Technical Manual
LioN-R EtherNet/IP
0980 ESL 811-EIP 16DI-M12-R
0980 ESL 812-EIP 16DO-M12-R
0980 ESL 813-EIP 8DI/8DO-M12-R

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1. About this manual

Please read the assembly and operating instructions of this manual carefully, before you put the LioN-R I/O-modules with EtherNet/IP interface into operation. The manual should be kept at a place that is accessible for all users.

The texts, illustrations, diagrams and examples being used in this manual are solely intended to explain the operation and handling of the LioN-R I/O-modules with EtherNet/IP interface.

To obtain further information on the installation and putting into operation of the devices, please do not hesitate to contact us. We will be glad to be at your disposal at any time.

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Belden Deutschland GmbH -Lumberg Automation™- reserves any technical changes or changes to this manual without prior notice.

1.1. Explanation of the symbolism

1.1.1. Use of notes

The following sign is used to mark important information.

1.1.2. Use of hazard warnings

Hazard warnings are marked as follows:

DANGER:
Violation of appropriate protection measures may cause danger to the life and health of the user.

ATTENTION:
Violation of appropriate protection measures may cause damage to other devices or material assets.

1.2. Safety guidelines

1.2.1. Normal conditions of use

The devices that are explained in this manual are intended to be used as decentralized Input / Output assemblies in an EtherNet/IP network.

Our products are designed, manufactured, tested and documented with respect to common safety standards. With attention to the handling specifications for planning, development and mounting and the safety instructions our products do not cause any danger to persons and property under normal conditions.

The modules comply to the rules of the
▪ EMC-directive (89/336/EWG, 93/68/EWG und 93/44/EWG)
▪ Low voltage directive (73/23/EWG)

They are designed to be used in the industrial area. The industrial environment is characterized by the fact that electrical consumers are not connected directly to the public low voltage network. For the application in residential areas, business areas and commercial areas additional measures are to be taken.

	Caution! This equipment can cause interferences in the residential area. In this case the operator can be required to accomplish appropriate measures.

The proper and safe function of the product requires an appropriate transport, storage, installation and mounting as well as a careful operation.

The intended operation of the device is only guaranteed with a completely installed housing. All devices connected to this equipment must fulfil the requirements of the EN 61558-2-4 and EN 61558-2-6.

Projecting, installation, commissioning, maintenance and test of the devices may be carried out only by an approved qualified electrical specialist who is familiar with the security standards of the automation technology.

During projecting, installation, commissioning, maintenance and test of the devices the regulations for safety and prevention of accidents in the specific application case have to be considered.

Only cables and accessories shall be installed that correspond to the requirements and regulations for safety, electromagnetic compatibility and if necessary telecommunication terminals as well as the specification data.
More information about the admitted cables and accessories for installation may be obtained from Belden Deutschland – Lumberg Automation™- or are described in this technical manual.

1.3. Qualified personnel

The requirements for the personnel depend on the requirement profile described by the ZVEI and VDMA or comparable organizations.

Only electrical specialists, who know the content of this manual, may install and maintain the described products.
These are persons who
- can assess the works to be performed and recognize possible dangers based on their technical education, knowledge and experience as well as their knowledge of the relevant standards.
- have the same level of knowledge as after a technical education due to an activity in a comparable area for several years.

Modifications to the hard- and software of our products, as far as they are not described in this technical manual, may be carried out only by Belden Deutschland GmbH -Lumberg Automation™.

ATTENTION!
Unqualified modifications to the hardware or software or the non-observance of the warning instructions given in this technical manual can entail heavy personal damages or damages to property.

1.4. Version information of the manual

Index	Created	Changed	Changed	Changed	Changed	Changed
Version number	1.0					
Date	March 2013					
Name / department	Knipp/PM					

2.   System description

LioN (Lumberg I/O network)-R is a stand-alone fieldbus device for the decentralized operation in rough industrial environment for the simple handling of the I/O data in a superordinate bus system. It is particularly suitable for application places with moderate I/O concentration on distributed assemblies.

The LioN-R I/O-module series has a very robust metal housing made of die-cast zinc. The module electronics is protected against environmental influences by the fully encapsulated housings. As the protection degree the modules offer IP67. The permissible temperature range of modules is -10 °C to + 60 °C. The module series is therefore very well suited for the direct field use in harsh industrial environments.

However, in spite of the robust construction the module series offers compact dimensions and a low weight.

The integrated 2-port Ethernet switch of the modules allows a line or a star topology for the EtherNet/IP network. Furthermore, the implemented DLR (Device Level Ring) protocol 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 Amps per channel. The output circuits are galvanically isolated from the remaining network and sensor electronics.

The modules with implemented outputs offer a fail-safe functionality. During the configuration of the module the behaviour of every single output channel in case of a communication interrupt or lost can be adjusted.

For the connection of the network and the I/O-devices the module series provides the widely-used M12-connector with A-coding for the I/O-signals and D-coding for the network. In addition, the connectors are colour-coded to avoid confusion between the terminals.

The network parameters like IP-address, subnet mask and gateway can be adjusted by rotary switches (last octet of IP-address) or the integrated web server. For an automated assignment of the network parameters by appropriate servers the modules support the BOOTP (Bootstrap) and DHCP (Dynamic Host Configuration) protocols.

3. Product overview

3.1. I/O-module variants

Part number	Description	I/O-connection	Design
LioN-R module 16 digital input			
0980 ESL 811-EIP 16DI-M12-R SAP number: 934 691-001	16 DI	8xM12	Rugged
LioN-R module 16 digital output			
0980 ESL 812-EIP 16DO-M12-R SAP number: 934 691-002	16 DO	8xM12	Rugged
LioN-R module 8 digital input / 8 digital output			
0980 ESL 813-EIP 8DI/8DO-M12-R SAP number: 934 691-003	8 DI / 8 DO	8xM12	Rugged

3.2. Accessories

Part number	Description
EtherNet/IP	
0985 706 100/... M	EtherNet/IP, high-flex, double-ended cord set, M12 male to male straight, 4-pin, D-coding, 24AWG TPE cable, stranded/unshielded, 2 twisted pairs with teal jacket.
0985 706 101/... M	EtherNet/IP, high-flex, double-ended cord set, M12 male to male straight, 4-pin, D-coding, 24AWG TPE cable, stranded/unshielded cross-over cable with two twisted pairs with teal jacket.
0985 706 103/... M	EtherNet/IP, high-flex, double-ended cord set, M12 male to RJ45 male straight, 4-pin, D-coding, 24AWG TPE cable, stranded/unshielded, 2 twisted pairs with teal jacket.
0985 707 100/... M	EtherNet/IP, moderate-flex, double-ended cord set, M12 male to male straight, 4-pin, D-coding, 24AWG PVC cable, solid/shielded, 2 twisted pairs with teal jacket.
0985 707 101/... M	EtherNet/IP, moderate-flex, double-ended cord set, M12 male to male straight, 4-pin, D-coding, 24AWG PVC cable, solid/shielded, cross-over cable, 2 twisted pairs with teal jacket.
0985 S4549 100/... M	EtherNet/IP, double-ended cord set, M12 male to male straight, 4-pin, D-coding, 26AWG PUR halogen-free cable, stranded/shielded, 2 twisted pairs with water blue jacket.
0985 S4549 103/... M	EtherNet/IP, double-ended cord set, M12 male 4-pin D-coded to RJ45 male, 26AWG PUR halogen-free cable, stranded/shielded, 2 twisted pairs with water blue jacket.

Part number	Description
Power supply cables	
RK 40-637/... F RS 40-637/... F	Mini, 7/8" single-ended cord set, female (RK) or male (RS) straight, 4-pole, 18AWG TPE cable, IEC colour code
RK 40-602/... M RS 40-602/... M	Mini, 7/8" single-ended cord set, female (RK) or male (RS) straight, 4-pole, 18AWG PUR cable, IEC colour code
RK 40-739/... F	Mini, 7/8" single-ended cord set, female straight, 4-pole, 16AWG TPE cable, US colour code
RKW 40-637/... F RSW 40-637/... F	Mini, 7/8" single-ended cord set, female (RKW) or male (RSW) angled, 4-pole, 18AWG TPE cable, IEC colour code
RKW 40-602/... M RSW 40-602/... M	Mini, 7/8" single-ended cord set, female (RKW) or male (RSW) angled, 4-pole, 18AWG PUR cable, IEC colour code
RKW 40-739/... F	Mini, 7/8" single-ended cord set, female angled, 4-pole, 16AWG TPE cable, US colour code
RSRK 40-637/... F	Mini, 7/8" double-ended cord set, female to male straight, 4-pole, 18AWG TPE cable, IEC colour code
RSRK 40-602/... M	Mini, 7/8" double-ended cord set, female to male straight, 4-pole, 18AWG PUR cable, IEC colour code
RSRKW 40-637/... F	Mini, 7/8" double-ended cord set, male straight to female angled, 4-pole, 18AWG TPE cable, IEC colour code
RSRKW 40-602/... M	Mini, 7/8" double-ended cord set, male straight to female angled, 4-pole, 18AWG PUR cable, IEC colour code
Field attachables	
0986 EMC 102	Field attachable M12-plug for EtherNet/IP cable, straight, 4-pole, D-coded, with spring-type terminals
RSC 40/9 RSC 40/11 RSC 40/16	Field attachable connector, Mini, 7/8", male, 4-pole, /9 for cable diameter 6.0 to 8.0 mm, /11 for cable diameter 8.0 to 10.0 mm, /16 for cable diameter 12.0 to 14.0 mm
RKC 40/9 RKC 40/11 RKC 40/16	Field attachable connector, Mini, 7/8", female, 4-pole, /9 for cable diameter 6.0 to 8.0 mm, /11 for cable diameter 8.0 to 10.0 mm, /16 for cable diameter 12.0 to 14.0 mm
Other accessories	
RKV	Dust cover for unused MINI, 7/8" female socket connectors
RSV	Dust cover for unused MINI, 7/8" male plug connectors

