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Manual

Modbus TCP

LioN-X IO-Link Master:
0980 XSL 3912-121-007D-00F
(8 x IO-Link Class A, Multiprotocol)

LioN-Xlight IO-Link Master:
0980 LSL 3311-121-0006-008
(8 x IO-Link Class A, Modbus TCP)

0980 LSL 3310-121-0006-008
(4 x IO-Link Class A + 8 x DI, Modbus TCP)

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1 About this manual

1.1 General information

Please read the assembly and operating instructions in this manual carefully before starting up the modules. Keep the manual where it is accessible to all users.

The texts, figures, diagrams, and examples used in this manual are used exclusively 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.

Belden Deutschland GmbH
– Lumberg Automation™ –
Im Gewerbepark 2
D-58579 Schalksmühle
Germany
lumberg-automation-support.belden.com
www.lumberg-automation.com
catalog.belden.com

Belden Deutschland GmbH – Lumberg Automation™ – reserves the right to make technical changes or changes to this manual at any time without notice.

1.2 Explanation of symbols

1.2.1 Use of danger information

Danger information is denoted as follows:

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

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

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

1.2.2 Use of general information

General information is denoted as follows:

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

1.3 Version information

Index	Created	Changed
Version number	Version 1.0	Version 1.1
Date	03/2021	04/2021

Index	Changed	Changed
Version number	Version 1.2	
Date	05/2021	

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 (89/336/EEC, 93/68/EEC and 93/44/EEC) and the low voltage guideline (73/23/EEC).

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 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 this manual 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 manual, can result in serious personal injury or damage to equipment.

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

3 Designations and synonyms

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)
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
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
EIS	EtherNet/IP string
ERP	Enterprise Resource Planning system
ETH	ETHERNET
FE	Functional Earth
FME	Force Mode Enabled (EIP diagnostics)

FSU	Fast Start-Up
GSDML	General Station Description Markup Language
High-B	High-Byte
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/Q	I/O port pin 2 mode, Digital Input/switching signal
I/O	Input / Output
I/O port	X1 - X8
I/O port pin 2	Channel B of X1 - X8
I/O port pin 4 (C/Q)	Channel A of X1 - X8
IOL or IO-L	IO-Link
ISDU	Indexed Service Data Unit
IVE	IO-Link port Validation Error (EIP diagnostics)
I&M	Identification & Maintenance
JSON	JavaScript Object Notation (platform independent data format)
L+	I/O port pin 1, sensor power supply
LioN-X 60	LioN-X variants with a width of 60mm
Little Endian	Data format with Low-B on first place (EtherNet/IP)
LLDP	Link Layer Discovery Protocol
Low-B	Low-Byte
LSB	Least Significant Bit
LVA	Low Voltage Actuator Supply (EIP diagnostics)
LVS	Low Voltage System/Sensor Supply (EIP diagnostics)
MIB	Management Information Base

MP	Multi Protocol (PROFINET + EtherNet/IP + EtherCAT® + Modbus TCP)
MQTT	Message Queuing Telemetry Transport (open networking protocol)
MSB	Most Significant Bit
M12	Metric thread according to DIN 13-1 with 12 mm diameter
OLE	Output process data Length Error (EIP diagnostics)
OPC UA	Open Platform Communications Unified Architecture (platform independent, service-oriented architecture)
PLC	Programmable Logic Controller
PN	PROFINET
PNS	PROFINET string
PWR	Power
REST	REpresentational State Transfer
RFC	Request for Comments
RPI	Requested Packet Interval
SCA	Short Circuit Actuator/U_L/U_{Aux} (EIP diagnostics)
SCS	Short Circuit Sensor (EIP diagnostics)
SNMP	Simple Network Management Protocol
SP	Single Protocol (PROFINET, EtherNet/IP, EtherCAT® or Modbus TCP)
SPE	Startup Parameterization Error (EIP diagnostics)
U_{AUX}	$U_{Auxiliary}$
UDP	User Datagram Protocol
U_L	U_{Load}, supply voltage for the load circuit (Actuator supply on Class A IO-Link Master)
UL	Underwriters Laboratories Inc. (certification company)
UINT16	Unsigned integer with 16 bits or word in PLC (IW, QW)
UINT8	Byte in PLC (IB, QB)

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 and maintenance. They additionally enable easy and quick extension.

4.1 About LioN-X and LioN-Xlight

LioN-X and the LioN-Xlight variants are IO-Link Masters which convert standard input, standard output or IO-Link signals from sensors & actuators into an industrial Ethernet protocol (PROFINET, EtherNet/IP, EtherCAT®, Modbus TCP) 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 IO-Link Masters 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 Security	8 x IO-Link Class A
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
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
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
935701003	0980 LSL 3211-121-0006-004	LioN-Xlight M12-60 mm, IO-Link Master EtherCAT®	8 x IO-Link Class A

Article number	Product designation	Description	I/O port functionality
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

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

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-Xlight

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 5: 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 6: 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 Modbus TCP product features

Modbus Mode

Features MODBUS server via a standard TCP network. The number of allowed operations for holding registers is dependent on the device configuration. The device supports 4 up to 8 TCP sockets for communication.

Data connection

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

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

Data transmission rates

Featuring a transmission rate of up to 100 MBit/s, the Modbus TCP devices can handle both fast transmission of I/O data and transmission of larger volumes of data.

Diagnostic data

The devices support diagnosis flags and extended diagnostic data that can be appended to the I/O data.

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 device variant, the device has 4 Class A or 8 Class A ports with an additional hard-wired digital input on pin 2 of the I/O port. For detailed information see chapter I/O port overview on page 18.

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

IO-Link port connections

The IO-Link port connection option provided by the module series is the 5-pin M12 connector.

Validation & Backup

The Validation & Backup function checks if the right device is connected and stores / monitors 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.

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 134.

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

You can read the IO-Link Device parameters and write new parameters in single write mode (single write mode doesn’t activate the automated mechanism of the "Validation and Backup" function) to the IO-Link Device.

5.4 Security features

Firmware signature

All official firmware update packages contain a signature which prevents 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 protect the Web interface against unauthorized access. You can manage the allowed users by different access levels “Admin” or “Write”.

Default user settings:

User: admin

Password: private

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

5.5 Other features

Interface protection

The modules have reverse polarity, short-circuit and overload protection for all interfaces.

For more details, see section Port assignments on page 30.

Failsafe

The modules support a failsafe function. This allows you to define the behavior of every single channel configured as an output in the case of a loss of the 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 green-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

