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Manual

PROFINET

LioN-X Digital-I/O Multiprotocol:
0980 XSL 3900-121-007D-01F (16 x Input/Output)
0980 XSL 3901-121-007D-01F (16 x Input)
0980 XSL 3903-121-007D-01F (8 x Input, 8 x Output isolated)
0980 XSL 3923-121-007D-01F (8 x Input, 8 x Output)

Contents

1 About this manual

1.1 General information

Please read the assembly and operating instructions in this manual carefully before starting up the devices. 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 devices.

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

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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

Version	Created	Changes
1.0	03/2023	
1.1	07/2023	Warning in ch. Setting the rotary encoding switches on page 40

Table 1: Overview of manual revisions

2 Safety instructions

2.1 Intended use

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

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

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

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

AOI	Add-On Instruction
API	Application Programming Interface
BF	Bus Fault LED
Big Endian	Data format with High-B on first place (PROFINET)
BUI	Back-Up Inconsistency (EIP diagnostics)
CC	CC-Link IE Field
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)
CoAP	Constrained Application Protocol
CSP+	Control & Communication System Profile Plus
DCP	Discovery and Configuration Protocol
DevCom	Device Comunicating (EIP diagnostics)
DevErr	Device Error (EIP diagnostics)
DI	Digital Input
DIA	Diagnostic LED
DO	Digital Output
DIO	Digital Input/Output
DTO	Device Temperature Overrun (EIP diagnostics)
DTU	Device Temperature Underrun (EIP diagnostics)
DUT	Device under test
EIP	EtherNet/IP
ERP	Enterprise Resource Planning system
ETH	ETHERNET
FE	Functional Earth
FME	Force Mode Enabled (EIP diagnostics)
FSU	Fast Start-Up

GSDML	General Station Description Markup Language
High-B	High-Byte
ICT	Invalid Cycle Time (EIP diagnostics)
IIoT	Industrial Internet of Things
ILE	Input process data Length Error (EIP diagnostics)
IME	Internal Module Error (EIP diagnostics)
I/O	Input / Output
I/O port	X1 .. X8
I/O port pin 2	Channel B of X1 .. X8
I/O port pin 4 (C/Q)	Channel A of X1 .. X8
IVE	IO-Link port Validation Error (EIP diagnostics)
I&M	Identification & Maintenance
JSON	JavaScript Object Notation (platform independent data format)
L+	I/O port pin 1, sensor power supply
LioN-X 60	LioN-X variants with a width of 60mm
Little Endian	Data format with Low-B on first place (EtherNet/IP)
LLDP	Link Layer Discovery Protocol
Low-B	Low-Byte
LSB	Least Significant Bit
LVA	Low Voltage Actuator Supply (EIP diagnostics)
LVS	Low Voltage System/Sensor Supply (EIP diagnostics)
MIB	Management Information Base
MP	Multiprotocol: PROFINET + EtherNet/IP + EtherCAT® + Modbus TCP (+ CC-Link IE Field Basic)
MQTT	Message Queuing Telemetry Transport (open networking protocol)
MSB	Most Significant Bit
M12	Metric thread according to DIN 13-1 with 12 mm diameter
NTP	Network Time Protocol
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
PWR	Power
REST	REpresentational State Transfer
RFC	Request for Comments
RPI	Requested Packet Interval
RWr	Word data input as seen from the master station (CC-Link)
RWw	Word data output as seen from the master station (CC-Link)
RX	Bit data input as seen from the master station (CC-Link)
RY	Bit data output as seen from the master station (CC-Link)
SCA	Short Circuit Actuator/U_L/U_{AUX} (EIP diagnostics)
SCS	Short Circuit Sensor (EIP diagnostics)
SLMP	Seamless Message Protocol
SNMP	Simple Network Management Protocol
SP	Single Protocol (PROFINET, EtherNet/IP, EtherCAT®, Modbus TCP or CC-Link IE Field Basic)
SPE	Startup Parameterization Error (EIP diagnostics)
U_{AUX}	$U_{Auxiliary}$, supply voltage for the load circuit (Actuator supply on Class B ports)
UDP	User Datagram Protocol
UDT	User-Defined Data Types
UINT8	Byte in PLC (IB, QB)
UINT16	Unsigned integer with 16 bits or word in PLC (IW, QW)
U_L	U_{Load}, supply voltage for the load circuit (Actuator supply on Class A)
UL	Underwriters Laboratories Inc. (certification company)
UTC	Coordinated Universal Time (Temps Universel Coordonné)

Table 2: Designations and synonyms

4 System description

The LioN modules (**L**umberg Automation™ **I**nput/**O**utput **N**etwork) function as the interface in an industrial Ethernet system: A central controller on the management level is able to communicate with the decentralized sensors and actuators on the field level. The line or ring topologies for which LioN modules can be used ensure not only reliable data communication but also significantly reduce the number of cables required and thus also the costs for installation and maintenance. They additionally enable easy and quick extension.

4.1 Device variants

The following Digital I/O device variants are available in the LioN-X family:

Article number	Product designation	Description	I/O port functionality
935705001	0980 XSL 3900-121-007D-01F	LioN-X M12-60 mm, I/O Device Multiprotocol (PN, EIP, EC, MB, CC) Security	16 x Input/Output universal
935706002	0980 XSL 3901-121-007D-01F	LioN-X M12-60 mm, I/O Device Multiprotocol (PN, EIP, EC, MB, CC) Security	16 x Input
935707001	0980 XSL 3903-121-007D-01F	LioN-X M12-60 mm, I/O Device Multiprotocol (PN, EIP, EC, MB, CC) Security	8 x Input, 8 x Output Mixmodule, galvanic isolated
935708001	0980 XSL 3923-121-007D-01F	LioN-X M12-60 mm, I/O Device Multiprotocol (PN, EIP, EC, MB, CC) Security	8 x Input, 8 x Output Mixmodule, without galvanic isolation of the outputs

Table 3: Overview of LioN-X Digital-I/O variants

4.2 I/O port overview

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

LioN-X 16DIO ports

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (In/Out)		Pin 2 / Ch. B (In/Out)	
0980 XSL 3900...	**Info:**	–	Type 3	Supply by U_L	Type 3	Supply by U_L
	X8:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X7:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X6:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X5:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X4:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X3:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X2:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)
	X1:	U_S (4 A)	DI	DO (2 A)	DI	DO (2 A)

Table 4: Port configuration of 0980 XSL 3900... variants

LioN-X 16DI ports

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (Input)	Pin 2 / Ch. B (Input)
0980 XSL 3901...	**Info:**	–	Type 3	Type 3
	X8:	U_S (4 A)	DI	DI
	X7:	U_S (4 A)	DI	DI
	X6:	U_S (4 A)	DI	DI
	X5:	U_S (4 A)	DI	DI
	X4:	U_S (4 A)	DI	DI
	X3:	U_S (4 A)	DI	DI
	X2:	U_S (4 A)	DI	DI
	X1:	U_S (4 A)	DI	DI

Table 5: Port configuration of 0980 XSL 3901... variants

LioN-X 8DI8DO ports with galvanic isolation of the outputs

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (In/Out)		Pin 2 / Ch. B (In/Out)	
0980 XSL 3903...	**Info:**	–	Type 3	Supply by U_L	Type 3	Supply by U_L
	X8:	–	–	DO (2 A)	–	DO (2 A)
	X7:	–	–	DO (2 A)	–	DO (2 A)
	X6:	–	–	DO (2 A)	–	DO (2 A)
	X5:	–	–	DO (2 A)	–	DO (2 A)
	X4:	U_S (4 A)	DI	–	DI	–
	X3:	U_S (4 A)	DI	–	DI	–
	X2:	U_S (4 A)	DI	–	DI	–
	X1:	U_S (4 A)	DI	–	DI	–

Table 6: Port configuration of 0980 XSL 3903... variants

LioN-X 8DI8DO ports without galvanic isolation of the outputs

Device variant	Port	Pin 1 U_S	Pin 4 / Ch. A (In/Out)		Pin 2 / Ch. B (In/Out)	
0980 XSL 3923...	**Info:**	–	Type 3	Supply by U_L	Type 3	Supply by U_L
	X8:	–	–	DO (2 A)	–	DO (2 A)
	X7:	–	–	DO (2 A)	–	DO (2 A)
	X6:	–	–	DO (2 A)	–	DO (2 A)
	X5:	–	–	DO (2 A)	–	DO (2 A)
	X4:	U_S (4 A)	DI	–	DI	–
	X3:	U_S (4 A)	DI	–	DI	–
	X2:	U_S (4 A)	DI	–	DI	–
	X1:	U_S (4 A)	DI	–	DI	–

Table 7: Port configuration of 0980 XSL 3923... variants

5 Overview of product features

5.1 PROFINET product features

Data connection

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

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

Data transmission rates

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

PROFINET RT IO Device

The LioN-X I/O Device supports PROFINET RT (real-time). This allows the transmission of time sensitive process data between network components in real-time communication.

PROFINET specification V2.41, Conformance Class C (CC-C)

The LioN-X I/O Device complies with the PROFINET specification V2.41 and meet the requirements of Conformance Class C (CC-C) for the integrated switch. This means the device can be used in PROFINET IRT networks.

Integrated switch

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

Media Redundancy Protocol

The additionally implemented Media Redundancy Protocol (MRP) enables the design of a highly available network infrastructure.

Fast Start-Up (FSU)

Fast Start-Up is an accelerated start-up process that enables a LioN-X I/O Device to start communicating on a PROFINET network after a very short time. This makes a faster tool change possible, for example. Thanks to the FSU feature, the network is ready to communicate in less than 500 ms.[1]

Shared Device

With the shared device functionality, two controllers can access the same I/O device via a PROFINET interface. This option is done by copying the configuration of the I/O device into the first and second controller and assigning it to the second controller as shared device. Every sub slot with I/O data can be assigned to **one** of the two PLCs which share the I/O data of the I/O device.

DCP

The Masters use the DCP protocol to automatically assign IP addresses.

Net Load Class III

The devices offer advanced robustness against net load according to Net Load Class III.

LLDP

The LLDP protocol is used to detect devices in the vicinity (neighborhood detection).

SNMPv1

The SNMPv1 protocol (according PROFINET standard V2.35) handles network component monitoring and communication between Master and Device (cannot be operated stand-alone).

Alarm and diagnostic messages

The modules support extended PROFINET alarm and diagnostic messages.

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1 Measured according to the specification: Internal switch is able to forward telegrams.

I&M functions

Identification and maintenance data (I&M) means information stored on the module. The identification data consist of manufacturer details for the module and can only be read. The maintenance data consist of system specific details created during the course of configuration. The modules can be uniquely identified online via the I&M data.

The device supports I&M data related to the PNO 2.832 standard (integration for PROFINET, Edition 2):

- I&M0 … I&M3 for the interface module (access slot, sub-slot 0x8000)

GSDML-based configuration and parameterization of the I/O ports

The GSDML offers the option of configuring and parameterizing the I/O ports on the master devices within an engineering tool of a PLC.

5.2 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.

5.3 Security features

Firmware signature

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

Syslog

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

User manager

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

Default user settings:

User: admin

Password: private

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

5.4 Other features

Interface protection

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

For more details, see section Port assignments on page 34.

Failsafe

The devices support a failsafe function. This allows you to define the behavior of every single channel configured as an output in the case of 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 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 Digital-I/O multiprotocol variants