4. Mounting

4.1. Outer dimensions

4.1.1. 0980 ESL 811-EIP 16DI-M12-R
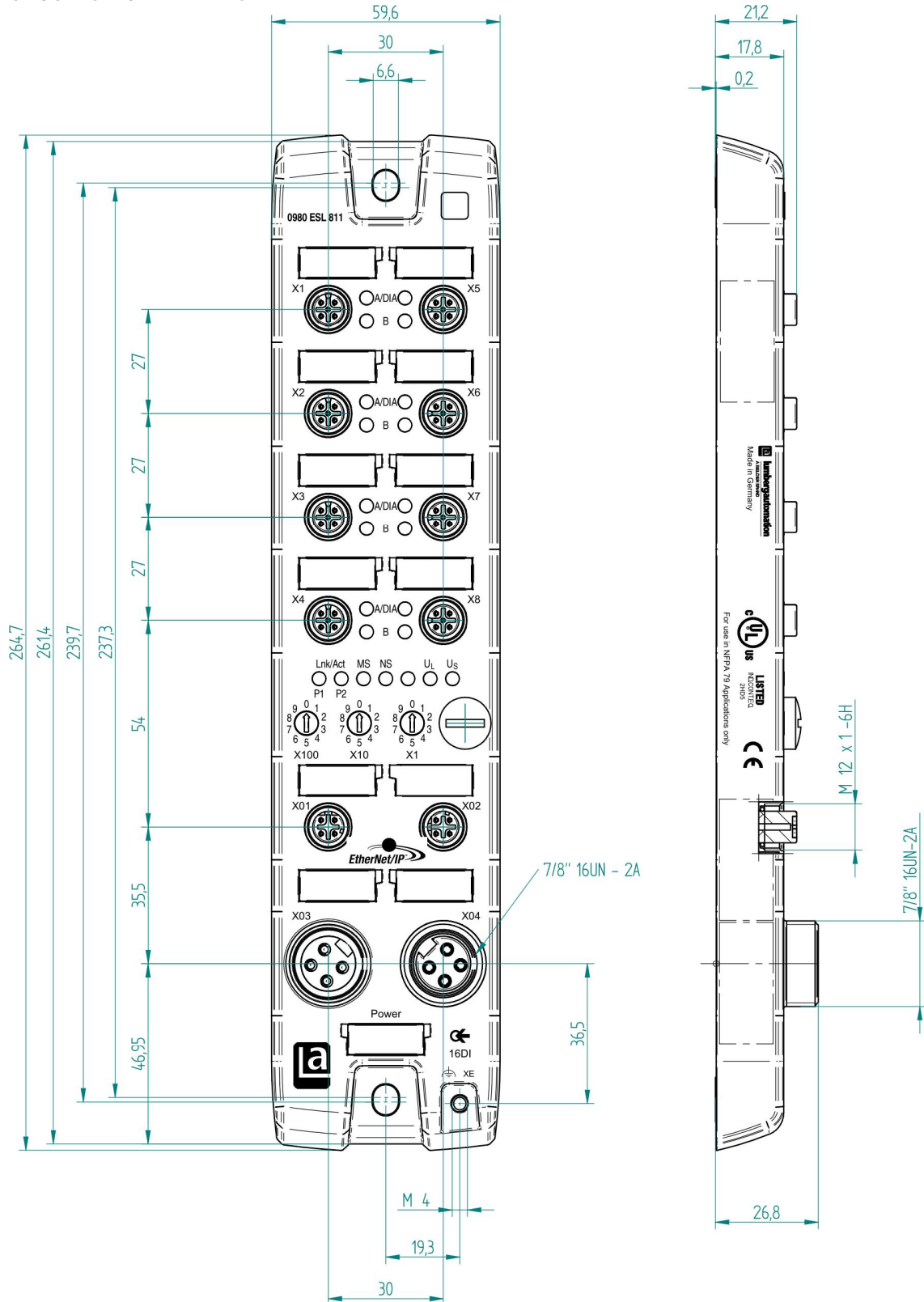
4.1.2. 0980 ESL 812-EIP 16DO-M12-R
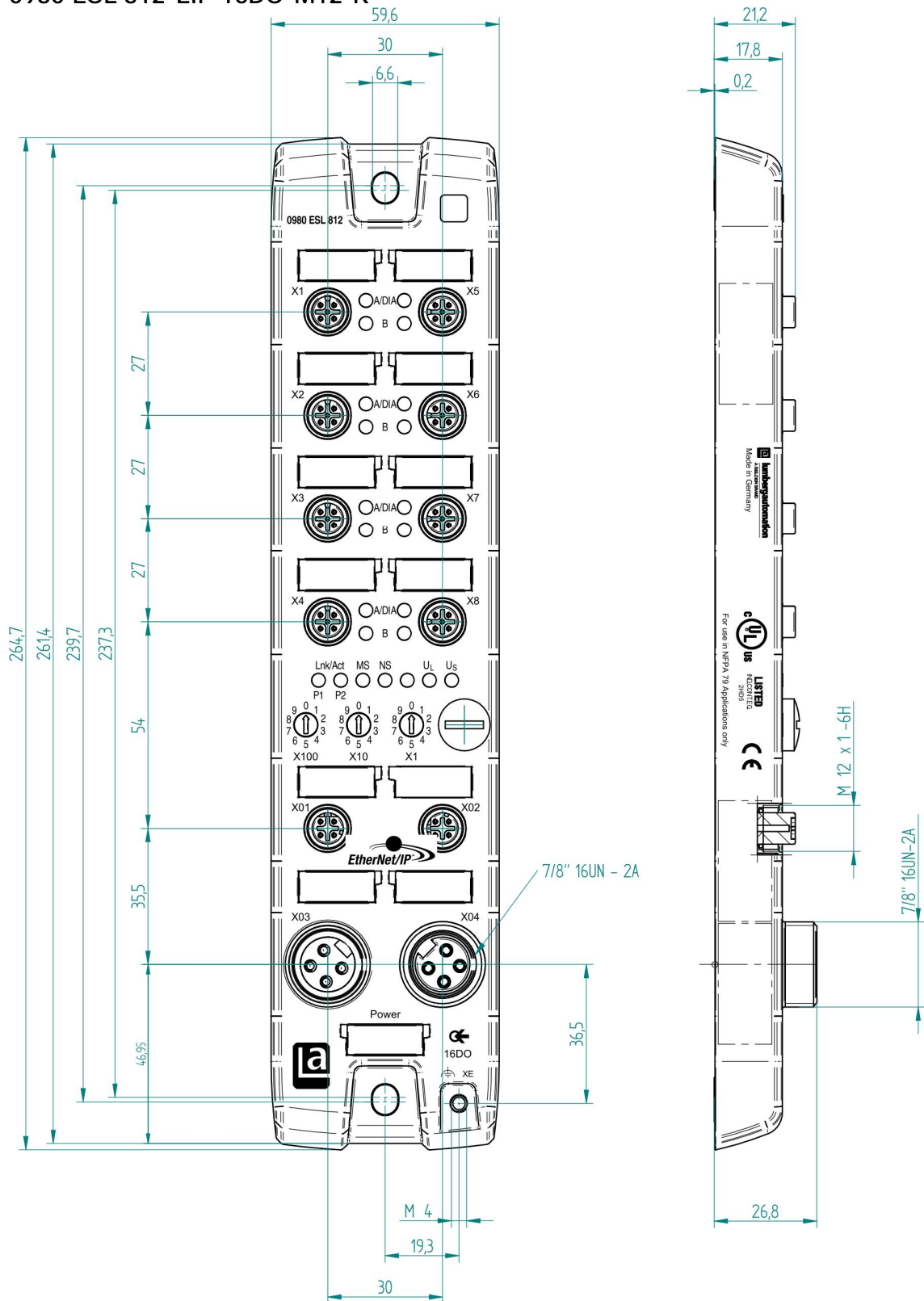
4.1.3. 0980 ESL 813-EIP 8DI/8DO-M12-R
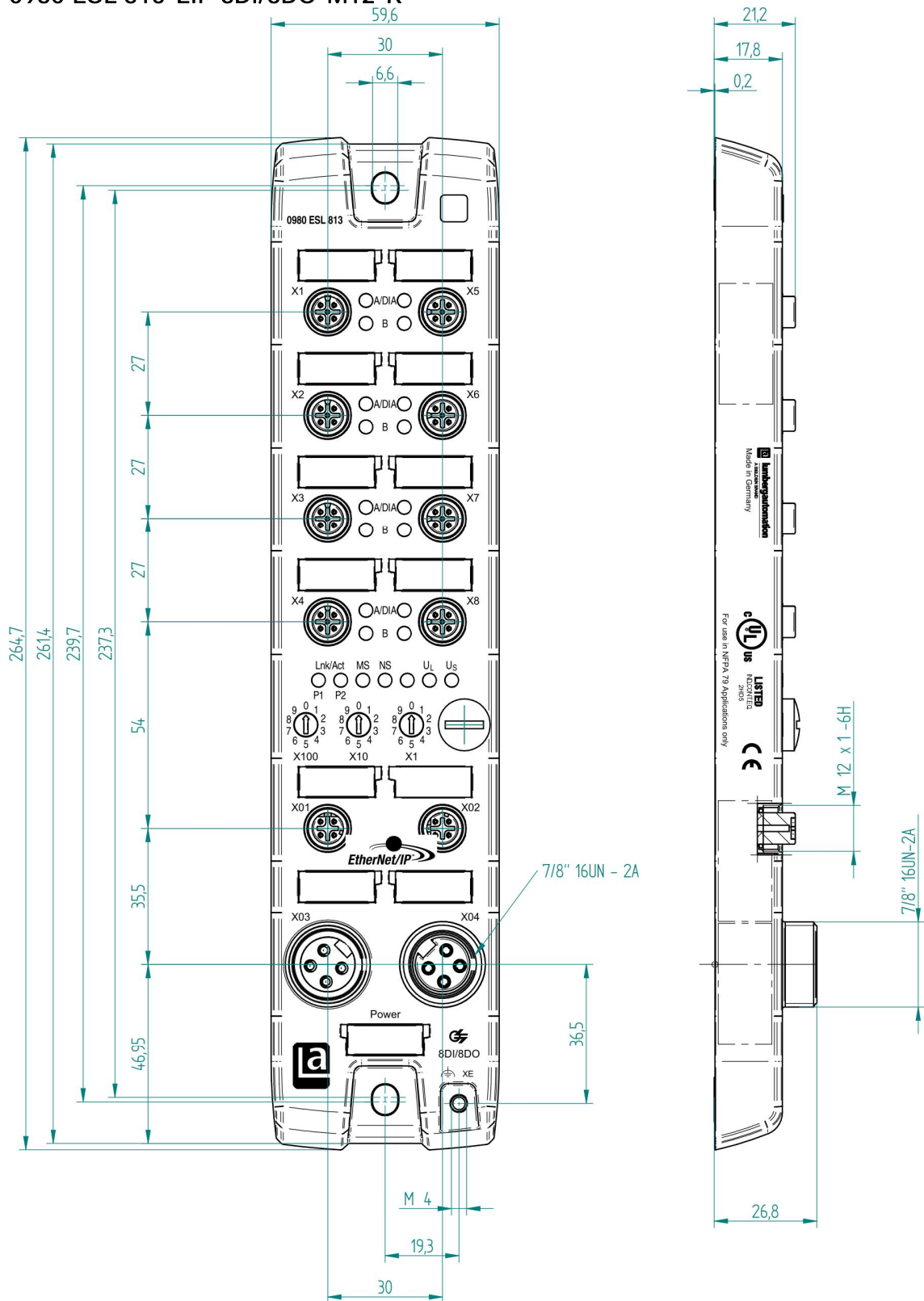
4.2. Notes for the field installation

