TURCK

Your Global Automation Partner

TBEN-LL-4FDI-4FDX Multi protocol module with Turck Safe Link

User Manual

Table of Contents

1 About these instructions

1.1 Target groups

These instructions are directed to qualified personnel or technically trained personnel (planer, developer, design engineer, installer, electrical specialist, operator, maintenance personnel etc.) and must be carefully read by anyone anyone who assembles, commissions, operates, maintains, dismantles or disposes of the device.

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

1.2 Explanation of symbols

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.
	**WARNING** WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.
	**CAUTION** CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.
	**NOTICE** CAUTION indicates a situation which, if not avoided, may cause damage to property.
	**NOTE** NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.
▶	**MANDATORY ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULT OF ACTION** This symbol denotes the relevant results of an action.

1.3 Additional documents

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

- Data sheet
- Declarations of conformity (current version)
- Approvals
- Notes on Use in Ex zone 2 and 22 (100022986)

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 safety manual applies to the following full safety modules with Turck Safe Link:

- TBEN-LL-4FDI-4FDX

2.2 Scope of delivery

The scope of delivery includes:

- TBEN-LL-4FDI-4FDX
- M12 closing caps for X0…X7
- Labels for X0…X7

2.3 Turck service

Turck supports you in your projects — from the initial analysis right through to the commissioning of your application. The Turck product database at www.turck.com offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

For the contact details of our branches worldwide, please see page [▷ 120].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The TBEN-LL-4FDI-4FDX is a decentralized multi-protocol module with Turck Safe Link.

The TBEN-LL-4FDI-4FDX serves for controlling signal devices as for example emergency stop buttons, position switches or OSSDs which are used to ensure human, material or machine protection.

The multiprotocol device can be operated with the three Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP mentioned above by automatic protocol detection without user intervention. The Safe Link protocol is used for safe communication between a maximum of 31 Safe Link modules.

TBEN-LL-4FDI-4FDX can be used in the following applications:

- Applications up to SIL 3 (according to IEC 61508)
- Applications up to SIL CL3 (according to EN 62061)
- Applications up to Category 4 and Performance Level e (according to EN ISO 13849-1)

The temperature range of -40…+70 °C and protection classes IP65, IP67 and IP69K allow installation directly in the field.

Devices with Ex marking are suitable for operation in hazardous areas in Zone 2 and Zone 22 (temperature range: -25…+60 °C).

The device must 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 must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The Performance Level as well as the safety category according to EN ISO 13849-1 depend on the external wiring, the application, the choice of the control devices as well as their arrangement on the machine.
- The user has to execute a risk assessment according to EN ISO 12100:2010.
- Based on the risk assessment a validation of the complete plant/machine has to be done in accordance with the relevant standards.
- Operating the device beyond the specification can lead to malfunctions or to the destruction of the device. The installation instructions must be observed.
- For trouble-free operation, the device must be properly transported, stored, installed and mounted.
- For the release of safety circuits in accordance with EN IEC 602041, EN ISO 13850 only use the output circuits of connectors X4…X7
- Change the default password of the integrated web server after the first login. Turck recommends the use of a secure password.

3.3 Residual risks (EN ISO 12100:2010)

The wiring proposals described in the following have been tested under operational conditions with the greatest care. Together with the connected periphery of safety related equipment and switching devices they fulfill relevant standards.

Residual risks remain, if

- the proposed wiring concept is is changed and connected safety related devices or protective devices are possibly not or insufficiently included in the safety circuit.
- the operator does not observe the relevant safety regulations specified for the operation, adjustment and maintenance of the machine. Observe intervals for inspection and maintenance of the machine.

Failure to follow these instructions can result in serious injury or equipment damage.

3.4 Warranty and liability

Any warranty and liability is excluded for:

- Improper application or not intended use of the product
- Non-observance of the user manual
- Mounting, installation, configuration or commissioning by unqualified persons

3.5 Notes on Ex protection

- When using the device in Ex areas, the user must have knowledge of explosion protection (IEC/EN 60079-14 etc.).
- Observe national and international regulations for explosion protection.
- Only use the device within the permissible operating and ambient conditions (see certification data and Ex approval specifications).
- The document "Notes on Use in Ex Zone 2 and 22" (ID 100022986) contains the approval data for using the device in hazardous areas. Observe the requirements in the document.

3.6 Requirements for Ex approval

- Only use the device in an area with no more than pollution degree 2.
- Only disconnect and connect circuits when there is no potentially explosive atmosphere or when the power supply is switched off
- Only operate the switches when there is no potentially explosive atmosphere or when the power supply is switched off.
- Connect the metal protective cover to the equipotential bonding in the Ex area (cable cross-section: 4 mm^2).
- 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 Lexan service window with the Ultem window.
  - Install the device in an area offering impact protection (e.g. in the robot arm) and attach a warning sign: "DANGER: Do not connect or disconnect circuits under live conditions. Do not actuate the switch under live conditions".
- Keep the service window of the devices closed during operation in order to comply with the IP protection.
- Do not install the device in areas critically exposed to UV light.
- Prevent risks caused by electrostatic charge.
- Provide unused male connectors with suitable sealing or blanking caps in order to ensure degree of protection IP65, IP67 or IP69K The tightening torque for the M4 screws is 0.5 Nm.

4 Product description

TBEN-LL-4FDI-4FDX is a decentralized safety block multi-protocol module with Turck Safe Link. The device has four 2-channel digital safety inputs (FDI) for the connection of different safety sensors as for example light barriers or emergency stop buttons. Four further safety channels (FDX) can be freely used as inputs (FDI) or outputs (FDO). The configuration of the safe I/Os and their function is realized by means of a software tool the Turck Safety Configuration.

The device has eight M12 connectors for connecting safe sensors and actuators.

The multiprotocol device can be operated with the three Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP mentioned above by automatic protocol detection without user intervention. The Safe Link protocol is used for safe communication between a maximum of 31 Safe Link modules.

4.1 Device overview

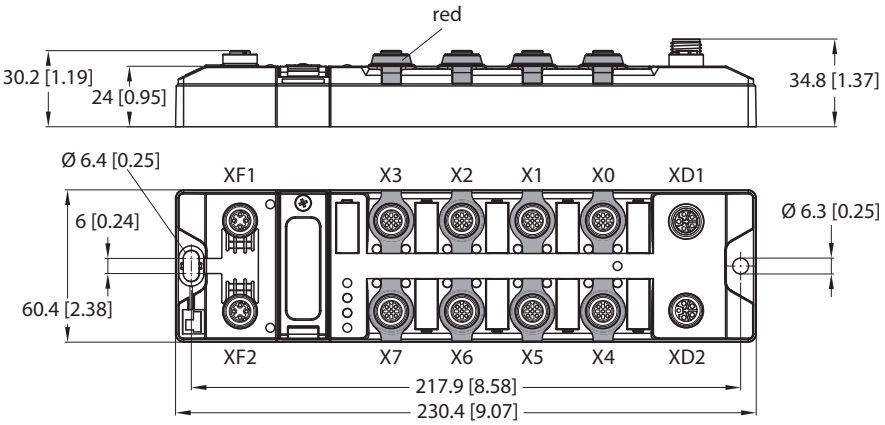


Fig. 1: TBEN-LL-4FDI-4FDX

4.1.1 Type label

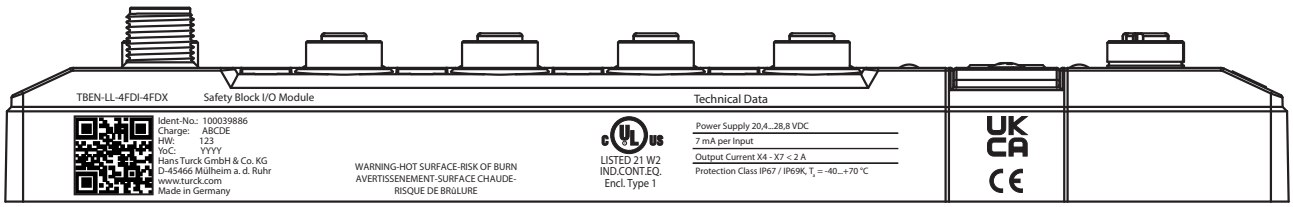
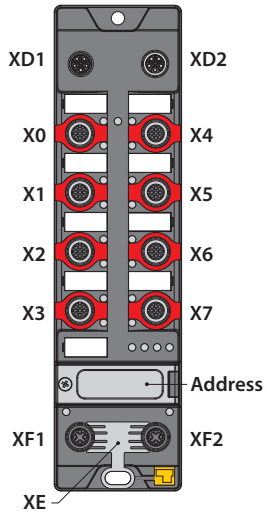


Fig. 2: Type plate – TBEN-LL-4FDI-4FDX

4.2 Properties and features

- Four safety-related SIL3 inputs FDI
- Four safety-related SIL3 in-/outputs FDX
- Safe PP/PM-switching of the actuator power supply
- Usable in SIL CL3 according to EN 62061 or PLe according to DIN EN ISO 13849-1
- Two 5-pin M12-connectors for voltage supply
- Two 4-pin M12-connectors for Ethernet
- Multiple LEDs for status indication
- Integrated Ethernet switch, allows line topology
- Integrated web server
- Transmission rate 10 Mbps and 100 Mbps
- Fiber-glass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Degree of protection IP65, IP67, IP69K

4.2.1 Switches and connectors



	Meaning
XD1	Power IN
XD2	Power OUT
X0	FDI0/1, safety-related input
X1	FDI2/3, safety-related input
X2	FDI4/5, safety-related input
X3	FDI6/7, safety-related input
X4	FDX8/9, safety-related in-/output
X5	FDX10/11, safety-related in-/output
X6	FDX12/13, safety-related in-/output
X7	FDX14/15, safety-related in-/output
Address	Rotary coding switches for address assignment
XF1	Ethernet 1
XF2	Ethernet 2
XE	Functional earth

4.2.2 Block diagram

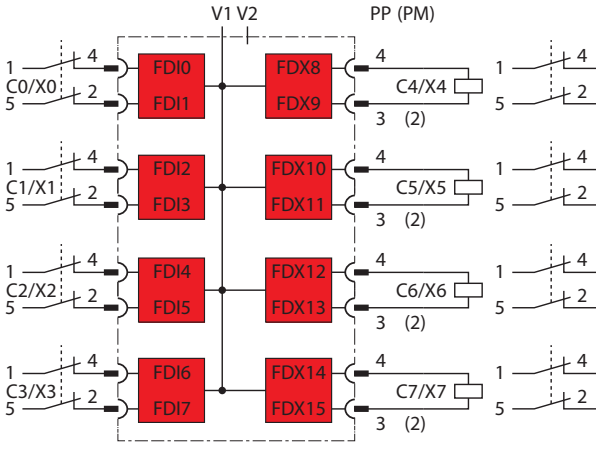


Fig. 3: Block diagram TBEN-LL-4FDI-4FDX

4.3 Functions and operating modes

4.3.1 Multiprotocol technology

The device can be used in the following Ethernet protocols:

- PROFINET
- EtherNet/IP
- Modbus TCP

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 protocol-specific features:

PROFINET

- Fast Startup (FSU), prioritized startup
- Topology detection
- Address allocation with LLDP
- Media redundancy protocol (MRP)
- S2 redundancy

EtherNet/IP

- Device Level Ring (DLR)

Ethernet ports used

Port	Protocol
00022	SFTP
00053	DNS TCP
00067	DHCP
00080	HTTP
00093	PROFINET DCP
00502	Modbus TCP
58554	Turck Services

4.3.2 Turck Safe Link

A Turck Safe Link network can consist of a maximum of one Safe Link manager and 30 Safe Link devices. Which TBEN-LL-4FDI-4FDX in the Turck Safe Link network will act as the Safe Link manager is determined by the user in the Turck Safety Configurator. The Safe Link manager monitors the connected devices and handles the safe process data traffic within the Safe Link network. It also establishes the connection to the higher-level, non-safe network. Turck Safe-Link modules thus enable the processing of safe machine data without a safety PLC.

4.3.3 Safety function

The TBEN-LL-4FDI-4FDX provide four safe digital SIL3 inputs (FDI) and four SIL3-connectors (FDX), configurable as in- or outputs.

The following devices can be connected to the safety inputs:

- 1- and 2-channel safety switches and sensors
- Contact based switches, e.g. emergency switches, protective door switches
- Sensors with OSSD switching outputs
- Antivalently switching OSSD sensors

The four safe SIL3 outputs can be used PP- or PM-switching.

Safe Status

In the safe state the device outputs are in LOW-state (0). The inputs report a LOW-state (0) to the logic.

Fatal Error

- Incorrect wiring at the output (i.e. capacitive load, energetic recovery)
- Short-circuit at the line control output T2
- Incorrect power supply
- Strong EMC disturbances
- Internal device error

4.3.4 Safety inputs (FDI)

The safe inputs are suitable for the connection of safety-related sensors:

- Max. eight 2-channel safety switches and sensors
- Contact based switches, e.g. emergency switches, protective door switches
- Sensors with OSSD switch outputs with test pulses
- Sensors with OSSD switch outputs without test pulses

Error detection and diagnostics

Internal:

- Device self test: Diagnosis of internal device errors

External:

- Cross connection diagnosis: The device detects a cross connection between the sensor supplies at the inputs or between one sensor supply to another potential (if the test pulses are activated)
- Discrepancy diagnosis: for 2-channel inputs
- Short-circuit diagnosis

Parameters

For each input the following types can be selected:

- Safe input for potential free contacts (NC/NC)
- Safe antivalent input for potential-free contacts (NC/NO)
- Safe electronic input at OSSD output with test pulses

4.3.5 Safety outputs (FDO)

The safe SIL3 outputs can be used PP- or PM-switching.

- Max. four 2-channel safety output (outputs are supplied via V1)

Error detection and diagnostics

Internal:

- Device self test: Diagnosis if an output can not change to the safe state due to an internal error.

External:

- Overload diagnosis
- Cross connection diagnosis
- Short-circuit diagnosis

Parameters

- Safe output PP-switching:
  Safe output, the load is connected between P-terminal and Ground-terminal.
- Safe output PM-switching:
  Safe output, the load is connected between P-terminal and M-terminal (mass), necessary for special loads which need a separation from Ground.

4.3.6 Configuration memory

A pluggable memory stick is included in the scope of delivery of TBEN-LL-4FDI-4FDX. It serves for storing the safety function configured via Turck Safety Configurator. It allows to transfer the configuration of one device to another device, e. g. for device exchange.

5 Installing

5.1 Installing a device in zone 2 and zone 22

The devices can be used in combination with the TB-SG-L (ID 100014865) protective housing set in zone 2 and zone 22.

DANGER
Potentially explosive atmosphere
Risk of explosion due to spark ignition
Operation in zone 2 or zone 22:
- ▶ Only install the device if there is no potentially explosive atmosphere present.
- ▶ Observe the requirements for Ex approval.

- ▶ Screw on the housing. Use a Torx T8 screwdriver.
- ▶ Replace the service window with the supplied Ultem window.
- ▶ Place the device on the base plate of the protective housing and fasten both together on the mounting plate [▷ 15].
- ▶ Connect the device, [▷ 18].
- ▶ Fit the housing cover and screw on as shown in the following figure. The tightening torque for the Torx T8 screw is 0.5 Nm.

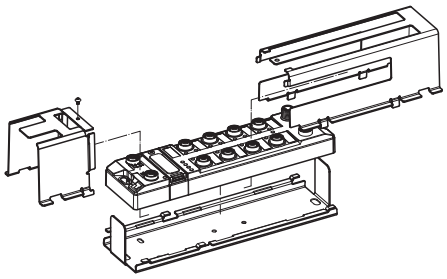


Fig. 4: Installing the device in the TB-SG-L protective housing

5.2 Mounting onto a mounting plate

NOTICE
Mounting on uneven surfaces
Device damage due to stresses in the housing
- ▶ Attach the device to the mounting plate with two M6 screws.

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

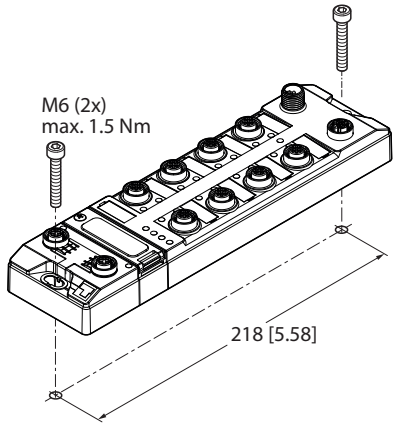


Fig. 5: Mounting the device onto a mounting plate

5.3 Grounding the device

5.3.1 Equivalent wiring diagram and shielding concept

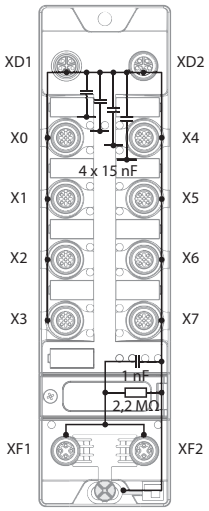


Fig. 6: Equivalent wiring diagram and shielding concept – TBEN-LL-4FDI-4FDX

5.3.2 Shielding of the fieldbus and I/O level

The fieldbus and the I/O level of the modules can be grounded separately.

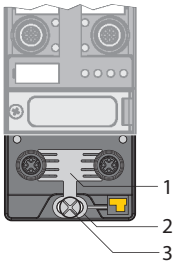


Fig. 7: Grounding clip (1), grounding ring (2) and metal screw (3)

The grounding ring (2) is the module grounding. The shielding of the I/O level is permanently connected to the module grounding. The module grounding is only connected to the reference potential of the installation when the module is mounted.

I/O level shielding

In the case of direct mounting on a mounting plate, the module grounding is connected to the reference potential of the system via the metal screw in the lower mounting hole (3). If module grounding is not desired, the electrical connection to the reference potential must be interrupted, e.g. by using a plastic screw.

Fieldbus level shielding

The grounding of the fieldbus level can either be connected directly via the grounding clip (1) or connected and routed indirectly via an RC element to the module grounding. If the grounding is to be routed via an RC element, the grounding clip must be removed.

In the delivery state, the grounding clip is mounted.

5.3.3 Disconnecting the direct grounding of the fieldbus level: removing the grounding clip

- ▶ Use a flat screwdriver to slide the grounding clip forward and remove it.

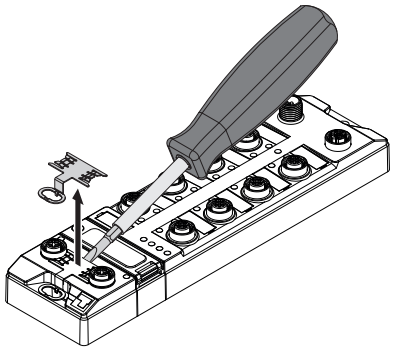


Fig. 8: Removing the grounding clamp

5.3.4 Grounding the fieldbus level directly: inserting the grounding clip

- ▶ Place the grounding clip between the fieldbus connectors by using a screwdriver in such way that the clip contacts the metal housing of the connectors.
- ▶ The shielding of the fieldbus cables is connected to the grounding clip.

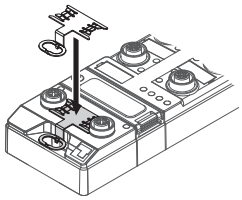


Fig. 9: Mounting the grounding clip

5.3.5 Grounding the device – mounting on a mounting plate

- ▶ For mounting onto a mounting plate: Fix the device with a metal screw through the lower mounting hole.
- ⇨ The module grounding is connected to the reference potential of the installation via the metal screw.
- ⇨ With mounted grounding clip: The shielding of the fieldbus and the module grounding are connected to the reference potential of the installation.

6 Connecting

WARNING
Intrusion of liquids or foreign bodies through leaking connections
Danger to life due to failure of the safety function

- Tighten M12 male connectors with a tightening torque of 0.8 Nm.
- Only use accessories that guarantee the degree of protection (IP65, IP67, IP69K).
- Close unused M12 connectors with the supplied screw caps. The tightening torque for the screw caps is 0.5 Nm.

6.1 Connecting a 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 there is no potentially explosive atmosphere or when the power supply is switched off.
- Only use connecting cables that are approved for use in potentially explosive atmospheres.
- Use all connectors or seal them with 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 M12 connectors

- When connecting the cables to the M12-connectors, use the torque screwdriver mentioned below.

Fig. 10: Torque screwdriver

Description	Type	ID
Torque screwdriver, torque range 0.4…1.0 Nm ▪ M8 (SW9) ▪ M12 for bus cables (SW13) ▪ M12 for sensor cables (SW14)	Torque-Wrench-Set Turck Line + BUS	6936171

6.3 Connecting the device to Ethernet

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

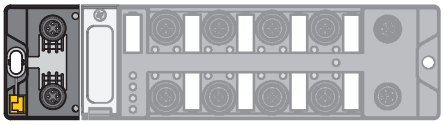


Fig. 11: M12 Ethernet connector

- Connect the device to Ethernet according to the pin assignment below.
- Provide unused male connectors with suitable sealing or blanking caps. The tightening torque for the M4 screws is 0.5 Nm.

Fig. 12: Pin assignment Ethernet connectors

6.4 Connecting the power supply

NOTE
The device is supplied via V1. V2 is only fed through.

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 0.8 Nm.

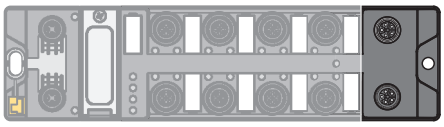


Fig. 13: M12 connector for connecting the supply voltage

- ▶ Connect the device to the power supply according to the pin assignment shown below.
- ▶ Close unused plug connectors with a suitable sealing cap (VS-M12-PWR, ID 100034822). The tightening torque for the screw caps is 0.5 Nm.

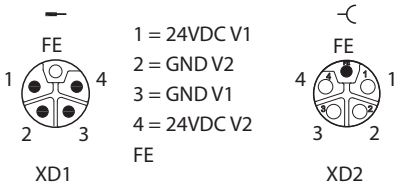


Fig. 14: Pin assignment power supply connectors

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

6.4.1 24 V supply (SELV/PELV)

WARNING
Use of incorrect or defective power supply unit
Danger to life due to dangerous voltages on touchable parts
- ▶ Only use for SELV or PELV power supplies in accordance with EN ISO 13849-2, which allow a maximum of 60 VDC or 25 VAC in the event of a fault.

External supply of sensors and actuators

Sensors and actuators with external power supply can also be connected to the device. The use of PELV power supplies must also be guaranteed for externally supplied sensors and actuators.

Decoupling of external electrical circuits

Decouple circuits that are not designed as SELV or PELV systems by means of optocouplers, or other measures.

WARNING
Potential differences
Dangerous additions of voltages

- ▶ Avoid potential differences between internal and external load voltage supplies (24 VDC).

6.5 Connecting safe sensors and actuators

NOTE
We recommend pre-assembled 5-pin sensor cables. Suitable cables can be found on www.turck.com.

DANGER
Wrong supply of sensors and actuators
Danger to life due to external supply
- ▶ Exclude external supply.
- ▶ Guarantee that the inputs are only supplied through the same 24 V source as the device itself.

The device has M12 connectors for connecting safe sensors and actuators. eight The maximum tightening torque is 0.6 Nm.

Safety inputs (FDI)

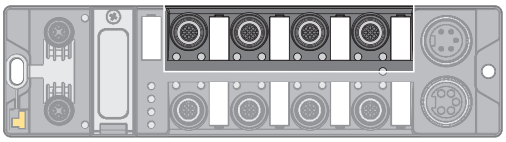


Fig. 15: M12 connector, safety inputs (FDI)

- ▶ Connect the sensors to the device according to the pin assignment.
- ▶ Provide unused male connectors with suitable sealing or blanking caps. The tightening torque for the M4 screws is 0.5 Nm.

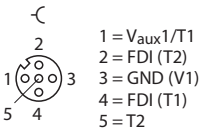


Fig. 16: Pin assignment FDI at X0…X3

Signal	Meaning
VAUX1/T1	Sensor supply/test pulse 1
FDI (T2)	Digital input 2
GND (V1)	Ground V1
FDI (T1)	Digital input 1
T2	Test pulse 2
FE	FE is connected to the thread of the M12 connector.

Safety in- and output (FDX)

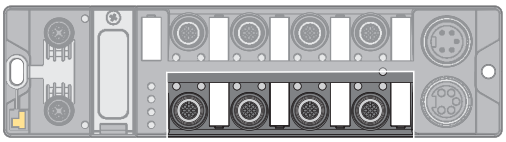


Fig. 17: M12 connector, safety in-/outputs (FDX)

- ▶ Connect the sensors and actuators to the device according to the pin assignment.
- ▶ Provide unused male connectors with suitable sealing or blanking caps. The tightening torque for the M4 screws is 0.5 Nm.

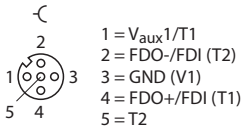


Fig. 18: Pin assignment FDX at X4…X7

Signal	Meaning
VAUX1/T1	Sensor supply/test pulse 1
FDO-/FDI (T2)	Digital output (M)/digital input 2
GND (V1)	Ground V1
FDO+/FDI (T1)	Digital output (P)/digital input 1
T2	Test pulse 2
FE	FE is connected to the thread of the M12 connector.

DANGER
Connection of fast reacting loads
Danger to life due to connection failures
- ▶ Use loads with mechanical or electrical inertia. Positive and negative test pulses have to be tolerated.

7 Commissioning

7.1 Initial commissioning

7.1.1 Mounting and electrical installation

- IP address at the device [▶ 26].
- Please assure the proper closing of the protective cover over the rotary coding switches [▶ 26].
- Install the device according to the instructions [▶ 14].
- Connect the Ethernet cables according o the instructions [▶ 19].
- Connect the power supply according to the instructions [▶ 20].
- Wire inputs and outputs depending on their application [▶ 22], Schaltungsbeispiele.
- Seal unused connectors with the respective protection caps [▶ 18].

Connecting the supply voltage

- Before the operating voltage is applied, assure that:
  - no wiring or grounding errors exist
  - a safe grounding of the device or of the application is guaranteed
- Connecting the supply voltage
- After the supply voltage is applied, check if all supply voltages as well as the output voltage are in the permitted range.
- Check if the device works properly or if errors are displayed by controlling the diagnostics an status displays.

7.1.2 Configuring in Turck Safety Configurator

- Configure the Safe Link network in Turck Safety Configurator [▶ 31].

7.1.3 Commissioning the device at the PLC

- Configure the device in the PLC.
- Configure the device in the configuration software.
- Load parameterization and configuration data via the PLC into the device.
- Execute a functional test.
- Check if the device works according to the configuration and if all safety functions react as experted.

7.2 Safety planning

The operator is responsible for the safety planning.

7.2.1 Prerequisites

- Perform a hazard and risk analysis.
- Develop a safety concept for the machine or plant.
- Calculate the safety integrity for the complete machine or plant.
- Validate the complete system.

7.2.2 Reaction time

If the device is operated with higher availability, the max. reaction time is extended (see "Safety Characteristic Data" [▶ 25]).

In addition to the reaction time in the device, any reaction times of other safety components in the system must also be taken into account. Please find the respective information in the technical data of the respective devices.

7.2.3 Safety characteristic data

Characteristic data	Value	Standard
Performance Level (PL)	e	EN/ISO 13849-1:2015
Safety category	4	
$MTTF_D$	> 100 years (high)	
Permissible duration of use (TM)	20 years	
DC	99 %	
SIL (Safety Integrity Level)	3	EN 61508
PFH	3.85×10^{-9} 1/h	
Maximum on-time	12 months	
SIL CL	3	EN 62061:2005+ Cor.:2010+A1:2013+A2:2015
PFH_D	5.08×10^{-9} 1/h	
SFF	98.22 %	

Max. reaction time in case of shutdown	Value	Standard
Turck Safe Link > local output	The values are calculated in the Turck Safety Configurator depending on the application and specified in the validation protocol	EN 61508
Local input > Turck Safe Link		
Local input <> local output	35 ms	

7.3 Addressing

TBEN-L…-4FDI-4FDX is a multi-protocol device. As with all multi-protocol devices, the network settings can be adjusted depending on the operating mode via three decimal rotary coding switches on the device (last byte of the IP address only), via the web server, the Turck Service Tool or the Turck Automation Suite (TAS). For more detailed information on configuring the network settings and the operating mode, please refer to the user manual at www.turck.com (100047771).

Setting the IP Address via rotary coding switches

- ▶ Open the cover above the switches.
- ▶ Set the last byte of the IP address via the three rotary coding switches under the cover at the device.
- ▶ Execute a power cycle.

DANGER
Intrusion of liquids or foreign bodies through open cover
Danger to life due to failure of the safety function
- ▶ Tightly close the cover above the switches.

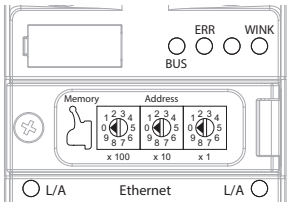


Fig. 19: Rotary coding switches at the device

In the delivery state, the rotary switches are set to 600 (0 - 0 - 0). Address 000 and addresses ≥ 900 are not valid F addresses.

Switch position	Mode	Description
000	Network reset	The Network reset resets the following the 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 gateway. The other network settings are stored in the non-volatile memory of the gateway 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 gateway.

Switch position	Mode	Description
400	DHCP	In DHCP mode, the network settings are automatically assigned 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 gateway, 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 complete network settings can be assigned manually via TAS (Turck Automation Suite), the DTM or a web server. The data are stored non-volatile in the device.
600	PGM-DHCP	In PGM-DHCP mode, the device is initially a DHCP client and sends DHCP requests until it is assigned a fixed IP address. The DHCP client is automatically deactivated as soon as the device has received an IP address via TAS (Turck Automation Suite), the DTM or the web server. The data are stored non-volatile in the device. In PROFINET: If a DHCP server is used in the network, problems may occur when assigning the IP address, as in this case both the DHCP server and the PROFINET controller (via DCP) attempt to assign the IP address.
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
901	Erase memory:	Deletes the content of the configuration memory
	Safe Link	Teaching-in the network for device replacement (without Turck Safety Configurator TSC), number of TBEN-modules, which are read-in:
921		1 module
922		2 modules
923		3 modules
924		4 modules

NOTE
Turck recommends setting the last byte of the IP address via the rotary coding switches before configuring the safety function of the devices in the Turck Safety Configurator.

Addressing the devices in Safe Link

The Safe Link node address is assigned in Turck Safety Configurator. Up to 31 Safe Link modules can communicate safely with each other via Turck Safe Link, whereby one of the modules is defined as a Turck Safe Link manager in the safety configuration in the Turck Safety Configurator.

7.4 Installing and licensing the Turck Safety Configurator (TSC)

7.4.1 Downloading the software

NOTE
A coupon code is required to download the software. The coupon code can be requested from Turck customer service. Further information can be found on the product page of the software.

▶ Enter the code.