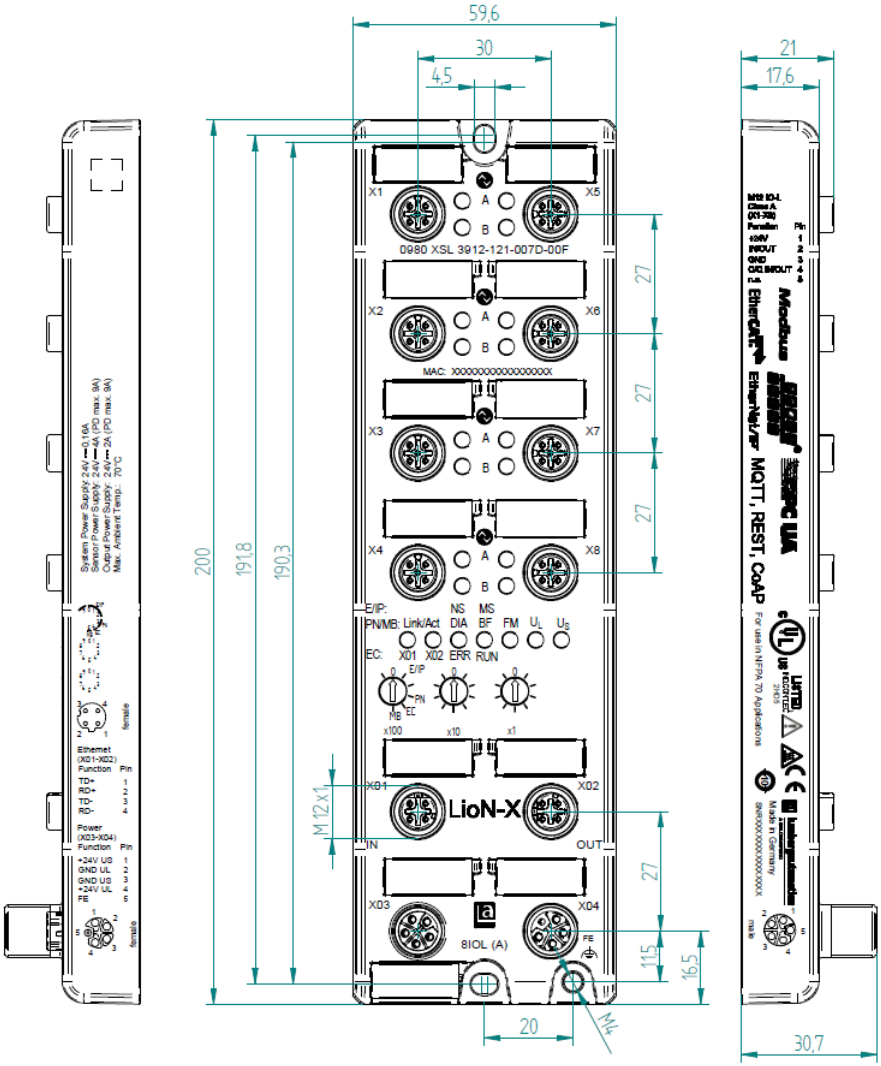


Figure 1: 0980 XSL 3912-121-007D-00F

6.2.2 LioN-Xlight variants with Modbus TCP

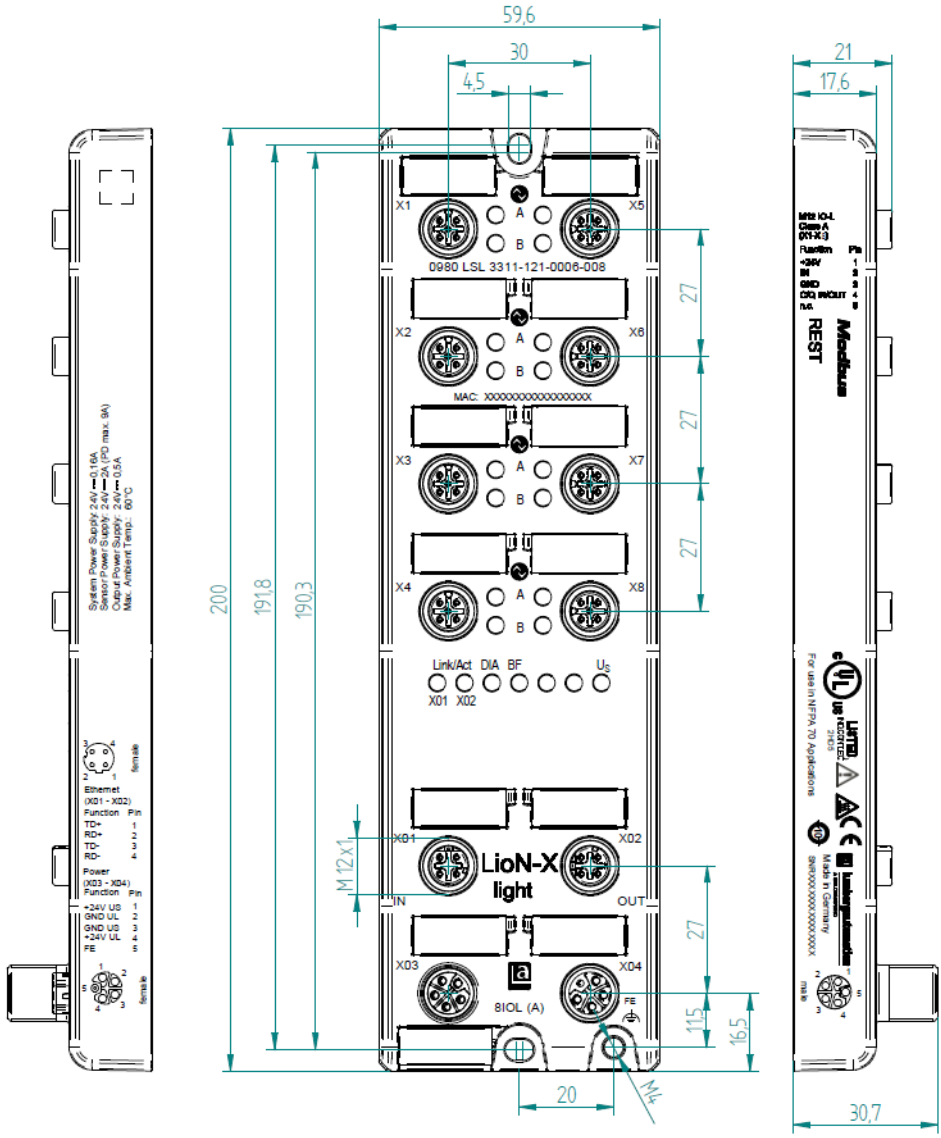


Figure 2: 0980 LSL 3311-121-0006-008

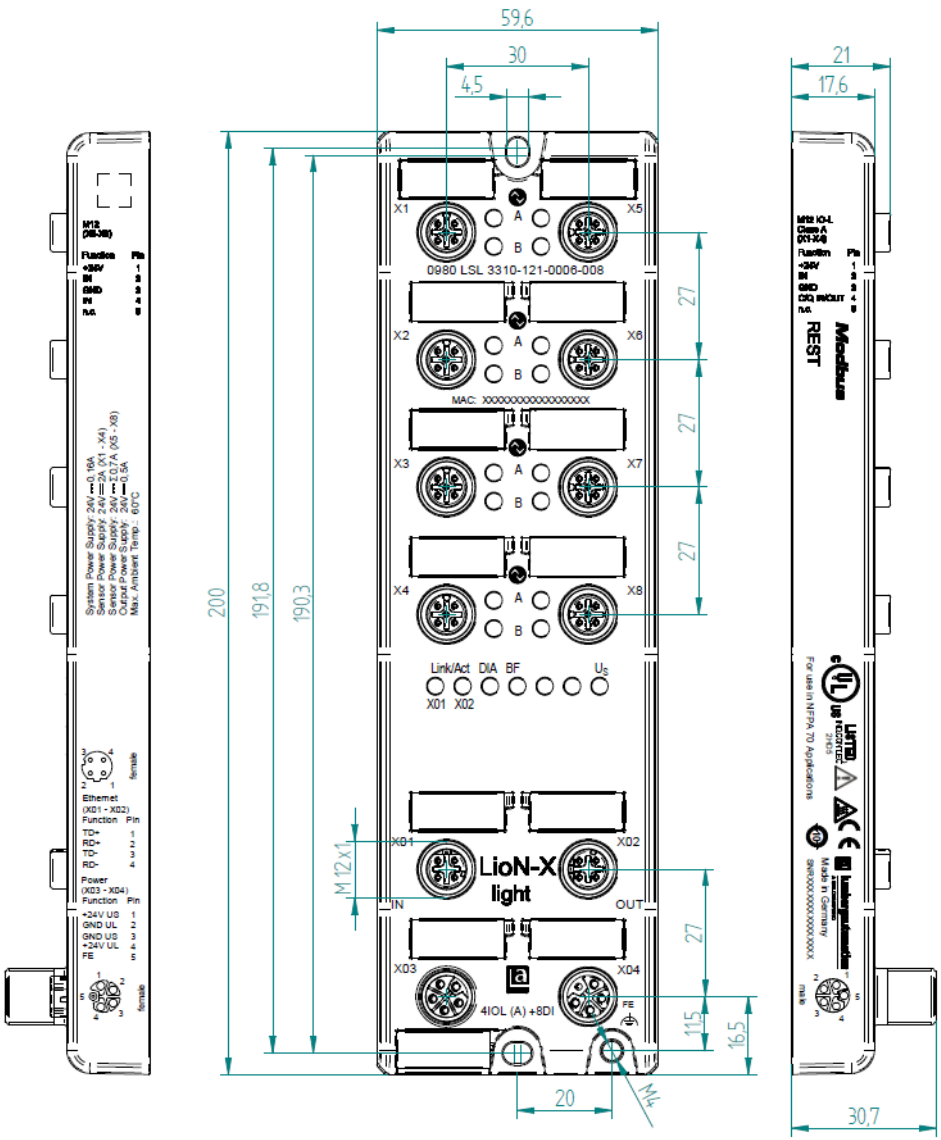


Figure 3: 0980 LSL 3310-121-0006-008

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 +115 °C (239 °F) for all LioN-X and LioN-Xlight variants.

Warning: Observe the following maximum output power for the sensor supply:

Max. 2.0 A per channel; max. 6.5 A in total (for **UL applications** max. 5 A in total) 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).

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

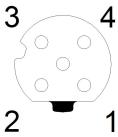


Figure 4: Schematic drawing, ports X01, X02

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 7: 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

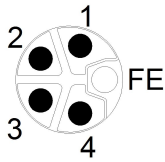


Figure 5: Schematic diagram of the M12 L-coding (connector X03 for Power In)

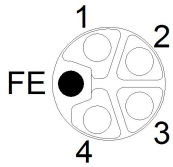


Figure 6: Schematic diagram of the M12 L-coding (socket X04 for Power Out)

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 (PE)	Functional ground

Table 8: Power supply with M12-Power

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

[1] U_L and U_S ground connected in device

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

6.3.3.1 IO-Link Class A

Color coding: black

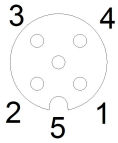


Figure 7: Schematic drawing I/O port as M12 socket IO-Link Class A

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 inputs or digital outputs
	3	GND	Ground/reference potential
	4	C/Q IN/OUT	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected

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 inputs
	3	GND	Ground/reference potential
	4	C/Q IN/OUT	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 inputs
	3	GND	Ground/reference potential
	4	C/Q IN/OUT	Ch. A: IO-Link data communication, digital input or digital output
	5	n.c.	not connected
IO-Link Class A, ports X5 - X8	1	+24 V	power supply +24 V
	2	IN	Ch. B: Digital inputs
	3	GND	Ground/reference potential
	4	C/Q IN	Ch. A: IO-Link data communication, digital input
	5	n.c.	not connected

Table 9: I/O ports as M12 socket IO-Link Class A

7 Starting operation

7.1 Device identification

With any MODBUS client, the server running on LioN-X can be reached to get identification data including vendor name, product code and revision.

The following table represents the device identification data.

Register	Length	Description	Default value	Access
401025	1	Device firmware "Version major"	–	RO (Read Only)
401026	1	Device firmware "Version minor"	–	RO
401027	32	Name of IO-Link device	–	RO
401043	1	Source of IP address: 0: DHCP 1: Static	–	RO
401044	2	IP address of device	–	RO
401046	3	MAC address	–	RO
401047	1	Active TCP connections	–	RO

7.2 MAC addresses

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

7.3 Modbus function codes

LioN-X devices support the following Modbus function codes:

- Function code 03 (0x03)
- Function code 06 (0x06)
- Function code 16 (0x10)

Write access to holding registers is subject to the device feature set and the configuration of the holding register.

7.4 State on delivery

Modbus TCP parameters in state on delivery or after a factory reset:

Network mode:	DHCP
Static IP address:	192.168.1.XXX (XXX = rotary switch position or last stored data)
Subnet mask:	255.255.255.0
Gateway address	0.0.0.0
Device designations:	0980 XSL 3912-121-007D-00F 0980 LSL 3311-121-0006-008 0980 LSL 3310-121-0006-008
Vendor code:	21
Product type:	Modbus TCP server

7.5 Setting the rotary encoding switches

Attention: Only applicable for LioN-X multiprotocol variants; not applicable for LioN-Xlight variants.

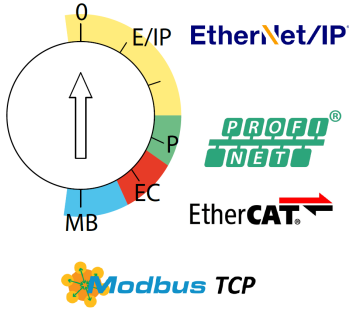
The LioN-X multiprotocol variants allow you to select different protocols for communication within an industrial Ethernet system. In this way the IO-Link Masters with multiprotocol function can be integrated into different networks without it being necessary to purchase products specific for each protocol. 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 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 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 or Modbus TCP.

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

Table 10: 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 38.

If you position the rotary encoding switch in a manner that is invalid, the device signals this to you with a blink code (the BF/MS LED blinks in red three times).

7.5.1 Modbus TCP

If you decide to use Modbus TCP as a protocol, use the first rotary encoding switch to select the protocol. The second rotary encoding switch (x10) can be used to configure the 10 position of the last octet of the IP address, and the third rotary encoding switch (x1) allows you to configure the 1 position. Values between 0 and 9 can be selected for the second and third switches. The first three octets of the IP address are set by default to 192.168.1.

For example, the rotary encoding switch setting 5(x100), 1(x10) and 0(x1) gives you an IP address of 192.168.10 for Modbus TCP. It is only possible to assign IP addresses between 192.168.1.1 and 192.168.1.99 for Modbus TCP via the rotary switches.

Rotary switch setting	Function
500 (state on delivery)	In the state on delivery, the DHCP and BOOTP functions are activated. The network parameters are initially requested via DHCP requests. If this is not successful, BOOTP requests are used. The network parameters are not saved, but the integrated web server can be used to save them.
500 (network parameters already saved)	The network parameters last saved are used (IP address, subnet mask, gateway address, DHCP on/off, BOOTP on/off).
005 ... 599	The last 2 digits of the saved or preset IP address are overwritten by the setting of the rotary switch.
979	The device performs a reset to the factory settings. The network parameters are also reset to the default values. Communication is not possible in this operation mode.

Table 11: Setting options of the rotary encoding switches for Modbus TCP

7.5.2 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 on page 36 again to select a new protocol.

For performing a factory reset via software configuration, see chapter OPC UA configuration on page 84 and the configuration section.

7.6 Setting network parameters

Use the two right-hand rotary switches (x10 and x1) on the front of the device to set the last octet of the static IP address. Each rotary switch in the range of Modbus TCP is assigned to one decimal digit, so that you can configure a number between **0 – 99**. During startup, the position of the rotary switches is typically read within one time cycle.

500

In state of delivery, the rotary switches are set to 000 and DHCP is enabled. In this position the device always uses the last stored network parameters.

The complete IP address, the subnet mask, the gateway address and the network mode (DHCP or BOOTP) can be configured and stored via the Web server or any other available configuration interfaces. New configuration interfaces can only be applied to after a restart of the device.

For additional information, see chapter Setting the rotary encoding switches on page 36.

8 Configuration Modbus TCP

The LioN-X devices support Modbus over a standard TCP network. It is possible to create 4 to 8 socket connections with devices.

8.1 Configuration parameters

Parameters of the LioN-X device can be configured via function code 06 and 16, depending on the features and the designated functionality of the holding register. To avoid malfunctioning of the device, there is a register which acts as latch switch.

