Your Global Automation Partner

TURCK

TBEN-L...-8IOLA

IO-Link Master Class A for Ethernet

Instructions for Use

Table of Contents

1 About these instructions

These instructions for use describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

This manual is written for specially trained personnel and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

When using the device in Ex circuits, the user must also have an additional knowledge of explosion protection (IEC/EN 60079-14 etc.).

1.2 Explanation of symbols used

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.
	**WARNING** WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided.
	**CAUTION** CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.
	**NOTICE** NOTICE indicates a situation which may lead to property damage if not avoided.
	**NOTE** NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.
▶	**CALL TO ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULTS OF ACTION** This symbol denotes relevant results of actions.

1.3 Additional documents

The following additional documents are available online at **www.turck.com**

- Data sheet
- Declarations of Conformity (current version)
- Commissioning manual IO-Link devices
- Notes on Use in Ex zone 2 and 22 (100022986)
- Approvals

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to **techdoc@turck.com**.

2 Notes on the product

2.1 Product identification

This instruction is valid for the following IO-Link master modules:

- TBEN-L4-8IOLA (ID 100028459)
- TBEN-LL-8IOLA (ID 100029880)

2.2 Scope of delivery

The scope of delivery includes:

- IO-Link master module
- M12 screw caps (IP65/IP67/IP69K)
- 7/8" dust caps
- Labeling clips

2.3 Turck service

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database under www.turck.com contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats.

The contact details of Turck subsidiaries worldwide can be found on p. [▷ 172].

3 For your safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Intended use

The multiprotocol I/O module TBEN-L…-8IOLA is an IO-Link master module according to IO-Link specification V1.1 and can be connected to an Ethernet network via the three Ethernet protocols PROFINET, Ethernet/IP and Modbus TCP. The module detects the bus protocol automatically during the start-up.

The IO-Link master module has eight IO-Link channels. Up to eight IO-Link sensors or IO hubs with IO-Link can be connected to the M12 sockets. In addition, up to 16 digital sensors can be directly connected. When using I/O hubs, it is possible to connect up to 128 digital sensors per device.

Installation directly in the field is possible thanks to degrees of protection IP65, IP67 or IP69K. Devices with Ex marking are suitable for operation in hazardous areas in Zone 2 and Zone 22.

The devices may only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 General safety notes

- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for industrial areas. When used in residential areas, take measures to avoid radio interference.
- Change the default password of the integrated web server after the first login. Turck recommends using a secure password.

3.3 Notes on explosion protection

- When operating the device in a hazardous area, the user must have a working knowledge of explosion protection (IEC/EN 60079-14, etc.).
- Observe national and international regulations for explosion protection.
- Only use the device within the permitted operating and ambient conditions (see certification data and Ex approval requirements for use in Ex area).

3.4 Ex approval requirements for use in Ex area

- Only use the device in an area with no more than pollution degree 2.
- Only disconnect and connect circuits when no voltage is applied.
- Only operate the switches if no voltage is present.
- Connect the metal protective cover to the equipotential bonding in the Ex area.
- Ensure impact resistance in accordance with EN IEC 60079-0 — alternative measures:
  - Install the device in the TB-SG-L protective housing (available in the set with Ultem window: ID 100014865) and replace the service window with an Ultem window.
  - Install the device in an area offering impact protection (e.g. in robot arm) and attach a warning: "DANGER: Only connect and disconnect circuits when no voltage is present. Do not operate switches when energized."
- Do not install the device in areas critically exposed to UV light.
- Prevent risks caused by electrostatic charge.
- Seal unused connectors with dummy plugs to ensure the degrees of protection IP65, IP67 or IP69K. The tightening torque for the screw caps is 0.5 Nm.

4 Product description

The devices are designed in a fully encapsulated housing with degree of protection IP65, IP67 and IP69K.

The IO-Link master module has eight Class A IO-Link ports for connecting IO-Link devices. The four IO-Link channels can be parameterized independently of each other and operated either in IO-Link mode or as DXP channel (DI or DO) in SIO mode.

With Turck's "Simple IO-Link Device Integration (SIDI)", IO-Link devices can be directly integrated into PROFINET via the GSDML file of the TBEN-L…-8IOLA.

In addition, the device has further eight digital channels, which are designed as universal DXP channels and can be used as inputs or outputs without configuration.

For connecting the supply voltage, 4-pin 7/8" connectors (TBEN-L4-8IOLA) or 5-pin , L coded M12 connectors (TBEN-LL-8IOLA) are available.

Two device types are available:

- TBEN-L4-8IOLA
- TBEN-LL-8IOLA

The multiprotocol device can be operated with the three Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP by automatic protocol detection without user intervention.w

4.1 Device overview

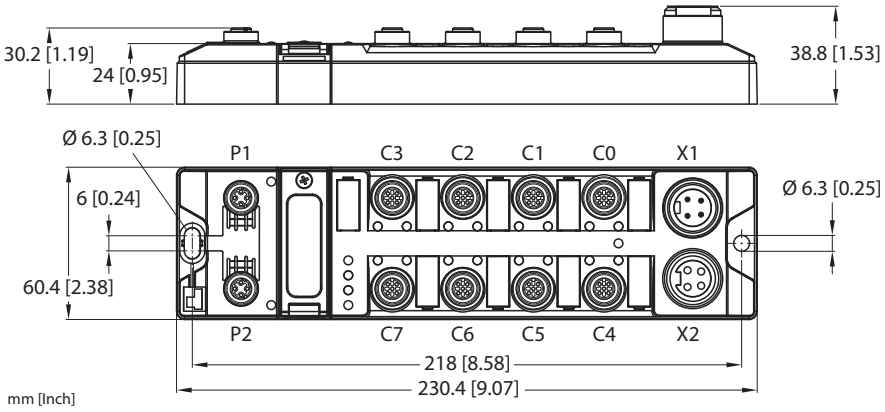


Fig. 1: Dimensions TBEN-L4-8IOLA

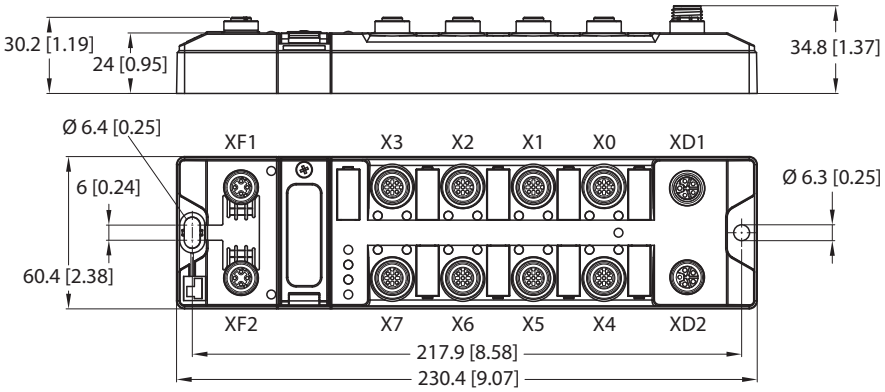


Fig. 2: Dimensions TBEN-LL-8IOLA

Connector		LED	Function
TBEN-L4	TBEN-LL		
X1	XD1	PWR	Power feed
X2	XD2		Continuation of the power to the next node

Connector		LED	Channel	Depending on the configuration	Auxiliary voltage
TBEN-L4	TBEN-LL				
C0	X0	0	Ch0	IO-Link port 1 (Class A) or DXP0 (SIO)	VAUX1
		1	Ch1	DXP1	
C1	X1	2	Ch2	IO-Link port 2 (Class A) or DXP2 (SIO)	VAUX1
		3	Ch3	DXP3	
C2	X2	4	Ch4	IO-Link port 3 (Class A) or DXP4 (SIO)	VAUX1
		5	Ch5	DXP5	
C3	X3	6	Ch6	IO-Link port 4 (Class A) or DXP6 (SIO)	VAUX1
		7	Ch7	DXP7	
C4	X4	8	Ch8	IO-Link port 5 (Class A) or DXP8 (SIO)	VAUX1
		9	Ch9	DXP9	
C5	X5	10	Ch10	IO-Link port 6 (Class A) or DXP10 (SIO)	VAUX1
		11	Ch11	DXP11	
C6	X6	12	Ch12	IO-Link port 7 (Class A) or DXP12 (SIO)	VAUX1
		13	Ch13	DXP13	
C7	X7	14	Ch14	IO-Link port 8 (Class A) or DXP14 (SIO)	VAUX1
		15	Ch15	DXP15	

Connector		LED		
TBEN-L4	TBEN-LL	TBEN-L4	TBEN-LL	Function
P1	XF1	ETH1	L/A	Ethernet
P2	XF2	ETH2	L/A	Ethernet

4.1.1 Operating elements

The device has the following operating elements:

- Rotary coding switches for adjusting the network settings
- Reset button for executing a device restart

4.1.2 Display elements

The device has the following LED indicators:

- Power supply
- Group and bus errors
- Status
- Diagnostics

4.1.3 Block diagram

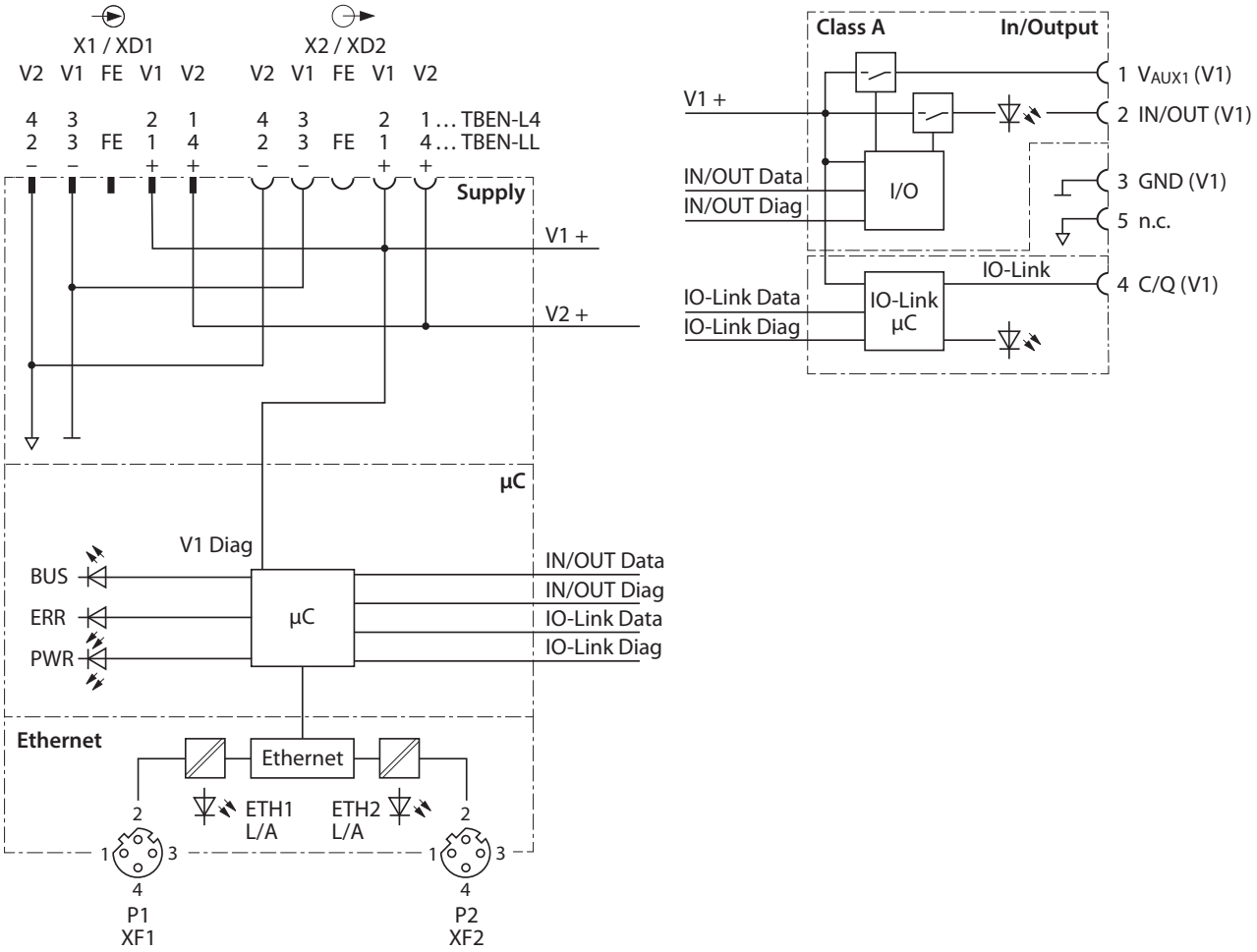


Fig. 3: Block diagram

4.2 Properties and features

- Fiber-glass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Protection class IP65, IP67, IP69K
- UV-resistant according to DIN EN ISO 4892-2
- Metal connectors
- Separated power groups for safety shutdown
- Integrated Ethernet-switch for building up a line-topology.
- Transmission speed 10 Mbps/100 Mbps
- Integrated web server
- 8 IO-Link ports Class A
- 16 universal digital DXP channels (PNP)
- Multiprotocol functionality: PROFINET IO Device, EtherNet/IP Device, Modbus TCP Slave
- ARGEE functionality [▶ 15]
- PROFINET:
  - Conformance Class B PA
  - Simple IO-Link Device Integration (SIDI)
  - Conformance according to PROFINET specifikation V2.35
  - System redundancy S2
  - Network load class 3
- EtherNet/IP:
  - Support of the IO-Link Parameter Object for asynchronous services (IO-Link CALL)
  - Predefined in- and oputput assemblies

4.3 Operating principle

The IO-Link master module connects IO-Link sensors and actuators with the higher-level control system. The device has an Ethernet interface and fieldbus-independent I/O electronics with IO-Link master functionality (Class A ports). Via the Ethernet interface, the IO-Link master is connected to an (existing) Ethernet network as an EtherNet/IP device, Modbus TCP slave or PROFINET device. During operation, the process data is exchanged between Ethernet and IO-Link. In addition the devices can process signals from up to 16 sensors and actuators via 16 configurable digital channels.

4.4 Functions and operating modes

4.4.1 Multiprotocol technology

The device can be used in the following three Ethernet protocols:

- Modbus TCP
- EtherNet/IP
- PROFINET

The required Ethernet protocol can be detected automatically or determined manually.

Automatic protocol detection

A multiprotocol device can be operated without intervention of the user (which means, without changes in the parameterization) in all of the three Ethernet protocols mentioned.

During the system start-up phase (snooping phase), the module detects which Ethernet protocol requests a connection to be established and adjusts itself to the corresponding protocol. After this an access to the device from other protocols is read-only.

Manual protocol selection

The user can also define the protocol manually. In this case, the snooping phase is skipped and the device is fixed to the selected protocol. With the other protocols, the device can only be accessed read-only.

Protocol dependent functions

The device supports the following Ethernet profile-specific functions:

PROFINET

- FSU (fast startup)
- Topology detection
- Address allocation with LLDP
- Media redundancy protocol (MRP)

EtherNet/IP

- QC (QuickConnect)
- Device Level Ring (DLR)

4.4.2 IO-Link channels

The IO-Link master module TBEN-L…-8IOL has eight Class A IO-Link channels.

The four eight IO-Link channels at pin 4 of the M12 connectors can be parameterized independently of each other and operated either in IO-Link mode or as universal DXP channel (DI or DO) in SIO mode. The maximum output current per DXP output in SIO mode at pin 4 is 0.5 A.

Simple IO-Link Device Integration (SIDI)

Turck's Simple IO-Link Device Integration (SIDI) simplifies the handling of IO-Link devices in PROFINET engineering systems. The IO-Link devices are integrated in the GSDML file of the master, which allows the user to select the devices from the device library (for example in TIA Portal) like sub modules on a modular I/O system and integrate them into the project. Plain-text access to all device properties and parameters is possible. IO-Link device-specific data such as measuring ranges, switching points, pulse rates, etc. can be set directly in the engineering system without programming or additional software [▷ 125].

NOTE
Data storage [▷ 158] is not possible when configuring IO-Link devices with SIDI.

IODD Configurator

The IODD Configurator is a browser-based configuration tool and called from the web server of the IO-Link master module.

NOTE
To call up the IODD Configurator, a login in the web server of the IO-Link master is required [▷ 28].

The IODD Configurator allows access to the plain text of all relevant IO-Link device parameters and supports and simplifies the parameterization, commissioning and maintenance of IO-Link devices.

IO-Link device-specific information is made available directly in the IO-Link master. The IODD suitable for the connected IO-Link devices is loaded into the IO-Link master and interpreted by the master. IO-Link events, diagnostics and process data of the IO-Link devices can thus be interpreted directly in the web server of the IOL master according to the specific device. In addition, the IODD Configurator provides information on the process data structure and pin assignment of the connected IO-Link devices.

The IODD Configurator supports the "Operator", "Maintenance" and "Expert" user roles specified by the IO-Link specification. The specific access rights for these user roles are defined by the IODD of the IO-Link devices.

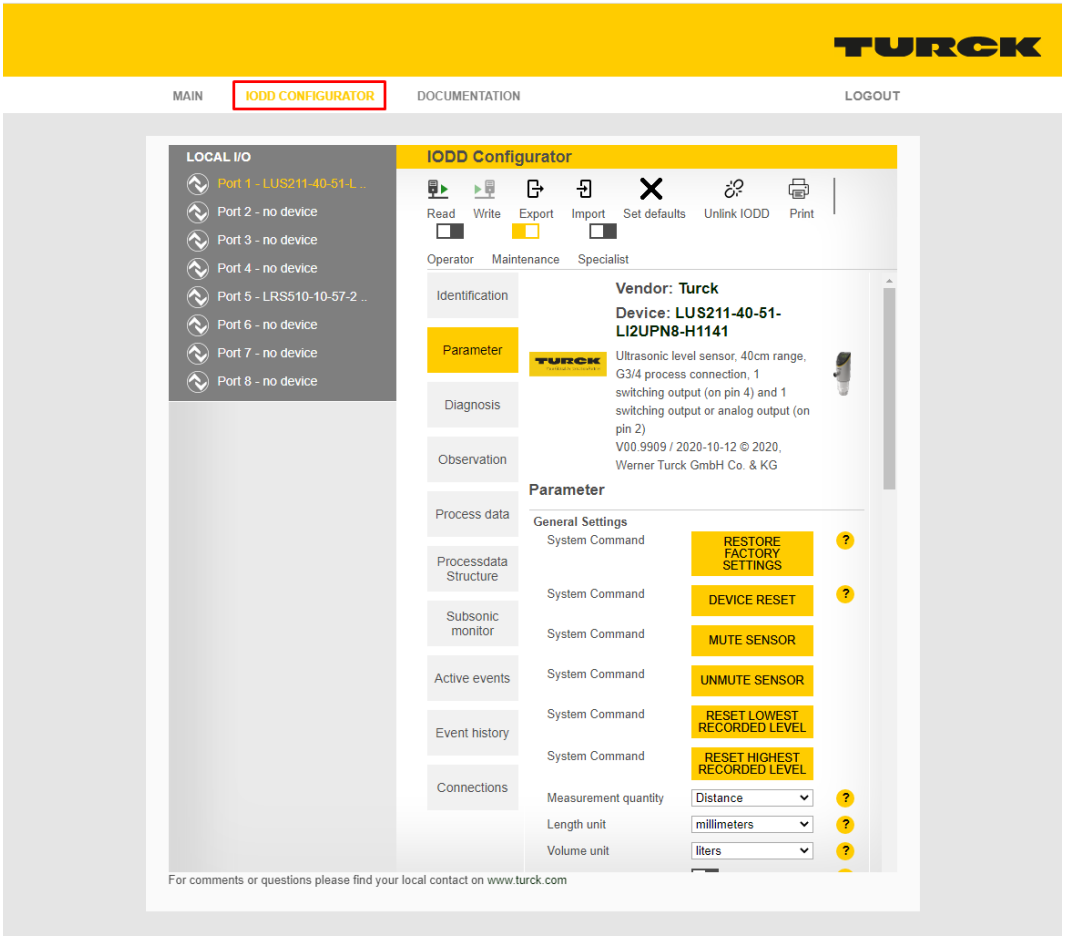


Fig. 4: IODD Configurator (using the TBEN-L4-8IOLA as an example)

4.4.3 Universal digital channels – functions

The device has eight universal digital channels on pin 2 of the M12 connectors, which can be used as inputs or outputs without configuration. Up to eight 3-wire PNP sensors or four PNP DC actuators can be connected. The maximum output current per DXP output at pin 2 is 2 A.

4.4.4 Turck ARGEE

The integrated development environment and device functionality ARGEE enables decentralized logic processing and small to medium control tasks directly in the field. ARGEE is the Turck functionality for Field Logic Control.

The ARGEE development environment is available for free download at www.turck.com.

5 Installing

5.1 Installing the device in Zone 2 and Zone 22

In Zone 2 and Zone 22, the devices can be used in conjunction with the protective housing set TB-SG-L (ID 100014865).

DANGER
Potentially explosive atmosphere
Risk of explosion through spark ignition
For use in Zone 2 and Zone 22:
- ▶ Only install the device if there is no potentially explosive atmosphere present.
- ▶ Observe requirements for Ex approval.

- ▶ Unscrew the housing. Use Torx T8 screwdriver.
- ▶ Replace the service window with the enclosed Ultem window.
- ▶ Place the device on the base plate of the protective housing and fasten both together on the mounting plate, see [▷ 17].
- ▶ Connect the device, see [▷ 18].
- ▶ Mount and screw the housing cover according to the following figure. The tightening torque for the Torx T8 screw is 0.5 Nm.

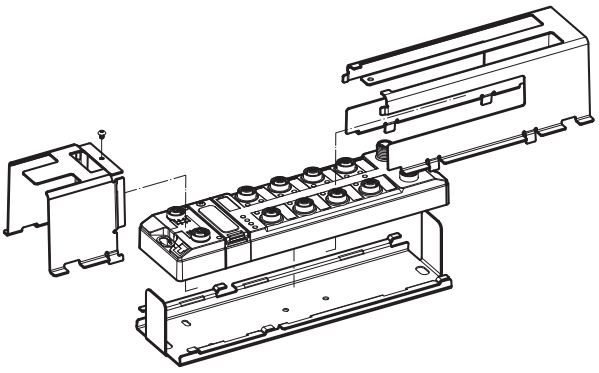


Fig. 5: Mounting the device in protection housing TB-SG-L

5.2 Mounting onto a mounting plate

NOTICE
Mounting on uneven surfaces
Device damage due to stresses in the housing
- ▶ Fasten the device to a flat mounting surface using two M6 screws.

The device can be screwed onto a flat mounting plate.

- ▶ Attach the module to the mounting surface with two M6 screws. The maximum tightening torque for the screws is 1.5 Nm.
- ▶ Avoid mechanical stresses.
- ▶ Optional: Ground the device.

5.3 Mounting the device outdoors

The device is UV-resistant according to DIN EN ISO 4892-2. Direct sunlight can cause material abrasion and color changes. The mechanical and electrical properties of the device are not affected.

- ▶ To avoid material abrasion and color changes: Protect the device from direct sunlight, e.g. by using protective shields.

5.4 Grounding the device

5.4.1 Equivalent wiring diagram and shielding concept

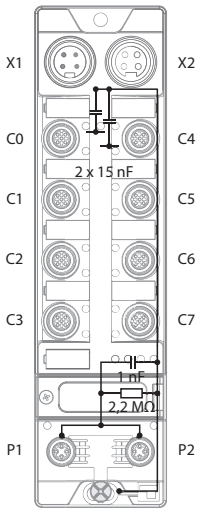


Fig. 6: TBEN-L4-8IOLA – equivalent wiring diagram and shielding concept

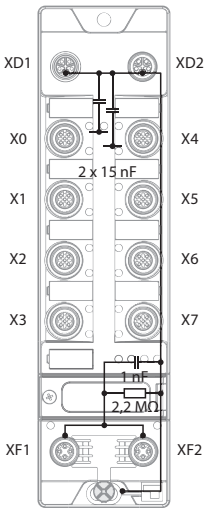


Fig. 7: TBEN-LL-8IOLA – equivalent wiring diagram and shielding concept

6 Connecting

NOTICE
Intrusion of liquids or foreign bodies through leaking connections
Loss of protection class IP65/IP67/IP69K, device damage possible

- Tighten M12 connectors with a tightening torque of 0.6 Nm.
- Tighten 7/8" connectors with a tightening torque of 0.8 Nm.
- Only use accessories that guarantee the protection class.
- Always seal unused connectors with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.

6.1 Connecting the device in Zone 2 and Zone 22

DANGER
Explosive atmosphere
Explosion due to ignitable sparks
For use in Zone 2 and Zone 22:

- Only disconnect and connect circuits when no voltage is applied.
- Only use connecting cables that are suitable for use in potentially explosive atmospheres.
- Use all connectors or seal them with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.
- Observe requirements for Ex approval.

6.2 Connecting the device to Ethernet

TBEN-L4-8IOLA

For the connection to Ethernet the device has an integrated auto-crossing switch with two 4-pin M12 Ethernet-connectors (P1 and P2). The maximum tightening torque is 0.6 Nm.

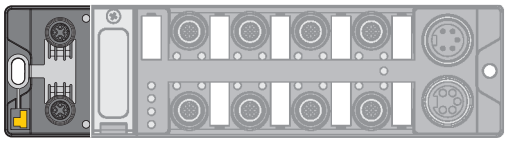


Fig. 8: M12 Ethernet connector

- Connect the device to Ethernet according to the pin assignment below.
- Always seal unused connectors with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.

Fig. 9: Pin assignment Ethernet connectors

TBEN-LL-8IOLA

For the connection to Ethernet the device has an integrated auto-crossing switch with two 4-pin M12 Ethernet-connectors (XF1 and XF2). The maximum tightening torque is 0.6 Nm.

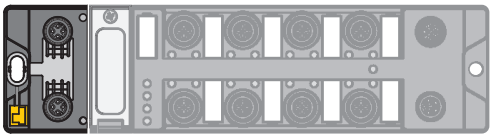


Fig. 10: M12 Ethernet connector

- Connect the device to Ethernet according to the pin assignment below.
- Always seal unused connectors with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.

Fig. 11: Pin assignment Ethernet connectors

6.2.1 QuickConnect and Fast Start-Up applications

- Do not use crossover cables in QuickConnect and Fast Start-Up applications.
- Connect incoming Ethernet cables to P1 or XF1.
- Connect outgoing Ethernet cables to P2 or XF2.

6.3 Connecting the power supply

TBEN-L4-8IOLA

For the connection to the power supply, the device has two 4-pin 7/8" connectors. V1 and V2 are galvanically isolated. The maximum tightening torque is 0.8 Nm.

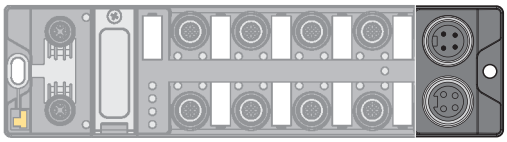


Fig. 12: TBEN-L4… – 7/8" connector for connecting the supply voltage

- ▶ Connect the device to the power supply according to the pin assignment shown below.
- ▶ Always seal unused connectors with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.

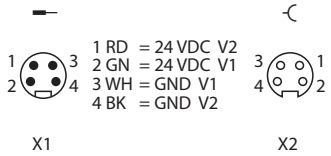


Fig. 13: TBEN-L4… – pin assignment power supply connectors

Connector	Function
X1	Power feed
X2	Continuation of the power to the next node

Voltage	Function
V1	System voltage: power supply 1 (incl. supply of electronics)
V2	Load voltage: power supply 2, fed through, not used in device

TBEN-LL-8IOLA

For the connection to the power supply, the device has two 5-pin, L coded M12 connectors. V1 and V2 are galvanically isolated. The maximum tightening torque is 0.6 Nm.

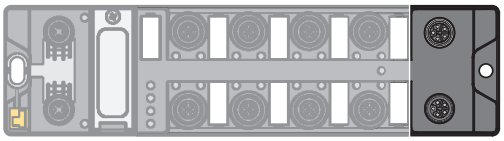


Fig. 14: M12 connector for connecting the supply voltage

- ▶ Connect the device to the power supply according to the pin assignment shown below.
- ▶ Always seal unused connectors with suitable screw caps or blind caps. The tightening torque for the screw caps is 0.5 Nm.

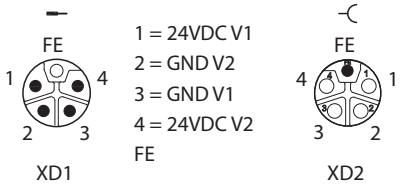


Fig. 15: Pin assignment power supply connectors

Connector	Function
XD1	Power feed
XD2	Continuation of the power to the next node

Voltage	Function
V1	System voltage: power supply 1 (incl. supply of electronics)
V2	Load voltage: power supply 2, fed through, not used in device

6.3.1 Supply concept

The device is supplied via voltage V1. V2 is not used in the device, but is passed through and is available to supply other nodes.

V1 = supply of the module electronics and the respective slots
V2 = fed through

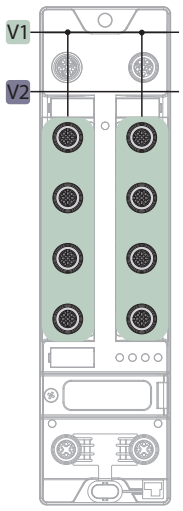


Fig. 16: Supply TBEN-LL-8IOLA

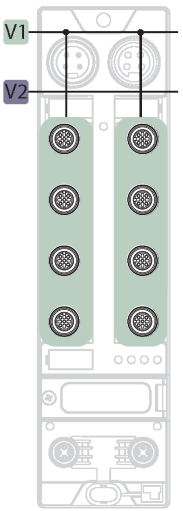


Fig. 17: Supply TBEN-L4-8IOLA

6.4 Connecting IO-Link devices and digital sensors and actuators

The device has eight M12 female connectors for connecting IO-Link devices and digital sensors and actuators. The maximum tightening torque is 0.6 Nm.

NOTICE
Wrong supply of IO-Link devices
Damage to the device electronics
- ▶ Only supply IO-Link devices with the voltage provided at the IO-Link master module.

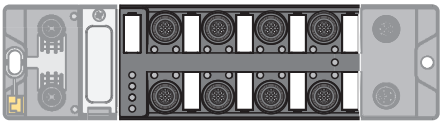
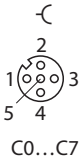


Fig. 18: M12 connectors, IO-Link master ports

- ▶ Connect the sensors and actuators to the device according to the pin assignment.

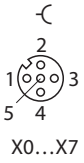
TBEN-L4-8IOLA



1 = V_{aux}1 (V1)
2 = DXP (V1)
3 = GND (V1)
4 = C/Q (V1)
5 = n.c.

Fig. 19: Pin assignment of IO-Link master ports C0…C7, Class A

TBEN-LL-8IOLA



1 = V_{aux}1 (V1)
2 = DXP (V1)
3 = GND (V1)
4 = C/Q (V1)
5 = n.c.

Fig. 20: Pin assignment of IO-Link master ports X0…X7, Class A

Pin	Meaning
Pin 1	VAUX1, switchable via process data
Pin 2	Digital in- or output (DXP)
Pin 3	Ground (V1)
Pin 4	IO-Link or digital in- or output (DXP)
Pin 5	Not connected

7 Commissioning

7.1 Adjusting network settings

The network settings can be adjusted via three decimal rotary coding switches on the device, via the web server or via the Turck Service Tool.

7.1.1 Adjusting network settings via rotary coding switches

The rotary coding switches are located together with the reset button under a service window.

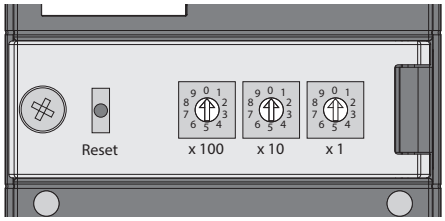


Fig. 21: Service window

- Open the service window above the switches.
- Set the rotary coding switch to the desired mode according to the table below.
- Carry out a voltage reset.
- NOTICE! IP65, IP67 or IP69K protection is not guaranteed when the service window above the rotary coding switches is opened. Damage to the device due to foreign material or liquids penetrating the device is possible. Tightly close the service window.

Switch positions

The network settings of the device depend on the selected mode. Changes to the settings become active after a voltage reset.

Switch settings 000 and 900 are no operation modes. After each reset of the device to the default values, the setting of an operating mode is necessary.

Switch position	Mode	Description
000	Network reset	The network reset resets the following network settings to the default values: IP address: 192.168.1.254 Subnet mask: 255.255.255.0 Gateway: 192.168.1.1
1…254	Rotary	In rotary mode (static rotary), the last byte of the IP address can be set manually at the device. The other network settings are stored non-volatile in the memory of the device and cannot be changed in rotary mode. Addresses from 1…254 can be set.
300	BootP	In BootP mode, the network settings are automatically assigned by a BootP server in the network. The subnet mask assigned by the BootP server and the default gateway address are stored non-volatile in the memory of the device.

Switch position	Mode	Description
400	DHCP	In DHCP mode, the network settings are by a DHCP server in the network. The subnet mask assigned by the DHCP server and the default gateway address are stored non-volatile in the memory of the device. DHCP supports three mechanisms for IP address allocation: ■ Automatic address assignment: The DHCP server assigns a permanent IP address to the client. ■ Dynamic address assignment: The IP address assigned by the server is only reserved for a certain period of time. After this time has elapsed or after the explicit release by a client, the IP address is reassigned. ■ Manual address assignment: A network administrator assigns an IP address to the client. In this case, DHCP is only used to transmit the assigned IP address to the client.
500	PGM	In PGM mode, the network settings are assigned manually via the Turck Service Tool, FDT/DTM or via a web server. The setting are stored to non-volatile the device.
600	PGM-DHCP	In PGM DHCP mode, the device initially operates a DHCP client and sends DHCP requests until it is assigned a permanent IP address. The DHCP client is automatically deactivated as soon as the device has received an IP address via the DTM, the Turck Service Tool or the web server If a DHCP server is used in the network, problems may occur when assigning the IP address, since in this case both the DHCP server and the PROFINET controller (via DCP), try to assign the IP address.
701…899	Name	The "Name" mode is used to set the DNS name of the device in Ethernet/IP networks. This mode is mainly used for DNS-based addressing in Schneider Electric controllers. The IP address is assigned automatically. The devices are addressed via the prefix "TBEN" and the address set on the rotary coding switches as follows: ■ Switch position 701: TBEN_701 … ■ Switch position 899: TBEN_899
900	Factory reset	The factory reset resets all settings to the default values: ■ Network setting (IP address, subnet mask, gateway) ■ PROFINET device name ■ Device parameters

7.1.2 Adjusting network setting via Turck Service Tool

- Connect the device to a PC via the Ethernet interface.
- Open the Turck Service Tool.
- Click **Search** or press [F5].

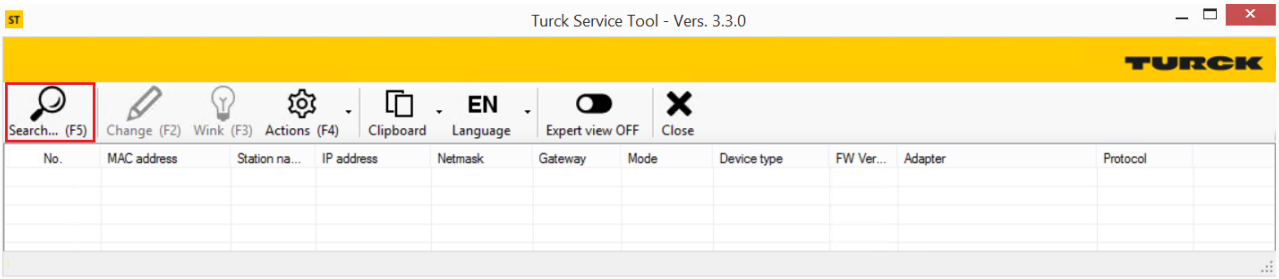


Fig. 22: Turck Service Tool: start screen

Turck Service Tool shows the devices found.

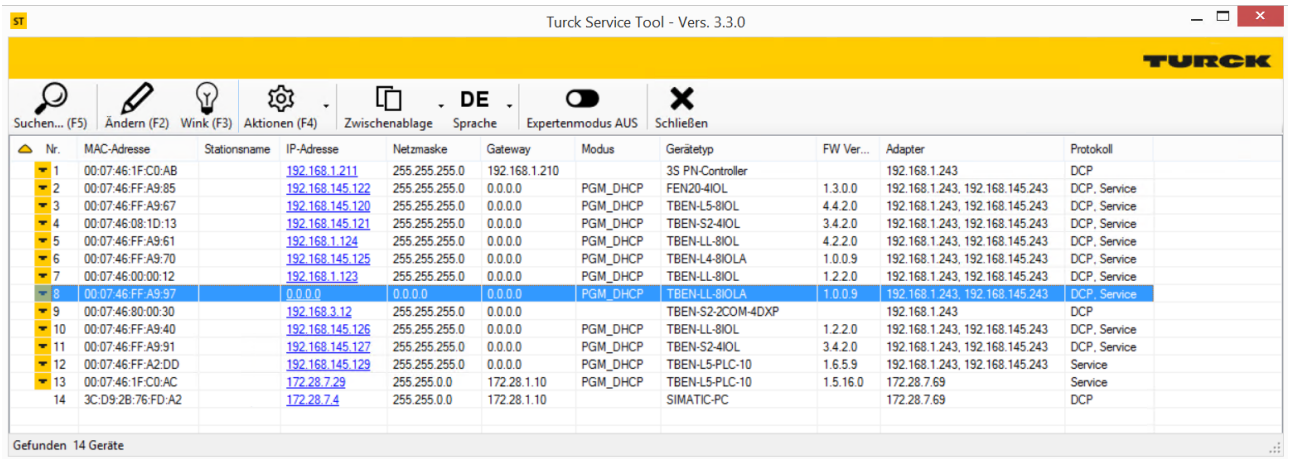


Fig. 23: Turck Service Tool: found devices

- ▶ Click on the desired device.
- ▶ Click **Change** or press [F2].

NOTE
Virtual network adapters may cause communication problems when accessing the found devices.

- ▶ Disable virtual network adapters.

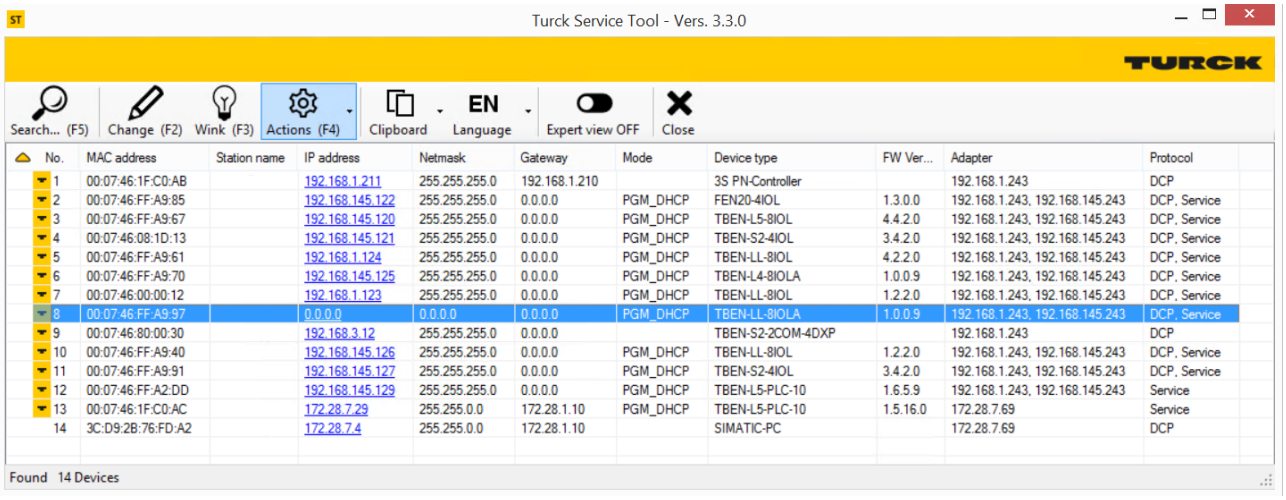


Fig. 24: Turck Service Tool: select the device to be addressed

NOTE
Clicking the device's IP address opens the web server.

- ▶ Change the IP address and the network mask if necessary.
- ▶ Accept the changes with Set in device.

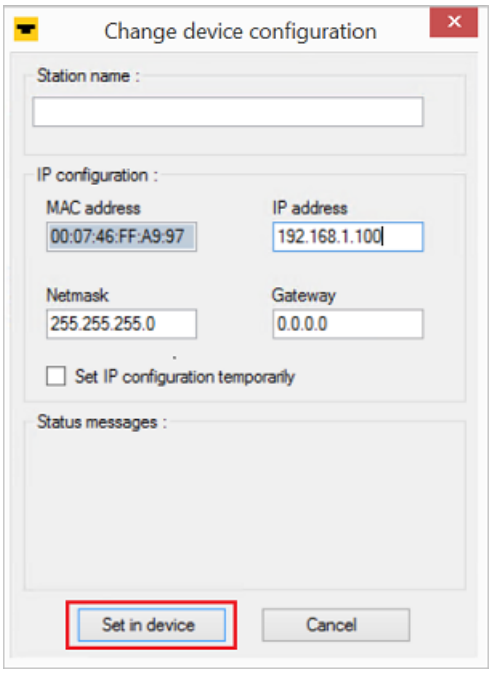


Fig. 25: Turck Service Tool: change device configuration

7.1.3 Adjusting network settings via the web server

A login is required in order to edit settings via the web server. The default password is “password”.

NOTE
To ensure greater security, Turck recommends changing the password after the first login.

- Enter the password in the Login field on the start page of the web server.
- Click **Login**.

NOTE
To be able to adjust the network settings via the web server, the device must be in PGM mode.

- Click **TBEN-L…** → **Parameter** → **Network**.
- Adjust the network settings.
- Write the changes into the device via **SET NETWORK CONFIGURATION**.

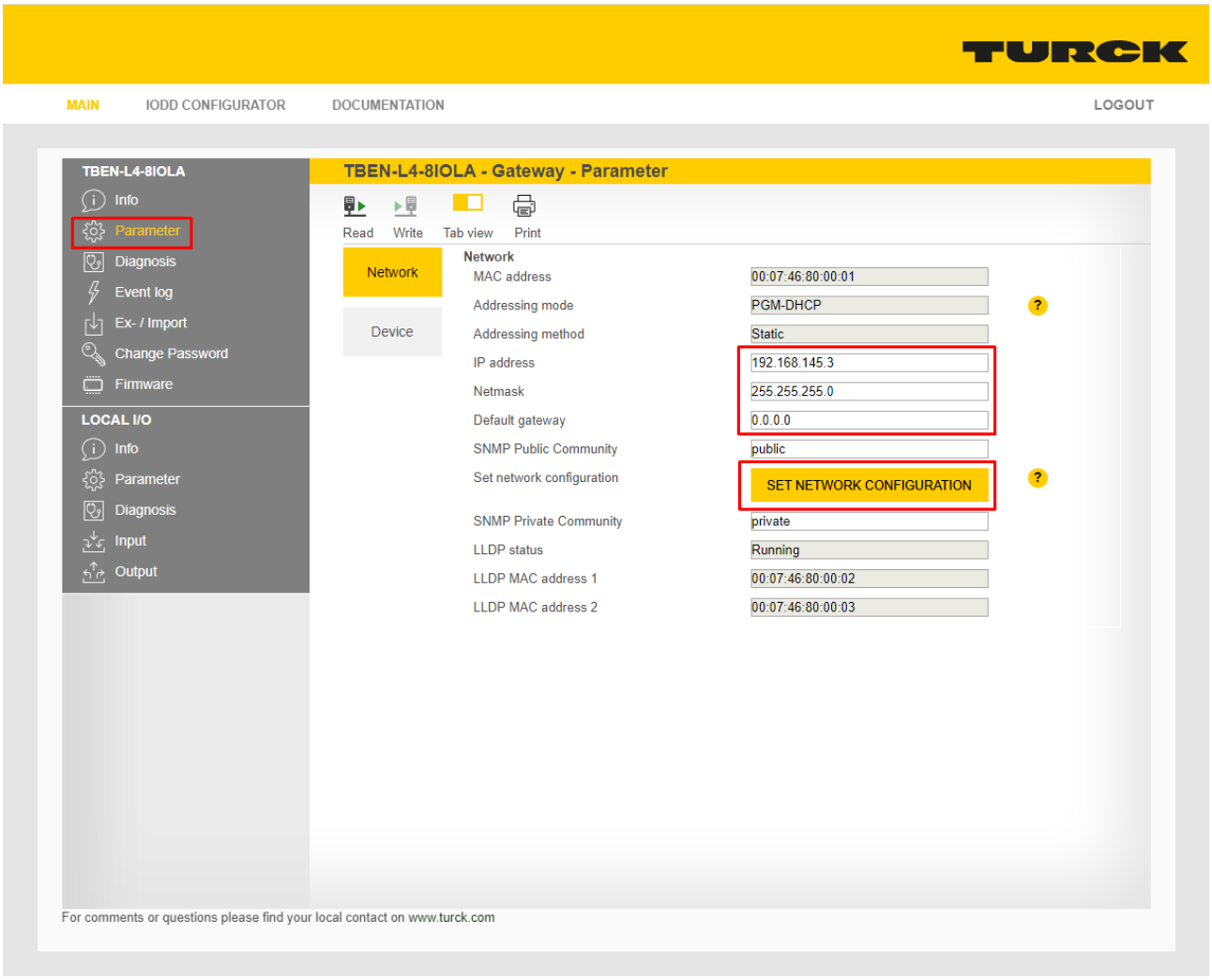


Fig. 26: Web server – adjusting network settings

7.2 Commissioning the device in PROFINET

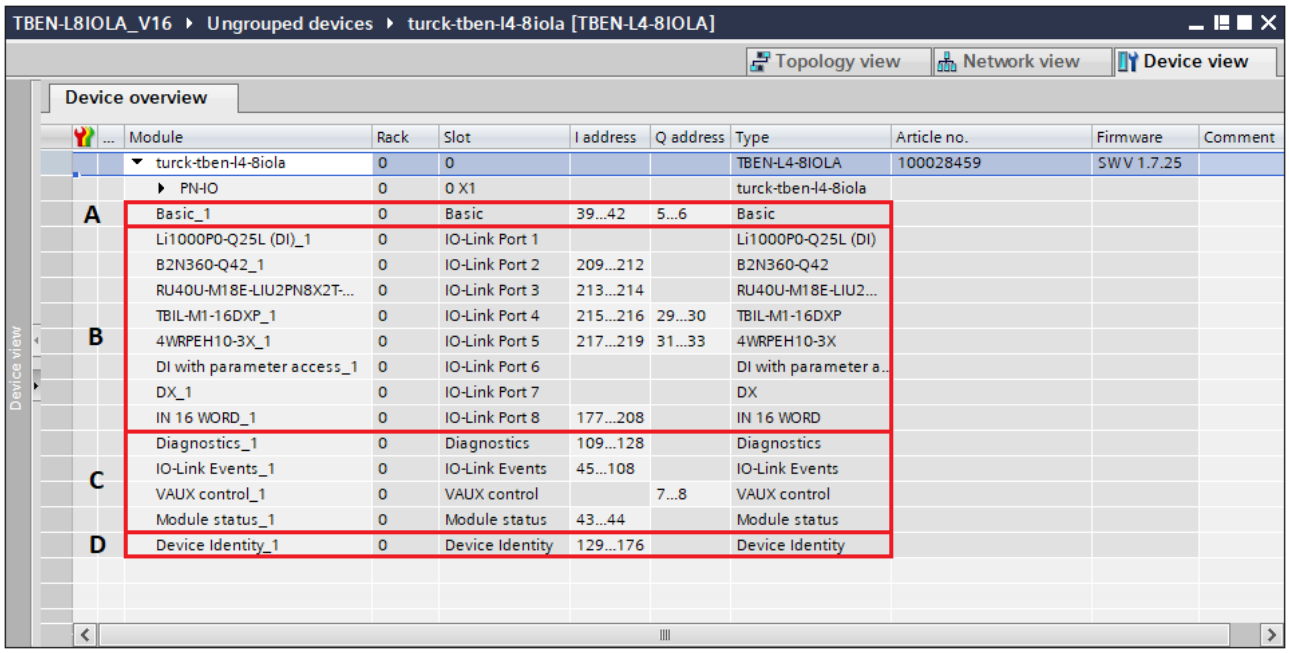
7.2.1 PROFINET IO device model

The technical properties of PROFINET IO devices are defined via their device description file, the PROFINET GSD file. A PROFINET IO device consists of 1…n slots, which can also contain 1…n sub slots. Sub slots are placeholders for sub modules and establish the interface to the process. Sub modules can contain parameters, data and diagnostics.

