![lumberg automation — A BELDEN BRAND]

Technical manual

LioN-P PROFINET
0980 ESL 301-xxx ... 0980 ESL 303-xxx
0980 ESL 391-xxx ... 0980 ESL 393-xxx

LioN-R PROFINET
0980 ESL 801-PNET 16DI-M12-R
0980 ESL 802-PNET 16DO-M12-R
0980 ESL 803-PNET 8DI/8DO-M12-R

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Content

1   About this manual

1.1   General information

Please read the assembly and operating instructions in this manual carefully before starting up the LioN-P and LioN-R modules with PROFINET IO interface. 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 LioN-P and LioN-R modules with PROFINET IO interface.

Please contact us if you have any detailed questions on installing and starting up the devices. We will be happy to help you.

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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:

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

1.3   Version information

Index	Created	Changed	Changed
Version number	Version 1.0	Version 1.1	Version 1.2
Date	May 2013	December 2015	February 2016
Name/department	Knipp/PM	Knipp/PM	Lieb/R&D

Table 1:   Overview of manual revisions

2   Safety instructions

2.1   Intended use

The devices described in this manual are decentralized input/output assemblies on a PROFINET IO 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 modules 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.

ⓘ NOTE

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

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

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

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.

3   System description

The LioN (Lumberg I/O network) -P and -R module series includes standalone fieldbus devices for decentralized use in harsh industrial environments. The devices feature easy handling of I/O data in a higher-level bus system. They are especially suitable for use in machines and installations with a moderate I/O concentration over separate assemblies.

The LioN-P/-R I/O module series has a very rugged metal housing of die-cast zinc. The module electronics are fully protected from environmental influences by the fully sealed housing. The modules feature degree of protection IP67. The permissible temperature range of the modules is -10°C to +60°C. The module series is therefore highly suitable for direct field use in harsh industrial environments.

Despite the sturdy construction, the module series has compact dimensions and a low weight.

The integrated 2-port Ethernet switch of the modules allows a bus or star topology to be set up for the PROFINET I/O network. The implemented Media Redundancy Protocol (MRP) enables the design of a highly available network infrastructure.

The LioN-R module series consists of three types of modules with different I/O functionality. Modules with 16 digital inputs (16 DI), 16 digital outputs (16 DO), and 8 digital inputs / 8 digital outputs (8DI / 8DO) are available. The output current is 1.6 A per channel. The output power circuits are electrically isolated from the rest of the network and the sensor electronics.

The modules with output functionality feature a failsafe function. During the configuration of these modules, the behavior of each output channel can be adjusted in case of interruption or loss of communication.

For connecting the network and the I/O devices, the module series features the widely-used M12 connector with A coding for the I/O signals and D coding for the network. The connectors are also color-coded to prevent the connections from being mixed up.

In accordance with the PROFINET specification, the modules get their network parameters from a DCP server. Rotary encoding switches are not required.

For the functions of the rotary encoding switches with multiprotocol, refer to the Multiprotocol Manual.

3.1   Product overview

3.1.1   Module variants

Item number	Description	I/O ports	Design
LioN-R 16 DI/ LioN-P 16 DI			
0980 ESL 801-PNET 16DI-M12-R SAP number: 934 692-001 0980 ESL 301-111 (singleprotocol) SAP number: 934 881-001 0980 ESL 301-121 (singleprotocol) SAP number: 934 878-001 0980 ESL 391-111 (multiprotocol) SAP number: 934 882-001 0980 ESL 391-121 (multiprotocol) SAP number: 934 879-001	Decentralized I/O module with 16 digital inputs. Connection of peripherals using 8 M12 slots	8 x M12	Sturdy/metal
LioN-R 16 DO/LioN-P 16 DO			
0980 ESL 802-PNET 16DO-M12-R SAP number: 934 692-002 0980 ESL 302-111 (singleprotocol) SAP number: 934 881-002 0980 ESL 302-121 (singleprotocol) SAP number: 934 878-002 0980 ESL 392-111 (multiprotocol) SAP number: 934 882-002 0980 ESL 392-121 (multiprotocol) SAP number: 934 879-002	Decentralized I/O module with 16 digital outputs, 1.6 A. Connection of peripherals using 8 M12 slots.	8 x M12	Sturdy/metal
LioN-R 8DI/8D/ LioN-P 8DI/8DO			
0980 ESL 803-PNET 8DI/8DO-M12-R SAP number: 934 692-003 0980 ESL 303-111 (singleprotocol) SAP number: 934 881-003 0980 ESL 303-121 (singleprotocol) SAP number: 934 878-003 0980 ESL 393-111 (multiprotocol) SAP number: 934 882-003 0980 ESL 393-121 (multiprotocol) SAP number: 934 879-003	Decentralized I/O module with 8 digital inputs and 8 digital outputs, 1.6 A. Connection of peripherals using 8 M12 slots.	8 x M12	Sturdy/metal

3.1.2   Accessories

Item number	Description
0985 342 100/… M	Connection cable for PROFINET, assembled on both sides with M12 connectors, straight, 4-pin, D-coded
0985 342 102/… M	Connection cable for PROFINET, assembled on both sides with an M12 connector, straight, 4-pin, D-coded
0985 342 104/… M	Connection cable for PROFINET, assembled on both sides with M12 connectors, straight, 4-pin, D-coded, and straight RJ45 plug

Table 2:   PROFINET

Item number	Description
0905 204 301/… M	Connection cable for power supply, assembled on one side with 7/8" socket, straight, 5-pin
0905 204 302/… M	Connection cable for power supply, assembled on both sides with 7/8" connector/socket, straight, 5-pin
0905 204 303/… M	Connection cable for power supply, assembled on both sides with 7/8" connector, straight, 5-pin
0905 204 308/… M	Connection cable for power supply, assembled on one side with 7/8" socket, angled, 5-pin
0905 204 309/… M	Connection cable for power supply, assembled on both sides with 7/8" connector/socket, angled, 5-pin
0905 204 310/… M	Connection cable for power supply, assembled on one side with 7/8" connector, angled, 5-pin

Table 3:   Configurable connectors

Item number	Description
0986 EMC 102	M12 cable connector for PROFINET IO cable, straight, 4-pin, D-coded, connection for spring terminal
RSC 50/11	Configurable 7/8" connector for power supply, straight, 5-pin, for cable diameter 8.0–10.0 mm
RKC 50/11	Configurable 7/8" socket for power supply, straight, 5-pin, for cable diameter 8.0–10.0 mm

Table 4:   Configurable connectors

Item number	Description
M12 cover	ZVK
Labels	ZBR 9/40

Table 5:   Other accessories

Item number	Description
0985 706 100/… M	Connection cable for PROFINET, with M12 connector at both ends, straight, 4-pin, D-coded, 24AWG TPE with blue-green casing, highly flexible, multi-wire/unshielded, 2 twisted wire pairs.
0985 706 101/… M	Connection cable for PROFINET, crossover, with M12 connector at both ends, straight, 4-pin, D-coded, 24AWG TPE with blue-green casing, highly flexible, multi-wire/unshielded, 2 twisted wire pairs.
0985 706 103/… M	Connection cable for PROFINET, with M12 connector at both ends, straight, 4-pin, D-coded and RJ-45 plug, 24AWG TPE with blue-green casing, highly flexible, multi-wire/unshielded, 2 twisted wire pairs.
0985 707 100/… M	Connection cable for PROFINET, with M12 connector at both ends, straight, 4-pin, D-coded, 24AWG PVC with blue-green casing, flexible, solid conductor/unshielded, 2 twisted wire pairs.
0985 707 101/… M	Connection cable for PROFINET, crossover, with M12 connector at both ends, straight, 4-pin, D-coded, 24AWG PVC with blue-green casing, flexible, solid conductor/unshielded, 2 twisted wire pairs.
0985 S4549 100/… M	Connection cable for PROFINET, with M12 connector at both ends, straight, 4-pin, D-coded, 26AWG PUR, halogen-free, with water-blue casing, multi-wire/shielded, 2 twisted wire pairs.
0985 S4549 103/… M	Connection cable for PROFINET, with M12 connector at both ends, straight, 4-pin, D-coded and RJ-45 plug, 26AWG PUR, halogen-free, with water-blue casing, multi-wire/shielded, 2 twisted wire pairs.

