Manual

LioN-X Hub Analog Input

0960 IOL 3857-001 (4 × Analog Input / 8 × Digital Input)

Contents

1 About this manual

1.1 General information

Download the latest version of this document at:
http://doc.beldensolutions.com

Read the assembly and operating instructions on the following pages carefully before starting up the modules. Keep this information where it is accessible to all users.

The texts, figures, diagrams, and examples used in this document are exclusively used to explain how to operate and apply the modules.

Please contact us if you have any detailed questions on installing and starting up the devices.

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1.2 Explanation of symbols

1.2.1 Use of danger information

Danger information is denoted as follows:

Danger: Means that death, serious physical injury or substantial damage to property will occur if the required safety measures are not taken.

Warning: Means that death, serious physical injury or substantial damage to property can occur if the required safety measures are not taken.

Caution: Means that minor physical injury or damage to property can occur if the required safety measures are not taken.

1.2.2 Use of general information

General information is denoted as follows:

Attention: Contains important information on the product, on how to manage the product, or on the respective section of the documentation to which your special attention is being drawn.

1.3 Version information

Version	Created	Changes
1.0	09/2026	

Table 1: Overview of manual revisions

Attention: In the interest of product improvement and further development, BELDEN reserves the right to change technical data in this manual or changes to the product without prior notice.

2 Safety instructions

2.1 Intended use

The products described in this manual are decentralized Input/Output assemblies on a fieldbus I/O network.

We adhere to all safety standards when developing, producing, testing, and documenting our products. When you adhere to the handling specifications and safety instructions described for the configuration, assembly, and correct operation, there should not normally be any risks for people or equipment.

The devices fulfill the requirements of the EMC guidelines (2014/30/EU) and the low voltage guideline (2014/35/EU).

The devices are designed to be used in the industrial sector. The industrial environment is distinguished by the fact that the consumer is not connected directly to the public low voltage network. Additional measures are required for use in residential areas or in business and commercial sectors.

Attention: This equipment may cause radio interference in residential areas. In this case the operator may be requested to carry out appropriate measures.

The proper and safe operation of this product depends on proper transportation, storage, assembly, and installation, and careful operation.

A completely assembled device housing is required for the proper operation of the devices. Only connect devices that fulfill the requirements of EN 61558-2-4 and EN 61558-2-6 to the Hubs.

During the configuration, installation, start-up, maintenance, and testing of the devices, adhere to the safety and accident-prevention guidelines for the specific application.

Only install cables and accessories that fulfill the requirements and regulations for safety, electromagnetic compatibility, and, where applicable, telecommunication end devices, as well as the specification information. Information on which cables and accessories are permitted for the installation

can be obtained from Belden Deutschland GmbH – Belden or is contained in this manual.

2.2 Qualified personnel

The configuration, installation, start-up, maintenance, and testing of the devices may only be performed by a qualified electrician who is familiar with the safety standards of the automation technology.

The personnel requirements are based on the requirement profiles described by ZVEI, VDMA, or equivalent organizations.

Only electricians who are familiar with the content of all provided device documentation are authorized to install and maintain the devices described. These are persons who

- based on their technical training, knowledge, and experience, and their knowledge of the pertinent standards, can evaluate the work to be carried out and identify any potential risks or
- based on working for several years in a related sector, have the same level of knowledge as they would have from the relevant technical training.

Only Belden Deutschland GmbH – Belden is permitted to make changes to the hardware or software of the products that go beyond the scope of this manual.

Warning: Making unqualified changes to the hardware or software, or non-adherence to the warning information contained in this document, can result in serious personal injury or damage to equipment.

Attention: Belden Deutschland GmbH accepts no liability for any damage caused by unqualified personnel or improper use. This automatically voids the warranty.

3 Designations and synonyms

AI	Analog Input, ports A1 .. A4
AO	Analog Output
AOI	Add-On Instruction
API	Application Programming Interface
BF	Bus Fault LED
Big Endian	Data format with High-B on first place (PROFINET and IO-Link)
BUI	Back-Up Inconsistency (EIP diagnostics)
CC	CC-Link IE Field
C/Q	I/O port pin 4 mode, IO-Link communication/switching signal
Ch. A	Channel A (Pin 4) of I/O port
Ch. B	Channel B (Pin 2) of I/O port
CIP	Common Industrial Protocol (media independent protocol)
CIP Safety™	Common Industrial Protocol for Safety applications, CIP Safety™ is a registered trademark of ODVA
Class A	IO-Link port specification (Class A)
Class B	IO-Link port specification (Class B)
CoAP	Constrained Application Protocol
CSP+	Control & Communication System Profile Plus
DAT	Device Acknowledgement Time
DCP	Discovery and Configuration Protocol
DevCom	Device Comunicating (EIP diagnostics)
DevErr	Device Error (EIP diagnostics)
DI	Digital Input, ports D1 .. D4
DIA	Diagnostic LED
DO	Digital Output
DIO	Digital Input/Output

DTO	Device Temperature Overrun (EIP diagnostics)
DUT	Device under test
EIP	EtherNet/IP™ is a registered trademark of ODVA
ERP	Enterprise Resource Planning system
ETH	ETHERNET
FE	Functional Earth
FME	Force Mode Enabled (EIP diagnostics)
FS	Functional Safety
FSU	Fast Start-Up
GSDML	General Station Description Markup Language
High-B	High-Byte
HTTPS	Hyper Text Transfer Protocol Secure
ICE	IO-Link port COM Error (EIP diagnostics)
ICT	Invalid Cycle Time (EIP diagnostics)
IE	IO-Link port Error (EIP diagnostics)
IN	IO-Link port Notification (EIP diagnostics)
IW	IO-Link port Warning (EIP diagnostics)
IIoT	Industrial Internet of Things
ILE	Input process data Length Error (EIP diagnostics)
IME	Internal Module Error (EIP diagnostics)
I/O	Input / Output
I/O port	X1 .. X8
I/O port pin 2	Channel B of I/O ports
I/O port pin 4 (C/Q)	Channel A of I/O ports
IODD	I/O Device Description
IOL or IO-L	IO-Link
I/Q	I/O port pin 2 mode, Digital Input/switching signal
ISDU	Indexed Service Data Unit
IVE	IO-Link port Validation Error (EIP diagnostics)
I&M	Identification & Maintenance

JSON	JavaScript Object Notation (platform independent data format)
L+	I/O port pin 1, sensor power supply
LioN-X 60	LioN-X variants with a width of 60mm
Little Endian	Data format with Low-B on first place (EtherNet/IP)
LLDP	Link Layer Discovery Protocol
Low-B	Low-Byte
LSB	Least Significant Bit
LVA	Low Voltage Actuator Supply (EIP diagnostics)
LVS	Low Voltage System/Sensor Supply (EIP diagnostics)
MIB	Management Information Base
MP	Multi-protocol: PROFINET + EtherNet/IP + EtherCAT® + Modbus TCP (+ CC-Link IE Field Basic)
MQTT	Message Queuing Telemetry Transport (open networking protocol)
MSB	Most Significant Bit
M12	Metric thread according to DIN 13-1 with 12 mm diameter
n.a.	not applicable
n.c.	no connection / not connected
NTP	Network Time Protocol
OFDT	One Fault Delay Time
OLE	Output process data Length Error (EIP diagnostics)
OPC UA	Open Platform Communications Unified Architecture (platform independent, service-oriented architecture)
PFH	Probability of dangerous Failure per Hour [h -1]
PD	Process Data
PDCT	Port and Device Configuration Tool
PLC	Programmable Logic Controller
PN	PROFINET
PWR	Power
Qualifier	Validity on a process value. Valid = "1"
REST	REpresentational State Transfer
RFC	Request for Comments

RO	Read Only
RPI	Requested Packet Interval
RTD	Resistance Temperature Detector
RW	Read/Write
RWr	Word data input as seen from the master station (CC-Link)
RWw	Word data output as seen from the master station (CC-Link)
RX	Bit data input as seen from the master station (CC-Link)
RY	Bit data output as seen from the master station (CC-Link)
SCA	Short Circuit Actuator/U_L/U_{AUX} (EIP diagnostics)
SCS	Short Circuit Sensor (EIP diagnostics)
SFRT	Safety Function Response Time
SIO mode	Standard Input Output mode
SLMP	Seamless Message Protocol
SNMP	Simple Network Management Protocol
SP	Single Protocol (PROFINET, EtherNet/IP, EtherCAT®, Modbus TCP or CC-Link IE Field Basic)
SPE	Startup Parameterization Error (EIP diagnostics)
T-B	Test Channel B
T-A	Test Channel A
U_{AUX}	$U_{Auxiliary}$, supply voltage for the load circuit (Actuator supply on Class B ports of Class A/B IO-Link Master)
UDP	User Datagram Protocol
UDT	User-Defined Data Types
UINT8	Byte in PLC (IB, QB)
UINT16	Unsigned integer with 16 bits or word in PLC (IW, QW)
U_L	U_{Load}, supply voltage for the load circuit (Actuator supply on Class A IO-Link-Master)
UL	Underwriters Laboratories Inc. (certification company)
UTC	Coordinated Universal Time (Temps Universel Coordonné)
WCDT	Worst Case Delay Time

WO	Write Only

Table 2: Designations and synonyms

4 System description

The LioN-Modules function as the interface in an industrial Ethernet system: A central controller on the management level is able to communicate with the decentralized sensors and actuators on the field level. The line or ring topologies for which LioN modules can be used ensure not only reliable data communication but also significantly reduce the number of cables required and thus also the costs for installation and maintenance. They additionally enable easy and quick extension.

4.1 About LioN-X

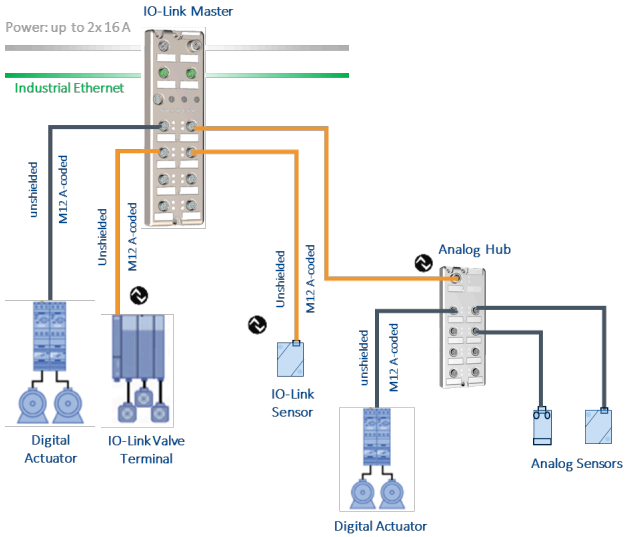
The LioN-X device variants convert input, standard output or IO-Link signals from sensors & actuators via an industrial Ethernet protocol (PROFINET, EtherNet/IP, EtherCAT®, Modbus TCP, CC-Link IE Field Basic) and/or into an IIoT protocol (REST API, CoAP, OPC UA, MQTT). For a logging functionality, there is Syslog on board. The robust 8 port housing design allows the use even in harsh environments where, for example, weld field immunity, high-temperature ranges, or protection classes IP67 and IP69K are needed.