Slot 0 is always reserved as Device Access Point (DAP). The DAP contains the physical interface to the Ethernet network and represents the device. The other slots and sub slots represent the other device functions. The structure is defined by the manufacturer of field devices. It is not necessary that every slot or respectively sub slot is related to physical functions. The allocation of the slots and sub slots and thus the assignment of functions (operation mode, diagnostics, etc.) is done in the configuration software of the PROFINET controller. This device model allows manufacturers to design modular and flexible decentralized field devices. User are flexible in configuring decentralized field devices.

7.2.2 Device Model

The TBEN-L…-8IOLA has eight parameterizable IO-Link channels, which can also be used as digital channels in SIO mode, and 8 universal I/O channels (DXP). In addition to that, five virtual slots are provided via GSDML in PROFINET. Those slots are used to map the different diagnostic data and status information (IO-Link and VAUX diagnostics, IO-Link-Events, module status) as well as the device identification for connected IO-Link devices into the master's process image .



...	Module	Rack	Slot	I address	Q address	Type	Article no.	Firmware	Comment
	turck-tben-l4-8iola	0	0			TBEN-L4-8IOLA	100028459	SW V 1.7.25	
	PN-IO	0	0 X1			turck-tben-l4-8iola			
A	Basic_1	0	Basic	39...42	5...6	Basic			
	Li1000P0-Q25L (DI)_1	0	IO-Link Port 1			Li1000P0-Q25L (DI)			
	B2N360-Q42_1	0	IO-Link Port 2	209...212		B2N360-Q42			
	RU40U-M18E-LIU2PN8X2T-...	0	IO-Link Port 3	213...214		RU40U-M18E-LIU2...			
	TBIL-M1-16DXP_1	0	IO-Link Port 4	215...216	29...30	TBIL-M1-16DXP			
B	4WRPEH10-3X_1	0	IO-Link Port 5	217...219	31...33	4WRPEH10-3X			
	DI with parameter access_1	0	IO-Link Port 6			DI with parameter a...			
	DX_1	0	IO-Link Port 7			DX			
	IN 16 WORD_1	0	IO-Link Port 8	177...208		IN 16 WORD			
	Diagnostics_1	0	Diagnostics	109...128		Diagnostics			
	IO-Link Events_1	0	IO-Link Events	45...108		IO-Link Events			
C	VAUX control_1	0	VAUX control		7...8	VAUX control			
	Module status_1	0	Module status	43...44		Module status			
D	Device Identity_1	0	Device Identity	129...176		Device Identity			

Fig. 27: TBEN-L…-8IOLA – slot overview in TIA-Portal

A	Basic slot e. g. For DXP channels and Data Valid signal
B	IO-Link ports for the configuration with specific IO-Link devices or for generic configuration
C	One slot each for diagnostics and status
D	Device identification, device and vendor ID of the connected IO-Link devices

7.2.3 Address setting in PROFINET

In IP-based communication, the field devices are addressed by means of an IP address. PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.

When delivered, each field device has, among other things, a MAC address. This information is sufficient to give the respective field device a unique name.

The address is assigned in two steps:

- Assignment of a unique plant specific name to the respective field device.
- Assignment of the IP address from the IO-Controller before the system start-up based on the plant-specific (unique) name.

PROFINET naming convention

The names are assigned via DCP. The device name is checked for correct spelling during input. The following rules apply for the use of the device name according to PROFINET specification V2.3.

- All device names must be unique.
- Maximum name size: 240 characters
  Allowed:
  - Lower case letters a…z
  - Numbers 0…9
  - Hyphen and dot
- The name may consist of several components separated by a period. A name component, i.e. a string between two dots, may be a maximum of 63 characters long.
- The device name must not start or end with a hyphen.
- The device name must not start with "port-xyz" (y…z = 0…9).
- The name must not have the form of an IP address (n.n.n, n = 0…999).
- Do not use special characters.
- Do not use capital letters.

7.2.4 FSU – Fast Start-Up (prioritized startup)

FSU enables a PLC to build up connections to PROFINET nodes in less than 500 ms after switching-on the network power supply (V1). The fast start-up is necessary for fast tool changing applications at robot arms for example in the automobile industry.

NOTE
For the correct cabling in FSU applications please observe the note in the chapter "Connecting the Device to Ethernet" [▶ 19] .

Fast Start-Up TBEN

The TBEN-L modules support the prioritized start-up (FSU). In order to enable FSU, the field bus nodes have to be configured respectively , for example in TIA-Portal (Siemens).

Autonegotiation	Deactivated
Transmission medium/duplex:	Set to a fixed value

- During configuration, please observe that the neighboring devices do also support FSU and that the settings for the ports of neighboring devices are identical.
- Set "Transmission rate/duplex" to a fix value.
- Deactivate auto-negotiation

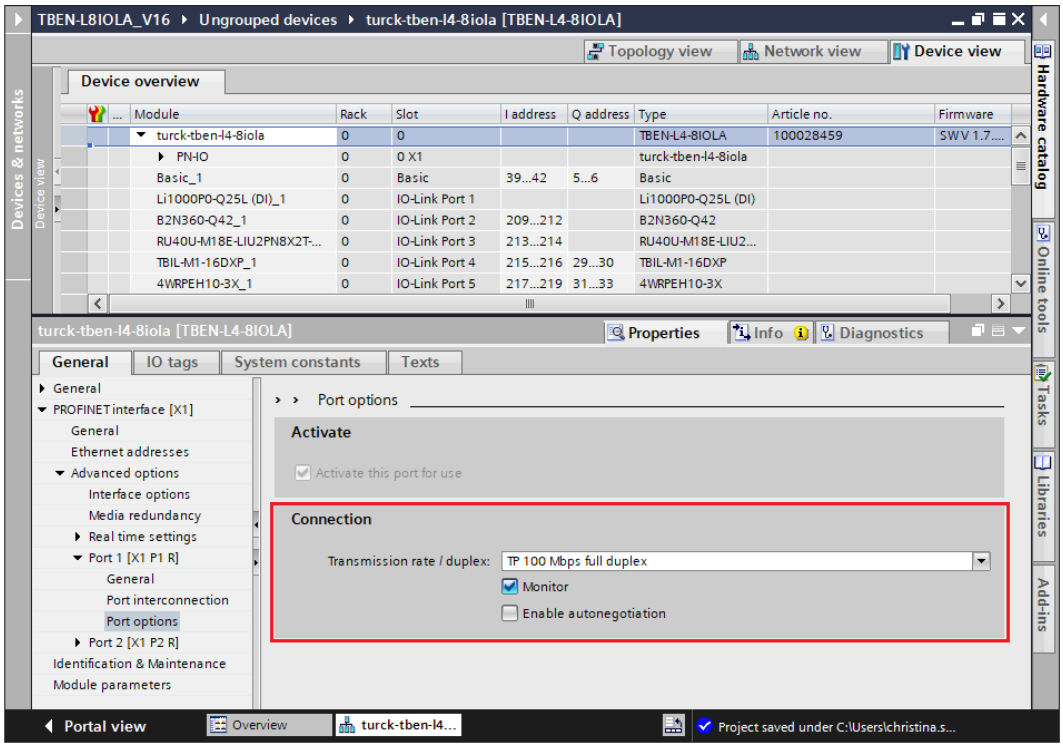


Fig. 28: TIA-Portal – port-settings for FSU

- Activate the prioritized start-up at the I/O device.

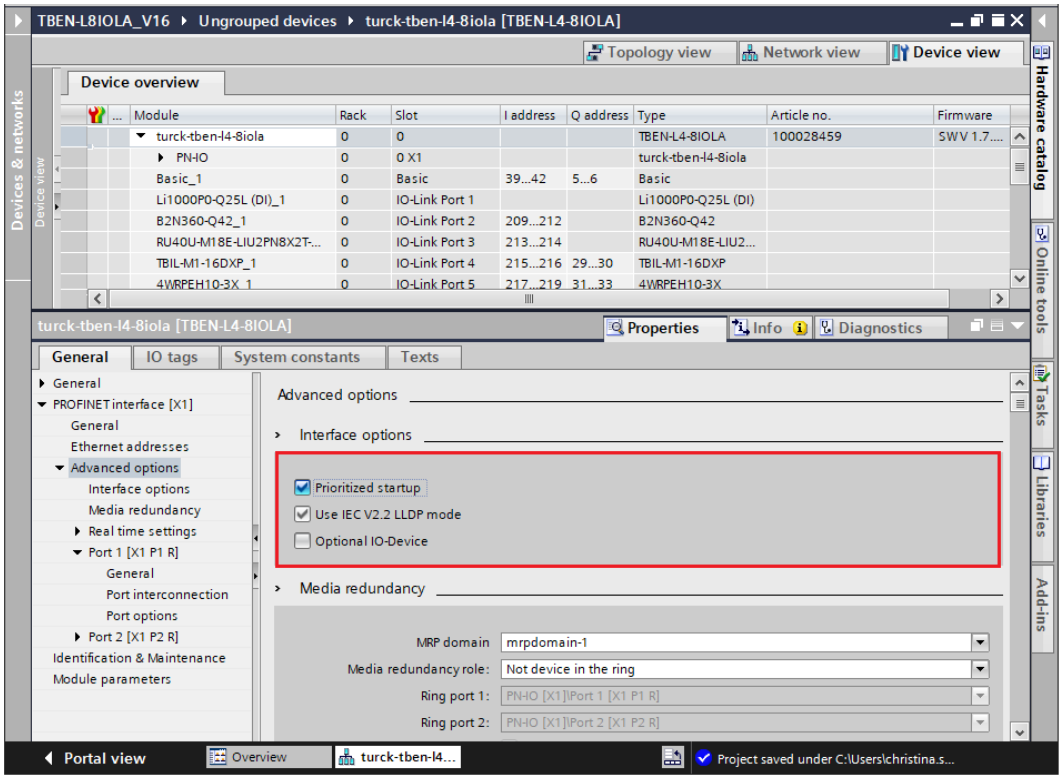


Fig. 29: TIA-Portal – prioritized start-up, activation at the I/O device

7.2.5 MRP (Media Redundancy Protocol)

The device supports MRP. MRP is a standardized protocol according to IEC 62439. It describes a mechanism for media redundancy in ring topologies. With MRP, a defective ring topology with up to 50 nodes is detected and reconfigured in the event of an error. With MRP a trouble-free switch-over is not possible.

A Media Redundancy Manager (MRM) checks the ring topology of a PROFINET network defined by the network configuration for functionality. All other network nodes are Media Redundancy Clients (MRC). In the error-free state, the MRM blocks normal network traffic on one of its ring ports, with the exception of the test telegrams. The physical ring structure thus becomes a line structure again at the logical level for normal network traffic. If a test telegram fails to appear, a network error has occurred. In this case, the MRM opens its blocked port and establishes a new functioning connection between all remaining devices in the form of a linear network topology.

The time between ring interruption and recovery of a redundant path is called reconfiguration time. For MRP, this is a maximum of 200 ms. Therefore, an application must be able to compensate for the 200 ms interruption. The reconfiguration time always depends on the Media Redundancy Manager (e.g. the PROFINET PLC) and the I/O cycle and watchdog times set here. For PROFINET, the response monitoring time must be selected accordingly > 200 ms.

It is not possible to use Fast Start-Up in an MRP network.

7.2.6 User data for acyclic services

The acyclic data exchange is by using via Record Data CRs (Communication Relation). Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data (AR = Application Relation)
- Writing of configuration data
- Reading and writing of device data
- Reading of diagnostic data
- Reading of I/O data
- Reading of Identification Data Objects (I&M functions)

Acyclic device user data

Index		Name	Data type	Access	Comment
Dec.	Hex.				
1	0x01	Module parameters	WORD	read/ write	Parameter data of the module (slot 0)
2	0x02	Module designation	STRING	read	Designation assigned to the module (slot 0)
3	0x03	Module revision	STRING	read	Firmware revision of the module
4	0x04	Vendor ID	WORD	read	Vendor ID for Turck
5	0x05	Module name	STRING	read	The device name assigned to the module
6	0x06	Module type	STRING	read	Device type of the module
7	0x07	Device ID	WORD	read	Device ID of the module
8…23	0x08… 0x17	reserved	-	-	-
24	0x18	Module diagnostics	WORD	read	Diagnostic data of the module (slot 0).
25…31	0x19… 0x1F	reserved	-	-	-
32	0x20	Input list	ARRAY of BYTE	read	List of all module input channels
33	0x21	Output list	ARRAY of BYTE	read	List of all module output channels
34	0x22	Diag. list	ARRAY of BYTE	read	List of all I/O-channel diagnostics
35	0x23	Parameter list	ARRAY of BYTE	read	List of all I/O-channel parameters
36… 28671	0x24… 0x6FFF	reserved	-	-	-
28672	0x7000	Module parameters	WORD	read/ write	Activate field bus protocol
28673… 45039	0x7001 … 0xAFEF	reserved	-	-	-
45040	0xAFF0	I&M0-functions		read	Identification & Maintaining
45041	0xAFF1	I&M0-functions	STRING[54]	read/ write	I&M Tag function and location

Index		Name	Data type	Access	Comment
45042	0xAFF2	I&M2-functions	STRING[16]	read/ write	I&M Installation Date
45043	0xAFF3	I&M3-functions	STRING[54]	read/ write	I&M Description Text
45044	0xAFF4	I&M4-functions	STRING[54]	read/ write	I&M Signature
45045… 45055	0xAFF5 … 0xAFFF	I&M5 to I&M15-functions		-	not supported

Acyclic I/O channel user data

Index		Name	Data type	Access	Comment
Dec.	Hex.				
1	0x01	Module parameters	specific	read/ write	Parameters of the module
2	0x02	Module type	ENUM UINT8	read	Contains the module type
3	0x03	Module version	UINT8	read	Firmware version of I/O channels
4	0x04	Module ID	DWORD	read	Module ID of the I/O
5…9	0x05 … 0x09	reserved	-	-	-
10	0x0A	Slave controller version	UINT8 array [8]	read	Version number of the slave controller.
11…18	0x0B… 0x12	reserved	-	-	-
19	0x13	Input data	specific	read	Input data of the respective I/O-channel
20…22	0x14 … 0x16	reserved	-	-	-
23	0x17	Output data	specific	read/ write	Output data of the respective I/O-channel
…	…	reserved	-	-	-

Index		Name	Data type	Access	Comment
Dec.	Hex.				
247	0xF7	CAP 1	Record	read/ write	Client access point for class 1 masters
248	0xF8	CAP 2	Record	read/ write	
249	0xF9	CAP 3	Record	read/ write	
250	0xFA	CAP 4	Record	read/ write	
251	0xFB	CAP 5	Record	read/ write	
252	0xFC	CAP 6	Record	read/ write	
253	0xFD	CAP 7	Record	read/ write	
254	0xFE	CAP 8	Record	read/ write	
255	0xFF	CAP 9	Record	read/ write	Client access point for class 2 masters

7.2.7 The IO-Link function block IOL_CALL

The IO-Link function block IOL_CALL is specified in the IO-Link specification "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET".

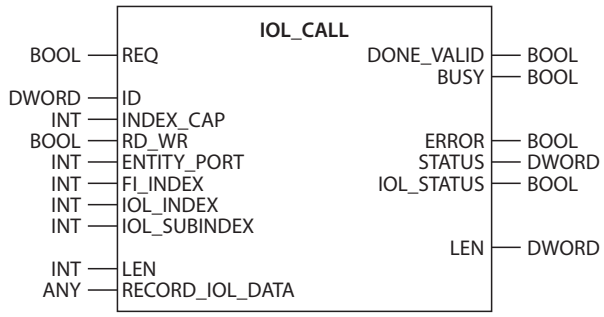


Fig. 30: IOL_CALL in accordance with IO-Link specification

NOTE
Depending on the controller manufacturer, the function blocks may deviate from the specification, e.g. in the representation and use of the variables used (example: Siemens function block IO_Link_Device for TIA Portal). For more information, refer to the documentation of the respective controller manufacturer.

Function block IOL_CALL: input variables

The following description of the function block variables is partially taken from the IO-Link specification.

Name in accordance with IO-Link specification	Data type	Meaning
REQ	BOOL	0 → 1 → 0: Send command
ID	DWORD	Address of the IO-Link master module Siemens CPU 300, 400 (PROFIBUS/PROFINET): Start address of the input data of the IO-Link master module ■ 3 S CODESYS: Addressing the IO-Link master ■ Siemens CPU 1200, 1500 (PROFIBUS/PROFINET): Hardware identifier of the IO-Link master module ■ Siemens CPU 300, 400 (PROFIBUS/PROFINET): Start address of the input data of the IO-Link master module
ITFMODULE	DWORD	Device name of the IO-Link master
INDEX_CAP	INT	Function block instance: 251…254
RD_WR	BOOL	0: Write access 1: Write access
ENTITY_PORT	INT	Address of the IO-Link port to be accessed.
FI_INDEX	INT	Constant value (65098): Defines the access as IO-Link function block IOL_CALL
IOL_INDEX	INT	Number of the IO-Link index which has to be read or written
IOL_SUBINDEX	INT	Number of the IO-Link sub index has to be read or written

Name in accordance with IO-Link specification	Data type	Meaning
LEN	INT	Length of the data to be read or written
RECORD_IOL_DATA		Source or destination for the data to be read/written

Function block IOL_CALL: output variables

The following description of the function block variables is partially taken from the IO-Link specification.

Name in accordance with IO-Link specification	Data type	Meaning
DONE_VALID	BOOL	0: Command was not executed. 1: Command was executed.
BUSY	BOOL	0: Command is currently not executed. 1: Command is currently executed.
ERROR	BOOL	0: No error present 1: Error while reading or writing.
STATUS	DWORD	Communication error status: status of the acyclic communication [▶ 37]
IOL_STATUS	DWORD	IO-Link error message: Error in the communication between IO-Link master ad IO-Link device [▶ 38]
LEN	INT	Length of the read data

IOL_CALL – communication error status

The status of the acyclic communication contains 4 byte and is structured as follows:

Byte 3	Byte 2	Byte 1	Byte 0
Manufacturer specific identifier (not always applicable)	0×80 Specifies the error as an error of acyclic communication.	Error code/ status code	Vendor specific identifier (not always applicable)

Status Code	Name	Meaning
0xFF000000	TIMEOUT	Internal error in the communication with the module
0x00FFF00	INVALID_HANDLE	
0x00FFFE00	HANDLE_OUT_OF_ BUFFERS	
0x00FFFD00	HANDLE_DESTINATION_ UNAVAILABLE	
0x00FFFC00	HANDLE_UNKNOWN	
0x00FFFB00	HANDLE_METHOD_ INVALID	
0xXX80A0XX	MASTER_READ_ERROR	Error while reading
0xXX80A1XX	MASTER_WRITE_ERROR	Error while writing
0xXX80A2XX	MASTER_MODULE_ FAILURE	Failure of the IO-Link master, bus failure possible
0xXX80A6XX	MASTER_NO_DATA	No data received
0xXX80A7XX	MASTER_BUSY	IO-Link master busy

Status Code	Name	Meaning
0xXX80A9XX	MASTER_FEATURE_NOT_SUPPORTED	Function not supported by IO-Link master.
0xXX80AAXX	MASTER_RESOURCE_UNAVAILABLE	IO-Link master not available.
0xXX80B0XX	ACCESS_INVALID_INDEX	Index invalid, wrong INDEX_CAP used
0xXX80B1XX	ACCESS_WRITE_LENGTH_ERROR	Length of data to be written can not be handled from the module, wrong module accessed.
0xXX80B2XX	ACCESS_INVALID_DESTINATION	Wrong slot accessed
0xXX80B03XX	ACCESS_TYPE_CONFLICT	IOL_CALL invalid
0xXX80B5XX	ACCESS_INVALID_INDEX	Error in IOL_CALL sequence
0xXX80B6XX	ACCESS_DENIED	IOL-Link master module refuses the access.
0xXX80C2XX	RESOURCE_BUSY	The IO-Link master module is busy or is waiting for an answer of the connected IO-Link device.
0xXX80C3XX	RESOURCE_UNAVAILABLE	
0xXX8901XX	INPUT_LEN_TOO_SHORT	The index to be read contains more data than defined in the input variable "LEN".

IOL_CALL – IOL_STATUS

The IOL_STATUS consists of 2 byte Error Code (IOL_M Error_Codes, according to "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET") and 2 byte Error Type (according to "IO-Link Interface and System").

Byte 3	Byte 2	Byte 1	Byte 0
IOL_M-Error-Code		IOL-Error Type	

IOL_M Error Code	Designation acc. to specification	Meaning
0x0000	No error	No error
0x7000	IOL_CALL Conflict	Unexpected write-request, read request expected
0x7001	Wrong IOL_CALL	Decoding error
0x7002	Port blocked	The accessed port is occupied by another task
…	reserved	
0x8000	Timeout	Timeout, IOL master or IOL device port busy
0x8001	Wrong index	Error: IOL index < 32767 or > 65535 selected
0x8002	Wrong port address	Port address not available
0x8003	Wrong port function	Port function not available
…	reserved	

IOL Error Type	Designation acc. to specification	Meaning
0x1000	COM_ERR	Communication error Possible source: the addressed port is parameterized as digital input DI and is not in IO-Link mode
0x1100	I_SERVICE_TIMEOUT	Timeout in communication, device does not respond in time
0x5600	M_ISDU_CHECKSUM	Master reports checksum error, access to device not possible
0x5700	M_ISDU_ILLEGAL	Device can not respond to master request
0x8000	APP_DEV	Application error in the device
0x8011	IDX_NOTAVAIL	Index not available
0x8012	SUBIDX_NOTAVAIL	Sub-Index not available
0x8020	SERV_NOTAVAIL	The service is temporarily not available.
0x8021	SERV_NOTAVAIL_LOCCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device via the master active)
0x8022	SERV_NOTAVAIL_DEVCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device via DTM or PLC etc. active)
0x8023	IDX_NOT_WRITEABLE	Access denied, index cannot be written
0x8030	PAR_VALOUTOFRNG	Parameter value out of the valid range
0x8031	PAR_VALGTLIM	Parameter value above upper limit
0x8032	PAR_VALLTLIM	Parameter value value below the lower limit
0x8033	VAL_LENOVRRUN	Length of data to be written does not match the length defined for this parameter
0x8034	VAL_LENUNDRUN	
0x8035	FUNC_NOTAVAIL	Function not available in the device
0x8036	FUNC_UNAVAILTEMP	Function not available in the device
0x8040	PARA_SETINVALID	Invalid parameter: Parameters not consistent with other parameters in the device.
0x8041	PARA_SETINCONSIST	Inconsistent parameters
0x8082	APP_DEVNOTRDY	Application not ready, device busy
0x8100	UNSPECIFIC	Vendor specific, according to device documentation
0x8101…0x8FFF	VENDOR_SPECIFIC	

7.3 Connecting the devices to a PROFINET master with TIA Portal

The following example describes the connection of the devices to a Siemens PLC in PROFINET by means of the programming software SIMATIC STEP7 Professional V15 (TIA-Portal).

Used hardware

The following hardware components are used in this example:

- Siemens PLC S7-1500
- IO-Link master TBEN-L…-8IOLA with the following configuration:
  - Port 1: Turck temperature sensor, TS-530-LI2UPN8X-…, IO-Link V1.0
  - Port 2: Channel used as DI
  - Port 3: Turck linear position sensor, Li100P0-Q25LM0-…, IO-Link V1.0
  - Port 4: Channel used as DI
  - Port 5: Channel used as DI
  - Port 6: Turck IO-Link hub: TBIL-M1-16DXP, IO-Link V1.1
  - Port 7: Turck ultra sonic sensor, RU130U-M18E-…, IO-Link V1.1
  - Port 8: Turck ultra sonic sensor, B2N360-Q42-…, IO-Link V1.1

Used Software

The following software tools are used in this example:

- SIMATIC STEP7 Professional V16 (TIA-Portal)
- GSDML file for TBEN-L…-8IOL (can be downloaded for free as ZIP archive "TBEN-L_PROFINET.zip" under www.turck.com)

Prerequisites

- The programming software has been started.
- A new project has been created.
- The PLC has been added to the project.

7.3.1 Installing the GSDML file

The GSDML file can be downloaded for free from www.turck.com .

- ▶ Adding the GSDML-file: Click **Options → Manage general station description files (GSD)**.
- ▶ Installing the GSDML-file: Define the source path for the GSDML-file and click **Install**.

⇨ The device is added to the Hardware catalog of the programming software.

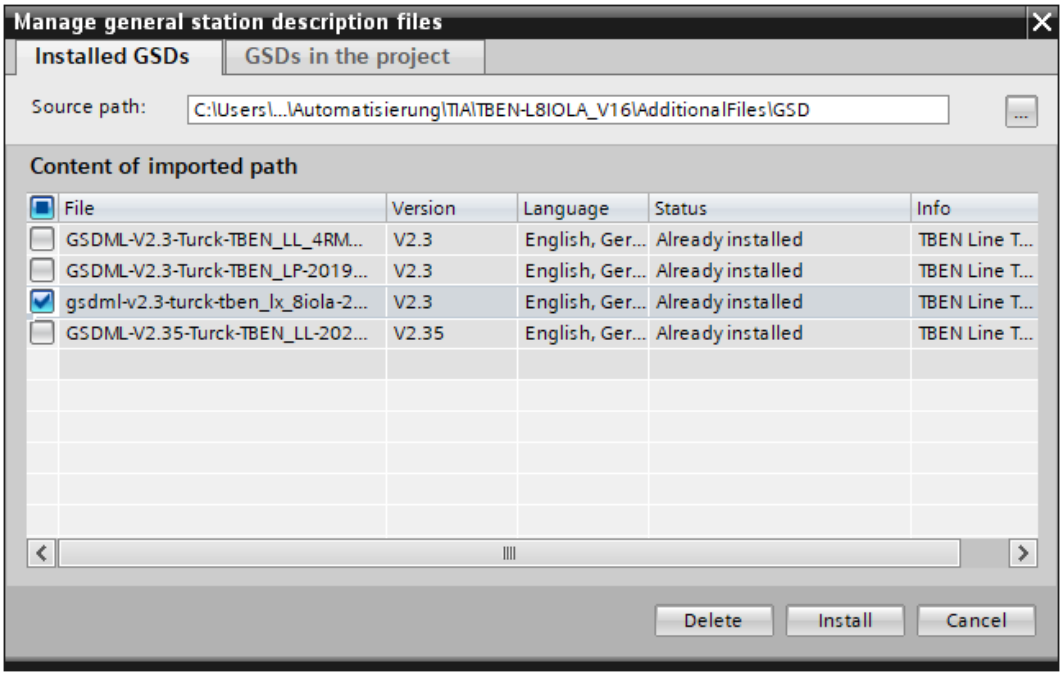


Fig. 31: TIA-Portal – installing the GSDML file

7.3.2 Connecting the devices to the PLC

- Select the device from the Hardware catalog and drag it into the **Device & networks** editor.
- Connect the devices to the PLC in the **Devices & networks** editor.

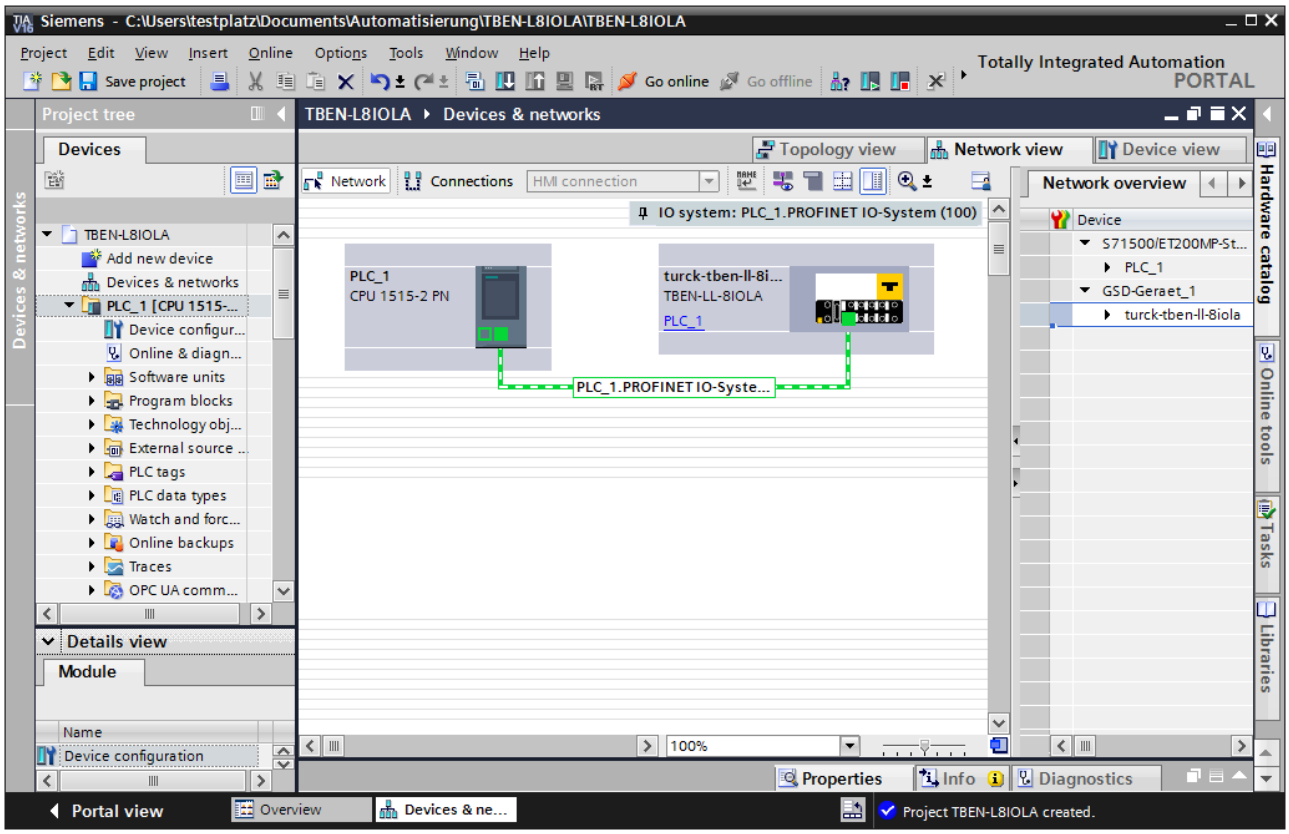


Fig. 32: Connecting the device to the PLC

7.3.3 Assigning the PROFINET device name

- Select **Online access** → **Online & diagnostics**.
- **Functions** → **Assign PROFINET device name.**
- Assign the desired PROFINET device name with **Assign name.**

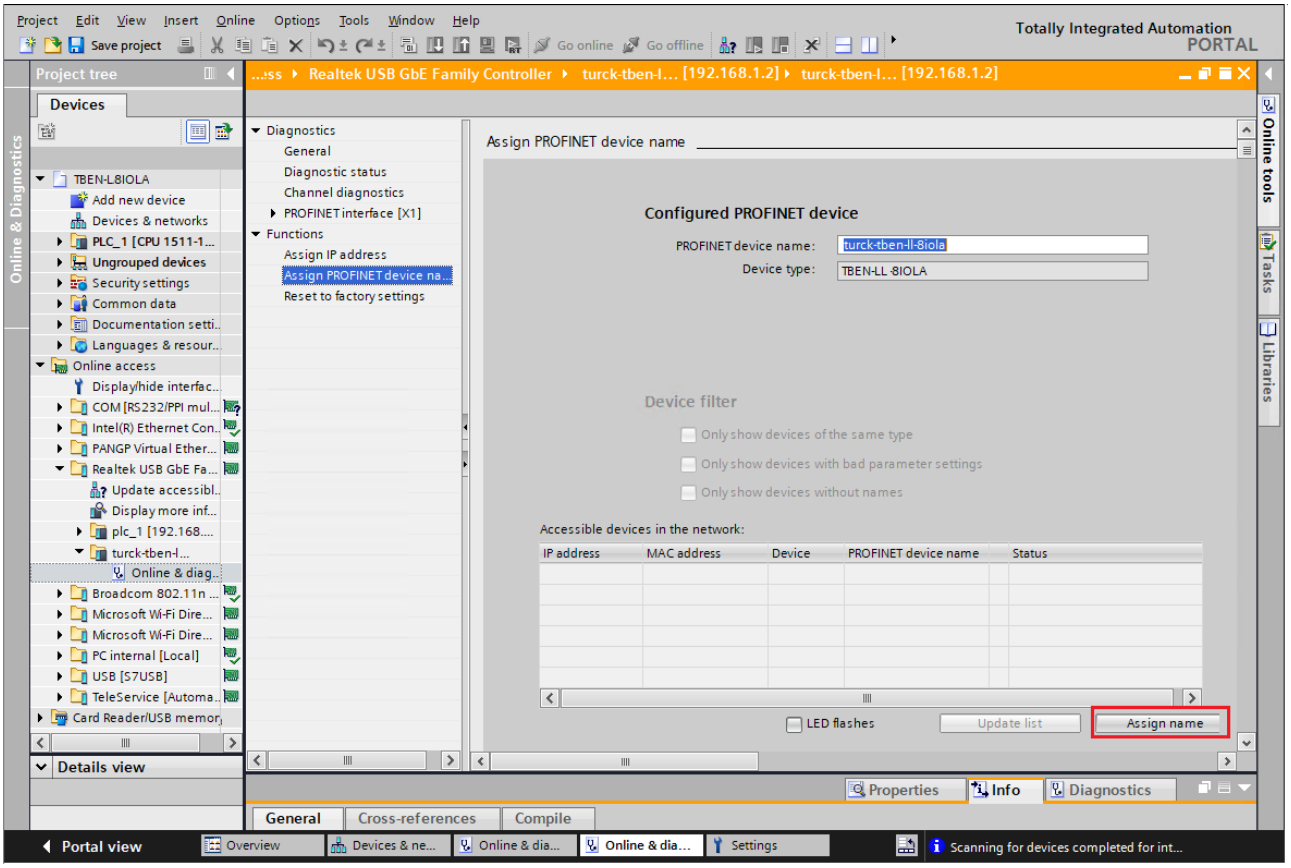


Fig. 33: TIA-Portal – assigning a PROFINET PROFINET name

7.3.4 Setting the IP address in TIA Portal

- Select **Device** → **Properties** tab → **Ethernet addresses**.
- Assign the desired IP address.

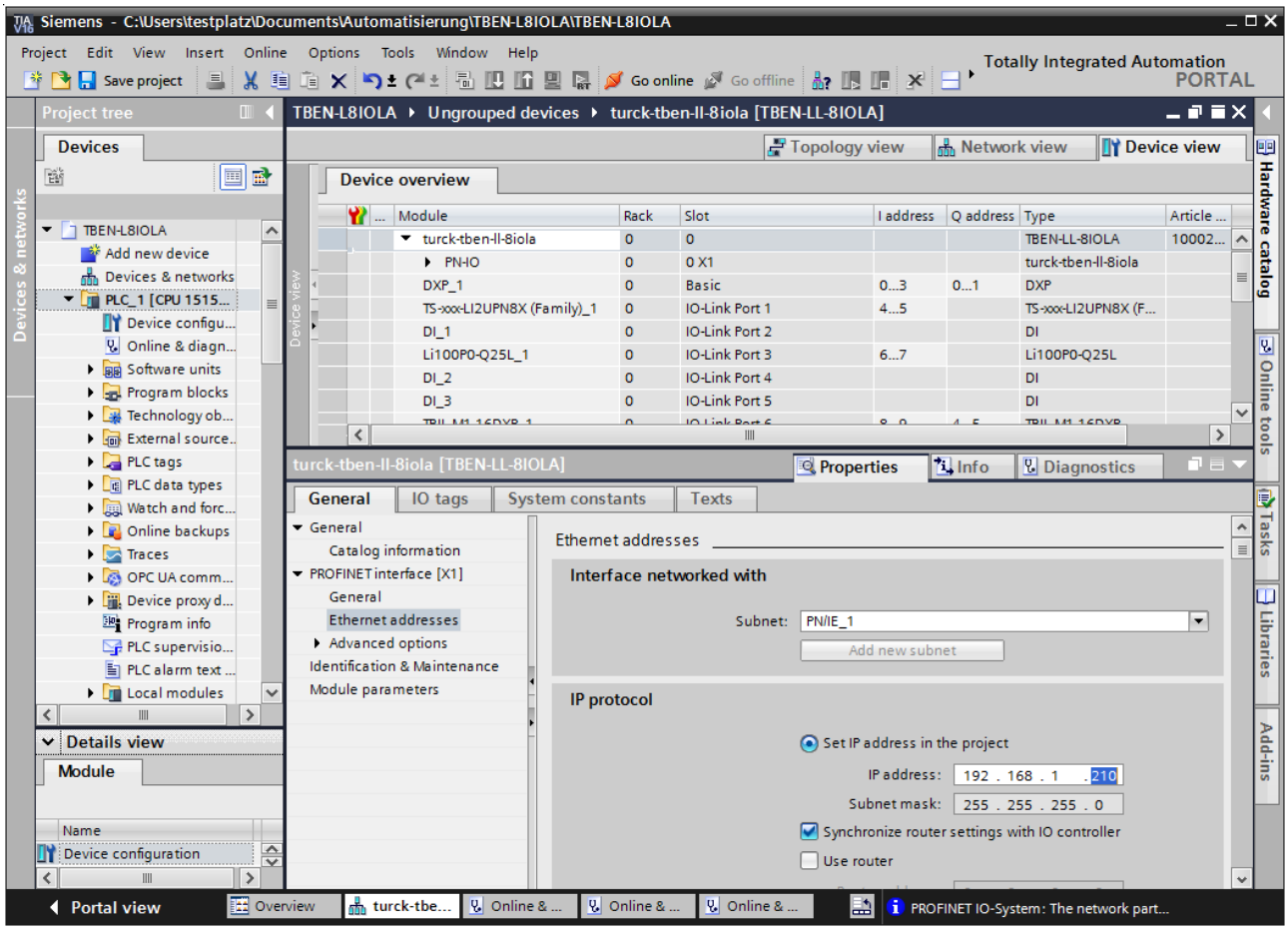


Fig. 34: IP -Portal– Assigning the IP address

7.3.5 Configuring device functions

The TBEN-L…-8IOLA appears as a modular slave with twelve empty virtual slots. Slots 0 and Basic are pre-configured.

The function of the twelve empty slots is already defined in the GSDML file. The slots can only be used for a specific purpose.

Slot	Meaning
0	Main module turck-tben-ll-8iola (default name) Parameterization of functions (protocol deactivation, etc.), which concern the complete module.
XI	Parameterization of PROFINET functions (MRP, etc.)
X1 P1	Parameterization of the Ethernet port properties (topology, connection options etc.).
X1 P2	
Basic	Parameters and diagnostics for the DXP-channels of the device (DXP 0… DXP 15) and Data Valid Signal from the IO-Link ports.
IO-Link port 1…8	Configuration of the eight IO-Link ports
Diagnostics	Optional mapping of the diagnostics (IO-Link and DXP-diagnostics) into the master's process image.
IO-Link Events	Optional mapping of the IO-Link events into the master's process image.
VAUX Control	Optional mapping of the VAUX diagnostics into the master's process image.
Module status	Optional mapping of the module status into the masters process image.
Device identification	Device identification and vendor ID of the connected IO-Link devices

Configuring IO-Link ports (example)

IO-Link-Port (Hardware)	Process data length	IO-Link device	GSDML entry
Port 1	2 byte IN	Turck temperature sensor, TS-530-LI2UPN8X-...	Port-configuration generic: IN 1 WORD
Port 2	1 Bit IN	-	DI
Port 3	2 byte IN	Turck linearity sensor, Li100P0-Q25LM0-...	Port configuration specific (SIDI): Li100P0-QU25L
Port 4	2 byte IN 2 byte OUT	Turck I/O hub, TBIL-M1-16DXP	Port configuration specific (SIDI): TBIL-M1-16DXP
Port 5	1 Bit IN	-	DI
Port 6	1 Bit IN	-	DI
Port 7	1 Bit IN	Turck ultrasonic sensor, RU130U-M18E-...	Port configuration specific (SIDI): RU40U-M18E-LiU2PN...(DI) The IO-Link port is configured as digital input only.
Port 8	4 byte IN	Turck inclinometer, B2N360-Q42-...,	Port configuration specific (SIDI): B2N360-Q42-E2LiUPN8X2

- Select **Device view** → **Device overview.**
- Select functions as operation mode, diagnostics etc. from the hardware catalog and add them to the device slots via drag&drop.

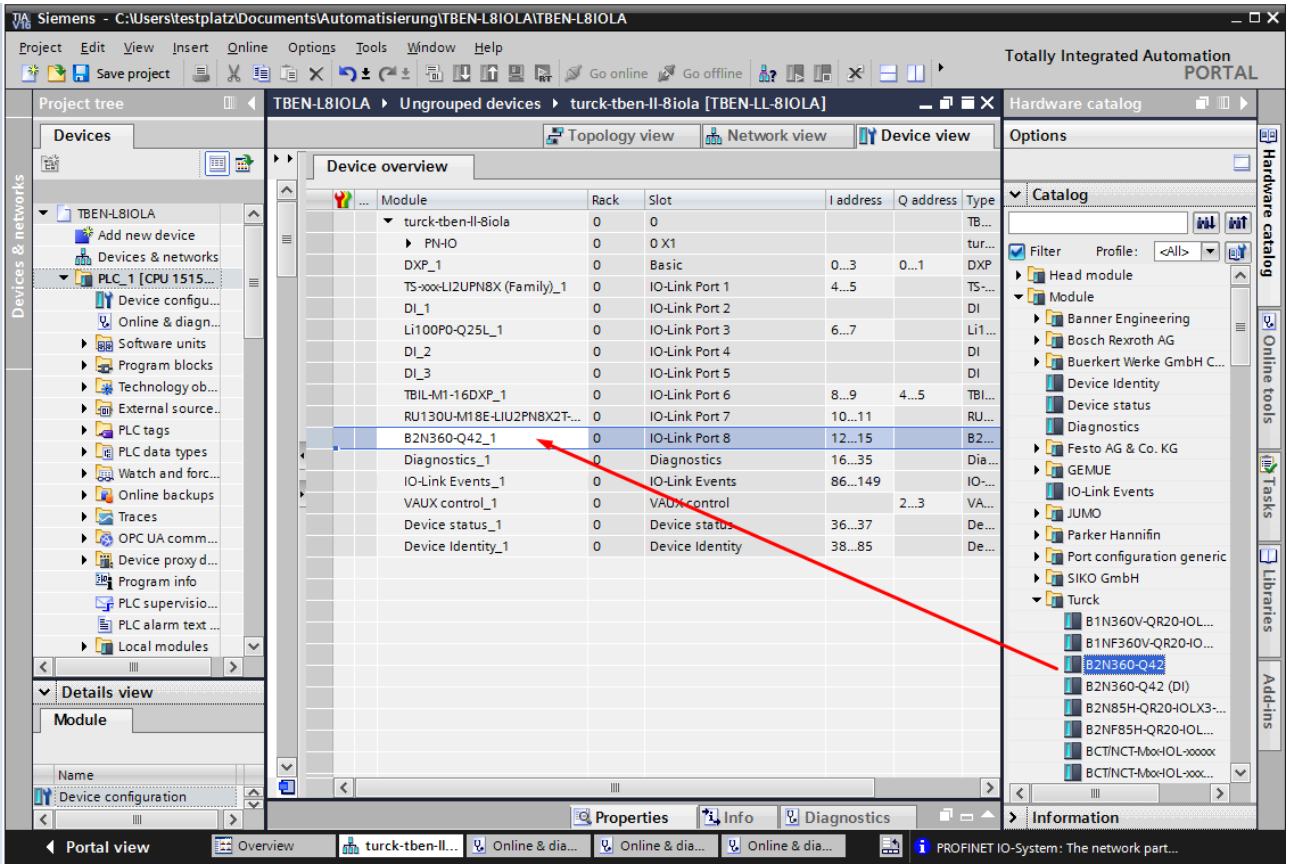


Fig. 35: TIA-Portal – configuring device slots

Setting IO-Link port parameters

- Select **Device view** → **Device overview**.
- Select the device to be parameterized.
- Click **Properties** → **General** → **Module parameters**.
- Set the **device parameters**.

In generic port configuration, the ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in SIO mode (DI or DO).

