivalent engineering values for the FCS shunt resistors are computed using the following formula:

$V_e = V_k * ((R_g + 2 * R_{sk}) / (R_g + 2 * R_{se}))$, where:

V_e = equivalent engineering units value

V_k = known engineering units value

R_g = nominal gage resistance

R_{sk} = known shunt resistance

R_{se} = equivalent shunt resistance

Equivalent strain calculator

This shunt tool is only applicable when the shunt scaling mode is selected. Calculation of the equivalent strain sets the *Physical span* value.

The equivalent strain value is calculated from the bridge resistance, shunt resistance, shunt polarity, strain gage factor and bridge factor. When any of these values are changed, the equivalent strain value and *Physical span* are no longer valid and must be recalculated.

Following is the formula for computing this in µm/m (microstrain) units if the shunt polarity is Up scale. If the shunt polarity is Down scale, multiply by -1.0.

$ES = 4.0e+06 * (R_b/(2 * R_b + 4 * R_s)) / (GF * BF)$, where:

R_b = Bridge resistance

R_s = Shunt resistance

GF = Strain gage factor (default is 2.0)

BF = Bridge factor (default is 1.0)

ES = Equivalent strain (µm/m)

Analog channels

Analog channels include Inputs and wiring diagrams, Inductive transducers, Piezoresistive transducers, Potentiometric transducers, Voltage sources, Current-fed piezoelectric transducers (IEPE, ICP®), Current sources and Resistance-based measurements.

NOTE
MX840B-R temperature channels using a 1-SCM-R-TCK-2 Thermocouple Adapter are included in analog channels.

See Input channels for more information about generic parameters.

- **Input mode**: Select the analog input mode from the possible available transducer types for the module. In the channel edit dialog, a wiring diagram for the selected input mode is available for reference.
- **Transducer power**: Specify the transducer power voltage.
  - For legacy eDAQ EHLS channels, transducer power must be an integer value in the range of 3–28 V or zero. For legacy eDAQ-lite ELHLS channels, transducer power must be an integer value in the range of 4–15 V or zero. If a SMSTRB or SMITC smart module is connected, the transducer power is controlled by the system to power the smart module.
  - For MX840B-R universal module and MX411B-R highly dynamic universal module channels, transducer power must be 5-24 V or zero (off).
  - For MX1601B-R standard module (universal amplifier) channels 1-8, transducer power must be 5-24 V or zero (off).
  - For MX1601B-R standard module (universal amplifier) channels 9-16, transducer power must be 15-30 V (independent of what the actual power supply voltage is) or zero (off).
- **Bridge Ohms**: Specify the bridge leg resistance in Ohms.
  - **For eDAQXR EBRG/ELBRG and SMSTRB channels**: If the type is Full or Half bridge, the value must be 80-10000 Ω. If the type is Quarter bridge, the value must be 120 or 350 Ω (depending on the specific EBRG/ELBRG layer or SMSTRB module).
  - **For MX1615B-R, MX840B-R, and MX411B-R module channels**: If the type is Full or Half bridge, the value must be 90-5000 Ω. If the type is Quarter bridge, the value must be 120 or 350 Ω (user selectable).
- **Leadwire Ohms**: For applicable strain gage bridge sensors, specify the bridge lead wire resistance in Ohms. For eDAQXR EXRBRG, EBRG/ELBRG and

SMSTRB channels only, the system can experimentally calculate the value. See Calculate lead wire resistance for more information.

NOTE
This parameter is generally not applicable to bridge sensors configured and wired to use excitation sense lines, because use of these sense lines automatically compensates for lead wire resistance effects. However, there is the following exception. This parameter is applicable to EXRBRG channels configured with a bridge mode that uses sense lines, and also configured to use the Internal shunt resistor scaling mode.

- **Install shunt resistor**: Select the desired shunt resistor to be installed when the **Shunt…** task in the Test control page is performed.
- **Excitation mode**: Set the regulated excitation mode to DC or AC.
  - For legacy eDAQ EBRG/ELBRG and SMSTRB channels, the excitation mode is always DC.
  - For MX840B-R universal module and MX411B-R highly dynamic universal module channels, the AC excitation mode is AC 4800 Hz sine.
  - For MX1615B-R bridge module (strain gage amplifier) channels, the AC excitation mode is AC 1200 Hz square.
  - For Potentiometric transducers and Inputs and wiring diagrams **> 3-wire quarter bridges (regulated)**, the excitation mode must be DC.
  - For Inductive transducers, the excitation mode must be AC.
  - For MX411B-R highly dynamic universal module channels, FIR filters are not compatible with the AC excitation mode.
- **Excitation range**: Set the regulated excitation voltage range. The available values depend on the module or layer. Please refer to the data sheets for more information.

NOTE
For the MX1615 module with the *Input mode* Bridge quarter 3 wire (no sense lines), the signal conditioner has an inherent large offset (typically, -2 mV/V for 350 Ω and -6 mV/V for 120 Ω). The data processor internally compensates for this offset which significantly reduces the negative limit of the measurement range.
- For 350 Ω with 5.0 V excitation, the range is reduced from -4 to -2 mV/V.
- For 350 Ω with 2.5 V excitation, the range is reduced from -8 to -6 mV/V.
- For 120 Ω with 2.5 V excitation, the range is reduced from -8 to -2 mV/V.
- For 120 Ω with 1.0 V excitation, the range is reduced from -20 to -18 mV/V.

The MX840B-R supports SSI encoders. The following three configuration parameters are applicable.

- **SSI coding**: For Digital timer inputs **> Absolute value encoder (SSI protocol)** inputs, set the SSI encoder protocol mode to Gray or Binary.
- **SSI clock**: For Digital timer inputs **> Absolute value encoder (SSI protocol)** inputs, set the SSI encoder clock frequency in kHz.

- **SSI bits**: For Digital timer inputs **> Absolute value encoder (SSI protocol)** inputs, specify the SSI bit resolution as an integer between 12 and 30.

The MX840B-R supports incremental encoders. The following three configuration parameters are applicable.

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

The MX411B-R supports a high sample rate mode option. The following configuration parameter is applicable.

- **Speed mode**: Select Normal or High. To be able to run a test, this channel parameter must match the speed mode as configured in the MX411B-R module. To change the configuration on the MX411B-R module, navigate to the Hardware page and open to tools for the module. Then select the desired speed mode. The module will temporarily disappear for a few seconds when the MX411B-R reboots.

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

CAN channels

CAN channels use Vector CAN databases or eDAQ CAN databases to decode specific signal values from incoming CAN messages on an eDAQXR, eDAQXR-lite, CX23-R, MX471B-R or MX840B-R CAN connector.

NOTE
On the eDAQXR or eDAQXR-lite, at least one channel from a CAN CCP or XCP database must be added to a test for raw CAN traffic to show.

The MX471B-R and MX840B-R support up to 128 CAN channels for each CAN connector. In reality, they cannot support that many channels if the CAN bus load is too high. As such, use caution when assigning CAN channels to these sources.

For the eDAQXR, eDAQXR-lite and CX23-R, there is no fixed limit on the number of CAN channels per CAN port. There is additional support for active queries (SAE® J1939-21 PGN requests) on for up to 75 messages per CAN connector. Furthermore, the default request messages can be edited by the user for special tasks such as J1939 address claiming.

See Input channels for more information about generic parameters.

Specific parameters

- **Input mode**: Value is CAN.
- **Edit CAN parameters**: Click to open a dialog. Dialog information may be changed only if the channel is not calibration locked. Click OK in the dialog to

apply changes. See Editing database source channel parameters for more information.

- **Save CAN parameters**: Click to open a dialog. Select the correct database to save changed CAN channel parameters. Changes that are not saved are lost when the Single channel editor is closed.
- **Expiration time**: Specify the time period in seconds that can elapse without data arriving on the CAN bus before data is considered stale and the output is set to the invalid value. The value may be any real number greater than zero.
- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.
- **Bit rate**: Set the bit rate from the drop-down list of valid values. If the CAN bit rate is changed, all channels on the same port are changed to the same bit rate value automatically.
- **Termination**: Set the state of the internal termination resistor as true or false. If the termination state is changed, all channels on the same port are changed to the same state automatically.
- **Request rate**: For unit channels, optionally set the rate for active query requests. When set (not *Off*), the unit transmits SAE® J1939-21 compliant PGN request messages at the specified rate. Since, request messages are only requests, they may or may not be honored by the connected CAN device. Request messages are only transmitted during a test run.
- **Request msg:** This field is optional and allows the user to specify a CAN message to transmit. When used, the field should consist of 8 hexadecimal digits specifying the CAN message ID, followed by 0, 2, 4, ... or 16 hexadecimal digits specifying the CAN message data bytes. The high-order bit of the CAN message ID specifies a 29-bit "extended" CAN frame. Valid message IDs range from "00000000" to "000007ff" (11-bit frames) and from "80000000" to "9fffffff" (29-bit frames).
  This field is often used to specify a message that should be used to poll an ECU (a connected CAN device) for a parameter value, but can be used for any purpose.
  If a "Request msg" is not set, and the user selects a "Request rate" other than "Off" for an Input Channel, the UI will automatically populate the "Request msg" field with an SAE® J1939.21 "Request" message formed from the channel's message ID (treated as a PGN).

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

CAN database sourced parameters can also be viewed and edited. See the topic Editing database source channel parameters for more information.

Technical Note: CAN Message ID Masking

For each signal, a CAN database file specifies which CAN message ID (or IDs) carry the signal, the bit position and length of the signal within the CAN message payload and the format of the signal data, including its endianness, scaling and offset. When a database has been imported into a unit, this information about each signal is displayed in the Databases page accessible in the System view.

In some cases, a signal may be carried in more than one CAN message ID. For example, SAE J1939 designates 8 of the CAN message ID bits as a "source address." SAE J1939 CAN messages transmitted by different source nodes in a CAN network may have different message IDs while still referring to the same SAE J1939 PGN and carrying the same signal. To accommodate such situations, a unit CAN database can specify both a CAN message ID value and an optional bit mask. To decide whether an incoming CAN message carries a particular signal, the bitwise-AND of its ID with the database bit mask is compared to the bitwise-AND of the database message ID value with the bit mask. If a mask is not specified, the message IDs must match exactly.

The eDAQ text database file format allows the user to explicitly specify both the message ID value and the bit mask. When imported into a unit, these values are shown in the Databases view as the "Value" and "Mask," respectively.

The Vector DBC database file format contains information about each message and signal which the unit uses to automatically determine an appropriate bit mask. SAE J1939 messages with a "null" source address value (0xFE) cause the unit to generate a mask which ignores the source address portion of the CAN message ID. SAE J1939 messages with a specific source address value and all non-J1939 messages, cause the unit to omit the mask, so that the specified message ID must be matched exactly. The message ID value and mask determined by the unit are shown in the Databases view as the "Message ID" and "Mask," respectively. The Mask value will be blank if masking is not being used (that is, if the CAN message IDs must match exactly).

Editing database source channel parameters

This topic is applicable to CAN channels sourced from Vector CAN DBC files and eDAQ TXT files.

NOTE
The current offering is for advanced users who understand CAN sufficiently to generate a valid CAN database file. Channel parameters currently have limited validations.

NOTE
CAN channels edited in the SXR test setup environment cannot be saved in any CAN database file. As such, it is advised that CAN channels be edited in the CAN database editor whenever this is feasible. However, for CAN databases imported from eDAQ TXT database files, the SXR setup environment is the only option available for editing existing channels.

Single channel editor > Edit CAN parameters dialog

Content may be edited only if the channel calibration is not locked.

In the parent Single channel editor dialog window, click **Edit CAN parameters** to open the child dialog window.

- **Message name:** Enter appropriate characters for a Message name.
- **Message ID:** Enter a valid value in hexadecimal format limited to 29 bit significance.
- **Mask:** Use FFFFFFFF by default. For advanced users, enter an appropriate value in hexadecimal format in the range of 0 to FFFFFFFF.
- **Bit start, Bit length:** The user must provide valid values. Basic validations are performed (e.g., the sum of the Bit start and Bit length currently cannot exceed 64 for Intel data formats or 71 for Motorola data formats).
- **Offset, Scale:** The user must provide valid values. The Scale cannot be 0.0.
- **Min, Max:** The user must provide valid values. The only validation is that the Max exceed the Min. However, the user should consider the following. These values are used to set the Range Min/Max parameters when a CAN channel is added to an SXR test. It is recommended that they be set to the actual maximum and minimum values based on the Data format, Scale and Offset values for integer data formats. For example, if the Data format is an Unsigned 16, Max is computed as 32767.0 * Scale + Offset, and Min is computed as -32768.0 * Scale + Offset.
- **Units:** There are no restrictions on user input for this.
- **Data format:** Select from the Data format pull down (SLSB, UMSB, ULSB, SMSB, FMSB or FLSB). For more information, see Table 2, CAN data type parameters in SIE file metadata.
- **Invalid value:** There are no restrictions on this value. However, it is currently advised that this be set to the Max or Min value for channels that use any of the integer Data format options, assuming the Max or Min value is defined using the recommendation provided above.
- **Request msg:** This field is optional and allows the user to specify a CAN message to transmit. When used, the field should consist of 8 hexadecimal digits specifying the CAN message ID, followed by 0, 2, 4, ... or 16 hexadecimal digits specifying the CAN message data bytes. The high-order bit of the CAN message ID specifies a 29-bit "extended" CAN frame. Valid message IDs range from "00000000" to "000007ff" (11-bit frames) and from "80000000" to "9fffffff" (29-bit frames).
  This field is often used to specify a message that should be used to poll an ECU (a connected CAN device) for a parameter value, but can be used for any purpose.
  If a "Request msg" is not set, and the user selects a "Request rate" other than "Off" for an Input Channel, the UI will automatically populate the "Request msg" field with an SAE® J1939.21 "Request" message formed from the channel's message ID (treated as a PGN).

Mode dependent channels/signals are supported for Basic signal multiplexing. Extended multiplexing is not supported (i.e., there can be only one Multiplexor channel/signal for any given Message ID). The user interface validates this limitation. The following parameters can viewed/edited in the Single channel editor only.

- **Mode dependent type:** Select the radio button to define the channel as a Multiplexor channel/signal or a Multiplexed channel/signal when applicable.

If the channel is a Multiplexor channel/signal, there are no other associated parameters. If the channel is a Multiplexed channel/signal, the following parameters are required.

- **Mode bit start, Mode bit length, Mode data format:** All three of these parameter values must be the same as the Bit start, Bit Length, Data format values defined for the Multiplexor channel signal. The user interface validates this requirement. The reason these parameters are required is that the system does not require that the Multiplexor channel exist in the database or the SXR channel set; however, it must exist in the database channel set to be able to export the database to a Vector CAN DBC file.
- **Mode value:** Enter the Multiplexor value used to identify that the CAN message is providing data for this specific Multiplexer channel/signal. The user interface validates this value. It must be a non-negative integer in the range of the Multiplexor signal. For example, if the Multiplexor signal is Unsigned 8 bit, then it must be in the range of 0 to 255, and if the Multiplexor signal is Signed 8 bit, then it must be in the range of 0 to 127.

CCP channels/signals are supported to a limited (introductory) degree for the eDAQXR and eDAQXR-lite only.

- **Protocol:** This is a read only, temporary identifier used to denote that the channel is a sourced channel, such as CCP. The value shown has no meaning for users.
- Click **OK** to return to the parent Single channel editor dialog window.
- Click **Save CAN parameters** to select a CAN database and save changes made in the Edit CAN parameters dialog.
  Make sure changes are saved to the correct database.
  After a database is selected, a dialog shows the save was successful.
  Closing the dialog does not save changes. Unsaved changes will be lost when the Single channel editor is closed.

GPS channels

GPS channels are sourced from the GPS connector on a data processor. EGPS-200, EGPS-200-Plus and Garmin GPS modules are supported.

The Garmin GPS (model GPS18X-5Hz) module requires the 5 Vdc power option and draws about 0.5 W. EGPS-200 and EGPS-200-Plus modules require the 12 Vdc power option and draw about 2.4 W. On boot up of the SomatXR/eDAQXR system, the power is always set to 5 Vdc.

With the power option set to 5 Vdc, the EGPS-200 and EGPS-200-Plus modules operate in a minimal mode that is sufficient to send a message to the SomatXR/eDAQXR data processor allowing it to identify the module. When the data processor receives this message, it switches to the 12 Vdc power mode.

CAUTION
The Garmin module can be instantly destroyed if it is connected to the GPS connector with the 12 Vdc power option selected! As such, always power off the SomatXR/eDAQXR system before connecting a Garmin GPS if an EGPS-200 or EGPS-200-Plus module was previously connected.

All GPS modules source standard NMEA sentences that provide GPS fix position, fix quality, fix date and time and other standard navigational parameters.

NOTE
Position accuracy varies with several factors including, but not limited to, GPS receiver configuration, location (geographic latitude, as it influences HDOP, and surrounding objects possibly blocking reception or causing multi-path reception), satellite constellation status and ionosphere conditions.

- The Garmin GPS module also sources dilution of precision parameters (i.e., positional, horizontal and vertical). All Garmin channels are sourced at 5 Hz.
- Both the EGPS-200 and EGPS-200-Plus modules source proprietary NMEA sentences that provide IMU information (i.e., tri-axial acceleration and vehicle yaw rate, roll rate and pitch rate). Both also provide a high accuracy 3D Speed computed channel. All of these channels are sourced at 200 Hz.
- The EGPS-200-Plus module additionally sources real time kinematic (RTK) parameters (i.e., yaw and pitch) using two antennae that must by properly and accurately mounted on the vehicle (see GPS modules for recommendations). These additional channels are sourced at 20 Hz.

All modules provide GPS PPS time sync pulses that allow the SomatXR/eDAQXR system to align the GPS channel data to be synchronized in phase with other SomatXR/eDAQXR channels (i.e., analog and digital input channels).

Note that this “PPS sync” can only be achieved when the GPS module is providing fix date and time information. This will not be immediately available when the GPS module is first connected to the SomatXR/eDAQXR system, or after the SomatXR/eDAQXR is power cycled, or if the vehicle loses GPS satellite reception for any other reason. The time required for the “PPS sync” to become active is in part module type dependent, but can vary from a few seconds to well over one minute. The system provides a “pps_sync_active” channel; this is a logical channel that is true (1) when the “PPS sync” is active and false (0) when it is not active.

The SomatXR/eDAQXR supports a GPS raw message channel that captures all of the NMEA sentences received from the GPS module. The timestamps for the messages are the times when the messages were received – not the “PPS sync” adjusted times.

See Input channels for more information about generic parameters.

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

- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

System channels

System channels are sourced from the data processor unit, such as CPU load, system temperature and memory use.

See Input channels for more information about generic parameters.

Specific parameters

- **Input mode**: This defaults to the EXRCPU/EXRLCPU layer, which is the source of the system channels.
- **Expiration time**: Specify the time period in seconds that can elapse without data before data is considered stale and the output is set to the invalid value. The value may be any real number greater than zero.
- **Invalid value**: Specify the value to be set when the expiration time has elapsed without any data. The value may be any real number.

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

Digital input channels

Digital inputs are sourced from an EDIO layer connected to the EXRCPU or an ELDIO layer connected to the EXRLCPU. See EDIO/ELDIO digital input/output layers for more information.

See Input channels for more information for generic parameters.

- **Threshold mode**: Only the Static mode is available.
- **Low threshold and High threshold (mV):** The threshold limits determine when an input channel switches from a logic value of 1 (Boolean True) to a logic value of 0 (Boolean False) and vice-versa. The High threshold is where the switch to logical 1 occurs, and the Low threshold is where the switch to logical 0 occurs. The difference between the High and Low thresholds is fixed by the hardware at (nominal) 1000 mV. For the High threshold, the maximum is 4800 mV and the minimum is 1 mV. Threshold values must be the same for all Digital input and Digital pulse counter channels on any given DIO Bank.
- **Transducer power**: Set the transducer power mode to Off, 5 V or 12 V. If the transducer power is changed, all digital input and output channels sourced from the same Bank are changed to the same mode automatically.

See Input channel scaling parameters for more information about scaling parameters.

Digital input channels (input state)

Digital inputs with programmable thresholds are sourced from EDIO layers connected to the EXRCPU or from ELDIO layers connected to the EXRLCPU.

Digital inputs applicable for detecting switch open/close states that have fixed thresholds are sourced from the EXRCPU layer Power/IO connector or from the EXRLCPU Power/IO connector. See EDIO/ELDIO digital input/output layers for more information.

See Input channels for more information about generic parameters.

EDIO specific parameters:

- **Threshold mode**: Only the Static mode is available.
- **Low threshold and High threshold (mV):** The threshold limits determine when an input channel switches from a logic value of 1 (Boolean True) to a logic value of 0 (Boolean False) and vice-versa. The High threshold is where the switch to logical 1 occurs, and the Low threshold is where the switch to logical 0 occurs. The difference between the High and Low thresholds is fixed by the hardware at (nominal) 1000 mV. For the High threshold, the maximum is 4800 mV and the minimum is 1 mV. Threshold values must be the same for all Digital input and Digital pulse counter channels on any given DIO Bank.
- **Transducer power**: Set the transducer power mode to Off, 5 V or 12 V. If the transducer power is changed, all digital input and output channels sourced from the same Bank are changed to the same mode automatically.

EXRCPU/EXRLCPU IO specific parameters: There are none. The Low and High thresholds are nominally 1/3 and 2/3 of the power supply voltage respectively.

See Input channel scaling parameters for more information about scaling parameters.

Digital input channels (pulse counters)

Digital input pulse counter channels with programmable thresholds are sourced from EDIO layers connected to the EXRCPU or from ELDIO layers connected to the EXRLCPU. See EDIO/ELDIO digital input/output layers for more information.

NOTE
The term pulse counter is used as a generic term to refer to channels that measure parameters that are derived from analog signals and are subsequently processed as “pulse events”.

See Input channels for more information about generic parameters.

EDIO/ELDIO specific parameters:

- **Threshold mode**: Only the Static mode is available.
- **Low threshold and High threshold (mV):** The threshold limits determine when an input channel switches from a logic value of 1 (Boolean True) to a logic value of 0 (Boolean False) and vice-versa. The High threshold is where the switch to logical 1 occurs, and the Low threshold is where the switch to logical 0 occurs. The difference between the High and Low thresholds is fixed by the hardware at (nominal) 1000 mV. For the High threshold, the maximum is 4800 mV and the minimum is 1 mV. Threshold values must be the same for all Digital input and Digital pulse counter channels on any given DIO Bank.

- **Transducer power**: Set the transducer power mode to Off, 5 V or 12 V. If the transducer power is changed, all digital input and output channels sourced from the same Bank are changed to the same mode automatically.
- **Input mode**: The following modes are available.
  - **Pulse frequency**: The pulse frequency in S/s (computed as the reciprocal of the “pulse period”).
  - **Pulse period**: The time period in seconds between falling edges.
  - **Pulse high period**: The time period in seconds that the signal is high (i.e., the time period between a rising edge and a falling edge).
  - **Pulse rate**: The number of pulses found in each sample period (based on falling edges).
  - **Encoder**: The encoder position using quadrature counting.
- **Pins**: The specific connector pin(s) that the input signal(s) is connected to. All input modes except the Encoder mode use only one input pin (e.g., any of pins 1-4 on each of the 9 EDIO connectors or 3 ELDIO connectors). The Encoder mode uses 2 pins (e.g., pins “1-2”, “3-4”, etc.).

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

Temperature channels

Temperature channels are sourced from the eDAQ legacy EITB and ENTB layers, eDAQ legacy EHLS SMITC modules and from MX1609KB-R Thermocouple Amplifier modules.

NOTE
MX840B-R thermocouple channels using a thermocouple adapter (e.g., 1-SCM-R-TCK-2) are included in Analog channels.

See Input channels for more information about generic parameters.

- **Sensor input mode**: Value is Thermocouple.
- **Thermocouple type**: Value depends on the hardware source and in some cases is configurable. For the EITB layer, the type is fixed by the hardware and cannot be changed. For the ENTB or ELNTB layer, the following thermocouple types are selectable on a channel by channel basis – T, J, E, K.

See Input channel scaling parameters for more information about scaling parameters.

See Input channel zero parameters for more information about zero parameters.

Message channels

Message channels are sourced from unit raw CAN messages or GPS raw NMEA sentences. Raw channels cannot be plotted or used as source channels for computed channels or DataModes™, but some message channels can be viewed or extracted using online or offline software.

CAN message channels

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

GPS message channels

- **Input mode**: Value is always GPS.

Camera channels

Camera channels are sourced from camera or video hardware connected through an EX23-R PoE Switch. See Setting up an Axis network camera for more information.

See Video display for viewing and controlling a video channel.

In Test configuration, a camera channel’s parameters may be edited in the Single channel editor.

See Input channels for more information about generic parameters.

- **Network node**: Select the network node that will process the video data stream. Since video streams typically consume significant CPU load, pay attention to network node load balancing.
- **Requested frame rate**: Set the number of video frames per second to capture and write to the SIE data file.

NOTE

The requested video frame rate will not always be the rate at which frames are actually acquired during a test run. Cameras support discrete sets of frame rates. SomatXR/eDAQXR supported cameras are limited to ones that provide a "best effort" response to the request rate. The meaning of "best effort" is camera type specific; however, the acquired rate will typically be less than or equal to the requested rate.

- **Image size**: Set the image resolution in pixels of each video frame captured.
- **Image compression**: Set the percentage of compression for each video frame captured.
- **Rotation**: Select a rotation angle as desired to show in the channel display from the device. Refer to the device manufacturer's documentation to verify support for rotation; some devices are limited to 0 and 180 degree rotation.

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

Viewing camera channels in Somat InField
To be able to view camera data in InField, it is necessary to create a channel with time information and add it to a Time history. Make sure that the Time History sample rate is higher than the camera frame rate.

To view the recorded data:

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

Consider the following when viewing camera data in InField:

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

2.6.8 Computed channels

Computed channel generic parameters

- **Name**: Enter a name for the channel. The name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<' and '>'). Invalid channel names are 'true' and 'false' (case sensitive).
- **Collect**: Select the Collect checkbox to write the channel data to the SIE data file during a test run.
- **Description**: Enter an optional detailed description of the computed channel.
- **Input channel with sample rate**: Set the desired input channel. In the edit dialog, the channel sample rate is displayed in S/s.
- **Measurand**: Enter the quantity being measured or the type of measurement associated with the computed channel.
- **Units**: Enter the physical units of measurement for the computed channel.
- **Data type**: The format of the channel data output (read only).

- **Custom column information**: For each column to be used, enter a unique name for the column header. Select either the “Text” or the “Numeric” sorting option.
- **Range min and Range max**: Enter the expected extreme values of the computed channel output.
- **Alarm min / Alarm max**: Enter the desired values for min and/or max alarms as a physical units value or as a % of Range min/max value.
- **Warning min / Warning max**: Enter the desired values for min and/or max warnings as a physical units value or as a % of Range min/max value.
- **Chart type**: Set the default chart type for the channel. Not in edit dialog.
- **Decimals**: Select the default decimal places for channel displays. Use the “Auto” option to apply the settings defined in the User Preferences. See User preferences **> General > Decimal point handling** for more information.

Anomaly detect

The Anomaly detect channel generates an output marking possible anomalies in transducer or computed channel data. The channel continuously tracks the selected parameters and outputs a status for each specified window. Use with a Bitmap trigger computed channel to generate triggers based on the anomaly detection.

NOTE
The Description is initialized on selection of the input channel.

- **Window samples**: Specify the number of input samples used to generate one output sample. This sets the size of the analysis window and also the associated output sample rate (i.e., the output sample rate is the input sample rate divided by this parameter). This can be any positive integer greater than one. The first output sample will have a time stamp of 0 in regard to elapsed run time. Because of this, the output data samples will appear to lead the input channel data samples when both are plotted against elapsed run time. A Time base shifter computed channel defined with a Lag of 1 sample can be used to change this if desired.
- **Flat line detect**
  - **On**: Select to enable flat line detection.
  - **Range gate**: Specify the gate for detecting a flat line anomaly. If the difference between the maximum and minimum data samples in the analysis window is less than the specified gate, the channel adds one (1) to the output.
- **Drift detect**
  - **On**: Select to enable drift detection.
  - **Mean gate**: Specify the gate for detecting a drift anomaly. Drift is measured against the reference mean value of the first analysis window of each test run. If the difference between current window mean and reference mean exceeds the specified gate, the channel adds two (2) to the output.
- **Limit detect**

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

- **Kurtosis detect**
  - **On**: Select to enable kurtosis detection.
  - **Maximum**: Specify the maximum kurtosis value. If the kurtosis coefficient for the data in the analysis window is greater than the specified maximum value, the channel adds eight (8) to the output. The following equation is used to calculate the kurtosis coefficient, K: $K = \frac{n\sum_{i=1}^{n}(x_i-\overline{x})^4}{\left(\sum_{i=1}^{n}(x_i-\overline{x})^2\right)^2}$ where, n is the number of data samples in the analysis window and $\overline{x}$ is the mean of the data samples in the analysis window.

Bitmap trigger

The Bitmap trigger computed channel produces a logical output based on the match of the input bitmap channel and the user-specified bitmap mask. Use with an Anomaly detect computed channel to generate a trigger when a defined anomaly is detected.

- **Bitmap check mode**: Set the trigger mode for the computed channel.
  - **Any bit in mask set**: If any bit in the specified bit mask is set, the output value is TRUE; otherwise it is FALSE.
  - **All bits in mask set**: If all bits in the specified bit mask are set, the output value is TRUE; otherwise it is FALSE.
- **Bit mask**: Enter the desired bit mask as an integer from 1-255.
- **Invert**: If selected, the output logic defined by the Bitmap check mode is inverted. Note that using inversion can identify anomaly-marked data segments and output a trigger stream to gate out these data segments in other computed channels or DataModes™.

Directional velocity

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

NOTE
Measurand and Units are inherited from the selected velocity input channel. Description and Range values are initialized on selection of the velocity input channel.

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

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

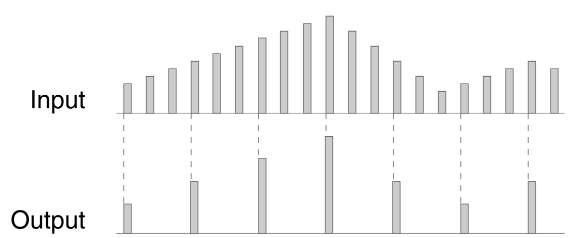
- **Direction channel is a sign channel**: Select this option if the direction input channel is a signed channel. In this case the direction channel values should be either -1 or +1. Deselect this option if the direction channel is a position channel and the signs must be determined from positional data values. In this case, if the current position channel sample is greater than the previous sample, the output is set to positive. If the current position channel sample is less than the previous sample, the output is set to negative. If they are equal, the sign remains at its current value.

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

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 for data storage. See Up sampler computed channel for information about simulating a higher sample rate.

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



Function generator

The Function generator computed channel generates an output channel that simulates the output of an analog function generator.

- **Waveform**: Set the shape of the output waveform to sine, triangle (ramp) or square.
- **Duty cycle**: For ramp and square type waveforms, specify the duty cycle in percent (1 to 99). Note that for a ramp waveform, a duty cycle of 99 results in a sawtooth wave, a duty cycle of 50 results in a triangle wave and a duty cycle of 1 results in a reverse sawtooth wave.

- **Period samples**: Specify the number of samples that comprise one waveform cycle. Note that the waveform frequency is the input channel sample rate divided by the period samples.
- **Cycles**: Specify the number of cycles to generate. After this number of cycles, the output remains constant at the last value of the last cycle.
- **Scale**: Specify the amplitude of the waveform.
- **Offset**: Specify the offset of the waveform.
- **Drift**: Specify the offset drift for each cycle. The drift value is distributed over the cycle period for a uniform offset drift.
- **Decay**: Specify the amplitude decay for each cycle. A decay value less than one results in decreasing amplitudes while a decay value greater than one results in increasing amplitudes. The decay value is distributed over the cycle period for a uniform decay.

Profile generator

This computed channel is provided for HBM internal use only at this time.

Integrator

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

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

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

- **Integration parameters**
  - **Initial value**: Enter the initial value for the integration.
  - **Scale factor**: Enter the scale factor for the integration.
- **Trigger reset options**
  - **Integrate only when true**: If selected, the integration is suppressed when the specified Channel is FALSE.
  - **Enable triggered reset**: If selected, the integration resets to the initial value when the specified Channel meets the Reset mode condition.
  - **Channel**: Set the trigger channel used for the Integrate only when true and Enable triggered reset options. This field may not be entered until at least one of those two options is selected.
  - **Reset mode**: If the Enable triggered reset option is selected, set the condition for the trigger channel to reset the integration.
    - **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.

- **Reset when sum exceeds**: When selected, the integration resets to the initial value when the absolute value of the integrator sum exceeds the entered value.

Interactive trigger

The Interactive trigger channel provides a means to trigger DataModes™ and other computed channels directly from the Test control page. The system supports up to eight Interactive triggers.

- **Trigger index**: Set the index from 1 to 8 to identify the trigger during a test run.
- **Invert trigger**: If selected, the trigger logic is inverted.

Over range detector

The Over range detector provides a simple user interface to allow users to determine if any selected channels in the test have exceeded a defined Alarm min / max value.

The output is a logical channel that is updated at the user selected test engine frame rate. The output is set to Boolean true (i.e., 1) when any input channel data sample exceeds a defined Alarm max or Alarm min value in the test engine frame period; otherwise, the output is set to Boolean false (i.e., 0). The output can be fed into a one or more Digital Output channels to drive an LED indicator.