Register	Length	Description	Default value	Access
400512	1	If **1** is written, then and only then the configuration registers described below can be written. If **0** is written, the updated configuration will be taken by the device Transition needs to be detected: **0** to **1**: Below described registers will be RW **1** to **0**: Configuration apply	0	RW ("Read/ Write")

8.2 General settings

Register	Length	Description	Default value	Access
400593	1	Report U_L/U_{Aux} Supply Voltage Fault 0 = Diagnosis disabled 1 = Diagnosis enabled 2 = Auto	0	RW
400594	1	Report Actuator fault without U_L/U_{Aux} voltage 0 = Diagnosis disabled 1 = Diagnosis enabled	0	RW
400595	1	Report U_S voltage Fault 0 = Diagnosis disabled 1 = Diagnosis enabled	0	RW
400596	1	Reserved	0	
400597	1	Output Auto restart 0 = Output Auto restart disabled 1 = Output Auto restart enabled	0	RW
400598	1	Web interface Lock 0 = Web interface disabled 1 = Web interface enabled	0	RW
400599	1	Force mode Lock 0 = Forcing disabled 1 = Forcing enabled	0	RW
400600	1	External Configuration Lock 0 = External Configuration disabled 1 = External Configuration enabled	0	RW

8.2.1 Force Mode Lock

The input and output process data can be forced for implementation reasons via different interfaces (e.g. Web interface, REST, OPC- UA, MQTT). The support of interfaces depends on the available software features. If the **Force Mode Lock** is enabled, it is no longer possible to force input and output process data through these interfaces.

Danger: Risk of physical injury or death! Unattended forcing can lead to unexpected signals and uncontrolled machine movements.

8.2.2 Web Interface Lock

The Web interface access can be configured. If **Web Interface Lock** is enabled, the Web pages are no longer reachable.

8.2.3 Report U_L/U_{Aux} Supply Voltage Fault

During commissioning, it is possible that no power supply is connected to the U_L/U_{Aux} pins. Therefore it can be helpful to suppress and disable the **Report U_L/U_{Aux} Supply Voltage Fault** diagnosis.

8.2.4 Report actuator fault without U_L/U_{Aux} voltage

During commissioning, it is possible that no power supply is connected to the U_L/U_{Aux} pins. Therefore it can be helpful to suppress and disable the **Report actuator fault without U_L/U_{Aux} voltage** diagnosis.

8.2.5 Report U_S voltage fault

During commissioning, it is possible that no power supply is connected to the U_S pins. Therefore it can be helpful to suppress and disable the **Report U_S voltage fault** diagnosis.

8.2.6 External configuration lock

Configuration parameters can be set via different alternative interfaces (e.g. Web interface, REST, OPC-UA, MQTT). An external configuration can only be done if no connection is established or if the **External configuration lock** is disabled during cyclic communication. Every new PLC configuration, transmitted through the configuration assembly, overwrites the device parameters.

8.3 Channel settings

Register	Length	Description	Default value	Access
400513… 400528	1	DO Surveillance Timeout Port X1 Ch A ... Port X8 Ch B Valid values: 0 to 255	0	RW ("Read/Write")
400529… 400544	1	DO Failsafe Port X1 Ch A ... Port X8 Ch B 0: Set Low 1: Set High 2: Hold Last	0	RW
400545… 400560	1	DI Filter Port X1 Ch A ... Port X8 Ch B 0: Disabled 1: 1 ms 2: 2 ms 3: 3 ms 4: 6 ms 5: 10 ms 6: 15 ms	3	RW
400561… 400576	1	DI Logic Port X1 Ch A ... Port X8 Ch B 0: Normally Open 1: Normally Close	0	RW
400577… 400592	1	DO Restart Port X1 Ch A ... Port X8 Ch B 0: Disable 1: Enable	1	RW

8.3.1 DO Surveillance Timeout (Ch1..16)

The digital output channels are monitored during runtime. The error states are detected and reported as a diagnosis. To avoid error states during the switching of output channels, the surveillance timeout can be configured as a delay with deactivated monitoring.

The delay time begins with a rising edge of the output control bit. After delay time has elapsed, the output is monitored and error states are reported by diagnosis. When the channel is permanently switched on or off, the typical filter value (not changeable) is 5 ms.

8.3.2 DO Failsafe (Ch1..16)

The LioN-X devices support a failsafe function for the channels used as digital outputs. In case of an internal device error, the PLC is in STOP state and cannot provide valid process data. The connection is interrupted or the communication is lost. The outputs are controlled according to the configured failsafe values.

Set Low:

If failsafe is active, the physical output pin of the channel is set to low (0).

Set High:

If failsafe is active, the physical output pin of the channel is set to high (1).

Hold Last:

If failsafe is active, the physical output pin of the channel holds the last valid process data state (0 or 1).

8.3.3 DO Restart Mode (Ch1..16)

In case of a short circuit or overload at an output channel, a diagnosis is reported and the output is switched to "off".

If the **DO Restart Mode** for this channel is enabled, the output will automatically be turned on again after a fix time delay for checking if the overload or short circuit condition is still active. When it is active, the channel is switched off again.

If the **DO Restart Mode** is disabled, the output channel is not automatically turned on again. It can be turned on after a logical reset of the process output data of the channel.

8.3.4 DI Logic (Ch1..16)

The logical state of an input channel can be configured via these parameters. If a channel is set to "Normally Open", a low signal ("0") is transferred to the process input data (e.g. if a non-damped sensor has an open switching output).

If a channel is set to "Normally Close", a high signal ("0") is transferred to the process input data (e.g. if a non-damped sensor has a closed switching output).

The channel LED shows, independent of these settings, the physical input state of the port pin.

8.3.5 DI Filter (Ch1..16)

A filter time for every digital input channel can be configured by these parameters. When there is no need for a filter it can be disabled.

8.4 IO-Link Port 1..8 settings

Register	Length	Description	Default value	Access
401513	64	IO-Link Ch. 1 Settings	-	RW ("Read/Write")
401577	64	IO-Link Ch. 2 Settings	-	RW
401641	64	IO-Link Ch. 3 Settings	-	RW
401705	64	IO-Link Ch. 4 Settings	-	RW
401769	64	IO-Link Ch. 5 Settings	-	RW
401833	64	IO-Link Ch. 6 Settings	-	RW
401897	64	IO-Link Ch. 7 Settings	-	RW
401961	64	IO-Link Ch. 8 Settings	-	RW

Register	Length	Description	Default value	Access
402025	16	IO-Link Ch. 1 Serial Nr.	0	RO
402041	16	IO-Link Ch. 2 Serial Nr.	0	RO
402057	16	IO-Link Ch. 3 Serial Nr.	0	RO
402073	16	IO-Link Ch. 4 Serial Nr.	0	RO
402089	16	IO-Link Ch. 5 Serial Nr.	0	RO
402105	16	IO-Link Ch. 6 Serial Nr.	0	RO
402121	16	IO-Link Ch. 7 Serial Nr.	0	RO
402137	16	IO-Link Ch. 8 Serial Nr.	0	RO

Detailed channel settings

The following example for channel 1 represents all possible port settings for IO-Link. The values are identical for all 8 ports.

Register	Length	Description	Default value	Access
401513	1	Port Mode 0 = Deactivated 1 = IO-Link Manual 2 = IO-Link Auto 3 = Digital Input 4 = Digital Output	3	RW
401514	1	Validation Option 0: No device check and clear (no data storage) 1: Type compatible V1.0 device (no data storage) 2: Type compatible V1.1 device (no data storage) 3: Type compatible V1.1 device with Backup + Restore (download + upload) 4 Type compatible V1.1 device with Restore (download master to device)	0	RW
401515	1	IQ Mode 0 = Deactivated 1 = Digital Input 2 = Digital Output	2	RW
401516	1	Cycle Time 0: As fast as possible 1: 1.6 ms 2: 3.2 ms 3: 4.8 ms 4: 8.0 ms 5: 20.8 ms 6: 40.0 ms 7: 80.0 ms 8: 120.0 ms	0	RW
401517	1	Vendor ID 0..65535 (0)	0	RW
401518	2	Device ID 0..16777215 (0)	0	RW

Register	Length	Description	Default value	Access
401520	1	Swap Mode: 0: RawIO-Link 1 ..16: 1..16 WORD 17.. 24: 1..8 DWORD 0 .. 30 Byte (0)	0	RW
401521	1	Swap Length 0 to 32	0	RW
401522	1	Swap offset 0..30 Byte (0)	0	RW
401523	1	Sensor supply enabled 0: Don’t supply electric voltage to sensor 1: Supply electric voltage to sensor	1	RW
401524	1	Pin2 LED enabled 0: Disable LED on Channel B 1: Enable LED on Channel B	1	RW
401525	1	Suppress All Diagnosis 0: Generate diagnosis on this channel 1: Do not generate any diagnosis on this channel	0	RW
401526	1	Failsafe mode 0: Set Low 1: Set High 2: Hold Last 3: Replacement Value (transferred via offset 14-46)	2	RW
401527	32	IOL Failsafe replacement values	0	RW
401559	1	Use Push Pull for Pin 4 0: Use High-Side switches 1: Use Push Pull	0	RW
401560	1	Reserved	0	RW
401561	1	Pin 4 current limit (Maximum current limit till Pin 4 is turned off)	2000	RW
401562	1	Pin 2 current limit (Maximum current limit till Pin 2 is turned off)	2000	RW

Register	Length	Description	Default value	Access
401563... 401576	14	Reserved	0	RW

8.4.1 Port Mode

The **Port Mode** describes how the IO-Link Master handles the presence of an IO-Link device at the port.

Deactivated:

The IO-Link port is deactivated but can be configured for later use. No diagnostics are generated if the IO-Link device is not connected.

IO-Link Auto:

The IO-Link port is activated and no explicit port configuration is needed. Configurations such as *Validation and Backup* (Inspection Level), *Vendor ID*, *Device ID* and *Cycle Time* are not required.

IO-Link Manual:

The IO-Link port is activated and explicit port configuration can be done for the parameters *Validation and Backup* (Inspection Level), *Vendor ID*, *Device ID* and *Cycle Time*.

Digital Output:

In this mode, the channel operates as digital output. The channel can be controlled by the *Digital Output Channel Control* (first two bytes of the output data) or by the *IO-Link Output Data* (first byte of each IO-Link device output data) of the cyclic process data. This depends on the *Digital Output Control* parameter in the general settings.

Digital Input:

In this mode, the channel operates as digital input. The channel state can be seen in the *Digital Input Channel* status of the cyclic process data.

8.4.2 Validation and Backup

With this parameter, the user can set the behavior of the IO-Link ports regarding the type compatibility and data storage mechanism of the connected IO-Link Device.

The precondition for using **Validation and Backup** is that you configure the **Port Mode** to "IO-Link Manual".

Definition of Backup (Device to Master)

A Backup (upload from IO-Link Device to Master) is performed when an IO-Link Device is connected and the master does not have any valid parameter data. The read parameter data are permanently stored on the master.

If parameter data is changed on the Device during runtime, the stored device parameters on the Master can be updated using the ParamDownloadStore (index 0x0002, subindex 0x00, value 0x05) command. This command sets the DS_UPLOAD_REQ flag on the device and thus the IO-Link Master executes an upload procedure from the IO-Link Device.

With an enabled Backup function, the IO-Link Master can be replaced.

Definition of Restore (Master to Device)

A Restore (download from IO-Link Master to Device) is performed when an IO-Link Device is connected and the master has valid parameter data stored which are usable for the device and not equal compared to the device parameters. This procedure can be blocked by the IO-Link Device via Parameter Storage Locked.

With an enabled Restore function, the IO-Link Device can be replaced.

No device check and clear (no data storage):

No check of connected **Vendor ID** or **Device ID** and no **Backup and Restore** support of the IO-Link Master parameter server.

Type compatible V1.0 device (no data storage):

Type compatible according IO-Link specification V1.0 which includes validation of **Vendor ID** and **Device ID**. The IO-Link specification V1.0 does not support IO-Link Master parameter server.

Type compatible V1.1 device (no data storage):

Type compatible according IO-Link specification V1.1 which includes validation of **Vendor ID** and **Device ID**. **Backup and Restore** is disabled.

Type compatible V1.1 device with Backup + Restore (download + upload):

Type compatible according IO-Link specification V1.1 which includes validation of **Vendor ID** and **Device ID**. Backup and Restore is enabled.

Type compatible V1.1 device with Restore (download Master to Device):

Type compatible according IO-Link specification V1.1 which includes validation of **Vendor ID** and **Device ID**. Only Restore is enabled.

8.4.3 IQ Mode

The operating mode of PIN 2(Channel B) of the respective IO-Link channel can be configured via this parameter.