Table 6:   Connection cables for data transfer

Item number	Description
0986 EMC 102	M12 cable connector for PROFINET IO cable, straight, 4-pin, D-coded, connection for spring terminal

Table 7:   Customizable connectors for data transfer

Item number	Description
RK 50-637/… F RS 50-637/… F	MINI, 7/8" connection cable, one end with cable plug (RS) or socket (RK), straight, 5-pin, 18AWG TPE, conductor IEC color-coded
RK 50-602/… M RS 50-602/… M	MINI, 7/8" connection cable, one end with cable plug (RS) or socket (RK), straight, 5-pin, 18AWG PUR, conductor IEC color-coded
RK 50-739/… F	MINI, 7/8" connection cable, one end with cable socket, straight, 5-pin, 18AWG TPE, conductor US color-coded

Table 8:   Connection cables for the power supply

4 Assembly and wiring

4.1 General information

Mount the module with 2 screws (M6x25 / 30) for LioN-R and 2 screws (M4x25/30) for LioN-P on a level surface. The torque required here is 1 Nm. Use washers for all fastening methods as per DIN 125. For the mounting holes, use a distance of 237.3 to 239.7 mm for the LioN-R modules, a distance of 190.3 to 191.8 mm for LioN-P modules with 7/8" connector/socket, and a distance of 196.8 to 198.3 mm for LioN-P modules with M12 power L-coded.

ℹ️ Note

The modules 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 "XE"

ℹ️ Note

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

ℹ️ Note

If the mounting surface not grounded, use a ground strap or a suitable PE line. Use an M4 screw to connect the ground strap or the PE line to the ground point and if possible put a washer and a toothed washer below the fixing screw.

┌───┐
| ℹ️ **Note** |
├───┤
| For UL application: |
| Be sure to use a UL-certified cable with a suitable evaluation to connect the |
| devices (CYJV or PVVA). To program the control, please refer to the OEM |
| information, and only use suitable accessories. |
└───┘

┌───┐
| ℹ️ **Note** |
├───┤
| For UL application: |
| 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. |
└───┘

┌───┐
| ⚠️ **WARNING** |
├───┤
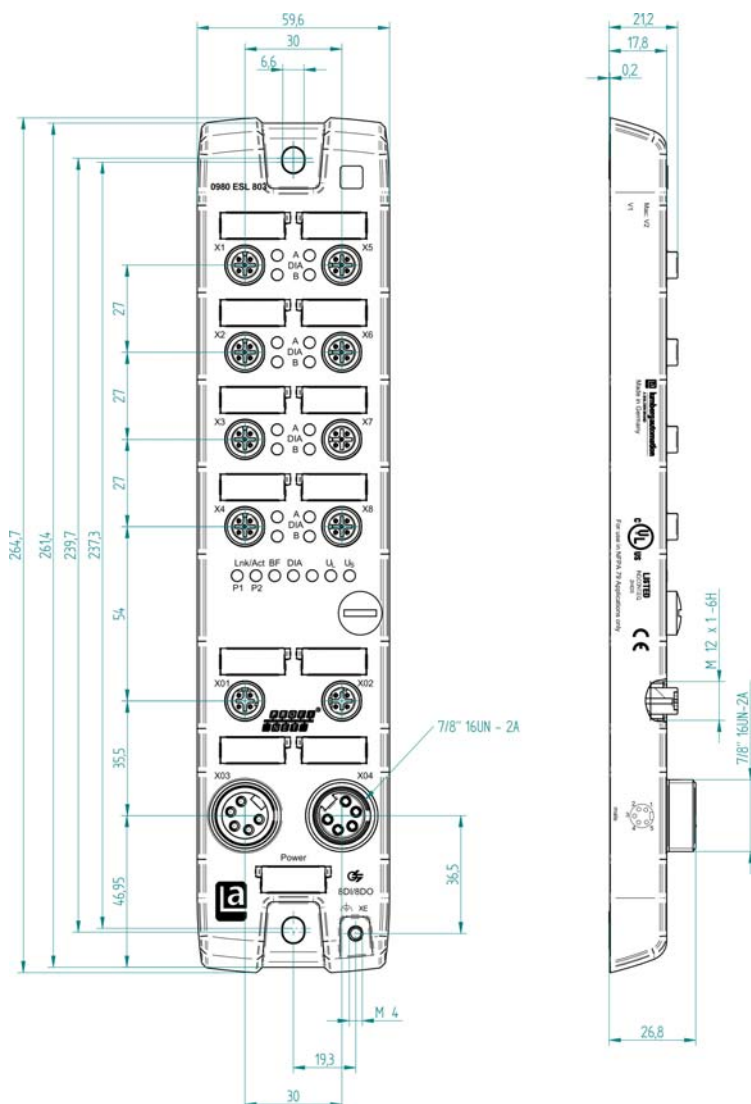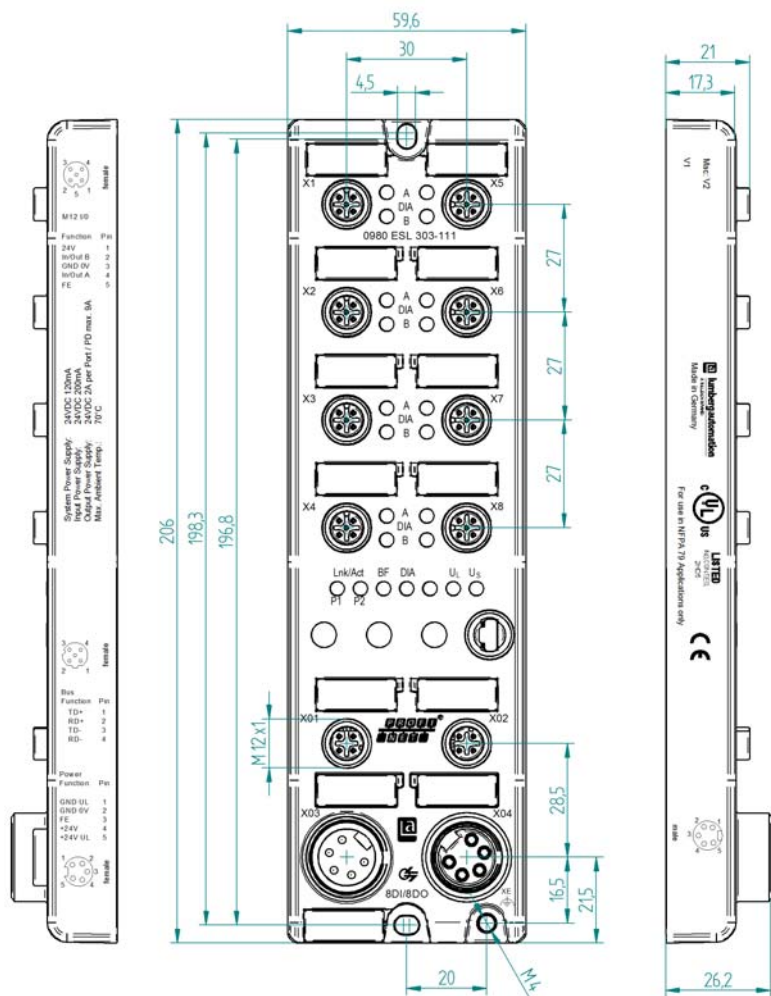| For UL application: |
| Use temperature-resistant cables with the following properties: |
| For the modules 0980 ESL3x1-121 and 0980 ESL109-121 heat-resistant up |
| to at least 85 °C. |
| For the modules 0980 ESL3x2-121 and 0980 ESL3x3-121 heat-resistant up |
| to at least 96 °C. |
└───┘