This computed channel is provided for use with analog sensor channels primarily; however, any sequential input channel or computed channel can be selected as long the one or both of the Alarm min / max parameter values are defined.

When a channel trips an alarm, a message is generated in the system Log file that starts with "Over range" to simplify searching the Log file for the messages. Only one Alarm max exceedance and one Alarm min exceedance message will be generated for each channel over the duration of a test run. This allows the user to determine which channel(s) have tripped an alarm limit, while preventing the Log file from becoming saturated with redundant error messages.

Select the maximum number and minimum timing for notifications sent for this computed channel in **Test configuration > Setup**. See Test setup **> Over range detection notifications** for more information.

- **Input channels**: Select the desired set of input channels. The input channels can have different sample rates. There is no limit on the number of input channels.
- **Enable notifications**: Select the checkbox so notifications (through email or the HBM Push application) may be sent for the Over range detector Computed channel. See Notifications (Page 241) for configuring email and HBM Push notifications to be sent from the system.

Pulse frequency

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

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

- **Output rate factor**: Specify the down sample factor that determines the output channel sample rate. For example, for an input channel with a sample rate of 10000 S/s and an Output rate factor of 1000, the output channel sample rate is 10 S/s. The value must be an integer of 10 or greater.
- **Output scale factor**: Specify the scale factor to convert the output data from Hz to the desired physical units. The Output scale factor cannot be zero.
- **Minimum output frequency**: Specify the minimum frequency, *f*, of the output channel between 0.001 and 1.0 Hz. If a new pulse is not detected within the period of 1/*f*, the output value is set to *f*. The value remains at *f* until the detected pulse period is less than 1/*f*. For example, if the minimum output frequency is 0.1 Hz and the input channel is a 50 Hz pulse train that suddenly stops, the pulse counter output remains at 50 Hz until a new pulse frequency is detected or until 10 seconds (1/*f*) have elapsed; at that point, the output value is set to 0.1 Hz. This minimum output frequency is also the initial output value until the first pulse is detected.

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

Run stopper

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

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

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

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

Signal calculator

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

- **Channels**: All input channels to a single Signal calculator channel must have the same sample rate, which also determines the computed channel sample rate.
- **Operators and functions**: See **More functions information** below.
- **Constants**: Constants cannot start with a decimal point (e.g., the term ".55" is invalid, but the terms "0.55", "-0.55" and even "+0.55" are valid).
- **Expression**: Double-click or drag and drop a channel or operator to add it to the Expression panel. Alternatively, build the expression using keyboard entry. All operators and referenced input channels are case sensitive.

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

More functions information

Category	Operator	Syntax	Return
Logical	>	*a* > *b*	TRUE if *a* is greater than *b*; else FALSE
	>=	*a* >= *b*	TRUE if *a* is greater than or equal to *b*; else FALSE
	<	*a* < *b*	TRUE if *a* is less than *b*; else FALSE
	<=	*a* <= *b*	TRUE if *a* is less than or equal to *b*; else FALSE
	==	*a* == *b*	TRUE if *a* is equal to *b*; else FALSE
	!=	*a* != *b*	TRUE if *a* is not equal to *b*; else FALSE
	!	!*a*	TRUE if *a* is FALSE; else FALSE
	&&	*a* && *b*	TRUE if *a* and *b* are TRUE; else FALSE
	||	*a* || *b*	TRUE if either *a* or *b* are TRUE; else FALSE
Arithmetic	^	*a* ^ *b*	*a* raised to the power of *b*
	*	*a* * *b*	The product of *a* and *b*
	/	*a* / *b*	The quotient of *a* and *b*
	%	*a* % *b*	The modulus of *a* and *b*
	+	*a* + *b*	The sum of *a* and *b*
	-	*a* - *b*	The difference of *a* and *b*
	fabs	fabs(*a*)	The absolute value of *a*
	sqrt	sqrt(*a*)	The square root of *a*
	log	log(*a*)	The natural logarithm of *a*
	log10	log10(*a*)	The base-10 logarithm of *a*
	exp	exp(*a*)	The exponential function of *a*
	sgn	sgn(*a*)	-1 for *a* < 0, 1 for *a* > 0, 0 for *a* = 0
	float	float(*a*)	Logical channel *a* converted to floating point
	floor	floor (*a*)	The largest integer less than or equal to *a*
	ceil	ceil(*a*)	The smallest integer greater than or equal to *a*
Trigonometric (all angles in radians)	sin	sin(*a*)	The sine of *a*
	cos	cos(*a*)	The cosine of *a*
	tan	tan(*a*)	The tangent of *a*
	asin	asin(*a*)	The arcsine of *a* in the range [-PI/2, PI/2]
	acos	acos(*a*)	The arccosine of *a* in the range [0, PI]
	atan	atan (*a*)	The arctangent of *a* in the range [-PI/2, PI/2]
	sinh	sinh(*a*)	The hyperbolic sine of *a*
	cosh	cosh(*a*)	The hyperbolic cosine of *a*
	tanh	tanh(*a*)	The hyperbolic tangent of *a*
	Pi	pi()	Function used to return Pi {3.141592653589793}

Application Note: Piecewise Linear Relationships

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

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

1. 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

2. 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

3. 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.

Smoothing filter

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

NOTE

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

- **Filter length**: Specify the filter length as an odd number between 3 and 201 samples. The filter is a simple boxcar filter where each output sample is the linear average across the filter length. For example, for a filter length of five, the filter averages the current sample, the two samples before and the two samples after. Note that the channel backfills the initial output samples with the first fully filtered output value. For example, if the filter length is nine, the first four output samples are assigned the same value as the fifth output sample value.

State mapper

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

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

- **State mapper options**
  - **Use default output value**: When selected, 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)**: Enter a default value to output if the first input sample does not meet any mapping conditions. When Use default output value is selected, the channel outputs the default value throughout the test run if the input does not meet any mapping conditions.
  - **Latch period (secs)**: Enter the time in seconds that the input channel must consistently meet the mapping conditions before the output state switches. The latch period is similar to a duty cycle on the output state preventing the output state from switching for at least this period of time. This feature can eliminate state switching transients in the output channel data stream. If the latch period is zero, the output state switches on each sample.
- **State mapper values**
  - Enter Min, Max and Value numbers in the fields of the grid to define state mapper conditions. When the input is greater than or equal to the Min and less than the Max, the channel outputs the specified Value. Several methods may be used to enter numbers defining state mapper conditions.
  - The default method is using the **Grid**. Each row represents one condition with Min, Max and Value fields. The system supports up to 32 mapping conditions, which is the number of rows accessible using the elevator bar on the right side of the grid.
  - Click **Editor** to change to the text editor input method. In the text editor, each line represents one condition with the Min, Max and Value entries separated by at least one space.
  - Switching between these two input methods retains all entered conditions which are reformatted appropriately.
  - Alternatively, click **Import** to import previously created state mapper conditions from an ASCII file. Each line of the ASCII file represents one condition with the Min, Max and Value entries separated by a space or tab. Importing state mapper conditions deletes any manually entered values. The conditions are shown in the grid or text editor after import.
  - Click **Clear** to clear all state mapper values.

Example: Angular Position

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

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

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

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

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

Statistics

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

NOTE
Measurand and Units are inherited from the selected input channel. Description and Range values are initialized on selection of the input channel.

- **Statistic**: Select the desired statistical mode from the set of options provided. The statistical math equations are listed below.
- **Percentile**: For the *X*th percentile mode, specify the X value as an integer between 0 and 100. The output is the value at the *X*th percentile of the sample window. If necessary, an output value is interpolated between the input values that border the exact *X*th percentile. Note that an X value of 0 returns the minimum input value and an X value of 100 returns the maximum input value.
- **Window samples**: Specify the number of input samples used to generate one output sample. This sets the size of the analysis window and also the associated output sample rate (i.e., the output sample rate is the input sample rate divided by this parameter). This can be any positive integer greater than one. The first output sample will have a time stamp of 0 in regard to elapsed run time. Because of this, the output data samples will appear to lead the input channel data samples when both are plotted against elapsed run time. A Time base shifter computed channel defined with a Lag of 1 sample can be used to change this if desired.

Statistical math equations

Following are the equations used to compute the statistical values where n is the specified number of window samples.

Mean	$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$
Standard deviation	$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2}$
RMS (root mean square)	$x_{rms} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2}$
Kurtosis	$K = \frac{n\sum_{i=1}^{n}(x_i-\overline{x})^4}{\left(\sum_{i=1}^{n}(x_i-\overline{x})^2\right)^2}$
Skewness	$g_1 = \frac{\sum_{i=1}^{n}(x_i-\overline{x})^3}{\sqrt{\frac{1}{n}\left(\sum_{i=1}^{n}(x_i-\overline{x})^2\right)^3}}$

Time base shifter

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

- **Shift direction**: Set the output to either Lag or Lead the input channel.
- **Shift count**: Enter the desired shift amount, *n*, from 1 to 10,000 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 DataMode™. For each sample in the selected input channel, the channel outputs the corresponding elapsed time in seconds since the start of the test run. The first sample is at zero seconds.

Timed trigger

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

- **Trigger start mode**: Set the start condition for the trigger.
  - **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

- **Period (secs)**: Enter the number of seconds after the trigger start to set the output channel state.
- **Conditional mode**: Set the output channel state based on the behavior of the input channel during the delay period.
  - **Unconditional**: Set the output to TRUE regardless of the input channel.

Trigger sustain setup

- **Period (secs)**: Enter the number of seconds to sustain the output channel state. At the end of the sustain period, the output value is set to FALSE and the system waits for the next trigger start condition.
- **Conditional mode**: Set the output channel state based on the behavior of the input channel during the sustain period.
  - **Unconditional**: Set the output to TRUE for the duration of the sustain period regardless of the input channel.

Track

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

- **Mode**: Set the tracker mode to Min track, Max track or Range track.

Trigger reset options

- **Enable triggered reset**: If selected, the tracker resets when the specified *Channel* meets the *Reset mode* condition. For Min track and Max track modes, resetting the tracker sets the output to the current sample value. For the Range track mode, resetting the tracker sets the output to zero.
- **Channel**: Set the trigger channel used for the *Enable triggered reset* option.
- **Reset mode**: If the *Enable triggered reset* option is selected, set the condition for the trigger channel to reset the tracker.
  - **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.

Triggered latch

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

Trigger

- **Channel**: Set the trigger channel used to latch input channel data. By default, the channel latches the input data value when the trigger channel transitions from FALSE to TRUE and holds this data value until the trigger channel transitions from TRUE to FALSE. When the trigger channel is FALSE, the channel outputs the same value as the input channel.

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

- **Invert**: If selected, the output logic is inverted. The channel latches the input data value when the trigger channel transitions from TRUE to FALSE and holds this data value until the trigger channel transitions from FALSE to TRUE.

Triggered zero suppression

The Triggered zero suppression computed channel generates an output channel that zero suppresses the input channel when a trigger condition is satisfied.

NOTE
The Triggered zero suppression computed channel is designed primarily to provide a reset for quadrature decoder channel outputs when a triggering event occurs.

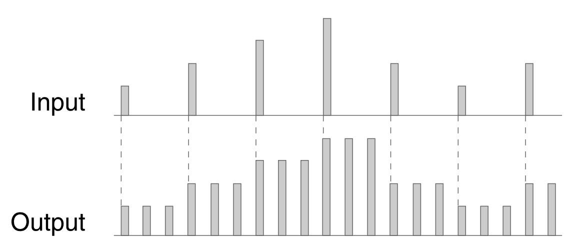
Suppression trigger and value

- **Channel**: Set the trigger channel used to suppress the input channel.
- **Mode**: Set the condition for suppressing the input channel.
  - **When true**: Suppress the input channel when the trigger channel is TRUE.
  - **On false - true edge**: Suppress the input channel when the trigger channel transitions from FALSE to TRUE.
  - **On true - false edge**: Suppress the input channel after the trigger channel transitions from TRUE to FALSE.
- **Value**: Enter the desired suppression value. The default value is zero.

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. See Down sampler computed channel for information about simulating a lower sample rate.

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



2.6.9 Output channels

Analog output channels (EHLS and EBRG)

The analog outputs for the EBRG and EHLS run continuously using dedicated hardware (i.e., in brief, a D/A converter that “follows” the A/D converter). There are no configuration parameters. The scaling parameters required to convert the analog output signal voltages to the channel specific physical units data are provided in the AOX file that can only be downloaded when an SIE test run is in progress.

See Test control **> Download the AOX file** for information on downloading the AOX file while an SIE test run is in progress.

Analog output channels (MX878B)

The MX878B Analog Output Module generates analog output signals in the range of +/-10 V. The source input channels are limited to FireWire connected MX modules. Configure analog outputs on the Output channels page.

NOTE
The support for the MX878B analog outputs is limited to an “analog follower” mode where the output simply follows the input channel. There are very limited options for using digital filters.

See Input channels for more information about generic parameters.

- **Source channel**: Select the desired source MXB input channel from the list of available channels. The Range Min/Max parameter values must be defined for the input channel. The MX878B channel output is scaled so that -10V is output at the Range Min setting and +10V is output at the Range Max setting.
- **Source signal**: The MX modules can generate two signals (that is, two data streams) for each channel. Signal 1 refers to the signal generated using the input channel parameterization. Signal 2 uses the same parameterization, with the following exceptions.
  - The sample rate is set to the highest value available for Signal 2 data streams (that is, 2500 S/s in Decimal sample rate domain and nominal 2400 S/s in Classic sample rate domain).
  - No digital filter is used.

Digital output channels

Digital outputs are sink channels available on EDIO layer and EXRCPU layer connectors or on ELDIO layer and EXRLCPU layer connectors. See EDIO/ELDIO digital input/output layers for more information. Configure digital outputs on the Output channels page.

EDIO/ELDIO layer specific configuration

- **Input channel**: Select the desired input channel from the list of available logical channels.
- **Output mode**: Select the desired output mode from the following options. The terms “Set sink” and “Clear sink” relate to closing and opening the switch that allows current to flow to ground or not. For example, an LED will illuminate

when the input channel is logic TRUE (i.e., channel value is 1) when a “Set sink” option is used. Use the “Clear sink” to invert this control logic.
Select one of the “latched” options to have the output stay in the same state after the input channel first transitions to logic TRUE. Select one of the “unlatched” options to have the output state change as the input channel changes from one logical value to the other logical value.

- Set sink unlatched
- Clear sink unlatched
- Set sink latched
- Clear sink latched

NOTE
For the following 2 parameters, the term “Low” is equivalent to “Set sink” and the term “High” is equivalent to “Clear sink”.

- **Initial state**: Select the desired output state to be set when the test is started (Low or High).
- **Final state**: Select the desired output state to be set after the test is stopped (Low, High, or No action which means the output will remain in the state it was in when the test run was stopped).
- **Transducer power**: This is applicable to the EDIO/ELDIO output channels only; the EXRCPU/EXRLCPU outputs do not provide power. Select the desired power setting (Nominal 5 V or 12 V). If the transducer power is changed, all digital input and output channels and all pulse counter channels on the same EDIO/ELDIO layer and same Bank are changed to the same power setting automatically.

2.6.10 DataModes™

DataMode™ generic parameters

- **Name**: Each DataMode must have a unique name and contain only valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<' and '>'). Invalid channel names are 'true' and 'false' (case sensitive).
- **Description**: Optional detailed description of the DataMode.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

Burst history

The Burst history DataMode™ is used to store data for transient events in an efficient manner. It can capture data before and after user-defined triggering events occur. It is particularly useful in minimizing data storage consumption when channels are defined with high data sampling rates. All channels must have the same sample rate.

- **Trigger mode**: Select one of the following triggering options.
  - **When true**: Storage of a burst record will be triggered whenever the trigger channel is TRUE.
  - **On false – true edge**: Storage of a burst record will be triggered when the trigger channel transitions from FALSE to TRUE.
- **Trigger channel**: Select the desired logical input channel for burst triggering. The trigger channel must have the same sample rate as the input channels.

Trigger time

- **Pre (secs)**: Specify the time period in seconds of data storage before the trigger.
- **Post (secs)**: Specify the time period in seconds of data storage after the trigger.
- **Storage mode**: Select the preferred storage mode.
  - **Standard mode**: This mode is provided for compatibility with the traditional SoMat DataMode implementations. In this mode, all burst records are the same size. However, no checks are made for triggers while a burst record is being stored. This can result in little or no post trigger data storage after significant events.
  - **Enhanced mode**: This mode checks for triggers all of the time. This mode ensures that data is stored for the full post trigger period irrespective of when the trigger occurs. In short, it fixes a potential significant shortcoming of the Standard mode and for this reason it is the default and recommended mode. This can result in burst records being different sizes, which is not a significant issue.
- **Number of bursts**: Select the Unlimited option to store all triggered burst event records. Optionally, specify a limit on the number of burst records to be stored. Note that when the Enhanced storage mode is used, burst storage is terminated after the total burst data samples stored exceeds the size of the specified number of burst records times the Standard burst record size.

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

- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list. All channels selected must have the same sample rate.

Burst message logger

The Burst message logger DataMode™ is used to store message data for transient events in an efficient manner. It can capture message data before and after user-defined triggering events occur. It is particularly useful in minimizing data storage consumption when video channels are used.

- **Trigger mode**: Select one of the following triggering options.
  - **When true**: A burst record will be stored whenever the trigger channel is TRUE.

- **On false – true edge**: A burst record will be stored when the trigger channel transitions from FALSE to TRUE.

- **Trigger channel**: Select the desired logical input channel for burst triggering.

Trigger time

- **Pre (secs)**: Specify the time period in seconds of data storage before the trigger.
- **Post (secs)**: Specify the time period in seconds of data storage after the trigger.

NOTE

Typically, some messages or video frames will be stored before the defined pre-trigger time and after the defined post-trigger time. The reason for this is a bit complex, but in brief, it's much more efficient to process the message data in blocks compared to processing one message (or one video frame) at a time. The storage overhead will typically be very minimal.

- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

Event slice

The Event slice DataMode™ stores a set of master channels and a set of slave channels in the output data file. The set of master channels provides a sequence of events, which are defined as state changes for any master channel. For each event, the system stores data samples for all master and slave channels in the output data file.

- **Store initial values**: Select to always store the initial channel values at the start of each test run.
- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering — when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

> **NOTE**
> The Event Slice DataMode provides a channel select tab for both Master channels and Slave channels.

Message logger

The Message logger DataMode™ stores one or more message or video channels in the output data file.

- **Trigger mode**: Select one of three available triggering options. Use triggering to eliminate undesired segments of the message stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
- **Trigger channel**: Select the logical input channel for triggering - when using a trigger option other than Always on.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list. All channels selected must have the same sample rate.

Peak valley

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

- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering - when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.

DataMode options

- **Hysteresis level**: Specify the desired hysteresis level for the peak valley processing algorithm. See Peak valley processing algorithm (Page 200) for an explanation of the effect of the user-defined hysteresis level. There are two modes for defining this:

  - **A floating point value**: The value must be greater than or equal to 0.0. This value is used as the hysteresis gate for all channels.
  - **A floating point value followed by the '%' character**: The value must be in the range of 0.0 to 100.0. For each channel the hysteresis gate is computed using the equation: (pv_hysteresis * (range_max – range_min) / 100.0).
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

Peak valley processing algorithm

After initializing, the peak valley processing algorithm alternates searching for peaks and valleys based on the user-defined hysteresis. There are three states of the algorithm - initialize, peak search and valley search.

- **Initialize**: The algorithm tracks the minimum and maximum input values until the difference between them exceeds the hysteresis level. If the minimum value precedes the maximum value, the minimum is the first stored valley and the algorithm switches to Peak search. If the maximum value precedes minimum value, the maximum is the first stored peak and the algorithm switches to Valley search.
- **Peak search**: The algorithm tracks the maximum value as a candidate peak and minimum value as a candidate valley. When the difference between the candidate values exceeds the hysteresis level, the candidate peak value is stored. The algorithm switches to Valley search.
- **Valley search**: The algorithm tracks the minimum value as a candidate valley and maximum value as a candidate peak. When the difference between the candidate values exceeds the hysteresis level, the candidate valley value is stored. The algorithm switches to Peak search.

Peak valley matrix

The Peak valley matrix DataMode™ stores multiple channels of peak valley reversal histograms in the output data file. The CX23-R/eDAQXR acquires peaks and valleys from triggered or un-triggered time history data streams using the user-defined hysteresis value and the peak valley processing algorithm. The resulting peak valley stream defines the set of peak valley reversals which are histogrammed using the user-defined options for the type and size of histogram.

NOTE

The cumulative size of all histogram matrices across all Rainflow, Peak Valley Matrix and Time at Level DataModes is limited to 650 MB. See SIE file size issues (Page 301) about storage area for histogram DataModes.

- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.

  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering - when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list. All channels selected must have the same sample rate.

DataModes options

- **Hysteresis level**: Specify the desired hysteresis level for the peak valley processing algorithm. See Peak valley processing algorithm (Page 200) for an explanation of the effect of the user-defined hysteresis level. There are two modes for defining this:
  - **A floating point value**: The value must be greater than or equal to 0.0. This value is used as the hysteresis gate for all channels.
  - **A floating point value followed by the ‘%’ character**: The value must be in the range of 0.0 to 100.0. For each channel the hysteresis gate is computed using the equation: (pv_hysteresis * (range_max – range_min) / 100.0).
- **Histogram mode**: Select one of the three available modes.
  - **Range-Mean** - Accumulate counts in bins with range and mean dimensions.
  - **Range only** - Accumulate counts in bins with only a range dimension.
  - **To-From** - Accumulate counts in bins with to and from dimensions.
- **Type**: The only option is Evenly divided. All bins are the same size, computed as (High bound - Low bound) / Number of bins.
- **Histogram bounds**: Enter the desired Low bound and High bound for each selected input channel. 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 for the histogram.
- **Number of bins**: Specify the desired number of bins in the histogram. For the Range-Mean and the To-From histogram modes, the value is 500 and applies to both dimensions. For the Range only mode, the value is 10000.

  The total number of bins per dimension is the user-specified number of bins plus two for underflow and overflow bins. For the range-mean and to-from histogram modes which have two dimensions, the total number of bins for the DataMode is the product of the total number of bins for each dimension.

Rainflow

The Rainflow DataMode™ stores multiple channels of rainflow cycle histograms in the output data file. The CX23-R/eDAQXR acquires peaks and valleys from triggered or un-triggered time history data streams using the user-specified hysteresis value and the peak valley processing algorithm. The resulting peak valley stream runs through the rainflow cycle counting algorithm to yield the set of closed cycles. The closed cycles are histogrammed using the user-defined options for the type and size of histogram.

NOTE
The cumulative size of all histogram matrices across all Rainflow, Peak Valley Matrix and Time at Level DataModes is limited to 650 MB. See SIE file size issues (Page 301) about storage area for histogram DataModes.

- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering - when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.

DataModes options

- **Hysteresis level**: Specify the desired hysteresis level for the peak valley processing algorithm. See Peak valley processing algorithm (Page 200) for an explanation of the effect of the user-defined hysteresis level. There are two modes for defining this:
  - **A floating point value**: The value must be greater than or equal to 0.0. This value is used as the hysteresis gate for all channels.
  - **A floating point value followed by the '%' character**: The value must be in the range of 0.0 to 100.0. For each channel the hysteresis gate is computed using the equation: (pv_hysteresis * (range_max – range_min) / 100.0).
- **Histogram mode**: Select one of the three available modes.
  - **Range-Mean** - Accumulate counts in bins with range and mean dimensions.
  - **Range only** - Accumulate counts in bins with only a range dimension.
  - **To-From** - Accumulate counts in bins with to and from dimensions.
- **Type**: The only option is Evenly divided. All bins are the same size, computed as (High bound - Low bound) / Number of bins.
- **Histogram bounds**: Enter the desired Low bound and High bound for each selected input channel. 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 for the histogram.

- **Number of bins**: Specify the desired number of bins in the histogram. For the Range-Mean and the To-From histogram modes, the value is 500 and applies to both dimensions. For the Range only mode, the value is 10000.

  The total number of bins per dimension is the user-specified number of bins plus two for underflow and overflow bins. For the range-mean and to-from histogram modes which have two dimensions, the total number of bins for the DataMode is the product of the total number of bins for each dimension.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list. All channels selected must have the same sample rate.

Rainflow cycle counting algorithm

Rainflow counted cycles are typically used in low cycle fatigue damage analyses. The rainflow counting algorithm is based on the "one-pass" algorithm described in the paper Simple Rainflow Counting Algorithms, International Journal of Fatigue, January 1982, by D. Socie and S. Downing. The algorithm described in this paper generates the set of closed cycles for the input peak valley sequence, assuming that the sequence repeats itself.

However, to support proper "rainflow histogram addition" (that is, generating a composite rainflow histogram from multiple rainflow histograms defined in a specific sequence), the system stores both the sequence of unclosed reversals and the histogrammed set of closed cycles in the Rainflow DataMode.

Time at level (One Dimensional)

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

NOTE

The cumulative size of all histogram matrices across all Rainflow, Peak Valley Matrix and Time at Level DataModes is limited to 650 MB. See SIE file size issues (Page 301) about storage area for histogram DataModes.

- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering - when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.

DataModes options

- **Type**: The only option is Evenly divided. All bins are the same size, computed as (High bound - Low bound) / Number of bins.
- **Number of bins**: The maximum number of bins is 10000. The total number of bins is this specified number plus two for underflow and overflow bins.
- **Histogram bounds**: Enter the desired Low bound and High bound for each selected input channel. 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 for the histogram.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

Time history

The Time history Data Mode™ stores multiple channels of triggered or un-triggered time history data streams in the output data file. All channels must have the same sample rate.

- **Trigger mode**: Select one of four available triggering options. Use triggering to eliminate undesired segments of the input data stream before it is processed by the DataMode.
  - **Always on**: Do not use triggering. Data storage is always on from the start of the test.
  - **Trigger**: Data storage starts when the trigger channel becomes TRUE and continues until the test run stops.
  - **Gate**: Data storage occurs when and only when the trigger channel is TRUE.
  - **One shot**: Store 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**: Select the logical input channel for triggering - when using a trigger option other than Always on. The trigger channel must have the same sample rate as the selected input channels.
- **Channel select**: From the channels list, select the desired input channels for the DataMode and click the appropriate arrow. Alternatively, drag and drop the desired channels to the appropriate list.

2.7 Setting up and running a basic test

See Test setup, Test control and SIE data for more information.

1. Open the web-based interface at the default IP address 192.168.100.101. In the header, click the **Setup** button to navigate to the Test configuration section.

2. In the Task pane, select Setup, then click the **New** button to define a new test setup. Edit the setup name and description as desired. The default name is "test_name."

3. In the Task pane, select Input channels, then click the **Add** button. Select the desired inputs and click **OK**. New channels show in the All input channels tab of the grid.

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

5. In the header, click the **Control** button to navigate to the Test and data control section. In the Task pane, Test control shows.

6. To view real time data, select a check box by a name in the Channels panel or drag a channel name into the Display Views panel. Select a chart in the **Select display type** dialog. The selected chart type shows for that channel in the Display Views panel. Click **Save**.

7. In the Task pane, click **Start** to run the test. The yellow LED flashes in the status bar of the web interface and on the unit. Real time data shows in the channel chart during the test run.

8. Click **Stop** to end the test run.

9. To download the SIE data file, click the file name in the Test run statistics panel.

3 Web browser interface

3.1 Recommended browsers

The recommended browsers for accessing the web interface are current versions of Google Chrome and Mozilla Firefox. Any browser supporting the feature sets listed below may also work, but are not officially recommended when using the web interface.

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

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

NOTE
Above or below 100% zoom, supported browsers will not always display the web interface optimally.

See Live data displays > **NOTE** for information about using HTTPS and possible effects of antivirus software.

3.2 Interface tour

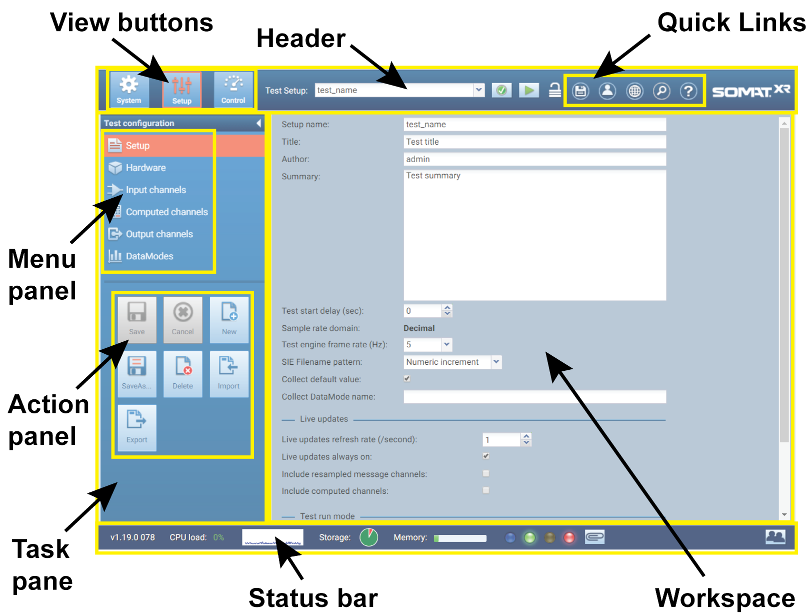
Navigate in the interface and dialogs using a mouse pointer or keyboard. Currently, not all screen regions support keyboard navigation. Mouse point or Tab between insertion points or options. Scroll among options using the mouse or up-arrow and down-arrow keys (not 10-key pad up-arrow or down-arrow keys). Click with the mouse pointer, Tab or Enter to select an option.

- Click **Help** button to display the help topic for the current page or the ? button to display the help for a dialog window or panel.
- When a Help window is minimized, access a Search bar and navigation links by clicking **Menu** in the header.
- Maximize a Help window to see the Search bar in the header.

As of v2.10, there was an initial offering of limited keyboard shortcuts. See your browser support for browser-specific keyboard shortcuts. As of v2.12 keyboard shortcuts were extended. See Keyboard shortcuts for an exhaustive list.

NOTE

Not all of the interface features may be visible depending on privileges set in Profiles> **Privileges** (Page 232). A logo for the unit type (SomatXR, eDAQXR or eDAQXR-lite) shows in the upper right corner of the interface window.



Header

The Header contains the View buttons, Test Setup titlebar and Quick Link buttons.

Click View buttons to show Task pane menu and action panels and associated workspaces.

More View button information

The View buttons navigate among options in the interface.

System configuration

- Manage profiles (user roles and responsibilities)
- Manage users
- Import and delete databases (configuration parameters for hardware control)
- Set up network connection
- Set up XCP over Ethernet networks
- Set up email servers and recipients, push services and notifications
- Configure FTP servers for automatic SIE uploads
- Configure system date and time
- Update data processor firmware
- Edit system preferences, impacting all system users
- Obtain support information and perform customer support tasks

Test configuration

- Manage test setups and hardware
- Create and edit input channels, computed channels, output channels and DataModes™
- Manage live update options
- Configure normal, cyclic or remote control of test runs
- Manage test stop options
- Manage channel sensor scaling based on signal measurements of input channels

Test and data control

- Control and monitor test runs
- Create, configure and display real time charts
- Delete, extract, rename or download test results as SIE data files

Use the Test Setup titlebar to select tests to edit or run.

More Test Setup information

On the Test configuration and the Test control pages, the titlebar contains the name of the current Test Setup.

On the Test configuration page, select the Test Setup to edit.

On the Test control page, select the Test Setup to run.

To the right of the selector are test indicators.

Diagnostic messages	One of four icons indicating the highest level message for the current test. Hover over the icon to display the number and types of messages. Click to display the Messages panel.	
		No messages
		Information
		Warning
		Alert/Notice
		Error
Live updates (Test configuration and Test control sections only)		Start live updates.
		Stop live updates.
Edit status		Test is unlocked and can be edited.
		Test is locked and cannot be edited.
		Test has been edited and not saved.

Use Quick Link buttons for Save, User preferences, Language, Search/filter of Workspace grid content and Help.

More Quick Link button information

	Save all	Save all pending changes. When changes are pending, the icon is **orange**. In Test control, right-click in the Workspace and select Revert Unsaved Changes to discard changes without saving.
	User menu	Open the user menu to Change password, set User preferences or Log off admin.
	Language	Change the interface language (English and Deutsch are the options. Help content is in English).
	Search	Open the **search bar** to filter lists or grid entries in the Workspace. When a search is active, the icon is **orange**.
	Help	Open the online help system.

Task pane

The Task pane changes according to the View selection and Menu item selection.

Selecting a Menu item (such as Profiles, Users, etc.) affects visible Workspace content, action buttons and information.

Selecting a button in the Action panel opens a dialog supporting the action.

The Task pane may be **minimized** to allow more space for the Workspace.

The state of the Task pane is remembered separately for each section and for future sessions.

When a button is gray, its function is disabled.

Workspace

The Workspace is the primary work area and shows dialogs according to the Menu item selection.

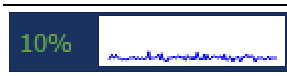
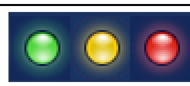
The Workspace may contain a grid interface. See Grid interface (Page 223) for information about showing and hiding columns.

When a grid is visible, click **Search** in the Quick Links to filter visible rows.

Status bar

The Status bar shows information about the data processing unit. See User preferences **> General** (Page 1) to show or hide CPU load, Storage, Memory or LEDs information in the status bar.