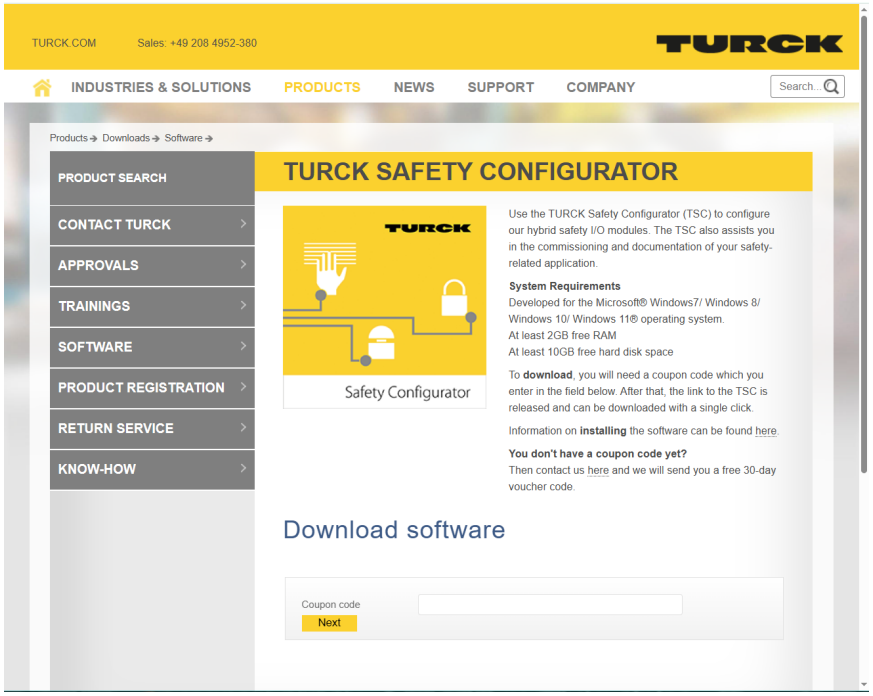


Fig. 20: Turck Safety Configurator: Entering the coupon code

▶ Download the software. Turck recommends to always use the latest software.

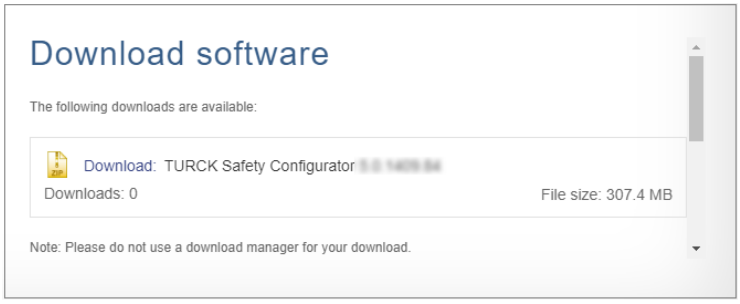


Fig. 21: Turck Safety Configurator: download

▶ Unpack the zip archive and install Turck Safety Configurator.

7.4.2 Installing the Software

Prerequisites:

- The software was downloaded.
- The zip archive was unpacked.

▶ Execute the installation file "install.exe", select the installation language and click **Next**.
▶ Select your country, agree to the license terms, and click **Next**.
▶ If you want to remove an already installed version of the software during the installation process: check the version you want to uninstall and click **Next**.
▶ Select **Standard installation** or **Virtual machine** and click **Next**.

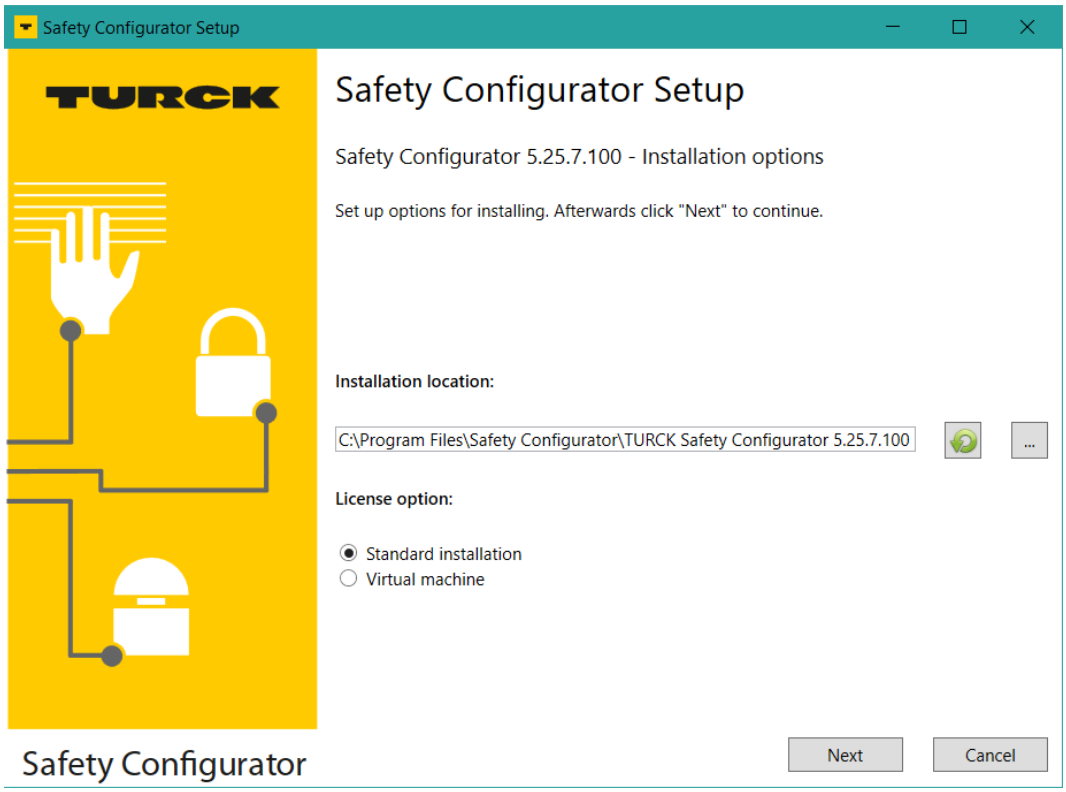


Fig. 22: License options

NOTE
The document "Installation and Licensing" (ID 100048623) contains further information on the licensing model and license management in the Turck Safety Configurator.

▶ Define the scope of installation, click **Next**, and start the installation.

After successful installation, the Turck Safety Configurator can be started and licensed.

7.4.3 Licensing the Software

The license must be activated when the Turck Safety Configurator is started for the first time after installation.

- ▶ Start the Turck Safety Configurator.
- ▶ Confirm the following dialog with **Yes**.

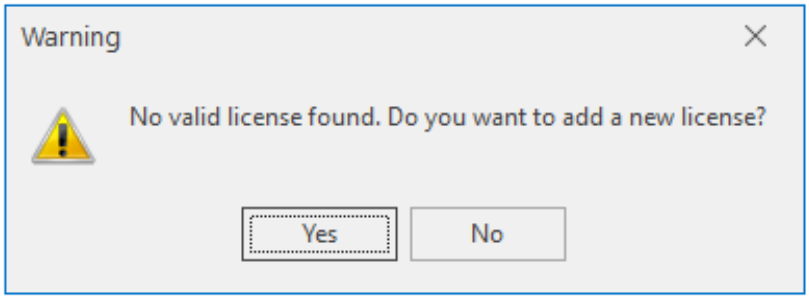


Fig. 23: Dialog box: no valid license found

- ▶ Add the coupon code in the **Add new license** window.

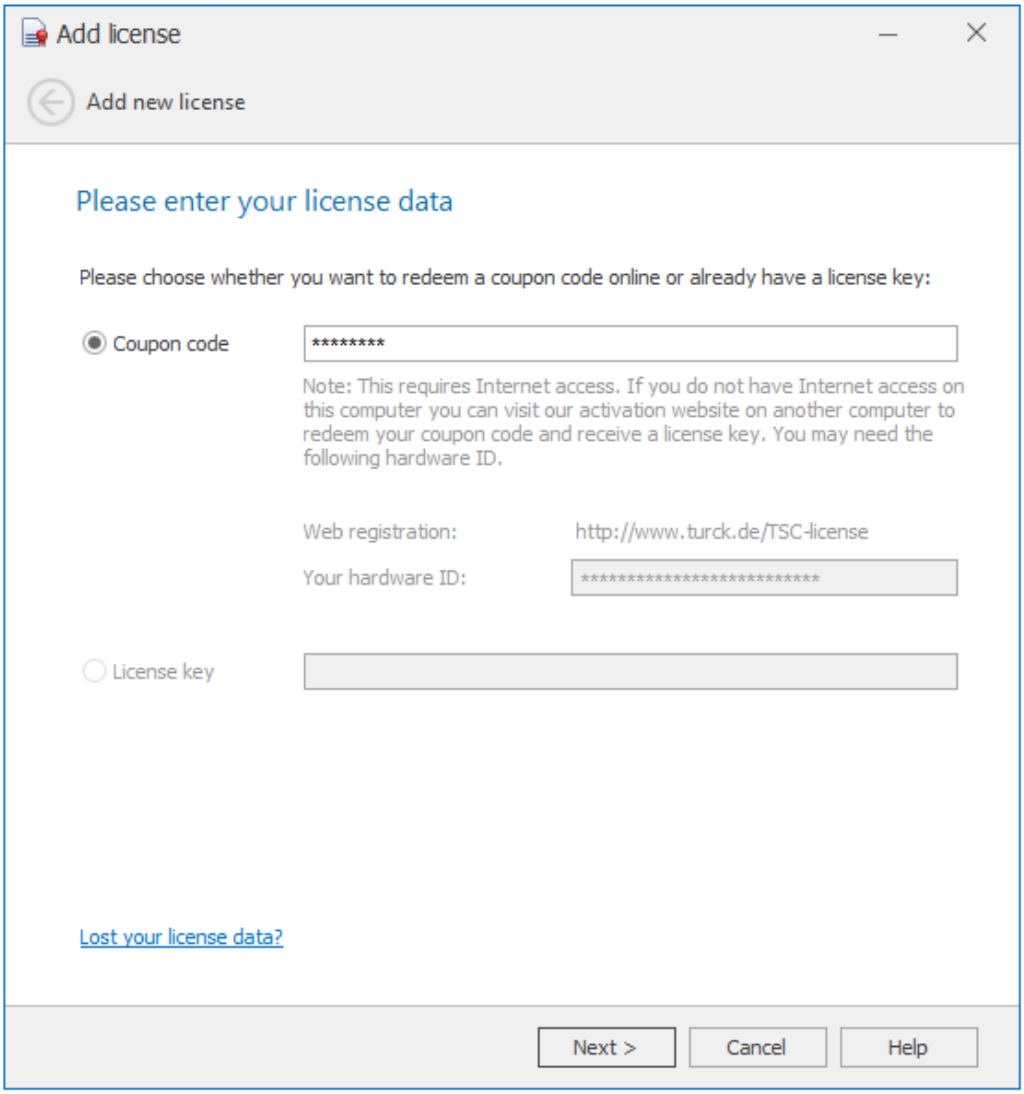


Fig. 24: Entering the coupon code

7.5 TSC: Creating a configuration and loading it into the devices

- ▶ Start the software.
- ⇨ Turck Safety Configurator starts with the Start assistant, which will lead through the first steps after program start.

7.5.1 Creating a new workspace

- ▶ In the start assistant, select option **New workspace**, enter a name and a storage location and create the new workspace with **Create and open hardware configuration**.

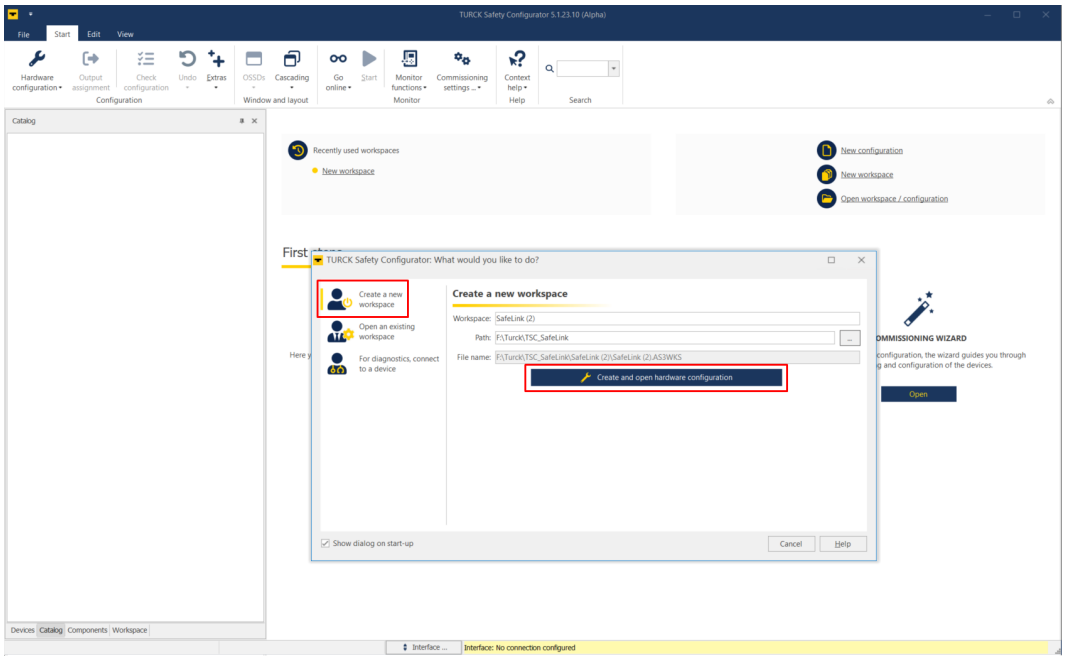


Fig. 25: Creating a new workspace

- ⇨ The new workspace is created.

7.5.2 Define the Safe Link manager and create the basic configuration

Turck uses the terms "Safe Link manager" and "Safe Link device". The following description only uses the term "master" due to the naming in the Turck Safety.

- ▶ Under **Select master**, select the TBEN-LL-4FDI-4FDX and confirm with **OK**.

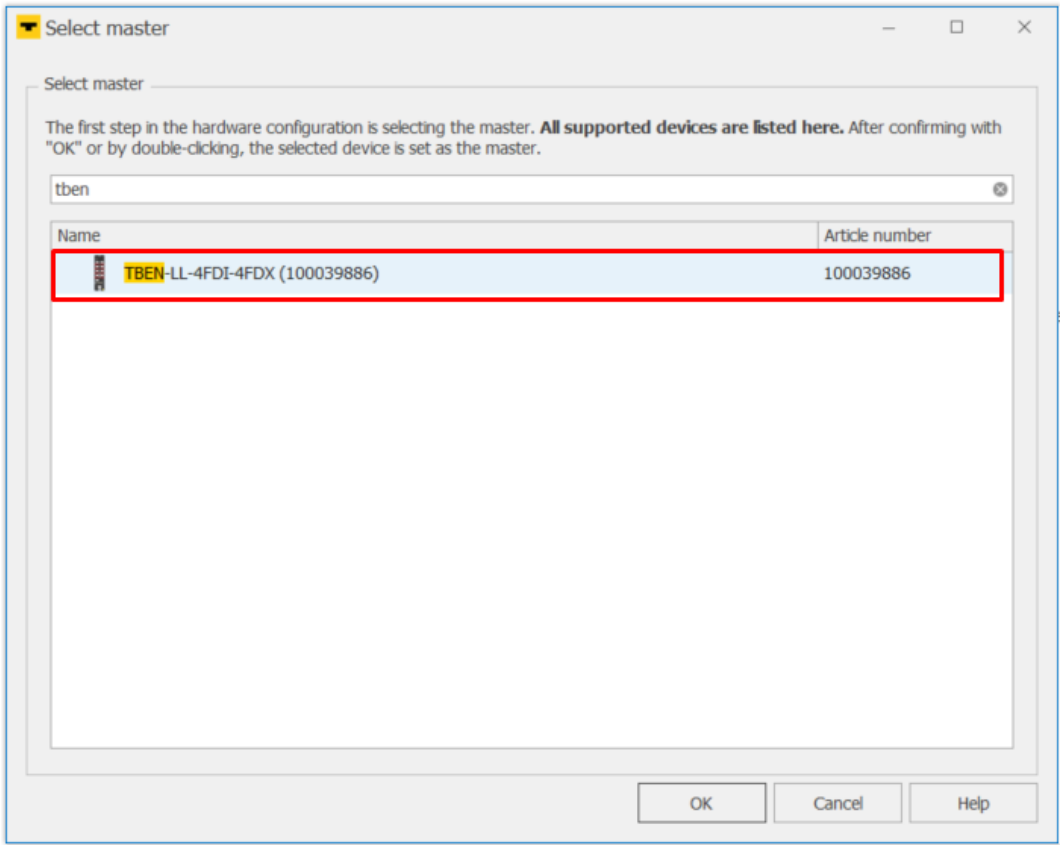


Fig. 26: Selecting a Safe Link manager (master)

➪ The **Properties window – TBEN-LL-4FDI-4FDX** is opened.

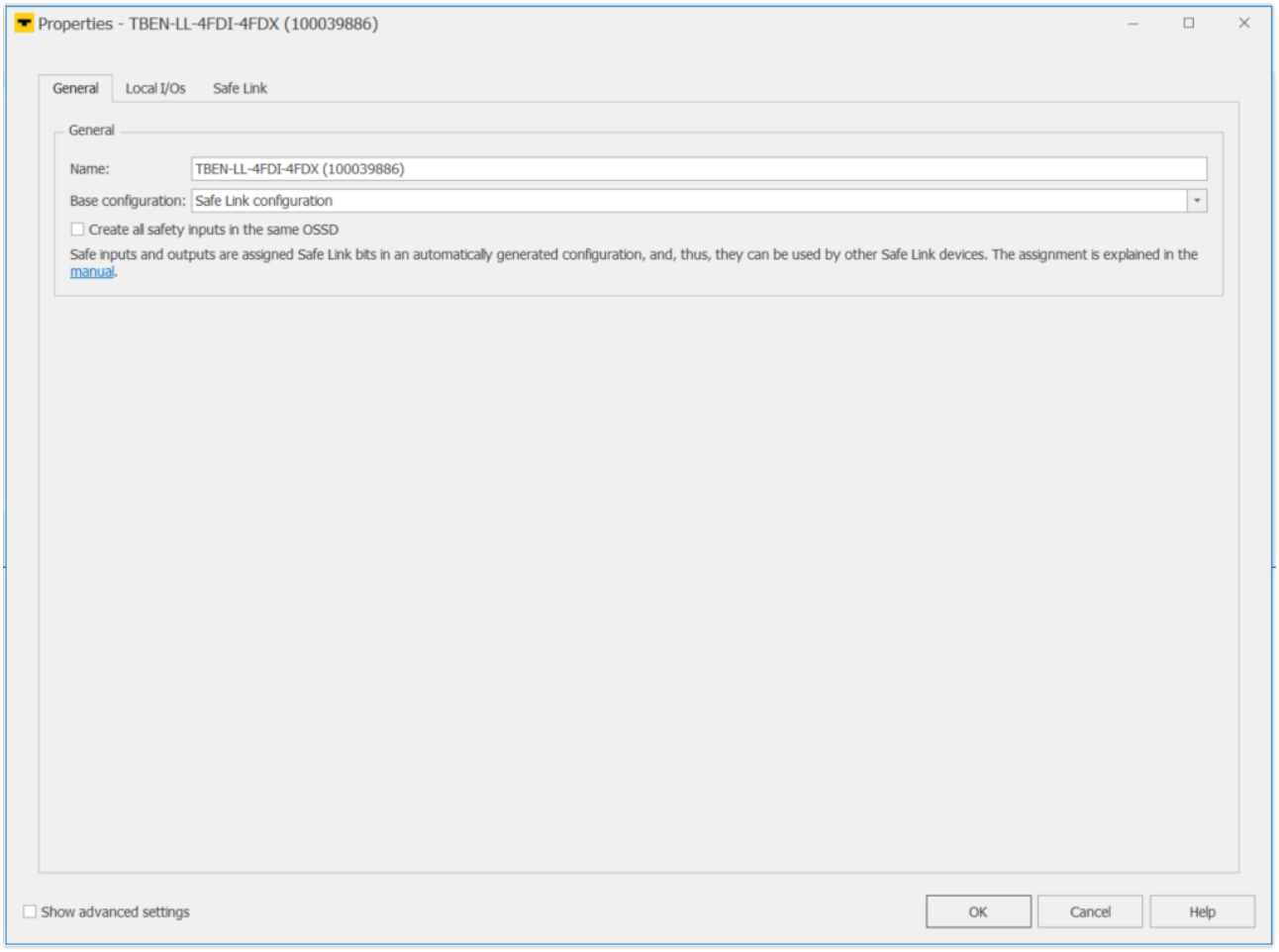


Fig. 27: Properties

Address assignment for the Safe Link manager (master)

The Safe Link address is assigned in the **Safe Link** tab.

- ▶ TBEN-LL-4FDI-4FDX as manager and set the device address.

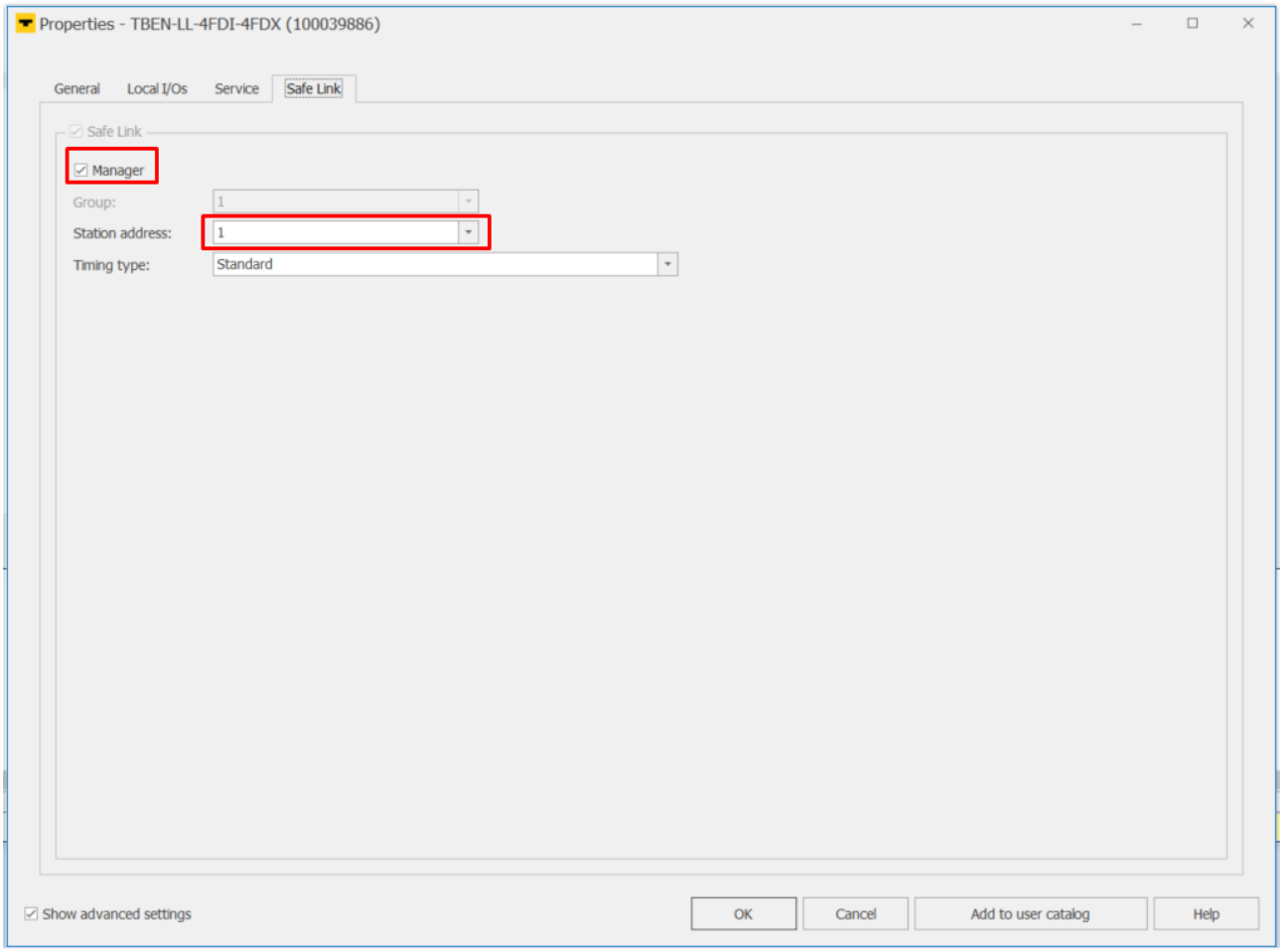


Fig. 28: Address assignment for the Safe Link manager

Configuring local I/Os

In the register tab **Local I/Os**, the safe slots of the TBEN-LL-4FDI-4FDX are configured.

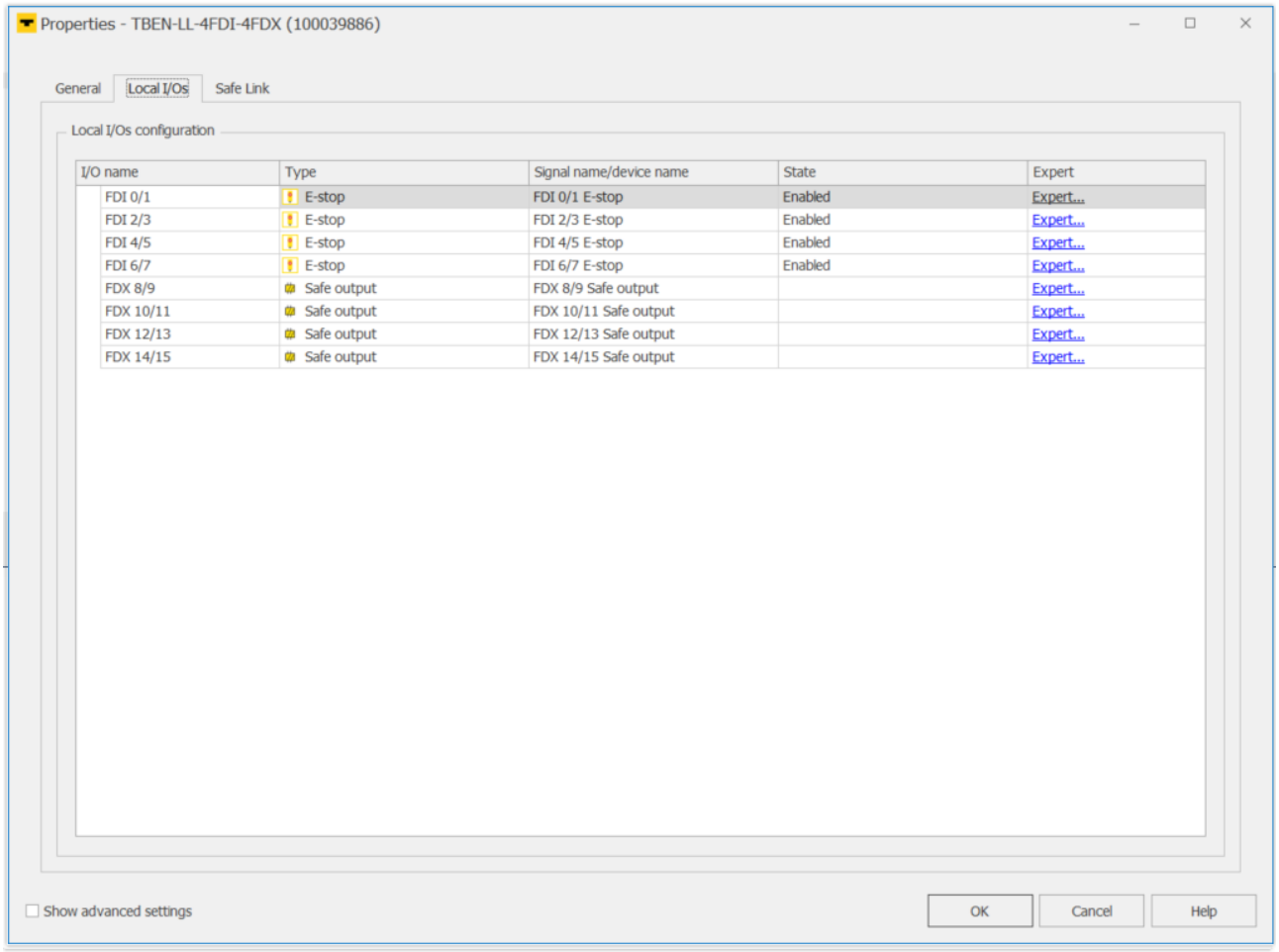


Fig. 29: Local I/Os in TSC

Basic configuration

NOTE
The basic configuration for the Safe Link manager needs to be adapted for the Safe Link manager (s. TSC: Safe Link application example [▶ 49]). For the Safe Link devices, the configuration can initially be adopted as it is and later adapted depending on the application.

In the basic configuration, the safe inputs (FDI) at C0…C3 are defined as double channel forced, safe inputs (dry contact). The safe in-/outputs (FDX) at C4…C7 are configured as safe outputs according to PLe.

Channel	Type designation	I/O name	Device name
FDI0/1	E-stop	Safe input (dry contact)	Double channel forced
FDI2/3	E-stop	Safe input (dry contact)	Double channel forced
FDI4/5	E-stop	Safe input (dry contact)	Double channel forced
FDI6/7	E-stop	Safe input (dry contact)	Double channel forced
FDX8/9	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FDX10/11	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FDX12/13	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FDX14/15	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)

▶ Complete the configuration with **OK**.
⇨ The basic configuration is applied.
⇨ The release circuits of the basic configuration are automatically created.