The modules are to be mounted on a flat surface, each with two screws.

Type of mounting	Screws	Torque
flat	M6x25/30	1,0 Nm
With all types of mounting a flat washer according to DIN 125 has to be used.		

Important note:
For the derivation of interference currents and/or for the EMC stability the module provides a grounding connection with a M4 thread, marked with the earth sign and XE.

It is necessary to connect this grounding connection by a low impedance connection to the reference earth. In case of a grounded mounting surface the connection can be set up directly through the mounting screws.

With a not grounded mounting surface a ground strap or a suitable PE-cable has to be used. This ground strap or PE-cable should be connected by a M4 screw to the grounding point underlayed by a flat and toothed washer.

5. Wiring

5.1. Pin assignments

All connector pin arrangements that are shown in this chapter show the view from the front to the mating area of the plug connectors.

5.1.1. EtherNet/IP ports, M12 female connectors, 4-pole, D-coded

Colour code of the connectors: green
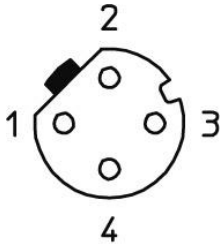
Connector	Pin	Signal	Function
EtherNet/IP ports X01, X02	1	TD+	Transmit Data +
	2	RD+	Receive Data -
	3	TD-	Transmit Data +
	4	RD-	Receive Data -

ATTENTION, risk of destruction!
Do not connect power supply lines (24 V DC) to the data lines.

5.1.2. Power supply connectors, MINI, 7/8″, 4-pole, male/female connectors

Colour code of the connectors: grey

X03(IN)   X04(OUT)
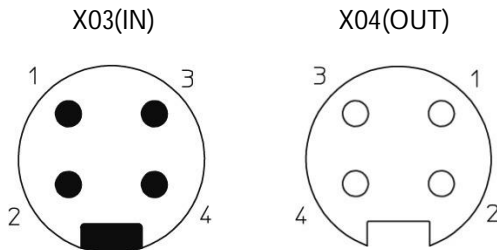
Connector	Pin	Signal	Function
Power supply X03, X04	1	+24 V DC	Actuator power UL
	2	+24 V DC	System/sensor power US
	3	0 V DC	System/sensor power US
	4	0 V DC	Actuator power UL

The power supply units that are used for the system/sensor and actuator power shall match PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage). Power supplies in accordance with EN 61558-2-6 (power transformer) or EN 60950-1 (switching power supplies) meet these requirements.

5.1.3. Sensor/actuator connector, M12-socket, 5-pole

Colour code of the connector: black
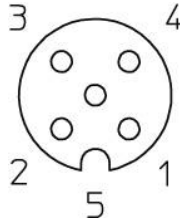
Connector	Pin	Function		
		0980 ESL 811	0910 ESL 812	0980 ESL 813
Sensor/ actuator	1	+24 V DC	n.c.	+24 V DC (ports X1..X4) n.c. (ports X5..X8)
	2	IN B	OUT B	IN B (ports X1..X4) OUT B (ports X5..X8)
	3	0 V DC	0 V DC	0 V DC
	4	IN A	OUT A	IN A (ports X1..X4) OUT A (ports X5..X8)
	5	Earth/GND	Earth/GND	Earth/GND

6. Configuring and commissioning

6.1. EDS-file

For the configuration of the I/O-modules in the control system an EDS-file is required. All three module types need an unique EDS-file. The files can be downloaded from our homepage under

http://www.beldensolutions.com/en/Service/Downloadcenter/Software_Lumberg/index.phtml.

On request the EDS-file would be mailed also by the support team.

The name of the files is as follows:

> EDS-V3.9-LumbergAutomation-0980ESL811-yyyymmdd.eds,
> EDS-V3.9-LumbergAutomation-0980ESL812-yyyymmdd.eds
> EDS-V3.9-LumbergAutomation-0980ESL813-yyyymmdd.eds,

in which „yyyymmdd" expresses the release date of the files.

After installing the EDS-files with the help of the hardware or network configuration tools of the specific PLC manufacturers the modules should be available in the hardware catalogues as "General Purpose Discrete I/O" devices.

6.2. MAC addresses

Each of the three I/O-modules gets one unique MAC address that is assigned on delivery. This address cannot be changed by the user. The MAC address assigned to a module is printed on the right side of the module.

6.3.   Setting the EtherNet/IP network parameters (IP-settings)

The network parameters such as IP-address, subnet mask and gateway address are set by three rotary switches that can be found on the front side of the modules.

The three rotary switches are used to adjust the operation mode for receiving the network parameters (IP-settings). During a power-on reset the switch settings are read in. The selected operation mode overwrites the stored settings.

The device supports the DHCP (Dynamic Host Configuration Protocol) and BOOTP (Bootstrap Protocol) protocols for receiving the necessary network parameters like IP-address and subnet mask.

6.3.1.   Default manufacturer settings of the network parameters

IP-address: 192.168.100.001
Subnet-mask: 255.255.255.000
Gateway address: 000.000.000.000

6.3.2.   Rotary switch setting 000 (delivery state)

In the delivery state the DHCP and BOOTP functionality is activated. The network parameters are requested by DHCP requests first and, if this is not successful, by BOOTP requests. The network parameters are not stored but storing is possible by using the integrated web server.

6.3.3.   Rotary switch setting 000 (network parameters have been stored before)

The last stored network parameters are used (IP-address, subnet mask, gateway address, DHCP on/off, BOOTP on/off)

6.3.4.   Rotary switch setting 001 to 254

The last octet of the stored or pre-adjusted IP-address is overwritten by the setting of the rotary switches.

6.3.5.   Rotary switch setting 255 to 998 (exception: 888)

The network parameters are requested by DHCP and BOOTP without storing.

6.3.6.   Rotary switch setting 888

The device performs a factory reset. The network parameters are restored to the factory settings. In this mode, no network communication is possible.

6.3.7.   Rotary switch setting 999

The default manufacturer IP-address 192.168.100.001 is used.

6.4. PLC configuration

6.4.1. Connections and Assembly Object

The three I/O-modules support the connection types "Exclusive Owner", "Input Only" and "Listen Only". The connection type "Exclusive Owner" is only supported by the modules with digital outputs.

By selecting the corresponding instance ID of the Assembly Object you can decide if diagnostic data is added to the standard process data or not.

The modules offer the following connections and assembly instance IDs in detail:

6.4.1.1. Module 0980 ESL 811-EIP 16DI-M12-R

Connection type	Diagnostics	Instance-ID	Length
Input Only	yes	Output: 193	0 Bytes
		Input: 101	4 Bytes
Input Only	no	Output: 193	0 Bytes
		Input: 102	3 Bytes
Listen Only	yes	Output: 192	0 Bytes
		Input: 101	4 Bytes
ListenOnly	no	Output 192	0 Bytes
		Input: 102	3 Bytes

6.4.1.2. Module 0980 ESL 812-EIP 16DO-M12-R

Connection type	Diagnostics	Instance-ID	Length
Exclusive Owner	yes	Output: 100	2 Bytes
		Input: 101	7 Bytes
		Configuration: 105	64 Bytes
Exclusive Owner	no	Output: 100	2 Bytes
		Input 102	3 Bytes
		Configuration: 105	64 Bytes
Input Only	yes	Output 193	0 Bytes
		Input: 101	7 Bytes
Input Only	no	Output 193	0 Bytes
		Input: 102	3 Bytes
Listen Only	yes	Output: 192	0 Bytes
		Input: 101	7 Bytes
Listen Only	no	Output: 192	0 Bytes
		Input: 102	3 Bytes

6.4.1.3. Module 0980 ESL 813-EIP 8DI/8DO-M12-R

Connection type	Diagnostics	Instance ID	Length
Exclusive Owner	yes	Output: 100	1 Byte
		Input: 101	6 Bytes
		Configuration: 105	32 Bytes
Exclusive Owner	no	Output: 100	1 Byte
		Input 102	3 Bytes
		Configuration: 105	32 Bytes
Input Only	yes	Output: 193	0 Bytes
		Input: 101	6 Bytes
Input Only	no	Output: 193	0 Bytes
		Input: 102	3 Bytes
Listen Only	yes	Output: 192	0 Bytes
		Input: 101	6 Bytes
Listen Only	no	Output: 192	0 Bytes
		Input: 102	3 Bytes

6.4.2. Configuration Assembly Instance

The configuration assembly instance is only available for the modules with digital outputs:

0980 ESL 812-EIP 16DO-M12-R
0980 ESL 813-EIP 8DI/8DO-M12-R

With this instance you can configure a surveillance timeout and fail safe for every single output channel.