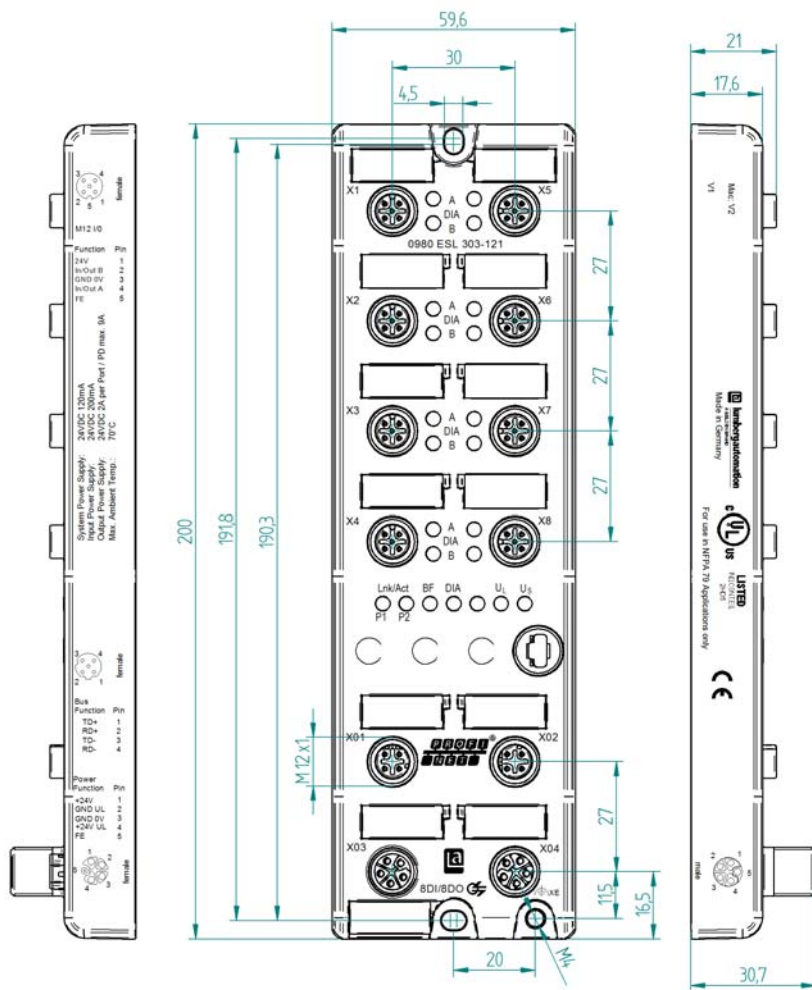## 4.2   Outer dimensions

4.2.1   Module 0980 ESL 803

4.2.2   Module 0980 ESL 303-111

4.2.3   Module 0980 ESL 303-121

4.3   Port assignments

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

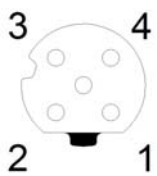## 4.3.1   PROFINET ports, M12 socket, 4-pin, D-coded

▶ Color coding: green

Figure 1:   Schematic drawing, ports X01, X02

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

Table 9:   Assignment of ports X01, X02

⚠ CAUTION

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

4.3.2   Connections for power supply with 7/8", 5-pin
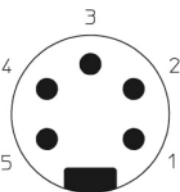
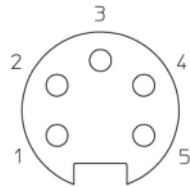▶ Color coding: gray

Figure 2:   Schematic drawing, port X03 (IN)

Figure 3: Schematic drawing, port X04 (OUT)

Port	Pin	Signal	Function	
		0980 ESL 801		**0980 ESL 802** **0980 ESL 803**
Power supply X03, X04	1	*see note	Actuator	GND (0V)
	2	GND (0V)	System/sensors	GND (0V)
	3	FE	Ground	Functional ground
	4	+24 V	System/sensors	U_S +24 V
	5	*see note	Actuator	V_L (+24 V)

Table 10: Assignment of ports X03, X04

ⓘ **NOTE**

For the input module 0980 ESL 801, the two contacts 1 and 5 are not required for the power supply to the actuators. However, these two contacts are connected to each other on the connector and socket side to enable 5-pin transmission of the power supply to a downstream module.

ⓘ **NOTE**

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.

ⓘ **NOTE**

For modules with a 7/8" housing, use the power supply voltage "SELV and Limited Energy".

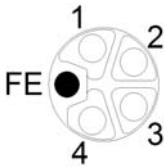### 4.3.3   Power supply with M12 power L-coded

▶ Color coding: gray

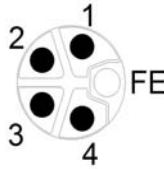*Figure 4:   Schematic diagram of the M12 L-coding (connector), port X03 (IN)*

Figure 5:   Schematic diagram of the M12 L-coding (socket), port X04 (OUT)

Power supply			
	Pin	Signal	Function
	1	V_s (+24V)	Sensor/system power supply
	2	GND_U_L	Ground/reference potential V_{aux}
	3	GND_V_S	Ground/reference potential V_s
	4	U_L (+24V)	Auxiliary supply (electrically isolated)
	PE (5)	PE	Functional ground

Table 11:   Assignment of X03, X04

ℹ️ **NOTE**

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.

4.3.4   Ports for the sensors/actuators

▶ Design: M12 socket, 5-pin
▶ Color coding: black
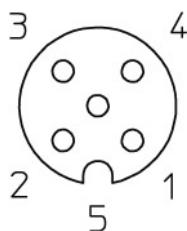
Figure 6:   Schematic drawing, ports X1 to X8

| Port | Pin | Function | | |
		16DI	**16DO**	**8DI/8DO**
Sensor/actuator	1	+24 V DC	n.c.	+24 V DC (ports X1..X4) n.c. (ports X5..X8)
	2	IN B	OUT B	IN B (ports X1..X4) OUT B (ports X5..X8)
	3	0 V DC	0 V DC	0 V DC
	4	IN A	OUT A	IN A (ports X1..X4) OUT A (ports X5..X8)
	5	Shielding/PE	Shielding/PE	Shielding/PE

Table 12: Assignment of ports X1 to X8

5   Configuration and startup

The configuration and startup of LioN-P/-R PROFINET modules described on the following pages was carried out using the **STEP 7** software of Siemens AG. If you are using a control system from another control system provider, please consult the associated documentation.

5.1   GSDML file

For configuration of the LioN-P/-R modules in the control system, a GSD file in XML format is required. This can be downloaded from our homepage http://www.beldensolutions.com/en/Service/download_center/index.phtml. On request, the GSDML file is also sent by the support team.

The file for the LioN-R PROFINET modules is named:
▶ GSDML-V2.3-LumbergAutomation-0980ESL80x-yyyymmdd.xml,

The file for the LioN-P PROFINET modules is named:
▶ GSDML-V2.3-LumbergAutomation-0980ESL39x-xxx-yyyymmdd.xml,

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

In **Step7** you create a new project and open the hardware manager "HW-Config". The GST file is installed using the menu command `Options >` Install station description files (GSDML)... and the subsequent dialog. The LioN-P/-R I/O modules with PROFINET interface are then available in the hardware catalog.

5.2   MAC addresses

The modules are assigned three MAC addresses upon delivery. These are unique and cannot be changed by the user.

5.3 SNMP

The modules support the Ethernet network protocol SNMP (Simple Network Management Protocol). The network management information is displayed according to MIB-II (Management Information Base), which is defined in RFC 1213.

## 5.4 Configuration of the LioN-R PROFINET I/O modules in STEP 7

After installation of the GSDML files for the LioN-R PROFINET modules, they are available in the hardware catalog at `PROFINET IO > Other field devices > I/O > Lumberg LioN-R`. The LioN-P PROFINET modules are available in the hardware catalog at `PROFINET IO > Other field devices > I/O > Lumberg LioN-P`.

An EDS file is required for the configuration of a module in the control system.

In the hardware catalog, click the product name of the modules **0980 ESL 801-PNET 16DI-M12-R, 0980 ESL 301-xxx, 0930 ESL 391-xxx, 0980 ESL 802-PNET 16DO-M12-R, 0980 ESL 302-xxx, 0980 ESL 392-xxx** or **0980 ESL 803-PNET 8DI/8DO-M12-R, 0980 ESL 303-xxx, 0980 ESL 393-xxx** and move the desired module to the PROFINET line of control

A suitable element for the I/O function is automatically used for slot 1 of the subrack.