Release circuits (OSSDs) of the basic configuration

In the basic configuration, the release circuits OSSD1…OSSD4 and OSSD61…OSSD64 are predefined as follows:

Release circuit (OSSD)	Channels
OSSD 1	FDX8/9
OSSD 2	FDX10/11
OSSD 3	FDX12/13
OSSD 4	FDX14/15
OSSD 29	FDI6/7
OSSD 30	FDI4/5
OSSD 31	FDI2/3
OSSD 32	FDI0/1

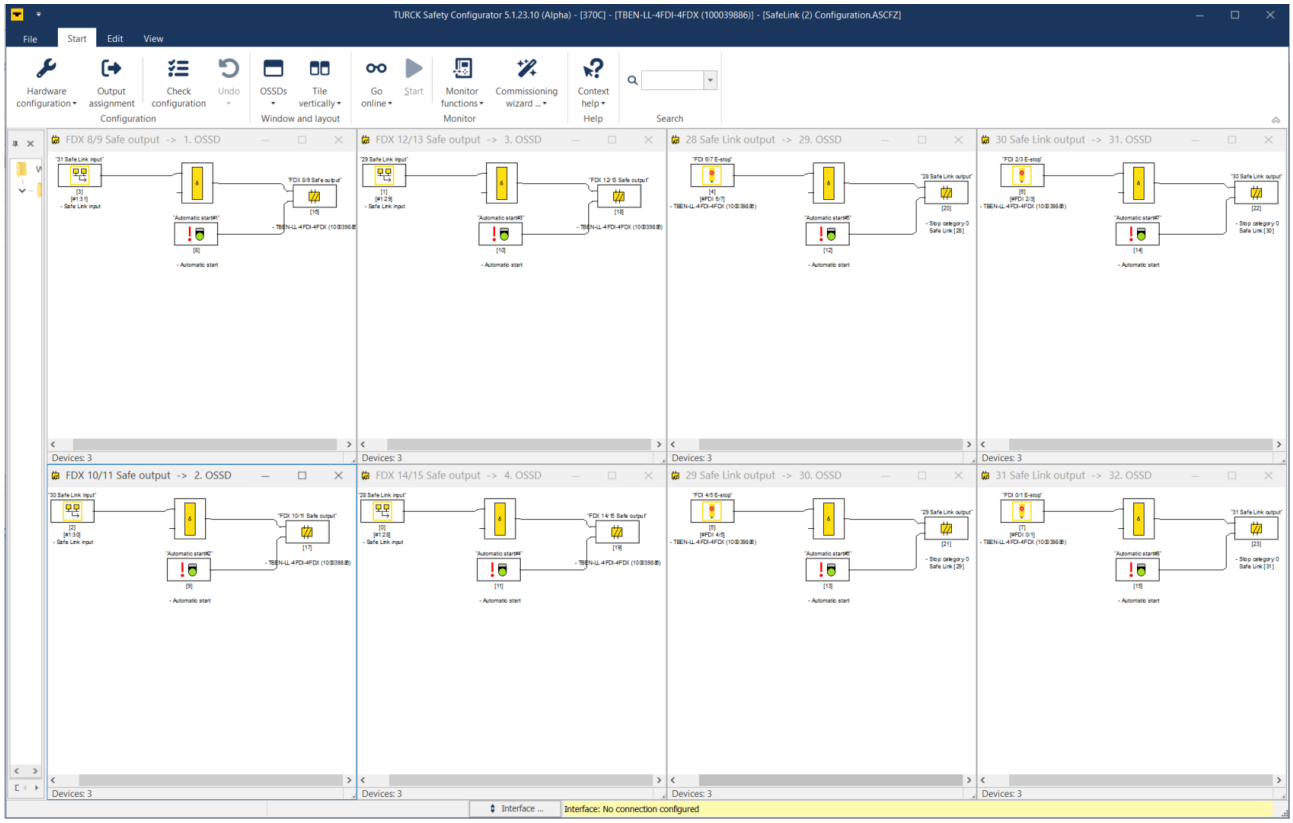


Fig. 30: Release circuits (OSSDs) of the basic configuration

7.5.3 Adapt the configuration of the safe channels to the application

The configuration of the safe channels can also be adapted to the application afterwards.

- ▶ Select the configuration of the device to be changed and open the **hardware configuration**.

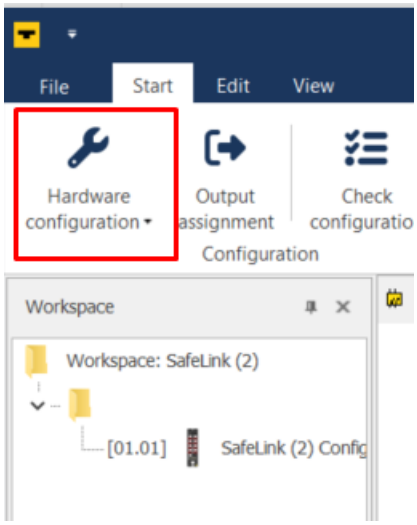


Fig. 31: Opening the hardware configuration

Adapt the channels of the TBEN-LL-4FDI-4FDX in the **Local I/Os** tab → to the requirements of the respective applications.

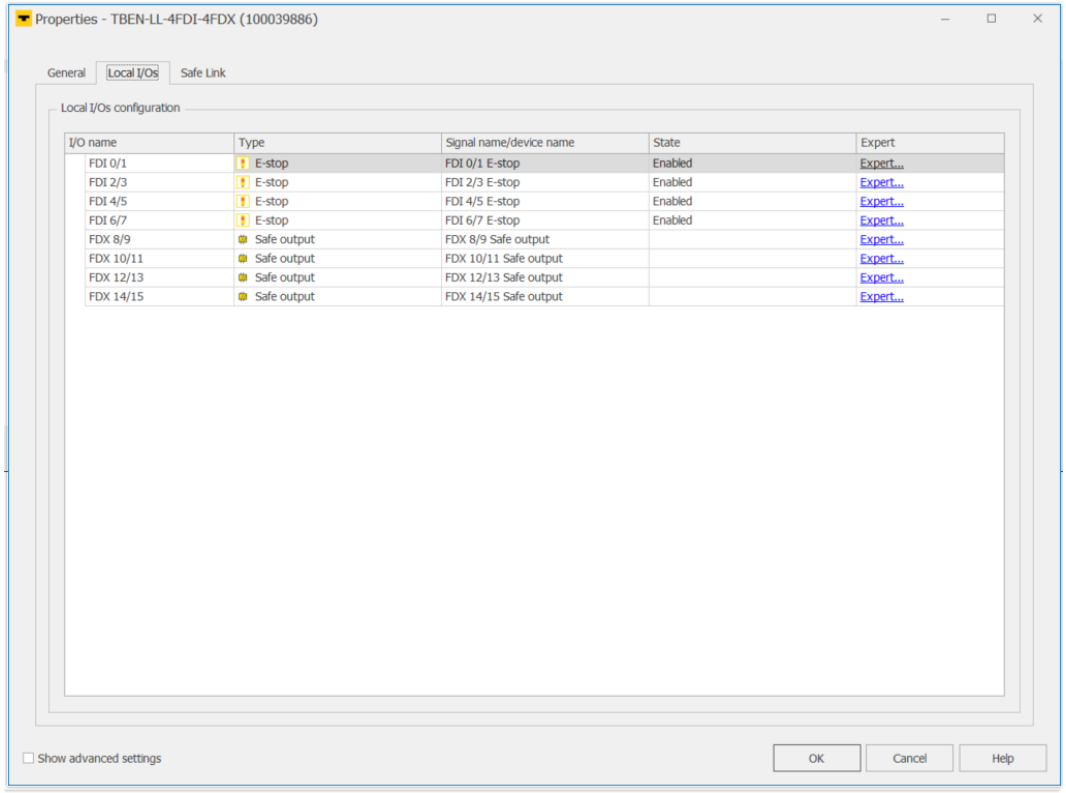


Fig. 32: Configuration of the local I/Os

Clicking **Expert** opens the expert settings for In- and outputs.

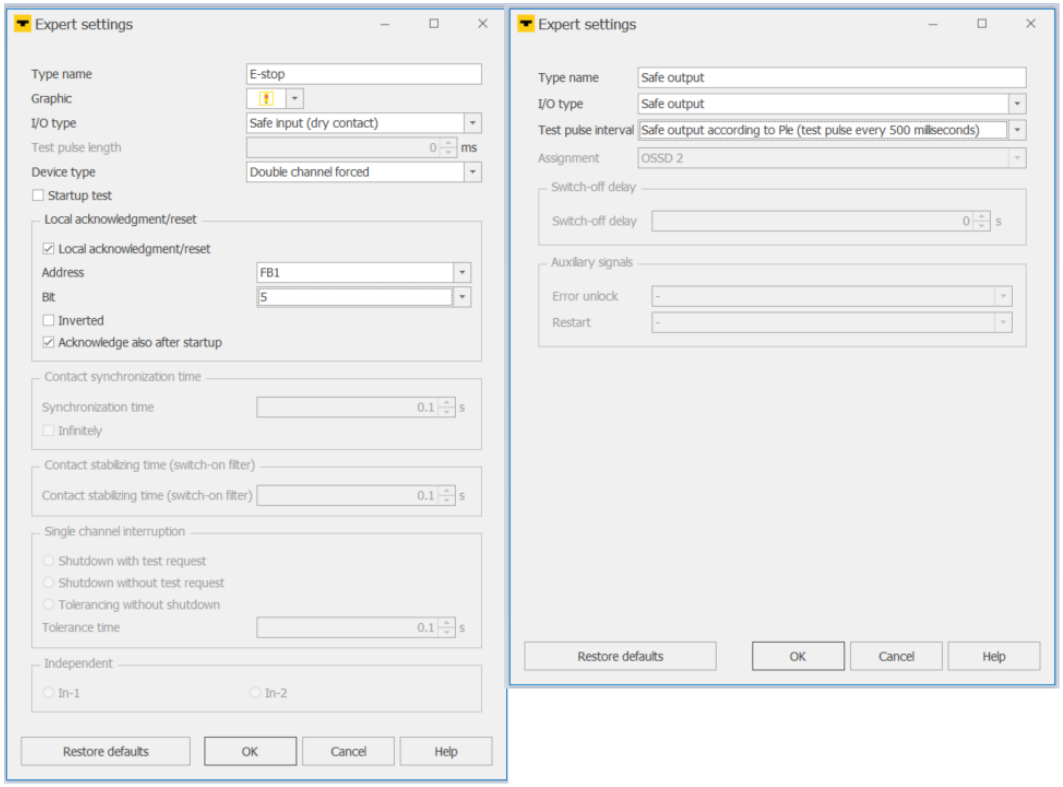


Fig. 33: Expert settings of the I/Os

NOTE
The description of the functions is part of the online help of the Turck Safety Configurator.

Advanced settings – Global error unlock

If the **Advanced settings** are activated, a fieldbus bit for a global error unlock of the device can be configured in the **Service** tab.

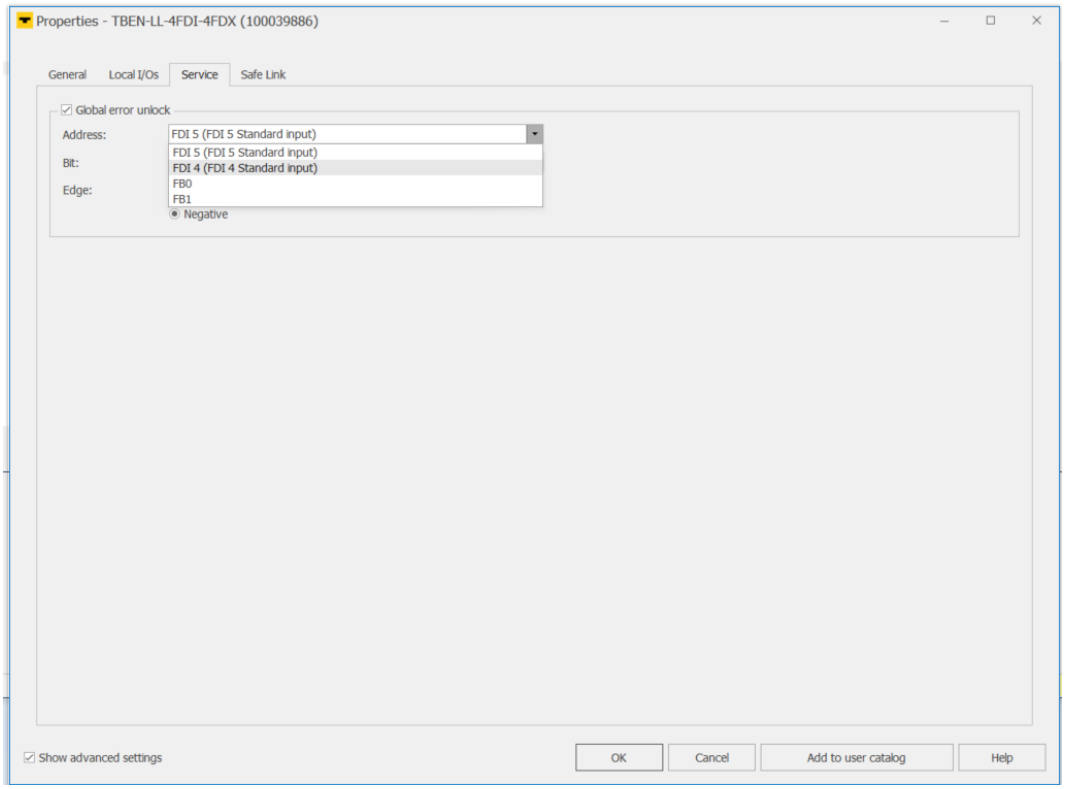


Fig. 34: TSC – Advanced settings, global error unlock

- ▶ Set the global error unlock and close the Properties dialog with **OK**.

NOTE
The global error unlock can also be executed via the process data bit "UNLK" in the device process output data Process output data.

Complete the hardware configuration in the start assistant

- ▶ Close the dialog box **hardware configuration** with **OK**.
- ⇨ The release circuits for the hardware configuration (example configuration) are created.

7.5.4 Adding Safe Link devices

The Safe Link manager can control up to 31 Safe Link devices. Adding a Safe Link device configuration to the Safe Link network is described below. All other Safe Link devices are configured accordingly.

- In the workspace, right-click on the Safe Link manager configuration and open the device selection window via **New configuration**.

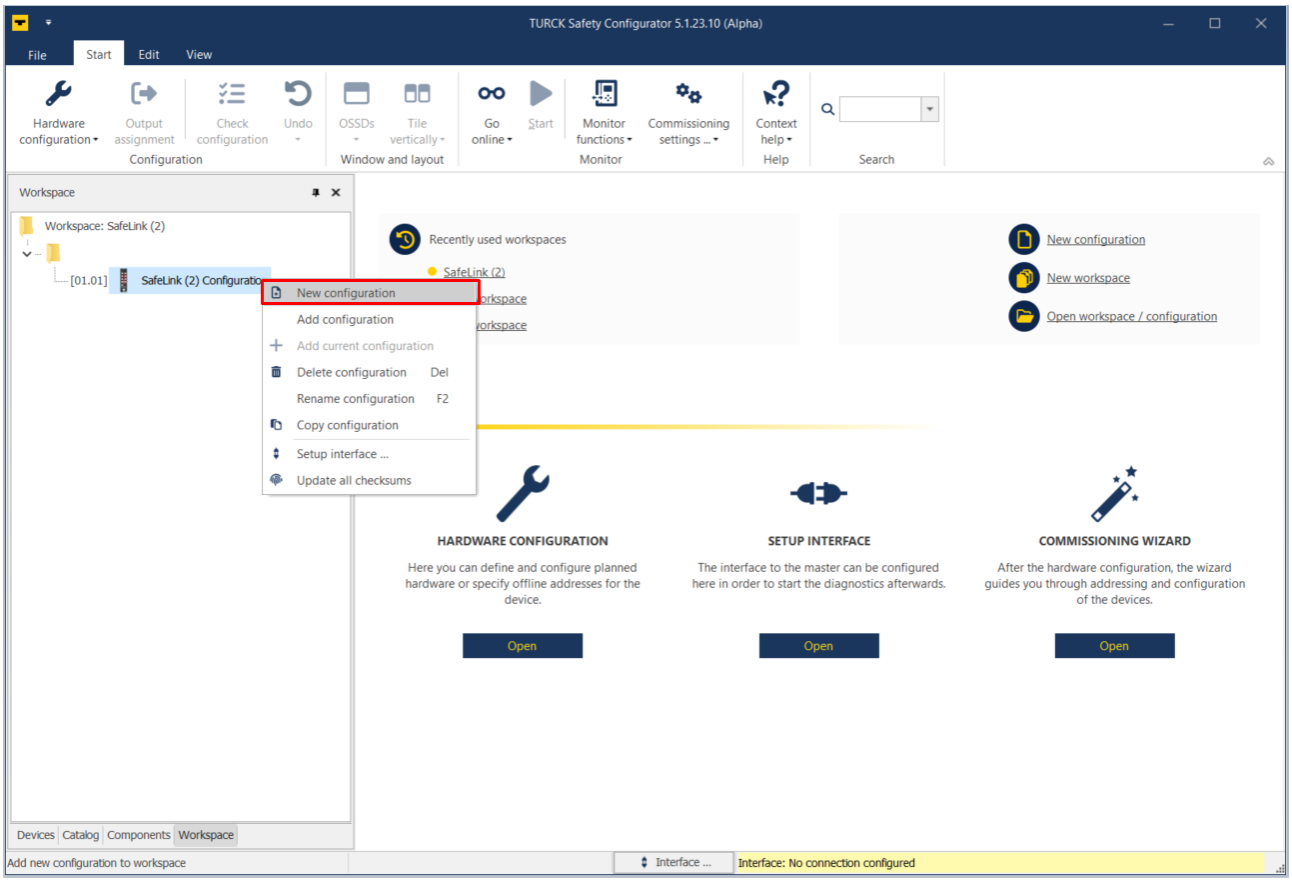


Fig. 35: Adding a new configuration for Safe Link device to the workspace

- Select the TBEN-LL-4FDI-4FDX in the subsequent **Select master** window.
- The configuration of the local I/Os corresponds to the basic configuration [▶ 36], the Safe Link device address is assigned automatically. [▶ 36]

- Optional: Configure **Local I/Os** according to the application (see **Adapting the configuration of the safe channels to the application** [▶ 38]) and assign the device address for the device under **Safe Link**.

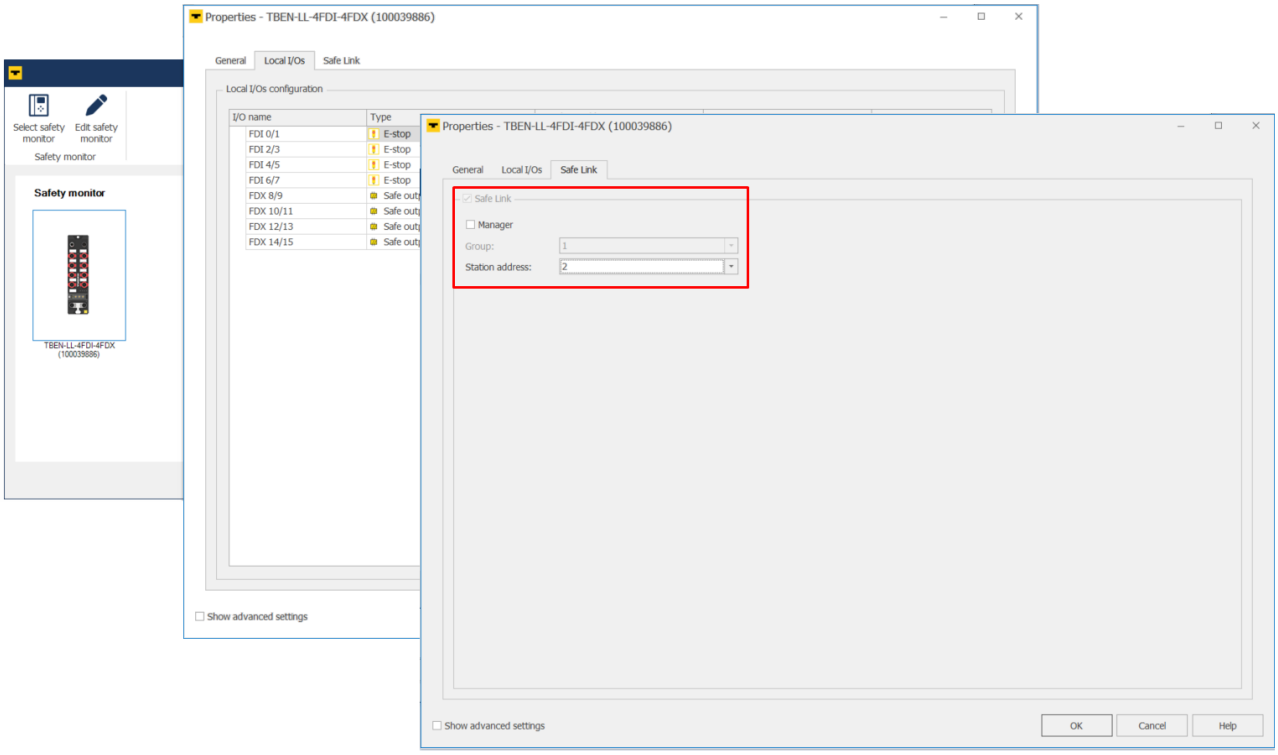


Fig. 36: Configuring Safe Link devices

➪ The new configuration of the Safe Link device is saved and the device is added to the workspace.

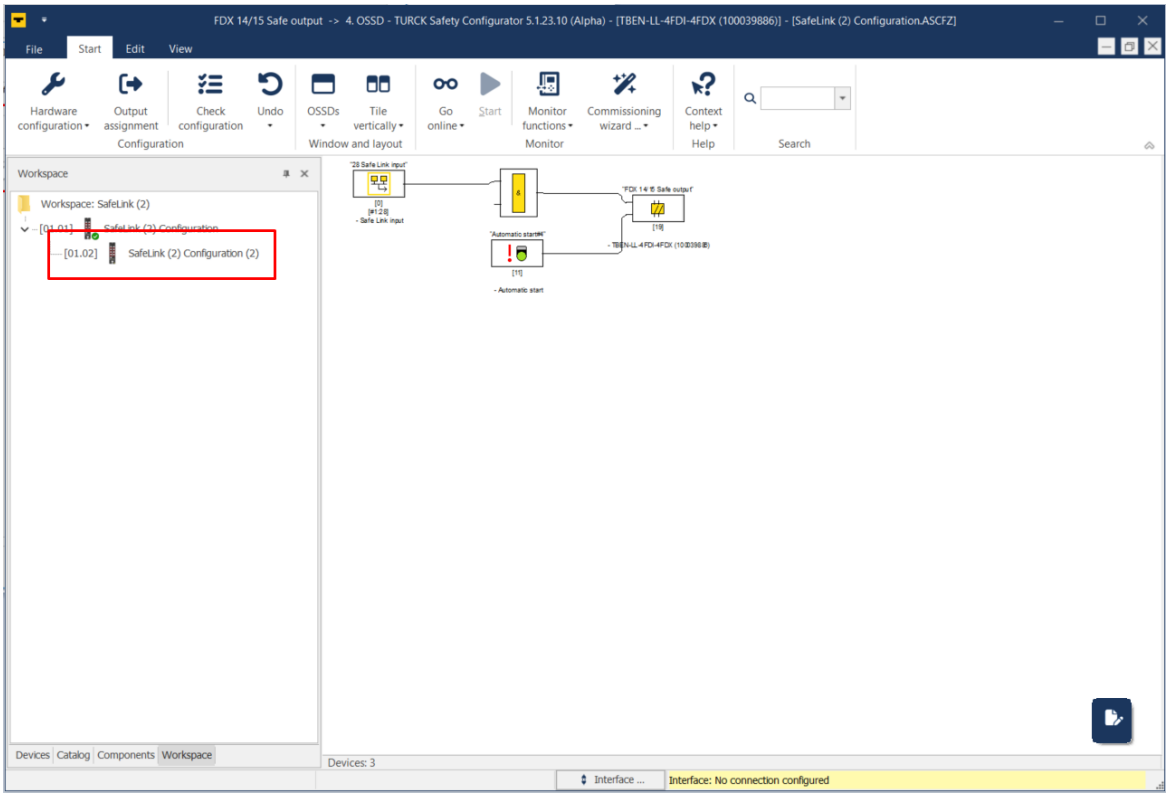


Fig. 37: Safe Link device in workspace

7.5.5 Assigning IP addresses to the safe Link devices

- Right-click on the devices one after the other and click on **Set interface**.

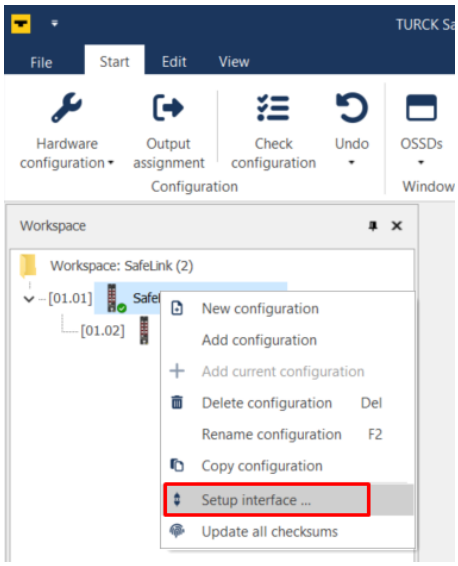


Fig. 38: Setting the interface

- Set the IP address of the devices according to the rotary coding switch position on the device.

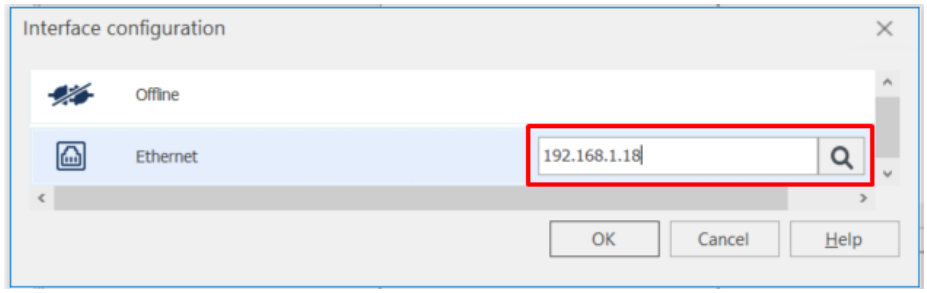


Fig. 39: Setting the IP address at the device

If the IP addresses of the devices are not known, the network can be searched for available devices using the search button.

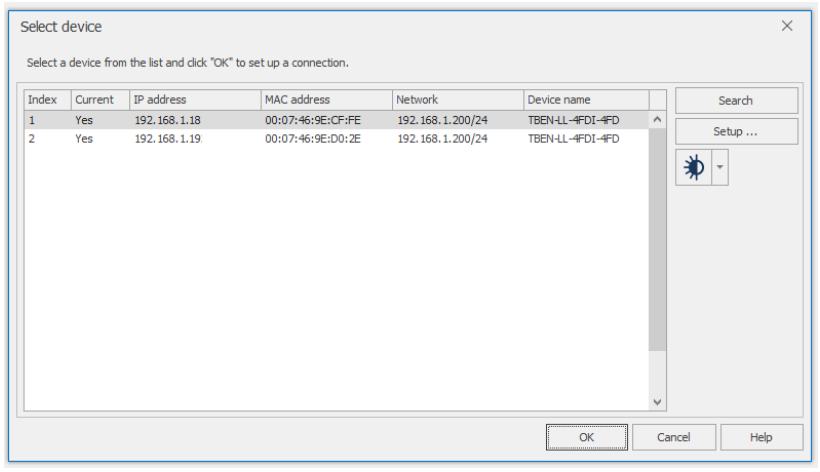


Fig. 40: Devices in the network

7.5.6 Load Safe Link configuration into the devices

- Start the commissioning wizard and click **Next >**.

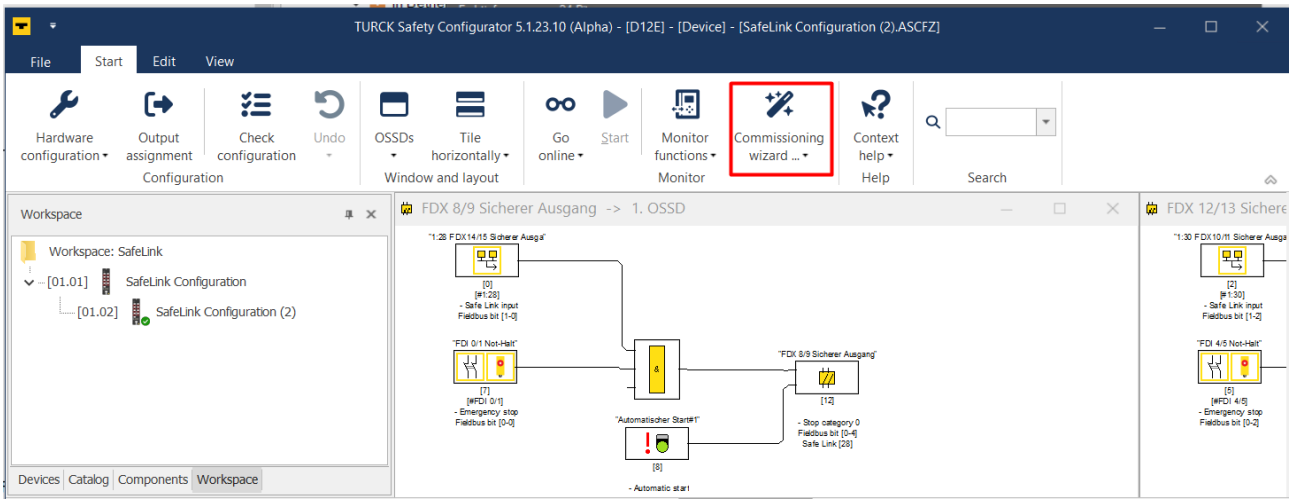


Fig. 41: TSC – starting the commissioning wizard

- In the dialog **Commissioning wizard settings**, enter the **Name of the validator** and the **Password for safety monitors (release password)** and confirm with **OK**.

