lumbergautomation
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Manual

LioN-P EtherCAT® Digital-I/O Multiprotocol

0980 ESL 390-111
0980 ESL 391-111
0980 ESL 392-111
0980 ESL 393-111
0980 ESL 390-121, 0980 ESL 390-121-DCU1
0980 ESL 391-121
0980 ESL 392-121
0980 ESL 393-121, 0980 ESL 393-121-DCU1

Technical Support
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Contents

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 modules with EtherCAT® 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 modules with EtherCAT® 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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1.2 Explanation of symbols

1.2.1 Use of danger information

Danger information is denoted as follows:

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

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

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

1.2.2 Use of general information

General information is denoted as follows:

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

1.2.3 EtherCAT® trademark information

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

1.3 Version information

Index	Created	Changed	Changed
Version number	Version 1.0	Version 2.0	
Date	October 2016	October 2017	
Name/ department	MJ/ R&D	MJ/ R&D	

Table 1: Overview of manual revisions

1.4 Designations and synonyms

PDO	Process Data Object
TxPDO	Transmit Process Data Object (I/O-device to EtherCAT® controller)
RxPDO	Receive Process Data Object (EtherCAT® controller to I/O-device)
USINT	8 Bit value
UDINT	32 Bit value
EC	EtherCAT®
DCU	Distributed Control Unit

2 Safety instructions

2.1 Intended use

The devices described in this manual are decentralized input/output assemblies on an EtherCAT® 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.

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

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

A completely assembled device housing is required for the proper operation of the 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

3.1 About the LioN-P module series

LioN modules (Lumberg input/output Network) function as the interface in an industrial fieldbus system: They enable a central controller on the management level to communicate with the decentralized sensors and actuators on the field level. The typical protocol specific topologies (logical ring topology for EtherCAT®) can be used not only in order to create reliable data communication but also to significantly reduce the number of cables required and thus also the costs for installation and maintenance. They additionally enable easy, quick extension.

The modules of the LioN-P series have a very sturdy metal housing made of die-cast zinc. The completely cast device housing protects the module electronics from environmental effects and allows the device to be used in a wide temperature range. Despite the sturdy construction, the modules have compact dimensions and a low weight. They are especially suitable for use in machines and installations with a moderate I/O concentration over separate assemblies.

3.2 Special product features

Robust design

The connection option provided by the module series is 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 ports from being mixed up. The output power circuits are electrically isolated from the rest of the network and the sensor electronics. This reliably protects the control devices from interference signals.

Integrated switch	The integrated 2-port Ethernet switch of the modules allows a line topology to be set up for the EtherCAT® network.
Failsafe function	The modules with digital output channels provide a failsafe function. This allows you to define the behavior of every single digital output channel in the case of an interruption or a loss of communication.
Integrated web server	The integrated web server provides status information, forcing of the inputs and outputs for installation checks and firmware update functionality.
Multiprotocol support	The multiprotocol modules allow you to select different protocols for communication within a fieldbus system. In this way the multiprotocol modules can be integrated into different networks without it being necessary to purchase modules specific for each protocol.

3.3 Product overview

The LioN-P module series consists of 3 variants of modules with different I/O functions. Detailed information is provided in the following table.

Item number	Description	I/O ports	Design
LioN-P module with 16 digital inputs 0980 ESL 391-111 Order number: 934 882-001 (7/8” power, multiprotocol) 0980 ESL 391-121 Order number: 934 879-001 (M12 power, multiprotocol)	16DI	8x M12	Sturdy/metal
LioN-P module with 16 digital outputs 0980 ESL 392-111 Order number: 934 882-002 (7/8” power, multiprotocol) 0980 ESL 392-121 Order number: 934 879-002 (M12 power, multiprotocol)	16DO	8x M12	Sturdy/metal
LioN-P module with 8 digital inputs and 8 digital outputs 0980 ESL 393-111 Order number: 934 882-003 (7/8” power, multiprotocol) 0980 ESL 393-121 Order number: 934 879-003 (M12 power, multiprotocol) 0980 ESL 393-121-DCU1 Order number: 934 879-005 (M12 power, multiprotocol with distributed control unit)	8DI/8DO	8x M12	Sturdy/metal
LioN-P module with 16 universal digital inputs and outputs 0980 ESL 390-111 Order number: 934 882-007 (7/8” power, multiprotocol) 0980 ESL 390-121 Order number: 934 879-007 (M12 power, multiprotocol) 0980 ESL 390-121-DCU1 Order number: 934 879-009 (M12 power, multiprotocol with distributed control unit)	16DI/DO	8x M12	Sturdy/metal

Table 2: Overview of module variants of the LioN-P series

4 Assembly and wiring

4.1 General information

Mount the module with 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 190.3 to 191.8 mm for LioN-P modules with 7/8" connector/socket, and a distance of 196.8 mm to 198.3 mm for LioN-P modules with M12 power L-coded.

Attention: 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**.

Attention: 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.

Attention: 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.

Attention: 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.

Attention: 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:

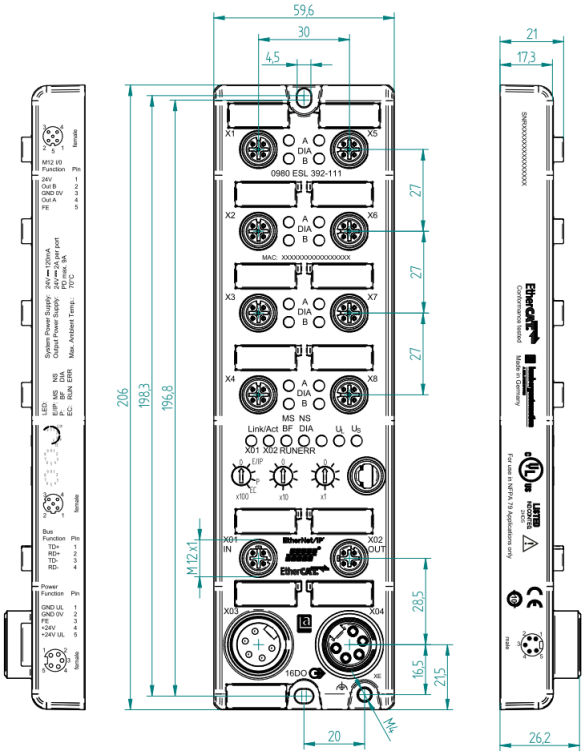
Use temperature-resistant cables with the following properties:

For the modules 0980ESL3x1-111 and 0980 ESL3x1-121 heat-resistant up to at least 85° C.

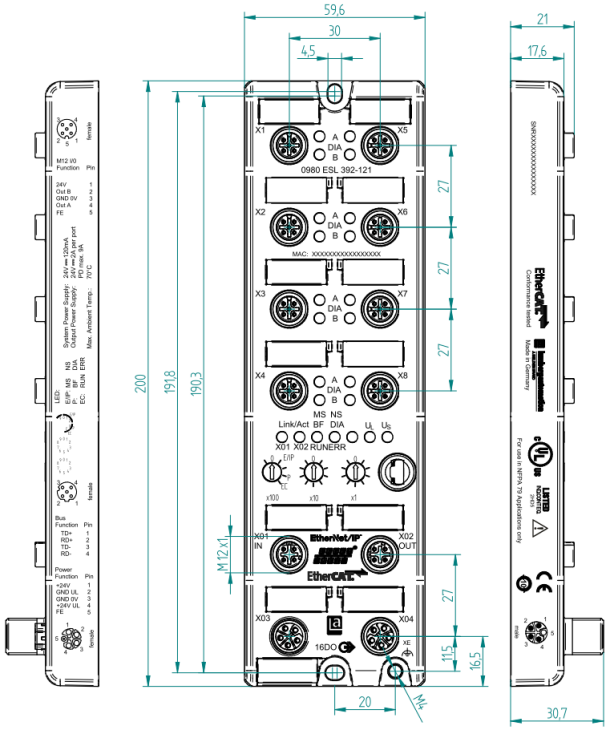
For the modules 0980ESL3x0-1x1, 0980ESL3x2-1x1 and 0980 ESL3x3-1x1 heat-resistant up to at least 96° C.

4.2 Outer dimensions

4.2.1 Module 0980 ESL 3xx-111



4.2.2 Module 0980 ESL 3xx-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 EtherCAT® ports

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

- Design: M12 socket, 4-pin, D-coded
- Color coding: green

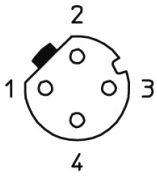


Figure 1: Schematic drawing, ports X01, X02

Port	Pin	Signal	Function
EtherCAT® Port X01 (IN), Port X02 (OUT)	1	TD +	Transmit Data +
	2	RD +	Receive Data +
	3	TD -	Transmit Data -
	4	RD -	Receive Data -

Table 3: Assignment of ports X01, X02

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

4.3.2 Power Supply with 7/8”, 5-pin

- Color coding: gray

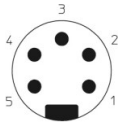


Figure 2: Schematic drawing, port X03 (IN)

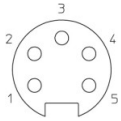


Figure 3: Schematic drawing, port X04 (OUT)

Port	Pin	Signal	Signal	Function
		0980 ESL 391-111	0980 ESL 390-111 0980 ESL 392-111 0980 ESL 393-111	
Power supply X03, X04	1	*see note	GND_U_L	Actuator
	2	GND_U_S	GND_U_S	System/sensors
	3	FE	FE	Functional earth
	4	U_S (+24 V)	U_S (+24 V)	System/sensors
	5	*see note	U_L (+24 V)	Actuator

Table 4: Assignment of ports X03, X04

Attention: For the input module 0980 ESL 391-111 and 0980 ESL 390-111 used with inputs only profile 16DI or 8DI, 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.

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

4.3.3 Power Supply with M12 power L-coded

- Color coding: gray

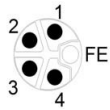


Figure 4: Schematic diagram of the M12 L-coding (connector), port X03 (IN)

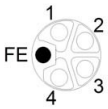


Figure 5: Schematic diagram of the M12 L-coding (socket), port X04 (OUT)

Port	Pin	Signal	Signal	Function
		0980 ESL 391-121	**0980 ESL 390-121** **0980 ESL 390-121-DCU1** **0980 ESL 392-121** **0980 ESL 393-121**	
Power supply X03, X04	1	U_S (+24 V)	U_S (+24 V)	System/sensors
	2	*see note	GND_U_L	Actuator
	3	GND_U_S	GND_U_S	System/sensors
	4	*see note	U_L (+24 V)	Actuator
	5	FE	FE	Functional earth

Table 5: Assignment of ports X03, X04

Attention: For the input module 0980 ESL 391-121 and 0980 ESL 390-121 used with inputs only profile 16DI or 8DI, the two contacts 2 and 4 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.

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

4.3.4 Ports for the sensors/actuators

- Design: M12 socket, 5-pin
- Color coding: black

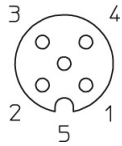


Figure 6: Schematic drawing, port X1 to X8

Function	Module	Sensor/ actuator port	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
16DI	0980 ESL 391-111 0980 ESL 391-121	X1 - X8	+24 V DC (U_S)	IN B	GND_U_S	IN A	FE / Func. earth
16DO	0980 ESL 392-111 0980 ESL 392-121	X1 - X8	n.c.	OUT B	GND_U_L	OUT A	FE / Func. earth
8DI/8DO	0980 ESL 393-111	X1 - X4 X5 - X8	+24 V DC (U_S) n.c.	IN B OUT B	GND_U_S GND_U_L	IN A OUT A	FE / Func. earth
	0980 ESL 393-121	X1 - X4 X5 - X8	+24 V DC (U_S) n.c.	IN B OUT B	GND_U_S GND_U_L	IN A OUT A	FE / Func. earth
	0980 ESL 393-121-DCU1	X1 - X4 X5 - X8	+24 V DC (U_S) n.c.	IN B OUT B	GND_U_S GND_U_L	IN A OUT A	FE / Func. earth
16DI/DO	0980 ESL 390-111 0980 ESL 390-121 0980 ESL 390-121-DCU1	X1 - X8	+24 V DC (U_S)	IN/OUT B	GND_U_S/ GND_U_L	IN/OUT A	FE / Func. earth

Table 6: Assignment of ports X1 to X8

5 Starting operation

5.1 Downloading and installing the ESI file

An EtherCAT® Slave Information File (ESI) file is required for the configuration of a module in the controller. All module variants are supported by one ESI file. You have the option of downloading the EDS file from our website or asking our support team to send it to you. The address of the website is:

http://www.beldensolutions.com/de/Service/Downloadcenter/Software_Lumberg

The file for the LioN-P EtherCAT® modules is named:

- LumbergAutomation-LioN-P-Digital-IO.xml

Install the ESI file for the module variant used with the aid of the hardware or network configuration tool of your controller manufacturer.

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

After the installation (TwinCAT® needs a restart, or use the menu bar **TWINCAT** > **EtherCAT Devices** > **Reload Device Descriptions**), the modules are available in the hardware catalogs.

5.2 Reading the MAC addresses

Every module has a unique MAC address assigned by the manufacturer that cannot be changed by the user. The assigned MAC address is printed on the front side of the module.

For EtherCAT® the MAC address has no function. For EoE (Ethernet over EtherCAT®) a virtual MAC address will be assigned to the I/O-module.

5.3 Setting the rotary switches

As the EtherCAT® devices are multiprotocol devices, it's required to set the X100 rotary switch in front of the module to position EC for the EtherCAT® protocol. After the power supply is restored, the modules read the switch settings.

- The X10 and X1 rotary switches are not used for EtherCAT®.
- Only the address setting 979 is used for a factory reset of the device.
- Using the rotary encoding switches, the following settings are possible for LioN-P EtherCAT® modules:

Rotary switch setting	Function
000 (state on delivery)	X100 = 0, Ethernet/IP In the state on delivery, the DHCP and BOOTP functions are activated. The network parameters are initially requested via DHCP requests. If this is not successful, BOOTP requests are used. The network parameters are not saved, but the integrated web server can be used to save them.
000 (network parameters already saved)	X100 = 0, Ethernet/IP The network parameters last saved are used (IP address, subnet mask, gateway address, DHCP on/off, BOOTP on/off).
4xx (EC x x)	The EtherCAT protocol will be started after power-up, if no other protocol setting is stored in the non volatile memory of the module. (state on delivery) If the device was used for another protocol before, a factory reset is required before the EtherCAT protocol can be used.
979	The device performs a reset to the factory settings. The network parameters are also reset to the default values. Communication is not possible in this operation mode.

Table 7: Setting options of the rotary encoding switches for LioN-P modules

For additional multiprotocol information refer to the manual: **Manual_LioN_P_Multiprotocol_EN.pdf**

5.4 Configuring the controller

5.4.1 PDO Assignments

The module supports different PDO assignment for input and output data.There are assignments for bit or byte access and with or without diagnosis data attached to the input data (TxPDO, I/O-module to EtherCAT® controller. By selecting the relevant PDO, you decide your preferred data content. The modules provide the following PDO assignments:

5.4.2 16DI modules: 0980 ESL 391-1x1

The PDO's 0x1A00 or 0x1A01 can be selected for the input data of the module.