More Status bar information

	Firmware version	Currently installed firmware version.
	CPU load	The most current CPU load reading and a chart of the last 60 readings. Mouse over the chart to display data points.
	Storage	Used (red) and available (green) storage on the internal drive. Mouse over the pie chart to display the percentages.
	Memory	Amount of memory being used by the unit with respect to its total memory. Mouse over the bar to display the percentage being used.
	LEDs	This mirrors the activity of the status LEDs on the connected device.
	System logs	Click to display the **System logs**, System information and System status pages (Click the tabs to see the pages). The icon turns **red** when an error or alert exists and the red status LED is lit.
	Online users	Click to display a list of the users currently logged in to the system.

3.2.1 Messages

There are four types of diagnostic messages. Click on an individual message to display the specific channel or DataMode™ in the web interface.

	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.
	Alert/Notice. A database cannot be exported.
	Error. These are errors that prevent a test run from being started.

Diagnostic messages are recalculated upon completion of individual values. For spreadsheet entries, validation takes place only after focus moves away from the cell. While the cell is considered to be in edit mode, no validations take place.

If the validation finds any errors or messages, appropriate cell or rows are highlighted and a message is added to the diagnostic messages list. If existing errors have been addressed, the highlighting and diagnostic message are removed.

3.3 Keyboard shortcuts

As of v2.12, keyboard shortcuts have been extended.

Due to the nature of web applications running inside of a browser, certain GUI shortcut keys will override any equivalent browser supported shortcut key. In this case, the browser's operation of that shortcut will not work. If the browser's shortcut key functionality is required, the user can either switch to a new tab and perform the shortcut key or use another method such as via browser menus or the mouse context menu.

Shortcut keys are NOT case sensitive. So, Ctrl-e is the same as Ctrl-E.

All shortcut keys are only applicable while a user is logged in. While logged out and on the authentication dialog, only `Ctrl + L` and `Ctrl + H` are available. See specific shortcut keys for more information.

`Ctrl + Space bar`

This toggles the state of all plots in the Test control view when a test is running. This control key is only applicable within the test control view and only while a test is running. It toggles the freeze and unfreeze state of all charts defined in all tabs. It has no functionality outside this context. It is effectively the same as clicking the snowflake and thaw button in the displays area.

This shortcut has no functionality in any modal dialogs.

`Ctrl + 0 (zero)`

This collapses or expands the task pane in the current view. This is the equivalent as pressing the arrow icon in the top right corner of the task pane. Can be accessed from any view.

If the task pane is expanded, it will be collapsed. If the task pane is collapsed, it will be expanded. The latest state of the task pane will be persisted and honored whenever the GUI is refreshed.

This shortcut has no functionality in any modal dialogs.

`Ctrl + 1 (one)`

This collapses or expands the first expandable panel in the current view. This is the equivalent as pressing the arrow icon in the top right corner of the panel. This can be accessed from any view that has expandable panels. If the panel is expanded, it will be collapsed. If the panel is collapsed, it will be expanded. The latest state of the panel will be persisted and honored whenever the GUI is refreshed.

Current views that support this are:

- Setup > Hardware> Sensors
- Setup > Input channels > Sensors
- Control > Test control > Channels

This shortcut key may be extended to other views/panels in the future. Introducing new expandable panels in a view may use `Ctrl + 2` if another expandable panel already exists. This shortcut has no functionality in any modal dialogs.

`Ctrl + ↑ (up arrow key)`

From the Test control view, this resizes the current chart by reducing the height of the chart. Each press of the key will reduce the size by 1 pixel vertically from the bottom of the chart until the minimum size of that chart is reached. It is possible to keep this key pressed to continuously resize the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Ctrl + ↓ (down arrow key)`

From the Test control view, this resizes the current chart by increasing the height of the chart. Each press of the key will increase the size by 1 pixel vertically from the bottom of the chart. There is no maximum size a chart can be. It is possible to keep this key pressed to continuously resize the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Ctrl + ← (left arrow key)`

From the Test control view, this resizes the current chart by reducing the width of the chart. Each press of the key will reduce the size by 1 pixel horizontally from the right of the chart until the minimum size of that chart is reached. It is possible to keep this key pressed to continuously resize the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Ctrl + → (right arrow key)`

From the Test control view, this resizes the current chart by increasing the width of the chart. Each press of the key will increase the size by 1 pixel horizontally from the right side of the chart. There is no maximum size a chart can be. It is possible to keep this key pressed to continuously resize the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Ctrl + D`

This displays the system dashboard dialog. This is the equivalent as pressing the "paperclip" icon in the status bar. This can be accessed from any view. The dialog can be closed by using the `Esc` key.

This shortcut has no functionality in any modal dialogs.

`Ctrl + E`

This displays a single channel editor dialog. The dialog can be closed by using the `Esc` key.

This shortcut key is only applicable to the editing of database or setup channels. For setup channels, this includes any source, output, computed or DataMode channels. It is not applicable and has no effect in any other context.

When this shortcut key is pressed, and an applicable grid of channels is in view, the following determines which channel will be edited.

- If exactly 1 channel has been selected (via the select checkbox), then that channel’s editor will be rendered.
- If multiple channels or no channels have been selected, then the channel that has focus will be edited (a cell in that channel is selected)
- Any other time, this shortcut key has no effect.

This shortcut key can be performed even when grid cells are being updated. In this case, the editing will be automatically stopped, any and all rippling as well as validations will be executed, and the appropriate single channel editor will be called. Any changes manually made to the channel prior to this shortcut key being pressed will be accepted and honored in the editor.

All the rules of editing a channel still apply. For example, if an SIE test is running, a setup channel will render in the single channel editor in “read-only” mode.

`Ctrl + H`

Display the context sensitive help window. This is the equivalent of pressing the help (?) button in the header if not in any modal dialog. If this shortcut key is pressed while in a modal dialog, and that dialog exposes a help control button in the header, then it will display the context sensitive help for that dialog.

This shortcut key is also available from the authentication dialog.

`Ctrl + I`

This displays or hides the status bar's online users popup.

If this popup is not already displayed, it will display it. If it is already displayed, it will hide it. This shortcut key can be executed from any view.

This shortcut has no functionality in any modal dialogs.

`Ctrl + L`

This displays or hides the locale/language menu.

If this popup is not already displayed, it will display it. If it is already displayed, it will hide it. This shortcut key can be executed from any view.

This shortcut has no functionality in any modal dialogs.

This shortcut key is also available from the authentication dialog.

`Ctrl + M`

This displays the diagnostic messages dialog. This is the equivalent to pressing the "severity" icon (showing numbers of Errors, Notices, Warnings and Informational messages) in the header bar. This can be accessed from any view that exposes this icon (Setups and Databases). The dialog can be closed by using the `Esc` key.

This shortcut has no functionality in any modal dialogs.

`Ctrl + O`

This opens the list of available setups. This will expand the list box in the header bar containing all defined setups. This can be accessed from any view that exposes this list box (Setup and Control). The dialog can be closed by using the `Esc` key.

This shortcut has no functionality in any modal dialogs.

`Ctrl + P`

This displays or hides the User options menu. This shortcut key can be executed from any view. This shortcut has no functionality in any modal dialogs.

`Ctrl + Q`

This displays or hides the header bar’s Search dialog.

If this dialog is not already displayed, it will display it. If it is already displayed, it will hide it. This shortcut key can be executed from any view. It will only function if the search ability is applicable in the current view.

This shortcut has no functionality in any modal dialogs.

`Ctrl + S`

This performs a save within the current context.

Within any editable dialog, this shortcut key has the effect of accepting all values within the dialog. It is effectively the same as clicking on the “OK” button. Any and all validations that would ordinarily be execute will still be executed and any validations will still be performed.

Outside of any modal dialog, this shortcut key will perform a “Save all”. It is effectively the same as clicking the diskette button on the navigation header bar. Any and all pending changes that can be saved will be saved. All validations and error reporting will still be performed.

This shortcut key can be performed even when grid cells are being updated. In this case, the editing will be automatically stopped, any and all rippling as well as validations will be executed, and the save will then be performed.

`Ctrl + U`

This starts or stops live updates.

This shortcut key is equivalent to pressing the Start or Stop button in the header - if the button is enabled. If the button is not enabled, this shortcut key has no functionality.

If there is no live updates already running, this shortcut key will attempt to start one. If a live update is already running, this shortcut key will stop the live updates.

This shortcut has no functionality in any modal dialogs or from any views that does not expose the live updates button (such as the System view).

`Alt + ↑ (up arrow key)`

From the Test control view, this moves the currently selected chart up. Each press of the key will move the chart up by 1 pixel until the top of the displays area is reached. It is possible to keep this key pressed to continuously move the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Alt + ↓ (down arrow key)`

From the Test control view, this moves the current chart down. Each press of the key will move the chart down by 1 pixel. There is no restriction how far down a chart can be moved. It is possible to keep this key pressed to continuously move the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Alt + ← (left arrow key)`

From the Test control view, this moves the current chart to the left. Each press of the key will move the chart left by 1 pixel until the leftmost side is reached. It is possible to keep this key pressed to continuously move the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Alt + → (right arrow key)`

From the Test control view, this moves the current chart to the right. Each press of the key will move the chart right by 1 pixel. There is no restriction how far across a chart can be moved. It is possible to keep this key pressed to continuously resize the chart in a speedy manner.

This shortcut key will operate on both the individual arrow key, or the appropriate arrow key on the numeric keypad if the `NumLock` key is not on.

`Alt + Enter`

From the Test control view, this opens the properties menu for the current active chart. If no active chart exists, or the chart type does not support any properties, this shortcut key does nothing. The dialog can be closed by using the `Esc` key.

This shortcut key has the same effect as clicking the properties button in the chart header (menu button).

`Alt + Ins (Insert)`

From the Test control view, this inserts a chart for the channel that has focus. If no channel has focus, no chart will be created. To focus on a channel, use the `Alt + 1 (one)` or `Alt + 2` shortcut keys to position to the appropriate grid and use the arrow keys to navigate around to the required channel. Once there, use this shortcut key to request the type of chart.

This shortcut key has the same effect as dragging a channel into an empty area of the displays panel. The newly created chart will be placed according to how many charts already exist in the displays view.

This shortcut key will operate on both the individual `Ins` key, or the `Ins` key on the numeric keypad if the `NumLock` key is not on.

`Alt + Del (Delete)`

From the Test control view, this deletes the active chart from the displays view. If no active chart exists, this shortcut key does nothing.

This shortcut key has the same effect as clicking the close button in the chart header (red X button).

This shortcut key will operate on both the individual `Del` key, or the `Del` key on the numeric keypad if the `NumLock` key is not on.

`Alt + + (plus)`

From the Test control view, this creates a new tab in the displays view.

This has the same effect as clicking the ('+') tab with the mouse.

`Alt + - (dash/hyphen)`

From the Test control view, this displays a deletion confirmation dialog for the current active tab in the displays view.

This has the same effect as clicking the ('x') button in the tab with the mouse.

`Alt + 0 (zero)`

This focuses on the task pane for the current view. The menu options can only be navigated via keyboard keys when it has focus.

`Alt + 1 (one)`

This focuses on the first component that can have focus.

From the Test control view, this focuses on the Test run statistics grid.

From the SIE data view, this focuses on the SIE files grid.

There is no other support at this time. However, this may be extended to other views in the future.

`Alt + 2`

This focuses on the second component that can have focus.

From the Test control view, this focuses on the Channels grid.

`Alt + 3`

From the Test control view, this selects across the tabs, left to right, in the displays view. For every press of this shortcut key, the active tab will be switched to the next tab in sequence. When navigating past the last tab, it will wrap around to the first tab again. The new display tab ('+') will never be navigated to.

This has the same effect as clicking the next tab with the mouse.

`Alt + 4`

From the Test control view, this selects across the charts in the displays view. For every press of this shortcut key, the active chart will be switched to the next chart in sequence. When navigating past the last chart, it will wrap around to the first chart again.

This has the same effect as clicking the next chart with the mouse.

`Alt + A`

From the Test control view, this downloads the AOX file.

This shortcut key has the same effect as clicking the "Get AOX File" button in the task pane. If this button is not available (grayed out), this shortcut key has no effect.

`Alt + C`

From the Test control view, this enables or disables remote control of a test run.

This shortcut key has the same effect as clicking the "Enable/Disable Remote Control" button in the task pane. If this button is not available (grayed out), this shortcut key has no effect.

`Alt + D`

From the Test control view, this toggles focus on the "Description" panel in the task pane. An expanded panel will collapse. A collapsed panel will expand and the cursor will show in the description window for editing text.

This shortcut key has the same effect as clicking the "arrow" button in the panel header. This panel is always available to be expanded or collapsed. However, depending on system state or user privileges, the edit box may not be enabled. In this case, the edit box will not get focus when this shortcut key is used to expand it.

From the SIE data view, delete SIE data files.

This shortcut key has the same effect as clicking the Delete button in the task pane. Will delete all files that have been selected. If no files are selected, will deleted the file that has focus.

`Alt + E`

From the SIE data view, extract information from an SIE data file.

This shortcut key has the same effect as clicking the Extract button in the task pane. If exactly one SIE file has been selected, it will extract information from this one file. If multiple files, or no files have been selected, the file that has focus will be extracted from.

`Alt + F`

From the Test control view, this toggles focus on the "Save data file as" panel in the task pane. An expanded panel will collapse. A collapsed panel will expand and the cursor will show in the SIE data file name window for editing text.

This shortcut key has the same effect as clicking the "arrow" button in the panel header. This panel is always available to be expanded or collapsed. However, depending on system state or user privileges, the edit box may not be enabled. In this case, the edit box will not get focus when this shortcut key is used to expand it.

`Alt + H`

From the Test control view, this displays context sensitive help for the current active chart. If no active chart exists, or no help is available for this chart type, this shortcut key does nothing.

This shortcut key has the same effect as clicking the help (?) button in the chart header.

`Alt + I`

From the Test control view, this displays or hides the shunts dialog.

This shortcut key has the same effect as clicking the "Shunts..." button in the task pain (if enabled).

`Alt + J`

From the Test control view, this displays the context menu for the current active tab in the display view. The context menu can be closed by using the `Esc` key.

This has the same effect as right clicking the active tab with the mouse.

`Alt + K`

From the Test control view, this opens the context menu for the current display view. The context menu can be closed by using the `Esc` key.

This has the same effect as right clicking the display view with the mouse.

`Alt + N`

This goes to the next channel within any Editor (if one exists). The next channel is defined as the channel after the current channel in the grid order - relative to the current tab/view.

If any unsaved changed exist in the dialog, a warning will be displayed notifying the user that those changes will be lost if they proceed.

`Alt + P`

This goes to the previous channel within any Editor (if one exists). The previous channel is defined as the channel before the current channel in the grid order - relative to the current tab/view.

If any unsaved changed exist in the dialog, a warning will be displayed notifying the user that those changes will be lost if they proceed.

`Alt + R`

From the Test control view, this expands or collapses the "Test run statistics" panel in the task pane.

This shortcut key has the same effect as clicking the "arrow" button in the panel header. This panel is always available to be expanded or collapsed. There is no edit capabilities in this panel.

From the SIE data view, rename an SIE data file.

This shortcut key has the same effect as clicking the Rename button in the task pane. If exactly one SIE file has been selected, it will rename this one file. If multiple files, or no files have been selected, the file that has focus will be renamed.

`Alt + S`

From within any view (System or Setup), this saves the entity currently being viewed. In other words, it simulates clicking the "Save" button located in the task pane.

From within any editable dialog (Database or Setup), save the entity currently being viewed. This simulates clicking the "OK" button in the dialog, then simulates clicking the "Save" button in the task pane. However, the current dialog is not closed.

`Alt + T`

From the Test control view, this displays or hides the trigger dialog.

This shortcut key has the same effect as clicking the "Trigger..." button in the task pain (if enabled).

`Alt + U`

From the Test control view, this starts or stops SIE test runs. If an SIE test is not already running, it requests start of a test run. If an SIE test is already running, it requests stop of a test run.

This shortcut key has the same effect as clicking the Start (green right-pointing triangle) and Stop (red square) buttons in the task pane. If these buttons are not available (grayed out), this shortcut key has no effect.

`Alt + V`

From the Test control view, this creates a new multi-channel DVM chart for all the channels in the current saved setup.

This has the same effect as clicking the "Show All Channels in DVM (Max 100)" button with the mouse.

From the SIE data view, display the SIE file viewer tool (XR Data Viewer).

This shortcut key has the same effect as clicking the View button in the task pane. If exactly one SIE file has been selected, it will view this one file. If multiple files, or no files have been selected, the file that has focus will be viewed.

`Alt + W`

From the Test control view, download the SIE file from a currently running or a recently run test. A browser dialog opens to save the file.

This shortcut key has the same effect as clicking the "file name" link in the panel. If this file name is not a hyperlink, no action is performed by this shortcut key.

From the SIE data view, download SIE data files.

This shortcut key has the same effect as clicking the Download button in the task pane. Will download all selected files. If no files are selected, will download the file that has focus.

`Alt + X`

From within any view (System or Setup), this cancels all unsaved changes made to the entity currently being viewed. In other words, it simulates clicking the "Cancel" button located in the task pane.

`Shift + F1`

This navigates to the System view.

This shortcut has no functionality in any modal dialogs.

`Shift + F2`

This navigates to the Setup view. This shortcut has no functionality in any modal dialogs.

`Shift + F3`

This navigates to the Control view. This shortcut has no functionality in any modal dialogs.

`F1`

In the System view, this navigates to the Profiles option.

In the Setup view, this navigates to the Setup option.

In the Control view, this navigates to the Test control option.

This shortcut has no functionality in any modal dialogs, or if the user has no privileges to that task.

`F2`

In the System view, this navigates to the Users option.

In the Setup view, this navigates to the Hardware option.

In the Control view, this navigates to the SIE data option.

This shortcut has no functionality in any modal dialogs, or if the user has no privileges to that task.

`F3`

In the System view, this navigates to the Databases option.

In the Setup view, this navigates to the Input channels option.

This shortcut has no functionality in any modal dialogs, system view or if the user has no privileges to that task.

`F4`

In the System view, this navigates to the Networks option.

In the Setup view, this navigates to the Computed channels option.

This shortcut has no functionality in any modal dialogs, system view or if the user has no privileges to that task.

`F5`

In the System view, this navigates to the XCP over Ethernet option.

In the Setup view, this navigates to the Output channels option.

This shortcut has no functionality in any modal dialogs, system view or if the user has no privileges to that task.

`F6`

In the System view, this navigates to the Notifications option.

In the Setup view, this navigates to the DataModes option.

This shortcut has no functionality in any modal dialogs, system view or if the user has no privileges to that task.

`F7`

In the System view, this navigates to the FTP servers option.

This shortcut has no functionality in any modal dialogs, system view, setup view or if the user has no privileges to that task.

`F8`

In the System view, this navigates to the Date and time option.

This shortcut has no functionality in any modal dialogs, system view, setup view or if the user has no privileges to that task.

`F9`

In the System view, this navigates to the Firmware option.

This shortcut has no functionality in any modal dialogs, system view, setup view or if the user has no privileges to that task.

`F10`

In the System view, this navigates to the Preferences option.

This shortcut has no functionality in any modal dialogs, system view, setup view or if the user has no privileges to that task.

`F11`

In the System view, this navigates to the Customer support option.

This shortcut has no functionality in any modal dialogs, system view, setup view or if the user has no privileges to that task.

3.4 Grid interface

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

Columns can be sorted or hidden using a drop down menu in each column header.

Selected column options persist for the client, at least until the user preferences are reset.

Sort and filter rows
Grids can be sorted automatically by selecting **Sort Ascending** or **Sort Descending** from the drop down menu. Rows are sorted according to the selected column. A small up arrow (Sort Ascending) or down arrow (Sort Descending) in the column shows rows are sorted by that column.

A list may be sorted by a column's contents, including the Collect column in Test configuration. However, while sorting by the Collect column in the All input channels tab, Computed channels will be sorted separately, below other input channels.

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

Grids can be filtered using the **Search** tool. For example, a grid interface could be searched for the word "memory" and only rows with the word "memory" in a cell will show. Click the Search tool in the Quick link buttons. Enter information in the search bar.

In Test configuration, on a channels tab, a red number also shows on the tab, which is the number of channels resulting from the search.

While a search is active, the **Search** icon will change color.

Clear the search bar to end filtering.

Column show or hide
In the grid interface, columns can be shown or hidden to make navigation easier. Select a check box to show the column. Useful identification columns are **Connection**, **Description** and **Name**.

At least one column check box must be selected. If only one column check box is selected, the selection will be greyed out so the column cannot be hidden.

Freeze a column
In a column's drop down menu, select **Freeze Column** to lock the column. When a column is locked, the option changes to **Unfreeze Column**.

In the grid interface, independent columns can be locked so they are always in view when the user scrolls horizontally. Independent columns are those that do not belong to a group, hence the column header background is not colored.

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

The directional keys can be used to navigate to a cell, with the up arrow key moving up one cell, the down arrow key moving down one cell and so on. The Tab key will move the selection to the right and wrap around to the first cell once it reaches the end of the row. The Enter key will allow the user to edit a cell while the Escape (Esc) key will cancel editing.

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

Selection of rows using the Shift key

NOTE
The boxes in the Collect column in Test configuration cannot be selected in groups using the Shift key.

Select a row box using a left mouse button or a keyboard Enter key.

Hold down a Shift key and:

- Click the left mouse button on another box (select a number of rows by selecting a box several rows above or below the first box)
- Or press a keyboard up- or down-arrow key (not the up- or down-arrow key on a 10-key pad)

This applies the first box's selected state (checked or not checked) to other boxes. Release the Shift key to make other selections.

Resize columns
Most columns can be resized by dragging the column border and reordered by dragging the column header.

3.5 System dashboard

3.5.1 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. Tabs for System information and System status show pages with more information.

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

- **Time**: System date and time the entry was written into the log.
- **Component**: System-level module where the log event took place.
- **Level**: The severity of the event. Possible values are notice, warning or error.
- **Message**: The content of the log entry. Double-click the entry to view the full, non-truncated message ().

NOTE
Updating the unit firmware deletes all system log messages.

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

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

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

Purging the system log
Click **Purge** to delete all log entries from the system. To specify which entries to purge, use the date and time filters first. Purge the whole log to turn off the ERROR (red) LED.

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

3.5.2 System information

The information is for support purposes, but may be useful to authorized users.

Module: A unique identifier for the main processor, which also shows in the Hardware and Edit Channel dialogs.

Serial number: This is a unique identifier assigned at the factory, which aligns with the Module identification and MAC address.

IP address: The address for the main processor, useful for connection by a PC through a local network. See Networks about IP address setup.

MAC address: This is a unique identifier for the main processor, used as a network address for most IEEE 802 network technologies, including Ethernet and Wi-Fi.

Power switch state: This may be enabled or disabled. Control of this state is done in the Hardware page. See Hardware **> Controlling a module**.

Firmware version: This is the firmware version installed on the main processor. See Firmware about updating the firmware from www.hbm.com.

FPGA version: This information is shown for support purposes. This is updated, if necessary, with a firmware update.

PM version: This information is shown for support purposes. This is updated, if necessary, with a firmware update.

Clock regulation: This may be regulated internally, use the local time of the connected PC or be set manually. See Date and time about setting clock regulation.

LEDS
See Status LEDs about information shown by the LED states.

Health
A system channel for each Health option may be created for a test. See Interface tour and User preferences for information about seeing status information in the status bar at the bottom of the web interface window.

CPU Usage: This shows the processing load on the main processor's CPU.

Temperature: This shows the temperature of the unit.

Storage: This shows total available storage and storage that is free.

Memory: This shows the amount of memory being used by the unit with respect to its total memory.

Voltages
System power information is shown here. A system channel for each option may be created for a test.

Get calibration certificate
Use this button to download the main processor's calibration certificate (an Acrobat pdf) to a connected PC.

Release notes
Use this button to download current release notes (an Acrobat pdf) to a connected PC. These notes are updated in each firmware version.

3.5.3 System status

The state of system communications can be seen on this page.

Ping server

This does a simple "ping" to the server connected. If no response is received within a reasonable period of time (2 seconds), "Fail" shows. If a response is received, "Success" shows.

Comet stream

This will monitor events coming from the comet stream. In particular, it looks at the "live_data" events. If it gets the expected number of events over a five second period, "Success" shows. If it gets none, "Fail" shows. If it receives less than the expected number, "Slow" shows.

API test

A simple API will be consumed to see if the api_server is responding. This api simply gets the system firmware version. If no response is ever received in relation to this api call, "Fail" shows. If a response is received, "Success" shows.

Browser compatibility

The GUI will run the same browser tests that it does at startup. It will check for certain versions of IE and the protocol used. Here are some of the messages that may show:

- This version of IE is not supported
- WEBGL is not supported by this browser
- Protocol is not secure (https)
- Not supported
- Supported, but zoom level is not 100%

If any of these states is detected, an "i" icon shows. When the icon is clicked, the Recommended browsers help topic shows.

If none of these states is detected, "Supported" shows. No help icon shows in this case.

Push server

This shows the results of an attempt to communicate with the push server. If successful, "Success" shows. If not, "Fail" shows. This does not require any push notifications to have been created/configured. See Notifications for configuring a push notification.

Refresh
Click the Refresh button to refresh communication tests.

3.6 Changing user password

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

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

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

Use the new password to sign in to future sessions.

3.7 User preferences

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

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

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

Exporting and restoring user preferences

User preferences can be exported to be loaded into other compatible systems or to restore preferences after a system reset.

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

To reset user preferences to factory default, click **Reset**. This affects the current user only.

Test configuration

- **Show non-applicable columns**: Deselect to hide columns in the Grid interface that are not applicable to the current channels or selected parameters. When selected, these cells display as "N/A."
- **Show list values indicator**: Select to show which entries in a grid view are defined from a list of valid values. When deselected, the indicator is hidden.
- **Select cell text on focus**: Select to automatically select all the text in an editable grid cell when it gains focus. Use this setting to replace cell values instead of append text to existing cell values.
- **Auto start charts in Single channel editor:** Select to automatically start the Single channel editor strip chart display when the Edit dialog window is created. Deselect this option if you do not want this behavior, which will require clicking on the Apply button to start the strip chart displays after the dialog window is created.

Logs

- **System logs page size**: Specify a value between 1-1000 to limit the number of entries per page in the System logs. The default value is 50.
- **Minimize log page**: Deselect to open the System logs panel as a maximized page by default. When selected, the log panel opens as a smaller display.

Resize the panel manually using the minimize and maximize buttons on the panel itself.

General

Decimal point handling

- **Default number of decimals**: Set the default number of decimal places shown on digital meters. There are several options for overriding the default value.
  - To override the number of decimals on a per channel basis, set the *Decimals* parameter in the Input channels grid.
  - To override the number of decimals on a Single channel digital meter, set the number of decimal places from the chart menu.
  - To override the number of decimals for all channels with a range min/max defined, select the **Use significant digits when Range min/max values are defined** option and set the **Significant digits** preference.
- **Use significant digits when Range min/max values are defined**: If selected, the number of decimals for channels with *Range min* and *Range max* values is automatically set based on the **Significant digits** preference.
- **Significant digits**: When the **Use significant digits when Range min/max values are defined** option is selected, set the number of significant digits to display. For example
  - With **Significant digits** set to 5 and a channel defined with a *Range min* of -5 kN and a *Range max* of 5 kN, the digital meter displays four decimal places (e.g. 2.3593, 0.3247).
  - With **Significant digits** set to 5 and a channel defined with a *Range min* of -5000 N and a *Range max* of 5000 N, the digital meter displays one decimal place (e.g. 2359.3, 324.7).

Status bar configuration

Select a checkbox to show data processing unit information (CPU load, Storage, Memory or LEDs) in the status bar. Deselect a checkbox to hide information.

Charts

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

- **Width**: Enter a value of 200 pixels or more. The default is 300.
- **Height**: Enter a value of 200 pixels or more. The default is 300.
- **Auto scale**: Select to automatically scale the y-axis based on the current and past data points. When deselected, the y-axis is defined by the min and max values supplied in the channel configuration. Depending on the min and max values, the chart may still opt to auto scale.
- **Grid lines**: Select to show chart grid lines. When deselected, the grid lines are not displayed.
- **Color order**: Arrange the colors to determine the order in which colors are assigned to new channels. Drag and drop or use the arrows to re-order the colors.

- **Background**: Select either black or white as the background color for new charts. The default is white.
- **Deactivate charts when viewing other pages**: Select this option to reduce CPU usage when viewing pages other than the Test control page during a test run. Returning to the Test control page reactivates the charts, but all historical chart data is lost. When unselected, the charts continue to run until the test is stopped.
- **Maintain aspect ratio for video displays**: This is selected by default so video displays retain their aspect ratio (such as 4:3) when their size is changed. If this is not selected, the image in video displays may distort when video display size is changed.

Live updates
The live updates settings define the default behavior of new test setups. For existing setups or to override the defaults, change the settings in Test setup.

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

- **Live updates refresh rate**: Specify the rate that live data refreshes on the hardware and input channel pages when live updates are running.
- **Live updates always on**: Select this option to automatically start live updates when the test setup is saved. Live updates can be stopped and started manually at any time when a test is not running. If not selected, live updates must be started manually.
- **Include resampled message channels**: Select this option to show live updates for resampled channels such as CAN, GPS and system channels.
- **Include computed channels**: Select this option to show live updates for computed channels.

Confirmations
Some non-critical confirmation dialogs may be turned off by deselecting the checkbox by the description. This is recommended only for advanced users.

Confirmation dialogs for critical actions, such as firmware updates affecting all users, cannot be turned off.

The default for all actions in the list is to show a confirmation dialog. Selecting the Reset button will revert back to the default state of showing a confirmation dialog.

Test configuration

- Delete setup
- Remove channel
- Delete DataMode
- Export setup with changes
- Export setup with errors

- Copy/Paste tip
- Equivalent strain warning

Test run

- Other users logged in warning
- Networked modules warning

System configuration

- Delete database
- Delete database channel
- Delete user
- Delete profile
- Delete network
- Delete mail server
- Delete FTP server
- Set time using PC
- Set time using GPS

Miscellaneous

- Purge logs
- Abort setup task for another session
- Delete displays view
- Header collect change
- HTTP usage warnings

SIE data

- **Compress files when downloading:** Select to have SIE files compressed “on the fly” and automatically decompressed by the web browser. Selecting this option can either significantly reduce or significantly increase SIE download time based on multiple factors. See the Operational notes topic Compressed SIE file downloads for more information on this preference.

3.8 System configuration

3.8.1 Profiles

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

User privileges

Hardware control	
Unselected	View only access to Hardware
Selected	Add and control Hardware
Test configuration	
View	View only access to all Test configuration pages
Edit	Full access to all Test configuration pages and functions
Test control	
None	No access to Test control
View	View and manipulate charts in Test control
Start/Stop	Start and stop test runs in Test control
All	Access to all Test control functions
SIE data files	
None	No access to SIE data
View	View SIE data files list
Rename/Delete	Rename and delete SIE data files
Download/Extract	Download and extract SIE data files
All	Rename, delete, download and extract SIE data files
Logs control	
None	No access to System logs
View	View and export System logs
Purge	View, export and purge System logs

System configuration	
Users and profiles	Manage Users and Profiles
Databases	Import Databases
Networks	Manage Networks
Servers (Notifications)	Manage Notifications
Servers (FTP Servers)	Manage FTP Servers
Date and time	Manage Date and time
Firmware	Update Firmware
Preferences	Set System preferences
Customer support	Download support packages and release notes from Customer support

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

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

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

A deleted profile is removed for all users.

NOTE
The default administrator profile cannot be deleted.

To reset credentials, see Managing users and privileges **> Default user and restoring default credentials** for more information.

3.8.2 Users

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

NOTE
Opening simultaneous sessions using one user ID is not recommended.

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

Adding a new user

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

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

Updating a user

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

Deleting a user

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

NOTE

The default user *admin* cannot be deleted.

To reset credentials, see Managing users and privileges **> Default user and restoring default credentials** for more information.

3.8.3 Databases

eDAQXR, eDAQXR-lite and CX23-R systems currently support Vector CAN database files (.dbc), eDAQ CAN database files (.txt) and HBM sensor database files (.sdbx). Only the eDAQXR and eDAQXR-lite systems currently support ECU description files (.a2l) (for XCP over Ethernet only).

The Databases page displays all imported databases in a tree view. Database specific information is provided in the read-only panel to the right of the tree view. This information varies, based on the type of database selected.

Importing a database

To import a database, navigate to the **System** view and select the **Databases** menu option. Click **Import**. An Import database file dialog shows.

Select from the four File types: .dbc (Vector CAN database file), .sdbx (HBM sensor database), .txt (eDAQ CAN database file) or .a2l (ECU description file, for XCP over Ethernet only).

Click **Browse** to select a file to import from a local directory or external device.

Vector CAN database files (.dbc)

Browse for and import the desired .dbc database file. Once imported, the new database appears in the databases list. Select the file from the list to display the CAN channels.

NOTE
If the system encounters a CAN signal that is not supported (or appears invalid for some reason), the system will reject that specific CAN signal and generate a warning in the Log file. The system will also automatically assign Min and Max parameter values if these are not defined in the DBC file.

For CAN .dbc files only, there is an option to prepend CAN Message names to CAN signal names to generate the composite CAN channel name. This option uses either a double colon (::) or an underscore (_) as a delimiter between the Message and Signal names. The delimiter used is based on the delimiter option defined in System preferences > System > Databases. The double colon is the recommended option. However, the underscore may be preferred for SIE data files in some analysis software (e.g., Catman).

NOTE
If the option to append Message names to Signal names is not used, duplicate Signal names are automatically made unique when importing by appending the string "_duplicate_" and a sequential number.

For CAN .dbc files that include CCP or XCP signals, there is an option to import an associated seed and key (.skb) file.