The input and output addresses defined by the Hardware Manager can be changed.
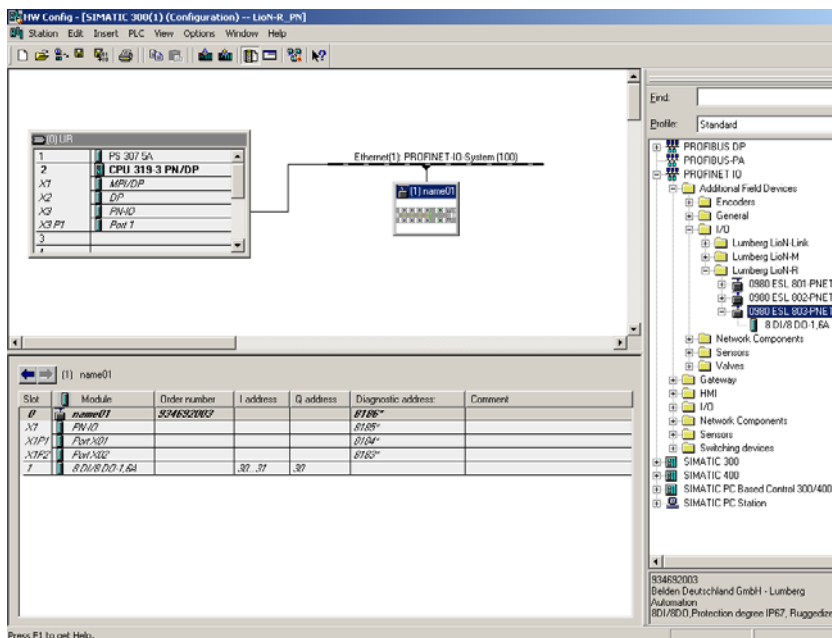
5.4.1 Assigning a unique device name

PROFINET I/O 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.

Select the module in "HW-Config" and open the menu Edit > Object properties. In the dialog box that opens, you can then change the device name.

Check whether the IP address displayed is correct, and the control unit and module are on the same Ethernet subsystem.

Confirm the entries by pressing "OK".
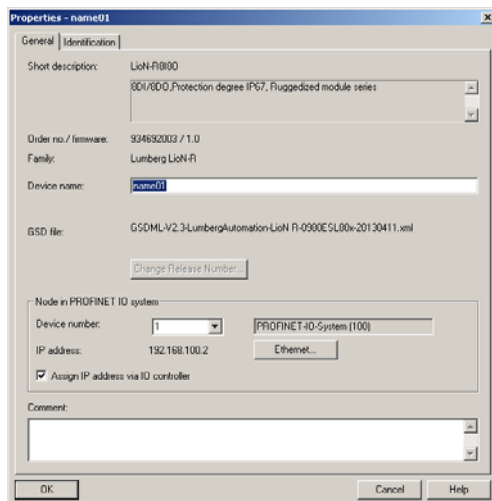
5.4.2   Assigning a device name to a LioN-R module

An online PROFINET connection between the programming device and the
module is required to assign the device name to a module.
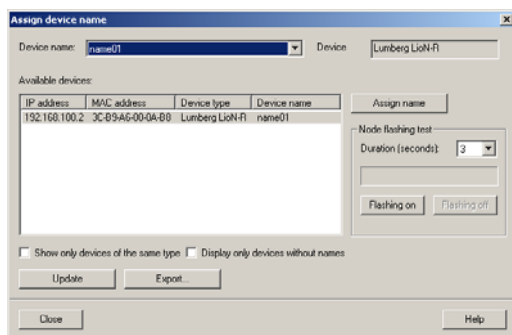
Select the LioN-R module and open the `Target device > Ethernet >`
`assign name` dialog.

5.4.3   Device replacement without removable media/PD

PROFINET I/O devices that support the function of device replacement
without removable media or PD can be replaced by the same devices in an
existing PROFINET network without having to use removable media or a
programming device. In this case, the I/O controller takes care of assignment
of the device name. To assign the device name, the I/O controller uses the
configured topology and the adjacent relationships determined by the I/O
devices.

The LioN-P/-R PROFINET modules support the function of the device
replacement without removable media/PD.

The topology of the network must be configured for use.

For configuration of the I/O controller in "HW-Config", the function must be
selected. If you double-click the PROFINET I/O port of the controller, the
Properties window opens. Enable the "Support device replacement without
exchangeable medium" function.
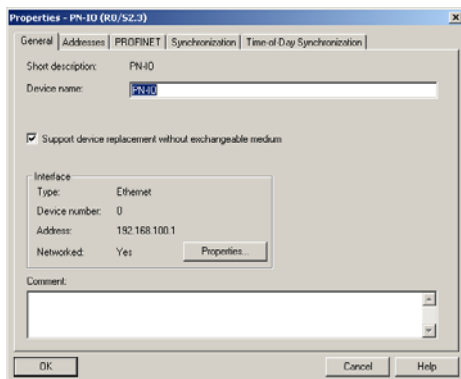
The interconnections of the PROFINET ports of the individual devices must
also be configured. If you double-click the port of a device in "HW-Config", its
Properties window opens. In the "Topology" tab, the interconnections are
established with partner ports of other devices on the network.
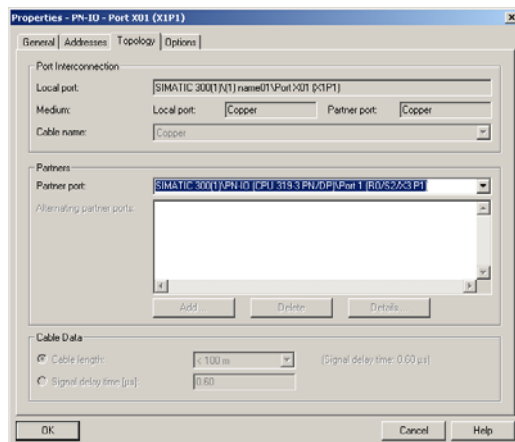
ℹ NOTE

The replacement device must be in the state on delivery (factory settings)
for replacement without removable media/PD. If necessary, the factory
settings must be restored.

5.4.4   The parameter settings of the LioN-R modules

You get to the parameter settings via the menu item `Object properties >`
Parameter. In "HW-Config", select the LioN-R module. In the configuration
table, right-click the "Slot 0" line and the PROFINET name of the module.

The following figure shows the parameter settings of module 0980 ESL 803-
PNET 8DI/8DO-M12-R.
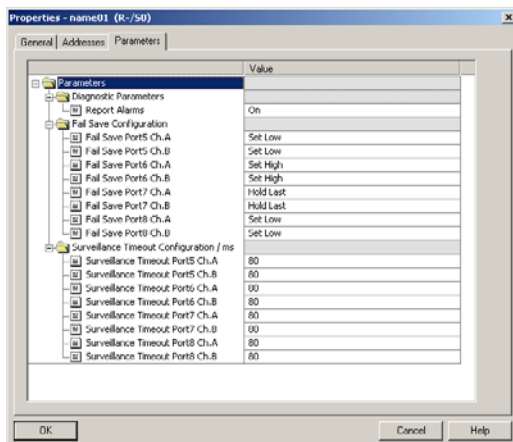
■ The Report Alarms parameter

With this parameter, you enable or disable the alarms of the device-specific diagnostics via PROFINET.

The setting is available for all three different types of modules (16DI, 16DO, 8DI/8DO).

■ The Fail Safe parameter

This parameter is provided by the module types with digital outputs (16DO, 8DI/DO).

The firmware of the modules provides a fail-safe function for the outputs. During the configuration of the modules, you have the option to define the status of the outputs after an interruption or a loss of communication.

The following options are available to you:

▶ **Set low** – deactivate the output channel (value = 0)
▶ **Set high** – activate the output channel (value = 1)
▶ **Hold last** – hold the last output status (value = 2)

■ **The Surveillance Timeout parameter**

This parameter is provided by the module types with digital outputs (16DO, 8DI/DO).

The firmware of the modules allows you to define a delay time before the monitoring of the output currents begins, known as the surveillance timeout. You can define this for every individual output channel.

The delay time begins after the status of the output channel changes, i.e. when this is activated (after a rising edge) or deactivated (after a falling edge). After this time has elapsed, the monitoring of the output begins and the diagnosis reports error statuses.

The value of the surveillance timeout is 0 to 255 ms. The standard value is 80 ms. When the output channel is in the static state, i.e. the channel is permanently switched on or off, the value is 100 ms.