5.4.2.1 PDO 0x1A00, Input data in byte format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A00	2	0x6000:01	1.0	USINT	Port X1A ... X4B (refer to Table 9)
		0x6000:02	1.0	USINT	Port X5A ... X8B (refer to Table 9)

Table 8: Input data in byte format

Content of Port X1A ... X4B and Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x6000:01	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
0x6000:02	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 9: Bit assignment for input data in byte format

- X1A ... X8A: Input status, channel A (contact pin 4) of slots X1 to X8
- X1B ... X8B: Input status, channel B (contact pin 2) of slots X1 to X8

5.4.2.2 PDO 0x1A01, Input data in bit format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A01	2	0x6020:01	0.1	BIT	Port X1A
		0x6020:02	0.1	BIT	Port X1B
		0x6020:03	0.1	BIT	Port X2A
		0x6020:04	0.1	BIT	Port X2B
		0x6020:05	0.1	BIT	Port X3A
		0x6020:06	0.1	BIT	Port X3B
		0x6020:07	0.1	BIT	Port X4A
		0x6020:08	0.1	BIT	Port X4B
		0x6020:09	0.1	BIT	Port X5A
		0x6020:0A	0.1	BIT	Port X5B
		0x6020:0B	0.1	BIT	Port X6A
		0x6020:0C	0.1	BIT	Port X6B
		0x6020:0D	0.1	BIT	Port X7A
		0x6020:0E	0.1	BIT	Port X7B
		0x6020:0F	0.1	BIT	Port X8A
		0x6020:10	0.1	BIT	Port X8B

Table 10: Input data in bit format

The PDO's 0x1A00 or 0x1A01 can be combined flexible with the PDO's 0x1A04 (Error Register) and/or 0x1A05 (Diagnostic Register).

5.4.2.3 PDO 0x1A04, Error register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A04	1	0x1001:01	1.0	USINT	Error Register

Table 11: Error Register

B7	B6	B5	B4	B3	B2	B1	B0	Error description
0	0	0	0	0	0	0	0	No error
-	0	0	0	0	-	1	1	Output overload error, MI-SCS
-	0	0	0	0	1	-	1	Voltage error, MI-LVS
1	0	0	0	0	-	-	1	Additional function forcing, MI-FC
1	0	0	0	0	-	-	1	Additional function device diagn., MI-IME

Table 12: Content of error register

Attention: **-** : Can be 0 or 1, if more than one error is active at the same time.

5.4.2.4 PDO 0x1A04, Diagnostic register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A05	4	0x2001:01	4.0	UDINT	Diagnostic Register

Table 13: Diagnostic Register

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	MI-IME	MI-FC	0	0	0	MI-SCS	0	MI-LVS
Byte 2	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 3	0	0	0	0	0	0	0	0
Byte 4	0	0	0	0	0	0	0	0

Table 14: Content of diagnostic register

TwinCAT representation as UDINT: 0x Byte 4 - Byte 3 - Byte 2 - Byte 1

Key

- MI-LVS: Module information byte – Low voltage of system/sensor power supply
- MI-SCS: Module information byte – Sensor short-circuit at an M12 slot
- MI-FC: Module information byte – Forcing active
- MI-IME Module information byte – Internal module error
- SCS-X1 ... SCS-X8: Sensor short-circuit at slot X1 to X8

5.4.3 16DO modules: 0980 ESL 392-1x1

The PDO's 0x1600 or 0x1601 can be selected for controlling the outputs of the module.

5.4.3.1 PDO 0x1600, Output data in byte format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1600	2	0x6200:01	1.0	USINT	Port X1A ... X4B (refer to Table 35)
		0x6200:02	1.0	USINT	Port X5A ... X8B (refer to Table 35)

Table 15: Output data in byte format

Content of Port X1A ... X4B and Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x6200:01	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
0x6200:02	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 16: Bit assignment for output data in byte format

- X1A ... X8A: Output data, channel A (contact pin 4) of slots X1 to X8
- X1B ... X8B: Output data, channel B (contact pin 2) of slots X1 to X8

5.4.3.2 PDO 0x1601, Output data in bit format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1601	2	0x6220:01	0.1	BIT	Port X1A
		0x6220:02	0.1	BIT	Port X1B
		0x6220:03	0.1	BIT	Port X2A
		0x6220:04	0.1	BIT	Port X2B
		0x6220:05	0.1	BIT	Port X3A
		0x6220:06	0.1	BIT	Port X3B
		0x6220:07	0.1	BIT	Port X4A
		0x6220:08	0.1	BIT	Port X4B
		0x6220:09	0.1	BIT	Port X5A
		0x6220:0A	0.1	BIT	Port X5B
		0x6220:0B	0.1	BIT	Port X6A
		0x6220:0C	0.1	BIT	Port X6B
		0x6220:0D	0.1	BIT	Port X7A
		0x6220:0E	0.1	BIT	Port X7B
		0x6220:0F	0.1	BIT	Port X8A
		0x6220:10	0.1	BIT	Port X8B

Table 17: Output data in bit format

For the input data direction (TxPDO of the device) the following flexible selectable PDO's are available:

5.4.3.3 PDO 0x1A02, Output status in byte format

This object delivers (optional selectable) the real outputs status as input data (TxPDO) to the controller (Output Mirror):

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A00	2	0x2200:01	1.0	USINT	Port X1A ... X4B (refer to Table 19)
		0x2200:02	1.0	USINT	Port X5A ... X8B (refer to Table 19)

Table 18: Output status in byte format

Content of Port X1A ... X4B and Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x2200:01	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
0x2200:02	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 19: Bit assignment for output status in byte format

- X1A ... X8A: Output status, channel A (contact pin 4) of slots X1 to X8
- X1B ... X8B: Output status, channel B (contact pin 2) of slots X1 to X8

5.4.3.4 PDO 0x1A03, Output status in bit format

This object delivers (optional selectable) the real outputs status as input data (TxPDO) to the controller (Output Mirror):

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A03	2	0x2020:01	0.1	BIT	Port X1A
		0x2020:02	0.1	BIT	Port X1B
		0x2020:03	0.1	BIT	Port X2A
		0x2020:04	0.1	BIT	Port X2B
		0x2020:05	0.1	BIT	Port X3A
		0x2020:06	0.1	BIT	Port X3B
		0x2020:07	0.1	BIT	Port X4A
		0x2020:08	0.1	BIT	Port X4B
		0x2020:09	0.1	BIT	Port X5A
		0x2020:0A	0.1	BIT	Port X5B
		0x2020:0B	0.1	BIT	Port X6A
		0x2020:0C	0.1	BIT	Port X6B
		0x2020:0D	0.1	BIT	Port X7A
		0x2020:0E	0.1	BIT	Port X7B
		0x2020:0F	0.1	BIT	Port X8A
		0x2020:10	0.1	BIT	Port X8B

Table 20: Input data in bit format

The PDO's 0x1A02 or 0x1A03 can be combined flexible with the PDO's 0x1A04 (Error Register) and/or 0x1A05 (Diagnostic Register).

5.4.3.5 PDO 0x1A04, Error register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A04	1	0x1001:01	1.0	USINT	Error Register

Table 21: Error Register

B7	B6	B5	B4	B3	B2	B1	B0	Error description
0	0	0	0	0	0	0	0	No error
-	0	0	0	0	-	1	1	Output overload error, MI-SCS
-	0	0	0	0	1	-	1	Voltage error, MI-LVS
1	0	0	0	0	-	-	1	Additional function forcing, MI-FC
1	0	0	0	0	-	-	1	Additional function device diagn., MI-IME

Table 22: Content of error register

Attention: **-** : Can be 0 or 1, if more than one error is active at the same time.

5.4.3.6 PDO 0x1A04, Diagnostic register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A05	4	0x2001:01	4.0	UDINT	Diagnostic Register

Table 23: Diagnostic Register

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	MI-IME	MI-FC	0	0	MI-SCA	0	MI-LVA	MI-LVS
Byte 2	0	0	0	0	0	0	0	0
Byte 3	CE-X4B	CE-X4A	CE-X3B	CE-X3A	CE-X2B	CE-X2A	CE-X1B	CE-X1A
Byte 4	CE-X8B	CE-X8A	CE-X7B	CE-X7A	CE-X6B	CE-X6A	CE-X5B	CE-X5A

Table 24: Content of diagnostic register

TwinCAT representation as UDINT: 0x Byte 4 - Byte 3 - Byte 2 - Byte 1

Key

- MI-LVS: Module information byte – Low voltage of system/sensor power supply
- MI-LVA: Module information byte – Low voltage of actuator power supply
- MI-SCA: Module information byte – Actuator short-circuit
- MI-FC: Module information byte – Forcing activ
- MI-IME Module information byte – Internal module error
- CE-X1A ... CE-X8A: Channel error, channel A (contact pin 4) of slots X1 to X8
- CE-X1B ... CE-X8B: Channel error, channel B (contact pin 2) of slots X1 to X8

5.4.4 8DI/8DO modules: 0980 ESL 393-1x1

The PDO 0x1A00 or 0x1A01 can be selected for the input data of the module.

The PDO 0x1600 or 0x1601 can be selected for controlling the outputs of the module.

5.4.4.1 PDO 0x1A00, Input data in byte format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A00	2	0x6000:01	1.0	USINT	Port X1A ... X4B (refer to Table 26)

Table 25: Input data in byte format

Content of Port X1A ... X4B and Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x6000:01	X4B	X4A	X3B	X3A	X2B	X2A	X1B	X1A
0x6000:02	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 26: Bit assignment for input data in byte format

- X1A ... X8A: Input status, channel A (contact pin 4) of slots X1 to X8
- X1B ... X8B: Input status, channel B (contact pin 2) of slots X1 to X8

5.4.4.2 PDO 0x1A01, Input data in bit format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A01	2	0x6020:01	0.1	BIT	Port X1A
		0x6020:02	0.1	BIT	Port X1B
		0x6020:03	0.1	BIT	Port X2A
		0x6020:04	0.1	BIT	Port X2B
		0x6020:05	0.1	BIT	Port X3A
		0x6020:06	0.1	BIT	Port X3B
		0x6020:07	0.1	BIT	Port X4A
		0x6020:08	0.1	BIT	Port X4B
		0x6020:09	0.1	BIT	Port X5A
		0x6020:0A	0.1	BIT	Port X5B
		0x6020:0B	0.1	BIT	Port X6A
		0x6020:0C	0.1	BIT	Port X6B
		0x6020:0D	0.1	BIT	Port X7A
		0x6020:0E	0.1	BIT	Port X7B
		0x6020:0F	0.1	BIT	Port X8A
		0x6020:10	0.1	BIT	Port X8B

Table 27: Input data in bit format

For the input data direction (TxPDO of the device) the following flexible selectable PDO's are available:

5.4.4.3 PDO 0x1A02, Output status in byte format

This object delivers (optional selectable) the real outputs status as input data to the controller (Output Mirror):

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A00	2	0x2200:01	1.0	USINT	Port X1A ... X4B (refer to Table 29)

Table 28: Output status in byte format

Content of Port X1A ... X4B and Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x2200:01	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 29: Bit assignment for output status in byte format

- X5A ... X8A: Output status, channel A (contact pin 4) of slots X5 to X8
- X5B ... X8B: Output status, channel B (contact pin 2) of slots X5 to X8

5.4.4.4 PDO 0x1A03, Output status in bit format

This object delivers (optional selectable) the real outputs status as input data to the EtherCAT controller (Output Mirror):

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A03	1	0x2020:01	0.1	BIT	Port X5A
		0x2020:02	0.1	BIT	Port X5B
		0x2020:03	0.1	BIT	Port X6A
		0x2020:04	0.1	BIT	Port X6B
		0x2020:05	0.1	BIT	Port X7A
		0x2020:06	0.1	BIT	Port X7B
		0x2020:07	0.1	BIT	Port X8A
		0x2020:08	0.1	BIT	Port X8B

Table 30: Input data in bit format

The PDO's 0x1A01 or 0x1A02, 0x1A02 or 0x1A03 can be combined flexible with the PDO's 0x1A04 (Error Register) and/or 0x1A05 (Diagnostic Register)

5.4.4.5 PDO 0x1A04, Error register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A04	1	0x1001:01	1.0	USINT	Error Register

Table 31: Error Register

B7	B6	B5	B4	B3	B2	B1	B0	Error description
0	0	0	0	0	0	0	0	No error
-	0	0	0	0	-	1	1	Output overload error, MI-SCS or MI-SCA
-	0	0	0	0	1	-	1	Voltage error, MI-LVS
1	0	0	0	0	-	-	1	Additional function forcing, MI-FC
1	0	0	0	0	-	-	1	Additional function device diagn., MI-IME

Table 32: Content of error register

Attention: **-** : Can be 0 or 1, if more than one error is active at the same time.

5.4.4.6 PDO 0x1A04, Diagnostic register

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A05	4	0x2001:01	4.0	UDINT	Diagnostic Register

Table 33: Diagnostic Register

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

Table 34: Content of diagnostic register

TwinCAT representation as UDINT: 0x Byte 4 - Byte 3 - Byte 2 - Byte 1

Key

- MI-LVS: Module information byte – Low voltage of system/sensor power supply
- MI-LVA: Module information byte – Low voltage of actuator power supply
- MI-SCS: Module information byte – Sensor short-circuit at an M12 slot
- MI-SCA: Module information byte – Actuator short-circuit
- MI-PRM: Module information byte – Parameter error
- MI-FC: Module information byte – Forcing activ
- MI-IME Module information byte – Internal module error
- SCS-X1 ... SCS-X8: Sensor short-circuit at slot X1 to X8
- CE-X5A ... CE-X8A: Channel error, channel A (contact pin 4) of slots 5 to X8
- CE-X5B... CE-X8B: Channel error, channel B (contact pin 2) of slots X5 to X8

The PDO's 0x1600 or 0x1601 can be selected for the output data of the module.