Click **Import** in the lower right corner of the dialog to download a file to the data processor.

eDAQ CAN database files (.txt)

The system supports legacy eDAQ CAN databases in a .txt format. eDAQ CAN database channel sets cannot be exported as a .txt file. When imported, these are converted to the internal database format that is used for Vector CAN databases, which can then be exported as a .dbc file.

Browse for and import the desired .txt database file. Once imported, the new database appears in the databases list. Select the file from the list to display the CAN channels.

Imported eDAQ CAN .txt files will have Message Names appended with "MSG_" and the hexadecimal Message ID.

NOTE
When CAN DB channels that have a Mask are added for the MX471B-R or MX840B-R, the CAN channel Mask field is gray. There is no current Mask support by these modules, but the channel may be used in a test.

HBM sensor database files (.sdbx)

Browse for and import the desired .sdbx database file. For information on converting standard .sdb files to compatible .sdbx files, see HBM sensor databases.

Once imported, the new database appears in the databases list. Select the file from the list to display an overview of the database and the number of supported and unsupported sensors.

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

ECU description file (.a2l)

The system supports import and viewing of .a2l database files for XCP over Ethernet only.

The .a2l database file describes an ECU (electronic control unit) for communication purposes.

The .a2l channel sets cannot be edited or exported. When imported, these are converted to the internal (.dbc) database format that is used for Vector CAN databases.

Browse for and import an .a2l database file to support XCP over Ethernet on the eDAQXR or eDAQXR-lite CPU. Once imported, the new database appears in the databases list. Select the file from the list to display the CAN channels.

Creating a database
To create an empty CAN database, navigate to the System view and select the Databases menu option. Click **New**. Channels can be added and edited using the same tools provided for imported databases.

> **NOTE**
> If the user wants to extend the channel set for an existing eDAQ CAN database which cannot be edited, they can proceed by creating a new Vector CAN DBC file and adding the desired channels. Channels from both databases can be assigned to the same CAN port when creating the SXR test.

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

Editing a database
For HBM sensor database files (.sdbx) only the database name and title can be edited (see below for creating or editing a Vector CAN database (.dbc)). Click on the database name in the Databases tree to display its contents. Make the desired changes and click **Save**.

NOTE
While the database contents are read-only, the channels can be edited during test configuration.

Exporting a database
To export a database, navigate to the System view, select the Databases menu option and select the desired database. Click **Export**. An Export database file dialog shows.

Only Vector CAN databases can be exported at this time.

NOTE
Edited CAN databases are exported in a simplified Vector DBC file format. This is provided primarily for portability from one eDAQXR, eDAQXR-lite or CX23-R device to another. The exported DBC file is not guaranteed to be usable by Vector applications (e.g., CANalyzer, CANape, etc.). The user interface does not validate all user changes that can result in the Vector applications rejecting the exported DBC file. For example, in Vector applications, a Signal or Message name is only valid using letters, numbers and underscores (_).

Saving a duplicate database with a new name
To name a duplicate database, navigate to the System view and select the Databases menu option. Click **Save As...**. A Save database configuration as dialog shows. Only Vector CAN database files may be duplicated with a new name.

Creating or editing a Vector CAN database
Only Vector CAN database files can be edited at this time. A new Vector CAN database can be created by clicking the **New** button. The database may be removed or saved with a new name.

To edit a database, select the desired Vector CAN database. Option buttons appear and an editable grid will show for the database.

Add a channel to a database:

- Click the **Add** button in the task pane.
- Right click in the field of the workspace, and click on Add.
- Right click on a channel row to see options. Click Add.

A new channel row shows, with 14 available fields populated. Only the Data format column has options for pull down selection (SLSB, UMSB, ULSB, SMSB, FMSB or FLSB).

Select the check box to the left of a channel row or right click in the channel row. Option buttons become available for use. **Paste** shows as an option only after **Copy** is done.

Copy or Paste in a channel of a database:

When **Copy** is selected on a channel, a dialog allows selection of channel parameters. Click **OK** after selection.

When **Paste** is selected on a channel, all parameters copied from a channel are applied to the selected channel.

Copy and **Paste** allow duplication of channel parameters, including name and description. Make sure parameters are valid. Minimal system checks are done and operator error is possible.

Duplicate channel:

When the **Duplicate channel** button is selected in the task pane when a channel is selected or in the drop down options for a channel, a dialog shows.

Enter the number of copies desired (the higher the number, the longer the time required to duplicate the channel).

Click **Duplicate channel** and the channels will show, with "_copy_" and a number appended to the original channel's name.

Remove a channel from a database:

A confirmation dialog shows when **Remove** is selected. Click **OK** to approve.

Save pending database changes:

Click the **Save** button or the yellow Save button in the interface header.

3.8.4 Networks

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

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

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

Defining a new network configuration
To define a new network configuration, click **New**. Select **Static** or **Dynamic** as desired.

Select **Static** and enter the appropriate parameters:

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

Select **Dynamic - Obtain IP address configurations automatically (DHCP)** (Dynamic Host Configuration Protocol), to get information such as an IP address, subnet mask and default gateway. If on a network with a DHCP server, use the HBM Device Manager (on the included USB drive) or contact your IT administrator to find out the IP address. If presented with a certificate warning, choose to proceed.

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

Changing the active network configuration

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

Modifying a network configuration

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

Deleting a network configuration

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

Network port use

Customers have requested in-depth information about port use. This information is made available to aid IT departments supporting users in the proper operation of our hardware, while maintaining security postures and enabling access for test and measurement tasks.

The ports 80 (HTTP) and 443 (HTTPS) are required to use the web interface.

SMTP can use 25, 465, 587, or 2525, where 25 is the most common. Please note that some IT departments may block use of port 25. This port is used for email notifications with outside SMTP servers (such as gmail).

Push notifications use port 443.

FTP client ports are 20 and 21.

3.8.5 XCP over Ethernet

NOTE

Always disconnect the cable from the eDAQXR ETH2 or eDAQXR-lite E1 connector before enabling or disabling XCP over Ethernet.
When XCP over Ethernet is enabled on an Ethernet network connector, the network interface for that connector does not support PTP synchronization, XR device networking, Quantum MX devices or cameras.
For the eDAQXR-lite, this means that enabling XCP/Ethernet on the one and only ETH expansion connector (E1) effectively limits the eDAQ-lite to a stand alone usage mode.
Use only the eDAQXR ETH2 port for XCP over Ethernet.
We highly recommend all XCP over Ethernet sources be on an isolated network.

On the XCP over Ethernet page, configure the network settings. The data processor uses XCP network configurations to determine how to boot up and communicate with XCP networks. Many XCP network configurations can be defined, but only the active configuration is considered at boot time.

NOTE
Currently, an .a2l database file may be imported only to support XCP over Ethernet on the eDAQXR and eDAQXR-lite CPUs. However, local Ethernet network settings must be set in the web interface.

Any change made to any active record will require a system reboot.

The Master control parameters apply to all network entries.

Make changes and click **Save**. A confirmation dialog shows before the system reboots.

Master Control
Click the down arrow to show the optional fields.

Enter information in the drop down fields for Default gateway and four Domain Name Systems (DNS).

Click the **Enable** clickbox to enable XCP over Ethernet through the eDAQXR ETH2 or eDAQXR-lite E1 connector.

After the system reboots with XCP over Ethernet enabled, connect an XCP over Ethernet cable to the appropriate Ethernet connector.

If the network configuration is correct, the XCP CAN channels can be seen in the Channel edit interface.

Changing the XCP network name
Enter a new **Network name** for the XCP network and click **Save**. The system reboots with the new Network name.

Defining a new network configuration

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

- **IP address assignment**: Set the type of IP address to either Static or Dynamic. For static assignment, enter correctly formatted IPV4 address, subnet mask, default gateway and broadcast values. Some fields are automatically populated based on the entered values, but they may be edited as necessary.
- **DNS server assignment**: For static IP assignment, manually format the Preferred and Secondary DNS servers.

Click **Save** to save the new configuration. To make the new configuration active, click the **Active** click box. A confirmation dialog shows before the system reboots. The unit reboots with the new settings.

Changing the active network configuration

Select the desired configuration from the networks list and click the **Active** click box. A confirmation dialog shows before the system reboots. The unit reboots with the new settings.

Modifying a network configuration

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

Deleting a network configuration

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

3.8.6 Notifications

The data processor can be configured to send notifications (through email or the HBM Push application) when certain critical events occur while running tests. This feature requires the CX23-R / eDAQXR / eDAQXR-lite HOST port to be connected at all times to a network that has access to the internet.

This feature provides the user with updates when using automatic or cyclical test configurations and/or automatic upload functionality of SIE files to FTP servers, as configured. As with any feature requiring network access, the scope of this help topic is to explain exactly what is required for proper configuration of the mail server functionality and any inquiries as to what content should be put into the configuration fields must be handled by the user and their local IT administrator.

Please note that currently only one mail server and one HBM Push ID can be configured at any given time.

Also note that the mail server configuration does not support encryption of any kind. The SMTP server selected by your IT administrator to be used in mail server configurations must not require encryption. Please be sure that this detail is not overlooked as it will be a common point of failure for properly configured server details, which may still not work properly due to the SMTP server's configuration of requiring encryption.

Click a New, Delete, Save or Cancel button to manage notification configurations.

Defining a new mail server configuration

Mail Server Name: This will be the Mail Server's identification in the list of Mail Servers.

Server Configuration: These settings must be provided by your IT administrator.

- **SMTP Server IP**: This is the IP address of the SMTP server given to you by your IT administrator. This must not be a Fully Qualified Domain Name (FQDN) and must be an IP address. This is a required field and may not be left blank.
- **Port**: This is the port to use to connect to your SMTP server IP given to you by your IT administrator. This is a required field and may not be left blank.
- **From Address**: This field must contain a properly formatted email address and will be used as the sender of the emails sent by the unit. If no From Address is specified, a default address will show for the unit, such as somatxr@cx23r-(serial number) or edaqxr@edaqxr-serial number. This is a required field and may not be left blank.

Configure Email Recipients

Email addresses specified in the Email Recipients list will receive any update emails that are configured to be sent by the unit. Each address must be separated by a comma (",") and any white space will be ignored. At least one email address must be specified in order for the email configuration to be accepted, as such, this is a required field and may not be left blank.

Enabling a mail server configuration

Select the desired configuration from the Mail Servers list and click **Make active**. The unit applies the new mail server settings and these settings go into effect immediately.

CAUTION

Make sure all entries are correct before making a mail server configuration active. Incorrect settings can render the email messaging system inoperable.

NOTE

Save all changes before making a mail server configuration active.

Configure Push Notification

Please note that currently only one HBM Push ID can be configured at any given time. However, users can receive notifications from multiple HBM devices through the HBM Push app.

A push notification is a simple message sent to devices that opt-in to a service, which supports distant monitoring of test events. Notifications for events are selected in the web interface. An HBM Push notification can be sent to smart phones, no matter where they are. A Push ID may be shared so others may be notified about selected events through the HBM Push app. All messages are encrypted during transmission.

In the web interface, click the **New ID** button and the **Request Push ID** dialog appears.

In the dialog, enter a name appropriate for identifying Push messages. The entered Name appears beneath the supplied Push ID in the web interface. The Name is also the title under which a message appears on a smartphone.

Enter an email address to receive an HBM Push activation link.

After entering information in the dialog, click **Request ID** to get a Push ID.

Click **Verify ID** and an email is sent to the entered Email address, containing a link to activate the HBM Push ID. Follow the link in the email to activate the Push ID.

After the HBM Push ID is activated, selected notifications will result in a message sent to the HBM Push service each time the event occurs.

Click **Make active** to begin or **Deactivate** to stop push notifications from the system.

After generating or changing a Push ID, save pending changes in the web interface.

Set up a mobile device to receive HBM Push notifications

On your mobile device, install the application and register the Push ID. Follow instructions in the HBM Push application to register the Push ID. The HBM Push app is freely available from www.hbm.com, the Google Play Store or the Apple Store.

NOTE
A user will not receive notifications until the Push ID is registered in the installed HBM Push app.

Click **Test Push** to verify a notification is sent as desired from the system.

Configure Notifications
The Notification Configuration, Test Stop Notification Configuration and the SIE File Notification Configuration sections contain all of the available notifications that can be emailed to the specified recipient list. At least one notification must be selected for the email configuration to be accepted by the unit.

Both Email and HBM Push notifications may be sent when a selected event occurs. Deselect a checkbox and a notification for that event will not be sent.

3.8.7 FTP Servers

The device can contain one or more configurations of FTP servers that could be used to automatically upload SIE files to a remote FTP server upon test completion. Several FTP server configurations can be defined, but only the active configuration is used at test start time. If no SIE files are to be transferred no FTP server configurations should be active.

See Cyclic test run mode for cyclical sending of test information to an FTP server.

Changing the active FTP server configuration
Select a complete configuration from the FTP Servers list and click the **Make active** button. The unit applies the new FTP server settings.

CAUTION
Make sure all entries are correct before making an FTP server configuration active. Incorrect settings can prevent the file from being transferred successfully.

NOTE
Save all changes before making an FTP server configuration active.
Configuration items discussed below should be obtained from the FTP server provider.

Defining a new FTP server configuration
To make a new FTP server configuration, click the **New** button.

- **FTP Server Name**: Enter a name that will be a good reminder of the destination.
- **Make Active**: Several FTP servers may be entered, but only one may be made active.

Server Configuration: These settings are strict and must conform to network requirements.

- **FTP Server IP**: This is the IP address of the FTP server, such as 255.255.255.255. This must be an IPv4 dotted numeric address. FQDN host names are not allowed and will be rejected with an error.
- **Destination Folder**: Optionally, specify a folder path. If the folder path does not exist on the FTP server, it may or may not be created. For example, a user may not have the privilege to create folders. An example of a file path is `/test_vehicle/road_test_3/driver_2/`. If a file path is not entered, the default destination is the root directory of the FTP server.

Authentication Configuration: These parameters are affected by the identity previously set up with an FTP server.

- **Username**: Provide the user name required to access the FTP server.
- **Password**: Provide the password required to access the FTP server.

Deleting an FTP server configuration
To delete an existing FTP server configuration, select the configuration from the FTP

server list and click the **Delete** button. The active FTP server configuration cannot be deleted.

Saving an FTP server configuration
To save an FTP server configuration, click the **Save** button.

Cancel creation of an FTP server configuration
To cancel creation of an FTP server configuration, click the **Cancel** button.

3.8.8 Date and time

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

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

After making changes, click the Update button to update the system date and time.

3.8.9 Firmware

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

Click the **Browse** button and select the image file. Click **Update** to begin the firmware upgrade. The update can take several minutes.

CAUTION
Do not power down the CPU during the firmware update! Allow the firmware upgrade to run to completion.

NOTE
In a networked system of units, there is an option to update all units at the same time. This not only saves time, it ensures that all units are running the same firmware version. It is strongly recommended that this option be used.

NOTE
Updating the unit firmware deletes all system log messages.

3.8.10 System preferences

System preferences apply to all users of the system. Changes to some of these preferences require a system reboot. For changes that do not require a system reboot, the changes take effect immediately for the user making the changes. Other users already logged in at the time of the change need to log out and log back in for the settings to take effect.

Exporting and restoring System preferences

System preferences can be exported to be loaded into other compatible systems or to restore preferences after a system reset, when a User profile has System configuration privileges for Preferences. See **User privileges** in Profiles for more information.

To export system settings, click **Export**. Name the file and select an appropriate folder for saving it, then click **Export**.

To load a saved preferences file, click **Import** and select the saved file. A dialog window shows. Confirmation causes a system reboot.

To reset user preferences to factory default, click **Reset**. A dialog window shows. Confirmation causes a system reboot.

System

- **Sample rate domain**: Select one of the options itemized below. This setting controls the sample rate domain that will be in effect when a new setup file is created. The sample rates and associated digital filter types and frequencies that are available when configuring input channels are based on the sample rate domain. Decimal is the default.
  - **Decimal**: Typical sample rates are 5000, 2500, 1000 and 500 S/s.
  - **Binary**: Typical sample rates are 4096, 2048, 1024 and 512 S/s.
  - **Classic**: Typical nominal sample rates include 4800, 2400, 1200 and 600 S/s.

NOTE

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

NOTE

SomatXR MX modules do not support the Binary domain. Legacy eDAQ layers do not support the Classic domain.

- **GPS sample clock regulation**: Select this option to use the GPS heartbeat signal to regulate the data processor sample clock whenever a GPS module is connected and receiving the heartbeat signal. While the internal unit sample clock is very accurate and stable, GPS provides an even more accurate and stable clock reference that can be used to slew the sample clock. One significant advantage of using this option is optimizing the accuracy of digital pulse timing channels over the full temperature range of the unit. Note that this option does not provide GPS calendar time regulation.

- **Sync to GPS time (Disables PTP)**: Select this option to use the GPS heartbeat signal for GPS date and time synchronization in addition to regulating the data processor sample clock. When this preference is selected, GPS sample clock regulation is automatically selected in the user interface.

> **NOTE**
> This option can only be used on standalone eDAQXR / eDAQXR-Lite units that do not have any MX modules connected. The user interface does not check for this limitation. However, the system does enforce this limitation when an SIE test run is started. The system will error reset if any MX module, or another eDAQXR / eDAQXR-Lite unit, or any other type of module that uses PTP (Precision Time Protocol (PTP/IEEE-1588) is connected using one of the Ethernet expansion ports.

The GPS Time sync mode can be used to remotely synchronize standalone units where it is not possible (or not practical) to network the units using Ethernet expansion port cables. See the Operational Note Remote Networking using GPS Time Sync for details on using this testing mode.

- **TEDS enabled**: This preference is no longer supported (as of the v2.2.0 release). TEDS is always enabled. It was originally provided for internal development debugging purposes only. However, it was subsequently found that disabling TEDS can cause problems with MX840B-R channels that are configured for Pulse frequency and Encoder frequency sensor input modes (using MX firmware versions 4.12.14.0, 4.10.4.0, and possibly earlier versions).
- **Allow modules to be renamed**: Select to allow custom module names. Rename modules on the Hardware page. Custom module names cannot match the internal module identifier and can contain only letters, numbers, spaces, dashes or underscores. A module name cannot start or end with a space or spaces.

> **NOTE**
> Modules named outside of the web interface that do not conform to the naming rules are automatically renamed. In the case of illegal characters, the characters are replaced with underscores. In the case of a name that matches the internal module identifier, the name is prefaced with an underscore.

- **Bridge shunt polarities**: Set the default polarities for bridge channels when installing shunts with a test run in progress or when using the shunt resistor sensor scaling mode. Select either Up scale for positive shunt polarity or Down scale for negative shunt polarity for each bridge configuration. Note that some SomatXR MX module bridge configuration modes support only one shunt polarity.
- **Exception handling**: Specify the **Max number of normal test restarts on error resets** as a value between 0 and 10. If a test stops on a critical error, the system reboots and always attempts to restart the test. As long as the "normal test restart counter" is not zero, the system attempts to restart the test as quickly as possible. However, after the count reaches 0, the system imposes a 5 minute delay on restarting the test. This is done to preclude the possibility of an "infinite loop of error resets" where the user does not have time to open the web browser interface and interactively stop the test. The counter is set to the Max number of normal test restarts on error resets value when starting a test run from the Test control page and is decremented on each test restart attempt initiated from an error reset.

NOTE
Power failures and user-initiated reboots are not error resets. The system always attempts to restart an interrupted test when either of these events occurs. The user is provided an opportunity to abort the test restart, but only while the restart is in progress – which could be a very short time period.

- **Databases**: Select Double colon ("::") or Underscore ("_") for the **CAN message and signal names delimiter**.
  The double colon is the default. However, the underscore may be preferred for SIE data files in some analysis software.
  See Databases > Importing a database for more information about import options. The double colon or underscore may be appended at CAN .dbc import. In the Import database file dialog, select the checkbox by Append message names to signal names.

User

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

Setup
Custom column names

Four user supplied customizable parameters can be used for a setup's source channel configuration. These can be used for any desired purpose and can contain any desired values. Those with a blank value will not show in the single channel editor.

When a User info name is entered and saved, custom column names are automatically filled in a new Test setup.

Custom column name type

For the Type, select Text or Numeric for sorting channel rows. Text is the default and will allow sorting of rows by the text string entered for the Custom column name. Numeric may be selected and will allow sorting of the rows numerically by the content entered for the Custom column name.

In Numeric sorting, strings that are not numbers are ignored in the sorting algorithm, and will be displayed at the top or bottom of the list in an arbitrary order.

Numeric content is simple number strings, such as positive or negative integers and decimals. Fractions, roots and other mathematical symbols, such as an equation, are not supported and will be sorted to the top or bottom of the list in an arbitrary order.

Calibration options

Use channel calibration dates and locks:

Channel calibration locks are used to ensure that channel configuration parameters are not accidentally changed. This is most significant for channels defined using experimental scaling that can be a time consuming and/or technically challenging process. The associated calibration dates provide a means for assessing the need to periodically rerun experimental scaling measurements. Since some users may find the overhead on using this feature annoying and unnecessary, this System preference is available to disable this functionality.

NOTE
When a new SXR setup is created, the setup inherits this option from this System preference and cannot be changed.

Select the checkbox so new test setups use channel calibration date and locks. In Test configuration, **Use channel calibration dates and locks** shows **True**. In a new test setup, a calibration date and the Calibration options... button show for a channel in any Edit channel dialog.

If the checkbox is not selected, a new test setup created in Test configuration will not have channel calibration dates and locks enabled. In Test configuration, **Use channel calibration dates and locks** will show **False**.

Allow SIE tests to be run with channels that are not calibrated:

The default is to prevent SIE tests from being run with uncalibrated channels. Select this checkbox to enable a SIE test to be run with a uncalibrated channels.This option is applicable to only a limited set of channel types.

Test

- **Allow test run if warnings exist in setup**: Select to start a test run when warnings are present. If deselected, test runs do not start until warnings are resolved.
- **Test engine frame rate default**: Select the preferred default for the rate that the system test engine processes data packets. This default is applied whenever a new setup file is created but it can be changed after a setup file has been created. See Test setup**> Test setup parameters > Test engine frame rate** for more information.
- **SIE Filename pattern default**: Select between Numeric increment or Date and time suffix for automatic naming of SIE files. For FTP uploads, if the filename mode is Date and time suffix, the extra timestamp normally put on the end of the FTP destination filename is omitted.
- **Minimize SIE file sizes using integer data types:** When selected, data will be stored in an 8, 16, 32 or 64 bit integer data type for supported channels - currently limited to CAN channels defined to use the Collect storage mode. There is no loss of data precision. CPU load will typically increase only modestly using this option. See SIE file size issues for more information.

NOTE
There are limitations on the stale data Invalid value imposed by the integer data types. If the Invalid value defined is over (or under) the limits of the data type, the system will automatically set the value to the maximum (or minimum) limit.

- **Include DataMode name and @ character in SIE metadata channel names:** Deselect the checkbox so the prefix "dm_name@" is not in SIE metadata for DataMode channel names. This prefix may be problematic for some analysis tools.

Sensor scaling
Select the **Use system defined sensor scaling filters** option to use the system defined sample rates and digital filters for zeroing and experimental sensor scaling for applicable channels (e.g., MXB-R module analog channels). The sample rates and filters are a function of the sample rate domain as defined in the table below. If deselected, the user defined sample rates and digital filters for each channel are used.

Sample rate domain	Sample rate	Filter type	Filter frequency
Decimal	100 S/s	FIR Butterworth	15 Hz
Classic	50 S/s	IIR Butterworth	10 Hz
Binary	102.4 S/s	FIR Butterworth	15 Hz

NOTE
The MX411B-R does not support FIR filters in High speed mode. In this usage case, the above Classic domain settings are also used in the Decimal domain.

3.8.11 Customer support

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

Databases

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

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

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

Before deleting the databases, the system generates a customer support package. The package contains a snapshot of all the databases that are being deleted. It is critical that allow this download to complete and to save the file in a safe location as it is the only means available to revert the system back to its state before the deletion.

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

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

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

Documents

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

3.9 Test configuration

3.9.1 Test setup

Test setups define the channels, computed channels and DataModes™ that the data processor acquires and processes during a test run. The Test setup page displays the parameters of the current setup configuration.

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

Test setup parameters

- **Setup name**: The setup name must be unique and contain valid characters (invalid characters are single and double quotes, tab, '\', '/', '|' and ',').
- **Title**: Enter an optional title of the test setup.
- **Author**: Enter an optional author of the test setup. The author defaults to the logged in user.
- **Summary**: Enter an optional detailed summary of the test setup.
- **Test start delay**: Specify the test start delay time in seconds. The default value of zero is the recommended setting in general. Non-zero delay times may be desired in the following scenarios.
  - Some sensors such as IEPE sensors require significant time to stabilize after excitation is applied.
  - For some sensor configurations, MX modules can start sending data before the signal conditioner circuitry is fully stabilized causing data to be tagged as "overflow data".

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

- **Sample rate domain**: The sample rate domain is read-only and based on the System preferences when the test setup is created. The sample rate domain cannot be changed once the setup is created.
- **Test engine frame rate**: The factory default value of 20 S/s (Decimal domain) is recommended for testing applications where the sample rates are relatively low and digital output rates of 20 S/s is acceptable. Take the following into account when setting the test engine frame rate.
  - Digital output channels are always updated at the test engine frame rate.

- The latency of the real time displays is a function of the test engine frame rate. For example, at 5 Hz, the latency is at least 0.2 seconds; at 20 Hz, the latency is at least 0.05 seconds.
- In general, increasing the test engine frame rate minimally increases the CPU load. For example, a channel sampled at 100 Hz is more efficient to process using five frames of 20 data samples compared to using 20 frames of five data samples. However, this is not critically important unless the test is running at high CPU load (i.e., 80% or higher).
- If the 100 Hz frame rate is used, the system can error reset if the test has all 16 channels on any EBRG or EHLS layer defined to use the 100 S/s Linear Phase 33 Hz sample rate / digital filter setting. The likelihood of seeing this error increases significantly when Smart Modules are used on the EHLS layer.

- **Invert the analog output signals of all channels that have a negative "sensor scaling slope"**: When the "sensor scaling slope" (in terms of the relation between A/D units and Physical units) is negative on any channel sourced from the EBRG and EHLS layers, the analog output signals will have inverted polarity relative to the channel data that the users will see in the data displays and what ends up in the SIE file. This is problematic for some users in some usage cases. To deal with this, we provide the option to invert the analog output signals of all channels that have a negative "sensor scaling slope."

NOTE
To be compatible with the TCE/eDAQ support for this option, the AOX file is not changed when this option is used. As such, the user is responsible for changing the sign of the Physical units value calculated from the Scale and Offset parameters in the AOX file.

NOTE
There is a known issue with using this option. If the input signal saturates the A/D converter on the negative rail (i.e., has a value of -32768), the inversion on those data samples will fail (because +32768 is out of range for the 16 bit D/A follower that generates the analog output signal).

- **SIE Filename pattern default**: Select between Numeric increment or Date and time suffix for automatic naming of SIE files. For FTP uploads, if the filename mode is Date and time suffix, the extra timestamp normally put on the end of the FTP destination filename is omitted.
- **Minimize SIE file sizes using integer data types:** Use this preference to enable the option to reduce SIE file sizes whenever a new SXR test setup is created. See System preferences **> Test > Minimize SIE file sizes using integer data types** for more information.
- **Collect storage mode options**: There are two options available.
  - **Collect default value**: Check this box to set the Collect channel parameter value to TRUE whenever any new channel is added to the setup. This is the

default setting. Uncheck this box to set the Collect channel parameter value to FALSE whenever any new channel is added to the setup.

  - **Collect DataMode name**: Optionally, specify a DataMode name to be associated with all channels that are stored in the SIE file using the Collect channel parameter. If a name is specified, it must be a valid and unique DataMode name. This is useful for sorting SIE channels by DataMode name in post processing applications

- **Use channel calibration dates and locks**: **False** shows when a new Test setup does not have channel calibration dates and locks enabled. **True** shows when a new Test setup has channel calibration dates and locks enabled. In the Input channels task pane, click the **Calibration options...** button. A dialog window is presented with the options available for calibrating channels or unlocking (removing) the calibration parameters so they can be edited.

NOTE
Currently, channels that have experimental scaling cannot be calibrated using this dialog window; to calibrate these channels, the Shunt scaling and/or the Two point scaling task(s) must be used.

- **Network mode**: Select Mode 1 or Mode 2.
For Mode 1, one eDAQXR/eDAQXR-lite serves as the networked system host (the master node), and all other connected eDAQXR/eDAQXR-lite units (the slave nodes) provide source data to the master node. Only one SIE file is generated on the master node.
For Mode 2, every node runs a test engine and generates an SIE file. This mode will typically only be used when Mode 1 cannot be used due to CPU processing limitations on the master node, or when there is insufficient SIE file storage space on the master node.

Test run mode
There are currently three test run modes supported.

- **Normal**: In this mode, test runs can only be started and stopped.
- **Cyclic**: In this mode, tests are automatically started after a test run is stopped under program control (e.g., using the Test duration option or using a Run Stopper computed channel). The user can specify a fixed number of test run cycles or specify that there is no limit to the number of test run cycles. See Cyclic test run mode for more information.
- **Remote Control**: In this mode, tests can be started and stopped using a remote switch connected to a designated port on the CX23-R/EXRCPU/EXRLCPU. See Remote control run mode for more information.

Test stop options
There are currently two test stop options supported in the Setup panel view. Note that the Run Stopper computed channel is another option. There are no restrictions on using multiple test stop options in the same test.

- **Stop on test duration**: Select the check box. Set days, 0 to 365. Set hours, 0 to 23. Set minutes, 0 to 59. Set seconds, 0 to 59. The minimum test duration time is 5 seconds. If a test in interrupted by a power cycle or other event that results in a reboot, the test run automatically started on reboot will run for the full specified test duration. This option is available for all Test run modes.

- **Stop test at**: Select the check box. When using test stop on date/time or test stop on time of day, the test may stop a little before or a little after the requested time. There are usage modes available.
  - Set both the UTC time of day and date. In this mode, the test run will stop shortly (i.e., typically within one second) after the specified date and time is reached. Note that this mode is not available if the Test run mode is Cyclic or Remote control.
  - Set both the UTC time of day only. In this mode, the test run will stop shortly after the specified time of day is reached. Note that this mode is not available if the Test run mode is Remote control.

Custom column names
Custom column names can be used for a setup's source channel configuration.

The column names can be used for any desired purpose and can contain any desired values. Custom names with a blank value will not show in the single channel editor.

If information is entered in **System configuration > Preferences > Setup > User info 1, 2, 3** or **4** a custom column name is automatically filled at the creation of a new Test setup.

Custom column name type

For the Type, select Text or Numeric for sorting channel rows. Text is the default and will allow sorting of rows by the text string entered for the Custom column name. Numeric may be selected and will allow sorting of the rows numerically by the content entered for the Custom column name.

In Numeric sorting, strings that are not numbers are ignored in the sorting algorithm, and will be displayed at the top or bottom of the list in an arbitrary order.

Numeric content is simple number strings, such as positive or negative integers and decimals. Fractions, roots and other mathematical symbols, such as an equation, are not supported and will be sorted to the top or bottom of the list in an arbitrary order.

See Grid interface for information about showing or hiding columns.

Over range detection notifications
Select the maximum number and minimum timing for notifications sent for the Over range detector channel. See Notifications for configuring email and HBM Push notifications to be sent from the system. While setting up an Over range detector channel, select the **Enable notifications** checkbox to apply notification controls during a test run.

- **Max notifications per test run**: Select the desired number in the range of one (1) to 50.
- **Min time (seconds) between notifications**: Select a time period in the range of 30 to 120 seconds.

- **Max over ranges reported per notification**: 50 is the limit and cannot be changed.

Live updates

> **NOTE**
> The default live updates settings for new test setups are defined in User preferences.

- **Live updates refresh rate**: Specify the rate that live data refreshes on the hardware and input channel pages when live updates are running.
- **Live updates always on**: Select this option to automatically start live updates when the test setup is saved. Live updates can be stopped and started manually at any time when a test is not running. If not selected, live updates must be started manually.
- **Include resampled message channels**: Select this option to show live updates for resampled channels such as CAN, GPS and system channels.
- **Include computed channels**: Select this option to show live updates for computed channels.

Creating a test setup

There are several methods to create a test setup.

- Click **New** to create a new test setup with default values. The new setup appears in the setups drop down list as *test_name*.
- Select an existing test setup and click **Save As...** to duplicate the setup under a new name. It is not possible to replace an existing setup.
- Click **Import**. Click **Browse** to select the test configuration to be imported. The file type is the Setup format .sxr. The format must be valid JSON and the syntax valid setup configuration. Click **Import**. See additional information in **Importing or exporting a test setup** below.

Deleting a test setup

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

Importing or exporting a test setup

Click **Import**. Click **Browse** to select the test configuration to be imported. The file type is the Setup format .sxr. The format must be valid JSON and the syntax valid setup configuration. Click **Import**.

To save a test setup to the local machine, select the desired setup and click **Export**. Exported setups can be imported on another device. Only one test setup can be exported at a time.

Cyclic test run mode

This test run mode is primarily provided to support long term unattended testing with SIE file data management features. However, it is applicable to a variety of other testing scenarios. Following are issues to be aware of when using this run mode.