Digital Output:

In this mode, the channel operates as digital output. The channel can be controlled by the *Digital Output Channel Control* (first two bytes of the output data) or by the *IO-Link Output Data* (first byte of each IO-Link device output data) of the cyclic process data. This depends on the *Digital Output Control* parameter in the general settings.

Digital Input:

In this mode, the channel operates as digital input. The channel state can be seen in the *Digital Input Channel* status of the cyclic process data.

Aux:

In this mode, Pin 2 of the IO-Link port acts as an auxiliary voltage output. The auxiliary voltage is fed by the U_{Aux} supply input. The auxiliary voltage output cannot be controlled.

8.4.4 Cycle Time

The IO-Link cycle time can be configured by this parameter.

The precondition for using **Cycle Time** is that you configure **Port Mode** to "IO-Link Manual".

As fast as possible:

The IO-Link port uses the max. supported IO-Link device and master update cycle time for the cyclic I/O data update between IO-Link Master and IO-Link Device.

1.6 ms, 3.2 ms, 4.8 ms, 8.0 ms, 20.8 ms, 40.0 ms, 80.0 ms, 120.0 ms:

The cycle time can be set manually to the provided options. This option can be used e.g. for IO-Link devices which are connected over inductive couplers. Inductive couplers are normally the bottleneck in the update cycle time between IO-Link Master and IO-Link Device. In this case, please refer to the data sheet of the inductive coupler.

8.4.5 Vendor ID

The **Vendor ID** is needed for the validation of the IO-Link device and can be configured with this parameter.

Precondition for using the **Vendor ID** is that you configure **Port Mode** to "IO-Link Manual". **Validation and Backup** must be set to a type compatible V1.X device.

8.4.6 Device ID

The **Device ID** is needed for the validation of the IO-Link device and can be configured with this parameter.

Precondition for using the **Device ID** is that you configure **Port Mode** to "IO-Link Manual". **Validation and Backup** must be set to a type compatible V1.X device.

8.4.7 Swapping Mode

The byte order of IO-Link is big endian. For setting output data in the correct format, the parameters **Swapping Mode** and **Swapping Offset** support the user. There can be selected up to 16 words or up to 8 double words for converting the output data.

Raw IO-Link Data:

No byte swap

Data type WORD:

Data byte order: Byte 1, Byte 2

Order after Swap: Byte 2, Byte 1

Data type DWORD:

Data byte order: Byte 1, Byte 2, Byte 3, Byte 4

Order after Swap: Byte 4, Byte 3, Byte 2, Byte 1

8.4.8 Swapping Offset

The **Swapping Offset** describes the start point in the process data for using the configured **Swapping Mode**. Both parameters are dependent on the configured output data size.

8.4.9 IOL Failsafe

The LioN-X devices support a failsafe function for the output data of the IO-Link channels. In case of an internal device error, the PLC is in STOP state and cannot provide valid process data, the connection is interrupted or the communication is lost: The output data of the IO-Link channels is controlled by the configured failsafe values.

Set Low:

If failsafe is active, all bits of the IO-Link output data are set to low (0).

Set High:

If failsafe is active, all bits of the IO-Link output data are set to high (1).

Hold Last:

If failsafe is active, all bits of the IO-Link output data arel hold the last valid process data state (0 or 1).

Replacement Value:

A **Replacement Value** can be set via the **IO-Link Failsafe** parameter object for every IO-Link device. If failsafe is active, these **Replacement Values** are transmitted to the IO-Link device. The current configured IO-Link output data size must be considered. Take into account that in the case of an error the

Replacement Values are sent instead of the output process data so that a configured **Swapping Mode** has influence on the byte order.

IO-Link Master Command:

If failsafe is active, an IO-Link-specific mechanism for valid/invalid output process data is used and the IO-Link device determines the behavior itself.

8.4.10 IOL Failsafe replacement values

32 holding registers represent byte-wise 32 replacement values. If failsafe is active, these values are transmitted to IO-Link device.

8.4.11 Output Data Size

The **Output Data Size** of the respective IO-Link device can be configured by this parameter. There can be up to 32 Bytes of IO-Link output data per port.

The **Output Data Size** of every IO-Link device has influence on the total **Output Data Size** of the connection. It has to be taken into account that all IO-Link output data fits into the total size.

This parameter is only settable when no connection is active.

8.4.12 Input Data Size

The **Input Data Size** of the respective IO-Link device can be configured by this parameter. There can be up to 32 Bytes of IO-Link input data.

The **Input Data Size** of every IO-Link device has influence on the total **Input Data Size** of the connection. It has to be taken into account that all IO-Link input data fits into the total size.

This parameter is only settable when no connection is active.

8.4.13 Serial number

The desired IO-Link device serial number, starting from 402025, can be written in the holding registers. Each serial number can contain a maximum of 32 bytes. 16 registers are assigned to each IO-Link channel.

9 Process data assignment

The LioN-X devices in general support process data communication in both directions. The consuming data in this context is defined as the process output data which controls physical outputs and IO-Link output data. The producing data in this context is defined as the process input data which contains the physical inputs, diagnostics and IO-Link input data with optional extended status and event data.

The following chapters describe the data images for the consuming and producing data direction which are assigned to the output and input assemblies.

9.1 Consuming data (output)

Register	Length	Description	Default value	Access
400001	16	Process Data Output Port 1	–	RW ("Read/Write")
400017	16	Process Data Output Port 2	–	RW
400033	16	Process Data Output Port 3	–	RW
400049	16	Process Data Output Port 4	–	RW
400065	16	Process Data Output Port 5	–	RW
400081	16	Process Data Output Port 6	–	RW
400097	16	Process Data Output Port 7	–	RW
400113	16	Process Data Output Port 8	–	RW

Each holding register holds two bytes of output data. Valid process data values depend on the port configuration.

Examples:

Port	Mode	Valid output data to be written
1	IO-Link 1 byte output	Least significant 1 byte of 400001
2	Digital output	Least significant bit (bit 0) of 400017
3	IO-Link 4 bytes output	All 2 bytes on registers 400033 to 400034
4	IO-Link 16 bytes output	All 2 bytes on registers 400049 to 400057
5	IO-Link 32 bytes output	All 2 bytes on registers 400065 to 400080

Table 12: Examples for consuming data

9.2 Producing data (input)

Register	Length	Description	Default value	Access
400257	16	Process Data Input Port 1	–	RO ("Read Only")
400273	16	Process Data Input Port 2	–	RO
400289	16	Process Data Input Port 3	–	RO
400305	16	Process Data Input Port 4	–	RO
400321	16	Process Data Input Port 5	–	RO
400337	16	Process Data Input Port 6	–	RO
400353	16	Process Data Input Port 7	–	RO
400369	16	Process Data Input Port 8	–	RO

Each holding register holds two bytes of input data. Valid process data values depend on the port configuration.

Examples:

Port	Mode	Valid input data to be read
1	IO-Link 1 byte input	Least significant 1 byte of 400257
2	Digital output	Least significant bit (bit 0) of 400273
3	IO-Link 4 bytes input	All 2 bytes on registers 400289 to 400290
4	IO-Link 16 bytes input	All 2 bytes on registers 400305 to 400312
5	IO-Link 32 bytes input	All 2 bytes on registers 400321 to 400336

Table 13: Examples for producing data

9.3 Channel B as digital output

Register	Length	Description	Default value	Access
400436	1	PIN 2 (Channel B) as DO (Bit wise)	–	RW ("Read/Write")

This holding register represents bitwise the values of Channel B (Pin 2) of IO-Link class-A port. Values written on this register will only have an effect if Channel B is configured as Digital Output.

400436	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Ch. B Digital Output	NA	NA	NA	NA	NA	NA	NA	NA	X8	X7	X6	X5	X4	X3	X2	X1

9.4 Channel B as digital input

Register	Length	Description	Default value	Access
400435	1	PIN 2 (Channel B) as DI (Bit wise)	–	RW ("Read/Write")

This holding register represents bitwise the values of Channel B (Pin 2) of IO-Link class-A port. Values written on this register will only have an effect if Channel B is configured as Digital Input.

400435	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Ch. B Digital Input	NA	NA	NA	NA	NA	NA	NA	NA	X8	X7	X6	X5	X4	X3	X2	X1

10 Diagnostics processing

Register	Length	Description	Default value	Access
400401	1	System/sensor power supply present 0: System/sensor power not present 1: System/sensor power supply present	–	RO ("Read Only")
400402	1	Error of the system/sensor power supply 0: System/sensor power supply fault not present 1: System/sensor power supply fault occurred	–	RO
400403	1	Auxiliary/Actuator power supply present 0: Auxiliary/Actuator power supply not present 1: Auxiliary/Actuator power supply present	–	RO
400404	1	Error of the auxiliary/actuator power supply 0: Auxiliary/actuator power supply fault not present 1: Auxiliary/actuator power supply fault occurred	–	RO
400405	1	Internal Module Error	–	RO
400406	1	Force mode diagnosis	–	RO
400407	1	Overload/short-circuit of the IO port sensor supply outputs This register represent bitwise status of Overload/short-circuit.	–	RO
400408	1	Overload/short circuit of the digital outputs Channel A (CQ) This register represent bitwise status of overload/short-circuit on digital outputs Channel A (CQ).	–	RO

Register	Length	Description	Default value	Access
400409	1	IQ short fault Overload/short circuit of the digital outputs Channel B (IQ). This register represent bitwise status of overload/short-circuit on digital outputs Channel B (IQ).	–	RO

Register	Length	Description	Default value	Access
400426	1	Status of IO-Link Ch. 1	–	RO
400427	1	Status of IO-Link Ch. 2	–	RO
400428	1	Status of IO-Link Ch. 3	–	RO
400429	1	Status of IO-Link Ch. 4	–	RO
400430	1	Status of IO-Link Ch. 5	–	RO
400431	1	Status of IO-Link Ch. 6	–	RO
400432	1	Status of IO-Link Ch. 7	–	RO
400433	1	Status of IO-Link Ch. 8	–	RO

Register	Length	Description	Default value	Access
402501	200	IO-Link events Ch. 1	–	RO
402701	200	IO-Link events Ch. 2	–	RO
402901	200	IO-Link events Ch. 3	–	RO
403101	200	IO-Link events Ch. 4	–	RO
403301	200	IO-Link events Ch. 5	–	RO
403501	200	IO-Link events Ch. 6	–	RO
403701	200	IO-Link events Ch. 7	–	RO
403901	200	IO-Link events Ch. 8	–	RO

10.1 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 diagnosis is generated.

The green U_S indicator is off.

The error diagnosis 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 18 V DC from the perspective of the system power supply.

The diagnostics in the holding register 400401 will be updated.

10.2 Error of the auxiliary/actuator power supply

The voltage value for the incoming auxiliary/actuator power supply is also monitored globally. If **Report U_L/U_{Aux} Supply Voltage Fault** is enabled, an error message is generated when the voltage drops below approx. 18 V or exceeds approx. 30 V. The U_L/U_{Aux} indicator shows red.

Holding register 400402 can be read to get the present status of the auxiliary/actuator power supply. The diagnostic data on holding register 400403 will be updated.

If output channels are set to **High State** and **Report DO Fault without U_L/U_{Aux}**, additional error diagnostics, caused by the voltage failure, are generated on the channels.

If **Report U_L/U_{Aux} Supply Voltage Fault** is disabled, no U_L/U_{Aux} or channel diagnostics appear.

10.3 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), holding register 400406 will be updated with the following data:

400406	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
sensor supply Short circuit	NA	NA	NA	NA	NA	NA	NA	NA	X8	X7	X6	X5	X4	X3	X2	X1

10.4 Overload/short circuit of the digital outputs

In case of an overload or a short circuit between pin 1 and pin 3 on the ports (X1 - X8), holding register 400407 will be updated with the following data. This diagnosis is valid if the respective port's channel A is in *Digital Output Mode*.