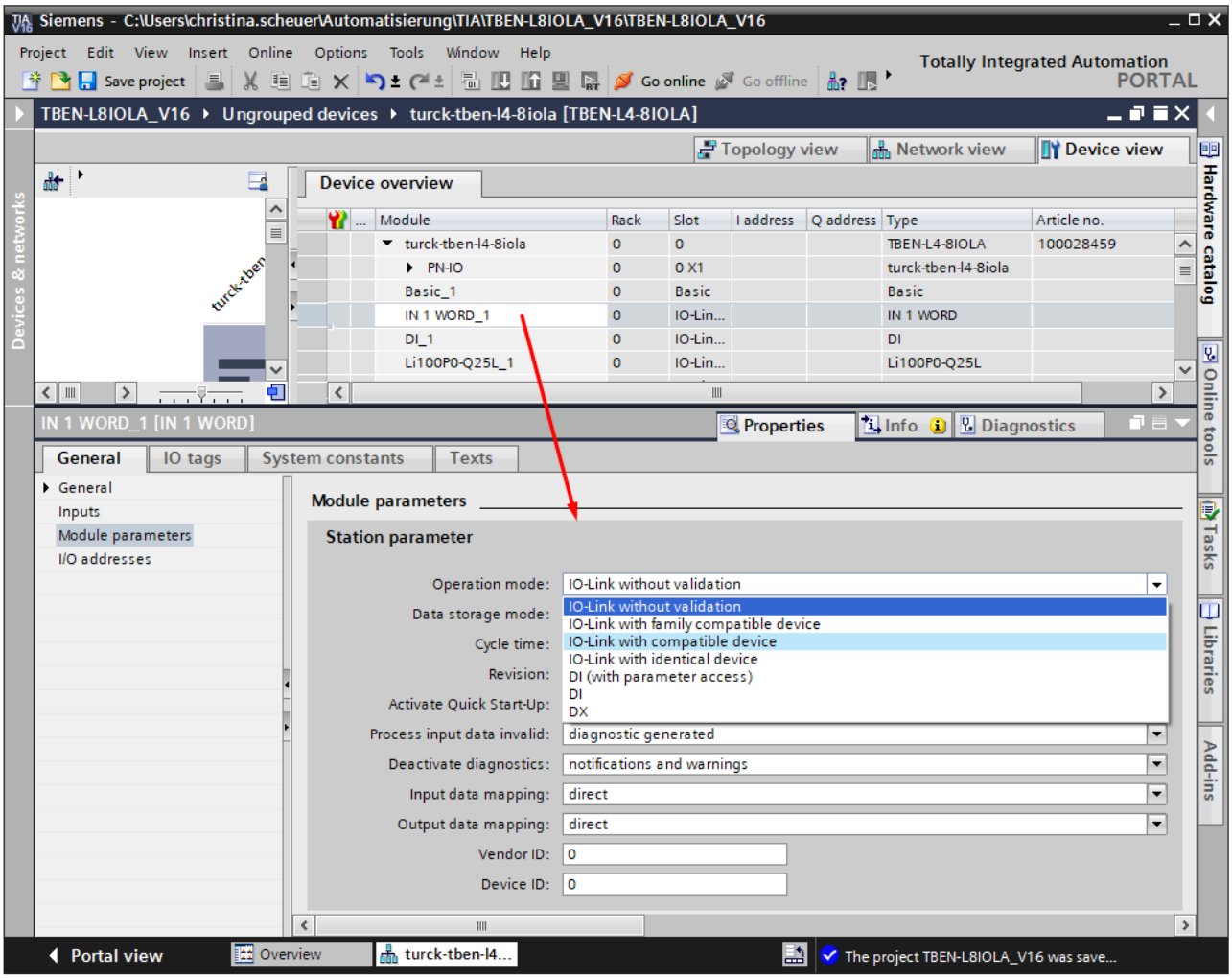


Fig. 36: TIA-Portal – IO-Link port with generic configuration

In specific port configuration, the IO-Link ports receive the parameters from the GSDML-file. Parameters like for example Operation mode, Data storage mode, Vendor- and Device ID cannot be changed. The IO-Link **device parameters** can also be set via GSDML.

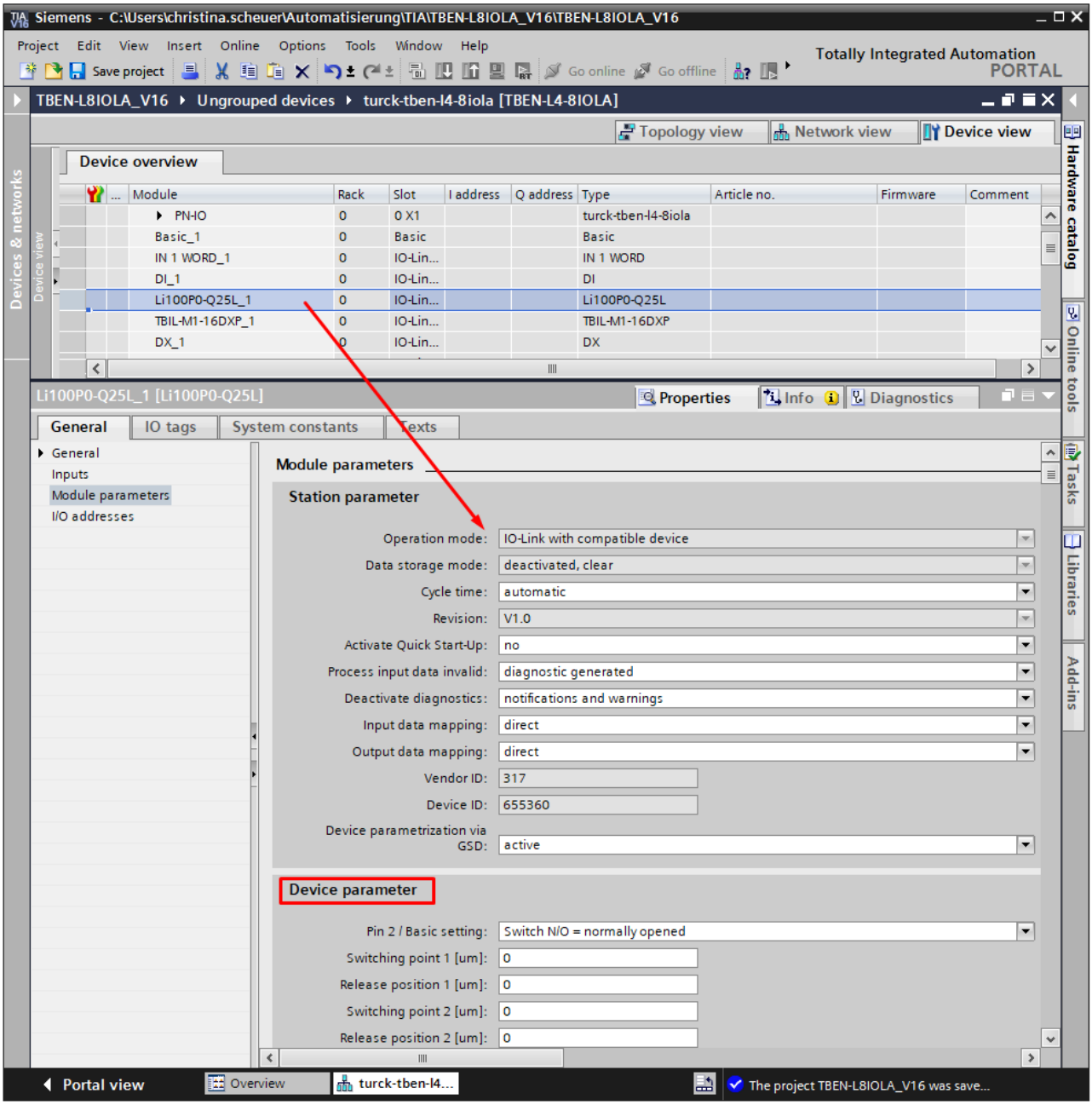


Fig. 37: TIA-Portal – IO-Link port with specific configuration (SIDI)

7.3.6 Connecting the device online with the controller

- ▶ Start the online mode (Go online).
- ⇨ The device has been successfully connected to the PLC.

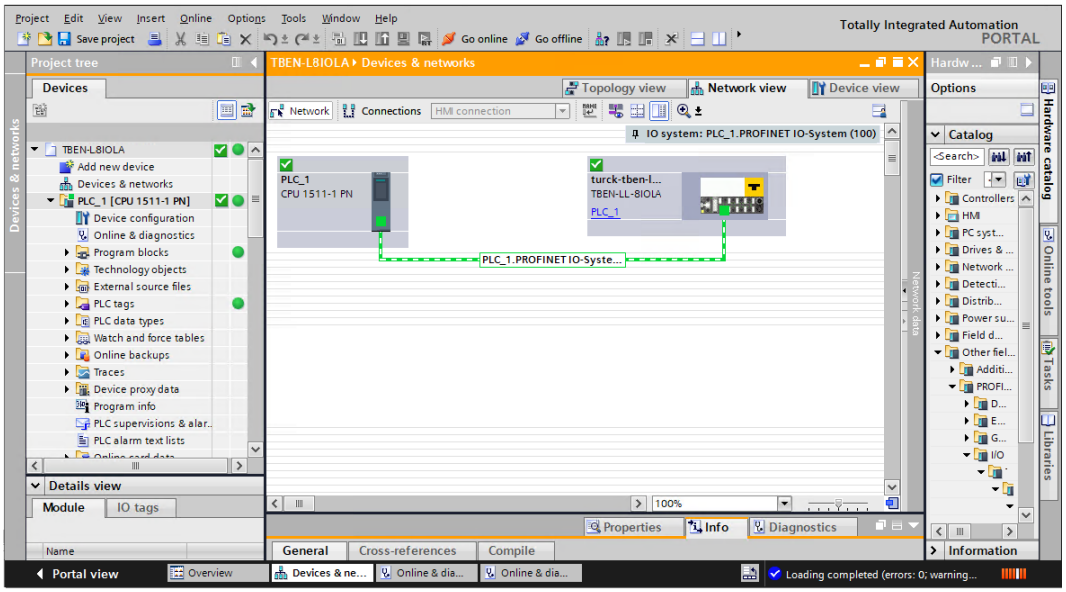


Fig. 38: TIA-Portal – online mode

7.3.7 PROFINET – mapping

The PROFINET mapping corresponds to the data mapping described in the sections “Process input data [▶ 149] and „Process output data” [▶ 152].

7.3.8 Use the IO_LINK_DEVICE function block in TIA Portal

The IO_LINK_DEVICE function block is based on the IOL_CALL function block according to the IO-Link specification.

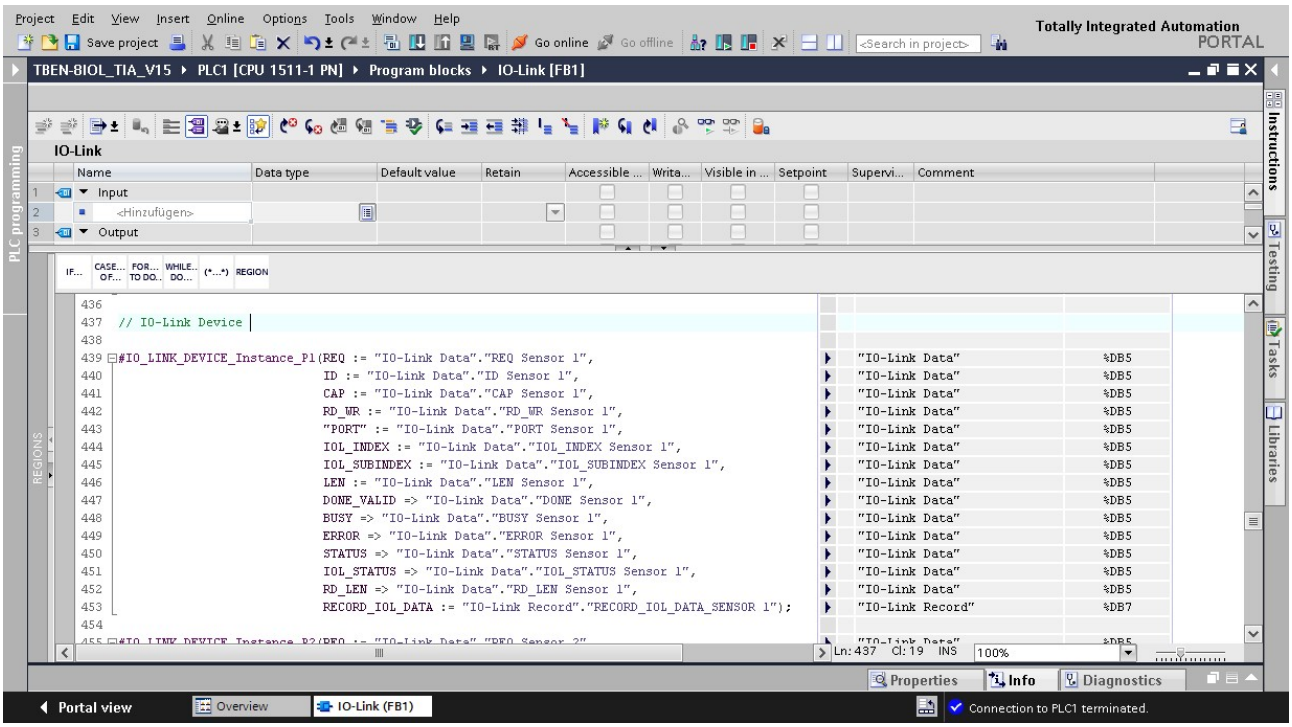


Fig. 39: Example call of Siemens FB "IO_LINK_DEVICE"

NOTE

The access to the port 0 functions of the IO-Link master with an IOL_INDEX of 65535 is not possible with version V3.0.2 of the Siemens IO_LINK_DEVICE block. In TIA-Portal V15, the old IOL_CALL function block can be used to access the port 0 functions.

Example accesses with IO_LINK_DEVICE

In this example, the watch table **Sensor1** serves to visualize the procedure of the read and write access via IO_LINK_DEVICE. The assignment of the SPDU-indices of IO-Link devices can be found in the respective device documentation.

The function block access to the device an the connected sensors is done via the input variable **ID**. The value which has to be set as ID depends on the used CPU:

Example:

- HW identifier of the **basic** slot (slot 1), for example with CPU 1511-PN (used in this example)
- Start address of the input data of the IO-Link master e.g. with CPU 315

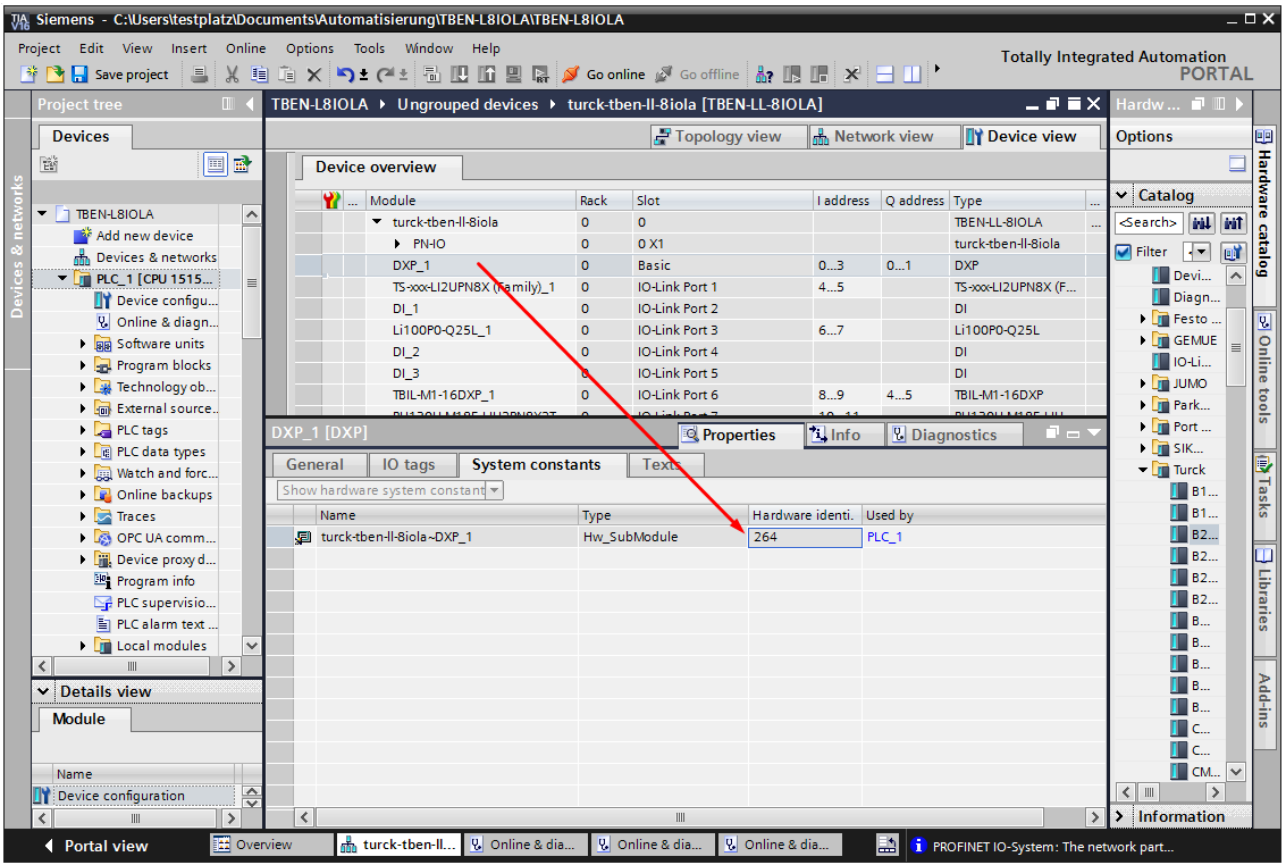


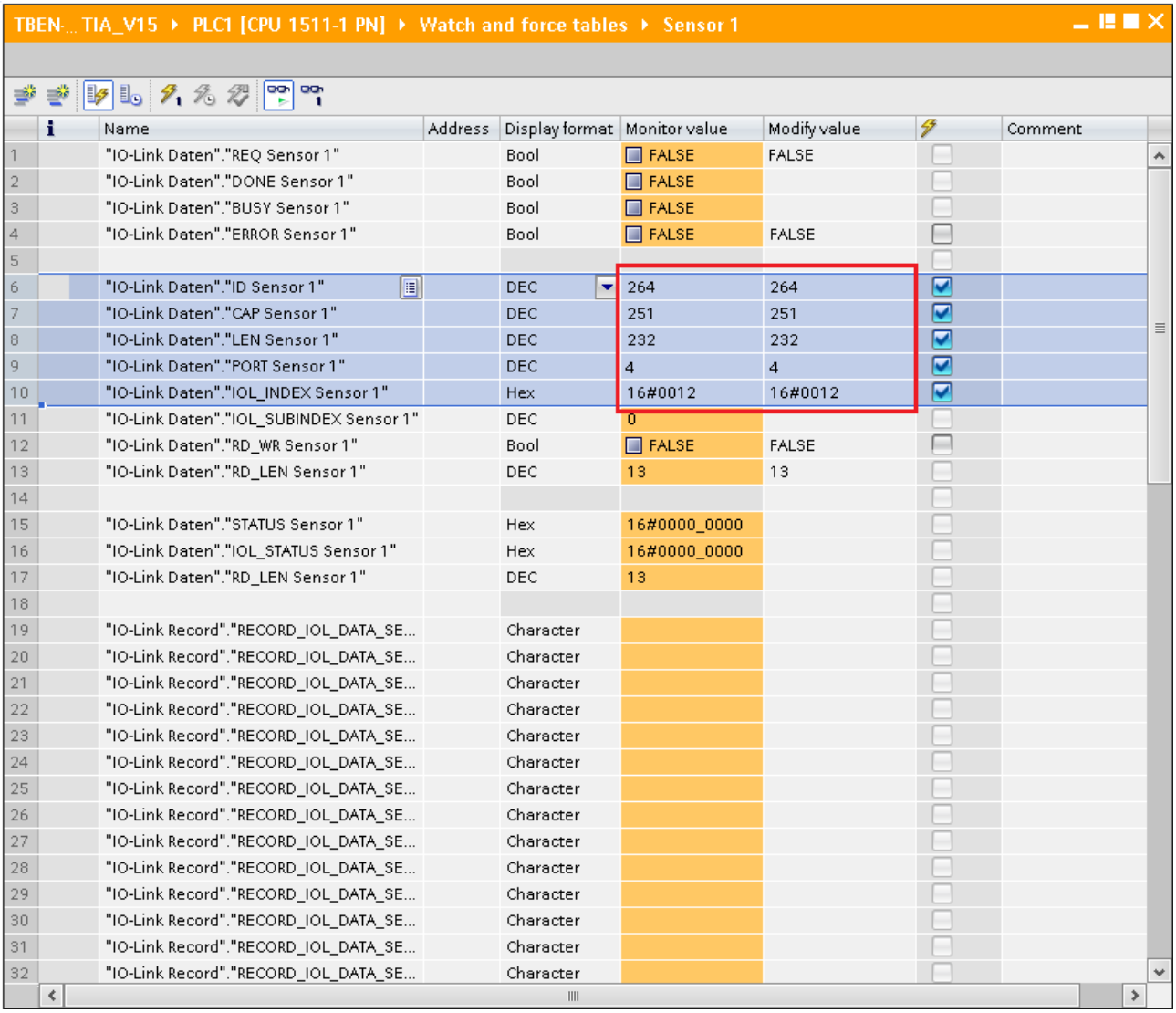
Fig. 40: HW identifier: Basic slot of the TBEN-L…-8IOLA in the example

Example read access – read product name

Reading out the product name (product name, index 0x12) of the Turck IO-Link I/O-hub TBIL-M1-16DXP at IO-Link port 4.

▶ Write the input variables of the function block via **control variable** as follows:

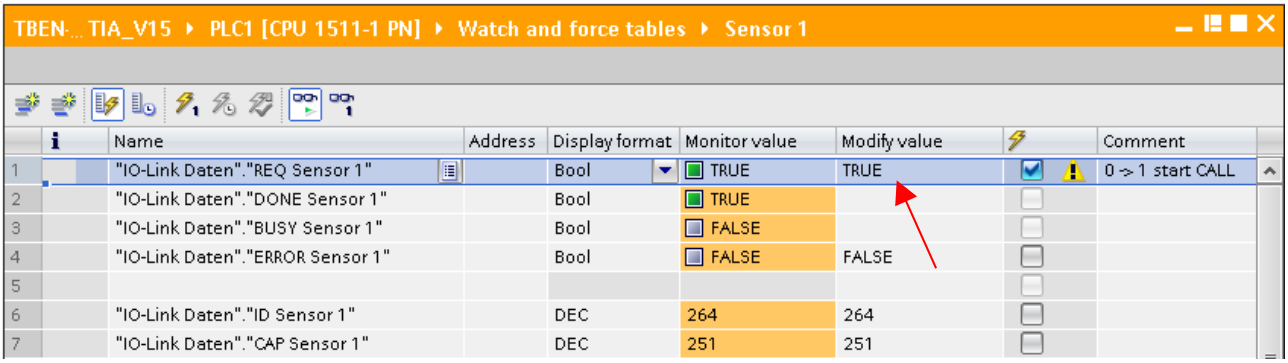
Variable	Value	Meaning
REQ	TRUE	Send a read request
ID	264	Hardware identifier of the **Basic** slot according to the configuration in the Device view
CAP	251	Function block instance
PORT	4	The I/O hub TBIL-M1-16DXP is connected to port 4.
IOL_INDEX	0x12	Index for product name



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	FALSE	FALSE	
2	"IO-Link Daten"."DONE Sensor 1"		Bool	FALSE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	
8	"IO-Link Daten"."LEN Sensor 1"		DEC	232	232	
9	"IO-Link Daten"."PORT Sensor 1"		DEC	4	4	
10	"IO-Link Daten"."IOL_INDEX Sensor 1"		Hex	16#0012	16#0012	
11	"IO-Link Daten"."IOL_SUBINDEX Sensor 1"		DEC	0		
12	"IO-Link Daten"."RD_WR Sensor 1"		Bool	FALSE	FALSE	
13	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	13	13	
14						
15	"IO-Link Daten"."STATUS Sensor 1"		Hex	16#0000_0000		
16	"IO-Link Daten"."IOL_STATUS Sensor 1"		Hex	16#0000_0000		
17	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	13		
18						
19	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
20	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
21	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
22	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
23	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
24	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
25	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
26	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
27	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
28	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
29	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
30	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
31	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			
32	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character			

Fig. 41: IO_LINK_DEVICE – input variables for read access

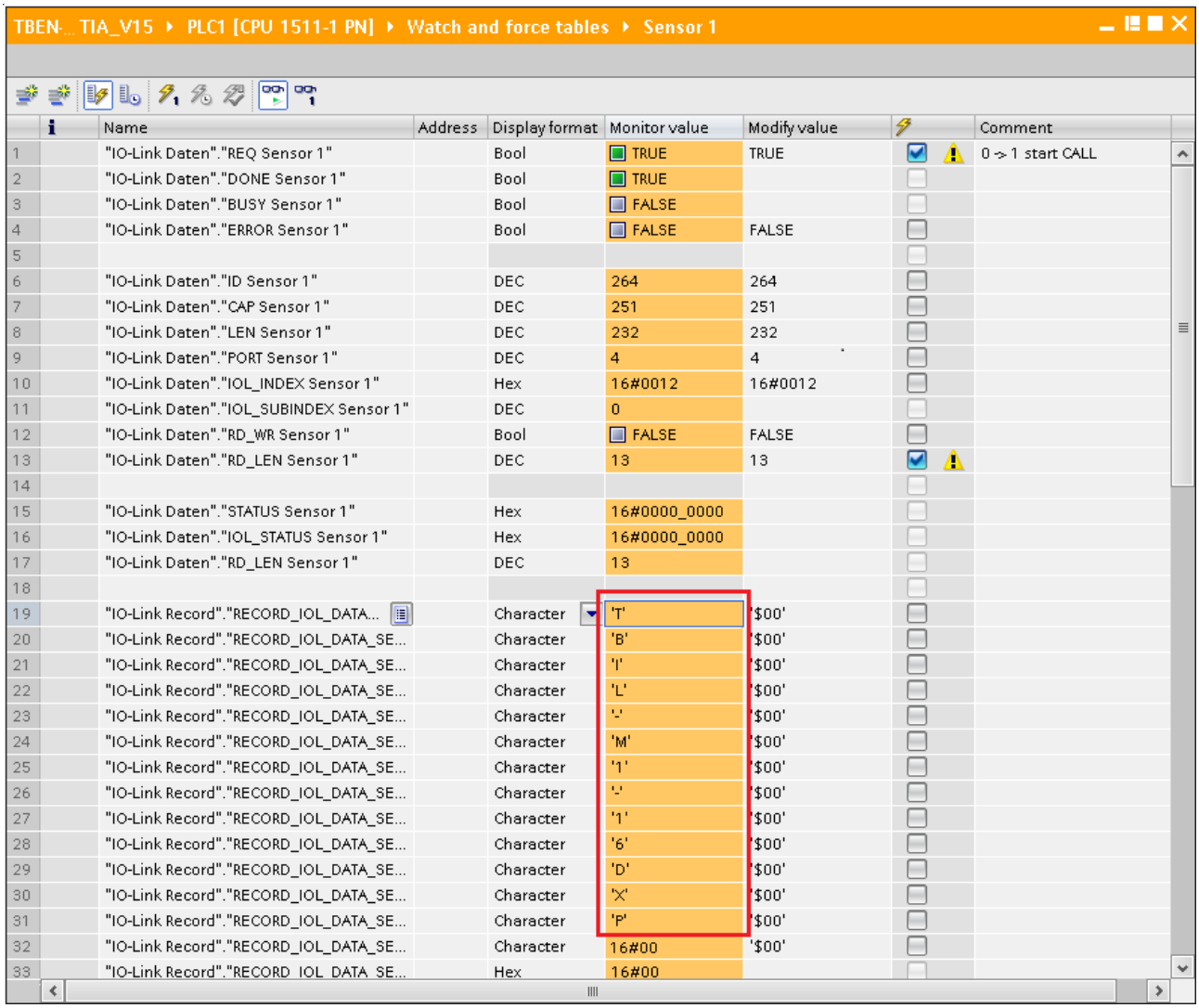
▶ Activate the read access via a rising edge at **REQ**.



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	TRUE	TRUE	0 -> 1 start CALL
2	"IO-Link Daten"."DONE Sensor 1"		Bool	TRUE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	

Fig. 42: IO_LINK_DEVICE – activate read access

⇨ In this example, the result of this request can be seen in the watch table (row 19 and following) in the **IO-Link Record**.



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	TRUE	TRUE	0 -> 1 start CALL
2	"IO-Link Daten"."DONE Sensor 1"		Bool	TRUE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	
8	"IO-Link Daten"."LEN Sensor 1"		DEC	232	232	
9	"IO-Link Daten"."PORT Sensor 1"		DEC	4	4	
10	"IO-Link Daten"."IOL_INDEX Sensor 1"		Hex	16#0012	16#0012	
11	"IO-Link Daten"."IOL_SUBINDEX Sensor 1"		DEC	0		
12	"IO-Link Daten"."RD_WR Sensor 1"		Bool	FALSE	FALSE	
13	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	13	13	
14						
15	"IO-Link Daten"."STATUS Sensor 1"		Hex	16#0000_0000		
16	"IO-Link Daten"."IOL_STATUS Sensor 1"		Hex	16#0000_0000		
17	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	13		
18						
19	"IO-Link Record"."RECORD_IOL_DATA...		Character	'T'	'$00'	
20	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'B'	'$00'	
21	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'I'	'$00'	
22	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'L'	'$00'	
23	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'-'	'$00'	
24	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'M'	'$00'	
25	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'1'	'$00'	
26	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'-'	'$00'	
27	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'1'	'$00'	
28	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'6'	'$00'	
29	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'D'	'$00'	
30	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'X'	'$00'	
31	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	'P'	'$00'	
32	"IO-Link Record"."RECORD_IOL_DATA_SE...		Character	16#00	'$00'	
33	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00		

Fig. 43: IO_LINK_DEVICE – product name TBIL-M1-16DXP

Example access write – rotate display

The display of the Turck - temperature sensor TS-500-LUUPN8X-H1141 at IO-Link Port 1 is rotated. The parameter **Measured value update time/rotating/disabling a display** in index 55 is set to 0x05 = 600 ms measured value update time, display rotated by 180°.

Temperature sensors TS series
IO-Link Parameters

Specific On-Request Data Objects – Parameter values

Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

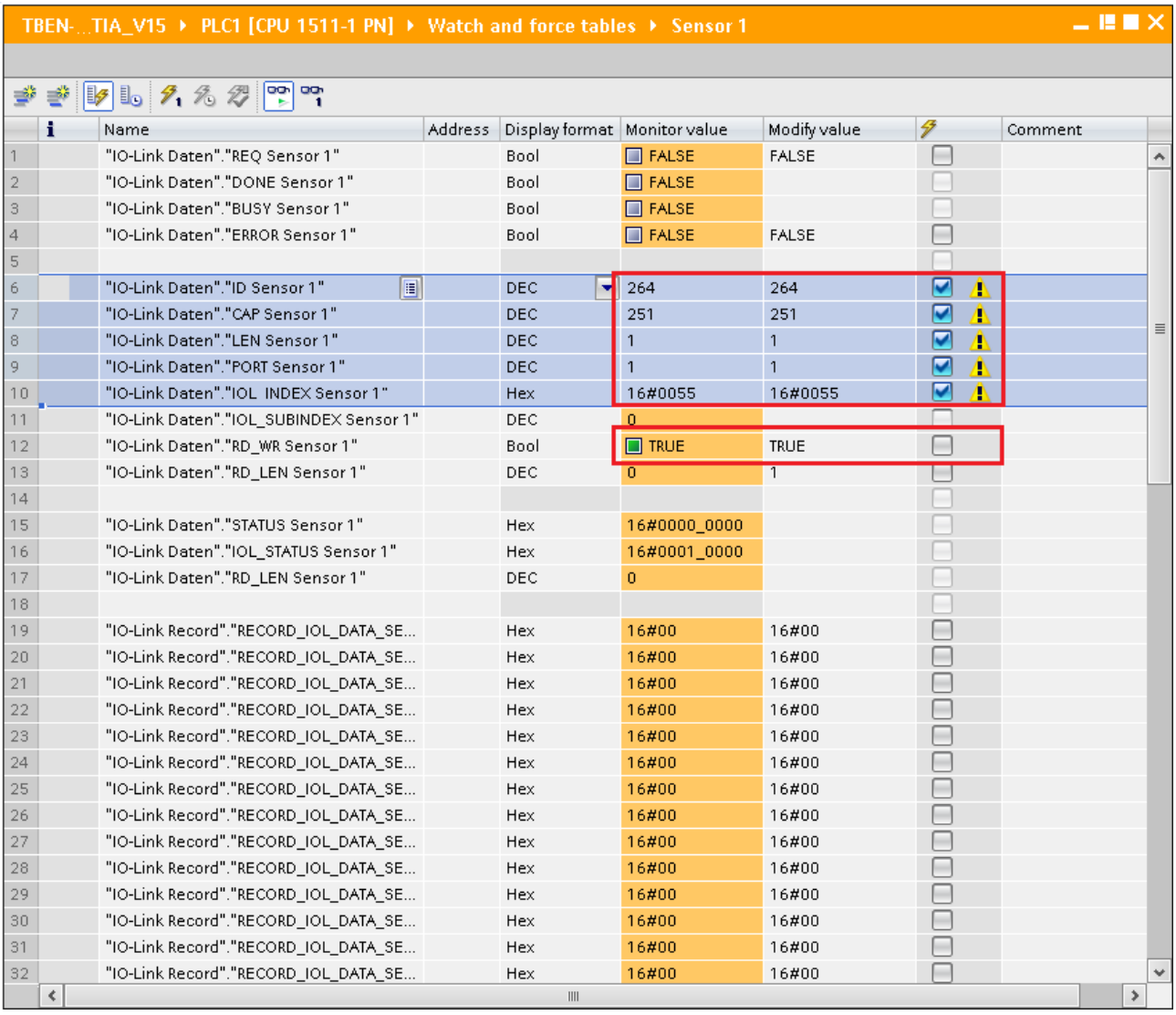
Index 0x56: Behaviour of output 1 in the event of error

Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

Fig. 44: Extract from the documentation for TS-500-…

- Write the input variables of the function block via **control variable** as follows.
- Activate the write access in the function block via **RD_WR Sensor 1**= TRUE.

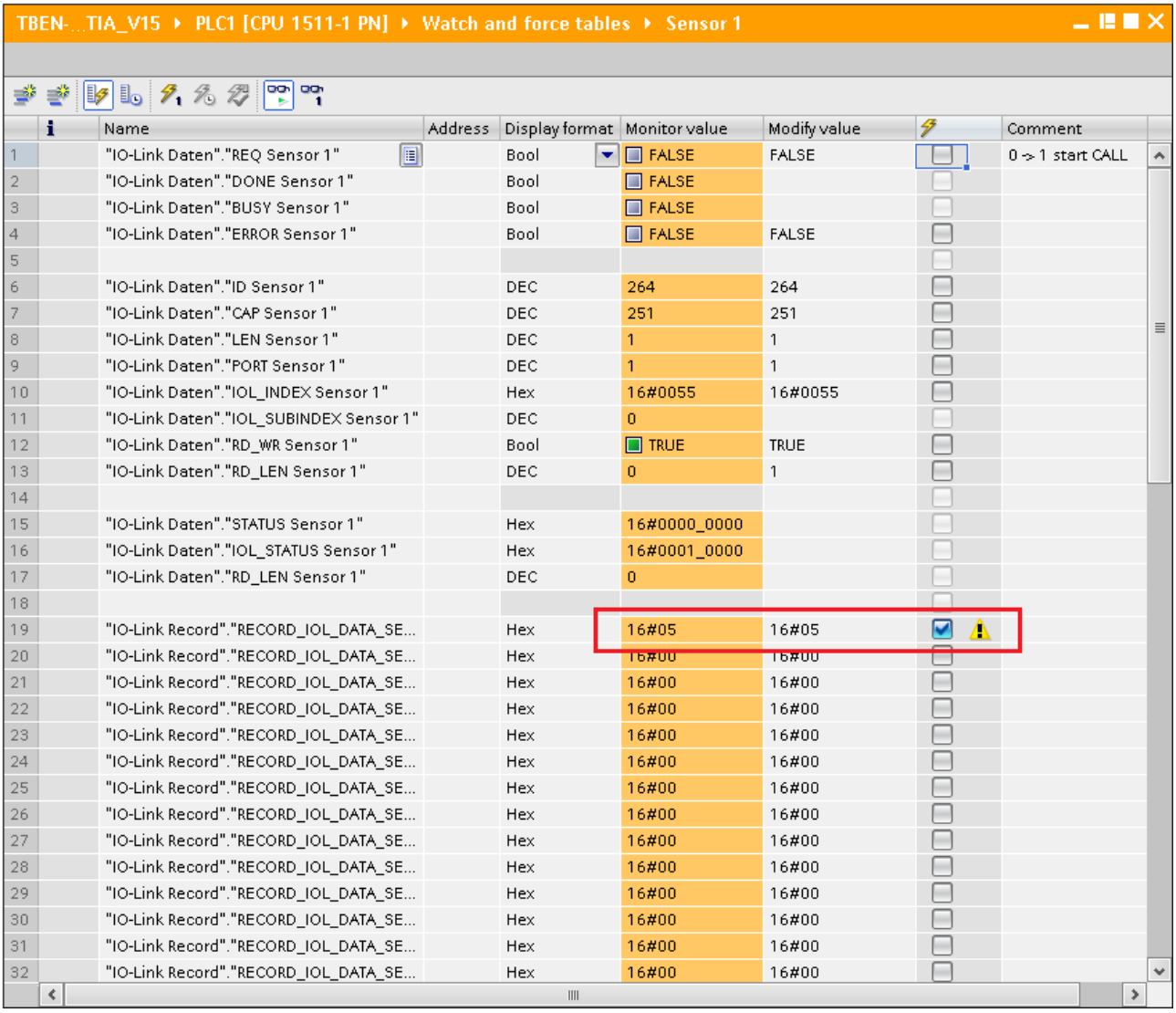
Variable	Value	Meaning
REQ	TRUE	Send a write request
ID	264	Hardware identifier of the **Basic** slot according to the configuration in the Device view
CAP	251	Function block instance
LEN	1	Length of the data to be written in byte
PORT	1	The temperature sensor TS-500-LUUPN8X-H1141 is connected to port 1.
IOL_INDEX	0x12	Index for **Measured value update time/rotating/disabling a display**



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	FALSE	FALSE	
2	"IO-Link Daten"."DONE Sensor 1"		Bool	FALSE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	
8	"IO-Link Daten"."LEN Sensor 1"		DEC	1	1	
9	"IO-Link Daten"."PORT Sensor 1"		DEC	1	1	
10	"IO-Link Daten"."IOL_INDEX Sensor 1"		Hex	16#0055	16#0055	
11	"IO-Link Daten"."IOL_SUBINDEX Sensor 1"		DEC	0		
12	"IO-Link Daten"."RD_WR Sensor 1"		Bool	TRUE	TRUE	
13	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	0	1	
14						
15	"IO-Link Daten"."STATUS Sensor 1"		Hex	16#0000_0000		
16	"IO-Link Daten"."IOL_STATUS Sensor 1"		Hex	16#0001_0000		
17	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	0		
18						
19	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
20	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
21	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
22	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
23	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
24	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
25	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
26	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
27	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
28	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
29	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
30	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
31	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
32	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	

Fig. 45: IO_LINK_DEVICE – input variables for read access

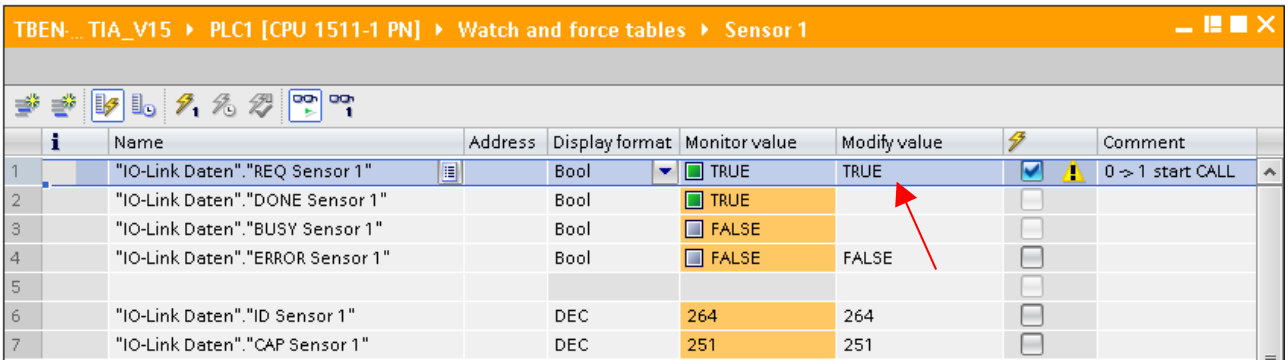
▶ Set the value to be written **0x05** via the first word of **IO-Link Record** in the watch table.



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	FALSE	FALSE	0 -> 1 start CALL
2	"IO-Link Daten"."DONE Sensor 1"		Bool	FALSE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	
8	"IO-Link Daten"."LEN Sensor 1"		DEC	1	1	
9	"IO-Link Daten"."PORT Sensor 1"		DEC	1	1	
10	"IO-Link Daten"."IOL_INDEX Sensor 1"		Hex	16#0055	16#0055	
11	"IO-Link Daten"."IOL_SUBINDEX Sensor 1"		DEC	0		
12	"IO-Link Daten"."RD_WR Sensor 1"		Bool	TRUE	TRUE	
13	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	0	1	
14						
15	"IO-Link Daten"."STATUS Sensor 1"		Hex	16#0000_0000		
16	"IO-Link Daten"."IOL_STATUS Sensor 1"		Hex	16#0001_0000		
17	"IO-Link Daten"."RD_LEN Sensor 1"		DEC	0		
18						
19	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#05	16#05	
20	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
21	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
22	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
23	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
24	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
25	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
26	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
27	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
28	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
29	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
30	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
31	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	
32	"IO-Link Record"."RECORD_IOL_DATA_SE...		Hex	16#00	16#00	

Fig. 46: IO_LINK_DEVICE – Control value 0x05 for index 0x55

▶ Activate the read Write access via a rising edge at **REQ**.



	Name	Address	Display format	Monitor value	Modify value	Comment
1	"IO-Link Daten"."REQ Sensor 1"		Bool	TRUE	TRUE	0 -> 1 start CALL
2	"IO-Link Daten"."DONE Sensor 1"		Bool	TRUE		
3	"IO-Link Daten"."BUSY Sensor 1"		Bool	FALSE		
4	"IO-Link Daten"."ERROR Sensor 1"		Bool	FALSE	FALSE	
5						
6	"IO-Link Daten"."ID Sensor 1"		DEC	264	264	
7	"IO-Link Daten"."CAP Sensor 1"		DEC	251	251	

Fig. 47: IO_LINK_DEVICE – activate read access

⇨ The display is now rotated about 180° and set to an actualization time of 600 ms

7.4 Commissioning the Device in Modbus TCP

7.4.1 Implemented Modbus functions

The devices support the following functions for accessing process data, parameters, diagnostics and other services.

Function Code	
3	Read Holding Registers – reading multiple output registers
4	Read Input Registers – reading multiple input registers
6	Write Single Register – writing single output register
16	Write Multiple Registers – writing multiple output
23	Read/Write Multiple Registers – reading and writing multiple registers

7.4.2 Modbus registers

Address	Access Type	Meaning
0x0000…0x01FF	read only	Process data of the inputs (identical to registers 0x8000…0x8FFF)
0x0800…0x09FF	read/write	Process data of the outputs (identical to registers 0x9000…0x9FFF)
0x1000…0x100B	read only	Module identifier
0x100C	read only	Module status
0x1017	read only	Register mapping revision (always 2, if not, mapping is incompatible with this description)
0x1020	read only	Watchdog, actual time in ms
0x1120	read/write	Watchdog, predefined time in ms (default: 500 ms)
0x1130	read/write	Modbus Connection Mode Register
0x1131	read/write	Modbus Connection Timeout in s. (def.: 0 = never)
0x113C…0x113D	read/write	Modbus Parameter Restore (reset of parameters to default values)
0x113E…0x113F	read/write	Modbus Parameter Save (permanent storing of parameters)
0x1140	read/write	Deactivate protocol Deactivates explicitly the selected Ethernet protocol: ■ Bit 0 = deactivate EtherNet/IP ■ Bit 1 = deactivate Modbus TCP ■ Bit 2 = deactivate PROFINET ■ Bit 15 = deactivate web server
0x1141	read/write	Active protocol ■ Bit 0 = EtherNet/IP active ■ Bit 1 = Modbus TCP active ■ Bit 2 = PROFINET active ■ Bit 15 = web server active
0x2400	read only	V1 in mV: 0 at < 18 V
0x8000…0x8400	read only	Process data of the inputs (identical to registers 0x0000…0x01FF)
0x9000…0x9400	read/write	Process data of the outputs (identical to registers 0x0800…0x09FF)
0xA000…0xA400F	read only	Diagnostics
0xB000…0xB400	read/write	Parameter

The following table shows the register mapping for the different Modbus addressing methods:

Description	Hex	Decimal	5 digit	Modicon
Inputs	0x0000…0x01FF	0…511	40001…40512	400001…400512
Outputs	0x0800…0x09FF	2048…2549	42049…42560	402049…402560
Module identifier	0x1000…0x1006	4096…4102	44097…44103	404097…404103
Module status	0x100C	4108	44109	404109
Watchdog, actual time	0x1020	4128	44129	404129
Watchdog, predefined time	0x1120	4384	44385	404385
Modbus Connection Mode Register	0x1130	4400	44401	404401
Modbus Connection Timeout in s.	0x1131	4401	44402	404402
Modbus Parameter Restore	0x113C…0x113D	4412…4413	44413…44414	404413…404414
Modbus Parameter Save	0x113E…0x113F	4414…4415	44415…44416	404415…404416
Deactivate protocol	0x1140	4416	44417	404417
Active protocol	0x1141	4417	44418	404418
V1 in mV	0x2400	9216	49217	409217
Process data inputs	0x8000, 0x8001	32768, 32769	-	432769, 432770
Process data outputs	0x9000, 0x9001	36864, 36865	-	436865, 436866
Diagnostics	0xA000, 0xA001	40960, 40961	-	440961, 440962
Parameter	0xB000, 0xB001	45056, 45057	-	445057, 445058

7.4.3 Data width

Module	Process input data	Process output data	Alignment
TBEN-L…-8IOL	344 byte	260	word by word

7.4.4 Register mapping

Input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB								LSB							
0x0000… 0x00xx	Process input data [▶ 149]															
	Module status															
0x00xx + 1 register	See status and control word [▶ 155]															

Output registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB								LSB							
	Output data															
0x0800… 0x08xx	Process output data [▶ 152]															

Diagnostic registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Diagnostics [▶ 156]															
0xA000	DXP channel diagnostics															
0xA001	IO-Link channel diagnosis															
…																
0xA004																

Parameter registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB								LSB							
IO-Link-Basic																
0xB000	SRO 15	SRO 14	SRO 13	SRO 12	SRO 11	SRO 10	SRO9	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
0xB001	EN DO 15	-	EN DO 13	-	EN DO 11	-	EN DO9	-	EN DO7	-	EN DO5	-	EN DO3	-	EN DO1	-
IO-Link port 1																
0xB002	Cycle time								GSD	Activate Quick Start-Up	Data Storage Mode		Operation mode			
0xB003	-	-	-	-	-	-	-	-	Mapping PDOUT		Mapping PDIN		Deactivate diag.		PDIN in-valid	Rev.
0xB004… 0xB005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0xB006	Vendor ID															
0xB007 …0xB008	Device ID															
0xB009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IO-Link port 2																
0xB00A… 0xB011	8 registers parameter data, assignment similar to port 1															
IO-Link port 3																
0xB012… 0xB019	8 registers parameter data, assignment similar to port 1															
IO-Link port 4																
0xB01A… 0xB021	8 registers parameter data, assignment similar to port 1															
IO-Link port 5																
0xB022… 0xB029	8 registers parameter data, assignment similar to port 1															
IO-Link port 6																
0xB02A… 0xB031	8 registers parameter data, assignment similar to port 1															
IO-Link port 7																
0xB032… 0xB039	8 registers parameter data, assignment similar to port 1															
IO-Link port 8																
0xB30A… 0xB041	8 registers parameter data, assignment similar to port 1															
VAUX1 monitoring																
0xB042	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C0/ X0 (Ch0/1)	

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xB043	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C1/ X1 (Ch2/3)	
0xB044	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C2/ X2 (Ch4/5)	
0xB045	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C3/ X3 (Ch6/7)	
0xB046	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C4/ X4 (Ch8/9)	
0xB047	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C5/ X5 (Ch10/11)	
0xB048	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C6/ X6 (Ch12/13)	
0xB049	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 C7/ X7 (Ch14/15)	

7.4.5 Error behavior (watchdog)

Behavior of outputs

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120):

Watchdog	Behavior of outputs
0 ms	All outputs maintain the actual value in case of an error
> 0 ms (default = 500 ms)	Outputs switch to 0 after the watchdog time has expired (setting in register 0x1120).