Use all benefits of the Belden product solution by additionally downloading the configuration tool *LioN-Management Suite* from https://www.belden.com to enable e.g. a fast and easy parameterization of the connected IO-Link devices via the embedded IODD interpreter.

4.2 IO-Link basics

IO-Link is a globally standardized technology that enables communication between devices ranging from complex and intelligent sensors through to the central control unit. The IO-Link standard is specified according to the standard IEC 61131-9 and represents the basis of communication.

In the following graphic, IO-Link connections are shown in orange, digital connections (standard I/O) in black and ethernet connections in green.



IO-Link connections
Digital connections (standard I/O)
Ethernet connections

Table 3: Connection types

An IO-Link system consists of an IO-Link Master and an IO-Link Device (e.g., sensors, actuators, valves, I/O modules). An IO-Link Master provides the interface to the higher-level controller and controls the communication to the

connected IO-Link Device. The connection between master and device can be achieved with a standard unshielded connection cable.

An IO-Link-Master can have multiple IO-Link ports. An IO-Link Device can be connected to each port. Therefore, the connection is referred to as point-to-point communication.

4.3 Device variants

The following LioN-X Analog Hub variants are available:

Article number	Product designation	Description	Port functionality
935713001	0960 IOL 3857-001	LioN-X M12 60 mm, 4AI/8DI Analog Hub	4 x universal Analog Input, 8 x Digital Input
935714001	0960 IOL 3858-001	LioN-X M12 60 mm, 4AO/8DI Analog Hub	4 x Analog Output, 8 x Digital Input

Table 4: Overview of LioN-X Analog Hub variants

Hub – 4AI/8DI

The Hub 0960 IOL 3857-001 offers 4 industrial analog inputs configurable as RTD/TD/Resistance. Additionally, 8 digital inputs are available. The digital input sensors and analog input sensors are powered by the IO-Link Master supply voltage on Pin1/L+.

5 Assembly and wiring

5.1 General information

Mount the device on a flat surface using 2 screws (M4x25/30). The torque required is 1 Nm. Use washers compliant with DIN 125 for all types of mounting, maintaining a distance of **149.3 mm (5.878 in) to 150.8 mm (5.937 in)** between the mounting holes.

Connect the IO-Link interface of the Hub to the IO-Link Master via a standardized M12 connecting lead.

For the intended use of a Hub, the connection to an IO-Link Master is absolutely necessary.

Attention: The devices have a ground connection with an M4 thread for the conduction of interference currents and the EMC immunity. This is labeled with the symbol functional earth and the designation "FE".

Attention: Use a low-impedance connection to connect the device to the reference ground. When using a grounded mounting surface, you can make the connection directly via the fixing screws.

Attention: If the mounting surface is ground-free, use a ground strap or a suitable FE line (FE = Functional Earth). Use an M4 screw to connect the ground strap or the FE line to the ground point and if possible put a washer and a toothed washer below the fixing screw.

Attention: For UL application:

Be sure to use a UL-certified cable with a suitable evaluation to connect the devices (CYJV or PVVA). To program the control, please refer to the OEM information, and only use suitable accessories.

Attention: For UL application:

The installation and operation of the devices is only permitted for interior use. Please observe the maximum installation and operating height of 2000 m (6561 ft) above sea level. Approved up to a maximum pollution degree of 2.

Warning: Terminals, housings of field-wired terminal boxes or components may exceed a temperature of +60° C (+140° F).

Warning: Any work on the electrical wiring of the modules may only be carried out when they are disconnected from the power supply.

Warning: For UL application with max. ambient temperature +70° C (+158° F):

Use temperature-resistant cables with following properties:

→ heat resistance up to at least +103° C.

Warning: The power supply may only be provided via the IO-Link port X01 of the module.

5.2 Outer dimensions

5.2.1 4AI/8DI variant

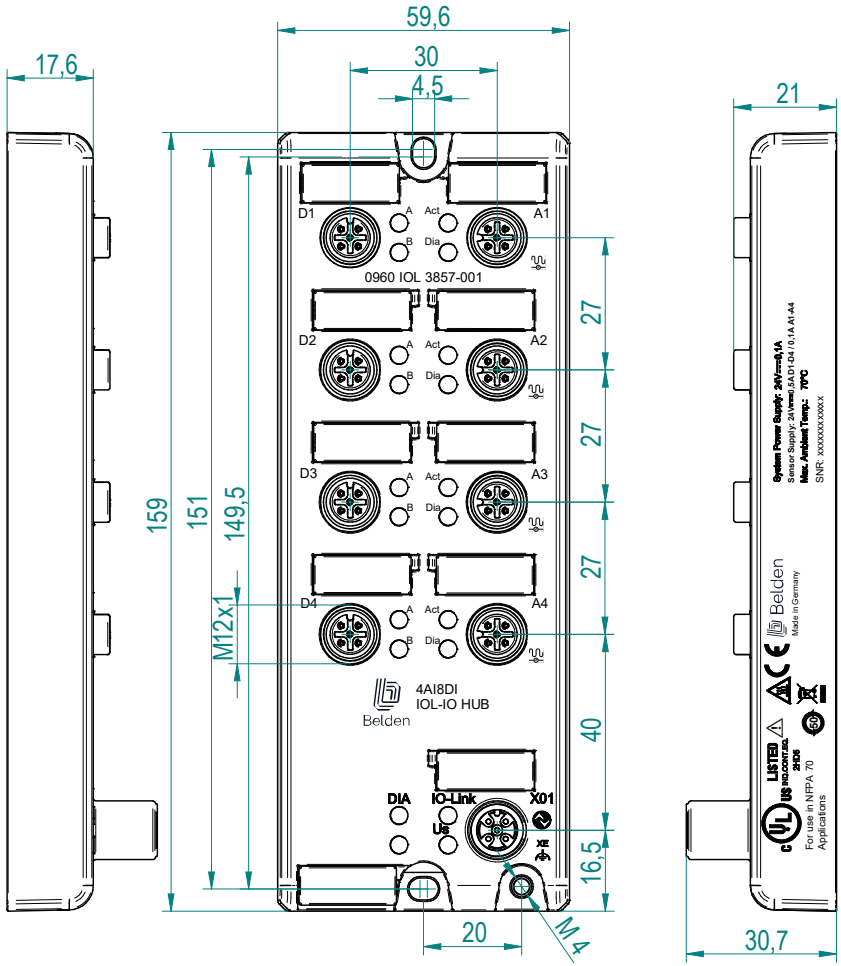


Figure 1: 0960 IOL 3857-001

5.3 Port assignments

All contact arrangements shown in this chapter are front views of the connector side of the device.

5.3.1 IO-Link interface

- Design: M12 socket (male), 5-pin, A-coded
- Color coding: black

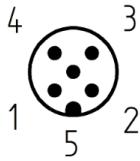


Figure 2: Schematic diagram port X01

Pin	Analog Hub	Function
1	+24 V DC (L+)	Supply voltage from the IO-Link Master
2	nc	
3	GND (L-)	Reference potential to L+
4	C/Q (IO-Link)	IO-Link data channel
5	nc	

Table 5: IO-Link interface

5.3.2 DI ports as M12 sockets

Color coding: black

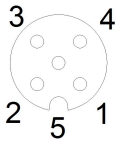


Figure 3: Schematic drawing DI port as M12 socket (female)

Pin	Signal	Function
1	+24 V	power supply +24 V
2	IN	Ch. B: Digital input
3	GND	Ground/reference potential
4	IN	Ch. A: Digital input
5	FE	Functional ground

Table 6: Pin assignments DI ports, D1 .. D4

5.3.3 Analog ports as M12 sockets

Color coding: black

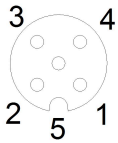


Figure 4: Schematic drawing Analog port as M12 socket, A1 .. A4

5.3.3.1 Analog Input ports

Device variant 0960 IOL 3857-001, ports A1 .. A4.

The pin assignment depends on the configured mode and wiring method:

RTD/Resistance

Mode	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
RTD/R 2-wire	RL+	n.c.	RL-	n.c.	FE
RTD/R 3-wire	RL+	R+	RL-	n.c.	FE
RTD/R 4-wire	RL+	R+	RL-	R-	FE

Table 7: Pin assignments for Analog Input ports with RTD/Resistance

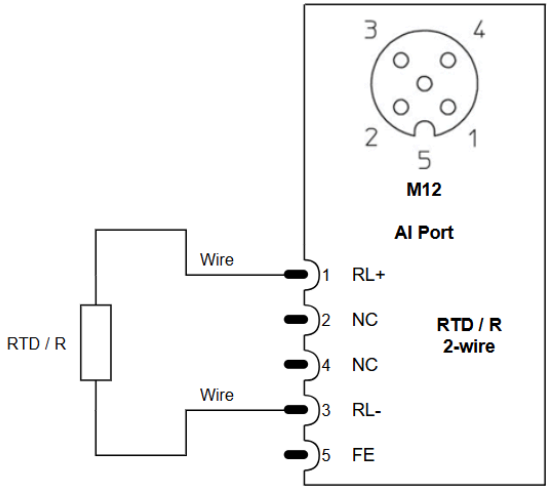


Figure 5: Connection diagram for RTD/R 2-wire

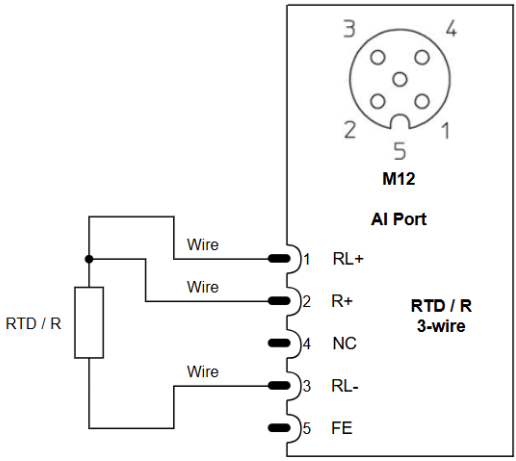


Figure 6: Connection diagram for RTD/R 3-wire

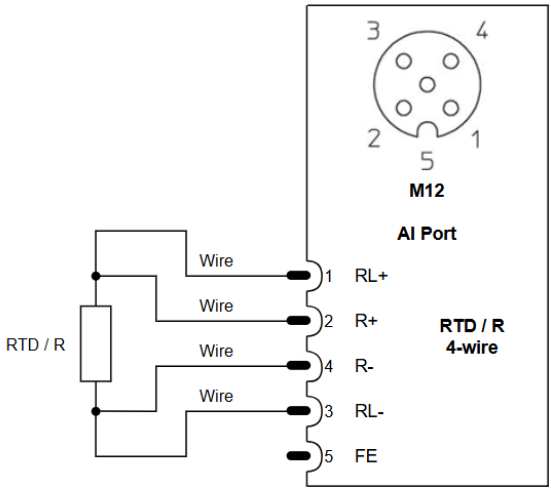


Figure 7: Connection diagram for RTD/R 4-wire

Thermocouple

When measuring temperature with a *thermocouple*, *Cold Junction Compensation / CJC* is required. This can be achieved in several ways:

- Fixed *Cold Junction Compensation / CJC* set to +25 °C / +77 °F
- Compensation via an additional temperature measurement from a PT100 or PT1000 sensor connected to the same port
- Compensation via an additional temperature measurement from a PT100 or PT1000 sensor at port A1