400407	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Overload/ short circuit of Channel A (CQ)	NA	NA	NA	NA	NA	NA	NA	NA	X8	X7	X6	X5	X4	X3	X2	X1

In case of an overload or a short circuit between pin 2 (Channel B) and pin 3 on the ports (X1 - X8), holding register 400408 will be updated with the following data. This diagnosis is valid if the respective port's channel B is in *Digital Output Mode*.

400408	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Overload/ short circuit of Channel B (IQ)	NA	NA	NA	NA	NA	NA	NA	NA	X8	X7	X6	X5	X4	X3	X2	X1

10.5 IO-Link channel status

IO-link contains standard data for the channel status. The states of an individual IO-Link channel can be read on holding registers 400426 – 400433.

States of IO-Link channel

0:	No device present
1:	Deactivated
2:	Diagnosis mode
3:	Pre-OP mode
4:	OP mode
5:	DI mode
6:	DO mode
254:	Power OFF
255:	No status available

10.6 IO-Link channel events

During operation, the IO-Link Master generates events for a particular channel. Holding registers 402501 – 404100 will hold up to 32 events.

Register	Length	Description	Default value	Access
402501	1	IO-Link Ch. 1 No. of events present	–	RO ("Read Only")
402502	5	IO-Link Ch. 1 Event 1	–	RO
402507	5	IO-Link Ch. 1 Event 2	–	RO
…		…		…
402662	5	IO-Link Ch. 1 Event 32	–	RO
402667	33	Reserved	–	RO
402701	1	IO-Link Ch. 2 No. of events present	–	RO
402702	5	IO-Link Ch. 2 Event 1	–	RO
402707	5	IO-Link Ch. 2 Event 2	–	RO
…		…		…
402762	5	IO-Link Ch. 2 Event 32	–	RO
402767	33	Reserved	–	RO
…		…		…
…		…		…
403901	1	IO-Link Ch. 8 No. of events present	–	RO
403902	5	IO-Link Ch. 8 Event 1	–	RO
403907	5	IO-Link Ch. 8 Event 2	–	RO
…		…		…
403962	5	IO-Link Ch. 8 Event 32	–	RO
403967	33	Reserved	–	RO

The following example shows details of a single event which is applicable for all 32 events on 8 channels:

Register	Length	Description	Default value	Access
402502	2	Timestamp	–	RO
402504	1	Event Type (Classification)	–	RO
402505	1	Event Code	–	RO
402506	1	Reserved	–	RO

The 32 event registers act like a ring buffer. Once FIFO buffer is full, the earliest event will be removed from buffer and all other events will be pushed one step up. Latest event details will be available then on event 32.

Timestamp:

Local timestamp of a device. Takes 4 bytes.

Event Type:

Classification of events. There are 3 different types of events. The type is classified via the values 1-3 on the respective holding register.

1:	Notification
2:	Warning
3:	Error

Event Code:

The event code represents a unique code for individual events as per IO-Link specifications. The following event code(s) will be generated on the respective holding register.

0x1000:	General Malfunction
0x1800:	No Device
0x1801:	Startup parametrization error
0x1802:	Incorrect Vendor ID - Inspection Level mismatch
0x1803:	Incorrect Device ID - Inspection Level mismatch
0x1804:	Short circuit at C/Q
0x1805:	PHY over temperature
0x1806:	Short circuit at L+
0x1807:	Overcurrent at L+
0x1808:	Device Event overflow
0x1809:	Backup inconsistency - memory out of range
0x180A:	Backup inconsistency - identity fault
0x180B:	Backup inconsistency - Data Storage unspecific error
0x180C:	Backup inconsistency - upload fault
0x180D:	Parameter inconsistency - download fault
0x180E:	P24 (Class B) missing or under voltage
0x180F:	Short circuit at P24 (Class B)
0x1810:	Short circuit at I/Q
0x1811:	Short circuit at C/Q (Digital)

0x1812:	Overcurrent at I/Q
0x1813:	Overcurrent at C/Q (Digital)
0x6000:	Invalid cycle time
0x6001:	Revision fault
0x6002:	ISDU batch failed
0xFF21:	DL: Device plugged in
0xFF22:	Device communication lost
0xFF23:	Data Storage identification mismatch
0xFF24:	Data Storage buffer overflow
0xFF25:	Data Storage parameter access denied
0xFF26:	Port status changed
0xFF27:	Data Storage upload completed
0xFF31:	DL: Incorrect Event signaling

11 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.

11.1 MQTT

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

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

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.

11.1.1 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 request. For more information see chapter MQTT configuration - Quick start guide on page 81.

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 14: 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 73.

11.1.2 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 (`*, #`).

11.1.2.1 Base topic

For LioN-X and the LioN-Xlight 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 15: Base topic variables on page 73.

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 15: 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 16: 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 17: 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 18: Topic use case examples

11.1.2.2 Publish topic

Overview of all publish JSON data for the defined topics:

Key	Data type
tbd	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 19: Identity/gateway

Key	Data type	Range	Default value	Remarks
fieldbus_protocol	json_string	profinet, ethernet/ip, ethercat		
network_configuration	json_string	**PNS:** dcp **EIS:** stored_value, bootp, dhcp		
rotary_switches	json_integer	0..999		
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 20: 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		
forcemode_enabled	json_boolean	true / false		

Table 21: Status/gateway

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

Table 22: 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 23: Identity/port/1 ... 8

Key	Data type	Range	Default value	Remarks
port	json_integer	1..8		
direction_cha	json_string	input/output input output		
direction_chb	json_string	input/output input output		
failsafe_cha	json_string	set_low set_high hold_last	set_low	
failsafe_chb	json_string	set_low set_high hold_last	set_low	
surveillance_timeout_cha	json_integer	0..255	80	
surveillance_timeout_chb	json_integer	0..255	80	

Table 24: 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		

Table 25: Status/port/1 ... 8

11.1.3 MQTT configuration - Quick start guide

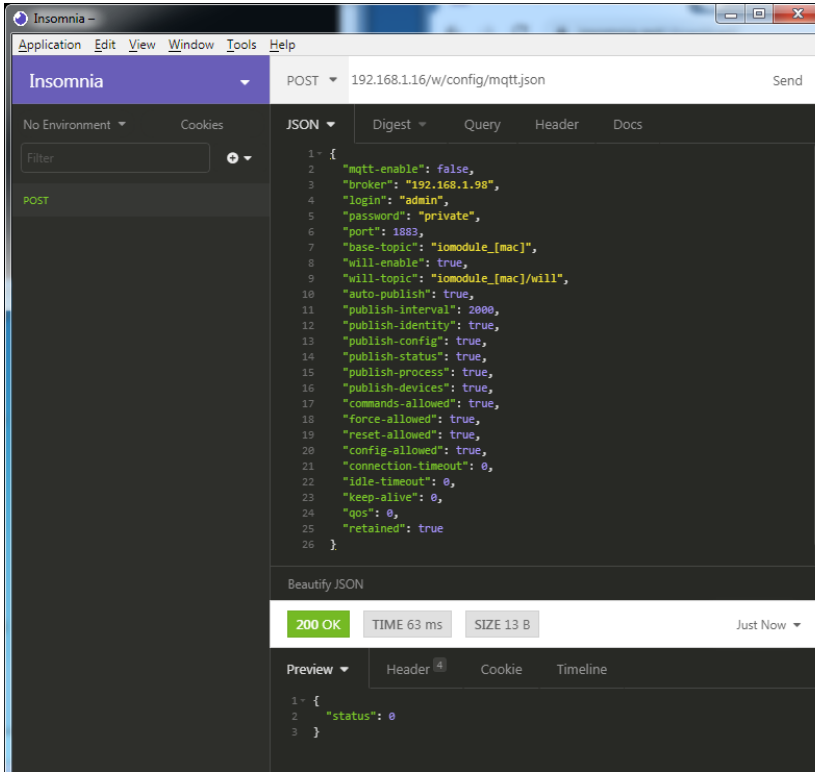
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

11.1.3.1 MQTT configuration via JSON

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

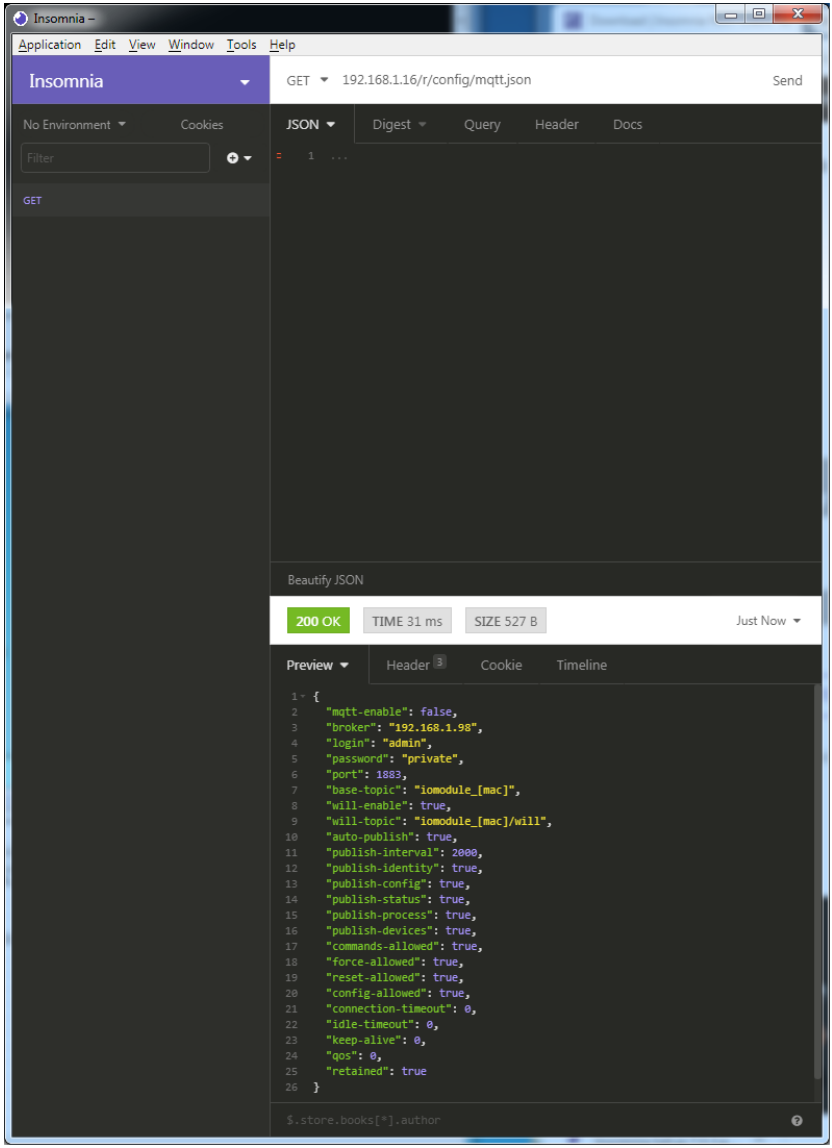
2. Configure MQTT:

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



3. Read MQTT:

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



11.2 OPC UA

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

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

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

11.2.1 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 request. For more information see OPC UA configuration - Quick start guide on page 87.