- This run mode does not provide for complete continuous acquisition and storage of test data. At least a few seconds will elapse between the test stop time and the next test start time. In some cases this elapsed time can be significantly more (e.g., tests with 1000 or more channels defined).
- Once a test run is started, it will continue to cycle test starts and stops until the user defined limit on cycles is reached (if applicable), or until the user interactively stops a test run, which effectively ends the cyclic test. The cyclic test can then be restarted anew.
- Tests restarted on power cycle interruptions or error resets do not decrement the counter for the number of cyclic runs remaining. However, if the user specified limit on error restarts is reached, the cyclic test will be ended. The user may want to increase this limit to the maximum of 10 error reset restarts for this reason.
- If the option to automatically upload SIE files to an FTP server is enabled, this will increase the CPU load somewhat while the upload is in progress. It is recommended that the user experimentally verify that the FTP uploads do not come close to overloading the CPU before committing to a long term unattended test.
- The default delay for starting the FTP upload after each test cycle stops is the minimum allowed value of 15 seconds. This delay is imposed to give the system a little time to recover from the high CPU consumption typically associated with starting test runs. This is probably adequate for most test scenarios. However, it is recommended that users experimentally evaluate this and increase the delay if deemed necessary.
- If the FTP upload is interrupted for any reason (e.g., the FTP server connection is lost), this could result in one or more SIE files not being uploaded. It could also result in an SIE file being only partially uploaded. The system does not attempt to “catch up” by uploading such SIE files later. As such, the user is responsible for retrieving any missing or partial SIE files.
- Note that emails alerts can be configured to assist the user in monitoring the status of the cycle test and FTP uploads (if applicable). However, it is recommended that users periodically connect to the unit to verify that the connection is still available at a minimum.

Remote control run mode

This test run mode is provided to support testing scenarios where using the GUI (user interface) on a PC or other type of device is impractical or undesired. A typical usage case is where the driver of a vehicle will also need to control test starts and stops with minimal effort and distractions. This is applicable to many vehicle tests, but is most common when running proving grounds tests on motorcycles, snowmobiles and other “single occupancy” vehicles.

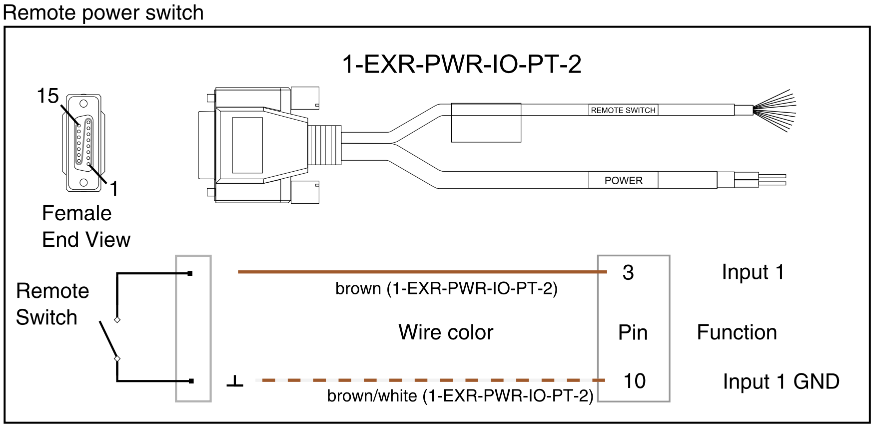
See the technical note Long term unattended testing considerations (Page 299) for more information about start and stop of long term testing.

To use the Remote test control mode, the user must configure the SXR test to use the Remote control run mode. In Test configuration, select the Setup menu item in the Task pane. Under Test run mode options, select Remote Control from the drop down menu.

On the EXRCPU or the EXRLCPU

The user must also provide and connect a control switch to the appropriate lead wires of the 1-EXR-PWR-IO-PT-2 power input cable. A single pole-single throw switch is recommended, as shown in the wiring diagram below.

Remote power switch



> **NOTE**
> In a Mode 1 or Mode 2 networked test, only IO switch 1 on the Master network node can be used for remote test run control.

> **NOTE**
> On the CX23-R, if a switch is not connected to the AUX port, the system detects this as logic 0 and does not start a test as soon as remote control is enabled. On the EXRCPU and the EXRLCPU, if a switch is not connected to Input 1 on the power connector port, the system detects this as logic 1 and starts a test as soon as remote control is enabled.

3.9.2 Hardware

The Hardware page displays the connected system modules, connectors and existing input channels. Connectors, channels and other devices appear under their top-level modules. Entries appear or disappear as hardware is connected or disconnected.

> **NOTE**
> Connected EX23-R modules are not shown. Devices such as cameras connected directly to an EX23-R appear under the eDAQXR/eDAQXR-lite device.

Each module displays basic information including module alias, serial number, firmware version and module status and provides a **control menu** for access to several module actions and settings. Existing input channels display basic channel information including the channel name, TEDS information and the channel sample rate. When a live update is running, the real-time readings are shown.

The Hardware page also includes the Sensors panel.

Changing a module alias
To change a module alias, simply click on the module name and enter the new alias.

NOTE
This option is only available if the System preferences setting **Allow modules to be renamed** is selected.

Controlling a module (Reboot, Flash LED, Update firmware, calibration certificate, etc.)
The module **control menu** contains several actions:

- **Reboot**: Click to shut down and restart a device.
- **Flash LED**: Click to identify a control unit or MX module by flashing one of its LEDs. For a CX23-R/EXRCPU/EXRLCPU, the green POWER LED flashes at 2 Hz. Click **Stop flashing** to resume normal LED behavior. Normal behavior is also resumed when a module is rebooted.
- **Update firmware**: Click to update unit or MX module firmware. For MX modules, the firmware version is red when an update is expected. For detailed information, see Configuring MX modules for use **> Updating MX firmware**.
- **Get calibration certificate**: Click to download the device/module calibration certificate.
- **Disable/Enable power switches**: Click to either disable or enable the CX23-R/EXRCPU/EXRLCPU power control switches (i.e., the front panel switch and the remote power switch). Disabling the switches is generally recommended for long term unattended testing where starting/stopping test runs is controlled by remotely turning the power supply to the CX23-R/EXRCPU/EXRLCPU on/off.
- **Sample rate domain**: For MX modules, set the domain to either Decimal or Classic. The MX module reboots automatically when this setting changes. For tests using legacy eDAQ layers, set the domain to either Decimal or Binary.
- **Query smart modules**: Click to prompt the eDAQXR/eDAQXR-lite device to discover all of the Smart modules currently connected to all EHLS/ELHLS layers in the stack.

Adding input channels
Expand the desired module. On the entry of the appropriate connector, click the add icon (). For TEDS connected sensors, the channel parameters are automatically defined. For other channels, use the presented dialog to set the channel parameters.

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

Drag and drop the sensor definition from the Sensors panel onto the desired channel.

When a sensor definition is successfully applied to a channel, this is indicated by the SDB sync icon ( ). Channel parameters can be manually edited, which is indicated by the SDB edited icon ( ).

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

Deleting channels
Expand the desired module and connector. On the channel entry, click the delete icon ( ).

Editing channels
Expand the desired module and connector to find the channel entry.

To edit the channel name, simply click on the existing name and enter a new name. If a channel name is changed, all references to the channel from computed channels or DataModes™ change automatically.

To edit the channel parameters, click the edit icon ( ).

Previewing video channels
Expand the desired module to find the camera channel entry. Click the eye icon ( ) to open the preview window.

The Video channel preview shows the video stream from the selected camera channel.

Click **Freeze** to pause the video.

Click **Rotate** to rotate the video display counter-clockwise by degree increments supported by the video device. Please refer to video device manufacturer's documentation for video image rotation, which may be limited to 180 or 90 degree increments.

3.9.3 Input channels

Input channels define what transducer and sensor data should be captured in a test run. Available input channels depend on the connected hardware and imported databases. The channel grid interface displays the channels defined for the current setup. Color-shaded column headers such as Input mode and Scaling mode can be clicked to display configuration option columns.

See Grid interface (Page 223) for information about showing and hiding columns.

A list may be sorted by a column's contents, including the Collect column in Test configuration. However, while sorting by the Collect column in the All input channels tab, Computed channels will be sorted separately, below other input channels.

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

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

On a channels tab, a number shows for total channels in the list.

To filter the channels listed, click the **Search** icon in the Quick link buttons. Enter information in the search bar. The list will show channels containing the entered information. A red number also shows on the tab, which is the number of channels resulting from the search.

While a search is active, the **Search** icon will change color.

Clear the search bar to end filtering.

Adding an input channel

There are two methods to add an input channel from the Input channels page.

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

Select the desired channels from discovered hardware on the network.

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

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

Editing an input channel

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

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

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

The Edit channel dialog windows provide a convenient way to focus on configuring a single channel. While the basic layout of all Edit dialog windows is the same, each one is tailored to the specific applicable parameters and specific available control option on a per channel basis.

To disable auto start of charts in the Single channel editor, see User preferences, Test configuration. In the Single channel editor, click on the tabs to switch among

Strip chart display, the Spectrum chart display, the Digital meter display or the Wiring diagrams as desired. Following are some pertinent notes on usage.

- Click on the wiring diagram for a larger view.
- Display units can be changed between Electrical (source) and Engineering (physical) if the channel is calibrated; otherwise the display units are Electrical. For EHLS and EBRG channels, the measuring range is set to the maximum based on the sensor input mode in use.
- After making changes to the parameters directly or indirectly via the Shunt scaling or Two point scaling tasks, click the Apply button once to see the effect of the changes on the channel data using the Strip chart, Spectrum chart or Digital meter. Multiple clicks on Apply may hinder system response.
- To capture data, enter a value in the **Time** field up to 7200 seconds to capture all messages in that time period, or enter a value in the **Number** field up to 10000 to capture that number of messages. Click on the **Capture** button to start the capture.

NOTE
If values are entered for both fields, the capture will stop when either limit is satisfied. If no value is entered in the **Time** or **Number** field, 10000 messages may be captured. To stop capture before either limit is reached, click the **Close** button. After capture, the number of captured samples shows in parentheses after **Value** at the top of the column.

- Captured data can viewed, searched, filtered and exported.
  - Pull down menus allow the **Time** or **Value** column to be hidden (one must stay visible) and contents sorted (ascending or descending).
  - To find data among captured samples, enter text in the **Search** field. Search field content is highlighted in the message **Time** and **Value** fields.
  - To filter data, enter text in the **Filter** field. Only the message rows with matching text in the **Time** or **Value** fields is shown. Clear the **Filter** field to see all captured message rows. At the top of the **Value** column, the number of filtered message shows in parentheses with the number of captured messages, such as (173/3004).
  - To export data, select message rows with the mouse or keyboard and click the **Export** button. Selected messages are saved as a tab delimited Text file to facilitate using Microsoft Excel (named “capture.txt” unless renamed by the user). The number of messages exported shows in parentheses at the top of the text document. Note that search results are not highlighted in the exported file.
- A button is gray if an option (such as Zero or Shunt…) is not available for a channel.
- Click OK to close the single channel editor. Click on Save to save the changes to the test setup file.

Applying TEDS sensor parameters
To simplify input channel configuration, SomatXR MX modules support TEDS

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

Channel parameters can be manually edited, which is indicated by the TEDS edited icon ( ) in the *TEDS* column.

Applying sensor database parameters

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

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

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

To reset the channel parameters to the applied database definition, select the channel and click **Sync SDB**.

NOTE

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

Defining sensor scaling properties

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

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

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

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

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

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

Removing an input channel
Select the desired channel or channels and click **Remove**. Removing channels referenced by computed channels or DataModes results in an error. Input channels cannot be recovered after removal.

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

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

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

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

Viewing the digital meter

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

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

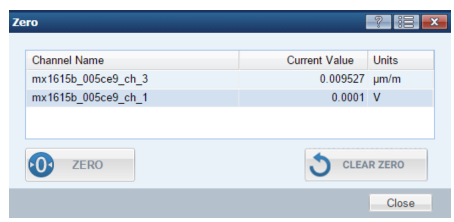
NOTE
Digital meters cannot be displayed while a test is running.

Zeroing channels

Zeroing a channel adds an offset, making the channel value as close as possible to the user defined zero target. The default zero target is 0.

Select one or more channels and click **Zero**.

NOTE
In the single channel editor, the *Mode* in Input channel zero parameters must be set to Interactive only or Normal Test Starts for a channel to be zeroed. By default, normally applicable channels such as bridges and encoders are set to this mode. Other channel types must be set manually if zeroing is required.



Click **ZERO** to measure the current channel data value, and adjust the cumulative zero offset which is stored in the offset in Input channel zero parameters. Click **CLEAR ZERO** to clear any previous zero offsets. After zeroing is complete, be sure to save the test setup.

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

Sensor scaling

Before running a test, many input sensors must be scaled. Define sensor scaling parameters directly in the Sensor Scaling grid in the Test Configuration section. Use shunt scaling for modules with a shunt resistor and applicable eDAQXR/eDAQXR-lite layers. Before starting the shunt scaling task, define all pertinent parameters for the bridge configuration, including the Shunt resistor and Shunt polarity. See Internal shunt resistor scaling for more information.

Two Point Scaling
Use the experimental two point scaling option to define the two point parameters based on experimental measurements. See Experimental two point scaling for more information.

Lead Wire Resistance
The system can accurately calculate the lead wire resistance if and only if the bridge resistances are all equal and known, and the resistances of all of the relevant lead wires are equal. To use this method, the Bridge type and Bridge resistance fields must be defined correctly. See Calculate lead wire resistance for more information.

eDAQXR EXRBRG sense line bridge channels display the Lead wire resistance parameter only when the Input mode: internal shunt resistor is selected.

Calibration Options
A column with a channel's calibration date may show in the grid. The calibration date format is "yyyy-mm-ddThh:mm:ss" in UTC. See Calibration options for more information.

3.9.4 Computed channels

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

See Grid interface (Page 223) for information about showing and hiding columns.

A list may be sorted by a column's contents, including the Collect column in Test configuration. However, while sorting by the Collect column in the All input channels tab, Computed channels will be sorted separately, below other input channels.

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

On a channels tab, a number shows for total channels in the list.

To filter the channels listed, click the **Search** icon in the Quick link buttons. Enter information in the search bar. The list will show channels containing the entered information. A red number also shows on the tab, which is the number of channels resulting from the search.

While a search is active, the **Search** icon will change color.

Clear the search bar to end filtering.

Available computed channels:

- Anomaly detect (Page 181)
- Bitmap trigger (Page 182)
- Directional velocity (Page 182)
- Down sampler (Page 183)
- Function generator (Page 183)
- Integrator (Page 184)
- Interactive trigger (Page 185)
- Over range detector (Page 185)
- Pulse frequency (Page 186)
- Run stopper (Page 186)
- Signal calculator (Page 187)
- Smoothing filter (Page 189)
- State mapper (Page 190)
- Statistics (Page 191)
- Time base shifter (Page 192)
- Time channel (Page 192)
- Timed trigger (Page 192)
- Track (Page 193)
- Triggered latch (Page 193)
- Triggered zero suppression (Page 194)
- Up sampler (Page 194)

NOTE
The Profile Generator computed channel is for HBM internal use only and is not supported for other users.

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

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

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

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

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

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

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

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

Removing a computed channel
Select the desired channel or channels and click **Remove**. Removing channels referenced by other computed channels or DataModes results in an error. Computed channels cannot be recovered after removal.

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

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

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

3.9.5 Output channels

The channel grid interface displays the output channels defined for the current setup.

See Grid interface (Page 223) for information about showing and hiding columns.

The All output channels view displays generic parameters for all defined output channels.

Analog and digital output types have their own tab views which display the specific parameters for outputs of that type.

On a channels tab, a number shows for total channels in the list.

To filter the channels listed, click the **Search** icon in the Quick link buttons. Enter information in the search bar. The list will show channels containing the entered information. A red number also shows on the tab, which is the number of channels resulting from the search.

While a search is active, the **Search** icon will change color.

Clear the search bar to end filtering.

Adding an output channel

There are two methods to add an output channel from the Output channels page.

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

Select the desired channels from discovered hardware on the network.

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

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

Editing an output channel

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

Alternately, edit output channel parameters directly in the channel grid. Select the All output channels tab to edit generic parameters and the analog or digital type tab to edit channel specific parameters.

Copying channel properties

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

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

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

Removing an output channel

Select the desired channel or channels and click **Remove**. Output channels cannot be recovered after removal.

Changing device hardware

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

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

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

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

3.9.6 DataModes™

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

See Grid interface (Page 223) for information about showing and hiding columns.

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

On a channels tab, a number shows for total channels in the list.

To filter the channels listed, click the **Search** icon in the Quick link buttons. Enter information in the search bar. The list will show channels containing the entered information. A red number also shows on the tab, which is the number of channels resulting from the search.

While a search is active, the **Search** icon will change color.

Clear the search bar to end filtering.

In the header, select the **check box** by the title **Name** to select or deselect all listed DataModes.

NOTE
When a large number of channels are selected for a DataMode, the GUI responsiveness can become sluggish. Typically with 500 channels or less, this is not overly intrusive to usability. However, if more than 500 channels are required for any given DataMode, it is recommended that users consider splitting the channels across multiple DataModes when possible; otherwise, users will need to be patient in regard to the GUI response when assigning or editing any of the DataMode parameters.

Available DataModes:

- Burst history (Page 196)
- Burst message logger (Page 197)
- Event slice (Page 198)
- Message logger (Page 199)
- Peak valley (Page 199)
- Peak valley matrix (Page 200)

- Rainflow (Page 201)
- Time at level (One Dimensional) (Page 203)
- Time history (Page 204)

Adding a DataMode

There are two options to add a DataMode.

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

Editing a DataMode

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

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

Removing a DataMode

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

DataMode Memory Consumption

Defined DataModes determine the rate at which the unit 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 unit consumes raw data storage memory as detailed below:

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

3.10 Test and data control

3.10.1 Test control

Preparing a test

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

Optionally, enter an SIE data file name in the Task pane. If no name is entered, the file name defaults to the setup file name. A unique file name is assigned based on the SIE file name pattern setting defined in the Test setup. The SIE filename cannot be changed after a test run is started; however, it can be changed after the test run is stopped.

Optionally, provide a test run description in the Task pane. This information is embedded in the SIE file as metadata and cannot be changed after the test run is started. Information entered here will show in a Run description column in the Test and data control SIE data page. If no information is entered, the column will show the text No Run Description. See SIE data for more information.

NOTE
Before starting a test, make sure there is adequate storage available on the CPU for the test, whether the CPU is used as a master or slave node. Less than 2 MB of available storage will not allow a test to start.

Live updates

In the header by the Test selector, click **Start live updates** or **Stop live updates** as needed to control live updates. These controls in **Test configuration** and **Test control** both control live updates. See Test setup **> Live updates** for more information about options.

Running a test
If the test run mode is either Normal or Cyclic, start the test run by clicking on the **Start** icon. A running test is indicated by the yellow LED flashing rapidly in the status bar and on the device. To stop the current test run, click **Stop**. If the test run mode is Cyclic, this ends the automatic cyclic starting and stopping of test runs.

If the test run mode is Remote Control, both the Start and Stop icons will be disabled when the SXR configuration file is selected. Click the **Enable Remote Control** button located above the **Start** and **Stop** icons.

The test run will start immediately if the physical remote control switch is in the on position. If no switch is connected to the eDAQXR or eDAQXR-lite, the test will start immediately. Otherwise, throw the switch to the on position to start the test. Note that the **Start** and **Stop** icons will remain disabled.

To end the remote control mode, which will typically span multiple test run starts and stops, click **Disable Remote Control**. If a test run is in progress, the test run will be stopped after the user confirms this action is desired.

See Remote control run mode for more information.

Enter characters to name a file in the **Save data file as** window. The file name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<' and '>' or the problematic character string ".sie" [case sensitive]). When ';' is in a test setup name, '_' replaces ';' in the SIE file name generated by a test run.

During the test run, the following run statistics are displayed in the Task pane:

- **File name**: SIE data file name. Click the file name to download the SIE file to the local machine.
- **Modified**: System date/time of the last update to the SIE file.
- **Size**: Current size of the SIE file. After the first 100 Kb, the units are displayed in kilobytes (Kb). Mouse over the field to see the exact file size in bytes.
- **Elapsed**: Total elapsed time in seconds for the current test run.

A file description may be entered in the **Description** window.

Viewing live data

The Display Views panel is a workspace for creating charts to display live channel data and limited test statistics while the test is running.

To create the first chart, select the desired channels from the Channels list. To add a new chart, drag a channel into an empty area of the Display Views panel. Add channels to an existing chart by dragging a channel onto the chart window or by clicking the chart window to make it the active window and selecting channels from the Channels list. To add a digital meter containing all test channels (up to the current maximum of 100), click the **Show All Channels in DVM** button at the top of the Channels list.

NOTE

Live display views can be configured before a test run is started and also while a test is running. When a test is running the user should pay attention to the CPU load indicator on the status bar to understand how much additional processing load is being consumed to drive the live displays. This can be significant and there is the possibility that the CPU will overload and the system will reset on error. The system is designed to preferentially disable the live displays when the CPU load is too high, but this functionality may not always work.

NOTE

The actual rendering of the live display charts is done on the client device (for example, on a PC or tablet). For most modern client devices with high processor or graphics accelerator speeds, the client device will usually not be a factor.

However, for reasons beyond the scope of this help topic, the web browser used can be a significant factor. As of the present software version, the user is strongly advised to use one of the recommended browsers. For more information, see Recommended browsers.

A related issue is anti virus software running on the client device. Using HTTPS will minimize the likelihood of anti virus software negatively impacting display capabilities. For users who are not connected to the Internet, disabling anti virus software should be considered.

Managing display views

The Display Views panel can contain many different display views, each with its own named tab. Left click, drag and drop a tab to move it. Tab positions are saved. Different views allow for a variety of chart types, sizes, locations and channels. Display views can be created or modified at any time.

To manage views, open the views menu by clicking the menu button ( ) or right clicking in the Display Views panel.

- **New View**: Create a blank view tab. Alternatively, click the plus (+) tab to the right of the existing view tabs.
- **Save View**: Save the current display view. To save all views, click the save button ( ).
- **Save View As**: Duplicate the current display view and save it under a new name.
- **Rename View**: Rename the current display view.
- **Delete View**: Remove the current display view. Alternatively, click the "x" on the view tab.
- **Import...**: Import charts from a selected Test Setup. All charts in all tabs are imported from the selected SXR file. Display views are saved immediately when charts are imported. If a tab is selected in the Display Views, charts are imported to a newly created tab. A tab without a chart on it will also be imported.
- **Cascade Charts**: Cascade all display views in layers from left to right, first to last manipulated display view.
- **Tile Charts**: Fit all display views as tiles in the Display Views panel.
- **Delete Charts**: Remove all display views. Alternatively, click the "x" on the view tabs.
- **Revert Unsaved Changes**: Undo dialog selections made since the last save.

Maximize or minimize a chart

To change the size of a chart, double left-click in the header bar of a chart.

Freeze or unfreeze all charts

- **Freeze All Charts**: Select the snowflake button to pause live data displays.
- **Unfreeze All Charts**: Select the defrost button to resume live data displays.

Chart types

- Strip chart: Plot of one or more channels as a function of time.
- Single channel digital meter: Digital display of a single channel value.
- Multi-channel digital meter: Tabular digital display of multiple channels.
- Analog meter: Analog gauge display of a single channel.
- Spectrum chart: Frequency domain spectrum plot of a single channel.
- X-Y plot : Plot of one channel on the Y-axis vs. another channel on the X-axis.
- Min/Max tracking of multi-channel digital meter with alarms: A Min/Max chart is a digital display of minimum, current and maximum data values for each channel. Warning and alarm level exceedance indicators are provided on a per channel basis.
- Interactive trigger chart: Display an interactive trigger channel as an interactive chart.
- Video display: Display of current frame of a single video channel.

Installing shunts

Shunt control allows installation and removal of shunt resistors during a test run. If the current test contains one or more applicable channels, click **Shunt...**. The **Shunt Control** dialog is presented.

To install the shunts on all applicable channels, which is every channel in the test defined using one of the Bridge sensor input modes, select one of the following shunt modes.

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

Opposite: This mode will apply the opposite shunt polarity relative to the **Normal** shunt polarity for all channels where it is supported by the hardware.

Up scale: This mode will apply the **Up scale** (positive swing) shunt polarity for all channels where it is supported by the hardware.

Down scale: This mode will apply the **Down scale** (negative swing) shunt polarity for all channels where it is supported by the hardware.

NOTE

Shunt polarity is based on electrical units scaling (i.e., mV/V scaling). If the sensor scaling slope is negative, the shunt polarity in output units is in the opposite direction. For example, the Up Scale option would result in a negative swing in the output data.

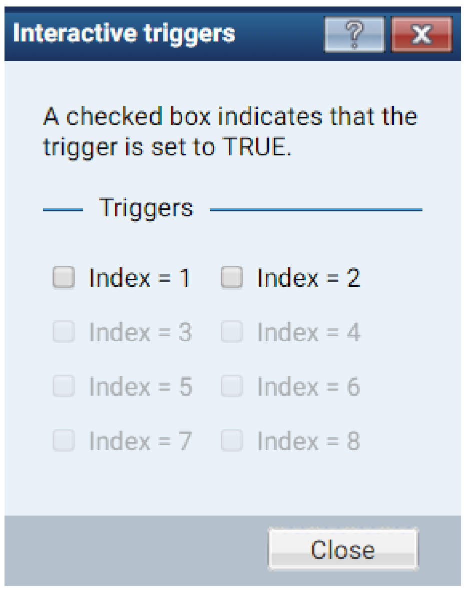
To remove the shunts, select **Remove shunt**.

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

NOTE
The Shunt Control dialog can remain open while navigating the web application and closes automatically at the end of the test run. (It is also closed if the web browser is reloaded or refreshed.)

Controlling interactive triggers
Interactive triggers provide a means to manually trigger computed channels and Data Modes during a test run. Set up interactive triggers using one or more Interactive trigger computed channels.

If the current test contains an Interactive Trigger computed channel, click **Trigger...**. The **Interactive triggers** dialog is presented.



To change the state of a trigger, check or uncheck the box. The change is applied immediately when the box is checked or unchecked.

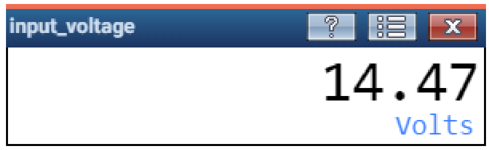
NOTE
The Trigger Control dialog can remain open while navigating the web application and closes automatically at the end of the test run. (It is also closed if the web browser is reloaded or refreshed.)

See Interactive trigger chart about creating an interactive chart for an interactive trigger channel.

Download the AOX file
To get the AOX file while the SIE test is in progress, click **Get AOX file**.
The file is downloaded with the suffix "aox" after the test name. See Output channels and AOX files for more information.

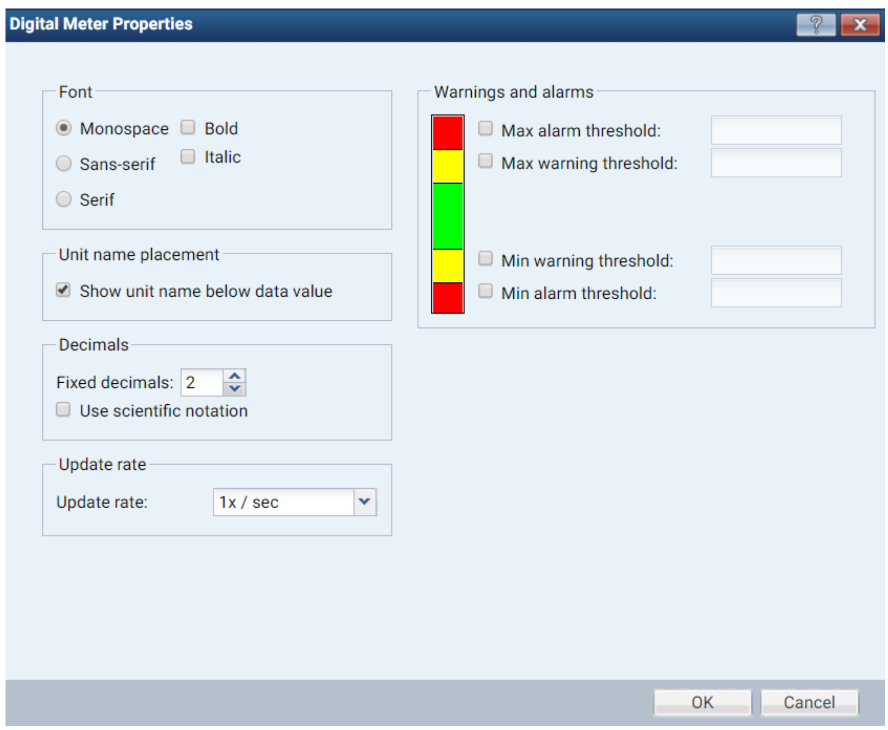
Single channel digital meter

The single channel digital meter displays the current value of the selected channel.



The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Update rate**: Select the rate at which the display refreshes at 1, 2, 5 or 10 times per second. Note that in cases where the channel sample rate is less than the selected update rate, the display refreshes at the lower sample rate.
- **Properties**: Select font, unit name placement, decimals, scientific notation, update rate, color scheme and warnings and alarms. After entering information in the Digital Meter Properties dialog, click the **OK** button.

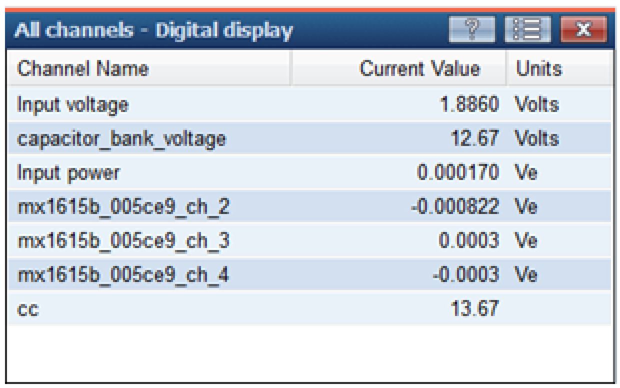


  - **Font**: Three font varieties are available. Monospace takes less space, sans-serif improves legibility and serif is easiest to read. Two additional formats are available, bold and italic.
  - **Unit name placement**: The units string is shown in the caption banner by default. Select "Show unit name below data value" to have it shown below the data in a larger font.
  - **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.
- ◦ **Warnings and alarms**: When the display is created, the values for these fields are based on the values specified in the grid interface / single channel editor for the selected channel. See System channels **> Scaling parameters > Warning and Alarm min and max** for more information. However, these initial values can be changed in the single channel digital meter.

Multi-channel digital meter

When multiple channels are selected, the digital meter display shows the current values of the channels in a grid.



NOTE

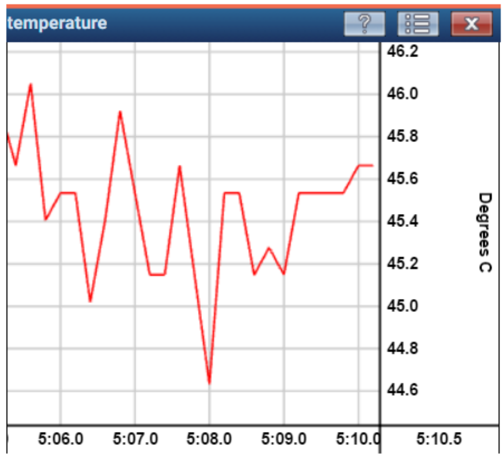
In the Channel select pane, there is an option to “Show All Channels in DVM (Max 100)”. This is provided as a short cut to allow users to see all channels if there are 100 or less defined in the test. However, using the selection check boxes, there is no limit on the number of channels that can be added.

The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Update rate**: Select the rate at which the display refreshes at 1, 2, 5 or 10 times per second. Note that in cases where the channel sample rate is less than the selected update rate, the display refreshes at the lower sample rate.
- **Font size**: Change text size among 1x, 2x, 3x, 4x or 5x options. Adjust the chart size by click and drag so the larger text is visible in the chart.

Strip chart

The strip chart is a plot of one or more channels as a function of time.



The following options are available from the menu. Click the **options menu button**:

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

Strip chart properties

NOTE
Change default chart options, such as background color and grid display, in User preferences.

After entering information in the Strip chart properties dialog, click the **OK** button.

Y-Axis

NOTE
For a chart with multiple y-axes, select <All Channels> to use the same scaling mode for all channels; otherwise select a specific channel to set the scaling mode for that channel only.

- **Scaling**: Select the Y-axis scaling mode.
  - **Automatic** (default): Y-axis lower and upper values are set automatically based on current and past readings.

- ◦ **From hardware**: Y-axis lower and upper values are based on the user defined *Range min* and *Range max* parameters specified in the test setup.
- ◦ **Fixed**: Y-axis lower and upper values are based on the user specified Min and Max values.

X-Axis

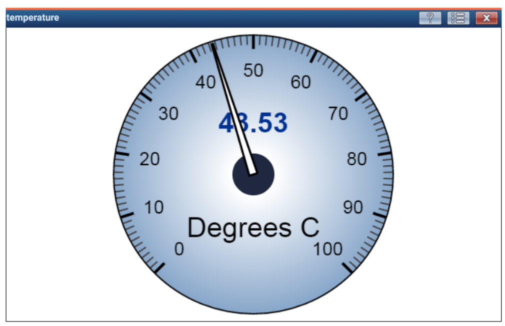
- **Time window (ms)**: Specify the span of the X-axis in milliseconds. Note that a value that is too large can cause performance issues.
- **Axis label format**: Set the time format for the X-axis label among options for hours, minutes, seconds or tenths of seconds.

Grid

- **Hide gridlines**: Select to hide the chart gridlines.

Analog meter

The analog meter is an analog gauge display of a single channel.



The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Properties**: Open the chart properties dialog box.
- **Decimals**: Select the number of decimal places to show.

