lumbergautomation
A BELDEN BRAND

Manual

EtherCAT®

LioN-X IO-Link Master Multiprotocol:
0980 XSL 3912-121-007D-00F (8 x IO-Link Class A)
0980 XSL 3912-121-007D-01F (8 x IO-Link Class A)
0980 XSL 3912-121-027D-01F (8 x IO-Link Class A)
0980 XSL 3913-121-007D-01F (8 x IO-Link Class A/B Mixmodule)
0980 XSL 3913-121-027D-01F (8 x IO-Link Class A/B Mixmodule)

LioN-Xlight IO-Link Master EtherCAT®:
0980 LSL 3211-121-0006-004 (8 x IO-Link Class A)
0980 LSL 3210-121-0006-004 (4 x IO-Link Class A + 8 x DI)

Contents

1 About this manual

1.1 General information

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.

1.2.3 EtherCAT® trademark information

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

1.3 Version information

Version	Created	Changes
1.0	03/2021	
1.1	04/2021	
1.2	05/2021	
1.3	11/2021	Ch. 3: enhancements Ch. 4.3
2.0	03/2022	New chapters: Ch. 10.6 ("NTP") Ch. 12 ("IODD") New device variants: 0980 XSL 3912-121-007D-01F 0980 XSL 3913-121-007D-01F
2.1	06/2022	Temporarily excluded device variant information for 0980 XSL 3913-121-007D-01F (shipping in 2023)
2.2	10/2022	Device variant information for 0980 XSL 3913-121-007D-01F included. Ch. 7.3: LED description
2.3	04/2023	Ch. IO-Link Parameterization on page 79: SDO values Ch. Device status object (0xF100) on page 98: Status ports 1..8
2.4	07/2023	Warning in ch. Setting the rotary encoding switches on page 45
2.5	10/2023	Added new feature HTTPS (several chapters updated). New device variants: 0980 XSL 3912-121-027D-01F 0980 XSL 3913-121-027D-01F

Table 1: Overview of manual revisions

2 Safety instructions

2.1 Intended use

The products described in this manual are decentralized IO-Link Masters on an Industrial Ethernet 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 modules fulfill the requirements of the EMC guidelines (2014/30/EU) and the low voltage guideline (2014/35/EU).

The IO-Link Masters 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 IO-Link Masters. Only connect devices that fulfill the requirements of EN 61558-2-4 and EN 61558-2-6 to the IO-Link Masters.

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 – Lumberg Automation™ 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 – Lumberg Automation™ – 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

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)
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
DIA	Diagnostic LED
DO	Digital Output
DIO	Digital Input/Output
DTO	Device Temperature Overrun (EIP diagnostics)
DTU	Device Temperature Underrun (EIP diagnostics)
DUT	Device under test
EIP	EtherNet/IP

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)
IDE	IO-Link port Device Error (EIP diagnostics)
IDN	IO-Link port Device Notification (EIP diagnostics)
IDW	IO-Link port Device 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	Multiprotocol: 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
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
RPI	Requested Packet Interval
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

Table 2: Designations and synonyms

4 System description

The LioN modules (**L**umberg Automation™ **I**nput/**O**utput **N**etwork) 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 and LioN-Xlight variants convert standard input, standard output or IO-Link signals from sensors & actuators into an industrial Ethernet protocol (PROFINET, EtherNet/IP, EtherCAT®, Modbus TCP, CC-Link IE Field Basic) and/or into a cloud protocol (REST API, OPC UA, MQTT). For the first time, there is now Syslog on board. The robust 8 port housing design allows the use even in harsh environments where e.g. weld field immunity, high temperature ranges or protection class IP67 & IP69K are needed. There are also LioN-Xlight single protocol versions available with a limited feature set at a highly attractive price point.

Use all benefits of the Lumberg Automation™ product solution by additionally downloading the configuration tool *LioN-Management Suite V2.0* from 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 Device variants

The following variants are available in the LioN-X and the LioN-Xlight family:

Article number	Product designation	Description	I/O port functionality
935700001	0980 XSL 3912-121-007D-00F	LioN-X M12-60 mm, IO-Link Master Multiprotocol (PN, EIP, EC, MB) Security	8 x IO-Link Class A
935700002	0980 XSL 3912-121-007D-01F	LioN-X M12-60 mm, IO-Link Master Multiprotocol (PN, EIP, EC, MB, CC) Security	8 x IO-Link Class A
935710001	0980 XSL 3912-121-027D-01F	LioN-X M12-60 mm, IO-Link Master Multiprotocol (PN, EIP, EC, MB, CC) Security, HTTPS	8 x IO-Link Class A
935703001	0980 XSL 3913-121-007D-01F	LioN-X M12-60 mm, IO-Link Master Multiprotocol (PN, EIP, EC, MB, CC) Security	8 x IO-Link Class A/B Mixmodule
935711001	0980 XSL 3913-121-027D-01F	LioN-X M12-60 mm, IO-Link Master Multiprotocol (PN, EIP, EC, MB, CC) Security, HTTPS	8 x IO-Link Class A/B Mixmodule
935701001	0980 LSL 3011-121-0006-001	LioN-Xlight M12-60 mm, IO-Link Master PROFINET	8 x IO-Link Class A
935702001	0980 LSL 3010-121-0006-001	LioN-Xlight M12-60 mm, IO-Link Master PROFINET	4 x IO-Link Class A + 8 x DI

Article number	Product designation	Description	I/O port functionality
935701002	0980 LSL 3111-121-0006-002	LioN-Xlight M12-60 mm, IO-Link Master EtherNet/IP	8 x IO-Link Class A
935702002	0980 LSL 3110-121-0006-002	LioN-Xlight M12-60 mm, IO-Link Master EtherNet/IP	4 x IO-Link Class A + 8 x DI
935701003	0980 LSL 3211-121-0006-004	LioN-Xlight M12-60 mm, IO-Link Master EtherCAT®	8 x IO-Link Class A
935702003	0980 LSL 3210-121-0006-004	LioN-Xlight M12-60 mm, IO-Link Master EtherCAT®	4 x IO-Link Class A + 8 x DI
935701004	0980 LSL 3311-121-0006-008	LioN-Xlight M12-60 mm, IO-Link Master Modbus TCP	8 x IO-Link Class A
935702004	0980 LSL 3310-121-0006-008	LioN-Xlight M12-60 mm, IO-Link Master Modbus TCP	4 x IO-Link Class A + 8 x DI
935701005	0980 LSL 3411-121-0006-010	LioN-Xlight M12-60 mm, IO-Link Master CC-Link IE Field Basic	8 x IO-Link Class A
935702005	0980 LSL 3410-121-0006-010	LioN-Xlight M12-60 mm, IO-Link Master CC-Link IE Field Basic	4 x IO-Link Class A + 8 x DI

Table 3: Overview of LioN-X and LioN-Xlight variants

4.3 I/O port overview

The following tables show the main I/O port differences of the LioN-X IO-Link Master family. Pin 4 and Pin 2 of the I/O ports can be configured partly to IO-Link, Digital Input or Digital Output.

LioN-X Class A IO-Link ports

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (C/Q)				Pin 2 / Ch. B (I/Q)	
0980 XSL 3x12...	**Info:**	–	Class A	Type 1	Supply by U_S [1)]	Supply by U_L [2)]	Type 1	Supply by U_L [2)]
	X8:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X7:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X6:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X5:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X4:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X3:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X2:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)
	X1:	Out (4 A)	IOL	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)

Table 4: Port configuration of 0980 XSL 3x12... variants

[1)] DO switch mode configured as "Push-Pull" (description in the configuration chapters).

[2)] DO switch mode configured as "High-Side" (description in the configuration chapters).

LioN-X Class A/B IO-Link ports

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (C/Q)				Pin 2 / Ch. B (I/Q)		
0980 XSL 3x13...	**Info:**	–	4 x Class A 4 x Class B	Type 1	Supply by U_S [1]	Supply by U_S [2]	Type 1	Supply by U_S [1]	Supply by U_{Aux}
	X8:	Out (4 A)	IOL (Class B)	DI	DO (0.5 A)	DO (2 A)	–	–	DO/Pwr (2 A)
	X7:	Out (4 A)	IOL (Class B)	DI	DO (0.5 A)	DO (2 A)	–	–	DO/Pwr (2 A)
	X6:	Out (4 A)	IOL (Class B)	DI	DO (0.5 A)	DO (2 A)	–	–	DO/Pwr (2 A)
	X5:	Out (4 A)	IOL (Class B)	DI	DO (0.5 A)	DO (2 A)	–	–	DO/Pwr (2 A)
	X4:	Out (4 A)	IOL (Class A)	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)	–
	X3:	Out (4 A)	IOL (Class A)	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)	–
	X2:	Out (4 A)	IOL (Class A)	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)	–
	X1:	Out (4 A)	IOL (Class A)	DI	DO (0.5 A)	DO (2 A)	DI	DO (2 A)	–

Table 5: Port configuration of 0980 XSL 3x13... variants

[1] DO switch mode configured as "Push-Pull" (description in the configuration chapters).

[2] DO switch mode configured as "High-Side" (description in the configuration chapters).

LioN-Xlight Class A IO-Link ports

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (C/Q)			Pin 2 / Ch. B (I/Q)
0980 LSL 3x11...	**Info:**	–	Class A	Type 1	Supply by U_S [1)]	Type 1
	X8:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X7:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X6:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X5:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X4:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X3:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X2:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X1:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI

Table 6: Port configuration of 0980 LSL 3x11... variants

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (C/Q)			Pin 2 / Ch. B (I/Q)
0980 LSL 3x10...	**Info:**	–	Class A	Type 1	Supply by U_S [1)]	Type 1
	X8:	Out (0.7 A)	–	DI	–	DI
	X7:	Out (0.7 A)	–	DI	–	DI
	X6:	Out (0.7 A)	–	DI	–	DI
	X5:	Out (0.7 A)	–	DI	–	DI
	X4:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X3:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X2:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI
	X1:	Out (2 A)	IOL	DI	DO (0.5 A*)	DI

Table 7: Port configuration of 0980 LSL 3x10... variants

[1)] With DO Switch Mode configured as "Push-Pull" (see description in the configuration chapters).

* For **UL applications**: Max. 0.25 A DO.

5 Overview of product features

5.1 EtherCAT® product features

Data connection

The connection option provided by LioN-X is the widely-used M12 connector with D-coding for the EtherCAT® network.

The connectors are also color-coded to prevent the ports from being mixed up.

Data transmission rates

Support of 100Mbit/s with auto crossover and auto negotiation corresponding to IEEE 802.3.

Integrated switch

The integrated Ethernet switch with Conformance Class C (CC-C) has two EtherCAT® ports and thus supports the establishment of a line or ring topology for the EtherCAT® network.

Alarm and diagnostic messages

The devices support messages and alarms via a ring buffer based *Diagnosis History Object*.

5.2 I/O port features

IO-Link specification.

LioN-X is ready for IO-Link specification v1.1.3.

8 x IO-Link Master ports

Depending on the variant, the Master device has 4 IO-Link Class A ports, 4 IO-Link Class A ports and 4 IO-Link Class B ports, or 8 IO-Link Class A ports with an additional digital input and optional output (0980 XSL 3x13... variants) on pin 2 of the I/O port. For detailed information see chapter I/O port overview on page 20.

Warning: If devices with electric isolation and devices without electric isolation are used within the same system, the electric isolation of all connected devices is annulled.

IO-Link port connections

The IO-Link port connection option provided by LioN-X devices is the 5-pin M12 connector. Pin 5 is not assigned for IO-Link Class A ports.

Validation & Backup

The Validation & Backup function checks if the right device is connected and stores the parameters of the IO-Link Device. The function thus gives you an easy option for replacing the IO-Link Device.

This is possible as of IO-Link specification V1.1 and only if the IO-Link Device **and** the IO-Link Master support the function.

IO-Link Device parameterization

IO-Link Device parameterization in an EtherCAT® network is possible via TwinCAT®.

LED

You can see the status of a port by the color of the matching LEDs and their flash pattern. For details on the meanings of the LED colors, please see section LEDs on page 187.

5.3 Integrated Web server

Network parameter display

Get an overview of network parameters such as the IP address, subnet mask and gateway.

Displaying diagnostics

View diagnostics via the integrated Web server.

User management

Use the integrated Web server for convenient management of all users.

IO-Link Device parameters

Reading and writing of IO-Link Device parameters is supported. The system command Store parameters is needed after parameter writing, to take over the changed parameter into the IO-Link Master backup memory when enabled.

HTTPS

LioN-X supports several security mechanisms (see also Security features on page 26). One of them is HTTPS (only applicable for device variants 0980 XSL 3912-121-027D-01F and 0980 XSL 3913-121-027D-01F), which allows encryption-based secure communication to access Web pages.

5.4 Security features

Firmware signature

The official firmware update packages contain a signature which helps prevent the system against manipulated firmware updates.

Syslog

The LioN-X multiprotocol variants support the traceability of messages centrally managed and logged via Syslog.

User manager

The Web server provides a user manager to help protect the Web interface against unauthorized access. You can manage the users by groups with different access levels “Admin” or “Write”.

Default user settings:

User: admin

Password: private

Attention: Change the default settings to help protect the device against unauthorized access.

5.5 Other features

Interface protection

The devices have reverse polarity, short-circuit and overload protection for each interface.

For more details, see section Port assignments on page 37.

Failsafe

The devices support a failsafe function. This allows you to define the behavior of every single channel configured as an output in the case of invalid PLC data (e.g. PLC in STOP) or of lost PLC communication.

Industrial Internet of Things

LioN-X is industry 4.0 ready and supports the integration in IIoT networks via REST API and the IIoT-relevant protocols MQTT, OPC UA and CoAP.

Color-coded connectors

The colored connectors help you avoid confusion in your cabling.

IP protection classes: IP65 / IP67 / IP69K

The IP protection class describes environmental influences that the devices can be exposed to without risk and without suffering damage or causing a risk for the user.

The whole LioN-X family offers IP65, IP67 and IP69K.

6 Assembly and wiring

6.1 General information

Mount the device on a flat surface using 2 screws (M4x 25/30). The torque required here is 1 Nm. Use washers for all fastening methods as per DIN 125.

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 for the ground 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.