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 27: OPC UA Configration

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"}]}
```

11.2.2 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.

11.2.3 OPC UA configuration - Quick start guide

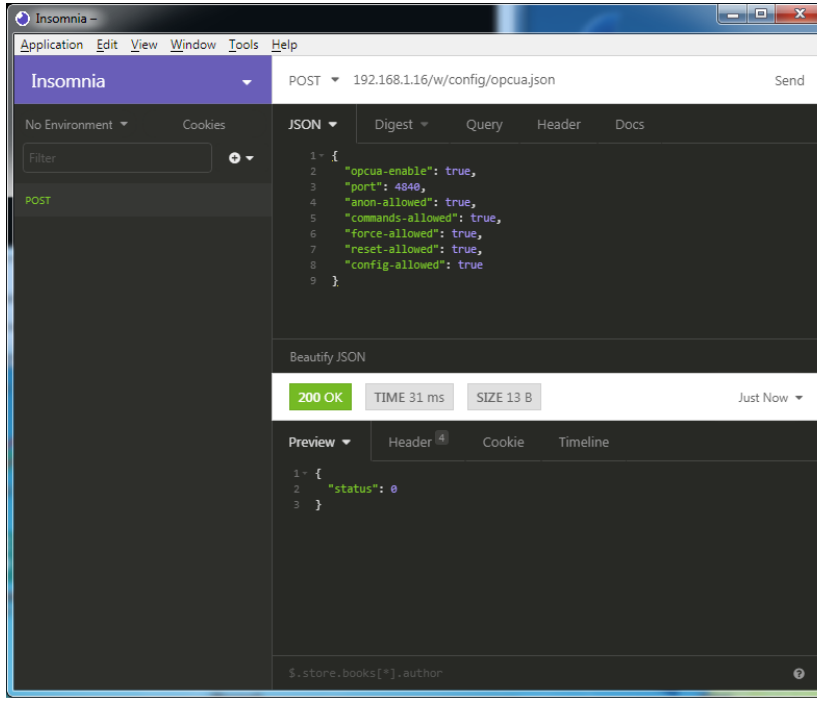
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

11.2.3.1 OPC UA configuration via JSON

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

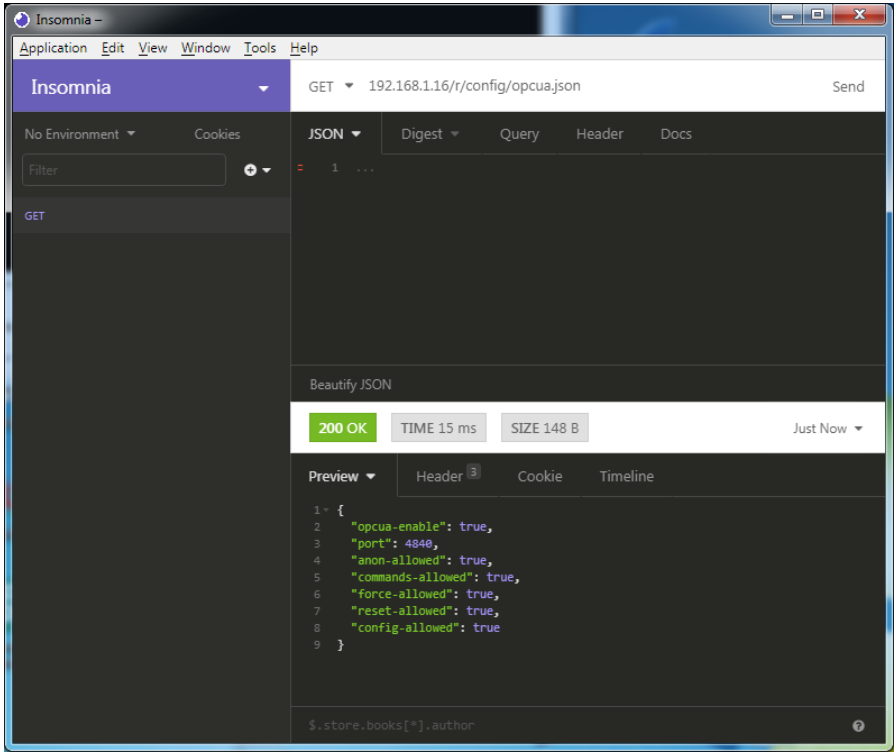
2. Configure OPC UA:

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



3. Read OPC UA:

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



11.3 REST API

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

For LioN-X and the LioN-Xlight 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	Not supported
	POST /datastorage	Not supported
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	Yes
	GET /parameters/{index}/subindices	Yes
	GET /parameters/{parameterName}/subindices	Not supported
	GET /parameters/{index}/value	Yes
	GET /parameters/{index}/subindices/{subindex}/value	Yes
	GET /parameters/{parameterName}/value	Not supported
	GET /parameters/{parameterName}/subindices/{subParameterName}/value	Not supported
	POST /parameters/{index}/value	Yes
	POST /parameters/{parameterName}/value	Not supported
	POST /parameters/{index}/subindices/{subindex}/value	Yes
	POST /parameters/{parameterName}/subindices/{subParameterName}/value	Not supported
	POST /blockparametrization	Not supported
	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 28: Support of REST API features according to the IO-Link specification

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

11.3.1 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.

11.3.2 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:** Internal module error (IME) **Force mode:** active **Actuator:** short **Sensor:** short **U_L:** fault **U_S:** fault	
			Element 1 = 1 Byte: Sensor short circuit ports X1-X8.	
			Element 2 =1 Byte: Actuator short circuit ports X1 Channel A-X4 Channel B	
			Element 3 = 1 Byte: Actuator short circuit ports X5 Channel A-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		

Name	Data type	Description	Example
channels	Array of CHANNEL (16)	Basic information about all input/output channels	
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	

Name	Data type	Description	Example
outputState	boolean	Output data bit to the physical output pin	
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	

Name	Data type	Description	Example
iq_mode	number	Pin2 mode according to IOL specification	
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	

Name	Data type	Description	Example
forcingActive	boolean	Force mode is currently active	
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.	

11.3.3 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 29: 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 30: 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 31: 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 32: IOL object

11.3.4 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.

11.3.4.1 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 33: 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 34: 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 35: Read ISDU data object

11.3.4.2 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 36: 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 37: 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 38: Write ISDU data object

11.3.5 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}
```

11.3.6 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}
```

11.4 CoAP server

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

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

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 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.

11.4.1 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 request. For more information see chapter CoAP configuration - Quick start guide on page 109.

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 39: 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"}]}
```

11.4.2 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 40: REST API access via CoAP

11.4.3 CoAP configuration - Quick start guide

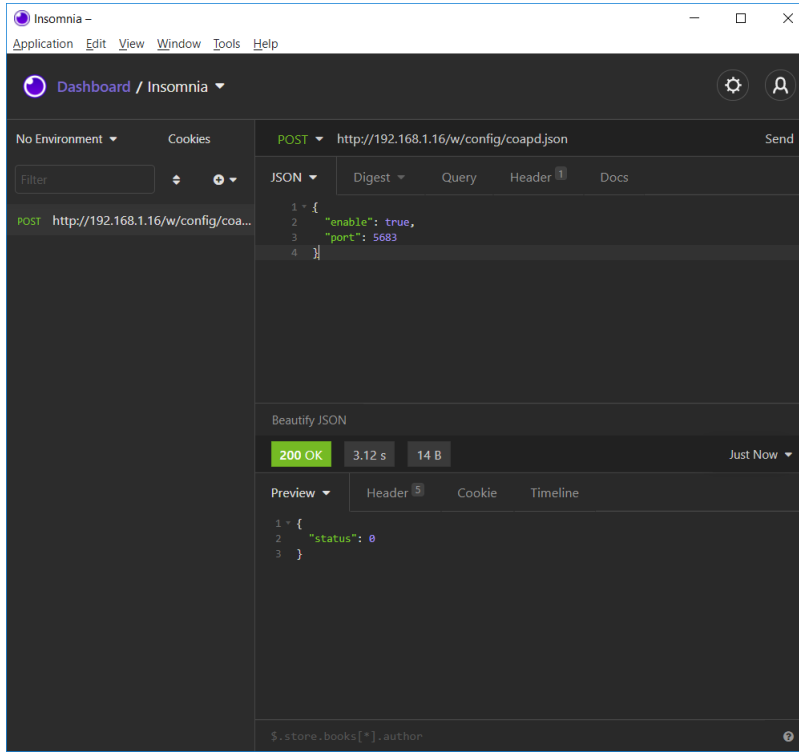
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

11.4.3.1 CoAP configuration via JSON

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

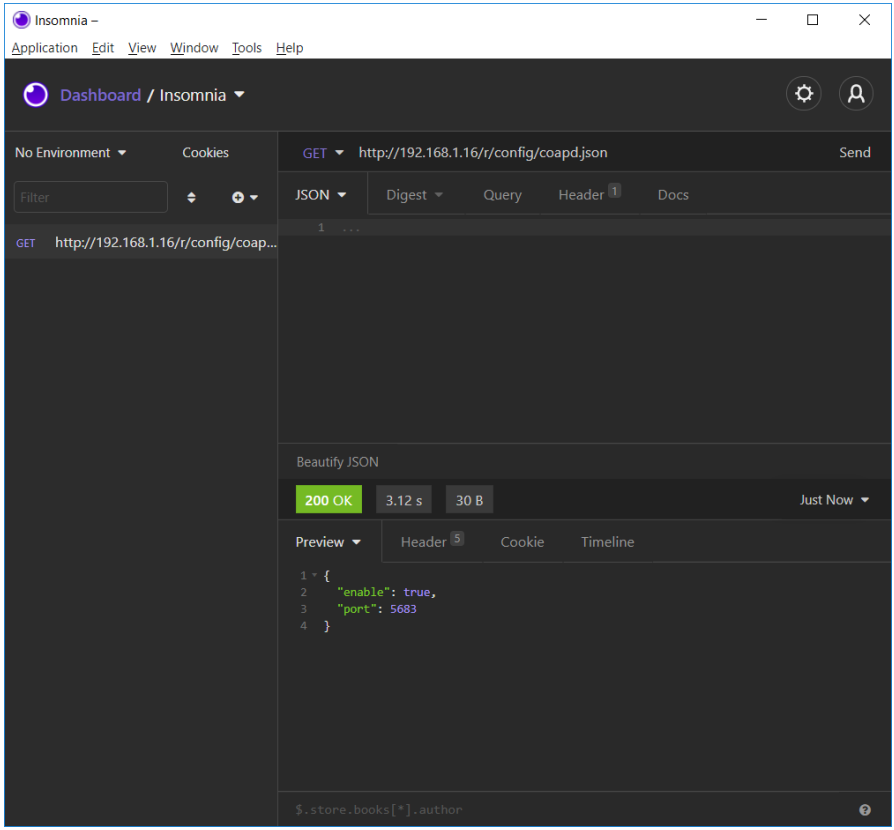
2. Configure CoAP:

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



3. Read CoAP configuration:

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



11.5 Syslog

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

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

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.

11.5.1 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 request. For more information see chapter Syslog configuration - Quick start guide on page 114.