Analog meter properties

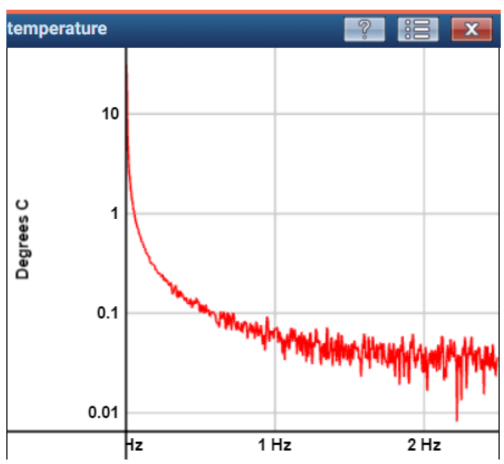
After entering information in the Analog Meter Properties dialog, click the **OK** button.

- **Value range (KB)**: Channel units show in the parentheses and on the analog meter (e.g., KB, Degrees C, %, mV, etc.). The Minimum and Maximum values may be specified for a channel in **Test configuration** Scaling mode of the edit channel dialog or the grid interface by specifying Range min. and Range max..
  - ◦ **Minimum value**: Specify the minimum value shown on the analog meter.
  - ◦ **Maximum value**: Specify the maximum value shown on the analog meter.
- **Angular range (degrees clockwise from North)**: Place the extremes for the meter by specifying angular degree values that are cumulatively 360 degrees or less, such as the defaults -135 and 135.
  - ◦ **Min. needle angle**: Specify the minimum angle for the extreme of needle travel.
  - ◦ **Max. needle angle**: Specify the maximum angle for the extreme of needle travel.

- **Tick spacing (KB)**: Unit type for the channel is shown in the parentheses here, as it shows on the dial of the analog meter (e.g., KB, Degrees C, %, mV, etc.). The lower the specified value, the larger the number of ticks.
  - **Minor ticks every**: Specify spacing between minor tick marks around the circumference of the meter.
  - **Major ticks every**: Specify spacing between major tick marks around the circumference of the meter.
- **Needle animation options**
  - **Disable transition smoothing**: Click to disable needle transition smoothing.
  - **Time constant for transition smoothing (sec)**: Specify the time interval after which the needle will have moved about 2/3 the distance to the new value. When the channel value changes, the needle moves smoothly to the new value, i.e., the higher the time constant value, the slower the needle moves in response to value changes.

Spectrum chart

The spectrum chart is a frequency domain spectrum plot of a single channel. The frequency is displayed along the horizontal axis and the spectral power/amplitude is displayed along the vertical axis. The vertical axis can be configured in one of three modes described under **Spectrum properties** below.



The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Properties**: Open the chart properties dialog box.

Spectrum properties

> **NOTE**
> Change default chart options, such as background color and grid display, in User preferences.

After entering information in the Spectrum properties dialog, click the **OK** button.

- **Output type**: Set the output type and scale for the Y axis.
  - **Amplitude (log10 Y axis)**: Spectral amplitude is shown on the vertical axis using a logarithmic scale.
  - **Power (dB from Peak)**: Attenuation from peak is shown on the vertical axis. The current peak amplitude is plotted as 0 and all other values are plotted in decibels below this peak value.
  - **Amplitude (linear Y axis)**: Spectral amplitude is shown on the vertical axis using a linear scale.

FFT Parameters

NOTE
The Hann window function is applied to the sample window when calculating the spectrum.

- **FFT size**: Set the size of the FFT window in number of samples.

Frequency Range (X Axis)

- **Automatic**: Select to automatically scale the horizontal axis. Zero Hz (representing the signal's DC bias) is placed at the left and the Nyquist frequency (half the sample rate) is placed at the right.
- **Minimum frequency**: If automatic scaling is not selected, specify the frequency value at the left edge of the horizontal axis.
- **Maximum frequency**: If automatic scaling is not selected, specify the frequency value at the right edge of the horizontal axis.

Output Range (Y Axis)

- **Automatic**: Select to automatically scale the vertical axis. The top and bottom values are set so that all spectral data is visible. The scaling may shift during a test as the spectrum changes.
- **Minimum value**: If automatic scaling is not selected, specify the value at the bottom edge of the vertical axis. For "Amplitude" output types, this value is in channel units. For the "Power" output type, this value is in decibels from peak (and values are always negative or zero).
- **Maximum value**: If automatic scaling is not selected, specify the value at the top edge of the vertical axis. For "Amplitude" output types, this value is in channel units. For the "Power" output type, this value is in decibels from peak (and values are always negative or zero).

X-Y plot

This is a chart for two channels, showing on a display with x and y axes. Both channels must have the same sample rate. A sample rate column shows in the channels list.

The X-Y plot shows the history of the data over a time period, until it is reset. For example, longitude and latitude values from GPS input may be used to plot a test vehicle’s path.

- **X axis (default)**: Display a single x-axis inheriting the properties of the first channel added to the chart.

- **Y axis: (default)**: Display a single y-axis inheriting the properties of the second channel added to the chart.

The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Properties**: Open the chart properties dialog box.
- **Reset**: Select to clear the chart during a test run.
- **Show legend**: Select to show a legend of channel names and colors in the field of the chart.
- **Plot points**: Select to show data as points (x,y) on the plot.

Properties
After entering information in the X-Y plot properties dialog, click the **OK** button.

Y-Axis

- **Scaling**: Select the Y-axis scaling mode.
  - **Automatic** (default): Y-axis lower and upper values are set automatically based on current and past readings.
  - **From hardware**: Y-axis lower and upper values are based on the user defined *Range min* and *Range max* parameters specified in the test setup.
  - **Fixed**: Y-axis lower and upper values are based on the user specified Min and Max values.

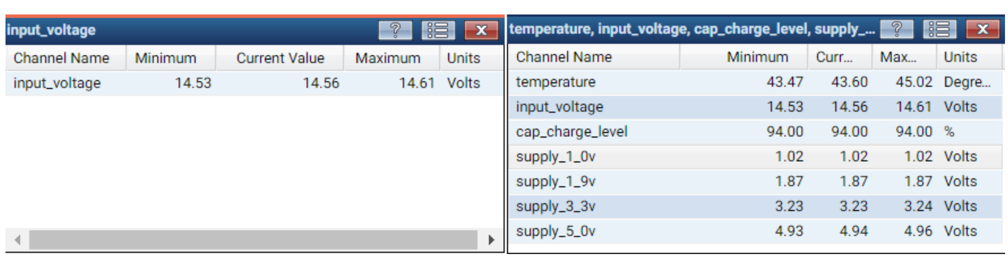
X-Axis

- **Scaling**: Select the X-axis scaling mode.
  - **Automatic** (default): X-axis lower and upper values are set automatically based on current and past readings.
  - **From hardware**: X-axis lower and upper values are based on the user defined *Range min* and *Range max* parameters specified in the test setup.
  - **Fixed**: X-axis lower and upper values are based on the user specified Min and Max values.

Time / Grid

- **Time window (ms)**: Specify the span of the X-axis in milliseconds. Note that a value that is too large can cause performance issues.
- **Hide gridlines**: Select to hide the chart gridlines.

Min/Max tracking of multi-channel digital meter with alarms


input_voltage

Channel Name	Minimum	Current Value	Maximum	Units
input_voltage	14.53	14.56	14.61	Volts

temperature, input_voltage, cap_charge_level, supply_...

Channel Name	Minimum	Curr...	Max...	Units
temperature	43.47	43.60	45.02	Degre...
input_voltage	14.53	14.56	14.61	Volts
cap_charge_level	94.00	94.00	94.00	%
supply_1_0v	1.02	1.02	1.02	Volts
supply_1_9v	1.87	1.87	1.87	Volts
supply_3_3v	3.23	3.23	3.24	Volts
supply_5_0v	4.93	4.94	4.96	Volts

A Min/Max chart is a digital display of minimum, current and maximum data values for each channel.

Warning and alarm level exceedance indicators are provided on a per channel basis. Note that these are currently used only in the single channel digital display and the test run time Min/Max chart displays.

The Min/Max values are tracked for the lifetime of chart control:

- If a test is started with a Min/Max chart open, the values will be tracked until the test is stopped, the chart is closed or the browser is closed or refreshed.
- If a test is started (time = 0 seconds) and afterwards a Min/Max chart is opened (time = 5 seconds), any min/max data between time = 0 and time = 5 will not be tracked.
- If a Min/Max chart for a channel is closed and another Min/Max chart is opened for that channel, the Min/Max chart will show data only from after its opening.

Specify appearance in Test Configuration
Specify Range min, Range max, Alarms and Warnings min and max in **Test Configuration** in the Scaling mode section of the Edit channels dialog or the grid interface.

See System channels**> Scaling Parameters > Range min and max** and **Warnings and Alarms min and max**(Page 176) for more information.

See also User preferences, **General** menu item for Decimal point handling of Range min/max values.

The following options are available from the menu. Click the **options menu button**:

- **Freeze**: Select to pause the data display. Deselect to resume live data.
- **Reset**: This resets the minimum and maximum 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.

Interactive trigger chart

An interactive trigger channel may be dragged into Display Views. Select Trigger to make an interactive trigger chart. The chart shows the channel name and trigger state (True or False). The trigger index number is shown in the chart header.

While a test or live update is running, click on the chart or the Index click box in the Interactive trigger dialog (when open), to change the trigger state. A chart and Index click box change states together.

Index identifiers (eight available), interactive trigger name and trigger results are selected in set up of an interactive trigger channel. See Interactive trigger for more information about set up of an interactive trigger channel.

Video display

The video display shows the video stream from the selected camera channel. See Camera channels for more information.

When the camera is correctly configured, the camera shows in the Test configuration Hardware panel. A dialog may show if the camera needs a reset to factory default. See Setting up an Axis network camera for more information.

> **NOTE**
> A video display may not show every frame and rotation.

In the Test configuration Hardware panel, click the eye icon by the camera channel for video display.

In the Test configuration Input channels panel, select the camera channel and click **Digital Meter** for video display. Freeze and Rotate buttons allow image control. The Rotate button temporarily overrides the channel editor Rotation setting for this display.

In the Test control panel, select the camera channel for video display in the Display Views panel. Change the size of the video display as desired, using the mouse cursor. An SIE test must be running to operate the Freeze and Rotate options. Rotate the image as desired during a test run. Click the Save button to use the rotated view in another test run.

- In the **Header** menu click **User options** and **Preferences**. In the **User Preferences** dialog menu, select **Charts**. A checkbox by **Maintain aspect ratio for video displays** is selected by default. This default makes the aspect ratio (such as 4:3) remain the same when the size of the video display is changed.
- If the checkbox is not selected, the image in video displays may be distorted when the video display size is changed.

The following options are available from the menu:

- **Freeze**: Select to pause the video display. Deselect to resume live video.
- **Rotate video**: Click to rotate the video display counter-clockwise by degree increments supported by the video device. Please refer to video device manufacturer's documentation for video image rotation, which may be limited to 180 or 90 degree increments.

3.10.2 SIE data

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

- File name: The file name provided from the Test control page before the test run. A red test name indicates that the test is currently running.
- Size (KB): The size of the SIE data file in KB.
- Modified: The date and time that the SIE data file was last modified.
- Author: The test author provided in Test setup.
- Summary: The test summary provided in the Test setup.
- Run description: The Description provided from the Test control page before the test run. If nothing was entered, this column will show the text No Run Description.

Row sort preference
Row sort preference persists through GUI refresh, unit reboot and firmware update. Deleting the database or resetting user preferences will reset the sort preference. Formerly, sort preferences defaulted to the File name column.

NOTE
The system is not designed to handle a large number of SXR or SIE files in an optimally user friendly manner. The reasons for this are complex. In brief, the user interface responsiveness will be degraded when too many SXR or SIE files exist. To avoid this situation, a good rule of thumb is to limit the number of SXR files to 20 or less and the number of SIE files to 50 or less. In situations where this is not feasible or desirable, the system will continue to function properly, but not optimally in regard to user interface responsiveness.

Downloading SIE data files
The easiest way to download a single SIE file to the local machine is to click its file name. Alternately, select the check box next to the desired file and click **Download**. Multiple SIE files can be downloaded by selecting multiple check boxes. However, only Chrome supports this well currently and that is subject to change.

See the topic SIE file metadata (Page 294) for information about SIE file content.

The XR Download Manager application is provided to circumvent all browsers and provide reliable and robust downloads of multiple SIE files, and as such, is recommended. This application may be downloaded from the HBM website under Software for QuantumX & SomatXR. See Personal computer support applications for Download Manager installation instructions.

Downloading SIE files (including the active SIE file) is allowed when an SIE data collection test in running. Please note the following.

1. Downloading SIE files requires CPU processing that competes with normal test run CPU processing. It is possible that starting an SIE download will result

in overloading the system to the point where the test will stop and the system will reset. This is of primary concern when the test is already loading the CPU significantly (for example, 80% or more). However for any test where an error reset is considered unacceptable, users are strongly advised to wait until the test is stopped before downloading the SIE file.

2. The CX23-R/EXRCPU buffers test data in memory before it is written to the SIE file. As a result, an active SIE file downloaded while a test is running will not contain acquired data that has been buffered, but not yet written. Some DataModes™, such as histograms, are not completely written to the file until the test run is stopped. Download the file again after the test has stopped to ensure that the file contains all test data.

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**.

The file name must be unique and contain valid characters (invalid characters are single and double quotes, '\', '@', '#', '&', '<' and '>' or the problematic character string ".sie" [case sensitive]). When ';' is in a test setup name, '_' replaces ';' in the SIE file name generated by a test run.

. 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!

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

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

Click the desired extraction option.

Extract test configuration
Enter the desired file name. Click **Export** to save the file to the local machine.

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

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

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

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

NOTE

Extraction of raw CAN/GPS channels from large data sets using the web interface may be unreliable. The SIE file data itself is not affected. These data sets can be retrieved by downloading the SIE file to a PC and using another application such as the XR Download Manager to perform the extraction.

Viewing SIE data

Several types of data and information can be viewed from SIE files, including strip charts and video.

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

The application **XR Data Viewer** opens in your browser.

View channels by clicking on the green Plus icon in the lower right corner of the viewer, then selecting a channel from a drop down list in the header. A green bar to the right of a channel chart shows the view is selected. Close a view by clicking the red X in the right hand corner of the channel chart.

View the value of a point on a chart by moving the mouse pointer on the chart.

Zoom in or out on the charts using the mouse scroll wheel.

To view more of a chart while zoomed in on a chart, use the mouse pointer to slide the bar on the time scale at the bottom of the viewer window.

4 Operational notes

4.1 Data Synchronization

This section discusses the accuracy of the phase synchronization of the data samples sourced form the legacy eDAQ layers using an eDAQ or eDAQXR system. Legacy eDAQ layer synchronization across channels is accomplished using a single master clock source that drives the data acquisition hardware. The term lag indicates that, in a Time History plot, the data appears later than it should while the term lead indicates that the data appears earlier than it should.

NOTE
Unless otherwise noted, the following discussion and numerical examples assume the Decimal sample rate domain.

Data Synchronization Characterization Method

A ±5000-millivolt triangle function generator waveform is fed in parallel into all channels to be characterized. The frequency of the waveform is set at the sample rate divided by 1000 to yield 1000 sample points per cycle. For each reversal, all data samples that fall between ±2000 millivolts are least squares fit to provide a very accurate measurement of the zero crossing time. The differences in these zero crossing times from one channel to the next represent the data skew from one channel to the next. For each test run, the data skew on at least 200 consecutive reversals is measured and then averaged. At least 3 test runs are performed and the average data skew over the set of test runs is the characterized data skew value.

Analog Channel Phase Synchronization

The EHLS and EBRG channels all employ pre-start periods to compensate for their analog guard filters. In addition to the guard filter skew, there are some other secondary factors that influence data synchronization, such as A/D converter conversion time and transport delays through gain amplifiers.

NOTE
This discussion assumes no digital filtering. Ideally, linear phase digital filters do not result in phase shifts. For the EHLS and EBRG channels, however, the linear phase filters for sample rates at or below 10000 S/s result in a five microsecond lead data skew. The Butterworth digital filters are designed to match their analog equivalents and, therefore, these filters do generate significant phase shifts which, in turn, significantly affects phase synchronization across channels.

Following is a table that contains actual data skew characterization test results (in microseconds) for one eDAQ stack. The data in this table is consistent with the data skew times discussed in this section. The first channel on the first EHLS layer was arbitrarily used as the data sync time reference channel. The test covered the first four channels on two EHLS layers and the first four channels on one EBRG layer. Where applicable, the phase synchronization was characterized using three different sample rates for both the Decimal and Binary sample rate domains.

Channel	Sample Rate (S/s)					
	25000	10000	2500	32768	8192	2048
HLSS_1.c01	0.00	0.00	0.00	0.00	0.00	0.00
HLSS_1.c02	0.37	0.37	0.37	0.37	0.40	0.38
HLSS_1.c03	-0.09	-0.10	-0.05	-0.09	-0.07	-0.06
HLSS_1.c04	-0.08	-0.09	-0.09	-0.09	-0.07	-0.05
HLSS_2.c01	0.11	0.14	0.21	0.10	0.15	0.05
HLSS_2.c02	0.16	0.17	0.19	0.15	0.23	0.16
HLSS_2.c03	0.12	0.14	0.17	0.11	0.16	0.11
HLSS_2.c04	0.31	0.32	0.37	0.30	0.33	0.30
Brg_1.c01	1.65	1.64	1.68	1.60	1.60	1.57
Brg_1.c02	1.55	1.54	1.59	1.50	1.49	1.46
Brg_1.c03	1.42	1.42	1.45	1.38	1.37	1.38
Brg_1.c04	1.57	1.57	1.63	1.52	1.49	1.55

EHLS and EBRG Channel Synchronization

For EHLS and EBRG channels, the relative data synchronization across all channels in any given legacy eDAQ layer stack is typically within a few microseconds. All of these channels use the same type of Butterworth 8-pole analog guard filter, which produces a delay of around 42 microseconds (±2 microseconds). The eDAQXR compensates for this delay by using a fixed value of 40 microseconds for the Decimal sample rate domain to pre-start digital data sampling and align the digital data as close as possible to the actual sample rate clock.

Digital Channel Synchronization

The legacy eDAQ EDIO digital input channels are synchronized to the analog channels as closely as possible. The EDIO layer reads the state of the digital input status register for each digital channel on each edge of the sample clock signal (i.e., when the analog channel A/D converters are read). However, because the digital status registers are updated when a digital input channel changes states, the precise time when a digital input channel changes state is, in general, somewhere in between sample clock edges and hence is not known exactly. Because of this, the digital input channels are expected to lag the analog channels by about half of the sample period on average.

4.2 Networked EXRCPU or EXRLCPU units

Networked eDAQXR/eDAQXR-lite units can be connected in a variety of ways.

Networking Modes: There are two modes that are supported. There is an SXR test configuration option to specify the desired mode. See Test setup **> Network mode** for more information.

NOTE
Before starting a test, make sure there is adequate storage available on the CPU for the test, whether the CPU is used as a master or slave node. Less than 2 MB of available storage will not allow a test to start.

Mode 1 Networking

One eDAQXR/eDAQXR-lite serves as the networked system host (subsequently referred to as the master node), and all other connected eDAQXR/eDAQXR-lite units provide source data to the master node (subsequently referred to as slave nodes). The master node is not defined in the SXR setup file. When the user starts a test on any network node, that node becomes the master node. This allows the user to experiment with CPU load balancing which is discussed later.

The master node is always used to start the test. The master node runs the test engine that processes all input channels, Computed channels and DataModes and drives the run time displays. A single SIE file is generated on the master node only.

The user only needs to communicate with the master eDAQXR/eDAQXR-lite.

All test runs modes (Normal, Cyclic and Remote control) are available in a networked system. If the Remote control run mode is used, the EXRCPU/EXRLCPU IO switch 1 on the master node must be used.

Mode 2 Networking

The primary difference between Mode 1 and Mode 2 from the user point of view is that every node runs a test engine and generates an SIE file. This mode will typically only be used when Mode 1 cannot be used due to CPU processing limitations on the master node, or when there is insufficient SIE file storage space on the master node.

While each node generates an SIE file, the SIE files are logically linked together. When the SIE file is downloaded on the master node (or on any slave node), the system generates a composite SIE file containing all of the data from all nodes. Similarly, if the user deletes an SIE file on any node, the SIE files on the other nodes are also deleted.

NOTE

There is the following restriction on the current offering for Mode 2 networking.

• Channels cannot be shared across the network nodes (i.e., channels defined on any given node cannot be used on another node for DataMode triggering, use in a computed channel, etc.).
The user interface does not prohibit this. If the user configures as SXR test in this way, the user interface will attempt to start the test run. However, the system will reset on error.

Physical Connection Options: These options are completely independent of the option to use Mode 1 or Mode 2 networking.

Connections with no EX23-R switch: A maximum of three eDAQXR units can be connected. A maximum of two eDAQXR-lite units can be connected.

1. For a minimal two eDAQXR node system, connect either of the ETH ports on one node to either of the ETH ports on the other node. For the two eDAQXR-lite node system, connect the E1 port of the first node to the E1 port of the second node.
2. For a three eDAQXR node system, select one node (the first node) to use both ETH1 and ETH2 ports. Connect one of the ports on the first node to either of the ETH ports on the second node, and connect the other port on the first node to either of the ETH ports on the third node.
3. Unused eDAQXR ETH ports can be used for other network devices such as MX modules, Axis cameras routed through a commercial POE switch, etc.

Connections using one or more EX23-R switches: There is no restriction on how many eDAQXR nodes can be connected.

1. Currently, the only officially supported connection mode is to connect all eDAQXR/eDAQXR-lite ETH1 ports to one of the EX23-R ports, and to connect nothing to any of the eDAQXR ETH2 ports.
2. Unused EX23-R ports can be used for other network devices such as MX modules, Axis cameras routed through a commercial POE switch, etc.

CPU load balancing (Mode 1): For many applications, the user does not need to be concerned with this issue. However, if the average CPU load of any node exceeds 50%, the user should consider options for balancing the CPU loads across the nodes, which may require some trial and error experimentation. Following are some guidelines.

1. The master node will typically have the highest CPU load. It is usually best to configure the units so that the slave nodes have as many eDAQ/eDAQ-lite layers as possible. Similarly, assign most MX modules and Axis cameras to slave nodes. EXRCPU/EXRLCPU CAN and GPS interfaces are processed almost completely in the test engine and so it is not very important which node these are connected to.

2. Source data streams from MX modules, Axis cameras and future network data are assigned to one of the eDAQXR/eDAQXR-lite network nodes for “first level” data handling. These network sources are all assigned to the master node by default. However, the user will often want to assign these to one of the slave nodes. Note that these network node assignments are completely independent of the physical ETH port network connections.
3. With a system configured, it is advised that the user run some check out tests with the System channel “cpu_load” added to the test for each network node. Start the checkout test and let it run for 5 minutes or so. Analyze the SIE data for these channels to assess the load balancing and decide if further action is required.
4. Bear in mind that adding run time displays will place additional (and often significant) load on the master CPU. As such, if these are not already defined in the checkout tests, configure the test so that the master node CPU load is as low as possible.

CPU load balancing (Mode 2): While this is somewhat less of a concern relative to Mode 1 networking, the master node still has the processing overhead for interacting with the user interface and running the display charts. As such, the suggestions above for Mode 1 networking are still applicable.

Status LEDs

RUN (yellow) LEDs on Master and Slave units have an 8 Hz flash to show a test run is in progress in Mode 1 or Mode 2 networking.

See Status LEDs for more information about operational information shown by other CPU LEDs.

4.3 Shunt scaling based on a known shunt scaling

This shunt tool allows the user to define a shunt scaling based on a known reference shunt scaling. This is used when the reference shunt resistor is not available in the hardware.

For example, a 175 kOhm shunt is known to be equivalent to a load of 1000 pounds, but the hardware only supports a 100 kOhm shunt resistor. The equivalent load using the 100 kOhm shunt is computed using the following formula :

$V_e = V_k * ((R_g + 2 * R_{sk}) / (R_g + 2 * R_{se}))$, where:

R_g = Bridge resistance (Ohm)

R_{sk} = Known shunt resistance (Ohm)

V_k = Known physical units value

R_{se} = Equivalent shunt resistance (Ohm)

V_e = Equivalent physical units value

The dialog window controls are described as follows:

Shunt resistance (kOhm): The known shunt resistance in kOhm units.

Physical value (units): The known physical value in Physical units.

NOTE
Be careful to ensure that the known shunt scaling applies to the same leg of the bridge circuit that will be used in the hardware shunt calibration; otherwise, the polarity of the computed shunt span may be inverted.

4.4 SIE file metadata

SomatXR/eDAQXR SIE channel metadata

Tag	Example	Comments
Metadata provided prior to v2.0.0		
"core:description"	BRG_1 Connector 1	User defined description
"core:uuid"	67d8876b-ef79-414e-8a72-94a615ba558a	System internal unique ID
"core:sample_rate"	2500	Sample rate in Hz
"data_type"	sequential_float32	Data storage data type (composite)
"core:schema"	somat:sequential	Data storage mode
"somat:data_format"	float	Data storage data format type
"somat:data_bits"	32	Data storage length in bits
"somat:input_channel"	ecpuxr_500016_brg_1_1	User defined name
"somat:connector"	connector1@brg_1.edaqxr-500016	Internal hardware connection name (not used in the GUI user interface)
"somat:datamode_type"	time_history	DataMode type
"somat:datamode_name"	dm	DataMode name
Additional metadata provided in v2.0.0		
"somat:user_interface_sample_rate"	2500	For all sample rate domains except the HBM Classic domain, this is the same as "core:sample_rate"
"somat:connection"	ecpuxr-500016:brg_1.c1	User interface hardware connection name. Does not include network node for expansion modules (e.g., MXB modules, Axis cameras)
"somat:module_type"	EBRG	Hardware module type (marketing name)
"somat:network_node"	edaqxr-500016	User assigned Network node (applicable for expansion modules only)

"somat:measurand"	Strain	User defined value for the measurement type (or any other thing the user decides to use it for)
"somat:user_defined_column_name_1"	Group	User defined column 1 name
"somat:user_defined_column_value_1"	A	User defined column 1 channel value
"somat:user_defined_column_name_2"	Chan #	User defined column 2 name
"somat:user_defined_column_value_2"	1	User defined column 2 channel value
"somat:user_defined_column_name_3"	Pictures	User defined column 3 name
"somat:user_defined_column_value_3"	rosette_tbar_3.jpg	User defined column 3 channel value
"somat:user_defined_column_name_4"	Installer	User defined column 4 name
"somat:user_defined_column_value_4"	Joe	User defined column 4 channel value
"somat:electrical_units"	mV/V	System defined electrical units (i.e., source data units before scaling)
"somat:output_units"	microstrain	User defined / selected output units (i.e., physical units)
"somat:scaling_mode"	defined_slope_intercept	Scaling mode used to convert from "electrical_units" to "output_units"
"somat:scaling_parameters"	m=1.0,b= 0.0	Comma separated parameter value list dependent on the scaling mode. See Table 1.
"somat:scaling_lead_wire_correction"	m=1987.3,b=3.123	Scaling corrected for lead wire resistance (always in the defined_slope_intercept parameter mode). See Table 1.
"somat:zero_offset_target"	0	Zero target value (typically 0)
"somat:zero_offset_value"	3.7653490230000002	Zero offset value
"somat:physical_range_min"	-4000	User defined physical units range min
"somat:physical_range_max"	4000	User defined physical units range max
"somat:digital_filter_type"	linear_phase_fir	Digital filter type (where applicable)
"somat:digital_filter_attenuation_frequency"	833	Digital filter attenuation frequency

"hbm_enum:digital_filter_type"	3	Digital filter type enumeration (where applicable)
"somat:excitation_mode"	ac_4800_hz_sine	Excitation mode
"somat:ac_excitation_carrier_frequency"	4800	AC excitation mode carrier frequency
"somat:ac_excitation_carrier_waveform"	sine	AC excitation mode carrier waveform
"somat:excitation_range"	5	Excitation range in volts
"somat:transducer_power_voltage"	12	Transducer power supply voltage
"somat:sensor_type"	bridge	
"somat:electrical_range_min"	-10	Electrical units range min
"somat:electrical_range_max"	10	Electrical units range max
"somat:bridge_type"	full	Bridge type (full, half, quarter)
"somat:bridge_wires"	6	Bridge wires (3,4,5,6) (applicable to strain gage bridges, inductive bridges, and potentiometers)
"somat:bridge_resistance"	350	Bridge resistance (Ohms)
"somat:bridge_lead_wire_resistance"	0.2	Bridge lead wire resistance (Ohms)
"somat:thermocouple_type"	k	Thermocouple type
"somat:encoder_quadrature"	true	Option to use quadrature counting
"somat:encoder_track_sign"	true	Option to use signed counter / frequency
“somat:encoder_index_reset”	true	Option to reset counter on zero index crossing
“somat:encoder_index_divisor”	1	Number of zero index crossings before counter is reset
“somat:encoder_pulses_per_round”	50	Pulses per revolution
“somat:stale_data_expiration_time”	5	If no new message data is received in this time period (seconds), the channel data is flagged as stale.

“somat:invalid_data_output_value”	65535	Output value to be used when message based channel data is flagged as stale or invalid.
"somat:can_bit_rate"	1000000	CAN bit rate
"somat:can_msg_id"	0x000007B6	CAN message ID (hex format)
"somat:can_bit_length"	16	CAN signal number of bits
"somat:can_bit_start"	48	CAN signal start bit position
"somat:can_data_format_string"	ULSB	CAN signal data format string. See Table 2.
"somat:can_offset"	0	CAN signal offset factor (linear scaling)
"somat:can_scale"	1	CAN signal scale factor (linear scaling)
"somat:can_max"	65535	CAN signal max value
"somat:can_min"	0	CAN signal min value
"somat:can_units"	counts	CAN signal units string
"somat:digital_threshold_high"	1800	Min signal level (in mV) crossing required for digital input channel to transition to logic 1 (true)
"somat:digital_threshold_low"	800	Max signal level (in mV) crossing required for digital input channel to transition to logic 0 (false)
"somat:internal_termination"	true	Boolean option to use internal termination (applicable to CAN channels, RS485 sensors on MX460 modules, etc.)
"somat:smart_module_type"	smstrb	Smart module type (smstrb or smitc)
"somat:smart_module_sn"	SMSTRB4-350-6676	Smart module serial number
"somat:teds_sensor_id"	HBM_UB9_10_1234	TEDS sensor ID
"somat:teds_calibration_date"	7/28/2015	TEDS sensor calibration date
"somat:teds_calibration_period"	720	TEDS sensor calibration period (days)
Additional metadata provided in v2.2.0		
"somat:can_request_msg"	98eafffb010000	CAN request message (system defined)
"somat:ssi_coding"	binary	SSI encoding mode (binary or gray)
"somat:ssi_clock"	1000	SSI clock frequency (kHz)

"somat:ssi_bits"	22	SSI bits (controls angular resolution)
"somat:sensor_id"	430605296858	HBM SDB ID
"somat:sensor_calibration_date"	12/22/2017 12:00:00 AM	HBM SDB sensor calibration date
"somat:sensor_calibration_period"	12/22/2018 12:00:00 AM	HBM SDB sensor calibration expiration date
Additional metadata provided in v2.8.4		
"somat:can_request_rate"	10	CAN request message rate (Hz) (applicable for CX23-R and eDAQXR CAN channels only)
"somat:channel_calibration_date"	2018-11-10T22:43:35	SXR channel calibration date and time (UTC)
"somat:zero_mode"	interactive_only	Zero mode (not_applicable, interactive_only, or normal_test_starts)
"somat:can_message_name"	MSG_ECM_VOLTAGES	CAN message name
"somat:can_source_database"	j1939.dbc	CAN source database file name
Additional metadata provided in v2.10.0		
"SampleCount"	805000	Expected number of samples. Actual number of samples could be less if there was a system crash.

Table 1: Scaling parameters

Scaling mode	Scaling parameters	Example
internal	(none)	
defined_slope_intercept	slope, intercept	m=1.0, b= 0.0
defined_zero_span	physical_span, electrical_span, electrical_zero	ps=1.0, es=1.0, ez=0.0
defined_two_point	physical_1, physical_2, electrical_1, electrical_2	p1=0.0, p2=1.0, e1=0.0, e2=1.0
experimental_two_point	physical_1, physical_2, electrical_1, electrical_2	p1=0.0, p2=1.0, e1=0.0, e2=1.0
strain_gage	gage_factor, bridge_factor	gf=2.0, bf=1.0

Scaling mode	Scaling parameters	Example
shunt	resistor, polarity, physical_span, electrical_ span, electrical_zero, deviation_from_ideal	res(kOhm)=100, pol=up_scale, ps=599.34, es=0.299, ez=0.000175, %dev=0.02364
defined_sensitivity_factor	sensitivity	sf=0.32675
scaling_lead_wire_correction (all modes except strain_gage)	slope(m), intercept(b)	m=1987.3, b=3.123
scaling_lead_wire_correction (strain_gage mode only)	gage_factor, bridge_factor_corrected	gf=2.0, bfc=0.9784

Table 2: CAN data type parameters

SXR format string	Data type	Byte order
UMSB	Unsigned integer	MSB First (Motorola)
ULSB	Unsigned integer	LSB First (Intel)
SMSB	Signed integer	MSB First (Motorola)
SLSB	Signed integer	LSB First (Intel)
FMSB	IEEE Floating point	MSB First (Motorola)
FLSB	IEEE Floating point	LSB First (Intel)

4.5 Long term unattended testing considerations

The CX23-R/eDAQXR system is designed to support fully unattended testing in remote locations. The primary functional requirement to support this is the following. Whenever a test run is interrupted for any of the following reasons, the CX23-R/eDAQXR starts a new test run when it reboots.