The configuration assembly instance ID is 105. The length of the configuration assembly instance is 32 words (= 64 bytes) for the 16 DO module and 16 words (= 32 bytes) for the 8DI/8DO module.

6.4.2.1. Surveillance timeout

The firmware of these modules allows the configuration of a delay time until the monitoring of the output currents is activated. This delay time is called the surveillance timeout and can be adjusted for every single output channel. The delay time is started whenever the status of the output channel changes, i.e. when it is activated (after a rising edge) or deactivated (after a falling edge). After this time, the monitoring of the output is enabled and error conditions are reported by diagnostics. The surveillance timeout can be adjusted from 0 to 255 ms. The default value for this parameter is 80 ms. In the static state of an output channel, this means if the output channel is permanent on or off, the surveillance timeout is fixed set to 100 ms.

a) 0980 ESL 812-EIP 16DO-M12-R

				MSB								LSB				
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	Surveillance timeout port X1, channel A (pin 4), possible values 0...255															
Word 1	Surveillance timeout port X1, channel A (pin 2), possible values 0...255															
•								•								
•								•								
•								•								
Word 14	Surveillance timeout port X8, channel A (pin 4), possible values 0...255															
Word 15	Surveillance timeout port X8, channel A (pin 2), possible values 0...255															

b) 0980 ESL 813-EIP 8DI/8DO-M12-R

				MSB								LSB				
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	Surveillance timeout port X5, channel A (pin 4), possible values 0...255															
Word 1	Surveillance timeout port X5, channel A (pin 2), possible values 0...255															
•								•								
•								•								
•								•								
Word 6	Surveillance timeout port X8, channel A (pin 4), possible values 0...255															
Word 7	Surveillance timeout port X8, channel A (pin 4), possible values 0...255															

6.4.2.2. Fail-safe function

The firmware of the modules provides a fail-safe function for the outputs. During the configuration of the modules, the status of the outputs after a communication interrupt or communication lost on the EtherNet/IP network can be defined.

The following options can be selected:

Set low   – the output channel is deactivated, value = 0
Set high   – the output channel is activated, value = 1
Hold last   – the last output state is hold, value = 2

a) 0980 ESL 812-EIP 16DO-M12-R

		MSB								LSB							
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 16		Fail safe port X1, channel A (pin 4), possible values 0…2															
Word 17		Fail safe port X1, channel A (pin 2), possible values 0…2															
•							•										
•							•										
•							•										
Word 30		Fail safe port X8, channel A (pin 4), possible values 0…2															
Word 31		Fail safe port X8, channel A (pin 4), possible values 0…2															

b) 0980 ESL 813-EIP 8DI/8DO-M12-R

		MSB								LSB							
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 8		Fail safe port X5, channel A (pin 4), possible values 0…2															
Word 9		Fail safe port X5, channel A (pin 2), possible values 0…2															
•							•										
•							•										
•							•										
Word 14		Fail safe port X8, channel A (pin 4), possible values 0…2															
Word 15		Fail safe port X8, channel A (pin 4), possible values 0…2															

6.4.3.   Configuration example

The configuration of the LioN-R EtherNet/IP modules described on the following pages was accomplished with the help of the RSLogix5000 software from Rockwell Automation. In case of using a control system from another controller supplier please attend to the associated documentation.