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 41: 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"}]}
```

11.5.2 Syslog configuration - Quick start guide

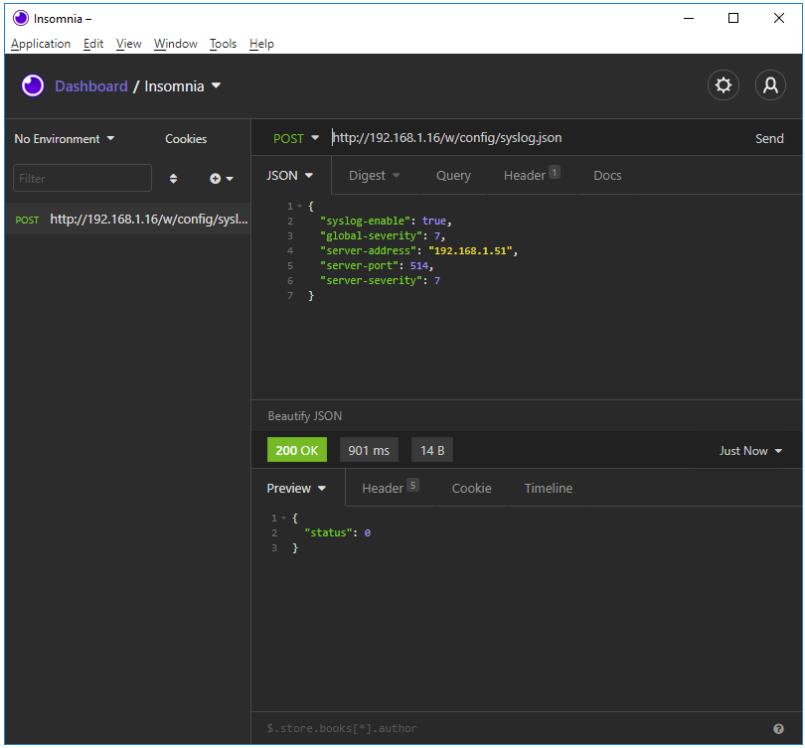
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

11.5.2.1 Syslog configuration via JSON

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

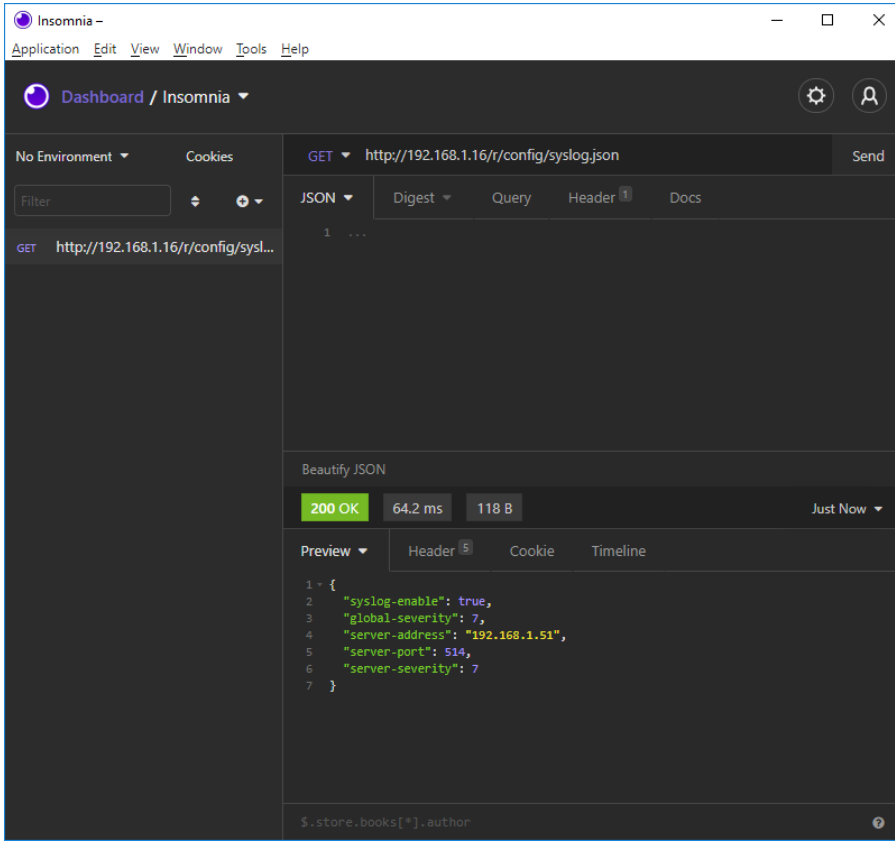
2. Configure Syslog:

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



3. Read Syslog configuration:

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



12 The integrated Web server

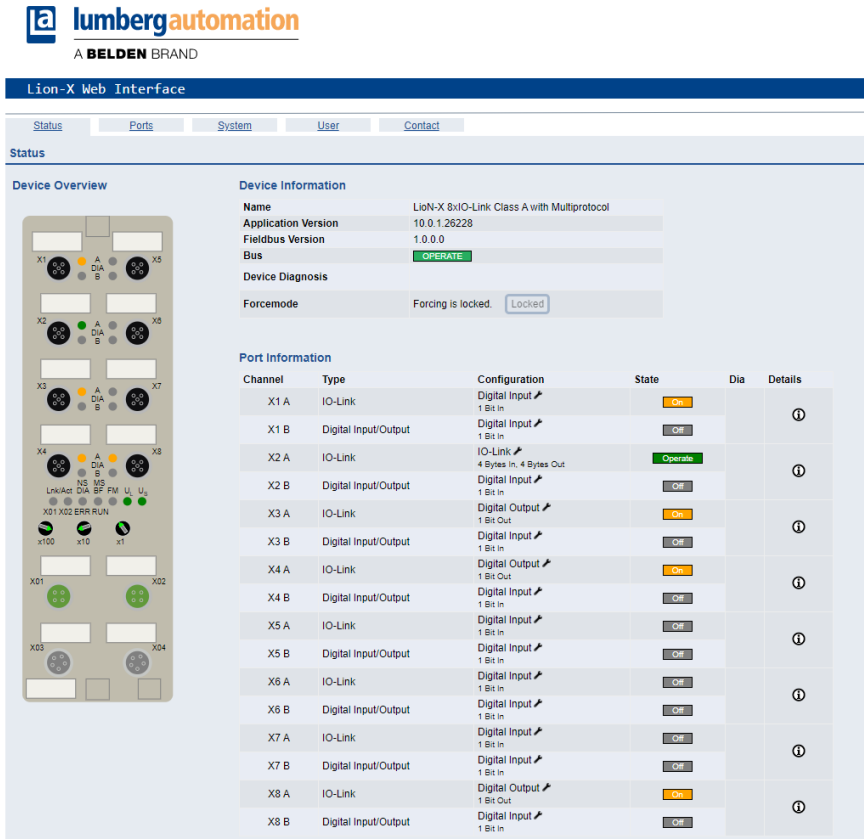
LioN-X and the LioN-Xlight variants are equipped with an integrated Web server which makes functions for the device configuration and the display of status and diagnostic information available via a Web interface.

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:// 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.

12.1 LioN-X 0980 XSL... variants

12.1.1 The Status page



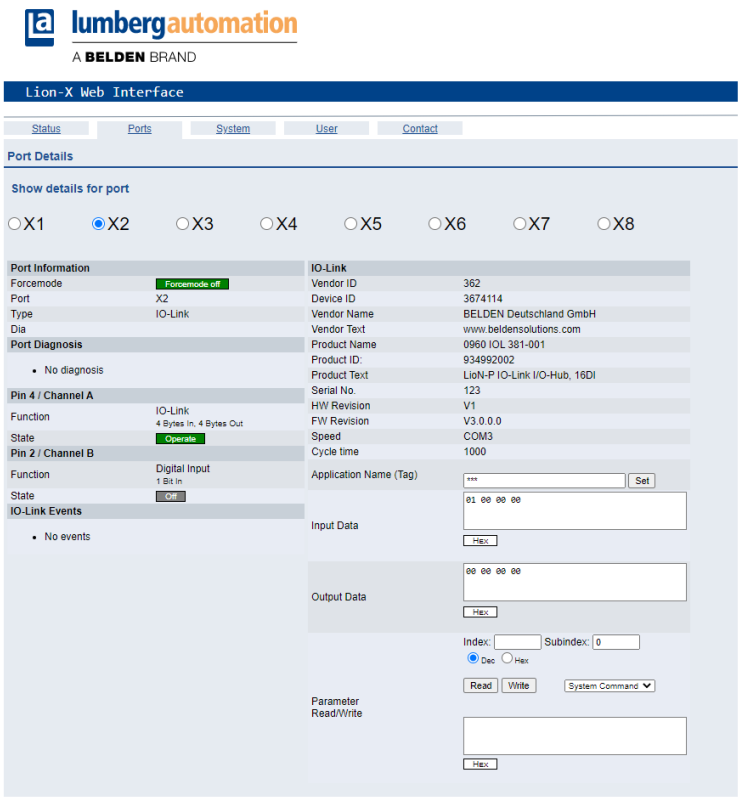
The status page provides a quick overview of the current state of the device.

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.

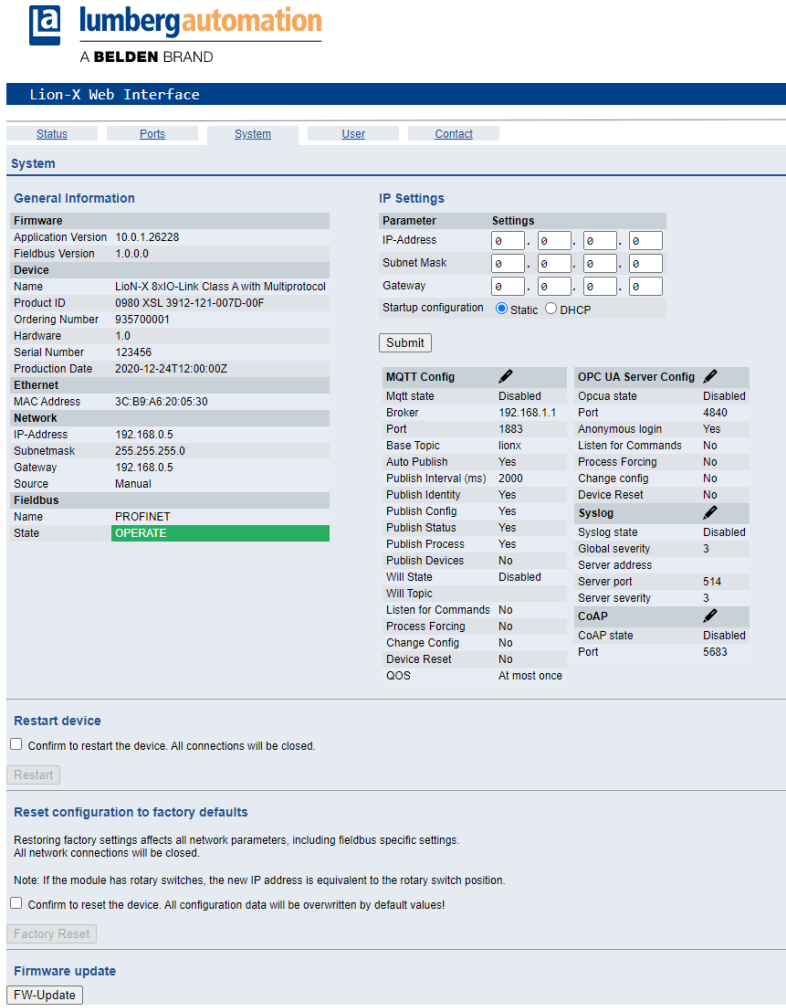
The "Port Information" table shows the configuration and state of the I/O ports.

12.1.2 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.

12.1.3 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

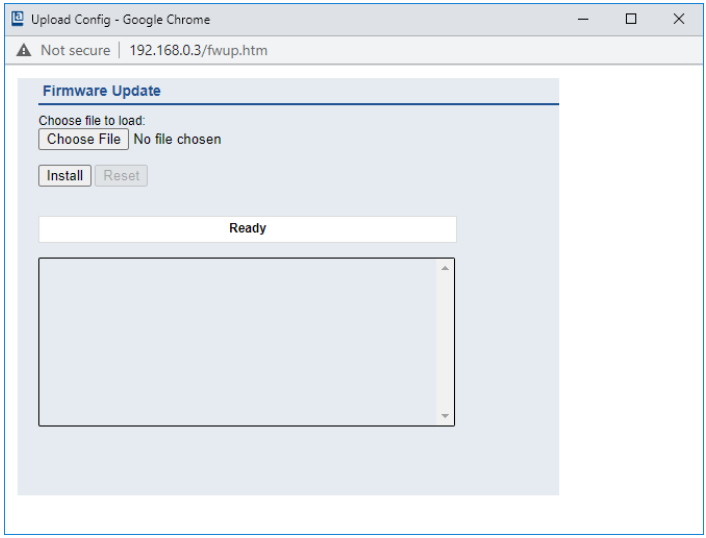
Use this parameter to change the current IP address of the module.

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.

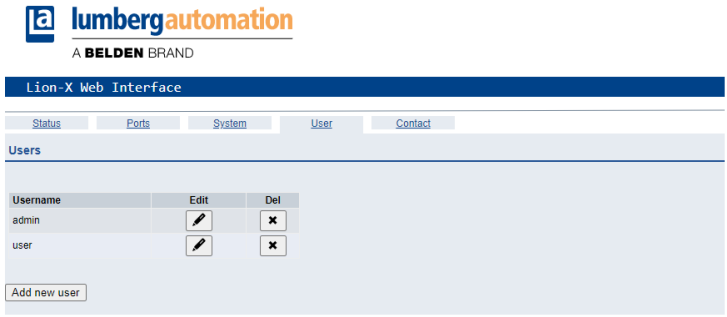
Firmware Update

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.



12.1.4 The User page



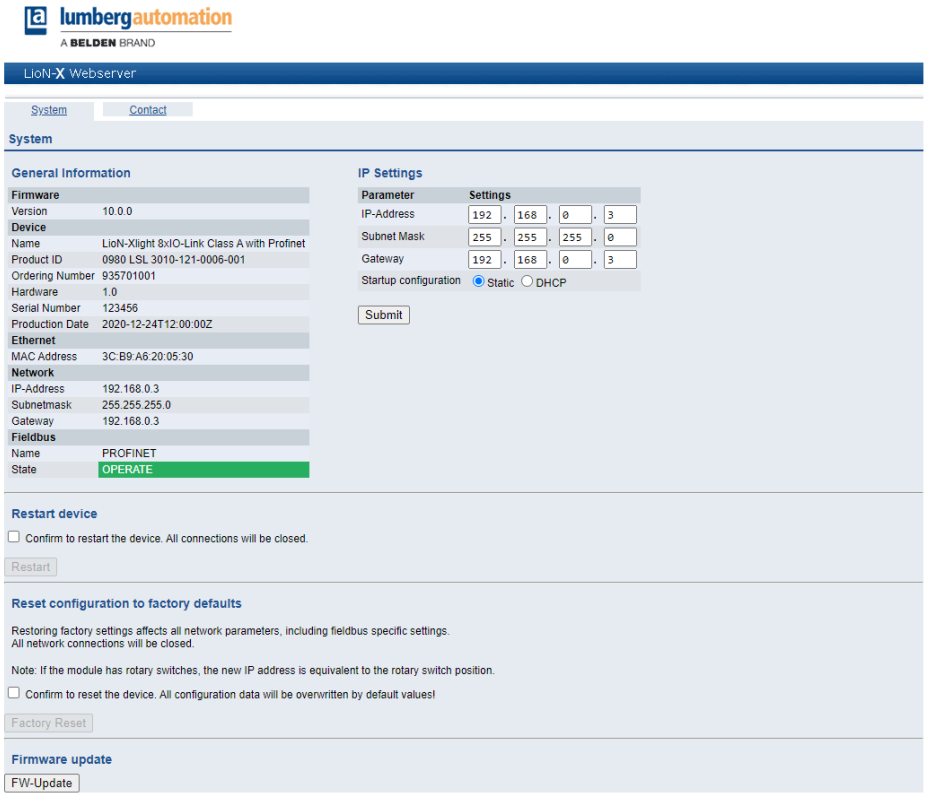
The User page provides the user management of the Web interface. New users with access rights **Admin** or **Write** can be added here. For security reasons please change the default admin password immediately after configuring the device.

Default user login data:

- User: admin
- Password: private

12.2 LioN-Xlight 0980 LSL... variants

12.2.1 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

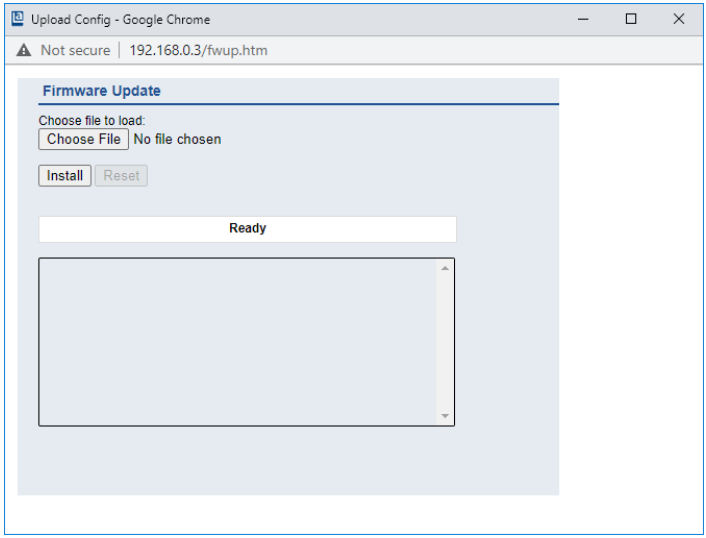
Use this parameter to change the current IP address of the module.

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.



13 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.

13.1 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...	-40 °C to +70 °C (-40 °F to +158 °F)
	0980 LSL 3x11-121...	-20 °C to +60 °C (-4 °F to +140 °F)
	0980 LSL 3x10-121...	
Weight	LioN-X 60 mm	ca. 500 gr.
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 42: General information

2 Not under UL investigation.

13.2 Modbus TCP protocol

Protocol	EtherNet/IP, CIP V3.27
Update cycle	1 ms
Transmission rate	100 Mbit/s, full duplex
Transmission procedure Autonegotiation	100BASE-TX supported
Product type	12 (Communications Adapter)
Product code	41000 (0980 XSL 3912-121-XXXX-YYY, 935700-001) 4100? (0980 LSL 3311-121-XXXX-YYY, 939701-004) 4100? (0980 LSL 3310-121-XXXX-YYY, 947702-004)
Supported Ethernet protocols	Ping ARP- HTTP TCP/IP DHCP/BOOTP
Switch functionality	Integrated
Modbus TCP interface Connections Autocrossing	2 M12 sockets, 4-pin, D-coded (see pin assignments) 2 M12 Hybrid male/female, 8-pin supported
Electrically isolated Ethernet ports -> FE	2000 V DC

Table 43: Modbus TCP protocol

13.3 Power supply of the module electronics/ sensors

Nominal voltage U_S	24 V DC (SELV/PELV)		
Voltage range	18-30 V DC		
Power consumption of module electronics	Typically 160 mA (+/-20 % at U_S nominal voltage)		
Voltage level of the sensor power supply	Min. (U_S – 1.5 V)		
Voltage ripple U_S	Max. 5 %		
Power supply interruption	Max. 10 ms		
Current consumption sensor system (L+ / Pin 1)	0980 XSL 3912-121...	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
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)	
Port X03, X04	M12-L-coded Power, connector/socket, 5-pole Pin 1 / Pin 3		

Table 44: Information on the power supply of the module electronics/ sensors

13.4 Power supply of the actuators

Nominal voltage U_L	24 V DC (SELV/PELV)
Voltage range	18-30 V DC
Voltage ripple U_L	Max. 5 %
Power supply interruption	Max. 10 ms
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 45: Information on the power supply of the actuators

13.5 IO-Link Master ports Class A, Pin 4

0980 XSL 3912-121...	Port X1 – X8	M12 socket, 5-pin, Pin 4
0980 LSL 3x11-121...		
0980 LSL 3x10-121...	Port X1 – X4	

Table 46: IO-Link Master ports, Class A (Ch. A / C/Q / Pin 4)

13.5.1 Configured as a digital input

Input connection	0980 XSL 3912-121...		Type 1 as per IEC 61131-2
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...	X1 - X4	Type 1 as per IEC 61131-2
		X5 - X8	Type 1 as per IEC 61131-2
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...		8