5.4.4.7 PDO 0x1600, Output data in byte format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1600	2	0x6200:01	1.0	USINT	Port X5A ... X8B (Table 36: Bit assignment for output data in byte format on page 40)

Table 35: Output data in byte format

Content of Port X5A ... X8B:

Index	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x6200:01	X8B	X8A	X7B	X7A	X6B	X6A	X5B	X5A

Table 36: Bit assignment for output data in byte format

- X5A ... X8A: Output data, channel A (contact pin 4) of slots X5 to X8
- X5B ... X8B: Output data, channel B (contact pin 2) of slots X5 to X8

5.4.4.8 PDO 0x1601, Output data in bit format

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1601	1	0x622:01	0.1	BIT	Port X5A
		0x622:02	0.1	BIT	Port X5B
		0x622:03	0.1	BIT	Port X6A
		0x622:04	0.1	BIT	Port X6B
		0x622:05	0.1	BIT	Port X7A
		0x622:06	0.1	BIT	Port X7B
		0x622:07	0.1	BIT	Port X8A
		0x622:08	0.1	BIT	Port X8B

Table 37: Output data in bit format

5.4.5 16DIO modules: 0980 ESL 390-1x1

The 16DI/DO universal modules supporting different preconfigured I/O profiles. For this “universal” module every I/O channel can be used as input **and** output for the 16DI/DO profile. If an I/O channel should be used as input, the PLC programmer should not set the appropriate output bit. With the preconfigured alternative profiles, this misuse can be reduced by using e.g. the 16DI, 16DO or 8DI/8DO profiles. In this profiles the I/O channels are set to input **or** output. The available profiles can be used to adapt the I/O-data of the device to standard I/O-modules on the market. For this reasons all profiles support additionally a flexible I/O bit mapping. For using this fexible I/O-mapping, refer to the “Device parameter” chapter with the sections IO Direction Configuration (for 16DIO modules w/wo DCU) on page 67 and I/O Mapping Configuration (for 16DIO modules w/wo DCU) on page 68.

The following table gives an overwiew of the availabale I/O profiles and the related PDO's in **byte** format:

Profile	Format	PDO			PDO Content			
		Type	Index	Size	Index	Size	Type	Name
16DI/DO	Byte	Input	0x1A00	2	0x6000:01	1.0	USINT	Physical Inputs 0 ... 7
					0x6000:02	1.0	USINT	Physical Inputs 8 ... 15
		Output	0x1600	2	0x6000:01	1.0	USINT	Physical Outputs 0 ... 7
					0x6000:02	1.0	USINT	Physical Outputs 8 ... 15
16DI	Byte	Input	0x1A00	2	0x6000:01	1.0	USINT	Physical Inputs 0 ... 7
					0x6000:02	1.0	USINT	Physical Inputs 8 ... 15
16DO	Byte	Output	0x1600	2	0x6200:01	1.0	USINT	Physical Outputs 0 ... 7
					0x6200:02	1.0	USINT	Physical Outputs 8 ... 15
8DI/DO	Byte	Input	0x1A10	1	0x6000:01	1.0	USINT	Physical Inputs 0 ... 7
		Output	0x1610	1	0x6200:01	1.0	USINT	Physical Outputs 0 ... 7
8DI	Byte	Input	0x1A10	1	0x6000:01	1.0	USINT	Physical Inputs 0 ... 7
8DO	Byte	Output	0x1610	1	0x6200:01	1.0	USINT	Physical Outputs 0 ... 7
8DI/8DO	Byte	Input	0x1A10	1	0x6000:01	1.0	USINT	Physical Inputs 0 ... 7
		Output	0x1610	1	0x6200:01	1.0	USINT	Physical Outputs 0 ... 7

Table 38: 16DIO profiles in byte format

The following table gives an overwiew of the availabale I/O profiles and the related PDO's in **bit** format:

Profile	Format	PDO			PDO Content			
		Type	Index	Size	Index	Size	Type	Name
16DI/DO	Bit	Input	0x1A01	2	0x6020:01	0.1	BIT	Physical Input 0
					:	:	:	:
					0x6020:10	0.1	BIT	Physical Input 15
		Output	0x1601	2	0x6220:01	0.1	BIT	Physical Output 0
					:	:	:	:
					0x6220:10	0.1	BIT	Physical Output 15
16DI	Bit	Input	0x1A01	2	0x6020:01	0.1	BIT	Physical Input 0
					:	:	:	:
					0x6020:10	0.1	BIT	Physical Input 15
16DO	Bit	Output	0x1601	2	0x6220:01	0.1	BIT	Physical Output 0
					:	:	:	:
					0x6220:10	0.1	BIT	Physical Output 15
8DI/DO	Bit	Input	0x1A11	1	0x6020:01	0.1	BIT	Physical Input 0
					:	:	:	:
					0x6020:08	0.1	BIT	Physical Input 7
		Output	0x1611	1	0x6220:01	0.1	BIT	Physical Output 0
					:	:	:	:
					0x6220:08	0.1	BIT	Physical Output 7
8DI	Bit	Input	0x1A11	1	0x6020:01	0.1	BIT	Physical Input 0
					:	:	:	:
					0x6020:08	0.1	BIT	Physical Input 7
8DO	Bit	Output	0x1611	1	0x6220:01	0.1	BIT	Physical Output 0
					:	:	:	:
					0x6220:08	0.1	BIT	Physical Output 7

8DI/8DO	Bit	Input	0x1A11	1	0x6020:01	0.1	BIT	Physical Input 0
					:	:	:	:
					0x6020:08	0.1	BIT	Physical Input 7
		Output	0x1611	1	0x6220:01	0.1	BIT	Physical Output 0
					:	:	:	:
					0x6220:08	0.1	BIT	Physical Output 7

Table 39: 16DIO profiles in bit format

The following tables showing the process data mapping for all profiles with the default I/O direction and mapping parameters.

- X1A ... X8A: Input status, channel A (contact pin 4) of slots X1 to X8
- X1B ... X8B: Input status, channel B (contact pin 2) of slots X1 to X8

5.4.5.1 PDO's 0x1A00/0x1600, 16DI/DO with data in byte format

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: 0x1A00		Output PDO: 0x1600	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	Physical Inputs 0 ... 7	0	Physical Outputs 0 ... 7	0
0x2304:02	1	X1B	Physical Inputs 0 ... 7	1	Physical Outputs 0 ... 7	1
0x2304:03	2	X2A	Physical Inputs 0 ... 7	2	Physical Outputs 0 ... 7	2
0x2304:04	3	X2B	Physical Inputs 0 ... 7	3	Physical Outputs 0 ... 7	3
0x2304:05	4	X3A	Physical Inputs 0 ... 7	4	Physical Outputs 0 ... 7	4
0x2304:06	5	X3B	Physical Inputs 0 ... 7	5	Physical Outputs 0 ... 7	5
0x2304:07	6	X4A	Physical Inputs 0 ... 7	6	Physical Outputs 0 ... 7	6
0x2304:08	7	X4B	Physical Inputs 0 ... 7	7	Physical Outputs 0 ... 7	7
0x2304:09	8	X5A	Physical Inputs 8 ... 15	0	Physical Outputs 8 ... 15	0
0x2304:0A	9	X5B	Physical Inputs 8 ... 15	1	Physical Outputs 8 ... 15	1
0x2304:0B	10	X6A	Physical Inputs 8 ... 15	2	Physical Outputs 8 ... 15	2
0x2304:0C	11	X6B	Physical Inputs 8 ... 15	3	Physical Outputs 8 ... 15	3
0x2304:0D	12	X7A	Physical Inputs 8 ... 15	4	Physical Outputs 8 ... 15	4
0x2304:0E	13	X7B	Physical Inputs 8 ... 15	5	Physical Outputs 8 ... 15	5
0x2304:0F	14	X8A	Physical Inputs 8 ... 15	6	Physical Outputs 8 ... 15	6
0x2304:10	15	X8B	Physical Inputs 8 ... 15	7	Physical Outputs 8 ... 15	7

Table 40: 16DI/DO PDO with Input/Output data in byte format

5.4.5.2 PDO 0x1A0, 16DI with data in byte format

Default I/O Direction parameter for all I/O ports: **Input**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: 0x1A00		Output PDO: -	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	Physical Inputs 0 ... 7	0	-	-
0x2304:02	1	X1B	Physical Inputs 0 ... 7	1	-	-
0x2304:03	2	X2A	Physical Inputs 0 ... 7	2	-	-
0x2304:04	3	X2B	Physical Inputs 0 ... 7	3	-	-
0x2304:05	4	X3A	Physical Inputs 0 ... 7	4	-	-
0x2304:06	5	X3B	Physical Inputs 0 ... 7	5	-	-
0x2304:07	6	X4A	Physical Inputs 0 ... 7	6	-	-
0x2304:08	7	X4B	Physical Inputs 0 ... 7	7	-	-
0x2304:09	8	X5A	Physical Inputs 8 ... 15	0	-	-
0x2304:0A	9	X5B	Physical Inputs 8 ... 15	1	-	-
0x2304:0B	10	X6A	Physical Inputs 8 ... 15	2	-	-
0x2304:0C	11	X6B	Physical Inputs 8 ... 15	3	-	-
0x2304:0D	12	X7A	Physical Inputs 8 ... 15	4	-	-
0x2304:0E	13	X7B	Physical Inputs 8 ... 15	5	-	-
0x2304:0F	14	X8A	Physical Inputs 8 ... 15	6	-	-
0x2304:10	15	X8B	Physical Inputs 8 ... 15	7	-	-

Table 41: 16DI PDO with Input data in byte format

5.4.5.3 PDO 0x1600, 16DO with data in byte format

Default I/O Direction parameter for all I/O ports: **Output**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: -		Output PDO: 0x1600	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	-	-	Physical Outputs 0 ... 7	0
0x2304:02	1	X1B	-	-	Physical Outputs 0 ... 7	1
0x2304:03	2	X2A	-	-	Physical Outputs 0 ... 7	2
0x2304:04	3	X2B	-	-	Physical Outputs 0 ... 7	3
0x2304:05	4	X3A	-	-	Physical Outputs 0 ... 7	4
0x2304:06	5	X3B	-	-	Physical Outputs 0 ... 7	5
0x2304:07	6	X4A	-	-	Physical Outputs 0 ... 7	6
0x2304:08	7	X4B	-	-	Physical Outputs 0 ... 7	7
0x2304:09	8	X5A	-	-	Physical Outputs 8 ... 15	0
0x2304:0A	9	X5B	-	-	Physical Outputs 8 ... 15	1
0x2304:0B	10	X6A	-	-	Physical Outputs 8 ... 15	2
0x2304:0C	11	X6B	-	-	Physical Outputs 8 ... 15	3
0x2304:0D	12	X7A	-	-	Physical Outputs 8 ... 15	4
0x2304:0E	13	X7B	-	-	Physical Outputs 8 ... 15	5
0x2304:0F	14	X8A	-	-	Physical Outputs 8 ... 15	6
0x2304:10	15	X8B	-	-	Physical Outputs 8 ... 15	7

Table 42: 16DI/DO PDO with Output data in byte format

5.4.5.4 PDO's 0x1A10/0x1610, 8DI/DO with data in byte format

Default I/O Direction parameter for all I/O ports: **Input/Output**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: 0x1A10		Output PDO: 0x1610	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	Physical Inputs 0 ... 7	0	Physical Outputs 0 ... 7	0
0x2304:02	Inactive	X1B	-	-	-	-
0x2304:03	1	X2A	Physical Inputs 0 ... 7	1	Physical Outputs 0 ... 7	1
0x2304:04	Inactive	X2B	-	-	-	-
0x2304:05	2	X3A	Physical Inputs 0 ... 7	2	Physical Outputs 0 ... 7	2
0x2304:06	Inactive	X3B	-	-	-	-
0x2304:07	3	X4A	Physical Inputs 0 ... 7	3	Physical Outputs 0 ... 7	3
0x2304:08	Inactive	X4B	-	-	-	-
0x2304:09	4	X5A	Physical Inputs 0 ... 7	4	Physical Outputs 0 ... 7	4
0x2304:0A	Inactive	X5B	-	-	-	-
0x2304:0B	5	X6A	Physical Inputs 0 ... 7	5	Physical Outputs 0 ... 7	5
0x2304:0C	Inactive	X6B	-	-	-	-
0x2304:0D	6	X7A	Physical Inputs 0 ... 7	6	Physical Outputs 0 ... 7	6
0x2304:0E	Inactive	X7B	-	-	-	-
0x2304:0F	7	X8A	Physical Inputs 0 ... 7	7	Physical Outputs 0 ... 7	7
0x2304:10	Inactive	X8B	-	-	-	-

Table 43: 8DI/DO PDO with Input/Output data in byte format

5.4.5.5 PDO 0x1A10, 8DI with data in byte format

Default I/O Direction parameter for all I/O ports: **Input**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: 0x1A10		Output PDO: -	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	Physical Inputs 0 ... 7	0	-	-
0x2304:02	Inactive	X1B	-	-	-	-
0x2304:03	1	X2A	Physical Inputs 0 ... 7	1	-	-
0x2304:04	Inactive	X2B	-	-	-	-
0x2304:05	2	X3A	Physical Inputs 0 ... 7	2	-	-
0x2304:06	Inactive	X3B	-	-	-	-
0x2304:07	3	X4A	Physical Inputs 0 ... 7	3	-	-
0x2304:08	Inactive	X4B	-	-	-	-
0x2304:09	4	X5A	Physical Inputs 0 ... 7	4	-	-
0x2304:0A	Inactive	X5B	-	-	-	-
0x2304:0B	5	X6A	Physical Inputs 0 ... 7	5	-	-
0x2304:0C	Inactive	X6B	-	-	-	-
0x2304:0D	6	X7A	Physical Inputs 0 ... 7	6	-	-
0x2304:0E	Inactive	X7B	-	-	-	-
0x2304:0F	7	X8A	Physical Inputs 0 ... 7	7	-	-
0x2304:10	Inactive	X8B	-	-	-	-

Table 44: 8DI PDO with Input data in byte format

5.4.5.6 PDO 0x1610, 8DO with data in byte format

Default I/O Direction parameter for all I/O ports: **Output**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: -		Output PDO: 0x1610	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	-	-	Physical Outputs 0 ... 7	0
0x2304:02	Inactive	X1B	-	-	-	-
0x2304:03	1	X2A	-	-	Physical Outputs 0 ... 7	1
0x2304:04	Inactive	X2B	-	-	-	-
0x2304:05	2	X3A	-	-	Physical Outputs 0 ... 7	2
0x2304:06	Inactive	X3B	-	-	-	-
0x2304:07	3	X4A	-	-	Physical Outputs 0 ... 7	3
0x2304:08	Inactive	X4B	-	-	-	-
0x2304:09	4	X5A	-	-	Physical Outputs 0 ... 7	4
0x2304:0A	Inactive	X5B	-	-	-	-
0x2304:0B	5	X6A	-	-	Physical Outputs 0 ... 7	5
0x2304:0C	Inactive	X6B	-	-	-	-
0x2304:0D	6	X7A	-	-	Physical Outputs 0 ... 7	6
0x2304:0E	Inactive	X7B	-	-	-	-
0x2304:0F	7	X8A	-	-	Physical Outputs 0 ... 7	7
0x2304:10	Inactive	X8B	-	-	-	-

Table 45: 8DO PDO with Output data in byte format

5.4.5.7 PDO's 0x1A10/0x1610, 8DI/8DO with data in byte format

Default I/O Direction parameter for all I/O ports: **Input/Output**.