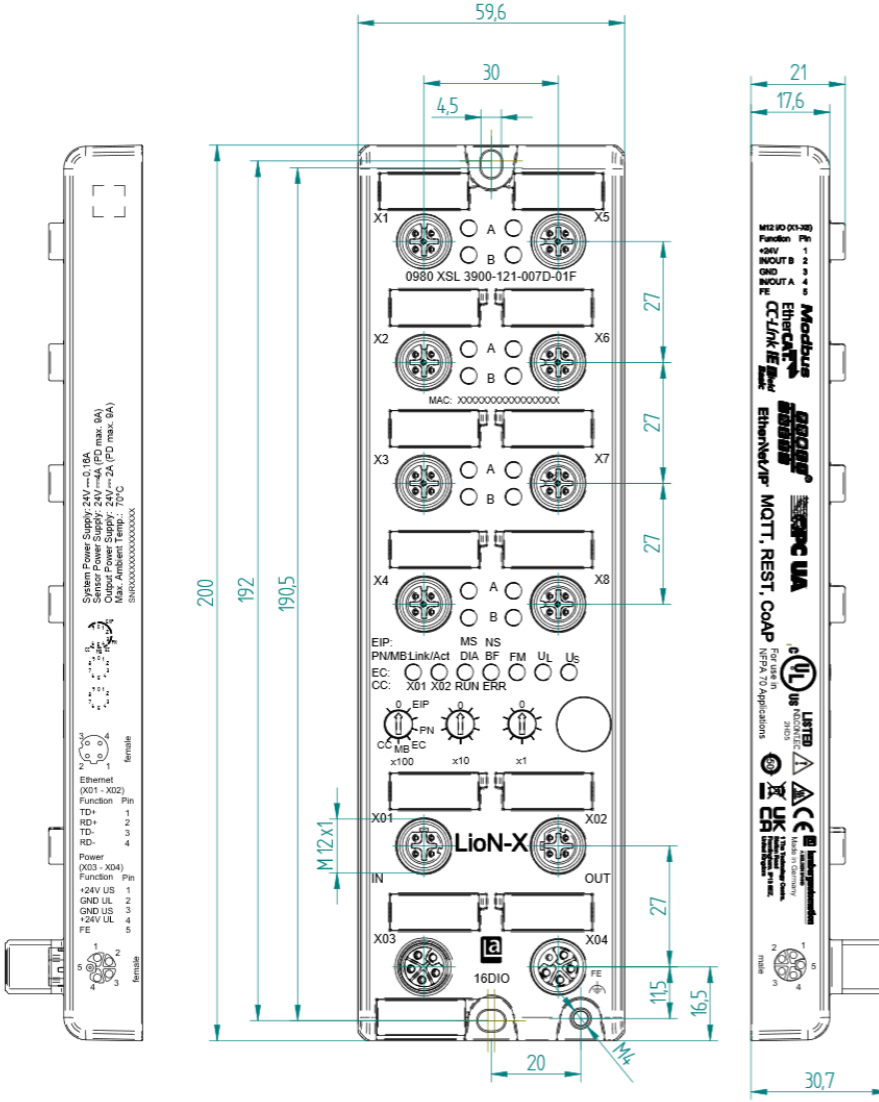


Figure 1: 0980 XSL 3900-121-007D-01F

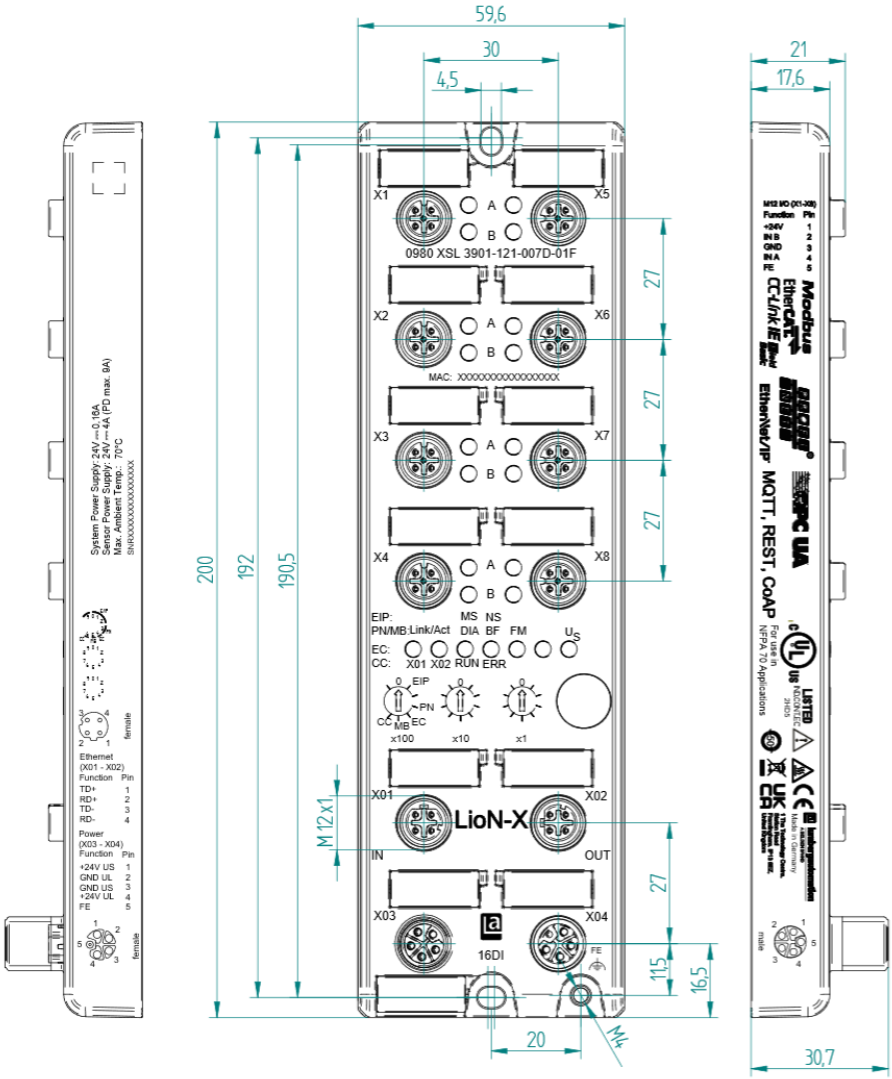


Figure 2: 0980 XSL 3901-121-007D-01F

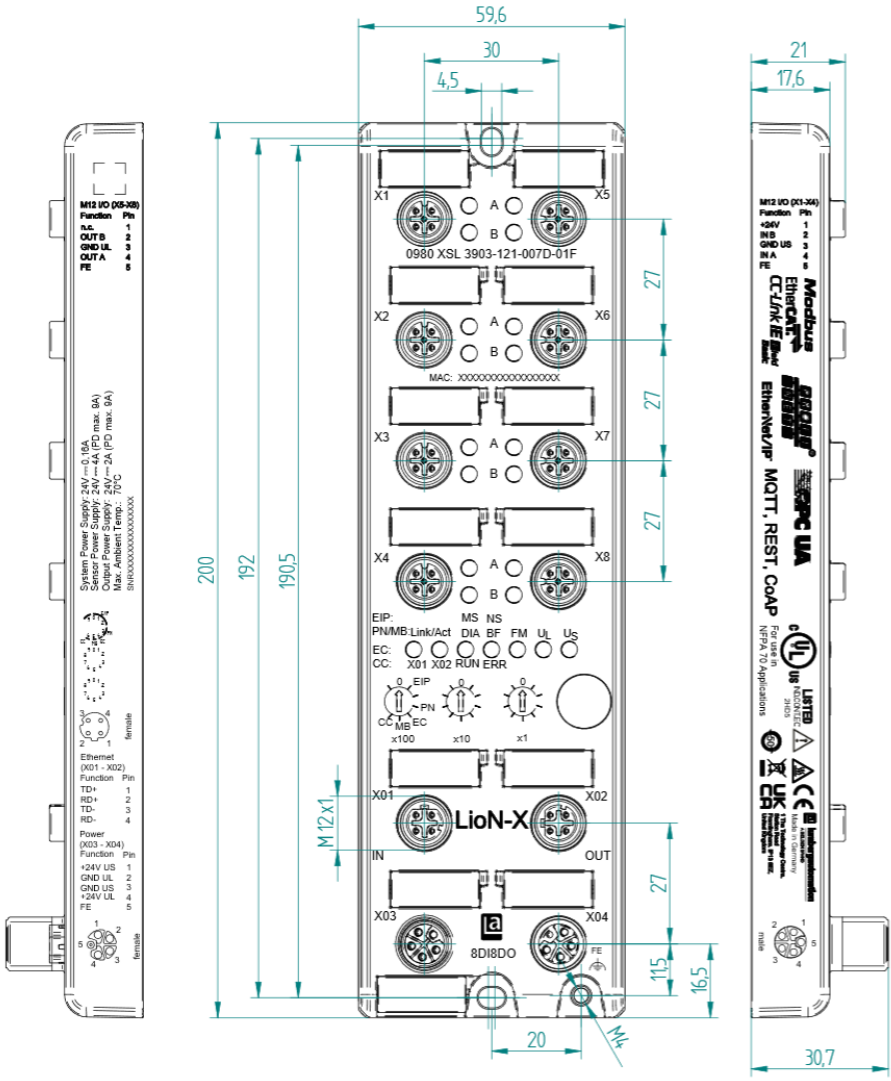


Figure 3: 0980 XSL 3903-121-007D-01F

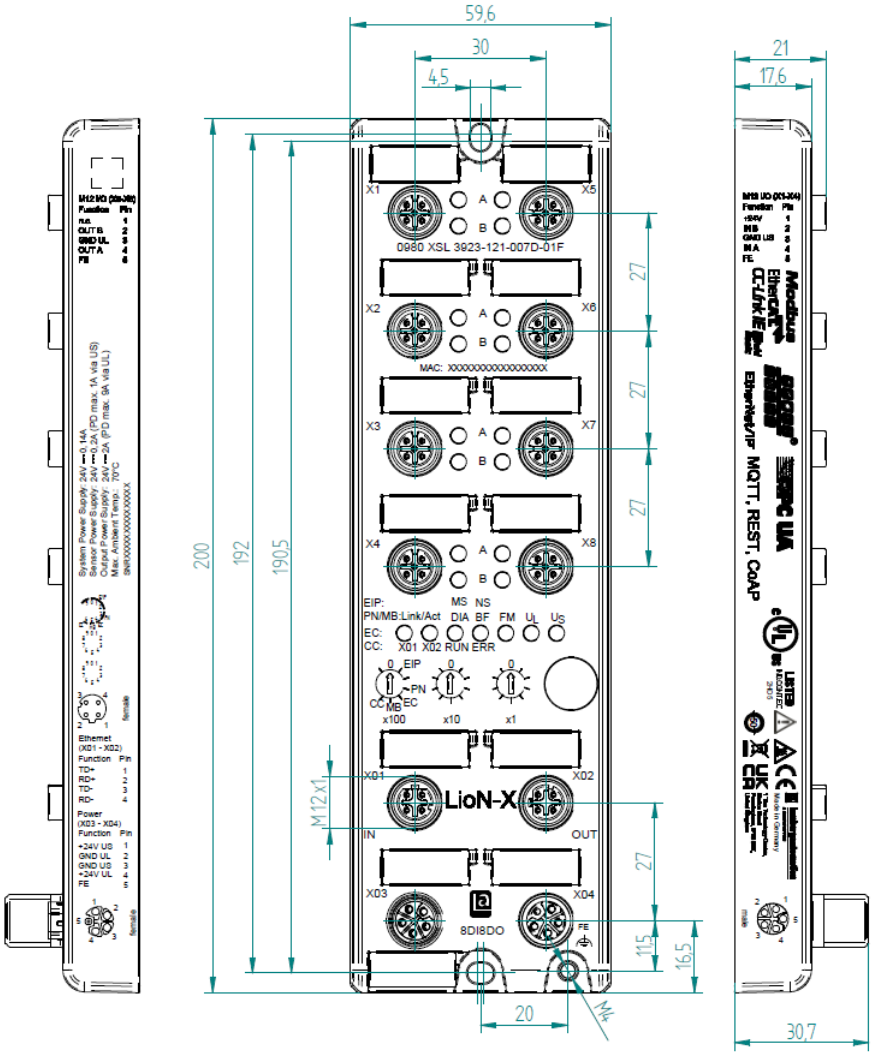


Figure 4: 0980 XSL 3923-121-007D-01F

6.2.2 Notifications

Attention:

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

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

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

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

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

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

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

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

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

6.3 Port assignments

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

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

Color coding: green

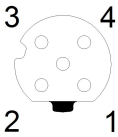


Figure 5: Schematic drawing, ports X01, X02

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

Table 8: Assignment of ports X01, X02

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

6.3.2 Power supply with M12 power L-coded

Color coding: gray

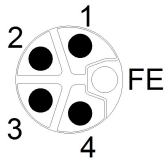


Figure 6: Schematic diagram of the M12 L-coding (connector X03 for Power In)

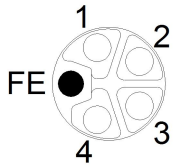


Figure 7: Schematic diagram of the M12 L-coding (socket X04 for Power Out)

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
	4	U_L (+24 V)	Load supply Actuator supply
	5	FE	Functional ground

Table 9: Pin assignments ports X03 and X04

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

Attention: For the input module 0980 XSL 3901-xxx, the two contacts 1 and 5 are not required for the voltage supply of the actuator. Nevertheless, these two contacts are bridged together on the plug and socket side to enable a 5-pole forwarding of the voltage supply to a subsequent module.

6.3.3 I/O ports as M12 sockets

Color coding: black

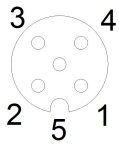


Figure 8: Schematic drawing I/O port as M12 socket

6.3.3.1 I/O ports

0980 XSL 3900-121...	Pin	Signal	Function
16DIO X1 .. X8	1	+24 V	power supply +24 V
	2	IN/OUT	Ch. B: Digital input or digital output
	3	GND	Ground/reference potential
	4	IN/OUT	Ch. A: Digital input or digital output
	5	FE	Functional ground

0980 XSL 3901-121...	Pin	Signal	Function
16DI X1 .. X8	1	+24 V	power supply +24 V
	2	IN	Ch. B: Digital input
	3	GND U_S	Ground/reference potential
	4	IN	Ch. A: Digital input
	5	FE	Functional ground

0980 XSL 39x3-121...	Pin	Signal	Function
8DI8DO X1 .. X4	1	+24 V	power supply +24 V
	2	IN	Ch. B: Digital input
	3	GND U_S	Ground/reference potential
	4	IN	Ch. A: Digital input
	5	FE	Functional ground
8DI8DO X5 .. X8	1	n.c.	–
	2	OUT	Ch. B: Digital output
	3	GND U_L	Ground/reference potential
	4	OUT	Ch. A: Digital output
	5	FE	Functional ground

Table 10: Pin assignments I/O ports

7 Starting operation

7.1 GSDML file

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

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

The GSDML file and the associated bitmap files are grouped together in an archive file named **GSDML-V2.41-BeldenDeutschland-LioN-X-yyyymmdd.xml**.

yyyymmdd stands for the date on which the file was issued.

Download this file and unpack it.

In Siemens TIA Portal® you create a new project and open the hardware manager under **Configure a device**. Under the menu command **Options** > **Manage general station description files (GSD)** the GSD file is installed by defining the file path.

The LioN-X variants are then available in the hardware catalog.

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 State on delivery

PROFINET parameters in state on delivery or after a factory reset:

PROFINET name:	Name not assigned
IP address:	0.0.0.0
Subnet mask:	0.0.0.0
Device designations:	0980 XSL 3900-121-007D-01F 0980 XSL 3901-121-007D-01F 0980 XSL 3903-121-007D-01F 0980 XSL 3923-121-007D-01F
Vendor ID:	0x016a
Device ID:	0x0400

7.4 Setting the rotary encoding switches

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

- 0980 XSL 3900-121-007D-01F
- 0980 XSL 3901-121-007D-01F
- 0980 XSL 3903-121-007D-01F
- 0980 XSL 3923-121-007D-01F

Caution: Risk of device damage due to memory malfunction

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

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

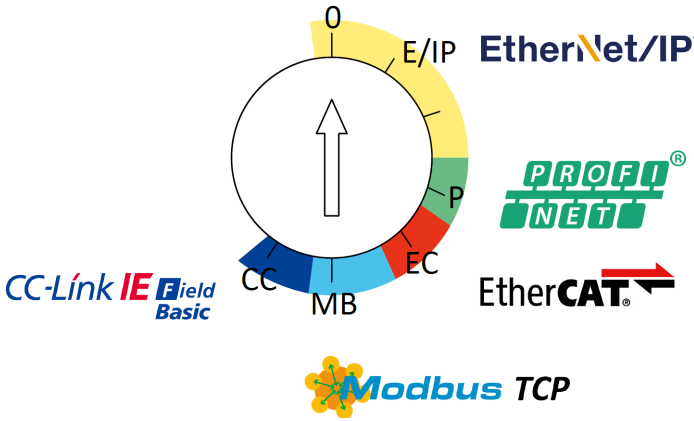
- Make sure that the power supply is maintained during the entire process.

The LioN-X multiprotocol variants allow you to select different protocols for communication within an industrial Ethernet system. In this way Digital I/O devices 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 I/O Device in different environments.

Using rotary encoding switches at the lower front of the devices, you can easily and conveniently set both the protocol and the address of the device, if the protocol to be used supports this. Once you have made a protocol selection and started the cyclical communication, the device stores this setting permanently and uses the selected protocol from this point on. To use another supported protocol with this device, perform a factory reset.

The multiprotocol devices have a total of three rotary encoding switches. With the first rotary encoding switch (x100) you set the protocol by using the

corresponding switch position. Additionally, x100 is used to set the third last digit of the IP address for EIP.



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

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

Table 11: 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 43.

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).

7.4.1 PROFINET

If you decide to use PROFINET, set the first rotary encoding switch to the value of "P".

7.4.2 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 40 again to select a new protocol.

For performing a factory reset via software configuration, see chapter OPC UA configuration on page 116 and the configuration section.

7.5 SNMPv1

The PROFINET IO device supports SNMP objects required by the PROFINET specification as per protocol standard SNMPv1. These include objects from RFC 1213 MIB-II (System Group and Interfaces Group) and the LLDP MIB.

Passwords:

- Read Community: public
- Write Community: private

8 Configuration and operation with SIEMENS TIA Portal®

Attention: The displayed examples of SIEMENS TIA Portal® have been made with TIA V15.

After installing the GSDML files for the LioN-X PROFINET variants, they are available in the hardware catalog under **Other field devices** > **PROFINET IO** > **IO** > **Belden Deutschland GmbH - Lumberg Automation** > **Lumberg Automation LioN-X**.

1. First, configure the TIA Portal® project and the control system in the usual way. Assign an IP address and subnet mask for the PROFINET port of the control unit.
2. Then choose the desired device from the Hardware catalog:

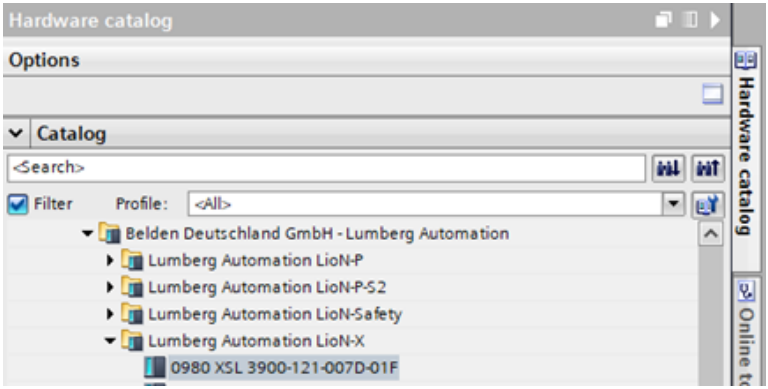


Figure 9: TIA Portal® Hardware catalog

3. Click on the article designations of the modules in the hardware catalog and drag and drop the desired device into the network view:

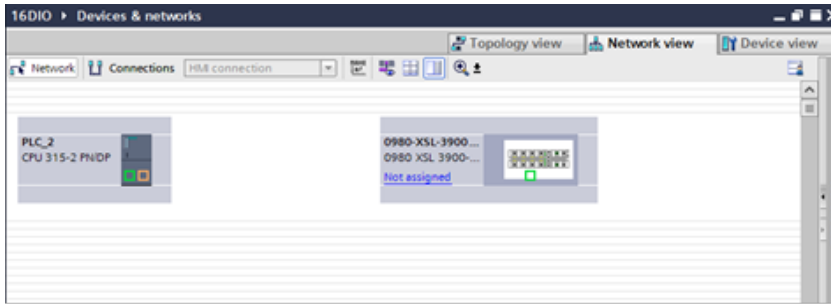


Figure 10: Network view

4. Assign the device to the PROFINET network:

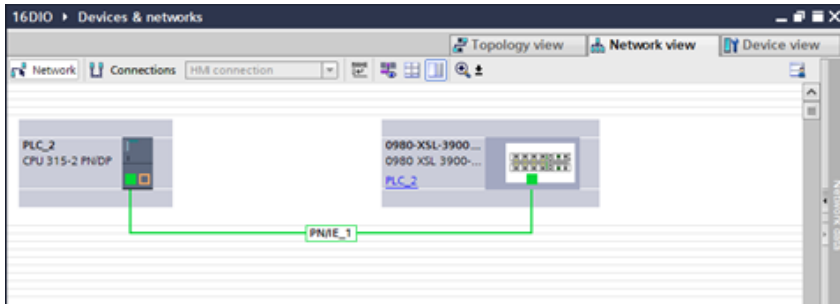


Figure 11: Assign device

5. Switch to the device configuration view and select the device to display configuration options:

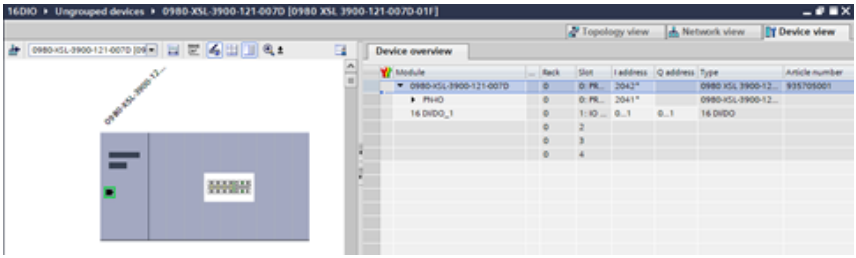


Figure 12: Device configuration

8.1 Assigning a device name and IP address

PROFINET IO devices are addressed on PROFINET via a unique device name. This can be freely assigned by the user but may only be used once on the network.

1. A click on the device icon or on the first line of the **Device overview** opens the settings for **PROFINET interface** > **Ethernet addresses**:

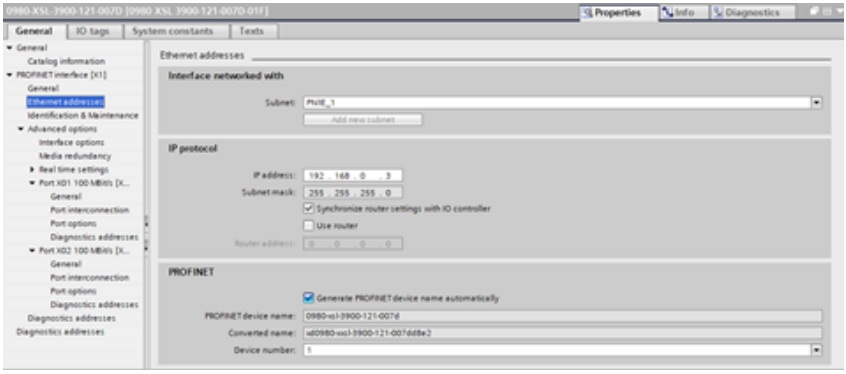


Figure 13: ETHERNET addresses

2. Check that the control unit and the I/O device are on the same Ethernet Subnet.
3. Accept the default settings for IP address and device name or change them if desired.