1. Install the EDS-files of the three modules in RSLogix5000 using the *EDS Hardware Installation Tool* under the *Tools* menu.
2. Select the correct controller.
3. Switch to the *I/O Configuration* section in the *Controller Organizer* and click with the right mouse button on *Ethernet*.
4. Select menu item *New Module...* The following selection window opens.
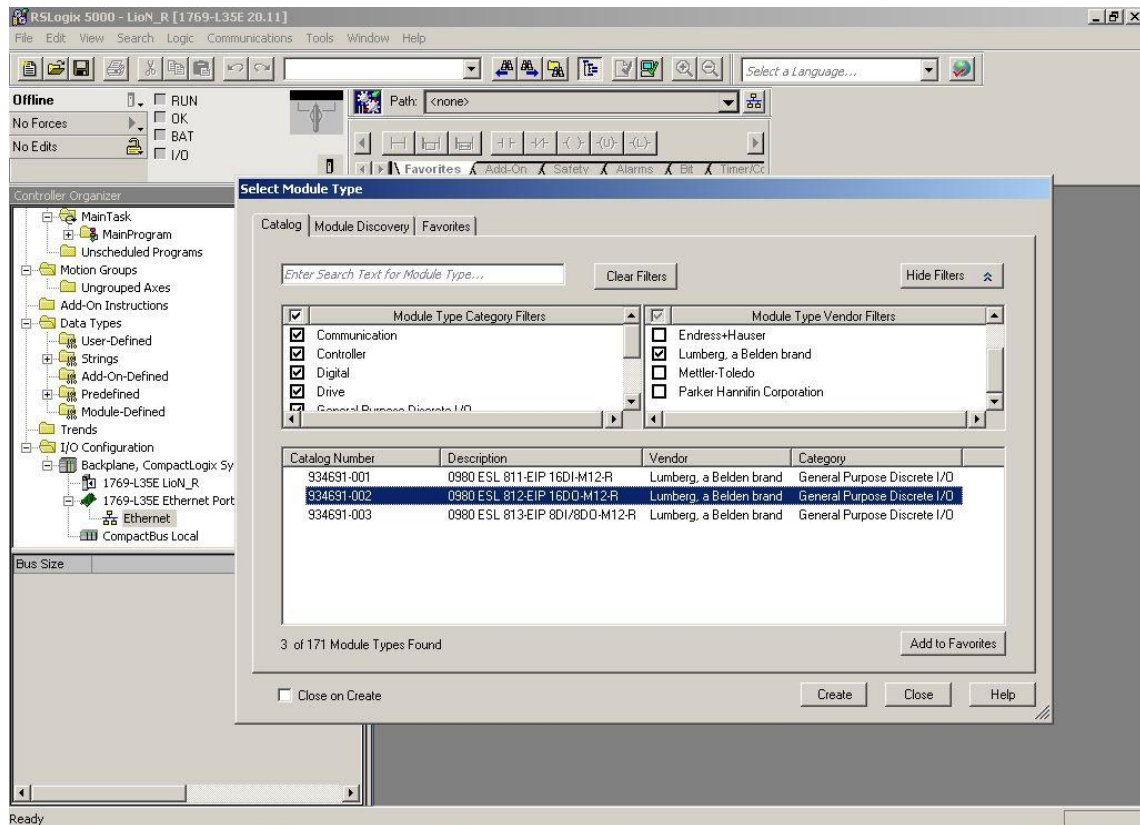
5. Select the module to add and press the button *Create*.
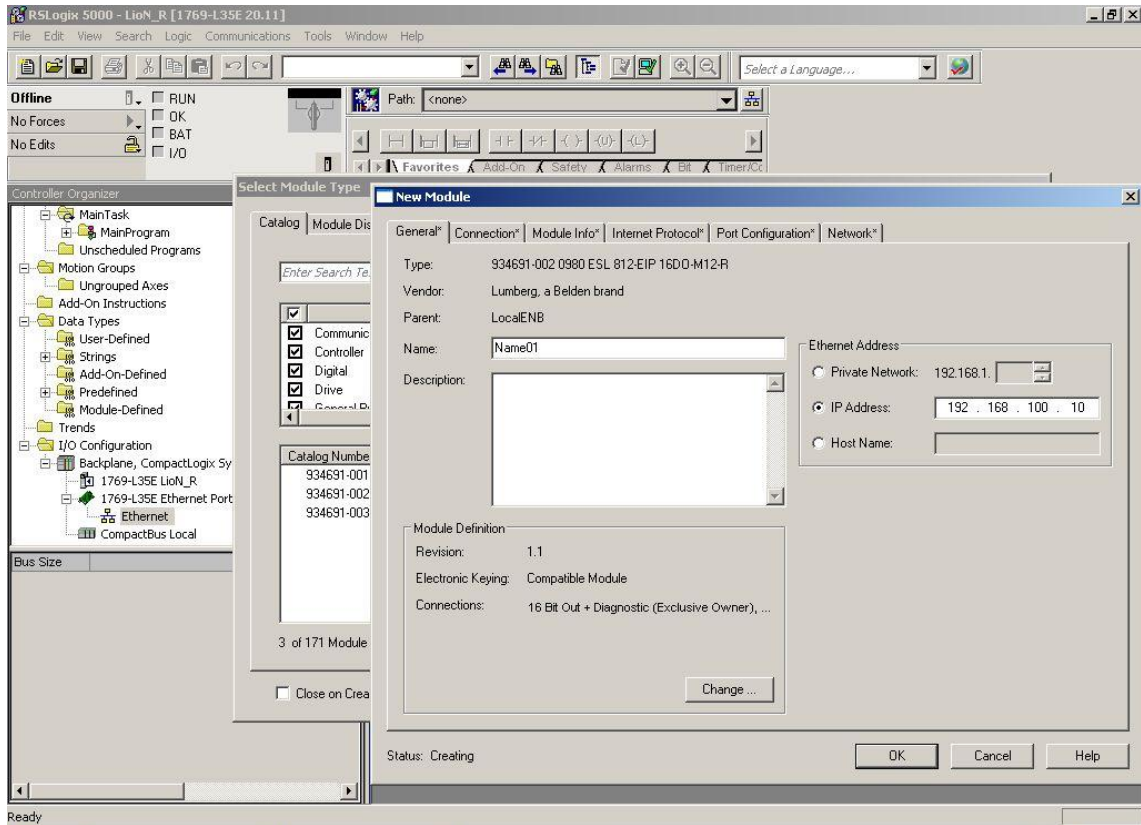
6. Enter a name for the module and the correct IP-address. In this case, the name *Name01* was selected. The IP-address was set to 192.168.100.10.
7. Press the button *Change* to change the settings for module revision, electronic keying and connection type.
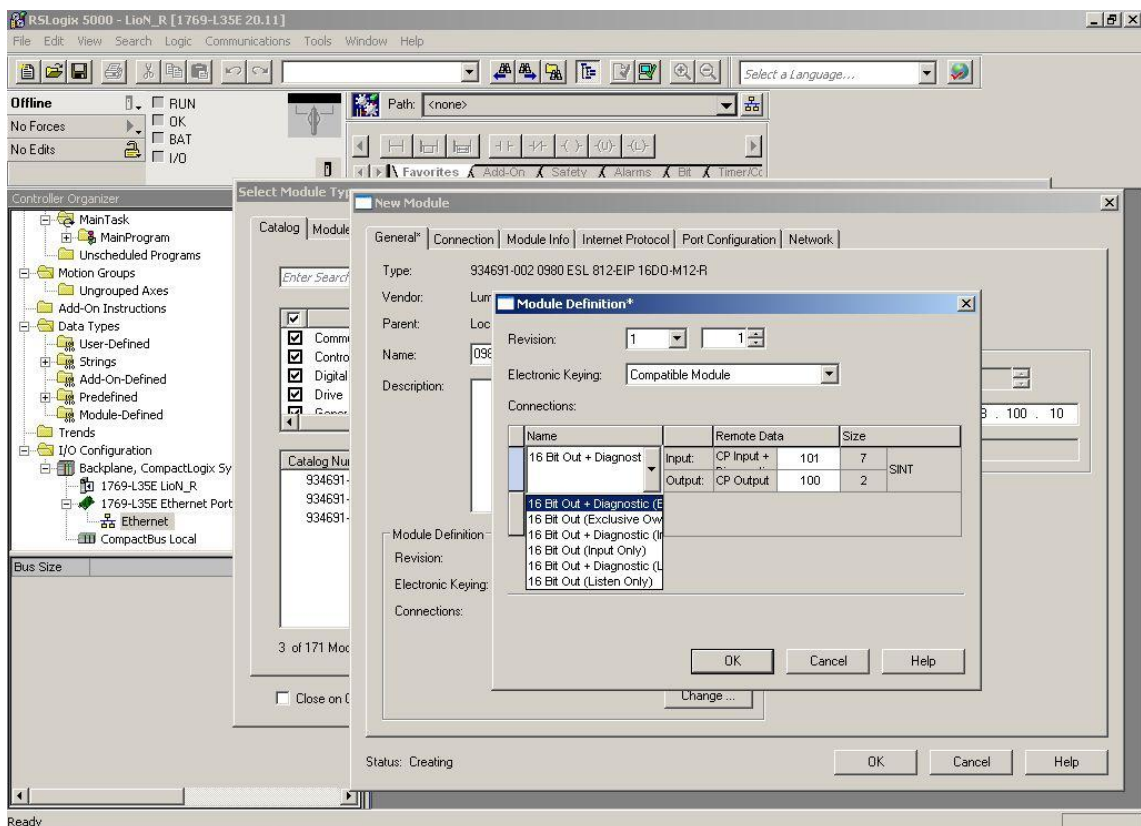
8. Select the connection you would like to establish with the module. The connection type determines which kind of process data and diagnostics is provided.
9. In the *Connection* folder of the *Module Properties* you see the selected connection type. This folder also allows the setting of the *Requested Packet Interval* and the *Input Type*. A value of 5 ms is the minimum value for the RPI parameter.
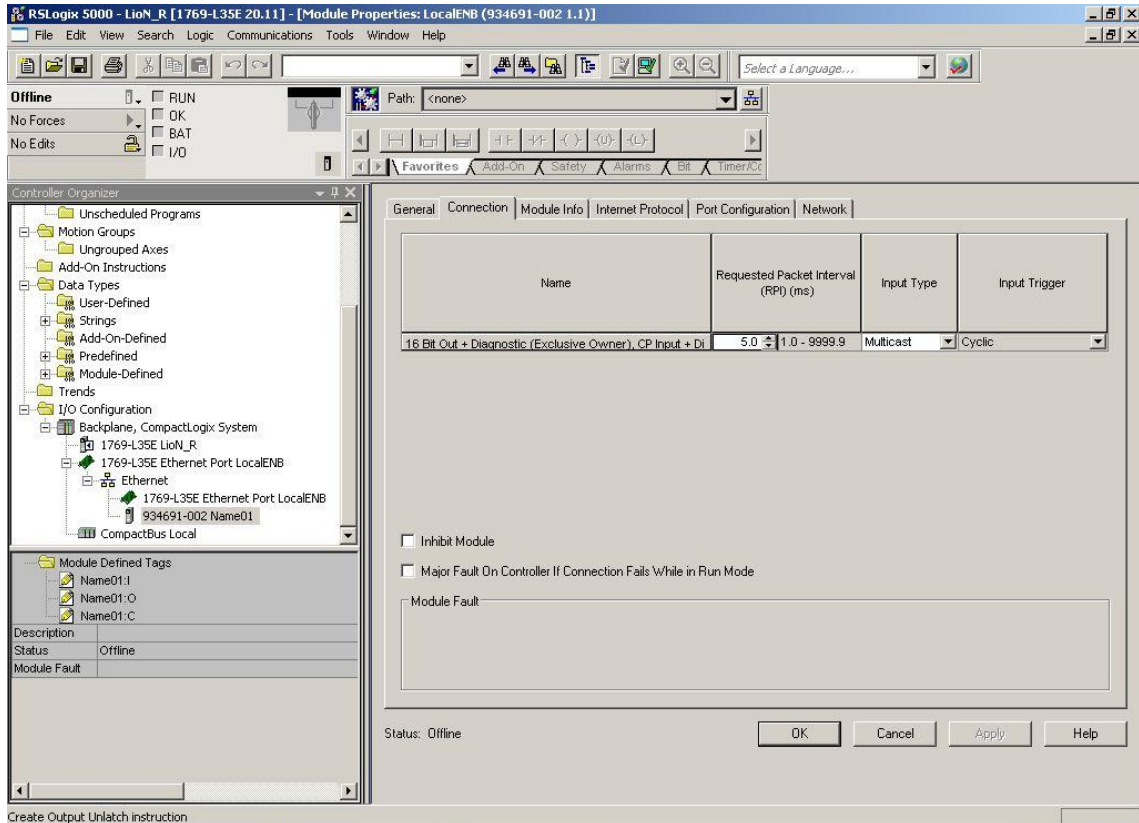
10. Switch to the *Controller Tags* section in the *Controller Organizer*. The controller tags for the configuration parameters are marked with the name of the module added by a ":C". For each of the 16 I/O-channels on the module it is possible to configure the Surveillance Timeout and Fail Safe parameters as described in the chapter 6.4.2 of this manual. See the following picture as an example.
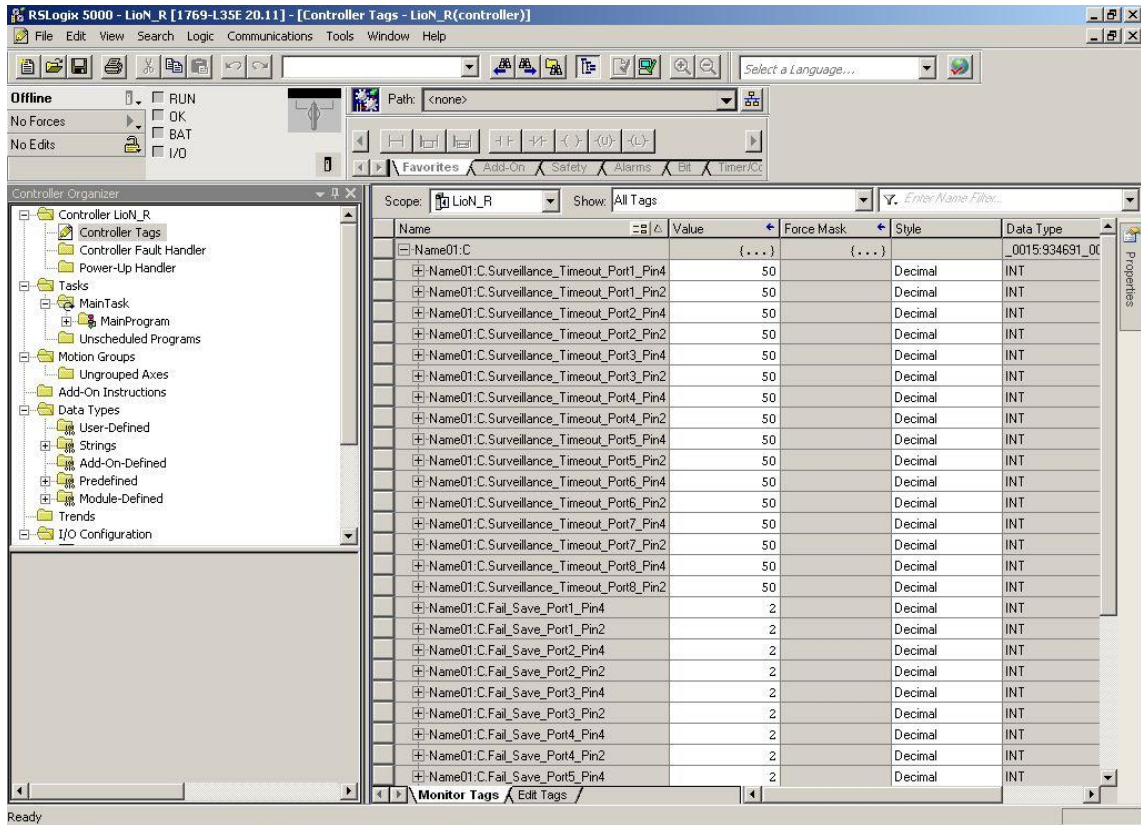
6.4.4. Initial connection parameter settings