Mode	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
TC with CJC fix value	n.c.	TC+	n.c.	TC-	FE
TC CJC 2nd port (1st port = A2, A3 or A4)	n.c.	TC+	n.c.	TC-	FE
TC CJC 2nd port (2nd port = A1)	CJC+	TC+	CJC-	TC-	FE
TC with CJC PT100/1000	CJC+	TC+	CJC-	TC-	FE

Table 8: Pin assignments for Analog Input ports with Thermocouple

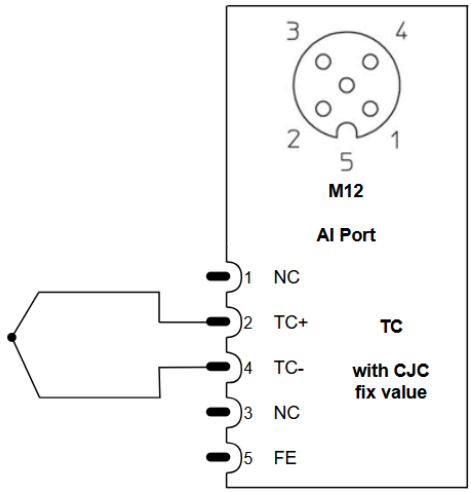


Figure 8: Connection diagram for Thermocouple with fix value

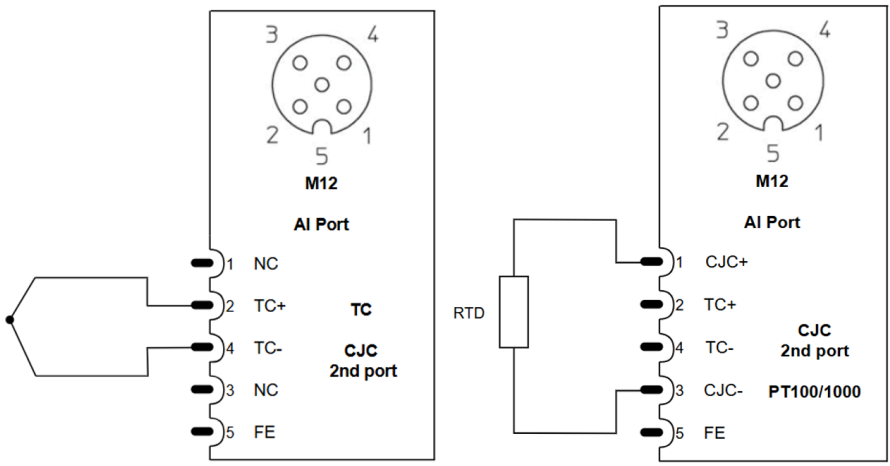


Figure 9: Connection diagram for Thermocouple with 2nd port

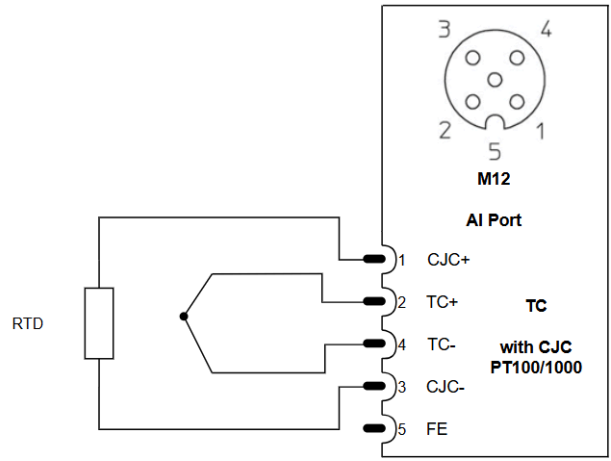


Figure 10: Connection diagram for Thermocouple with PT100/PT1000

Voltage & Current

Mode	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
U/I differential	U_S (from L+)	AI+	GND	AI-	FE
U/I single ended	U_S (from L+)	AI+	GND	n.c.	FE

Table 9: Pin assignments for Analog Input ports with Voltage & Current

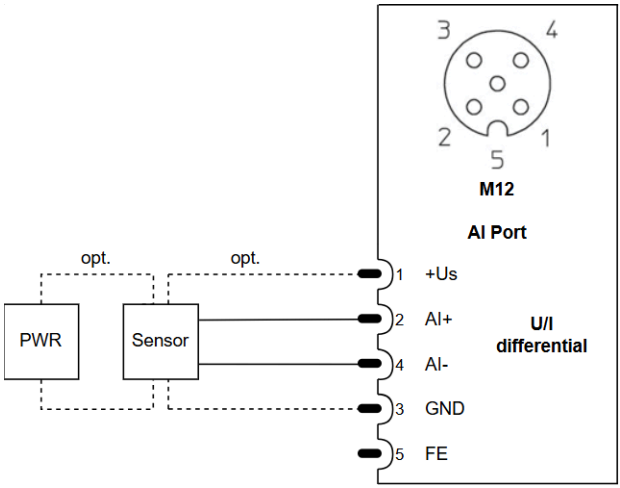


Figure 11: Connection diagram for U/I differential

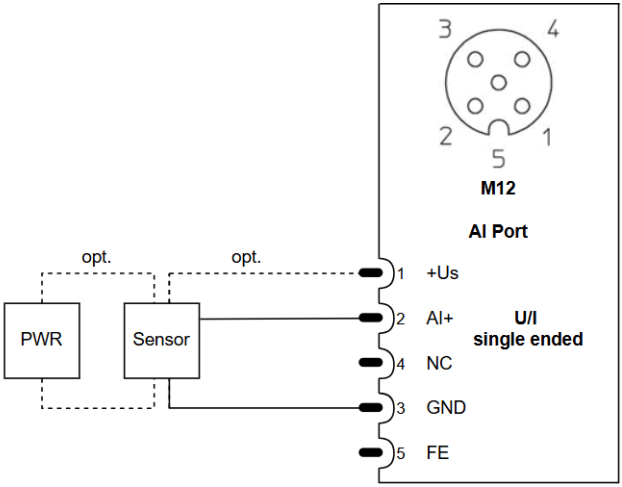


Figure 12: Connection diagram for U/I single ended

6 Configuration and startup

The Belden Hub variants are operated with an IO-Link Master from version 1.1 (the Belden IO-Link-Masters support only the standard 1.1 version).

The data storage mechanism is only supported in conjunction with an IO-Link Master with the standard 1.1 version.

7 Parameterization of the Hub

The parameters set during system commissioning are transferred to the Hub. The Hub and the IO-Link Master store these parameters. The behavior of the IO-Link Master and the connected Hub is defined on the IO-Link Master port.

7.1 IO-Link data storage

The Belden Hub and the Belden IO-Link Masters support the data storage functionality. All user-configurable parameters are stored on the hub and on the master (Exceptions: user serial number, index 0x48 and tool identification, index 0x60). In *IO-Link data storage* mode, the stored parameters can be transferred automatically to the new device in case of a device exchange.

7.2 IO-Link block parameterization

IO-Link features the option to transfer all parameter data from the controller as a block. Block communication is activated by the command "ParamDownloadStart", index 0x02, subindex 0, 3. Following successful configuration, deactivation is performed by means of the command "ParamDownloadEnd", index 0x02, subindex 0, 4.

The Belden Hub supports the block configuration described.

7.3 IO-Link factory reset

The device can be reset by activating the IO-Link-specified system command “Restore Factory Settings”. The command requires that "0x82" is written to the index 0x02, subindex 0.

7.4 Identification parameters

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0	8, 9	Vendor ID	RO (read only)	2	String	0x016A (362dec)
0	10, 11, 12	Device ID	RO	3	String	0x385701
0	10, 11, 12	Bootloader Device ID	RO	3	String	0x999001
0x0010	0	Vendor name	RO	64	String	Belden Deutschland GmbH
0x0011	0	Vendor text	RO	64	String	https://www.belden.com
0x0012	0	Product name	RO	64	String	0960 IOL 3857-001
0x0013	0	Product ID	RO	64	String	935713001
0x0014	0	Product Text	RO	64	String	LioN-X Analog Hub with 4 universal analog inputs
0x0015	0	Serial number	RO	16	String	(Production/user serial number)
0x0016	0	Hardware revision	RO	64	String	(Current HW version)
0x0017	0	Firmware revision	RO	64	String	(Current FW version)
0x0018	0	Application Specific tag	R/W	32	String	***
0x0019	0	Function tag	R/W	32	String	***

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0x001A	0	Location tag	R/W	32	String	***

Table 10: Identification parameters

7.5 Digital Input parameters

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0x0043	0	Input filter	R/W	16	UINT8	3 ms
0x0044	0	Input signal extension	R/W	16	UINT8	Off
0x0045	0	Input logic setting	R/W	16	UINT8	NO (Normally Open)
0x43BE	0	HW ID key	RO	64		HW1000_833409001
0x000D	0	Profile Characteristic	RO	6		0x0000 0x0031 (FW Update) 0x0040 0x0000 (Common Profile) 0x0081 0x0001 (Locator)
0x000E	0	PDInputDescriptor	RO			0x02 0x07 0x00 0x01 0x28 0x08 0x3 0x10 0x30 0x3 0x10 0x40 0x3 0x10 0x50 0x3 0x10 0x60 0x01 0x08 0x78

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0x000F	0	PDOutputDescriptor	RO			-

Table 11: Digital Input parameters

7.6 Generic parameters

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0x0048	0	User serial number	R/W	16	String	0
0x0060	0	Tool identification	R/W	1	UINT8	0 (b7: res. + b6 ... b0)
0x0002	0	Device Reset	WO (write only)	1	UINT8	(Write `0x80` to execute the command)
0x0002	0	Application Reset	WO	1	UINT8	(Write `0x81` to execute the command)
0x0002	0	Factory Reset	WO	1	UINT8	(Write `0x82` to execute the command)
0x0002	0	Back-to-Box	WO	1	UINT8	(Write `0x83` to execute the command)
0x0002	0	LocatorStart	WO	1	UINT8	(Write `0x7E` to execute the command)

Index	Sub-Index	Parameter	Access	Data length [byte]	Data type	Default value
0x0002	0	LocatorStop	WO	1	UINT8	(Write 0x7F to execute the command)

Table 12: General parameters

7.7 Description of parameter data

7.7.1 Input filter

An input filter time is specified by the parameter setting.

The filter times are variably configurable for each channel via the device parameter 0x43.

Index	Subindex Data length 8 bytes	Bit number	I/O channel / port	Parameter value
0x43	1	0-7	0 / D1A	0 = Off, 1-255 = Input filter in ms
0x43	2	0-7	1 / D1B	0 = Off, 1-255 = Input filter in ms
0x43	3	0-7	2 / D2A	0 = Off, 1-255 = Input filter in ms
0x43	4	0-7	3 / D2B	0 = Off, 1-255 = Input filter in ms
0x43	5	0-7	4 / D3A	0 = Off, 1-255 = Input filter in ms
0x43	6	0-7	5 / D3B	0 = Off, 1-255 = Input filter in ms
0x43	7	0-7	6 / D4A	0 = Off, 1-255 = Input filter in ms
0x43	8	0-7	7 / D4B	0 = Off, 1-255 = Input filter in ms

7.7.2 Input signal extension

The parameter setting specifies a minimum input switching time.