4. For a correctly working setup, the chosen device name must be programmed online in the I/O device. When the HW is already installed, you can easily change to online mode. The new I/O device should already be accessible via PROFINET:

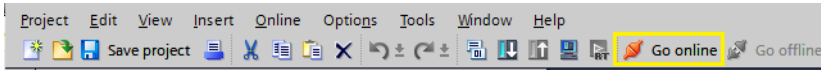


Figure 14: Go online

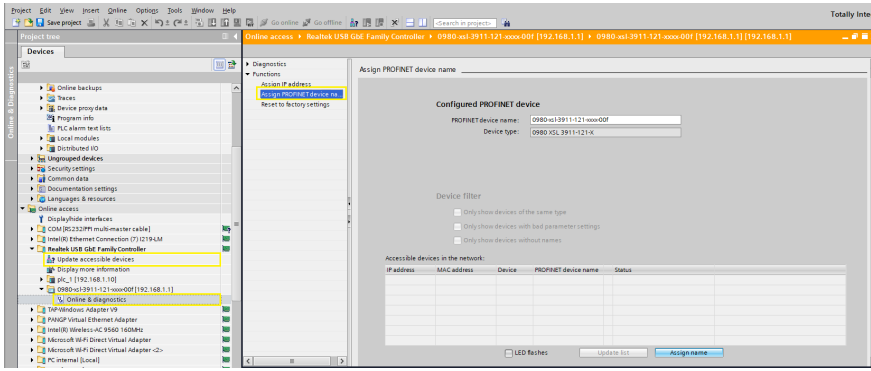


Figure 15: Online mode

5. Enter the same device name as configured in the offline project:

Figure 16: Assign device name

8.2 Configuring the I/O ports

For device 0980 XSL 3900-121-007D-01F, all I/O channels are pre-configured by default as 16 DI/DO.

This means you can attach a sensor or an actuator to each I/O channel without additional configuration of the channel direction (input or output). When you attach a sensor, do not activate the appropriate digital output via PLC.

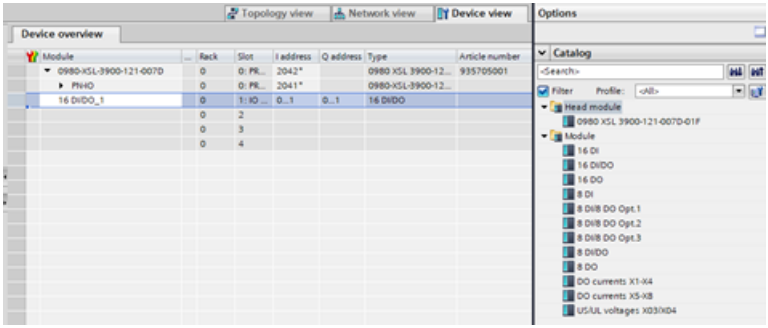


Figure 17: Channels pre-configuration

There are additional pre-configured channel setups available in the *Catalog* view. By removing the 16 DI/DO "Slot 1", you can set e.g. all I/O channels to 16 DO when choosing "Module 16 DO" from the *Catalog*.

The input and output addresses defined in the device overview can be changed.

8.2.1 Deleting the I/O configuration

1. To delete the current I/O configuration, select the respective slot in the *Device overview*:

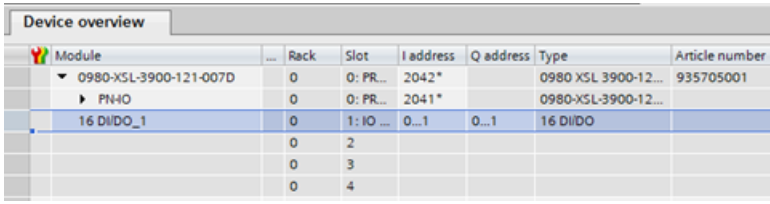


Figure 18: Device overview

2. Right click on the slot and select option *Delete* in the appearing menu:

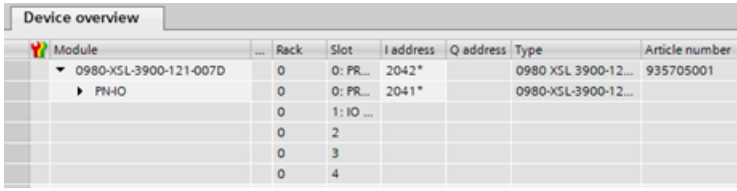


Figure 19: Free I/O Slot 1

8.2.2 Changing the I/O configuration

The *Module* folder of the I/O device inside the *Hardware catalog* shows all configurable options that can be selected:

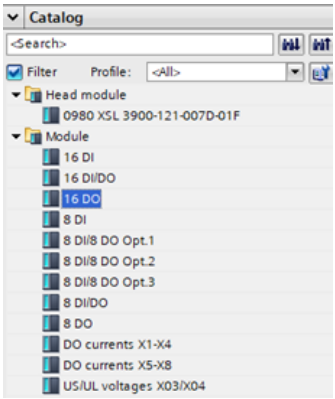
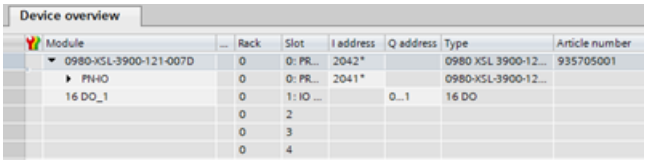
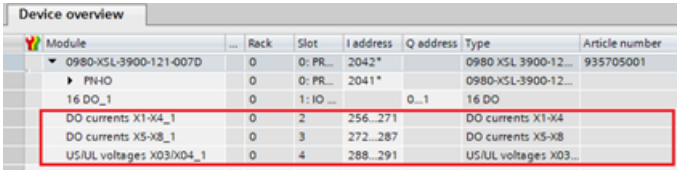


Figure 20: I/O channel configuration

Select the desired option, click and hold down the left mouse button to drag the configuration to a free slot:



There are three additional slots (2 .. 4) for optional output current and voltage measurements:



8.3 Parameterization of the Status/Control Module

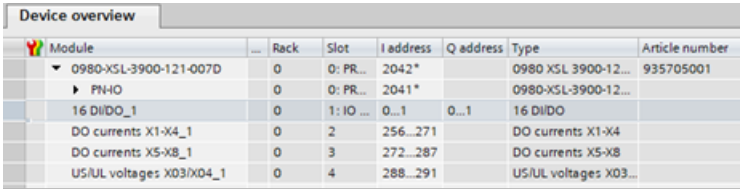


Figure 21: Status/Control Module

Parameters of the 16 DI/DO device variant:

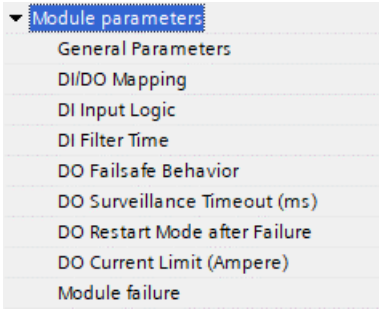


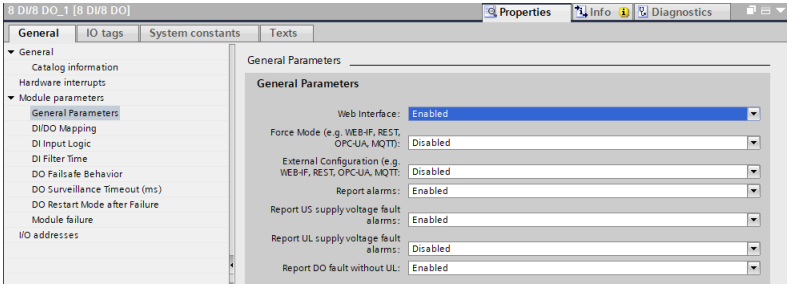
Figure 22: Parameters of the 16 DI/DO device variant

The variants 0980 XSL 3901… and 0980 XSL 3903... support sub-sets of the mentioned parameters. For variant 0980 XSL 3900…, the parameter sub-sets can be different in dependency of the chosen I/O configuration, e.g. "8DI" instead of "16 DI/DO".

Certain configuration parameters apply only to Digital Outputs or only to Digital Inputs. For these to be effective, the corresponding channel must have output or input functionality and must also be configured accordingly.

Configuration parameter	Applicable for channel configuration
Surveillance Timeout	DIO, Output
Failsafe	DIO, Output
Auto Restart	DIO, Output
Current Limit	DIO, Output
Input Filter Time	DIO, Input
Input Logic	DIO, Input

8.3.1 General Parameters



Web Interface

The Web interface access can be set to "Enabled" or "Disabled" with this parameter. In case of the "Disabled" setting, the Web pages are not reachable.

Default: Enabled

Force Mode

The input and output I/O data can be forced (= changed) for implementation reasons. This can be done by different interfaces (e.g. Web-Interface, REST, OPC UA, MQTT). With this function the possibility of forcing I/O data can be enabled or disabled.

Default: Disabled

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

External Configuration

Configuration and parameter data can be set over different external interfaces outside the GSDML configuration (e.g. Web interface, REST, OPC UA, MQTT). With this option, the “External Configuration” can be enabled or disabled. An external configuration can only be done, if no cyclic PLC connection is active. Every new PLC connection overwrites the external configuration settings.

Default: Disabled

Report Alarms

This is a global switch for enabling or disabling all PROFINET alarms.

Default: Enabled

Report U_S supply voltage fault alarms

The U_S supply voltage fault alarm can be set to "Disabled" or "Enabled" with this parameter.

Default: Enabled

Report U_L supply voltage fault alarms

The U_L supply voltage fault alarm can be set to "Disabled", "Enabled" or "Auto Mode" with this parameter.

In "Auto Mode", the U_L diagnosis will be activated with the first rising slope detection after power-up.

Default: Disabled

Attention: "Report U_L supply voltage fault" is disabled in the default setting to avoid diagnostic messages due to switching the supply voltage on or off later on.

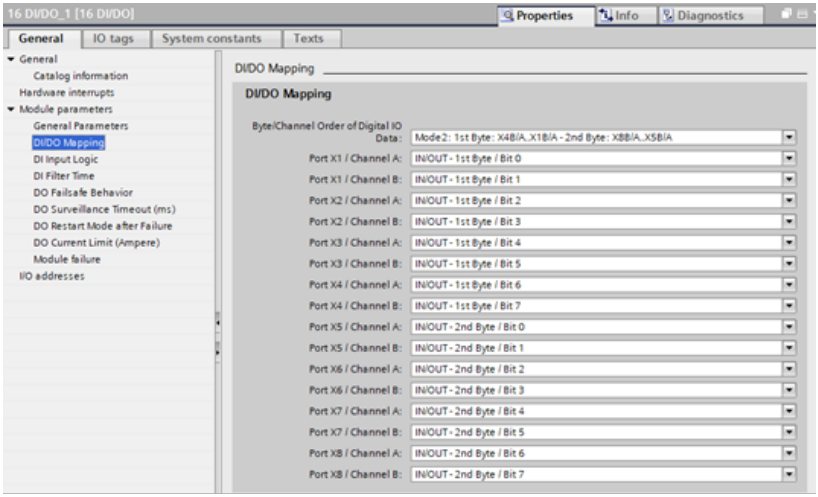
Report DO fault without U_L

The diagnosis of digital outputs can be configured in dependency of the U_L status.

When the output will be active without active U_L while this parameter is set to "Enabled", a diagnosis message will be generated for the output channel.

Default: Enabled

8.3.2 DI/DO Mapping



Byte/Channel order of Status/Control I/O data

With this parameter, 4 (Mode 1 – 4) pre-defined bit mappings for the digital I/O bits can be selected.

Mode 5 can be used for a free, user defined mapping. The parameter settings “Port X1 / Channel A” – “Port X8 / Channel B” must be used for this. These parameters enable all I/O channels to be freely assigned to a Bit in the Slot 1 I/O data. It should be noticed that duplicate assignments are not possible here. If faulty parameterization is detected in the LioN-X device, a fault will be registered.

When chosen Mode 1 – Mode 4, the “Port X1 / Channel A” – “Port X8 Channel B” settings will be ignored in the LioN-X device.

The chosen mapping will be used in the same way for input and output data direction.

Key

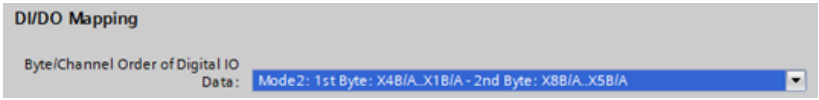
1st Byte = low address byte in a Siemens PLC

2nd Byte = high address byte in a Siemens PLC

(applicable for a Siemens PLC using Big-Endian format)

Mode 1:

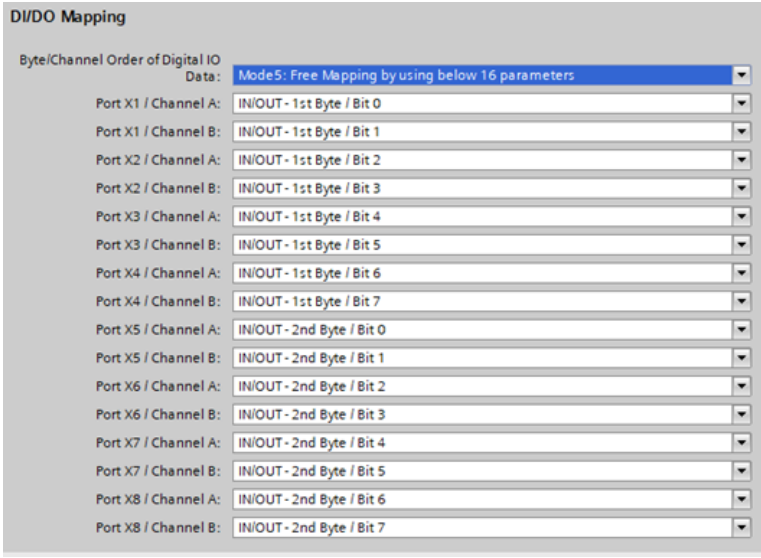
Mode 2:



Mode 3:

Mode 4:

Mode 5:

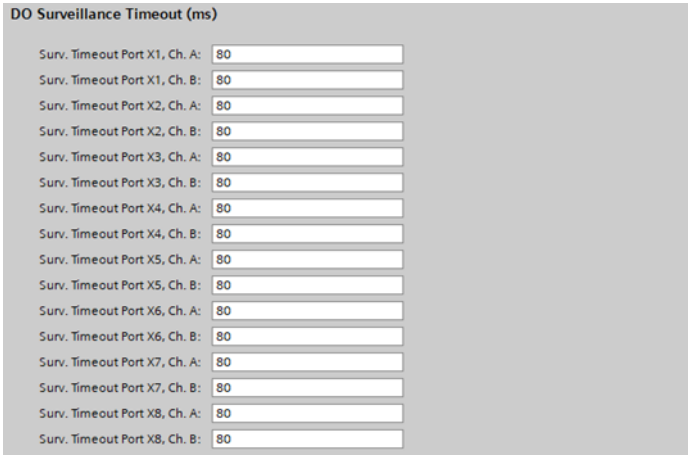


For detailed I/O mapping refer to chapter Process data assignment on page 74.

8.3.3 DO Surveillance Timeout (ms)

For channels configured as digital output, the firmware of the modules allows you to set a delay time before output status monitoring is enabled.

The delay time is referred to as the "Surveillance Timeout" and can be configured for each output channel. The delay time begins with a rising edge of the output control bit. After this time has elapsed, the output is monitored, and error states are reported by diagnostics.

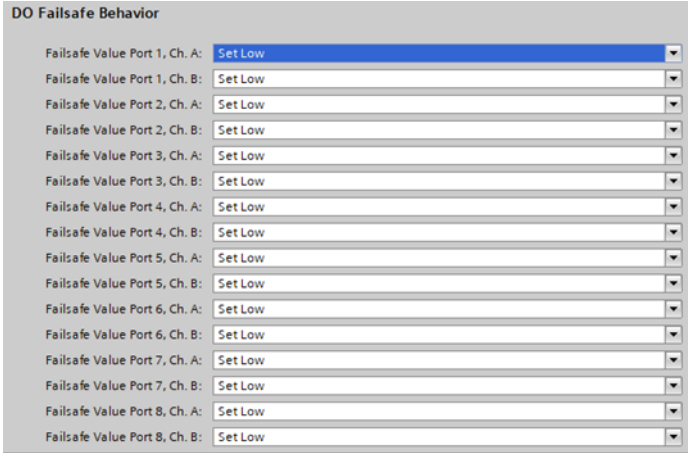


The *DO Surveillance-Timeout (ms)* parameter can be set from 0 to 255 ms. When an output channel is in static state, i.e., when the channel is permanently switched on or off, the typical filter value (not changeable) is 5 ms before a diagnostic message will be generated in case of a detected output error.

Default: 80 ms

8.3.4 DO Failsafe Behavior

The device supports a failsafe function for the channels used as digital outputs. During configuration of the devices, the status of the PROFINET IO device outputs can be defined after an interruption, or loss of communication on the PROFINET IO network.



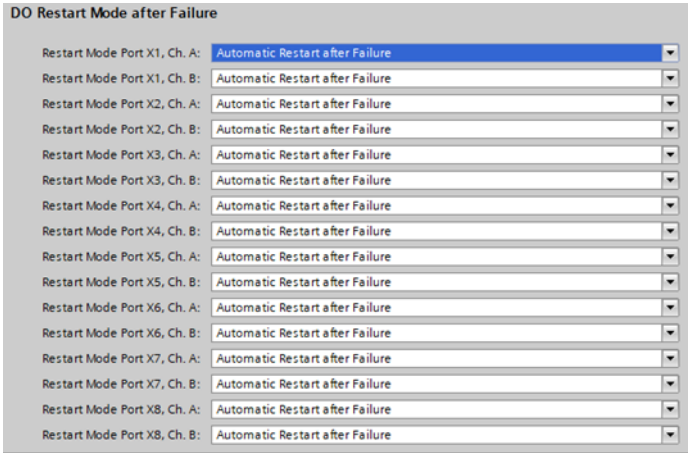
The following options can be selected:

- Set Low - the output channel is disabled and/or the output bit set to "0".
- Set High - the output channel is enabled and/or the output bit set to "1".
- Hold last – the last output state is kept.