Mapping Parameter (Default values, Reference)			Process data			
Index : Byte	Value	Port	Input PDO: 0x1A10		Output PDO: 0x1610	
			Byte	Bit	Byte	Bit
0x2304:01	0	X1A	Physical Inputs 0 ... 7	0	-	-
0x2304:02	1	X1B	Physical Inputs 0 ... 7	1	-	1
0x2304:03	2	X2A	Physical Inputs 0 ... 7	2	-	2
0x2304:04	3	X2B	Physical Inputs 0 ... 7	3	-	3
0x2304:05	4	X3A	Physical Inputs 0 ... 7	4	-	4
0x2304:06	5	X3B	Physical Inputs 0 ... 7	5	-	5
0x2304:07	6	X4A	Physical Inputs 0 ... 7	6	-	6
0x2304:08	7	X4B	Physical Inputs 0 ... 7	7	-	-
0x2304:09	0	X5A	-	-	Physical Outputs 0 ... 7	0
0x2304:0A	1	X5B	-	-	Physical Outputs 0 ... 7	1
0x2304:0B	2	X6A	-	-	Physical Outputs 0 ... 7	2
0x2304:0C	3	X6B	-	-	Physical Outputs 0 ... 7	3
0x2304:0D	4	X7A	-	-	Physical Outputs 0 ... 7	4
0x2304:0E	5	X7B	-	-	Physical Outputs 0 ... 7	5
0x2304:0F	6	X8A	-	-	Physical Outputs 0 ... 7	6
0x2304:10	7	X8B	-	-	Physical Outputs 0 ... 7	7

Table 46: 8DI/8DO PDO with Input/Output data in byte format

5.4.5.8 PDO's 0x1A01/0x1601, 16DI/DO with data in bit format

Default I/O Direction parameter for all I/O ports: **Input/Output**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: 0x1A01	Output PDO: 0x1601
			Bit	Bit
0x2304:01	0	X1A	Physical Input 0	Physical Output 0
0x2304:02	1	X1B	Physical Input 1	Physical Output 1
0x2304:03	2	X2A	Physical Input 2	Physical Output 2
0x2304:04	3	X2B	Physical Input 3	Physical Output 3
0x2304:05	4	X3A	Physical Input 4	Physical Output 4
0x2304:06	5	X3B	Physical Input 5	Physical Output 5
0x2304:07	6	X4A	Physical Input 6	Physical Output 6
0x2304:08	7	X4B	Physical Input 7	Physical Output 7
0x2304:09	8	X5A	Physical Input 8	Physical Output 8
0x2304:0A	9	X5B	Physical Input 9	Physical Output 9
0x2304:0B	10	X6A	Physical Input 10	Physical Output 10
0x2304:0C	11	X6B	Physical Input 11	Physical Output 11
0x2304:0D	12	X7A	Physical Input 12	Physical Output 12
0x2304:0E	13	X7B	Physical Input 13	Physical Output 13
0x2304:0F	14	X8A	Physical Input 14	Physical Output 14
0x2304:10	15	X8B	Physical Input 15	Physical Output 15

Table 47: 16DI/DO PDO with Input/Output data in bit format

5.4.5.9 PDO's 0x1A01, 16DI with data in bit format

Default I/O Direction parameter for all I/O ports: **Input**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: 0x1A01	Output PDO: -
			Bit	Bit
0x2304:01	0	X1A	Physical Input 0	-
0x2304:02	1	X1B	Physical Input 1	-
0x2304:03	2	X2A	Physical Input 2	-
0x2304:04	3	X2B	Physical Input 3	-
0x2304:05	4	X3A	Physical Input 4	-
0x2304:06	5	X3B	Physical Input 5	-
0x2304:07	6	X4A	Physical Input 6	-
0x2304:08	7	X4B	Physical Input 7	-
0x2304:09	8	X5A	Physical Input 8	-
0x2304:0A	9	X5B	Physical Input 9	-
0x2304:0B	10	X6A	Physical Input 10	-
0x2304:0C	11	X6B	Physical Input 11	-
0x2304:0D	12	X7A	Physical Input 12	-
0x2304:0E	13	X7B	Physical Input 13	-
0x2304:0F	14	X8A	Physical Input 14	-
0x2304:10	15	X8B	Physical Input 15	-

Table 48: 16DI PDO with Input data in bit format

5.4.5.10 PDO 0x1601, 16DO with data in bit format

Default I/O Direction parameter for all I/O ports: **Output**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: -	Output PDO: 0x1601
			Bit	Bit
0x2304:01	0	X1A	-	Physical Output 0
0x2304:02	1	X1B	-	Physical Output 1
0x2304:03	2	X2A	-	Physical Output 2
0x2304:04	3	X2B	-	Physical Output 3
0x2304:05	4	X3A	-	Physical Output 4
0x2304:06	5	X3B	-	Physical Output 5
0x2304:07	6	X4A	-	Physical Output 6
0x2304:08	7	X4B	-	Physical Output 7
0x2304:09	8	X5A	-	Physical Output 8
0x2304:0A	9	X5B	-	Physical Output 9
0x2304:0B	10	X6A	-	Physical Output 10
0x2304:0C	11	X6B	-	Physical Output 11
0x2304:0D	12	X7A	-	Physical Output 12
0x2304:0E	13	X7B	-	Physical Output 13
0x2304:0F	14	X8A	-	Physical Output 14
0x2304:10	15	X8B	-	Physical Output 15

Table 49: 16DO PDO with Output data in bit format

5.4.5.11 PDO's 0x1A11/0x1611, 8DI/DO with data in bit format

Default I/O Direction parameter for all I/O ports: **Input/Output**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: 0x1A11	Output PDO: 0x1611
			Bit	Bit
0x2304:01	0	X1A	Physical Input 0	Physical Output 0
0x2304:02	Inactive	X1B	-	-
0x2304:03	1	X2A	Physical Input 1	Physical Output 1
0x2304:04	Inactive	X2B	-	-
0x2304:05	2	X3A	Physical Input 2	Physical Output 2
0x2304:06	Inactive	X3B	-	-
0x2304:07	3	X4A	Physical Input 3	Physical Output 3
0x2304:08	Inactive	X4B	-	-
0x2304:09	4	X5A	Physical Input 4	Physical Output 4
0x2304:0A	Inactive	X5B	-	-
0x2304:0B	5	X6A	Physical Input 5	Physical Output 5
0x2304:0C	Inactive	X6B	-	-
0x2304:0D	6	X7A	Physical Input 6	Physical Output 6
0x2304:0E	Inactive	X7B	-	-
0x2304:0F	7	X8A	Physical Input 7	Physical Output 7
0x2304:10	Inactive	X8B	-	-

Table 50: 8DI/DO PDO with Input/Output data in bit format

5.4.5.12 PDO 0x1A11, 8DI with data in bit format

Default I/O Direction parameter for all I/O ports: **Input**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: 0x1A11	Output PDO: -
			Bit	Bit
0x2304:01	0	X1A	Physical Input 0	-
0x2304:02	Inactive	X1B	-	-
0x2304:03	1	X2A	Physical Input 1	-
0x2304:04	Inactive	X2B	-	-
0x2304:05	2	X3A	Physical Input 2	-
0x2304:06	Inactive	X3B	-	-
0x2304:07	3	X4A	Physical Input 3	-
0x2304:08	Inactive	X4B	-	-
0x2304:09	4	X5A	Physical Input 4	-
0x2304:0A	Inactive	X5B	-	-
0x2304:0B	5	X6A	Physical Input 5	-
0x2304:0C	Inactive	X6B	-	-
0x2304:0D	6	X7A	Physical Input 6	-
0x2304:0E	Inactive	X7B	-	-
0x2304:0F	7	X8A	Physical Input 7	-
0x2304:10	Inactive	X8B	-	-

Table 51: 8DI PDO with Input data in bit format

5.4.5.13 PDO 0x1611, 8DO with data in bit format

Default I/O Direction parameter for all I/O ports: **Output**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	Value	Port	Input PDO: -	Output PDO: 0x1611
			Bit	Bit
0x2304:01	0	X1A	-	Physical Output 0
0x2304:02	Inactive	X1B	-	-
0x2304:03	1	X2A	-	Physical Output 1
0x2304:04	Inactive	X2B	-	-
0x2304:05	2	X3A	-	Physical Output 2
0x2304:06	Inactive	X3B	-	-
0x2304:07	3	X4A	-	Physical Output 3
0x2304:08	Inactive	X4B	-	-
0x2304:09	4	X5A	-	Physical Output 4
0x2304:0A	Inactive	X5B	-	-
0x2304:0B	5	X6A	-	Physical Output 5
0x2304:0C	Inactive	X6B	-	-
0x2304:0D	6	X7A	-	Physical Output 6
0x2304:0E	Inactive	X7B	-	-
0x2304:0F	7	X8A	-	Physical Output 7
0x2304:10	Inactive	X8B	-	-

Table 52: 8DO PDO with Output data in bit format

5.4.5.14 PDO's 0x1A11/0x1611, 8DI/8DO with data in bit format

Default I/O Direction parameter for all I/O ports: **Input/Output**.

Mapping Parameter (Default values, Reference)			Process data	
Index : Byte	**Value**	**Port**	**Input PDO: 0x1A11**	**Output PDO: 0x1611**
			Bit	**Bit**
0x2304:01	0	X1A	Physical Input 0	-
0x2304:02	1	X1B	Physical Input 1	-
0x2304:03	2	X2A	Physical Input 2	-
0x2304:04	3	X2B	Physical Input 3	-
0x2304:05	4	X3A	Physical Input 4	-
0x2304:06	5	X3B	Physical Input 5	-
0x2304:07	6	X4A	Physical Input 6	-
0x2304:08	7	X4B	Physical Input 7	-
0x2304:09	8	X5A	-	Physical Output 0
0x2304:0A	9	X5B	-	Physical Output 1
0x2304:0B	10	X6A	-	Physical Output 2
0x2304:0C	11	X6B	-	Physical Output 3
0x2304:0D	12	X7A	-	Physical Output 4
0x2304:0E	13	X7B	-	Physical Output 5
0x2304:0F	14	X8A	-	Physical Output 6
0x2304:10	15	X8B	-	Physical Output 7

Table 53: 8DI/8DO PDO with Input/Output data in bit format

5.4.5.15 PDO 0x1A04, Error register

The PDO's 0x1A00, 0x1A01, 0x1A10 or 0x1A11 can be combined flexible with the PDO's 0x1A04 (Error register) and/or 0x1A05 (Diagnosis register).

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A04	1	0x1001:01	1.0	USINT	Error Register

Table 54: Error register

B7	B6	B5	B4	B3	B2	B1	B0	Error description
0	0	0	0	0	0	0	0	No error
-	0	0	0	0	-	1	1	Output overload error, MI-SCS or MI-SCA
-	0	0	0	0	1	-	1	Voltage error, MI-LVS
1	0	0	0	0	-	-	1	Additional function parameter error, MI-PRM
1	0	0	0	0	-	-	1	Additional function forcing, MI-FC
1	0	0	0	0	-	-	1	Additional function device diagn., MI-IME

Table 55: Content of error register

Attention: **-** : Can be 0 or 1, if more than one error is active at the same time.

5.4.5.16 PDO 0x1A05, Diagnosis register

The PDO's 0x1A00, 0x1A01, 0x1A10 or 0x1A11 can be combined flexible with the PDO's 0x1A04 (Error register) and/or 0x1A05 (Diagnosis register).

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A05	4	0x2001:01	4.0	UDINT	Diagnostic Register

Table 56: Diagnostic Register

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	MI-IME	MI-FC	MI-PRM	0	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 2	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 3	CE-X4B	CE-X4A	CE-X3B	CE-X3A	CE-X2B	CE-X2A	CE-X1B	CE-X1A
Byte 4	CE-X8B	CE-X8A	CE-X7B	CE-X7A	CE-X6B	CE-X6A	CE-X5B	CE-X5A

Table 57: Content of diagnostic register

TwinCAT representation as UDINT: 0x Byte 4 - Byte 3 - Byte 2 - Byte 1

Key

- MI-LVS: Module information byte – Low voltage of system/sensor power supply
- MI-LVA: Module information byte – Low voltage of actuator power supply
- MI-SCS: Module information byte – Sensor short-circuit at an M12 slot
- MI-SCA: Module information byte – Actuator short-circuit
- MI-PRM: Module information byte – Parameter error
- MI-FC: Module information byte – Forcing activ
- MI-IME Module information byte – Internal module error
- SCS-X1...SCS-X8: Sensor short-circuit at slot X1 to X8
- CE-X5A ... CE-X8A: Channel error, channel A (contact pin 4) of slots 5 to X8
- CE-X5B ... CE-X8B: Channel error, channel B (contact pin 2) of slots X5 to X8

5.4.6 16DIO DCU module: 0980 ESL 390-121-DCU1

The DCU variant of the 0980 ESL 390-121 “Universal” module has the same process data objects as described in chapter 16DIO modules: 0980 ESL 390-1x1 on page 41. The additional DCU specific process data objects are described in the following chapters. For detailed information about the DCU module refer to the manual “Manual_LioNP_ Micro_DCU_EN.pdf”

5.4.6.1 PDO 0x1A06, DCU Inputs (2 Bytes)

These two bytes can be used for DCU applications as additional Input data (TxPDO, EtherCAT® slave to controller). The transfer of the data can be disabled in the Process Data PDO assignment of the engineering tool.

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A06	2	0x6040:01	1.0	USINT	DCU Inputs 0 ... 7
		0x6040:02	1.0	USINT	DCU Inputs 8... 15

Table 58: PDO 0x1A06, DCU Inputs

5.4.6.2 PDO 0x1602, DCU Outputs (2 Bytes)

These two bytes can be used for DCU applications as additional Output data (RxPDO, EtherCAT® controller to slave). The transfer of the data can be disabled in the Process Data PDO assignment of the engineering tool.

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1602	2	0x6240:01	1.0	USINT	DCU Outputs 0 ... 7
		0x6240:02	1.0	USINT	DCU Outputs 8... 15

Table 59: PDO 0x1602, DCU Outputs

5.4.6.3 PDO 0x1A08, DCU Additional Inputs (8 Signed Integer)

These eight Signed Integer values can be used for DCU applications (e.g. for counters) as additional Input data (TxPDO, EtherCAT® slave to controller). The transfer of the data can be disabled in the Process Data PDO assignment of the engineering tool.

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1A08	2	0x6080:01	2.0	INT	DCU Additional Input 0
		0x6080:02	2.0	INT	DCU Additional Input 1
		0x6080:03	2.0	INT	DCU Additional Input 2
		0x6080:04	2.0	INT	DCU Additional Input 3
		0x6080:05	2.0	INT	DCU Additional Input 4
		0x6080:06	2.0	INT	DCU Additional Input 5
		0x6080:07	2.0	INT	DCU Additional Input 6
		0x6080:08	2.0	INT	DCU Additional Input 7

Table 60: PDO 0x1A08, DCU Additional Inputs

5.4.6.4 PDO 0x1604, DCU Additional Outputs (8 Signed Integer)

These eight Signed Integer values can be used for DCU applications as additional output data (RxPDO, EtherCAT® controller to slave). The transfer of the data can be disabled in the Process Data PDO assignment of the engineering tool.