5.4.5 Prioritized startup

Prioritized startup is not supported by LioN-P/-R modules. Do not select the "Prioritized startup" field in the "Properties - Interface (X1)" window for this reason.
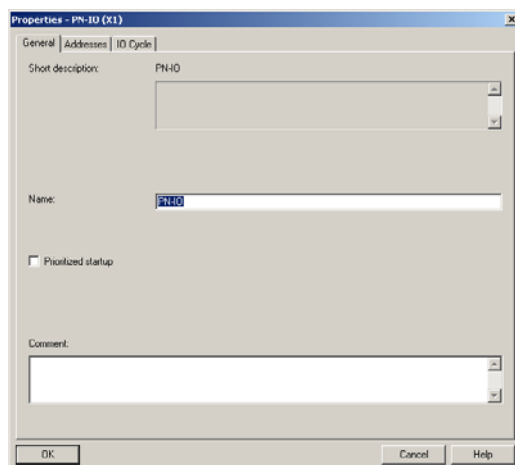
5.4.6   Resetting the LioN-R modules to factory settings

The LioN-P /-R modules are reset to the factory settings in **Step 7** via the menu item `Target device > Edit accessible devices`. After you search through the subscribers accessible online and select the LioN-P/-R module, this module is reset to the factory settings by clicking the "Reset to factory settings" button.

5.5   Media Redundancy Protocol (MRP)

Redundant PROFINET communication can be implemented with the LioN-P modules via a ring topology without the use of additional switches. A 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-P modules).
▶ 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.

Example of setting up the MRP redundancy manager in STEP7:
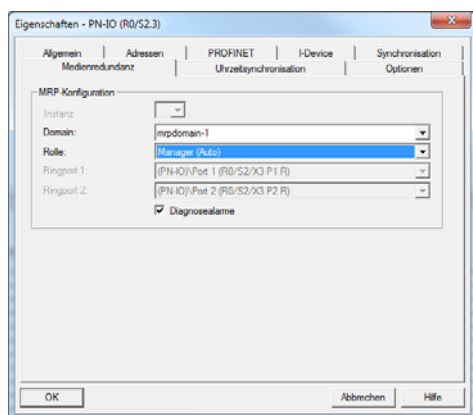
Example of setting up an MRP redundancy client in STEP7:
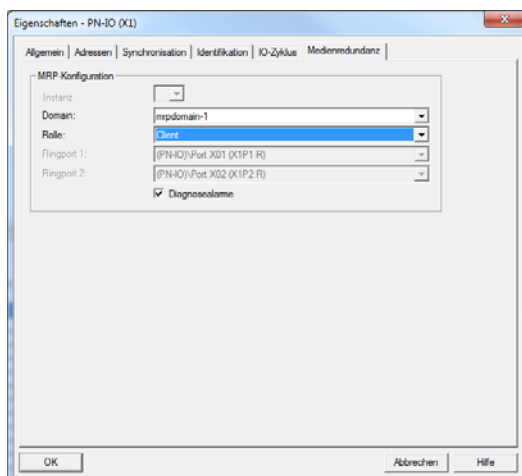
Example of setting up the response monitoring times in STEP7:
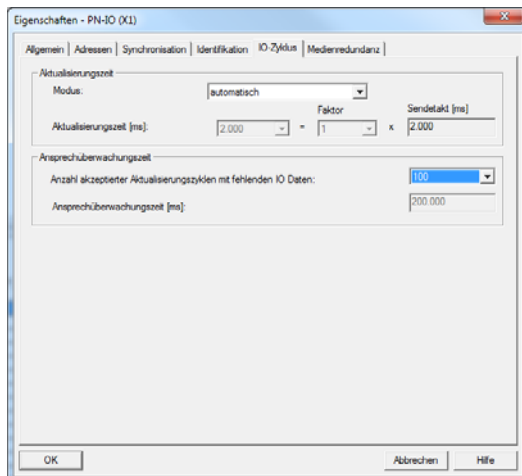
6 Assignment of the process data

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

6.1   16DI modules:
- 0980 ESL 801-PNET 16DI-M12-R
- 0980 ESL 301-xxx
- 0980 ESL 391-xxx

6.1.1   Input data

The module provides two bytes of status information of the digital inputs. The bit assignment is as follows:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	4B	4A	3B	3A	2B	2A	1B	1A
Byte n+1	8B	8A	7B	7A	6B	6A	5B	5A

The following applies here:

▶ 1A ... 8A: Actual status of input channel A (contact pin 4) of the M12 socket connections 1 to 8.
▶ 1B ... 8B: Actual status of input channel B (contact pin 2) of the M12 socket connections 1 to 8.

6.2   16DO modules:
- 0980 ESL 802-PNET 16DO-M12-R
- 0980 ESL 302-xxx
- 0980 ESL 392-xxx

6.2.1   Input data

This module provides two bytes of input data that reflect the current status of the output channels.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	4B	4A	3B	3A	2B	2A	1B	1A
Byte n+1	8B	8A	7B	7A	6B	6A	5B	5A

The following applies here:

▶ 1A ... 8A: Actual status of output channel A (contact pin 4) of the M12
socket connections 1 to 8.
▶ 1B ... 8B: Actual status of output channel B (contact pin 2) of the M12
socket connections 1 to 8.

6.2.2 Output data

This module requires two bytes of status information for control of the digital
outputs.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	4B	4A	3B	3A	2B	2A	1B	1A
Byte n+1	8B	8A	7B	7A	6B	6A	5B	5A

The following applies here:

▶ 1A ... 8A: Target status of output channel A (contact pin 4) of the M12
socket connections 1 to 8.
▶ 1B ... 8B: Target status of output channel B (contact pin 2) of the M12
socket connections 1 to 8.

6.3 8DI/8DO modules:
- 0980 ESL 803-PNET 8DI/8DO-M12-R
- 0980 ESL 303-xxx
- 0980 ESL 393-xxx

6.3.1 Input data

This module provides two bytes of input data that reflects the current status
of the input and output channels.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	4B	4A	3B	3A	2B	2A	1B	1A
Byte n+1	8B	8A	7B	7A	6B	6A	5B	5A

The following applies here:

▶ 1A ... 4A: Actual status of input channel A (contact pin 4) of the M12
  socket connections 1 to 4.
▶ 1B ... 4B: Actual status of input channel B (contact pin 2) of the M12
  socket connections 1 to 4.

▶ 5A ... 5A: Actual status of output channel A (contact pin 4) of the M12
  socket connections 5 to 8.
▶ 5B ... 5B: Actual status of output channel B (contact pin 2) of the M12
  socket connections 5 to 8.

6.3.2   Output data

This module requires two bytes of status information for control of the digital
outputs.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	8B	8A	7B	7A	6B	6A	5B	5A

The following applies here:

▶ 5A ... 8A: Target status of output channel A (contact pin 4) of the M12
  socket connections 1 to 8.
▶ 5B ... 8B: Target status of output channel B (contact pin 2) of the M12
  socket connections 1 to 8.

7   Diagnostic properties of the modules

The modules provide advanced diagnosis behavior, in particular for the output channels to determine errors in the transmission. The firmware of the modules distinguishes between 5 different types of error.

7.1   Channel error

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

Target value	Actual value	Comment
Active	Active	OK, no diagnosis
Off	Off	OK, no diagnosis
Active	Off	Short-circuit Channel indicator is red. Channel error bit in the diagnosis is set. Channel is locked after the error is rectified.
Off	Active	Voltage is fed back in Red and yellow/white channel indicators are activated. Channel error bit in the diagnosis is set. Channel is not locked after the error is rectified.

Table 13: Interpretation of channel errors

ⓘ Note

If both output channels of an M12 slot are activated when a channel error occurs, the controller locks both channels, even if only one channel is affected by the error. If only one channel is activated, the controller only locks this one. Locked channels are deactivated and remain in the Off state if you do not reset them using the controller.

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

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

When a channel is in the static state – that is, when it is permanently
activated or deactivated – the controller uses a fixed specified duration of 100
ms for filtering the error message.

7.2   Voltage error at the M12 slots (sensor short-circuit)

On each M12 input connector of the modules, contact 1 provides a 24 V
potential for power supply. This potential is obtained from the system/sensor
voltage U_S and monitored.