6.2 Outer dimensions

6.2.1 LioN-X multiprotocol variants

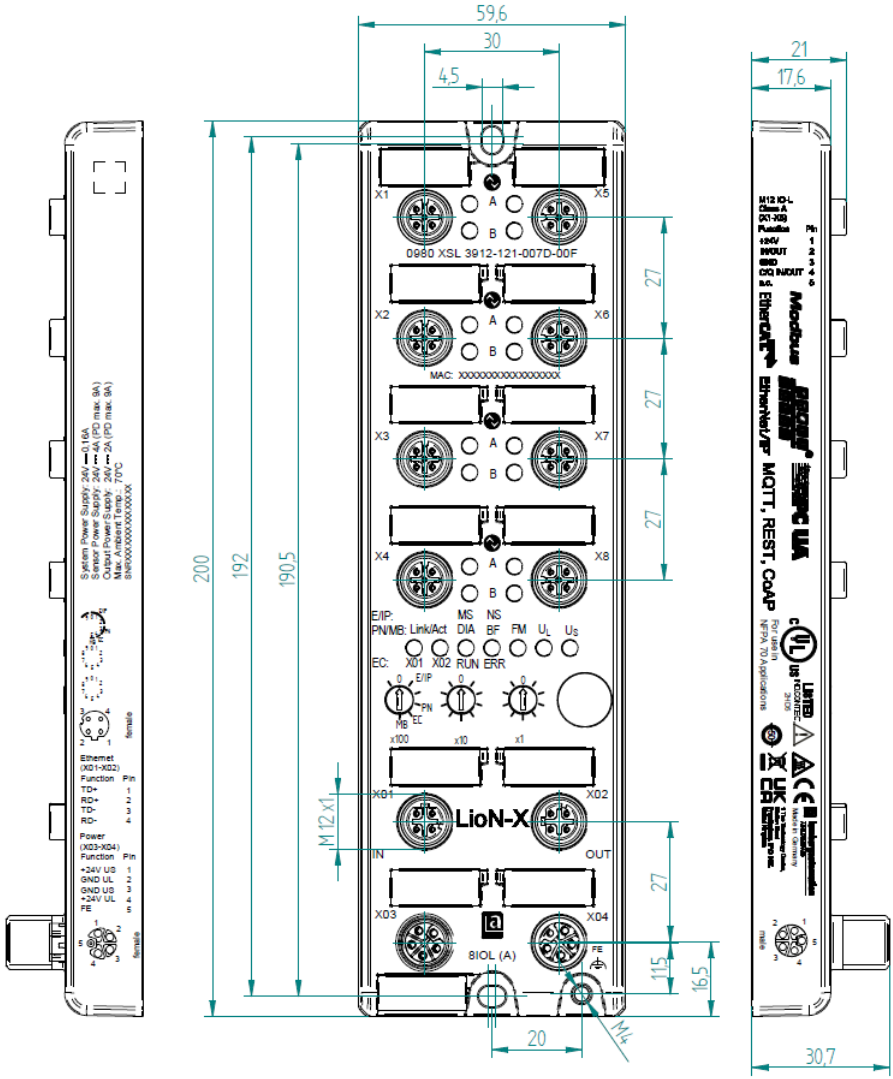


Figure 1: 0980 XSL 3912-121-007D-00F

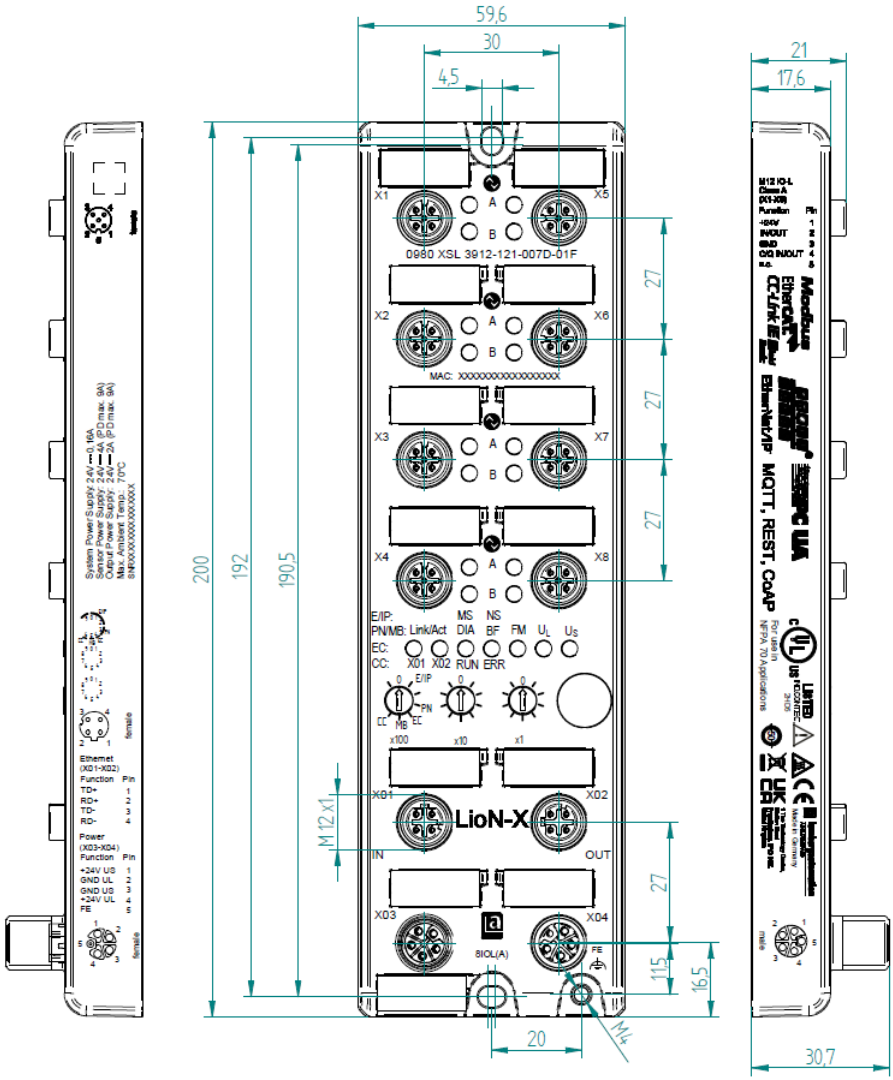


Figure 2: 0980 XSL 3912-121-007D-01F

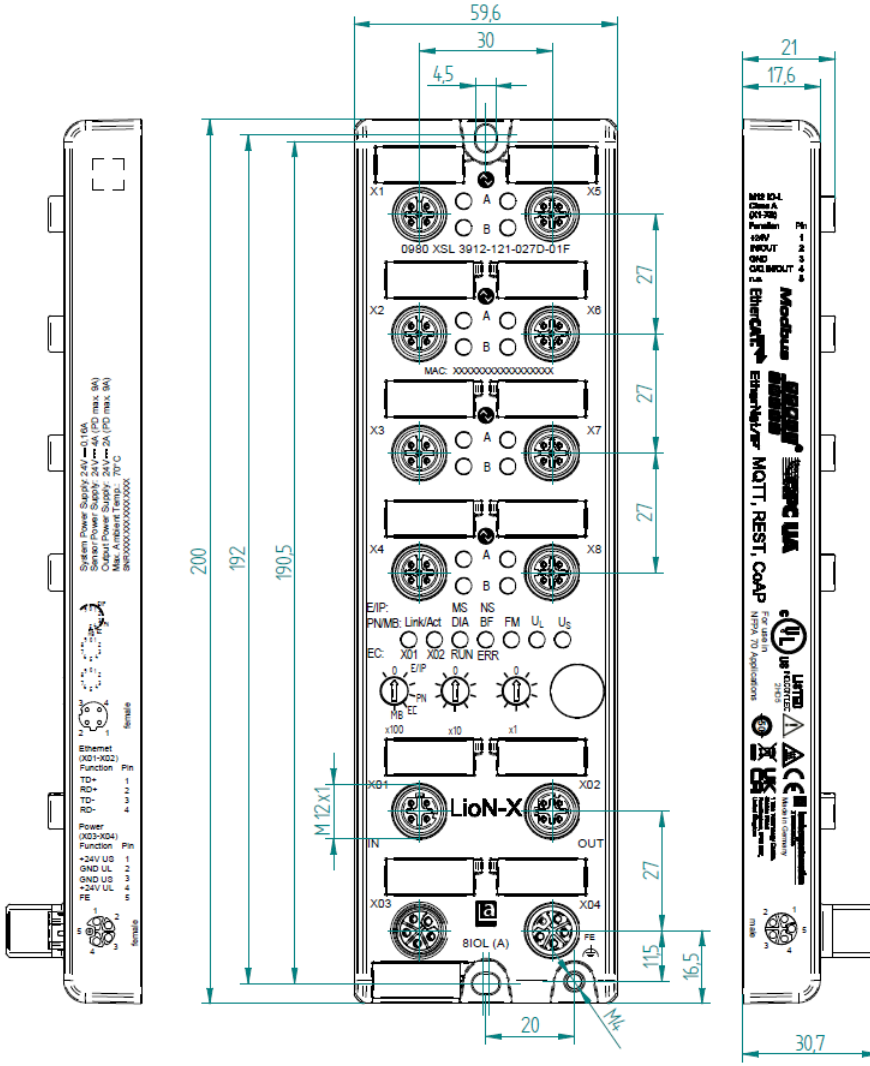


Figure 3: 0980 XSL 3912-121-027D-01F

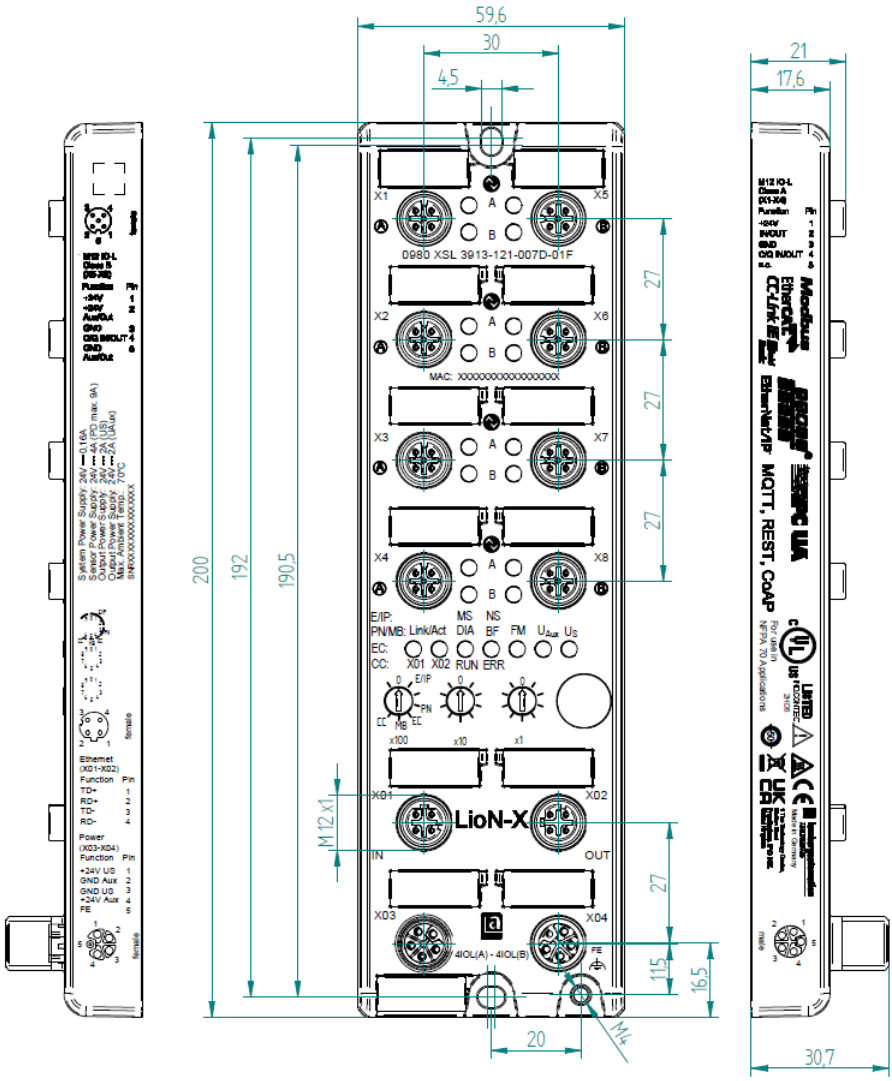


Figure 4: 0980 XSL 3913-121-007D-01F

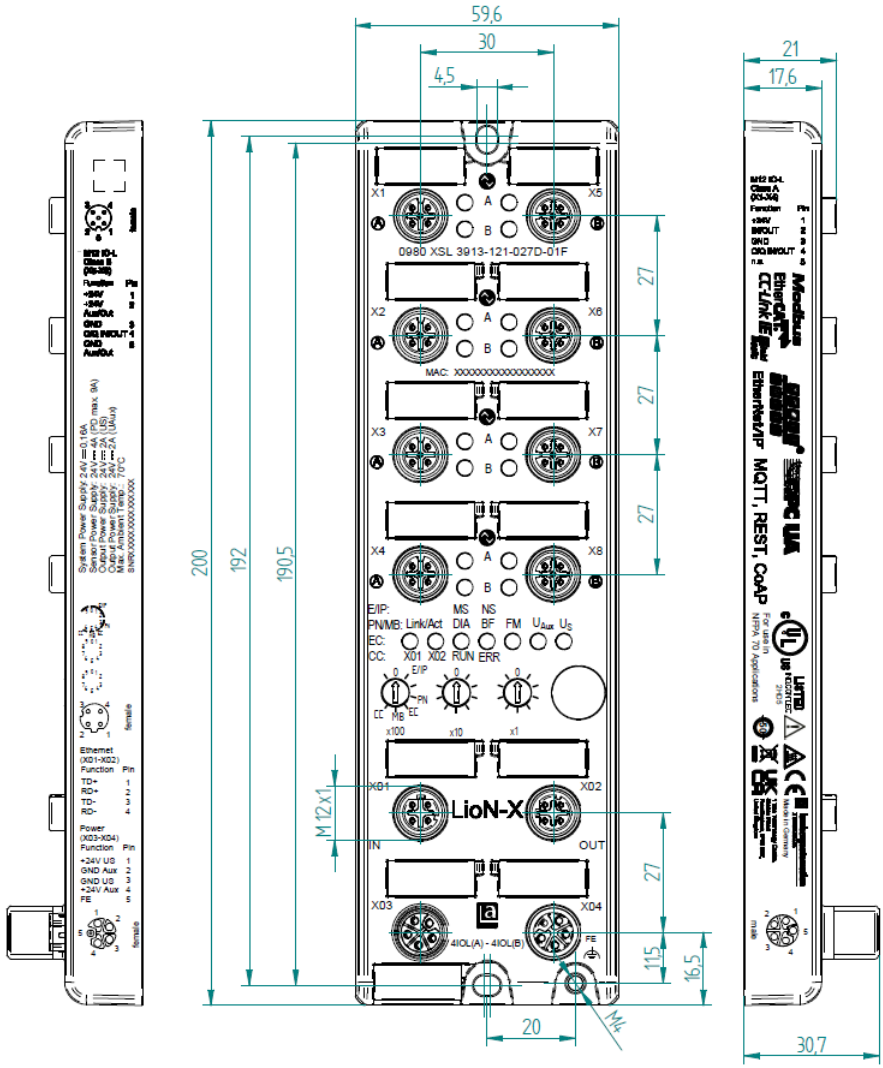


Figure 5: 0980 XSL 3913-121-027D-01F

6.2.2 LioN-Xlight variants with EtherCAT®

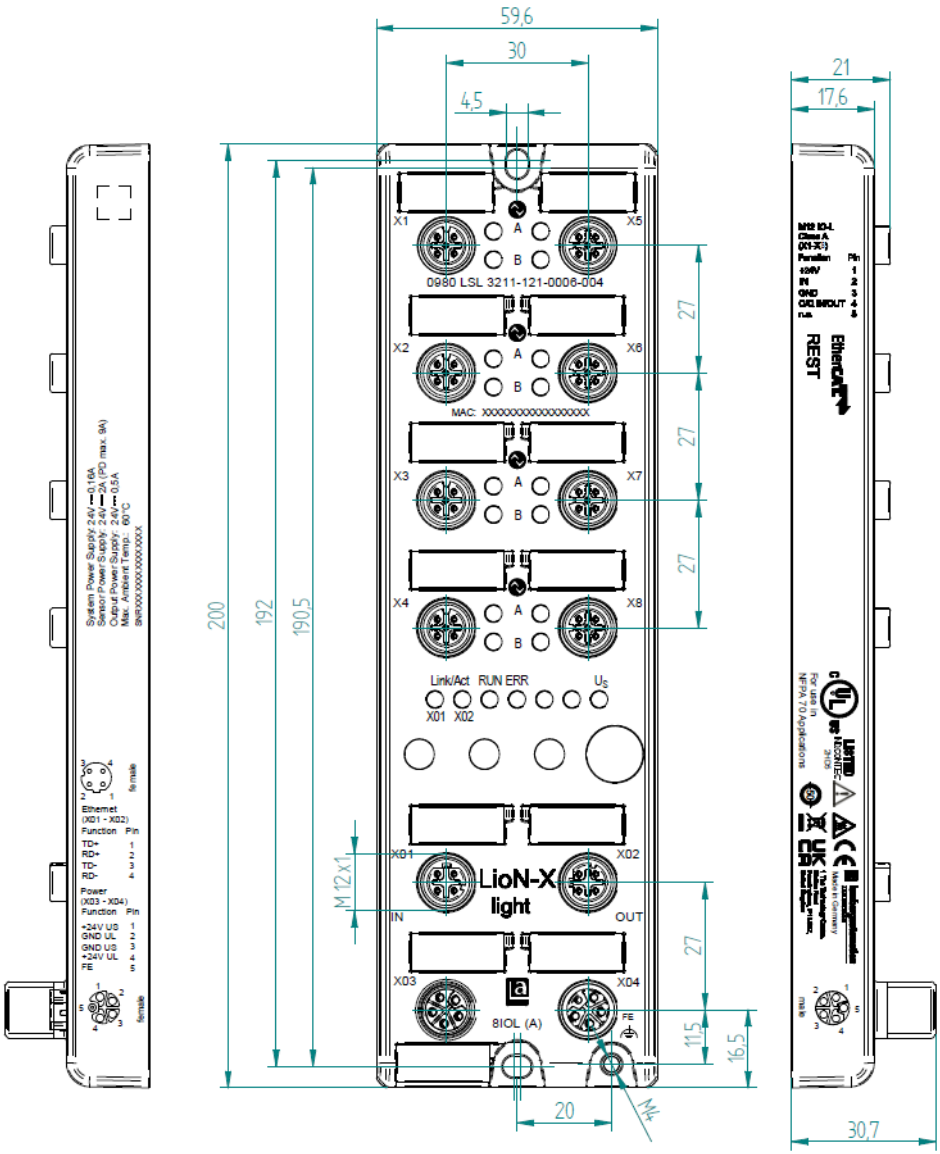


Figure 6: 0980 LSL 3211-121-0006-004

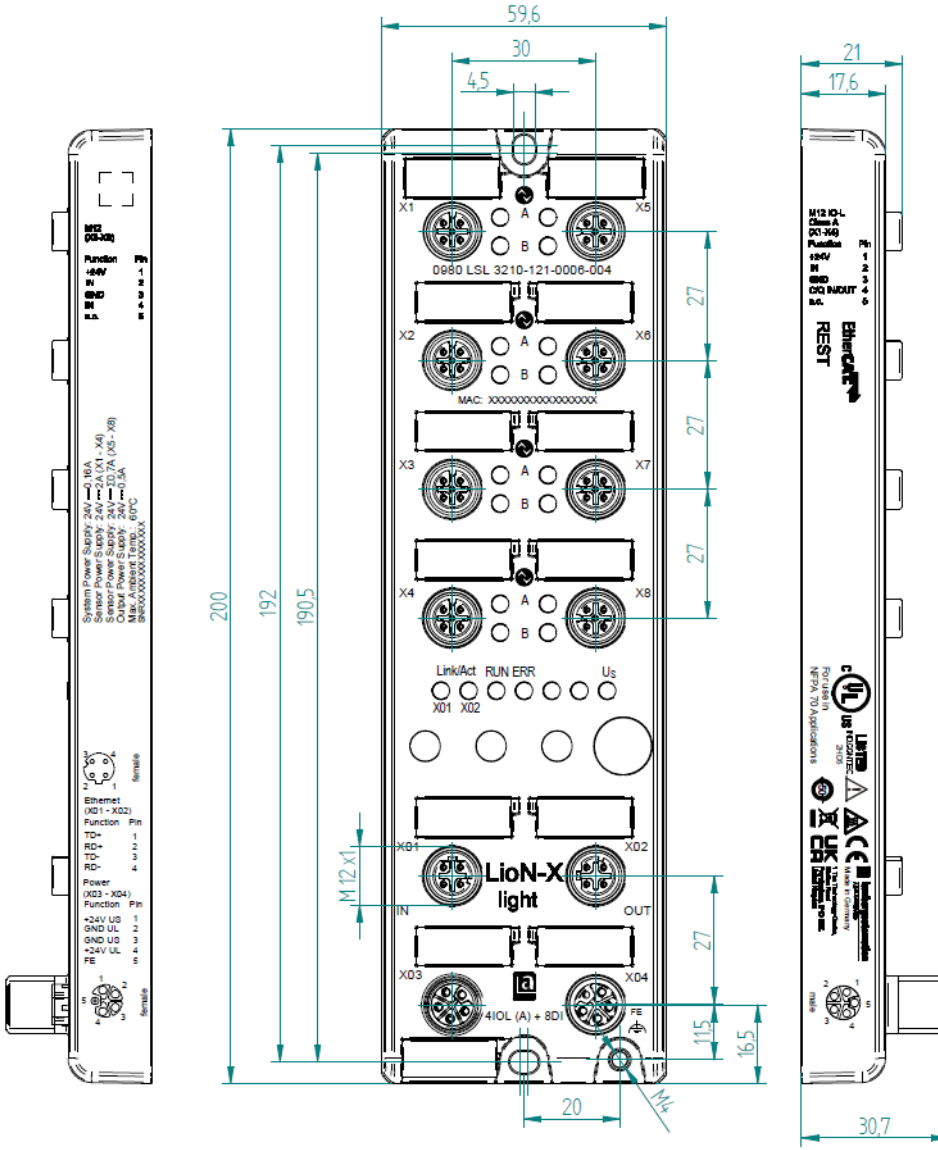


Figure 7: 0980 LSL 3210-121-0006-004

6.2.3 Notifications

Attention:

For **UL applications**, 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.

Only approved for interior use. Please note the maximum elevation of 2000 meters. Approved up to a maximum soiling level of 2.

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

Warning: For **UL applications** at a maximum ambient temperature of +70 °C (158 °F):

Use temperature-resistant cables with heat resistance up to at least +125 °C (257 °F) for all LioN-X and LioN-Xlight variants.

Warning: Observe the following maximum output power for the sensor supply of Class A devices:

Max. 4.0 A per port; for **UL applications** max. 5 A for every port pair X1/X2, X3/X4, X5/X6, X7/X8; max. 9.0 A in total (with derating) for the whole port group X1 .. X8.

Warning: Observe the following maximum output power for the sensor supply of Class A/B devices:

Max. 4.0 A per port; for **UL applications** max. 5.0 A from U_S power supply for every port pair X1/X2, X3/X4, X5/X6, X7/X8 and max. 5.0 A from U_{AUX} power supply in total for port group X5/X6/X7/X8; max. 9.0 A in total (with derating) for the whole port group X1 .. X8.

6.3 Port assignments

All the contact arrangements shown in this chapter show the frontal view of the connection area for the connectors.

6.3.1 Ethernet ports, M12 socket, 4-pin, D-coded

Color coding: green

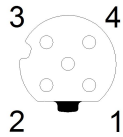


Figure 8: Schematic drawing, ports X01, X02

Port	Pin	Signal	Function
Ethernet Ports X01, X02	1	TD+	Transmit data plus
	2	RD+	Receive data plus
	3	TD-	Transmit data minus
	4	RD-	Receive data minus

Table 8: Assignment of ports X01, X02

Caution: Risk of destruction! Never connect the power supply to the data cables.

6.3.2 Power supply with M12 power L-coded

Color coding: gray

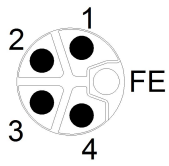


Figure 9: Schematic diagram of the M12 L-coding (connector X03 for Power In)

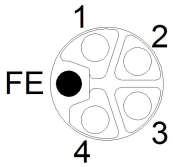


Figure 10: Schematic diagram of the M12 L-coding (socket X04 for Power Out)

6.3.2.1 IO-Link Master with Class A ports

Power supply	Pin	Signal	Function
	1	U_S (+24 V)	Sensor/system power supply
	2	GND_U_L	Ground/reference potential U_L
	3	GND_U_S	Ground/reference potential U_S[1]
	4	U_L (+24 V)	Load supply (**NOT** electrically isolated to U_S internally in device)
	5	FE	Functional ground

Table 9: Power supply with M12-Power Class A

Attention: Only use power supply units for the system/sensor and actuator supply that correspond to PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage). Power supplies according to EN 61558-2-6 (transformers) or EN 60950-1 (switching power supply units) fulfill these requirements.

[1] U_L and U_S ground connected in device

6.3.2.2 IO-Link Master with Class A/B ports

Power supply	Pin	Signal	Function
Mixed IO-Link (Class A/B) I/O ports	1	U_S (+24 V)	Sensor/system power supply
	2	GND_U_{AUX}	Ground/reference potential U_{AUX} (electrically **isolated** to GND_U_S internally in device)
	3	GND_U_S	Ground/reference potential U_S
	4	U_{AUX} (+24 V)	Auxiliary supply (electrically **isolated** to U_S internally in device)
	5	FE	Functional ground

Table 10: Power supply with M12-Power Class A/B

Attention: Only use power supply units for the system/sensor and actuator supply that correspond to PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage). Power supplies according to EN 61558-2-6 (transformers) or EN 60950-1 (switching power supply units) fulfill these requirements.

6.3.3 I/O ports as M12 sockets

Color coding: black

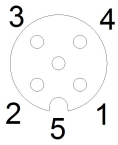


Figure 11: Schematic drawing I/O port as M12 socket IO-Link

6.3.3.1 IO-Link ports (Class A and Class B)

0980 XSL 3x12-121...	Pin	Signal	Function
IO-Link Class A, ports X1 .. X8	1	+24 V	power supply +24 V
	2	IN/OUT	Ch. B: Digital input or digital output
	3	GND	Ground/reference potential
	4	C/Q	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected

0980 XSL 3x13-121...	Pin	Signal	Function
IO-Link Class A, ports X1 .. X4	1	+24 V	power supply +24 V
	2	IN/OUT	Ch. B: Digital input or digital output
	3	GND	Ground/reference potential
	4	C/Q	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected
IO-Link Class B, ports X5 .. X8	1	+24 V	power supply +24 V
	2	+24 V AUX/OUT	Ch. B: Auxiliary power supply (electrically isolated with respect to the sensor/ system power supply U_S) or digital output
	3	GND	Ground/reference potential of +24 V
	4	C/Q	Ch. A: IO-Link data communication, digital input or digital output
	5	GND AUX	Ground/reference potential of +24 V AUX/ OUT

0980 LSL 3x11-121...	Pin	Signal	Function
IO-Link Class A, ports X1 .. X8	1	+24 V	power supply +24 V
	2	IN	Ch. B: Digital input
	3	GND	Ground/reference potential
	4	C/Q	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected

0980 LSL 3x10-121...	Pin	Signal	Function
IO-Link Class A, ports X1 .. X4	1	+24 V	power supply +24 V
	2	IN	Ch. B: Digital input
	3	GND	Ground/reference potential
	4	C/Q	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected
Digital Input, ports X5 .. X8	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	n.c.	not connected

Table 11: I/O ports as IO-Link Class A and Class B

Used signal names compared to the IO-Link specification conventions:

Pin	LioN-X	IO-Link specification	Comment
1	+24 V	L+	Supplied by U_S
2	IN/OUT	I/Q	
	+24 V AUX/OUT	2L	Supplied by U_{AUX}
3	GND	L-	
4	C/Q IN/OUT	C/Q	
5	GND AUX	2M	

7 Starting operation

7.1 ESI file

An ESI file in XML format is required to configure the LioN-X and LioN-Xlight devices. All device variants are grouped in a single ESI file. The file can be downloaded from the product pages on our online catalog: catalog.belden.com

On request, the ESI file is also sent by the support team.

The file for the LioN-X EtherCAT® devices is named:

LumbergAutomation-LioN-X-IO-Link-Master.xml

Download this file and unpack it.

Install the ESI file for the device variant used via the hardware or network configuration tool of your controller manufacturer.

For TwinCAT®, the ESI file has to be copied into the installation folder, e.g.: `C:\TwinCAT\3.1\Config\Io\EtherCAT`

After installation, TwinCAT® needs a system restart. Alternatively, use the menu bars in TwinCAT® to reload the application:

TWINCAT > **EtherCAT Devices** > **Reload Device Descriptions**.

The LioN-X and LioN-Xlight devices are then available in the hardware catalog.

7.2 MAC addresses

Every device has three unique MAC address assigned by the manufacturer that cannot be changed by the user. The first assigned MAC address is printed onto the device.

For EtherCAT®, the MAC address has no function. For EoE (Ethernet over EtherCAT®), a virtual MAC address will be assigned to the device.

7.3 Setting the rotary encoding switches

The following LioN-X IO-Link Master variants support multiprotocol application for the protocols EtherNet/IP (E/IP), PROFINET (P), EtherCAT® (EC) and Modbus TCP (MB):

- 0980 XSL 3912-121-007D-00F

The following LioN-X IO-Link Master variants additionally provide the protocol CC-Link IE Field Basic (CC):

- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

Caution: Risk of device damage due to corrupt device memory

Any interruption of the power supply to the device during and after protocol selection can lead to a corrupt device memory.

After selecting a protocol followed by a restart of the device, the new protocol is initialized. This can take up to 15 seconds. During this time the device is not usable and the LED indicators are out of function. When the protocol change is complete, the LED indicators return to normal operation and the device can be used again.

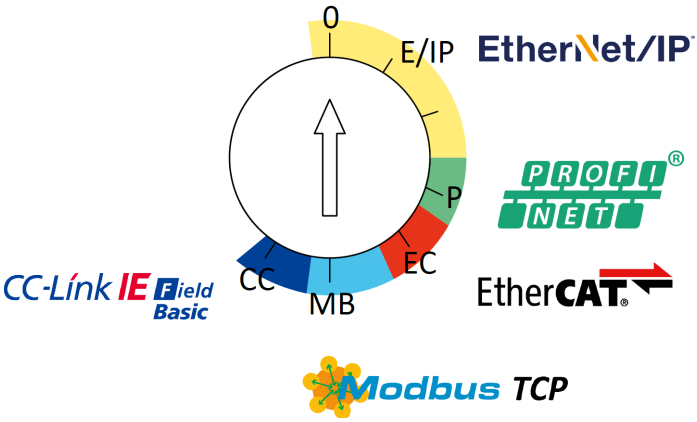
- Make sure that the power supply is maintained during the entire process.

The LioN-X multiprotocol variants allow you to select different protocols for communication within an industrial Ethernet system. In this way the IO-Link Masters with multiprotocol function can be integrated into different networks without it being necessary to purchase products specific for each protocol. This technology also gives you the option to use the same IOL-Master in different environments.

Using rotary encoding switches at the lower front of the devices, you can easily and conveniently set both the protocol and the address of the device, if the protocol to be used supports this. Once you have made a protocol selection and started the cyclical communication, the device stores this

setting permanently and uses the selected protocol from this point on. To use another supported protocol with this device, perform a factory reset.

The multiprotocol devices have a total of three rotary encoding switches. With the first rotary encoding switch (x100) you set the protocol by using the corresponding switch position. Additionally, x100 is used to set the third last digit of the IP address for EIP.



With the other rotary encoding switches (x10 / x1), you set the last two digits of the IP address when you are using EtherNet/IP, Modbus TCP or CC-Link IE Field Basic.

Protocol	x100	x10	x1
EtherNet/IP	0-2	0-9	0-9
PROFINET	P	–	–
EtherCAT®	EC	–	–
Modbus TCP	MB	0-9	0-9
CC-Link IE Field	CC	0-9	0-9

Table 12: Assignment of the rotary encoding switches for each protocol

The setting you make to select a protocol is described detailed in the protocol-specific sections.

In delivery state no protocol settings are stored in the device. In this case only the desired protocol has to be chosen. To take over a changed rotary

encoding switch setting (protocol setting), a power cycle or “Reset” from the Web interface is necessary.

Once you have set the protocol using the rotary encoding switches, the device stores this setting when it starts in cyclic communication. Changing the protocol using the rotary encoding switch is no longer possible after this point. The device will always start using the stored protocol from that point on. The IP address can be changed depending on the selected protocol.

To change the protocol, carry out a factory reset. In this way you restore the factory settings of the respective device. How you perform the factory reset for your device is described in chapter Factory reset on page 48.

If you position the rotary encoding switch in a manner that is invalid, the device signals this to you with a blink code (the RUN and ERR LEDs are off).

7.3.1 Factory reset

A factory reset restores the original factory settings and thus resets the changes and settings you have made up to that point. It also resets the protocol selection. To perform a factory reset, set the first rotary encoding switch (x100) to 9, the second (x10) to 7, and the third (x1) also to 9.

Afterwards perform a power cycle and wait 10 seconds due to internal memory write processes.

During the factory reset, the U_S LED is blinking red. After the internal memory write processes have finished, the U_S LED returns to display static green or red light, in dependency of the actual U_S voltage.

	x100	x10	x1
Factory Reset	9	7	9

Follow the steps from section Setting the rotary encoding switches again to select a new protocol.

For performing a factory reset via software configuration, see chapter OPC UA configuration on page 120 and the configuration section.

8 Configuration and operation in TwinCAT® 3

8.1 PDO assignments

The LioN-X and LioN-Xlight devices support different PDO (Process Data Object) assignments for input and output data.

By selecting the relevant PDO, you can choose your preferred I/O data content. The devices feature a dynamic, slot-based PDO assignment. The following PDO assignments are provided:

8.1.1 Input data

PDO 0x1A00

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A00	32	0x6000:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6000:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A01

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A01	32	0x6010:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6010:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A02

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A02	32	0x6020:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6020:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A03

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A03	32	0x6030:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6030:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A04

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A04	32	0x6040:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6040:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A05

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A05	32	0x6050:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6050:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A06

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A06	32	0x6060:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6060:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A07

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A07	32	0x6070:1	1	UINT32	1st byte of IO-Link input data
		…	…	…	…
		0x6070:32	1	UINT32	32nd byte of IO-Link input data

PDO 0x1A08

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A08	4	0x2080:1	1	UINT32	Digital input status of ports X1 .. X4 Bitwise
		0x2080:2	1	UINT32	Digital input status of ports X5 .. X8 Bitwise
		0x2080:3	1	UINT32	State of IO-Link Communication Bitwise
		0x2080:4	1	UINT32	Status of IO-Link Process Data valid Bitwise

PDO 0x1A09

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A09	1	0x10F3: 4	1	UINT32	Flag “New Messages Available” from Diagnostic Object 0x10F3

PDO 0x1A0A

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A0A	1	0x10F8: 0	1	UINT32	Timestamp Object 0x10F8

PDO 0x1A80

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1A80	8	0xF100:1	1	UINT32	Status IO-Link port 1
		0xF100:2	1	UINT32	Status IO-Link port 2
		0xF100:3	1	UINT32	Status IO-Link port 3
		0xF100:4	1	UINT32	Status IO-Link port 4
		0xF100:5	1	UINT32	Status IO-Link port 5
		0xF100:6	1	UINT32	Status IO-Link port 6
		0xF100:7	1	UINT32	Status IO-Link port 7
		0xF100:8	1	UINT32	Status IO-Link port 8

8.1.2 Output data

PDO 0x1600

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1600	32	0x7000:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7000:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1601

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1601	32	0x7010:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7010:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1602

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1602	32	0x7020:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7020:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1603

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1603	32	0x7030:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7030:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1604

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1604	32	0x7040:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7040:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1605

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1605	32	0x7050:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7050:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1606

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1606	32	0x7060:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7060:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1607

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1607	32	0x7070:1	1	UINT32	1st byte of IO-Link output data
		…	…	…	…
		0x7070:32	1	UINT32	32nd byte of IO-Link output data

PDO 0x1608

PDO		PDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x1608	4	0x2280:1	1	UINT32	Digital output mapping for ports X1 .. X4 Bitwise
		0x2280:2	1	UINTtwincat32	Digital output mapping for ports X5 .. X8 Bitwise
		0x2280:3	1	UINT32	Control of IO-Link COM mode Bitwise
		0x2280:4	1	UINT32	Reserved

8.1.3 Modular slots

The ESI file features a modular slot-based PDO configuration for different IO-Link configurations. The following slots are available:

Slot name	Description
STD_IN_1_bit	IO-Link port as standard Digital Input
IOL_I_1byte	IO-Link, 1 byte of process data input
IOL_I_2byte	IO-Link, 2 bytes of process data input
IOL_I_4byte	IO-Link, 4 bytes of process data input
IOL_I_6byte	IO-Link, 6 bytes of process data input
IOL_I_8byte	IO-Link, 8 bytes of process data input
IOL_I_10byte	IO-Link, 10 bytes of process data input
IOL_I_16byte	IO-Link, 16 bytes of process data input
IOL_I_24byte	IO-Link, 24 bytes of process data input
IOL_I_32byte	IO-Link, 32 bytes of process data input
STD_OUT_1_bit	IO-Link port as standard Digital Output
IOL_O_1byte	IO-Link, 1 bytes of process data output
IOL_O_2byte	IO-Link, 2 bytes of process data output
IOL_O_4byte	IO-Link, 4 bytes of process data output
IOL_O_6byte	IO-Link, 6 bytes of process data output
IOL_O_8byte	IO-Link, 8 bytes of process data output
IOL_O_10byte	IO-Link, 10 bytes of process data output
IOL_O_16byte	IO-Link, 16 bytes of process data output
IOL_O_24byte	IO-Link, 24 bytes of process data output
IOL_O_32byte	IO-Link, 32 bytes of process data output
IOL_I/O_1/1byte	IO-Link, 1 byte of process data input 1 byte of process data output

Slot name	Description
IOL_I/O_2/2byte	IO-Link, 2 bytes of process data input 2 bytes of process data output
IOL_I/O_2/4byte	IO-Link, 2 bytes of process data input 4 bytes of process data output
IOL_I/O_4/4byte	IO-Link, 4 bytes of process data input 4 bytes of process data output
IOL_I/O_4/2byte	IO-Link, 4 bytes of process data input 2 bytes of process data output
IOL_I/O_2/8byte	IO-Link, 2 bytes of process data input 8 bytes of process data output
IOL_I/O_4/8byte	IO-Link, 4 bytes of process data input 8 bytes of process data output
IOL_I/O_8/2byte	IO-Link, 8 bytes of process data input 2 bytes of process data output
IOL_I/O_8/4byte	IO-Link, 8 bytes of process data input 4 bytes of process data output
IOL_I/O_8/8byte	IO-Link, 8 bytes of process data input 8 bytes of process data output
IOL_I/O_4/32byte	IO-Link, 4 bytes of process data input 32 bytes of process data output
IOL_I/O_32/4byte	IO-Link, 32 bytes of process data input 4 bytes of process data output

Slot name	Description
IOL_I/O_16/16byte	IO-Link, 16 bytes of process data input 16 bytes of process data output
IOL_I/O_24/24byte	IO-Link, 24 bytes of process data input 24 bytes of process data output
IOL_I/O_32/32byte	IO-Link, 32 bytes of process data input 32 bytes of process data output

8.2 Device parameters

The LioN-X and LioN-Xlight devices support different parameters. The parameters must be transferred from the controller to the device during startup. The following blocks of parameters can be adjusted.