PDO		PDO Content			
Index	Size	Index	Size	Type	Name
0x1604	2	0x6280:01	2.0	INT	DCU Additional Output 0
		0x6280:02	2.0	INT	DCU Additional Output 1
		0x6280:03	2.0	INT	DCU Additional Output 2
		0x6280:04	2.0	INT	DCU Additional Output 3
		0x6280:05	2.0	INT	DCU Additional Output 4
		0x6280:06	2.0	INT	DCU Additional Output 5
		0x6280:07	2.0	INT	DCU Additional Output 6
		0x6280:08	2.0	INT	DCU Additional Output 7

Table 61: PDO 0x1A08, DCU Additional Outputs

5.4.7 Device parameter

The module variants (16DI, 16DO, 8DI/8DO, 16DI/DO) support different parameters. The parameters must be transferred in the startup from the controller to the device. The following blocks of parameters can be adjusted:

5.4.7.1 General device settings

Index (Bit)	Parameter	Default value	Available in variant
0x2300:01	Web interface locked: 0 = false, 1 = true	0	1).
0x2300:02	Force mode locked: 0 = false, 1= true	1	1).
0x2300:03	Disable all emergency messages: 0 = false, 1 = true	0	1).
0x2300:04	Disable UL emergency messages: 0 = false, 1 = true	0	2).
0x2300:05	Disable actuator emergency messages without U_L: 0 = false, 1 = true	0	2).
0x2300:06	DCU Startup: 0 = locked, 1 = disabled, 2 = run	1	3).
0x2300:07	Automatic Output Restart after failure: 0 = false, 1 = true	1	4).

Table 62: Possible parameter options for the general device settings

1). Available in all variants: 16DI, 16DO, 8DI/8DO w/wo DCU, 16DI/DO w/wo DCU
2). Available in variants with outputs: 16DO, 8DI/8DO w/wo DCU, 16DI/16DO w/wo DCU (in profiles with outputs)
3). Available in DCU variants: 8DI/8DO with DCU, 16DI/DO with DCU
4). Available in variants 16DI/DO w/wo DCU

5.4.7.2 Failsafe function (for modules with output channels)

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:

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

Index (Bit)	Parameter
0x2301:01	Failsafe port X1, channel A (pin 4), possible values: 0 … 2
0x2301:02	Failsafe port X1, channel B (pin 4), possible values: 0 … 2
:	:
:	:
0x2301:0F	Failsafe port X8, channel A (pin 4), possible values: 0 … 2
0x2301:10	Failsafe port X8, channel B (pin 4), possible values: 0 … 2

Table 63: Possible failsafe values for module 16DO and 16DIO w/wo DCU and profiles with outputs

Warning: For the **16DIO** module with the profiles 8DI/DO and and 8DI/8DO all 16 possible output channels can be parametrized due to the flexible direction configuration of the I/O ports. Please consider your I/O direction configuration, when you adapt the failsafe parameter.

Index (Bit)	Parameter
0x2301:01	Failsafe port X5, channel A (pin 4), possible values: 0 … 2
0x2301:02	Failsafe port X5, channel B (pin 4), possible values: 0 … 2
:	:
:	:
0x2301:07	Failsafe port X8, channel A (pin 4), possible values: 0 … 2
0x2301:08	Failsafe port X8, channel B (pin 4), possible values: 0 … 2

Table 64: Possible failsafe values for module 8DI/8DO

5.4.7.3 Surveillance timeout (for modules with output channels)

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 states.

The value of the surveillance timeout is 0 to 255 ms. The default 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.

Index (Bit)	Parameter
0x2302:01	Surveillance timeout port X1, channel A (pin 4), possible values: 0 … 255
0x2302:02	Surveillance timeout port X1, channel B (pin 4), possible values: 0 … 255
:	:
:	:
0x2302:0F	Surveillance timeout port X8, channel A (pin 4), possible values: 0 … 255
0x2302:10	Surveillance timeout port X8, channel B (pin 4), possible values: 0 … 255

Table 65: Possible surveillance timeout values for module 16DO and 16DIO w/wo DCU and profiles with outputs

Attention: For the **16DIO** module with the profiles 8DI/DO and 8DI/8DO all 16 possible output channels can be parametrized due to the flexible direction configuration of the I/O ports. Please consider your I/O direction configuration, when you adapt the surveillance timeout parameter.

Index (Bit)	Parameter
0x2302:01	Surveillance timeout port X5, channel A (pin 4), possible values: 0 … 255
0x2302:02	Surveillance timeout port X5, channel B (pin 4), possible values: 0 … 255
:	:
:	:
0x2302:07	Surveillance timeout port X8, channel A (pin 4), possible values: 0 … 255
0x2302:08	Surveillance timeout port X8, channel B (pin 4), possible values: 0 … 255

Table 66: Possible surveillance timeout values for module 8DI/8DO and 8DI/8DO with DCU

5.4.7.4 IO Direction Configuration (for 16DIO modules w/wo DCU)

With these parameters the I/O direction for the I/O channels can be set. The available settings are “Input/Output”=0, “Input”=1 and “Output”=2.

With this “IO Direction Configuration” and the appropriate “IO Mapping Configuration” (described in the next section) the module can be adapted to the most comparable standard I/O modules on the market.

For every profile (16DI/DO, 16DI, 16DO, 8DI/DO, 8DI, 8DO, 8DI/8DO) appropriate default settings are pre-configured. For the most applications is therefore no adaption of this parameters necessary.

Index (Bit)	Parameter
0x2303:01	IO Direction Configuration Port X1A: 0=”Input/Output”, 1=”Input”, 2=”Output”
0x2303:02	IO Direction Configuration Port X1B: 0=”Input/Output”, 1=”Input”, 2=”Output”
:	:
:	:
0x2303:0F	IO Direction Configuration Port X8A: 0=”Input/Output”, 1=”Input”, 2=”Output”
0x2303:10	IO Direction Configuration Port X8B: 0=”Input/Output”, 1=”Input”, 2=”Output”

Table 67: Possible I/O Direction Configuration

The following table gives an overview of the preconfigured I/O direction for every profile: (Some channels are set to inactive, refer for these settings to Table 70: Default I/O Mapping Configuration on page 70).

Index (Port)	16DI/DO	16DI	16DO	8DI/DO	8DI	8DO	8DI/8DO
0x2303:01 (X1A)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:02 (X1B)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:03 (X2A)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:04 (X2B)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:05 (X3A)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:06 (X3B)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:07 (X4A)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:08 (X4B)	Input/Output	Input	Output	Input/Output	Input	Output	Input
0x2303:09 (X5A)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0A (X5B)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0B (X6A)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0C (X6B)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0D (X7A)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0E (X7B)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:0F (X8A)	Input/Output	Input	Output	Input/Output	Input	Output	Output
0x2303:10 (X8B)	Input/Output	Input	Output	Input/Output	Input	Output	Output

Table 68: Default I/O Direction Configuration

Warning: Please choose the “IO Direction Configuration” and “IO Mapping Configuration” carefully, to avoid malfunctions.

5.4.7.5 I/O Mapping Configuration (for 16DIO modules w/wo DCU)

With this parameters the mapping of the physical I/O channels can be set.

- Every output control bit in the output data telegram from the EtherCAT® controller can be mapped to the preferred physical output channel (X1A - X8B). The available settings are channel 0 - 7, 0 - 15 (depending on the I/O profile) or 255 for channel inactive.
- Every physical input input bit to the EtherCAT® controller can be mapped to the preferred bit position in the input data telegram. The available settings are channel 0 - 7, 0 - 15 (0 = X1A - 15 = X8B) or 255 for channel inactive.

- For I/O channels configured as “Input/Output” the mapping configuration is valid for input (producing data) and output (consuming data) direction.

For every profile (16DI/DO, 16DI, 16DO, 8DI/DO, 8DI, 8DO, 8DI/8DO) appropriate default settings are pre-configured. For the most applications is therefore no adaption of this parameters necessary.

Index : Byte	Parameter
0x2304:01	IO Mapping Configuration Port X1A: 0 ... 15=”Process Data Channel 0 ... 15”, 255=”Inactive”
0x2304:02	IO Mapping Configuration Port X1B: 0 ... 15=”Process Data Channel 0 ... 15”, 255=”Inactive”
:	:
:	:
0x2304:0F	IO Mapping Configuration Port X8A: 0 ... 15=”Process Data Channel 0 ... 15”, 255=”Inactive”
0x2304:10	IO Mapping Configuration Port X8B: 0 ... 15=”Process Data Channel 0 ... 15”, 255=”Inactive”

Table 69: Possible I/O Mapping Configuration

The following mapping table gives an overview of the preconfigured I/O port channel (X1A – X8B) relation to the I/O process data channel (0 - 15) for every profile:

Index : Byte (Port)	I/O process data channel (0 - 15), 255 = Inactive / Not available						
	16DI/DO	16DI	16DO	8DI/DO	8DI	8DO	8DI/8DO
0x2304:01 (X1A)	0	0	0	0	0	0	0
0x2304:02 (X1B)	1	1	1	255 (Inactive)	255 (Inactive)	255 (Inactive)	1
0x2304:03 (X2A)	2	2	2	1	1	1	2
0x2304:04 (X2B)	3	3	3	255 (Inactive)	255 (Inactive)	255 (Inactive)	3
0x2304:05 (X3A)	4	4	4	2	2	2	4
0x2304:06 (X3B)	5	5	5	255 (Inactive)	255 (Inactive)	255 (Inactive)	5
0x2304:07 (X4A)	6	6	6	3	3	3	6
0x2304:08 (X4B)	7	7	7	255 (Inactive)	255 (Inactive)	255 (Inactive)	7
0x2304:09 (X5A)	8	8	8	4	4	4	0
0x2304:0A (X5B)	9	9	9	255 (Inactive)	255 (Inactive)	255 (Inactive)	1
0x2304:0B (X6A)	10	10	10	5	5	5	2
0x2304:0C (X6B)	11	11	11	255 (Inactive)	255 (Inactive)	255 (Inactive)	3
0x2304:0D (X7A)	12	12	12	6	6	6	4
0x2304:0E (X7B)	13	13	13	255 (Inactive)	255 (Inactive)	255 (Inactive)	5
0x2304:0F (X8A)	14	14	14	7	7	7	6
0x2304:10 (X8B)	15	15	15	255 (Inactive)	255 (Inactive)	255 (Inactive)	7

Table 70: Default I/O Mapping Configuration

Example for process data in **byte** format:

- 0x2304:11 (X6A) = 10 for the 16DI/DO means, that the input bit of X6A is mapped to producing bit 10 (byte 1 / bit 2) and the output bit of consuming byte 1 / bit 2 will used as output control information for port X6A.

Example for process data in **bit** format:

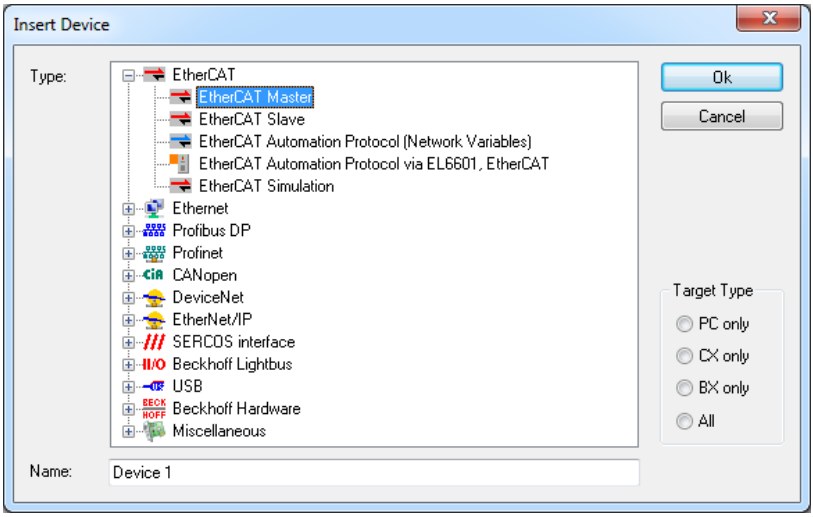
- 0x2304:11 (X6A) = 10 for the 16DI/DO means, that the input bit of X6A is mapped to producing bit 10 and the output bit of consuming bit 10 /will be used as output control information for port X6A.

Warning: Please choose the “IO direction configuration” and “IO Mapping configuration” carefully, to avaoid malfunctions.

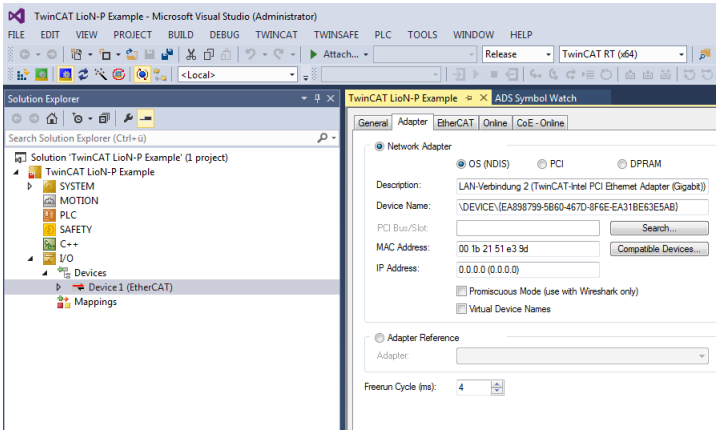
5.4.8 Configuration example with TwinCAT® 3

The configuration and start-up of the modules described on the following pages refers to the TwinCAT® 3 software from Beckhoff Automation GmbH. If you are using a control system from another provider, please consider the related documentation.

1. Install the ESI file of the module family in TwinCat®. For TwinCat® the ESI file normally has to be copied to the installation folder, e.g.: C:\TwinCAT \3.1\Config\Io\EtherCAT After the installation (TwinCAT® needs a restart, or use the menu bar **TwinCAT** > **EtherCAT Devices** > **Reload Device Descriptions**), the modules are available in the hardware catalog.
2. Start TwinCat and open a new project.
3. Change to the “I/O” option in the Solution Explorer in the left workspace window. With a right mouse click on devices choose the option: “Add New Item …” and choose “EtherCAT Master”.



4. If not already done, choose the network adapter and install the driver for EtherCAT real time communication.
5. Click to “Adapter” and “Compatible Devices…” for choosing the driver and installation of the EtherCAT driver.