In the case of a sensor short-circuit, a voltage error is reported. Both channel
indicators of the M12 input socket light up red, and the relevant error bit for
the sensor short-circuit is set in the diagnosis bytes.

The error message is filtered by the "Surveillance-Timeout" parameter. The
same parameters as for the channel errors are also used for the voltage
errors.

7.3   Overload of output drivers

The output drivers of the modules with output functions (variants 16DO and
8DI/8DO) report an error when they detect an overload. This error is reported
by setting the relevant channel error bits in the diagnosis bytes.

ℹ️ **Note**

If both output channels of an M12 slot are activated when a channel error
occurs, the controller locks both channels, even if only one channel is
affected by the error. If only one channel is activated, the controller only
locks this one. Locked channels are deactivated and remain in the `Off` state
if you do not reset them using the controller.

If there is an overload, the status indicator of the active output channel lights up red. If both output channels of an M12 slot are active during an overload, both status indicators light up red.

A channel error alarm is sent to the PROFINET I/O controller.

The overload error is filtered by the "Surveillance-Timeout" parameter. The same setting of the "Surveillance-Timeout" parameter applies to the channel, voltage, and overload errors, which are explained in sections 7.1 and 7.2.

7.4   Error in the actuator power supply

The voltage value at the connections for the power supply of the actuators is monitored globally and on the module level.

If the actuator power supply U_L goes outside the voltage range of 18 to 30 V, an error is reported. The U_L indicator lights up red, and the actuator undervoltage bit is set in the module information byte.

---

i Note

Every output channel that is active at the same time as the error occurs in supply voltage U_L is locked. This means that for correct operation, the output channel must be reset by the controller when the status of the supply voltage U_L is normalized again.

We recommend deactivating all output channels with the controller as soon as the undervoltage is detected. Otherwise, because it is locked, every active output channel will report a diagnosis when the voltage value is normalized again.

The error message is filtered by means of a fixed filter period of 300 ms.

7.5   Error in the system/sensor power supply

The voltage value for the system/sensor power supply is also monitored globally. If the value goes outside the voltage range of 18 to 30 V, an error message is created.

The U_S indicator lights up red and the sensor undervoltage bit is set in the module information byte.

The error message has no effect on the outputs and is not filtered, but is reported immediately.

⚠ Caution

It must definitely be ensured that the supply voltage, measured at the most remote participant is not below 18 V DC from the perspective of the system power supply.

7.6   Diagnostic display in the integrated web server

The LioN-R modules indicate the fault diagnosis on the status page of the integrated web server. For information on opening the status page, please refer to the chapters of this manual that follow.

In the data area of the status page, up to 5 bytes of diagnostics data can be shown, depending on the module. The diagnostic bytes are structured as follows, going from the left to the right:

7.6.1   16DI modules

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	0	0	0	0	SC	0	LV-U_S
Byte 2	X8	X7	X6	X5	X4	X3	X2	X1

Table 14: Bit assignment for the 16 DI modules

7.6.2   16DO modules

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	0	0	0	AC	0	LV-U_L	LV-U_S
Byte 2	0	0	0	0	0	0	0	0
Byte 3	0	0	0	0	0	0	0	0
Byte 4	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 5	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A

Table 15: Bit assignment for the 16 DO modules

7.6.3   8DI/8DO modules

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	0	0	0	AC	SC	LV-U_L	LV-U_S
Byte 2	0	0	0	0	X4	X3	X2	X1
Byte 3	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A

Table 16: Bit assignment for the 8DI/8DO modules

7.6.4   Key:

▶ LV-U_S: Undervoltage of sensor supply U_S
▶ LV-U_L: Undervoltage of actuator supply U_L
▶ AC: Actuator short-circuit
▶ X1...X8: M12 slot with diagnostics
▶ X1-A...X8-A: M12 slot, channel A
▶ X1-B...X8-B: M12 slot, channel B

7.7 Alarm and error messages of LioN-P/-R modules via PROFINET

> ### ℹ **Note**
>
> Alarm and error messages are only transmitted via PROFINET when the parameter for diagnostics is activated in the configuration of the modules in the control system.

If both LioN-P/-R modules detect an error condition, an alarm message will be triggered. The modules support diagnostic alarms. Diagnostic alarms are triggered in case of peripheral faults such as overload, short-circuit, and undervoltage.

An alarm is triggered in case of an incoming event (such as sensor short-circuit) as well as an outgoing event.

The evaluation of the alarms depends on the PROFINET I/O controller used.

7.7.1 Alarm evaluation in STEP 7

In **STEP 7** the user program execution is interrupted through the triggering of a diagnostic alarm, and a diagnostic block is called. The following blocks are used:

Cause of the alarm	OB call
Peripheral error (short-circuit, overload, wire breakage, undervoltage of an I/O module)	OB B2
Complete failure of the system	OB B6

Initial information on the cause of the error and error type is already delivered based on the OB called and its start information. You can receive more detailed information about the error event in the error OB by calling SFB 54 RALRM (read supplementary alarm information). For this, SFB 54 must be called in every error OB.

If the error OB called does not exist in the CPU, the CPU goes into the STOP operating state.

It is also possible to call a diagnostic data record using its data record number with the system function block SFB 52 "RDREC" in OB 1.

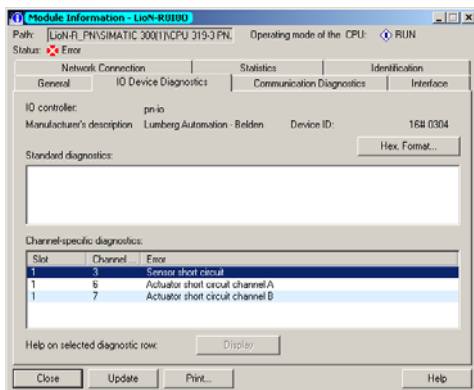## 7.7.2   Structure of diagnostic data records

For the presentation of the diagnostic data records, the block version 0x0101 and the format identifier (USI, user structure identifier) 0x8000 is used.

The data values "ChannelNumber" and "ChannelError" have the following values, depending on the error that has occurred:

Error type	Reference	ChannelNumber	ChannelErrorType
Undervoltage of sensor or actuator supply	Module	0x8000	0x0002
Sensor short-circuit	M12 slot	0x0001 to 0x0008 Number of the M12 slot	0x0102
Actuator short-circuit	Channel A of an M12 slot	0x0001 to 0x0008 Number of the M12 slot	0x0100
Actuator short-circuit	Channel B of an M12 slot	0x0001 to 0x0008 Number of the M12 slot	0x0101

In case of an accumulation of errors, the Channel diagnostics section is repeated with the data values "ChannelNumber", "ChannelProperties", and "ChannelErrorType"for each error in the diagnostics data record. The following figures illustrate this relationship based on the online diagnostics in **Step7**.

To display the diagnostics in **STEP7**, use a mouse click to select the Hardware Manager of the malfunctioning I/O module and open the Online Diagnostics with the menu item `Target device > Diagnostic status > IO-Device Diagnosis`.

Confirming the "Hexadecimal representation" button in the window above
opens a view of the diagnostic data record in hexadecimal format, along with
its structure.
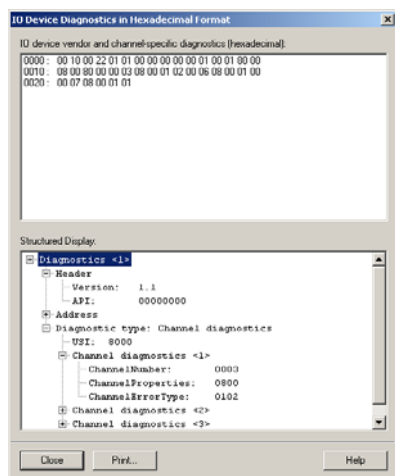
8 The integrated web server

The LioN-P/-R modules are equipped with an integrated web server which makes functions available for the configuration of modules and display of status and diagnostic information.

Using a standard web browser, the provided functions can be accessed via an existing TCP/IP connection.