8.2.1 Extended parameters

The following table represents extended parameters of the IO-Link ports.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name (specification)**
0x23n0	2	0x23n0:1	1	UINT8	**Data Storage** 0 = Data Storage disabled (stored data set is preserved) 1 = Data Storage download only (IOLM → IOLD) 2 = Data Storage upload only (IOLD → IOLM) 3 = Data Storage download and upload 4 = Data Storage disabled and cleared (a previously stored data set is cleared) Others: reserved
		0x23n0:2	1	UINT8	**Fail Safe Mode** 0 = Set Low 1 = Set High 2 = Hold Last Value 3 = Replacement value (refer object 0x2301) 4 = IO-Link master command Others: reserved

Key:

n = number between 0 .. 7 (port number -1)

8.2.2 Failsafe replacement values

The firmware of the devices provides a fail-safe function for the port while in IO-Link mode. During device configuration, you have the option to define the replacement value of the IO-Link output data.

The following table represents failsafe replacement values of IO-Link output data while the port is in IO-Link mode.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x23n1	2	0x23n1:1	1	UINT8	Failsafe replacement value byte 1
		…	…	…	…
		0x23n1:32	32	UINT8	Failsafe replacement value byte 32

Key:

n = number between 0 .. 7 (port number -1)

8.2.3 Failsafe mode for the digital output

The firmware of the devices provides a fail-safe function for ports in digital output mode. During device configuration, you have the option to define the status of channels A and B for ports in digital output mode in the case of an interruption or the loss of communication.

The following table represents possible failsafe replacement values of ports in digital output mode.

The following options are available:

Set low (default value)	Deactivate the output channel (value = 0)
Set high	Activate the output channel (value = 1)
Hold last	Hold the last output status (value = 2)

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2380	16	0x2380 : 1	1	UINT8	**Port 1 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 2	1	UINT8	**Port 1 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 3	1	UINT8	**Port 2 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved

SDO		SDO content			
		0x2380 : 4	1	UINT8	**Port 2 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 5	1	UINT8	**Port 3 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 6	1	UINT8	**Port 3 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 7	1	UINT8	**Port 4 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 8	1	UINT8	**Port 4 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 9	1	UINT8	**Port 5 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 10	1	UINT8	**Port 5 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved

SDO		SDO content			
		0x2380 : 11	1	UINT8	**Port 6 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 12	1	UINT8	**Port 6 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 13	1	UINT8	**Port 7 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 14	1	UINT8	**Port 7 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 15	1	UINT8	**Port 8 Channel A** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved
		0x2380 : 16	1	UINT8	**Port 8 Channel B** 0 = Set Low 1 = Set High 2 = Hold Last Others: reserved

8.2.4 General device settings

The device supports the setting of different parameters. The following blocks of parameters can be adjusted:

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2381	7	0x2381:1	1	BOOL	Web Interface Locked 0 = false, 1 = true
		0x2381:2	1	BOOL	Force Mode Locked 0 = false, 1 = true
		0x2381:3	1	BOOL	Disable U_S Emergency Messages 0 = false, 1 = true
		0x2381:4	1	BOOL	Disable U_L Emergency Messages 0 = false, 1 = true
		0x2381:5	1	BOOL	Disable Actuator Emergency Messages without U_L 0 = false, 1 = true
		0x2381:6	1	BOOL	Enable External Configuration 0 = false, 1 = true
		0x2381:7	1	BOOL	Automatic Output Restart after failure 0 = false, 1 = true

8.2.5 Surveillance timeout

The firmware of the devices allows you to define a delay time before the automatic monitoring of the output currents. This is known as the surveillance timeout.

You can define the surveillance timeout for every individual output channel.

The delay time begins after the output channel has been activated (after a rising edge) or deactivated (after a falling edge). After the surveillance timeout has elapsed, the monitoring of the output begins and the diagnosis will report error states.

The value of the surveillance timeout is 0 to 255 ms. The default value is 80 ms. While an output channel is in static state (permanently switched on or off), the respective value is 100 ms.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2382	16	0x2382:1	1	UINT8	Surveillance Timeout Port 1 Channel A
		0x2382:2	1	UINT8	Surveillance Timeout Port 1 Channel B
		0x2382:3	1	UINT8	Surveillance Timeout Port 2 Channel A
		0x2382:4	1	UINT8	Surveillance Timeout Port 2 Channel B
		0x2382:5	1	UINT8	Surveillance Timeout Port 3 Channel A
		0x2382:6	1	UINT8	Surveillance Timeout Port 3 Channel B
		0x2382:7	1	UINT8	Surveillance Timeout Port 4 Channel A
		0x2382:8	1	UINT8	Surveillance Timeout Port 4 Channel B

SDO		SDO content			
		0x2382:9	1	UINT8	Surveillance Timeout Port 5 Channel A
		0x2382:10	1	UINT8	Surveillance Timeout Port 5 Channel B
		0x2382:11	1	UINT8	Surveillance TimeoutPort 6 Channel A
		0x2382:12	1	UINT8	Surveillance Timeout Port 6 Channel B
		0x2382:13	1	UINT8	Surveillance Timeout Port 7 Channel A
		0x2382:14	1	UINT8	Surveillance Timeout Port 7 Channel B
		0x2382:15	1	UINT8	Surveillance Timeout Port 8 Channel A
		0x2382:16	1	UINT8	Surveillance Timeout Port 8 Channel B

8.2.6 Digital I/O mode, Channel B

The device supports the configuration of channel B (Pin 2) of the IO-Link port via SDO 0x2383 in input or output mode.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2383	8	0x2383 : 1	1	UINT8	**Digital I/O Mode Port 1 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 2	1	UINT8	**Digital I/O Mode, Port 2 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 3	1	UINT8	**Digital I/O Mode, Port 3 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 4	1	UINT8	**Digital I/O Mode, Port 4 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 5	1	UINT8	**Digital I/O Mode, Port 5 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 6	1	UINT8	**Digital I/O Mode, Port 6 Channel B** 1 = Input 2 = Output Others = reserved
		0x2383: 7	1	UINT8	**Digital I/O Mode, Port 7 Channel B** 1 = Input 2 = Output Others = reserved

SDO		SDO content			
		0x2383: 8	1	UINT8	**Digital I/O Mode, Port 8 Channel B** 1 = Input 2 = Output Others = reserved

8.2.7 Digital Input logic

The device supports the configuration of digital input logic for Channel A (Pin 4) and Channel B (Pin 2) of the IO-Link port.

The following values are only applicable for ports in *Digital Input* mode.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2384	16	0x2384 : 1	1	UINT8	**Digital Input logic Port 1 Channel A** 0: NO 1: NC
		0x2384: 2	1	UINT8	**Digital Input logic Port 1 Channel B** 0: NO 1: NC
		0x2384: 3	1	UINT8	**Digital Input logic Port 2 Channel A** 0: NO 1: NC
		0x2384: 4	1	UINT8	**Digital Input logic Port 2 Channel B** 0: NO 1: NC
		0x2384: 5	1	UINT8	**Digital Input logic Port 3 Channel A** 0: NO 1: NC
		0x2384: 6	1	UINT8	**Digital Input logic Port 3 Channel B** 0: NO 1: NC
		0x2384: 7	1	UINT8	**Digital Input logic Port 4 Channel A** 0: NO 1: NC

SDO		SDO content			
		0x2384: 8	1	UINT8	**Digital Input logic Port 4 Channel B** 0: NO 1: NC
		0x2384: 9	1	UINT8	**Digital Input logic Port 5 Channel A** 0: NO 1: NC
		0x2384: 10	1	UINT8	**Digital Input logic Port 5 Channel B** 0: NO 1: NC
		0x2384: 11	1	UINT8	**Digital Input logic Port 6 Channel A** 0: NO 1: NC
		0x2384: 12	1	UINT8	**Digital Input logic Port 6 Channel B** 0: NO 1: NC
		0x2384: 13	1	UINT8	**Digital Input logic Port 7 Channel A** 0: NO 1: NC
		0x2384: 14	1	UINT8	**Digital Input logic Port 7 Channel B** 0: NO 1: NC
		0x2384: 15	1	UINT8	**Digital Input logic Port 8 Channel A** 0: NO 1: NC
		0x2384: 16	1	UINT8	**Digital Input logic Port 8 Channel B** 0: NO 1: NC

8.2.8 Digital Input filter

The device supports the configuration of a digital input filter for Channel A (Pin 4) and Channel B (Pin 2) of the IO-Link port.

The following values are only applicable for ports in *Digital Input* mode.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2385	16	0x2385 : 1	1	UINT8	Digital Input Filter Port 1 Channel A
		0x2385: 2	1	UINT8	Digital Input Filter Port 1 Channel B
		0x2385: 3	1	UINT8	Digital Input Filter Port 2 Channel A
		0x2385: 4	1	UINT8	Digital Input Filter Port 2 Channel B
		0x2385: 5	1	UINT8	Digital Input Filter Port 3 Channel A
		0x2385: 6	1	UINT8	Digital Input Filter Port 3 Channel B
		0x2385: 7	1	UINT8	Digital Input Filter Port 4 Channel A
		0x2385: 8	1	UINT8	Digital Input Filter Port 4 Channel B
		0x2385: 9	1	UINT8	Digital Input Filter Port 5 Channel A
		0x2385: 10	1	UINT8	Digital Input Filter Port 5 Channel B
		0x2385: 11	1	UINT8	Digital Input Filter Port 6 Channel A
		0x2385: 12	1	UINT8	Digital Input Filter Port 6 Channel B
		0x2385: 13	1	UINT8	Digital Input Filter Port 7 Channel A
		0x2385: 14	1	UINT8	Digital Input Filter Port 7 Channel B
		0x2385: 15	1	UINT8	Digital Input Filter Port 8 Channel A
		0x2385: 16	1	UINT8	Digital Input Filter Port 8 Channel B

8.2.9 Digital Output restart

The device supports the configuration of a digital output timeout before restart for Channel A (Pin 4) and Channel B (Pin 2) of the IO-Link port.

The following values are only applicable for ports in *Digital Output* mode.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x2386	16	0x2386 : 1	1	BOOL	Digital output timeout before restart in ms Port 1 Channel A
		0x2386: 2	1	BOOL	Digital output timeout before restart in ms Port 1 Channel B
		0x2386: 3	1	BOOL	Digital output timeout before restart in ms Port 2 Channel A
		0x2386: 4	1	BOOL	Digital output timeout before restart in ms Port 2 Channel B
		0x2386: 5	1	BOOL	Digital output timeout before restart in ms Port 3 Channel A
		0x2386: 6	1	BOOL	Digital output timeout before restart in ms Port 3 Channel B
		0x2386: 7	1	BOOL	Digital output timeout before restart in ms Port 4 Channel A
		0x2386: 8	1	BOOL	Digital output timeout before restart in ms Port 4 Channel B
		0x2386: 9	1	BOOL	Digital output timeout before restart in ms Port 5 Channel A
		0x2386: 10	1	BOOL	Digital output timeout before restart in ms Port 5 Channel B
		0x2386: 11	1	BOOL	Digital output timeout before restart in ms Port 6 Channel A

SDO		SDO content			
		0x2386: 12	1	BOOL	Digital output timeout before restart in ms Port 6 Channel B
		0x2386: 13	1	BOOL	Digital output timeout before restart in ms Port 7 Channel A
		0x2386: 14	1	BOOL	Digital output timeout before restart in ms Port 7 Channel B
		0x2386: 15	1	BOOL	Digital output timeout before restart in ms Port 8 Channel A
		0x2386: 16	1	BOOL	Digital output timeout before restart in ms Port 8 Channel B

8.2.10 Additional IO-Link port settings

The device firmware provides the following additional setting options for each individual IO-Link port via SDO.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x30n0	6	0x30n0:1	1	UINT8	Swap Mode
		0x30n0:2	1	UINT8	Swap Length
		0x30n0:3	1	UINT8	Swap Offset
		0x30n0:4	1	BOOL	Sensor Supply Enabled 0 = false, 1 = true
		0x30n0:5	1	BOOL	Pin 2 LED Enabled 0 = false, 1 = true
		0x30n0:6	1	BOOL	Supress All Diagnosis 0 = false, 1 = true
		0x30n0:7	1	BOOL	Pin 4 DO use of Push-Pull 0 = Use High-Side switches 1 = Use Push-Pull
		0x30n0:8	1	UINT16	Pin 4 current limit in mA (Maximum current limit till Pin 4 is turned off) Default: 2000
		0x30n0:9	1	UINT16	Pin 2 DO use of Push-Pull in mA (Maximum current limit till Pin 2 is turned off) Default: 2000

Key:

n = number between 0 .. 7 (port number -1)

Swap Mode

The byte order swapping will be made for the selected count of data types or for the complete length of I/O-Data with the selected Data Type (Word = 2 Bytes or DWord = 4 Bytes).

Swap Length

The swapping can be setup to Word (2 Bytes) or DWord (4 Bytes)

- Word Swapping: Byte 1 - Byte 2 => Byte 2 - Byte 1
- DWord Swapping: Byte 1 - Byte 4 => Byte 4 – Byte 1

Swapping Offset

A swapping offset in bytes can be setup in dependency of the configured I/O-Data length. When setup to "2", the swapping will be processed from the 3rd Byte.

8.2.11 IO-Link Parameterization

The device features read or write of ISDU (IO-Link Service Data) parameters via SDO 0x40n0.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x40n0	7	0x40n0:1	1	UINT8	**Control** 0x00: no action 0x02: read 0x03: write
		0x40n0:2	1	UINT8	**Status** 0x00: No activity 0x01: Active/busy 0x02: Access finished 0x03: Error 0x04: ISDU blocked
		0x40n0:3	1	UINT16	Index
		0x40n0:4	2	UINT8	Subindex
		0x40n0:5	1	UINT8	Length
		0x40n0:6	232	UINT232	Data
		0x40n0:7	2	UINT16	**Error** 0x00: No error in ISDU request 0x01: Error during ISDU request

Key:

n = number between 0 .. 7 (port number -1)

8.2.12 IO-Link configuration data

This is the standard 0x80n0 object for the IO-Link configuration data as per the IO-Link device profile.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x80n0	7	0x80n0:4	4	UINT32	Device ID
		0x80n0:5	4	UINT32	Vendor ID
		0x80n0:32	1	UINT8	**IO LINK revision** Version of the implemented IO-Link specification (of the connected IO-Link device) according to version 1.0 of the IO-Link specification. **Bit 0...3:** Minor Rev **Bit 4...7:** Major Rev
		0x80n0:33	1	UINT8	Frame Capability
		0x80n0:34	1	UINT8	Cycle Time
		0x80n0:35	1	UINT8	Offset Time
		0x80n0:36	1	UINT8	**Process data IN length** Number and structure of input data This value is transmitted in IO-Link format as "ProcessDataIn" according to version 1.0 of the IO-Link specification. **Bit 0...4:** Length **Bit 5:** reserved **Bit 6:** SIO Indicator (if device supports standard I/O mode) **Bit 7:** Byte Indicator (if value of length is interpreted as bit length or as byte length +1)
		0x80n0:37	1	UINT8	**Process data OUT length** Number and structure of input data This value is transmitted in IO-Link format as "ProcessDataOut" according to version 1.0 of the IO-Link specification. **Bit 0...4:** Length **Bit 5:** reserved **Bit 6:** SIO Indicator (if device supports standard I/O mode) **Bit 7:** Byte Indicator (if value of length is interpreted as bit length or as byte length +1)

SDO		SDO content			
		0x80n0:38	2	UINT16	Compatible ID
		0x80n0:39	2	UINT16	Reserved
		0x80n0:40	2	UINT16	**Master Control** Control of the IO-Link master port. Defines the different operating modes of the IO-Link master. **Bits 0...3:** 0: Inactive 1: Digital Input Port 2: Digital Output Port 3: Communication over IO-Link Protocol 4: Digital input with support for acyclic IO-Link

Key:

n = number between 0 .. 7 (port number -1)

8.2.13 IO-Link serial number

This is the standard 0x80n1 object for the IO-Link serial number as per the IO-Link device profile.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x80n1	20	0x80n1:1	1	VISIBLE_STRING	Serial Number

Key:

n = number between 0 .. 7 (port number -1)

8.2.14 IO-Link information data

This is standard 0x90n0 object for the IO-Link information data as per the IO-Link device profile.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x90n0	7	0x90n0:4	4	UINT32	Device ID
		0x90n0:5	4	UINT32	Vendor ID
		0x90n0:32	1	UINT8	**IO LINK revision** Version of the implemented IO-Link specification (of the connected IO-Link device) according to version 1.0 of the IO-Link specification. **Bit 0...3:** Minor Rev **Bit 4...7:** Major Rev
		0x90n0:33	1	UINT8	Frame Capability
		0x90n0:34	1	UINT8	Cycle Time
		0x90n0:35	1	UINT8	Offset Time
		0x90n0:36	1	UINT8	**Process data IN length** Number and structure of input data This value is transmitted in IO-Link format as "ProcessDataIn" according to version 1.0 of the IO-Link specification. **Bit 0...4:** Length **Bit 5:** reserved **Bit 6:** SIO Indicator (if device supports standard I/O mode) **Bit 7:** Byte Indicator (if value of length is interpreted as bit length or as byte length +1)

SDO		SDO content			
		0x90n0:37	1	UINT8	**Process data OUT length** Number and structure of input data This value is transmitted in IO-Link format as "ProcessDataOut" according to version 1.0 of the IO-Link specification. **Bit 0...4:** Length **Bit 5:** reserved **Bit 6:** SIO Indicator (if device supports standard I/O mode) **Bit 7:** Byte Indicator (if value of length is interpreted as bit length or as byte length +1)

Key:

n = number between 0 .. 7 (port number -1)

8.2.15 IO-Link serial number of connected devices

This is the standard 0x90n1 object for the IO-Link serial number of connected devices as per the IO-Link device profile.

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x9n01	20	0x90n1:1	1	VISIBLE_STRING	Serial Number

Key:

n = number between 0 .. 7 (port number -1)

8.3 Configuration example with TwinCAT® 3

The configuration and start-up of the devices described below refer to the TwinCAT® 3 software by Beckhoff Automation GmbH & Co. KG. If you use the control system of another provider, refer to the corresponding documentation.

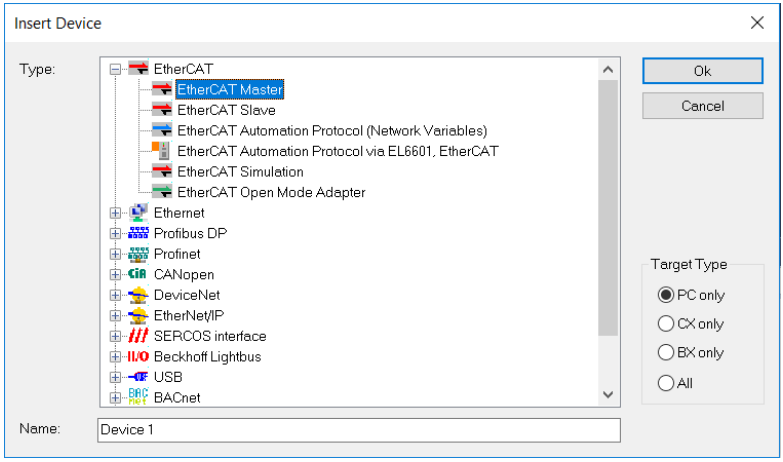
1. Install the ESI file of the device family in TwinCAT®. For TwinCAT®, the ESI file must be copied into the installation folder, e.g.: `C:\TwinCAT\3.1\Config\Io\EtherCAT`.

2. After installation, TwinCAT® needs a system restart. Alternatively, use the menu bars in TwinCAT® to reload the application: **TWINCAT** > **EtherCAT Devices** > **Reload Device Descriptions**.

The devices are now available in the hardware catalog.

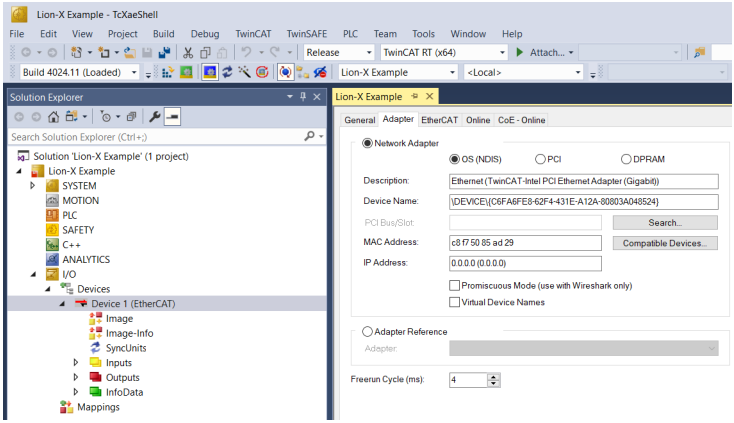
3. Start TwinCAT® and open a new project.

4. Browse to **Solution Explorer** > **I/O** > **Devices** in the left workspace window. Right-click on **Devices** and choose the option **Add New Item …** > **EtherCAT Master**.



5. If not already done, choose the network adapter and install the driver for EtherCAT® real time communication.

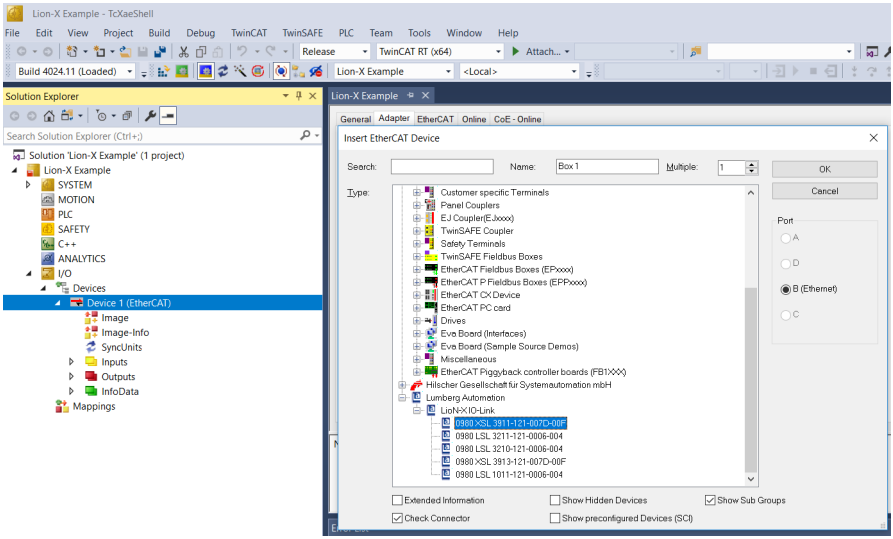
Browse to **Adapter** in the right workspace window and click on **Compatible Devices...** to choose the driver and start the installation.



8.3.1 Configuration of 0980 XSL 391x-1x1 devices

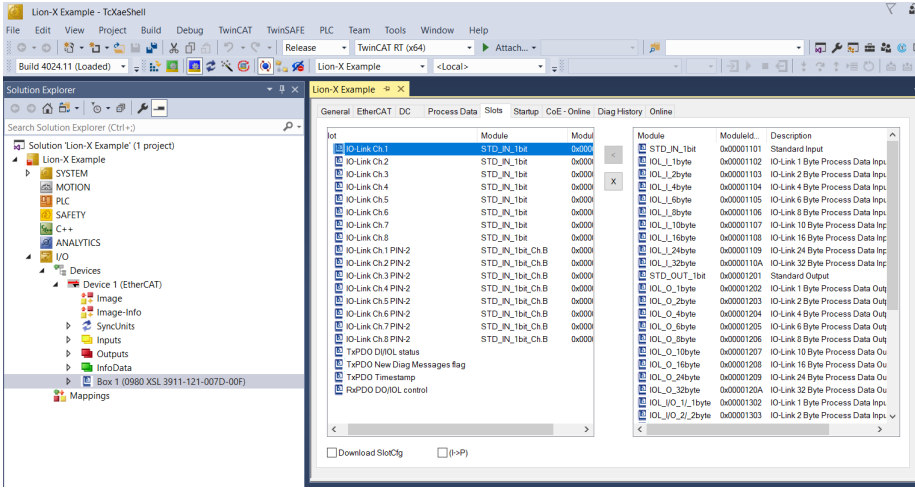
1. Selecting the I/O device from the hardware catalog:

Browse to **Solution Explorer** > **I/O** > **Devices** in the left workspace window. Right-click on **Device 1 (EtherCAT)** and choose the option **Add New Item ...**. Select the device and click on **OK**.



2. Configuring the “Slots”:

Browse to **Slots** in the right workspace window and configure the IO-Link channels. You can change, for example, the Input/Output length, the channel mode, or the I/O mode of Channel B (Pin 2). Additional PDOs like "TXPDO" for the DI/IOL status, "TxPDO" for a new diagnostic messages flag, "TxPDO" for a timestamp and "RxPDO" for DO/IOL control can be set as well.