This minimum switching time is used for both the Logic-1 and Logic-0 status.

The switching time extensions are variably configurable for each channel via the device parameter index 0x44.

Index	Subindex Data length 8 bytes	Bit number	I/O channel / port	Parameter
0x44	1	0-7	0 / D1A	0 = Off, 1-255 = Input signal extension in ms
0x44	2	0-7	1 / D1B	0 = Off, 1-255 = Input signal extension in ms
0x44	3	0-7	2 / D2A	0 = Off, 1-255 = Input signal extension in ms
0x44	4	0-7	3 / D2B	0 = Off, 1-255 = Input signal extension in ms
0x44	5	0-7	4 / D3A	0 = Off, 1-255 = Input signal extension in ms
0x44	6	0-7	5 / D3B	0 = Off, 1-255 = Input signal extension in ms
0x44	7	0-7	6 / D4A	0 = Off, 1-255 = Input signal extension in ms
0x44	8	0-7	7 / D4B	0 = Off, 1-255 = Input signal extension in ms

7.7.3 Input logic settings (NO/NC)

The parameter determines whether the switched input is displayed as logic 1 (normal mode) or alternatively as logic 0 (inverted mode).

Index	Subindex Data length 8 bytes	Bit number	I/O channel / port	Parameter
0x45	1	0	0 / D1A	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	2	0	1 / D1B	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	3	0	2 / D2A	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	4	0	3 / D2B	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	5	0	4 / D3A	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	6	0	5 / D3B	NO (Normally Open) = 0, NC (Normally Closed) = 1
0x45	7	0	6 / D4A	NO (Normally Open) = 0, NC (Normally Closed) = 1

Index	Subindex / Data length 8 bytes	Bit number	I/O channel / port	Parameter
0x45	8	0	7 / D4B	NO (Normally Open) = 0, NC (Normally Closed) = 1

7.7.4 User serial number

This parameter allows the user to set a user-specific serial number. The user-specific serial number is displayed when the identification parameter, index 0x15, is read.

If the contents of index 0x48 are equal to zero, the production serial number is displayed on index 0x15.

This parameter is excluded from factory reset and always keeps its value. In case the user-specific serial number should be cleared, this parameter must be written to zero manually.

Index	Subindex/Data length 16 bytes	Bit number	Parameter
0x48	1-16	16 x 0 ... 7	User serial number (default: 16 x 0x00)

7.7.5 Identification

This parameter can be used to display different tool configurations. The content of this parameter is transmitted to the cyclic input data.

Index	Subindex/Data length 1 bytes	Bit number	Parameter
0x60	1	0 ... 6	Identification

Table 13: ID for detecting correct tool change

The parameter (index 0x60) is outside the data storage range.

7.8 Parameterization Analog Input (AI)

The AI parameters can be configured to meet your specific needs. There are both parameters concerning the whole device, like *Temperature unit* (°C or °F), as well as parameters for single channels, like the *Wiring Type*.

7.8.1 Device parameters AI

Index	Subindex	Parameter	Access	Data length
0x59	0	Temperature unit	RW	1 Byte
0x5A	0	Mains suppression	RW	1 Byte

Table 14: General device parameters for Analog Input

7.8.1.1 Temperature unit

With this parameter you set the temperature unit per device. The default value is highlighted.

Name	Index	Length	Access	Values
Temperature unit	0x59	1 Byte	RW	**0: °C** 1: °F

7.8.1.2 Mains suppression

With this parameter you set the suppression per device. The default value is highlighted.

Name	Index	Length	Access	Values
Mains suppression	0x5A	4 Byte	RW	**0: Off** 1: 50 Hz 2: 60 Hz

7.8.2 Channel parameters AI

Index	Subindex	Parameter	Access	Data length
0x50	1 .. 4 for A1 .. A4	Port mode & Data representation	RW (Read/Write)	4 Byte
0x51	1 .. 4 for A1 .. A4	Voltage range	RW	4 Byte
0x52	1 .. 4 for A1 .. A4	Current range	RW	4 Byte
0x53	1 .. 4 for A1 .. A4	Resistance range	RW	4 Byte
0x54	1 .. 4 for A1 .. A4	RTD PT/Ni type	RW	4 Byte
0x55	1 .. 4 for A1 .. A4	Thermocouple type	RW	4 Byte
0x56	1 .. 4 for A1 .. A4	Wiring Type for voltage and current	RW	4 Byte
0x57	1 .. 4 for A1 .. A4	Wiring Type for RTD and resistance	RW	4 Byte
0x58	1 .. 4 for A1 .. A4	TC cold junction configuration	RW	4 Byte
0x5B	1 .. 4 for A1 .. A4	Input averaging filter	RW	4 Byte
0x63	1 .. 4 for A1 .. A4	Wire break error	RW	4 Byte
0x64	1 .. 4 for A1 .. A4	Cold junction error	RW	4 Byte
0x65	1 .. 4 for A1 .. A4	Supply error (port 5-8)	RW	4 Byte
0x66	1 .. 4 for A1 .. A4	Lower limit exceeded error	RW	4 Byte
0x67	1 .. 4 for A1 .. A4	Upper Limit exceeded error	RW	4 Byte

Table 15: Channel device parameters for Analog Input

7.8.2.1 Port mode & Data representation

With this parameter you set the port mode (voltage / current / resistance / RTD / TC) and the individual data representation (Standard, Extended or NE43) for each analog input port. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Port mode & Data representation	0x50	1: Port A1	1 Byte	RW	**0: Deactivated (Yellow Port LED off)** 1: Voltage - Data representation: Standard 2: Voltage - Data representation: Extended (Similar Siemens S7) 3: Voltage - Data representation: NE43 4: Current - Data representation: Standard 5: Current - Data representation: Extended (Similar Siemens S7) 6: Current - Data representation: NE43 7: Resistance - Data representation: Standard 8: RTD PT/Ni - Data representation: Standard 9: Thermocouple - Data representation: Standard
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.2 Voltage range

With this parameter you set the voltage range per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Voltage range	0x51	1: Port A1	1 Byte	RW	**0: -10 V .. 10 V** 1: 0 V .. +10 V 2: +2 V .. +10 V 3: -1 V .. +1 V 4: -500 mV .. +500 mV 5: -100 mV .. +100 mV
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.3 Current range

With this parameter you set the current range per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Current range	0x52	1: Port A1	1 Byte	RW	**0: +4 mA .. +20 mA** 1: 0 mA .. +20 mA 2: -20 mA .. +20 mA
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.4 Resistance range

With this parameter you set the resistance range per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Resistance range	0x53	1: Port A1	1 Byte	RW	**0: Resistance 0-100 Ω** 1: Resistance 0-400 Ω 2: Resistance 0-2000 Ω 3: Resistance 0-4000 Ω
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.5 RTD PT/Ni type

With this parameter you set the RTD PT/Ni type per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
RTD PT/Ni type	0x54	1: Port A1	1 Byte	RW	**0: RTD PT 100, -200 °C .. +850 °C, -328 °F .. +1562 °F** 1: RTD PT 200, -200 °C .. +850 °C, -328 °F .. +1562 °F 2: RTD PT 500, -200 °C .. +850 °C, -328 °F .. +1562 °F 3: RTD PT 1000, -200 °C .. +850 °C, -328 °F .. +1562 °F 4: RTD PT 100, -200 °C .. +150 °C, -328 °F .. +302 °F 5: RTD PT 200, -200 °C .. +150 °C, -328 °F .. +302 °F 6: RTD PT 500, -200 °C .. +150 °C, -328 °F .. +302 °F 7: RTD PT 1000, -200 °C .. +150 °C, -328 °F .. +302 °F 8: RTD NI 100, -60 °C .. +250 °C, -76 °F .. +482 °F 9: RTD NI 1000, -60 °C .. +250 °C, -76 °F .. +482 °F
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.6 Thermocouple type

With this parameter you set the Thermocouple type per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Thermocouple type	0x55	1: Port A1	1 Byte	RW	**0: Type B, +100 °C .. +1820 °C, +212 °F .. +3308 °F** 1: Type C, 0 °C .. +2315 °C, +32 °F .. +4199 °F 2: Type E, -270 °C .. +1000 °C, -454 °F .. +1832 °F 3: Type G, 0 °C .. +2315 °C, +32 °F .. +4199 °F 4: Type J, -210 °C .. +1200 °C, -346 °F .. +2192 °F 5: Type K, -270 °C .. +1370 °C, -454 °F .. +2498 °F 6: Type N, -270 °C .. +1300 °C, -454 °F .. +2372 °F 7: Type R, -50 °C .. +1768 °C, -58 °F .. +3214 °F 8: Type S, -50 °C .. +1768 °C, -58 °F .. +3214 °F 9: Type T, -270 °C .. +400 °C, -454 °F .. +752 °F
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.7 Wiring type for voltage and current

With this parameter you set the wiring type for voltage and current per analog channel. The settings will be ignored for channels not configured as current or voltage. Value 1, “Single ended”, is not available for voltage and current ranges covering negative values. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Wiring type for voltage and current	0x56	1: Port A1	1 Byte	RW	**0: Differential** 1: Single ended
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.8 Wiring type for RTD and resistance

With this parameter you set the wiring type for voltage and current per analog channel. The settings will be ignored for channels not configured as RTD or resistance. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Wiring type for RTD and resistance	0x57	1: Port A1	1 Byte	RW	**0: 2-wire** 1: 3-wire 2: 4-wire
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.9 TC cold junction configuration

With this parameter you set the TC (Thermocouple) cold junction configuration per analog channel. The settings will be ignored for channels not configured as TC. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
TC cold junction configuration	0x58	1: Port A1	1 Byte	RW	**0: Pt1000** 1: Pt100 2: Cold junction of channel A1 (invalid value for channel A1 itself) 3: Fixed = +25 °C / +77 °F
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

Attention: To set central *Cold Junction Compensation / CJC* on Port A1 using a PT100/1000 sensor, port A1 must be configured for 'TC' (Thermocouple) BEFORE setting *Cold Junction Compensation / CJC* on ports A2 .. A4.

The CJC for port A1 can never be set to '2'. You must always select the sensor being used, either PT100 or PT1000.

7.8.2.10 Input averaging filter

With this parameter you set the Input averaging filter per analog channel. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Input averaging filter	0x5B	1: Port A1	1 Byte	RW	0: Off 1: Fast **2: Standard** 3: Smooth
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.11 Wire break error

With this parameter you set the Wire break error per analog channel. Per analog port, the wire break error warning can be enabled or disabled. This only affects the IO-Link event, the corresponding error bit of the process data always represents the actual error state. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Wire break error	0x63	1: Port A1	1 Byte	RW	0: Disabled **1**: **Enabled**
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.12 Cold junction error

With this parameter you set the cold junction error per analog channel. Per analog port, the cold junction error warning can be enabled or disabled. This only affects the IO-Link event, the corresponding error bit of the process data always represents the actual error state. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Cold junction error	0x64	1: Port A1	1 Byte	RW	0: Disabled **1**: **Enabled**
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.13 Supply error ports A1 .. A4

With this parameter you set the supply error for the ports A1 .. A4 per analog channel. The supply error warning can be enabled or disabled for each analog port A1 .. A4 in case of an error (Short circuit/overload) on Pin 1 for external sensor supply. This only affects the IO-Link event, the corresponding error bit of the process data usually represents the actual error state. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Supply error (port A1-A4)	0x65	1: Port A1	1 Byte	RW	0: Disabled **1**: **Enabled**
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.14 Lower limit exceeded error

With this parameter you set the lower limit exceeded error for the ports A1 .. A4 per analog channel. Per analog channel, the Lower limit exceeded error warning can be enabled or disabled. This only affects the IO-Link event, the corresponding error bit of the process data always represents the actual error state. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Lower limit exceeded error	0x66	1: Port A1	1 Byte	RW	**0: Disabled** **1**: Enabled
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

7.8.2.15 Upper limit exceeded error

With this parameter you set the upper limit exceeded error for the ports A1 .. A4 per analog channel. Per analog channel, the upper limit exceeded error warning can be enabled or disabled. This only affects the IO-Link event, the corresponding error bit of the process data always represents the actual error state. The default value is highlighted.