To use the web server, the modules need their own IP address. In accordance with the PROFINET standard, all PROFINET I/O devices are delivered with the IP address `0.0.0.0`. Consequently, the modules must be assigned a free IP address that differs from the factory setting prior to use of the web server. The IP address can be assigned with **STEP 7**, for example; see section 5.4 of this manual.

If the PROFINET I/O controller assigns the IP address itself, the assigned IP address can be used to call the web server.
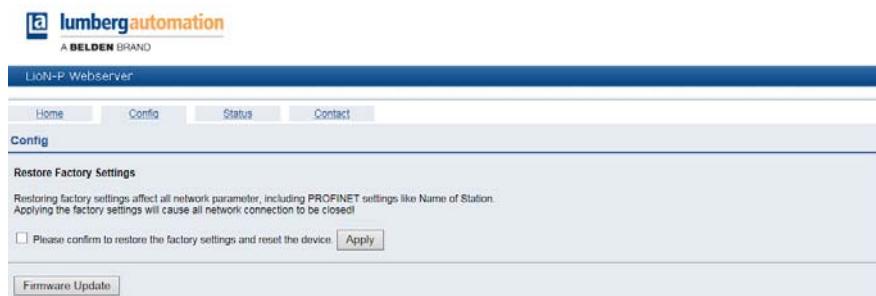
8.1 The Home page

Enter `http://` followed by the IP address, such as `http://192.168.1.1`, in your web browser's address bar. If the Home page of the module is not displayed, check your browser and firewall settings.
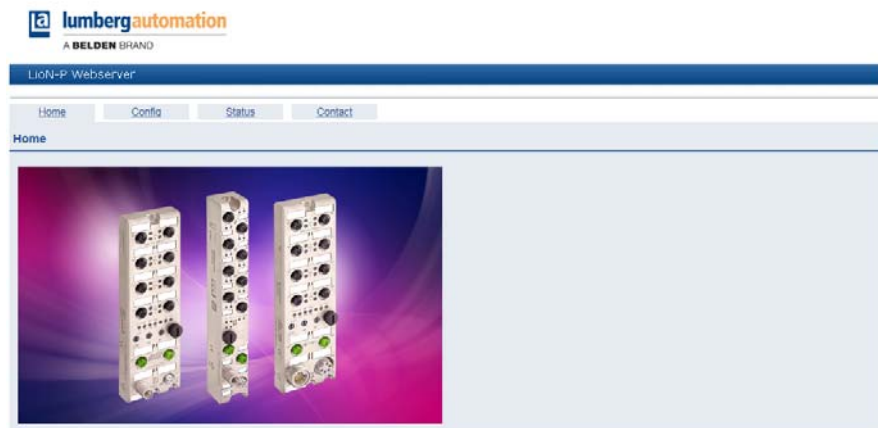
8.2   The Configuration page (Config)

If you select the "Config" menu item from the menu bar of the Home window, a new window with the configuration options will open.

On this page, you can reset the modules to the factory settings. To do this, check the box and confirm by pressing the "Apply" button.

ⓘ **Note**

Please note that if you reset the modules to the factory settings, the
PROFINET name and IP address are also reset to the default values. It may
not be possible to access the web server of the modules and exchange data
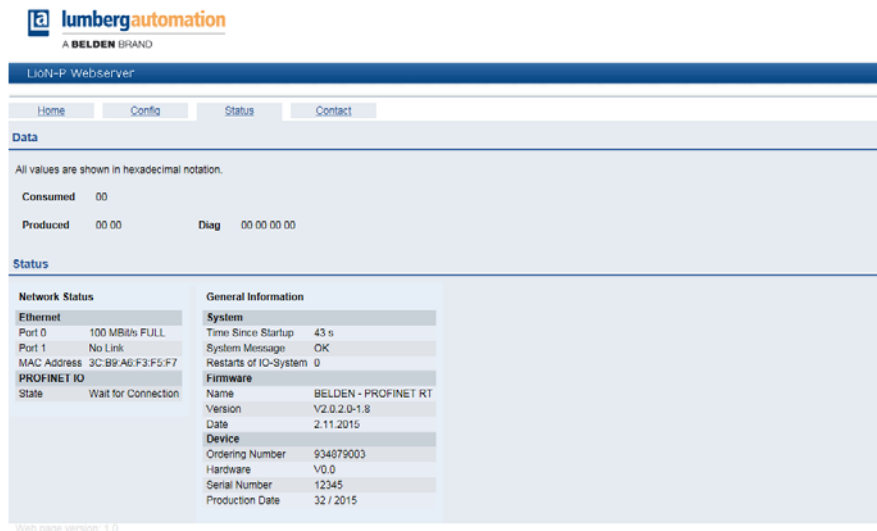in the PROFINET network after the reset.

8.3   The Status page

In the top section, this page provides information about the current status of
the I/O channels and diagnostics. The I/O data is specified in the form of two
bytes in hexadecimal notation. The diagnostics of the modules includes five
bytes.

The lower section of the status page contains information about the current
status of the two Ethernet ports of the modules in regard to connection,
transmission rate, and transmission mode.

In the "General Information" area, you will find the following system-related
information on the runtime of the modules, firmware versions, and
manufacturing information.

The status information on this page is updated in a web browser only after
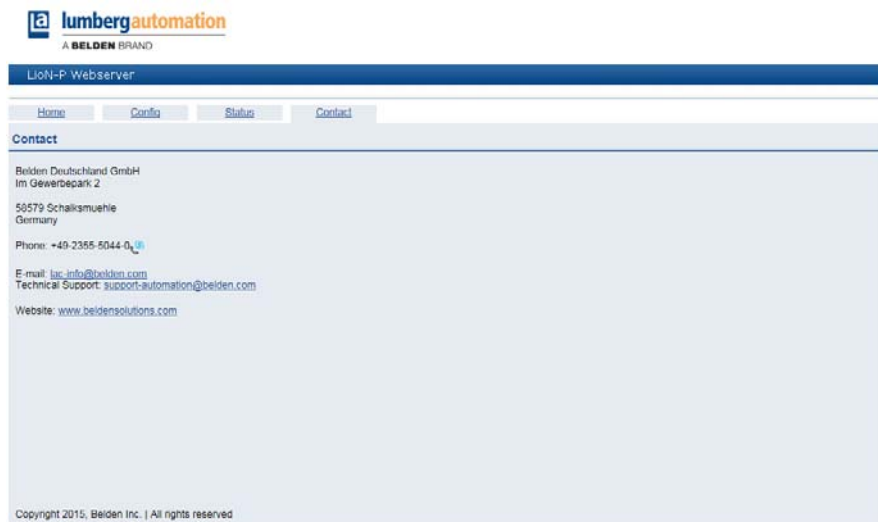reopening or refreshing of the page.

8.4   The Contact page

The address of the contact page is:

```
http://[IP-Adresse]/contact.htm
```

This page provides information on the contact data for Belden Deutschland GmbH.

8.5   Reading the process and diagnostic data

You have the option to read the process and diagnostic data for the LioN-R
modules using the integrated web server. The web server provides the data
in standardized JSON format. The data is accessed via the website. The
relevant address is:

```
http://[IP-Adresse]/data.jsn
```

In higher programming languages, the process and diagnostic data is read
via HTTP requests. The following example uses the GET command in an
HTTP request to obtain the data:

HTTP request:
```
GET /data.jsn HTTP/1.1
```

HTTP response:
```
HTTP/1.1 200 OK
Server: servX
Content-Length: 73
Content-Type: application/json
{"consumed": [0,0], "produced": [0,0,0,0,0,0,0]}
```

The response has the following object structure:

Process data

▶ Produced (inputs): Array[a,b]

▶ Consumed (outputs): Array[a,b]

Diagnostics

▶ Diag: Array[a,b,c,d,e]

9   Technical data

9.1   General

Protection class	IP 67 (only when the connectors are screwed in or when protective caps are used)
Ambient temperature	Lion-R (0980 ESL 8xx): -10 °C to +60 °C (+14 °F to +140 °F) Lion-P(0980ESL 3xx): -40 °C to +70 °C (-40 °F to +158 °F)
Ambient moisture	98% RH (for UL application 80% RH
Weight	615 g (LioN-R); 480 g (LioN-P)
Housing material	Die-cast zinc
Vibration resistance (oscillation)	15 g / 5–500 Hz
Shock resistance	50 g / 11 ms
Torques: M6/M4 fixing screws M12 connector	 1.0 Nm 0.5 Nm