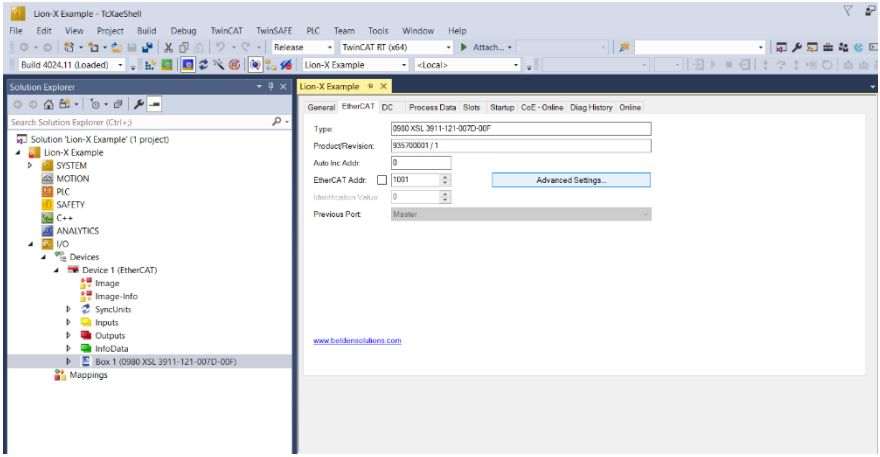
3. Configure the Process Data:

Browse to **Process Data** in the right workspace window and choose the PDOs for Inputs and Outputs.

8.3.2 EoE IP address

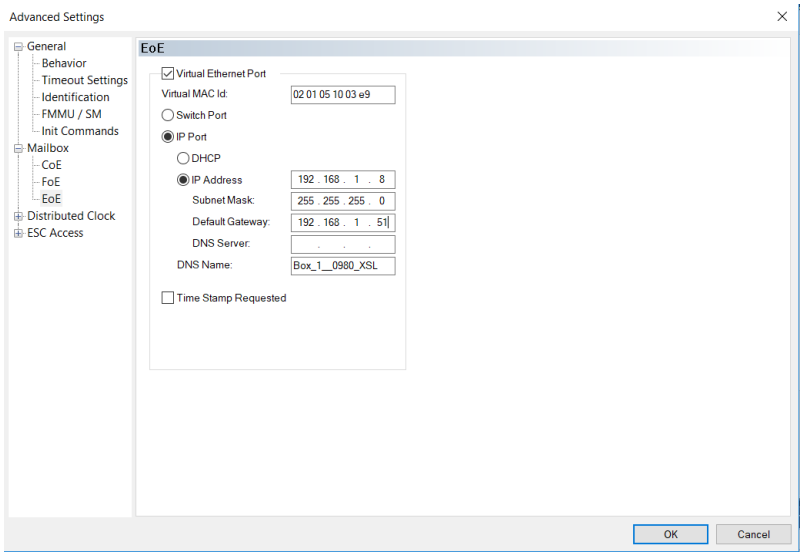
1. Set the IP address for the EoE (Ethernet over EtherCAT®) protocol:

For using the Web interface of the device, the IP address must be set. Click on **EtherCAT** > **Advanced Settings...** in the right workspace window and navigate to **Mailbox** > **EoE**.



2. Disable the option **Virtual Ethernet Port** when using no Web services.

3. Activate **IP Port** and **IP Address** when using Web services. Enter your IP settings depending from your local network adapter settings.



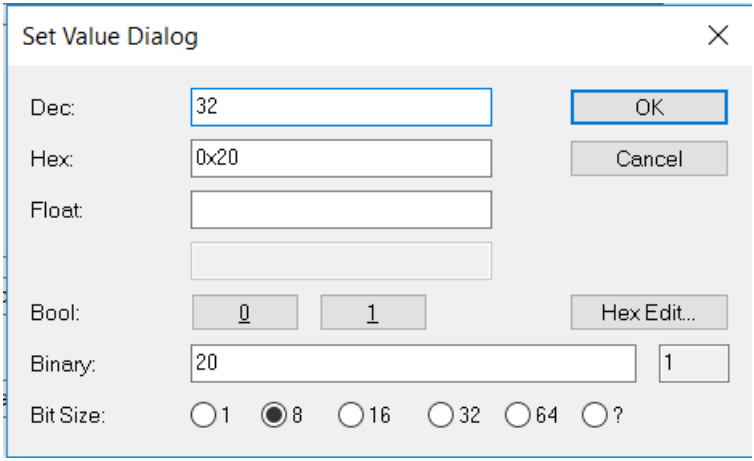
8.3.3 Activate configuration

Warning: Risk of personal injury or damage of the equipment. Keep away from moveable machine parts during setting up the inputs or outputs of the device.

1. When the device is connected to the EtherCAT® network, click on **TwinCAT** in the top ribbon and choose **Activate Configuration** in the upcoming window.

2. Click again on **TwinCAT** in the top ribbon and choose **Restart TwinCAT (Config Mode)**. Accept the dialog boxes by clicking on **Yes**. The device will now be changed to “OP” state and will be transferring I/O data.

3. Click on **Write...** to set up any output of the device.



9 Diagnostics processing

9.1 Diagnostics (0x2001)

Index	Size	Index	Size	Type	Name
0x2001	09	0x2001:1	1	BOOL	U_S supply fault
		0x2001:2	1	BOOL	U_L supply present
		0x2001:3	1	BOOL	U_L supply fault
		0x2001:4	1	BOOL	Internal Module Error
		0x2001:5	1	BOOL	Force Mode Diagnostic
		0x2001:6	1	UINT8	Sensor Short Fault
		0x2001:7	1	UINT8	CQ Short Fault
		0x2001:8	1	UINT8	IQ Short Fault
		0x2001:9	1	UINT8	P24 Short Fault (Class B)

9.2 Error of the system/sensor power supply

The voltage value for the incoming system/sensor power supply is also monitored globally. If the voltage drops below approx. 18 V, or exceeds approx. 30 V, an error message is generated. The IO-Link specification requires at least 20 V at the L+ (pin1) output supply of the I/O ports. At least 21 V of U_S supply voltage for the IO-Link Master are required to minimize the risk of internal voltage drops in the IO-Link Master.

The green U_S indicator is off.

The error message has no effect on the outputs.

Caution: It must definitely be ensured that the supply voltage, measured at the most remote participant is not below 21 V DC from the perspective of the system power supply.

9.3 Error of the auxiliary/actuator power supply

The voltage value for the incoming auxiliary/actuator power supply is also monitored globally. If U_{Aux} diagnostic messaging is enabled, an error message is generated if the voltage drops below approx. 18 V or exceeds approx. 30 V.

The U_{Aux} indicator shows red. If output channels are enabled, additional error messages caused by the voltage failure are generated on the I/O ports. U_{Aux} diagnostic messaging is disabled by default and must be enabled via parameterization.

9.4 Overload/short-circuit of the I/O port sensor supply outputs

In case of an overload or a short circuit between pin 1 and pin 3 on the ports (X1 .. X8), the following channel-specific diagnostic messages are generated:

9.5 Overload/short circuit of the digital outputs

A channel error is determined by comparing the target value set by a controller and the actual value of an output channel.

When an output channel is activated (rising edge of the channel state), the channel errors are filtered for the period that you set using the "Surveillance-Timeout" parameter during the configuration of the module. The value of this parameter can range from 0 to 255 ms; the factory setting is 80 ms.

The filter is used to avoid premature error messages when a capacitive load is activated or an inductive load is deactivated, and during other voltage peaks when a status changes.

In static state of the output channel, that is, while the channel is permanently switched on, the filter time between error detection and the diagnostic message is typically 5 ms.

9.6 IO-Link C/Q error

If an IO-Link Device in COM mode is unplugged, an incorrect IO-Link Device is plugged in, or an electrical fault occurs on the C/Q (Pin 4) line, for example, due to a short circuit, an error message is generated.

9.7 Diagnostic history object (0x10F3)

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0x10F3	69	0x10F3: 1	1	UINT8	Maximum Messages
		0x10F3: 2	1	UINT8	Newest Message
		0x10F3: 3	1	UINT8	Newest Acknowledged Message
		0x10F3: 4	1	BOOL	New Messages Available
		0x10F3: 5	1	UINT16	Flags
		0x10F3: 6-69	1	OCTET_STRING	Diagnosis Message Buffer

9.7.1 Maximum Messages

Number of diagnosis messages which can be stored in the diagnosis history (subindex 6 onwards).

9.7.2 Newest Message

Sub-index of the newest diagnosis message (6 .. 69).

9.7.3 Newest Acknowledge Message

Overwrite mode (SI5, bit 4 = 0)

- Read = 0:

  When the message queue will be overwritten, the slave sets SI3 to "0".

- Writing = 0:

  The slave clears all messages, i.e. resets SI2, SI3, SI4 and SI5 bit 5 Messages are deleted even if they were not acknowledged or read before.

- Writing = 1 .. 5:

  The slave returns SDO abort with code 0x06090032 (value of parameter written too low).

- Writing = 6 .. 69:

  SI3 = written value (without checking)

  All messages up to the age of the message which is in the written sub-index are acknowledged. The slave does not check if those messages have been read before.

  The slave returns SDO abort with code 0x06090030 (value range of parameter exceeded) in the following case: SI3 is written with a value of a sub-index which does not hold a message.

- Writing = 69 .. 255:

  The slave returns SDO abort with code 0x06090031 (value of parameter written too high).

Acknowledge mode (SI5, bit 4 = 1)

- Read = 0:

  No messages have been acknowledged so far.

- Read = 0:

  Sub-index of latest acknowledged diagnosis message (6-69)

- Writing = 0:

  All acknowledged messages will be deleted.

- Writing = 1 .. 5:

  The slave returns SDO abort with code 0x06090032 (value of parameter written too low).

- Writing = 6 .. 69:

  Messages are acknowledged

  All messages up to the age of the message which is in the written sub-index are acknowledged. The slave does not check if those messages have been read before. The slave returns SDO abort with code 0x06090030 (value range of parameter exceeded) in the following case: SI3 is written with a value of a sub-index which does not hold a message.

- Writing = 69 .. 255:

  The slave returns SDO abort with code 0x06090031 (value of parameter written too high).

9.7.4 New Messages Available

Overwrite mode:

- 0: newest message was read
- 1: newest message was not read

Acknowledge mode:

- 0: no unacknowledged message
- 1: diagnosis messages are available which can be acknowledged (SI2 ! = SI3).

9.7.5 Flags

Flags to control sending and storing of diagnosis messages:

Bit 0: Enable Emergency sending

- 0: Default, if device does not support emergency sending.
- 1: New diagnosis messages shall be sent as emergency message.

Bit 1: Disable info messages

- 0: Info messages are stored in the diagnosis message queue (default).

- 1: Info messages will not be stored in the diagnosis message queue.

Bit 2: Disable warning messages

- 0: Warning messages are stored in the diagnosis message queue (default).
- 1: Warning messages will not be stored in the diagnosis message queue.

Bit 3: Disable error messages

- 0: Error messages are stored in the diagnosis message queue (default).
- 1: Error messages will not be stored in the diagnosis message queue.

Bit 4: Mode selection for diagnosis history handling

- 0: Overwrite mode. Old messages are overwritten by new ones when buffer is full.
- 1: Acknowledge mode. New messages do only overwrite messages which were acknowledged before.

Bit 5: Overwrite/Discard Information (read only)

In Overwrite mode:

- 1: Unacknowledged messages have been overwritten (= buffer overrun) (SI3 is set to "0", too).

In Acknowledge mode:

- 1: Message buffer is full with acknowledged messages and a new message is discarded.

Bit 6 .. 15: reserved

9.7.6 Diagnosis Message Buffer

Depending on SI1, the EtherCAT® slave can store up to 64 messages; the first message is stored in sub-index 6, the second in sub-index 7and so on. When the queue is full, the EtherCAT® slave shall overwrite sub-index 6 and the following, in a way that always the latest maximum messages (SI1) shall be accessible by the EtherCAT® master.

9.8 Diagnostic data object (0xA0n0)

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0xA0n0	2	0xA0n0: 1	1	UINT8	IO-Link State
		0xA0n0: 2	1	UINT8	Lost Frames

IO-Link State

State of the IO-Link Master (state machine of the IO-Link port)

0x0 = Port inactive

0x01 = Digital input

0x02 = Digital output

0x03 = Establish communication

0x04-0x07: reserved

0x08 = Communication OPERATE

0x09 = Communication STOP

Lost Frames

Counter of lost IO-Link telegrams. Reset counter during start-up.

9.9 Device status object (0xF100)

SDO		SDO content			
Index	**Size**	**Index**	**Size**	**Type**	**Name**
0xF100	8	0xF100: 1	1	UINT8	Status Port 1
		0xF100: 2	1	UINT8	Status Port 2
		0xF100: 3	1	UINT8	Status Port 3
		0xF100: 4	1	UINT8	Status Port 4
		0xF100: 5	1	UINT8	Status Port 5
		0xF100: 6	1	UINT8	Status Port 6
		0xF100: 7	1	UINT8	Status Port 7
		0xF100: 8	1	UINT8	Status Port 8

Status Ports 1 .. 8

Status of the IO-Link port (state machine of the IO-Link port)

0x_0 = Port Inactive

0x_1 = Port in SIO Digital Input

0x_2 = Port in SIO Digital Output

0x_3 = Port in Communication OP

0x_4 = Port in Communication STOP

0x0_ = No Error

0x1_ = Watchdog Error

0x2_ = Buffer Overflow

0x3_ = Invalid Device Id

0x4_ = Invalid Vendor Id

0x5_ = Invalid IO-Link Version

0x6_ = Invalid Frame Capability

0x7_ = Invalid Cycle Time

0x8_ = Invalid PD in length

0x9_ = Invalid PD out length

0xA_ = No Device detected

0xB_ = Error PreOP

9.10 Emergency messages

If set in the parameters, the Device sends emergency messages to the Master in case of a detected diagnosis on the Device.

Emergency error code	B7	B6	B5	B4	B3	B2	B1	B0	Error description
0x0000	0	0	0	0	0	0	0	0	No error
0x2300	–	0	0	0	0	0	1	1	Sensor short circuit
0x3100	–	0	0	0	0	1	–	1	U_S Voltage error
0x3300	–	0	0	0	0	1	–	0	U_L Voltage error
0xF000	1	0	0	0	0	0	–	1	Additional function forcing
0xFF00	1	0	0	0	0	0	–	1	Additional function parameter error

10 IIoT functionality

The LioN-X variants offer a number of new interfaces and functions for the optimal integration into existing or future IIoT (Industrial Internet of Things) networks. The devices continue to work as field bus devices which communicate with and are controlled by a PLC (Programmable Logic Controller).

In addition, the devices offer common IIoT interfaces, which enable new communication channels besides the PLC. The communication is performed via IIoT-relevant protocols MQTT and OPC UA. With the help of these interfaces not only all information in a LioN-X device can be read. They also enable its configuration and control, if the user wishes. All interfaces can be configured extensively and offer read-only functionality.

All LioN-X variants provide user administration, which is also applicable for accessing and configuring the IIoT protocols. This allows you to manage all modification options for the device settings via personalized user authorizations.

All IIoT protocols can be used and configured independently of the field bus. It is also possible to use the devices completely without the help of a PLC and control them via IIoT protocols.

Attention: When using the IIoT functionality, a protected local network environment without direct access to the Internet is recommended.

10.1 MQTT

MQTT functions are **only** applicable for the following LioN-X variants:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

The MQTT (Message Queuing Telemetry Transport) protocol is an open network protocol for machine-to-machine communication, which provides the transmission of telemetric data messages between devices. The integrated MQTT client allows the device to publish a specific set of information to an MQTT broker.

The publishing of messages can either occur periodically or be triggered manually.

10.1.1 MQTT configuration

In **delivery state**, MQTT functions are **disabled**. The MQTT client can be configured either using the Web interface or directly via a JSON object sent in an HTTP/HTTPS request. For more information see chapter MQTT configuration - Quick start guide on page 117.

The configuration URL is:

`http://[ip-address]/w/config/mqtt.json`

The configuration can also read back as a JSON file:

`http://[ip-address]/r/config/mqtt.json`

The configuration is a JSON object. Each JSON member is a configuration element. The object must not contain all elements. Only the provided elements will be changed. The configuration changes apply only after a device restart.

The following configuration elements are available (default values in bold):

Element	Data type	Description	Example data
mqtt-enable	boolean	Master switch for the MQTT client.	true / **false**
broker	string	IP address of the MQTT Broker	"**192.168.1.1**"
login	string	Username for MQTT Broker	"admin" (Default: **null**)
password	string	Password for MQTT Broker	"private" (Default: **null**)
port	number	Broker port	**1883**
base-topic	string	Base topic	"iomodule_[mac]" (Default: "**lionx**")
will-enable	boolean	If true, the device provides a last will message to the broker	true / **false**
will-topic	string	The topic for the last will message.	(Default: **null**)
auto-publish	boolean	If true, all enabled domains will be published automatically in the specified interval.	**true** / false
publish-interval	number	The publish interval in ms if auto-publish is enabled. Minimum is 250 ms.	**2000**
publish-identity	boolean	If true, all identity domain data will be published	**true** / false
publish-config	boolean	If true, all config domain data will be published	**true** / false
publish-status	boolean	If true, all status domain data will be published	**true** / false
publish-process	boolean	If true, all process domain data will be published	**true** / false
publish-devices	boolean	If true, all IO-Link Device domain data will be published	true / **false**
commands-allowed	boolean	Master switch for MQTT commands. If false, the device will not subscribe to any command topic, even if specific command topics are activated below.	true / **false**
force-allowed	boolean	If true, the device accepts force commands via MQTT.	true / **false**
reset-allowed	boolean	If true, the device accepts restart and factory reset commands via MQTT.	true / **false**
config-allowed	boolean	If true, the device accepts configuration changes via MQTT.	true / **false**

Element	Data type	Description	Example data
qos	number	Selects the "Quality of Service" status for all published messages.	**0 = At most once** 1 = At least once 2 = Exactly once

Table 13: MQTT configuration

MQTT response:

The resulting response is a JSON object with a "status" field. Status should be "0" if no error occurred and "-1" if there is an error.

In case of an error, the response contains an error array.

The error array contains an error object for each error occurred. The object consists of a field "Element" which names the config element which caused the error, and a field "Message" for the error message.

- A malformed JSON object produces an error.
- Not existing parameters produce an error.
- Parameters with a wrong data type produce an error.

It is not allowed to write all available parameters at once. You may write only one or a limited number of parameters.

Examples:

```
{"status": -1, "error": [{"Element": "publish-interval", "Message": "Integer
 expected"}]}

{"status": 0}

{"status": -1, "error": [{"Element": "root", "Message": "Not a JSON
 object"}]}
```

For more information see chapter MQTT topics on page 105.

10.1.2 MQTT topics

MQTT mainly relates to topics. All messages are attached to a topic which adds context to the message itself. Topics may consist of any string and they are allowed to contain slashes (`/`) as well as wildcard symbols (`*, #`).

10.1.2.1 Base topic

For all LioN-X variants there is a configurable Base topic which is the prefix for all topics. The Base topic can be chosen freely by the user. The Base topic can also contain selected variables as shown in Table 14: Base topic variables on page 105.

Variables in the Base topic have to be written in brackets ("[ ]"). The following variables are possible:

Variable	Description
mac	The MAC address of the device
name	The name of the device
order	The ordering number of the device
serial	The serial number of the device

Table 14: Base topic variables

Example:

The Base topic `"io_[mac]"` translates to `"io_A3B6F3F0F2F1"`.

All data is organized in domains. The domain name is the first level in the topic after the Base topic. Note the following notation:

`Base-Topic/domain/….`

There are the following domains:

Domain name	Definition	Example content
identity	All fixed data which is defined by the used hardware and which cannot be changed by configuration or at runtime.	Device name, ordering number, MAC address, port types, port capabilites and more.
config	Configuration data which is commonly loaded once at startup, mostly by a PLC.	IP address, port modes, input logic, failsafe values and more.
status	All (non-process) data which changes quite often in normal operation.	Bus state, diagnostic information, IO-Link Device status and data.
process	All process data which is produced and consumed by the device itself or by attached devices.	Digital inputs, digital outputs, cyclic IO-Link data.
iold	IO-Link Device parameters according to the IO-Link specification.	Vendor name, product name, serial number, hardware revision, software revision and more.

Table 15: Data domains

There is often one topic used for all gateway related information and topics for each port. All identity topics are published just once at start-up, because this information should never change. All other topics are published either in a fixed interval or just triggered manually, according to the configuration.

Topic	Content examples	Total publish count	Publish interval
[base-topic]/identity/gateway	Name, ordering number, MAC, vendor, I&M etc.	1	Startup
[base-topic]/identity/port/n	Port name, port type	8	Startup
[base-topic]/config/gateway	Configuration parameters, ip address etc.	1	Interval
[base-topic]/config/port/n	Port mode, data storage, mapping, direction	8	Interval
[base-topic]/status/gateway	Bus state, device diagnosis, master events	1	Interval
[base-topic]/status/port/n	Port or channel diagnosis, IO-Link state, IO-Link Device events	8	Interval
[base-topic]/process/gateway	All Digital IN/OUT	1	Interval
[base-topic]/process/port/n	Digital IN/OUT per port, IOL-data, pdValid	8	Interval
[base-topic]/iold/port/n	IO-Link Device parameter	8	Interval

Table 16: Data model

An MQTT client which wants to subscribe to one or more of these topics can also use wildcards.

Full topic	Description
[base-topic]/identity/gateway	Receive only indentity objects for the gateway
[base-topic]/identity/#	Receive all data related to the identity domain
[base-topic]/status/port/5	Receive only status information for port number 5
[base-topic]/+/port/2	Receive information of all domains for port number 2
[base-topic]/process/port/#	Receive only process data for all ports
[base-topic]/config/#	Receive config data for the gateway and all ports.

Table 17: Use case examples

10.1.2.2 Publish topic

Overview of all publish JSON data for the defined topics:

Key	Data type
product_name	json_string
ordering_number	json_string
device_type	json_string
serial_number	json_string
mac_address	json_string
production_date	json_string
fw_name	json_string
fw_date	json_string
fw_version	json_string
hw_version	json_string
vendor_name	json_string
vendor_address	json_string
vendor_phone	json_string
vendor_email	json_string
vendor_techn_support	json_string
vendor_url	json_string
vendor_id	json_integer
device_id	json_integer

Table 18: Identity/gateway

Key	Data type	Range	Default value	Remarks
fieldbus_protocol	json_string	PROFINET, EtherNet/IP, EtherCAT®		
ip_address	json_string		192.168.1.1	
subnet_mask	json_string		255.255.255.0	
report_alarms	json_boolean		0.0.0.0	
report_ul_alarm	json_boolean	true / false	true	
report_do_fault_without_ul	json_boolean	true / false	false	
force_mode_lock	json_boolean	true / false	false	
web_interface_lock	json_boolean	true / false	false	
do_auto_restart	json_boolean	true / false	true	
fast_startup	json_boolean	true / false	false	PROFINET and EIP only

Table 19: Config/gateway

Key	Data type	Range	Default value	Remarks
protocol	json_string	wait_for_io_system wait_for_io_Connection failsafe connected error		
ethernet_port1	json_string	100_mbit/s_full 100_mbit/s 10_mbit/s_full 100_mbit/s		
ethernet_port2	json_string	100_mbit/s_full 100_mbit/s 10_mbit/s_full 100_mbit/s		
module_restarts	json_integer	0 .. 4294967295		
channel_diagnosis	json_boolean	true / false		
failsafe_active	json_boolean	true / false		
system_voltage_fault	json_boolean	true / false		
actuator_voltage_fault	json_boolean	true / false		
internal_module_error	json_boolean	true / false		
simulation_active_diag	json_boolean	true / false		
us_voltage	json_integer	0 .. 32		in Volts
ul_voltage	json_integer	0 .. 32		in Volts
forcemode_enabled	json_boolean	true / false		

Table 20: Status/gateway

Key	Data type	Range	Default value	Remarks
Input_data	json_integer[]			
output_data	json_integer[]			

Table 21: Process/gateway

Key	Data type	Range	Default value	Remarks
port	json_integer	1 .. 8		
type	json_string	digital_universal digital_input digital_Output io_link		
max_output_power_cha	json_string	2.0_mA 0.5_mA		
max_output_power_chb	json_string	2.0_mA 0.5_mA		
channel_cha	json_string	input/output input output io_link aux		
channel_chb	json_string	input/output input output io_link aux		

Table 22: Identity/port/1 .. 8

Key	Data type	Range	Default value	Remarks
port	json_integer	1 .. 8		
direction_cha	json_string	input/output input output		
restart_mode_cha	json_string	Manual Auto		
restart_mode_chb	json_string	Manual Auto		
input_polarity_cha	json_string	NO NC		
input_polarity_chb	json_string	NO NC		
input_filter_cha	json_integer			ms
input_filter_chb	json_integer			ms
do_auto_restart_cha	json_boolean	true / false		
do_auto_restart_chb	json_boolean	true / false		

Table 23: Config/port/1 .. 8

Key	Data type	Range	Default value	Remarks
port	json_integer	1 .. 8		
physical_state_cha	json_integer	0 .. 1		
physical_state_chb	json_integer	0 .. 1		
actuator_short_circuit_cha	json_boolean	true / false		
actuator_short_circuit_chb	json_boolean	true / false		
sensor_short_circuit	json_boolean	true / false		
current_cha	json_integer			mA
current_chb	json_integer			mA
current_pin1	json_integer			mA

Table 24: Status/port/1 .. 8

10.1.2.3 Command topic (MQTT Subscribe)

The main purpose of MQTT is to publish data from the device to a broker. This data can then be received by any subscriber who is interested in this data. But also the other way round is possible. The device can subscribe to a topic on the broker and is then able to receive data. This data can contain configuration or forcing data. This allows the user to fully control a device via MQTT only, without using other ways of communication like Web or REST.

If the configuration allows commands in general, the device subscribes to special Command topics on which it can receive commands from other MQTT clients. The Command topic is based upon the Base topic. It always has the following form:

`[base-topic]/command`

After the Command topic, there are fixed topics for different writeable objects. The data format of the MQTT payload is always JSON. It is possible to set only a subset of the possible objects and fields.