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...		
Status indicator	yellow LED		
Diagnostic indicator	red LED per channel		

Table 47: IO-Link Master Class A ports, pin 4, configured as digital inputs

13.5.2 Configured as a digital output

Attention: For LioN-X variants, the power for the outputs is supplied via the U_L power supply.

Attention: For LioN-Xlight variants, the power for the outputs is supplied via the U_S power supply.

Output type	normally open, p-switching	
Nominal output current per channel Signal status “1” Signal status “0”	 min. (U_L -1 V) max. 2 V	
Max. output current per device	0980 XSL 3912-121...	16 A (M12 Power)
	0980 LSL 3x11-121...	4 A
	0980 LSL 3x10-121...	2 A
Max. output current per channel[3]	0980 XSL 3912-121...	2 A
	0980 LSL 3x11-121...	0.5 A (power supplied via U_S)
	0980 LSL 3x10-121...	0.25 A for **UL applications**
Short-circuit/overload protected	yes/yes	
Behavior in case of short circuit or overload	disconnection with automatic power-on	
Number of digital outputs	0980 XSL 3912-121...	8
	0980 LSL 3x11-121...	
	0980 LSL 3x10-121...	4
Status indicator	yellow LED per output	
Diagnostic indicator	red LED per channel	

Table 48: IO-Link Master Ports configured as digital outputs

[3] Max. 2.0 A per channel; max. 6.5 A in total (for **UL applications** max. 5.0 A in total) 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).

13.5.3 Configured as an IO-Link port in COM mode

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	8
Min. IO-Link cycle time	400 µs

Table 49: As an IO-Link port in COM mode

13.6 IO-Link Master ports Class A, Pin 2

0980 XSL 3912-121...	Port X1 – X8	M12 socket, 5-pin, Pin 2
0980 LSL 3x11-121...		
0980 LSL 3x10-121...		

Table 50: IO-Link Master ports, Class A (Ch. B, Pin 2)

13.6.1 Configured as a digital input

Input connection	0980 XSL 3912-121...		Type 1 as per IEC 61131-2
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...	X1 - X4	Type 1 as per IEC 61131-2
		X5 - X8	Type 1 as per IEC 61131-2
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...		8
	0980 LSL 3x11-121...		
	0980 LSL 3x10-121...		
Status indicator	white LED		
Diagnostic indicator	red LED per channel		

Table 51: IO-Link Master Class A ports, pin 2, configured as digital inputs

13.6.2 Configured as a digital output

Attention: For LioN-X variants, the power for the outputs is supplied via the U_L power supply.

Attention: For LioN-Xlight variants, the power for the outputs is supplied via the U_S power supply.

Output type	normally open, p-switching	
Nominal output current per channel Signal status “1” Signal status “0”	min. (U_L -1 V) max. 2 V	
Max. output current per device	0980 XSL 3912-121...	16 A (M12 Power)
	0980 LSL 3x11-121...	4 A
	0980 LSL 3x10-121...	2 A
Max. output current per channel[4]	0980 XSL 3912-121...	2 A
	0980 LSL 3x11-121...	0 A (no outputs)
	0980 LSL 3x10-121...	
Short-circuit/overload protected	yes/yes	
Behavior in case of short circuit or overload	disconnection with automatic power-on	
Number of digital outputs	0980 XSL 3912-121...	8
	0980 LSL 3x11-121...	–
	0980 LSL 3x10-121...	–
Status indicator	white LED per output	
Diagnostic indicator	red LED per channel	

Table 52: IO-Link Master Ports configured as digital outputs

[4] Max. 2.0 A per channel; max. 6.5 A in total (for **UL applications** max. 5.0 A in total) 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).

13.7 LEDs

U_L	Green	Auxiliary sensor/actuator voltage OK 18 V (+/- 1 V) < U_L < 30 V (+/- 1 V)
	Red*	Auxiliary sensor/actuator voltage LOW U_L < 18 V (+/- 1 V) or U_L > 30 V (+/- 1 V) * if "Report U_L 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)
	off	None of the above conditions
X1 .. X8 A	Green	IO-Link COM Mode: IO-Link communication exists
	Flashing green	IO-Link COM Mode: No IO-Link communication.
	Yellow	Standard-IO 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 C/Q (pin 4) 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.
	Flashing yellow	Data exchange with another subscriber.
	off	No connection to another subscriber. No link, no data exchange.

MS	Green	Device is ready for operation.
	Flashing green	Device is ready but not configured yet.
	Red	Serious error that cannot be resolved
	Flashing Red	Minor error that can be resolved Example: An incorrect or contradictory configuration is classified as a minor error
	Alternately flashing red/green	The device is performing a self-test.
	off	The device is switched off.
NS	Green	Connected: The device has at least one connection.
	Flashing green	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.
	Flashing Red	Connection has exceeded time limit or connection interrupted.
	Alternately flashing red/green	The device is performing a self-test
	off	The device is switched off or has not been assigned an IP address

Table 53: Information on the LED colors

14 Accessories

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

http://www.beldensolutions.com