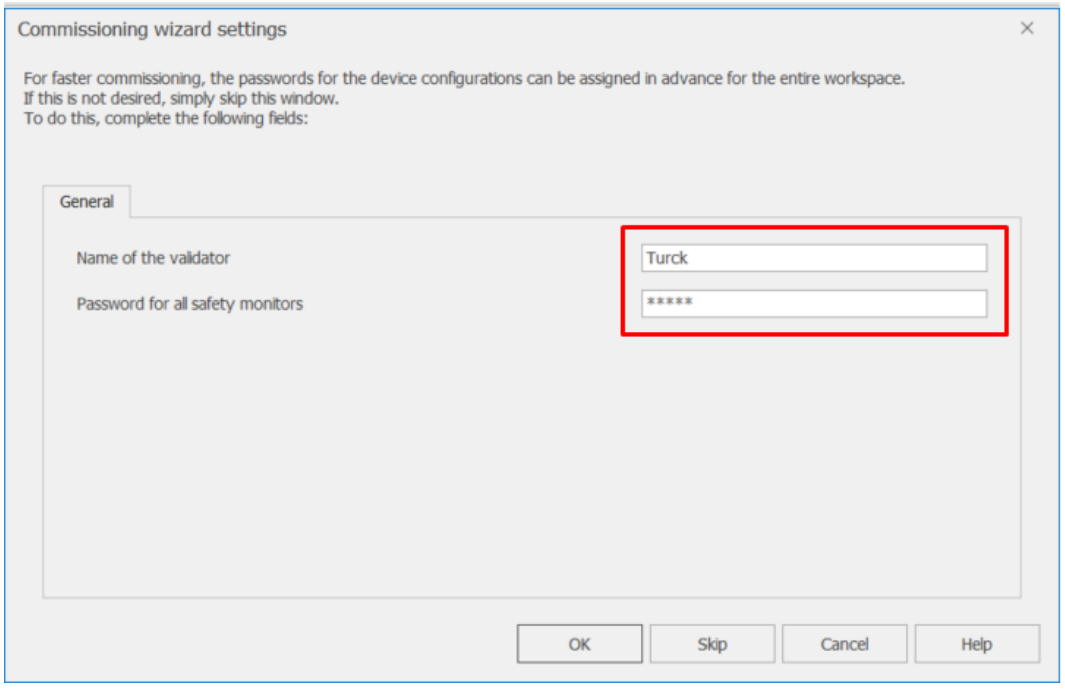
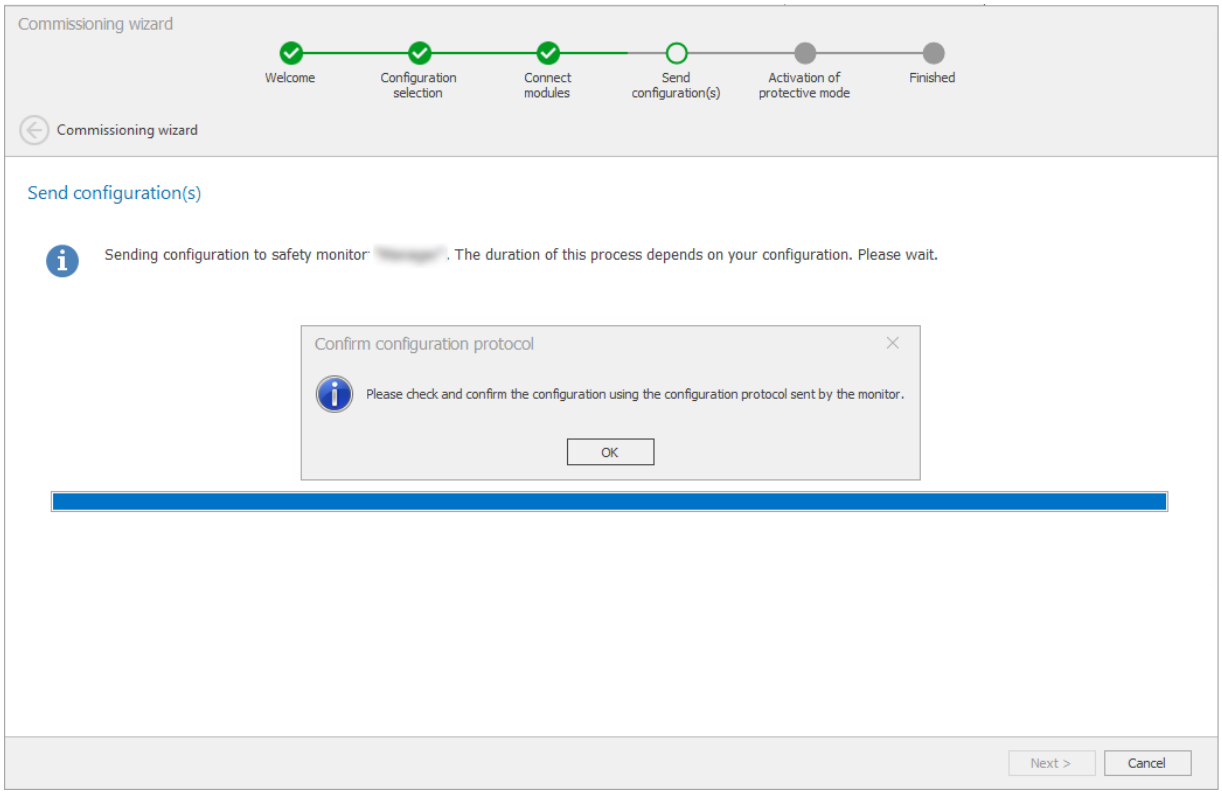


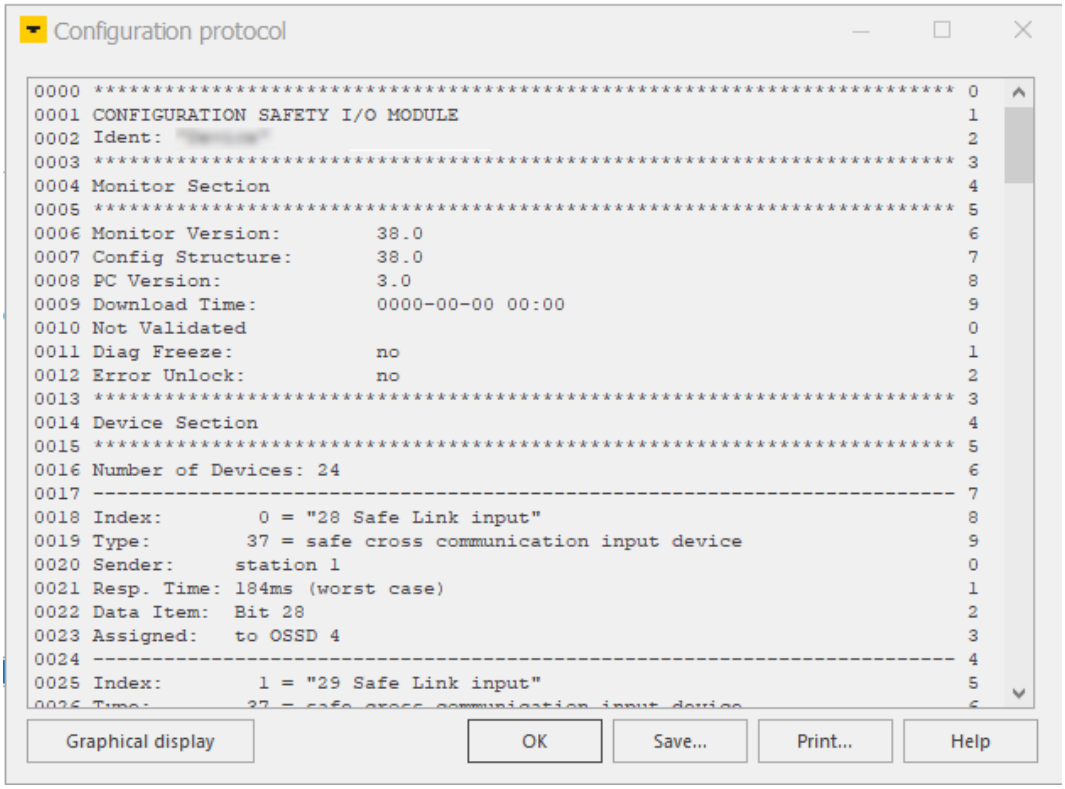
Fig. 42: TSC – Commissioning wizard, assigning a password

➪ The first connected is prepared for the configuration download.



➪ The configuration is sent to the first device.

➪ The configuration log for the first device is created.



▶ Check and release the configuration using the configuration log.

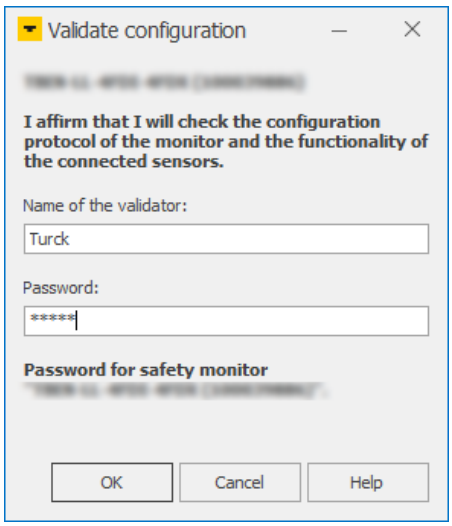


Fig. 43: Release configuration

➪ All devices in the network are then configured. The software generates a configuration log for each device, which must be released by the user.

After restarting the Safe Link manager, the network is taught in. All participants in the network and their configuration are then stored in the Safe Link manager.

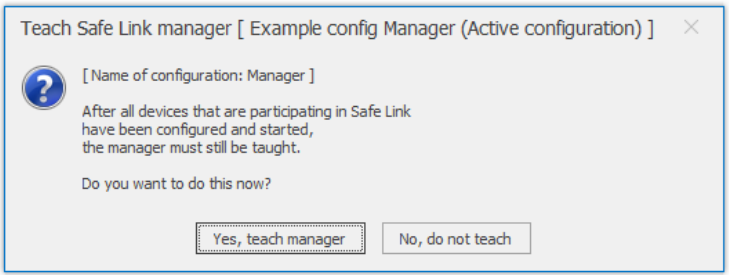


Fig. 44: Teaching in the Safe Link manager

▶ Click **Yes, teach manager** and load the configuration of the Safe Link devices via **Start teach** into the Safe Link manager.

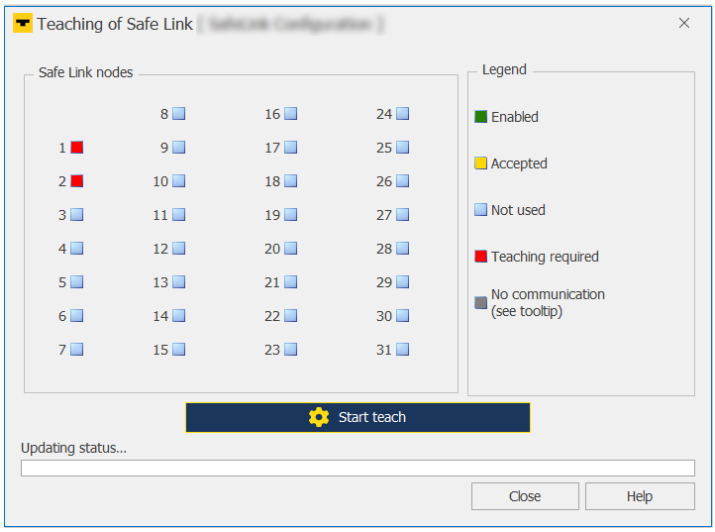


Fig. 45: Manager teach-in completed

▶ Complete commissioning via **Finish**.

⇨ The Turck Safety Configurator changes to the online mode and opens the diagnostics configuration.

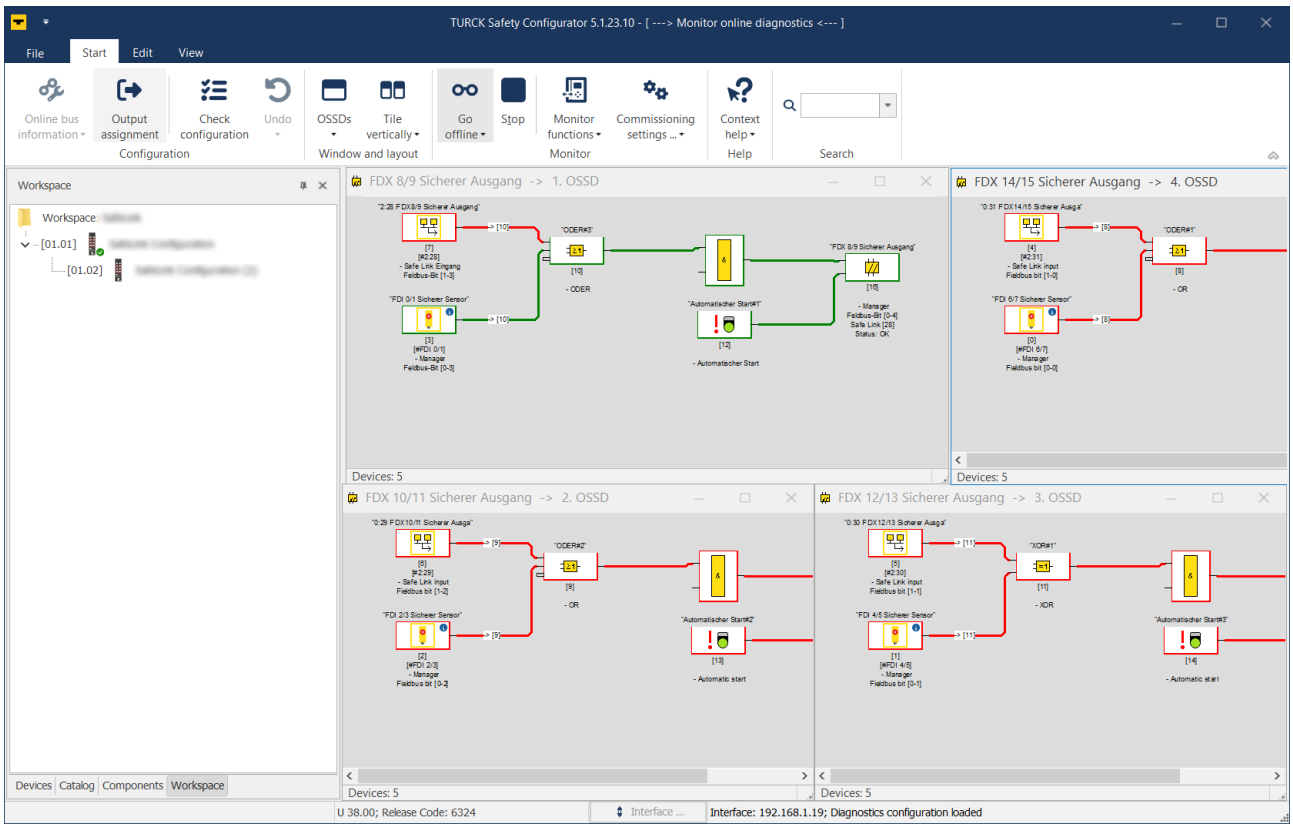


Fig. 46: Online diagnostics

7.6 TSC: Safe Link application example

The project archive of the application example **Example config** can be downloaded at the product TBEN-LL-4FDI-4DX on www.turck.com.

▶ Unzip the **Example config.AS3ARV** project archive and open the workspace of the application example.

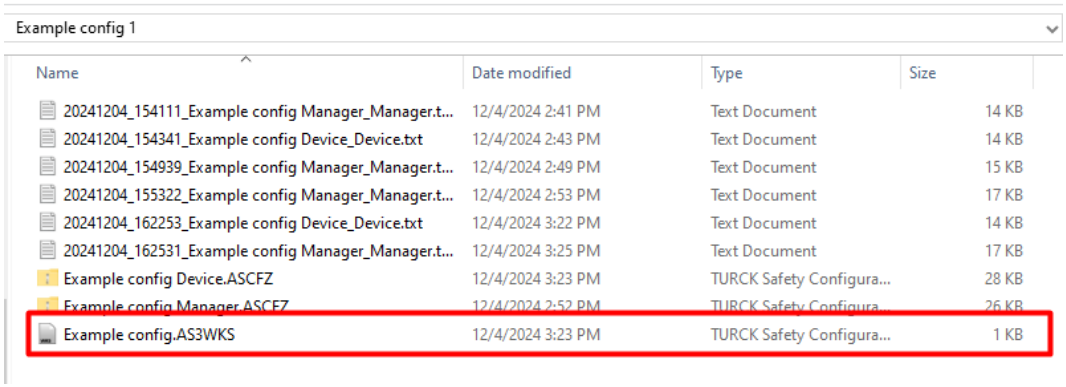


Fig. 47: Unzipped archive of the application example

➪ The Turck Safety Configurator opens the **Example config** workspace with two predefined configurations for Safe Link manager and Safe Link device.

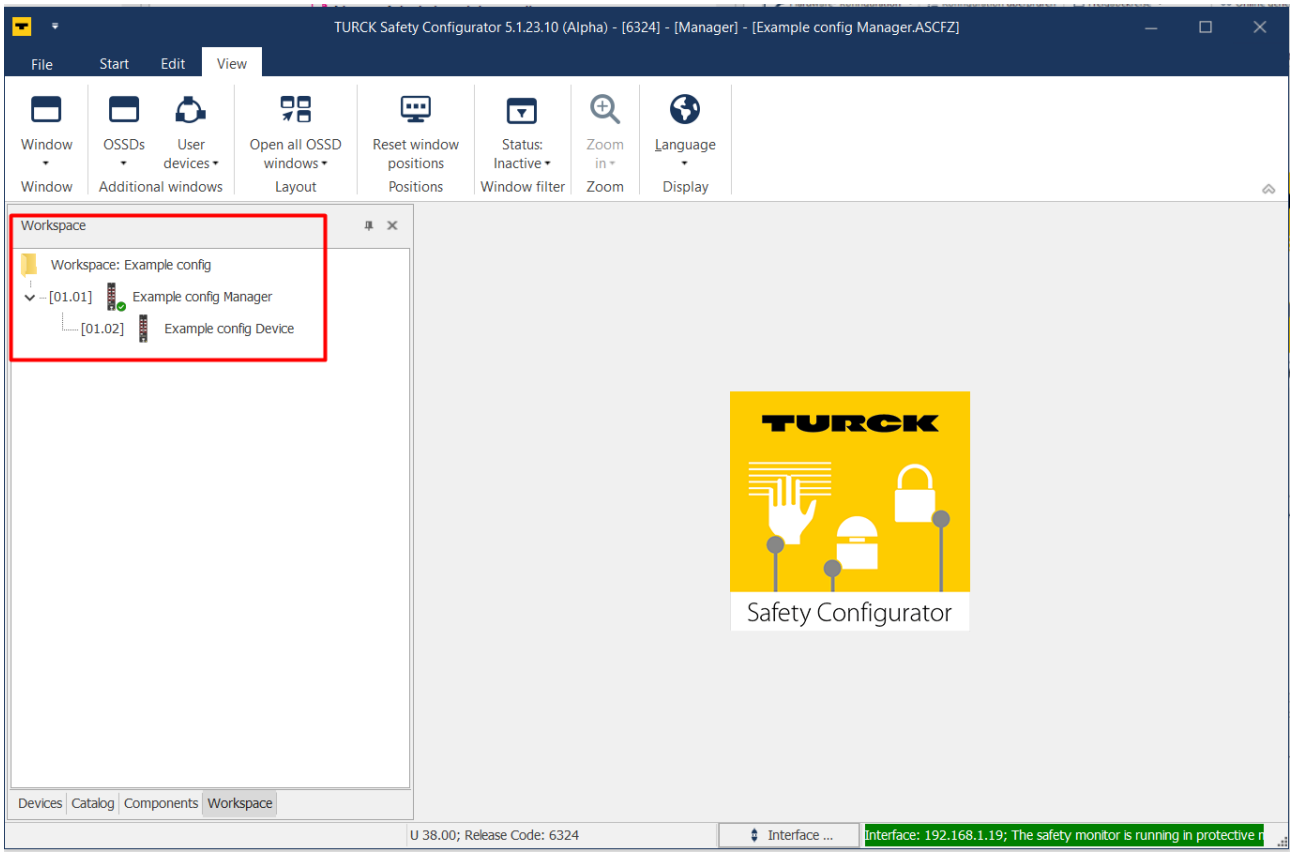


Fig. 48: Example configurations for Safe Link manager and Safe Link device

Assigning the IP addresses of the Safe Link devices (setting the interface)

- Right-click on the devices one after the other and click on **Set interface**.

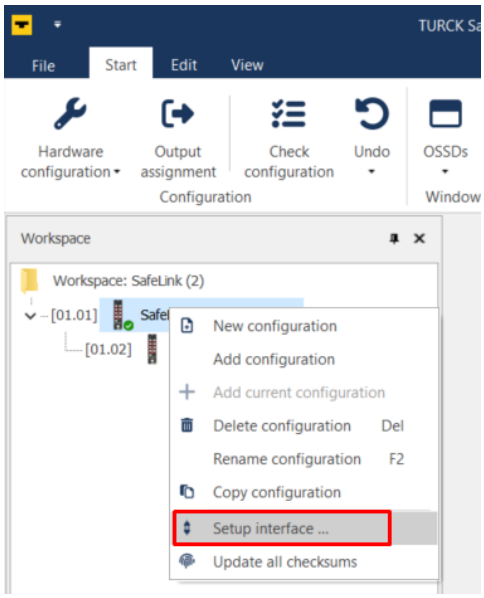


Fig. 49: Setting the interface

- Set the IP address of the devices according to the rotary coding switch position on the device.

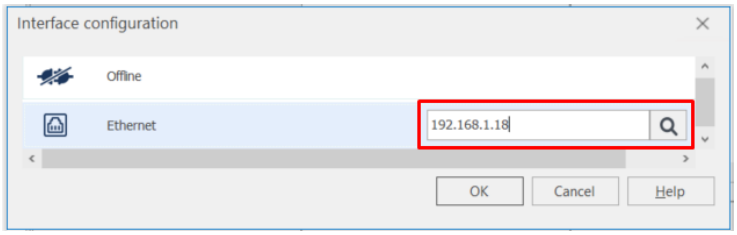


Fig. 50: Setting the IP address at the device

If the IP addresses of the devices are not known, the network can be searched for available devices using the search button.

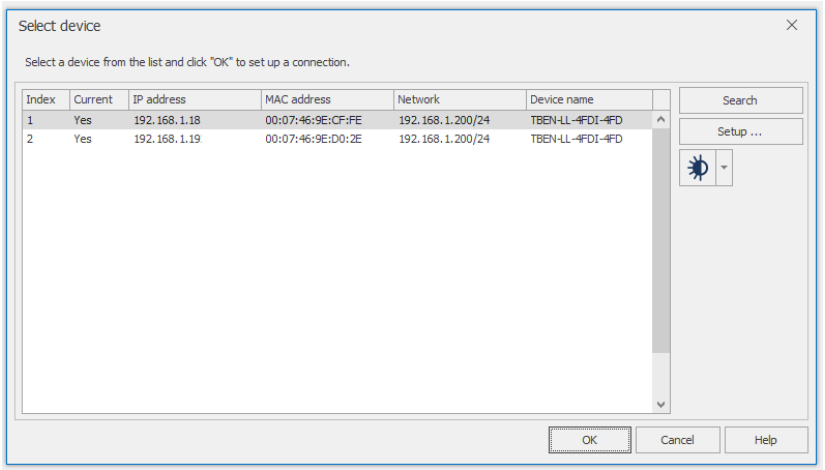


Fig. 51: Devices in the network

Release circuits (OSSDs) of the example configurations

The example configurations of the Safe Link manager and the Safe Link device each contain four release circuits.

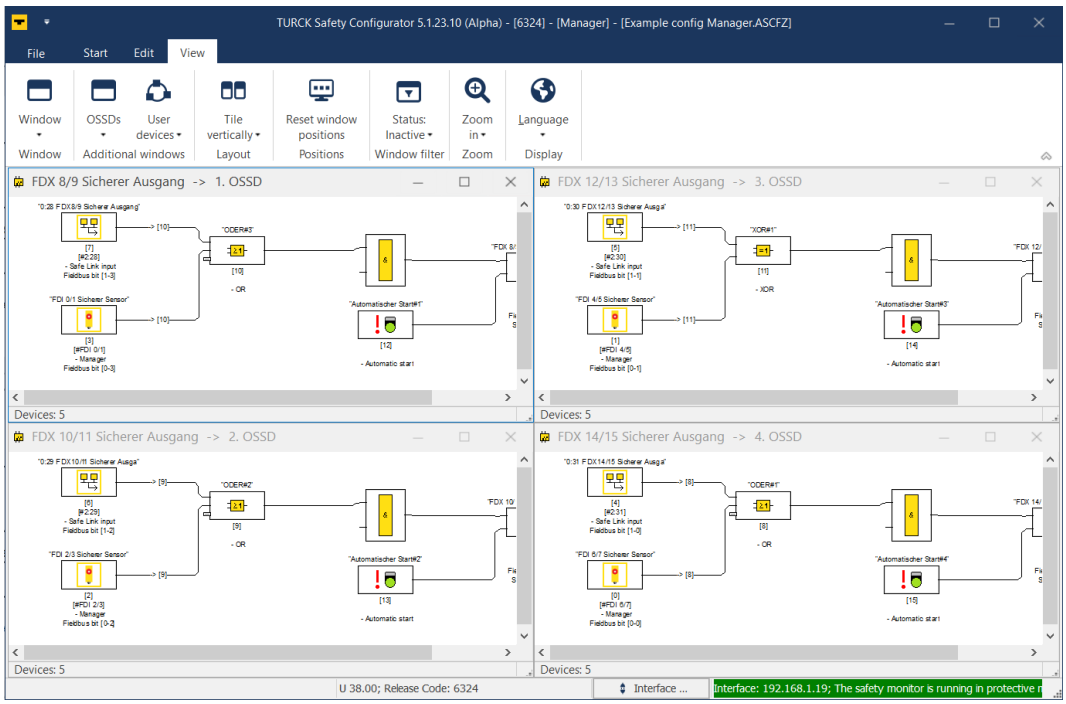


Fig. 52: Example configuration, OSSDs Safe Link manager

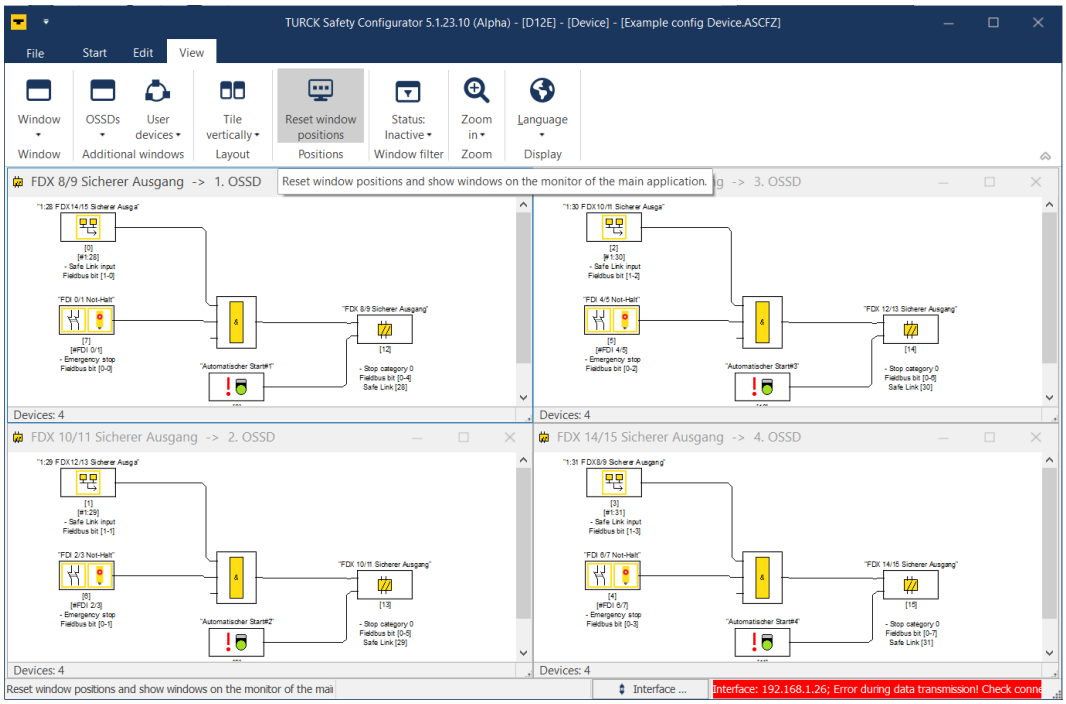


Fig. 53: Example configuration, OSSDs Safe Link device

Safety configuration of the application example

Safety sensors:

- Safe Link manager, Safe Link address **1**: 2-channel emergency stop at X0 (input FDI0/1)
- Safe Link device, Safe Link address **2**: 2-channel emergency stop at X0 (input FDI0/1)

NOTE
The example configuration only contains the OSSDs of the safe outputs of the devices. All OSSDs of the manager and the device have the same structure in the example configuration.

Safe Link manager configuration, 1. OSSD FDX 8/9 (example)

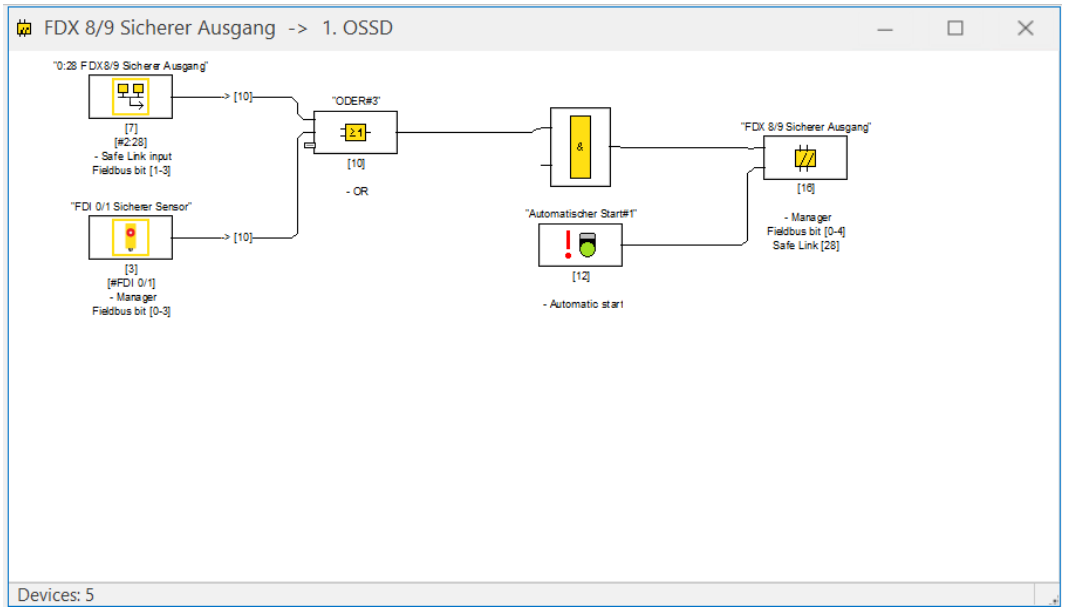


Fig. 54: Configuration 1. OSSD (FDX8/9) of the Safe Link manager

- The 2-channel emergency stop at X0 (FDI0/1) switches the output at FDX 8/9 via an OR function block and is linked to fieldbus bit 0-3 via the output assignment.
- The 2nd input of the OR function block is linked to Safe Link bit 2:28 (from the Safe Link device, address 2) and to fieldbus bit 1-3.
- The output at FDX8/9 is linked to fieldbus bit 0-4 (from the manager) and Safe Link bit 28 (from the manager).

Safe Link device configuration, 1. OSSD FDX 8/9 (example)

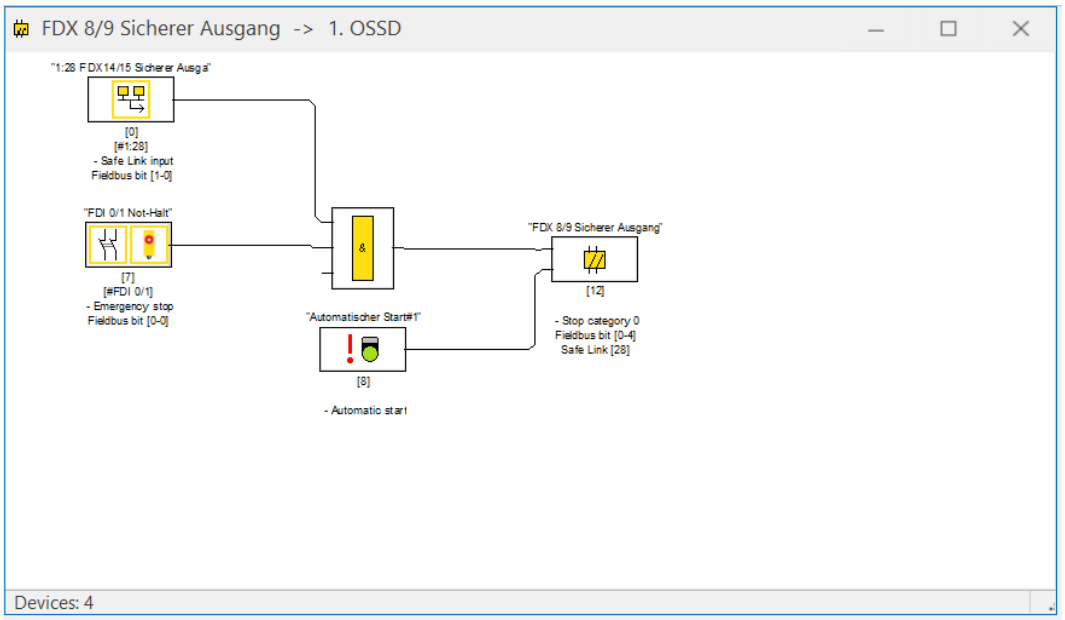


Fig. 55: Configuration 1. OSSD (FDX8/9) of the Safe Link device

- The 2-channel emergency stop at X0 (FDI0/1) switches the output at FDX 8/9 via an AND function block and is linked to fieldbus bit 0-0 via the output assignment.
- The 2nd input of the AND function block is linked to Safe Link bit 1:28 (from the Safe Link device, address 1) and to fieldbus bit 1-0.
- The output at FDX8/9 is linked to fieldbus bit 0-4 (from the device) and Safe Link bit 28 (from the device).