In case of using the PLC configuration tools of other manufacturers you might be requested to enter further parameters to establish the communication connection between the EtherNet/IP I/O-scanner of your manufacturer and the LioN-R I/O-modules. The following tables provide a list of useful parameters.

a) Module 0980 ESL 811-EIP 16DI-M12-R with diagnostics

Connection Type	Input only
Trigger Mode	Cyclic
Requested Packet Interval (RPI)	minimum 5 ms
Originator To Target (O->T) connection parameters	
Real Time Transfer Format	Heartbeat
Connection Type	POINT2POINT
Assembly Instance ID	193
Data Type	USINT
Data Size	1 byte
Data Length	0 bytes
Target To Originator (T->O) connection parameters	
Real Time Transfer Format	Connection is pure data and is modeless
Connection Type	MULTICAST
Assembly Instance ID	101
Data Type	USINT
Data Size	1 byte
Data length	4 bytes

b) Module 0980 ESL 812-EIP 16DO-M12-R with diagnostics

Connection Type	Exclusive Owner
Trigger Mode	Cyclic
Requested Packet Interval (RPI)	minimum 5 ms
Originator To Target (O->T) connection parameters	
Real Time Transfer Format	32-bit run/idle header
Connection Type	POINT2POINT
Assembly Instance ID	100
Data Type	USINT
Data Size	1 byte
Data Length	2 bytes
Target To Originator (T->O) connection parameters	
Real Time Transfer Format	Connection is pure data and is modeless
Connection Type	MULTICAST
Assembly Instance ID	101
Data Type	USINT
Data Size	1 Byte
Data length	7 bytes

c) Module 0980 ESL 813-EIP 8DI/DO-M12-R with diagnostics

Application Type	Exclusive Owner
Trigger Mode	Cyclic
Requested Packet Interval (RPI)	minimum 5 ms
Originator To Target (O->T) connection parameters	
Real Time Transfer Format	32-bit run/idle header
Connection Type	POINT2POINT
Assembly Instance ID	100
Data Type	USINT
Data Size	1 byte
Data Length	1 byte
Target To Originator (T->O) connection parameters	
Real Time Transfer Format	Connection is pure data and is modeless
Connection Type	MULTICAST
Assembly Instance ID	101
Data Type	USINT
Data Size	1 byte
Data length	6 bytes

6.5. Device Level Ring

The firmware of both LioN-M I/O-modules supports the redundancy function DLR (Device Level Ring, ring topology). The supported DLR class is "beacon based" according to the EtherNet/IP specification.

7. Bit assignment

Please note that the amount of provider data (input data bytes) may vary depending on the selection whether diagnostic data should be transmitted or not. The modules provide one byte of module related diagnostics which is called the module information byte. The following diagnostic bytes contain port or channel related diagnostics. The diagnostic data is added as additional bytes to the standard process input data.

7.1. Module 0980 ESL 811-EIP 16DI-M12-R

7.1.1. Input Assembly Instance ID 101 (Input with diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	0	MI-SCS	0	MI-LVS
Byte 3	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1

Legend:
X1-A...X8-A: Input status of channel A (contact pin 4) on ports X1 to X8
X1-B...X8-B: Input status of channel B (contact pin 2) on ports X1 to X8
MI-LVS: Module information byte – low voltage system/sensor power U_S
MI-SCS: Module information byte – sensor short circuit on one M12 socket
SCS-X1...SCS-X8: Sensor short circuit on ports X1 to X8

7.1.2. Input Assembly Instance ID 102 (Input without diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	0	MI-SCS	0	MI-LVS

Legend:
X1-A...X8-A: Input status of channel A (contact pin 4) on ports X1 to X8
X1-B...X8-B: Input status of channel B (contact pin 2) on ports X1 to X8
MI-LVS: Module information byte – low voltage system/sensor power U_S
MI-SCS: Module information byte – sensor short circuit on one M12 socket

7.2. Module 0980 ESL 812-EIP 16DO-M12-R

7.2.1. Input Assembly Instance ID 101 (Input with diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	MI-SCA		MI-LVA	
Byte 3	LVA-X8	LVA-X7	LVA-X6	LVA-X5	LVA-X4	LVA-X3	LVA-X2	LVA-X1
Byte 4	OVL-X8	OVL-X7	OVL-X6	OVL-X5	OVL-X4	OVL-X3	OVL-X2	OVL-X1
Byte 5	CE-X4B	CE-X4A	CE-X3B	CE-X3A	CE-X2B	CE-X2A	CE-X1B	CE-X1A
Byte 6	CE-X8B	CE-X8A	CE-X7B	CE-X7A	CE-X6B	CE-X6A	CE-X5B	CE-X5A

Legend:
X1-A...X8-A:	Output status of channel A (contact pin 4) on ports X1 to X8
X1-B...X8-B:	Output status of channel B (contact pin 2) on ports X1 to X8
MI-LVA:	Module information byte – low voltage actuator
MI-SCA:	Module information byte – actuator short circuit
LVA-X1... LVA-X8:	Actuator low voltage on ports X1 to X8
OVL-X1...OVL-X8:	Output driver overload on ports X1 to X8
CE-X1A...CE-X8A:	Channel error on channel A (contact pin 4) on ports X1 to X8
CE-X1B...CE-X8B:	Channel error on channel B (contact pin 2) on ports X1 to X8

7.2.2. Input Assembly Instance ID 102 (Input without diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	MI-SCA		MI-LVA	

Legend:
X1-A...X8-A:	Output status of channel A (contact pin 4) on ports X1 to X8
X1-B...X8-B:	Output status of channel B (contact pin 2) on ports X1 to X8
MI-LVA:	Module information byte – low voltage actuator
MI-SCA:	Module information byte – actuator short circuit

7.2.3. Output Assembly Instance ID 100

All values are target values.

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

Legend:

X1-A...X8-A:	Output status of channel A (contact pin 4) on ports X1 to X8
X1-B...X8-B:	Output status of channel B (contact pin 2) on ports X1 to X8

7.3. Module 0980 ESL 813-EIP 8DI/8DO-M12-R

7.3.1. Input Assembly Instance ID 101 (Input with diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 3	LVA-X8	LVA-X7	LVA-X6	LVA-X5	LVS-X4	LVS-X3	LVS-X2	LVS-X1
Byte 4	OVL-X8	OVL-X7	OVL-X6	OVL-X5				
Byte 5	CE-X8B	CE-X8A	CE-X7B	CE-X7A	CE-X6B	CE-X6A	CE-X5B	CE-X5A

Legend:

X1-A...X4-A:	Input status of channel A (contact pin 4) on ports X1 to X4
X1-B...X4-B:	Input status of channel B (contact pin 2) on ports X1 to X4
X5-A...X8-A:	Output status of channel A (contact pin 4) on ports X5 to X8
X5-B...X8-B:	Output status of channel B (contact pin 2) on ports X5 to X8
MI-LVS:	Module information byte – low voltage system/sensor power U_S
MI-LVA:	Module information byte – low voltage actuator
MI-SCS:	Module information byte – sensor short circuit
MI-SCA:	Module information byte – actuator short circuit
LVS-X1...LVS-X4:	Sensor low voltage on ports X1...X4
LVA-X5...LVA-X8:	Actuator low voltage on ports X5...X8
OVL-X5...OVL-X8:	Output driver overload on ports X5...X8
CE-X5A...CE-X8A:	Channel error on channel A (contact pin 4) on ports X5 to X8
CE-X5B...CE-X8B:	Channel error on channel B (contact pin 2) on ports X5 to X8

7.3.2. Input Assembly Instance ID 102 (Input without diagnostics)

All values are actual values.

INPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X4-B	X4-A	X3-B	X3-A	X2-B	X2-A	X1-B	X1-A
Byte 1	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A
Byte 2	0	0	0	0	MI-SCA	MI-SCS	MI-LVA	MI-LVS

Legend:

X1-A...X4-A:	Input status of channel A (contact pin 4) on ports X1 to X4
X1-B...X4-B:	Input status of channel B (contact pin 2) on ports X1 to X4
X5-A...X8-A:	Output status of channel A (contact pin 4) on ports X5 to X8
X5-B...X8-B:	Output status of channel B (contact pin 2) on ports X5 to X8
MI-LVS:	Module information byte – low voltage system/sensor power U_S
MI-LVA:	Module information byte – low voltage actuator
MI-SCS:	Module information byte – sensor short circuit
MI-SCA:	Module information byte – actuator short circuit

7.3.3. Output Assembly Instance ID 100

All values are target values.

OUTPUT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X8-B	X8-A	X7-B	X7-A	X6-B	X6-A	X5-B	X5-A

Legend:

X5-A...X8-A:	Output status of channel A (contact pin 4) on ports X5 to X8
X5-B...X8-B:	Output status of channel B (contact pin 2) on ports X5 to X8

8. Diagnostics handling

The modules offer an extended diagnostics behaviour especially for the output channels that is explained in this chapter.

There are five different types of faults that need to be distinguished.

8.1. Channel error

Channel errors result from a comparison between the target value of an output channel set by a control unit or PLC and its actual value.

Target value	Actual value	Remark
Active	Active	OK, no diagnostics
Off	Off	OK, no diagnostics
Active	Off	Short circuit Channel indicator is solid red. Channel error bit is set in the diagnostics. Channel is locked after fault disappeared.
Off	Active	Power feed back on channel Channel indicators red and yellow/white are on. Channel error bit is set in the diagnostics. Channel is not locked after fault disappeared.

IMPORTANT!
The locked channel after a channel error is deactivated and remains in the off state unless it is deactivated by the control unit or PLC and reactivated again.