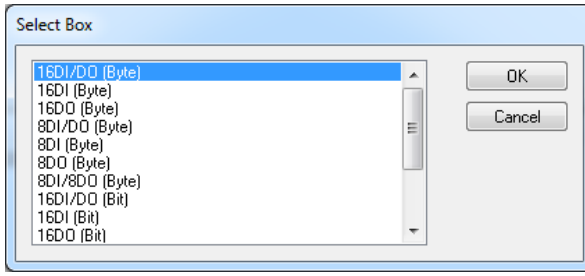


5.4.8.1 Configuration of 0980 ESL 390-1x1 modules

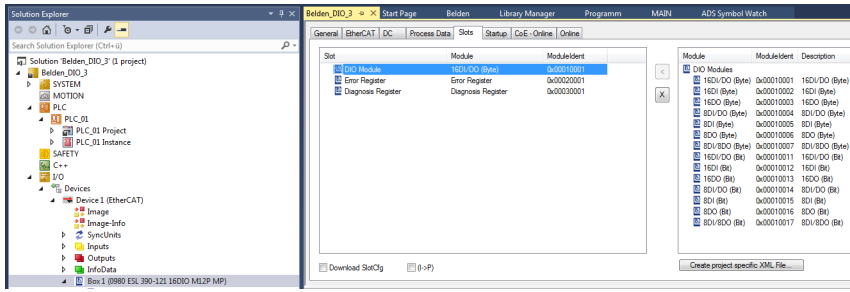
1. Select the I/O device from the hardware catalog: Change to the “I/O” option in the Solution Explorer in the left workspace window. With a right mouse

click on the EtherCAT master (Device 1) and choose the option: “Add New Item …”, select the device and click the OK button.

2. Select the I/O profile.



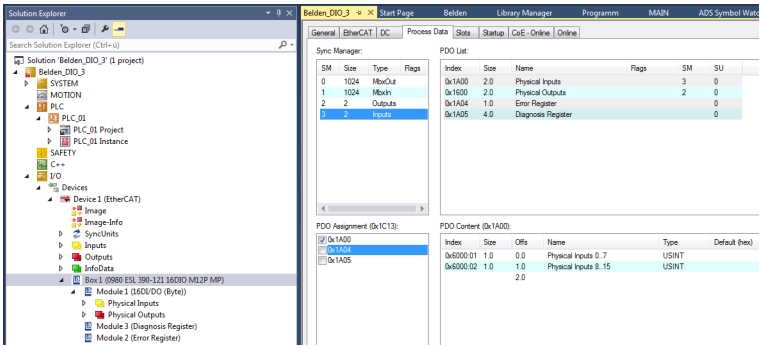
3. Configure the “Slots”: Change to the “Slots” tab if the slot configuration should be changed. E.g the profile can be changed, or the default activation of the Error- and Diagnosis Register can be removed. The Error- and Diagnosis Register settings can also be set within the “Process Data” tab.



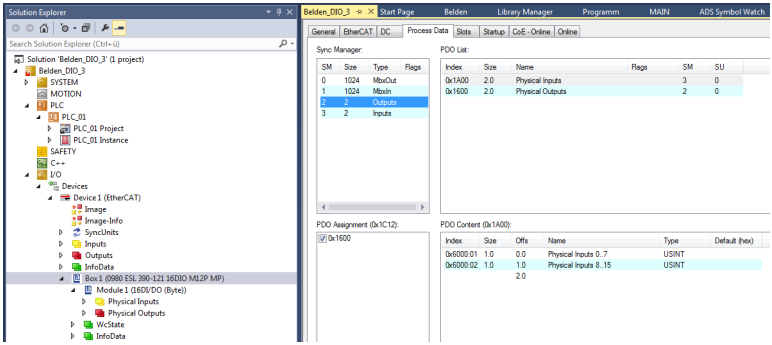
Warning: If you change the I/O profile after changing the parameter settings in the “Startup” tab, all already changed parameters are remaining in the “Startup” tab. Please delete and insert in this case the whole I/O box, for avoiding wrong parameter settings.

4. Configure the Process Data: Change to the “Process Data” tab and choose your Inputs and Outputs PDO’s as described in chapter 16DIO modules: 0980 ESL 390-1x1 on page 41 and 16DIO DCU module: 0980 ESL 390-121-DCU1 on page 61.
5. Click to “Inputs” in the Sync Manager frame and choose your Inputs PDO’s in the PDO Assignment frame. E.g. disable the 0x1A04 and 0x1A05 check

boxes, if no Error- and Diagnosis Register data should be transferred the EtherCAT® controller.

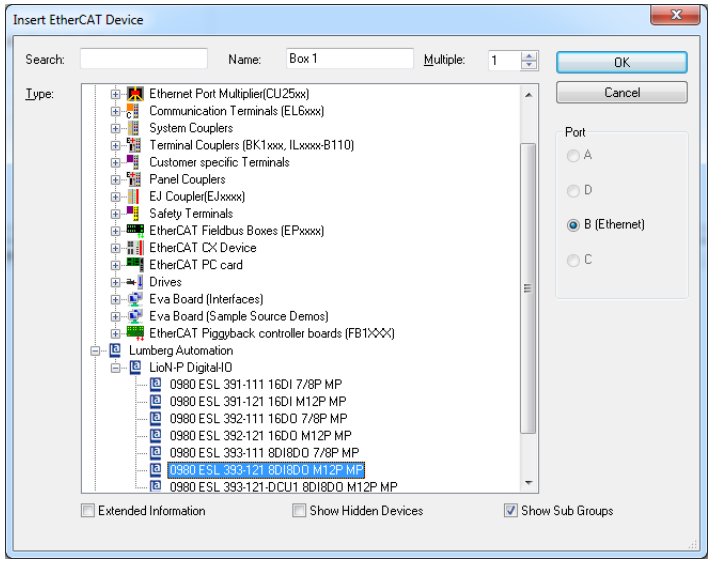


6. Click to “Outputs” in the Sync Manager frame and choose your Outputs PDO’s in the PDO Assignment box, if changes are required.

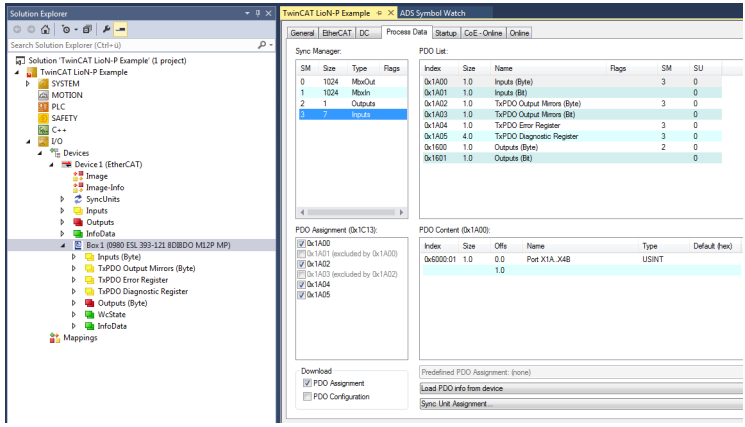


5.4.8.2 Configuration of 0980 ESL 391-1x1 - 0980 ESL 393-1x1 modules

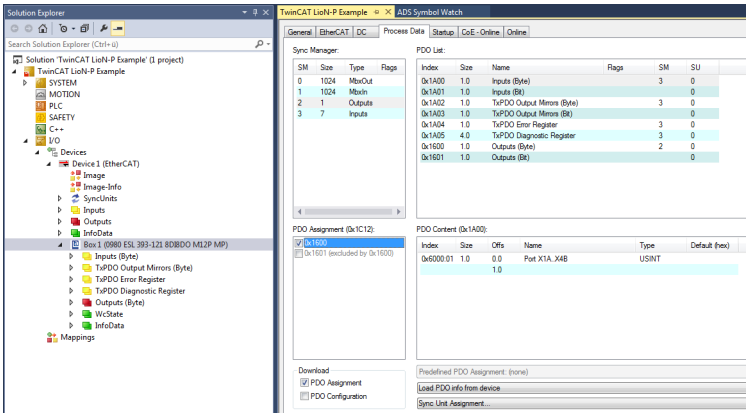
1. Select the I/O device from the hardware catalog. Change to the “I/O” option in the Solution Explorer in the left workspace window. With a right mouse click on the EtherCAT master (Device 1) and choose the option: “Add New Item …”, select the device and click the OK button:



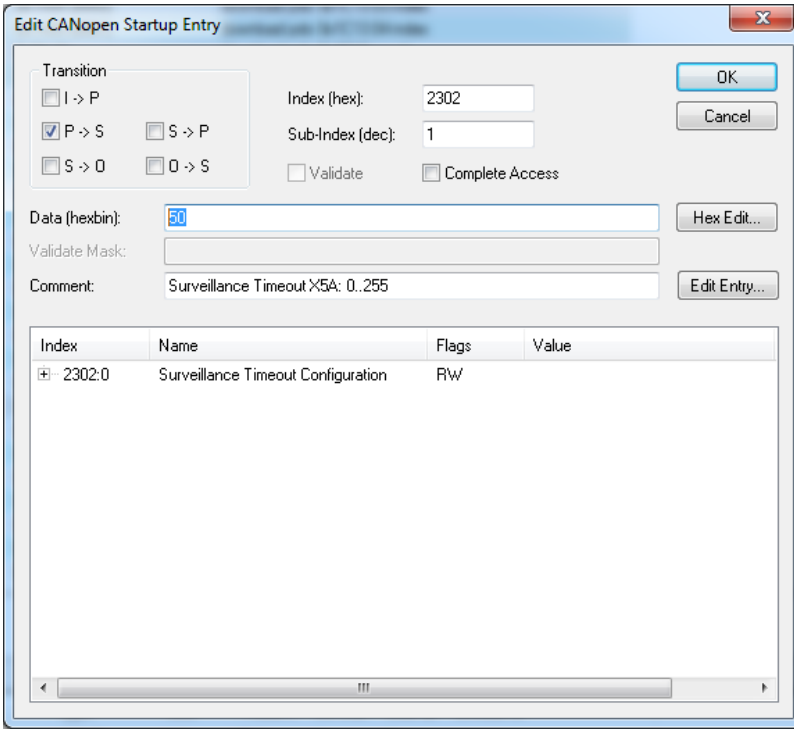
2. Configure the Process Data: Change to the “Process Data” tab and choose your Inputs and Outputs PDO’s as described in chapter 5.4.2 – 5.4.4.
3. Click to “Inputs” in the Sync Manager frame and choose your PDO’s in the PDO Assignment frame.



4. Click to “Outputs” in the Sync Manager frame and choose your PDO’s in the PDO Assignment frame.

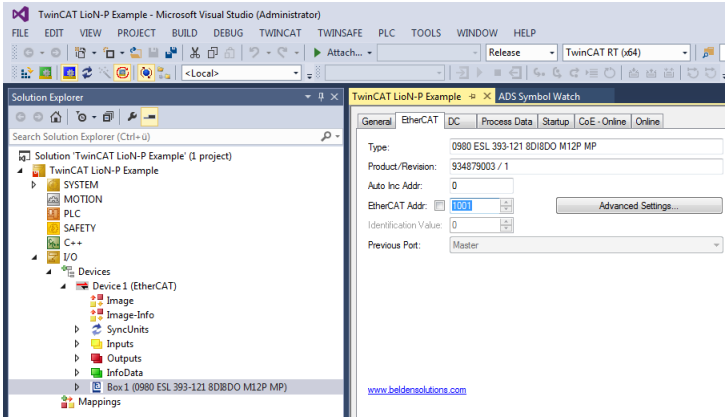


5. Parameter settings: Change to the “Startup” folder and check the default device parameter settings. After double clicking one parameter, the edit dialog box opens. The new value can be entered into the Data input bar:

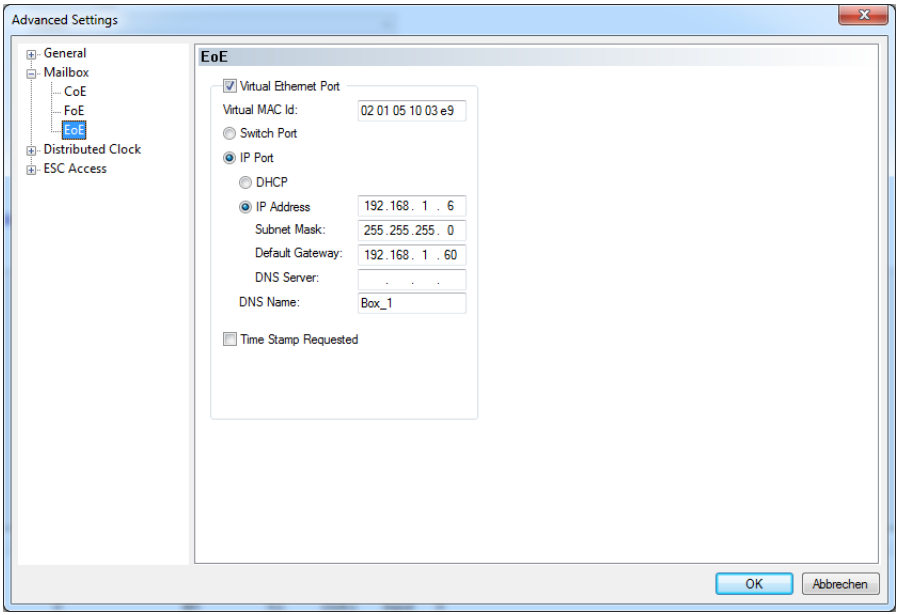


5.4.8.3 EoE IP address

1. Set the IP address for the EoE protocol. For using the web interface of the device, the IP-address must be set. Click the “Advanced Settings…” button in the EtherCAT Tab and navigate to “Mailbox” and “EoE”.



2. Disable the option “Virtual Ethernet Port” if no web services should be used.
3. Click “IP Port” and “IP Address” when web services will be used. Enter your IP-settings depending from your local network adapter settings.

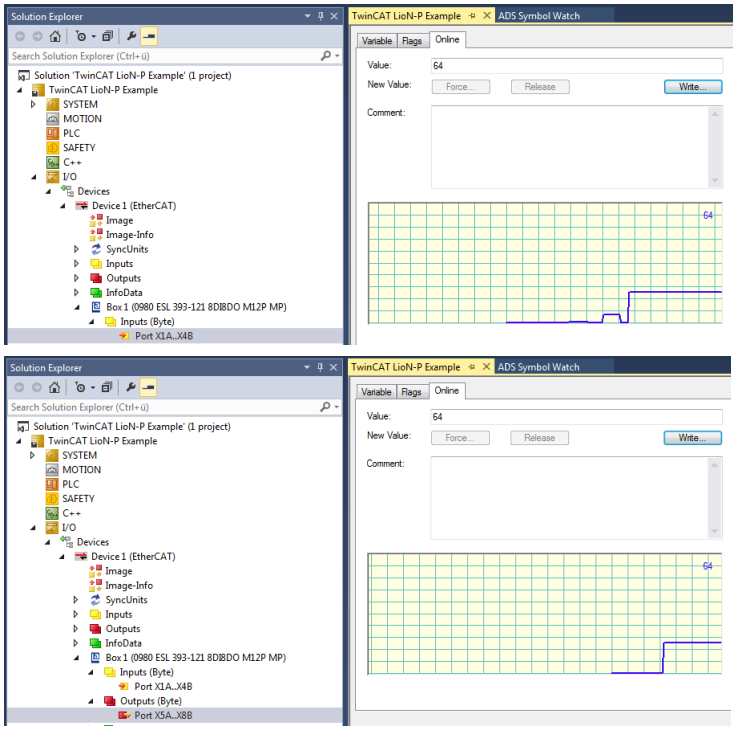


5.4.8.4 Activate Configuration

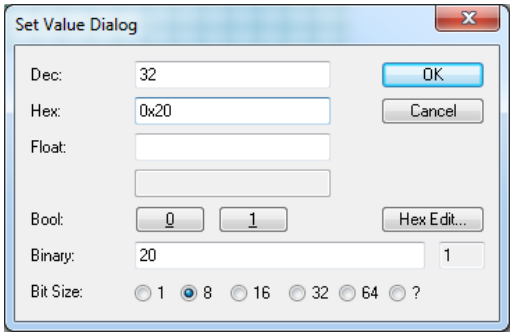
1. When the device is connected to the EtherCAT® network click to the “TWINCAT” tab and choose “Activate Configuration”.