Function (after downloading the configuration to the devices):

If the emergency stop is not activated, the FDX8/9 output on the Safe Link manager (left window) is switched and the output signal is forwarded from the Safe Link manager to the Safe Link device (right window) via the Safe Link bit 1:28. Due to the bonding, the output on the Safe Link device only switches if the emergency stop on X0 on the Safe Link device (right window) is also not actuated.

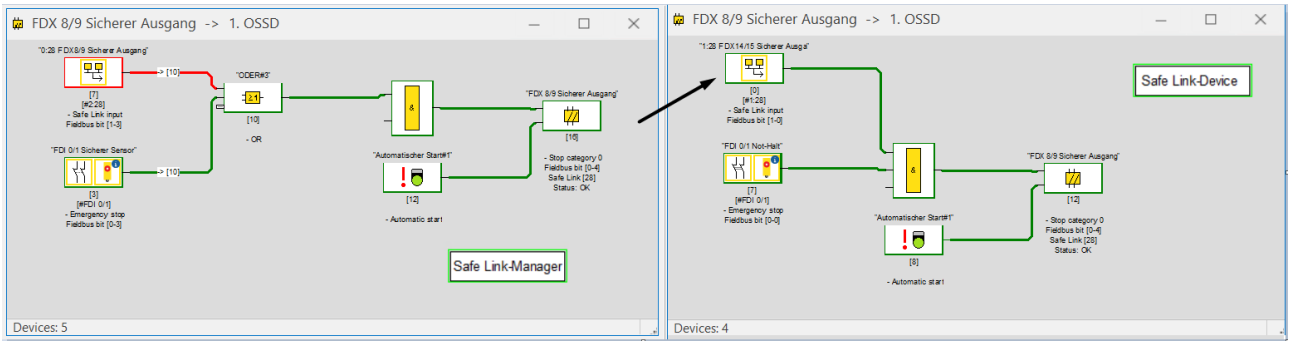


Fig. 56: Emergency stop not triggered, output switched

If the emergency stop on X0 of the Safe Link manager (left window) is activated, the outputs on the Safe Link manager and Safe Link device are deactivated.

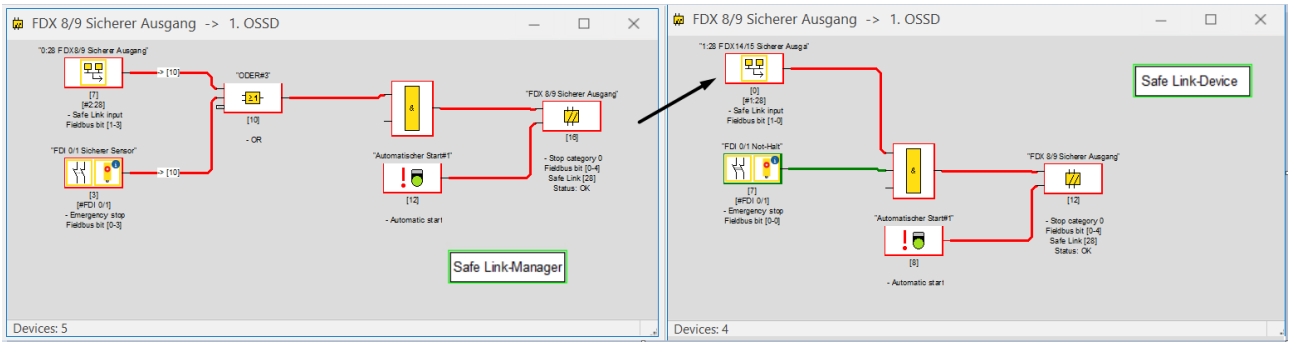


Fig. 57: Emergency stop on manager triggered, output deactivated

Actuating the emergency stop on X0 of the Safe Link device (right window) only deactivates the output on the Safe Link device.

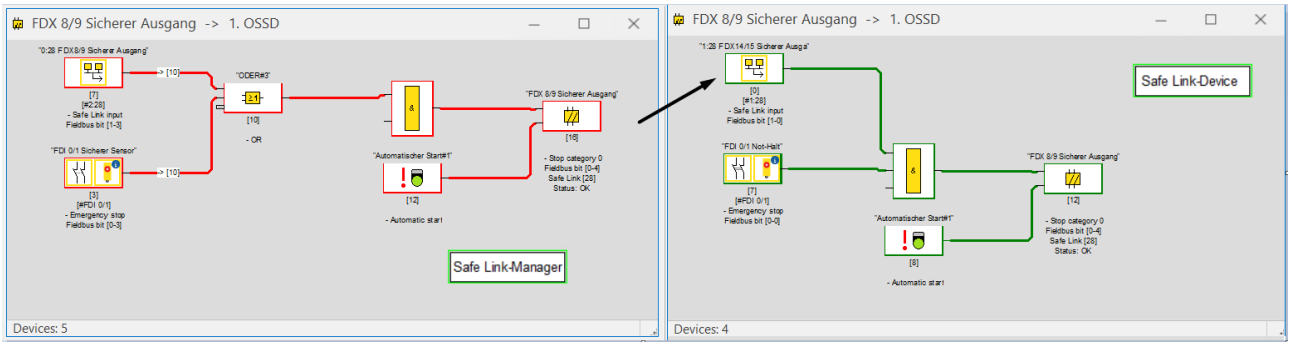


Fig. 58: Emergency stop triggered on device, output deactivated

7.7 Commissioning the device in PROFINET

7.7.1 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.

NOTE
DCP is a standard protocol and is not part of the installation of TAS, for example. The protocol can also be used outside of PROFINET in IPC operating systems (Windows, Linux), for example, and is available in tool packages such as WinPcap, Npcap, Wireshark, etc.

When delivered, each field device has, among other things, a MAC address. The MAC address 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 device name is checked for correct spelling during input. The following rules apply to the use of the device name in accordance with 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 name must not begin with "port-xyz" (y…z = 0…9).
- The name must not have the form of an IP address (n.n.n.n, n = 0…999).
- Do not use special characters.
- Do not use capital letters.

7.7.2 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.

7.7.3 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	-	-	-

Index		Name	Data type	Access	Comment
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 fieldbus protocol
28673… 45039	0x7001 … 0xAFEF	reserved	-	-	-
45040	0xAFF0	I&M0-functions		read	Identification & Maintaining
45041	0xAFF1	I&M1-functions	STRING[54]	read/ write	I&M Tag function and location
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

7.8 Connecting the devices to a PROFINET controller with TIA Portal

Prerequisites

- The software is started.
- A new project has been created.
- The controller has been added to the project.

7.8.1 Installing the GSDML-file

The GSDML file for the device is available for free download at www.turck.com as part of the ZIP archive "TBEN-LL-MP1-FILE.zip".

▶ Adding the GSDML file: Click **Options** → **Manage general station description files (GSD)**.

▶ Installing the GSDML file: Define the storage location of the GSDML file and click **Install**.

⇨ The device is added to the hardware catalog.

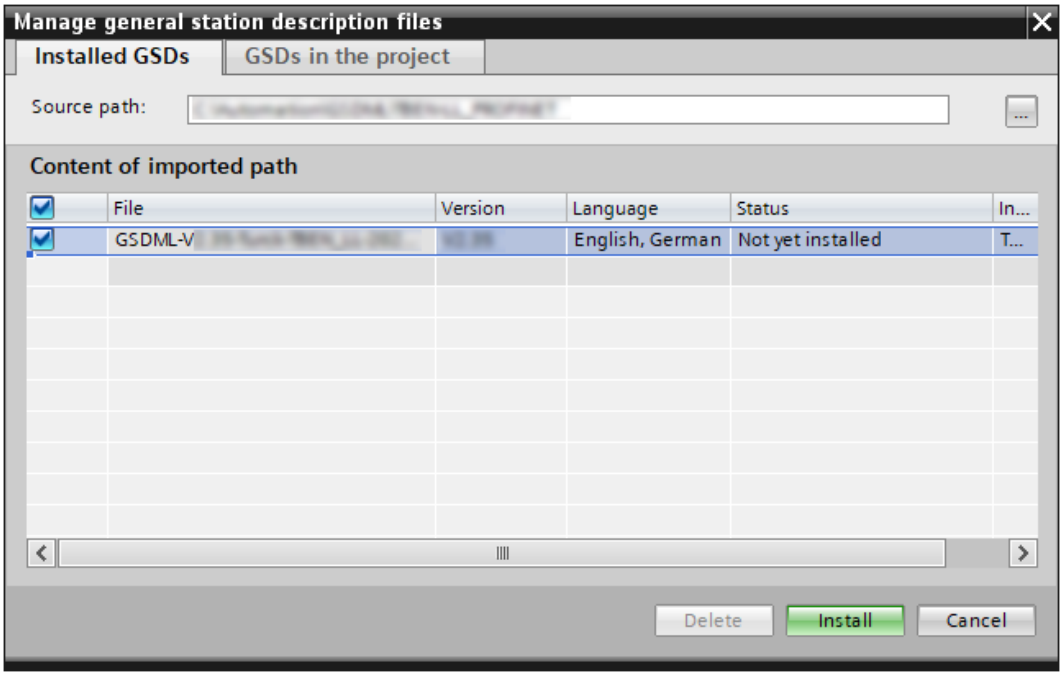


Fig. 59: Installing the GSDML file in TIA Portal

7.8.2 Connecting the device to the PLC

- Select the TBEN-LL-4FDI-4FDX from the Hardware catalog and drag it into the Device & networks editor.
- Connect the devices to the PLC in the **Devices & networks** editor.

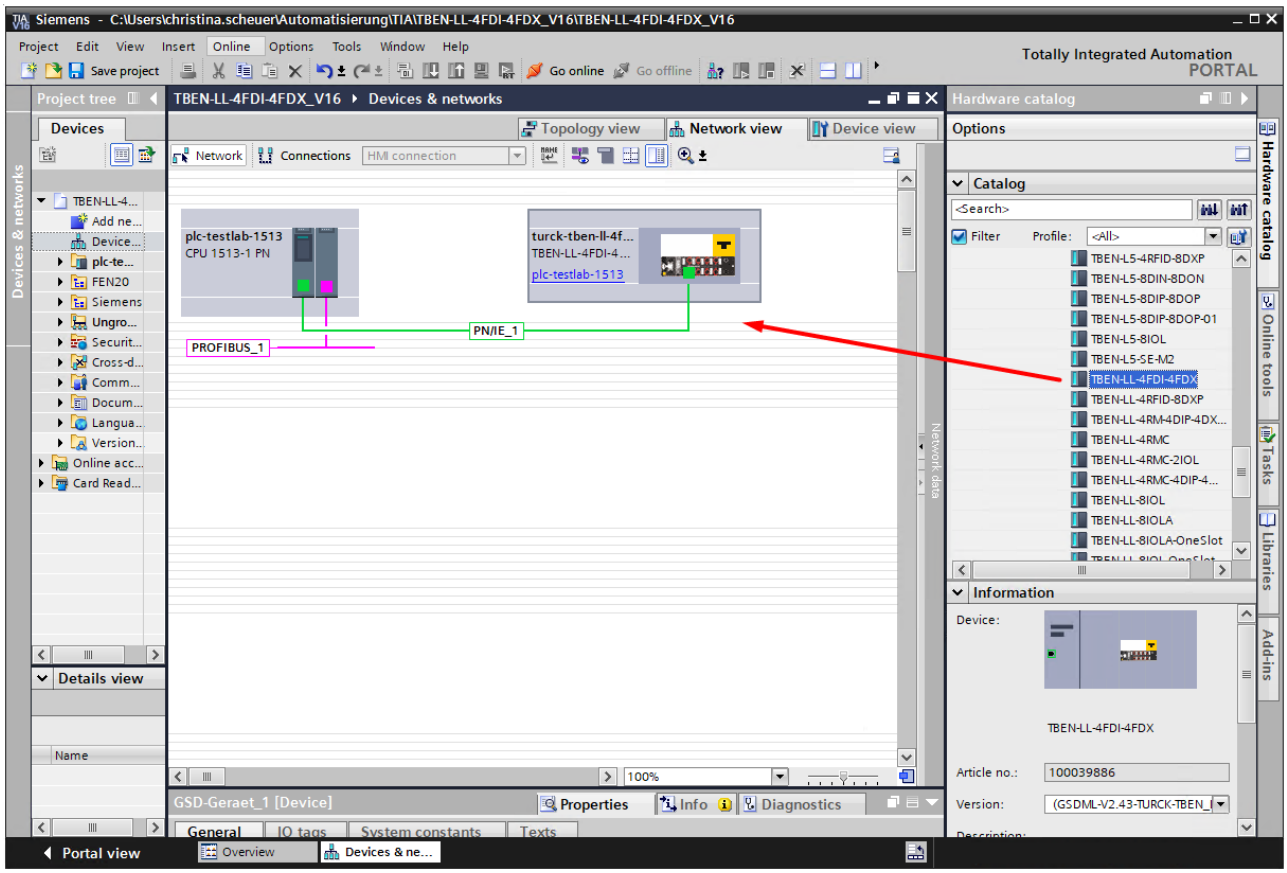


Fig. 60: Connecting the device to the PLC

7.8.3 Assigning the PROFINET device name

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

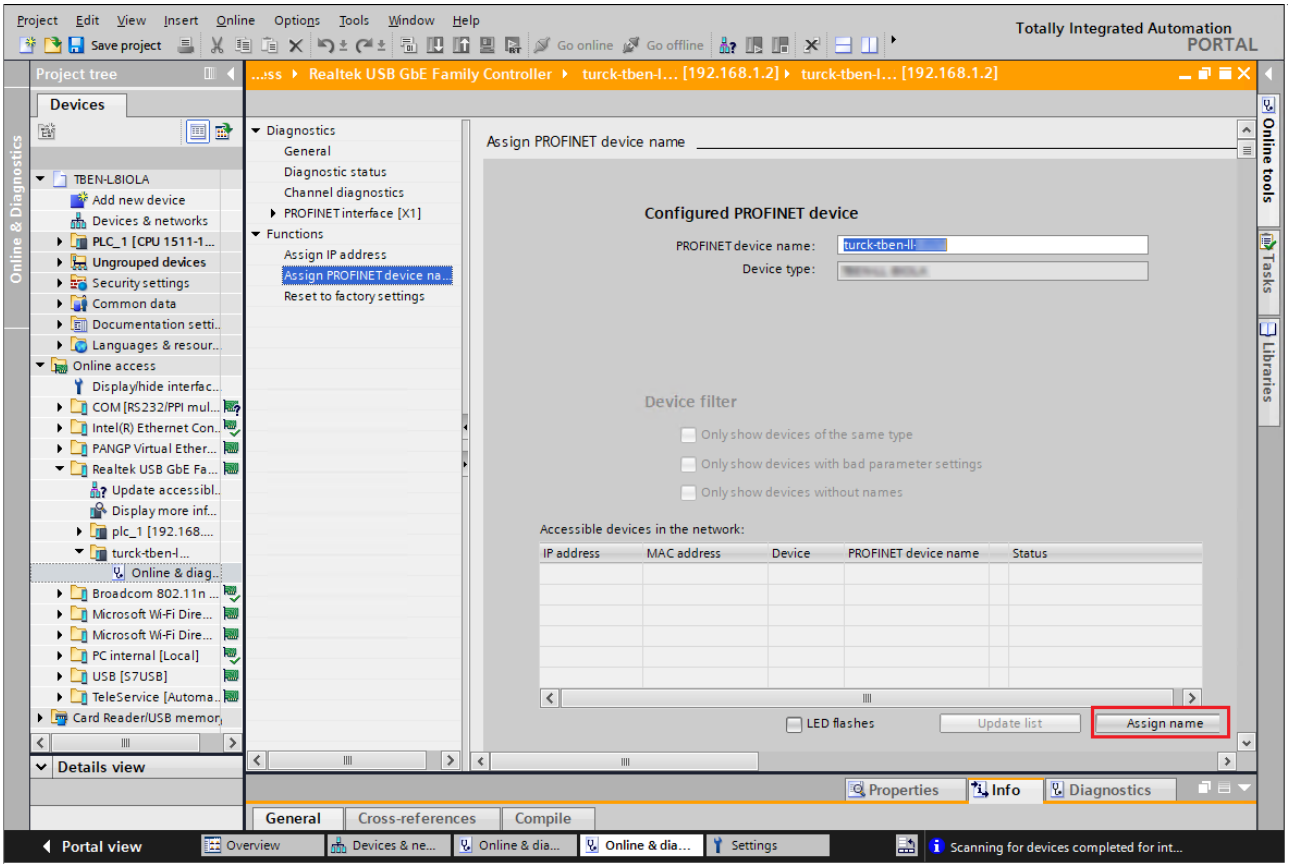


Fig. 61: Assign PROFINET the device name in TIA Portal

7.8.4 Setting the IP address in TIA Portal

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

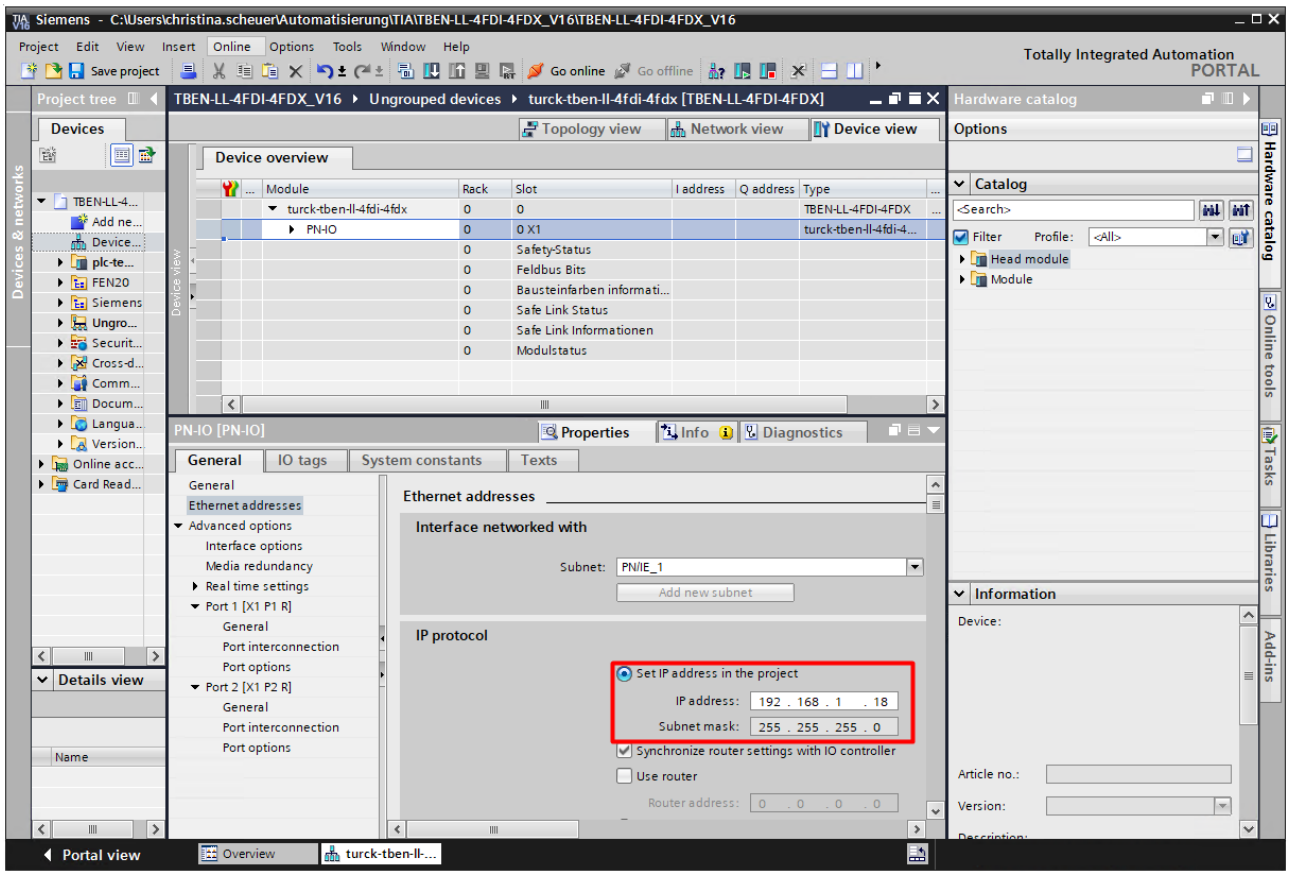


Fig. 62: TIA Portal: Assigning the IP address

7.8.5 Connecting the device online with the controller

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

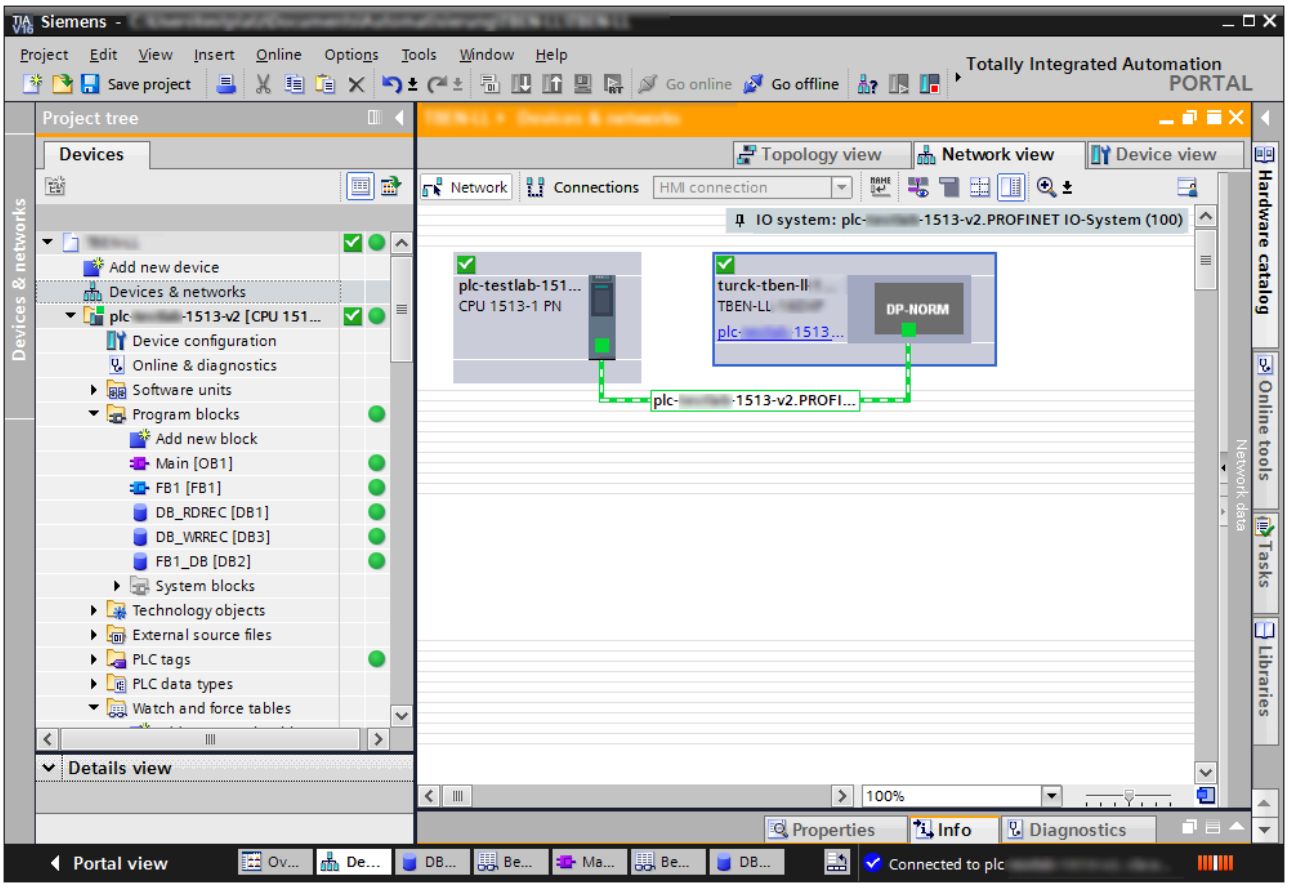


Fig. 63: TIA Portal: Online mode

7.9 Commissioning the devices in Modbus TCP

7.9.1 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

7.9.2 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…0xA400	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
Process data inputs	0x0000…0x01FF	0…511	40001…40512	400001…400512
Process data outputs	0x0800…0x09FF	2048…2559	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
Parameters	0xB000, 0xB001	45056, 45057	-	445057, 445058

Register 0x1130: Modbus connection mode

This register defines the behavior of the Modbus connections.

Bit	Designation	Value	Meaning
0	MB_OnlyOneWrite Permission	**0**	All Modbus connections receive the write authorization.
		1	Only one Modbus connection can receive the write permission. A write permission is opened until a disconnect. After the disconnect the next connection which requests a write access receives the write authorization.
1	MB_ImmediateWrite Permission	**0**	With the first write access, a write authorization for the respective Modbus connection is requested. If this request fails, an exception response with exception-code 0x01 is generated. If the request is accepted, the write access is executed and the write authorization remains active until the connection is closed.
		1	The write authorization for the respective Modbus connection is already opened during the connection establishment. The first Modbus connection thus receives the write authorization, all following connections do not (only if bit 0 = 1).
2…15	Reserved	-	-

Register 0x1131: Modbus connection timeout

This register defines after which time of inactivity a Modbus connection is closed through a disconnect.

Value range: 0…65535 s

default: 0 s = never (Modbus connection will never be closed)

Behavior of the BUS LED

If Modbus is the active protocol in case of a connection timeout and no further Modbus connections exist, the BUS LED behaves as follows:

Connection timeout	BUS LED
Timeout	Green flashing

Register 0x113C and 0x113D: Restore Modbus connection parameters

Registers 0x113C and 0x113D serve for resetting the parameter-register 0x1120 and 0x1130 to 0x113B to the default settings. The service resets the parameters without saving them.

Procedure:

- ▶ Write 0x6C6F to register 0×113C.
- ▶ To activate the reset of the registers, write 0x6164 (”load”) within 30 seconds in register 0x113D. Both registers can also be written with one single request using the function codes FC16 and FC23.
- ⇨ The parameters are reset to default values.
- ▶ Save changes via a subsequent Save service.

Register 0x113E and 0x113F: Save Modbus connection parameters

Registers 0x113E and 0x113F are used for the non-volatile saving of parameters in registers 0x1120 and 0x1130 to 0x113B.

Procedure:

- ▶ Write 0x7361 to register 0×113E.
- ▶ Write 0x7665 (”save”) within 30 seconds in register 0x113F to activate the reset of the registers. Both registers can also be written with one single request using the function codes FC16 and FC23.
- ⇨ The parameters are saved.

7.9.3 Register mapping

Input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Safety Unit Status (Safety Status) [▶ 106]																
0x0000														SUUM	SUCM	SUPM
Safety configuration integrity (Memory and F-Config Status) [▶ 106]																
0x0001	Reserved								F ERR	-	-	COM LO	-	CNF MM	NCNF	PMS
Safety diagnostics (Safe Status) [▶ 106]																
0x0002	Safety diagnostics X1								Safety diagnostics X0							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0x00003	Safety diagnostics X3								Safety diagnostics X2							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0x0004	Safety diagnostics X5								Safety diagnostics X4							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0x0005	Safety diagnostics X7								Safety diagnostics X6							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
Field bus bits [▶ 108]																
0x0006	FBI15	FB14	FB13	FB12	FB11	FB10	FB9	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1	FB0
Device Color Information (only Safe Link manager) [▶ 106]																
0x0007	Device Color Information 4				Device Color Information 3				Device Color Information 2				Device Color Information 1			
…	…															
0x0046	Device Color Information 256				Device Color Information 255				Device Color Information 254				Device Color Information 253			
Safe Link-Status (only Safe Link manager) [▶ 107]																
0x0047	Reserved								Safe Link Interface				Status Safe Link nodes			
0x0048	LEM (Last error message)															
0x0049	Last error message – additional information								Last error message – additional information (low byte)							
0x004A	Last error message – additional information (high byte)								Last error message – additional information							
0x004B	Status node 2								Status node 1							
…	…															
0x0059	Status node 30								Status node 29							
0x005A	Reserved								Status node 31							
Safe Link-Status (only Safe Link manager) [▶ 107]																
0x005B	Reserved								-	-	-	-	RPSE	GSE	NLR	MSN

Output registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Unlock Safe Unit [▶ 110]																
0x0800	reserved															UNLK
Field bus bits Field bus_output data_TBIP																
0x0801	FB15	FB14	FB13	FB12	FB11	FB10	FB9	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1	FB0

Diagnostic registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Safety configuration integrity (Memory and F-Config Status) [▶ 106]																
0xA000	Reserved								F ERR	-	-	COM LO	-	CNF MM	NCNF	PMS
Safety diagnostics (Safe Status) [▶ 106]																
0xA001	Safety diagnostics X1								Safety diagnostics X0							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0xA002	Safety diagnostics X3								Safety diagnostics X2							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0xA003	Safety diagnostics X5								Safety diagnostics X4							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
0xA004	Safety diagnostics X7								Safety diagnostics X6							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
Safe Link-Status (only Safe Link manager) [▶ 107]																
0xA005	Reserved								-	-	-	-	RPSE	GSE	NLR	MSN

7.9.4 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.

7.10 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" (client) and "Modbus TCP Slave" (server) only because of the naming in CODESYS.

Prerequisites

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

7.10.1 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 **Device** in the project tree **TX715-P3CV01**.
▶ Select **Add Device**.
▶ Select **Ethernet Adapter**.
▶ Click **Insert device.**
⇨ The Ethernet Adapter is added to the project tree as **Ethernet (Ethernet)**.