Name	Index	Subindex	Length	Access	Values
Upper limit exceeded error	0x67	1: Port A1	1 Byte	RW	**0: Disabled** **1**: Enabled
		2: Port A2	1 Byte	RW	
		3: Port A3	1 Byte	RW	
		4: Port A4	1 Byte	RW	

8 Process data assignment

This chapter describes the assignment of the process data of the controller to the I/O channels.

The process data length is invariable for all LioN-X Analog Hubs. The following tables show the structure of the data. It is not possible to configure the process data length.

Explanations of the abbreviations used:

D1A .. D4A:	Current status of input channel A (pin 4) of the M12 connectors 1 to 4.
D1B .. D4B:	Current status of input channel B (pin 2) of M12 connectors 1 to 4.
MD-LVS	Module diagnosis – system/sensor power supply voltage too low
PD-SE-D1 .. D4	Port diagnosis – supply error (short-circuit or overload) on D1 .. D4
PD-SE-An	Port diagnosis – supply error (short-circuit or overload) on A1 .. A4 (separate bits)
PD-An Diagn.	Port diagnosis for port A1 .. A4 is active, check corresponding port diagnosis byte (byte 11-4 or byte 3-6) for detailed information.
ID	ID byte for identification of a tool change, 0 = default, ID = 0–127
CJE	Cold Junction Error (analog IN only) on A1 .. A4
WBR	Wire Break on A1 .. A4
LLE	Lower Limit Exceeded on A1 .. A4
ULE	Upper Limit Exceeded on A1 .. A4

8.1 Input data for 4AI/8DI modules

Device 0960 IOL 3857-001 supplies a total of 16 bytes of input data as follows:

Byte	Description	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Digital Inputs	D4B	D4A	D3B	D3A	D2B	D2A	D1B	D1A
1	reserved	–							
2	Analog value	High Byte AI A1							
3	Analog value	Low Byte AI A1							
4	Analog value	High Byte AI A2							
5	Analog value	Low Byte AI A2							
6	Analog value	High Byte AI A3							
7	Analog value	Low Byte AI A3							
8	Analog value	High Byte AI A4							
9	Analog value	Low Byte AI A4							
10	Modul diagnosis	PD-A4	PD-A3	PD-A2	PD-A1	–	PD-SE-D1 .. D4	–	MD-LVS
11	Port diagnosis A1				A1 SE	A1 CJE	A1 WBR	A1 LLE	A1 ULE
12	Port diagnosis A2				A2 SE	A2 CJE	A2 WBR	A2 LLE	A2 ULE
13	Port diagnosis A3				A3 SE	A3 CJE	A3 WBR	A3 LLE	A3 ULE
14	Port diagnosis A4				A4 SE	A4 CJE	A4 WBR	A4 LLE	A4 ULE
15	Device identification		ID						

Table 16: Input process data 0960 IOL 3857-001

8.2 Value representation for the voltage range

The following tables show measurement representations for the different values from Voltage range on page 39.

8.2.1 Voltage range -10 V .. +10 V

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.05185 × 10^{-4}) V			
> 10.1000 V	“Upper limit value exceeded” ON	32767	7FFF
< 10.0500 V	“Upper limit value exceeded” OFF	32767	7FFF
10.0000 V	Nominal range	32767	7FFF
9.991 V		32736	7FE0
0.005 V		16	0010
0 V		0	0000
-0.0050 V		-16	FFF0
-9.996 V		-32752	8010
-10.0005 V		-32767	8001
-10.0008 V		-32768	8000
> -10.0500 V	“Lower limit value underrun” OFF	-32768	8000
< -10.1000 V	“Lower limit value underrun” ON	-32768	8000

Table 17: -10 V .. +10 V - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.6169 × 10^{-4}) V			
> 11.759 V	“Upper limit value exceeded” ON	32767	7FFF
< 11.60 V	“Upper limit value exceeded” OFF	32071	7D47
11.851 V	Overload range	32767	7FFF
11.759 V		32512	7F00
10 V	Nominal range	27648	6C00
5.926 V		16384	4000
0 V		0	0000
-1.76 V		-4865	ECFF
-2.500 V		-6912	E500
-5.926 V		-16384	C000
-10 V	Nominal range	-27648	9400
-11.759 V	Overload range	-32512	8100
-11.851 V		-32768	8000
> -11.60 V	”Lower limit value underrun” OFF	-32071	82B9
< -11.759 V	“Lower limit value underrun” ON	-32768	8000

Table 18: -10 V .. +10 V - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 10^{-3}) V			
> 10.50 V	“Upper limit value exceeded” ON	> 10500	> 2904
< 10.25 V	“Upper limit value exceeded” OFF	< 10250	< 280 A
10.00 V	Nominal range	10000	2710
5.00 V		5000	1388
2.00 V		2000	07D0
0 V		0	0000
-2.00 V		-2000	F830
-5.00 V		-5000	EC78
-10.00 V		-10000	D8F0
> -10.25 V	”Lower limit value underrun” OFF	> -10250	> D7F6
< -10.50 V	“Lower limit value underrun” ON	< -10500	> D6FC

Table 19: -10 V .. +10 V - Measurement value representation ‘NE43’

8.2.2 Voltage range 0 V .. +10 V

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.05185 × 10^{-4}) V			
> 10.1000 V	“Upper limit value exceeded” ON	32767	7FFF
< 10.0500 V	“Upper limit value exceeded” OFF	32767	7FFF
10.0000 V	Nominal range	32767	7FFF
9.991 V		32736	7FE0
0.005 V		16	0010
0 V		0	0000

Table 20: 0 V .. +10 V - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.6169 × 10^{-4}) V			
> 11.759 V	“Upper limit value exceeded” ON	32767	7FFF
< 11.60 V	“Upper limit value exceeded” OFF	< 32071	< 7D47
11.851 V	Nominal range	32767	7FFF
11.759 V		32512	7F00
10 V		27648	6C00
5.926 V		16384	4000
0 V		0	0000

Table 21: 0 V .. +10 V - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 10^{-3}) V			
> 10.50 V	“Upper limit value exceeded” ON	> 10500	> 2904
< 10.25 V	“Upper limit value exceeded” OFF	< 10250	< 280 A
10.00 V	Nominal range	10000	2710
5.00 V		5000	1388
2.00 V		2000	07D0
0 V		0	0000

Table 22: 0 V .. +10 V - Measurement value representation ‘NE43’

8.2.3 Voltage range +2 V .. +10 V

Representation: Proprietary	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 2.44148 × 10^{-4}) V+ 2 V			
> 10.1000 V	“Upper limit value exceeded” ON	32767	7FFF
< 10.0500 V	“Upper limit value exceeded” OFF	32767	7FFF
10.0000 V	Nominal range	32767	7FFF
9.999 V		32766	7FFE
9.992 V		32736	7FE0
2.0004 V		16	0010
2.0 V		0	0000
> 1.95 V	“Lower limit value underrun” OFF	0	0000
< 1.90 V	“Lower limit value underrun” ON	0	0000
> 1.5 V	“Wire break” OFF	0	0000
< 1.45 V	“Wire break” ON	0	0000
0 V		0	0000

Table 23: +2 V .. +10 V - Measurement value representation ‘Proprietary’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 2.89352 × 10^{-4}) V+ 2 V			
> 11.407 V	“Upper limit value exceeded” ON	32767	7FFF
< 11.28 V	“Upper limit value exceeded” OFF	32077	7D47
11.481 V	Maximum range	32767	7FFF
11.407 V	Overload range	32512	7F00
10 V	Nominal range	27653	6C05
6.741 V		16384	4000
2.000 V	Nominal range	0	0000
0.592 V	Overload range	-4866	ECFE
0V	Maximum range	-32768	8000
> 0.676 V	”Lower limit value underrun” and ”wire break” OFF	-4576	EE20
< 0.592 V	”Lower limit value underrun” and ”wire break” ON	-32768	8000

Table 24: +2 V .. +10 V - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 10^{-3}) V			
> 10.50 V	“Upper limit value exceeded” ON	> 10500	> 2904
< 10.25 V	“Upper limit value exceeded” OFF	< 10250	< 280 A
10.00 V	Nominal range	10000	2710
5.00 V		5000	1388
2.00 V		2000	07D0
0 V	Nominal range	0	0000
> 1.95 V	”Lower limit value underrun” OFF	> 1950	> 079E
< 1.90 V	“Lower limit value underrun” ON	< 1900	> 076B
> 1.05 V	“Wire break” OFF	> 1050	> 041A
< 1.00 V	“Wire break” ON	< 1000	< 03E8

Table 25: +2 V .. +10 V - Measurement value representation ‘NE43’

8.2.4 Voltage range -1 V .. +1 V

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.05185 × 10^{-5}) V			
> 1.0100 V	“Upper limit value exceeded” ON	32767	7FFF
< 1.0050 V	“Upper limit value exceeded” OFF	32767	7FFF
1.0000 V	Nominal range	32767	7FFF
0.999 V		32766	7FFE
0.996 V		32736	7FE0
0 V		16	0010
0 V		1	0001
0 V		0	0000
0 V		-1	FFFF
0 V		-16	FFF0
-0.909 V		-32752	8010
-0.999 V		-32767	8001
-1.000 V		-32768	8000
> -1.0050 V	“Lower limit value underrun” OFF	-32768	8000
< -1.0100 V	“Lower limit value underrun” ON	-32768	8000

Table 26: -1 V .. +1 V - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.6169 × 10^{-5}) V			
> 1.175 V	“Upper limit value exceeded” ON	32767	7FFF
< 1.160 V	“Upper limit value exceeded” OFF	< 32076	< 7DC4
1.185 V	Maximum range	32767	7FFF
1.175 V	Overload range	32512	7F00
1 V	Nominal range	27651	6C03
0.593 V		16384	4000
0 V		0	0000
-0.593 V		-16384	C000
-1 V	Nominal range	-27651	93FD
-1.175 V	Overload range	-32512	8100
-1.185 V	Maximum range	-32768	8000
> -1.160 V	”Lower limit value underrun” OFF	> -32076	> 82B4
< -1.175 V	“Lower limit value underrun” ON	-32767	8000

Table 27: -1 V .. +1 V - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 10^{-4}) V			
> 1.050 V	“Upper limit value exceeded” ON	>10500	> 2904
< 1.025 V	“Upper limit value exceeded” OFF	<10250	< 280A
1.000 V	Nominal range	10000	2710
0.500 V		5000	1388
0 V		0	0000
- 0.500 V		-5000	EC78
-1.000 V		-10000	D8F0
> -1.025 V	”Lower limit value underrun” OFF	> -10250	> D7F6
< -1.050 V	”Lower limit value underrun” ON	< -10500	> D6FC