[…]/forcing

Use the Command topic `[base-topic]/command/forcing` for *Force object* data. The *Force object* can contain any of the following properties:

Property	Data type	Example values	Remarks
forcemode	boolean	true / false	Forcing Authority: on/off
digital	array (Table 26: Force object: Digital on page 114)		
iol	array (Table 27: Force object: IOL (IO-Link devices only) on page 114)		

Table 25: Force object properties

For the *Force object* properties `digital` and `iol`, there are several value specifications arrayed:

Property	Data type	Example values	Remarks
port	integer	1, 2, 5	
channel	string	"a", "b"	
force_dir	string	"out", "in", "clear"	
force_value	integer	0, 1	

Table 26: Force object: Digital

Property	Data type	Example values	Remarks
port	integer	0, 1, 5	
output	array[integer]	[55, 88, 120]	
input	array[integer]		Input-Simulation

Table 27: Force object: IOL (IO-Link devices only)

[…]/config

Use the Command topic `[base-topic]/command/config` for *Config object* data. The *Config object* can contain any of the following properties:

Property	Data type	Example values	Remarks
portmode	array (Table 29: Config object: Portmode on page 115)		
ip_address	string	"192.168.1.5"	
subnet_mask	string	"255.255.255.0"	
gateway	string	"192.168.1.100"	

Table 28: Config object properties

For the *Conig object* property `portmode`, there are several value specifications arrayed:

Property	Data type	Example values	Remarks
port	integer	2	
channelA*	string	"dio", "di", "do", "iol", "off"	
channelB*	string	"dio", "di", "do", "iol", "off", "aux"	
inlogicA	string	"no", "nc"	
inlogicB	string	"no", "nc"	
filterA	integer	3	input filter in ms
filterB	integer	3	input filter in ms
autorestartA	boolean		
autorestartB	boolean		
iolValidation	integer	0 = NoCheck 1 = Type 1.0 2 = Type 1.1 3 = Type 1.1 BR 4 = Type 1.1 RES	
iolDeviceID	integer		for validation
iolVendorID	integer		for validation

Table 29: Config object: Portmode

*channelA = Pin 4, channelB = Pin 2

[…]/reset

Use the Command topic `[base-topic]/command/reset` for *Reset object* data about restart and factory reset issues. The *Reset object* can contain any of the following properties:

Property	Data type	Example values	Remarks
factory_reset	boolean	true / false	
system_reset	boolean	true / false	

Table 30: Reset object properties

[…]/publish

Use the Command topic `[base-topic]/command/publish` for *Publish object* data.

Trigger publish of all topics manually (can be used when auto publish is off or long interval is set).

10.1.3 MQTT configuration - Quick start guide

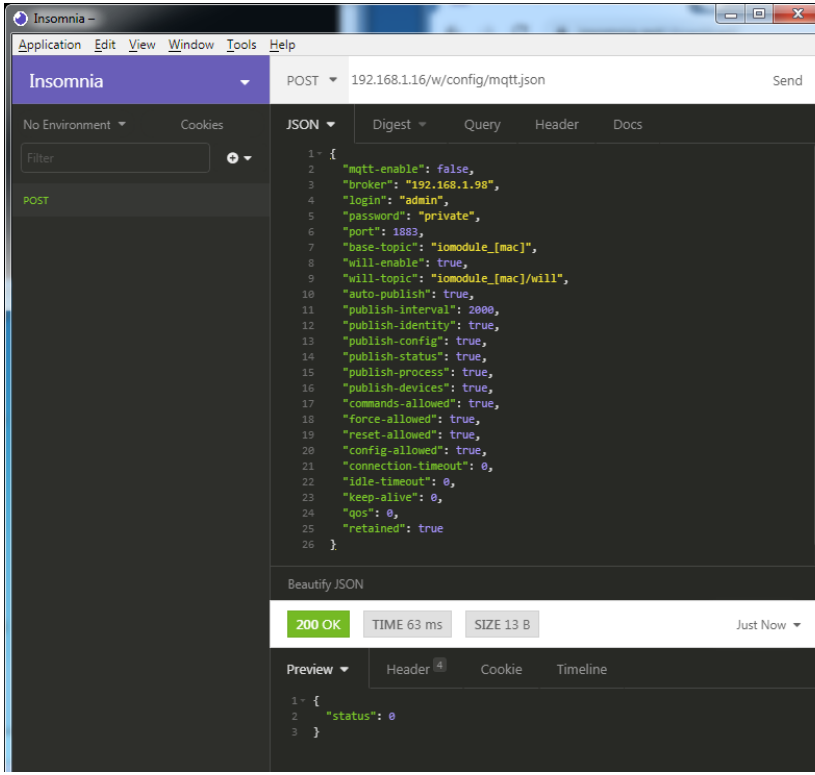
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

10.1.3.1 MQTT configuration via JSON

1. Depending on your application case, download and install *Insomnia* or a comparable application: https://insomnia.rest/download/

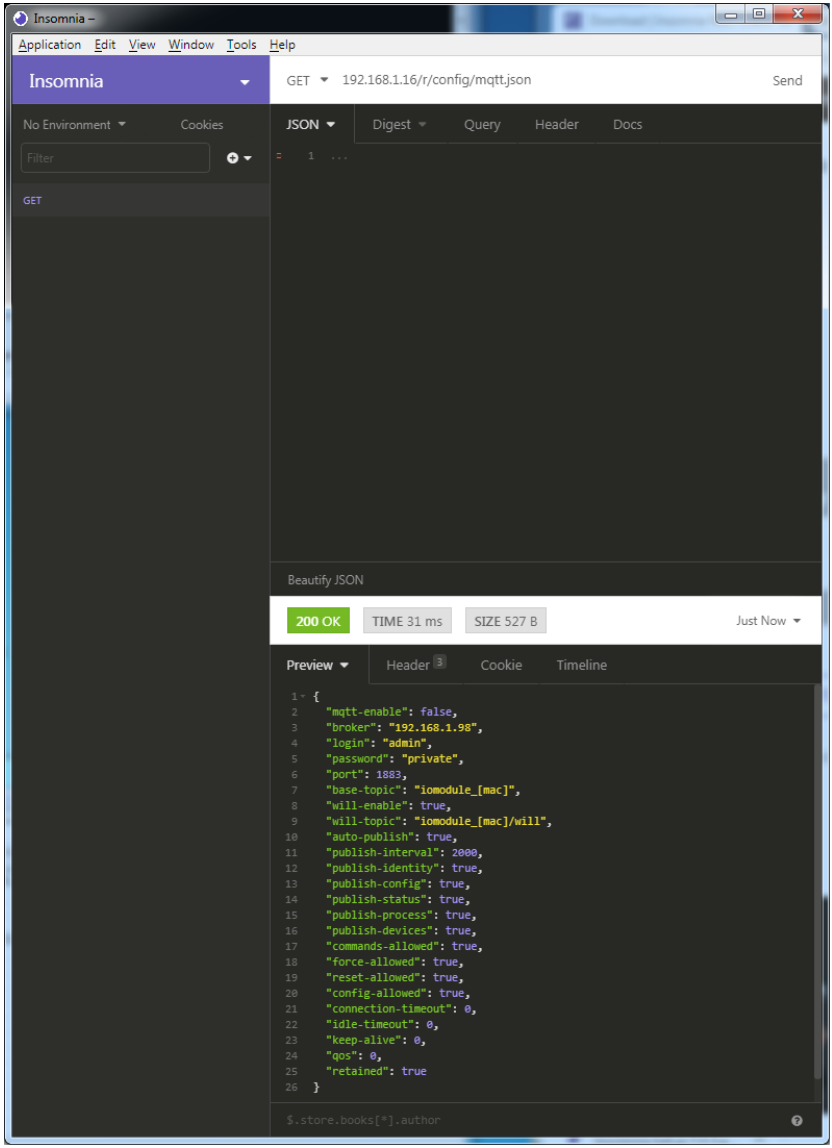
2. Configure MQTT:

POST: `[IP-address]/w/config/mqtt.json`



3. Read MQTT:

GET: `[IP-address]/r/config/mqtt.json`



10.2 OPC UA

OPC UA functions are **only** applicable for the following LioN-X variants:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

OPC Unified Architecture (OPC UA) is a platform-independent standard with a service-oriented architecture for communication in and with industrial automation systems.

The OPC UA standard is based on the client-server principle and lets machines and devices, regardless of any preferred field bus, communicate horizontally among each other as well as vertically to the ERP system or the cloud. LioN-X provides an OPC UA server on field device level, with which an OPC UA client can connect for information exchange secure in transmission.

For OPC UA, we comply (apart from the exceptions listed below) with the IO-Link Companion Specification, which can be downloaded from catalog.belden.com or directly from io-link.com.

Feature	Support
Managing IODDs (chapter 6.1.6 in the specification)	Not supported
Mapping IODD information to OPC UA ObjectTypes (chapter 6.3 in the specification)	Not supported
IOLinkIODDDeviceType (chapters 7.2 ff. in the specification)	Not supported
ObjectTypes generated based on IODDs (chapters 7.3 ff. in the specification)	Not supported
Creation of Instances based on ObjectTypes generated out of IODDs (chapter 7.4 in the specification)	Not supported
IODDManagement Object (chapter 8.2 in the specification)	Not supported
RemoveIODD Method (chapter 8.3 in the specification)	Not supported

Table 31: Non-supported OPC UA features according to the IO-Link Companion Specification

10.2.1 OPC UA configuration

In **delivery state**, OPC UA functions are **disabled**. The OPC UA Server can be configured either using the Web interface or directly via a JSON Object sent in an HTTP/HTTPS request. For more information see OPC UA configuration - Quick start guide on page 123.

The configuration URL is:

`http://[ip-address]/w/config/opcua.json`

The configuration can also read back as a JSON file:

`http://[ip-address]/r/config/opcua.json`

The configuration is a JSON object. Each JSON member is a configuration element. The object must not contain all elements. Only the provided elements will be changed. All configuration changed applies only after a device restart.

There are the following configuration elements (default values in bold):

Element	Data type	Description	Example data
port	integer	Server port for the OPC UA server.	0, **4840**, 0xFFFF
opcua-enable	boolean	Master switch for the OPC UA server.	true / **false**
anon-allowed	boolean	If true, anonymous login is allowed.	**true** / false
commands-allowed	boolean	Master switch for OPC UA commands. If false there will be no writeable OPC UA objects.	true / **false**
force-allowed	boolean	If true, the device accepts force commands via OPC UA.	true / **false**
reset-allowed	boolean	If true, the device accepts restart and factory reset commands via OPC UA.	true / **false**
config-allowed	boolean	If true, the device accepts configuration changes via OPC UA.	true / **false**

Table 32: OPC UA Configuration

All configuration elements are optional and do not need a specific order. Not every element is required to be sent. This means that only configuration changes will be taken over.

Optional: The configuration parameters of OPC UA can be set directly via the Web interface. It is possible to download the Web interface for sharing with other devices.

Response:

The resulting response is a JSON object with a status field. Status should be "0" if no error occurred and "-1" if there is an error.

In case of an error, the response contains an error array.

The error array contains an error object for each error occurred. The object consists of a field "Element" which names the config element which caused the error, and a field "Message" for the error message.

Examples:

```
{"status": -1, "error": [{"Element": "upcua-enable", "Message": "Boolean
 expected"}]}

{"status": 0}

{"status": -1, "error": [{"Element": "root", "Message": "Not a JSON
 object"}]}
```

10.2.2 OPC UA address space

OPC UA provides different services on the LioN-X devices with which a client can navigate through the hierarchy of the address space and read or write variables. In addition, the client can monitor up to 10 attributes from the address space for value changes.

A connection to an OPC UA server is established via the endpoint URL:

```
opc.tcp://[ip-address]:[port]
```

Various device data such as MAC address, device settings, diagnostics or status information can be read via *Identity objects*, *Config objects*, *Status objects* and *Process objects*.

Command objects can be read and written. This makes it possible, for example, to transfer new network parameters to the device, to use Force Mode or to reset the entire device to its factory settings.

The following figures illustrate the OPC UA address space of the LioN-X devices. The objects and information displayed depend on the device variant used.

10.2.3 OPC UA configuration - Quick start guide

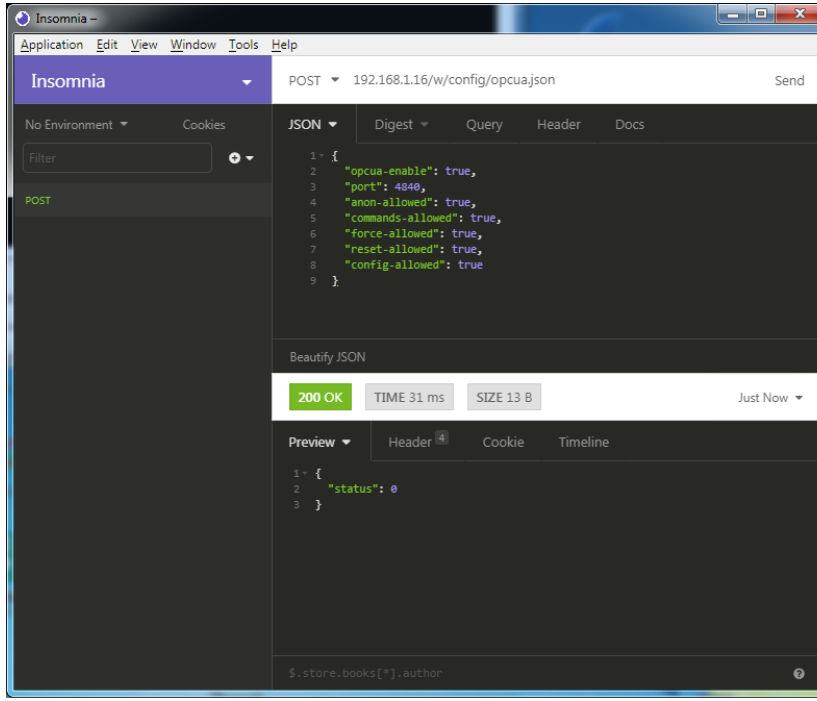
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

10.2.3.1 OPC UA configuration via JSON

1. Depending on your application case, download and install *Insomnia* or a comparable application: https://insomnia.rest/download/

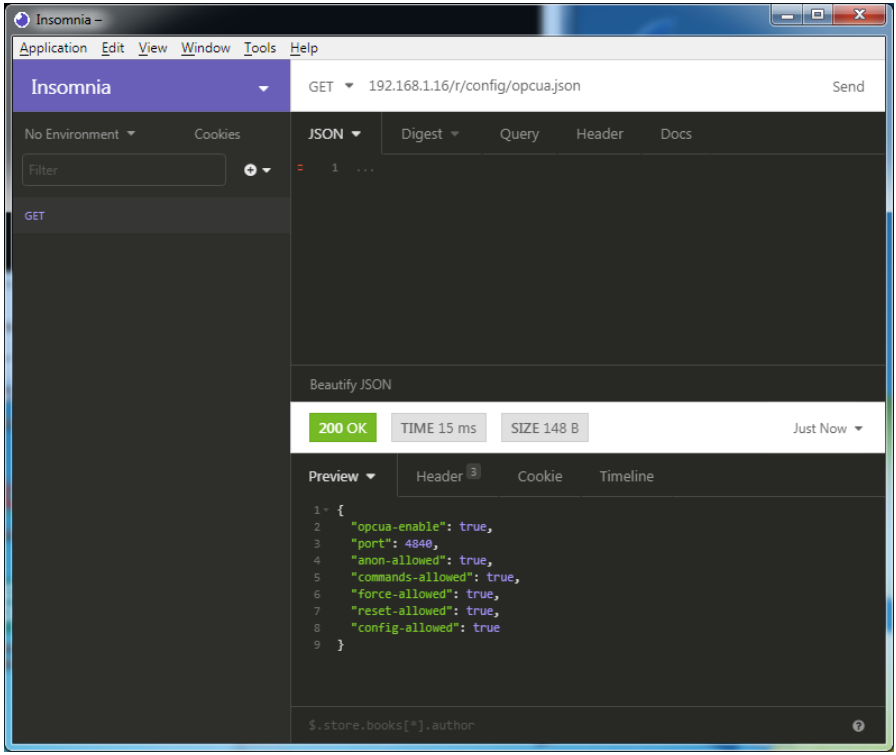
2. Configure OPC UA:

POST: `[IP-address]/w/config/opcua.json`



3. Read OPC UA:

GET: `[IP-address]/r/config/opcua.json`



10.3 REST API

The Representational State Transfer – Application Programming Interface (REST API) is a programmable interface which uses HTTP/HTTPS requests to GET and POST data. This enables the access to detailed device information.

For all LioN-X variants, the REST API can be used to read the device status. For the LioN-X multiprotocol variants, the REST API can also be used to write configuration and forcing data.

There are two different REST API standards you can use for the requests:

1. A standardized REST API that has been specified by the IO-Link Community and is described separately:

   `JSON_Integration_10222_V100_Mar20.pdf`

   Please download the file from catalog.belden.com or directly from io-link.com.

   Attention: Consider the following table to get an overview of the supported features of the IO-Link specification:

Feature		Supported
Gateway	GET /identification	Yes
	GET /capabilities	Yes
	GET /configuration	Yes
	POST /configuration	Yes
	POST /reset	Yes
	POST /reboot	Yes
	GET /events	Yes
Master	GET /masters	Yes
	GET /capabilities	Yes
	GET /identification	Yes
	POST /identification	Yes

Feature		Supported
Port	GET /ports	Yes
	GET /capabilities	Yes
	GET /status	Yes
	GET /configuration	Yes
	POST /configuration	Yes
	GET /datastorage	Yes
	POST /datastorage	Yes
Devices	GET /devices	Yes
	GET /capabilities	Yes
	GET /identification	Yes
	POST /identification	Yes
	GET /processdata/value	Yes
	GET /processdata/getdata/value	Yes
	GET /processdata/setdata/value	Yes
	POST /processdata/value	Yes
	GET /parameters	Not supported
	GET /parameters/{index}/subindices	Not supported
	GET /parameters/{parameterName}/subindices	Not supported
	GET /parameters/{index}/value	Not supported
	GET /parameters/{index}/subindices/{subindex}/value	Not supported
	GET /parameters/{parameterName}/value	Not supported
	GET /parameters/{parameterName}/subindices/{subParameterName}/value	Not supported
	POST /parameters/{index}/value	Not supported
	POST /parameters/{parameterName}/value	Not supported
	POST /parameters/{index}/subindices/{subindex}/value	Not supported
	POST /parameters/{parameterName}/subindices/{subParameterName}/value	Not supported
	POST /blockparametrization	Yes
	GET /events	Yes

Feature		Supported
IODD	GET /iodds	Not supported
	POST /iodds/file	Not supported
	DELETE /iodds	Not supported
	GET /iodds/file	Not supported

Table 33: Support of REST API features according to the IO-Link specification

2. A customized Belden REST API that is described in the following chapters.

10.3.1 Standard device information

Request method:	http GET
Request URL:	`<ip>/info.json`
Parameters	n.a.
Response format	JSON

The goal of the "Standard device information" request is to get a complete snapshot of the current device status. The format is JSON. For IO-Link devices, all ports with connected IO-Link device information are included.

10.3.2 Structure

Name	Data type	Description	Example
name	string	Device name	"0980 XSL 3912-121-007D-00F"
order-id	string	Ordering number	"935 700 001"
fw-version	string	Firmware version	"V.1.1.0.0 - 01.01.2021"
hw-version	string	Hardware version	"V.1.00"
mac	string	MAC address of the device	"3C B9 A6 F3 F6 05"
bus	number	0 = No connection 1 = Connection with PLC	1
failsafe	number	0 = Normal operation 1 = Outputs are in failsafe	0
ip	string	IP address of the device	
snMask	string	Subnet Mask	
gw	string	Default gateway	
rotarys	array of numbers (3)	Current position of the rotary switches: Array element 0 = x1 Array element 1 = x10 Array element 2 = x100	
ulPresent	boolean	True, if there is a UL voltage supply detected within valid range	
usVoltage_mv	number	US voltage supply in mV	
ulVoltage_mv	number	UL voltage supply in mV (only available for devices with UL supply)	
inputs	array of numbers (2)	Real state of digital inputs. **Element 0 = 1 Byte:** Port X1 Channel A to Port X4 Channel B **Element 0 = 1 Byte:** Port X5 Channel A to Port X8 Channel B	\[128,3\]
output	array of numbers (2)	Real State of digital outputs. **Element 0 =1 Byte:** Port X1 Channel A to port X4 Channel B **Element 0 = 1 Byte:** Port X5 Channel A to port X8 Channel B	\[55,8\]

Name	Data type	Description		Example
consuming	array of numbers (2)	Cyclic data from PLC to device		
producing	array of numbers (2)	Cyclic data from device to PLC		
diag	array of numbers (4)	Diagnostic information	**Element 0 = 1 Byte:** Bit 7: Internal module error (IME) Bit 6: Forcemode active Bit 3: Actuator short Bit 2: Sensor short Bit 1: U_L fault Bit 0: U_S fault	
			Element 1 = 1 Byte: Sensor short circuit ports X1 .. X8.	
			Element 2 =1 Byte: Actuator short circuit ports X1 Channel A to X4 Channel B	
			Element 3 = 1 Byte: Actuator short circuit ports X5 Channel A to X8 Channel B	
fieldbus	FIELDBUS Object			
FIELDBUS Object				
fieldbus_name	string	Currently used fieldbus		
state	number	Fieldbus state		
state_text	number	Textual representation of fieldbus state: 0 = Unknown 1 = Bus disconnected 2 = Preop 3 = Connected 4 = Error 5 = Stateless		
forcing	FORCING Object	Information about the forcing state of the device		
channels	Array of CHANNEL (16)	Basic information about all input/output channels		

Name	Data type	Description	Example
iol	IOL Object	Contains all IO-Link related information such as events, port states, device parameters.	
iol/diagGateway	array of DIAG	Array of currently active device/ gateway related events	
iol/diagMaster	array of DIAG	Array of currently active IOL-Master related events	
iol/ports	array of PORT (8)	Contains one element for each IO-Link port	
CHANNEL Object			
name	string	Name of channel	
type	number	Hardware channel type as number: 0 = DIO 1 = Input 2 = Output 3 = Input/Output 4 = IO-Link 5 = IOL AUX 6 = IOL AUX with DO 7 = IOL AUX with DO. Can be deactivated. 8 = Channel not available	
type_text	string	Textual representation of the channel type	
config	number	Current configuration of the channel: 0 = DIO 1 = Input 2 = Output 3 = IO-Link 4 = Deactivated 5 = IOL AUX	
config_text	string	Textual representation of the current config	
inputState	boolean	Input data (producing data) bit to the PLC	
outputState	boolean	Output data bit to the physical output pin	

Name	Data type	Description	Example
forced	boolean	True, if the output pin of this channel is forced	
simulated	boolean	True, if the input value to the PLC of this channel is simulated	
actuatorDiag	boolean	True, if the output is in short circuit / overload condition	
sensorDiag	boolean	True, if the sensor supply (Pin 1) is in short circuit / overload condition	
maxOutputCurrent_mA	number	Maximum output current of the output in mA	
current_mA	number	Measured current of the output in mA (if current measurement is available)	
voltage_mV	number	Measured voltage of this output in mV (if voltage measurement is available)	
PORT Object			
port_type	string	Textual representation of the IO-Link port type	
iolink_mode	number	**Current port mode:** 0 = Inactive 1 = Digital output 2= Digital input 3 = SIO 4 = IO-Link	
iolink_text	string	Textual representation of the current port mode	"Digital Input"
aux_mode	number	Indicates the configured mode for the Pin 2: 0 = No AUX 1 = AUX output (always on) 2 = Digital output (can be controlled by cyclic data) 3 = Digital input	
aux_text	string	Textual representation of the current aux mode	"AUX Output"
cq_mode	number	Port mode according to IOL specification	
iq_mode	number	Pin2 mode according to IOL specification	

Name	Data type	Description	Example
port_status	number	Port status according to IOL specification	
ds_fault	number	Data storage error number	
ds_fault_text	string	Textual data storage error.	
device	DEVICE Object	IO-Link device parameters. → Null if no IO-Link communication active	
diag	array of DIAG (n)	Array of port related events	
DIAG Object			
error	number	Error code	
source	string	Source of the current error.	"device" "master"
eventcode	number	Event code according to IO-Link specification	
eventqualifier	number	Event qualifier according to IO-Link specification	
message	string	Error message	"Supply Voltage fault"
DEVICE Object		Standard parameters of the IOL-Device	
device_id	number		
vendor_id	number		
serial	string		
baudrate	string	Baudrate (COM1,2,3)	
cycle_time	number	Cycle time in microseconds	
input_len	array of numbers (n)	IOL input length in bytes	
output_len	array of numbers (n)	IOL output length in bytes	
input_data	array of numbers (n)	IOL input data	
output_data	array of numbers (n)	IOL output data	
pd_valid	number	"1", if IOL input data is valid	
pdout_valid	number	"1", if IOL output data is valid	
FORCING Object		Forcing information of the device	
forcingActive	boolean	Force mode is currently active	

Name	Data type	Description	Example
forcingPossible	boolean	True, if forcing is possible and force mode can be activated	
ownForcing	boolean	True, if forcing is performed by REST API at the moment	
forcingClient	string	Current forcing client identifier	
digitalOutForced	array of numbers (2)	The force values of all 16 digital output channels.	
digitalOutMask	array of numbers (2)	The forcing mask of all 16 digital output channels.	
digitalInForced	array of numbers (2)	The force values of all 16 digital input channels.	
digitalInMask	array of numbers (2)	The forcing mask of all 16 digital input channels.	

10.3.3 Configuration and forcing

Method: POST

URL: `<ip>/w/force.json`

Parameters: None

Post-Body: JSON Object

Property	Data type	Example values	Description
forcemode	boolean	true / false	Forcing authority on/off
portmode	array (Port mode object)		
digital	array (Digital object)		
iol	array (IOL object)		

Table 34: Root object

Property	Data type	Example values	Remarks
port	integer	0..7	
channel	integer	"a","b"	optional default is "a"
direction	string	"dio","di","do","iol", "off", "aux"	
aux	string	"dio","di","do","iol", "off", "aux"	IOL only, but optional
inlogica	string	"no","nc"	
inlogicb	string	"no","nc"	

Table 35: Port mode object

Property	Data type	Example values	Remarks
port	integer	0..7	
channel	string	"a","b"	
force_dir	string	"phys_out","plc_in","clear"	optional default is "phys_out"
force_value	integer	0,1	

Table 36: Digital object

Property	Data type	Example values	Remarks
port	integer	0..7	
output	array[integer] or null to clear forcing	[55,88,120]	Output forcing
input	array[integer] or null to clear forcing	[20,0,88]	Input simulation to PLC

Table 37: IOL object

10.3.4 Reading and writing ISDU parameters

The *Indexed Service Data Unit* (ISDU) provides a highly flexible message format, which can contain single or multiple commands.