NOTE
Setting the outputs to predefined substitute values is not possible in Modbus TCP. Eventually parameterized substitute values will not be used.

Behavior of the BUS LED

When the watchdog triggers, the BUS LED lights up red.

Behavior of the device in case of loss of Modbus communication

If Modbus is the active protocol and all Modbus connections are closed, the watchdog switches all outputs to "0" after the watchdog time has expired, unless another protocol (PROFINET, EtherNet/IP) has been activated in the meantime.

7.5 Connecting devices to a Modbus Client with CODESYS

Naming convention

Turck uses the terms "Modbus client" and "Modbus server" according to Modbus Organization. The following description uses the terms "Modbus TCP Master" and "Modbus TCP Slave" only because of the naming in CODESYS.

Used hardware

The following hardware components are used in this example:

- TX715-P3CV01 (IP address: 192.168.145.72)
- Block module TBEN-LL-… (IP address: 192.168.145.200)

Used software

The following software tools are used in this example:

- CODESYS 3.5.14.2 (can be downloaded for free under www.turck.com).

Prerequisites

- The programming software has been started.
- A new project has been created.
- The PLC has been added to the project.

7.5.1 Connecting the device to the PLC

The following components have to be added to CODESYS first, in order to connect the device to the PLC.

- Ethernet adapter
- Modbus TCP client (in CODESYS: Modbus TCP Master)
- Modbus TCP server (in CODESYS: Modbus TCP Slave)

Adding the Ethernet Adapter

- ▶ Right-click the **Device (TX715-P3CV01)**
- ▶ Select **Add Device**.
- ▶ Select **Ethernet Adapter**.
- ▶ Click **Add Device**.
- ⇨ The Ethernet Adapter is added to the project tree as **Ethernet (Ethernet.**

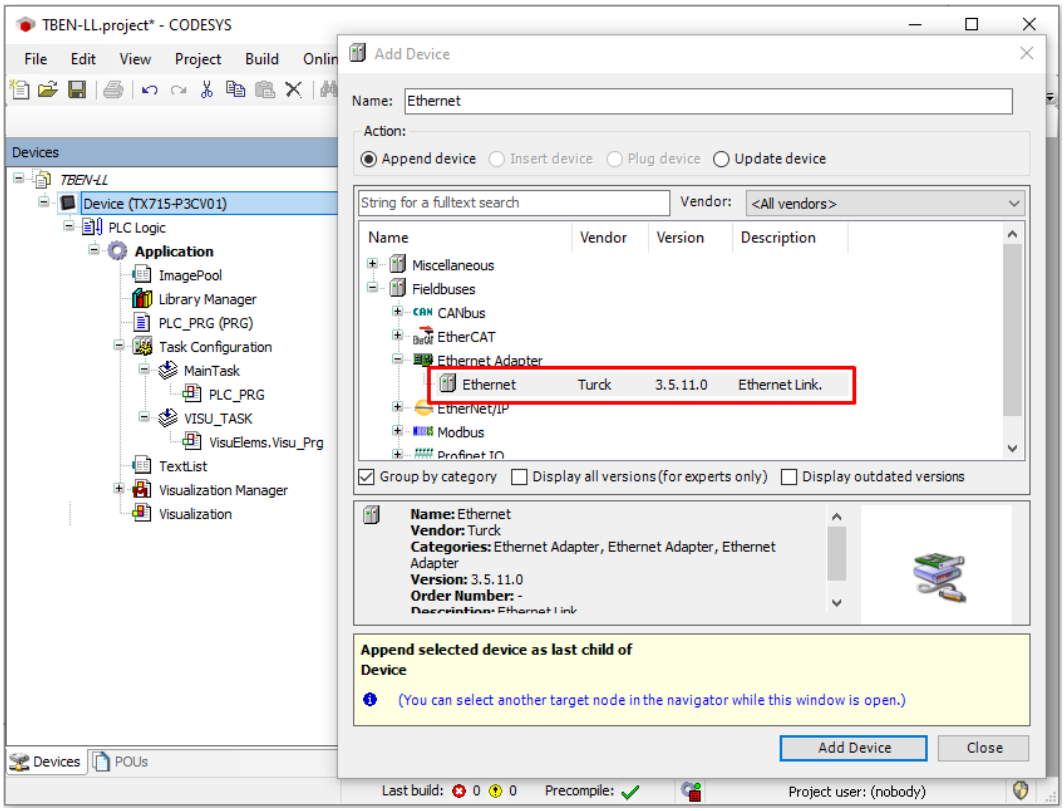


Fig. 48: Adding the Ethernet Adapter

Adding the Modbus TCP Master

- ▶ Right-click the **Ethernet (Ethernet)** in the project tree.
- ▶ Select **Add Device**.
- ▶ Double-click **Modbus TCP Master**.
- ⇨ The **Modbus TCP Master** is added to the project tree.

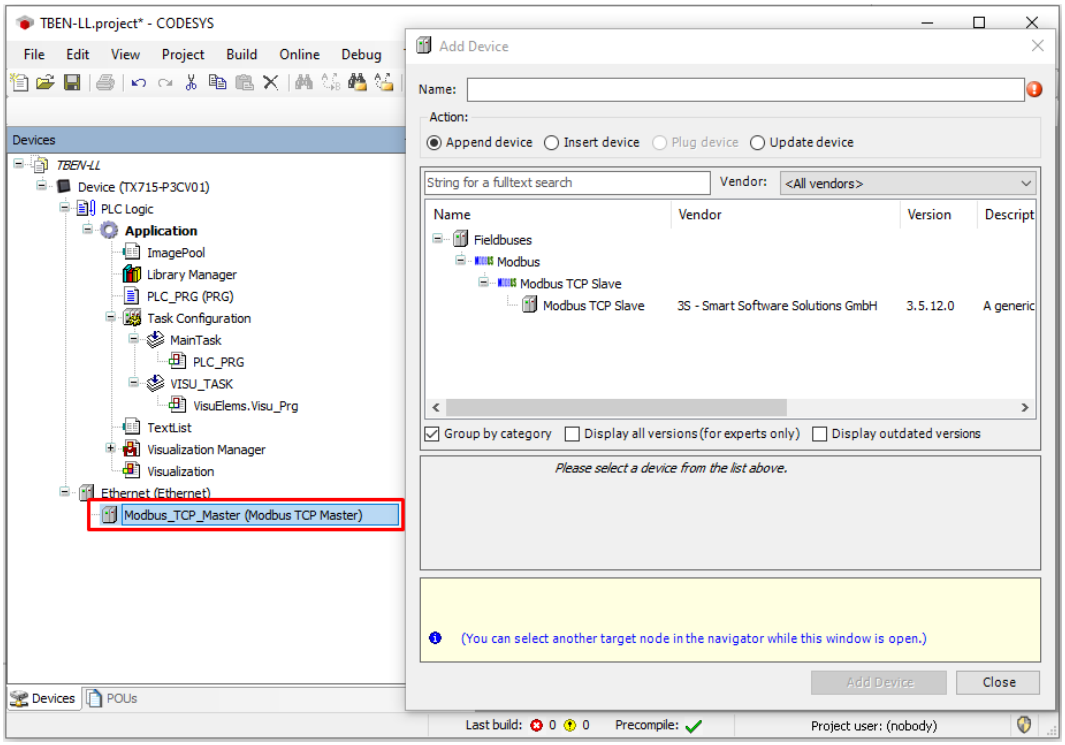


Fig. 49: Adding the Modbus TCP Master

Adding the Modbus TCP Slave

- ▶ Right-click the **Modbus TCP Master** in the project tree.
- ▶ Select **Add Device**.
- ▶ Double-click **Modbus TCP Slave**.
- ⇨ The **Modbus TCP Slave** is added to the project tree.

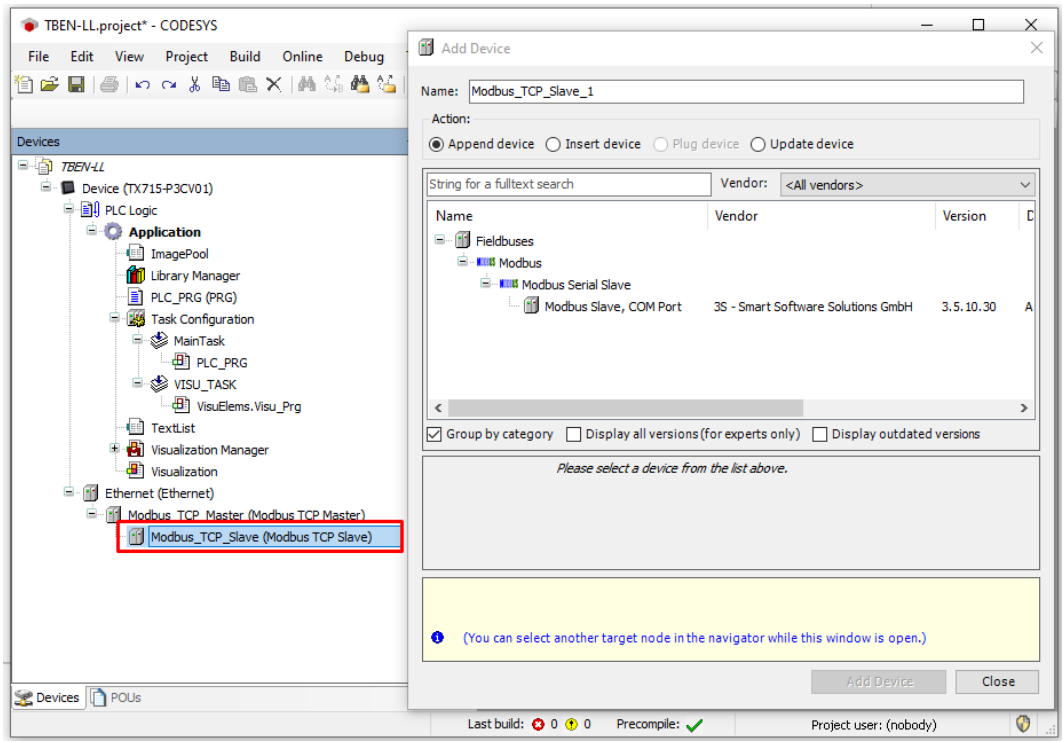


Fig. 50: Adding the Modbus TCP Slave

7.5.2 Configuring the Network Interface

- Click **Device** → **Scan Network**.
- Select Modbus client (here: TX715-P3CV01) and confirm with OK.

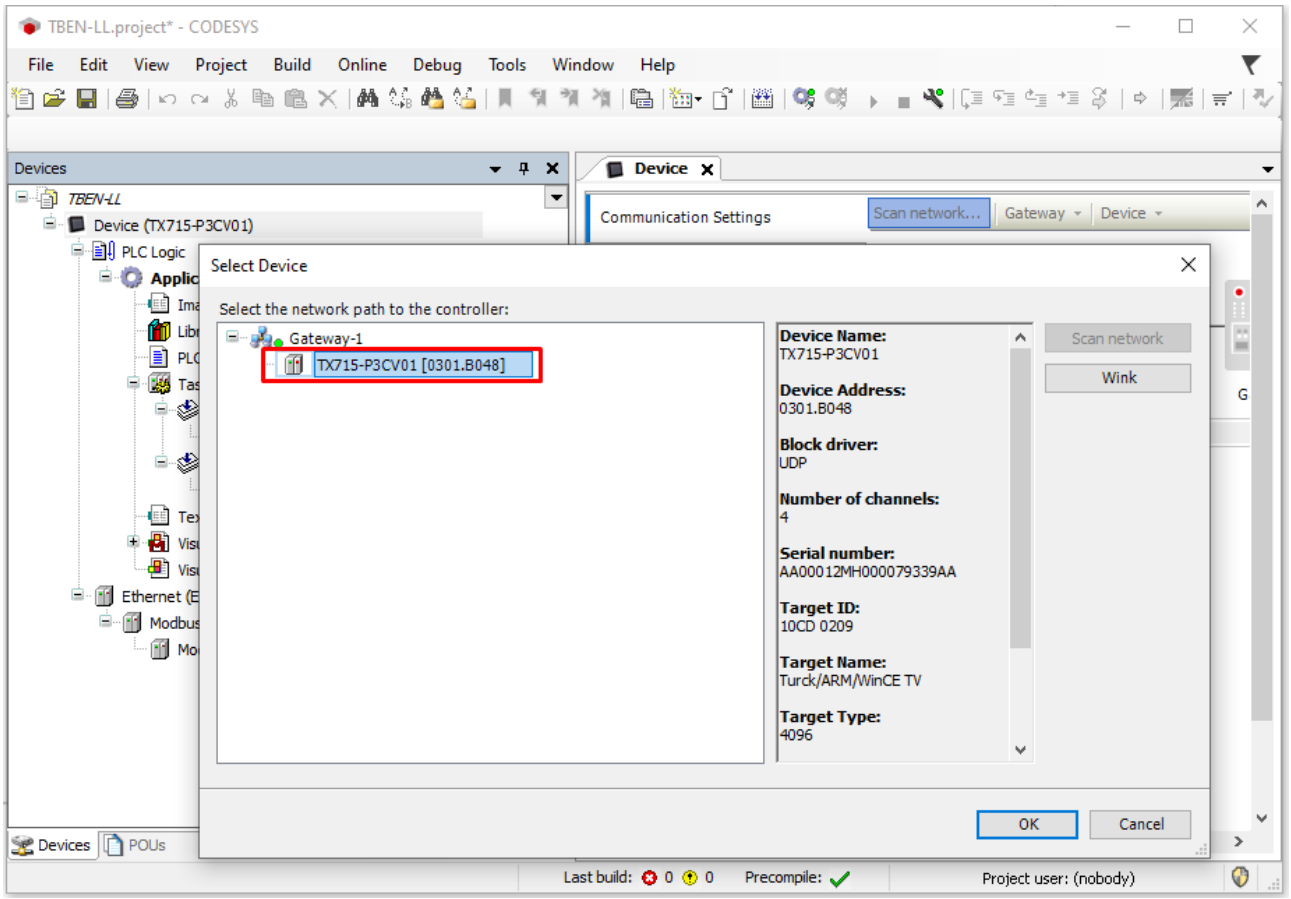


Fig. 51: Configuring the network interface to the Modbus TCP Master

- Double-click **Ethernet**.
- Open the dialog box **Network Adapter** by clicking the **…** button in the register tab **General**.
- Select the interface of the TX715 (here: 192.168.145.72).

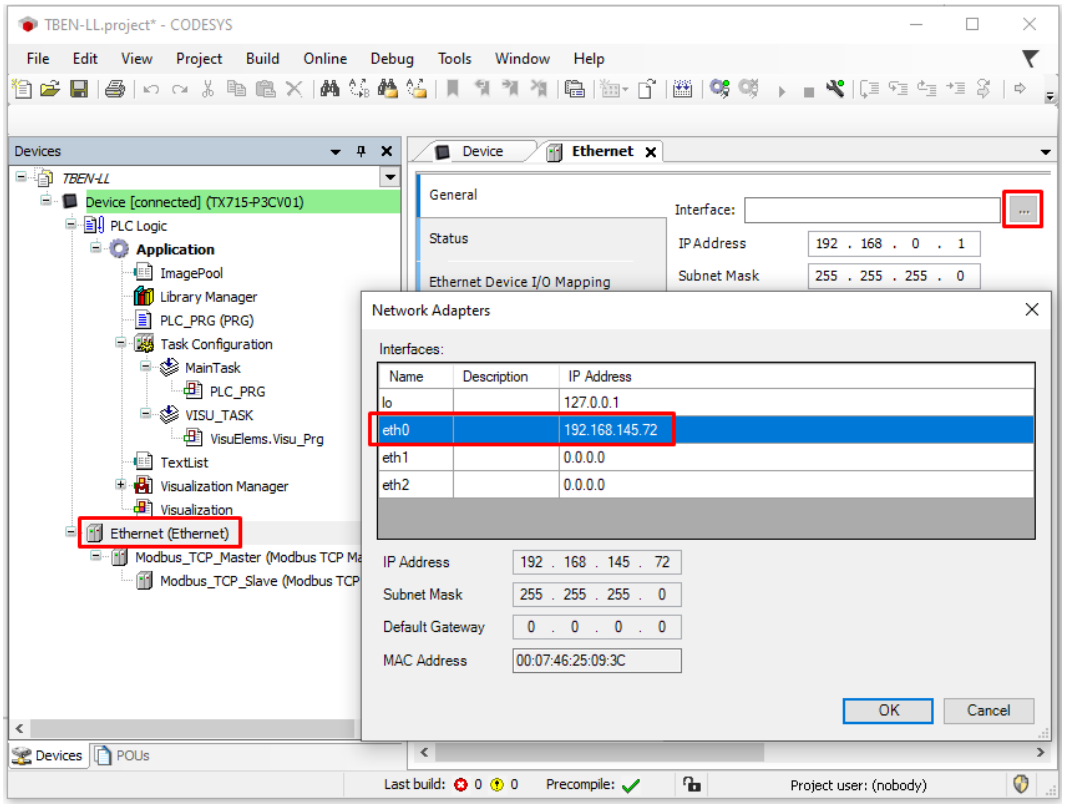


Fig. 52: Selecting the interface

7.5.3 Modbus TCP Slave: Setting the IP address

- Double-click the **Modbus TCP Slave**.
- Enter the device's IP address in the **General** register tab (here: 192.168.145.200).

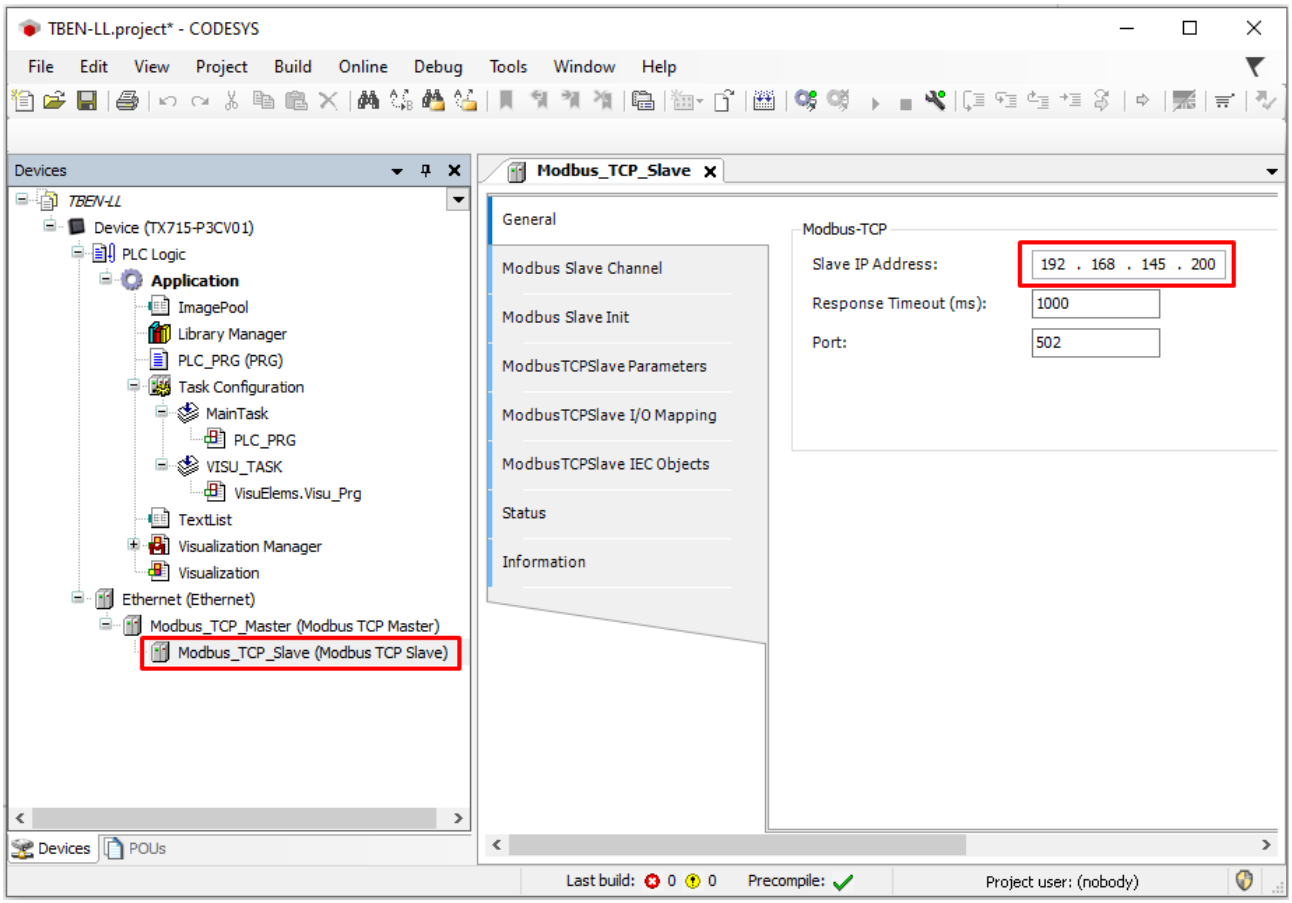


Fig. 53: Modbus TCP Slave: Setting the IP address

7.5.4 Defining modbus channels

Defining channel 0 (input data)

- Double-click **Modbus TCP Slave**.
- In the register tab **Modbus Slave Channel** select **Add Channel**.
- Enter the following values:
  Channel name
  Access type: Read Input Registers
  Offset: 0X0000
  Length: 1 register
- Confirm with OK.

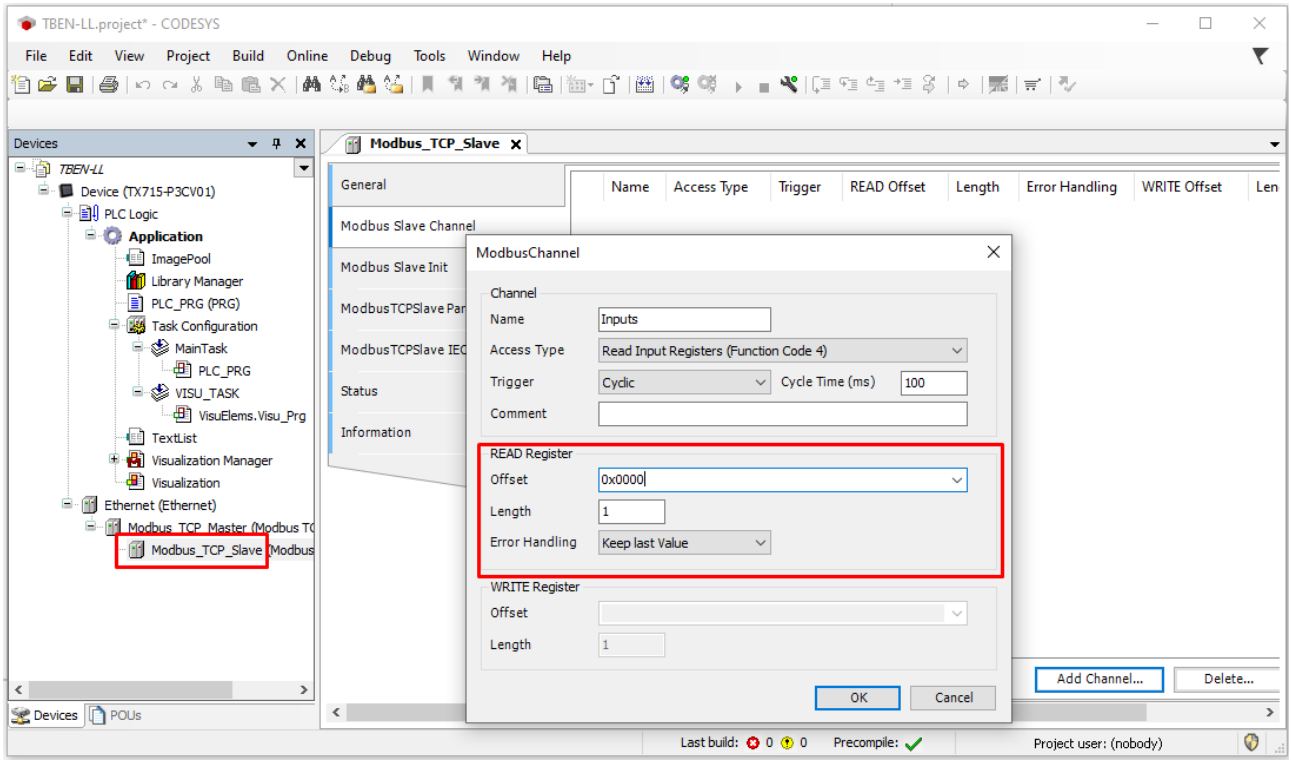


Fig. 54: Defining the input register

Defining channel 1 (output data)

- Double-click **Modbus TCP Slave**.
- In the register tab **Modbus Slave Channel** select **Add Channel**.
- Enter the following values:
  Channel name
  Access type: Write Single Register
  Offset: 0x0800
  Length: 1 register
- Confirm with OK.

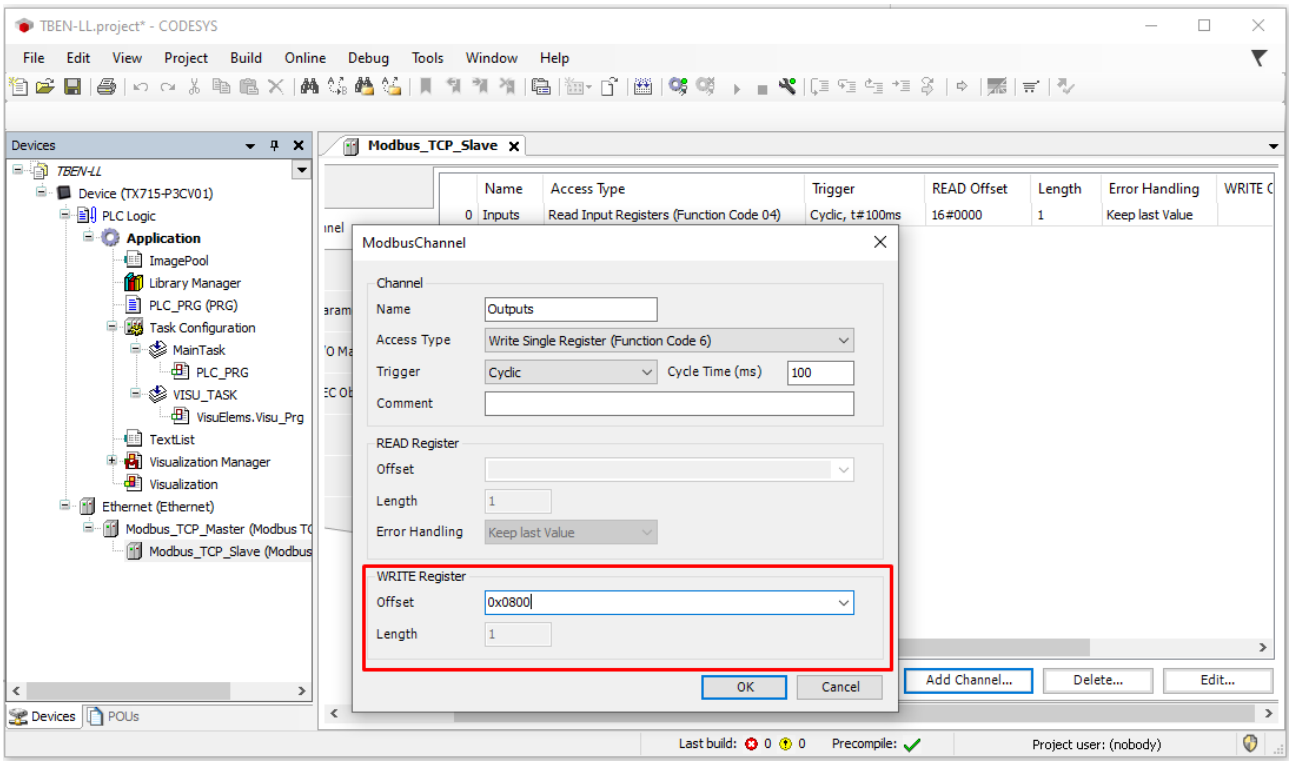


Fig. 55: Defining the output data register

7.5.5 Going online with the PLC

- ▶ Select the device.
- ▶ Click **Online** → **Login**.

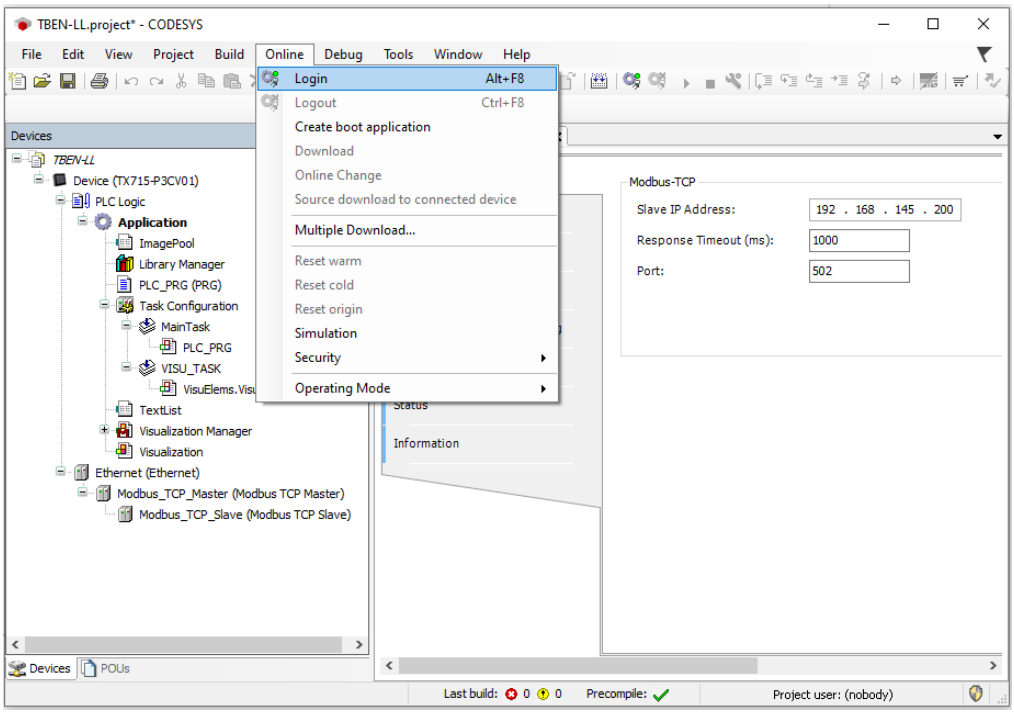


Fig. 56: Login

- ▶ Download the application to the PLC and start it via **Debug** → **Start**.
- ⇨ The Modbus TCP communication is setup.

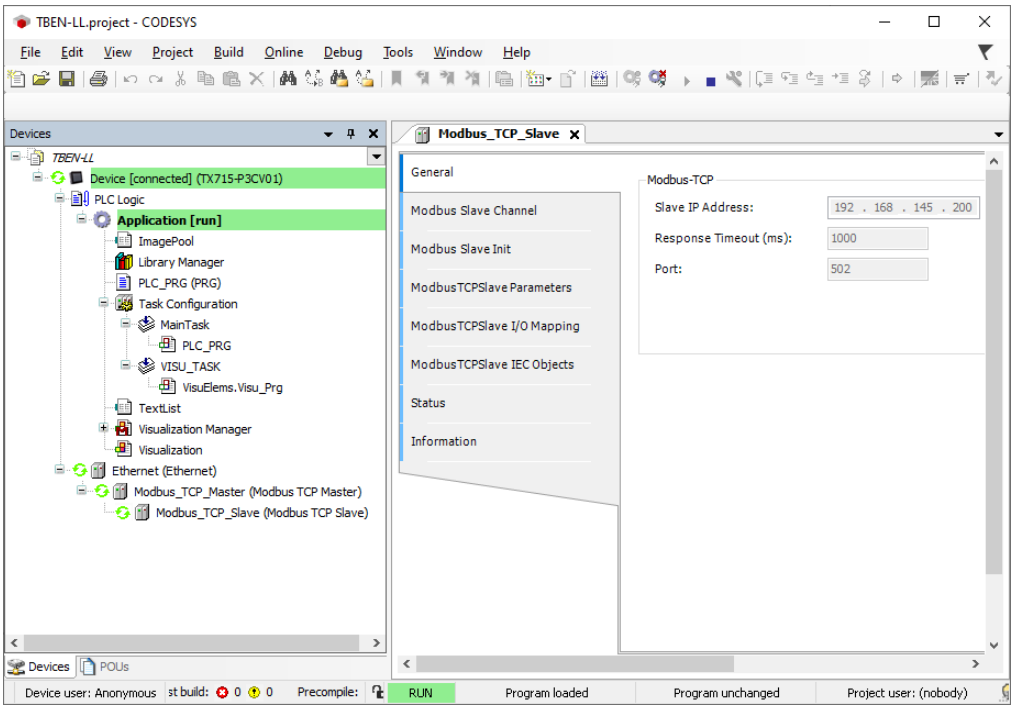


Fig. 57: Modbus TCP communication

7.5.6 Reading process data

The process data can be interpreted by means of the mapping ([▶ 59]) if the device is connected to the PLC.

- ▶ Double click **Modbus TCP Slave**.
- ▶ Click onto register tab **ModbusTCP Slave I/O Mapping**.
- ▶ Set the function **Always update variables to Enabled 1(…)**.
- ➪ The process data are displayed.

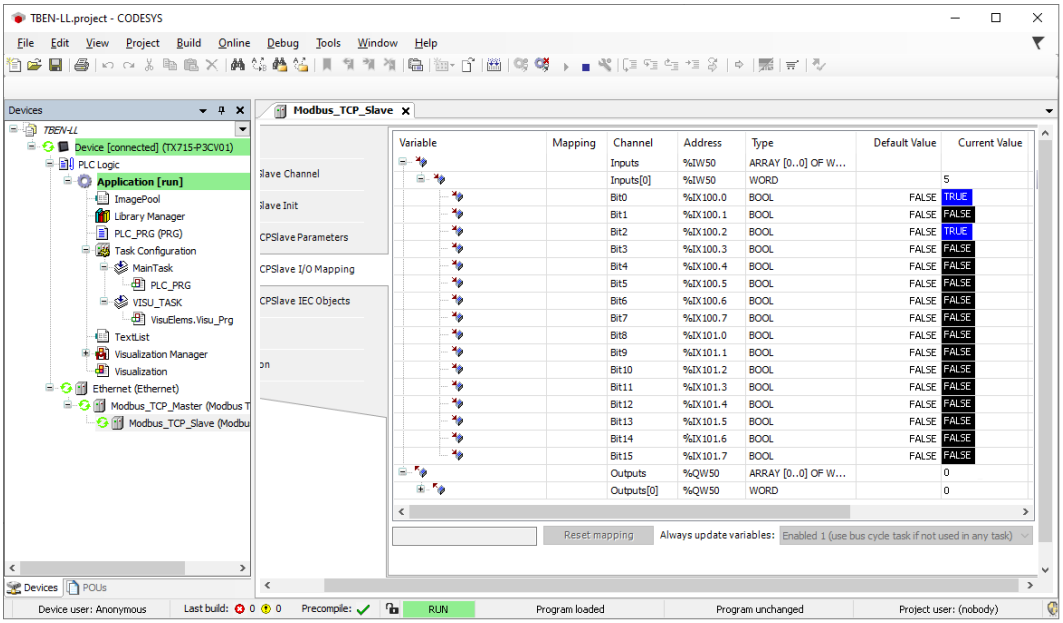


Fig. 58: Process data

7.6 Commissioning the device in EtherNet/IP

7.6.1 Common EtherNet/IP features

Feature	Description
QuickConnect	Yes (only digital channels, no IO-Link)
Device Level Ring (DLR)	Yes
Number of TCP connections	3
Number of CIP connections	10
Input Assembly Instances [▶ 82]	103, 120, 121, 122, 123, 124, 125, 126
Output Assembly Instances [▶ 91]	104, 150, 151, 152
Configuration Assembly Instance [▶ 79]	106

7.6.2 EDS files and catalog files

The EDS and catalog files for Rockwell RS Logix or Logix Designer (Studio 5000) can be downloaded free of charge from www.turck.com.

- TBEN-L_ETHERNETIP.zip

7.6.3 QuickConnect (QC)

The devices support QuickConnect. The maximum start-up times defined for QuickConnect are, however, only guaranteed for the digital channels.

QuickConnect enables a PLC to build up connections to EtherNet/IP nodes in less than 500 ms after switching-on the power supply for the EtherNet/IP network. The fast start-up is necessary for fast tool changing applications at robot arms for example in the automobile industry.

QuickConnect can be activated via the web server of the device, via Configuration Assembly (e.g. in Logix Designer (Studio 5000)) or via Class Instance Attribute.

NOTE
Activating QuickConnect activated the automatic setting of all necessary port-properties.

Port property	Status
Auto negotiation	Deactivated
Transmission speed	100BaseT
Duplex	Full duplex
Topology	Linear
AutoMDIX	Deactivated

Please read chapter [▶ 19] for more information about the correct Ethernet-cabling in QC-applications.

Activating QuickConnect via Configuration Assembly

The Configuration Assembly is part of the device's Assembly Class.

- Configure the Configuration Assembly in Logix Designer (Studio 5000).
- Activate QuickConnect via byte9, bit 0 = 1 in the Controller Tags.

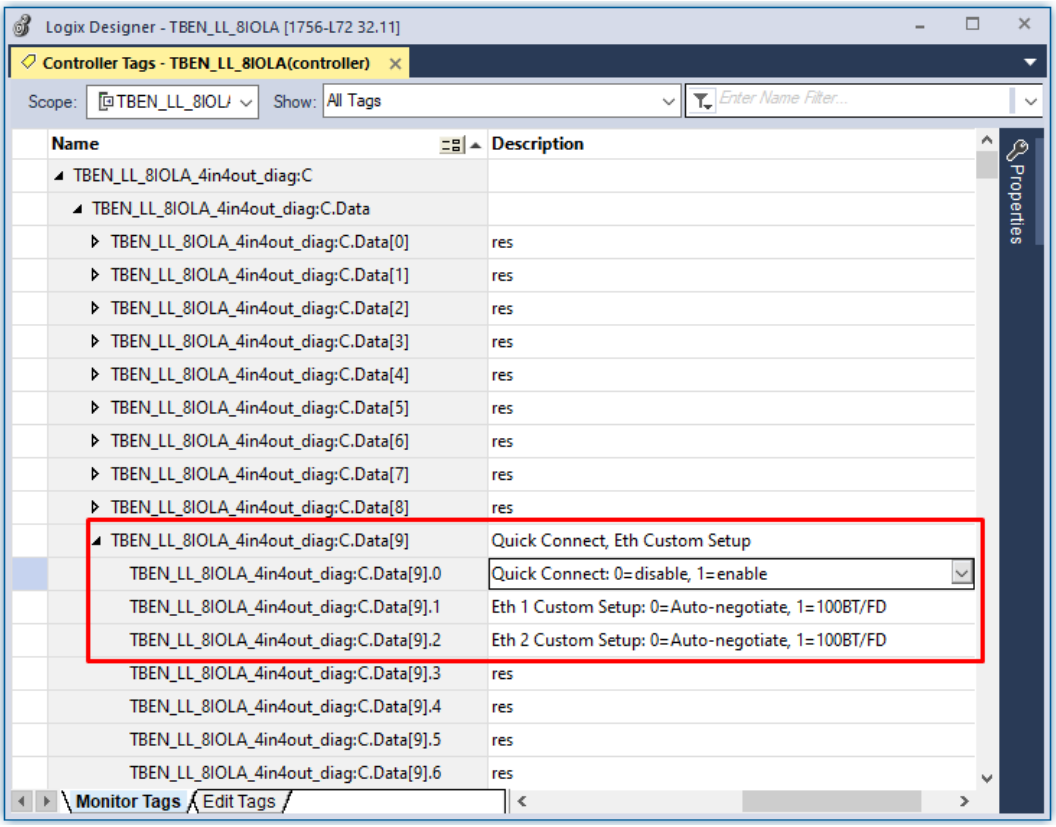


Fig. 59: Configuring QuickConnect in Logix Designer

Activating Quick Connect via Class Instance Attribute

- Activate Quick Connect via Class Instance Attribute as follows:

Class	Instance	Attribute	Value
0xF5	0x01	0x0C	0: deactivated (default) 1: activated

Activating QuickConnect via the Webserver.

- ▶ Activate the checkbox **Activate QuickConnect** in the web server.

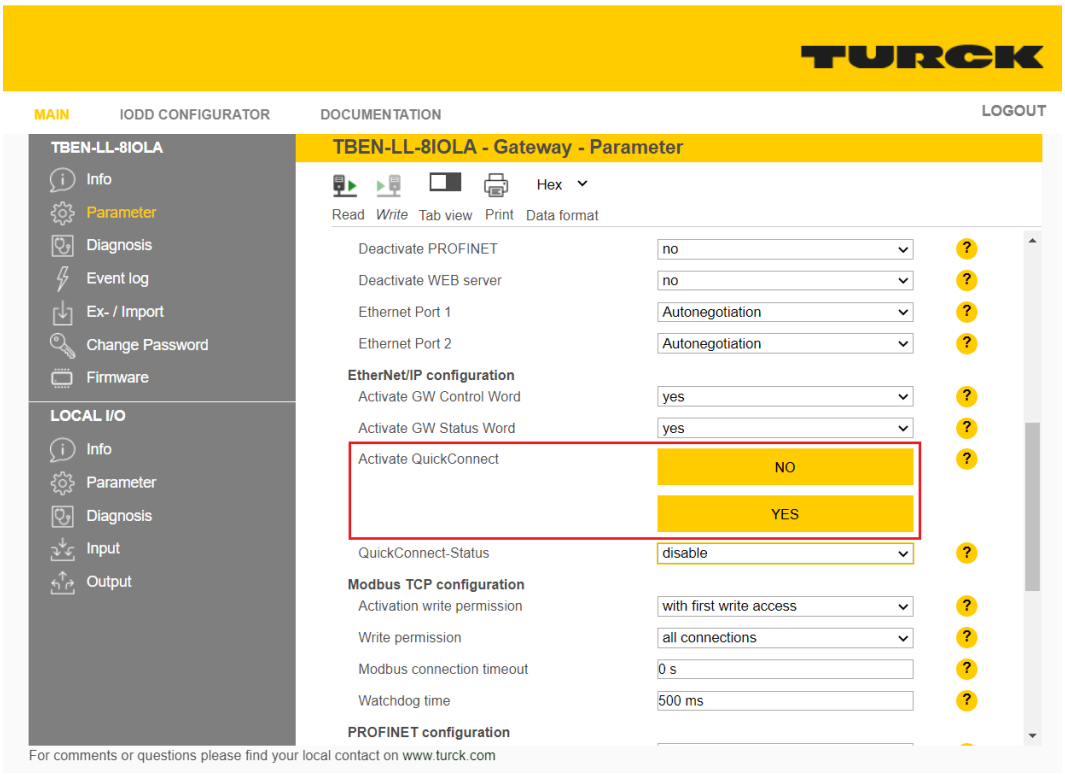


Fig. 60: Activating Quick Connect in the web server

7.6.4 Device Level Ring (DLR)

The devices support DLR. The Device Level Ring (DLR)-redundancy protocol is used to increase the stability of EtherNet/IP networks. DLR-enabled devices have an integrated switch and can thus be integrated into a ring topology. The DLR protocol is used to detect an interruption in the ring. If the data line ins interrupted, data are sent through an alternative network section, so that the network can be reconfigured as soon as possible. DLR-capable network nodes are provided with extended diagnostic functions which enable the devices to localize errors and thus decrease the time for error search and maintenance.

7.6.5 Diagnostic messages via process data

The diagnostic messages of the IO-Link channels are directly mapped into the process data Process input data – TBEN-L…-8IOL.

Additionally, the device's status word contains the module diagnostics:

Byte 1 (MSB)								**Byte 0 (LSB)**							
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	AR-GEE	DIAG

7.6.6 EtherNet/IP standard classes

The modules support the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Class Code		Object name
Dec.	Hex.	
01	0x01	Identity Object [▶ 76]
04	0x04	Assembly Object [▶ 77]
06	0x06	Connection Manager Object [▶ 94]
245	0xF5	TCP/IP Interface Object [▶ 95]
246	0xF6	Ethernet Link Object [▶ 97]

Identity Object (0x01)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to the Turck products.

Instance attributes

Attr. no.		Attribute name	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Vendor	G	UINT	Contains the manufacturer ID. Turck = 0x30
2	0x02	Product type	G	UINT	Shows the general product type. Communications Adapter 12_{dez} = 0x0C
3	0x03	Product code	G	UINT	Identifies a special product in a device type. default: 27247_{dec} = 0x6A6F
4	0x04	Revision ■ Major ■ Minor	G	STRUCT OF: ■ USINT ■ USINT	Revision of the device which is represented by the Indentity Object. ■ 0x01 ■ 0x06
5	0x05	Device status	G	WORD	WORD
6	0x06	Serial number	G	UDINT	Contains the last 3 bytes of the MAC ID
7	0x07	Product name	G	STRUCT OF: USINT STRING [13]	i. e.: TBEN-LL-8IOLA

Device Status

Bit	Name	Definition
0…1	Reserved	Default = 0
2	Configured	TRUE = 1: The application in the device has been configured (default setting).
3	Reserved	Default = 0

Bit	Name	Definition
4…7	Extended Device Status	0011 = no I/O connection established 0110 = at least one I/O connection is in RUN mode 0111 = at least one I/O connection established, all in IDLE mode All other settings = reserved
8	Minor recoverable fault	Recoverable fault, e.g.: ■ Undervoltage ■ Force mode of DTM active ■ Diagnostics at I/O channel active
9…10	Reserved	
11	Diag	Common error bit
12…15	Reserved	Default = 0

Common services

Service code		Class	Instance	Service name
Dec.	Hex.			
1	0x01	Yes	Yes	Get_Attribute_All Returns a predefined list of object attributes
5	0x05	No	Yes	Reset Starts the reset service for the device
14	0x0E	Yes	Yes	Get_Attribute_Single Returns the content of a specified attribute.
16	0x10	No	No	Set_Attribute_Single Modifies a single attribute

Assembly Object (0x04)

The Assembly Object combines attributes of several objects and allows data to be sent from one object to another or to receive data in a targeted manner

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to the Turck products.