Default: Set Low

8.3.5 DO Restart Mode after Failure

With this parameter, the digital output restart behavior can be set.



- Automatic Restart after Failure:

  In case of detecting an output short circuit or overload, the output will be switched off. However, after a time delay, the output will automatically be turned on again for checking if the overload or short circuit condition is active.

- Restart after Output Reset:

  In case of detecting an output short circuit or overload, the output will be switched off.

  The output will not be set automatically. Before the output can be turned on again, it must be logically reset by the PLC.

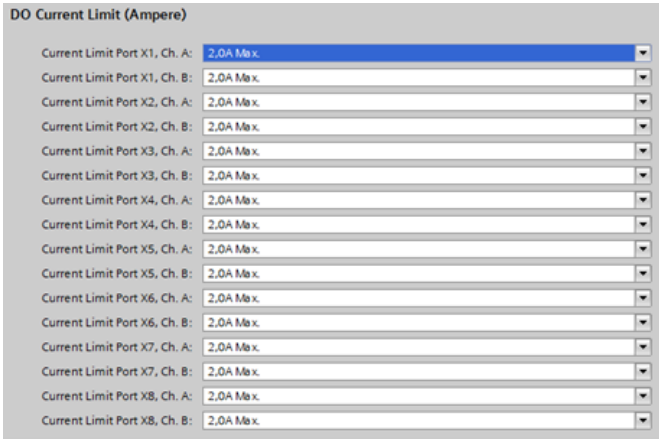
Default: Automatic Restart after Failure

8.3.6 DO Current Limit

With this option, the mode of the digital output switch can be selected.

- The following values are available: 0.5 A; 1.0 A; 1.5 A; 2,0 A; 2.0 A Max.

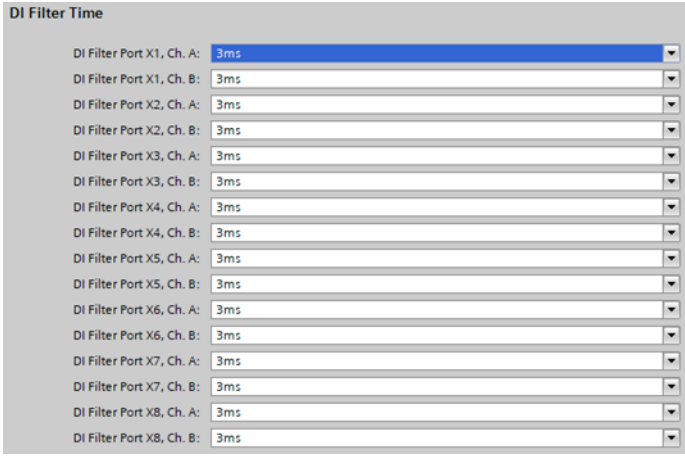
This means that the level for actuator overload diagnostic can be managed by this selection. *2.0 A Max.* means, that current limitation is **not** active and the maximum output current for this output is available.



Default: High-Side Switch (2.0 A Max.)

8.3.7 DI Filter Time

With this parameter, the filter time of the digital input can be defined.



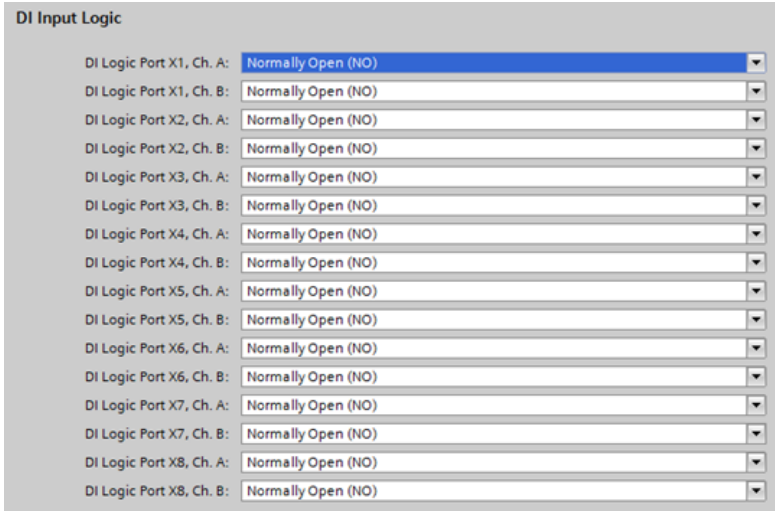
The following options are available:

Off; 1 ms; 2 ms; 3 ms; 6 ms; 10 ms; 15 ms

Default: 3 ms

8.3.8 DI Input Logic

This parameter can be used to configure the logic of the channels used as digital inputs.



- NO (Normally Open):

  A non-damped sensor has an open switching output (low signal) in this case. The device input detects a low signal and returns a "0" to the control unit.

  The LED of the channel shows the physical input state.

- NC (Normally Closed):

  A non-damped sensor has a closed switching output (high signal) in this case. The device input detects a high signal, inverts the signal, and returns a "0" to the control unit.

  The channel LED displays, independent of the setting, the physical input state.

Default: NO (Normally Open) for all channels

8.4 Media Redundancy Protocol (MRP)

Redundant PROFINET communication can be implemented with the LioN-X devices via a ring topology without the use of additional switches. An MRP redundancy manager terminates the ring, detects individual failures, and transmits the data packets on the redundant path in case of error.

The following conditions must be met to use MRP:

- All devices must support MRP.
- MRP must be enabled on all devices.
- Connections to the devices are only possible via the ring ports. A mesh topology is not permissible.
- A max. of 50 devices are permissible in the ring.
- All devices share the same redundancy domain.
- One device must be configured as the redundancy manager.
- All other devices must be configured as redundancy clients.
- Prioritized boot (FSU) is permissible.
- The response monitoring time of all devices must be greater than the reconfiguration time (typically 200 ms, min. 90 ms for LioN-X devices).
- It is recommended to use automatic network settings on all devices.

The following figures show a possible MRP ring configuration. The PLC is used as the redundancy manager while all other devices are clients. To detect an individual failure, it is advisable to use the diagnostics alerts.

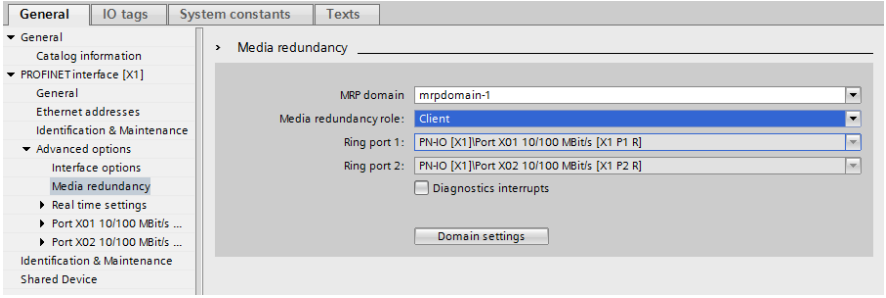


Figure 23: Example of setting up an MRP redundancy client in TIA Portal®

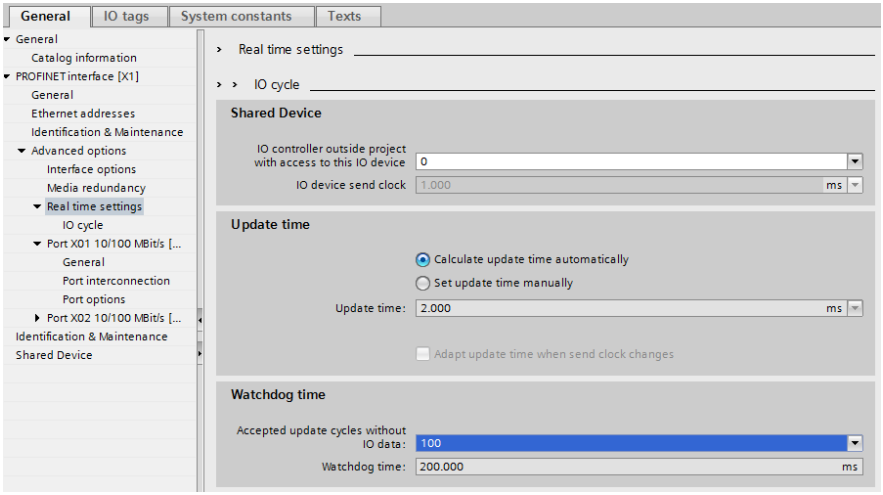


Figure 24: Example of setting up the Watchdog time monitoring in TIA Portal® for using MRP

8.5 Identification & maintenance (I&M)

The PROFINET IO device has the ability to uniquely identify the devices installed in the system via an electronic nameplate. This device-specific data can be read acyclic by the user at any time. Furthermore, the installation date, location code and further descriptions can be stored in the device during installing the system. The I&M functions provide the following functionality.

8.5.1 Supported I&M features

8.5.1.1 I&M data of the PN-IO Device

For reading (I&M 0 - 3) and writing (I&M 1 - 3) I&M data, the appropriate Hardware identifier for Slot **0: PROFINET Interface X1** must be chosen:

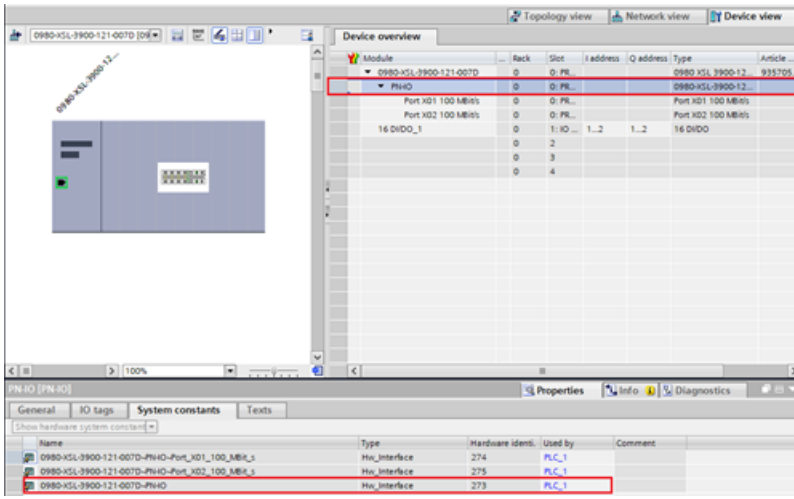


Figure 25: TIA Portal® hardware identifier of PROFINET interface for I&M 0-3 RDREC/WRREC

The device-specific I&M features can be read (0-3) or written (1-3) via slot 0. The specified index is used for mapping the data sets.

Data object	Length [byte]	Access	Default value / Description
MANUFACTURER_ID	2	Read	0x016A (Belden Deutschland GmbH)
ORDER_ID	20	Read	Order number of module in ASCII
SERIAL_NUMBER	16	Read	Defined in production process in ASCII[2]
HARDWARE_REVISION	2	Read	Hardware revision of device
SOFTWARE_REVISION	4	Read	Software revision of device
REVISION_COUNTER	2	Read	Incremented for every statically stored parameter change on the PROFINET IO device (e.g., device name or IP address)
PROFILE_ID	2	Read	0xF600 (Generic device)
PROFILE_SPECIFIC_TYPE	2	Read	0x0003 (IO modules)
IM_VERSION	2	Read	0x0101 (I&M Version 1.1)
IM_SUPPORTED	2	Read	0x000E (I&M 1 … 3 & 5 is supported)

Table 12: I&M 0 (Slot 0: PROFINET Interface X1, Index 0xAFF0)

Data object	Length [byte]	Access	Default value / Description
TAG_FUNCTION	32	Read/ Write	0x20 ff. (empty)
TAG_LOCATION	22	Read/ Write	0x20 ff. (empty)

Table 13: I&M 1 (Slot 0: PROFINET Interface X1, Index 0xAFF1)

[2] The serial number in the I&M data differs from the printed serial number on the housing. Printed serial number on housing: 9 characters article number + 9 characters ongoing number I&M0 serial number: 9 characters ongoing number (same last 9 characters as printed serial number on housing)

Data object	Length [byte]	Access	Default value / Description
INSTALLATION_DATE	16	Read/ Write	0x20 ff. (empty); Supported data format is a visible string with a fix length of 16 byte; “YYYY-MM-DD hh:mm” or “YYYY-MM-DD” filled with blank spaces

Table 14: I&M 2 (Slot 0: PROFINET Interface X1, Index 0xAFF2)

Data object	Length [byte]	Access	Default value / Description
DESCRIPTOR	54	Read/ Write	0x20 ff. (empty)

Table 15: I&M 3 (Slot 0: PROFINET Interface X1, Index 0xAFF3)

8.5.2 Reading and writing I&M data

In its standard library, SIEMENS offers TIA Portal® system function modules that allow I&M data to be read and written. A data set contains a 6-byte *BlockHeader* and the I&M record.

The data requested on reading, or the data to be written thus only start after the existing header. For writing, the header content must additionally be taken into account. Table 16: Data set with BlockHeader and I&M Record on page 68 shows the structure of a data set.

- For reading I&M 0..3, the RDREC block must be configured with `LEN = 6 Byte Block Header + I&M data length`.

Data object	Length [byte]	Data type	Coding	Description
BlockType	2	Word	I&M 0: 0x0020 I&M 1: 0x0021 I&M 2: 0x0022 I&M 3: 0x0023	BlockHeader
BlockLength	2	Word	I&M 0: 0x0038 I&M 1: 0x0038 I&M 2: 0x0012 I&M 3: 0x0038	
BlockVersionHigh	1	Byte	0x01	
BlockVersionLow	1	Byte	0x00	
I&M Data	I&M 0: 54 I&M 1: 54 I&M 2: 16 I&M 3: 54	Byte		I&M Record

Table 16: Data set with BlockHeader and I&M Record

8.5.2.1 I&M Read Record

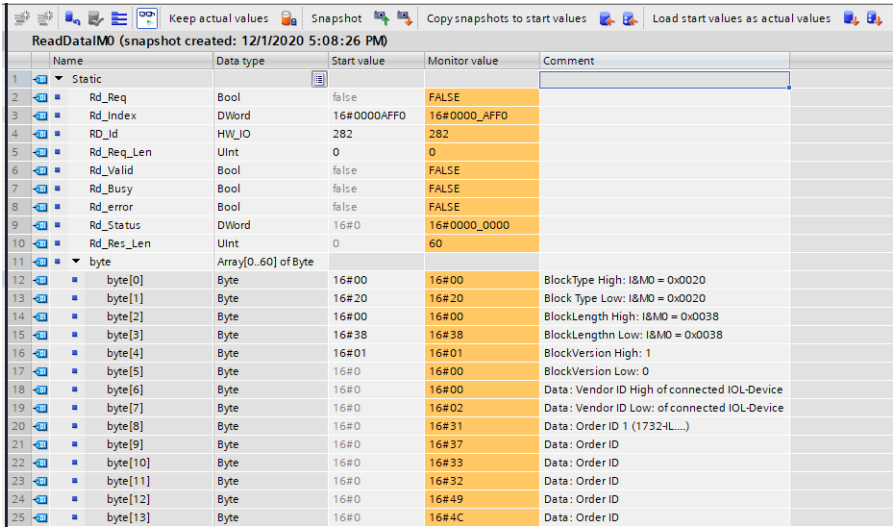
I&M data can be read via the standard RDREC (SFB52) function block in the **Siemens PLC**. The logical address of the slot/sub-slot (ID) and the I&M index (INDEX) must be used as handover parameters. The return parameters show the length of the I&M data received and contain a status or error message.