   Warning: Before you set the inputs or outputs of the module, be aware that no personal injury or damage to equipment can be happen.

2. Click again the “TWINCAT” tab and choose “Restart TwinCAT (Config Mode)”. Accept the dialog boxes with “Yes” and device will be change into the “OP” state and transfers I/O data.



3. Click the “Write…” Button for setting an output of the device.



6 The integrated web server

The modules provide an integrated web server for configuration, monitoring, and diagnosis. You have the option to call up the websites saved on it by entering the address in a web browser. To do this, replace the placeholder [IP-Adresse] with the IP address of the relevant module. For using the integrated web server in an EtherCAT® environment, the EoE protocol must be configured for the EtherCAT® controller and field module (refer to chapter EoE IP address on page 77).

If the modules web pages does not open, check your browser and firewall settings.

6.1 The Status page

The address of the Status page is: http://[IP-Adresse]/status.htm.

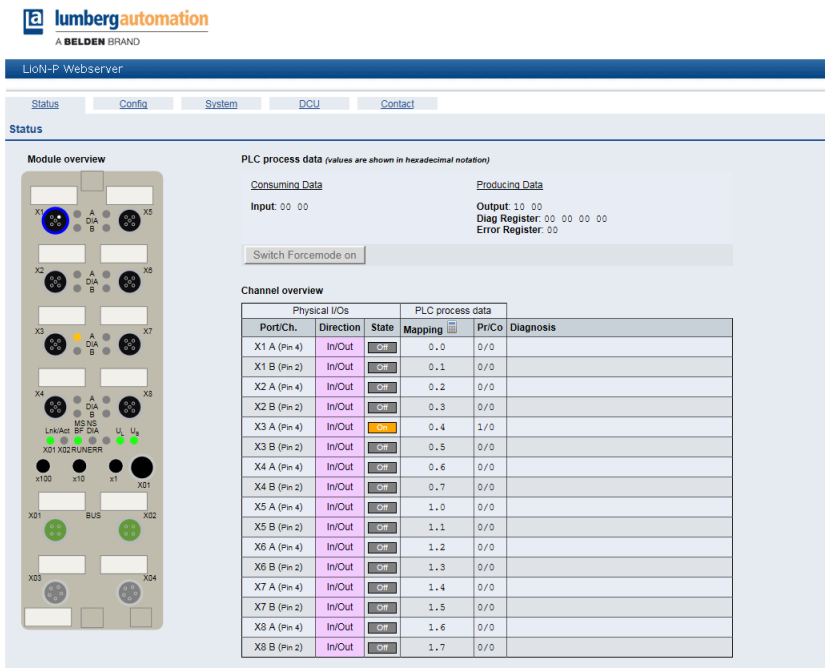
This website shows the current status of the overall module and the respective status of the individual channels. The Consumed/Produced process data and the Diagnosis-/Error Register data are in hexadecimal format as well as graphically in the Module overview and Channel overview areas available.

For the detailed Diagnosis- and Error Register description refer to the description of the PDO's 0x1A04 (Error Register) and 0x1A05 (Diagnosis Register). The Channel overview table is broken down into three different areas. The status of the physical input and output data for the I/O channels as

well as the process data sent to and received from the EtherCAT® controller is displayed. Channel errors are displayed in the last column.

In the LioN-P modules the channel direction, the current channel status, the I/O mapping configured through the controller as well as the currently mapped process data (Pr/Co) for all channels will be displayed.

Changes to the I/O mapping can only be made in the profiles of the 16DIO modules (0980 ESL 390-1x1 w/wo DCU) during the configuration of the module.



6.1.1 Force Mode

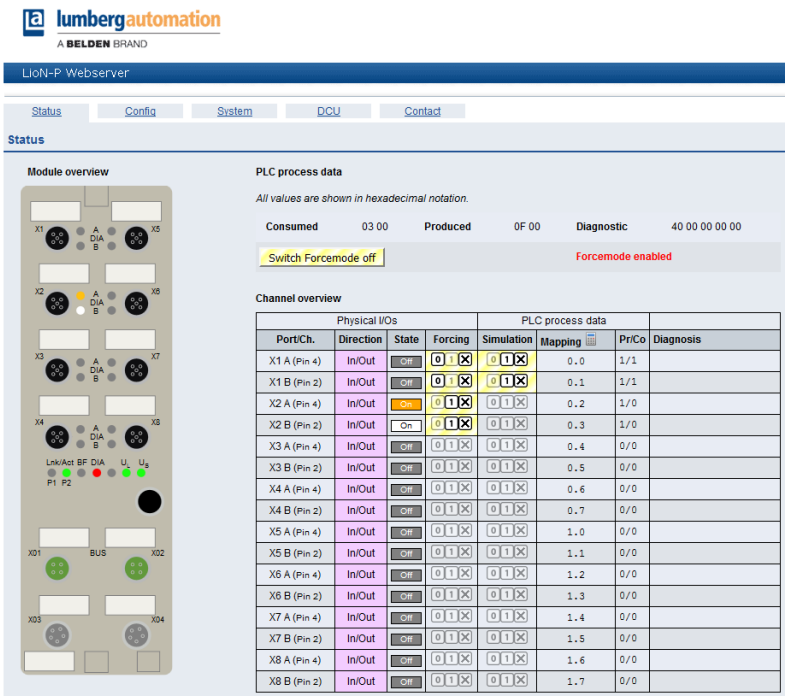
The force mode can be a useful instrument when starting up the machine or during troubleshooting inside the machine. The data for the input and output channels can be overwritten and indepentenly set through the web server. Therefore, each output can be manually set and each input simulated independent of the output process data from the controller or the the real physical input status.

The “Switch Forcemode On” button activates the Force Mode. If the status page or the web server is exited, the Force Mode is automatically switched off.

To use the Force Mode in the online mode (with connection to the EtherCAT® controller), the web interface and Force Mode has to be activated through the controller parametrization.

If the Force Mode is activated in online mode through the web server, Force Mode is automatically switched off, if the device changes into the failsafe state (connection interruption, controller changes the device from OP to SafeOP or in case of an internal module error).

Warning: Using of the force mode can result in serious personal injury or damage to equipment. Be carefully when using the force mode.



The 0 and 1 buttons in the Forcing column can be used to set the physical output data for the individual channels. The X button cancels Forcing for the corresponding channel. In a similar manner, the Simulation column can be

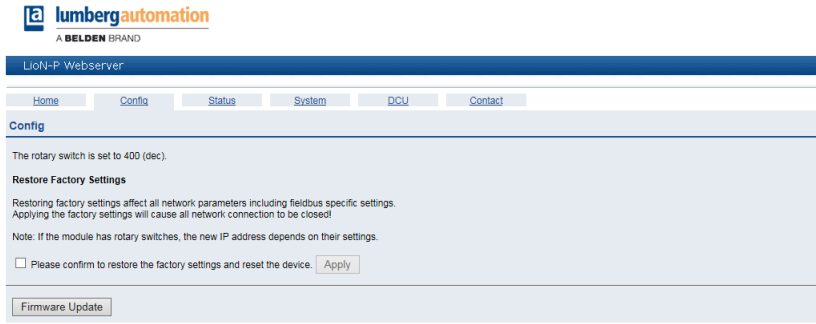
used to simulate the input data of the individual channels before mapping into process data.

6.2 The Configuration page (Config)

The address of the configuration page is: http://[IP-Adresse]/config.htm.

On this page you have the option to access the following values and parameters:

Restore Factory Settings:	The module restores the factory settings.
Firmware Update:	The firmware of the device can be updated with this function. Refer to chapter Firmware Update with EoE on page 93 for further information.



6.3 The System page

The address of the System page is: http://[IP-Adresse]/system.htm.

This page delivers the following data and options:

- Network MAC address
- Network state
- System status:

- System runtime
- System information
- Number of restarts of the I/O system

▶ Firmware version and date

▶ Device information:

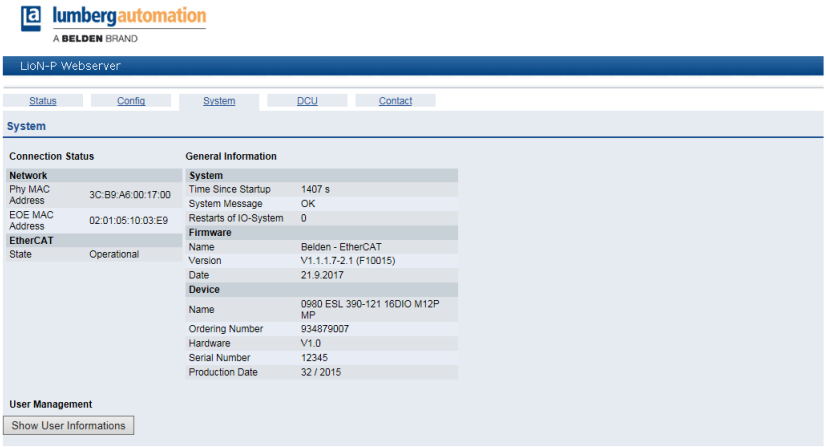
- Ordering number
- Serial number
- Production year and week

▶ User Management:

- Creating, changing or deleting of user or user settings
- The default login settings are:

  User: admin

  Password: private
- Only access with Admin permissions enables new users to be created or passwords to be changed.



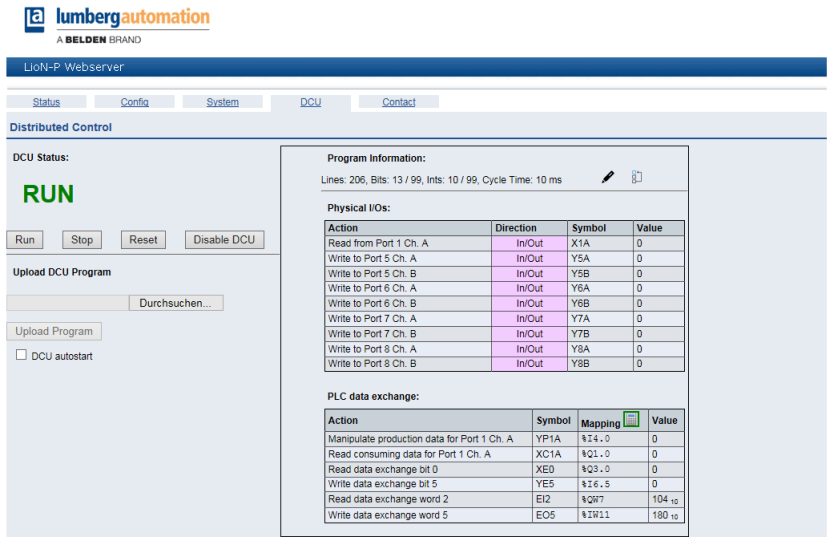
The information on this page is updated in a web browser only after reopening or manual refreshing of the page.

6.4 The DCU page

The address of the DCU page is: http://[IP-Adresse]/contact.htm.

This page is only available for the devices 0980 ESL 390-121-DCU1 and 0980 ESL 393-121-DCU1.

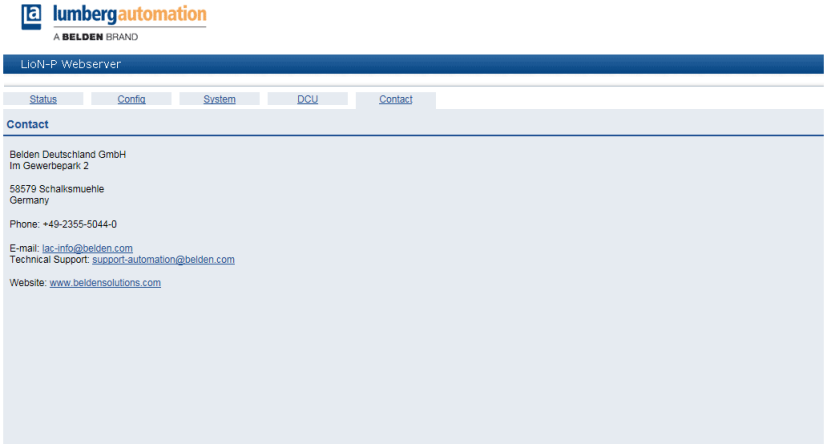
This page provides status and control information for the Distributed Control Unit (DCU) of the device. Control tasks can be executed on the device with this feature. The LioN-P DCU modul can work with a connected EtherCAT® controller in Online Mode. For detailed information of the DCU function refer to the manual: Manual_LioN-P_Micro_DCU_EN.pdf



6.5 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.


lumbergautomation
A BELDEN BRAND
LioN-P Webserver
Status
Config
System
DCU
Contact
Contact
Belden Deutschland GmbH
Im Gewerbepark 2
58579 Schalksmuehle
Germany
Phone: +49-2355-5044-0
E-mail: lac-info@belden.com
Technical Support: support-automation@belden.com
Website: www.beldensolutions.com

7 Diagnostics processing

The modules provide advanced diagnosis behavior, in particular for the output channels. 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. (Automatic output restart is parametrized as default value for the 16DIO “Universal” devices.)
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 71: Interpretation of channel errors

Attention: 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)

At every M12 input socket of the modules, pin 1 supplies a monitored sensor voltage US.

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.

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.

Attention: 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.

The error message is filtered by the "Surveillance-Timeout" parameter.

7.4 Error in the actuator power supply

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

If the actuator power supply U_L goes outside the voltage range of 18.6 to 30 V, an error is reported. The U_L indicator lights up red, and the actuator under voltage bit is set in the module information byte.

When output channels are activated, the voltage error is also displayed by setting the relevant error bits of the M12 slots.

Attention: 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 18.6 to 30 V, an error message is created.

The U_S indicator lights up red and the sensor under voltage 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 18.6 V DC from the perspective of the system power supply.

8 Emergency Messages

When parametrized the device sends emergency messages to the master in case of detected diagnosis on the device. The coding of the first part of the emergency messages is leaned to the CiA 301 and CiA 401 specification. The second part of the emergency messages is the known error register, which can be also added via PDO to the cyclic input data.