Instance attributes

Attr. no.		Attribute name	Get/Set	Type	Value
Dec.	Hex.				
3	0x03	Data	S	ARRAY OF BYTE	Identifies a special product in a device type. default: 27247_{dec} = 6A6F
4	0x04	Size	G	UINT	Number of bytes in attribute 3: 256 or variable

Common services

Service code		Class	Instance	Service name
Dec.	Hex.			
14	0x0E	Yes	Yes	Get_Attribute_Single Returns the content of a specified attribute.

EtherNet/IP Connections

EtherNet/IP connection	Input assembly		Output assembly		Configuration assembly		Connection supported by		Exclusive Owner
	Instance	Size (in 8 bit)	Instance	Size (in 8 bit)	Instance	Size (in 8 bit)	Rockwell	Omron	
Exclusive Owner	103	346	104	262	106	160	x	-	x
Input only	103	346	254	0	1	0	x	x	-
Listen only	103	346	255	0	1	0	x	x	-
Exclusive Owner (Omron)	101	346	102	262	1	0	-	x	x
IOL 4 IN/4 OUT, diagnostics	120	58	150	38	106	160	x	x	x
IOL 6 IN/6 OUT, diagnostics	122	74	151	54	106	160	x	x	x
IOL 8 IN/8 OUT, diagnostics	124	90	152	70	106	160	x	x	x
IOL 4 IN/4 OUT	121	38	150	38	106	160	x	x	x
IOL 6 IN/6 OUT	123	54	151	54	106	160	x	x	x
IOL 8 IN/8 OUT	125	70	152	70	106	160	x	x	x
IOL 32 IN/32 OUT, diagnostics, IOL device identification	126	394	104	262	106	160	x	x	x

Config Assembly (Instance 106)

The modules support Configuration Assembly.

The Configuration Assembly contains:

10 byte device configuration data (EtherNet/IP specific)

+ 136 Byte (parameter data, depending on device type)

The description of the parameters can be found in chapter [▶ 134].

Byte no.		**Bit no.**							
Dec.	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Device configuration data									
0…8	0x00… 0x08	-	-	-	-	-	-	-	-
9	0x09	-	-	-	-	-	Eth2 port setup	Eth1 port setup	QuickConnect
DXP channels									
10	0x0A	-	-	-	-	-	-	-	SRO0
11	0x0B	-	-	-	-	-	-	-	SRO1
…	…								
24	0x18	-	-	-	-	-	-	-	SRO14
25	0x19	-	-	-	-	-	-	-	SRO15
26	0x1A	-	-	-	-	-	-	-	EN DO1
27	0x1B	-	-	-	-	-	-	-	EN DO3
28	0x1C	-	-	-	-	-	-	-	EN DO5
29	0x1D	-	-	-	-	-	-	-	EN DO7
30	0x1E	-	-	-	-	-	-	-	EN DO9
31	0x1F	-	-	-	-	-	-	-	EN DO11
32	0x20	-	-	-	-	-	-	-	EN DO13
33	0x21	-	-	-	-	-	-	-	EN DO15
IO-Link port parameters									
		IO-Link port 1							
34	0x22	-	-	-	-	Operation mode			
35	0x23	-	-	-	-	-	-	Data Storage Mode	
36	0x24	Cycle time							
37	0x25	-	-	-	-	-	-	-	Revision
38	0x26	-	-	-	-	-	-	-	Quick Start-Up
39	0x27	-	-	-	-	-	-	-	GSD
40	0x28	-	-	-	-	-	-	-	PDIN invalid
41	0x29	-	-	-	-	-	-	-	Deactivate diagnostics
42	0x2A	-	-	-	-	-	-	Mapping PDIN	
43	0x2B	-	-	-	-	-	-	Mapping PDOUT	
44…45	0x2C… 0x2D	Vendor ID							
46…49	0x2E… 0x31	Device ID							

Byte no.		Bit no.							
Dec.	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
50…65	0x32…0x41	**IO-Link port 2** assignment similar to IO-Link port 1							
66…81	0x42…0x51	**IO-Link port 3** assignment similar to IO-Link port 1							
82…97	0x52…0x61	**IO-Link port 4** assignment similar to IO-Link port 1							
98…113	0x62…0x71	**IO-Link port 5** assignment similar to IO-Link port 1							
114…129	0x72…0x81	**IO-Link port 6** assignment similar to IO-Link port 1							
130…145	0x82…0x91	**IO-Link port 7** assignment similar to IO-Link port 1							
146…161	0x92…0xA1	**IO-Link port 8** assignment similar to IO-Link port 1							
162	0xA2	-	-	-	-	-	-	VAUX1 C0/X0 (Ch0/1)	
163	0xA3	-	-	-	-	-	-	VAUX1 C1/X1 (Ch2/3)	
164	0xA4	-	-	-	-	-	-	VAUX1 C2/X2 (Ch4/5)	
165	0xA5	-	-	-	-	-	-	VAUX1 C3/X3 (Ch6/7)	
166	0xA6	-	-	-	-	-	-	VAUX1 C4/X4 (Ch8/9)	
167	0xA7	-	-	-	-	-	-	VAUX1 C5/X5 (Ch10/11)	
168	0xA8	-	-	-	-	-	-	VAUX1 C6/X6 (Ch12/13)	
169	0xA9	-	-	-	-	-	-	VAUX1 C7/X7 (Ch14/15)	

Device Configuration Data

The default values are written in **bold**.

Designation	Value		Meaning
QuickConnect	0	**disabled**	QuickConnect is deactivated.
	1	Activated	QuickConnect is activated.
Eth x Port-Setup	0	**Auto negotiation**	The port is set to autonegotiation.
	1	100BT/FD	Defined setting of communication parameters for the Ethernet port to: ■ 100BaseT ■ Full duplex

Input assembly instances

EtherNet/IP connection	Input assembly		Device status	Basic I/O (in byte)	IO-Link inputs (in byte)	Diagnostics (in byte)	Event data (in byte)
	Instance	Size (in 8 bit)	(in byte)				
Exclusive Owner	103	346	2	4	256	20	64
Input only	103	346	2	4	256	20	64
Listen only	103	346	2	4	256	20	64
Exclusive Owner (Omron)	101	346	2	4	256	20	64
IOL 4 IN/4 OUT, diagnostics	120	58	2	4	32	20	0
IOL 6 IN/6 OUT, diagnostics	122	74	2	4	48	20	0
IOL 8 IN/8 OUT, diagnostics	124	90	2	4	64	20	0
IOL 4 IN/4 OUT	121	38	2	4	32	0	0
IOL 6 IN/6 OUT	123	54	2	4	48	0	0
IOL 8 IN/8 OUT	125	70	2	4	64	0	0
IOL 32 IN/32 OUT, diagnostics, IOL device identification	126	394	2	4	256	20	64

Input instance 101 and 103 – standard input (32 byte IN, diagnostics)

The description of the input data can be found in chapter "Operating" [▶ 149]

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x12	16 words per port															
…																
0x73 … 0x82																
Diagnostics																
	VAUX1															
0x83	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/ X3 Ch6/ Ch7	VERR V1 C2/ X2 Ch4/ Ch5	VERR V1 C1/ X1 Ch2/ Ch3	VERR V1 C0/ X0 Ch0/ Ch1
	DXP channels															
0x84	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	IO-Link port diagnostics															
	Port 1															
0x85	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
…																
	Port 8															
0x8C	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
	IO-Link Events															
0x8D	Port (1st Event)								Qualifier (1st Event)							
0x8E	Event Code low byte (1st Event)								Event Code high byte (1st Event)							
…																
0xAB	Port 16th Event)								Qualifier (16th Event)							
0xAC	Event Code low byte (16th Event)								Event Code high byte (16th Event)							

Instance 120 – 4 byte IN, diagnostics

The description of the input data can be found in chapter "Operating" [▶ 149]

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	Diag
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x04	2 words per port															
…																
0x11 … 0x12																
Diagnostics																
	VAUX1															
0x13	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1
	DXP channels															
0x14	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	IO-Link port diagnostics															
	Port 1															
0x15	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
…																
	Port 8															
0x1C	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-

Instance 121 – 4 byte IN

The description of the input data can be found in chapter “Operating” [▶ 149]

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x04	2 words per port															
…																
0x11 … 0x12																

Instance 122 – 6 byte IN, diagnostics

The description of the input data can be found in chapter "Operating" [▶ 149]

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x05	3 words per port															
…																
0x18 … 0x1A																
Diagnostics																
	VAUX1															
0x1B	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1
	DXP channels															
0x1C	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	IO-Link port diagnostics															
	Port 1															
0x1D	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
…																
	Port 8															
0x24	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-

Instance 123 – 6 byte IN

The description of the input data can be found in chapter “Operating” [▶ 149]

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x05	3 words per port															
…																
0x18 … 0x1A																

Instance 124 – 8 byte IN, diagnostics

The description of the input data can be found in chapter “Operating” [▶ 149]

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x06	4 words per port															
…																
0x1F … 0x22																
Diagnostics																
	VAUX1															
0x23	-	-	-	-	-	-	-	-	VERR V1 C7/ X7 Ch14/ Ch15	VERR V1 C6/ X6 Ch12/ Ch13	VERR V1 C5/ X5 Ch10/ Ch11	VERR V1 C4/ X4 Ch8/ Ch9	VERR V1 C3/ X3 Ch6/ Ch7	VERR V1 C2/ X2 Ch4/ Ch5	VERR V1 C1/ X1 Ch2/ Ch3	VERR V1 C0/ X0 Ch0/ Ch1
	DXP channels															
0x24	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	IO-Link port diagnostics															
	Port 1															
0x25	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
…																
	Port 8															
0x2C	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-

Instance 125 – 8 byte IN

The description of the input data can be found in chapter “Operating” [▶ 149]

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x06	4 words per port															
…																
0x1F … 0x22																

Instance 126 – standard input (32 byte IN, diagnostics) + IOL device identification

The description of the input data can be found in chapter "Operating" [▶ 149]

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status word																
0x00	-	FCE	-	-	-	-	V1	-	-	-	-	-	-	-	-	DIAG
Inputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
Process data valid																
0x02	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x03 … 0x12	16 words per port															
…																
0x73 … 0x82																
Diagnostics																
	VAUX1															
0x83	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1
	DXP channels															
0x84	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	IO-Link port diagnostics															
	Port 1															
0x85	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
…																
	Port 8															
0x8C	GEN ERR	OVL	V HIGH	V LOW	ULV E	LLV U	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPR	-
	IO-Link Events															
0x8D	Port (1st Event)								Qualifier (1st Event)							
0x8E	Event Code low byte (1st Event)								Event Code high byte (1st Event)							
…																
0xAB	Port 16th Event)								Qualifier (16th Event)							
0xAC	Event Code low byte (16th Event)								Event Code high byte (16th Event)							

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Device identification																
	IO-Link port 1															
0xAD	Vendor ID (MSB)								Vendor ID (LSB)							
0xAE	Device ID								Device ID (LSB)							
0xAF	Device ID (MSB)								Device ID							
	IO-Link port 2															
0xB0	Vendor ID (MSB)								Vendor ID (LSB)							
0xB1	Device ID (byte 1)								Device ID LSB (byte 0)							
0xB2	Device ID MSB (byte 3)								Device ID (byte 2)							
…																
	IO-Link port 8															
0xC2	Vendor ID (MSB)								Vendor ID (LSB)							
0xC3	Device ID								Device ID (LSB)							
0xC4	Device ID (MSB)								Device ID							

Output assembly instances

EtherNet/IP connection	Output assembly		Control word (in byte)	DXP outputs (in byte)	IO-Link outputs (in byte)	VAUX (in byte)
	Instance	Size (in 8 bit)				
Exclusive Owner	104	262	2	2	256	2
Exclusive Owner (Omron)	102	262	2	2	256	2
IOL 4 IN/4 OUT	150	38	2	2	32	2
IOL 6 IN/6 OUT	151	54	2	2	48	2
IOL 8 IN/8 OUT	152	70	2	2	64	2
IOL 4 IN/4 OUT, diagnostics	150	38	2	2	32	2
IOL 6 IN/6 OUT, diagnostics	151	54	2	2	48	2
IOL 8 IN/8 OUT, diagnostics	152	70	2	2	64	2

Instance 102 and 104 – standard output

The description of the output data can be found in chapter “Operating” [▶ 152].

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control Word																
0x00	-	reserved														
DXP outputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
IO-Link process output data																
0x02 … 0x11	16 words per port															
…																
0x72 … 0x81																
VAUX1																
0x82	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1

Instance 150 – 4 byte OUT

The description of the output data can be found in chapter “Operating” [▷ 152].

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control Word																
0x00	-	reserved														
DXP outputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
IO-Link process output data																
0x02 … 0x03	2 words per port															
…																
0x10 … 0x11																
VAUX1																
0x12	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1

Instance 151 – 6 byte OUT

The description of the output data can be found in chapter “Operating” [▶ 152].

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control Word																
0x00	-	reserved														
DXP outputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
IO-Link process output data																
0x02 … 0x04	3 words per port															
…																
0x17 … 0x19																
VAUX																
0x1A	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1

Instance 152 – 8 byte OUT

The description of the output data can be found in chapter “Operating” [▶ 152].

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control Word																
0x00	-	reserved														
DXP outputs																
0x01	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
IO-Link process output data																
0x02 … 0x05	4 words per port															
…																
0x1E … 0x21																
VAUX1																
0x22	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1

Connection Manager Object (0x05)

This object is used for connection and connectionless communications, including establishing connections across multiple subnets.

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to the Turck products.

Common services

Service code		Class	Instance	Meaning
Dec.	Hex.			
84	0x54	no	yes	FWD_OPEN_CMD (opens a connection)
78	0x4E	no	yes	FWD_CLOSE_CMD (closes a connection)
82	0x52	no	yes	UNCONNECTED_SEND_CMD

TCP/IP Interface Object (0xF5)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to the Turck products.

Class attributes

Attr. no.		Designation	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Revision	G	UINT	1
2	0x02	Max. object instance	G	UINT	1
3	0x03	Number of instances	G	UINT	1
6	0x06	Max. class identifier	G	UINT	7
7	0x07	Max. instance attribute	G	UINT	6

Instance Attributes

Attr. no.		Designation	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Status	G	DWORD	Interface status
2	0x02	Configuration capability	G	DWORD	Interface capability flag
3	0x03	Configuration control	G/S	DWORD	Interface control flag
4	0x04	Physical link object	G	STRUCT	
		Path size		UINT	Number of 16 bit words: 0x02
		Path		Padded EPATH	0x20, 0xF6, 0x24, 0x01
5	0x05	Interface configuration	G	Structure of:	TCP/IP network interface configuration
		IP address	G	UDINT	Actual IP address
		Network mask	G	UDINT	Actual network mask
		Gateway addr.	G	UDINT	Actual default gateway
		Name server	G	UDINT	0 = no server address configured
		Name server 2	G	UDINT	0 = no secondary server address configured
		Domain name	G	UDINT	0 = no Domain Name configured
6	0x06	Host name	G	STRING	0 = no host name configured
12	0x0C	QuickConnect	G/S	BOOL	0 = deactivate 1 = activate

Common services

Service code		Class	Instance	Meaning
Dec.	Hex.			
1	0x01	Yes	Yes	Get_Attribute_All
2	0x02	No	No	Set_Attribute_All
14	0x0E	Yes	Yes	Get_Attribute_Single
16	0x10	No	Yes	Set_Attribute_Single

Interface Status

The Status attribute indicates the status of the TCP/IP network interface.

Bit	Designation	Meaning
0…3	Interface configuration status	Indicates the status of the Interface Configuration attribute: 0 = The Interface Configuration attribute has not been configured 1 = The Interface Configuration attribute contains valid configuration. 2…15 = reserved
4…31	Reserved	

Configuration Capability

The Configuration Capability indicates the device's support for optional network configuration capability.

Bit	Designation	Meaning	Value
0	BOOTP client	The device is capable of obtaining its network configuration via BOOTP.	1
1	DNS client	The device is capable of resolving host names by querying a DNS server.	0
2	DHCP client	The device is capable of obtaining its network configuration via DHCP.	1

Configuration control

The Configuration Control attribute is used to control network configuration options.

Bit	Designation	Meaning
0…3	Startup configuration	Determines how the device shall obtain its initial configuration. 0 = The device shall use the interface configuration values previously stored (for example, in non-volatile memory or via hardware switches, etc). 1…3 = reserved
4	DNS Enable	Always 0
5…31	Reserved	Set to 0

Interface Configuration

This attribute contains the configuration parameters required to operate a TCP/IP device.

To change this attribute, proceed as follows:

- ▶ Read out the attribute.
- ▶ Change the parameters.
- ▶ Set the attribute.
- ⇨ The TCP/IP Interface Object applies the new configuration upon completion of the Set service. If the value of the Startup Configuration bits (Configuration Control attribute) is 0, the new configuration is stored in non-volatile memory.

The device does not reply to the set service until the values are safely stored to non-volatile memory.

An attempt to set any of the components of the Interface Configuration attribute to invalid values results in an error (status code 0x09) returned from the Set service. If initial configuration is obtained via BOOTP or DHCP, the Interface Configuration attribute components are all 0 until the BOOTP or DHCP reply is received. Upon receipt of the BOOTP or DHCP reply, the Interface Configuration attribute shows the configuration obtained via BOOTP/DHCP.

Host name

This attribute contains the device's host name. The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up. The mechanism allows the DHCP client to transmit its host name to the DHCP server. The DHCP server then updates the DNS records on behalf of the client.

Ethernet Link Object (0xF6)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to the Turck products.

Class attributes

Attr.-no.		Designation	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Revision	G	UINT	1
2	0x02	Max. object instance	G	UINT	1
3	0x03	Number of instances	G	UINT	1
6	0x06	Max. class identifier	G	UINT	7
7	0x07	Max. instance attribute	G	UINT	6

Instance attributes

Attr.-no.		Designation	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Interface speed	G	UDINT	Speed in megabit per second (e.g. (z. B. 10, 100, 1000 etc.)
2	0x02	Interface flags	G	DWORD	Interface capability flag
3	0x03	Physical address	G	ARRAY OF USINT	Contains the interface's MAC address (Turck: 00:07:46:xx:xx:xx)
6	0x06	Interface control	G	2 WORD	Allows port-wise changes of the Ethernet-settings
7	0x07	Interface type	G		
10	0x0A	Interface label	G		

Interface flags

Bit	Designation	Meaning	Default value
0	Link status	Indicates whether or not the Ethernet communications interface is connected to an active network. 0 = inactive link 1 = active link	Depends on application
1	Half/full duplex	0 = Half duplex 1 = Full duplex If the Link Status flag is 0, the value of the Half/Full Duplex flag is indeterminate.	Depends on application
2…4	Negotiation status	Indicates the status of the automatic autonegotiation 0 = autonegotiation in progress 1 = autonegotiation and speed detection failed, Using default values for speed and duplex (10Mbps/ half duplex). 2 = auto-negotiation failed but detected speed (default: half duplex). 3 = successfully negotiated speed and duplex 4 = Autonegotiation not started, yet Forced speed and duplex.	Depends on application
5	Manual setting requires reset	0 = interface can activate changes to link parameters (auto-negotiate, duplex mode, interface speed) automatically 1 = device requires a Reset service to be issued to its Identity Object in order to adapt the changes.	0
6	Local Hardware Fault	0 = interface detects no local hardware fault 1 = local hardware error detected	0

Common services

Service code		Class	Instance	Meaning
Dec.	Hex.			
1	0x01	Yes	Yes	Get_Attribute_All
14	0x0E	Yes	Yes	Get_Attribute_Single
76	0x4C	No	Yes	Enetlink_Get_and_Clear

7.6.7 Vendor Specific Classes (VSC)

In addition to supporting the above named CIP Standard Classes, the device support the vendor specific classes (VSCs) described in the following.

Class code		Name	Description
Dec.	Hex.		
100	0x64	Gateway Class [▶ 100]	Data and parameters for the field bus specific part of the device.
103	0x67	IO-Link Parameter Object [▶ 101]	ISDU object for acyclic transmission of parameter data between IO-Link master and IO-Link device
138	0x8A	IO-Link Events Class [▶ 105]	IO-Link Events
140	0x8C	Device Identity [▶ 106]	Device and vendor ID of the connected IO-Link devices
179	0xB3	IO-Link Port Class [▶ 107]	Parameters and diagnostics of the IO-Link-channels
198	0xC6	Basic Class [▶ 109]	Parameters and diagnostics of the digital channels channels
199	0xC7	VAUX Control Class [▶ 112]	Parameters and diagnostics for VAUX

Gateway Class (VSC 100)

This class contains all information concerning the whole device.

Object Instance 2, Gateway Instance

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	**Hex.**				
109	0x6D	Device Status	G	STRUCT	Contains the device status.
115	0x73	On IO connection timeout	G/S	ENUM USINT	Reaction when the time limit for an I/O connection is exceeded:
					0: SWITCH IO FAULTED (0): The channels are switched to the substitute value.
					1: SWITCH IO OFF (1): The outputs are set to 0.
					2: SWITCH IO HOLD (2): No further changes to I/O data. The outputs are held.
138	0x8A	GW status register	G/S	DWORD	Activates or deactivates the mapping of the status word into the device's input data. Activating or deactivating of the status word is only possible in Assembly Instance 103.
139	0x8B	GW Control Register	G/S	DWORD	Activates or deactivates the mapping of the control word into the device's output data. Activating or deactivating of the control word is only possible in Assembly Instance 104.
140	0x8C	Disable Protocols	G/S	UINT	Deactivation of the used Ethernet protocol.
					Bit 0: Deactivates EtherNet/IP (cannot be deactivated via the EtherNet/IP interface).
					Bit 1: Deactivates Modbus TCP
					Bit 2: Deactivates PROFINET
					Bit 15: Deactivates the web server

IO-Link Parameter Object (VSC 103)

The IO-Link Parameter Object enables the acyclic transfer of parameter data between the IO-Link master and the IO-Link device.

Instance 1 of the object addresses the IO-Link master

The instance attribute numbers address the IO-Link port at the IO-Link master or the port 0 functions of the IO-Link master.

- **1…n**: IO-Link port at IO-Link master, n = number of IO-Link ports at IO-Link master
- **128**: Port-0 functions of the IO-Link master

Instance attributes

Common services

Service code		Class	Instance	Service name
Dec.	Hex.			
14	0x0E	Yes	No	Get_Attribute_Single Returns the content of a specified attribute.
75	0x4B	No	Yes	Read_ISDU The service reads parameters from the connected IO-Link device.
76	0x4C	No	Yes	Write_ISDU The service writes parameters from the connected IO-Link device.

Read_ISDU - Request

Data	Value/content	Description	
Class	0x67	IO-Link Parameter Object	
Instance	0x01	Addressing the IO-Link master	
Instance attribute	0x01…n, 128	IO-Link port number, or 128 for Port-0 functions	
Service code	0x4B	Read_ISDU	
Data	Request parameters for the ISDU Read Service		
	Name	**Data type**	**Description**
Data byte 0	Index (LSB)	UINT	LSB from index of the IO-Link ISDU object acc. to IODD
Data byte 1	Index (MSB)	UINT	MSB from index of the IO-Link ISDU object acc. to IODD
Data byte 2	Sub index	USINT	Sub index from the IO-Link ISDU object acc. to IODD

Read_ISDU – Response

- CIP Service Response, General-Status ≠ 0 → error-free access
  structure of the response:

Name	Data type	Description
ISDU data	Array of Byte	Read data, max. 232 byte

- CIP Service Response, General-Status ≠ 0 → access error
  structure of the response:

Name	Data type	Description
IOL_Master Error	UINT	IO-Link master specific, see IO-Link master Error Codes
IOL_Device Error	UINT	IO-Link device specific, see IO-Link device Error Codes and device documentation

Example:
Read access – name of device at port 4 is read out

Data	Value/content	Description	
Class	0x67	IO-Link Parameter Object	
Instance	0x01	Addressing the IO-Link master	
Instance attribute	0x04	IO-Link port number	
Service code	0x4B	Read_ISDU: read access	
Data	Request parameters for the ISDU Read Service		
	Name	**Data type**	**Description**
Data byte 0	0x12	UINT	Index for the product name in the device (e.g. Turck I/O hub TBIL-M1-16DXP) according to IODD
Data byte 1	0x00	UINT	-
Data byte 2	0x00	USINT	The index has no sub index.

- CIP Service Response:

Name	Data type	Description
ISDU data	Array of Byte	**Error-free access:** Content: 54 42 49 4C 2D 4D 31 2D 31 36 44 58 50 (TBIL-M1-16DXP) **Access error:** Content: Error code

Write_ISDU – Request

Data	Value/content	Description	
Class	0x67	IO-Link Parameter Object	
Instance	0x01	Addressing the IO-Link master	
Instance attribute	0x01…n, 128	IO-Link port number, or 128 for Port-0 functions	
Service code	0x4C	Write_ISDU	
Data	Request parameters for the ISDU write service		
	Name	**Data type**	**Description**
Data byte 0	Index (LSB)	UINT	LSB from index of the IO-Link ISDU object acc. to IODD
Data byte 1	Index (MSB)	UINT	MSB from index of the IO-Link ISDU object acc. to IODD
Data byte 2	Sub index	USINT	Sub index from the IO-Link ISDU object acc. to IODD
Data byte 3…data byte n	Data	Array of Byte	Parameter data (n= length of ISDU object + 3)

Write_ISDU – Response

- CIP Service Response, general status = 0 → error-free access
  Service response without further data
- CIP Service Response, general status ≠ 0 → access error
  structure of the response:

Name	Data type	Description
IOL_Master Error	UINT	IO-Link master specific, see IO-Link master Error Codes
IOL_Device Error	UINT	IO-Link device specific, see IO-Link device Error Codes and device documentation

Example:
Write access – Application Specific Tag is written into the device at port 4

Data	Value/content	Description
Class	0x67	IO-Link Parameter Object
Instance	0x01	Addressing the IO-Link master
Instance attribute	0x04	IO-Link port number
Service code	0x4C	Write_ISDU: Write access

Data	Value/content	Description
Data	Request parameters for the ISDU write service	
	Name	**Data type**	**Description**
	0x18	UINT	Index for the application specific tag in the device (e.g. In Turck I/O-Hub TBIL-M1- 16DXP)
	0x00	USINT	The index has no sub index.
	Byte 0: 0x54 Byte 1: 0x65 Byte 2: 0x6D Byte 3: 0x70 Byte 4: 0x65 … Byte 17: 0x31 Byte 18…31: 00		The Application Specific Tag of the device can consist of 32 byte, example: ASCII: Temperature_sensor1 Hex: 54 65 6d 70 65 72 61 74 75 72 65 5f 73 65 6e 73 6f 72 31 00 00… The remainder of the 32 bytes not required is filled with 00.

IO-Link master error codes

Error code	Designation acc. to specification	Meaning
0x0000	No error	No error
0x7000	IOL_CALL Conflict	Unexpected write-request, read request expected
0x7001	Wrong IOL_CALL	Decoding error
0x7002	Port blocked	The accessed port is occupied by another task
…	reserved	
0x8000	Timeout	Timeout, IOL master or IOL device port busy
0x8001	Wrong index	Error: IOL index < 32767 or > 65535 selected
0x8002	Wrong port address	Port address not available
0x8002	Wrong port function	Port function not available
…	reserved	

IO-Link device error codes

Error code	Designation acc. to specification	Meaning
0x1000	COM_ERR	Communication error Possible source: the addressed port is parameterized as digital input DI and is not in IO-Link mode
0x1100	I_SERVICE_TIMEOUT	Timeout in communication, device does not respond in time
0x5600	M_ISDU_CHECKSUM	Master reports checksum error, access to device not possible
0x5700	M_ISDU_ILLEGAL	Device can not respond to master request
0x8000	APP_DEV	Application error in the device
0x8011	IDX_NOTAVAIL	Index not available
0x8012	SUBIDX_NOTAVAIL	Sub-Index not available
0x8020	SERV_NOTAVAIL	The service is temporarily not available.

Error code	Designation acc. to specification	Meaning
0x8021	SERV_NOTAVAIL_LOCCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device at the device active)
0x8022	SERV_NOTAVAIL_DEVCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device via DTM/PLC etc. active)
0x8023	IDX_NOT_WRITEABLE	Access denied, Index cannot be written
0x8030	PAR_VALOUTOFRNG	Parameter value out of the valid range
0x8031	PAR_VALGTLIM	Parameter value value above the upper limit
0x8032	PAR_VALLTLIM	Parameter value value below the lower limit
0x8033	VAL_LENOVRRUN	Length of data to be written does not match the length defined for this parameter
0x8034	VAL_LENUNDRUN	
0x8035	FUNC_NOTAVAIL	Function not available in the device
0x8036	FUNC_UNAVAILTEMP	Function temporarily not available in the device
0x8040	PARA_SETINVALID	Invalid parameter: Parameters not consistent with other parameters in the device.
0x8041	PARA_SETINCONSIST	Inconsistent parameters
0x8082	APP_DEVNOTRDY	Application not ready, device busy
0x8100	UNSPECIFIC	Vendor specific, according to device documentation
0x8101… 0x8FF	VENDOR_SPECIFIC	

IO-Link Event Class (VSC 138)

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
1	0x01	IO-Link Events – port 1	G	USINT	Port number of the port which sends the 1st IO-Link Event.
…	…				
16	0x10	IO-Link Events – port 16	G	USINT	Port number of the port which sends the 16th IO-Link Event.
17	0x11	IO-Link Events – Qualifier 1	G	USINT	Qualifier of the 1st IO-Link Event
…	…				
32	0x20	IO-Link Events – Qualifier 16	G	USINT	Qualifier of the 16th IO-Link Event
33	0x21	IO-Link Events – Event Code 1	G	USINT	Event Code of the 1st IO-Link Event
…	…				
48	0x30	IO-Link Events – Event Code 16	G	USINT	Event Code of the 16th IO-Link Event

Device Identity (VSC 140)

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
1	0x01	Device Identity 1 - vendor ID	G	UINT	Vendor ID of the IO-Link device at IO-Link-Port 1…8
2	0x02	Device Identity 2 - vendor ID	G	UINT	
3	0x03	Device Identity 3 - vendor ID	G	UINT	
4	0x04	Device Identity 4 - vendor ID	G	UINT	
5	0x05	Device Identity 5 - vendor ID	G	UINT	
6	0x06	Device Identity 6 - vendor ID	G	UINT	
7	0x07	Device Identity 7 - vendor ID	G	UINT	
8	0x08	Device Identity 8 - vendor ID	G	UINT	
9	0x09	Device Identity 1 - device ID	G	UDINT	Device ID of the IO-Link device at IO-Link-Port 1…8
10	0x0A	Device Identity 2 - device ID	G	UDINT	
11	0x0B	Device Identity 3 - device ID	G	UDINT	
12	0x0C	Device Identity 4 - device ID	G	UDINT	
13	0x0D	Device Identity 5 - device ID	G	UDINT	
14	0x0E	Device Identity 6 - device ID	G	UDINT	
15	0x0F	Device Identity 7 - device ID	G	UDINT	
16	0x10	Device Identity 8 - device ID	G	UDINT	

IO-Link Port Class (VSC 179)

This class has one instance per IO-Link port on the IO-Link master module.

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
1	0x01	IOL port … – Operation mode	G/S	USINT	0: IO-Link without validation
					1: IO-Link with family compatible device
					2: IO-Link with compatible device
					3: IO-Link with identical device
					4: DI (with parameter access)
					8: DI
					9: DX
2	0x02	IOL port … – Data storage mode	G/S	USINT	0: activated
					1: overwrite
					2: read in
					3: deactivated, clear
3	0x03	IOL port … – Cycle time	G/S	USINT	See [▶ 139]
4	0x04	IOL port … – Revision	G/S	USINT	Automatic
					1: V1.0
5	0x05	IOL port … – Activate Quick Start-Up	G/S	USINT	0: no
					1: yes
6	0x06	IOL port … - Process input data invalid	G/S	USINT	0: diagnostics generated
					1: no diagnostics generated
7	0x07	IOL port … – Deactivate diagnostics	G/S	USINT	0: no
					1: Notifications
					2: Notifications and warnings
					3: yes
8	0x08	IOL port … – Input data mapping	G/S	USINT	0: direct
					1: swap 16 bit
					2: swap 32 bit
					3: swap all
9	0x09	IOL port … – Output data mapping	G/S	USINT	0: direct
					1: swap 16 bit
					2: swap 32 bit
					3: swap all
10	0x0A	IOL port … – Vendor ID	G/S	UINT	
11	0x0B	IOL port … – Device ID	G/S	196	
12	0x0C	IOL port … – Device parameterization via GSD		USINT	0: disabled
					1: active
13	0x0D	IOL port … – Wrong or missing device	G	USINT	0: -
					1: active
14	0x0E	IOL port … – Data storage error	G	USINT	0: -
					1: active

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
15	0x0F	IOL port … - Process input data invalid	G	USINT	0: -
					1: active
16	0x10	IOL port … – Hardware error	G	USINT	0: -
					1: active
17	0x11	IOL port … – Maintenance events	G	USINT	0: -
					1: active
18	0x12	IOL port … – Out of specification error	G	USINT	0: -
					1: active
19	0x13	IOL port … – Parameterization error	G	USINT	0: -
					1: active
20	0x14	IOL port … – Overtemperature	G	USINT	0: -
					1: active
21	0x15	IOL port … – Lower limit value underrun	G	USINT	0: -
					1: active
22	0x16	IOL port … – Upper limit value exceeded	G	USINT	0: -
					1: active
23	0x17	IOL port … – Undervoltage	G	USINT	0: -
					1: active
24	0x18	IOL port … – Overvoltage	G	USINT	0: -
					1: active
25	0x19	IOL port … – Overload	G	USINT	0: -
					1: active
26	0x1A	IOL port … – Common error	G	USINT	0: -
					1: active
27	0x1B	IOL port … – Port parameterization error	G	USINT	0: -
					1: active
28	0x1C	IOL port … – Input data word 0	G	UINT	
…	…	…	…	…	
43	0x2B	IOL port … – Input data word 15	G	UINT	
44	0x2C	IOL port … – Output data word 0	G	UINT	
…	…	…	…	…	
59	0x3B	IOL port … – Output data word 15	G	UINT	

Basic Class (VSC 198)

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
1	0x01	Basic 0 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
2	0x02	Basic 1 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
3	0x03	Basic 2 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
4	0x04	Basic 3 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
5	0x05	Basic 4 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
6	0x06	Basic 5 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
7	0x07	Basic 6 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
8	0x08	Basic 7 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
9	0x09	Basic 8 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
10	0x0A	Basic 9 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
11	0x0B	Basic 10 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
12	0x0C	Basic 11 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
13	0x0D	Basic 12 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
14	0x0E	Basic 13 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
15	0x0F	Basic 14 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
16	0x10	Basic 15 – Manual output reset after overcurr.	G/S	USINT	0: no
					1: yes
17	0x11	Basic 1 – Activate output	G	USINT	0: no
					1: yes
18	0x12	Basic 3 – Activate output	G	USINT	0: no
					1: yes
19	0x13	Basic 5 – Activate output	G	USINT	0: no
					1: yes
20	0x14	Basic 7 – Activate output	G	USINT	0: no
					1: yes

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
21	0x15	Basic 9 – Activate output	G	USINT	0: no
					1: yes
22	0x16	Basic 11 – Activate output	G	USINT	0: no
					1: yes
23	0x17	Basic 13 – Activate output	G	USINT	0: no
					1: yes
24	0x18	Basic 15 – Activate output	G	USINT	0: no
					1: yes
25	0x19	Basic 0 – Overcurrent output	G	USINT	0: -
					1: active
26	0x1A	Basic 1 – Overcurrent output	G	USINT	0: -
					1: active
27	0x1B	Basic 2 – Overcurrent output	G	USINT	0: -
					1: active
28	0x1C	Basic 3 – Overcurrent output	G	USINT	0: -
					1: active
29	0x1D	Basic 4 – Overcurrent output	G	USINT	0: -
					1: active
30	0x1E	Basic 5 – Overcurrent output	G	USINT	0: -
					1: active
31	0x1F	Basic 6 – Overcurrent output	G	USINT	0: -
					1: active
32	0x20	Basic 7 – Overcurrent output	G	USINT	0: -
					1: active
33	0x21	Basic 8 – Overcurrent output	G	USINT	0: -
					1: active
34	0x22	Basic 9 – Overcurrent output	G	USINT	0: -
					1: active
35	0x23	Basic 10 – Overcurrent output	G	USINT	0: -
					1: active
36	0x24	Basic 11 – Overcurrent output	G	USINT	0: -
					1: active
37	0x25	Basic 12 – Overcurrent output	G	USINT	0: -
					1: active
38	0x26	Basic 13 – Overcurrent output	G	USINT	0: -
					1: active
39	0x27	Basic 14 – Overcurrent output	G	USINT	0: -
					1: active
40	0x28	Basic 15 – Overcurrent output	G	USINT	0: -
					1: active

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
41	0x29	Basic 0 – DI input	G	USINT	0: off
					1: on
42	0x2A	Basic 2 – DI input	G	USINT	0: off
					1: on
43	0x2B	Basic 4 – DI input	G	USINT	0: off
					1: on
44	0x2C	Basic 6 – DI input	G	USINT	0: off
					1: on
45	0x2D	Basic 7 – DI input	G	USINT	0: off
					1: on
46	0x2E	Basic 10 – DI input	G	USINT	0: off
					1: on
47	0x2F	Basic 12 – DI input	G	USINT	0: off
					1: on
48	0x30	Basic 14 – DI input	G	USINT	0: off
					1: on
49	0x31	Basic 0 – Input values valid	G	USINT	0: no
					1: yes
50	0x32	Basic 2 – Input values valid	G	USINT	0: no
					1: yes
51	0x33	Basic 4 – Input values valid	G	USINT	0: no
					1: yes
52	0x34	Basic 6 – Input values valid	G	USINT	0: no
					1: yes
53	0x35	Basic 8 – Input values valid	G	USINT	0: no
					1: yes
54	0x36	Basic 10 – Input values valid	G	USINT	0: no
					1: yes
55	0x37	Basic 12 – Input values valid	G	USINT	0: no
					1: yes
56	0x38	Basic 14 – Input values valid	G	USINT	0: no
					1: yes
57	0x39	Basic 0 – DXP input value	G	USINT	0: off
					1: on
58	0x3A	Basic 2 – DXP input value	G	USINT	0: off
					1: on
59	0x3B	Basic 4 – DXP input value	G	USINT	0: off
					1: on
60	0x3C	Basic 6 – DXP input value	G	USINT	0: off
					1: on

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
61	0x3D	Basic 8 – DXP input value	G	USINT	0: off
					1: on
62	0x3E	Basic 10 – DXP input value	G	USINT	0: off
					1: on
63	0x3F	Basic 12 – DXP input value	G	USINT	0: off
					1: on
64	0x40	Basic 14 – DXP input value	G	USINT	0: off
					1: on
65	0x41	Basic – output value	G	WORD	0: DXP 0 1: DXP 1 2: DXP 2 3: DXP 3 4: DXP 4 5: DXP 5 6: DXP 6 7: DXP 7 8: DXP 8 9: DXP 9 10: DXP 10 11: DXP 11 12: DXP 12 13: DXP 13 14: DXP 14 15: DXP 15

VAUX Control Class (VSC 199)

This class contains parameters and diagnostics for monitoring the 24 VDC sensor and actuator supply.

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
1	0x01	VAUX control - VAUX1 Pin1 C0/X0 (Ch0/1)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
2	0x02	VAUX control - VAUX1 Pin1 C1/X1 (Ch2/3)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
3	0x03	VAUX control - VAUX1 Pin1 C2/X2 (Ch4/5)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
4	0x04	VAUX control - VAUX1 Pin1 C3/X3 (Ch6/7)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off

Attr. no.		Designation	Get/ Set	Type	Meaning
Dec.	Hex.				
5	0x05	VAUX control - VAUX1 Pin1 C4/X4 (Ch8/9)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
6	0x06	VAUX control - VAUX1 Pin1 C5/X5 (Ch10/11)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
7	0x07	VAUX control - VAUX1 Pin1 C6/X6 (Ch12/13)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
8	0x08	VAUX control - VAUX1 Pin1 C7/X7 (Ch14/15)	G/S	USINT	0: 24 VDC
					1: switchable
					2: off
9	0x09	VAUX control - VAUX1 Pin1 C0/X0 (Ch0/1)	G	USINT	0: off
					1: on
10	0x0A	VAUX control - VAUX1 Pin1 C1/X1 (Ch2/3)	G	USINT	0: off
					1: on
11	0x0B	VAUX control - VAUX1 Pin1 C2/X2 (Ch4/5)	G	USINT	0: off
					1: on
12	0x0C	VAUX control - VAUX1 Pin1 C3/X3 (Ch6/7)	G	USINT	0: off
					1: on
13	0x0D	VAUX control - VAUX1 Pin1 C4/X4 (Ch8/9)	G	USINT	0: off
					1: on
14	0x0E	VAUX control - VAUX1 Pin1 C5/X5 (Ch10/11)	G	USINT	0: off
					1: on
15	0x0F	VAUX control - VAUX1 Pin1 C6/X6 (Ch12/13)	G	USINT	0: off
					1: on
16	0x10	VAUX control - VAUX1 Pin1 C7/X7 (Ch14/15)	G	USINT	0: off
					1: on

7.7 Connecting the devices to an EtherNet/IP scanner with Studio 5000

Used hardware

The following hardware components are used in this example:

- Rockwell Contoller ControlLogix 1756-L72, Logix 5572
- Rockwell Scanner 1756-EN2TR
- IO-Link master module TBEN-L…-8IOLA

Used software

The following software tools are used in this example:

- Logix Designer (Studio 5000)
- Catalog file for Turck compact stations TURCK_BLOCK_STATIONS_V24. L5K" as part of the file "TBEN-S_ETHERNETIP.zip" (downloadable free of charge under www.turck.com)

Catalog files

Turck provides catalog files "TURCK_BLOCK_STATIONS_Vxx.L5K" for use in Rockwell Automation's RSLogix/Studio5000. The catalog files contain predefined, application-dependent device configurations with different input and output data widths and descriptions of the configuration, input and output tag data. The predefined device configurations correspond to the input and output assembly instances described in the section "Assembly Object" in the chapter "Commissioning Devices with EtherNet/IP" → under "EtherNet/IP standard classes".

NOTE
The catalog file is available in the L5K file format and must be converted to the "ACD" file format before it can be used. The file is opened in RSLogix/Studio5000 and saved as a project (*.ACD).

Prerequisites

- An instance of the programming software Logix Designer (Studio 5000) with the catalog files is opened.
- A new project has been created in a second instance of the programming software Logix Designer (Studio 5000).
- The PLC and the Scanner mentioned above have been added to the project in the second instance of the programming software Logix Designer (Studio 5000).

7.7.1 Adding the devices from the catalog files to the new project

- ▶ Right-click the device entry and use **Copy**.

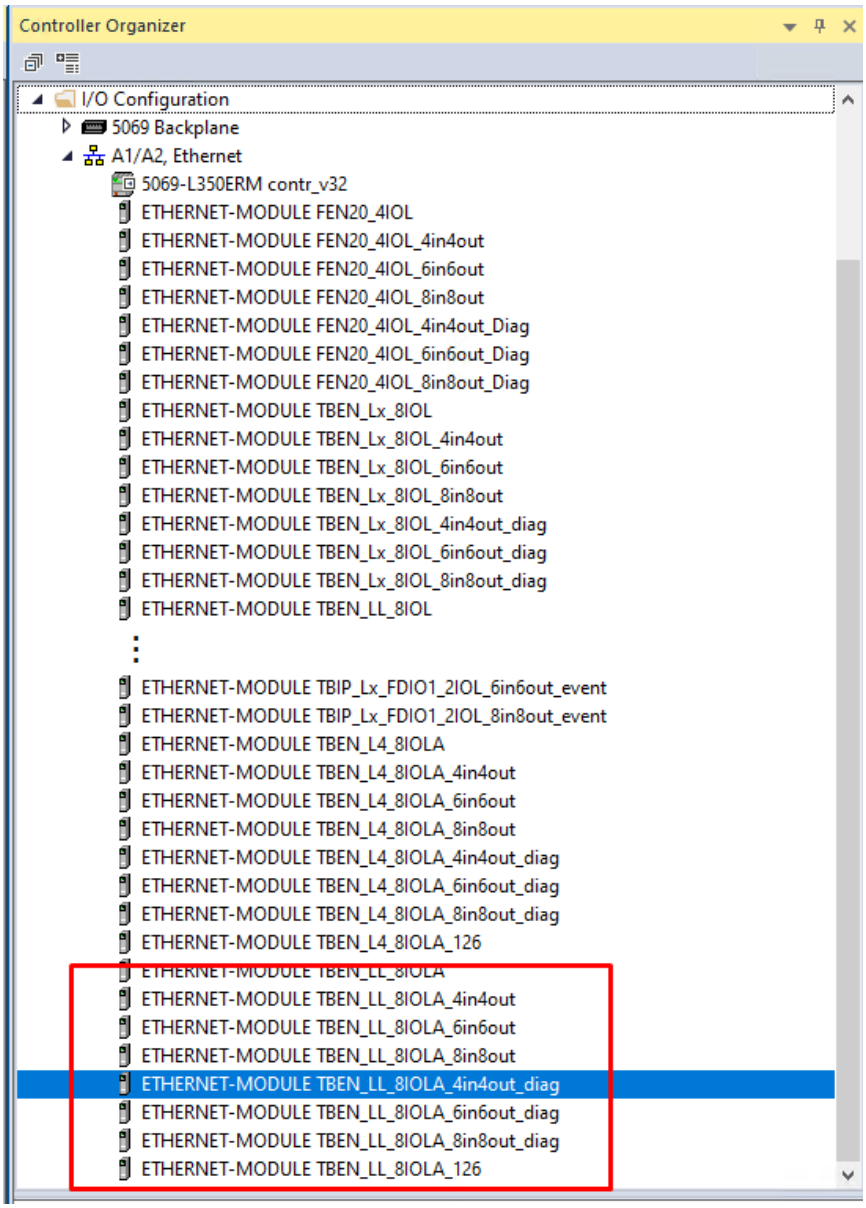


Fig. 61: Logix Designer – copying the device entry from catalog file

- Right-click the EtherNet/IP-Scanner in the second instance of the software Logix Designer (Studio 5000) and add the device to the project via **Paste**. Here in the example the configuration with 4 byte each input and output data plus diagnostics **TBEN_LL_8IOLA_4in-4out_diag** is used.