- Power supply is lost
- Power is switched off (via the front panel push button switch, or a switch connected to the remote power control wires)
- CX23-R/eDAQXR resets on error
- User initiates a CX23-R/eDAQXR reboot using the web browser interface

NOTE
Before starting a test, make sure there is adequate storage available on the CPU for the test, whether the CPU is used as a master or slave node. Less than 2 MB of available storage will not allow a test to start.

Power control switches: In releases prior to v2.0.0, the system could apparently very rarely “lose track” of the On/Off state that is changed each time the momentary contact front panel push button switch is depressed. One instance of this was reported by a customer and it was also seen once in QA testing. Because on this, the option to completely disable the front panel switch and also the remote power switch was added. See Hardware (Page 258) **> Controlling a module (Reboot, Flash LED, Update firmware, calibration certificate, etc.) > Disable/Enable power switches** for more information. There has been significant rework of the system code responsible for tracking the state of the power switches and while this may not be an issue anymore, that is not known conclusively.

Issues with MX modules: There are multiple issues that can come into play when MX modules are used with the CX23-R/eDAQXR. These issues typically occur very rarely when only 1 or 2 MX modules are connected. However, as the number of connected MX modules increases and the EX23-R switch is used, the likelihood of these issues showing up increases significantly. Note that these issues come into play only when a test run is started after a power up or reboot.

1. **MX subscription time stamps out of phase tolerance**: In brief, this means that one or more of the MX channels would be out of phase by more than the allowable limit of 10 µs if the test run was started. When this happens, the CX23-R/eDAQXR reboots the MX module(s) and then reboots itself. If this happens, about 2.5 minutes of test data will be lost. Typically when this happens, the MX channels phase skew is less than ½ of a sample period. For most testing applications, this is insignificant and because of that, there is a System preference to not reboot the system if the skew is less than ½ of a sample period.
2. **MX modules never synchronize on power up or reboot**: It always takes a little time for the MX modules to synchronize to the CX23-R/eDAQXR system using PTPv2. Typically, the time required is a fraction of a minute. However, sometimes the MX modules take a very long time to achieve synchronization. If all MX modules are not synchronized within 5 minutes, the CX23-R/eDAQXR reboots all MX modules then reboots itself. If this happens, about 7.5 minutes of test data will be lost.
3. **MX modules are not discovered on power up or reboot**: The CX23-R/eDAQXR discovers MX modules by monitoring the Ethernet connection traffic and waiting for the MX modules to provide an “announcement” message indicating that all required services are available. Typically, this takes no more than a few seconds. However, sometimes the proper announcement messages are not received as expected, and in this case the CX23-R/eDAQXR reboots the MX module. If this happens, about 6 minutes of test data will be lost.

Summary

All of the known issues with long term unattended testing have workarounds that will limit data losses to relatively short periods (i.e., less than 10 minutes) when any of these issues comes into play on a system power up or reboot.

4.6 Reset to factory defaults rescue

Perform this operation only when communication to the data processor unit is not possible and all other attempts to establish communication have been exhausted.

Contacting HBM customer service prior to performing this operation is strongly recommended.

All SXR setup files will be moved to a recovery location and will not be available when the rescue is completed; however, it is possible (but not certain) that they can be restored after the rescue.

To restore the unit to factory default:

1. Power down the unit.
2. Press and hold the power switch.
3. When the LEDs flash, stay on and start flashing again, then stay on and start flashing a third time, very quickly release the power switch.

NOTE
It will take about 23 seconds before the LEDS start flashing the 3rd time. There is only about a 1 second window of opportunity to release the power switch.

NOTE
To recover the SXR files that were relocated, do the following. When the unit reboots, immediately navigate to the Customer Service option in the System page and select the Download customer support package. Contact HBM customer service for further instructions.

4.7 SIE file size issues

The data types used for channels are set to minimize CPU load, which means that 64 bit floats are used for all channels where any numerical processing is required. The only exception to this are the MX channels that source data as 32 bit floats, with no numerical processing required. This includes the MX840 CAN channels. However, the MX471 CAN channels are currently stored as 64 bit floats.

See System preferences **> Test > Minimize SIE file sizes using integer data types** option.

Users commonly want to know how long a test can run before it fills up the SIE storage area or reaches a maximum desired SIE file size.

When the system is used in a simple “channel data logger” mode where all channels are stored using the Collect time history storage option (or one or more Time History DataModes configured to use the *Always on* triggering option), this can be calculated with reasonable accuracy using the following steps.

1. There is some overhead in the SIE file for storing the metadata (e.g., SXR setup files, system and hardware information and SIE tags for channel parameters). **As a rule of thumb, this overhead can be estimated as about three times the SXR file size.** While this is insignificant for most testing scenarios, it can be a significant factor for short term tests and/or tests at very low sample rates like 1 S/s or less.
2. The remainder of the SIE file will contain the channel data. For each channel, the storage rate can be computed using the following formula:

bytes_per_second = bytes_per_sample * sample_rate * overhead_factor

a. Refer to the first section of this topic to set **data_type_bytes**. It will be either **4** (for 32 bit float) or **8** (for 64 bit float).

b. The **sample_rate** is available in the user interface.

c. The **overhead_factor** is computed as follows. There are **40** bytes of overhead used for each SIE block of data stored. The amount of data (in bytes) in any SIE block is determined by the following algorithm (provided using C based pseudo code).

```
if (sample_rate >= 50) block_time = 5;
else if (sample_rate >= 10) block_time = 10;
else if (sample_rate >= 2) block_time =20;
else if (sample_rate > 0.4) block_time = 40;
else block_time = 80;
bytes_per_block = sample_rate * block_time * bytes_per_
sample;
if (bytes_per_block > 8000)
bytes_per_block = 8000;
else if (bytes_per_block < bytes_per_sample)
bytes_per_block = bytes_per_sample;
overhead_factor = (bytes_per_block + 40) / bytes_per_block;
```

NOTE

The “block_time” parameter in the above algorithm is the time between block write to the SIE file. For example, at 50 S/s, blocks are written every 5 seconds, and at 1 S/s, blocks are written every 20 seconds.

Of course, it is common for the system to be used in a more complicated mode than a simple “channel data logger”.

1. The storage rate for CAN and GPS raw message channels is not deterministic. However, the user can usually get good estimates by running some tests that store only these channels.

2. For histogram DataModes, the storage area is computed using the following formulas.
  a. For one dimensional histograms: bytes = (bins + 2) * 8
  b. For two dimensional histograms: bytes = (bins + 2) * (bins + 2) * 8

NOTE
The histograms are stored in DRAM memory while the test is running. They are written to the SIE file when the test is stopped. SIE storage space is reserved for this to ensure they can be stored, even if the SIE storage area is fully consumed during the test.

  c. When sequential DataModes such as the Burst History, Peak Valley and Time History with gated triggering are used, the storage rate is not deterministic and in general not feasible to estimate.

4.8 Compressed SIE file downloads

The compressed SIE file download feature only changes data in transit. Regardless of whether compressed SIE file downloads are on or off, the user will still receive an uncompressed SIE file on their computer. This is not to be mistaken with “compressed SIE files” which would compress the SIE file itself into an archive such as zip, tar, gz, etc. and then transfer that compressed file resulting in the user having a compressed archive after a download completes. To reiterate, the user will ALWAYS receive an uncompressed SIE file on the downloading machine regardless of whether or not compressed SIE file downloads are enabled or not.

The following topic is provided to help the user ascertain whether it makes sense to turn compressed SIE file downloads on or off. Due to the many variables at play the following comparisons should be balanced against the user’s application and business requirements.

For example, if the application of use requires the XR unit to be connected, accessed, and data downloaded over a metered cellular connection, then on those grounds alone, turning on compressed SIE file downloads makes sense.

As another example, if the application of use allows for a direct ethernet connection to the XR unit for SIE downloads, it may or may not make sense to turn compressed SIE file downloads on, depending on the size of the SIE file, the network negotiation speed of the link, and the speed of computer executing the download.

The two metrics affected by this option are time and total data transferred.

The total download time with compression turned on depends heavily on the network link speed and the machine being used to execute the download. A slow machine with limited processing power and RAM for example may take an extremely long time to decompress the data after it has arrived, making the total transfer time much longer than a typical SIE download with compression turned off. However, a very powerful machine may take much less time to decompress the data after it has arrived, thus reducing the total transfer time. As expected, higher link speeds will generally yield shorter download time, than lower link speeds.

The total data transferred will depend heavily on the type of data collected. For example, SIE files with diverse data types such as CAN, analog, and video channels in it will have vastly varied compression ratios from test to test, compared to SIE files where only typical analog numerical data is stored which would ordinarily yield higher and more consistent compression ratios. With SIE compressed downloads turned on, the user can expect a considerable reduction in the total data transferred. For customers using metered cellular connections, this is an attractive option.

In our theoretical setup, firmware version 2.8.0 was used, the SIE data comprised of simple numerical values (no CAN, no video), varying SIE file sizes of 100MB, 500MB, and 1000MB, with downloads executed at the specified connection speeds, with compression turned on or off, using a very powerful machine with lots of processing power and memory.

The following table shows our laboratory results using the CX23-R.

SIE File Size	Network Speed	Compression	Total Data Transferred	% Compression	Total Download Time (seconds)
100MB	1Gbit	Off	103,283KB	N/A	10
100MB	100Mbit	Off	103,283KB	N/A	12
100MB	10Mbit	Off	103,283KB	N/A	91
500MB	1Gbit	Off	503,547KB	N/A	53
500MB	100Mbit	Off	503,547KB	N/A	55
500MB	10Mbit	Off	503,547KB	N/A	439
1000MB	1Gbit	Off	1,004,968KB	N/A	93
1000MB	100Mbit	Off	1,004,968KB	N/A	111
1000MB	10Mbit	Off	1,004,968KB	N/A	875
100MB	1Gbit	On	5,087KB	95%	11
100MB	100Mbit	On	5,087KB	95%	14
100MB	10Mbit	On	5,087KB	95%	10
500MB	1Gbit	On	13,166KB	97%	45
500MB	100Mbit	On	13,166KB	97%	52
500MB	10Mbit	On	13,166KB	97%	45
1000MB	1Gbit	On	42,889KB	95%	95
1000MB	100Mbit	On	42,889KB	95%	100
1000MB	10Mbit	On	42,889KB	95%	96

In all cases, with compression turned off, the total data transferred was as expected, 100MB, 500MB, and 1000MB respectively. However, with compression turned on (in this case achieving 95% to 97% compression), the total data transferred for a 100MB file was reduced to 5MB, 500MB file was reduced to 13MB, and 1000MB file reduced to 43MB approximately.

The resultant download times were very similar when using a 1 Gbit or 100Mbit connection whether compression was turned on or off, however when using a slower 10 Mbit connection (which is similar to performance one may see using a metered cellular connection), there were huge reductions in the time required to download an SIE file (in addition to the advantage of reducing the overall data transferred).

The following table shows our laboratory results using the eDAQXR.

SIE File Size	Network Speed	Compression	Total Data Transferred	% Compression	Total Download Time (seconds)
100MB	1Gbit	Off	99,916KB	N/A	12
100MB	100Mbit	Off	99,916KB	N/A	12
100MB	10Mbit	Off	99,916KB	N/A	90
500MB	1Gbit	Off	501,101KB	N/A	61
500MB	100Mbit	Off	501,101KB	N/A	60
500MB	10Mbit	Off	501,101KB	N/A	440
1000MB	1Gbit	Off	1,000,961KB	N/A	90
1000MB	100Mbit	Off	1,000,961KB	N/A	115
1000MB	10Mbit	Off	1,000,961KB	N/A	873
100MB	1Gbit	On	17,152KB	82%	13
100MB	100Mbit	On	17,152KB	82%	13
100MB	10Mbit	On	17,152KB	82%	16
500MB	1Gbit	On	61,155KB	87%	49
500MB	100Mbit	On	61,155KB	87%	49
500MB	10Mbit	On	61,155KB	87%	56
1000MB	1Gbit	On	52,274KB	95%	55
1000MB	100Mbit	On	52,274KB	95%	55
1000MB	10Mbit	On	52,274KB	95%	58

In all cases, with compression turned off, the total data transferred was as expected, 100MB, 500MB, and 1000MB respectively. However, with compression turned on (in this case achieving between 82% and 95% compression), the total data transferred for a 100MB file was reduced to 17MB, 500MB file was reduced to 61MB, and 1000MB file reduced to 52MB approximately.

As stated earlier, **we recommend that the user tests the typical use cases for the application of the XR unit to find what best meets their time and business requirements.**

4.9 CAN CCP/XCP

NOTE
A .dbc file is required to support CAN CCP/XCP on the eDAQXR and eDAQXR-lite CPUs.
Currently, an .a2l database file may be imported only to support XCP over Ethernet on the eDAQXR and eDAQXR-lite CPUs.

NOTE
eDAQXR and eDAQXR-lite support for CAN CCP/XCP do not allow altering of network signal parameters or re-programming of an ECU (a connected CAN device).

Simplified instructions:

1. Connect a CCP or XCP source to the appropriate CAN connector on the CPU.
2. Import a Vector .dbc database containing information for the CCP or XCP signals. See Databases for more information about importing a Vector .dbc database file.
3. Where needed, import the .skb file associated with the CCP or XCP database file to populate the protocol for communication with the ECU.
4. In Test setup, select channels for the test setup from the CCP or XCP database.
5. CAN channel parameters may be edited in the web interface only if System preferences > Setup > channel calibration is not locked. See Editing database source channel parameters for more information about editing parameters.

4.10 XCP over Ethernet

NOTE
Currently, an .a2l database file may be imported only to support XCP over Ethernet on the eDAQXR and eDAQXR-lite CPUs.

Simplified instructions:

1. Connect an XCP source to the appropriate Ethernet connector on the CPU (on the eDAQXR-lite, this will not allow connection to another network).

2. Import an .a2l database file containing XCP over Ethernet information to the web interface of the CPU (see Databases for more information about importing an .a2l database file).
3. Enter specific network settings into the web interface of the CPU (see XCP over Ethernet for more information).
4. In Test setup, select channels for the test setup from the CCP or XCP database.
5. CAN channel parameters may be edited in the web interface only if System preferences >Setup > channel calibration is not locked. See Editing database source channel parameters for more information about editing parameters.

NOTE
eDAQXR and eDAQXR-lite support for CAN CCP/XCP do not allow altering of network signal parameters or re-programming of an ECU (a connected CAN device).

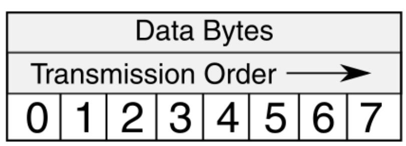
4.11 CAN database decoding and numbering

Importing eDAQ CAN databases has shown need for informing users of byte order, decoding and numbering schemes.

4.11.1 Byte and bit numbering

CAN messages contain from 0 to 8 data bytes, and thus from 0 to 64 bits.

Byte numbering
The data bytes are **always** numbered 0, 1, ..., 7 in the order they are transmitted:



Bit Numbering
The CAN specification (ISO 11898-1) specifies that multi-bit fields in a CAN frame, including data bytes, are **always** transmitted most-significant **bit** first. When it is necessary to number the up to 64 possible data bits in a CAN message, two different systems are used: **Standard**, **sequential** and **reverse** bit numbering.

Standard (or Sawtooth) Bit Numbering

In standard (sometimes also called "sawtooth") bit numbering, bits within a byte are numbered in ascending order of significance. This results in a sawtooth pattern when viewing the bits in transmission order.

	Transmission Order →							
	MSB							LSB
Data Byte 0	7	6	5	4	3	2	1	0
Data Byte 1	15	14	13	12	11	10	9	8
	...	...	...	...	...	...	...	...
Data Byte 7	63	62	61	60	59	58	57	56

MSB = Most Significant Bit, LSB=Least Significant Bit.

Sequential Bit Numbering

In sequential bit numbering, bits are numbered in transmission order. Thus, within a given byte, lower-numbered bits are more significant and higher-numbered bits are less significant.

	Transmission Order →							
	MSB							LSB
Data Byte 0	0	1	2	3	4	5	6	7
Data Byte 1	8	9	10	11	12	13	14	15
	...	...	...	...	...	...	...	...
Data Byte 7	56	57	58	59	60	61	62	63

MSB = Most Significant Bit, LSB=Least Significant Bit.

Reverse Bit Numbering

In reverse bit numbering, bits are numbered in reverse transmission order: the reverse number of a bit is the difference between 63 and the sequential bit number.

	Transmission Order →							
	MSB							LSB
Data Byte 0	63	62	61	60	59	58	57	56

	Transmission Order →							
	MSB							LSB
Data Byte 1	55	54	53	52	51	50	49	48
	...	...	...	...	...	...	...	...
Data Byte 7	7	6	5	4	3	2	1	0

MSB = Most Significant Bit, LSB=Least Significant Bit.

Byte Ordering

As already stated, the CAN specification (ISO 11898-1) specifies that multi-bit fields in a CAN frame, including data bytes, are always transmitted most-significant bit first. However, there are two ways to encode signal values which span multiple adjacent data bytes: **Motorola** and **Intel** byte ordering.

Motorola Byte Ordering

In Motorola byte ordering, encoded signal value bits appearing in earlier-transmitted (lower-numbered) bytes are **more significant** than bits appearing in later-transmitted (higher-numbered) bytes. The following examples show the significance (binary weight) of each bit in a series of Motorola encoding examples.

	Transmission Order →																
	Data Byte 0									**Data Byte 1**							
4-bit signal, unaligned			2^3	2^2	2^1	2^0											
8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0									
8-bit signal, unaligned					2^7	2^6	2^5	2^4		2^3	2^2	2^1	2^0				
12-bit signal, right-aligned					2^{11}	2^{10}	2^9	2^8		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
12-bit signal, left-aligned	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4		2^3	2^2	2^1	2^0				

	Transmission Order →																
	Data Byte 0									Data Byte 1							
16-bit signal, aligned	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}		2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Yellow-highlighted cells indicate bits that are part of a signal's encoded value.

Intel Byte Ordering

In Intel byte ordering, encoded signal value bits appearing in earlier-transmitted (lower-numbered) bytes are **less significant** than bits appearing in later-transmitted (higher-numbered) bytes. The following examples show the significance (binary weight) of each bit in a series of Intel encoding examples.

	Transmission Order →																
	Data Byte 0									Data Byte 1							
4-bit signal, unaligned			2^{3}	2^{2}	2^{1}	2^{0}											
8-bit signal, aligned	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}									
8-bit signal, unaligned	2^{3}	2^{2}	2^{1}	2^{0}										2^{7}	2^{6}	2^{5}	2^{4}
12-bit signal, right-aligned	2^{3}	2^{2}	2^{1}	2^{0}						2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}
12-bit signal, left-aligned	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}						2^{11}	2^{10}	2^{9}	2^{8}
16-bit signal, aligned	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}

Yellow-highlighted cells indicate bits that are part of a signal's encoded value.

4.11.2 Specifying a Signal

In order to decode a signal's value from a CAN message, the position of the encoded bits and the format of those bits must be unambiguously known. This is usually accomplished by a combination of three parameters: one to specify the position according to some scheme; one to specify the total number of bits; and one to specify the format of the bits. Unfortunately, the scheme used to specify the position differs significantly from system to system. VECTOR names the following six schemes:

Motorola Signal Schemes

- **Motorola Forward LSB** - The **standard bit number** of the **least-significant bit** is specified.
- **Motorola Forward MSB** - The **standard bit number** of the **most-significant bit** is specified.
- **Motorola Sequential** - The **sequential bit number** of the **most-significant bit** is specified.
- **Motorola Backward** - The **reverse bit number** of the **least-significant bit** is specified.

	Transmission Order →																			
	Data Byte 0								**Data Byte 1**											
Sequential Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**Signal Position**			
Sawtooth Bit Number	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8				
Reverse Bit Number	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	Forward LSB	Forward MSB	Sequential	Backward
4-bit signal, unaligned			2^3	2^2	2^1	2^0											2	5	2	58
8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0									0	7	0	56
8-bit signal, unaligned					2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0					12	3	4	52
12-bit signal, right-aligned					2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	8	3	4	48

	Transmission Order →																			
	Data Byte 0								**Data Byte 1**											
12-bit signal, left-aligned	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}					12	7	0	52
16-bit signal, aligned	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	8	7	0	48

MSB = Most Significant Bit, LSB=Least Significant Bit. Yellow-highlighted cells indicate bits that are part of a signal's encoded value.

Intel Signal Schemes

- **Intel Standard** - The **standard bit number** of the **least-significant bit** is specified.
- **Intel Sequential** - The **sequential bit number** of the **least-significant bit** is specified.

	Transmission Order →																			
	Data Byte 0									Data Byte 1									Signal Position	
Sequential Bit Number	0	1	2	3	4	5	6	7		8	9	10	11	12	13	14	15			
Sawtooth Bit Number	7	6	5	4	3	2	1	0		15	14	13	12	11	10	9	8		Standard	Sequential
4-bit signal, unaligned			2^3	2^2	2^1	2^0													2	5
8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0											0	7
8-bit signal, unaligned	2^3	2^2	2^1	2^0										2^7	2^6	2^5	2^4		4	3
12-bit signal, right-aligned	2^3	2^2	2^1	2^0						2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4		4	3
12-bit signal, left-aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0						2^{11}	2^{10}	2^9	2^8		0	7
16-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8		0	7

MSB = Most Significant Bit, LSB=Least Significant Bit. Yellow-highlighted cells indicate bits that are part of a signal's encoded value.

eDAQXR Setup Files (SXR) and VECTOR DBC Database Files (DBC)

CAN signals in eDAQXR setup files are specified using three parameters:

- `db_bit_start` specifies the **standard bit number** of:
  - for Motorola signals, the **most significant bit**; this is equivalent to the **Motorola Forward MSB** position.
  - for Intel signals, the **least significant bit**; this is equivalent to the **Intel Standard** position.
- `db_bit_length` specifies the total number of bits in the encoded signal value.
- `db_data_format` specifies the layout of the bits in the encoded signal value:
  - `xMSB` specifies Motorola byte ordering.
  - `xLSB` specifies Intel byte ordering.

- `Uxxx` specifies unsigned integer encoding.
- `Sxxx` specifies signed integer encoding; the most-significant bit is replaced by a sign bit.
- `Fxxx` specifies IEEE 754 floating-point encoding; the `db_bit_length` must be either 32 or 64.

In VECTOR DBC database files, the reckoning of a signal's position and length is identical to that of the eDAQXR (**Motorola Forward MSB** and **Intel Standard** are used).

Examples

	Transmission Order →																				
	Data Byte 0										**Data Byte 1**									**db_bit_start**	**db_bit_length**
Motorola	**Standard Numbering**	7	6	5	4	3	2	1	0		15	14	13	12	11	10	9	8			
	4-bit signal, unaligned			2^3	2^2	2^1	2^0													5	4
	8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0											7	8
	8-bit signal, unaligned					2^7	2^6	2^5	2^4		2^3	2^2	2^1	2^0						3	8
	12-bit signal, right-aligned					2^{11}	2^{10}	2^9	2^8		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		3	12
	12-bit signal, left-aligned	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4		2^3	2^2	2^1	2^0						7	12
	16-bit signal, aligned	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		7	16
Intel	**Standard Numbering**	7	6	5	4	3	2	1	0		15	14	13	12	11	10	9	8			
	4-bit signal, unaligned			2^3	2^2	2^1	2^0													2	4
	8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0											0	8
	8-bit signal, unaligned	2^3	2^2	2^1	2^0										2^7	2^6	2^5	2^4		4	8
	12-bit signal, right-aligned	2^3	2^2	2^1	2^0						2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4		4	12
	12-bit signal, left-aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0						2^{11}	2^{10}	2^9	2^8		0	12
	16-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8		0	16

MSB = Most Significant Bit, LSB=Least Significant Bit. Yellow-highlighted cells indicate bits that are part of a signal's encoded value. Blue-highlighted cells show which bit is identified by the "start bit" / "bit position" parameter.

eDAQ Database Files (TXT)

CAN signals in Vector DBC database files are specified using five parameters:

- The `bitpos` specifies the **sequential bit number, plus an offset (see below) of**of,
  - for Motorola signals, the **most significant bit**; this is equivalent to the **Motorola Sequential** position.
  - for Intel signals, **the bit following the last-transmitted bit, minus the signal length**.
    - For signals which have whole-byte sizes (8, 16, ..., 64), this is equivalent to the position of the **first-transmitted bit**.
    - For signals which have fractional-byte sizes, this is equivalent to the position of the **first-transmitted bit plus the number of fractional bits minus one**.
  - **for 11-bit CAN messages, an offset of 16 is applied**, so that the first-transmitted data bit has a `bitpos` of 16 and the last has a `bitpos` of 80.
  - **for 29-bit CAN messages, an offset of 32 is applied**, so that the first-transmitted data bit has a `bitpos` of 32 and the last has a `bitpos` of 96.
- The `bitlength` specifies the total number of bits in the encoded signal value.
- The `dataformat` specifies the layout of the bits in the encoded signal value:
  - `xMSB` specifies Motorola byte ordering.
  - `xLSB` specifies Intel byte ordering.
  - `Uxxx` specifies unsigned integer encoding.
  - `Sxxx` specifies signed integer encoding; the most-significant bit is replaced by a sign bit.
  - `Fxxx` specifies IEEE 754 floating-point encoding; the `db_bit_length` must be either 32 or 64.

Examples

In these examples, we assume 11-bit CAN messages with a `bitpos` offset of 16. For 29-bit CAN messages, the `bitpos` of each example should be increased by a further 16.

	Transmission Order →																				
	Data Byte 0										**Data Byte 1**									**bitpos**	**bitlength**
Motorola	**Sequential Numbering with +16 Offset**	16	17	18	19	20	21	22	23		24	25	26	27	28	29	30	31			

	Transmission Order →																		
	Data Byte 0									**Data Byte 1**								`bitpos`	`bitlength`
	4-bit signal, unaligned			2^3	2^2	2^1	2^0											18	4
	8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0									16	8
	8-bit signal, unaligned					2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0					20	8
	12-bit signal, right-aligned					2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	20	12
	12-bit signal, left-aligned	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0					16	12
	16-bit signal, aligned	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	16	16
Intel	**Sequential Numbering with +16 Offset**	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
	4-bit signal, unaligned			2^3	2^2	2^1	2^0											18	4
	8-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0									16	8
	8-bit signal, unaligned	2^3	2^2	2^1	2^0									2^7	2^6	2^5	2^4	Not Supported	Not Supported
	12-bit signal, right-aligned	2^3	2^2	2^1	2^0					2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	Not Supported	Not Supported
	12-bit signal, left-aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0					2^{11}	2^{10}	2^9	2^8	20	12
	16-bit signal, aligned	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	16	16

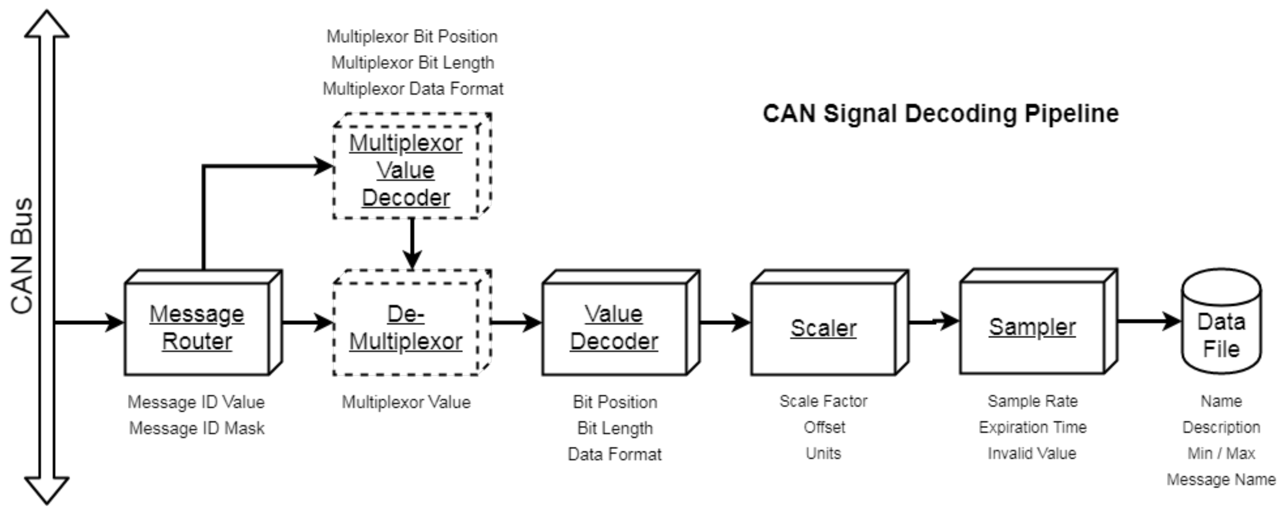
Red-highlighted "8-bit unaligned" and "12-bit right-aligned" example signals are not supported by the legacy eDAQ because their least-significant bits do not coincide with the least-significant bit of the data byte. Yellow-highlighted cells indicate bits that are part of a signal's encoded value. Blue-highlighted cells show which bit is identified by the "start bit" / "bit position" parameter.

4.12 XR CAN signal decoding

4.12.1 CAN Signal Decoding Pipeline

Conceptually, each CAN signal channel specified by an XR test setup creates a "decoding pipeline" which extracts the value of the signal from received CAN bus messages. The decoding pipeline determines which CAN message(s) carry the signal, how to decode the signal's value from the message's payload, how to scale the signal into engineering units, and when too much time has passed since the signal was last received. At each sample point, the latest known value of the signal is recorded in the SIE file without interpolation. If too much time has passed since the signal was last received, a special invalid value is recorded instead to indicate stale data.

The following diagram illustrates the stages involved in a CAN signal decoding pipeline.

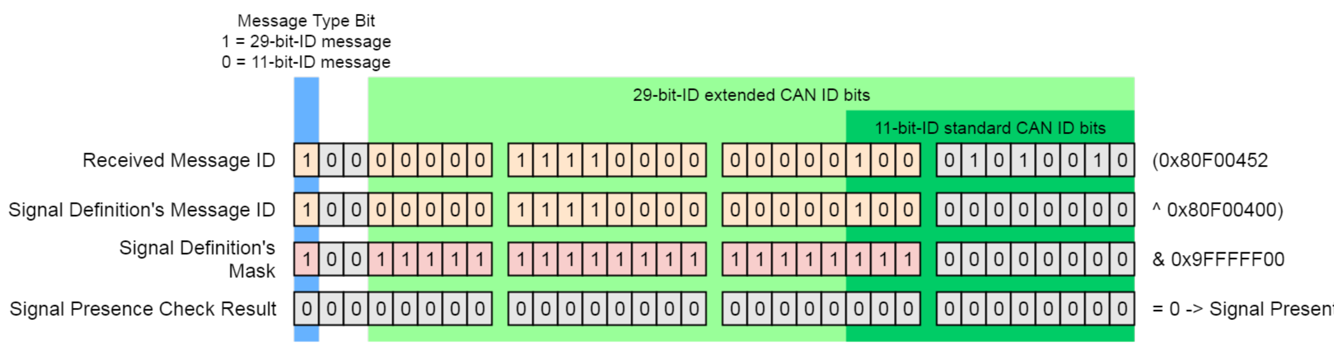


Message Router

The Message Router examines each CAN message observed on the bus to determine whether a signal value should be extracted from the message. CAN signal definitions specify a "Message ID Value" and a "Message ID Mask." The bits of the received message ID specified by the Message ID Mask are checked against the corresponding Message ID Value bits. If all bits match, the message is forwarded to the rest of the pipeline to extract the signal value.

For this check, the message ID is treated as a 32-bit value. The most significant bit is set to 1 to indicate a 29-bit extended CAN message ID, or cleared to 0 to indicate an 11-bit standard CAN message ID. Therefore, values in the range <0x00000000, 0x000007FF> are possible for 11-bit standard CAN frames, and values in the range <0x80000000, 0x9FFFFFFF> are possible for 29-bit extended CAN frames.

The following diagram illustrates the CAN message ID check. In the example illustrated, the least-significant 8 bits of the message ID are ignored (as might be the case if the user wishes to record a signal contained in a J1939 PGN regardless of the Source Address).



NOTE

If the most-significant bit of the Message ID Mask bit is set, then the Message Router will only pass messages that match the CAN frame type (standard or extended) specified by the most-significant bit of the Message ID Value. Set the most-significant mask bit to zero to accept both standard and extended CAN messages.
Examples:
Value 0x00000001, Mask 0xFFFFFFFF will only accept 11-bit-ID standard CAN messages with an ID of 1.
Value 0x00000001, Mask 0x7FFFFFFF will accept both 11-bit-ID and 29-bit-ID CAN messages with an ID of 1.

Demultiplexor

The demultiplexor is an optional pipeline stage used to handle multiplexed signals. Signals are multiplexed when they appear in a particular message only if a value somewhere else in the message payload has a specific value. In this situation, the CAN signal definition specifies the position, length and data format of the multiplexor value, and a value which the multiplexor field must hold in order for the message to be decoded. The decoding of the multiplexor value is performed in the same manner as the signal value decoding; refer to the Value Decoder section below for more information.

Value Decoder

Once a message has been determined to contain a signal value by the Message Router and (optionally) the Demultiplexor, the message is passed to the Value Decoder to extract the raw (unscaled) signal value from the message payload. The CAN signal definition specifies a bit position, length and data format which are used to convert the appropriate payloads bits into a raw numeric value.