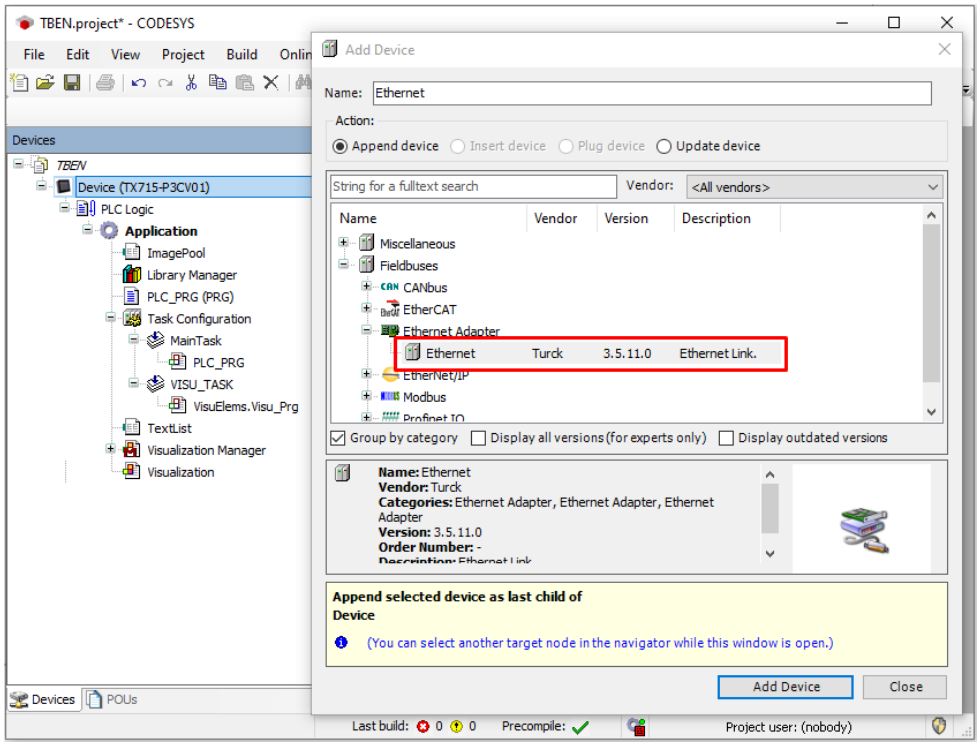


Fig. 64: Adding the Ethernet Adapter

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.

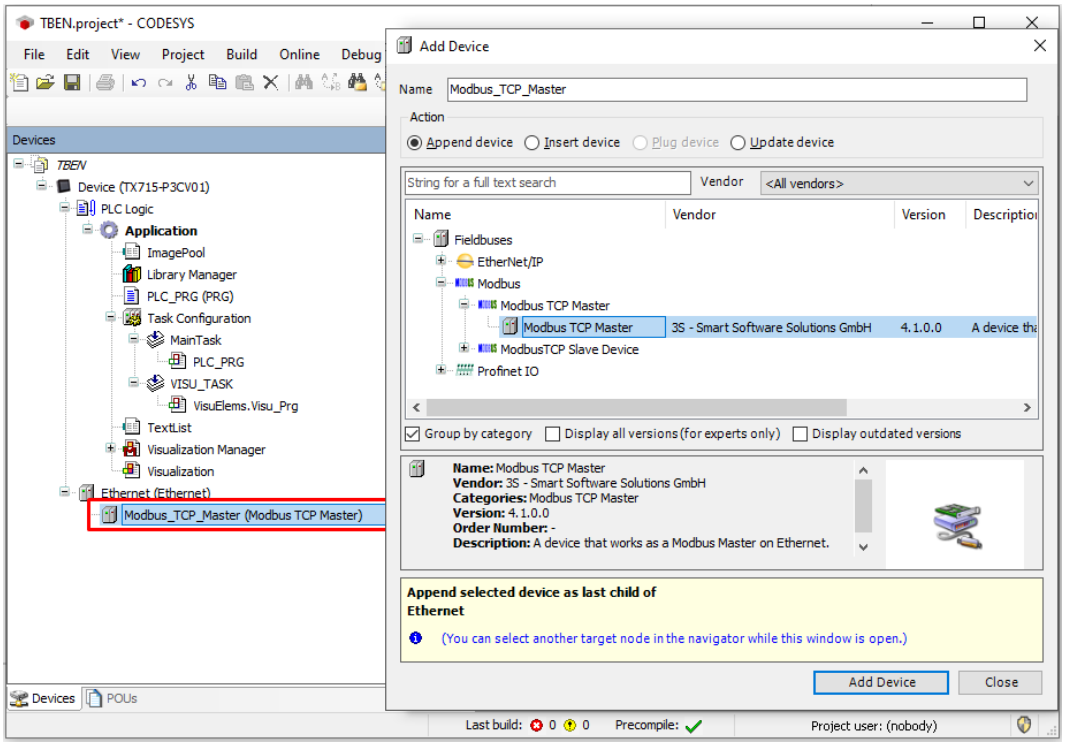


Fig. 65: Adding the Modbus TCP Master

Adding the Modbus TCP Server (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.

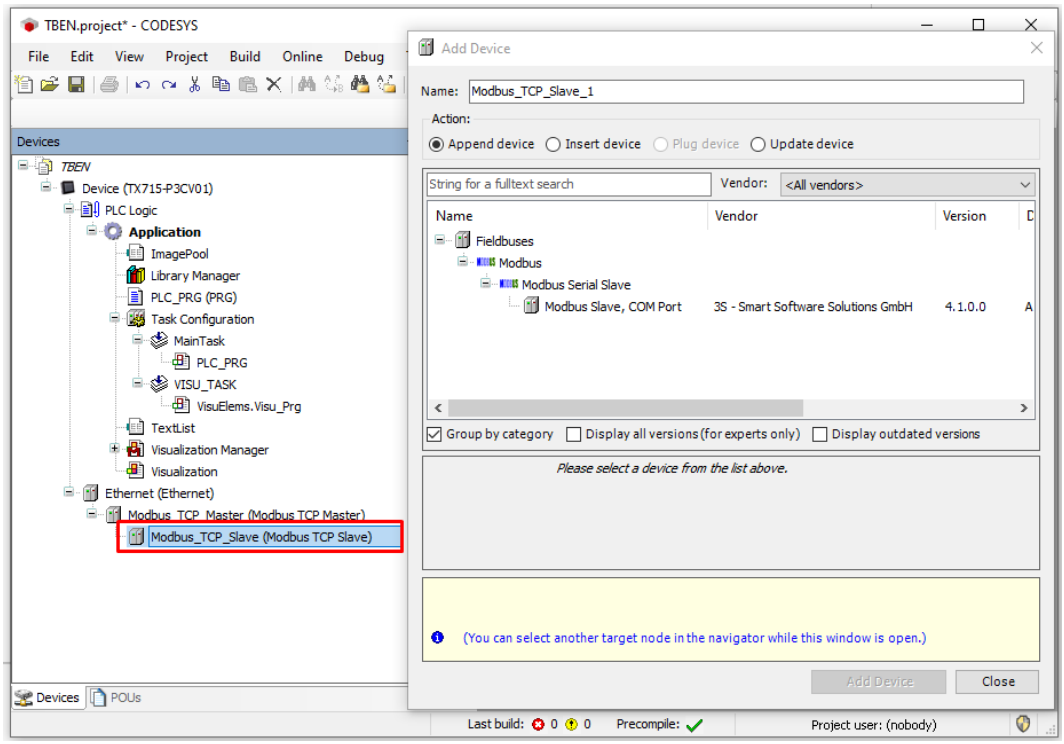


Fig. 66: Adding the Modbus TCP Slave

7.10.2 Configuring the Network Interface

- Click **Device → Scan network**.
- Select Modbus TCP Master (here: TX715-P3CV01) and confirm with OK.

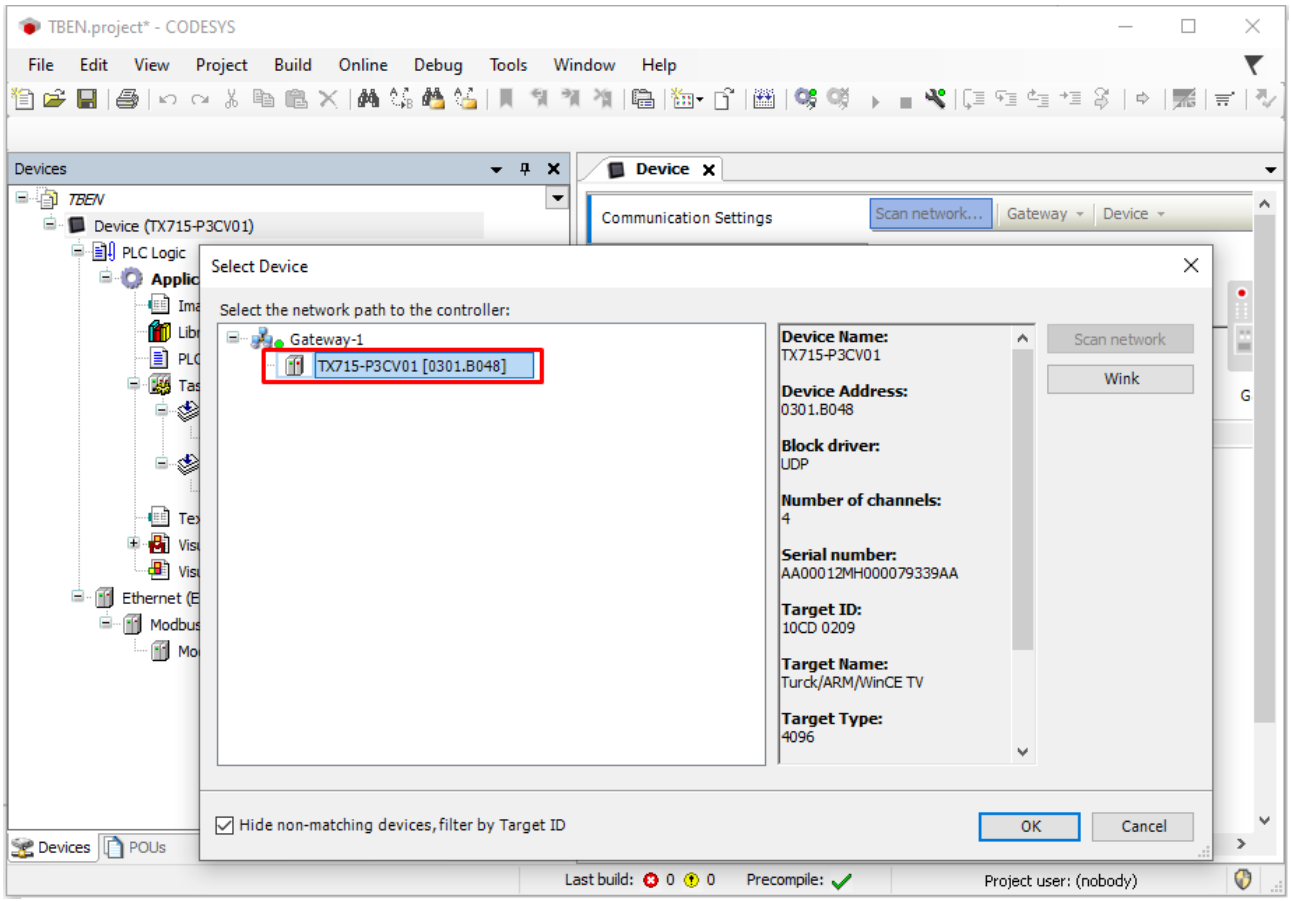


Fig. 67: Configuring the network interface

- Double-click **Ethernet**.
- Open the dialog box **Network Adapter** by clicking the **Browse…** button in the register tab **General**.
- Select the interface TX715-P3CV01 (here: 192.168.145.72)

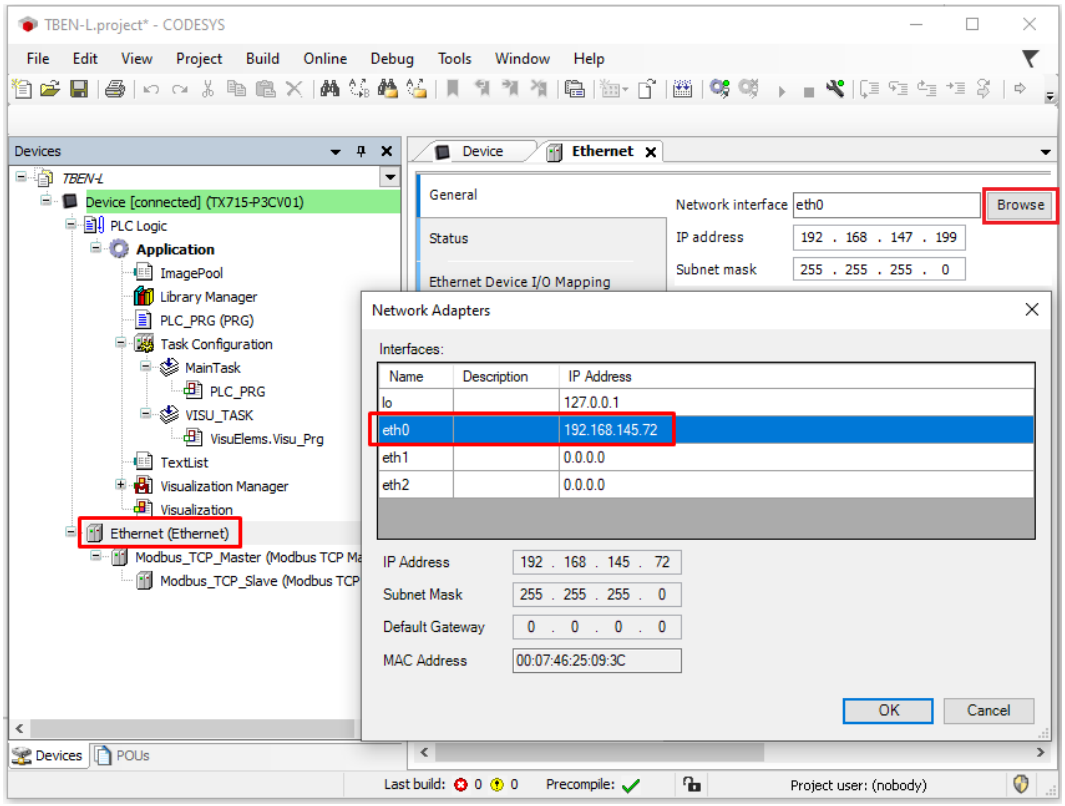


Fig. 68: Selecting the interface

7.10.3 Modbus TCP Server (Slave): setting the IP address

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

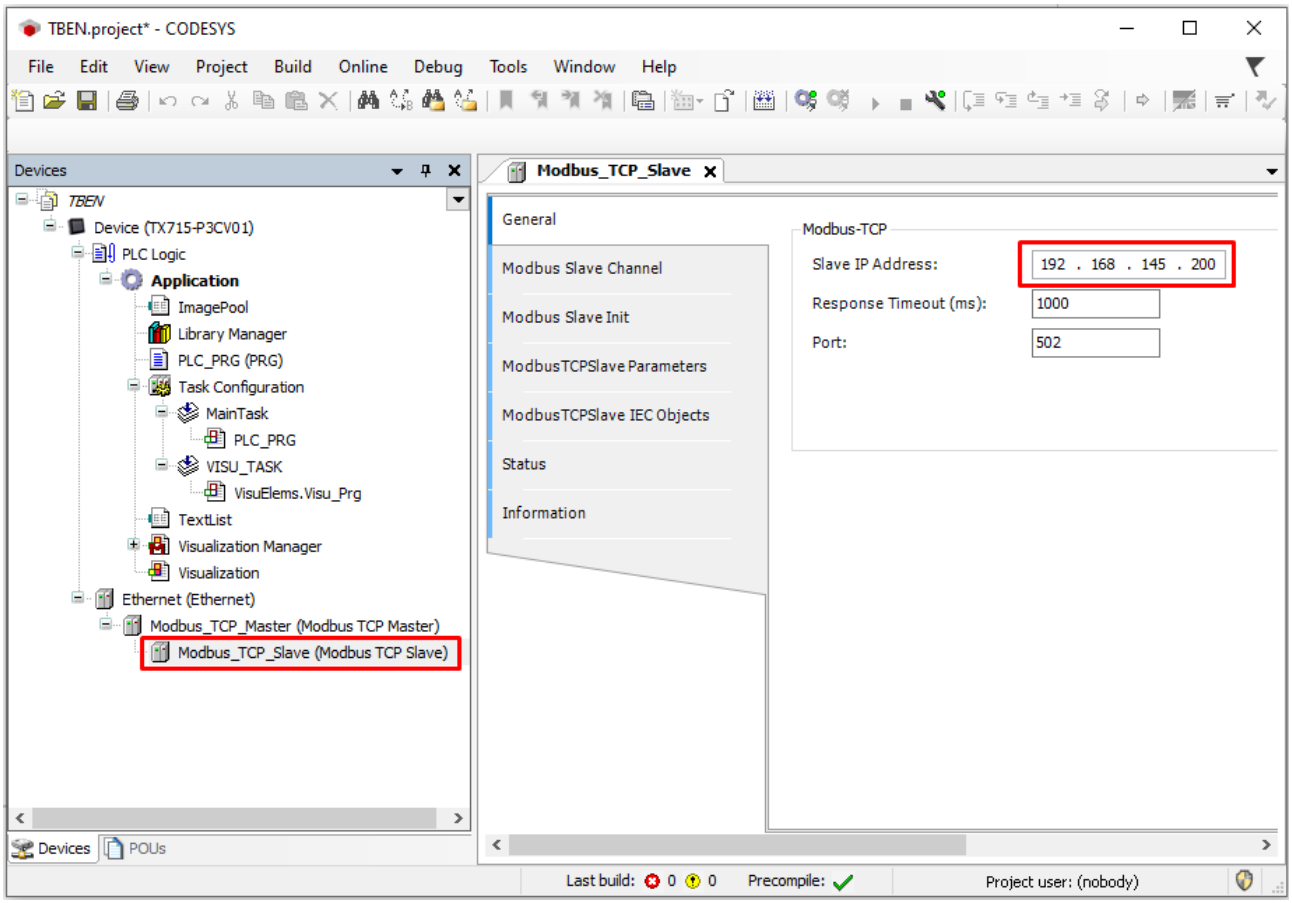


Fig. 69: Modbus TCP Slave: Setting the IP address

7.10.4 Defining modbus channels

Defining channel 0 (input data)

- Double click **Modbus TCP Slave**.
- In the register tab select **Modbus Slave Channel** → **Add Channel**.
- Enter the following values:
  Channel name
  Access type: Read Input Registers
  Offset: 0x0000
  Length: 1 register
- Confirm with OK.

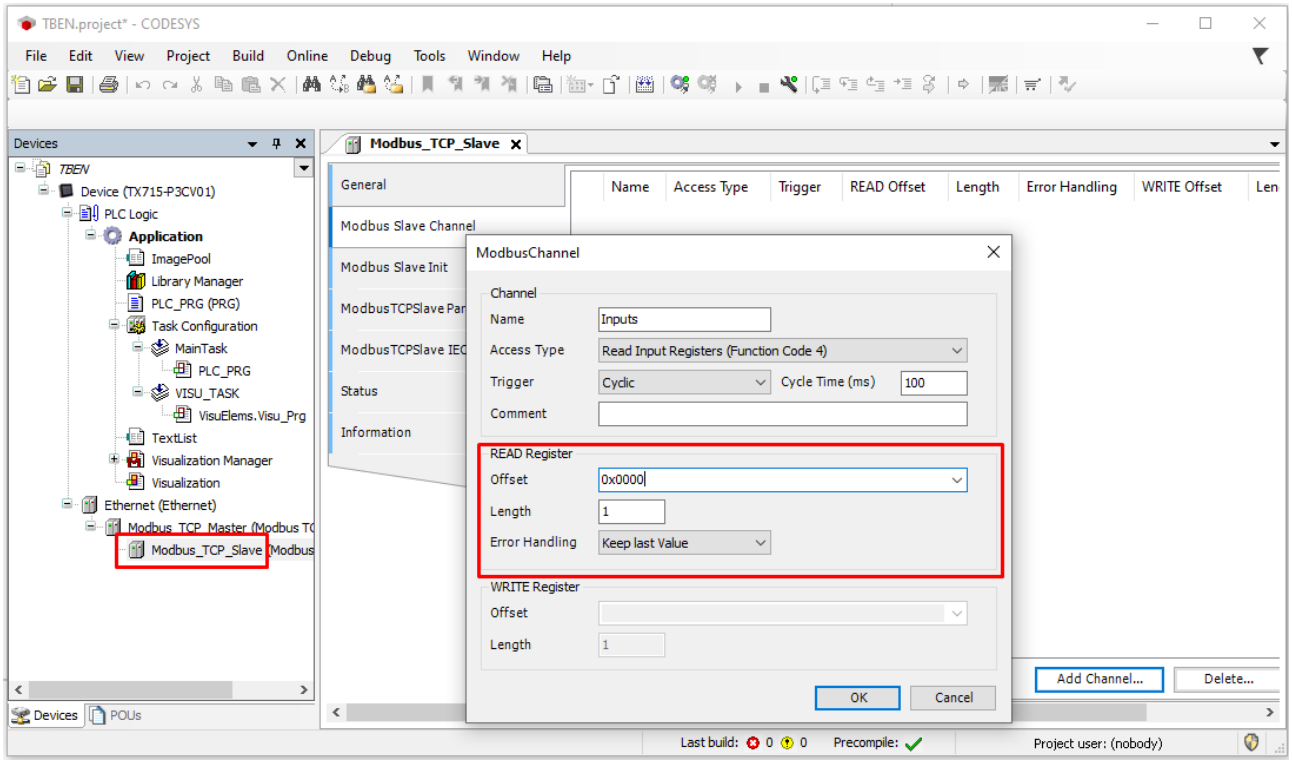


Fig. 70: Defining the input register

Defining channel 1 (output data)

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

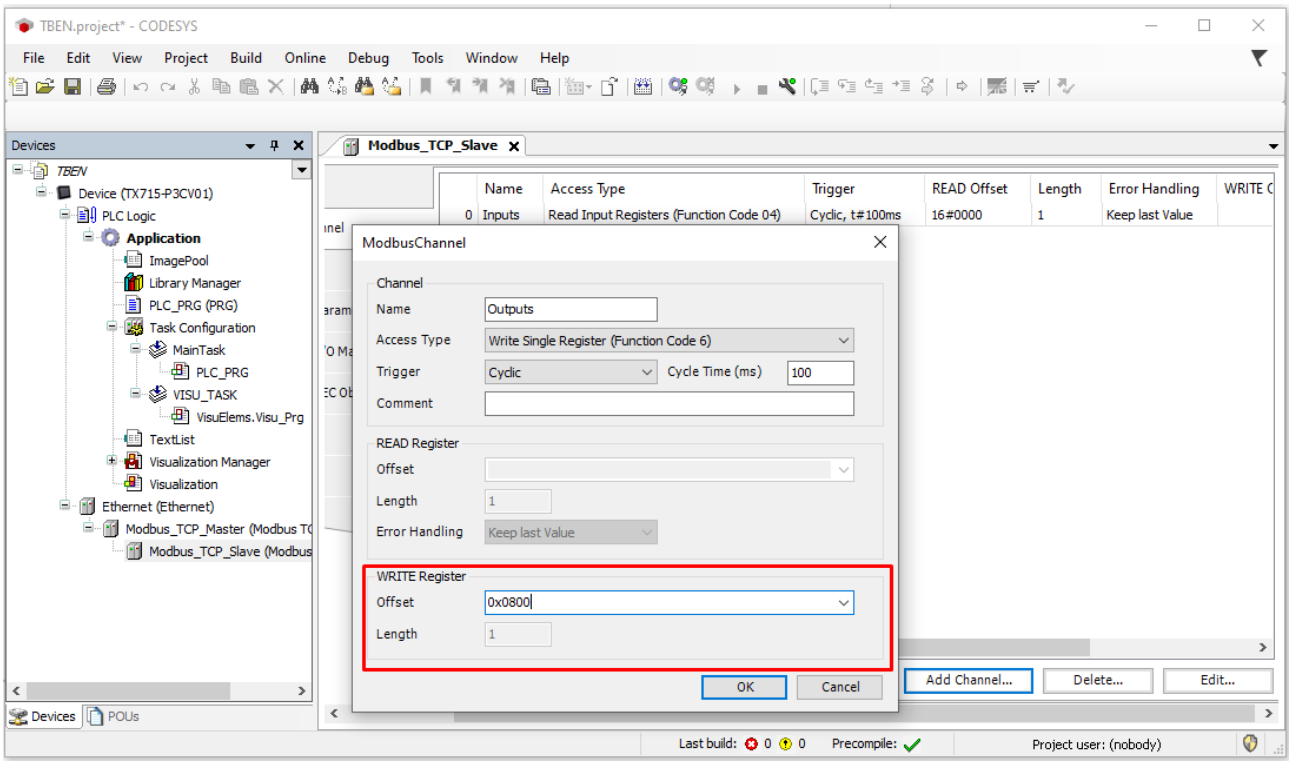


Fig. 71: Defining the output data register

7.10.5 Going online with the PLC

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

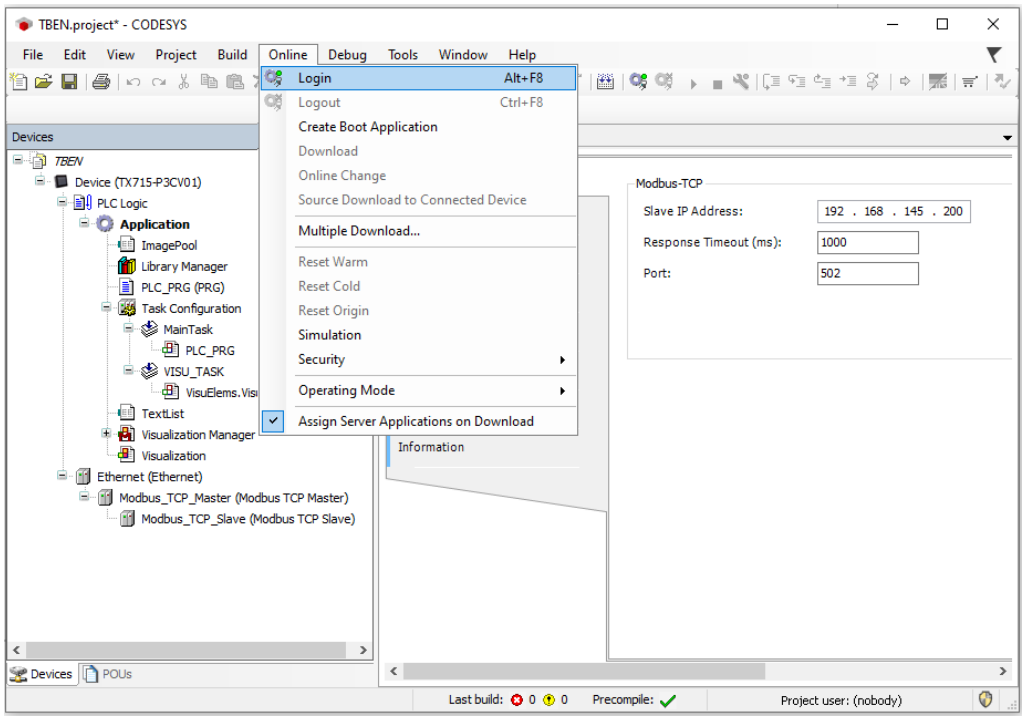


Fig. 72: Login

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

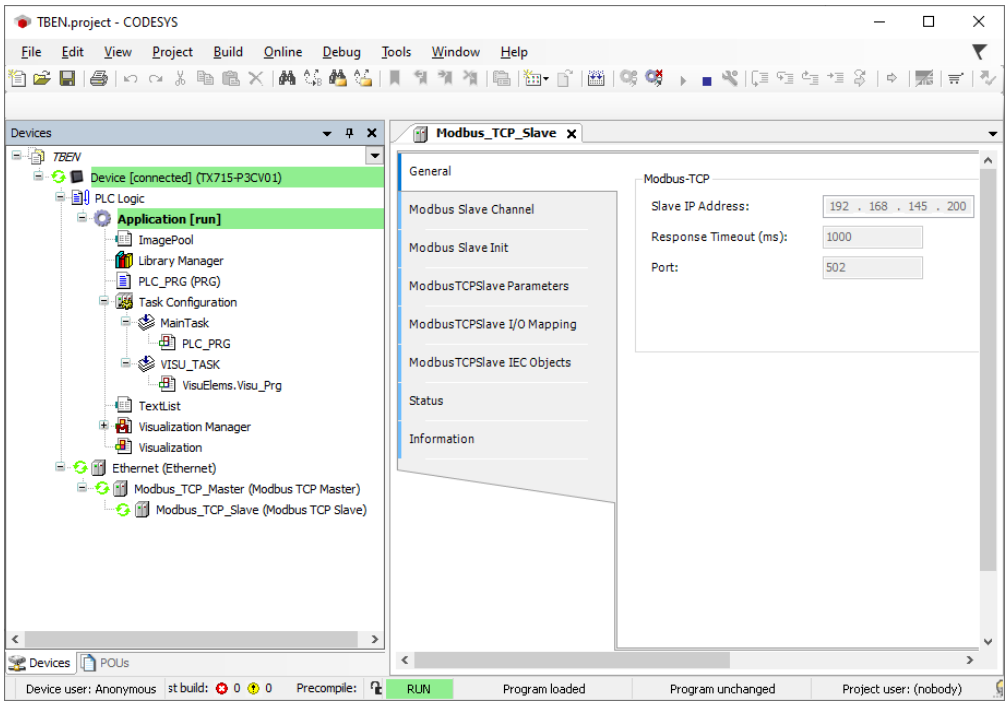


Fig. 73: Modbus TCP communication

7.10.6 Reading process data

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

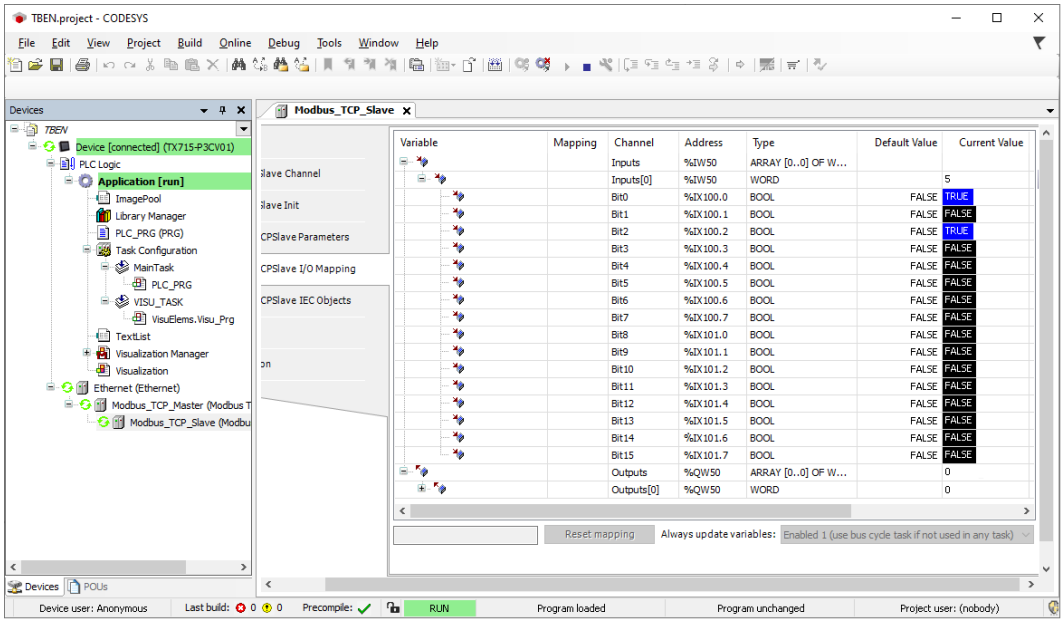


Fig. 74: Process data

7.11 Commissioning the device in EtherNet/IP

7.11.1 Common EtherNet/IP features

Feature	Description
QuickConnect	< 500 ms
Device Level Ring (DLR)	Yes
Number of TCP connections	3
Number of CIP connections	10
Input assembly instance	103
Output assembly instance	104
Configuration assembly Instance	106

7.11.2 EDS files and catalog files

The EDS and catalog files can be downloaded free of charge from www.turck.com.