LioN-X IOL-Masters with IIoT support reading and writing ISDU parameters from connected IOL-Devices. It is possible to do this as a bulk transfer by reading and writing of multiple ISDU parameters via a single request.

10.3.4.1 Reading ISDU

Method: POST

URL: `<ip>/r/isdu.json`

Parameters: port (0-7)

Example:

```
192.168.1.20/r/isdu.json?port=5
```

Post-Body: JSON array of read ISDU object

Property	Data type	Example values	Remarks
ix	integer	0-INT16	Index to be read
subix	integer	0-INT8	Subindex to be read

Table 38: Read ISDU object

Property	Data type	Example values	Remarks
status	integer	0, -1	0 = no error, -1= an error occured
message	string		Error Message if error occured
data	array (Read ISDU data object)		data, if no error occured. otherweise null

Table 39: Read ISDU response object

Property	Data type	Example values	Remarks
ix	integer	0-INT16	Index that was read
subix	integer	0-INT8	Subindex that was read
status	integer	0, -1	0 = no error, -1= an error occured
eventcode	integer		IOL eventcode if status is -1
data	array[integer]		data, if no error occured. otherweise null

Table 40: Read ISDU data object

10.3.4.2 Writing ISDU

Method:	POST
URL:	`<ip>/w/isdu.json`
Parameters:	port (0-7)
Post-Body:	JSON array of write ISDU object

Property	Data type	Example values	Remarks
ix	integer	0-INT16	Index to be read
subix	integer	0-INT8	Subindex to be read
data	array[integer]		Data to be written

Table 41: Write ISDU object

Response: Write ISDU response object

Property	Data type	Example values	Remarks
status	integer	0, -1	0 = no error, -1= an error occured
message	string		Error Message if error occured
data	array (Write ISDU data object)		data, if no error occured. otherweise null

Table 42: Write ISDU response object

Property	Data type	Example values	Remarks
ix	integer	0-INT16	Index that was written
subix	integer	0-INT8	Subindex that was written
status	integer	0, -1	0 = no error, -1= an error occured
eventcode	integer		IOL eventcode if status is -1

Table 43: Write ISDU data object

Attention: For LioN-X device variants with HTTPS feature, https:// must be used in front of <ip> for every REST API.

10.3.5 Example: Reading ISDU

ISDU read request

```
[
 {"ix":5,"subix":0},
 {"ix":18,"subix":0},
 {"ix":19,"subix":0},
 {"ix":20,"subix":0}
]
```

Response

```
{
 "message":"OK",
 "data":
[
 {"ix":5,"subix":0,"status":-1,"eventcode":32785},
 {"ix":18,"subix":0,"data":[79,68,83,49,48,76,49,46,56,47,76,65,54,44,50,
        48,48,45,77,49,50],"status":0},
 {"ix":19,"subix":0,"data":[53,48,49,50,57,53,51,53],"status":0},
 {"ix":20,"subix":0,"data":[100,105,115,116,97,110,99,101,32,115,101,110,
        115,111,114],"status":0}
],
"status":0}
```

10.3.6 Example: Writing ISDU

ISDU write request

```
[
 {"ix":24,"subix":0,"data":[97,98,99,100,101,102]},
 {"ix":9,"subix":0,"data":[97,97,97,97,97,98]}
]
```

Response

```
{
 "message":"OK",
 "data":[
 {"ix":24,"subix":0,"status":0},
 {"ix":9,"subix":0,"eventcode":32785,"status":-1}
],
"status":0}
```

10.4 CoAP server

The CoAP server functions are **only** applicable for the following LioN-X variants:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

The **Co**nstrained **A**pplication **P**rotocol (CoAP) is a specialized Internet application protocol for constrained networks such as lossy or low power networks. CoAP is useful especially in M2M (Machine to Machine) communication and can be used to translate simplified HTTP/HTTPS requests of low speed networks.

CoAP is based on the Server-Client principle and a service layer protocol that lets nodes and machines communicate with each other. The LioN-X multiprotocol variants provide CoAP server functionalities via a REST API interface over UDP.

10.4.1 CoAP configuration

In delivery state, CoAP functions are *disabled*. The CoAP server can be configured either using the Web interface or directly via a JSON object sent in an HTTP/HTTPS request. For more information see chapter CoAP configuration - Quick start guide on page 145.

The configuration URL is:

`http://[ip-address]/w/config/coapd.json`

The configuration can also read back as a JSON file:

`http://[ip-address]/r/config/coapd.json`

The configuration is a JSON object. Each JSON member is a configuration element. The object must not contain all elements. Only the provided elements will be changed. The configuration changes apply only after a device restart.

The following configuration elements are available (default values in bold):

Element	Data type	Description	Example data
enable	boolean	Master switch for the CoAP server	true / **false**
port	integer (0 to 65535)	Port of the CoAP server	**5683**

Table 44: CoAP configuration

CoAP response:

The resulting response is a JSON object with a "status" field. Status should be "0" if no error occurred, and "-1" if there is an error.

In case of an error, the response contains an error array.

The error array contains an error object for each error occurred. The object consists of a field "Element" which names the config element that caused the error, and of a field "Message" for the error message.

Examples:

```
{"status": -1, "error": [{"Element": "upcua-enable", "Message": "Boolean
 expected"}]}

{"status": 0}

{"status": -1, "error": [{"Element": "root", "Message": "Not a JSON
 object"}]}
```

10.4.2 REST API access via CoAP

A connection to the CoAP server running on the LioN-X multiprotocol variants can be established via the following URL:

`coap://[ip-address]:[port]/[api]`

For LioN-X, the following REST API Requests (JSON format) can be accessed via a CoAP endpoint:

Type	API	Note
GET	/r/status.lr	
GET	/r/system.lr	
GET	/info.json"	
GET	/r/config/net.json	
GET	/r/config/mqtt.json	
GET	/r/config/opcua.json	
GET	/r/config/coapd.json	
GET	/r/config/syslog.json	
GET	/contact.json	
GET	/fwup_status	
GET	/iolink/v1/gateway/identification	
GET	/iolink/v1/gateway/capabilities	
GET	/iolink/v1/gateway/configuration	
GET	/iolink/v1/gateway/events	
GET	/iolink/v1/masters	
GET	/iolink/v1/masters/1/capabilities	
GET	/iolink/v1/masters/1/identification	
GET	/iolink/v1/masters/1/ports	
GET	/iolink/v1/masters/1/ports/{port_number}/capabilities	This API is available for all 8 ports. {port_number} should be between "1" and "8".
GET	/iolink/v1/masters/1/ports/{port_number}/status	This API is available for all 8 ports. {port_number} should be between "1" and "8".
GET	/iolink/v1/masters/1/ports/{port_number}/configuration	This API is available for all 8 ports. {port_number} should be between "1" and "8".
GET	/iolink/v1/devices/master1port{port_number}/identification	This API is available for all 8 ports. {port_number} should be between "1" and "8".

Type	API	Note
GET	/iolink/v1/devices/master1port{port_number}/capabilities	This API is available for all 8 ports. {port_number} should be between "1" and "8".
GET	/iolink/v1/devices/master1port{port_number}/processdata/getdata/value	This API is available for all 8 ports. {port_number} should be between "1" and "8".
GET	/iolink/v1/devices/master1port{port_number}/events	This API is available for all 8 ports. {port_number} should be between "1" and "8".

Table 45: REST API access via CoAP

10.4.3 CoAP configuration - Quick start guide

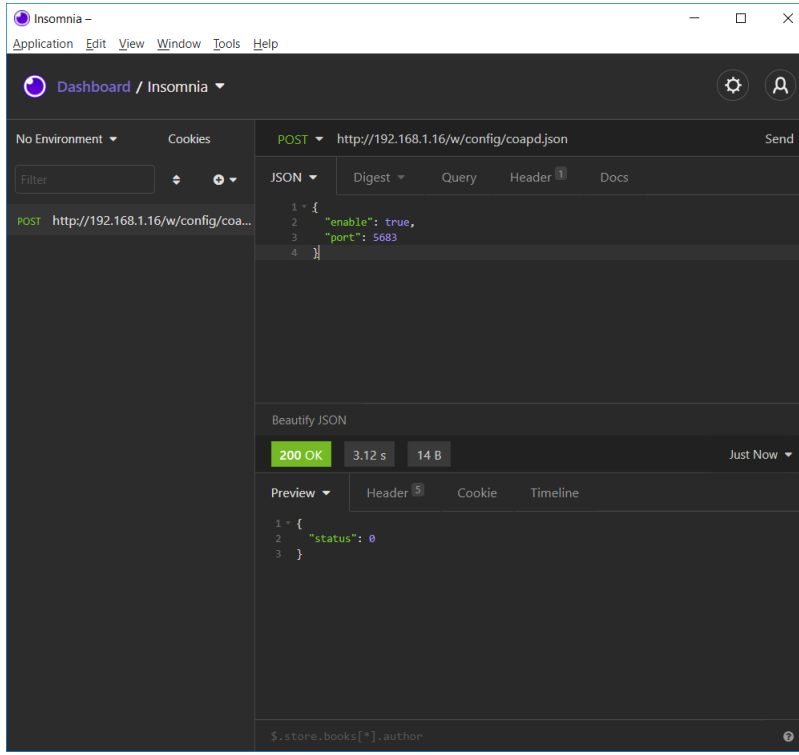
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

10.4.3.1 CoAP configuration via JSON

1. Depending on your application case, download and install *Insomnia* or a comparable application: https://insomnia.rest/download/

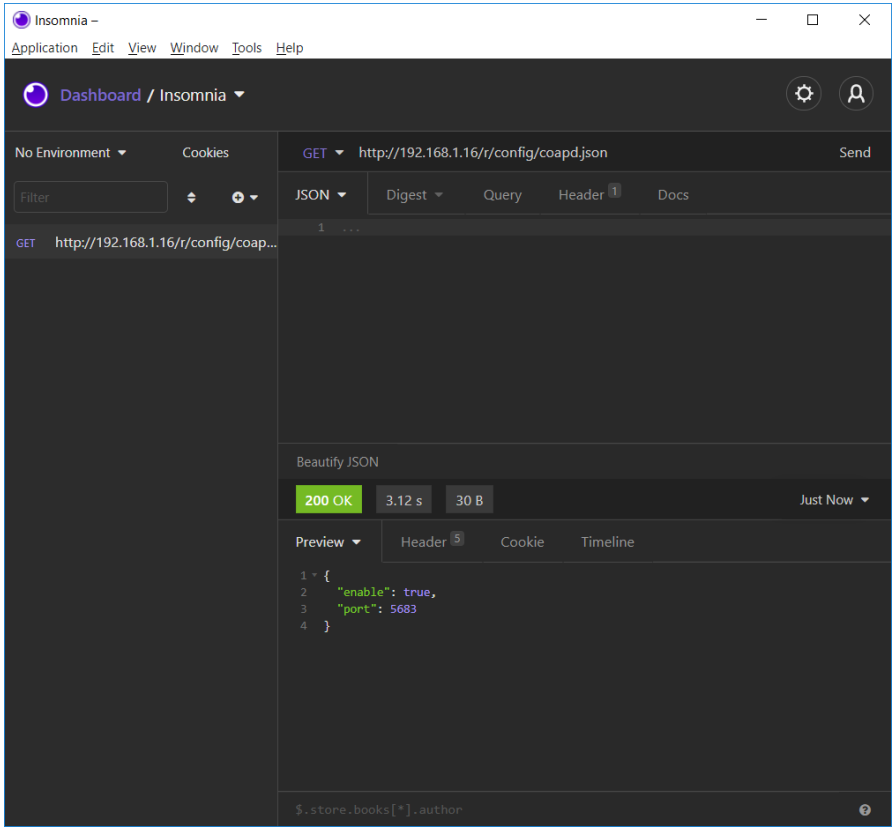
2. Configure CoAP:

POST: `[IP-address]/w/config/coapd.json`



3. Read CoAP configuration:

GET: `[IP-address]/r/config/coapd.json`



10.5 Syslog

Syslog functions are **only** applicable for the following LioN-X variants:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

The LioN-X multiprotocol variants provide a Syslog client which can connect with a configured Syslog server and is able to log messages.

Syslog is a platform-independent standard for logging messages. Each message contains a timestamp as well as information about the severity level and the subsystem. The Syslog protocol RFC5424 is based on the Server-Client principle and lets machines and devices send messages in the network and collect them centrally. (For more details on the used syslog standard, please refer to https://datatracker.ietf.org/doc/html/rfc5424.)

LioN-X supports the storage of 256 messages in a ring buffer which are sent to the configured Syslog server. When the ring is full with 256 messages, the oldest message is always replaced by the newly arriving messages. All messages can be saved on the Syslog server. The Syslog client of the IO-Link Master will not store any message permanently.

10.5.1 Syslog configuration

In **delivery state**, Syslog functions are **disabled**. The Syslog client can be configured either using the Web interface or directly via a JSON object sent in an HTTP/HTTPS request. For more information see chapter Syslog configuration - Quick start guide on page 150.

The configuration URL is:

```
http://[ip-address]/w/config/syslog.json
```

The configuration can also read back as a JSON file:

```
http://[ip-address]/r/config/syslog.json
```

The configuration is a JSON object. Each JSON member is a configuration element. The object must not contain all elements. Only the provided elements will be changed. The configuration changes apply only after a device restart.

The following configuration elements are available (default values in bold):

Element	Data type	Description	Example data
syslog-enable	boolean	Master switch for the Syslog client	true / **false**
global-severity	integer	Severity level of Syslog client 0 – Emergency 1 – Alert 2 – Critical **3 – Error** 4 – Warning 5 – Notice 6 – Info 7 – Debug The client will log all messages of severity according to the setting, including all below levels.	0/1/2/**3**/4/5/6/7
server-address	string (IP address)	IP address of the Syslog server	192.168.0.51 (Default: **null**)
server-port	integer (0 to 65535)	Server port of the Syslog server	**514**
server-severity	integer (0 to 7)	Severity level of Syslog server 0 – Emergency 1 – Alert 2 – Critical **3 – Error** 4 – Warning 5 – Notice 6 – Info 7 – Debug	0/1/2/**3**/4/5/6/7

Table 46: Syslog configuration

Syslog response:

The resulting response is a JSON object with a "status" field. Status should be "0" if no error occurred, and "-1" if there is an error.

In case of an error, the response contains an error array.

The error array contains an error object for each error occurred. The object consists of a field "Element" which names the config element that caused the error, and of a field "Message" for the error message.

Examples:

```
{"status": -1, "error": [{"Element": "upcua-enable", "Message": "Boolean
 expected"}]}

{"status": 0}

{"status": -1, "error": [{"Element": "root", "Message": "Not a JSON
 object"}]}
```

10.5.2 Syslog configuration - Quick start guide

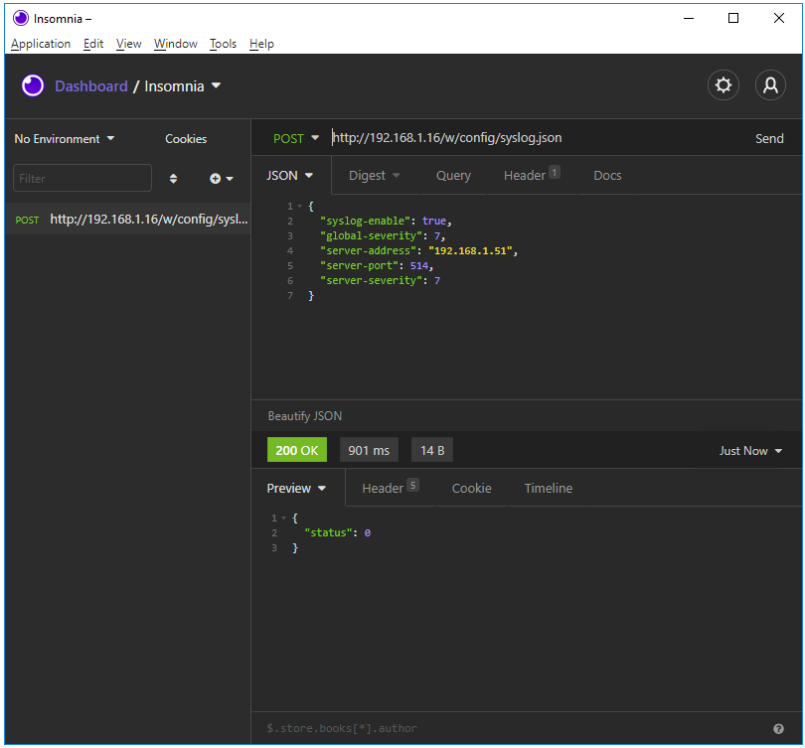
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

10.5.2.1 Syslog configuration via JSON

1. Depending on your application case, download and install *Insomnia* or a comparable application: https://insomnia.rest/download/

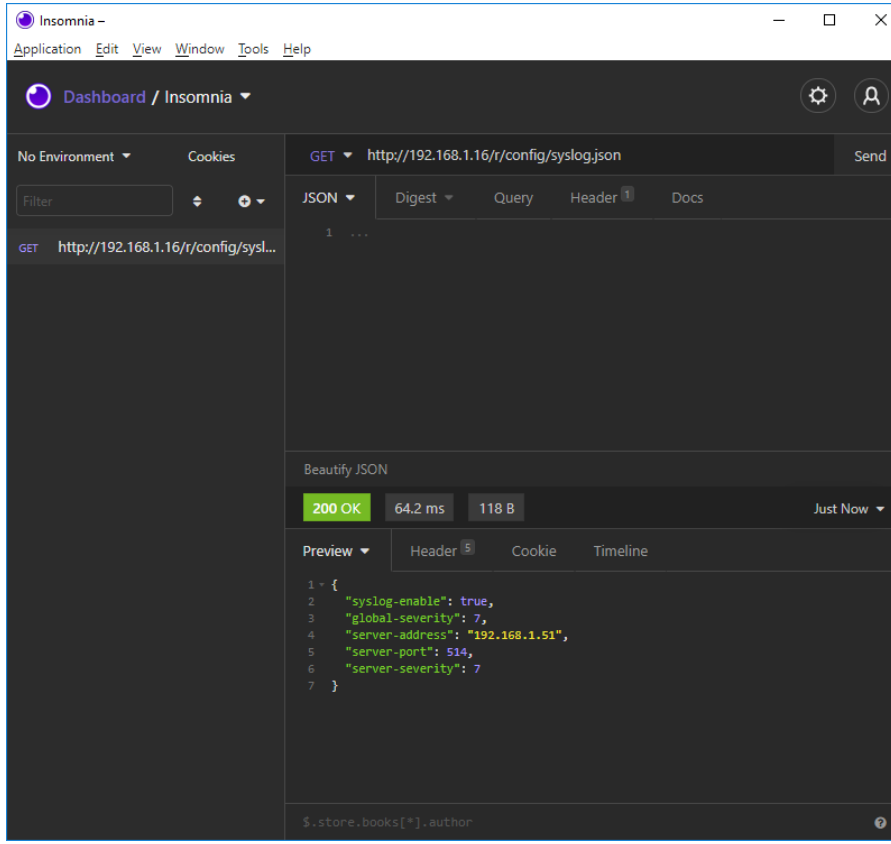
2. Configure Syslog:

POST: `[IP-address]/w/config/syslog.json`



3. Read Syslog configuration:

GET: `[IP-address]/r/config/syslog.json`



10.6 Network Time Protocol (NTP)

The NTP function is **only** applicable for the following LioN-X variant:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

The LioN-X multiprotocol variants provide an NTP client (version 3) which can connect with a configured NTP server and is able to synchronize the network time at a configurable interval.

NTP is a network protocol which uses UDP datagrams to send and receive timestamps in order to synchronize with a local clock. The NTP protocol RFC1305 is based on the Server-Client principle and exclusively supplies the synchronization with Coordinated Universal Time (UTC). (For more details on the used NTP standard, please refer to https://datatracker.ietf.org/doc/html/rfc1305.)

10.6.1 NTP configuration

In **delivery state**, the NTP client is **disabled**. The NTP client can be configured either using the Web interface or directly via a JSON object sent in an HTTP/HTTPS request. For more information see chapter NTP configuration - Quick start guide on page 154.

The configuration URL is:

`http://[ip-address]/w/config/ntpc.json`

The configuration can also read back as a JSON file:

`http://[ip-address]/r/config/ntpc.json`

The configuration is a JSON object. Each JSON member is a configuration element. The object must not contain all elements. Only the provided elements will be changed. The configuration changes apply only after a device restart.

The following configuration elements are available (default values in bold):

Element	Data type	Description	Example data
NTP client state	boolean	Master switch for the NTP client	true / **false**
Server address	string	IP address of the NTP server	192.168.1.50
Server port	integer	Port of the NTP server	**123**
Update interval	integer	Interval at which the client will connect with the configured NTP server (see table row "Server address"). **Note: This value is in seconds.**	1/2/10/**60**

Table 47: NTP configuration

NTP response:

The resulting response is a JSON object with a "status" field. Status should be "0" if no error occurred, and "-1" if there is an error.

In case of an error, the response contains an error array.

The error array contains an error object for each error occurred. The object consists of a field "Element" which names the configuration element that caused the error, and of a field "Message" for the error message.

Examples:

```
{"status": -1, "error": [{"Element": "ntpc-enable", "Message": "Boolean
 expected"}]}

{"status": 0}

{"status": -1, "error": [{"Element": "root", "Message": "Not a JSON
 object"}]}
```

10.6.2 NTP configuration - Quick start guide

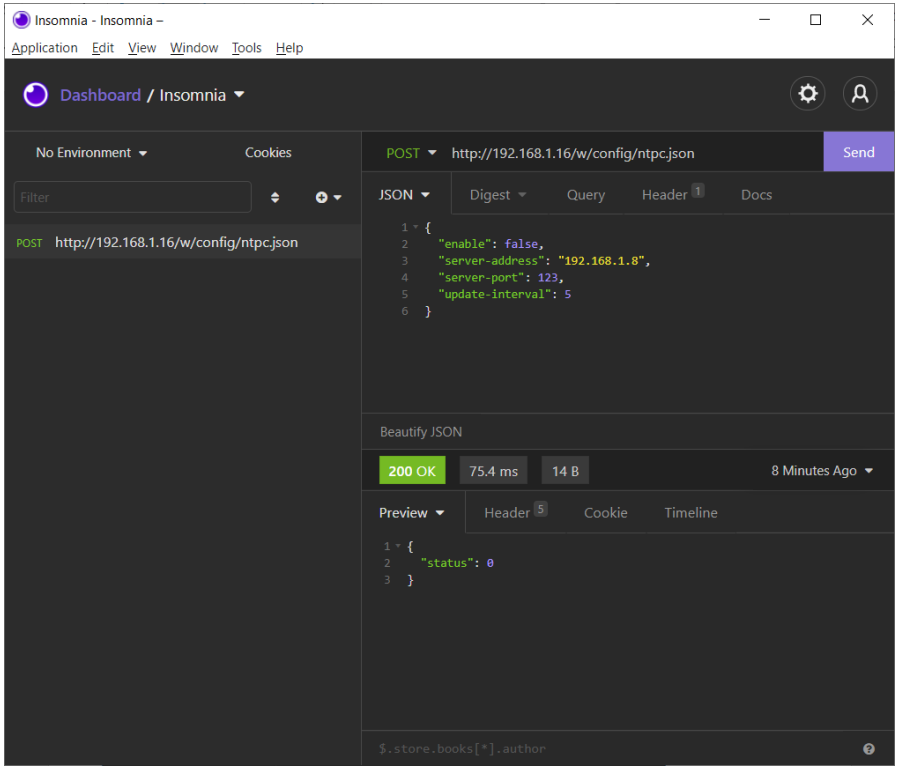
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

10.6.2.1 NTP configuration via JSON

1. Depending on your application case, download and install *Insomnia* or a comparable application: https://insomnia.rest/download/

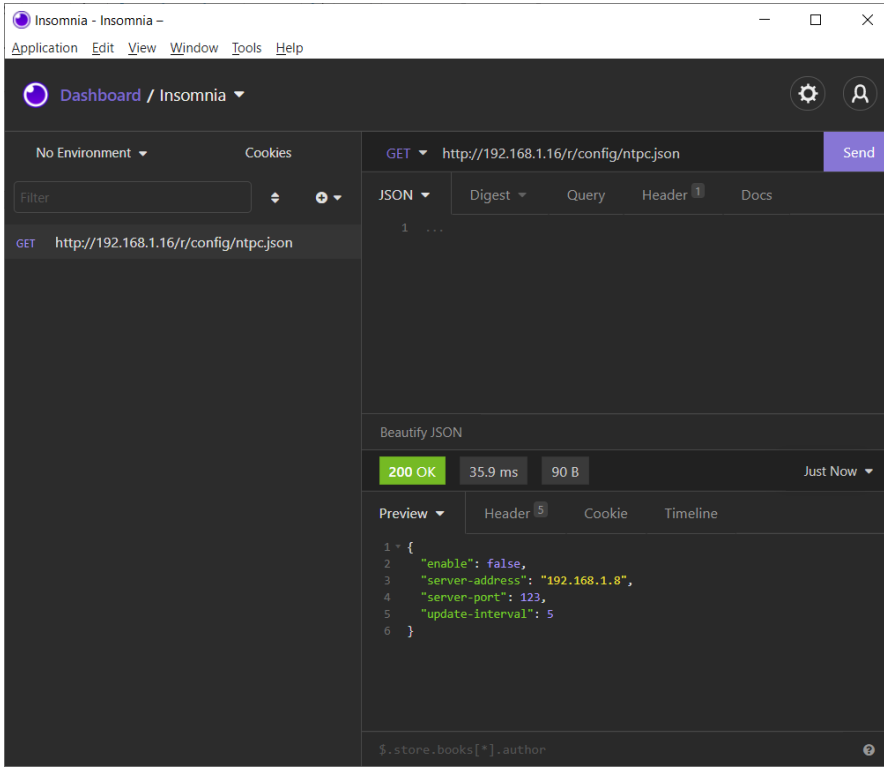
2. Configure NTP:

POST: `[IP-address]/w/config/ntpc.json`



3. Read NTP configuration:

GET: `[IP-address]/r/config/ntpc.json`



11 The integrated Web server

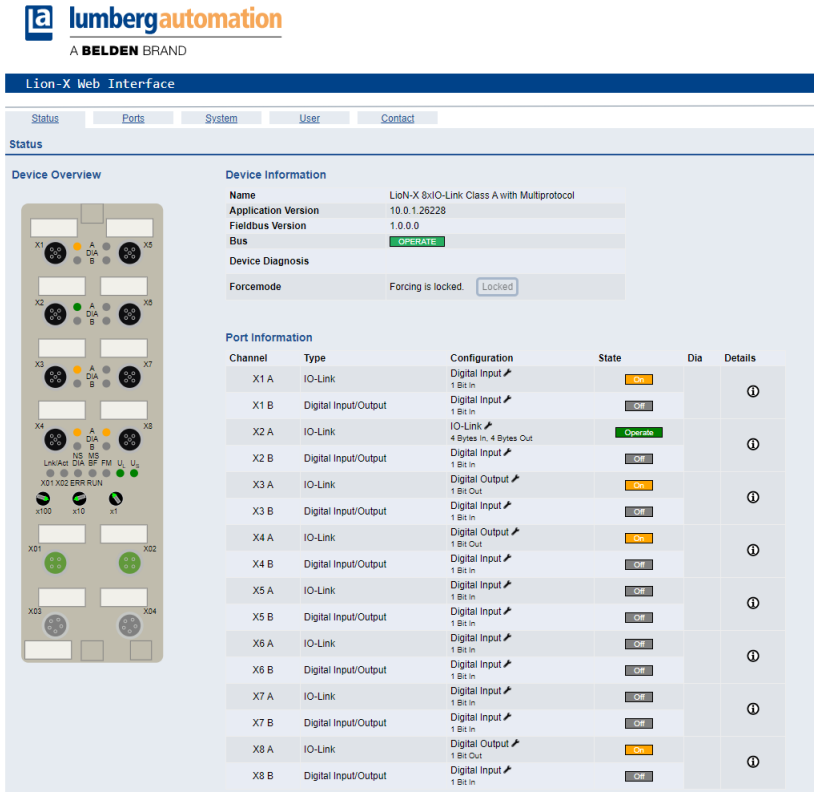
All device variants are equipped with an integrated Web server which makes functions for the device configuration and the display of status and diagnostic information available via a Web interface.