Table 28: -1 V .. +1 V - Measurement value representation ‘NE43’

8.2.5 Voltage range -500 mV .. +500 mV

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 1.52593 × 10^{-2}) mV			
> 505.0 mV	“Upper limit value exceeded” ON	32767	7FFF
< 502.5 mV	“Upper limit value exceeded” OFF	32767	7FFF
500.000 mV	Nominal range	32767	7FFF
499.95 mV		32766	7FFE
499.527 mV		32736	7FE0
244.244 mV		16	0010
0.015 mV		1	0001
0 mV		0	0000
-0.015 mV		-1	FFFF
-244.244 mV		-16	FFF0
-499.771 mV		-32752	8010
-499.999 mV		-32767	8001
-500.000 mV		-32768	8000
> -502.5 mV	”Lower limit value underrun” OFF	-32768	8000
< -505.0 mV	“Lower limit value underrun” ON	-32768	8000

Table 29: -500 mV .. +500 mV - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 1.80845 × 10^{-2}) mV			
> 587.9 mV	“Upper limit value exceeded” ON	32767	7FFF
< 580 mV	“Upper limit value exceeded” OFF	< 32071	> 7D47
592.6 mV	Maximum range	32767	7FFF
587.9 mV	Overload range	32512	7F00
500.0 mV	Nominal range	27647	6BFF
296.3 mV		16384	4000
0 mV		0	0000
-296.3 mV		-16384	C000
-500.0 mV	Nominal range	-27647	9401
-587.9 mV	Overload range	-32512	8100
-592.6 mV	Maximum range	-32768	8000
< -580 mV	”Lower limit value underrun” OFF	> -32071	> 82B9
> -587.9 mV	“Lower limit value underrun” ON	-32768	8000

Table 30: -500 mV .. +500 mV - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 5 × 10^{-2}) mV			
> 0.5250 mV	“Upper limit value exceeded” ON	> 10500	> 2904
< 0.5125 mV	“Upper limit value exceeded” OFF	< 10520	< 280 A
0.500 mV	Nominal range	10000	2710
0.250 mV		5000	1388
0 mV		0	0000
-0.250 mV		-5000	EC78
-0.500 mV		-10000	D8F0
> - 0.5125 mV	”Lower limit value underrun” OFF	> -10250	> D7F6
< -0.5250 mV	”Lower limit value underrun” ON	< -10500	> D6FC

Table 31: -500 mV .. +500 mV - Measurement value representation ‘NE43’

8.2.6 Voltage range -100 mV .. +100 mV

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.05185 × 10^{-3}) mV			
> 101.000 mV	“Upper limit value exceeded” ON	32767	7FFF
< 100.500 mV	“Upper limit value exceeded” OFF	32767	7FFF
100.00 mV	Nominal range	32767	7FFF
99.999 mV		32766	7FFE
99.905 mV		32736	7FE0
0.049 mV		16	0010
0.003 mV		1	0001
0 mV		0	0000
-0.003 mV		-1	FFFF
-0.049 mV		-16	FFF0
-99.954 mV		-32752	8010
-99.999 mV		-32767	8001
-100.000 mV		-32768	8000
> -100.500 mV	”Lower limit value underrun” OFF	-32768	8000
< -101.000 mV	“Lower limit value underrun” ON	-32768	8000

Table 32: -100 mV .. +100 mV - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 3.6169 × 10^{-3}) mV			
> 117.5 mV	“Upper limit value exceeded” ON	32767	7FFF
< 116.0 mV	“Upper limit value exceeded” OFF	32072	7D48
118.5 mV	Maximum range	32767	7FFF
117.5 mV	Overload range	32512	7F00
100.0 mV	Nominal range	27652	6C04
59.3 mV		16384	4000
0 mV		0	0000
-59.3 mV		-16384	C000
-100.0 mV	Nominal range	-27652	93FC
-117.5 mV	Overload range	-32512	8100
-118.5 mV	Minimum range	-32768	8000
> -116.0 mV	”Lower limit value underrun” OFF	-32072	82B8
< -117.5 mV	“Lower limit value underrun” ON	-32768	8000

Table 33: -100 mV .. +100 mV - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Voltage value U_M = (dec. value × 10^{-2}) mV			
> 0.1050 mV	“Upper limit value exceeded” ON	> 10500	> 2904
< 0.1025 mV	“Upper limit value exceeded” OFF	< 10520	< 280 A
0.100 mV	Nominal range	10000	2710
0.050 mV		5000	1388
0 mV		0	0000
-0.050 mV		-5000	EC78
-0.100 mV		-10000	D8F0
> - 0.1025 mV	”Lower limit value underrun” OFF	> -10250	> D7F6
< -0.1050 mV	”Lower limit value underrun” ON	< -10500	> D6FC

Table 34: -100 mV .. +100 mV - Measurement value representation ‘NE43’

8.3 Value representation for the current range

The following tables show measurement representations for the different values from Current range on page 40.

8.3.1 Current range +4 mA .. +20 mA

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 4.883 × 10^{-4}) + 4 mA			
> 20.20 mA	“Upper limit value exceeded” ON	32767	7FFF
< 20.10 mA	“Upper limit value exceeded” OFF	32767	7FFF
20 mA	Nominal range	32767	7FFF
12.00 mA		16384	4000
4 mA		0	0000
> 3.70 mA	”Lower limit value underrun” and ”underflow” OFF	0	0000
< 3.60 mA	”Lower limit value underrun” and ”under-flow” ON	0	0000
> 3.00 mA	“Wire break” OFF	0	0000
< 2.90 mA	“Wire break” ON	0	0000

Table 35: +4 mA .. +20 mA - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 5.787 × 10^{-4}) + 4 mA			
> 22.814 mA	“Upper limit value exceeded” ON	32767	7FFF
< 22.565 mA	“Upper limit value exceeded” OFF	< 32080	> 7D50
22.962 mA	Maxmimal range	32767	7FFF
22.814 mA	Overload range	32512	7F00
20 mA	Nominal range	27647	6BFF
13.481 mA		16384	4000
4.000 mA		0	0000
1.185 mA		-4864	ED00
0 mA	Minimum range	-32768	8000
> 1.303 mA	”Lower limit value underrun” and ”wire break” OFF	> -4660	> EDCC
< 1.185 mA	”Lower limit value underrun” and ”wire break” ON	-32768	8000

Table 36: +4 mA .. +20 mA - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 10^{-3}) mA			
> 20.80 mA	“Upper limit value exceeded” ON	> 20800	> 5140
< 20.50 mA	“Upper limit value exceeded” OFF	< 20500	< 5014
22.00 mA	Nominal range	22000	55F0
21.00 mA		21000	5208
10 mA		10000	2710
4 mA		4000	0FA0
0 mA		0	0000
> 3.80 mA	”Lower limit value underrun” OFF	> 3800	>0ED8
< 3.60 mA	“Lower limit value underrun” ON	< 3600	< 0E10
> 2.20 mA	“Wire break” OFF	> 2200	>0898
< 2.00 mA	“Wire break” ON	< 2000	<07D0

Table 37: +4 mA .. +20 mA - Measurement value representation ‘NE43’

8.3.2 Current range 0 mA .. +20 mA

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 6.104 × 10^{-4}) mA			
> 20.20 mA	“Upper limit value exceeded” ON	32767	7FFF
< 20.10 mA	“Upper limit value exceeded” OFF	32767	7FFF
20 mA	Nominal range	32767	7FFF
10.00 mA		16384	4000
0 mA		0	0000

Table 38: 0 mA .. +20 mA - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 7.234 × 10^{-4}) mA			
> 23.519 mA	“Upper limit value exceeded” ON	32767	7FFF
< 23.206 mA	“Upper limit value exceeded” OFF	< 32079	> 7D4F
23.703 mA	Maximum Range	32767	7FFF
23.519 mA	Overload Range	32512	7F00
20 mA	Nominal Range	27648	6C00
11.852 mA		16384	4000
0 mA		0	0000

Table 39: 0 mA .. +20 mA - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 10^{-3}) mA			
> 20.80 mA	“Upper limit value exceeded” ON	> 20800	> 5140
< 20.50 mA	“Upper limit value exceeded” OFF	< 20500	< 5014
22.00 mA	Nominal range	22000	55F0
21.00 mA		21000	5208
10 mA		10000	2710
4 mA		4000	0FA0
0 mA		0	0000

Table 40: 0 mA .. +20 mA - Measurement value representation ‘NE43’

8.3.3 Current range -20 mA .. +20 mA

Representation: Standard	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 6.1037 × 10^{-4}) mA			
> 20.20 mA	“Upper limit value exceeded” ON	32767	7FFF
< 20.10 mA	“Upper limit value exceeded” OFF	32767	7FFF
20 mA	Nominal range	32767	7FFF
10.00 mA		16384	4000
0 mA		0	0000
-10.00 mA		-16384	C000
-20.00 mA		-32768	8000
> -20.10 mA	”Lower limit value underrun” and ”underflow” OFF	-32768	8000
< -20.20 mA	”Lower limit value underrun” and ”underflow” ON	-32768	8000

Table 41: -20 mA .. +20 mA - Measurement value representation ‘Standard’

Representation: Extended	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 7.2338 × 10^{-4}) mA			
> 23.519 mA	“Upper limit value exceeded” ON	32767	7FFF
< 23.206 mA	“Upper limit value exceeded” OFF	< 32080	< 7D50
23.703 mA	Maximum range	32767	7FFF
23.519 mA	Overload range	32512	7F00
20 mA	Nominal range	27648	6C00
11.852 mA		16384	4000
0 mA		0	0000
-11.852 mA		-16384	C000
-20.00 mA		-27648	9400
-23.519 mA	Overload range	-32512	8100
-23.703 mA	Minimum range		
> -23.206 mA	”Lower limit value underrun” OFF	> -32080	> 82B0
> -23.519 mA	“Lower limit value exceeded” ON	-32767	8000

Table 42: -20 mA .. +20 mA - Measurement value representation ‘Extended’ (similar to Siemens S7)

Representation: NE43	Diagnostics	Decimal	Hexadecimal (two´s complement)
Current value I_M = (dec. value × 10^{-3}) mA			
> 20.80 mA	“Upper limit value exceeded” ON	> 20800	> 5140
< 20.50 mA	“Upper limit value exceeded” OFF	< 20500	< 5014
22.00 mA	Nominal range	22000	55F0
21.00 mA		21000	5208
10.00 mA		10000	2710
4.00 mA		4000	0FA0
0.00 mA		0	0000
-10.00 mA		-10000	D8F0
-21.00 mA		-21000	ADF8
-22.00 mA		-22000	AA10
> -20.50 mA	”Lower limit value underrun” OFF	> -20500	> AFEC
< -20.80 mA	“Lower limit value underrun” ON	< -20800	< AEC0

Table 43: -20 mA .. +20 mA - Measurement value representation ‘NE43’

8.4 Value representation for the resistance range

The following tables show measurement representations for the different values from Resistance range on page 40.