7.11.3 Device Level Ring (DLR)

The devices support DLR (Device Level Ring). The 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 is interrupted, data are sent through an alternative network section, so that the network can be reconfigured as soon as possible.

DLR-capable network nodes (DLR supervisor) are provided with extended diagnostic functions which enable the devices to localize errors and thus decrease the time for error search and maintenance. Normally, the controller (i.e. the controller/PLC) assumes the supervisor function, all other network nodes are DLR participants. The supervisor blocks one of its two ports for normal Ethernet traffic, so that a line topology is created for normal Ethernet telegrams. DLR messages can continue to use the ring in both directions and thus continuously check the function of the ring.

7.11.4 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 [▶ 81]
04	0x04	Assembly Object [▶ 83]
06	0x06	Connection Manager Object [▶ 85]
245	0xF5	TCP/IP Interface Object [▶ 86]
246	0xF6	Ethernet Link Object [▶ 89]

Identity Object (0x01)

The following description 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_{dec} = 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-4FDI-4FDX

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 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 Changes a single attribute

Assembly Object (0x04)

Assembly Objects bind attributes of multiple objects. to allow data to or from each object to be sent or received over a single connection.

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.

Class attributes

Attr. no.		Attribute name	Get/set	Type	Value
Dec.	Hex.				
1	0x01	Revision	G	UINT	2
2	0x02	Max. object instance	G	UINT	104

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: $27247_{dec.}$ = 0x6A6F
4	0x04	Size	G	UINT	Number of bytes in attribute 3: 256 or variable

Common services

Service code		Class	Instance	Service name
Dec.	Hex.			
1	0x01	Yes	Yes	Get_Attribute_All Returns a predefined list of object attributes.
14	0x0E	Yes	Yes	Get_Attribute_Single Returns the content of a specified attribute.

Configuration Assembly (instance 106)

The modules support Configuration Assembly.

The Configuration Assembly contains:

10 byte device configuration data (EtherNet/IP specific)

+ 4 bytes Parameter

Device configuration data

Default values are shown in **bold**.

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

■ Configuration Assembly

Byte no.		Bit no.							
Dec.	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Device configuration data									
0…9	0x00…0x09	-	-	-	-	-	Eth2 port setup	Eth1 port setup	QuickConnect
Parameter data									
10	0x0A	-	-	-	-	-	-	-	Disable Missing Safety Node diagnosis
11	0x0B	-	-	-	-	-	-	-	Disable Node Learning Required diagnosis
12	0x0C	-	-	-	-	-	-	-	Disable General Safe Link Error diagnosis
13	0x0D	-	-	-	-	-	-	-	Disable Rotary Switch Position Error diagnosis

Process data instances

Instance 103 and Instance 104

- Input Assembly Instance 103

Device	Input data
as Safe Link manager	186 bytes
as Safe Link device	14 bytes

- Output Assembly Instance 104

Device	Output data
as Safe Link manager	6 bytes
as Safe Link device	6 bytes

Process data mapping

NOTE
Activating or deactivating the status and control Word in EtherNet/IP changes the process data mapping.

▶ Observe the offset in the device's process data mapping.

Connection Manager Object (0x06)

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. 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 (10 Mbps/ 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) auto-matically 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

7.11.5 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	Data and parameters for the fieldbus-specific part of the device
134	0x86	Safety Status	Integrity of the safe unit, Safe diagnostics
135	0x87	Safe Unit Status	Status of the safe link network
136	0x88	Safe Link Information	Safe link error bits (safe link manager only)
137	0x89	Device Color Information	OSSD status (safe link manager only)
177	0xB1	Fieldbus bits	Field bus bits

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 substitute value.
					1: SWITCH IO OFF (1): The outputs are switched 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

Safety Status (VSC 134)

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	No memory stick plugged	G	USINT	0: - 1: active
2	0x02	No configuration available	G	USINT	0: - 1: active
3	0x03	Configuration mismatch	G	USINT	0: - 1: active
4	0x04	Communication loss	G	USINT	0: - 1: active
5	0x05	Fatal error	G	USINT	0: - 1: active
6	0x06	Wait for input signal 0	G	USINT	0: - 1: active
…	…				
13	0x0D	Wait for input signal 7	G	USINT	0: - 1: active
14	0x0E	Test input 0	G	USINT	0: - 1: active
…	…				
21	0x15	Test input 7	G	USINT	0: - 1: active
22	0x16	Input error 0	G	USINT	0: - 1: active
…	…				
29	0x1D	Input error 7	G	USINT	0: - 1: active
30	0x1E	Cross-circuit channel 0	G	USINT	0: - 1: active
…	…				
45	0x2D	Cross-circuit channel 7	G	USINT	0: - 1: active
46	0x2E	reserved			
47	0x2F	Output overload 0	G	USINT	0: - 1: active
…	…				
53	0x35	Output overload 7	G	USINT	0: - 1: active
54	0x36	Protective mode	G	USINT	0: - 1: active
55	0x37	Configuration mode	G	USINT	0: - 1: active
56	0x38	Unkown mode	G	USINT	0: - 1: active

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
57	0x39	No memory stick plugged	G	USINT	0: - 1: active
58	0x3A	No configuration available	G	USINT	0: - 1: active
59	0x3B	Configuration mismatch	G	USINT	0: - 1: active
60	0x3C	Communication loss	G	USINT	0: - 1: active
61	0x3D	Fatal error	G	USINT	0: - 1: active
62	0x3F	Normal state 0	G	USINT	0: - 1: active
…	…				
69	0x45	Normal state 7	G	USINT	0: - 1: active
70	0x46	Wait for input signal 0	G	USINT	0: - 1: active
…	…				
77	0x4D	Wait for input signal 7	G	USINT	0: - 1: active
78	0x4E	Test input 0	G	USINT	0: - 1: active
…	…				
85	0x55	Test input 7	G	USINT	0: - 1: active
86	0x56	Input error 0	G	USINT	0: - 1: active
…	…				
93	0x5D	Input error 7	G	USINT	0: - 1: active
94	0x5E	Cross-circuit channel 0	G	USINT	0: - 1: active
…	…				
109	0x6D	Cross-circuit channel 7	G	USINT	0: - 1: active
110	0x6E	Output overload 0	G	USINT	0: - 1: active
…	…				
117	0x75	Output overload 7	G	USINT	0: - 1: active
118	0x76	Unlock safety unit	G	USINT	0: - 1: active

Safe Link Status (VSC 135)

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	Disable Missing Safety Node diagnosis	G/S	USINT	0: No 1: Yes
2	0x02	Disable Node Learning Required diagnosis	G/S	USINT	0: No 1: Yes
3	0x03	Disable General Safe Link Error diagnosis	G/S	USINT	0: No 1: Yes
4	0x04	Disable Rotary Switch Position Error diagnosis	G/S	USINT	0: No 1: Yes
5	0x05	Safe Link node status	G	USINT	0: unknown 1: initialization 2: pre-operational 3: operational
6	0x06	Safe Link Interface Status	G	USINT	0: Inactive/not configured 1: Active (Ethernet) 2: Active (fieldbus)
7	0x07	Last error message	G	UINT	
8	0x08	Last error message additional information	G	UDINT	
9	0x09	Status Node 1	G	USINT	0: missing 1: invalid 2: wrong SADR 3: UDID mismatch 4: Wrong parameter 5: valid 6: ok 254: - 255: -
…	…				
39	0x27	Status Node 31	G	USINT	0: missing 1: invalid 2: wrong SADR 3: UDID mismatch 4: Wrong parameter 5: valid 6: ok 254: - 255: -

Safe Link Information (VSC 136)

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	Missing Safety Node	G	USINT	0: Inactive
					1: active
2	0x02	Node Learning Required	G	USINT	0: Inactive
					1: active
3	0x03	General Safe Link Error	G	USINT	0: Inactive
					1: active
4	0x04	Rotary Switch Position Error	G	USINT	0: Inactive
					1: active

Device Color Information (VSC 137)

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	Device status 1	G	USINT	0: Green 1: Green flashing 2: Yellow 3: Yellow flashing 4: Red 5: Red flashing 6: Gray/off 7: Green/yellow
…	…				
256	0x100	Device status 256	G	USINT	0: Green 1: Green flashing 2: Yellow 3: Yellow flashing 4: Red 5: Red flashing 6: Gray/off 7: Green/yellow

Fieldbus Bits (VSC 177)

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	Fieldbus bit input 0	G	USINT	0: -
					1: active
…	…				
16	0x10	Fieldbus bit input 15	G	USINT	0: -
					1: active
17	0x11	Fieldbus bit output 0	G	USINT	0: -
					1: active
…	…				
32	0x20	Fieldbus bit output 15	G	USINT	0: -
					1: active

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

Used hardware

The following hardware components are used in this example:

- Rockwell PLC ControlLogix 1756-L72, Logix 5572
- Rockwell Scanner 1756-EN2TR
- Block module TBEN-LL-4FDI-4FDX

Used software

The following software tools are used in this example:

- Rockwell Studio 5000
- Catalog file "TBEN-LL-4FDI-4FDX….l5k" as part of the as part of the file "TBEN-LL-MP1-FILE.zip" (downloadable free of charge under www.turck.com)

Prerequisites

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

7.12.1 Adding the device from the catalog file to the new project

The L5K file contains a device entry for the Safe Link manager **ETHERNET-MODULE TBEN_LL_4FDI_4FDX_manager** and a device entry for a Safe Link device **ETHERNET-MODULE TBEN_LL_4FDI_4FDX_device**. Depending on the device function, different process data variables are defined in the assembly instances.

- In the project with the open catalog file: Right-click on the device entry of the Safe Link manager **ETHERNET-MODULE TBEN_LL_4FDI_4FDX_manager** and copy via **Copy**.

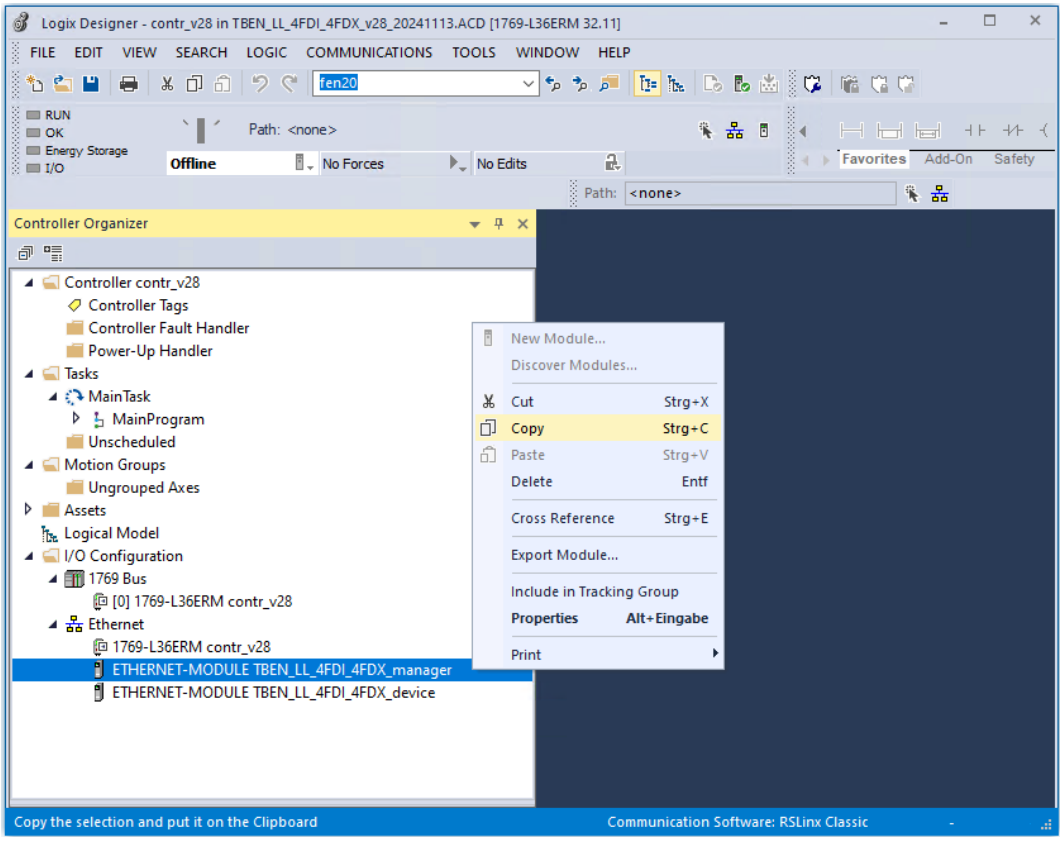


Fig. 75: Copying manager device entry in Logix Designer from catalog file

- Right-click the EtherNet/IP Scanner in the 2nd instance of Logix Designer and add the Safe Link manager to the project via **Paste**.
- Also add the Safe Link devices **ETHERNET-MODULE TBEN_LL_4FDI_4FDX_device** via copy and paste from the catalog file.

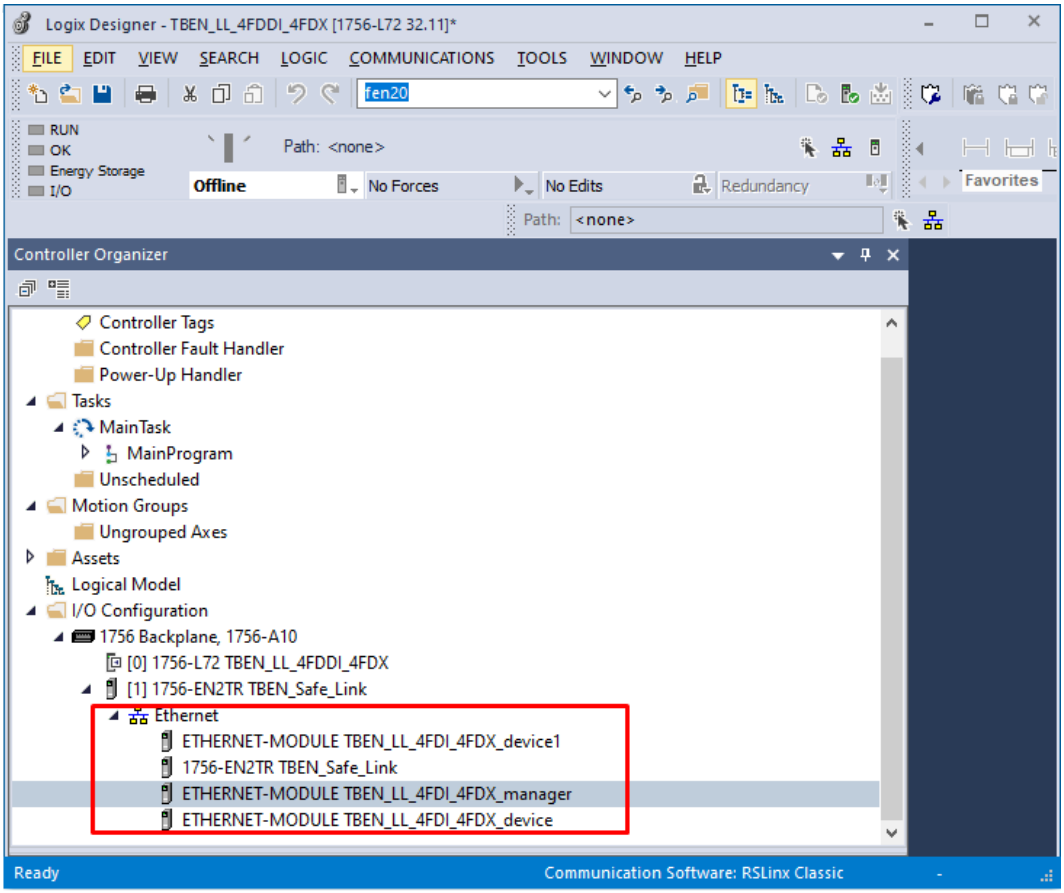


Fig. 76: New project with one Safe Link manager and several Safe Link devices

7.12.2 Configuring the devices in Logix Designer

- Double-click the device entry (here: Safe Link manager) to open it.
- Optional: Change the device name.
- Set the IP address of the device (example: 192.168.145.181).

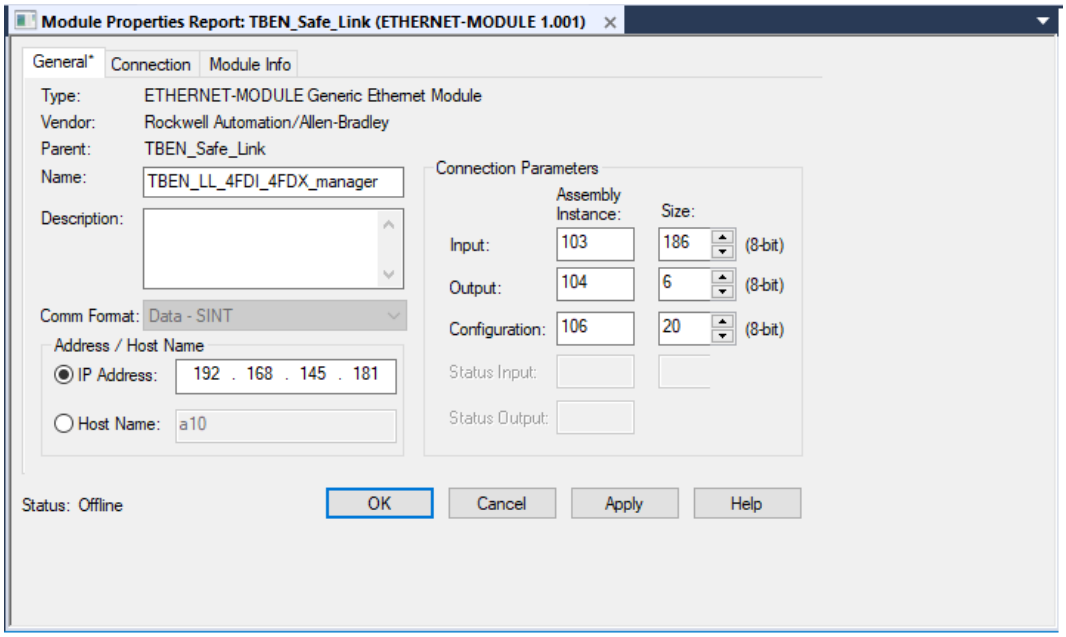


Fig. 77: Configuring the device

- Optional: Set the connection parameters.

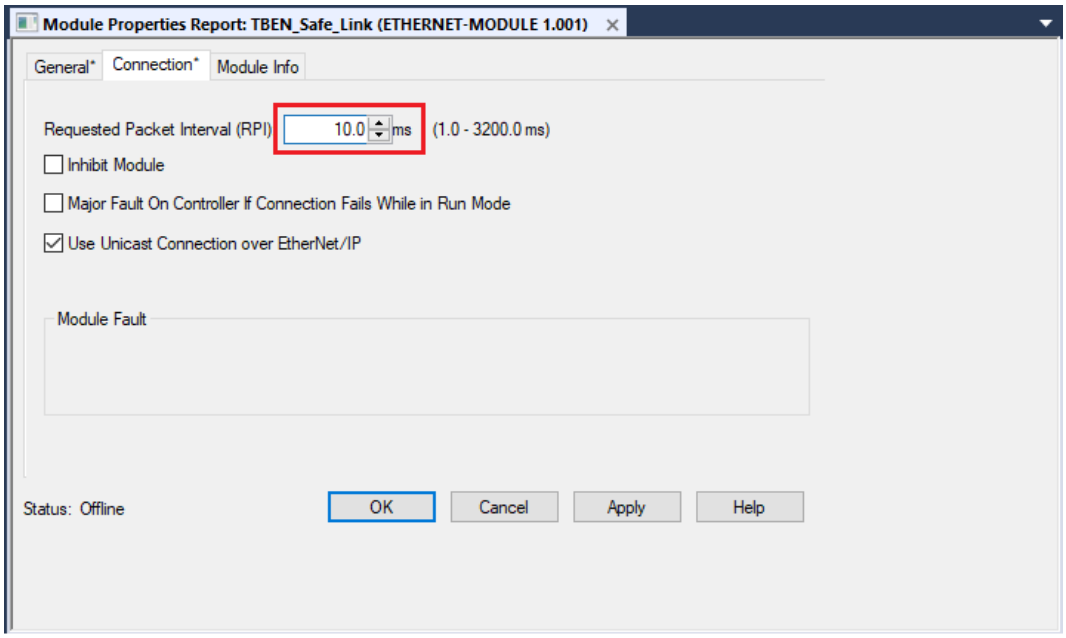


Fig. 78: Setting the connection parameters

7.12.3 Parameterizing the device

- Open the Controller Tags of the device.
- Parameterize the device via the Controller Tags (here **TBEN_LL_4FDI_-4FDX_manager:C**).

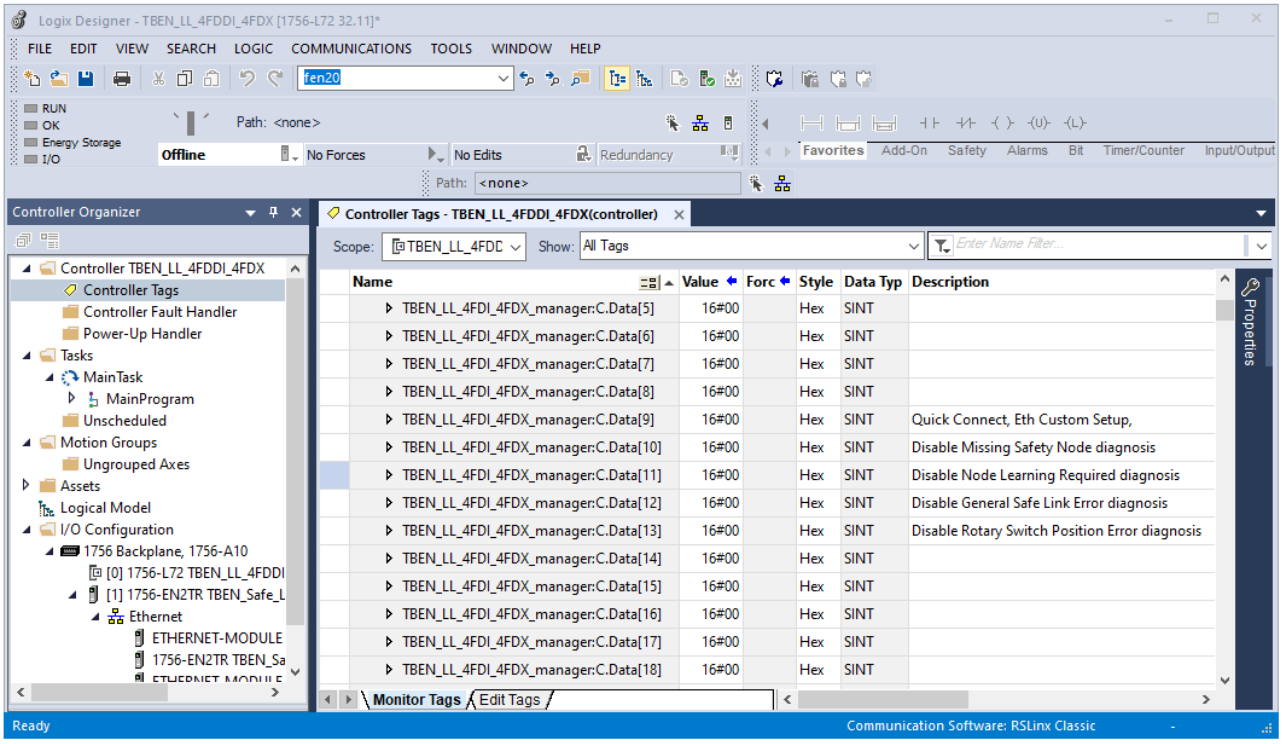


Fig. 79: Controller Tags, parameterizing the device

7.12.4 Going online with the PLC

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

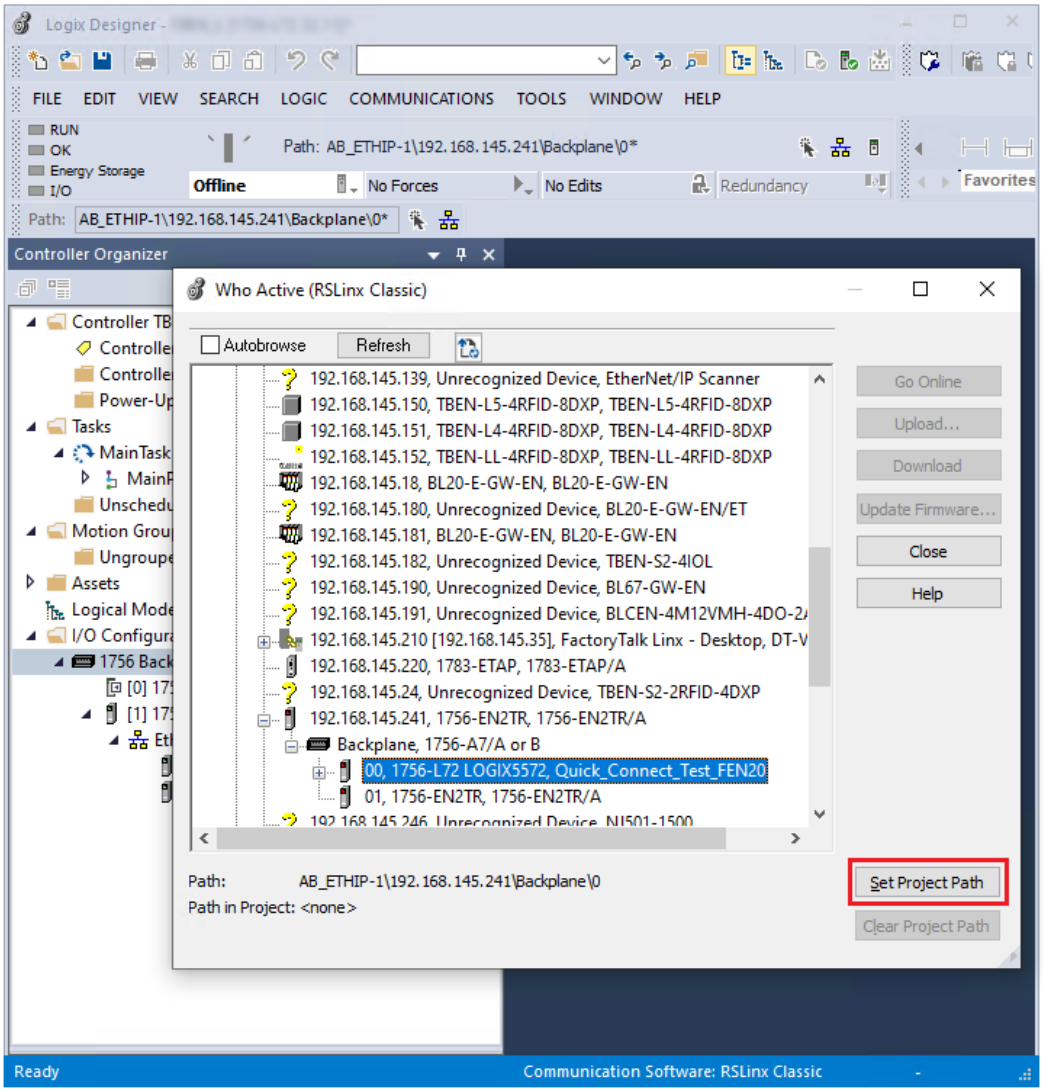


Fig. 80: Setting the communication path

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

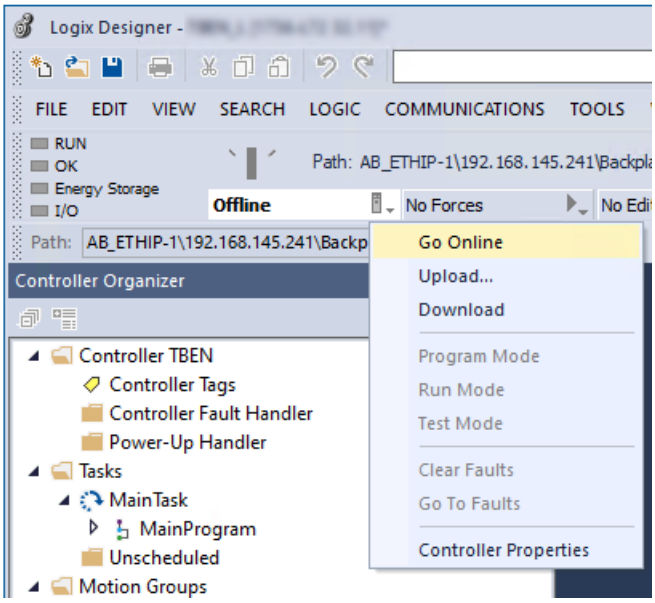


Fig. 81: Going online with the device

- ▶ 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.

7.12.5 Reading process data

- ▶ Open the Controller Tags in the project tree by double-clicking the entry.
- ⇨ Access to the input data (here: **TBEN_LL_4FDI_4FDX_manager:I**) and the output data (here: **TBEN_LL_4FDI_4FDX_manager:O**) is possible.