The Web interface provides an overview of the configuration and status of the device. It is also possible to use the Web interface to trigger a reboot, reset to the factory defaults, or perform a firmware update.

Enter "http://" or "https://" followed by the IP address, such as "http://192.168.1.5", in your Web browser’s address bar. If the status page of the device is not displayed, check your browser and firewall settings.

11.1 LioN-X 0980 XSL... variants

11.1.1 The Status page



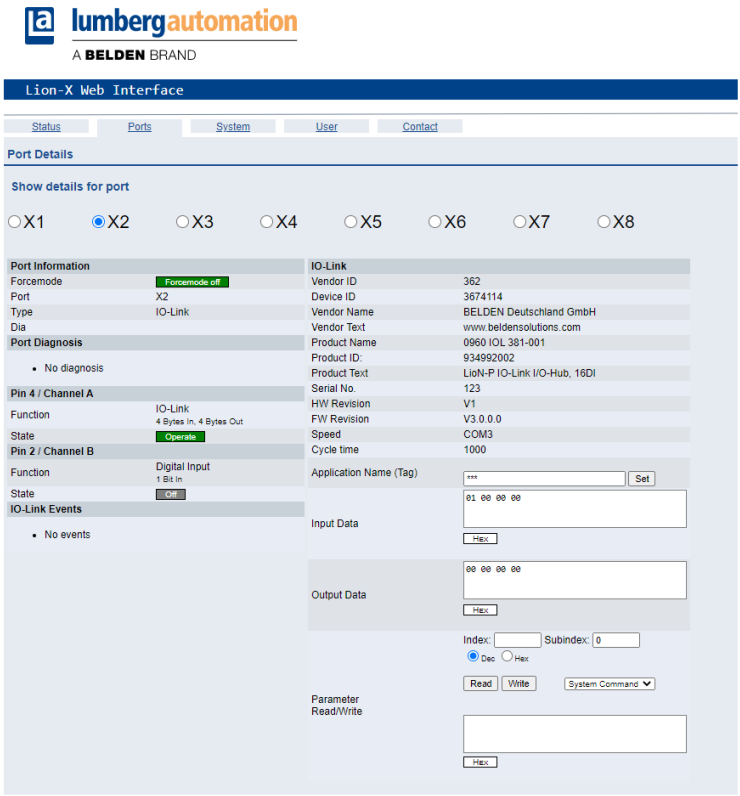
The status page provides a quick overview of the current state of the device.

The left side shows a graphical representation of the module with all its LEDs and the positions of the rotary encoding switches.

The right side shows the "Device Information" table with some basic data for the module; for example, the variant, the cyclic communication status and a diagnostic indicator. The indicator shows whether diagnostics for the module exist.

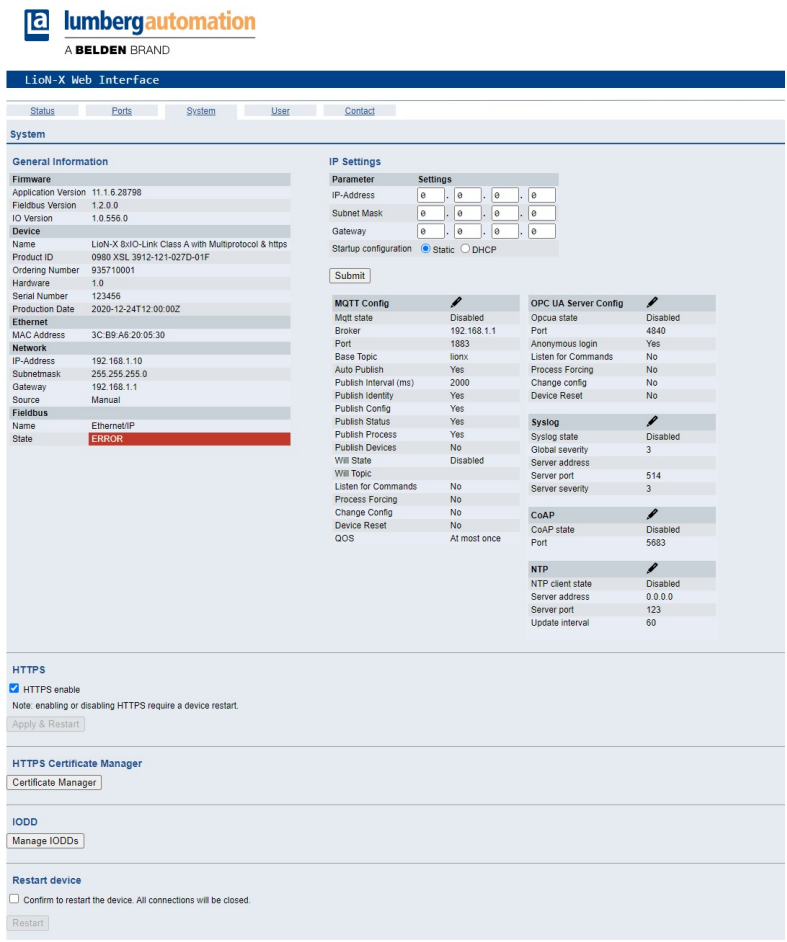
The "Port Information" table shows the configuration and state of the I/O ports.

11.1.2 The Ports page



The page shows detailed port information. In the field **Port Diagnosis**, incoming and outgoing diagnostics are displayed as clear text. **Pin 2** and **Pin 4** contain information about the configuration and state of the port. For IO-Link ports, additional information relating to the connected sensor and the process data is displayed.

11.1.3 The System page



The System page shows the basic information for the module like Firmware version, Device information, Ethernet, Network and Fieldbus information.

Restart Device

The module initializes a software reset.

Reset to Factory Settings

The module restores to the default factory settings.

IP Settings

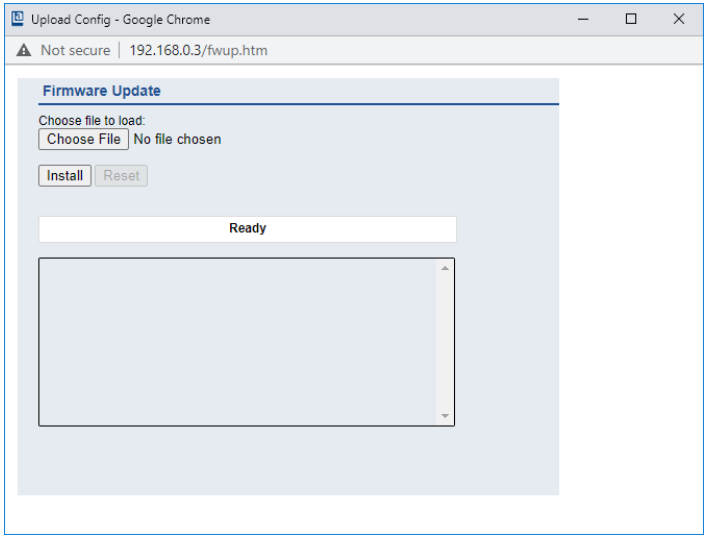
Use this parameter to change the current IP address of the module.

For PROFINET, this is only useful during commissioning. Normally, the PLC sets the IP address at start-up by detecting the PROFINET module via its device name.

Firmware Update

The module initializes a Firmware update.

For a firmware update choose the **.ZIP* container available on our website or ask our support team. Afterwards follow the instructions shown on your screen.



11.1.3.1 HTTPS

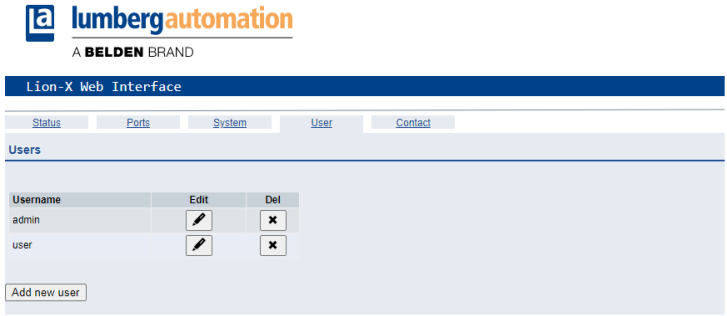
Https-based or http-based communication with the LioN-X Web server. If this option is selected, the communication with the LioN-X Web server will be secure and encryption-based.

11.1.3.2 HTTPS certificate manager

The HTTPS certificate manager shows a default certificate and the currently active certificate for the Web server. Your are allowed to delete, upload and select new certificates. For an example of how to create and sign your own certificate with *Mako Server* by Real Time Logic LLC, refer to chapter Certificate creation – example on page 162.

Attention: It is not possible to delete the default certificate.

11.1.4 The User page



The User page provides the user management of the Web interface. New users with access rights "Admin" or "Write" can be added here. For

security reasons please change the default admin password immediately after configuring the device.

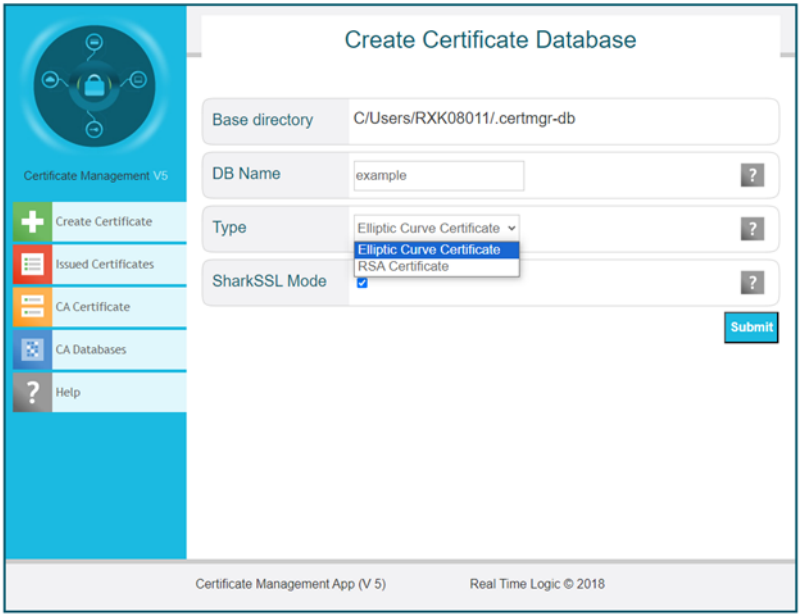
Default user login data:

- User: admin
- Password: private

11.1.5 Certificate creation – example

1. Create certificate database:

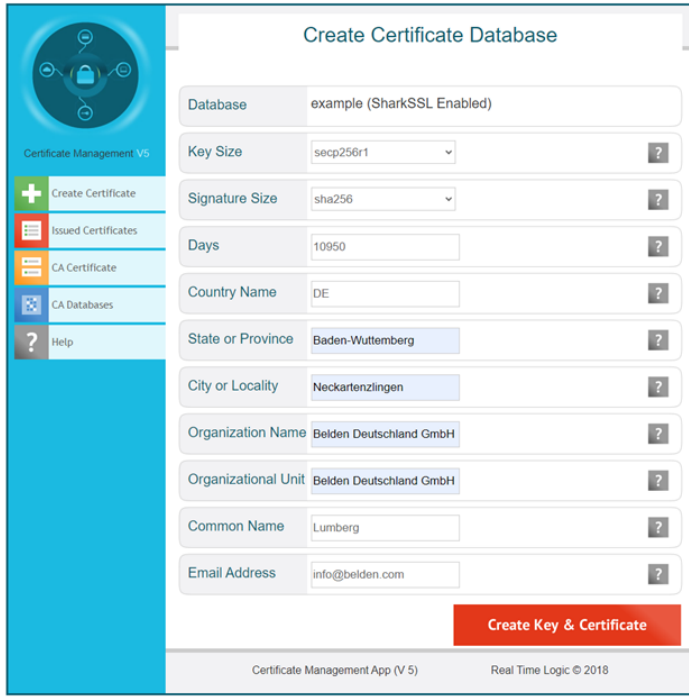
   In *Makro server* by Real Time Logic LLC, navigate to *Create Certificate Database*. Enter *DB Name*, select *Type* as “Eliptic Curve Certificate”, and select *SharkSSL Mode* as shown below.



2. Create certificate:

   - Key Size: Any value from drop down list can be selected. “secp256r1” is recommended.
   - Signature size: "sha256" → The higher the number in the encryption, the higher the security level of communication.

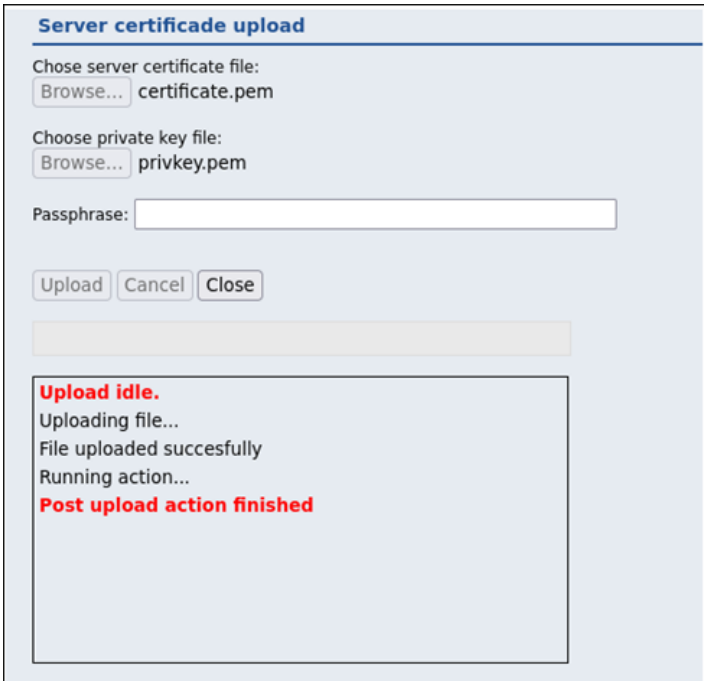
- Days: Enter the number of days you wish this certificate to be valid (e.g. "10950" for 10 years).
- Country name: "DE" ("DE" stands for Germany. For other countries, please refer to https://www.ssl.com/country-codes/).
- State or Province: Enter your local province or state (e.g. "Baden-Württemberg").
- City or Locality: Enter name of city (e.g. "Neckartenzlingen").
- Organization Name: Enter name of organization (e.g. "Belden Deutschland GmbH").
- Organization Unit: Enter name of organization unit (e.g. "Belden Deutschland GmbH").
- Common Name: The common name here belongs to domain name. It must reflect fully or in parts the domain name of where LioN-X device is accessible.
- Email address: The e-mail address of the certificate's creator.



3. Upload the certificate onto the LioN-X device:

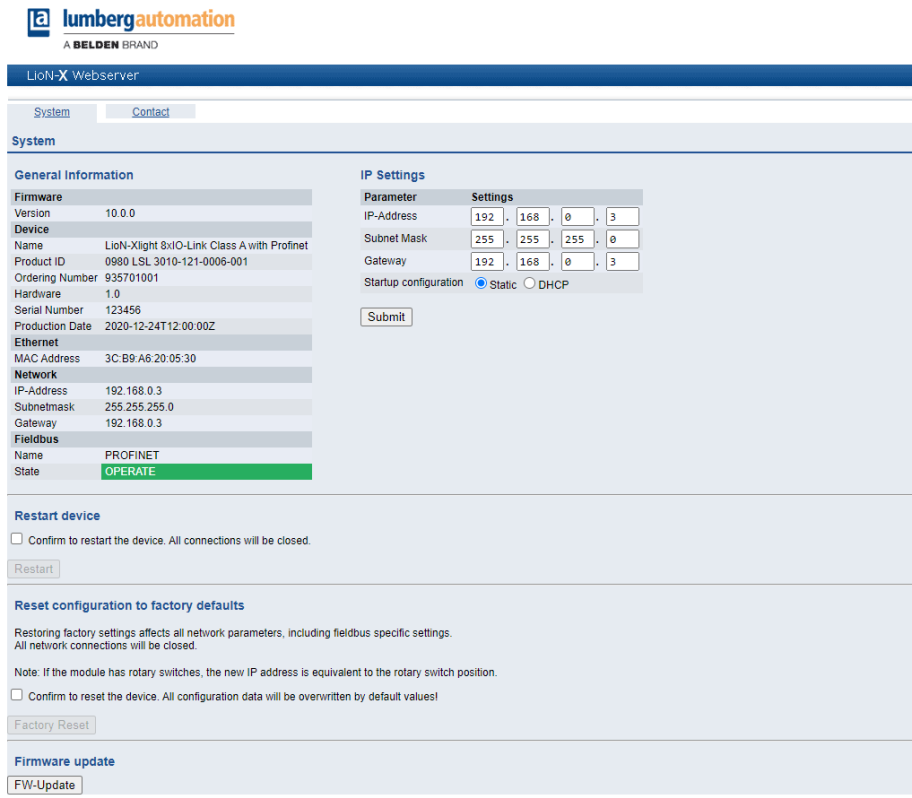
   In the HTTPS certificate manager (Belden Web interface), click on the button *Upload* and choose the ".pem" and ".key" files generated in the previous step for the upload.

   Click on *Upload*.



11.2 LioN-Xlight 0980 LSL... variants

11.2.1 The System page



The System page shows the basic information for the module like Firmware version, Device information, Ethernet, Network and Fieldbus information.

Restart Device

The module initializes a software reset.

Reset to Factory Settings

The module restores to the default factory settings.

IP Settings

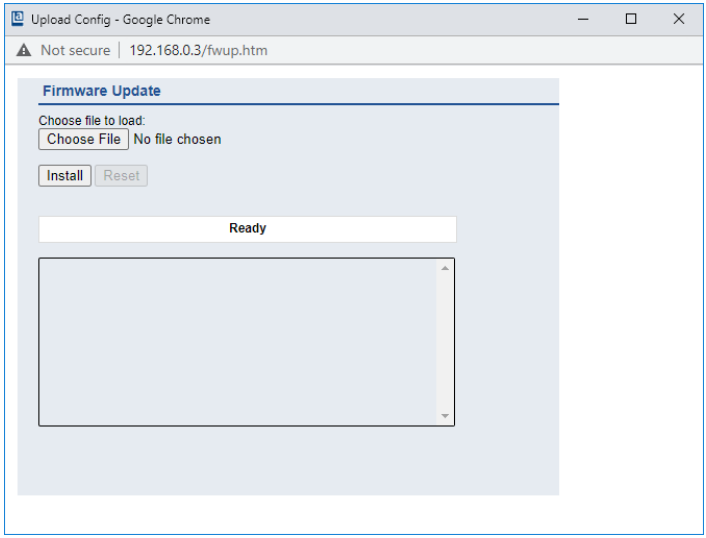
Use this parameter to change the current IP address of the module.

For PROFINET, this is only useful during commissioning. Normally, the PLC sets the IP address at start-up by detecting the PROFINET module via its device name.

Firmware Update

The module initializes a Firmware update.

For a firmware update choose the **.ZIP* container available on our website or ask our support team. Afterwards follow the instructions shown on your screen.



12 IODD

IODD functions are **only** applicable for the following device variants:

- 0980 XSL 3912-121-007D-00F
- 0980 XSL 3912-121-007D-01F
- 0980 XSL 3912-121-027D-01F
- 0980 XSL 3913-121-007D-01F
- 0980 XSL 3913-121-027D-01F

The **IO D**evice **D**escription (IODD) is a set of files formally describing an IO-Link Device. The IODD is created by the vendor and is mandatory for each IO-Link Device.

Belden LioN-X IO-Link Masters with the "IODD on Module" functionality are ready to use IODDs in order to make the IO-Link Device configuration much more easier and the process data human readable in a better way. IODDs can be uploaded via the Web Interface and remanently stored on the IO-Link Master afterwards.

If a corresponding IO-Link Device is connected, the stored IODD is used to provide a user friendly configuration page, where all parameters of the device can be viewed and edited. Additionally, according to the IODD, the process data will also be formatted and displayed to the user.

12.1 IO-Link Device parameters and ISDU requests

Every IO-Link Device provides parameters that can be read and written via the special IO-Link service ISDU (**I**ndexed **S**ervice **D**ata **U**nit).

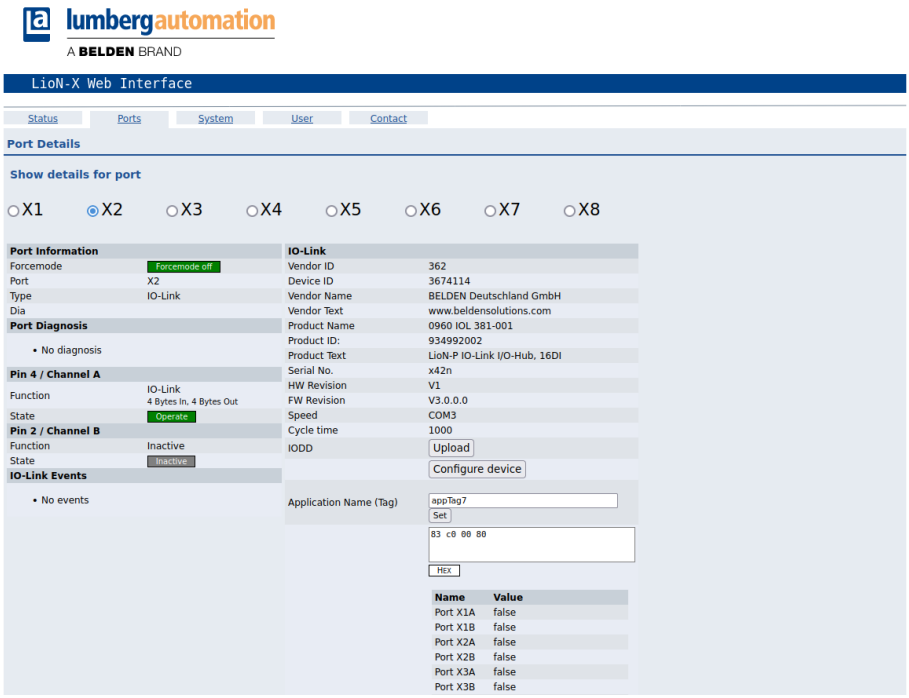
Every parameter is addressed by an index. Sub-indices are possible but optional. Some parameters (most of them read-only) are mandatory for IO-Link devices an can be found always on the same indices (See *Table B.8* in the *IO-Link Interface and System Specification*: https://io-link.com/share/Downloads/Package-2020/IOL-Interface-Spec_10002_V113_Jun19.pdf).

A vendor can use additional parameters and therefore more indices for their devices in order to provide additional configuration options. These vendor specific parameters can be described in an IODD. The "IODD on Module" feature of the LioN-X IO-Link Masters can read and parse this information out of an IODD and use it to provide the user viewing and editing options for vendor specific parameters without any additional knowledge about the vendor specific device features.

12.2 Web GUI functionality

All of the "IODD on Module" features are accessible via the LioN-X Web interface.

12.2.1 Port Details page



The Port Details Page shows all information about the selected port. In the left column, all port and channel specific information is displayed. If the port is configured as IO-Link and there is an IO-Link Device connected, all IO-Link information for the connected device is displayed in the right column.

IODD buttons

The row called *IODD* provides access to the "IODD on Module" features. The button *UPLOAD* will let the user upload an IODD file into the module, regardless of the original device the IODD has been designed for.

The maximum number of IODDs is limited due to storage space. If there is no more space left for new IODDs, there will be an error message. In this case, navigate to the IODD Management page to delete IODDs which are no longer used.