8.4.1 Resistance range 0 Ω .. 400 Ω

Resistance	Diagnostics	Decimal	Hexadecimal (two´s complement)
Resistance R_M = (dec. value × 0.0122074) Ω			
> 600.00 Ω	“Wire break” ON	32767	7FFF
< 500.00 Ω	“Wire break” OFF	23767	7FFF
> 404.00 Ω	“Upper limit value exceeded” ON	32767	7FFF
< 401.00 Ω	“Upper limit value exceeded” OFF	32767	7FFF
400.00 Ω	Nominal range	32767	7FFF
399.998 Ω		32766	7FFE
200.00 Ω		16384	4000
0.0122 Ω		1	0001
0 Ω		0	0000

Table 44: 0 ohm .. 400 ohm - Measurement value representation

8.4.2 Resistance range 0 Ω .. 100 Ω

Resistance	Diagnostics	Decimal	Hexadecimal (two´s complement)
Resistance R_M = (dec. value × 0.00305185) Ω			
> 214.00 Ω	“Wire break” ON	32767	7FFF
< 150.00 Ω	“Wire break” OFF	23767	7FFF
> 102.00 Ω	“Upper limit value exceeded” ON	32767	7FFF
< 101.00 Ω	“Upper limit value exceeded” OFF	32767	7FFF
100.00 Ω	Nominal range	32767	7FFF
99.999 Ω		32766	7FFE
50.002 Ω		16384	4000
0.003 Ω		1	0001
0 Ω		0	0000

Table 45: 0 ohm .. 100 ohm - Measurement value representation

8.4.3 Resistance range 0 Ω .. 2000 Ω

Resistance	Diagnostics	Decimal	Hexadecimal (two´s complement)
Resistance R_M = (dec. value × 0.061037) Ω			
> 2320.00 Ω	“Wire break” ON	32767	7FFF
< 2100.00 Ω	“Wire break” OFF	32767	7FFF
> 2020.00 Ω	“Upper limit value exceeded” ON	32767	7FFF
< 2001.00 Ω	“Upper limit value exceeded” OFF	32767	7FFF
2000.00 Ω	Nominal range	32767	7FFF
1999.938 Ω		32766	7FFE
1000.030 Ω		16384	4000
0.061 Ω		1	0001
0 Ω		0	0000

Table 46: 0 ohm .. 2000 ohm - Measurement value representation

8.4.4 Resistance range 0 Ω .. 4000 Ω

Resistance	Diagnostics	Decimal	Hexadecimal (two´s complement)
Resistance R_M = (dec. value × 0.122074) Ω			
> 4640.00 Ω	“Wire break” ON	32767	7FFF
< 4200.00 Ω	“Wire break” OFF	32767	7FFF
> 4040.00 Ω	“Upper limit value exceeded” ON	32767	7FFF
< 4001.00 Ω	“Upper limit value exceeded” OFF	32767	7FFF
4000.00 Ω	Nominal range	32767	7FFF
3999.877 Ω		32766	7FFE
2000.060 Ω		16384	4000
0.122 Ω		1	0001
0 Ω		0	0000

Table 47: 0 ohm .. 4000 ohm - Measurement value representation

8.5 Value representation for the PT/Ni type

The following tables show measurement representations for the different values from RTD PT/Ni type on page 41.

8.5.1 RTD PT 100/200/500/1000 extended range

For parameter *RTD PT/Ni type*, values 0 .. 3.

Measured value in degrees Celsius	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -202 °C	“Lower limit value underrun” ON	-2020	F81C
-200 °C	Nominal range	-2000	F830
-135 °C		-1350	FABA
-1 °C		-10	FFF6
0 °C		0	0000
+1 °C		10	000A
+850 °C		8500	2134
> +858.5 °C	“Upper limit value exceeded” ON	8585	2189

Table 48: RTD PT extended range - Measurement value representation (Celsius)

Measured value in degrees Fahrenheit	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -331.6 °F	“Lower limit value underrun” ON	-1658	F986
-328 °F	Nominal range	-1640	F998
-211 °F		-1055	FBE1
+30.2 °F		151	0097
+32 °F		160	00A0
+33.8 °F		169	00A9
+1562 °F		7810	1482
> +1577.3 °F	“Upper limit value exceeded” ON	7886	1ECE

Table 49: RTD PT extended range - Measurement value representation (Fahrenheit)

8.5.2 RTD Ni 100/1000

For parameter *RTD PT/Ni type*, values 8 and 9.

Measured value in degrees Celsius	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -60.6 °C	“Lower limit value underrun” ON	-6060	
+60C	Nominal range	-6000	
-1 °C		-100	
0 °C		00	
+1 °C		100	
+250 °C		25000	
> +252.5 °C	“Upper limit value exceeded” ON	25250	

Table 50: RTD Ni extended range - Measurement value representation (Celsius)

Measured value in degrees Fahrenheit	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -77.08 °F	“Lower limit value underrun” ON	-3850	
-76 °F	Nominal range	-3800	
+30.2 °F		-1510	
+32 °F		1600	
+33.8 °F		1690	
+482 °F		24100	
> +486.5 °F	“Upper limit value exceeded” ON	24320	

Table 51: RTD Ni extended range - Measurement value representation (Fahrenheit)

8.5.3 RTD PT 100/200/500/1000 normal range

For parameter *RTD PT/Ni type*, values 4 .. 7.

Measured value in degrees Celsius	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -202 °C	“Lower limit value underrun” ON	-20200	B118
-200 °C	Nominal range	-20000	B1E0
-100 °C		-10000	D8F0
0 °C		0	0000
+100 °C		10000	2710
+150 °C		15000	3A98
> +151.5 °C	“Upper limit value exceeded” ON	15150	3B2E

Table 52: RTD PT normal range - Measurement value representation (Celsius)

Measured value in degrees Fahrenheit	Diagnostics	Decimal	Hexadecimal (two´s complement)
> -331.6 °F	“Lower limit value underrun” ON	-16580	BF3C
-328 °F	Nominal range	-16400	BFF0
-148 °F		-7400	E318
+32 °F		1600	0640
+212 °F		10600	2968
+302 °F		15100	3AFC
> +304.7 °F	“Upper limit value exceeded” ON	15230	3B7E

Table 53: RTD PT normal range - Measurement value representation (Fahrenheit)

8.6 Value representation for the thermocouple type

The following tables show measurement representations for the different values from Thermocouple type on page 41.

Measured value in degrees Celsius	Decimal	Hexadecimal (two´s complement)
-270 °C	-2700	F574
-135 °C	-1350	FABA
-1 °C	-10	FFF6
0 °C	0	0000
1 °C	10	000A
850 °C	8500	2134
2315 °C	23150	5A6E

Table 54: Thermocouple - Measurement value representation (Celsius)

Measured value in degrees Fahrenheit	Decimal	Hexadecimal (two´s complement)
-454 °F	-2270	F722
-211 °F	-1055	FBE1
30.2 °F	151	0097
32 °F	160	00A0
33.8 °F	169	00A9
1562 °F	7810	1e82
4199 °F	20995	5203

Table 55: Thermocouple - Measurement value representation (Fahrenheit)

8.6.1 Thermocouple Type B

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type B	ON	OFF	ON	OFF
+100 °C .. +1820 °C	+99 °C	+100 °C	+1838.2 °C	+1820 °C
+212 °F .. +3308 °F	+210.2 °F	+212 °F	+3340.76 °F	+3308 °F

8.6.2 Thermocouple Type C

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type C	ON	OFF	ON	OFF
0 °C .. +2315 °C	-1 °C	0 °C	+2338.15 °C	+2315 °C
+32 °F .. +4199 °F	-30.2 °F	+32 °F	+4240.67 °F	+4199 °F

8.6.3 Thermocouple Type E

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type E	ON	OFF	ON	OFF
-270 °C .. +1000 °C	-272.7 °C	-270 °C	+1010 °C	+1000 °C
-454 °F .. +1832 °F	-458.86 °F	-454 °F	+1850 °F	+1832 °F

8.6.4 Thermocouple Type G

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type G	ON	OFF	ON	OFF
0 °C .. +2315 °C	-1 °C	0 °C	+2338.15 °C	+2315 °C
+32 °F .. +4199 °F	-30.2 °F	+32 °F	+4240.67 °F	+4199 °F

8.6.5 Thermocouple Type J

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type J	ON	OFF	ON	OFF
-210 °C .. +1200 °C	-212.1 °C	-210 °C	+1212 °C	+1200 °C
-346 °F .. +2192 °F	-349.78 °F	-346 °F	+2213.6 °F	+2192 °F

8.6.6 Thermocouple Type K

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type K	ON	OFF	ON	OFF
-270 °C .. +1370 °C	-272.7 °C	-270 °C	+1383.7 °C	+1370 °C
-454 °F .. +2498 °F	-458.86 °F	-454 °F	+2522.66 °F	+2498 °F

8.6.7 Thermocouple Type N

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type N	ON	OFF	ON	OFF
-270 °C .. +1300 °C	-272.7 °C	-270 °C	+1313 °C	+1300 °C
-454 °F .. +2372 °F	-458.86 °F	-454 °F	+2395.4 °F	+2372 °F

8.6.8 Thermocouple Type R

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type R	ON	OFF	ON	OFF
-50 °C .. +1768 °C	-50.5 °C	-50 °C	+1785.68 °C	+1768 °C
-58 °F .. +3214 °F	-58.9 °F	-58 °F	+3246.224 °F	+3214.4 °F

8.6.9 Thermocouple Type S

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type S	ON	OFF	ON	OFF
-50 °C .. +1768 °C	-50.5 °C	-50 °C	+1785.68 °C	+1768 °C
-58 °F .. +3214 °F	-58.9 °F	-58 °F	+3246.224 °F	+3214.4 °F

8.6.10 Thermocouple Type T

Thermocouple	Lower limit value underrun		Upper limit value exceeded	
Type T	ON	OFF	ON	OFF
-270 °C .. +400 °C	-272.7 °C	-270 °C	+404 °C	+400 °C
-454 °F .. +752 °F	-458.86 °F	-454 °F	+759.2 °F	+752 °F

9 Diagnostic Properties

The devices offer the following diagnostic messages dependent on their function:

9.1 Device Status

<table>
<tr><th>Index</th><th>Sub Index / Data length 1 Byte</th><th>Length</th><th>Parameter</th></tr>
<tr><td>0x24</td><td>0</td><td>Octet</td><td>
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Device is operating properly.</td></tr>
<tr><td>1</td><td>Maintenance-Required</td></tr>
<tr><td>2</td><td>Out-of-Specification</td></tr>
<tr><td>3</td><td>Functional-Check</td></tr>
<tr><td>4</td><td>Failure</td></tr>
<tr><td>5-255</td><td>Reserved</td></tr>
</table>
Table 56: Read only – Contains the current status of the device.
</td></tr>
</table>

9.2 Device status in detail

<table>
<tr><th>Index</th><th>Subindex / data length N x ArrayT</th><th>Parameter</th></tr>
<tr><td>0x25</td><td>1-24</td><td>
<table>
<tr><th>Subindex</th><th>Object name</th><th>Data type</th><th>Comment</th></tr>
<tr><td>1</td><td>Error_Warning_1</td><td>3 octets</td><td rowspan="4">All octets 0x00: no error/warning
Octet 1: Event qualifier
Octet 2, 3: Event code</td></tr>
<tr><td>2</td><td>Error_Warning_2</td><td>3 octets</td></tr>
<tr><td>3</td><td>Error_Warning_3</td><td>3 octets</td></tr>
<tr><td>4</td><td>Error_Warning_4</td><td>3 octets</td></tr>
<tr><td>:</td><td>:</td><td>:</td><td>:</td></tr>
<tr><td>n</td><td>Error_Warning_n</td><td>3 octets</td><td></td></tr>
</table>
Table 57: Read only – Contains the extended status of the device.
</td></tr>
</table>