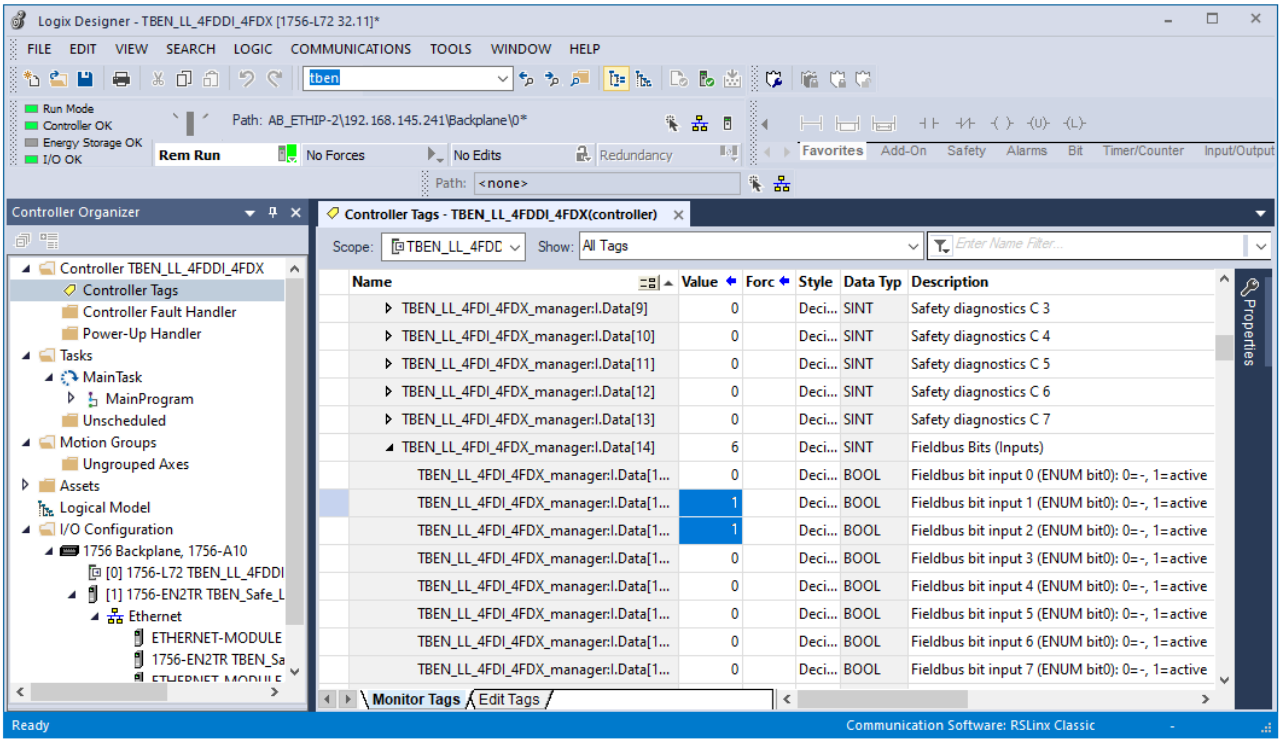


Fig. 82: Controller Tags of the process data in the project tree of the Logix Designer

8 Parameterizing and configuring

8.1 Parameters

The device has the following parameters.

Default values are shown in **bold**.

Parameter name	Value	Meaning
PROFINET configuration		
Deactivate I/O ASSISTANT Force Force Mode	**0**	**No**
	1	Yes
Deactivate all diagnostics	**0**	**No**
	1	Yes
Field bus configuration		
Deactivate EtherNet/IP	**0**	**No**
	1	Yes
Deactivate Modbus TCP	**0**	**No**
	1	Yes
Deactivate WEB server	**0**	**No**
	1	Yes
Safe Link Status		
Disable Missing Safety Node diagnosis	**0**	**No**
	1	Yes
Disable Node Learning Required diagnosis	**0**	**No**
	1	Yes
Disable General Safe Link Error diagnosis	**0**	**No**
	1	Yes
Disable Rotary Switch Position Error diagnosis	**0**	**No**
	1	Yes

9 Operating

9.1 Process input data

Word no.	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
n	**Safety Unit Status (Safety Status)** [▶ 106]															
	reserved													SUUM	SUCM	SUPM
n + 1	**Safety configuration integrity (Memory and F-Config Status)** [▶ 106]															
	reserved								F ERR	-	-	COM LO	-	CNF MM	NCNF	PMS
n + 2	**Safety diagnostics (Safe Status)** [▶ 106]															
	Safety diagnostics X1								Safety diagnostics X0							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
n + 3	Safety diagnostics X3								Safety diagnostics X2							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
n + 4	Safety diagnostics X5								Safety diagnostics X4							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
n + 5	Safety diagnostics X7								Safety diagnostics X6							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
Field bus bits [▶ 108]																
n + 6	FBI15	FB14	FB13	FB12	FB11	FB10	FB9	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1	FB0
Device Color Information (only Safe Link manager) [▶ 106]																
n + 7	Device Color Information 4				Device Color Information 3				Device Color Information 2				Device Color Information 1			
…	…															
n + 70	Device Color Information 256				Device Color Information 255				Device Color Information 254				Device Color Information 253			
	Safe Link-Status (only Safe Link manager) [▶ 107]															
n + 71	reserved								Safe Link Interface				Status Safe Link nodes			
n + 72	LEM (Last error message)															
n + 73	Last error message – additional information								Last error message – additional information (low byte)							
n + 74	Last error message – additional information (high byte)								Last error message – additional information							
n + 75	Status node 2								Status node 1							
…																
n + 89	Status node 30								Status node 29							
n + 90	reserved								Status node 31							
	Safe Link-Status (only Safe Link manager) [▶ 107]															
n + 91	reserved								Safe Link error bits							
									-	-	-	-	RPSE	GSE	NLR	MSN
	Module status															
n + 92	-	-	-	-	-	-	-	DIAG	-	-	FCE	-	-	COM	V1	-

Safety Unit Status

Name	Value	Meaning
SUPM	Protective mode	
	0	Not active
	1	Active
SUCM	Configuration mode	
	0	Not active
	1	Active
SUUM	Unknown mode	
	0	Not active
	1	Active

Safety configuration integrity (Memory and F-Config Status)

Name	Code	Meaning
PMS	512	No memory chip plugged
NCNF	513	No configuration available
CNFMM	514	Configuration mismatch
COMLO	516	Communication loss
FERR	519	Fatal Error

Safety diagnostics connector X0…X7

Name	Code	Meaning
RGG	-	Normal state
WAIT	528	Waiting for input signal
TEST	544	Test input
ERRFIN	560	Error at input
TCCH0	576	Cross-circuit channel 0
TCCH1	592	Cross-circuit channel 1
OVL	62…	Overload at output (pin 4)

Device Color Information

Shows the status of the OSSDs in the Turck Safety Configurator:

Value	Meaning
0	green
1	Green blinking
2	Yellow
3	Yellow blinking
4	Red
5	Red blinking
6	gray/off
7	green/yellow

Safe Link Status

Name	Value/ENUM	Meaning
SLNS (Safe Link node status)	0x00	unknown
	0x01	Initialization
	0x02	Pre-operational
	0x03	Operational
SLIS (Safe Link interface status)	0x00	Inactive/not configured
	0x01	Active (Ethernet)
	0x02	Active (fieldbus)
LEM (Last error message)	0…65535	
LEMADD (Last error message – additional information)	0… 4294967295	
STNO… (Status node…)	0x00	Missing
	0x01	Invalid
	0x02	Wrong SADR
	0x03	UDID mismatch
	0x04	Wrong param
	0x05	Valid
	0x06	OK

Safe Link information: Safe Link error bits

Name	Meaning
MSN	Missing safety node
NLR	Node learning required
GSE	General safe link error
RPSE	Rotary switch position error

Status of the safe unit (fieldbus bits)

Name	Meaning
FB 0.0…1.7	Outputs at TBEN-LL-4FDI-4FDX, which can be linked to the states of the safe signals in the Turck Safety Configurator and used as inputs in the non-safe controller.

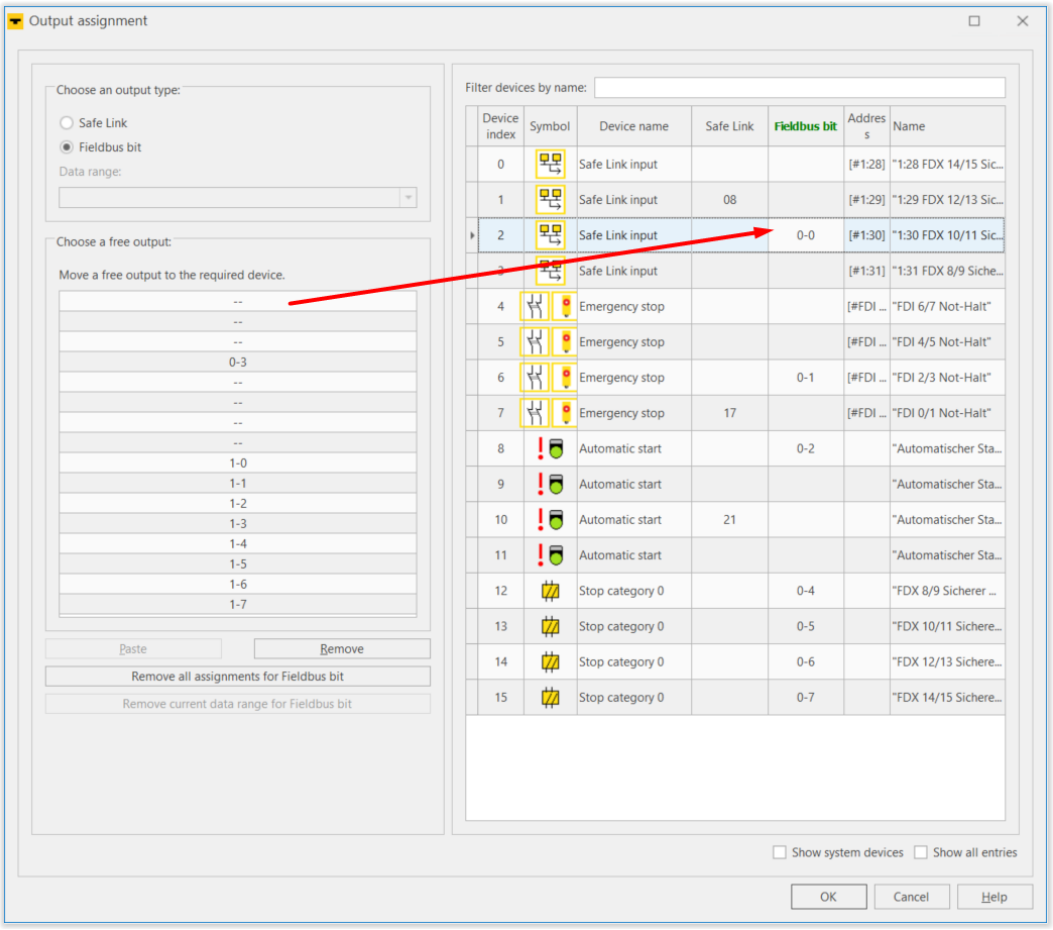


Fig. 83: TSC – assignment of fieldbus bits

Safe Link bits

Name	Meaning
01…27	The Safe Link bits are used to link the Safe Link devices within the Safe Link network.

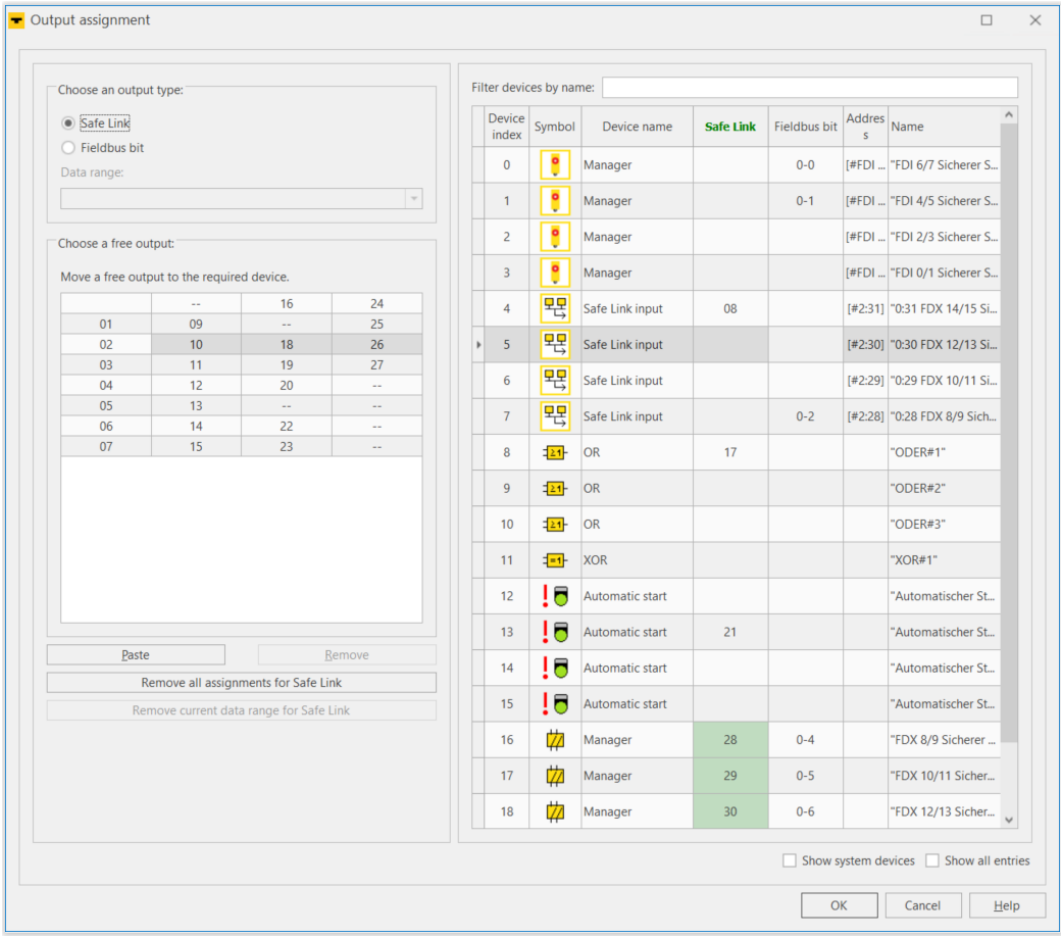


Fig. 84: TSC – assignment of Safe Link bits

9.2 Process output data

Byte no.	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
n	**Control-Wort** (no function)															
Unlock Safe Unit [▶ 110]																
n + 1	Reserved															UNLK
Field bus bits Field bus_output data_TBIP																
n + 2	FB15	FB14	FB13	FB12	FB11	FB10	FB9	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1	FB0

Field bus bits

Name	Meaning
FB0.0… FB1.7	These bits are output bits of the controller that can be linked to inputs on the TBEN-LL-4FDI-4FDX in the Turck Safety Configurator.

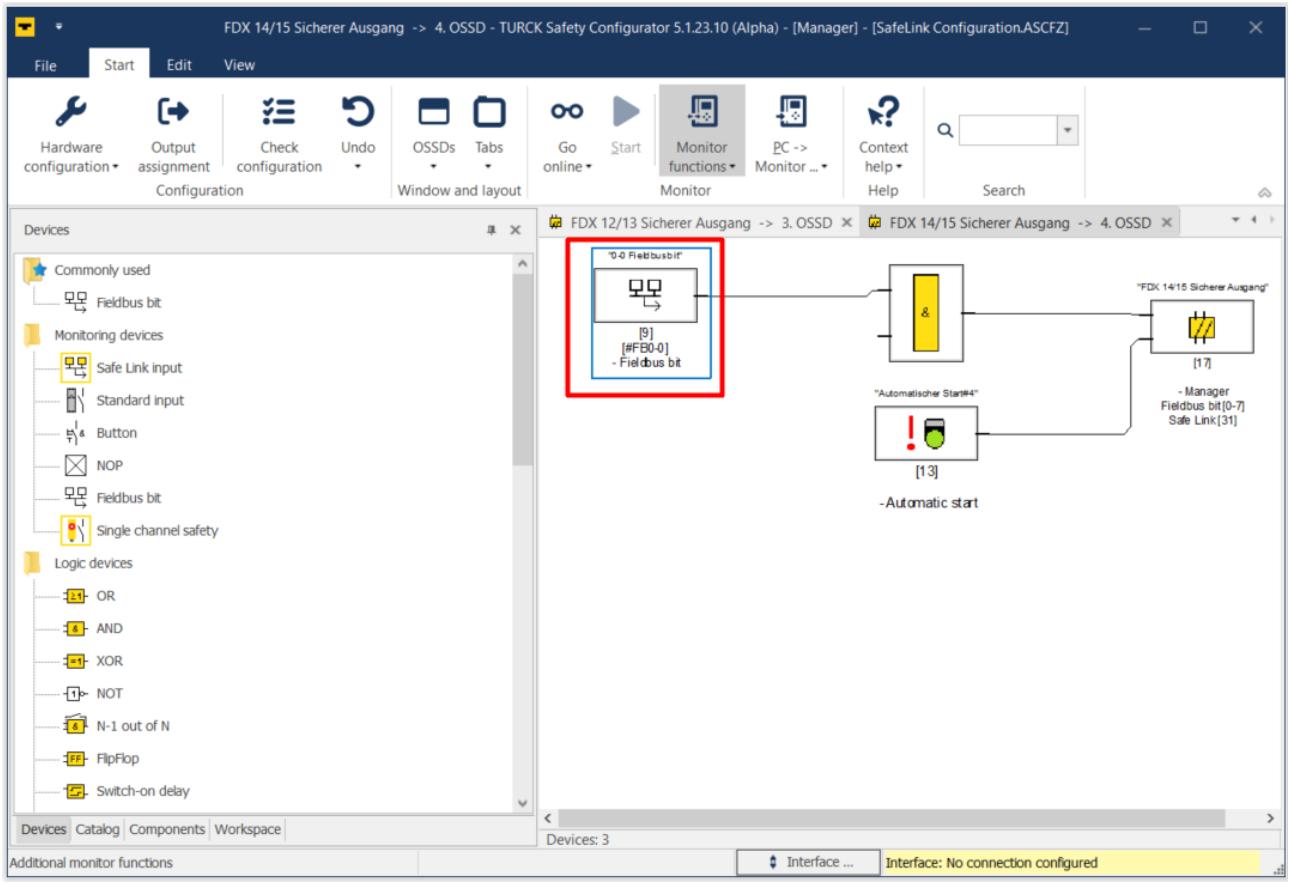


Fig. 85: Field bus bit at FDX channel

Unlock Safe Unit

Name	Meaning
UNLK	This bit serves for unlocking the safe unit. It responds to a falling edge.

- ▶ Set bit UNLK to 1 and back to 0.
- ⇨ The safe unit is unlocked.

9.3 Using the configuration memory

9.3.1 Storing a configuration

The safety function is automatically stored to the memory stick after a configuration has been downloaded to the device via Turck Safety Configurator.

Storing the configuration during module start

- ✓ The device is not supplied.
- ✓ The memory chip is empty.
- ✓ The device has stored a valid configuration.
- ▶ Plug the empty memory chip into the device.
- ▶ Switch-on the power supply.
- ⇨ The configuration will be loaded from the device to the memory stick during device start.

Storing the configuration during operation

- ✓ The device is connected to the Turck Safety Configurator.
- ✓ The memory chip is plugged from the device start and contains the actual configuration (identical configuration as in the Turck Safety Configurator).
- ▶ Load a new or changed configuration into the device via Turck Safety Configurator.

9.3.2 Loading a configuration from the memory chip

- ✓ Memory chip with valid configuration
- ▶ Set the rotary coding switches to 900 (F_Reset)
- ▶ Execute a power cycle.
  - ⇨ The device is reset.
- ▶ Set the rotary coding switch to an address unequal to "9xx".
- ▶ Plug the memory chip containing a valid configuration onto the device.
- ▶ Switch-on the power supply.
- ⇨ The configuration will be loaded from the memory chip to the device during device start.

9.3.3 Deleting the memory chip (Erase Memory)

The content of the memory chip can either be deleted by using the rotary coding switches or via the Turck Safety Configurator.

Deleting the configuration via rotary switch setting (901)

- ▶ Plug the memory chip into device.
- ▶ Set the rotary coding switches to 901 (Erase Memory).
- ▶ Execute a power cycle at the device.
- ⇨ The content of the memory chip is deleted. The procedure completed as soon as the ERR LED stops blinking.

Deleting the configuration via Turck Safety Configurator

- Select the function **monitor settings** → **delete configuration** in the Turck Safety Configurator to delete the content of the memory stick.

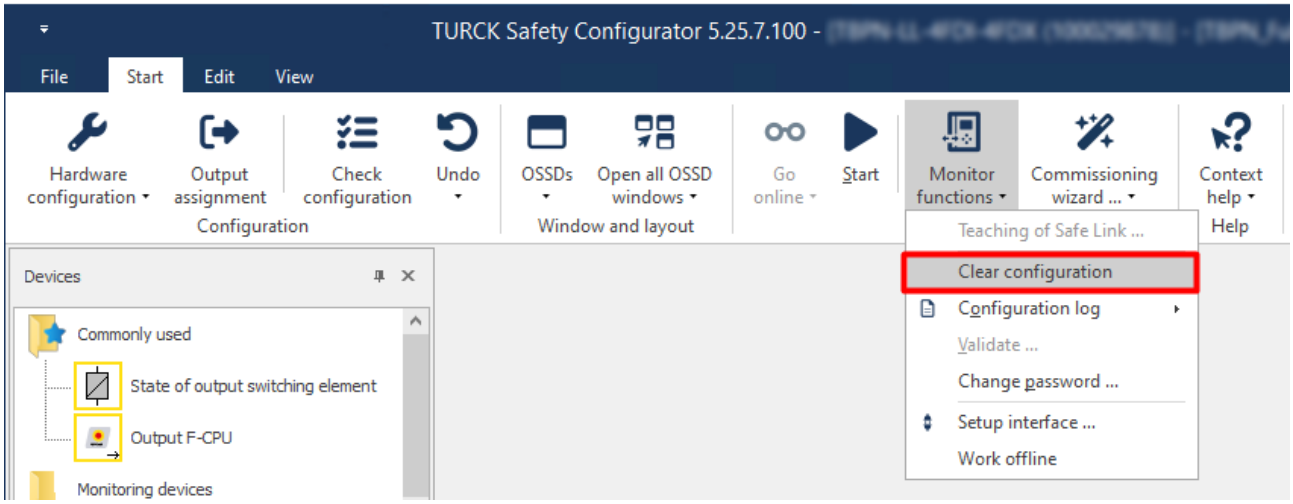


Fig. 86: Deleting the configuration via Turck Safety Configurator

⇨ The configuration on the memory chip is deleted. The procedure completed as soon as the ERR LED stops blinking.

9.3.4 Configuration transfer and module behavior

Configuration			Module behavior	Diagnostics
In device	**External memory**	**Device/ memory**		
Invalid/ none	Invalid/ none	-	Device start → Device **not** running	No configuration available , s. "Memory and F-Config Status" [▶ 106]
Invalid/ none	Valid	-	Device start →Device running → Loading the configuration from the memory to the device	-
Valid	Invalid/ none	-	Device start →Device running → Loading the configuration from the device to the memory	-
Valid	Valid	equal	Device start →Device running	-
Valid	Valid	unequal	Device start →Device running	Configuration mismatch, s. "Memory and F-Config Status" [▶ 106]
Valid	No memory chip plugged	-	Device start → Device **not** running	No memory chip plugged, s. "Memory and F-Config Status" [▶ 106]
Valid	Memory chip pulled	-	During operation	No memory chip plugged, s. "Memory and F-Config Status" [▶ 106]
changed during operation	Valid	unequal	During operation → The new configuration is checked. → Loading the configuration from the memory to the device	-

9.4 Reset the device to factory settings (factory reset)

NOTE
Sets the device and the plugged memory chip to factory settings, the content of the memory stick is deleted.

- ▶ Plug the memory chip into device.
- ▶ Set the rotary coding switches to 900 (Factory Reset).
- ▶ Execute a power cycle at the device.
- ⇨ The device as well as the plugged memory chip are reset, stored configuration is deleted.
- ⇨ The procedure completed as soon as the ERR LED stops blinking.

10 Restarting after device exchange or modification

10.1 Replacing the device

The replacement device has to be a device of the same type with the identical or a higher device version.

- ▶ Disconnect the device to be replaced from the power supply and network connection.
- ▶ Disconnect the connected sensors and actuators.
- ▶ Insert the memory chip of the device to be replaced into the new device. The memory chip is located under the cover of the service window.
- ▶ Set the last byte of the IP address on the new device (e.g. “1-6-8”). The address set must match the address of the old device.
- ▶ Note: Close the service window tightly to ensure the degree of protection (IP65, IP67, IP69K).
- ▶ Connect the new device to the power supply and wait until the configuration has been loaded from the memory chip to the safe unit.
- ▶ Disconnect the power supply.
- ▶ Connect the sensors and actuators and establish a network connection..
- ▶ Switch the power supply back on and wait until the device has finished restarting.

Read in the Safe Link network at the Safe Link manager

If a device is replaced, the Safe Link Manager must re-read the network. Reading is carried out via the Turck Safety Configurator. The setting of the rotary coding switch on the manager for reading in the network depends on how many devices have been replaced in the Safe Link network (see rotary coding switch position 921…925).

- ▶ Set the rotary coding switch on the Safe Link Manager (e.g. 921 if a device has been replaced in the network).
- ⇨ The network is read in. The error message on the manager disappears.
- ▶ Set the rotary coding switch on the Safe Link Manager back to the initial position (e.g. fix IP address).

11 Maintenance

The TBEN-LL-4FDI-4FDX is maintenance-free for the duration of use of 20 years.

Used cables as well as connected sensors and actuators have to be tested according to vendor specifications during the duration of use of TBEN-LL-4FDI-4FDX.

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

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at
https://www.turck.de/en/return-service-6079.php
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Decommissioning

The machine manufacturer is responsible for decommissioning the TBEN-LL-4FDI-4FDX. The operator must ensure that the device is used for its intended purpose.

Please observe the storage and transport requirements according to the general technical data.

14 Disposal

Defective or faulty devices must not, in any event, be put back into circulation. Send those devices back to Turck for testing and disposal.

15 Technical data

15.1 Technical data

Devices	
TBEN-LL-4FDI-4FDX	
■ ID	100039886
■ YoC	According to device labeling

Power supply	
V1 (incl. electronics supply)	24 VDC
V2	24 VDC, only through connected
Current feed-through	
■ XD1 tot XD2 (M12)	Max. 16 A per voltage group
Permissible range	20.4…28.8 VDC
Total current	9 A, observe derating [▷ 119]
■ Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (100022986)
Isolation voltages	≥ 500 VAC
Connector	
■ TBEN-LL-4FDI-4FDX	M12, L coded, 5-pin
Power loss	< 5 W

Interfaces	
Ethernet	2 × M12, 4-pin, D coded
Service interface	Ethernet

System and protocol data	
Transmission rate	10 Mbps/100 Mbps
Protocol detection	Automatic
Web server	Integrated
Service interface	Ethernet via XF1 or XF2
Modbus TCP	
Address assignment	Static IP, BOOTP, DHCP
Supported Function Codes	FC3, FC4, FC6, FC16, FC23
Number of TCP connections	8
Input register, start address	0 (0x0000)
Output register, start address	2048 (0x0800)
EtherNet/IP	
Address assignment	According to EtherNet/IP standard
Device Level Ring (DLR)	Supported
Number of Class 3 connections (TCP)	3
Number of Class 1 connections (CIP)	10
Input Assembly Instance	103
Output Assembly Instance	104

System and protocol data	
Configuration Assembly Instance	106
PROFINET	
Address assignment	DCP
MinCycle Time	1 ms
Diagnostics	According to PROFINET alarm handling
Automatic address setting	Supported
Media Redundancy Protocol (MRP)	Supported
Turck Safe Link	
Max. number of managers	1
Max. number of devices	30
Shutdown times	The shutdown times depend on the application. The validation protocol of the Turck Safety Configurator contains the determined worst-case switch-off times for the respective application.

Times	
Internal delay time (for calculating the watchdog time)	10 ms
Response times	See Safety Characteristic Data [▶ 25]

General technical data	
Max. cable length	
■ Ethernet	100 m (per segment)
■ Sensor/actuator	30 m
Dimensions (W × L × H)	60.4 × 230.4 × 39 mm
Operating temperature	-40 °C… +70 °C
■ Ex derating	-25 °C… +60 °C S. document "Notes on Use in Ex zone 2 and 22" (100022986)
Storage temperature	-40 °C… +85 °C
Operating altitude	Max. 5000 m
Degree of protection	IP65, IP67, IP69K The degree of protection is only guaranteed if unused connections are closed with suitable screw caps or blind caps.
Housing material	Fibre-glass reinforced Polyamide (PA6-GF30)
Housing color	black
Material connectors	brass, nickel-plated
Window material	Lexan
Material screw	303 stainless steel
Material label	Polycarbonate
Halogen-free	Yes
Mounting	2 mounting holes, Ø 6.3 mm

Standard/directive conformity	
Directives	2006/42/EG machine directive
	2014/35/EU Low Voltage Directive
	2014/30/EU EMC directive
Vibration test	According to IEC 60068-2-6/ IEC 60068-2-47, acceleration up to 20 g
Drop and topple	According to IEC 60068-2-31/IEC 60068-2-32
Shock test	According to IEC 60068-2-27
Electromagnetic compatibility	According to IEC 61131-2/IEC 61326-3-1
Approvals and certificates	CE
	UV-resistant according to DIN EN ISO 4892-2A (2013)
Note on ATEX/IECEx	S. document "Notes on Use in Ex zone 2 and 22" (100022986)

15.2 Technical data – safety inputs

General technical data	
Connector	M12, 5-pin
Input delay	2.5 ms

Safety inputs for OSSD	
Signal voltage, low level	IEC 61131-2, type 1 (< 5 V; < 0.5 mA)
Signal voltage high level	IEC 61131-2, type 1 (< 15 V; < 2 mA)
Max. OSSD supply per channel	2 A per connector C0/X0…C7/X7 1.5 A at 70° C, observe derating [▶ 119]
Max. tolerated test pulse width	1 ms
Min. interval between two test pulses	12 ms at 1 ms test pulse width 8.5 ms at 0.5 ms test pulse width 7.5 ms at 0.2 ms test pulse width

Safety inputs for potential free contacts	
Loop resistance	< 150 Ω
Max. line capacity	max. 1 µF at 150 Ω, limited by line capacity
Test pulse typ.	0.6 ms
Test pulse max.	0.8 ms
Sensor supply	Supply VAUX1/T1 max. 2 A, observe derating [▶ 119]
Interval between two test pulses, minimum	900 ms (for static inputs)
Connection to external potential	Not allowed

15.3 Technical data – safety outputs

General technical data	
Connector	M12, 5-pin
Safety outputs	
Suitable for inputs according to EN 61131-2, type 1	
Output level in OFF-state	< 5 V
Output level in OFF-state	< 1 mA
Test pulse resistive load, max.	0.5 ms
Test pulse, max.	1.25 ms
Interval between two test pulses, typical	500 ms
Interval between two test pulses, minimum	250 ms
Actuator supply	Supply VAUX1/T1, max. 2 A, observe derating [▶ 119]
Max. total current for device	9 A
Max. output current	2 A (resistive) 2 A (DC load)
	1 A (inductive)
Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (100022986)
The user have to provide an additional overcurrent protection on site.	

15.4 Derating

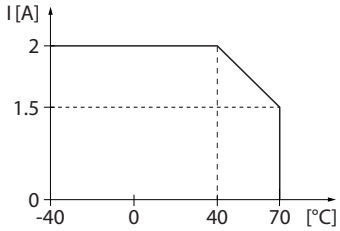


Fig. 87: Derating – output current

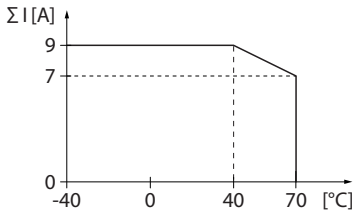


Fig. 88: Derating – total current

16 Turck branches — contact data

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