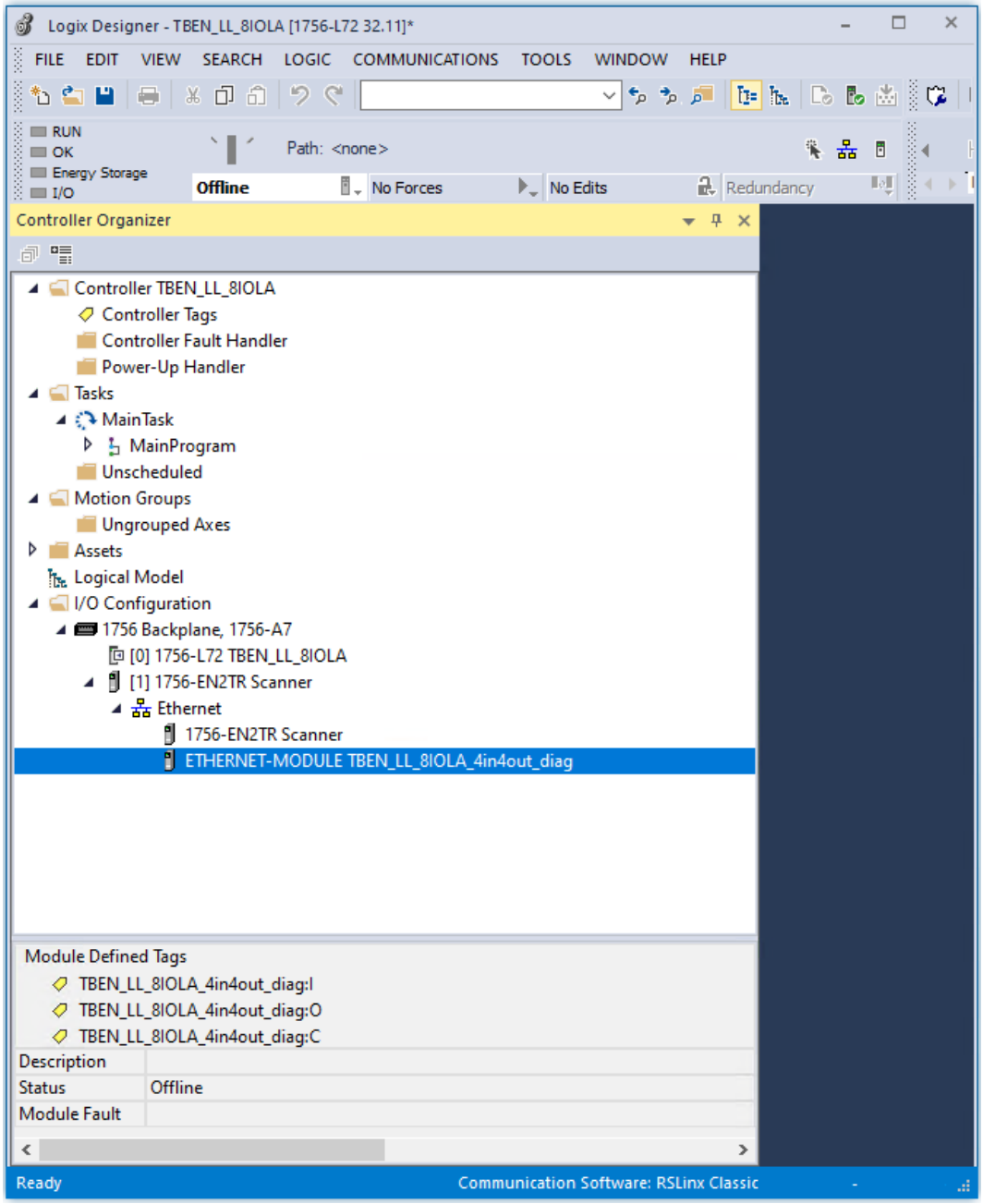


Fig. 62: Logix Designer – predefined configuration of TBEN-LL-8IOLA in the new project

7.7.2 Configuring the device

- Open the device entry by double-clicking.
- If necessary, define a module name.
- Enter the IP address of the device or a Host Name.

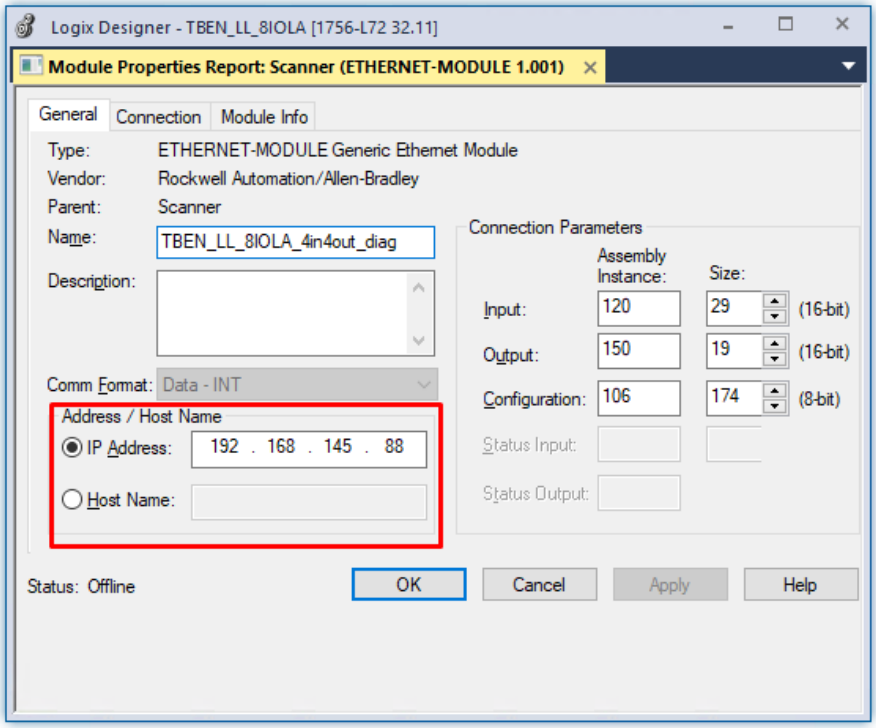


Fig. 63: Setting module name and IP address

- Optional: Set the connection parameters.

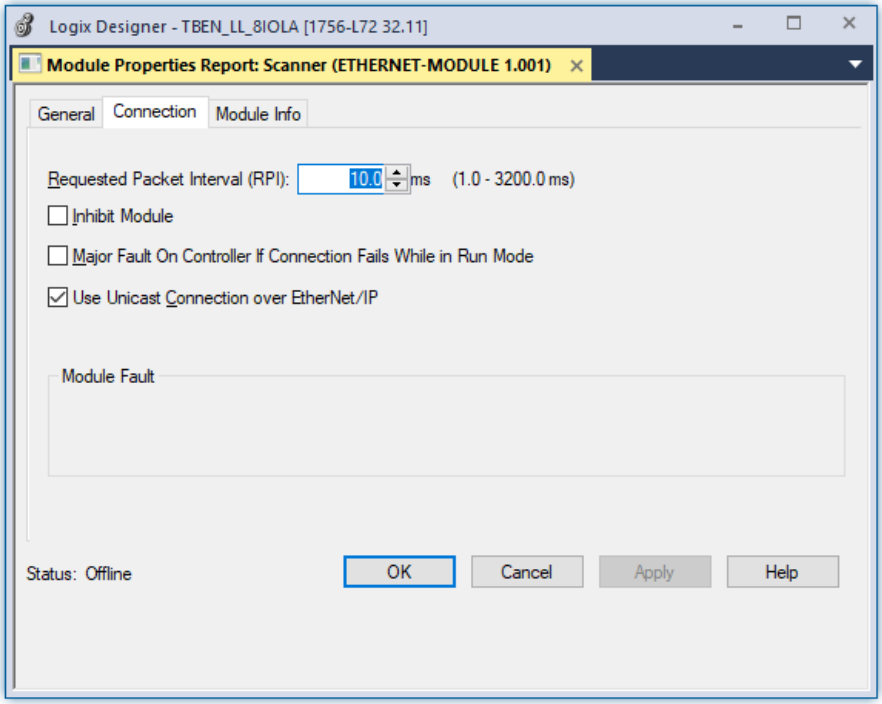


Fig. 64: Setting the connection parameters

7.7.3 Parameterizing the device

- Open the Controller Tags of the device.
- Parameterize the device by using the Controller Tags (in the example: **TBEN_LL_8IOLA_4in4out_diag:C**).

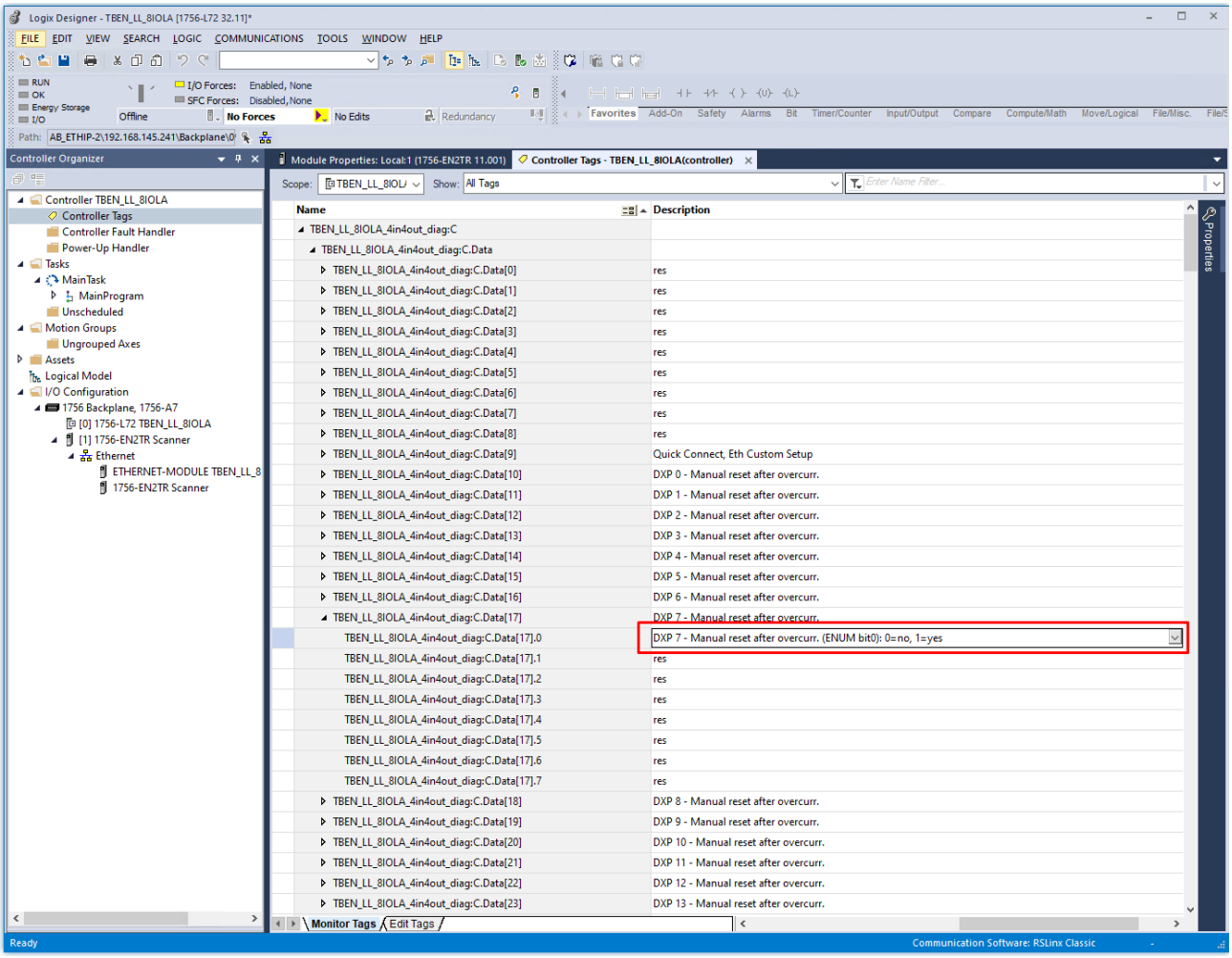


Fig. 65: Parameterizing the device

7.7.4 Going online with the PLC

- ▶ Search the network via **Who Active** function.
- ▶ Select the PLC.
- ▶ Set the communication path via **Set Project Path**.
- ⇨ The communication path is set.

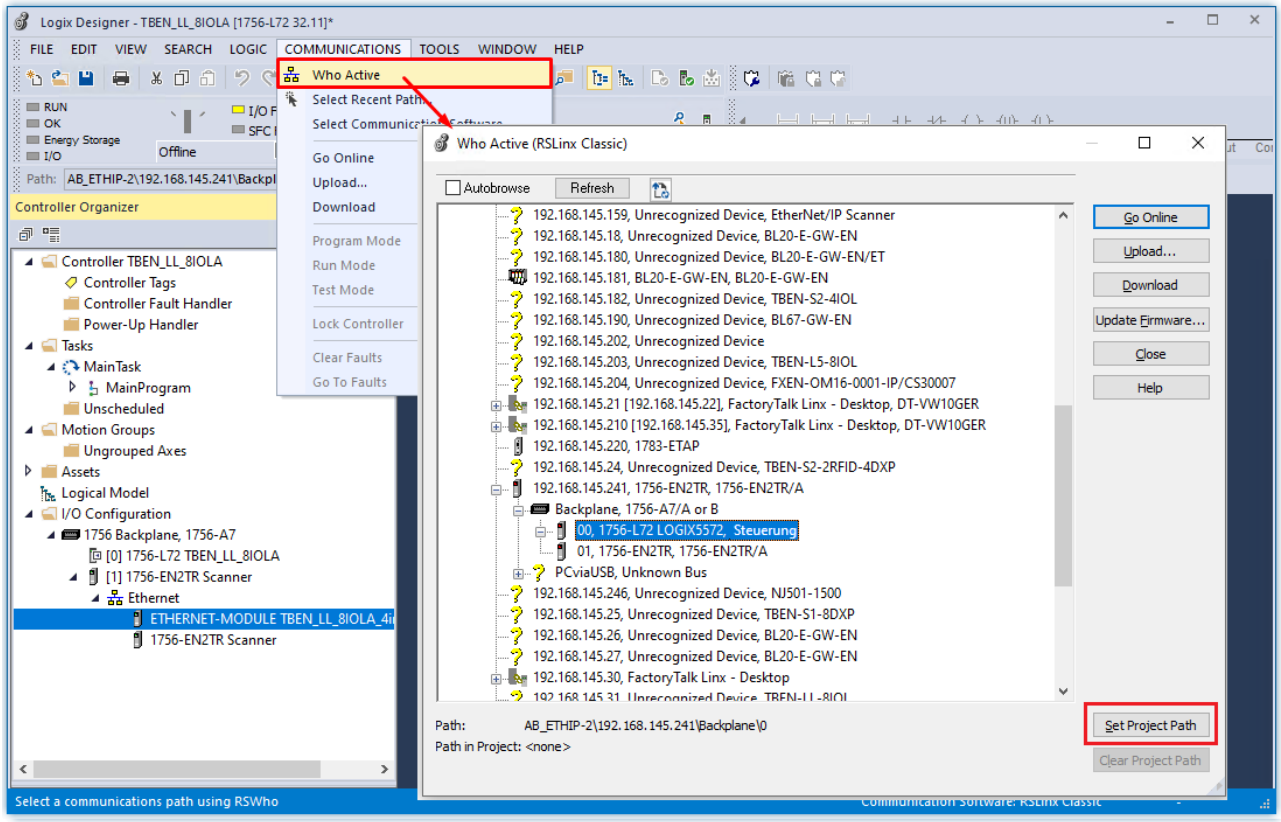


Fig. 66: Setting the communication path

- ▶ Select the PLC.
- ▶ Click **Go online**.

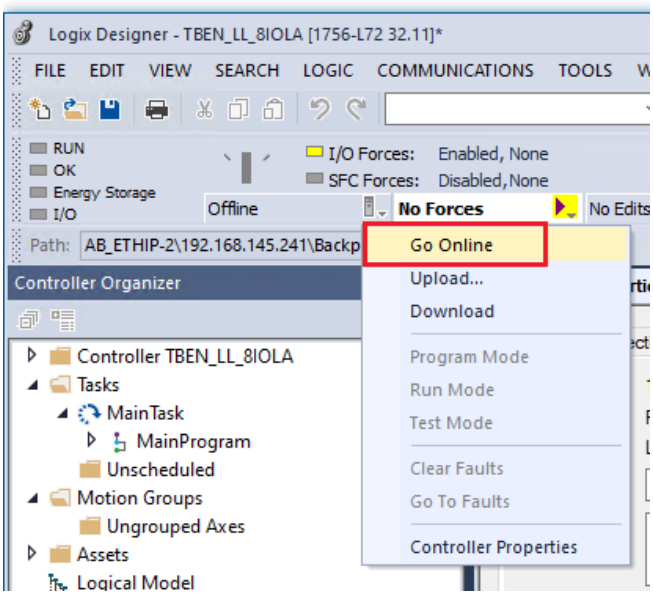


Fig. 67: Going online with the device

- ▶ Click **Download** In the following dialog (Connect To Go Online).
- ▶ Confirm all following messages.
- ⇨ The program is downloaded to the PLC. The online connection is established.

7.7.5 Reading process data

- ▶ Open the Controller Tags in the project tree by double-clicking.
- ⇨ Access tot he parameter data (**TBEN_LL_8IOLA_4in4out_diag:C**), input data (**TBEN_LL_8IOLA_4in4out_diag:I**) and output data (**TBEN_LL_8IOLA_4in4out_diag:O**) is possible.

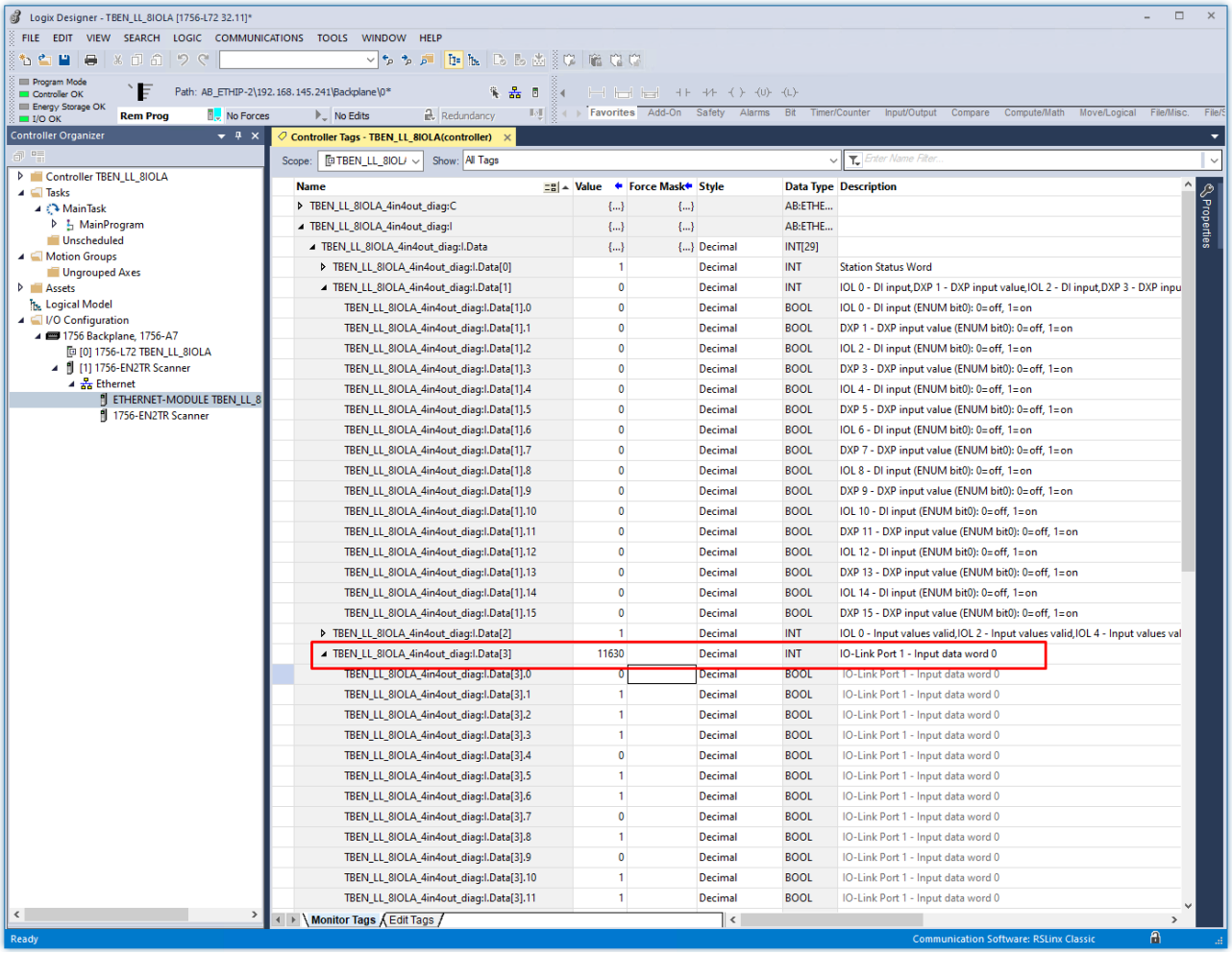


Fig. 68: Controller Tags in project tree – IO-Link data for IO-Link port 1

7.8 Commissioning IO-Link devices

7.8.1 Commissioning IO-Link devices via IODD Configurator

The IO-Link devices connected to the IO-Link master can be commissioned using the IODD Configurator via generic or device-specific IODDs The IODD Configurator is called up via the web server of the IO-Link master module.

NOTE
To call up the IODD Configurator, a login in the web server of the IO-Link master is required [▶ 28].

Connected IO-Link devices are read in and initially mapped by a generic IODD.

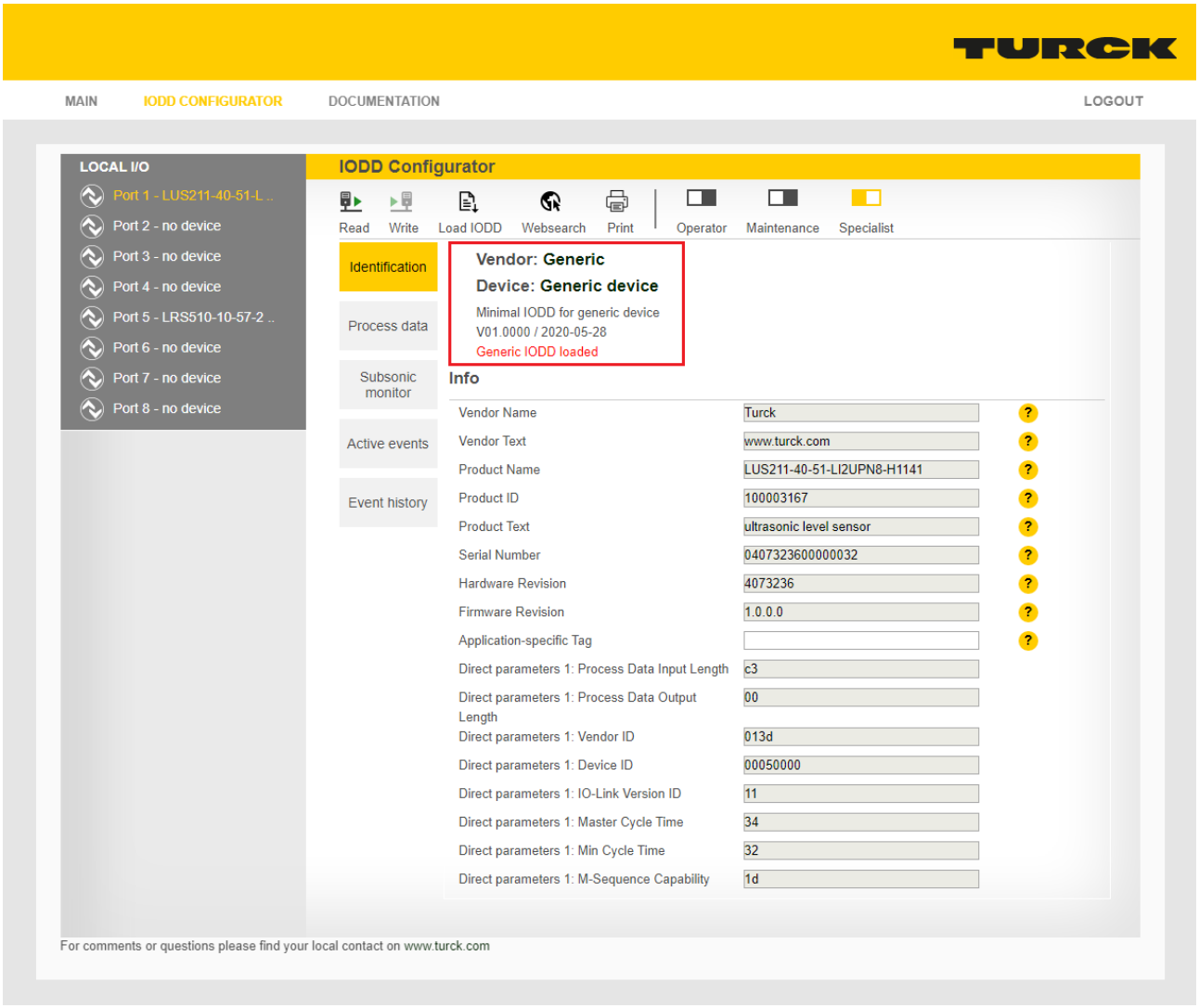


Fig. 69: IODD Configurator: IO-Link device with generic IODD

Device-specific IODDs can be loaded either directly from the local file system via **Load IODD** or from the database of the IO-Link consortium via **Websearch**. A PC with Internet access is required for the **Websearch** function.

When using a device-specific IODD, the IO-Link device is mapped with all IO-Link device-specific parameters, process data, etc. that are defined in the IODD.

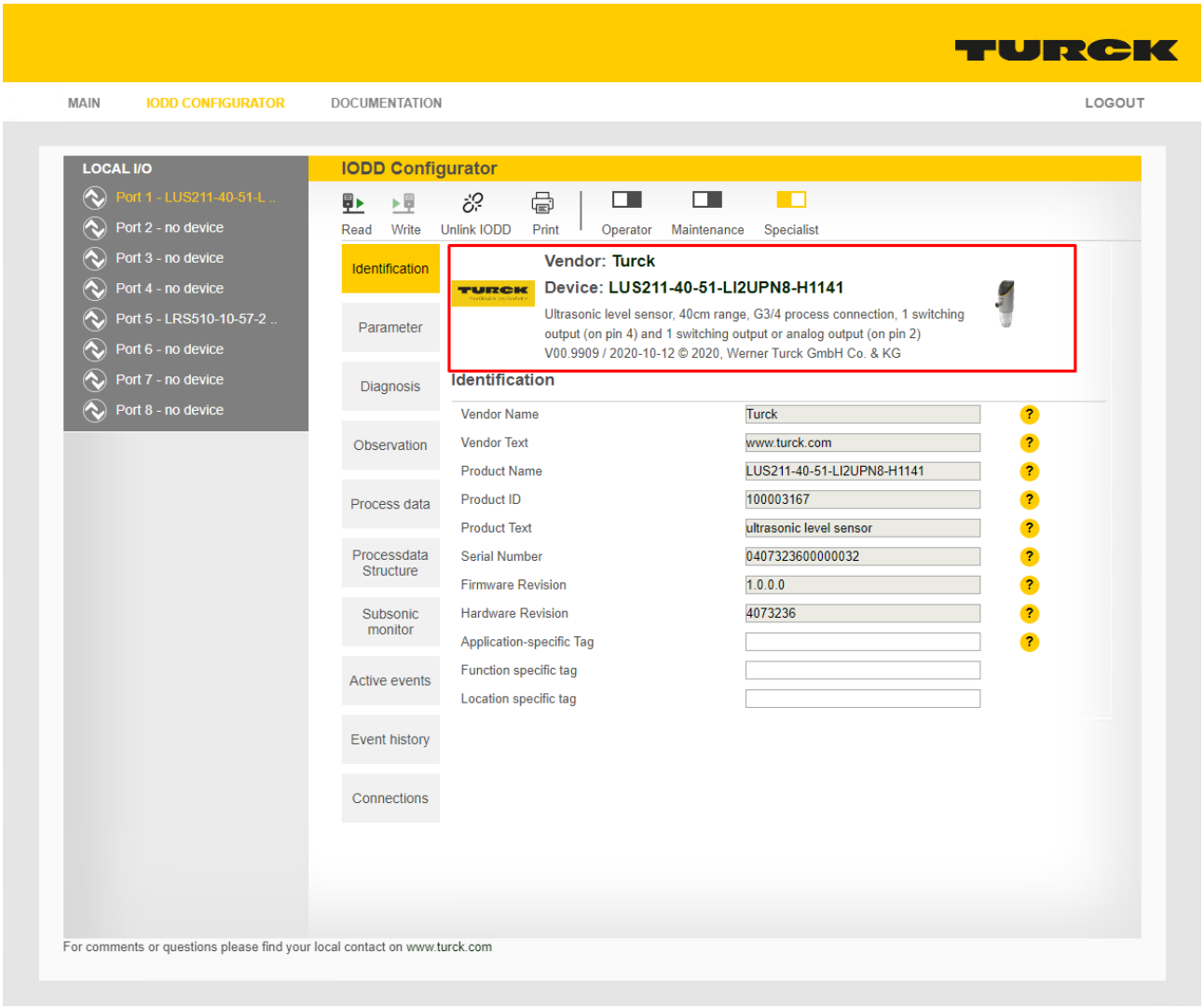


Fig. 70: IODD Configurator: IO-Link device with device specific IODD

Unlink IODD disconnects the connection to the device-specific IODD and causes the IO-Link device to be mapped again by a generic IODD. Via **Print**, the respective page content can be printed or saved as a PDF file, e.g., for system documentation.

Parameter settings for IO-Link devices can be exported or imported as *.json files in the **Parameter** menu item **Set defaults** resets the values in the IODD Configurator interface to default settings. To reset IO-Link devices, the **RESTORE FACTORY SETTINGS** system command must be executed.

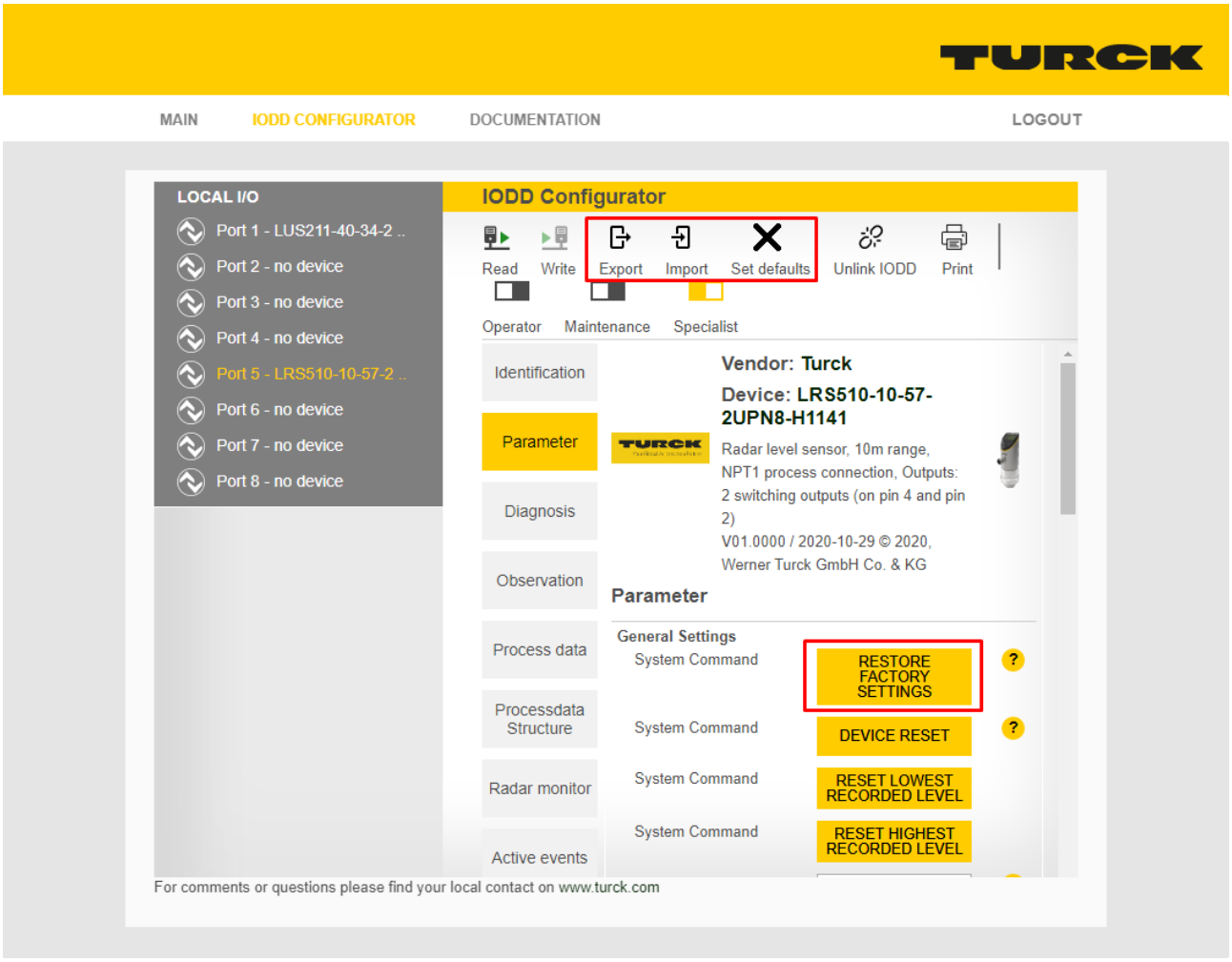


Fig. 71: IODD Configurator: Parameters of the IO-Link device

7.8.2 Commissioning IO-Link devices via SIDI (PROFINET only)

The IO-Link devices are defined in the GSMDL file of the IO-Link master. They can be selected directly in PROFINET engineering and assigned to the IO-Link ports of the IO-Link master module.

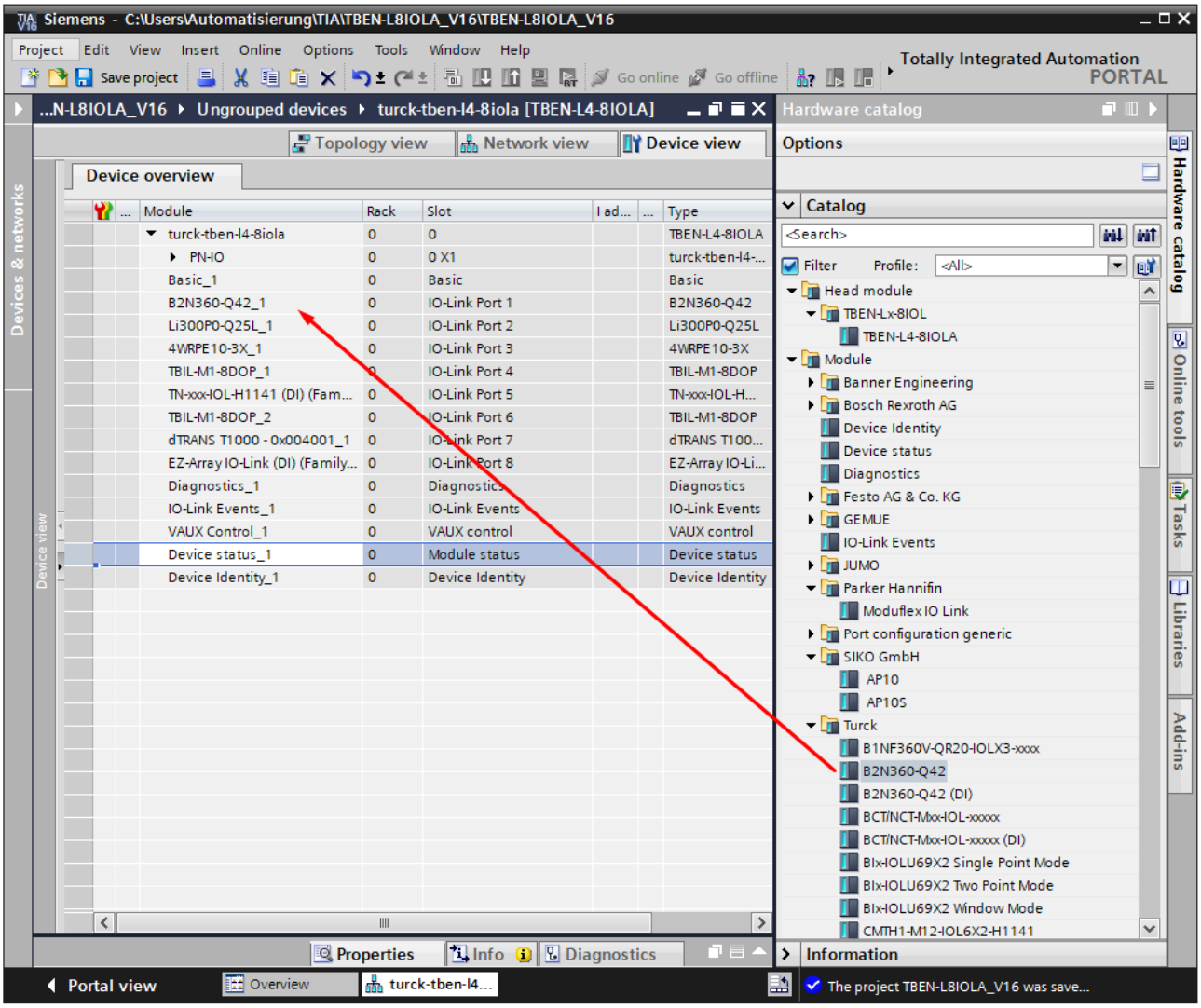


Fig. 72: Example: TIA Portal, IO-Link device in hardware catalog (SIDI)

Parameterizing IO-Link devices via PROFINET engineering

To be able to parameterize IO-Link devices via the GSDML, the "Device parameterization via GSD" parameter must be activated on the IO-Link master port (default setting).

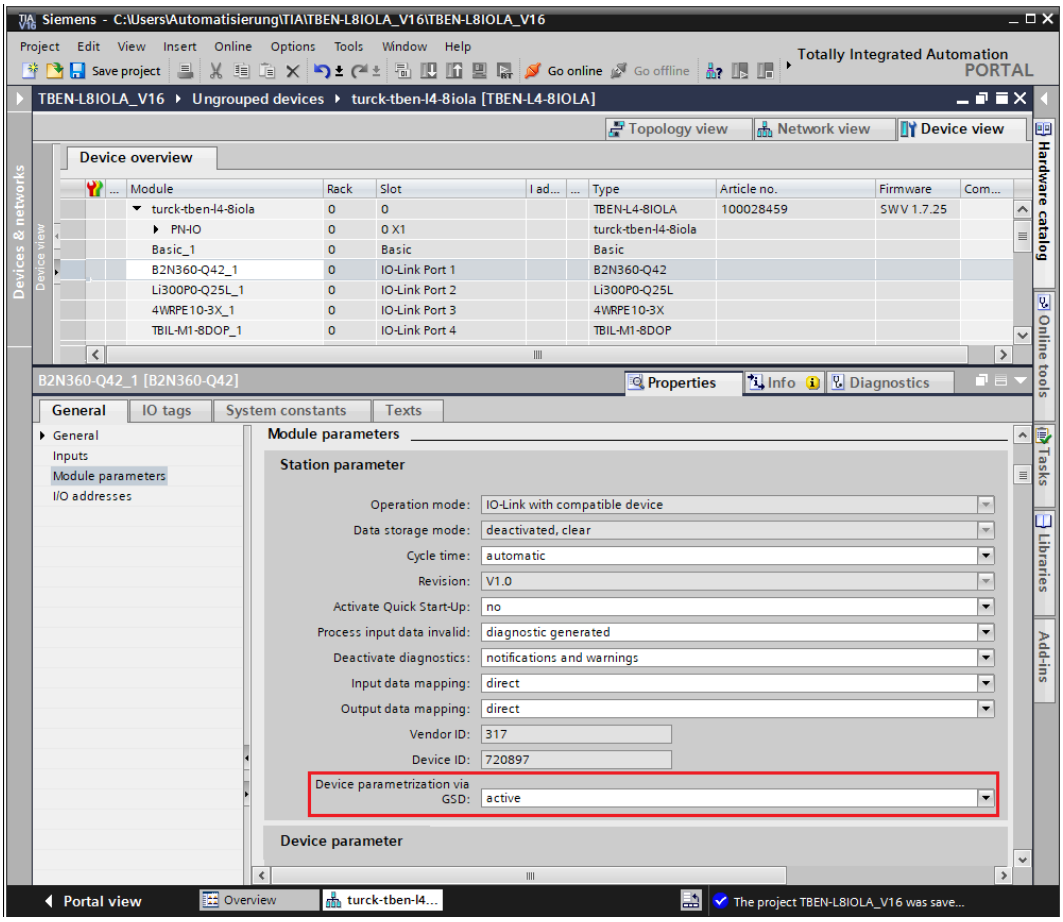


Fig. 73: Example: TIA Portal, "Device parameterization via GSD" parameter

The parameters of the IO-Link devices are set directly in PROFINET engineering.

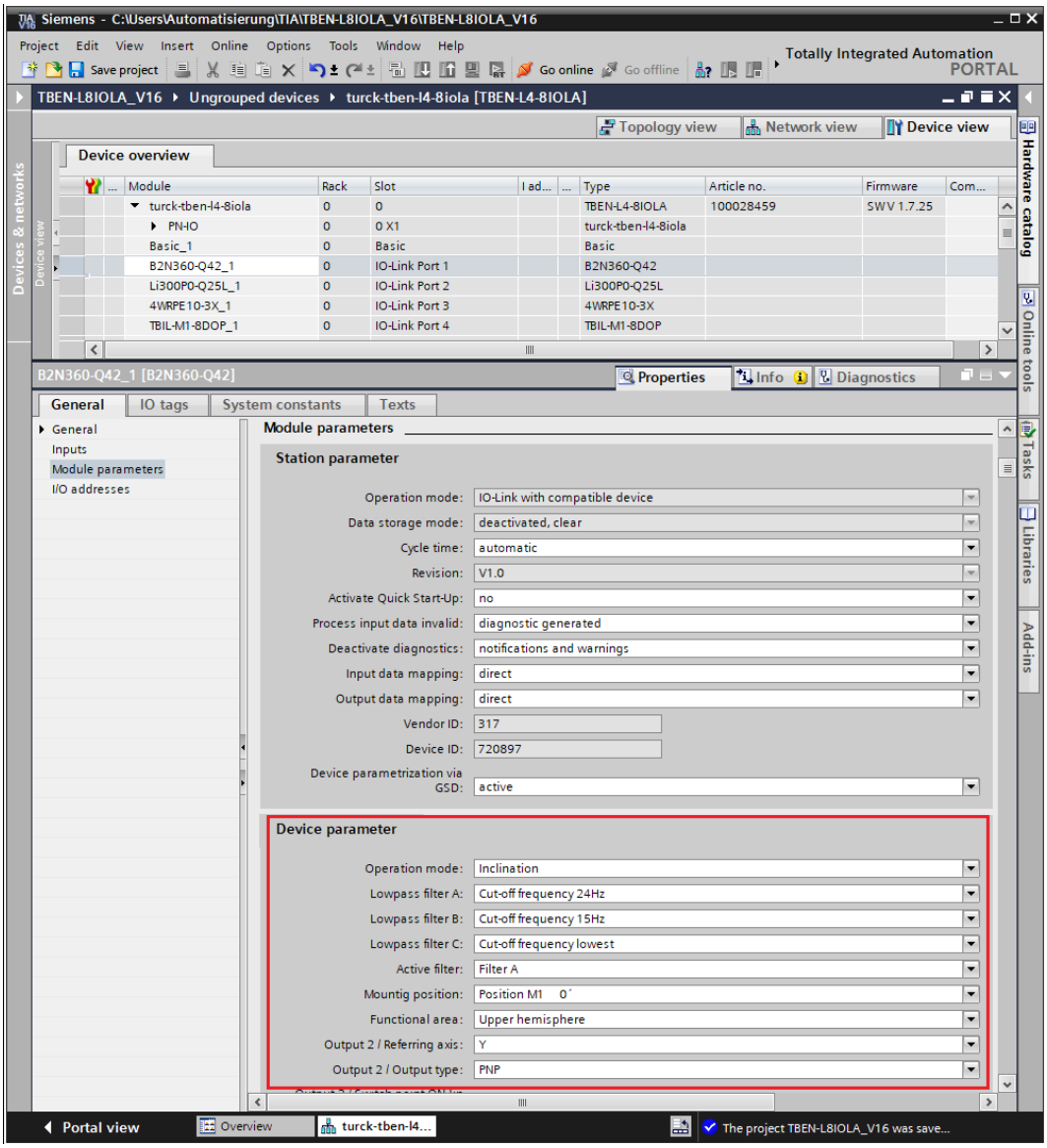


Fig. 74: Example: TIA Portal, IO-Link device parameters via GSDML

The parameterization of the IO-Link devices is controlled by the PLC. After a restart or an IO-Link device exchange, the start-up parameters stored in the PLC are written to the connected IO-Link devices. Parameter settings made during runtime either via the PLC (e.g., via IO-Link call accesses), directly at the IO-Link device (e.g., via operating elements) or at the IO-Link master (e.g., via web server or DTM) only apply temporarily and are overwritten with the parameter settings from the PLC at every restart.

Various IO-Link port parameters (station parameters) such as ”operating mode”, ”data retention mode”, ”manufacturer ID” and ”device ID” are defined via the GSDML file and cannot be changed.

NOTE
Data storage [▸ 158] is not possible when configuring IO-Link devices with SIDI.

Parameterizing IO-Link devices via IO-Link mechanisms

The "Device parameterization via GSD" parameter must be deactivated. Parameters and process data structures of the IO-Link devices are structured via the GSDML and displayed in PROFINET engineering (e.g., in CODESYS) in a device-specific manner. However, parameter handling is performed via IO-Link mechanisms (e.g., data management).