<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>b7 ... b6</td><td>Mode</td><td>
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Reserved</td></tr>
<tr><td>1</td><td>Event single shot</td></tr>
<tr><td>2</td><td>Event disappears</td></tr>
<tr><td>3</td><td>Event appears</td></tr>
</table>
</td></tr>
<tr><td>b5 ... b4</td><td>Type</td><td>
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Reserved</td></tr>
<tr><td>1</td><td>Notification</td></tr>
<tr><td>2</td><td>Warning</td></tr>
<tr><td>3</td><td>Error</td></tr>
</table>
</td></tr>
<tr><td>b3</td><td>Source</td><td>
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Device (remote)</td></tr>
<tr><td>1</td><td>Master (local)</td></tr>
</table>
</td></tr>
<tr><td>b2 ... b0</td><td>Instance</td><td>
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Unknown</td></tr>
<tr><td>1 ... 3</td><td>Reserved</td></tr>
<tr><td>4</td><td>Application</td></tr>
<tr><td>5 ... 7</td><td>Reserved</td></tr>
</table>
</td></tr>
</table>

Table 58: Event qualifier

Event code	Type	Device Status	Description
0x5111	Warning	2	MD-LVS: Module diagnosis – system/sensor power supply voltage too low
0x7710	Error	4	PD-SE-D1...D4: Port diagnosis – supply error (short-circuit or overload) on D1 .. D4
0x8CA4	Error	4	SE: Supply error Pin 1 on A1
0x8CA5	Error	4	SE: Supply error Pin 1 on A2
0x8CA6	Error	4	SE: Supply error Pin 1 on A3
0x8CA7	Error	4	SE: Supply error Pin 1 on A4
0x8CC4	Error	4	CJE: Cold junction error on A1
0x8CC5	Error	4	CJE: Cold junction error on A2
0x8CC6	Error	4	CJE: Cold junction error on A3
0x8CC7	Error	4	CJE: Cold junction error on A4
0x8CE4	Error	4	WBR: Wire break on A1
0x8CE5	Error	4	WBR: Wire break on A2
0x8CE6	Error	4	WBR: Wire break on A3
0x8CE7	Error	4	WBR: Wire break on A4
0x8CF4	Error	4	LLE: Lower limit exceeded on A1
0x8CF5	Error	4	LLE: Lower limit exceeded on A2
0x8CF6	Error	4	LLE: Lower limit exceeded on A3
0x8CF7	Error	4	LLE: Lower limit exceeded on A4
0x8D04	Error	4	ULE: Upper limit exceeded on A1
0x8D05	Error	4	ULE: Upper limit exceeded on A2
0x8D06	Error	4	ULE: Upper limit exceeded on A3
0x8D07	Error	4	ULE: Upper limit exceeded on A4

Table 59: Event codes for peripheral errors

Error code	Description
0x8011	Index not available
0x8012	Subindex not available

Error code	Description
0x8023	Access denied
0x8033	Parameter length overrun
0x8034	Parameter length underrun
0x8035	Function not available

Table 60: Error codes for access management

10 IO-Link IODD

There is an IODD device description file available for every Belden IO-Link device. The IODD file contains a variety of information about system integration, including communication properties, device parameters, and identification, process and diagnostic data.

10.1 Device description file download

You can find the matching device description file in each case in the Belden download area at:

https://www.belden.com/products/i-o-systems

or in the IO-Link Community download area at

https://ioddfinder.io-link.com.

Attention: We recommend that you download and install the most up-to-date version of the relevant IODD from the download area.

11 Technical data

The following sections give an overview of the most important functional data needed to operate the device. For further information and detailed technical data, see the respective **Data Sheet** of your required product in the product specific download area on https://catalog.belden.com.

11.1 General

Ambient temperature during operation		-40 °C … +70 °C (-40 °F … +158 °F)
Ambient storage temperature		-40 °C … +85 °C (-40 °F … +185 °F)
Ambient humidity		95 % RH (for UL applications 80 % PRH)
Weight		Approx. 380 g (13.4 oz)
Housing material		Die-cast zinc
Protection class: Plugged in and properly screwed together (according to DIN EN 60529)		IP65, IP67 and IP69K (not subject to UL inspection)
Pollution Degree		3
Flammability class		UL 94
Vibration, sinusoidal		EN 60068-2-6 5-500 Hz / 15 g
Shock, semi-sinusoidal EN 60068-2-27		EN 60068-2-27 50 g / 11 ms
EMC immunity, EMC interference emission		EN 61000-6-2 EN 61000-6-4
Torques	Fixing screws M4/M6:	1.0 Nm
	M12 connector:	0.5 Nm
Installation position		Any
Approvals		CE, UL, IO-Link

Table 61: General information

11.2 IO-Link interface

Specification	IO-Link spec. v1.1.5
Physical transmission	IO-Link, 24 V Half duplex
Transfer rate	COM 3 (230.4 kBaud)
Limitation IO-Link expansion	max. 20 m (65.6 ft)
IO-Link standard	IEC 61131-9
Process data	16 bytes input data 0 bytes output data
Frame type	Type_2_V
Cycle time	Max. 4 ms

Table 62: Information on the bus system

11.3 Power supply for the device electronics/ sensors

Nominal voltage U_S	24 V DC
Nominal voltage range[1]	19.2 V DC .. 28.8 V DC (SELV/PELV to EN60950 - 1)
Max. voltage range	18 V DC .. 30 V DC
Power consumption/supply	Max. 100 mA
Reverse polarity protection	Yes
Overload protection	Yes
Fuse	An external fuse is recommended for the 4AI/8DI version.
Voltage level of the sensor power supply	Min. (U_S – 1.5 V)
Power consumption of sensors	max. 500 mA in total for ports D1 .. D4 and max. 100 mA for each port A1 .. A4 (at T_U = 30 °C / 86 °F) per device
Operational indicator (U_S)	LED green for U_S >18 V LED red for U_S <18 V

Table 63: Information on the power supply for the device electronics/ sensors

[1] The device should be supplied with a Limited Energy power supply in accordance with UL 61010-1, 3rd edition, section 9.4, or with LPS (Limited Power Source) in accordance with UL 60950-1 or class 2 in accordance with UL 1310 or UL 1585.

11.4 Digital inputs

Standard digital input (8/16DIO)	Type 1 In accordance with IEC 61131-2
Input current at 24 V DC	Typically 4.6 mA
Input channels	8 ×
Input type	Normally open p-switching
Input filter	Configurable via software Off, 0.5 ms, 1 ms, 2 ms, 3 ms (default)
Input pulse extension	Configurable via software Off (default), 0.5 ms, 1 ms, 2 ms, 3 ms
Sensor power supply overload protection	Yes
Status indicator	Yellow LED for channel A (red for sensor voltage overload) White LED for channel B

Table 64: Information on the inputs

11.5 Analog ports

Caution: Device damage / loss of warranty or guarantee claims

Only signals/voltage levels that correspond to the permissible measuring ranges and limit values specified in this manual may be present at the analog M12 ports. Incorrect wiring (e.g., reverse polarity, incorrect pin assignment) as well as the connection of input values that do not comply with the specification (e.g., impermissible signal voltage/current, external overload, or faulty external signal sources) may lead to permanent device damage or failure. Damage resulting from operation outside the specification is excluded from the manufacturer's warranty/guarantee.

Attention: Configure the operating mode **BEFORE** connecting any sensors. Sensors may only be connected and operated in the operating modes intended for them; otherwise, there is a risk of damaging the sensors.

Attention: If resistors are operated in 2-wire or 3-wire measurement mode, unused pins must remain unconnected.

Number of Analog Input Channels	4
Connection	M12, 5-poles, A-coded
Number of Ports	4 (A1 to A4)
Channel Type	U (+/-100 mV, +500 mV, +1000 mV, 0/+2 V .. +10 V, +/-10 V) I (0/+4 mA .. +20 mA, +/-20 mA) PT 100, PT 200, PT 500, PT 1000, Ni100, Ni1000 TC Type (K, B, E, J, N, R, S, T, C, G) R (0 .. 100 Ohm, 0 .. 400 Ohm, 0 .. 2000 Ohm, 0 .. 4000 Ohm)
Input Wiring	2-, 3-, 4-wire (un/shielded)
Resolution (A/D)	15 bit + sign (16 bit)
Accuracy / Precision	< 0,15 % (basic error at +25 °C / +77 °F)
Conversion Time (A/D)	
Process Data Update	
Temperature Fault	< +/- 0,01 %/K
Input Filter	
Limit Frequency (3dB)	
Signal Delay	
Input Resistance	voltage > 100 kOhm, current < 200 Ohm
Data Format	Standard, Extended (Siemens S7), NE43
Calibration	
Permissible Conductor Length to the Sensor	max. 30 m
Protective Circuit	Suppressor diode
Status indicator	LED yellow per port
Diagnostic indicator	LED red per port
Operating modes	voltage, current, RTD, R, TC
Input signal type	differential, single ended
Operating mode Voltage (Input)	Single ended: max. +15 V Differential: max. +/-15 V
Operating mode Current (Input)	Single ended: max. +25 mA Differential: max. +/-25 mA

Error total (Full scale value)	< 0,9 %

Table 65: Information on the analog ports

11.6 LEDs

LED	LED color	Description
U_S	Off	Module de-energized
	Green	Power supply of system/sensor OK (U_S >18 V)
	Red	Power supply of system/sensor <18 V (+/-1 V)
IO-Link	Green	No communication
	Flashing green	IOL communication OK
	Red	Communication error
DIA	Off	No diagnosis exists
	Red	Module diagnosis available
A (DI ports D1 .. D4, channel A)	Off	Channel A – signal = ‘0’ / DI OFF
	Yellow	Channel A – signal = ‘1’ / DI ON
	Red	Sensor voltage overload
B (DI ports D1 .. D4, channel B)	Off	Channel B – signal = ‘0’ / DI OFF
	White	Channel B – signal = ‘1’ / DI ON
Act (Analog ports A1 .. A4, channel A)	Off	Port inactive
	Yellow	Port active
Dia (Analog ports A1 .. A4, channel B)	Off	No diagnosis
	Red	Diagnostic error (e.g. voltage error, overload, broken wire)

Table 66: Information on LED colors

12 Recycling note

The symbol of a crossed-out wheeled bin shown on the device indicates that the device MUST NOT be disposed of with household waste at the end of its service life.

After its service life, the used device must be disposed of properly as electronic waste in accordance with the locally applicable disposal regulations.

End users are responsible for deleting personal data from the used device prior to disposal.

End users are obliged to separate used batteries and accumulators that are not enclosed by the used device from the used device in a nondestructive manner before disposing of the used device. The used batteries and accumulators must be handed in for separate collection. This does not apply if the used device is handed in for reuse.

13 Accessories

In order to get access to various types of accessories, please visit our Web page:

https://www.belden.com