When the channel is activated (rising edge of channel status) or deactivated (falling edge) the channel error is filtered for a time period that can be adjusted by the parameter *Surveillance Timeout* during the configuration of the module in the control unit/PLC. The *Surveillance Timeout* can be set from 0 to 255 ms. The default setting is 50 ms.

The filter is used to avoid premature error reports in case of switching on a capacitive load or switching off an inductive load and other voltage peaks during a status change.

In the static state of the channel, i.e., while it is permanently switched on or off, a fixed time of 100 ms for filtering the error report is used.

8.2. Voltage error on M12 sockets

On every M12 input socket of the modules, the pin 1 provides a 24 Volts power supply signal. This power supply signal corresponds to the system/sensor power U_S. The status of this power supply signal is monitored.

In case of a sensor short circuit a voltage error is reported. Both channel indicators of the M12 socket light up red and the corresponding error bit *Sensor low voltage* in the diagnostic bytes is set.

The voltage error report is also filtered by the parameter *Surveillance Timeout*. The same parameter settings as for the channel error are also used for the voltage error.

8.3.   Overload error of the output drivers

The output drivers of the modules 0980 ESL 812 – 16DO and 0980 ESL 813 – 8DI/8DO report an error if they detect an overload condition.

This error is reported by setting the corresponding overload status bits in the diagnostic bytes. The diagnostic message is related to an M12-port on a module, not to an output channel.

The LED status indicator of the overloaded output channel turns on red.

The overload error is filtered by the parameter *Surveillance Timeout*. The same setting of the parameter *Surveillance Timeout* applies to the channel, voltage and overload errors that are explained in the chapters 8.1 and 8.2.

8.4.   Error on actuator power supply U_L

The voltage level on the actuator power supply is also monitored globally and module related at the power supply connectors.

In case of the fact that U_L exceeds the voltage level of 18 V to 30 V an error is reported.

The indicator U_L turns on red.

The bit *Actuator low voltage* in the module information byte is set. If output channels are activated the voltage error of U_L on the M12 sockets is additionally reported by setting the corresponding error bits.

IMPORTANT!
Every output channel, which is active at the same time when the global error on the power supply U_L is detected, is locked. This means, the output channel has to be reset for correct operation by the control unit/PLC if the status of power supply U_L is normal again.

This error is filtered by a fixed filter time of 300 ms.

8.5.   Error on system/sensor power supply U_S

The voltage level of the system/sensor power supply U_S is also monitored globally. If it exceeds the voltage range of 18 to 30 V an error is reported.

The indicator U_S turns on red and the bit *Sensor low voltage* in the module information byte is set. Because of the fact that a low voltage of U_S also affects the voltage levels of the pins 1 on the M12 sockets, the voltage error on the M12 input sockets is also reported.

This error has no impact on any outputs and is not filtered. The error is reported immediately.
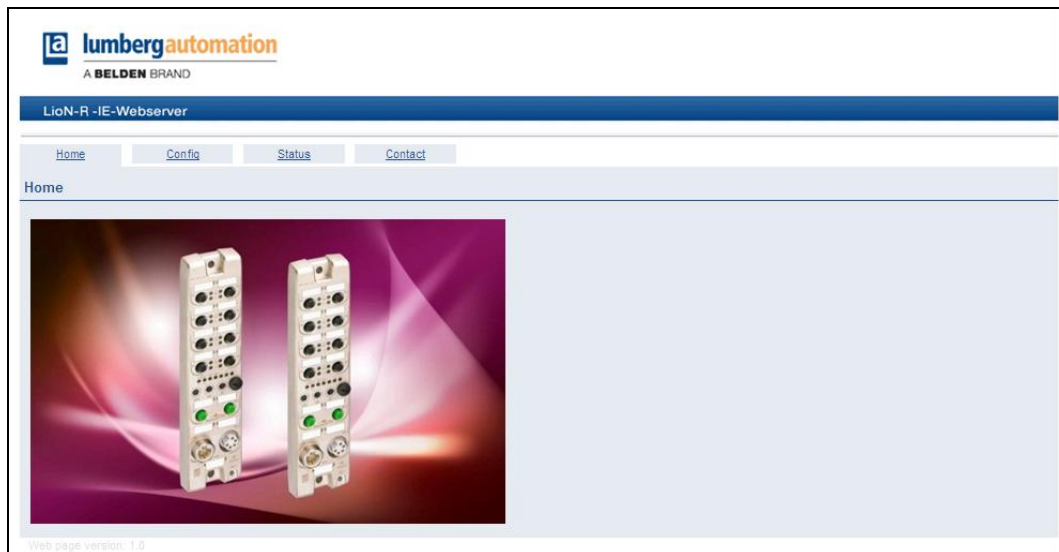
9. The embedded web server

Both I/O-modules provide an embedded web server for configuration, monitoring and diagnostics.

9.1. The Home page

The Home page can be reached through a web browser by selecting the address:

http://[IP-address]/home.htm.

The placeholder [IP-Address] should be replaced by the actual IP-address of the I/O-module.

9.2. The *Config* page
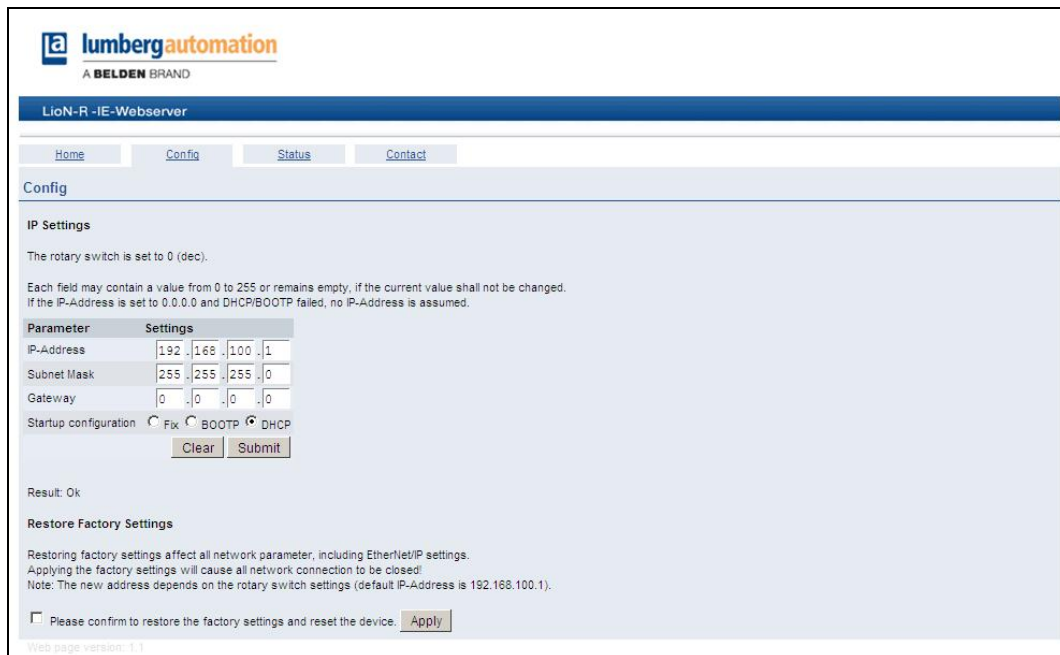
The Config page can be reached through a web browser by selecting the address:

http://[IP-address]/config.htm.

The following values and parameters can be read and changed through this page:

o Network parameters (IP settings)
  ▪ IP-address, read- and writeable
  ▪ Subnet mask, read- and writeable
  ▪ Gateway address, read- and writeable

o Startup configuration
  ▪ Fix, I/O-module uses the fixed IP settings set up by the parameters above.
  ▪ BOOTP, I/O-module receives IP settings by a BOOTP server.
  ▪ DHCP, I/O-module receives IP settings by a DHCP server.

o Restore Factory Settings
  ▪ Resets the I/O-module to default factory settings.

By pressing the button Submit the new parameter settings are transmitted to the I/O-module.
The new settings are adopted by the I/O-module only after a power-on reset.
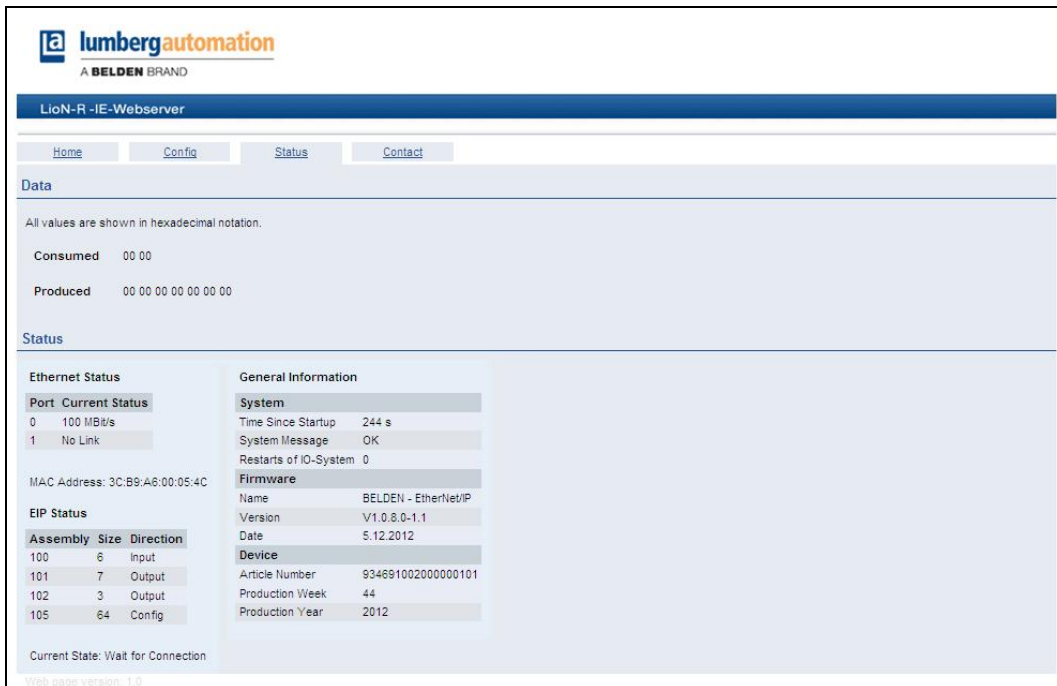
9.3. The *Status* page

The Status page can be reached through a web browser by selecting the address:

http://[IP-address]/status.htm.