The emergency message has a format of 8 Bytes and is coded as follows:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Emergency Error Code		Error Register CoE 0x1001	Diagnostic Register				

Table 72: Byte content of the emergency message

Emergency Error Code Byte 1, Byte 2	Error Register (CoE 0x1001, Byte 3)								
	B7	B6	B5	B4	B3	B2	B1	B0	Error description (Bit 7 – Bit 0)
0x0000	0	0	0	0	0	0	0	0	No error
0x2300	-	0	0	0	0	-	1	1	Output overload error, MI-SCS or MI-SCA
0x3100	-	0	0	0	0	1	-	1	Voltage error, MI-LVS
0x3300	-	0	0	0	0	1	-	0	Voltage error outputs, MI-LVA
0xF000	1	0	0	0	0	-	-	1	Additional function forcing, MI-FC
0xFF00	1	0	0	0	0	-	-	1	Additional function device diagn., MI-IME
0xFF01 **1)**.	1	0	0	0	0	-	-	1	Additional function parameter error, MI-PRM

Table 73: Content of error register (CoE register 0x1001)

1). Only for modules 0980 ESL 390-1x1 and 0980 ESL 390-121-DCU1

Attention: **-** : Can be 0 or 1, if more than one error is active at the same time.

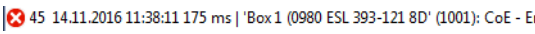
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	MI-IME	MI-FC	MI-PRM	0	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 6	CE-X4B	CE-X4A	CE-X2B	CE-X2A	CE-X2A	CE-X2A	CE-X1B	CE-X1A
Byte 7	CE-X8B	CE-X8A	CE-X7B	CE-X7A	CE-X6A	CE-X6A	CE-X5B	CE-X5A
Byte 8	0	0	0	0	0	0	0	0

Table 74: Content of diagnostic register (depends on the module: 16DI, 16DO or 8DI/8DO)

Key

- MI-LVS: Module information byte – Low voltage of system/sensor power supply
- MI-LVA: Module information byte – Low voltage of actuator power supply
- MI-SCS: Module information byte – Sensor short-circuit at an M12 slot
- MI-SCA: Module information byte – Actuator short-circuit
- MI-PRM: Module information byte – Parameter error
- MI-FC: Module information byte – Forcing active
- MI-IME: Module information byte – Internal module error
- SCS-X1 ... SCS-X8: Sensor short-circuit at slot X1 to X8
- CE-X5A ... CE-X8A: Channel error, channel A (contact pin 4) of slots 5 to X8
- CE-X5B ... CE-X8B: Channel error, channel B (contact pin 2) of slots X5 to X8

The following example shows the emergency message received by the TwinCAT master for short circuit on the sensor supply pin 1 of port X2.



9 Firmware update

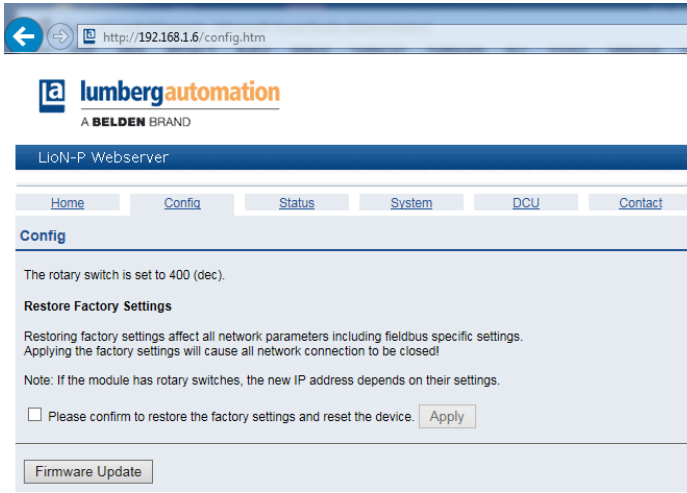
A firmware update of the module is possible over the integrated webserver of the module via the EoE (Ethernet over EtherCAT®) protocol, or via the FoE protocol (File over EtherCAT®).

Warning: Don't interrupt the power supply of the device during the update.

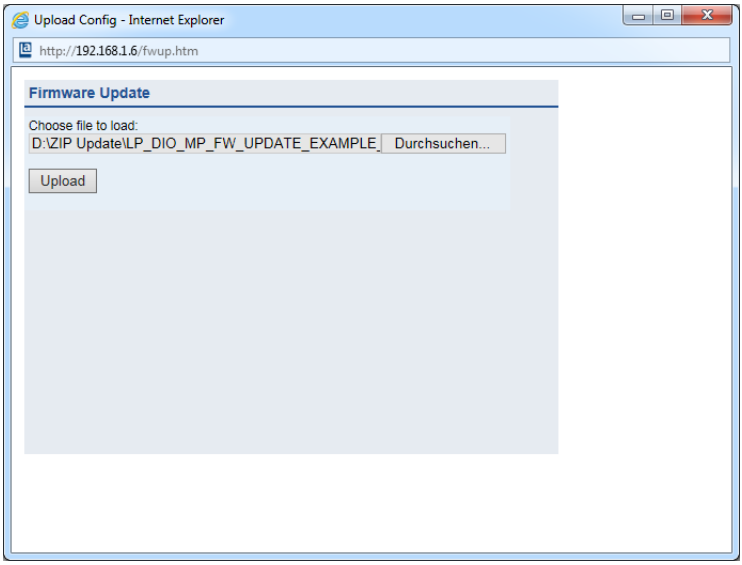
9.1 Firmware Update with EoE

The EoE service must be supported from master and device. For configuring the EoE service on device side refer to chapter Configuration example with TwinCAT® 3.

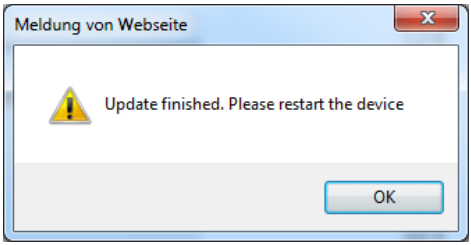
If the EoE service is configured and the device is at least in the Pre-Op state, enter the IP address of the device in your browser and navigate to the "Config" Page.



1. Press the **Firmware Update** button and select the update file provided by Belden.



2. Press **Upload** and wait for the following message

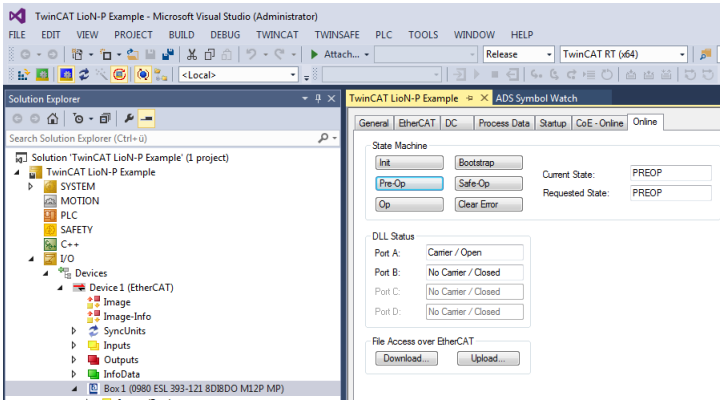


Attention: Upon the next restart, the device will use the new firmware.

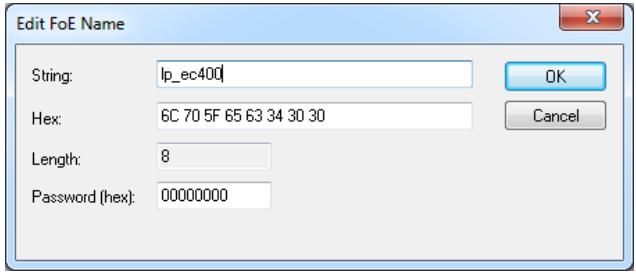
9.2 Firmware Update with FoE

The FoE service must be supported from master and device. The FoE service is supported from device side per default setting.

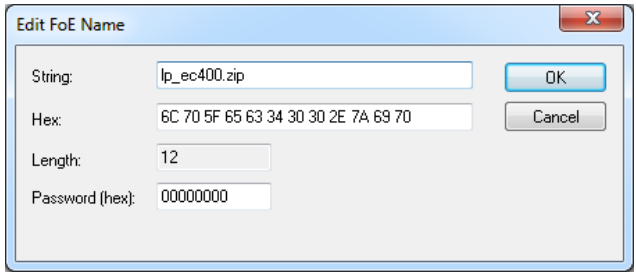
If the FoE service is configured and the device is at least in the Pre-Op state, follow the example for TwinCAT:



1. Press the **Download** button in the **File Access over EtherCAT** box and select the update file provided by Belden:



2. Add the file extension ".zip" in the string field if not visible.



3. Press **OK** and wait until the file has been transferred into the device.

Attention: After the file has been transferred, a reset command or power cycle is needed. Upon the restart of the device, the update package will be extracted and the old firmware files will be replaced

by the files in the update package. The LED left of the U_S LED (U_L LED for devices with outputs) is flickering and blinking red during the update. After all files have been extracted, the U_L and U_S LED are blinking green two times, afterwards the device performs a restart in order the firmware update to be finished.

10 Technical data

10.1 General

Protection class	IP 67 (only when the connectors are screwed in or when protective caps are used)
Ambient temperature	LioN-P: -40° C to +70° C (-40° F to +158° F)
Weight	480 g (LioN-P)
Housing material	Die-cast zinc
Vibration resistance (oscillation)	15 g / 5–500 Hz
Shock resistance	50 g / 11 ms
Torques: M4 fixing screws M4 ground connection M12 connector	 1.0 Nm 1.0 Nm 0.5 Nm

Table 75: General information

10.2 Bus system

Protocol	EtherCAT® (ETG.1000 V1.2)
ESI file	LumbergAutomation-LioN-P-Digital-IO.xml
Data transmission rate	100 Mbit/s, full duplex
Transmission procedure Autonegotiation	100BASE-TX is supported
Type of addressing	Auto-increment addressing, Fixed addressing
Min. Cycle Time	250 µs
Mailbox Protocols	CanOpen over EtherCAT (CoE), File access over EtherCAT (FoE), Ethernet over EtherCAT (EoE)
Product code	0x37b92ad7 (934882007, 0980 ESL 390-111 16DIO 7/8P) 0x37b92ad1 (934882001, 0980 ESL 391-111 16DI 7/8P) 0x37b92ad2 (934882002, 0980 ESL 392-111 16DO 7/8P) 0x37b92ad3 (934882003, 0980 ESL 393-111 8DI8DO 7/8P) 0x37b91f1f (934879007, 0980 ESL 390-121 16DIO M12P) 0x37b91f20 (934879008, 0980 ESL 390-121-DCU1 16DIO M12P) 0x37b91f19 (934879001 0980 ESL 391-121 16DI M12P) 0x37b91f1a (934879002 0980 ESL 392-121 16DO M12P) 0x37b91f1b (934879003 0980 ESL 393-121 8DI8DO M12P) 0x37b91f1d (934879007 0980 ESL 393-121-DCU1 8DI8DO M12P)
Supported Ethernet protocols	Ping ARP HTTP TCP/IP
Switch functions	Integrated

EtherCAT interface	2x M12 sockets
Port	4-pin, D-coded (see pin assignment)
Autocrossing	is supported

Table 76: Information about the bus system

10.3 Power supply for the module electronics/ sensors

Nominal voltage U_S	24 V DC (SELV/PELV)
Voltage range	18 to 30 V DC
Power consumption of module electronics	Typically 95 mA
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) per Port
Reverse polarity protection	Yes
Operational indicator (U_S)	LED green, 18.6 V <= U_S <= 30 V LED red, U_S < 18.6 V or U_S > 30 V

Table 77: Information about the power supply for the module electronics/ sensors

10.4 Power supply for the actuators

Nominal voltage U_L	24 V DC (SELV/PELV)
Voltage range	18 to 30 V DC
Electric isolation	Yes
Threshold value of the undervoltage detection	Typ. 17 V
Delay time of the undervoltage detection	< 20 ms

Operational indicator (U_L)	LED green, 18.6 V <= U_L <= 30 V LED red, U_L < 18.6 V or U_L > 30 V

Table 78: Information about the power supply for the actuators

10.5 Inputs

Input specification	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	16x with 16DI 0x with 16DO 8x with 8DI/8DO 16x with 16DIO
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 79: Information about the inputs

10.6 Outputs

Every single channel can switch 2.0 A output load. The output load for the 4 channels of the port groups X1/X2, X3/X4, X5/X6, X7/X8 is limited to 6.5 A.

Output specification	Typically 2 A as per IEC 61131-2
Nominal output current per channel: Signal status “1” Signal status “0”	2 A, see Info 1 Max. 2 A Max. 1 mA (according to specification)

Signal level of the outputs: Signal status “1” Signal status “0”	 Min. (U_L – 1 V) Max. 2 V
Short-circuit protection	Yes
Max. output current per module	7/8 Power connector: As per U_L approval: 9 A (12 A see Info 2) M12 Power connector: As per U_L approval: 9 A (16 A per supply point)
Overload protection	Yes
Number of digital channels	0x with 16DI 16x with 16DO 8x with 8DI/8DO 16x with 16DIO
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

Table 80: Information about the outputs

Info 1:

- With inductive loads of consumption category DC13 (EN60947-5-1), the outputs can provide currents of 1.6 A at 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 mm^2)
  - Ambient temperature max. 40° C

10.7 LEDs

U_S	Green	System/sensor power supply, voltage level 18.6 V <= U_S <=30 V
	Red	System/sensor power supply, voltage level 18.6 V > U_S or U_S > 30 V
	Off	No system/sensor power supply
U_S	Green	Actuator power supply, voltage level 18.6 V <= U_L <=30 V
	Red	Actuator power supply, voltage level 18.6 V > U_L 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
X01 Link/Act X02 Link/Act	Green	Ethernet connection exists to another subscriber Link connection created
	Flashing yellow	Data exchange with another subscriber
	Off	No connection to another subscriber No link, no data exchange
RUN	Green	The device is in state OPERATIONAL.
	Single flash	The device is in state SAFE-OERATIONAL
	Blinking	The device is in state PRE-OPERATIONAL
	Flickering	The device is booting and has not entered the INIT state. Or the device is in state BOOTSTRAP / Firmware download in progress.
	Off	The device is in state INIT.

ERR	Red	Application controller failure. E.g. PDI watchdog timeout.
	Flickering	Booting error
	Blinking	Invalid configuration, general configuration error
	Single flash	Local error / unsolicited state change
	Double flash	Watchdog error
	Off	No error
DCU/FM	Blue	DCU program stop
	Blue blinking 1 Hz	DCU program run
	off	DCU/FM off
	Red blinking 1 Hz	DCU error
	Blue/red blinking	Force mode active

Table 81: Information about the LED colors

11 Accessories

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

http://www.beldensolutions.com