Keep actual values | Snapshot | Copy snapshots to start values | Load start values as actual values

ReadDataIM0 (snapshot created: 12/1/2020 5:08:26 PM)

	Name	Data type	Start value	Monitor value	Comment
1	Static				
2	Rd_Req	Bool	false	FALSE	
3	Rd_Index	DWord	16#0000AFF0	16#0000_AFF0	
4	RD_Id	HW_IO	279	279	
5	Rd_Req_Len	UInt	0	0	
6	Rd_Valid	Bool	false	FALSE	
7	Rd_Busy	Bool	false	FALSE	
8	Rd_error	Bool	false	FALSE	
9	Rd_Status	DWord	16#0	16#0000_0000	
10	Rd_Res_Len	UInt	0	60	
11	byte	Array[0..60] of Byte			
12	byte[0]	Byte	16#00	16#00	BlockType High: I&M0 = 0x0020
13	byte[1]	Byte	16#20	16#20	Block Type Low: I&M0 = 0x0020
14	byte[2]	Byte	16#00	16#00	BlockLength High: I&M0 = 0x0038
15	byte[3]	Byte	16#38	16#38	BlockLengthn Low: I&M0 = 0x0038
16	byte[4]	Byte	16#01	16#01	BlockVersion High: 1
17	byte[5]	Byte	16#0	16#00	BlockVersion Low: 0
18	byte[6]	Byte	16#0	16#01	Data: Vendor ID High of connected IOL-Device
19	byte[7]	Byte	16#0	16#6A	Data: Vendor ID Low: of connected IOL-Device
20	byte[8]	Byte	16#0	16#39	Data: Order ID 1 (935 700 001)
21	byte[9]	Byte	16#0	16#33	Data: Order ID
22	byte[10]	Byte	16#0	16#35	Data: Order ID
23	byte[11]	Byte	16#0	16#20	Data: Order ID
24	byte[12]	Byte	16#0	16#37	Data: Order ID
25	byte[13]	Byte	16#0	16#30	Data: Order ID
26	byte[14]	Byte	16#0	16#30	Data: Order ID
27	byte[15]	Byte	16#0	16#20	Data: Order ID
28	byte[16]	Byte	16#0	16#30	Data: Order ID
29	byte[17]	Byte	16#0	16#30	Data: Order ID
30	byte[18]	Byte	16#0	16#31	Data: Order ID
31	byte[19]	Byte	16#0	16#20	Data: Order ID
32	byte[20]	Byte	16#0	16#20	Data: Order ID

Figure 26: Read example I&M0 of PROFINET IO device



Keep actual values | Snapshot | Copy snapshots to start values | Load start values as actual values

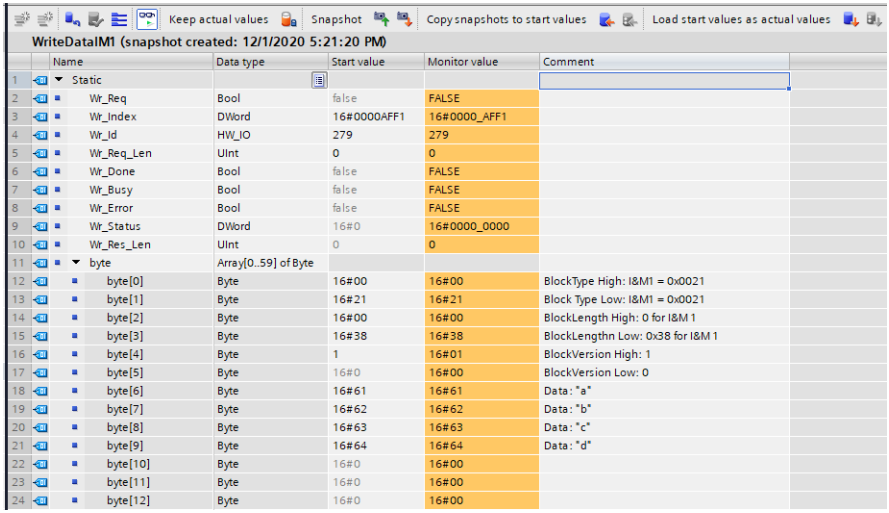
ReadDataIM0 (snapshot created: 12/1/2020 5:08:26 PM)

	Name	Data type	Start value	Monitor value	Comment
1	Static				
2	Rd_Req	Bool	false	FALSE	
3	Rd_Index	DWord	16#0000AFF0	16#0000_AFF0	
4	RD_Id	HW_IO	282	282	
5	Rd_Req_Len	UInt	0	0	
6	Rd_Valid	Bool	false	FALSE	
7	Rd_Busy	Bool	false	FALSE	
8	Rd_error	Bool	false	FALSE	
9	Rd_Status	DWord	16#0	16#0000_0000	
10	Rd_Res_Len	UInt	0	60	
11	byte	Array[0..60] of Byte			
12	byte[0]	Byte	16#00	16#00	BlockType High: I&M0 = 0x0020
13	byte[1]	Byte	16#20	16#20	Block Type Low: I&M0 = 0x0020
14	byte[2]	Byte	16#00	16#00	BlockLength High: I&M0 = 0x0038
15	byte[3]	Byte	16#38	16#38	BlockLengthn Low: I&M0 = 0x0038
16	byte[4]	Byte	16#01	16#01	BlockVersion High: 1
17	byte[5]	Byte	16#0	16#00	BlockVersion Low: 0
18	byte[6]	Byte	16#0	16#00	Data: Vendor ID High of connected IOL-Device
19	byte[7]	Byte	16#0	16#02	Data: Vendor ID Low: of connected IOL-Device
20	byte[8]	Byte	16#0	16#31	Data: Order ID 1 (1732-IL....)
21	byte[9]	Byte	16#0	16#37	Data: Order ID
22	byte[10]	Byte	16#0	16#33	Data: Order ID
23	byte[11]	Byte	16#0	16#32	Data: Order ID
24	byte[12]	Byte	16#0	16#49	Data: Order ID
25	byte[13]	Byte	16#0	16#4C	Data: Order ID

Figure 27: Read example I&M0 on port X1 with connected IOL-Device

8.5.2.2 I&M Write Record

I&M data can be written via the standard WRREC (SFB53) function block in the **Siemens PLC**. The logical address of the slot/sub-slot (ID), the I&M index (INDEX) and the data length (LEN) must be used as handover parameters. The return parameters contain a status or error message.



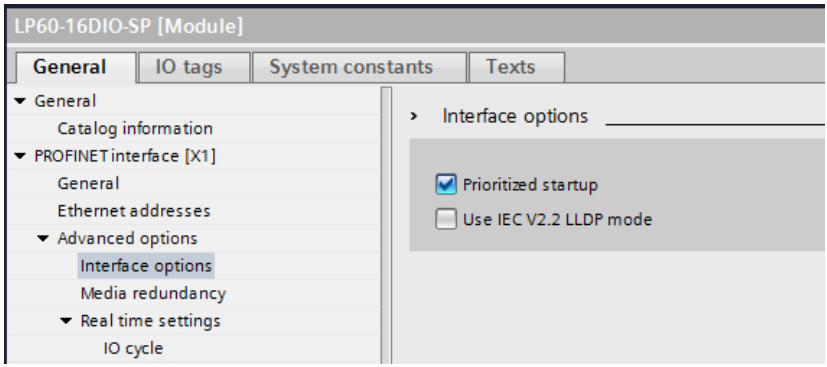
	Name	Data type	Start value	Monitor value	Comment
1	Static				
2	Wr_Req	Bool	false	FALSE	
3	Wr_Index	DWord	16#0000AFF1	16#0000_AFF1	
4	Wr_Id	HW_IO	279	279	
5	Wr_Req_Len	UInt	0	0	
6	Wr_Done	Bool	false	FALSE	
7	Wr_Busy	Bool	false	FALSE	
8	Wr_Error	Bool	false	FALSE	
9	Wr_Status	DWord	16#0	16#0000_0000	
10	Wr_Res_Len	UInt	0	0	
11	byte	Array[0..59] of Byte			
12	byte[0]	Byte	16#00	16#00	BlockType High: I&M1 = 0x0021
13	byte[1]	Byte	16#21	16#21	Block Type Low: I&M1 = 0x0021
14	byte[2]	Byte	16#00	16#00	BlockLength High: 0 for I&M 1
15	byte[3]	Byte	16#38	16#38	BlockLengthn Low: 0x38 for I&M 1
16	byte[4]	Byte	1	16#01	BlockVersion High: 1
17	byte[5]	Byte	16#0	16#00	BlockVersion Low: 0
18	byte[6]	Byte	16#61	16#61	Data: "a"
19	byte[7]	Byte	16#62	16#62	Data: "b"
20	byte[8]	Byte	16#63	16#63	Data: "c"
21	byte[9]	Byte	16#64	16#64	Data: "d"
22	byte[10]	Byte	16#0	16#00	
23	byte[11]	Byte	16#0	16#00	
24	byte[12]	Byte	16#0	16#00	

Figure 28: Example of a completed I&M1 write action of a PROFINET IO device

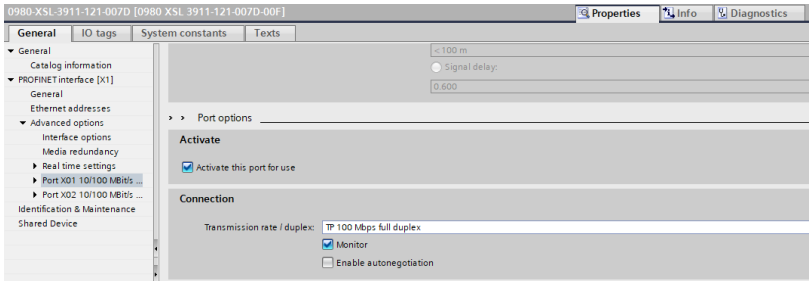
8.6 Fast Start Up (FSU) / Prioritized Startup

The LioN-X devices with Fast Start-Up (FSU) support an optimized system start-up. This guarantees a faster restart after the power supply is restored.

Fast Start-Up can be activated for the LioN-X devices with **PROFINET interface [X1]** > **Advanced options** > **Interface options** with the option *Prioritized start-up*.



For better FSU performance, the transmission settings of ports X01 and X02 should be set to:



Attention: The settings for the local and the partner port must be identical.

Measured boot times

PROFINET FSU time:[1)]

< 450 ms

Start time **with** FSU activated:[2)]

< 500 ms

Start time **without** FSU activated:[2)]

~5500 ms

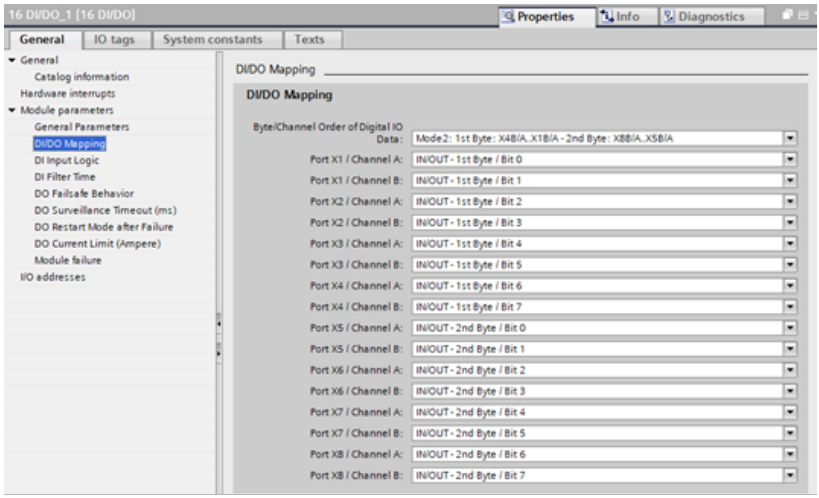
1) Measured according to specification: Internal switch is able to forward telegrams.

2) PLC reads one digital input and sets one digital output on I/O-Device after power-up of the DUT. The PLC is connected directly to DUT port X01 without any additional switch between PLC and DUT.

9 Process data assignment

This chapter describes the cyclic I/O data mapping between the PLC and the I/O device. The mapping depends on the device specific setting of parameter *DI/DO Mapping*.

For the DI/DO Mapping Mode configuration, see chapter DI/DO Mapping on page 55.



Key

X1A = Port 1, Channel A

1st Byte = low address byte in a Siemens PLC

2nd Byte = high address byte in a Siemens PLC

(applicable for a Siemens PLC using Big-Endian format)

9.1 0980 XSL 3900-121-007D-01F

9.1.1 16 DI/DO

9.1.1.1 Mapping Mode 1

Slot	Input/Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A
	2nd Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

9.1.1.2 Mapping Mode 2

Default setting

Slot	Input/Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
	2nd Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.1.1.3 Mapping Mode 3

Slot	Input/Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B
	2nd Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.1.1.4 Mapping Mode 4

Slot	Input/Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A
	2nd Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

9.1.1.5 Mapping Mode 5

The mapping for this mode depends on the user settings.

9.1.2 16 DI

9.1.2.1 Mapping Mode 1

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A
	2nd Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

9.1.2.2 Mapping Mode 2

Default setting

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
	2nd Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.1.2.3 Mapping Mode 3

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B
	2nd Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.1.2.4 Mapping Mode 4

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A
	2nd Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

9.1.2.5 Mapping Mode 5

The mapping for this mode depends on the user settings.

9.1.3 16 DO

9.1.3.1 Mapping Mode 1

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A
	2nd Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

9.1.3.2 Mapping Mode 2

Default setting

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
	2nd Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.1.3.3 Mapping Mode 3

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B
	2nd Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.1.3.4 Mapping Mode 4

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A
	2nd Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

9.1.3.5 Mapping Mode 5

The mapping for this mode depends on the user settings.

9.1.4 8 DI

9.1.4.1 Mapping Mode 5

Default setting

All 16 inputs are physically available, but only 8 inputs can be mapped to one input byte.

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.1.5 8 DI/8 DO, Opt. 1

9.1.5.1 Mapping Mode 5

Default setting

All 16 inputs/outputs are physically available, but only 8 inputs and 8 outputs can be mapped to one input byte and one output byte.

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.1.6 8 DI/8 DO, Opt. 2

9.1.6.1 Mapping Mode 5

Default setting

All 16 inputs/outputs are physically available, but only 8 inputs and 8 outputs can be mapped to one input byte and one output byte.

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

9.1.7 8 DI/8 DO, Opt. 3

9.1.7.1 Mapping Mode 5

Default setting

All 16 inputs/outputs are physically available, but only 8 inputs and 8 outputs can be mapped to one input byte and one output byte.

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.1.8 8 DI

9.1.8.1 Mapping Mode 5

Default setting

All 16 outputs are physically available, but only 8 outputs can be mapped to one output byte.

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.2 0980 XSL 3901-121-007D-01F

9.2.1 16 DI

9.2.1.1 Mapping Mode 1

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A
	2nd Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

9.2.1.2 Mapping Mode 2

Default setting

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
	2nd Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.2.1.3 Mapping Mode 3

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B
	2nd Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.2.1.4 Mapping Mode 4

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A
	2nd Byte	X8B	X7B	X6B	X5B	X4B	X3B	X2B	X1B

9.2.1.5 Mapping Mode 5

The mapping for this mode depends on the user settings.

9.2.2 8 DI

9.2.2.1 Mapping Mode 5

Default setting

All 16 inputs are physically available, but only 8 inputs can be mapped to one input byte.

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8A	X7A	X6A	X5A	X4A	X3A	X2A	X1A

9.3 0980 XSL 3903-121-007D-01F

9.3.1 8 DI/8 DO

9.3.1.1 Mapping Mode 5

Default setting

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.4 0980 XSL 3923-121-007D-01F

9.4.1 8 DI/8 DO

9.4.1.1 Mapping Mode 5

Default setting

Slot	Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A

Slot	Output	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1st Byte	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

9.5 DO currents X1 .. X4

This module can be configured optionally in slots 2, 3 or 4 when digital outputs are used. The content is four UINT16 of the actual measured output current.

A measured value of 1000mA will be transferred as "0x03E8 = b0000001111101000".

Slot	Input	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit
2 .. 4	1st Byte X1	15	14	13	12	11	10	9	8
	2nd Byte X1	7	6	5	4	3	2	1	0
	3rd Byte X2	15	14	13	12	11	10	9	8
	4th Byte X2	7	6	5	4	3	2	1	0
	5th Byte X3	15	14	13	12	11	10	9	8
	6th Byte X3	7	6	5	4	3	2	1	0
	7th Byte X4	15	14	13	12	11	10	9	8
	8th Byte X4	7	6	5	4	3	2	1	0

9.6 DO currents X5 .. X8

This module can be optionally configured in slots 2, 3 or 4 when digital outputs are used. The content is four UINT16 of the actual measured output current.

A measured value of 1000mA will be transferred as "0x03E8 = b0000001111101000".

Slot	Input	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit
2 .. 4	1st Byte X1	15	14	13	12	11	10	9	8
	2nd Byte X1	7	6	5	4	3	2	1	0
	3rd Byte X2	15	14	13	12	11	10	9	8
	4th Byte X2	7	6	5	4	3	2	1	0
	5th Byte X3	15	14	13	12	11	10	9	8
	6th Byte X3	7	6	5	4	3	2	1	0
	7th Byte X4	15	14	13	12	11	10	9	8
	8th Byte X4	7	6	5	4	3	2	1	0

9.7 U_S/U_L voltages X03/X04

This module can be optionally configured in slots 2, 3 or 4. The content is two UINT16 of the actual measured supply voltage U_S and U_L.

A measured value of 24 V will be transferred as "0x5DC0 = 0b0101110111000000".

Slot	Input	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit
2 .. 4	1st Byte U_S	15	14	13	12	11	10	9	8
	2nd Byte U_S	7	6	5	4	3	2	1	0
	3rd Byte U_L	15	14	13	12	11	10	9	8
	4th Byte U_L	7	6	5	4	3	2	1	0

9.8 PROFINET channel diagnostics mapping

Port	X8	X7	X6	X5	X4	X3	X2	X1
I/O Pin	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
I/O Channel	B/A	B/A	B/A	B/A	B/A	B/A	B/A	B/A
PN Diagn. Channel	8	7	6	5	4	3	2	1

Table 17: PROFINET channel diagnostics mapping

10 Diagnostics

10.1 Detailed diagnostics description

10.1.1 Error of the system/sensor power supply U_S

The voltage value for the incoming system/sensor power supply is monitored globally for the device. If the voltage drops below approx. 18 V, or exceeds approx. 30 V, an error message is generated

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

The following device diagnostic is generated:

Channel number of diagnostic	0x8000 (diagnostic not channel-specific)
Channel related diagnostic code	`0x0002`
Channel related diagnostic code message	`Undervoltage`

- For **disabled** U_S supply voltage fault alarms, the U_S indicator LED is "off" in case of voltage drops below approx. 18 V.
- For **enabled** U_S supply voltage fault alarms, the U_S indicator LED is "red" in case of voltage drops below approx. 18 V.

10.1.2 Error of the actuator power supply U_L

The voltage value for the incoming U_L power supply is monitored globally for the device. If U_L supply voltage alarms are enabled, an error message is generated in case the voltage drops below approx. 18 V or exceeds approx. 30 V.

If output channels are active, additional error messages caused by the voltage failure are generated on the I/O ports. U_L supply voltage alarms are disabled by default and can be enabled via parameterization.

The following device diagnostic is generated:

Channel number of diagnostic	0x8000 (diagnostic not channel-specific)
Channel related diagnostic code	`0x0118`
Channel related diagnostic code message	`Low voltage or over voltage of actuator power supply (UL)`
Extended description	`Check wire connection and UL power supply inclusive tolerance`

- For **disabled** U_L supply voltage fault alarms, the U_L indicator LED is "off" in case of voltage drops below approx. 18 V.
- For **enabled** U_L supply voltage fault alarms, the U_L indicator LED is "red" in case of voltage drops below approx. 18 V.