The following values and parameters can be read through this page. All values and parameters are read-only.

o Data
  ▪ Consumed (output) and Produced (input) data
o LAN-port status
  ▪ Duplex Mode (full duplex, half duplex)
  ▪ Speed (10 MBit, 100 MBit)
o Network parameter
  ▪ MAC Adresse
o Size and direction of the Assembly Instances

- o EtherNet/IP status
  - ▪ Standby, Operational
- o Device status
  - ▪ Operating time
  - ▪ System informations
  - ▪ Number of I/O-system restarts
- o Firmware version and date
- o Device information
- o Revision
  - ▪ Part number
  - ▪ Serial number
  - ▪ Year and week of production

9.4. The *Contact* page

The Contact page can be reached through a web browser by selecting the address:

http://[IP-address]/contact.htm.

This page gives information about our contact data.
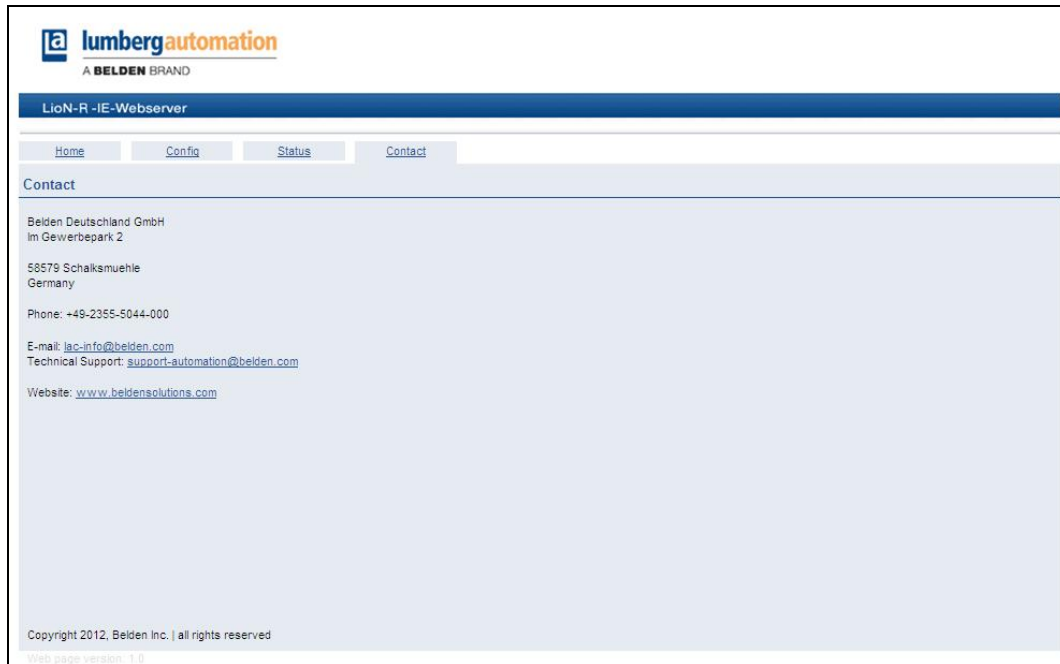
9.5. Upload of process and diagnostic data using the web interface

The process and diagnostic data of the two I/O-modules can be uploaded by means of the integrated web server. The web server provides this data in the standardized JSON format. Access to the data is granted by the following web page:

http://[IP-address]/data.jsn

In higher level programming languages a HTTP request uploads the process and diagnostic data.
The following example uses the GET command in a 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

{"ProcessData": {"In": [0,0],"Out": [0,12]}
,"Diagnostic": [4,48,0,0,0]}
```

The response has the following object structure:
- ProcessData
  - In: Array[a,b]
  - Out: Array[a,b]
- Diagnostic: Array[a,b,c,d,e]

10. Technical data

10.1. General data

Degree of protection	IP 67 (only with screwed connectors)
Ambient temperature	-10°C (+14°F) / +60°C (+140°F)
Weight	605 g
Housing material	Zinc diecasting
Vibration resistance	15 g / 5–500 Hz
Shock resistance	50 g / 11 ms
Torques: • Fastening screw M4 • M12 connectors	 1,0 Nm 0,5 Nm

10.2. Technical data of the bus system

Protocol	EtherNet/IP
EDS-files	EDS-V3.9-LumbergAutomation-0980ESL811-yyyymmdd.eds EDS-V3.9-LumbergAutomation-0980ESL812-yyyymmdd.eds EDS-V3.9-LumbergAutomation-0980ESL813-yyyymmdd.eds
Transmission rate	10/100 Mbit/s, Full Duplex
Transmission method Autonegotiation	100BASE-TX supported
Vendor code	21_D
Product type	7
Product type string	"General Purpose Discrete I/O"
Product code	811 (0980 ESL 811-EIP 16DI-M12-R) 812 (0980 ESL 812-EIP 16DO-M12-R) 813 (0980 ESL 813-EIP 8DI/8DO-M12-R)
Supported Ethernet protocols	• Ping • ARP • LLDP • SNMP (Network diagnostics) • HTTP • TCP/IP • DHCP • BOOTP
Switch-functionality	integrated

EtherNet/IP-interface
    Connections
 	
    Autocrossing
	
	2 M12-sockets, 4-pole, D-coded (see pin assignments)
	
	supported

10.3. Technical data of the power supply for the electronics and sensors

Rated voltage U_S	24 V DC (SELV/PELV)
Voltage range	18–30 V DC
Current consumption electronics	typ. 95 mA
Voltage level power supply sensors	min. (U_S - 1.5 V)
Power consumption sensors	max. 200 mA (at T_u 30°C)
Reverse polarity protection	yes
Operation indicator (U_S)	LED green, 18 V ≤ U_S ≤ 30 V LED red, U_S <18 V or U_S > 30 V
Connection	Mini, 7/8" connectors male / female, 4-pole see pin assignments

10.4. Technical power supply actuators

Rated voltage U_L	24 V DC (SELV/PELV)
Voltage range	18–30 V DC
Galvanic separation	yes
Low voltage threshold	typ. 17 V
Delay time low voltage detection	< 20 ms
Inverse polarity protection	yes
Operation indicator (U_L)	LED green, 18 V ≤ U_L ≤ 30 V LED red, U_L <18 V or U_L > 30 V
Connection	Mini, 7/8″ connectors male/female, 4-pole see pin assignments

CAUTION!
The inverse polarity protection only works, if the actuator power supply is protected by an over-current fuse (10 A, mT) and switched off after a short circuit within 10 to 100 ms at the latest.

ATTENTION!
A power supply unit with current control or a wrong fuse lead to damage of the module in case of inverse polarity connection.

10.5. Technical data inputs

Input circuit	Type 3 according to IEC 61131-2
Rated input voltage	24 V DC
Input current at 24 V DC	typ. 5 mA
Short-circuit proof	yes
Channel type	N.O., p-switching
Number of digital channels	16
Status indication	LED yellow for channel A, LED white for channel B
Diagnostic indication	LED red per socket
Connection	M12 female connector, 5 poles see pin assignments

10.6. Technical data outputs

Output circuit	Type 1.6 A according to IEC 61131-2
Rated output current per channel:	1.6 A, please see Info 1
Signal state "1" Signal state "0"	max. 1.6 A max. 1 mA (according to specification)
Signal level of the outputs Signal state "1" Signal state "0"	 min. (U_L - 1 V) max. 2 V
Short-circuit proof	yes
Max. output current per module	according to UL-approval: 9.0 A, (12.0 A please see Info 2)
Overload-proof	yes
Number of digital channels	16
Channel type	N.O., p-switching
Status indication	LED yellow for channel A, LED white for channel B
Diagnostics indication	LED red per channel
Connection	M12 female connector, 5 poles see pin assignments
Info 1: The outputs are able to switch currents of 1.6 A with a frequency of 1 Hz with inductive loads of the utilization category DC13 (EN60947-5-1).	
Info 2: Technically feasible and approved under the following conditions: Looped through sensor/system power, maximum 2.5 A Minimum cross section of power supply cable: 4x 1.0 mm² Ambient temperature maximum 40 °C/ 104 °F	

10.7. LED indicators

U_S	green	System-/ sensors power supply, voltage level 18 V ≤ U_S ≤ 30 V
	red	System-/ sensors power supply, voltage level U_S <18 V or U_S > 30 V
	off	System-/ sensors power supply missing
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	Actuator power supply missing
X1...X8 A/DIA	yellow	Channel status A
	red	Periphery fault (sensor or actuator overload/short circuit)
	off	Not connected, no status, no fault
X1...X8 B	white	Channel status B
	red	Periphery fault (actuator overload/short circuit)
	off	Not connected, no status, no fault
P1 Lnk / Act P2 Lnk / Act	green	Ethernet connection to another participant exists. Link detected.
	yellow flashing	Data exchange with another participant.
	off	No connection with another participant. No link, no data exchange.
MS	green	Device ready for operation
	green flashing	Stand-by, device not configured
	red	Fatal, non-recoverable fault
	red flashing	Light, recoverable fault. For example, a wrong or inconsistent configuration is classified as a light fault.
	red/green alternating flashing	Device performs a self-test.
	off	Device switched off.
NS	green	Connected: The device has at least one existing connection.
	green flashing	No connection: The device has no existing connections. IP-address is available.
	red	Redundant IP-address. The device detected that its IP-address is already used by another device.
	red flashing	Connection time-out
	red/green alternating flashing	Device performs a self-test.
	off	Device switched off or no IP-address available