Table 17: General information

9.2   Bus system

Protocol	PROFINET I/O RT is supported
GSDML file	LioN-R: GSDML-V2.3-LumbergAutomation-0980ESL80x-yyyymmdd.xml LioN-P: GSDML-V2.3-LumbergAutomation-0980ESL39x-xxx-yyyymmdd.xml
Transmission rate	100 Mbit/s, full duplex
Transmission procedure Autonegotiation	100BASE-TX is supported
Vendor ID	$0016A_H$
DeviceID	0304_H

Table 18: Information on the bus system

Supported Ethernet protocols	Ping ARP LLDP SNMP (network diagnostics) DCP HTTP TCP/IP
Switch functionality	Integrated IRT is supported
PROFINET interface Connections Autocrossing	2 M12 sockets, 4-pin, D-coded (see pin assignments) is supported

Table 18:   Information on the bus system

9.3 Power supply for the module electronics/sensors

Nominal voltage U_S	24 V DC (SELV/PELV)
Voltage range	18-30 V DC
Power consumption of module electronics	Typically 100 mA (0980 ESL 8xx) Typically 120 mA (0980 ESL 3xx) Typically 200 mA (0980 ESL 109, 0980 ESL 309)
Voltage level of the sensor power supply	Min. (U_S – 1.5 V)
Current consumption of sensors	Max. 200 mA (at T_U = 30 °C)
Reverse polarity protection	Yes
Operational indicator (U_S)	LED green, 18 V <= U_S <= 30 V LED red, U_S < 18 V or U_S > 30 V

Table 19:   Information on the power supply for the module electronics/sensors

9.4 Power supply for the actuators

Nominal voltage U_L	24 V DC (SELV/PELV)
Voltage range	18–30 V DC
Electric isolation	Yes
Threshold value of the undervoltage detection	Typically 17 V

Table 20:   Information on the power supply for the actuators

Delay time of the undervoltage detection	< 20 ms
Reverse polarity protection	Yes
Operational indicator (U_L)	LED green, 18 V <= U_L <= 30 V LED red, U_L < 18 V or U_L > 30 V

Table 20: Information on the power supply for the actuators

ℹ **Note**

The reverse polarity protection only works if the supply of the actuators is protected within overcurrent fuse (10 A, mT) and switched off upon short-circuit within 10–100 ms at the latest.

⚠ **Warning**

In case of polarity reversal, a power supply unit with current regulation or an incorrect fuse will lead to destruction of the module.

9.5   Inputs

Input connection	Type 3 as per IEC 61131-2
Nominal input voltage	24 V DC
Input current at 24 V DC	Typically 5 mA
Short-circuit protection	Yes
Channel type	Normally open, p-switching
Number of digital channels	16 with 16DI 0 with 16DO 8 with 8DI/8DO
Status indicator	LED yellow for channel A, LED white for channel B
Diagnosis indicator	LED red for each slot
Port	M12 socket, 5-pin See pin assignment

Table 21: Information on the inputs

9.6   Outputs

Output connection	Type 1.6 A as per IEC 61131-2 (LioN-R)
	Type 2.0 A as per IEC 61131-2 (LioN-P)
Nominal output current per channel:	1.6 A, see info 1 (LioN-R)
	2.0 A (LioN-P)
Signal status "1"	max. 1.6 A (LioN-R, 0980 ESL 8xx…)
	max. 2.0 A (LioN-P, 0980 ESL 3xx…)
Signal status "0"	max. 1 mA (standard specifications)
Signal level of the outputs:	
Signal status "1"	Min. $(V_L - 1 V)$
Signal status "0"	max. 2 V
Short-circuit protection	Yes
Max. output current per module	0980 ESL 8xx…:
	As per U_L approval: 9 A (12 A see info 2)
	0980 ESL 3xx…
	As per U_L approval: 9 A (16 A per supply point))
Overload protection	Yes
Number of digital channels	0 with 16 DI
	16 with 16DO
	8 with 8DI/8DO
Channel type	Normally open, p-switching
Status indicator	LED yellow per channel A, LED white per channel B
Diagnosis indicator	LED red per channel
Port	M12 socket, 5-pin
	See pin assignment

Info 1: With inductive loads of consumption category DC13 (EN60947-5-1), the outputs are able to connect currents of 1.6 A with a frequency of 1 Hz.

Info 2: Technically possible and approved under the following conditions:
▶ Looped sensor/system power supply max. 2.5 A
▶ Power supply cable STL 204 (5 x 1.0 mm²)
▶ Ambient temperature max. 40 °C/ 104 °F

Table 22:   Information on the outputs

9.7   LEDs

U_S	Green	System/sensor power supply, voltage level 18 V <= U_S <=30 V
	Red	System/sensor power supply, voltage level 18 V <= U_S <=30 V
	Off	No system/sensor power supply
U_L	Green	Actuator power supply, voltage level 18 V <= U_L <= 30 V
	Red	Actuator power supply, voltage level U_L< 18 V or U_L > 30 V
	Off	No actuator power supply
X1…X8 A/DIA	Yellow	Channel status A "On"
	Red	Periphery error (sensor or actuator overload/short-circuit)
	Off	Not connected, status "Off", no error
X1…X8 B	White	Channel status B "On"
	Red	Periphery error (actuator overload/short-circuit)
	Off	Not connected, status "Off", no error
P1 Lnk / Act P2 Lnk / Act	Green	Ethernet connection exists to another subscriber. Link connection established.
	Flashing yellow	Data exchange with another subscriber.
	Off	No connection to another subscriber. No link, no data exchange.
BF	Red	No configuration, no or slow physical connection
	Red flashing at 2 Hz	No data exchange
	Off	No error
DIA	Red	Watchdog timeout; diagnostics present; system error
	Red flashing at 2 Hz, 3 sec	DCP signal service is initiated via the bus
	Off	No error message exists

Table 23: Information on the LED colors

10 Declaration of conformity

BELDEN
SENDING ALL THE RIGHT SIGNALS

Lumberg Automation™ and Hirschmann™ Products

Declaration of Conformity

We Wir	**Belden Deutschland GmbH**
Adress Adresse	Im Gewerbepark 2, 58579

declare under our sole responsibilty, that the products
erklären in alleiniger Verantwortung, dass die Produkte

Name Bezeichnung	0980 ESL 801-PNET 16DI-M12-R 0980 ESL 802-PNET 16DO-M12-R 0980 ESL 803-PNET 8DI/8DO-M12-R
Type Typ	I/O-Module für Profinet

angelehnt an die Direktive
corresponding to directive

EMC-Directive 2004/108/EC

fulfils the requirements of the following standards
den Anforderungen der folgenden Normen entspricht

Standards DIN EN 61000-6-4: 2007 and DIN EN 61000-6-2: 2006

Schalksmühle, den 18.03.2013

Belden Deutschland Gmbh
Standort Neckartenzlingen
Stuttgarter Str. 45-51 . 72654 Neckartenzlingen
Postfach 16 49 - 72606 Nürtingen
Deutschland

Dr. Hubert Ermer   Uwe Widmann

BELDEN
SENDING ALL THE RIGHT SIGNALS

Lumberg Automation™ and Hirschmann™ Products

Declaration of Conformity

We Wir	**Belden Deutschland GmbH**
Adress Adresse	Im Gewerbepark 2, 58579 Schalksmühle

declare under our sole responsibilty, that the products
erklären in alleiniger Verantwortung, dass die Produkte

Name Bezeichnung	0980 ESL 301-xxx, 0980 ESL 302-xxx, 0980 ESL 303-xxx, 0980 ESL 391-xxx, 0980 ESL 392-xxx, 0980 ESL 393-xxx
Type Typ	I/O Module für PROFINET Digital IO I/O Module für Multiprotokoll Digital IO

corresponding to directive
angelehnt an die Direktive

EMC-Directive 2004/108/EC

fulfils the requirements of the following standards
den Anforderungen der folgenden Normen entspricht

Standards DIN EN 61000-6-4: 2007 and DIN EN 61000-6-2: 2006

Schalksmühle, den 14.10.2015

Axel Vornhagen

Dr. Thomas Schöpf