10.1.3 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 (GND) on the ports (X1 .. X8), the following channel-specific diagnostic messages are generated:

Channel number of diagnostics	0x01 .. 0x08
Channel related diagnostic code	0x0102
Channel related diagnostic code message	Sensor short circuit

- The dedicated red port DIA indicator is active when an error is detected.

10.1.4 Overload/short circuit of the I/O port Ch. A as actuator outputs

The digital outputs on the Channel A (pin 4) are protected against short circuits and overloads. In case of a fault, the output is automatically switched to "inactive" and then cyclically switched back to "active" when the default setting is used (*DO Restart Mode* Parameter = “Automatic Restart after Failure”).

In *DO Restart Mode* Parameter = “Restart after Output Reset”, the output must be set to "low" via PLC, before the output can be set again to "high".

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

The filter is used to avoid premature error messages when a capacitive load is activated.

The device sends the following PROFINET diagnostic message in the case of a fault:

Channel number of diagnostics	0x01 .. 0x08
Channel related diagnostic code	`0x0100`
Channel related diagnostic code message	`Actuator short circuit or supply error channel A`

- The dedicated red port DIA indicator is active when an error is detected.

10.1.5 Overload/short circuit of the I/O port Ch. B as actuator outputs

The digital outputs on the Channel B (I/Q / pin 2) are protected against short circuits and overloads. In case of a fault, the output is automatically switched to "inactive" and then cyclically switched back to "active" when the default setting is used (*DO Restart Mode* Parameter = “Automatic Restart after Failure”).

In *DO Restart Mod*e Parameter = “Restart after Output Reset”, the output must be set to "inactive" via PLC, before the output can be set again to "active".

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

The filter is used to avoid premature error messages when a capacitive load is activated.

The device sends the following PROFINET diagnostic message in the case of a fault:

Channel number of diagnostics	0x01 .. 0x08
Channel related diagnostic code	`0x0101`
Channel related diagnostic code message	`Actuator short circuit or supply error channel B`

- The dedicated red port DIA indicator is active when an error is detected.

10.1.6 Generic parameter error

When a device parameter will be written to an invalid address (e.g. Sub-Slot / Index) or the parameter data content is detected as invalid for the device, the following device specific diagnostic messages will be generated:

Channel number of diagnostics	0x8000 (diagnostics not channel-specific)
Channel related diagnostic code	`0x0010`
Channel related diagnostic code message	`Parameter error`

10.1.7 I/O mapping parameter error

The individual I/O data mapping parameter of the Status/Control data will be checked by the PROFINET IO device. When an error is detected inside this parameter block (e.g. a bit is mapped twice), the following message will be generated:

Channel number of diagnostics	0x8000 (diagnostics not channel-specific)
Channel related diagnostic code	`0x011A`
Channel related diagnostic code message	`I/O mapping configuration faulty`

10.1.8 Force mode diagnostic

In case of activated forcing, the following diagnostic message will be generated:

Channel number of diagnostics	0x8000 (diagnostics not channel-specific)
Channel related diagnostic code	`0x000A`
Channel related diagnostic code message	`Simulation active`

10.1.9 Internal module error

Internal module error states (e.g. internal abnormal states) will be reported by the following diagnostic message. For detailed information also use the Web interface of the device.

Channel number of diagnostics	0x8000 (diagnostics not channel-specific)
Channel related diagnostic code	`0x0009`
Channel related diagnostic code message	`Error`

10.2 Table of PROFINET diagnostic codes

The following table gives an overview of the defined diagnostic codes in PROFINET (0x0000 – 0x17FF) specification. Not all listed codes are used.

Diagnostic code	Definition	Type
0x0000	Reserved	
0x0002	Undervoltage	Error
0x0009	Error	Error
0x000A	Simulation active	Error
0x0010	Parameter error	Error
0x0118	Low voltage of actuator power supply (U_L). Check power supply	Error
0x011A	I/O mapping configuration faulty	Error

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

The MQTT (Message Queueing 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 114.

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
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 18: 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 99.

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 a string and they are allowed to contain slashes (`/`). In topic filters, there also wildcard symbols like e.g. (#) allowed.

11.1.2.1 Base topic

For all LioN-X variants there is a configurable Base topic which is the prefix for all topics. The Base topic can be chosen freely by the user. The Base topic can also contain selected variables as shown in Table 19: Base topic variables on page 99.

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
ip0 ip1 ip2 ip3	IP address octets

Table 19: 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, 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 data.

Table 20: 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, state	8	Interval
[base-topic]/process/gateway	All Digital IN/OUT	1	Interval
[base-topic]/process/port/n	Digital IN/OUT per port, pdValid	8	Interval

Table 21: 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 22: Use case examples

11.1.2.2 Publish topic

Overview of all publish JSON data for the defined topics:

Identity/gateway	
Key	**Data type**
product_name	json_string
ordering_number	json_string
device_type	json_string
serial_number	json_string
mac_address	json_string
production_date	json_string
fw_name	json_string
fw_date	json_string
fw_version	json_string
hw_version	json_string
family	json_string
location	json_string
country	json_string
fax	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 23: Identity/gateway

Config/gateway				
Key	**Data type**	**Range**	**Default value**	**Remarks**
fieldbus_protocol	json_string	PROFINET EtherNet/IP EtherCAT® Modbus TCP CC-Link IE Field Basic		
network_configuration	json_string	PROFINET: ▶ DCP ▶ Manual EtherNet/IP: ▶ Manual ▶ Rotary ▶ DHCP EtherCAT®: ▶ Manual Modbus TCP: ▶ Manual ▶ DHCP ▶ Rotary CC-Link IE Field Basic: ▶ Manual ▶ Rotary		
rotary_switches	json_integer	0 .. 999		
ip_address	json_string		192.168.1.1	
subnet_mask	json_string		255.255.255.0	
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	

Config/gateway				
Key	**Data type**	**Range**	**Default value**	**Remarks**
fast_startup	json_boolean	true / false	false	PROFINET and EIP only

Table 24: Config/gateway

Status/gateway				
Key	**Data type**	**Range**	**Default value**	**Remarks**
protocol	json_string	PROFINET: ▶ UNKNOWN ▶ OFFLINE ▶ STOP ▶ IDLE ▶ OPERATE EtherNet/IP: ▶ CONNECTED ▶ DISCONNECTED EtherCAT®: ▶ PREOP ▶ SAFEOP ▶ OP ▶ INIT ▶ UNKNOWN Modbus TCP: ▶ No Connections ▶ Connected CC-Link IE Feld Basic: ▶ ON ▶ STOP ▶ DISCONNECTED ▶ ERROR		
system_voltage_fault	json_boolean	true / false		
actuator_voltage_fault	json_boolean	true / false		
internal_module_error	json_boolean	true / false		
simulation_active_diag	json_boolean	true / false		
us_voltage	json_integer	0 .. 32		in Volts
ul_voltage	json_integer	0 .. 32		in Volts
forcemode_enabled	json_boolean	true / false		

Table 25: Status/gateway

Process/gateway				
Key	**Data type**	**Range**	**Default value**	**Remarks**
Input_data	json_integer[]			
output_data	json_integer[]			

Table 26: Process/gateway

Identity/port/1 .. 8				
Key	**Data type**	**Range**	**Default value**	**Remarks**
port	json_integer	1 .. 8		
type	json_string	Digital Input DIO Digital Output DIO Pin 4 Only DI Pin 4 Only DO Pin 4 Only Not available Unknown		
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	Digital Input Digital Output DIO Digital Input/Output Auxiliary Power Auxiliary with DO Not available Unknown		
channel_chb	json_string	Digital Input Digital Output DIO Digital Input/Output Auxiliary Power Auxiliary with DO Not available Unknown		

Table 27: Identity/port/1 .. 8

Config/port/1 .. 8				
Key	**Data type**	**Range**	**Default value**	**Remarks**
port	json_integer	1 .. 8		
direction_cha	json_string	Output Input Inactive Auxiliary Power DIO Unknown		
direction_chb	json_string	Output Input Inactive Auxiliary Power DIO Unknown		
restart_mode_cha	json_string	Manual Auto		
restart_mode_chb	json_string	Manual Auto		
input_polarity_cha	json_string	NO NC		
input_polarity_chb	json_string	NO NC		
input_filter_cha	json_integer			ms
input_filter_chb	json_integer			ms
do_auto_restart_cha	json_boolean	true / false		
do_auto_restart_chb	json_boolean	true / false		
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	

Config/port/1 .. 8				
Key	**Data type**	**Range**	**Default value**	**Remarks**
surveillance_timeout_chb	json_integer	0 .. 255	80	
io_mapping_cha	json_integer	0 .. 15	channel number	16DIO only
io_mapping_chb	json_integer	0 .. 15	channel number	16DIO only

Table 28: Config/port/1 .. 8

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

Table 29: Status/port/1 .. 8

11.1.2.3 Command topic (MQTT Subscribe)

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

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

`[base-topic]/command`

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

[…]/forcing

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

Property	Data type	Example values	Remarks
forcemode	boolean	true / false	Forcing Authority: on/off
digital	array (Table 31: Force object: Digital on page 111)		

Table 30: Force object properties

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

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

Table 31: Force object: Digital

[…]/config

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

Property	Data type	Example values	Remarks
portmode	array (Table 33: Config object: Portmode on page 112)		
ip_address	string	"192.168.1.5"	
subnet_mask	string	"255.255.255.0"	
gateway	string	"192.168.1.100"	

Table 32: Config object properties

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

Property	Data type	Example values	Remarks
port	integer	2	
channelA*	string	"dio", "di", "do", "iol", "off"	
channelB*	string	"dio", "di", "do", "iol", "off", "aux"	
inlogicA	string	"no", "nc"	
inlogicB	string	"no", "nc"	
filterA	integer	3	input filter in ms
filterB	integer	3	input filter in ms
autorestartA	boolean		
autorestartB	boolean		

Table 33: Config object: Portmode

*channelA = Pin 4, channelB = Pin 2

[…]/reset

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

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

Table 34: Reset object properties

[…]/publish

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

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

11.1.3 MQTT configuration - Quick start guide

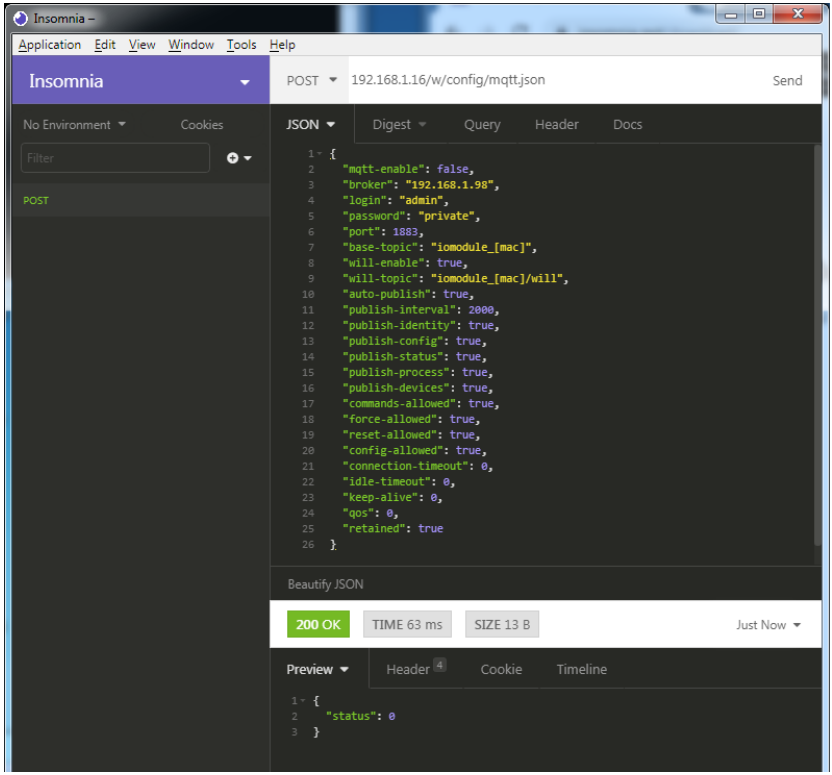
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

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/

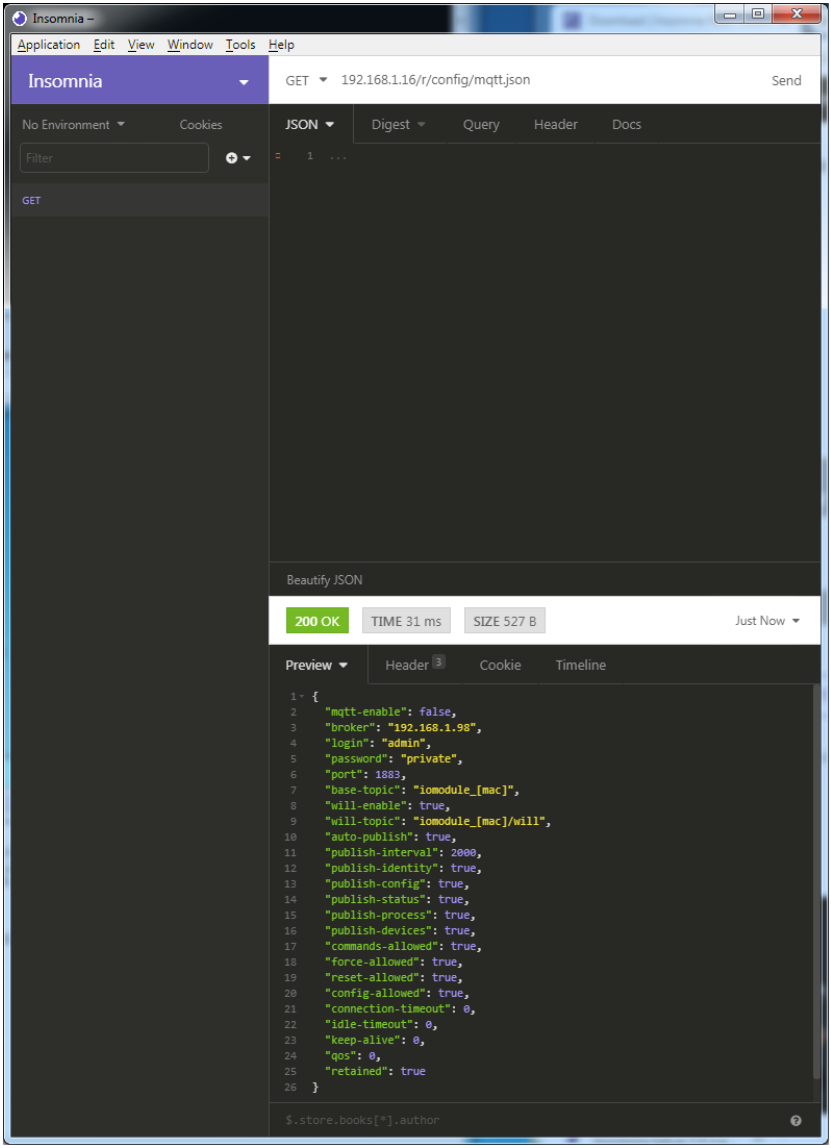
2. Configure MQTT:

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



3. Read MQTT:

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



11.2 OPC UA

OPC 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.

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.

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.