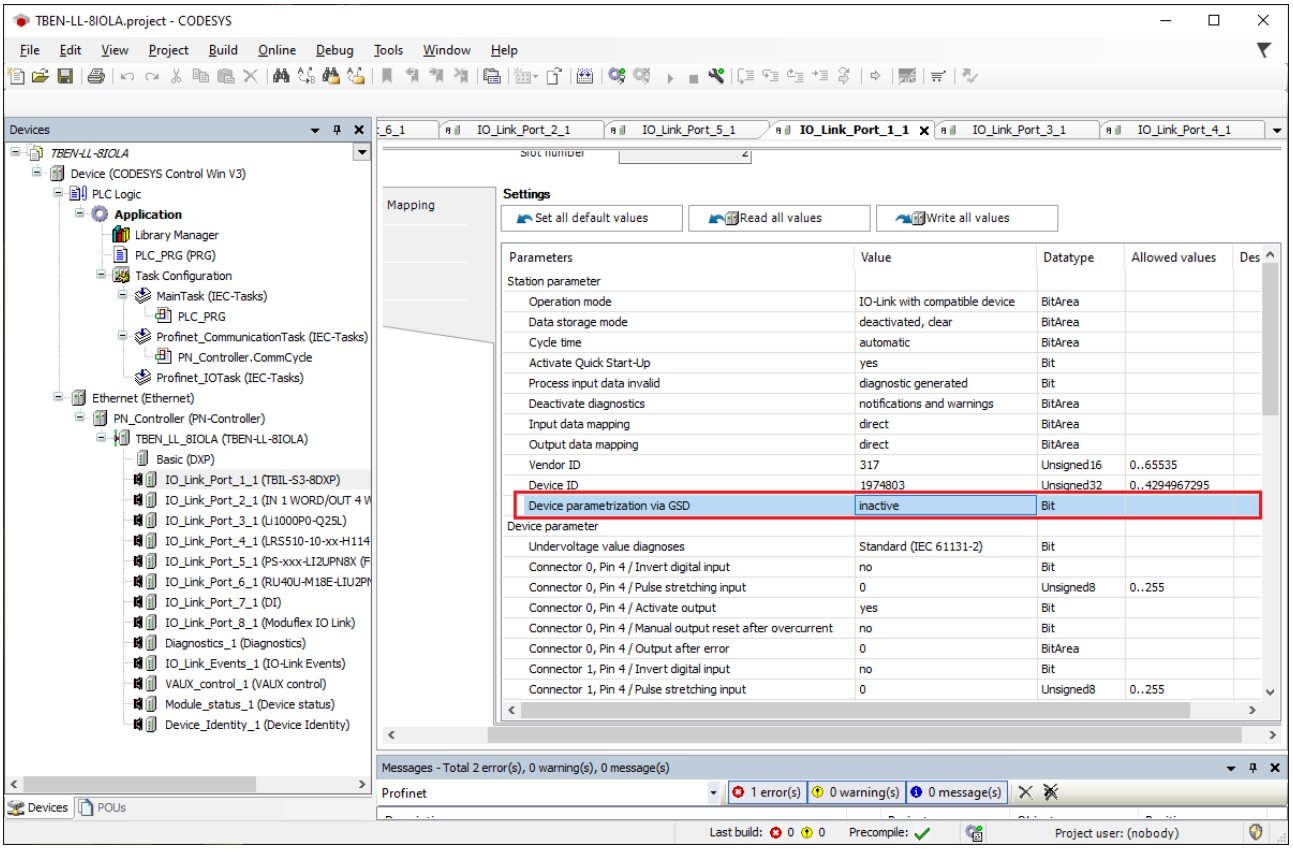


Fig. 75: PROFINET engineering (CODESYS); Device parameterization via GSD inactive

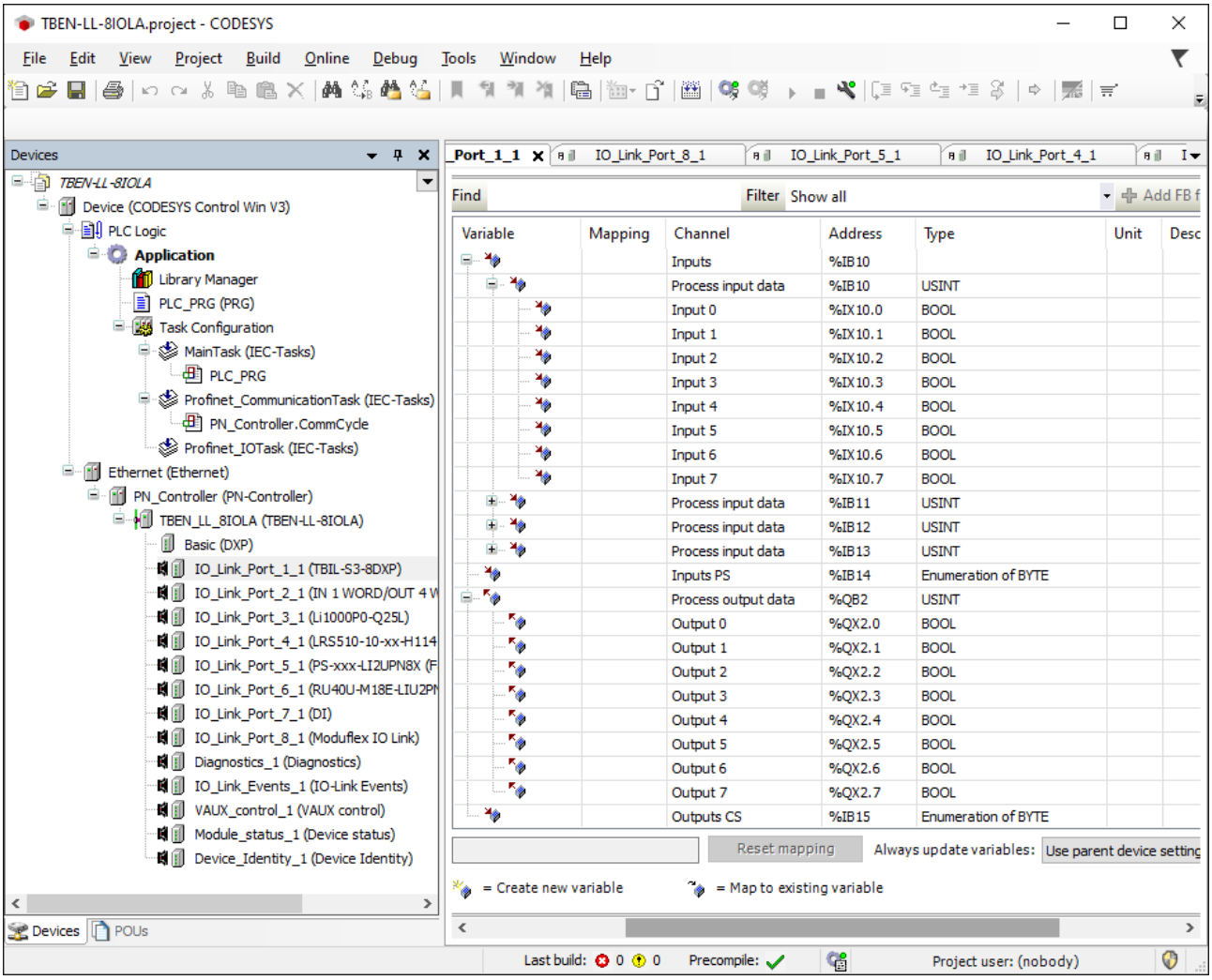


Fig. 76: PROFINET engineering (CODESYS): Process data structure IO-Link device with SIDI

7.8.3 Topology Scan in the DTM: read in connected IO-Link devices

The Topology Scan in PACTware allows to read-in of an IO-Link configuration down to the IO-Link device. IO-Link device, known in PACTware, are added to the IO-Link ports of the master. Either the respective sensor DTMs in PACTware or the sensor IODDs via IODD DTM Configurator have to be installed.

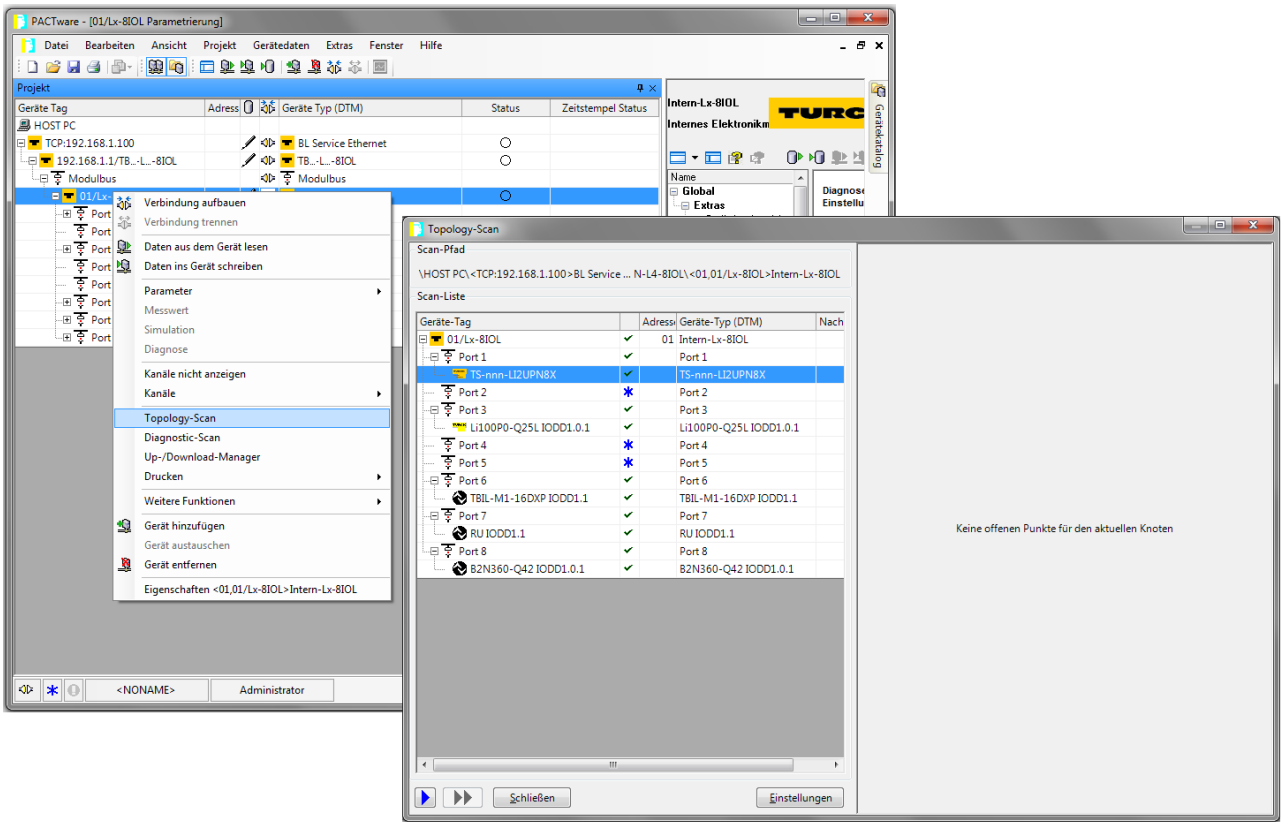


Fig. 77: PACTware: Topology scan

7.8.4 Commissioning IO-Link devices V1.0 (data storage)

IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. If an IO-Link V1.0 device is used, data storage on the IO-Link port must be deactivated, e.g. via DTM or the web server of the IO-Link master.

The following example shows how to deactivate data storage via DTM.

- ▶ Set **Data storage mode** at the port to **deactivated, clear**.
- ▶ Load the parameter changes into the device.
- ▶ Connect the IO-Link V1.0 device.
- ⇨ The LED IOL at the IO-Link port is green, IO-Link communication active.

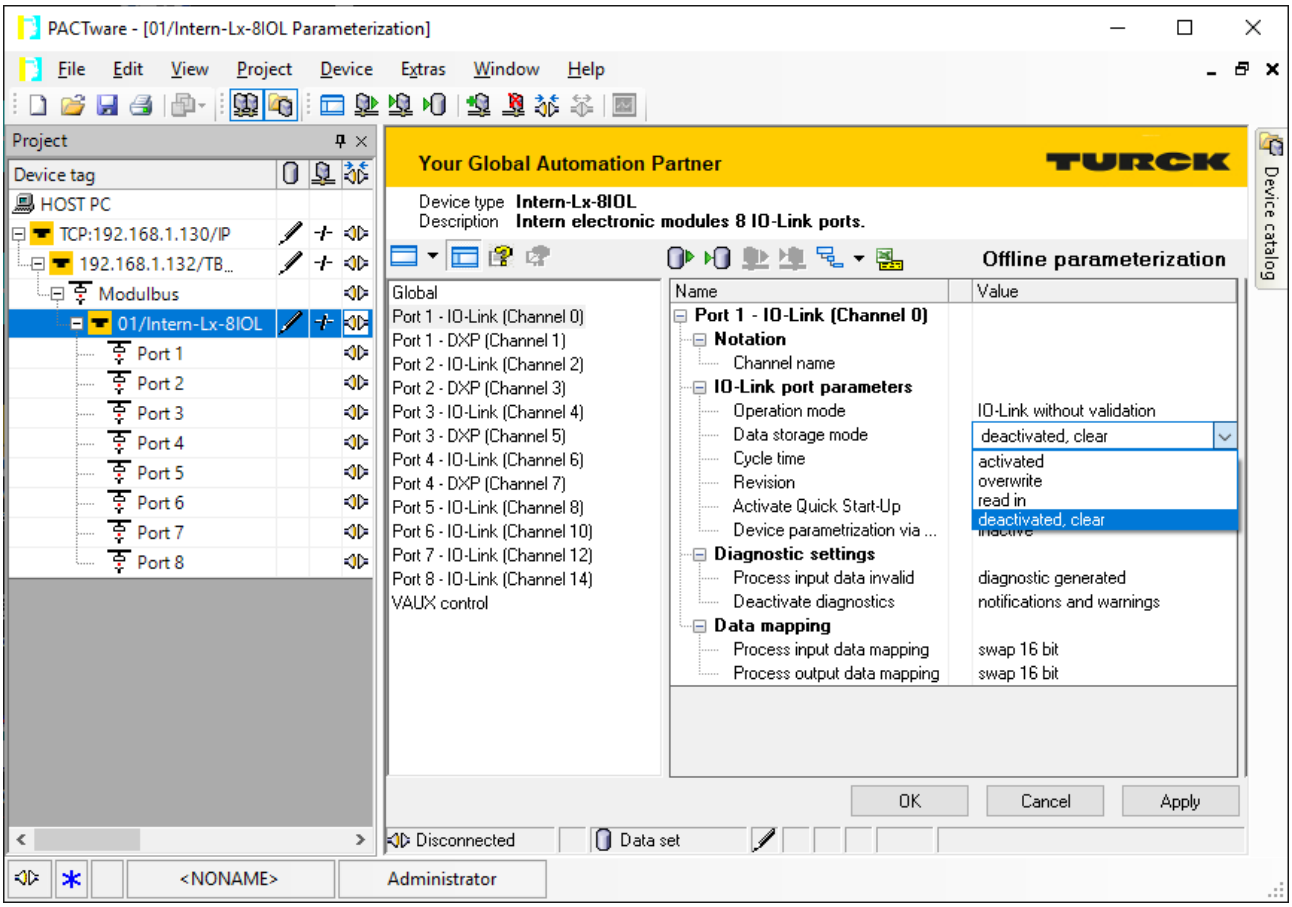


Fig. 78: Example: Deactivate or respectively delete the data storage mode with the DTM

7.8.5 Commissioning IO-Link devices V1.1 (data storage)

If another device type is connected to an IO-Link port that has already been used, the data storage memory of the master should first be deleted, e.g. via DTM or the web server of the IO-Link master. The following example shows the deletion of the data storage memory via the DTM

The data storage memory of the master can be deleted in two ways:

- Set back the master to factory settings.
- Delete the data storage memory via the parameter **Data storage mode**.

Resetting the master to factory settings with the DTM

- ▶ From the **Factory settings** drop-down menu, select **Set to factory settings**.
- ▶ Load the parameter changes into the device.
- ⇨ The DTM resets the device automatically.

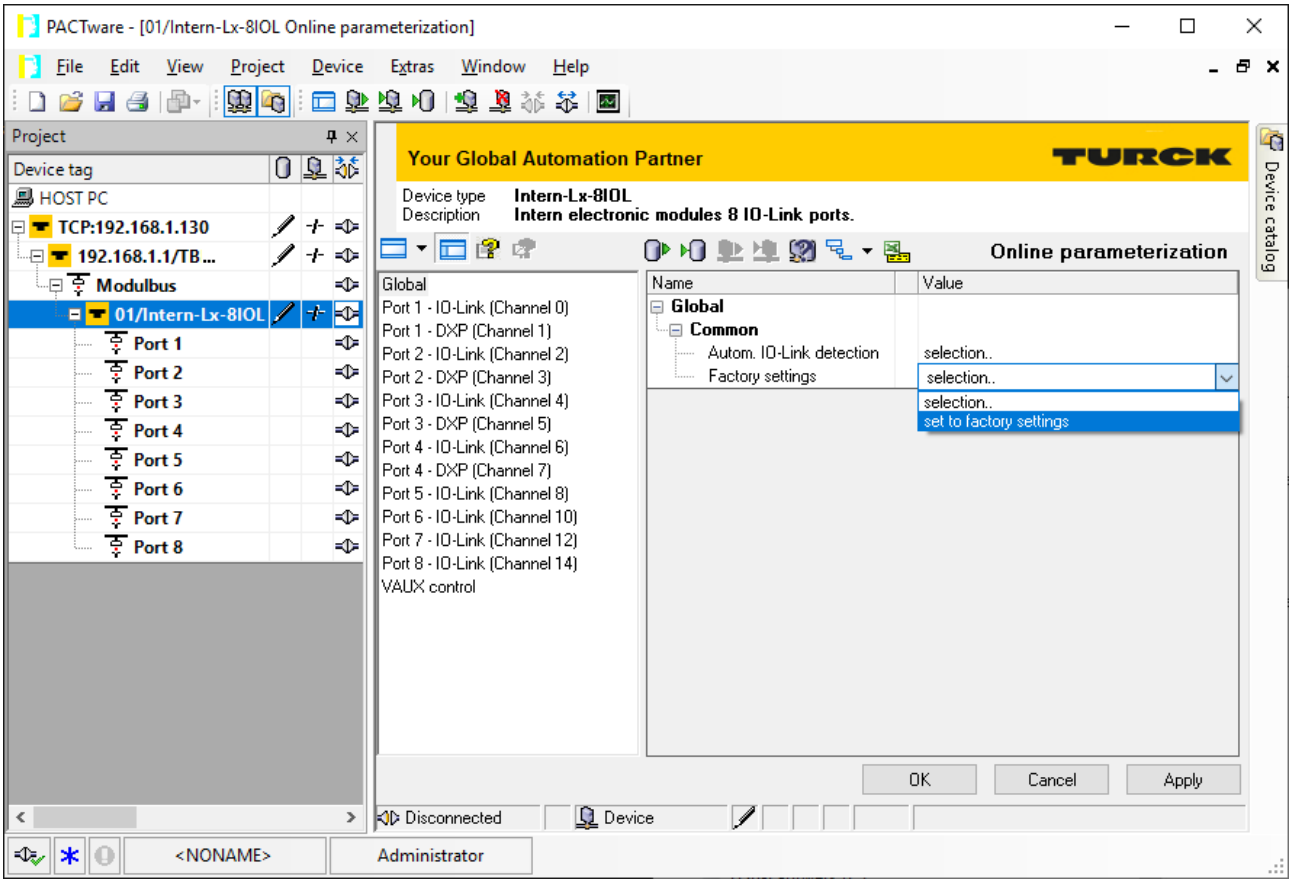


Fig. 79: Example: Reset device to factory settings via DTM

- ▶ Connect the IO-Link V1.1 device.
- ⇨ The LED IOL at the IO-Link port is green, IO-Link communication active.

Delete the data storage memory via parameters

- ▶ Set Data storage mode to **deactivated, clear**.
- ▶ Load the parameter changes into the device.
- ▶ Re-activate the data storage, if necessary.
- ▶ Load the parameter changes into the device.
- ▶ Connect the IO-Link V1.1 device.
- ⇨ The LED IOL at the IO-Link port is green, IO-Link communication active.

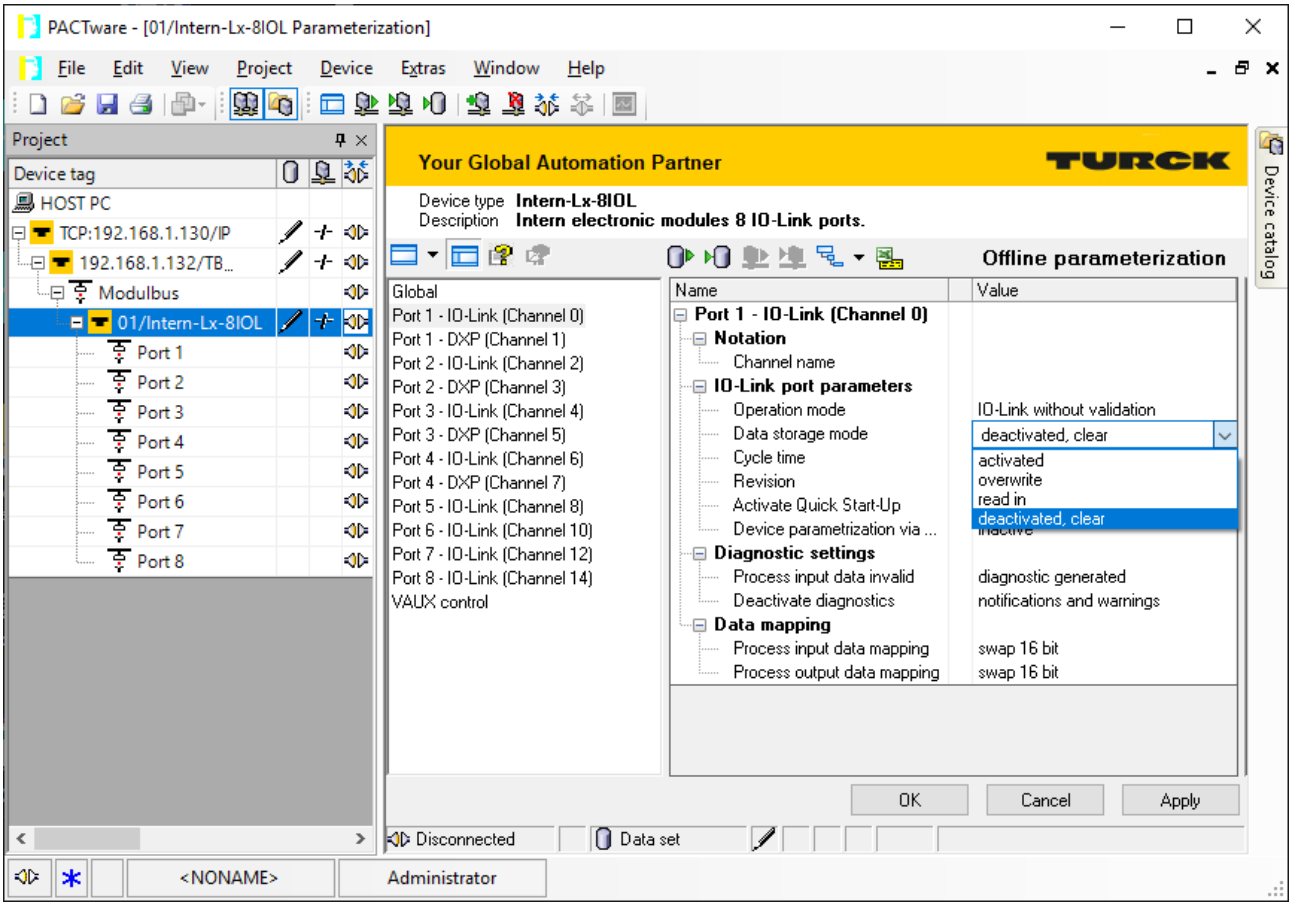


Fig. 80: Example: Deactivate or respectively delete the data storage mode with the DTM

8 Parameterizing and configuring

8.1 Parameters

The device has 4 bytes of module parameters, 16 bytes each of IO-Link port parameters and 16 bytes of parameters for VAUX1/VAUX2 monitoring.

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
Manual reset after overcurr. (SRO)																
0x00	SRO 15	SRO 14	SRO 13	SRO 12	SRO 11	SRO 10	SRO9	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
Activate output (EN DO)																
0x01	EN DO15	-	EN DO13	-	EN DO11	-	EN DO9	-	EN DO7	-	EN DO5	-	EN DO3	-	EN DO1	-
IO-Link port 1																
0x02	Cycle time								GSD	Activate quick start-up	Data storage mode		Operation mode			
0x03	-								Mapping PCDO		Mapping PDIN		Deactivate diag.		PDIN invalid	Rev.
0x04… 0x05	-								-	-	-	-	-	-	-	-
0x06	Vendor ID (MSB)								Vendor ID (LSB)							
0x07	Device ID								Device ID (LSB)							
0x08	Device ID (MSB)								Device ID							
0x09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IO-Link port 2																
0x0A… 0x11	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 3																
0x12… 0x19	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 4																
0x1A… 0x21	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 5																
0x22… 0x29	Assignment similar to IO-Link port 1 (Word 0x02…0x09)															
IO-Link port 6																
0x2A… 0x31	Assignment similar to IO-Link port 1 (Word 0x02…0x09)															
IO-Link port 7																
0x32… 0x39	Assignment similar to IO-Link port 1 (Word 0x02…0x09)															

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IO-Link port 8																
0x3A… 0x41	Assignment similar to IO-Link port 1 (Word 0x02…0x09)															
VAUX1 control																
0x42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C0/X0 (Ch0/1)	
0x43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C1/X1 (Ch2/3)	
0x44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C2/X2 (Ch4/5)	
0x45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C3/X3 (Ch6/7)	
0x46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C4/X4 (Ch8/9)	
0x47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C5/X5 (Ch10/11)	
0x48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C6/X6 (Ch12/13)	
0x49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VAUX1 pin1 C7/X7 (Ch14/15)	

The default values are written in **bold**.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Manual output reset after overcurrent (SROx)	**0**	**0x00**	**No**	The output switches on automatically after an overload.
	1	0x01	Yes	The output is manually switched-off after an overload until a new set command is given (rise and fall).
Activate output Ch… (EN DO…)	**0**	**0x00**	**No**	The output at pin 2 is deactivated.
	1	0x01	Yes	The output at pin 2 is activated.
Operation mode	**0**	**0x00**	**IO-Link without validation**	Pin 4 is operated in IO-Link mode. The master does not check if the connected device matches the configured one.
	1	0x01	IO-Link with family compatible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the MSB of the Device ID (this byte defines the product family) of the connected device match those of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	2	0x02	IO-Link with compatible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the Device ID of the connected device match those of the configured one. If the Vendor ID matches, but the Device ID not, then the master tries to write the Device ID to the device. If the writing is successful, then the device is a compatible one, process data exchange is possible. If writing the Device ID is not successful, then process data exchange is not possible. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	3	0x03	IO-Link with identical device	Pin 4 is operated in IO-Link mode. The master checks if the device type (Vendor ID and Device ID) and the serial number of the connected device match the data of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Operation mode	4	0x04	DI (with parameter access)	Pin 4 is generally operated as simple digital input. However, an acyclic parameter access from the PLC or the DTM is possible. The IO-Link master starts the port in IO-link mode, parameterizes the device and sets the port back into SIO mode. The port remains in SIO mode until a new IO-Link request is sent from the higher-level control. Data storage is not supported. Connected devices have to support the SIO mode. In case of a parameter access, the IO-Link communication at the port is started. Switching signals are interrupted.
	8	0x08	DI	Pin 4 is operated as simple digital input. Data storage is not supported.
	9	0x09	DX	The channel is operated as universal digital DXP channel.
Data Storage Mode	Synchronization of parameter data of IO-Link devices (storing the parameter of the connected device in the master). If the synchronization is not possible, a diagnostic message is displayed (DS_ERR). In this case the data memory of the master must be deleted: ▶ Select option "deactivated, delete" to delete the data memory of the master IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. When using IO-Link devices with IO-Link V1.0: ▶ Select option "deactivated, delete" to deactivate data storage.			
	0	0x00	Activated	Synchronization of parameter data activated. The actual data (master or device) serve as the reference data.
	1	0x01	Overwrite	Synchronization of parameter data activated, the data in the master serve as reference data.
	2	0x02	Read in	Synchronization of parameter data activated. The data in the connected IO-Link device serve as reference data.
	3	**0x03**	**Deactivated, clear**	Synchronization of parameter data deactivated. The data set in the master is deleted.
Activate Quick Start-Up	For fast applications (e.g. tool changing applications) the start-up time of IO-Link devices can be shortened. The start-up time defined in the IO-Link specification (TSD = Device Detection Time) is reduced.			
	0	**0x00**	**No**	The start-up time is within the specified range (0.5 s). All IO-Link devices in accordance with the specification can be operated.
	1	0x01	Yes	The start-up time is reduced to approx. 100 ms. It is not supported by every IO-Link device. It can thus be necessary to check if the used IO-Link device starts in this mode.
Device parameterization via GSD (GSD)	**0**	**0x00**	**Inactive**	The port is generic or is not parameterized.
	1	0x01	Active	In PROFINET the port is parameterized with a specific device type from the GSDML-file (SIDI [▷ 14]).

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Cycle time	**0**	**0x00**	**Automatic**	The lowest cycle time supported by the device is taken from the table.
	16… 191	0x10 … 0xBF	1.6 = 132,8 ms	Settable in steps of 0.8 or 1.6 ms.
	255	0xFF	Automatic, compatible	Compatibility mode The mode solves possible communication problems with sensors of the SGB family from IFM.
Revision	**0**	**0x00**	**Automatic**	The Master defines the IO-Link revision automatically.
	1	0x01	V1.0	IO-Link Revision V 1.0 is used.
Process input data invalid (PDIN invalid)	**0**	**0x00**	**Diagnostic generated**	If the process data are invalid, a respective diagnostic message is generated.
	1	0x01	No diagnostic generated	Invalid process data do not cause a diagnostic message.
Deactivate diagnostics	Influences the sending of IO-Link-Events from the master to the fieldbus. Depending on the parameterization, the master transmits Events based on their priority to the fieldbus or not.			
	0	0x00	No	The master transmits all IO-Link Events to the fieldbus.
	1	0x01	Notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
	2	**0x02**	**Notifications and warnings**	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
	3	0x03	Yes	The master doesn't transmit any IO-Link Event to the fieldbus.
Process inpput data mapping (Mapping PDIN)	Optimization of the process data mapping for the used fieldbus: The I/O-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side. PROFINET: With PROFINET, the parameter is permanently set to **0x00** = direct and cannot be changed.			
	0	0x00	Direct	The process data are not swapped. i.e.: 0x0123 4567 89AB CDEF
	1	**0x01**	**Swap 16 bit**	The bytes are swapped per word. i.e.: 0x2301 6745 AB89 EFCD
	2	0x02	Swap 32 bit	The bytes are swapped per double word. i.e.: 0x6745 2301 EFCD AB89
	3	0x03	Swap all	All bytes are swapped. i.e.: 0xEFCD AB89 6745 2301
Process output data mapping (Mapping PDOUT)	see above **Process input data mapping**			
Vendor ID	0…65535 0x0000…0xFFFF			Vendor ID for the port configuration check
Device ID	0…16777215 0…0x00FFFFFF			Device ID for the port configuration check, 24 bit value

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
VAUX1 C…/X… Ch…	**0**	**0x00**	**24 VDC**	The 24 VDC sensor/actuator supply at pin 1 is switched on.
	1	0x01	Switchable	The 24 VDC sensor/actuator supply at pin1 is switchable via the process data.
	2	0x02	Off	The 24 VDC sensor/actuator supply at pin 1 is switched off.

Values for the parameter "cycle time" in ms:

Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
Auto	0x00	16	0x58	31.2	0x7E	60.8	0x92	91.2	0xA5	121.6	0xB8
1.6	0x10	16.8	0x5A	32	0x80	62.4	0x93	92.8	0xA6	123.2	0xB9
2.4	0x18	17.6	0x5C	33.6	0x81	64	0x94	94.4	0xA7	124.8	0xBA
3.2	0x20	18.4	0x5E	35.2	0x82	65.6	0x95	96	0xA8	126.4	0xBB
4	0x28	19.2	0x60	36.8	0x83	67.1	0x96	97.6	0xA9	128	0xBC
4.8	0x30	20	0x62	38.4	0x84	68.8	0x97	99.2	0xAA	129.6	0xBD
5.6	0x38	20.8	0x67	40	0x85	70.4	0x98	100.8	0xAB	131.2	0xBE
6.4	0x40	21.6	0x66	41.6	0x86	72	0x99	102.4	0xAC	132.8	0xBF
7.2	0x42	22.4	0x68	43.2	0x87	73.6	0x9A	104	0xAD	Reserved	
8	0x44	23.2	0x6A	44.8	0x88	75.2	0x9B	105.6	0xAE		
8.8	0x46	24.0	0x6C	46.4	0x89	76.8	0x9C	107.2	0xAF		
9.6	0x48	24.8	0x6E	48	0x8A	78.4	0x9D	108.8	0xB0		
10.4	0x4A	25.6	0x70	49.6	0x8B	80	0x9E	110.4	0xB1		
11.2	0x4C	26.4	0x72	51.2	0x8C	81.6	0x9F	112	0xB2		
12.0	0x4E	27.2	0x74	52.8	0x8D	83.2	0xA0	113.6	0xB3		
12.8	0x50	28	0x76	54.4	0x8E	84.8	0xA1	115.2	0xB4		
13.6	0x52	28.8	0x78	56	0x8F	86.4	0xA2	116.8	0xB5		
14.4	0x54	29.6	0x7A	57.6	0x90	88	0xA3	118.4	0xB6		
15.2	1x56	30.4	0x7C	59.2	0x91	89.6	0xA4	120	0xB7	Auto., comp.	0xFF

8.1.1 Adapting process data mapping

The mapping of process data can be adapted application-specifically via the IO-Link master's parameterization.

Depending on the used fieldbus, it can be necessary to swap process data word-wise, double word-wise or completely in order to align them to the data structure in the PLC. The process data mapping is determined channel by channel through the parameters **process input data mapping** and **process output data mapping**.

Example mapping for field buses with Little Endian-format

Mapping through the IO-Link master → field bus → PLC						
Byte	**Device at IO-Link port**	**Device process data in IO-Link master**		**Parameter: Process data mapping**	**Device process data to fieldbus**	
Byte 0		Status/Control			Status/Control	
Byte 1						
IO-Link port 1						
Byte 2	Temperature sensor TS…	Temperature	Low byte	**Swap 16 bit**	Temperature	High byte
Byte 3			High byte			Low byte
IO-Link port 2						
Byte 4	Linearity sensor Li…	Position	Low byte	**Swap 16 bit**	position	High byte
Byte 5			High byte			Low byte
IO-Link port 3						
Byte 6	I/O hub TBIL-…	Digital signals	0…7	**Direct**	Digital signal	0…7
Byte 7		Digital signals	8…15		Digital signal	8…15
IO-Link port 4						
Byte 8		Diagnostics		**swap all**	Counter/position value	Most Significant Byte
Byte 9	Rotary encoder RI…	Counter/position value	Low byte			High byte
Byte 10			High byte			Low byte
Byte 11			Most Significant Byte		Diagnostics	

8.1.2 PROFINET parameters

For PROFINET, a distinction must be made between the PROFINET device parameters and the parameters of the I/O channels.

PROFINET device parameters

Default values are shown in **bold**.

Parameter name	Value	Meaning	Description
Output behavior at communication loss	**0**	**Set to 0**	The device switches the outputs to "0". No error information is sent.
	1	Hold current value	The device keeps the current data at the outputs.
Deactivate all diagnostics	**0**	**No**	Diagnostic and alarm messages are generated.
	1	Yes	Diagnostic and alarm messages are suppressed.
Disable output power diagnosis	**0**	**No**	No function
	1	yes	
Deactivate I/O-ASSISTANT Force Mode	**0**	**No**	
	1	Yes	The Force Mode of the DTM is deactivated.
Deactivate EtherNet/IP	**0**	**No**	Explicit disabling of the Ethernet protocols or the web server
	1	Yes	
Deactivate Modbus TCP	**0**	**No**	
	1	Yes	
Deactivate web server	**0**	**No**	
	1	Yes	

8.2 IO-Link functions for acyclic communication

The acyclic access to the data of IO-Link devices is realized via IO-Link CALLs. A distinction must be made between data of the IO-Link master (IOLM) and data of connected IO-Link devices (IOLD).

The addressing of the IO-Link CALL defines which device is addressed via the CALL:

The addressing is defined by the so called Entitiy_Port:

- Entity_Port 0 = IO-Link master module (IOLM)
- Entity_Port 1 = IO-Link device at IO-Link port 1
- …
- Entity_Port 8 = IO-Link device at IO-Link port 8

8.2.1 Port functions for Port 0 (IO-Link Master)

IO-Link index (port function invocation)

The access to the IO-Link master functionalities (port 0) is done via index 65535.

Subindex 64: Master Port Validation Configuration

The object writes a specific configuration of the devices which have to be connected to the IO-Link port to the master. The master stores the data for the IO-Link device expected at the port and then accepts only one device at the port with exactly matching data (vendor ID, device ID and serial number).

The Master Port Validation Configuration is only useful in combination with an operation mode with validation (**IO-Link with family compatible device**, **IO-Link with compatible device**, **IO-Link with identical device**).

Entity_Port	IO-Link sub index	Read/write	Length
0	64	Write	Max. 192 byte

Structure of the command IOL_Port_Config:

	Content	Size	Format	Comment
IOL1	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL2	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL3	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL4	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	

	Content	Size	Format	Comment
IOL5	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL6	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL7	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL8	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	

Subindex 65: IO-Link Events

The object reads IO-Link Event diagnostics.

Entity_Port	IO-Link sub index	Read/write	Length
0	65	Read	255 byte

NOTE
Only "appears" (coming diagnostics) and "Single Shot Events" are shown, as long as they are pending.

Structure of the read data:

- Byte 0 contains 2 bit per IO-Link port which show, if the process data of the connected device are valid or not.
- 4 byte per diagnostic event, which assign and specify the diagnostics more precisely. A maximum of 14 Events per IO-Link port are shown.

Byte no.	Bit no.								Description
	7	6	5	4	3	2	1	0	
0								x	PD_Valid Input Port 1
							x		PD_Valid Output Port 1
						x			PD_Valid Input Port 2
					x				PD_Valid Output Port 2
				x					PD_Valid Input Port 3
			x						PD_Valid Output Port 3
		x							PD_Valid Input Port 4
	x								PD_Valid Output Port 4

Byte no.	Bit no.								Description
	7	6	5	4	3	2	1	0	
1								x	PD_Valid Input Port 5
							x		PD_Valid Output Port 5
						x			PD_Valid Input Port 6
					x				PD_Valid Output Port 6
				x					PD_Valid Input Port 7
			x						PD_Valid Output Port 7
		x							PD_Valid Input Port 8
	x								PD_Valid Output Port 8
2	Qualifier								Defines the type of the event (Warning, Notification, Single Shot Event, etc.) in accordance with IO-Link specification "IO-Link Interface and System".
3	Port								IO-Link port which sends an event
4	Event Code high byte								High or- low byte of the error code sent
5	Event Code low byte								
…									…
223	Qualifier								see byte 2 - 5
224	Port								
225	Event Code high byte								
226	Event Code low byte								

Subindex 66: Set Default Parameterization

Writing this object sets the IO-Link master back to factory settings. Any parameter setting and configuration is overwritten. The data storage buffer is deleted as well.

Entity_Port	IO-Link sub index	Read/write	Length
0	66	Write	4 byte

Structure of the reset command:

Byte 3	Byte 2	Byte 1	Byte 0
0xEF	0xBE	0xAD	0xDE

Subindex 67: Teach Mode

The master reads all data (device-Id, vendor-ID, serial number, etc.) from the connected device and saves them. All all previously saved device data are overwritten.

Entity_Port	IO-Link sub index	Read/write	Length
0	67	Write	1 byte

Structure of the Teach command:

Byte 0	
0x00	Teach all ports
0x01	Teach port 1
0x02	Teach port 2

Byte 0	
0x03	Teach port 3
0x04	Teach port 4
0x05	Teach port 5
0x06	Teach port 6
0x07	Teach port 7
0x08	Teach port 8
0x09…0xFF	Reserved

Subindex 68: Master Port Scan Configuration

The object reads the configuration of the IO-Link devices connected to the IO-Link master.

28 byte are returned per IO-Link port.

Entity_Port	IO-Link sub index	Read/write	Length
0	68	Read	Max. 120 byte

Structure of the response telegram:

IO-Link-port	Content	Length	Format	Description
Port 1	Vendor ID	2 byte	UINT16	Vendor ID of the connected device
	Device ID	4 byte	UINT32	Device ID of the connected device
	Function ID	2 byte	UINT16	Reserved
	Serial Number	16 byte	UINT8	Serial number of the connected device
	COM_Revision	1 byte	UINT8	IO-Link version
	Proc_In_Length	1 byte	UINT8	Process input data length of the connected device, s. section "Length of the process data from the connected IO-Link device" [▶ 146]
	Proc_Out_Length	1 byte	UINT8	Process input data length of the connected device, s. section "Length of the process data from the connected IO-Link device" [▶ 146]
	Cycle time	1 byte	UINT8	Cycle time of the connected device
Port 2… port 8	Structure similar to port 1			

Length of the process data from the connected IO-Link device

The structure of the input and output data is identical except for bit 6. The SIO bit is only contained in the process input data.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	SIO	BYTE	LENGTH				

Bit 6: SIO (only valid for process input data)

SIO	
0	SIO mode not supported
1	SIO mode supported by device

Bit 7 and bits 0...4 in combination provide information about the length of the process data.

BYTE	LENGTH	Meaning
0	0	No process data
0	1	1 bit process data
0	n (2…15)	n bit of process data, structured in bits
0	16	16 bit of process data, structured in bits
0	17…31	Reserved
1	0, 1	Reserved
1	2	3 byte, structured in bytes
1	n (3…30)	n + 1 byte, structured in bytes
1	31	32 byte, structured in bytes

Subindex 69: Extended Port Diagnostics

The object reads the Extended Port Diagnostics.

Entity_Port	IO-Link sub index	Read/write	Length
0	68	Read	Max. 120 byte

Structure of the Extended Port Diagnostics:

Byte no.	Bit no.							
	7	6	5	4	3	2	1	0
0	NO_SIO	TCYC	-	-	DS_F	NO_DS	-	-
1	-	WD	MD	PDI_H	-	-	NO_PD	
2	-	-	-	-	-	-	-	-
3	Device status according to IO-Link specification							

Diagnostic bit	Meaning
NO_DS	The parameterized port mode does not support data storage. Remedy: ■ Change the parameterization of the port.

Diagnostic bit	Meaning
DS_F	Error in the data storage, synchronization not possible Possible causes: ■ Connected device does not support data storage ■ Overflow of the data storage buffer Remedy: ▶ Connect a device that supports data storage. ▶ Clear the data storage buffer. ▶ Deactivate the data storage.
TCYC	The device does not support the cycle time parameterized in the master. Remedy: ▶ Increase the cycle time set in the master.
NO_SIO	The device does not support the SIO mode. Remedy: ▶ Select the IO-Link mode for this port.
NO_PD	No process data available The connected device is not ready for operation. Remedy: ▶ Check the configuration.
PDI_E	The connected device reports invalid process data in accordance with IO-Link specification V1.0.
PDI_H	The connected device reports invalid process data in accordance with IO-Link specification V1.1.
MD	Missing device, no IO-Link device detected. Remedy: ■ Check the IO-Link cable. ■ Change the device.
WD	Wrong device detected: one or more parameters of the connected device (Vendor ID, Device ID, serial number) does not/do not match the data which are stored in the master for this device. Remedy: ■ Change the device. ■ Adapt the master parameterization

Device Status

Value	Meaning
0	Device works correctly
1	Maintenance Event
2	Out-of-Specification Event
3	Functional check
4	Error
5…255	Reserved

8.3 Parameterizing IO-Link devices with the IODD Configurator

The parameter settings made in the IODD Configurator on the IO-Link device are saved in the device and, depending on the setting of the master parameter "Data storage mode" [▶ 137], can be saved in the IO-Link master and written to a new IO-Link device in the event of a device replacement.

NOTE
If IO-Link devices are configured and parameterized in PROFINET via SIDI (Simple IO-Link Device Integration) in the PLC, all parameter changes via the IODD Configurator are temporary and are overwritten by the IO-Link device parameter set from the PLC on restart.

Parameterizing IO-Link device V1.0

NOTE
To call up the IODD Configurator, a login in the web server of the IO-Link master is required [▶ 28].

- ▶ Change **parameters** as required. Changed parameter settings are marked accordingly.
- ▶ Write changed parameters to the IO-Link device via **Write.**

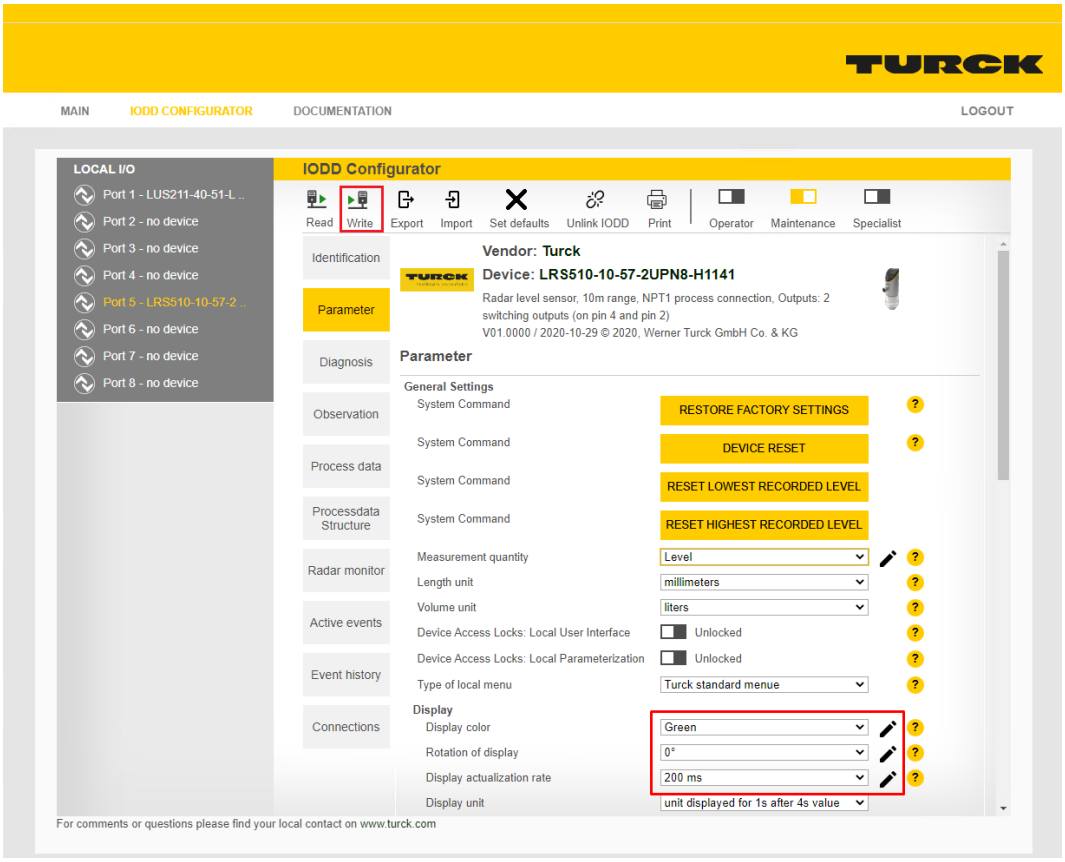


Fig. 81: IODD Configurator - parameterizing the IO-Link device

Set defaults resets all device parameters to the default values defined in the IODD.