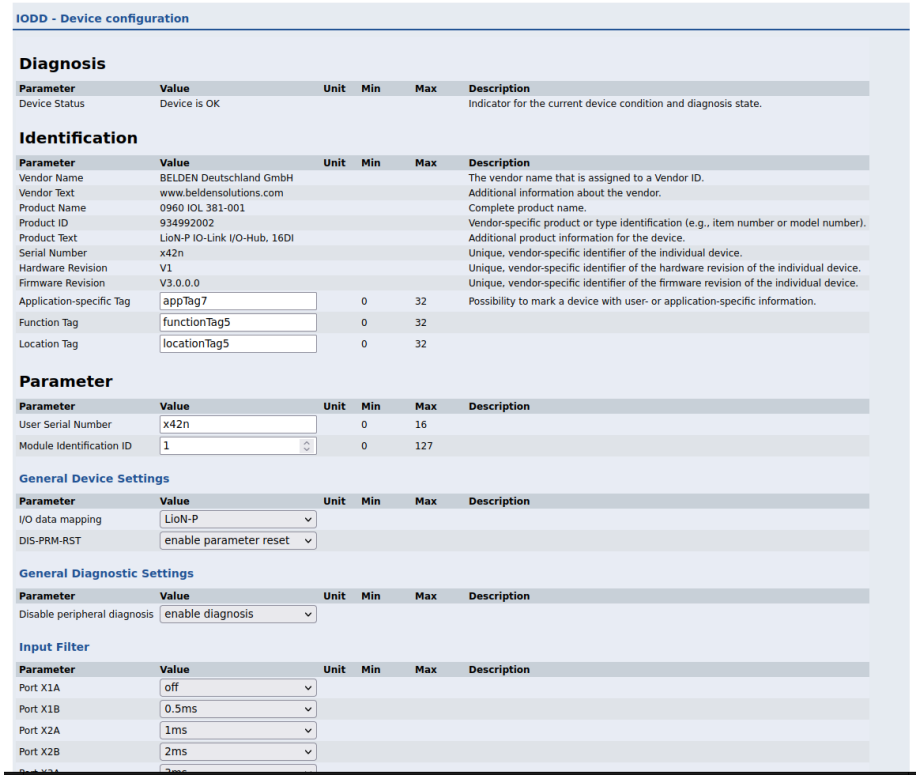
If there is a matching IODD for the currently connected device already stored in the system, the button *CONFIGURE* is shown in the interface. By clicking this button, the Parameter Page will open to configure the device.

Process data

For every connected IO-Link Device, raw process data for input and output direction (set of bytes) is on display.

If a matching IODD providing information about process data is already stored in the system, this data will also be displayed in a user-friendly format according to the IODD.

12.2.2 Parameters page



The parameters page "IODD – Device configuration" shows all parameters which are provided by the IODD of the device. That means the parameter set is variable and depends on the connected IO-Link Device.

The stored IODD reads the parameter meta data, such as names, units, min/max values, descriptions etc. The values will be obtained directly from the connected device. For that reason it may take several seconds until the page is updated.

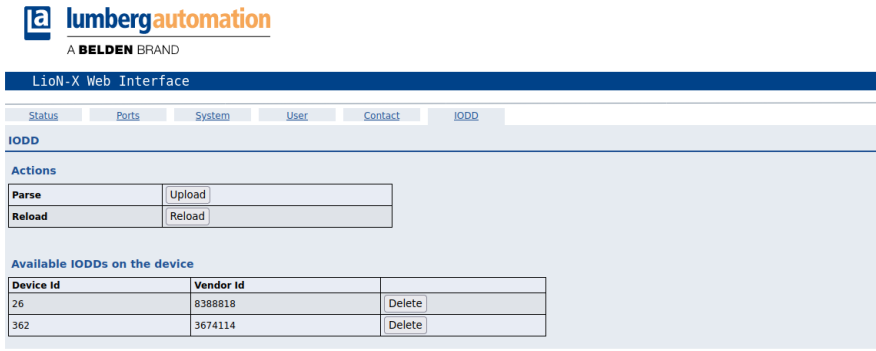
If not already saved into the browser, you will be asked for your credentials to continue. A valid user access with Web Interface group membership is needed in order to edit the device parameters. After the registration, enabled values can be changed. Disabled values cannot be changed and may be

marked as "read-only" in the IODD. All values are directly written back to the device after any change.

Limitations

- Editing parameter values will directly change them inside the connected device. No parameter server action is triggered by that.
- There is a maximum size of the IODD in order to be uploaded into the system. This depends on several values, such as file size, parameter count, nesting levels etc.

12.2.3 IODD Management page



The IODD Management Page can be accessed via the System page displaying all IODDs that are currently stored in the system. All IODDs matching connected devices are marked. On the IODD Management page, you can manually delete any IODD in the system.

Standard Definitions File

IODDs are usually referencing to a Standard Definitions File. The latest Standard Definitions File is already pre-installed on the system when the device is shipped. It can also be updated manually by clicking the button "Upload Standard Definitions File".

13 Firmware update

A firmware update of the device is possible via the integrated Web server using the EoE protocol (Ethernet over EtherCAT®), or the FoE protocol (File over EtherCAT®).

Warning: Risk of data loss, damage to the device and injury due to uncontrolled machine movements.

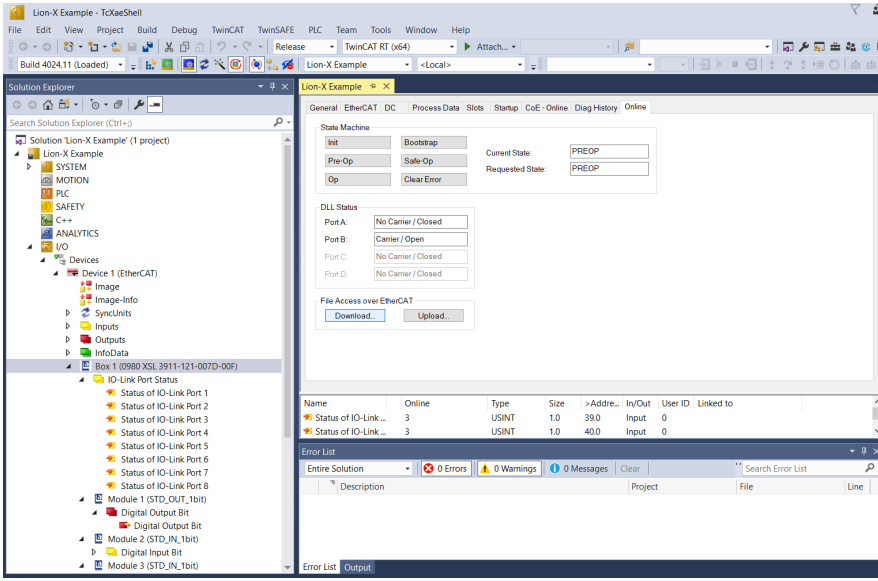
- Do **NOT** interrupt the power supply to the device during the update.

13.1 Firmware update via FoE

The FoE service must be supported by the IOL-Master and the IOL-Device. The FoE service on the Lion-X variants is supported by default. If the FoE service is configured and the device is in "Pre-Op" state, an update via FoE can be done by using TwinCAT® like in the following example:

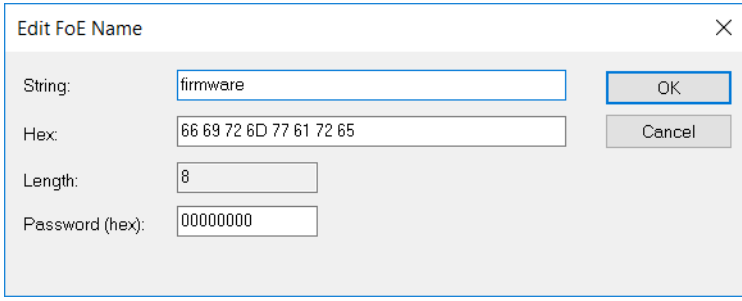
1. Rename the file name of the firmware update file provided by Belden to “firmware”.

2. In TwinCAT®, select the device you want to update:

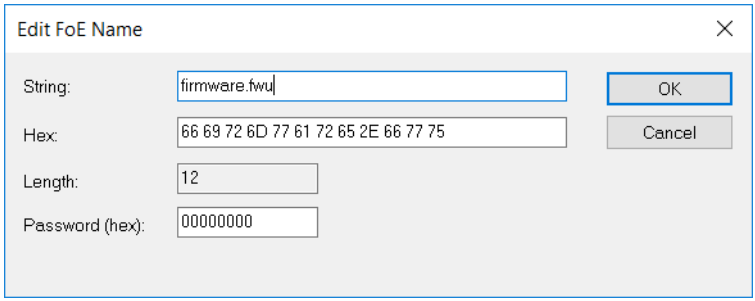


3. In the device window on the right, go to the box **File Access over EtherCAT** and press **Download**.

4. In the following window, select the update file provided by Belden:



4. Add the file extension ".fwu" to the file name in field **String:** if not visible:



5. Press **OK** and wait until the file has been transferred to the device.

Attention: After the file has been transferred, the device will reset automatically. During the restart, older firmware update files will be replaced by the files in the update package.

14 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 catalog.belden.com.

14.1 General

Protection class (Only applies if the connectors are screwed together or if protective caps are used.)[2]	IP65 IP67 IP69K	
Ambient temperature (during operation and storage)	0980 XSL 3x12-121... 0980 XSL 3x13-121...	-40 °C .. +70 °C (-40 °F .. +158 °F)
	0980 LSL 3x11-121...	-20 °C .. +60 °C (-4 °F .. +140 °F)
	0980 LSL 3x10-121...	
Weight	LioN-X 60 mm	approx. 500 gr. (17.6 oz)
Ambient moisture	Max. 98% RH (For UL applications: Max. 80% RH)	
Housing material	Die-cast zinc	
Surface finish	Frosted nickel	
Flammability class	UL 94 (IEC 61010)	
Vibration resistance (oscillation) DIN EN 60068-2-6 (2008-11)	15 g / 5-500 Hz	
Shock resistance DIN EN 60068-2-27 (2010-02)	50 g / 11 ms +/- X,Y,Z	
Fastening torques	M4 fixing screws	1 Nm
	M4 ground connection	1 Nm
	M12 connector	0.5 Nm
Permitted cables	Ethernet cables according to IEEE 802.3, min. CAT 5 (shielded) Max. length of 100 m, not routed out of facility (= local network)	

Table 48: General information

2 Not under UL investigation.

14.2 EtherCAT® protocol

Protocol	EtherCAT® (ETG.1000 V1.2)
ESI file	LumbergAutomation-LioN-X-IO-Link.xml
Transmission rate	100 Mbit/s, full duplex
Type of addressing	Auto-increment addressing, Fixed addressing
Min. cycle time	1 ms
Vendor ID	$16A_H$
Device ID	0x0400 (same for all LioN-X devices)
Mailbox protocols	CanOpen over EtherCAT® (CoE) File access over EtherCAT® (FoE) Ethernet over EtherCAT® (EoE)
Supported Ethernet protocols	Ping ARP HTTP / HTTPS TCP/IP
Switch functionality	Integrated
EtherCAT® interface Port	2x M12 sockets 4-pin, D-coded (see pin assignments)

Table 49: EtherCAT® protocol

14.3 Power supply of the module electronics/ sensors

Port X03, X04	M12-L-coded Power, connector/socket, 5-pole Pin 1 / Pin 3		
Nominal voltage U_S	24 V DC (SELV/PELV)		
Current U_S	Max. 16 A		
Voltage range	21 .. 30 V DC		
Power consumption of module electronics	Typically 160 mA (+/-20 % at U_S nominal voltage)		
Power supply interruption	Max. 10 ms		
Voltage ripple U_S	Max. 5 %		
Current consumption sensor system (L+ / Pin 1)	0980 XSL 3912-121... 0980 XSL 3913-121...	Port X1 .. X8 (Pin 1)	max. 4 A per port (at $T_{ambient}$ = 30° C)
	0980 LSL 3x11-121...	Port X1 .. X8 (Pin 1)	max. 2 A per port (at $T_{ambient}$ = 30° C)
	0980 LSL 3x10-121...	Port X1 .. X4 (L+ / Pin 1)	max. 2 A per port (at $T_{ambient}$ = 30° C)
		Port X5 .. X8 (Pin 1)	max. 0.7 A in total for ports X5 .. X8
Voltage level of the sensor power supply	Min. (U_S – 1.5 V)		
Short circuit/overload protection of sensor supply	Yes, per port		
Reverse polarity protection	Yes		
Operational indicator (U_S)	LED green:	18 V (+/- 1 V) < U_S	
	LED red:	U_S < 18 V (+/- 1 V)	

Table 50: Information on the power supply of the module electronics/ sensors

14.4 Power supply of the actuators

14.4.1 IO-Link Class A devices (U_L)

Nominal voltage U_L	24 V DC (SELV/PELV)
Voltage range	18 .. 30 V DC
Current U_L	Max. 16 A
Voltage ripple U_L	Max. 5 %
Reverse polarity protection	Yes
Operational indicator (U_L)	LED green: 18 V (+/- 1 V) < U_L LED red: U_L < 18 V (+/- 1 V) or U_L > 30 V (+/- 1 V) * if "Report U_L supply voltage fault" is enabled.
Port X03, X04	M12_L-coded Power, connector/socket, 5-pole Pin 2 / Pin 4

Table 51: Information on the power supply of the actuators

14.4.2 IO-Link Class A/B devices (U_{AUX})

Nominal voltage U_{AUX}	24 V DC (SELV/PELV)
Voltage range	18 .. 30 V DC
Current U_{AUX}	Max. 16 A
Voltage ripple U_{AUX}	Max. 5 %
Reverse polarity protection	Yes
Electric isolation $U_S \leftrightarrow U_{AUX}$	500 V
Operational indicator (U_{AUX})	LED green: 18 V (+/- 1 V) < U_{AUX} LED red: U_{AUX} < 18 V (+/- 1 V) or U_{AUX} > 30 V (+/- 1 V) * if "Report U_{AUX} supply voltage fault" is enabled.
Port X03, X04	M12_L-coded Power, connector/socket, 5-pole Pin 2 / Pin 4

Table 52: Information on the power supply of the actuators

14.5 I/O ports Channel A (Pin 4)

0980 XSL 3912-121...	Port X1 .. X8	Class A	IOL, DI, DO	M12 socket, 5-pin, Pin 4
0980 LSL 3x11-121...	Port X1 .. X8	Class A	IOL, DI, DO	
0980 LSL 3x10-121...	Port X1 .. X4	Class A	IOL, DI, DO	
	Port X5 .. X8	–	—, DI, —	
0980 XSL 3913-121...	Port X1 .. X4	Class A	IOL, DI, DO	
	Port X5 .. X8	Class B	IOL, DI, DO	

Table 53: IO-Link Master ports: Functional overview for Ch. A (Pin 4)

14.5.1 Configured as digital input, Ch. A (Pin 4)

Input connection	0980 XSL 3912-121...		Type 1 as per IEC 61131-2
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...		
	0980 XSL 3913-121...		
Nominal input voltage	24 V DC		
Input current	Typically 3 mA		
Channel type	Normally open, p-switching		
Number of digital inputs	0980 XSL 3912-121...	X1 .. X8	8
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...		
	0980 XSL 3913-121...		
Status indicator	yellow LED		
Diagnostic indicator	red LED per channel		

Table 54: I/O ports Ch. A (Pin 4) configured as digital inputs

14.5.2 Configured as digital output, Ch. A (Pin 4)

Attention: For variants 0980 XSL 3912-121-007D-00F, 0980 XSL 3912-121-007D-01F and 0980 XSL 3912-121-027D-01F, the digital outputs of Channel A are **supplied by the U_L power** when parameterized to "High-Side Switch" mode.

Attention: For variants 0980 XSL 3913-121-007D-01F and 0980 XSL 3913-121-027D-01F, the digital outputs are supplied as follows:

- "X1 .. X8 / Channel A" are supplied by the U_S power

Attention: For variants 0980 LSL 3010-121-0006-001 and 0980 LSL 3011-121-0006-001 , the digital outputs of Channel A are **supplied by the U_S power**.

Output type	normally open, p-switching (parameterized to "High-Side Switch" mode)	
Nominal output voltage per channel Signal status “1” Signal status “0”	 min. (U_S -1 V) **or** min. (U_L -1 V) depending on the device variant max. 2 V	
Max. output current per device	0980 XSL 3912-121...	9 A (power supplied via U_L)
	0980 XSL 3913-121...	9 A (power supplied via U_S)
	0980 LSL 3x11-121...	4 A (power supplied via U_S)
	0980 LSL 3x10-121...	2 A (power supplied via U_S)
Max. output current per channel[3]	0980 XSL 3912-121... (X1 .. X8)	2 A (power supplied via U_S)
	0980 XSL 3913-121... (X1 .. X8)	2 A (power supplied via U_S)
	0980 LSL 3x11-121... (X1 .. X8)	0.5 A (power supplied via U_S)
	0980 LSL 3x10-121... (X1 .. X4)	0.25 A for **UL applications**

[3] Max. 2.0 A per channel; for every port pair X1/X2, X3/X4, X5/X6, X7/X8 max. 6.5 A (for **UL applications** max. 5.0 A); for the whole port group X1 .. X8 max. 9.0 A in total (with derating).

Short-circuit/overload protected	yes/yes	
Behavior in case of short circuit or overload	deactivation with automatic power-on (parameterized)	
Number of digital outputs	0980 XSL 3912-121... (X1 .. X8)	8
	0980 XSL 3913-121... (X1 .. X8)	
	0980 LSL 3x11-121... (X1 .. X8)	
	0980 LSL 3x10-121... (X1 .. X4)	4
Status indicator	yellow LED per output	
Diagnostic indicator	red LED per channel	

Table 55: I/O ports Ch. A (Pin 4) configured as digital outputs

14.5.3 Configured as IO-Link port in COM mode, Ch. A

IO-Link Master specification	v1.1.3 ready, IEC 61131-9	
Communication rates	4.8 kbaud (COM 1) 38.4 kbaud (COM 2) 230.4 kbaud (COM 3)	
Line lengths in the IO-Link Device	max. 20 m	
Number of IO-Link ports	0980 XSL 3912-121... (X1 .. X8)	8
	0980 XSL 3913-121... (X1 .. X8)	8
	0980 LSL 3x11-121... (X1 .. X8)	8
	0980 LSL 3x10-121... (X1 .. X4)	4
Min. IO-Link cycle time	400 µs	

Table 56: Configured as IO-Link port in COM mode

14.6 I/O ports Channel B (Pin 2)

0980 XSL 3912-121...	Port X1 .. X8	Class A	DI, DO	M12 socket, 5-pin, Pin 2
0980 LSL 3x11-121...	Port X1 .. X8	Class A	DI	
0980 LSL 3x10-121...	Port X1 .. X4	Class A	DI	
	Port X5 .. X8	–	DI	
0980 XSL 3913-121...	Port X1 .. X4	Class A	DI, DO	
	Port X5 .. X8	Class B	DO, U_{AUX}	

Table 57: IO-Link Master ports: Functional overview for Ch. B (Pin 2)

14.6.1 Configured as a digital input, Ch. B (Pin 2)

Input connection	0980 XSL 3912-121...		Type 1 as per IEC 61131-2
	0980 XSL 3913-121...		
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...		
Nominal input voltage	24 V DC		
Input current	Typically 3 mA		
Channel type	Normally open, p-switching		
Number of digital inputs	0980 XSL 3912-121...	X1 .. X8	8
	0980 XSL 3913-121...	X1 .. X4	4
	0980 LSL 3x11-121...	X1 .. X8	8
	0980 LSL 3x10-121...	X1 .. X8	8
Status indicator	white LED		
Diagnostic indicator	red LED per channel		

Table 58: I/O ports Ch. B (Pin 2) configured as digital inputs

14.6.2 Configured as a digital output, Ch. B (Pin 2)

Attention: For variants 0980 XSL 3912-121-007D-00F, 0980 XSL 3912-121-007D-01F and 0980 XSL 3912-121-027D-01F, the digital outputs of Channel B are **supplied by the U_L power**.

Attention: For variants 0980 XSL 3913-121-007D-01F and 0980 XSL 3913-121-027D-01F, the digital outputs are supplied as follows:

- "X1 .. X4 / Channel B" are supplied by the U_S power
- "X5 .. X8 / Channel B" are supplied by the U_{AUX} power

Attention: For variants 0980 LSL 3010-121-0006-001 and 0980 LSL 3011-121-0006-001, the digital outputs of Channel B are **supplied by the U_S power**.

Output type	normally open, p-switching	
Nominal output voltage per channel Signal status “1” Signal status “0”	min. (U_S -1 V) **or** min. (U_L -1 V) **or** min. (U_{AUX} -1 V) depending on the device variant max. 2 V	
Max. output current per device	0980 XSL 3912-121...	9 A (power supplied via U_L)
	0980 XSL 3913-121...	8 A (power supplied via U_{AUX})
	0980 LSL 3x11-121...	4 A (power supplied via U_S)
	0980 LSL 3x10-121...	2 A (power supplied via U_S)
Max. output current per channel [4,5]	0980 XSL 3912-121...	2 A (power supplied via U_S)
	0980 XSL 3913-121...	X1 .. X4: 2 A (power supplied via U_S)
		X5 .. X8: 2 A (power supplied via U_{AUX})
	0980 LSL 3x11-121...	0 A (no outputs on Ch. B)
	0980 LSL 3x10-121...	0 A (no outputs on Ch. B)
Short-circuit/overload protected	yes/yes	
Behavior in case of short circuit or overload	deactivation with automatic power-on (parameterized)	
Number of digital outputs	0980 XSL 3912-121...	8
	0980 XSL 3913-121...	8
	0980 LSL 3x11-121...	–
	0980 LSL 3x10-121...	–
Status indicator	white LED per output	

4 For Class A devices: Max. 2.0 A per channel; for every port pair X1/X2, X3/X4, X5/X6, X7/X8 max. 6.5 A (for **UL applications** max. 5.0 A); for the whole port group X1 .. X8 max. 9.0 A in total (with derating).

5 For Class A/B devices: Max. 2.0 A per channel; for every port pair X1/X2, X3/X4, X5/X6, X7/X8 max. 6.5 A (for **UL applications** max. 5.0 A); for port group X5/X6/X7/X8 max. 5.0 A from U_{AUX}; for the whole port group X1 .. X8 max. 9.0 A in total (with derating).

Diagnostic indicator	red LED per channel

Table 59: I/O ports Ch. B (Pin 2) configured as digital outputs

14.7 LEDs

LED	Color	Description
U_L/U_{AUX}	Green	Auxiliary sensor/actuator voltage OK 18 V (+/- 1 V) < U_L/U_{AUX} < 30 V (+/- 1 V)
	Red*	Auxiliary sensor/actuator voltage LOW U_L/U_{AUX} < 18 V (+/- 1 V) or U_L/U_{AUX} > 30 V (+/- 1 V) * if "Report U_L/U_{AUX} supply voltage fault" is enabled.
	OFF	None of the above conditions.
U_S	Green	System/sensor voltage OK 18 V (+/- 1 V) < U_S < 30 V (+/- 1 V)
	Red	System/sensor voltage LOW U_S < 18 V (+/- 1 V) or U_S > 30 V (+/- 1 V)
	Red flashing	Device performs a factory reset (position of rotary encoding switches: 9-7-9)
	OFF	None of the above conditions.
X1 .. X8 A	Green	IO-Link COM Mode: IO-Link communication exists.
	Green flashing	IO-Link COM Mode: No IO-Link communication.
	Yellow	Standard-I/O Mode: Status of digital input or output on C/Q (pin 4) line "on".
	OFF	None of the above conditions
X1 .. X8 B	White	Status of digital input or digital output on pin 2 line "on".
	Red	Short circuit on pin 4 and pin 2 line. / All modes: Overload or short circuit on L+ (pin 1) line / communication error
	OFF	None of the above conditions.
P1 Lnk/Act P2 Lnk/Act	Green	Ethernet connection to another subscriber exists. Link detected.
	Yellow flashing	Data exchange with another subscriber.
	OFF	No connection to another subscriber. No link, no data exchange.

LED	Color	Description
BF	Red	Bus fault. No configuration, no or slow physical connection.
	Red flashing at 2 Hz	Link exists but no communication link to the EtherCAT® controller.
	OFF	EtherCAT® controller has established an active connection to the device.
DIA	Red	EtherCAT® module diagnostic alarm active.
	Red flashing at 1 Hz	Watchdog time-out; fail safe mode is active.
	Red flashing at 2 Hz, 3 sec	DCP signal service is initiated via the bus.
	Red double flash	Firmware update
	OFF	None of the above conditions.
MS	Green	Device is ready for operation.
	Green flashing	Device is ready but not configured yet.
	Red	Serious error that cannot be resolved.
	Red flashing	Minor error that can be resolved Example: An incorrect or contradictory configuration is classified as a minor error.
	Flashing alternately: Red / Green	The device is performing a self-test.
	OFF	The device is switched off.

LED	Color	Description
NS	Green	Connected: The device has at least one connection.
	Green flashing	No connection: The device has no connection. IP address exists.
	Red	Duplicate IP address: The device has detected that the assigned IP address is already being used by another device.
	Red flashing	Connection has exceeded time limit or connection interrupted.
	Flashing alternately: Red / Green	The device is performing a self-test.
	OFF	The device is switched off or has not been assigned an IP address.

Table 60: Information on the LED colors

14.8 Data transfer times

The following tables give an overview of the internal data transfer times of the LioN-X IO-Link Master with a connected IO-Link Device as digital I/O extension (Belden article 0960 IOL 380-021 16DIO Hub with a minimum cycle time of 1 ms).

There are three measured data direction values for each use case:

- **PLC to DO:** Transfer of a changed PLC output data to IO-Link Device digital output.
- **DI to PLC:** Transfer of a changed digital input signal on IO-Link Device to PLC.
- **Round-trip time (RTT):** Transfer of a changed PLC output data to IO-Link Device digital output. The digital output is connected to an IO-Link Device digital input. Transfer of the changed digital input signal on IO-Link Device to PLC. RTT = [PLC to DO] + [DI to PLC].

The measured values are taken from the ethernet data transmission line. The values are therefore without PLC processing times and PLC cycle time.

The configurable digital input filter value on 0960 IOL 380-021 was set to "off" (0 ms).

For calculation of user specific data transfer and round-trip times of possible input filters, PLC processing and cycles times must be taken into calculation.

The measured values are valid for a maximum of 48 bytes of IO-Link data for the IO-Link Master in each direction (Input/Output).

Use case 1:

IO-Link Master configuration with enabled Web interface and *disabled* IIoT protocols

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	3.7	6.0	7.7
DI to PLC	1.1	3.0	4.3
RTT	6.1	8.9	11.1

Use case 2:

IO-Link Master configuration with enabled Web interface and *enabled* IIoT protocols

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	7.7	10.0	13.4
DI to PLC	3.3	4.4	5.6
RTT	12.1	14.3	17.0

15 Accessories

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

http://www.beldensolutions.com

16 References

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