Tree overview of OPC UA objects:

- Gateway
  - Identity
    - Name
    - MAC
    - Ordering Number
    - Production Date
    - Capabilites
    - Firmware Versions
  - Status (r)
    - US present
    - UL present
    - US diag
    - UL diag
    - US Voltage
    - UL Voltage
    - IME
    - Forcemode Diag
    - Rotary positions
  - Forcing (r)
    - Forcing active
    - Forcing client
    - OwnForcing flag
  - Config (rw)
    - IP Config
    - suppressActuatorDiagWithoutUL
    - suppressUSDiag
    - suppressULDiag
    - quickConnect
  - Process (r)
    - Digital Inputs
    - Digital Outputs
    - Producing Data (to PLC)
    - Consuming Data (from PLC)
    - Valid masks
  - Commands (w)
    - Restart
    - Factory Reset
    - Forcemode enable

- Ports
  - Port *n ("X1"-"X8")*
    - Identity
      - Port Name
      - Port Type
    - Channel *m* ("Pin 4" / "Pin 2")
      - Identity (r)
        - Channel Name
        - Channel Type
        - MaxOutputCurrent
      - Status (r)
        - Actuator Diag
        - Actuator Voltage
        - Actuator Current
        - Channel Failsafe flag
      - Config (rw)
        - Surveillance Timeout
        - Failsafe Config
        - Channel Direction
        - Channel Current Limit
        - Auto Restart
        - InputFilterTime
        - InputLogic
      - Process (r)
        - Output Bit
        - Input Bit
        - Consuming Bit
        - Producing Bit
      - Forcing (rw)
        - Force channel on/off
        - Force value on/off
        - Simulate channel
        - SImulate value
    - Status (r)
      - Pin 1 Short Circuit Dia
      - Pin 1 Voltage
      - Pin 1 Current
    - Config (rw)
      - Pin 1 Current limit