The parameter set of the IO-Link device can be exported or imported using the **Export** and **Import** functions.

9 Operating

9.1 Process input data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	DXP15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP9	DXP8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
0x01	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x02 … 0x11	IO-Link port 1, structure depends on the channel parameterization (0…32 byte per channel)															
0x12 … 0x21	IO-Link port 2, structure depends on the channel parameterization (0…32 byte per channel)															
0x22 … 0x31	IO-Link port 3, structure depends on the channel parameterization (0…32 byte per channel)															
0x32 … 0x41	IO-Link port 4, structure depends on the channel parameterization (0…32 byte per channel)															
0x42 … 0x51	IO-Link port 5, structure depends on the channel parameterization (0…32 byte per channel)															
0x52 … 0x61	IO-Link port 6, structure depends on the channel parameterization (0…32 byte per channel)															
0x62 … 0x71	IO-Link port 7, structure depends on the channel parameterization (0…32 byte per channel)															
0x72 … 0x81	IO-Link port 8, structure depends on the channel parameterization (0…32 byte per channel)															
Diagnostics																
	VAUX1/VAUX2															
0x82	-	-	-	-	-	-	-	-	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/ Ch9	VERR V1 C3/X3 Ch6/ Ch7	VERR V1 C2/X2 Ch4/ Ch5	VERR V1 C1/X1 Ch2/ Ch3	VERR V1 C0/X0 Ch0/ Ch1
	DXP channels															
0x83	ERR DXP 15	ERR DXP 14	ERR DXP 13	ERR DXP 12	ERR DXP 11	ERR DXP 10	ERR DXP9	ERR DXP8	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	IO-Link port 1															
0x84	GEN-ERR	OVL	V HIGH	V LOW	ULVE	LLVU	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPE	-
0x85	IO-Link port 2, assignment similar to port 1															
0x86	IO-Link port 3, assignment similar to port 1															
0x87	IO-Link port 4, assignment similar to port 1															
0x88	IO-Link port 5, assignment similar to port 1															
0x89	IO-Link port 6, assignment similar to port 1															
0x8A	IO-Link port 7, assignment similar to port 1															
0x8B	IO-Link port 8, assignment similar to port 1															
IO-Link Events																
0x8C	Port (1st Event)								Qualifier (1st Event)							
0x8D	Event Code low byte (1st Event)								Event Code high byte (1st Event)							
…																
0xAA	Port 16th Event)								Qualifier (16th Event)							
0xAB	Event Code low byte (16th Event)								Event Code high byte (16th Event)							
Device status (status word)																
0xAC	-	FCE	-	-	-	COM	V1	-	-	-	-	-	-	-	AR-GEE	DIAG
Device identification (only for PROFINET with the plugged module and for EtherNet/IP with input assembly 126)																
IO-Link port 1																
0xAD	Vendor ID (MSB)								Vendor ID (LSB)							
0xAE	Device ID								Device ID (LSB)							
0xAF	Device ID (MSB)								Device ID							
IO-Link port 2																
0xB0	Vendor ID (MSB)								Vendor ID (LSB)							
0xAE	Device ID								Device ID (LSB)							
0xAF	Device ID (MSB)								Device ID							
…																
IO-Link port 8																
0xC2	Vendor ID (MSB)								Vendor ID (LSB)							
0xC3	Device ID								Device ID (LSB)							
0xC4	Device ID (MSB)								Device ID							

Meaning of the process data

Name	Value	Meaning
I/O data		
DXP… (SIO)	Digital input at IO-Link port	
	0	No input signal at DXP-channel (pin 4, SIO)
	1	Input signal at DXP (pin 4, SIO)
DXP…	DXP input	
	0	No input signal at DXP channel (pin 2)
	1	Input signal at DXP channel (pin 2)
DVS…	Input value valid (Data Valid Signal)	
	0	The IO-Link data are invalid. Possible causes: ■ Sensor supply is below the admissible range. ■ IO-Link port is parameterized as simple digital input. ■ No IO-Link device connected to the master. ■ No input data received from the connected device (only valid for devices with an input data length > 0). ■ No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0). ■ The connected device sends an **process input data invalid** error.
	1	The IO-Link data are valid.
IO-Link process input data	Process input data of the connected device The order of the IO-Link process input data can be changed via the parameter **Process input data mapping**.	
Diagnostics	[▷ 155]	
IO-Link Events	[▷ 143]	
Device status	[▷ 155]	
Vendor ID	Vendor ID of the IO-Link device at the respective IO-Link port	
Device ID	Device ID of the IO-Link device at the respective IO-Link port	

9.2 Process output data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	DXP 15	DXP 14 (SIO)	DXP 13	DXP 12 (SIO)	DXP 11	DXP 10 (SIO)	DXP 9	DXP 8 (SIO)	DXP7	DXP6 (SIO)	DXP5	DXP4 (SIO)	DXP3	DXP2 (SIO)	DXP1	DXP0 (SIO)
IO-Link process output data																
0x01 … 0x10	IO-Link port 1, structure depends on the channel parameterization (0…32 byte per channel)															
0x11 … 0x20	IO-Link port 2, structure depends on the channel parameterization (0…32 byte per channel)															
0x21 … 0x30	IO-Link port 3, structure depends on the channel parameterization (0…32 byte per channel)															
0x31 … 0x40	IO-Link port 4, structure depends on the channel parameterization (0…32 byte per channel)															
0x41 … 0x50	IO-Link port 5, structure depends on the channel parameterization (0…32 byte per channel)															
0x51 … 0x60	IO-Link port 6, structure depends on the channel parameterization (0…32 byte per channel)															
0x61 … 0x70	IO-Link port 7, structure depends on the channel parameterization (0…32 byte per channel)															
0x71 … 0x80	IO-Link port 8, structure depends on the channel parameterization (0…32 byte per channel)															
VAUX1																
0x81	-	-	-	-	-	-	-	-	VAUX1 C7/X7 (Ch14/ Ch15)	VAUX1 C6/X6 (Ch12/ Ch13)	VAUX1 C5/X5 (Ch10/ Ch11)	VAUX1 C4/X4 (Ch8/9)	VAUX1 C3/X3 (Ch6/7)	VAUX1 C2/X2 (Ch4/5)	VAUX1 C1/X1 (Ch2/3)	VAUX1 C0/X0 (Ch0/1)

Meaning of the process data

Name	Value	Meaning
I/O data		
DXP… (SIO)	Digital output at IO-Link port (pin 4)	
	0	DXP channel: Output inactive
	1	Output active, max. output current 0.5 A
DXP…	DXP output (pin 4)	
	0	Output inactive
	1	Output active, max. output current 2 A
VAUX1 C…/X… (Ch…/Ch…)	0	The 24 - VDC sensor/actuator supply of the connector is switched off.
	1	The 24 - VDC - sensor/actuator supply of the connector is switched on.

9.3 LED displays

The device has the following LED indicators:

- Power supply
- Group and bus errors
- Status
- Diagnostics

LED PWR	Meaning
Off	No voltage connected or under voltage at V1
Green	Voltage at V1 OK

LED BUS	Meaning
Off	No voltage connected
Green	Active connection to a master
Green flashing 3 × in 2 s	ARGEE active
Green flashing (1 Hz)	Device is ready for operation
Red	IP address conflict, Restore mode active, F_Reset active or Modbus connection timeout
Red flashing	Wink command active
Red/green (1 Hz)	Autonegotiation and/or waiting for DHCP-/BootP-address assignment

Note: The Ethernet ports P1 and P2 or XF1 and XF2 each have an LED ETH or L/A.

LEDs ETH… or L/A	Meaning
Off	No Ethernet connection
Green	Ethernet connection established, 100 Mbps
Green flashing	Ethernet traffic, 100 Mbps
Yellow	Ethernet connection established, 10 Mbps
Yellow blinking	Ethernet traffic, 10 Mbps

LED IOL 0, 2, 4, 6, 8, 10, 12, 14 (IO-Link port 1…8)	Meaning (Channel in IO-Link-mode)
Off	Port inactive, no IO-Link communication, diagnostics deactivated
Green flashing	IO-Link communication, process data valid
Red flashing	IO-Link communication active and module error, invalid process data
Red	IO-Link supply error free, no IO-Link communication and or respectively or module error, process data invalid
Red blinking	Overload supply VAUX1 both connector LEDs are flashing

LED IOL 0, 2, 4, 6, 8, 10, 12, 14 (IO-Link port 1…8)	Meaning (Channel in IO-mode) Meaning (input)	Meaning (output)
Off	No input signal	Output inactive
Green	Input signal active	Output active (max. 0,5 A)
Red	–	Output active with overload/ short-circuit
Red blinking	Overload supply VAUX1 both connector LEDs are flashing	

LED DXP 1, 3, 5, 7, 9, 11, 13, 15	Meaning (input)	Meaning (output)
Off	No input signal	Output inactive
Green	Input signal active	Output active (max. 2 A)
Red	–	Output active with overload/ short-circuit
Red blinking	Overload supply VAUX1 both connector LEDs are flashing	

9.4 Software diagnostic messages

The device provides the following software diagnostic messages:

- Device status
- Vi overcurrent diagnostics
  Overcurrent diagnostics for the sensor-/ actuator supply VAUX1
- DXP diagnostics
  diagnostic messages of the universal digital channels of the device
- IOL diagnostics
  Diagnostic messages of the IO-Link channels if parameterized as digital in. or digital output.
- IO-Link master diagnostics
  The IO-Link-master reports problems within the IO-Link communication.
- IO-Link device diagnostics
  The device diagnostics map the IO-Link Event Codes (according to the IO-Link specification) sent from the IO-Link devices to the diagnostic telegram of the master.
  Event Codes can be read from the connected devices by using appropriate device tools (e.g. IODD-Interpreter).
  Further information concerning the IO-Link Event Codes and their meaning can be found in the IO-Link specification or in the documentation of the connected devices.

9.4.1 Status- and control word

Status Word

EtherNet/IP/ Modbus	Modbus PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Byte 1	-	-	-	-	-	-	ARGEE	DIAG
Byte 1	Byte 0	-	FCE	-	-	-	-	V1	-

Bit	Description
ARGEE	ARGEE program running
DIAG	Diagnostic messages at the device
FCE	The DTM Force Mode is activated. The actual output values may no match the ones defined and sent by the field bus.

The status word is mapped into the device's process data.

In EtherNet/IP the mapping can be deactivated via the Gateway Class (VSC 100).

NOTE
Activating or deactivating the status and control word modifies the process data mapping.

Control Word

The control word has no function.

9.4.2 Diagnostic telegram

Channel	Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
V1		**V1 overcurrent diagnostics**							
	0	VERR V1 C7/X7 Ch14/ Ch15	VERR V1 C6/X6 Ch12/ Ch13	VERR V1 C5/X5 Ch10/ Ch11	VERR V1 C4/X4 Ch8/Ch9	VERR V1 C3/X3 Ch6Ch7	VERR V1 C2/X2 Ch4Ch5	VERR V1 C1/X1 Ch2Ch3	VERR V1 C0/X0 Ch0Ch1
	1	-	-	-	-	-	-	-	-
DXP		**DXP diagnostics**							
	0	ERR DXP7	ERR DXP6	ERR DXP5	ERR DXP4	ERR DXP3	ERR DXP2	ERR DXP1	ERR DXP0
	1	ERR DXP15	ERR DXP14	ERR DXP13	ERR DXP12	ERR DXP11	ERR DXP10	ERR DXP9	ERR DXP8
IO-Link		**Device diagnostics**				**Master diagnostics**			
IO-Link port 1	0	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPE	-
	1	GEN ERR	OLV	V HIGH	V LOW	ULVE	LLVU	OTEMP	PRM ERR
IO-Link port 2	2…3	Assignment similar to IO-Link port 1							
…	…								
IO-Link port 8	14…15								

NOTE
A “process data invalid” diagnostic (PD_INV) can be sent from both devices, IO-Link master or IO-Link device.

Meaning of Diagnostic Bits

Bit	Meaning
V1 overcurrent diagnostics	
VErrV1 C…/X… Ch…Ch…	Overcurrent VAUX1 (pin1) at connector/channel group
IOL as digital input or digital output	
ERR Chx	Error at channel
IO-Link master diagnostics	
CFGER	Wrong or missing device The connected device does not match the channel configuration or there is no device connected to the channel. This diagnostic message depends on the parameterization of the channel.
DSER	Data storage error Possible causes: ■ Data storage mismatch: IO-Link device in accordance with IO-Link V1.0 connected. The data storage buffer contains data of another device. ■ Overflow of the data storage buffer ■ The connected device may be locked for parameter changes or for data storage.

Bit	Meaning
PPE	Port parameterization The port parameters are inconsistent. The device parameterization via GSD is active, but not working. Possible causes: ■ The IO-Link-master did not receive GSDML-parameters for a connected device. The connected device was not parameterized by a PROFINET PLC via GSDML. ■ The port is in operation mode "IO-Link without validation" or "DI". These modes do not allow parameterization via GSDL file. ■ Data storage mode is active. The parameter is not set to "deactivated, clear". A device parameterization via GSDML is not possible with activated data storage. ■ Vendor or Device ID are "0". The connected device can not be identified and is thus not parameterizable.
IO-Link master/device diagnostics	
PDINV	Evaluating Process Input Data The IO-Link master or the IO-Link device report invalid process input data. The connected device is not in status "operate", which means, it is not ready for operation. Possible sources: ■ The connected device does not match the configured one, additional diagnostic message **Wrong or missing device**. ■ Diagnostic message **Process input data invalid** because the process value can not be measured (depends on the IO-Link device).
IO-Link device diagnostics	
	The IO-Link device diagnostics depend on the IO-Link device used. For more detailed information on the diagnoses, please refer to the documentation for the IO-Link device.
EVT1	Maintenance events A Maintenance Event in accordance with the IO-Link specification occurred, maintenance necessary.
EVT2	Out-of-specification events An Out-of-Specification Event in accordance with the IO-Link specification occurred.
GENERR	Common error The device sends an error (device status 4, in accordance with IO-Link specification), which is not clearly specified. Read out the device Event Codes in order to be able to specify the error more precisely.
HWER	Hardware error General hardware error or device malfunction of the connected device
LLVU	Lower limit value underrun The process value lies under the parameterized measurement range or the chosen measurement range has been chosen too high.
OLV	Overload The connected device detected an overload.
OTMP	Overtemperature A temperature diagnosis is available on the connected device.
PRMERR	Parameterization error The connected device reports a parameterization error (loss of parameters, no parameter initialization, etc.).

Bit	Meaning
ULVE	Upper limit value exceeded The process value exceeds the parameterized measurement range or the chosen measurement range has been chosen too low.
VLOW	Undervoltage One of the voltages at the connected device is below the defined range.
VHIGH	Overvoltage One of the voltages at the connected device exceeds the defined range.

9.4.3 PROFINET diagnostics

Device diagnostics (slot 0, according to configuration tool)		**PROFINET diagnostics**	
	Connector	Error code	Channel
Undervoltage V1	-	0x0002	0

DXP diagnostics (slot 1 according to configuration tool)			**PROFINET diagnostics**	
	Channel	Connector	Error code	Channel
Overcurrent output	DXP1	C0/X0	0x0001	1
	DXP3	C1/X1	0x0001	3
	DXP5	C2/X2	0x0001	5
	DXP7	C3/X3	0x0001	7
	DXP9	C4/X4	0x0001	9
	DXP11	C5/X5	0x0001	11
	DXP13	C6/X6	0x0001	13
	DXP15	C7/X7	0x0001	15

VAUX1 diagnostics (slot 1 according to configuration tool)	**PROFINET diagnostics**	
	Error code	Channel
Overcurrent VAUX1 at C0/X0 Ch0/Ch1	0x01D0	0
Overcurrent VAUX1 at C1/X1 an Ch2/Ch3	0x01D1	
Overcurrent VAUX1 at C2/X2 an Ch4/Ch5	0x01D2	
Overcurrent VAUX1 at C3/X3 an Ch6/Ch7	0x01D3	
Overcurrent VAUX1 at C4/X4 Ch8/Ch9	0x01D4	
Overcurrent VAUX1 at C5/X5 an Ch10/Ch11	0x01D5	
Overcurrent VAUX1 at C6/X6 an Ch12/Ch13	0x01D6	
Overcurrent VAUX1 at C7/X7 an Ch14/Ch15	0x01D7	

9.5 Using IO-Link data storage

IO-Link data storage is only possible if IO-Link devices connected to the IO-Link master are not parameterized by a controller (e.g., via a GSDML). This means that parameterization of IO-Link devices in PROFINET via SIDI (Simple IO-Link-Device-Integration [▶ 14]) excludes the use of data storage.

Data storage mode

NOTE
Data storage mode is only available for devices complying with the IO-Link specification V1.1. IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage.

In the IO-Link master, the data storage mode can be set using the parameter "data storage mode".

- 0 = activated
- 1 = overwrite
- 2 = read in
- 3 = deactivated, clear

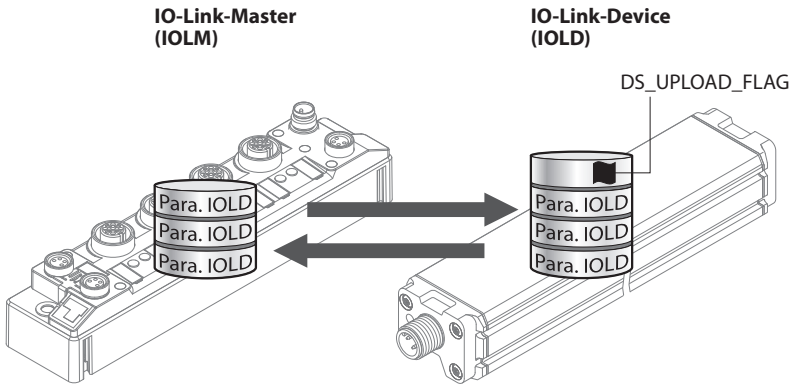


Fig. 82: Data storage mode – general principle, Para. IOLD = parameters of the IO-Link device

A change of parameters in the device is indicated by the status of the DS_UPLOAD_FLAG bit:

- 0 = no changes in the device's parameter set
- 1 = changes in the device's parameter set (e. g. via DTM, at the device, etc.)

9.5.1 Parameter "Data storage mode" = activated

The synchronization of the parameter sets is bidirectional.
The actual data set (master or device) is valid:
The following applies:

- The data set in the device is actual, if DS_UPLOAD_FLAG = 1.
- The data set in the Master is actual, if DS_UPLOAD_FLAG = 0.

Use Case 1: Parameterizing the Device using e.g. a DTM

✓ The IO-Link device is already installed in the system and connected to the master.
▶ Parameterizing the device via DTM.
⇨ DS_UPLOAD_FLAG = 1, parameter set in the device changed.
⇨ The parameter data are transferred from the new IO-Link device to the IO-Link master.

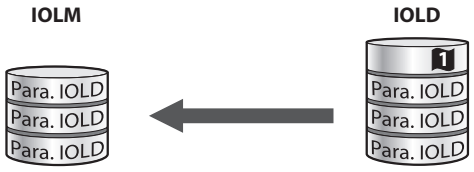


Fig. 83: Data storage mode activated – parameter set in the device changed

Use case 2: replace a defective device with a device in the delivery state.

✓ The **new** IO-Link device has **not** been connected to the master before.
▶ The parameters of the new device remain unchanged, DS_UPLOAD_FLAG = 0.
⇨ The parameter data of the defective device are transferred from the IO-Link master to the new IO-Link device.

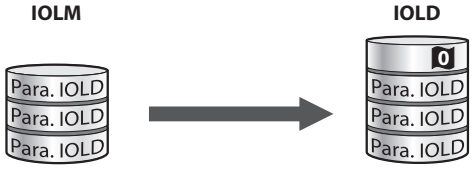


Fig. 84: Data storage mode activated – parameter set in the device unchanged

Use case 3: replace a defective device with a device with unknown (changed) parameters

✓ The **new** IO-Link device has **not** been connected to the master before.
▶ The parameters of the new device remain unchanged, DS_UPLOAD_FLAG = 1.
⇨ The parameter data are transferred from the new IO-Link device to the IO-Link master.

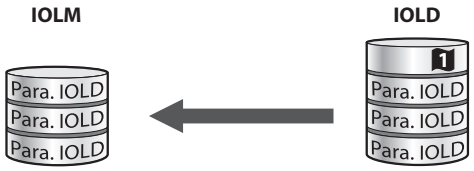


Fig. 85: Data storage mode activated – parameter set in the device changed

NOTE
If device replacement is necessary when data storage is activated, an IO-Link replacement device with unknown parameter data should be reset to its factory settings before connection to the IO-Link master.
Turck IO-Link devices can be reset to factory settings via a system command using a generic IO-Link DTM and the device specific IODD. For the reset of third party devices, please read the corresponding manufacturer documentation.

9.5.2 Parameter "Data storage mode" = read in

- The data set in the device is **always** the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the master.
- The status of the DS_UPLOAD_FLAG is ignored.

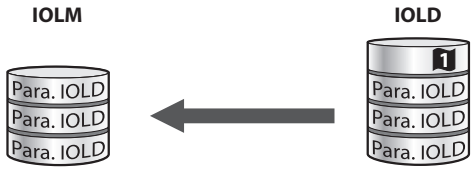


Fig. 86: Data storage mode = read in – parameter set in the device changed

9.5.3 Parameter "Data storage mode" = overwrite

- The data set in the master is **always** the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the device.
- The status of the DS_UPLOAD_FLAG is ignored.

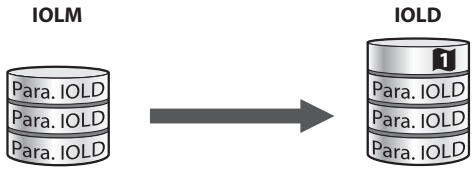


Fig. 87: Data storage mode = overwrite – parameter set in the master changed

9.5.4 Parameter "Data storage mode" = deactivated, clear

- The data set in the master is deleted.
- The synchronization of parameter sets is deactivated.

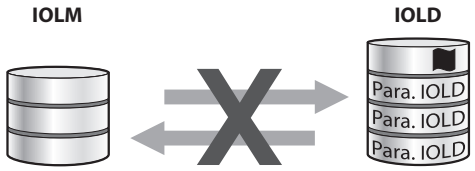


Fig. 88: Data storage mode deactivated – no synchronization

9.6 Operating IO-Link devices (IODD Configurator)

The IODD Configurator offers many functions for monitoring IO-Link devices during operation and for reading out and checking process data. The functions vary depending on the IO-Link device used and the associated IODD.

The **Process data** currently present on the IO-Link device is prepared and displayed according to the data structure of the IO-Link device. The chronological progression can be displayed using the chart function.

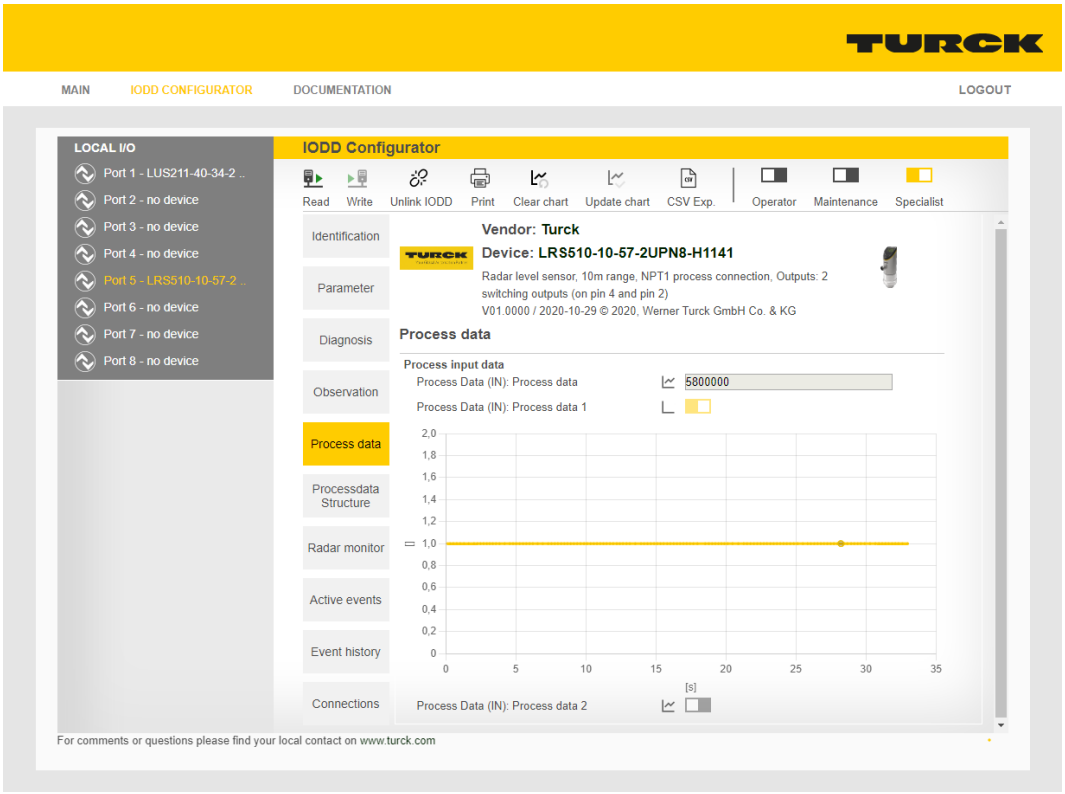


Fig. 89: IODD Configurator: Process data of an IO-Link device

Diagnostics present at the device are displayed under **Diagnosis**.

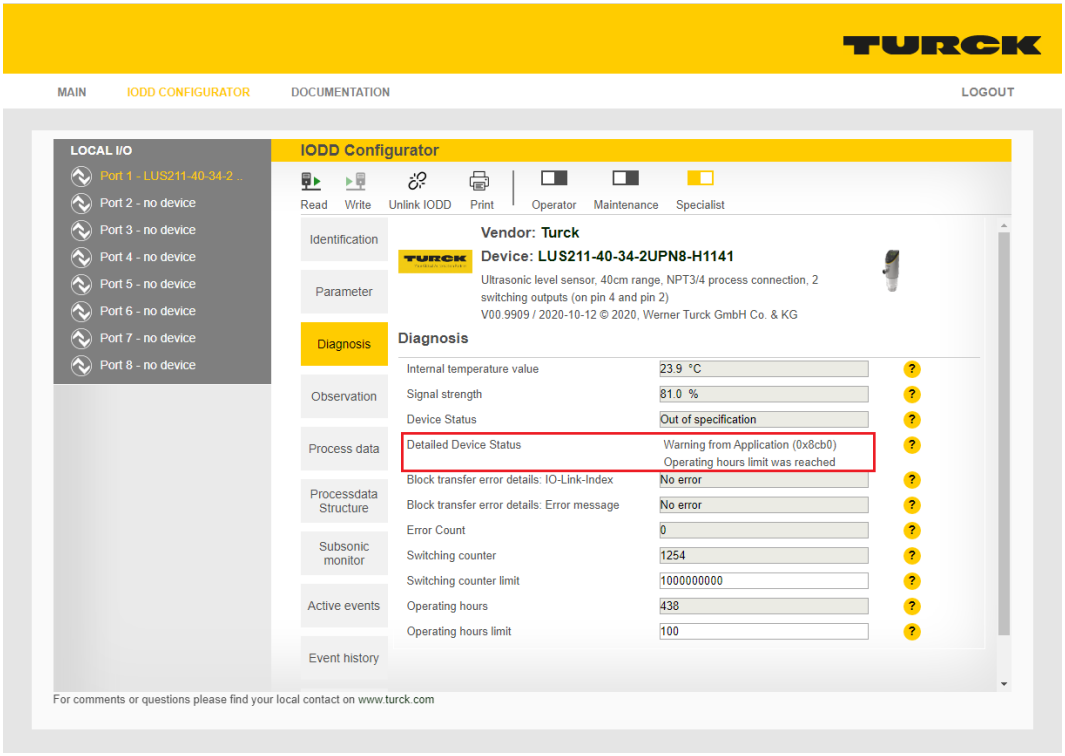


Fig. 90: IODD Configurator: Diagnostics at the IO-Link device

Current IO-Link events are processed under **Active Events** and displayed in plain text. The **Event History** provides past events.

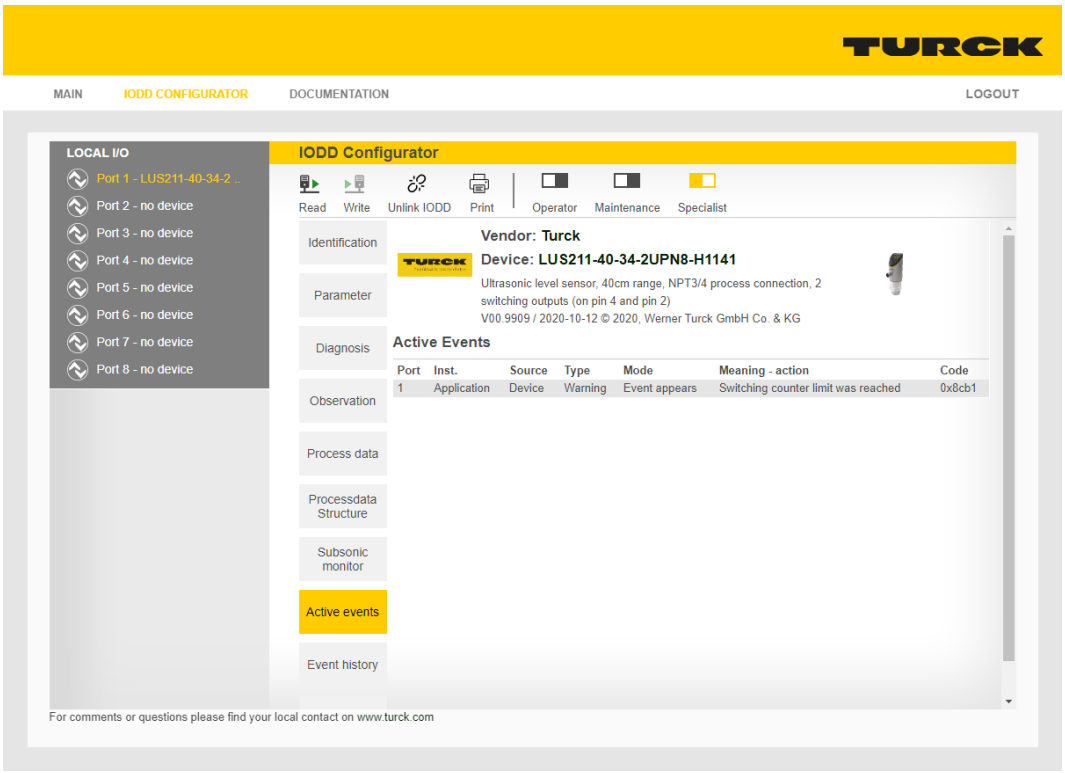


Fig. 91: IODD Configurator: Active Events

In addition, the IODD Configurator offers the special functions of some sensors such as the **Radar monitor** for Turck radar sensors or the **Subsonic monitor** for Turck ultrasonic sensors.

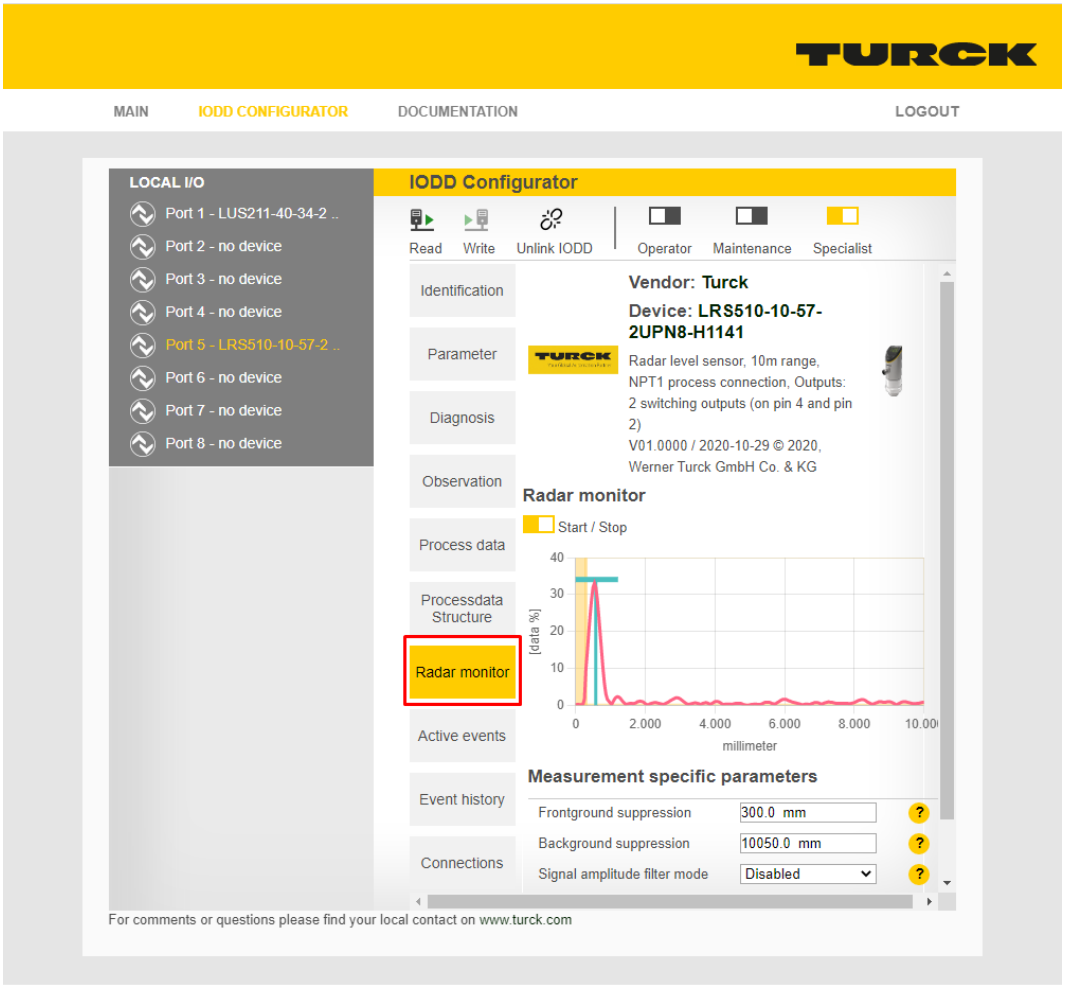


Fig. 92: IODD Configurator: Radar monitor

10 Troubleshooting

If the device does not work as expected, proceed as follows:

- ▶ Exclude environmental disturbances.
- ▶ Check the connections of the device for errors.
- ▶ Check device for parameterization errors.

If the malfunction persists, the device is faulty. In this case, decommission the device and replace it with a new device of the same type.

10.1 Resolving parameterization errors in the IO-Link master

Fault	Possible causes:	Remedy
Digital output does not switch	The IO-Link port (pin 4) was not parameterized as a DX channel.	▶ Set the channel to DX via the Operating mode parameter.
	The output at pin 2 is deactivated per default.	▶ Enable the output function via parameter **Activate output** (EN_DO =1).

IO-Link channels

LED behavior	Diagnostics	Possible causes:	Remedy
LED ERR constant red, LED IOL red blinking	Data storage error	IO-Link device according to IO-Link V1.0 connected IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage.	▶ Set parameter Data storage mode to **deactivated, clear**. ⇨ Data storage remain deactivated.
		The data storage buffer contains data of another device.	▶ Set parameter Data storage mode to **deactivated, clear**. ▶ Re-activate the data storage if necessary.
	Wrong or missing device	The connected device does not match the configured one (wrong vendor ID, device ID etc.)	▶ Adapt the parameterization of the IO-Link port (vendor ID, device ID, etc.) at the master. The parameterization can be done manually via DTM, the web server or similar or by teaching the master using the IO-Link-Call (port 0 function, sub index 67: Teach mode).
	Process input data invalid	Certain IO-Link devices send a **process input data invalid** diagnosis if the process value cannot be measured.	▶ Deactivate the sending of the diagnosis for the IO-Link port with the parameter **Process input data invalid → No diagnostic generated.**

11 Maintenance

Ensure that the plug connections and cables are always in good condition.

The devices are maintenance-free, clean dry if required.

12 Repair

The device must not be repaired by the user. Take defective devices out of operation and return them to Turck for an error analysis. Observe our return acceptance conditions when returning the device to Turck.

12.1 Returning devices

Returns to Turck can only be accepted if the device has been equipped with a Decontamination declaration enclosed. The decontamination declaration can be downloaded from
https://www.turck.de/en/retoure-service-6079.php
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Disposal

The devices must be disposed of correctly and must not be included in general household garbage.

14 Technical data

Technical data	
Supply	
Supply voltage	24 VDC
Permissible range	18…30 VDC
Current feedthrough XD1 to XD2	Max. 16 A per voltage group
Total current	Max. 9 A (per voltage group) ■ ATEX: 9 A (per module) ■ UL: 6 A (per voltage group) at ambient temperature > 55 °C
Power consumption	
Operating current (at 24 VDC nominal voltage)	< 120 mA (outputs inactive)
Operating current (at 28.8…18.0 VDC)	■ V1: 300…250 mA Operating conditions: ■ All outputs active, no load ■ Ethernet connection active
Sensor/actuator supply V_{AUX1}	Supply connectors from V1, short-circuit proof, max. 2 A per connector
Potential isolation	Galvanic isolation from V1 and V2 voltage group, voltages up to 500 VDC
Connectors	
Ethernet	2 × M12 female connector, 4-pin, D coded
Supply	
■ TBEN-L4-8IOLA	2 × 7/ 8" 4-pin ■ X1: 7/8" male connector ■ X2: 7/8" female connector
■ TBEN-LL-8IOLA	2 × M12, 5-pin, L coded ■ XD1: M12 female connector ■ XD2: M12 male connector
Digital in-/outputs	8× M12, 5-pin, A coded
Permissible torques ■ M12 ■ 7/8" ■ M6 screws (mounting)	 0.6 Nm 0.8 Nm 1.5 Nm
Max. cable length	
■ Ethernet	100 m (per segment)
Isolation voltages	
V1 to V2	≥ 500 VAC
V1/V2 to the fieldbus	≥ 500 VAC
System data	
Transmission rate	10 Mbps/100 Mbps
Protocol detection	Automatic
Web server	Integrated, 192.168.1.254
Service interface	Ethernet via P1 or P2 or XF1 or XF2
ARGEE	

Technical data	
Supported from firmware version	1.0.0.0
Modbus TCP	
Address assignment	Static IP, DHCP
Supported Function Codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of TCP connections	8
Input register start address	0 (0x0000)
Output register start address	2048 (0x0800)
Local port	Port 502, fixed setting
EtherNet/IP	
Address assignment	According to EtherNet/IP standard
Device Level Ring (DLR)	Supported
Quick Connect (QC)	< 150 ms
Number of Class 3 (TCP) connections	3
Number of Class 1 (CIP) connections	10
Input Assembly Instances	103, 120, 121, 122, 123, 124, 125, 126
Output Assembly Instances	104, 150, 151, 152
Configuration Assembly Instances	106
PROFINET	
PROFINET specification	V 2.35
Conformance Class	B (RT)
Address assignment	DCP
MinCycle Time	1 ms
Fast start-up (FSU)	< 150 ms
Diagnostics	According to PROFINET alarm handling
Topology detection	Supported
Automatic address setting	Supported
Media Redundancy Protocol (MRP)	Supported
System redundancy	S2
Network load class	3
Digital inputs	
No. of channels	8 DXP and 8 SIO (DXP)
Input type	PNP
Type of input diagnostics	Channel diagnostics
Switching threshold	EN 61131-2 ■ Pin 2: Type 3, PNP ■ Pin 4: Type 1, PNP
Signal voltage low level	< 5 V
Signal voltage high level	> 11 V
Signal current low level	< 1.5 mA
Signal current high level	> 2 mA
Input delay	0.05 ms
Potential isolation	Galvanic isolation to Ethernet, voltage proof up to 500 VAC

Technical data	
Digital outputs	
No. of channels	8 DXP and 8 SIO (DXP)
Output type	PNP
Type of output diagnostics	Channel diagnostics
Output voltage	24 VDC from potential group
Output current per channel	Pin 2 (DXP 0, 2, 4, 6): 2 A Pin 4 (DXP 1, 3, 5, 7): 0.5 A
Potential isolation	Galvanic isolation to Ethernet, voltage proof up to 500 VAC
IO-Link	
No. of channels	8
IO-Link	Pin 4 in IO-Link mode
IO-Link specification	Version 1.1
IO-Link port type	Class A
Frame type	Supports all specified frame types
Supported devices	Max. 32 byte input/32 byte output
■ Input data	■ Per channel max. 32 byte
■ Output data	■ Per channel max. 32 byte
Transmission rate	4.8 kbps (COM 1) 38.4 kbps (COM 2) 230.4 kbps (COM 3)
Connection cable	Length: max. 20 m standard lines, 3- or 4-wire (depending on the application), unshielded
Mounting	
Type of mounting	Via 2 mounting holes, Ø 6.3 mm
Mounting distance (device to device)	≥ 50 mm Valid for operation in the ambient temperatures mentioned below with sufficient ventilation as well as maximum load (horizontal mounting). At ambient temperatures of < 30 °C, the devices can also be mounted directly next to each other.
Standard/directive conformity	
Vibration test	According to EN 60068-2-6
Acceleration	Up to 20 g
Shock test	According to EN 60068-2-27
Drop and topple	According to IEC 60068-2-31/IEC 60068-2-32
Electro magnetic compatibility	According to EN 61131-2
Approvals and certificates	CE, UKCA, FCC
UL cond.	cULus LISTED 21 W2, Encl.Type 1 IND.CONT.EQ.

Technical data	
General information	
Dimensions (B × L × H)	60.4 × 230.4 × 39 mm
Operating temperature	-40…+70 °C
Storage temperature	-40…+85 °C
Operating altitude	Max. 5000 m
Protection class	IP65/IP67/IP69K
MTTF	114 years acc. to SN 29500 (Ed. 99) 20 °C
Housing material	PA6-GF30
Housing color	Black
Material window	Lexan
Material label	Polycarbonate
Halogen free	Yes

FCC declaration

NOTE
This device complies with the limits for a Class A digital device, according to Part 15 of the FCC Rules. Operation of this equipment in a residential area may cause harmful interference. In this case, the user must correct the interference at his own expense.

15 Appendix: approvals and markings

15.1 ATEX, IECEx and UKEX

Type designation	TBEN-L…-8IOLA
Supply voltage	24 VDC ±10 %
Input current I_{max}	9 A (total per module)
Output current I_{max}	1,5 A (per output)

Approvals	Marking according to ATEX directive UKSI (SI 2016/1107)	EN 60079-0/-7/-31
ATEX approval no.: TÜV 20 ATEX 264795 X UKEX approval no.: TURCK Ex-20002HX	Ex II 3 G Ex II 3 D	Ex ec IIC T4 Gc Ex tc IIIC T115 °C Dc
IECEx approval no.: IECEx TUN 20.0010X		Ex ec IIC T4 Gc Ex tc IIIC T115 °C Dc

Ambient temperature T_{amb}.: -25 °C…+60 °C

16 Turck subsidiaries — contact information

Germany	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr **www.turck.de**
Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria **www.turck.com.au**
Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Wien **www.turck.at**
Belgium	TURCK MULTIPROX Lion d'Orweg 12, B-9300 Aalst **www.multiprox.be**
Brazil	Turck do Brasil Automação Ltda. Rua Anjo Custódio Nr. 42, Jardim Anália Franco, CEP 03358-040 São Paulo **www.turck.com.br**
Canada	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 **www.turck.ca**
China	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin **www.turck.com.cn**
Czech Republic	TURCK s.r.o. Na Brne 2065, CZ-500 06 Hradec Králové **www.turck.cz**
France	TURCK BANNER S.A.S. 11 rue de Courtalin Bat C, Magny Le Hongre, F-77703 MARNE LA VALLEE Cedex 4 **www.turckbanner.fr**
Great Britain	TURCK BANNER LIMITED Blenheim House, Hurricane Way, GB-SS11 8YT Wickford, Essex **www.turckbanner.co.uk**
Hungary	TURCK Hungary kft. Árpád fejedelem útja 26-28., Óbuda Gate, 2. em., H-1023 Budapest **www.turck.hu**
India	TURCK India Automation Pvt. Ltd. 401-403 Aurum Avenue, Survey. No 109 /4, Near Cummins Complex, Baner-Balewadi Link Rd., 411045 Pune - Maharashtra **www.turck.co.in**
Italy	TURCK BANNER S.R.L. Via San Domenico 5, IT-20008 Bareggio (MI) **www.turckbanner.it**

Japan	TURCK Japan Corporation ISM Akihabara 1F, 1-24-2, Taito, Taito-ku, 110-0016 Tokyo www.turck.jp
Korea	Turck Korea Co, Ltd. B-509 Gwangmyeong Technopark, 60 Haan-ro, Gwangmyeong-si, 14322 Gyeonggi-Do www.turck.kr
Malaysia	Turck Banner Malaysia Sdn Bhd Unit A-23A-08, Tower A, Pinnacle Petaling Jaya, Jalan Utara C, 46200 Petaling Jaya Selangor www.turckbanner.my
Mexico	Turck Comercial, S. de RL de CV Blvd. Campestre No. 100, Parque Industrial SERVER, C.P. 25350 Arteaga, Coahuila www.turck.com.mx
Netherlands	Turck B. V. Ruiterlaan 7, NL-8019 BN Zwolle www.turck.nl
Poland	TURCK sp.z.o.o. Wroclawska 115, PL-45-836 Opole www.turck.pl
Romania	Turck Automation Romania SRL Str. Siriului nr. 6-8, Sector 1, RO-014354 Bucuresti www.turck.ro
Russian Federation	TURCK RUS OOO 2-nd Pryadilnaya Street, 1, 105037 Moscow www.turck.ru
Sweden	Turck Sweden Office Fabriksstråket 9, 433 76 Jonsered www.turck.se
Singapore	TURCK BANNER Singapore Pte. Ltd. 25 International Business Park, #04-75/77 (West Wing) German Centre, 609916 Singapore www.turckbanner.sg
South Africa	Turck Banner (Pty) Ltd Boeing Road East, Bedfordview, ZA-2007 Johannesburg www.turckbanner.co.za
Turkey	Turck Otomasyon Ticaret Limited Sirketi Inönü mah. Kayisdagi c., Yesil Konak Evleri No: 178, A Blok D:4, 34755 Kadiköy/ Istanbul www.turck.com.tr
USA	Turck Inc. 3000 Campus Drive, USA-MN 55441 Minneapolis www.turck.us

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