Scaler

The scaler stage applies a multiplicative scale factor and a linear offset in order to convert the raw signal value to an engineering value. The CAN signal definition specifies the appropriate scale factor, offset and unit name.

Sampler

The sampler tracks the latest received value of a signal. At each sample point at the sample rate specified by the user in the test setup definition, the last-received value is recorded. If too much time has passed since a value was received, a user-specified invalid data value is recorded instead of the last-received value.

Data File

The data file (SIE) also stores additional metadata from the CAN signal definition, such as the message name, signal name and description, and min/max measurement range. This information is not interpreted or used by the system other than to record the information in the metadata.

4.12.2 CAN Signal Definition Parameters

Parameter Descriptions

- Metadata Parameters
  - **Name** - The name of the signal. When added to a setup as an input channel, the new channel's name is set to this value. For maximum compatibility with other software, use only letters, numbers and underscores (_).
  - **Description** - A human-readable description of the signal. When added to a setup as an input channel, the new channel's description is set to this value.
  - **Message name** - The name of the CAN message which carries this signal.
  - **Min** - The minimum allowable signal value.
  - **Max** - The maximum allowable signal value.

- **Message Router Parameters**
  - **Message ID** - The CAN message ID of the message(s) which contain this signal. See the **Message Router** section above for more information on how this value is interpreted.
  - **Mask** - The bit mask to apply to the message ID before comparing it to a received message ID. See the **Message Router** section above for more information on how this value is interpreted.
- **Demultiplexor Parameters (Optional)**
  - **Mode bit start** - The bit position of the multiplexor signal value; see Bit start below for a description of how bit position is reckoned.
  - **Mode bit length** - The width of the multiplexor signal in bits, including any sign bit.
  - **Mode data format** - The format of the multiplexor signal value encoding; see Data format below for a description of the supported values. Note that `FMSB`/`FLSB` are not supported for multiplexor signals.
  - **Mode value** - The value which the multiplexor signal must contain in order for the main signal value to be extracted from the message.
- **Value Decoder Parameters**
  - **Bit start** - The standard bit number of the signal's most-significant bit (for Motorola byte order signals) or least-significant bit (for Intel byte order signals); i.e. the Motorola Forward MSB or Intel Standard bit positions, respectively. See CAN database decoding and numbering for more information.
  - **Bit length** - The width of the signal in bits, including any sign bit.
  - **Data format** - The format of the signal value encoding. The supported values are:
    - `UMSB` - An unsigned number stored in Motorola (big-endian) byte order.
    - `ULSB` - An unsigned number stored in Intel (little-endian) byte order.
    - `SMSB` - A signed number stored in Motorola (big-endian) byte order.
    - `SLSB` - A signed number stored in Intel (little-endian) byte order.
    - `FMSB` - An IEEE 754 floating-point number stored in Motorola (big-endian) byte order. The bit length must be either 32 or 64 for single-precision or double-precision IEEE 754 formats, respectively.
    - `FLSB` - An IEEE 754 floating-point number stored in Intel (little-endian) byte order. The bit length must be either 32 or 64 for single-precision or double-precision IEEE 754 formats, respectively.
- **Scaler Parameters**
  - **Scale** - A multiplicative scale factor to apply to the decoded signal value after decoding.
  - **Offset** - A constant offset value to apply to the decoded signal value after scaling.
  - **Units** - The name of the units in which the signal's value is measured.

- **Sampler Parameters**
  - **Sample rate** - The number of times per second that the latest signal value should be recorded. This parameter can only be configured after a CAN signal has been added to a test setup as a channel.
  - **Expiration time** - The time after which, if no signal value has been received, the **invalid value** should be recorded instead of the latest signal value. This parameter can only be configured after a CAN signal has been added to a test setup as a channel.
  - **Invalid value** - The value to record if no signal value has been received after the specified **expiration time**.
- **Other Parameters**
  - **Request message** - Optionally specifies a CAN message which the CX23-R / eDAQXR should transmit on the bus. This field can be used for any purpose, but is commonly used to enter a polling or request message to elicit transmission of certain parameters by a CAN node. The format of the message is a sequence of hexadecimal digits. The first 8 digits specify the CAN message ID. The mostsignificant bit should be set to 1 to transmit a 29-bit-ID extended CAN message, or 0 to transmit an 11-bit-ID extended CAN message. Following these digits, pairs of digits can be entered to specify the message payload. From 0 to 8 payload bytes may be specified (i.e., 0 to 16 hexadecimal digits).
    - **Example**: `00000123AABBCC` means to transmit an 11-bit-ID standard CAN frame with ID 0x123, a DLC of 3, and payload bytes `AA BB CC`.
    - **Example**: `81234567DDEEFF0011` means to transmit a 29-bit-ID extended CAN frame with ID 0x1234567, a DLC of 5, and payload bytes `DD EE FF 00 11`.
  - **Protocol** - This field is read-only. It is set by the Vector DBC database importer when a CCP or XCP-on-CAN measurement is loaded. CCP and XCP-on-CAN measurements cannot be configured directly by the user and must always be imported from a Vector DBC database file.

Vector DBC Database Import

Parameter	Import Source
Name	This value is taken from the signal name specified in the DBC file. If the user selected the "Prepend message names to signal names" option during import, the message name specified in the DBC is prepended to the signal name and separated from it by a delimiter. The delimiter defaults to a double-colon (::) but can be changed in **System > Preferences > System > Databases**. If a duplicate name is encountered during import, a number is appended to the signal name and separated from it by a delimiter. The delimiter is `_duplicate_`.
Description	This value is taken from the signal name specified in the DBC file. If the DBC file was exported by a CX23-R or eDAQXR, the description previously stored is preserved via a special DBC signal attribute named `HBK_SIGNAL_DESCRIPTION`.
Message name	This value is taken from the message name specified in the DBC file.
Min	This value is taken from the minimum value specified in the DBC file. If the minimum value is equal to or greater than the maximum value, a new minimum value is calculated which is equal to the minimum representable value given the signal's data type, bit length, scale factor and offset; or, for floating-point signals, -1000000000.
Max	This value is taken from the maximum value specified in the DBC file. If the maximum value is equal to or less than the minimum value, a new maximum value is calculated which is equal to the maximum representable value given the signal's data type, bit length, scale factor and offset; or, for floating-point signals, +1000000000.
Message ID	This value is taken from the message ID specified in the DBC file. For J1939 PGNs with a NULL source address, the source address bits of the message ID are cleared to zero.
Mask	This value is set to `0xFFFFFFFF`, except for J1939 PGNs with a NULL source address, in which case the value is set to `0xFFFFFF00`. If the DBC file was exported by a CX23-R or eDAQXR, the mask previously stored is preserved via a special DBC signal attribute named `HBK_SIGNAL_MESSAGE_ID_MASK`.
Mode bit start	For multiplexed (`m`) signals, this value is taken from the bit position specified for the corresponding multiplexor (`M`) signal in the DBC file.
Mode bit length	For multiplexed (`m`) signals, this value is taken from the bit length specified for the corresponding multiplexor (`M`) signal in the DBC file.
Mode data format	For multiplexed (`m`) signals, this value is taken from the data format specified for the corresponding multiplexor (`M`) signal in the DBC file.
Mode value	For multiplexed (`m`) signals, this value is taken from the multiplexor value specified in the DBC file.
Bit start	This value is taken from the bit position specified in the DBC file.
Bit length	This value is taken from the bit length specified in the DBC file.
Data format	This value is taken from the data format specified in the DBC file.
Scale	This value is taken from the scale factor specified in the DBC file.
Offset	This value is taken from the offset specified in the DBC file.
Units	This value is taken from the unit value specified in the DBC file.

Parameter	Import Source
Invalid vlaue	If the DBC file was exported by a CX23-R or eDAQXR, the invalid value previously entered is preserved via a special DBC signal attribute named `HBK_SIGNAL_INVALID_DATA_VALUE`. Otherwise, a default value is calculated. For signals with length 8, 16, 32 or 64, the default value is the maximum representable value. For signals with other lengths, the default value is the maximum representable value plus the scale factor. For floating-point signals, the default value is 1e15.
Request message	This value is blank, unless the DBC file was exported by a CX23-R or eDAQXR, in which case the request message previously stored is preserved via a special DBC signal attribute named `HBK_SIGNAL_REQUEST_MSG`.
Protocol	This value is set to CCP or XCP if the DBC specifies that the signal is acquired via CCP or XCP-on-CAN. In either case, additional CCP /XCP parameters are stored in the signal definition. These additional parameters are not accessible to the user.

eDAQ Text Database Import

<table>
<tr><th>Parameter</th><th>Import Source</th></tr>
<tr><td>Name</td><td>This value is taken from the <code>id</code> column.</td></tr>
<tr><td>Description</td><td>This value is taken from the <code>description</code> column.</td></tr>
<tr><td>Message name</td><td>This value is set to a string of the form <code>MSG_0xHHHHHHHH</code> where <code>HHHHHHHH</code> is the message ID specified in the <code>value</code> column.</td></tr>
<tr><td>Min</td><td>This value is taken from the <code>min</code> column.</td></tr>
<tr><td>Max</td><td>This value is taken from the <code>max</code> column.</td></tr>
<tr><td>Message ID</td><td>This value is taken from the <code>value</code> column. If the <code>value</code> column also contains payload bytes beyond the message ID, they are removed.</td></tr>
<tr><td>Mask</td><td>This value is taken from the <code>mask</code> column. If the mask column also describes payload bytes beyond the message ID, those bytes are removed.</td></tr>
<tr><td>Mode bit start</td><td rowspan="4">This values are set automatically if the importer detects that the <code>value</code> and <code>mask</code> columns implement multiplexing by including and masking out payload bits. Only one multiplexor is supported. If the <code>value</code> and <code>mask</code> include two or more gaps for multiplexor values, a warning is issued and the extended multiplexing is not honored.</td></tr>
<tr><td>Mode bit length</td></tr>
<tr><td>Mode data format</td></tr>
<tr><td>Mode value</td></tr>
<tr><td>Bit start</td><td>This value is taken from the <code>bitpos</code> column, after appropriate translation from legacy eDAQ bit position reckoning to DBC reckoning (Motorola Forward MSB / Intel Standard).</td></tr>
<tr><td>Bit length</td><td>This value is taken from the <code>bitlength</code> column.</td></tr>
<tr><td>Data format</td><td>This value is taken from the <code>dataformat</code> column.</td></tr>
<tr><td>Scale</td><td>This value is taken from the <code>scale</code> column.</td></tr>
<tr><td>Offset</td><td>This value is taken from the <code>offset</code> column.</td></tr>
<tr><td>Units</td><td>This value is taken from the <code>units</code> column.</td></tr>
<tr><td>Invalid vlaue</td><td>This value is calculated as the maximum representable value given the signal's data type, bit length, scale factor and offset.</td></tr>
<tr><td>Request message</td><td>This value is taken from the <code>request</code> column.</td></tr>
<tr><td>Protocol</td><td>This value is always blank (CCP and XCP-on-CAN signals cannot be stored in an eDAQ text database).</td></tr>
</table>

4.12.3 Live Data Capture in Database Editor

The XR's CAN database signal editor includes a Data capture tool that allows the user to capture live data from a CAN bus in order to see how the signal being edited will be decoded. The data capture view has the following parameters:

- **Bit rate** - Specify the desired CAN bus bit rate in bits per second.
- **Termination** - Select true to install an internal termination resistor.

- **Module** - Select the module to which the CAN bus is connected.
- **Port** - Select the port number to which the CAN bus is connected on the selected module.

Click the **Apply** button to apply the selected parameters.

Data may be temporarily captured. Click the **Capture** button to open the dialog. Pull-down menus allow the Time or Value column to be hidden (one must stay visible) and contents sorted (ascending or descending). Limit the data capture by entering a value in the field for Time (7200 seconds is the maximum) or Number (20000 samples is the maximum).

Click the **Capture** button and a dialog shows. If no value is entered in the Time or Number field, 10000 messages may be captured. To stop capture before this limit, the Time or Number is reached, click the **Close** button. After capture, the number of captured samples shows in parentheses after Value at the top of the column.

To find data among captured samples, enter data in the Search field. Search field content is highlighted among the data samples.

To filter data, enter data in the Filter field. Only matching data among the samples shows in the columns. Clear the Filter field to see all captured data. At the top of the Value column, the number of filtered samples shows in parentheses with the number of captured samples, such as (2/15). Captured data may be searched or filtered before export. Search results are not highlighted in the exported file.

Select rows with the mouse or keyboard and click the **Export** button. Selected rows may be saved as a Text Document (named `capture.txt` unless renamed by the user). The number of rows exported shows in parentheses at the top of the text document. An exported file may be opened in Microsoft Excel with tab delimited columns.

When editing is completed, click **OK**. The information entered in the dialog will show in the spreadsheet grid cells.

4.13 AOX files

AOX files containing channel parameters can be generated from the eDAQXR (not the eDAQXR-lite) Test control page while a test is running. An AOX file can include networked CPUs and connected channels. The AOX file may be viewed as text.

Test setup information shows at the top of the text file.

- **SetupFile**: This is the name of the associated Test setup file, with the suffix .sxr.
- **RunNumber**: This is the number appended to the particular test run from which the AOX file was generated while using the Test setup file.
- **NumXdcrChs**: This is the number of channels in the test.

Channel descriptions show in a tab-delimited table in the text file.

- **ID**: This is the CPU type, serial number, the layer and the channel connector number for a channel.
- **Units**: This is the unit for the recorded values on a channel, for example, V, mV/V, °C etc.
- **NodeName**: This repeats the ID but only for the CPU.
- **Connector**: This repeats the ID but only for the connector, such as `brg_2_c1`, which is the number of the layer in a stack and the connector number on the layer for the channel.
- **Eng_FSMin**: This is the engineering units full scale minimum for the channel. See Generic parameters Range min/max in Input channels.
- **Eng_FSMax**: This is the engineering units full scale maximum for the channel. See Generic parameters Range min/max in Input channels.
- **Scale**: This is the scaling factor or slope scaling parameter applied to a channel. See **Slope** in Input channel scaling parameters. In the AOX file, the scale is normally near 1. Changes from 1 in the Slope will only be visible as Scale in the AOX file if the Range min/max is also changed to allow a slope/scale greater than 1 to show.
- **Offset**: This is the offset or intercept scaling parameter applied to a channel. See **Intercept** in Input channel scaling parameters. In the AOX file, the offset is normally near 0 (zero).
- **Volts_FSMin**: This is the full scale voltage minimum for the channel.
- **Volts_FSMax**: This is the full scale voltage maximum for the channel.

4.14 Remote Networking using GPS Time Sync

Overview: There are many applications where the user needs to generate SIE files on multiple eDAQXR / eDAQXR-Lite unit where the channel data is in sync and in phase across all of the units.

If all of the units are in relatively close proximity, the units can be connected using the Ethernet expansion ports, using an EX23-R PTP switch module if more than 3 units are to be used. The user has the option of using Mode 1 or Mode 2 networking, both of which provide SIE files where channel data is in sync across all network nodes.

For some applications, it is impossible or impractical to use the Ethernet expansion ports to physically connect units. However, these units can be "remotely networked" by connecting a GPS module to each unit, and enabling the **Sync to GPS Time (disables PTP)** System preference for each unit.

NOTE
The Garmin GPS module is **strongly** recommended. The EGPS-200 module is inferior for this application. The EGPS-200 module is prone to sporadically failing to provide the GPS (PPS sourced) timing messages for long periods (e.g., one minute or more). This can compromise data sync/phase accuracy. It also takes much longer for the EGPS-200 to start generating the GPS timing messages compared to the Garmin module. Use of the Garmin GPS is assumed in the remainder of the operational note.

Scope: This operational mode is applicable in test scenarios where GPS satellite connectivity is maintained continuously. If GPS satellite connectivity is maintained continuously, data skew is expected to be less than a few µs (microseconds) across all units for test runs of any duration.

Test setup and test run suggestions: This operational mode is best suited for tests that are defined to be "simple data loggers" where either the Collect data storage option is used for all channels, or Time History DataModes are used exclusively for data storage. It is assumed that one of these options will be used in the remainder of this operational note.

The following channels should be included in the test setup for all units.

- **gps:pps_sync_lock**: This is the most important channel for feedback on sync/phase accuracy. It is updated at 5 S/s using the Garmin (only 1 S/s using the EGPS-200). A value of **1** means the GPS timing messages have been received as expected; a value of **0** means they have not been received and the eDAQXR clock time can drift from the GPS satellite clock time. A value of **2** means the GPS module is not connected, which should normally never be seen.
- **gps:utc_seconds**: This is useful as a "ball park" sanity check on sync maintenance and phase alignment. It is updated a 5 Hz using the Garmin. As such the resolution is only 200 ms. If this channel is not in phase across all units, then data skew across the units has been significantly compromised.
- **gps:number_of_satellites_in_use**: This is useful as a sanity check on the **gps:pps_sync_lock** channel data. Note that even if the number of satellites in use drops down to less than **2** (for the Garmin GPS module), PPS sync lock will still be **1**. The reason for this is that the Garmin module has an internal clock that it syncs to the GPS clock when satellite PPS signals are available. When satellite PPS signals are not available, the Garmin continues to send "simulated PPS signal" timing messages to the system.

GPS modules / antennae should of course be positioned to have an unobstructed view of the sky and horizons as much as possible. Test runs should not be started until GPS satellite connectivity is established and the GPS **pps_sync_lock** channel data is stable at **1** for a short period of time at least (i.e., a few minutes is recommended).

It is impossible to start SIE test runs across all units at the same "exact" time (i.e., anywhere close to the phase accuracy of less than a few µs for EBRG / EHLS channel realized in standalone unit tests and Mode 1 or Mode 2 networked tests). At best, the user may be able to start the tests within a one second or so of each other. There are two ways to deal with this problem so that all SIE file data samples start at the same “exact” time (within a few µs). This is referred to as “time zero phase alignment”.

Using a Time History DataMode trigger to achieve time zero phase alignment: This is applicable for tests that use Time History DataModes exclusively for all channel data storage. It is best explained using an example. Assume the GPS channels are sampled at the default value 5 S/s which is recommended.

Assume there are two units – **A** and **B**. Assume unit **A** has some channels sampled at 500 Hz and some sampled at 1000 Hz. Assume Unit **B** has some channels sampled at 2500 Hz. Proceed as follows.

- For each unit, define a **Time Base Shifter** Computed channel using the GPS **utc_seconds** channel as the input channel and configure for a **Lag** of **1** sample period (which is the default). Name this Computed channel **prev_utc_seconds**.
- For each unit, define a **Signal Calculator** Computed channel using the following expression, **prev_utc_minute** == **0 && utc_minute** == **1** and name this channel **trig_5**. (Note that the values **0** and **1** are not likely the values to be used when the test runs are started; this is discussed a little later.)
- For unit **A**, define two **Up Sampler** Computed channels. Name one as **trig_500**, and set the up sample **Factor** to **100**. Name the other as **trig_1000**, and set the up sample **Factor** to **200**.
- For unit **B**, define one **Up Sampler** Computed channel. Name it as **trig_2500**, and set the up sample **Factor** to **500**.
- For each unit, define all of the **Time History** DataModes required to cover all channel sample rates, and set the **Trigger mode** to **Trigger**. For the **Trigger channel**, select the appropriate channel previously defined (e.g., for the Time History with **5** S/s channels, use **trig_5**, for the Time History with **500** S/s channels, user **trig_500**, etc.).
- Don’t forget to have the System preference **Sync to GPS Time** enabled. To minimize the SIE file size, don’t forget to uncheck the **Collect** boxes for all channels included in the Time History DataModes.

The SXR setup files are now almost completely defined in preparation for an SIE test run. The last task to be done before actually starting the test runs is to pick the time when the **Time History** DataModes will be triggered. Assume it is **9:30** based on UTC time. On modern PCs, the PC time is usually very close to UTC time but adjusted for local time. So, it’s usually safe to use the PC time in deciding on the trigger time. To give yourself a few minutes, you could target the trigger time to **9:35:00.000000**. To do this, edit the previously defined **Signal Calculator** Computed channels (on unit **A** and on unit **B**) to show the following expression, **prev_utc_minute** == **34 && utc_minute** == **35**. Save the changes, and start the SIE test run.

It is advised that Digital meter chart displays of the GPS **utc_minutes** and **utc_ seconds** channels are used so that it can be verified that the SIE test runs on both units are actually running before **9:35:00.000000**.

For subsequent SIE test runs, simply adjust the values in the **Signal Calculator** Computed channels to set the desired trigger time.

Using post processing to achieve time zero phase alignment: This is applicable for tests configured to use the Collect data storage mode for all channels. In every SIE file, the “exact” test run start time is stored in a metadata object (i.e., “tag” for users familiar with the Somat **libsie** application). To find this object is an SIE file, proceed as follows.

- Open the **SIE Viewer** application. (Contact support if you do have this application.)
- Browse for the SIE file.
- Click on the Metadata button in the File Overview section.
- Click on the Tags ID “sie:xml_metadata”. The metadata is shown in the window pane on the right.
- Click on the Formatted button.
- Click on the Export button and save the text file (using the root SIE file name with extension “.txt” is one suggestion).
- Open Notepad or any text editor and search for the string “core:start_time”.

Following is what you will find.

<tag id="core:start_time">2019-11-25T16:03:11.000000000</tag>

Once all test run start times are known, use a post processing application to remove all data samples (for all channels in all SIE files) that precede the test run start time for the SIE file with the latest run start time. Note that the **InField** application can be used to accomplish this. Following are some facts that may be useful.

- All SIE test runs are started on a whole second of UTC time, for both Decimal and Binary sample rates domains.
- In the Decimal sample rate domain, as long as all analog and digital input channel sample rates are 1 S/s or above, all of these channels will have a whole number of samples in a 1 second time period.
- In the Binary sample rate domain, as long as all analog and digital input channel sample rates are 0.8 S/s or above, all of these channels will have a whole number of samples in a 1.25 second time period.

What Happens if GPS Satellite Connectivity is Lost: Based on experimental evaluations (with the Garmin module only), periodic loss of all satellites in view for periods of no more than a few minutes, will not affect the data skew (i.e., it will still be maintained to within a few µs).

Of course, much longer periods of satellite dropouts should be expected to result in some transient increase in data skew, and possibly data skew that will endure for the duration of the test run. Consider starting a new test run in this situation.

NOTE
If the GPS cable is disconnected (or severed) during a test run, do not reconnect the GPS the cable (or connect a new cable or GPS module). Reconnecting will usually result in very large permanent channel data skew, and can even result in system error resets. The best option is to stop the test, then connect the GPS module cable, and then start a new test run.

4.15 SIE file “ragged edge cleanup” on test run stops

Overview: The XR systems (eDAQXR, eDAQXR-Lite, CX23-R) are designed to enforce “ragged edge cleanup” whenever possible when SIE test runs are stopped. The term “ragged edge cleanup” means that the last data sample for all eligible channels will have the same timestamp, which means that the data for all channels will span the same period.

Scope: In general, “ragged edge cleanup” is applicable for all sample rate domains (Decimal, Binary, and Classic) and for all test run modes (Normal, Cyclic, and Remote control). It is applicable for Mode 1 networked systems as well as standalone systems.

- **It is applicable only to channels that use the Collect storage mode. It is not applicable to any channels defined in any DataMode.**
- **It is not applicable for Mode 2 networked systems.**

Exceptions: In any test scenario where “ragged edge cleanup” is applicable, if a stop time cannot be found in 5 seconds after the search for a test stop with no “ragged edges”, the test run will be stopped with “ragged edges”. There is no GUI notification of this; however, there is a **FORCED STOP** Log file message generated. Note that this is not considered an error, and as such, the red LED is not turned on. An example message follows.

test stopping "test_name" now = 2019-11-08T19:13:09.014694929 FORCED STOP

Limitations:

- It is not applicable to channels with sample rates less than **1 S/s**. If the sample rate of any channel is below this, it may or may not have a ragged edge relative to the channels with samples rates greater than or equal to **1 S/s**.
- It is not applicable if any **Time Base Shifter** Computed channel is used in the test.
- It is not applicable if the **Run Stopper** Computed channel is used to stop the test run.
- It is applicable if an **Up Sampler** or a **Down Sampler** Computed channel is used in the test, and the sample rate for the computed channel is equal to one of the sample rates available for input channels (e.g., 100, 200, 500, etc. for the Decimal domain). It may be applicable for other sample rates (e.g., 250, 400,

1250, etc.). However, for “unusual” sample rates like 100/3 = 3.3333333 S/s, a **FORCED STOP** will result.

- It is not applicable when a test is stopped due to a power supply loss; however, it is applicable if power to the system is switched off (e.g., using the front panel switch).
- It is not applicable when a test is stopped on an error reset, or when a test is stopped on a user initiated software reset.

NOTE

There may be other unknown test scenarios where the system will attempt to find a test stop time that results in no “ragged edges”, but fails to do so within the 5 second time out period for one reason or another. If this occurs, a **FORCED STOP** Log file message will be generated.

4.16 EBRG and EHLS digital filter limitations

Overview: Tests started on an eDAQXR system will error reset when the buffers in the DSP (Digital Signal Processor) overflow. This will result in either a **Samples Lost** error or a **Packets Lost** error being reported in the Log file. From a user point of view, there is no significant differences between the two exception messages. Following are examples of the Log messages.

```
error on 'hls_1': layer exception: Samples%20Lost%200xC1FF
ERRNO=EXCEPTION; reboot required
```

```
error on 'hls_1': layer exception: Packets%20Lost
ERRNO=EXCEPTION; reboot required
```

The limitations are in some cases dependent on the **Test engine frame rate** setup parameter. If this parameter is set to 100 Hz in the Decimal domain or 102.4 Hz in the Binary domain, the DSP uses a max queue time of 10 ms; otherwise it uses a max queue time of 20 ms. In general, the time of 20 ms is more optimal for lower samples rates (e.g., 200 Hz and below), and the time for 10ms is more optimal for higher sample rates (e.g. 5000 Hz and above). The specifics of the max queue time setting on DSP performance is complicated and beyond the scope of this operational note.

Single layer limitations with all channels using the same sample rate and digital filter. The following limitations are known to exist when only one BRG / HLS layer is used in an SIE test run.

- Decimal 100000 S/s Null: Maximum of 10 channels (Packets Lost).
- Decimal 20000 S/s Linear Phase 6667 Hz: Maximum of 13 channels (Packets Lost).
- Decimal 10000 S/s Butterworth 1500 Hz: Maximum of 15 channels per layer (Packets Lost) if and only if **Test engine frame rate** is not set to 100Hz.
- Decimal 100 S/s Linear Phase 33 Hz: Maximum of 15 channels per layer (Packets Lost) if and only if **Test engine frame rate** is not set to 100Hz. **Note:**

Using v2.12.0, we no longer see this limitation. However, since the reason for this is not known, we have not removed this as a “possible limitation”.

- Binary 98304 S/s Null: Maximum of 14 channels (Packets Lost).
- Binary 4096 S/s Butterworth 640 Hz: Maximum of 15 channels per layer (Samples Lost).

Single layer limitations with channels using different sample rates and digital filters. The number of single layer configurations that fit into this category are unknown since there are too many possible configurations to test rigorously.

The 20000 S/s Linear Phase 6667 Hz filter is known to be particularly problematic. For example, a test with only 4 channels using this sample rate / digital filter, and using 12 channels at any other sample rate / digital filter will mostly likely reset on error.

NOTE

The 25000 S/s Linear Phase 8333 Hz is supported for all 16 channels and it is advised that this choice be used in lieu of 20000 S/s Linear Phase 6667 Hz filter as general practice.

Following is the only currently known single layer test configuration that doesn’t use any channels with the 20000 S/s Linear Phase 6667 Hz filter and still error resets.

- Decimal 4 channels using 10000 S/s Linear Phase 3333 Hz, and 12 channels using 500 S/s or lower sample rate with a Linear Phase filter (Samples Lost) if and only if **Test engine frame rate** is not set to 100Hz.

Multiple layer considerations with channels using different sample rates and digital filters. The above discussion is focused on single layer issues. Of course, typical usage involves multiple BRG / HLS layers in the eDAQXR stack. Following are a couple of simple tips for distributing channels across layers.

- In general, distribute the channels as evenly as possible across the layers. For example, if the test has 36 channels to use on 3 BRG layers, use 12 channels on each of the 3 layers.
- As much as possible avoid mixing high sample rate channels and low sample rate channels on the same layer. If this cannot be avoided, in some cases increasing the low sample rates will eliminate the error resets. In other cases, decreasing the high sample rates may be the only option.

The user may have to resort to “trial and error” testing to find a solution to avoid the error resets. In this event, proceed as follows.

- Create a **New** SXR test, and **Add** all channels to be used in the test.
- Leave the channels with the default configurations (i.e., using the Voltage input mode with no transducer power). This will not harm any sensors, so nothing needs to be physically disconnected.
- Change only the sample rate / digital filter for each channel to match what was defined in the test that error reset. This test will also error reset because the DSP

processing is invariant on the specifics of channel configuration settings – other than the sample rate / digital filter setting.

- At this point, the user can investigate changes to the test to hopefully find a solution (e.g., moving channels to a different layer, or decreasing [or in some cases increasing] some of the channel sample rates).

5 Revision History

Version	Date	Notes
1.0 / A4718-1.0 en	09.2017	Initial release
2.0 / A4718-2.0 en	12.2017	SIE file metadata, MX460B-R, long term unattended testing considerations
2.2 / A4718-3.0 en	03.2018	MX460B-R Crank wheel sensors, SIE data viewer, XR Emulator, Updated Networking eDAQXR units topic, Extended SIE metadata for v2.2, new topic: SIE file size issues
2.4 / A04718_04_E00_00	06.2018	eDAQXR-lite EXRLCPU, ELBRG, ELDIO, ELHLS and ELNTB layers, TEDS conflicts, Channel calibration options, System information, System status, Calculating leadwire resistance, Main processor mounting options, X-Y chart and Download AOX file, Extensive topic order changes for EXRCPU and EXRLCPU
2.6 / A04718_05_E00_00	09.2018	Network mode 1 and 2, Editing Vector CAN databases, CAN, GPS and IO interfaces, rearrange table of contents, Single channel editor strip chart controls, Vector CAN channel parameter editing, Input channel zero parameters, optional GPS cables correction, Chart type to Test control from Single channel editor, Reset to factory defaults rescue, Powering from a vehicle changes, Over range detector notifications, and Zero Reset button becomes CLEAR ZERO
A04718_05_E00_01	09.2018	New topic: Standards Declaration, manual only
2.8 / A04718_06_E00_00	12.2018	Currently EX23-R ports 5 and 6 do not support PTP synchronization without configuration change, Extension of EGPS-200 module instructions, SIE metadata extension for v2.8, Define sensitivity factor for bridge sensors, No Test stop at UTC time or day for Remote control mode, Viewing Test run statistics, Font size option in multi-channel digital meter charts, Exporting a Vector CAN database, Auto start charts in Single channel editor, SIE file compression and New operational note about compressed SIE file download
2.10 / A04718_07_E00_00	07.2019	Spectrum chart in the Single channel editor, Confirmation dialog always on for deleting a test setup or database, PTP on EX23-R ports 5 and 6, Channel tab visibility option removed, Sample rate column for X-Y plot (chart), CAN channel CCP extension, Minimize SIE file sizes option in System preferences and Test setup, Export and restore System preferences, Interactive trigger chart, Warnings at test run start for networked units, SIE file name invalid characters or problematic string, Purge system log to turn off red LED, Input or CAN channel data capture, Edit and save CAN channel parameters, Improved chart import in Display Views, Correction of EBRG/ELBRG description, eDAQ CAN DB import, edit and export as DBC, XCP on Ethernet, EXRBRG information, EXRBRG Sense line Lead wire resistance parameter, Sensitivity factor, A2L file import, Network port use, Keyboard shortcuts, 8 Hz Yellow LED in Mode 1 and 2 networked test runs, Operational note about CAN DB decoding and numbering and CAN DB channel Mask field gray for MX471/MX840
2.10.2 / A04718_07_E00_01	09.2019	For notifications connect HOST port to network with internet, Messages topic, Intel and Motorola data formats validation with Bit start and Bit length sum, Minor edits to CAN database decoding and numbering topic, All XCP over Ethernet sources on an isolated network, XR CAN signal decoding note, MX471C CAN / CAN FD Module, No altering of network signal parameters or re-programming of an ECU

Version	Date	Notes
2.12 / A04718_08_E00_00	12.2019	Bell icon for Alert/Notice that a database cannot be exported, Drag and drop a Display View tab to move it (not alphabetical at import), System preferences optional prefix dm_name@ in SIE metadata channel names, Extended keyboard shortcuts and topic, Sync to GPS time (Disables PTP) preference, AOX file note, MX1609TB-R thermocouple amplifier, ELHLS transducer power 4-15 V, No test start at less than 2 MB available storage on CPU, Analog channels transducer power notes edited, Adding legacy eDAQ layers to a stack, Edited installing EXRCPU on eDAQ layers for yellow LED, Edited powering CPUs (isolation), Import .a2l database file support for only XCP over Ethernet, Extended instructions about CCP and XCP channel use, CAUTION when power supply is removed from CPU yellow LED lit indicating capacitors hold a charge (discharge can cause damage), Improved Two point scaling interface, Yellow status LED extension, Operational note Remote Networking using GPS Time Sync, Removed all support for EXRBRG layer, Operational note SIE file “ragged edge cleanup” on test run stops, Operational note EBRG and EHLS digital filter limitations
2.12.1 / A04718_08_E00_01	12.2019	Extend Keyboard shortcuts

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