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"}]}
```

11.2.1.1 Gateway objects

Identity

Name	Data type	Example
Device Name	UA_STRING	
Device ID	UA_STRING	
MAC address	UA_STRING	
Ordering Number	UA_STRING	
Serial Number	UA_STRING	
Production Date	UA_STRING	
Hardware Version	UA_STRING	
App Firmware Version	UA_STRING	
Fieldbus Firmware Version	UA_STRING	
IO Firmware Version	UA_STRING	
Running Fieldbus	UA_STRING	
Forcemode supported	UA_BOOLEAN	Forcing supported by module variant

Status (read)

Name	Data type	Unit	Example
US present	UA_BOOLEAN		
UL present	UA_BOOLEAN		
US diagnosis	UA_BOOLEAN		
UL diagnosis	UA_BOOLEAN		
Internal Module Error diag	UA_BOOLEAN		

Name	Data type	Unit	Example
Forcemode diag	UA_BOOLEAN		
US voltage	UA_DOUBLE	V	23.2
UL voltage	UA_DOUBLE	V	22.9
Rotary position	UA_UINT16		343

Forcing (read)

Name	Data type	Example
Forcing active	UA_BOOLEAN	
Forcing client	UA_STRING	if forcemode is not active, string is empty
Own Forcing	UA_BOOLEAN	Indicates if OPC UA is currently forcing
Forcing possible	UA_BOOLEAN	true if forcing by OPC UA is possible
Forcemode lock	UA_BOOLEAN	Forcing locked by PLC

Config (read + write)

Name	Data type	Example
IP address	UA_STRING	
Subnet Mask	UA_STRING	
Default Gateway IP	UA_STRING	
Suppress US diag	UA_BOOLEAN	
Suppress UL diag	UA_BOOLEAN	
Supppres Actuator Diag w/o UL	UA_BOOLEAN	
QuickConnect	UA_BOOLEAN	

Process (read)

Name	Data type	Example
Input Data	UA_UINT16	ioInput for all channels
Output Data	UA_UINT16	ioOutput for all channels
Consuming Data	UA_UINT16	Data from the PLC to the device
Producing Data	UA_UINT16	Data from the device to the PLC

Commands (write)

Name	Arguments	Return	Example
Restart	void	UA_INT32	
Factory reset	void	UA_INT32	
Forcemode enable	void	UA_INT32	
Forcemode disable	void	UA_INT32	

11.2.1.2 Ports objects

Identity

Name	Data type	Example
Name	UA_STRING	"X1"
Type	UA_STRING	"DIO"

Channel *m* ("Pin 4" / "Pin 2")

See details in Channel objects on page 123.

Status (read)

Name	Data type	Unit	Example
Sensor Diag	UA_BOOLEAN		
Pin 1 Voltage	UA_DOUBLE	V	22.5
Pin 1 Current	UA_INT16	mA	1900

Config (read + write)

Name	Data type	Unit	Example
Pin 1 Current Limit	UA_INT16	mA	1000

11.2.1.3 Channel objects

Identity (read)

Name	Data type	Unit	Example
Name	UA_STRING		"X1A"
Type	UA_STRING		"DIO"
MaxOutputCurrent	UA_INT16	mA	1300

Status (read)

Name	Data type	Unit	Example
Actuator Diag	UA_BOOL		
Actuator Voltage	UA_DOUBLE	V	23.5
Actuator Current	UA_INT16	mA	800
Channel Failsafe	UA_BOOL		

Config (read + write)

Name	Data type	Unit	Example / Remarks
Surveillance Timeout	UA_UINT8	ms	80 ms
Failsafe Config	UA_ENUMERATION		Low Hi Hold Last
Channel DIrection	UA_ENUMERATION		DIO Input Output Inactive
Channel Current Limit	UA_UINT16	mA	2000 mA
Auto Restart	UA_BOOL		

Name	Data type	Unit	Example / Remarks
InputFilterTime	UA_UINT8	ms	3ms
InputLogic	UA_ENUMERATION		NO NC

Process (read)

Name	Data type	Example / Remarks
Output	UA_BOOLEAN	Output type channels only.
Input	UA_BOOLEAN	Input type channels only.
Consuming	UA_BOOLEAN	
Producing	UA_BOOLEAN	

Forcing (read + write)

Name	Data type	Example / Remarks
Force channel	UA_BOOLEAN	Enable forcing with the current force value or disable forcing for this channel. Output type channels only.
Force value	UA_BOOLEAN	When changed by the user it will start forcing with the new value if forcing is enabled for opcua. Output type channels only.
Simulate channel	UA_BOOLEAN	Enable simulation with the current force value or disable simulation for this channel. Input type channels only.

Name	Data type	Example / Remarks
Simulate value	UA_BOOLEAN	When changed by the user it will start simulation with the new value if forcing is enabled for opcua. Input type channels only.

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

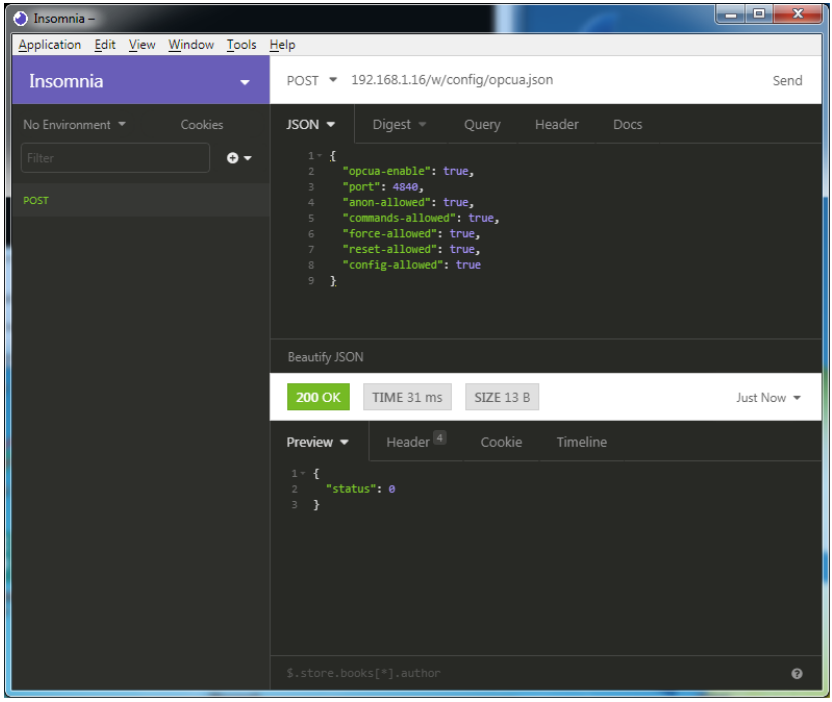
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

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/

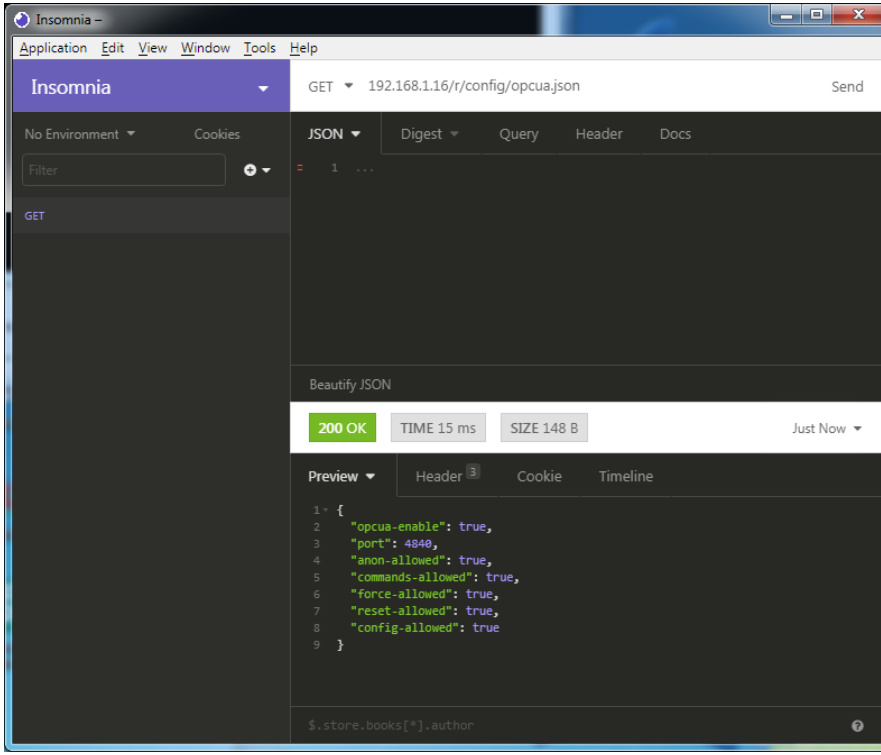
2. Configure OPC UA:

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

The customized Belden REST API 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.

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

Name	Data type	Description	Example
CHANNEL Object			
name	string	Name of channel	
type	number	Hardware channel type as number: 0 = DIO 1 = Input 2 = Output 3 = Input/Output 4 = Channel not available 5 = Channel not available 6 = Channel not available 7 = Channel not available 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 = Channel not available 4 = Deactivated 5 = Channel not available	
config_text	string	Textual representation of the current config	
inputState	boolean	Input data (producing data) bit to the PLC	
outputState	boolean	Output data bit to the physical output pin	
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	

Name	Data type	Description	Example
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 port type	
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"
ds_fault	number	Data storage error number	
ds_fault_text	string	Textual data storage error.	
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"
message	string	Error message	"Supply Voltage fault"
FORCING Object		Forcing information of the device	
forcingActive	boolean	Force mode is currently active	
forcingPossible	boolean	True, if forcing is possible and force mode can be activated	
AuthPossible	boolean	True, if the JSON Interface can obtain forcing autorization	
ownForcing	boolean	True, if forcing is performed by REST API at the moment	
currentClient	string	Current forcing client identifier	

Name	Data type	Description	Example
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)		

Table 35: 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", "off", "aux"	
inlogica	string	"no","nc"	
inlogicb	string	"no","nc"	

Table 36: 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 37: Digital object

11.4 CoAP server

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 138.

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 38: 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	

Table 39: REST API access via CoAP

11.4.3 CoAP configuration - Quick start guide

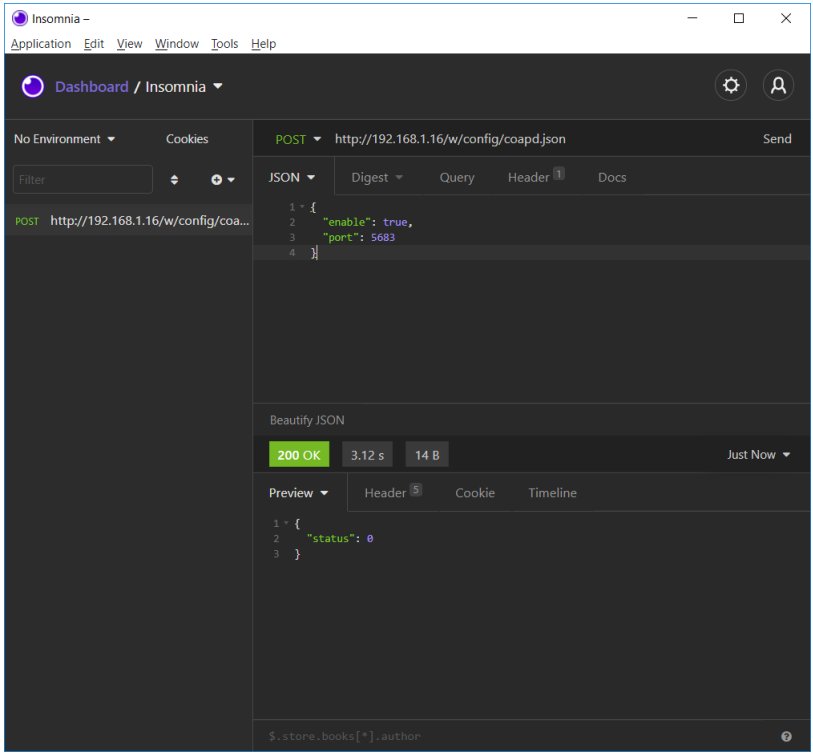
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

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/

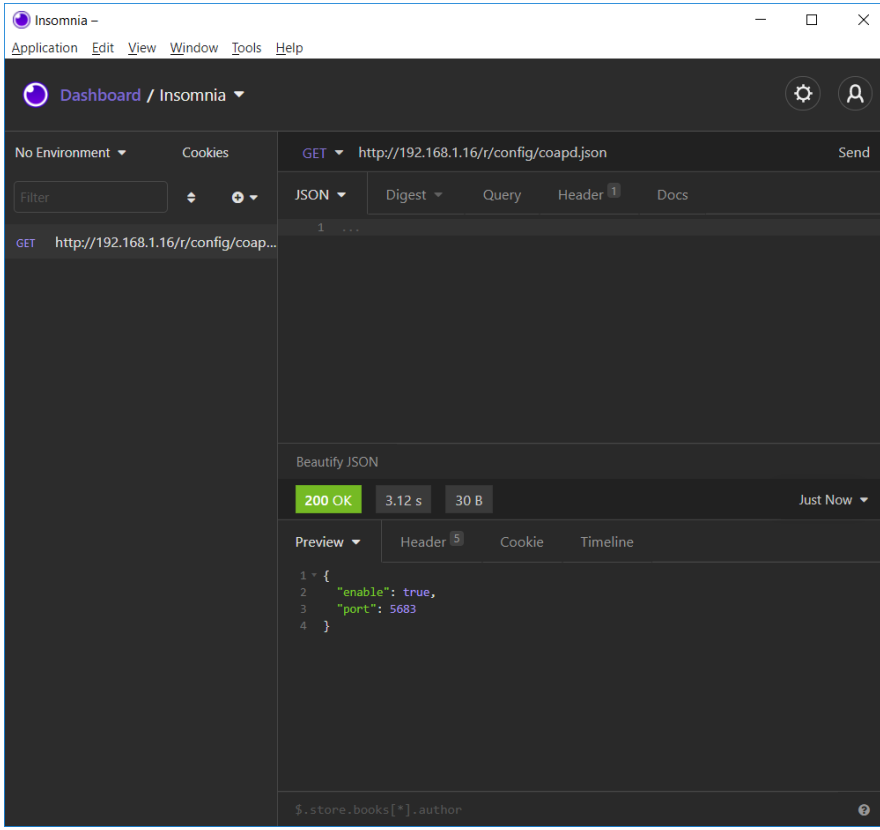
2. Configure CoAP:

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



3. Read CoAP configuration:

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



11.5 Syslog

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 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 143.

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 40: 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

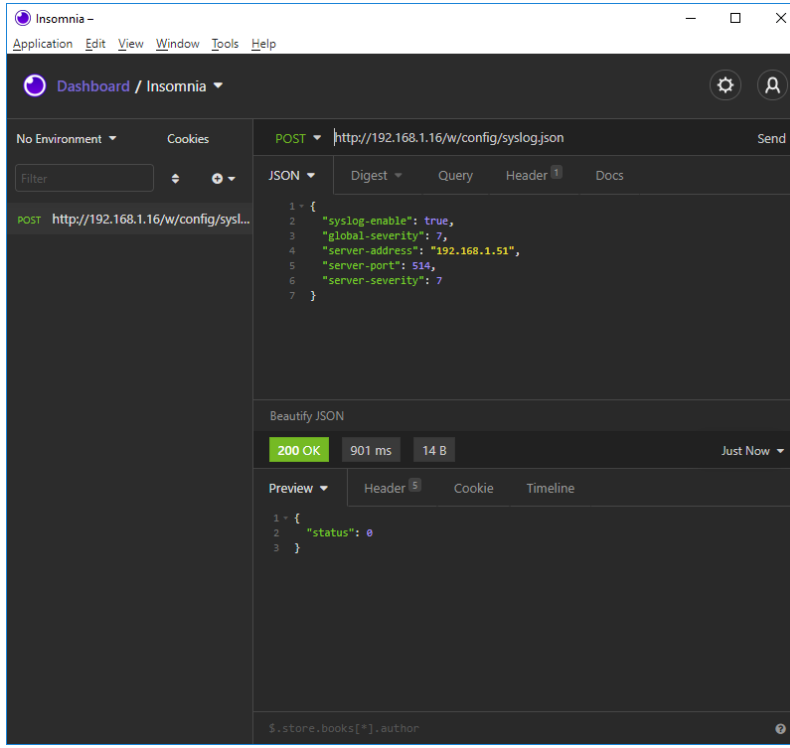
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

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/

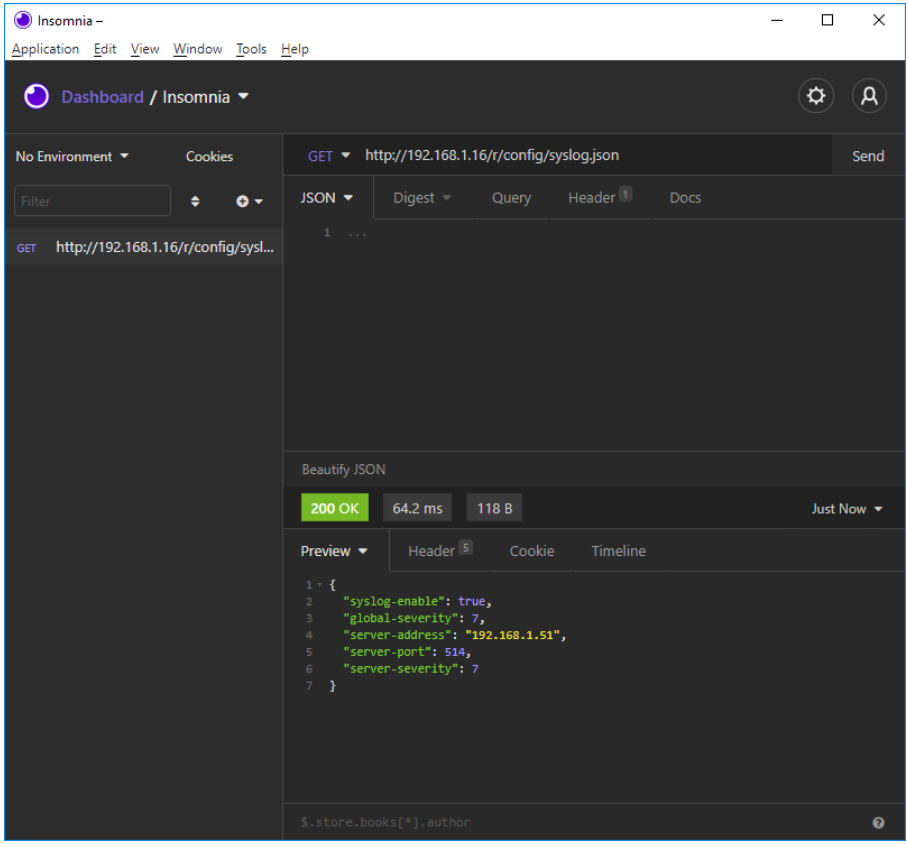
2. Configure Syslog:

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



3. Read Syslog configuration:

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



11.6 Network Time Protocol (NTP)

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

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

11.6.1 NTP configuration

In **delivery state**, the NTP client is **disabled**. The NTP client can be configured either using the Web interface or directly via a JSON object sent in an HTTP request. For more information see chapter NTP configuration - Quick start guide on page 147.

The configuration URL is:

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

The configuration can also read back as a JSON file:

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

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

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

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

Table 41: NTP configuration

NTP response:

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

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

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

Examples:

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

{"status": 0}

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

11.6.2 NTP configuration - Quick start guide

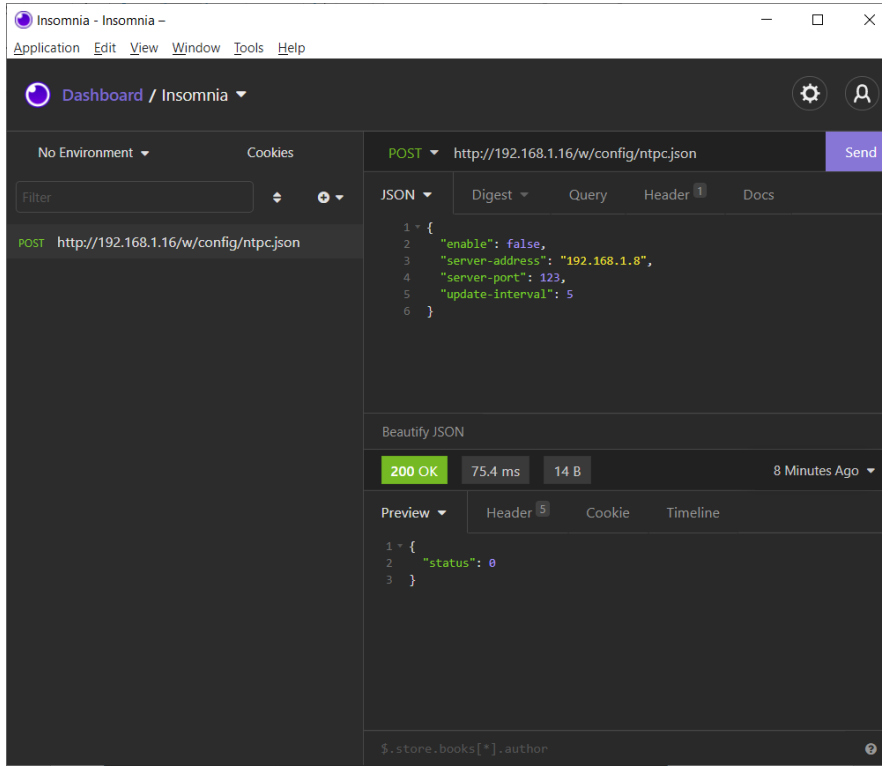
Attention: Lumberg Automation™ is not responsible for any content of the referenced Web pages and provides no warranty for any functionality of the named third party software.

11.6.2.1 NTP configuration via JSON

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

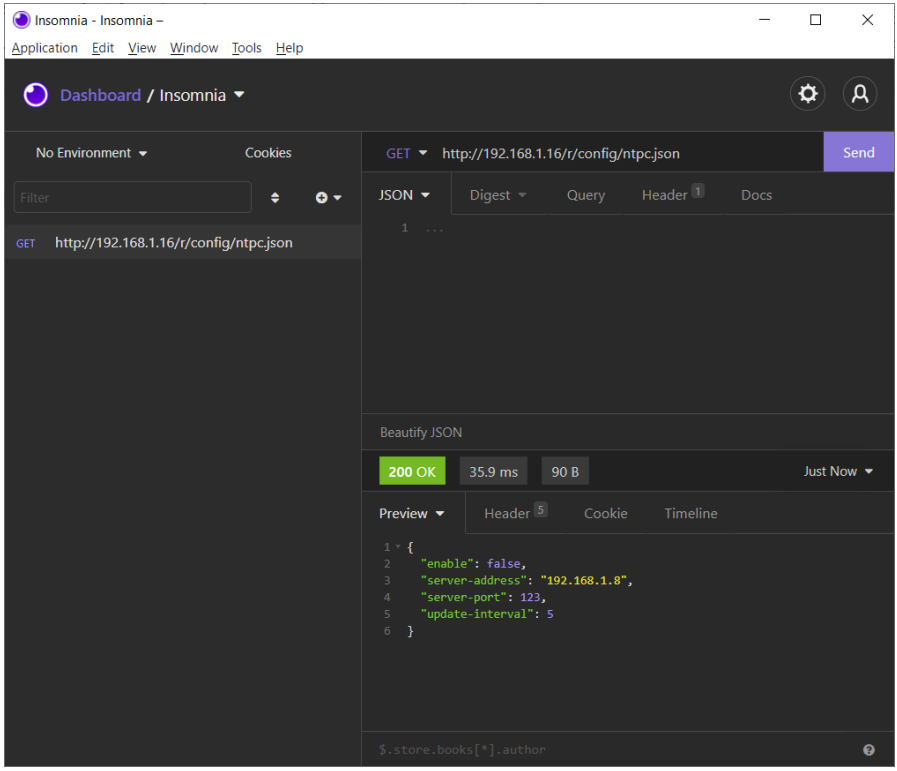
2. Configure NTP:

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



3. Read NTP configuration:

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



12 The integrated Web server

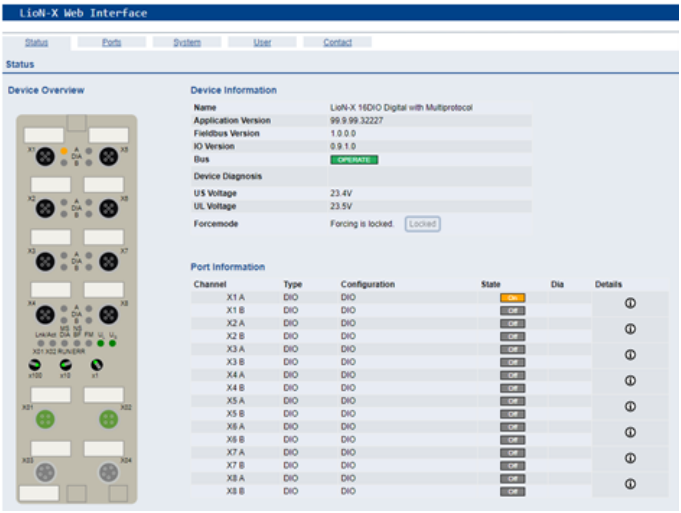
All device variants are equipped with an integrated Web server which makes functions for the device configuration and the display of status and diagnostic information available via a Web interface.

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

Enter "http://" 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.

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

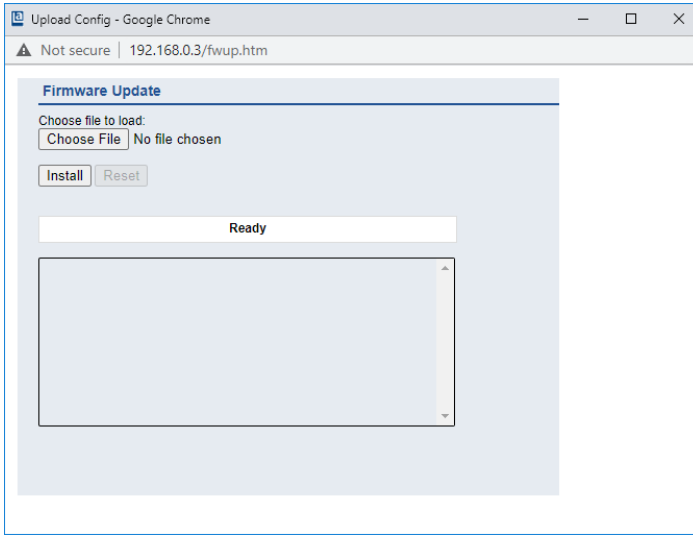
Use this parameter to change the current IP address of the module.

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.

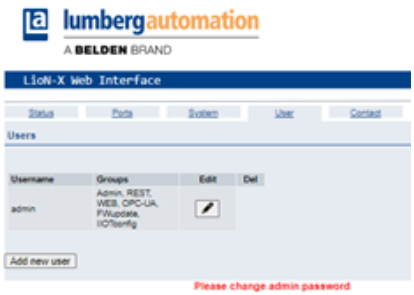
Firmware Update

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

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.)[3]	IP65 IP67 IP69K	
Ambient temperature (during operation and storage)	0980 XSL 3x00-121... 0980 XSL 3x01-121... 0980 XSL 3x03-121...	-40 °C .. +70 °C (-40 °F .. +158 °F)
Weight	LioN-X 60 mm	approx. 500 gr. (17.6 oz)
Ambient moisture	Max. 98% RH (For UL applications: Max. 80% RH)	
Housing material	Die-cast zinc	
Surface finish	Frosted nickel	
Flammability class	UL 94 (IEC 61010)	
Vibration resistance (oscillation) DIN EN 60068-2-6 (2008-11)	15 g/5–500 Hz	
Shock resistance DIN EN 60068-2-27 (2010-02)	50 g/11 ms +/- X, Y, Z	
Fastening torques	M4 fixing screws	1 Nm
	M4 ground connection	1 Nm
	M12 connector	0.5 Nm
Permitted cables	Ethernet cables according to IEEE 802.3, min. CAT 5 (shielded) Max. length of 100 m, not routed out of facility (= local network)	

Table 42: General information

[3] Not under UL investigation.

13.2 PROFINET protocol

Protocol	PROFINET IO device V2.41
Conformance Class	C (CC-C)
Netload Class	III
Update cycle	1 ms
GSDML file	GSDML-V2.41-LumbergAutomation-LioN-Xyyyymmdd.xml
Transmission rate	100 Mbit/s, full duplex
Transmission procedure Autonegotiation	100BASE-TX is supported
Vendor ID	$16A_H$
Device ID	0x0400 (same for all LioN-X variants)
Supported Ethernet protocols	Ping ARP LLDP SNMPv1 (network diagnostics) ▶ Read Community: public ▶ Write Community: private DCP HTTP TCP/IP MRP Client
PROFINET feature	Fast Start UP (Prioritized startup) Shared Device
Switch functionality	Integrated IRT is supported
PROFINET interface Connections Autocrossing	2 M12 sockets, 4-pin, D-coded (see pin assignments) 2 M12 Hybrid male/female, 8-pin is supported
Electrically isolated Ethernet ports -> FE	2000 V DC

Table 43: PROFINET protocol

13.3 Power supply of the module electronics/ sensors

Port X03, X04	M12-L-coded Power, connector/socket, 5-pole Pin 1 / Pin 3		
Nominal voltage U_S	24 V DC (SELV/PELV)		
Current U_S	Max. 16 A		
Voltage range	21 .. 30 V DC		
Power consumption of module electronics	Typically 160 mA (+/-20 % at U_S nominal voltage)		
Power supply interruption	Max. 10 ms		
Voltage ripple U_S	Max. 5 %		
Current consumption sensor system (Pin 1)	0980 XSL 3x00-121... 0980 XSL 3x01-121...	Port X1 .. X8 (Pin 1)	max. 4 A per port (at $T_{ambient}$ = 30° C)
	0980 XSL 3x03-121...	Port X1 .. X4 (Pin 1)	max. 4 A per port (at $T_{ambient}$ = 30° C)
Voltage level of the sensor power supply	Min. (U_S – 1.5 V)		
Short circuit/overload protection of sensor supply	Yes, per port		
Reverse polarity protection	Yes		
Operational indicator (U_S)	LED green:	18 V (+/- 1 V) < U_S	
	LED red:	U_S < 18 V (+/- 1 V)	

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

Attention: Do not exceed the following maximum currents for the sensor supply:

- Max. 4.0 A per port

- Max. 5.0 A for each port pair X1/X2, X3/X4, X5/X6, X7/X8
- Max. 9.0 A in total for the whole port group X1 .. X8

Pay attention to the derating!

13.4 Power supply of the actuators

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

Table 45: Information on the power supply of the actuators

13.5 I/O ports

0980 XSL 3900-121...	Ports X1 .. X8	DI, DO	M12 socket, 5-pin
0980 XSL 3901-121...	Ports X1 .. X8	DI	
0980 XSL 39x3-121...	Ports X1 .. X4	DI	
	Ports X5 .. X8	DO	

Table 46: I/O ports: Overview of functions

13.5.1 Digital inputs

Input connection	0980 XSL 3900-121...		Type 3 as per IEC 61131-2
	0980 XSL 3901-121...		
	0980 XSL 39x3-121...		
Nominal input voltage	24 V DC		
Input current	Typically 3 mA		
Channel type	Normally open, p-switching		
Number of digital inputs	0980 XSL 3900-121...	X1 .. X8	16
	0980 XSL 3901-121...		
	0980 XSL 39x3-121...	X1 .. X4	8
Status indicator	yellow LED for Channel A (Pin 4) white LED for Channel B (Pin 2)		
Diagnostic indicator	red LED per port		

Table 47: I/O ports configured as digital input

13.5.2 Digital outputs

Attention: Do not exceed the following maximum currents for the sensor supply:

- Max. 2.0 A per port
- Max. 5.0 A for each port pair X1/X2, X3/X4, X5/X6, X7/X8
- Max. 9.0 A in total for the whole port group X1 .. X8 (X5 .. X8 at 8DI8DO devices)

  Pay attention to the derating!

Output type	normally open, p-switching	
Nominal output voltage per channel Signal status “1” Signal status “0”	 min. (U_L -1 V) max. 2 V	
Max. output current per device	0980 XSL 3900-121...	9 A
	0980 XSL 39x3-121...	9 A
Max. output current per channel	0980 XSL 3900-121... (X1 .. X8)	2 A
	0980 XSL 39x3-121... (X5 .. X8)	2 A
Short-circuit/overload protected	yes/yes	
Behavior in case of short circuit or overload	deactivation with automatic power-on (parameterized)	
Number of digital outputs	0980 XSL 3900-121... (X1 .. X8)	16
	0980 XSL 39x3-121... (X5 .. X8)	8
Status indicator	yellow LED per output Channel A (Pin 4) white LED per output Channel B (Pin 2)	
Diagnostic indicator	red LED per channel	

Table 48: I/O ports configured as digital output

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

13.6 LEDs

LED	Color	Description
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)
	Red flashing	Device performs a factory reset (position of rotary encoding switches: 9-7-9)
	OFF	None of the above conditions.
X1 .. X8 A	Yellow	Status of digital input or digital output on pin 4 line "on".
	Red	Short circuit on pin 4 line. / Overload or short circuit on L+ (pin 1) line / communication error
	OFF	None of the above conditions.
X1 .. X8 B	White	Status of digital input or digital output on pin 2 line "on".
	Red	Short circuit on pin 2 line. / Overload or short circuit on L+ (pin 1) line / communication error
	OFF	None of the above conditions.
P1 Lnk/Act P2 Lnk/Act	Green	Ethernet connection to another subscriber exists. Link detected.
	Yellow flashing	Data exchange with another subscriber.
	OFF	No connection to another subscriber. No link, no data exchange.

LED	Color	Description
BF	Red	Bus fault. No configuration, no or slow physical connection.
	Red flashing at 2 Hz	Link exists but no communication link to the PROFINET controller.
	OFF	PROFINET controller has established an active connection to the device.
DIA	Red	PROFINET module diagnostic alarm active.
	Red flashing at 1 Hz	Watchdog time-out; fail safe mode is active.
	Red flashing at 2 Hz, 3 sec	DCP signal service is initiated via the bus.
	Red double flash	Firmware update
	OFF	None of the above conditions.

Table 49: Information on the LED colors

13.7 Data transfer times

The following tables give an overview of the internal data transfer times of LioN-X.

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

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

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

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

Use case 1:

LioN-X Digital-I/O configuration with enabled Web interface and *disabled* IIoT protocols

16DIO variant (0980 XSL 3900-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	2.2	3.6	5.0
DI to PLC	3.1	3.0	4.7
RTT	6.0	7.6	9.0

8DI/8DO variant without galvanic isolation (0980 XSL 3913-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	1.9	3.2	4.7
DI to PLC	2.1	2.6	3.1
RTT	4.0	5.8	7.0

8DI/8DO variant with galvanic isolation (0980 XSL 3903-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	2.2	3.6	5.3
DI to PLC	3.3	4.0	4.6
RTT	6.0	7.6	9.0

Use case 2:

LioN-X Digital-I/O configuration with enabled Web interface and *enabled* IIoT protocols

16DIO variant (0980 XSL 3900-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	3.4	5.1	7.6
DI to PLC	5.8	6.4	7.6
RTT	10.0	11.5	14.0

8DI/8DO variant without galvanic isolation (0980 XSL 3913-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	3.2	4.8	7.1
DI to PLC	3.3	3.8	4.3
RTT	7.0	8.6	11.0

8DI/8DO variant with galvanic isolation (0980 XSL 3903-121-007D-01F):

Data direction	Data transfer time in ms		
	Minimum	Average	Maximum
PLC to DO	3.5	5.2	7.6
DI to PLC	5.7	6.4	7.1
RTT	10.0	11.6	14.0

14 Accessories

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

http://www.beldensolutions.com