TURCK

Your Global Automation Partner

TBEN-LL-...
Digital I/O Modules

Instructions for Use

Table of Contents

1 About these instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are written for specifically trained personnel and must be read carefully by anyone entrusted with the installation, commissioning, operation, maintenance, disassembly or disposal 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)
- Notes on Use in Ex zone 2 and 22 (100022986)
- Approvals

1.4 Feedback about these instructions

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

2 Notes on the product

2.1 Product identification

This instruction is valid for the following devices:

- TBEN-LL-16DIP
- TBEN-LL-16DOP
- TBEN-LL-16DXP
- TBEN-LL-8DIP-8DOP

2.2 Scope of delivery

The delivery consists of the following:

- I/O module
- Screw caps or blind caps for network and I/O connectors
- Labeling clips

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 [▷ 155].

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

Due to the Turck multiprotocol technology, the multiprotocol I/O modules for Ethernet can be operated in the four Ethernet protocols PROFINET, EtherNet/IP, Modbus TCP and CC-Link field Basic. The modules detect the bus protocol automatically during the start-up.

The TBEN-L devices provide eight M12 female connectors for the connection of up to 16 digital sensors or actuators.

The devices meet the requirements for passive safety [▶ 28] and can be used in the following applications:

- Applications up to SIL CL2 (according to EN 62061:2016, section 6.7.7)
- Applications up to Category 3 and Performance Level d (according to EN ISO 13849-1: 2016)

Installation directly in the field is possible thanks to degree of protection IP65, IP67 IP67K. Devices with the Ex marking are suitable for use in the Ex area in zone 2 and zone 22.

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.

3.1.1 Foreseeable Misuse

The device is not suitable for:

- The permanent use in liquids

Modifications to the device

It is not permitted to modify the technical function or the construction of the device.

3.2 General safety instructions

- 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.
- Change the default password of the integrated web server after the first login. Turck recommends the use of a secure password.

3.3 Notes on UL approval

- Use UL certified CYJV cables that are suitable for the current/voltage rating and have an insulation temperature of at least 75 °C.
- Only use the device in an area with no more than pollution degree 2.

3.4 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.

3.5 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

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

Depending on the device variant, eight digital input and output channels, 16 digital input channels, 16 digital output channels or 16 universal digital I/O channels which can be used as inputs or outputs are available for connecting digital sensors and actuators. The connections for the digital sensors and actuators are designed as A-coded M12 sockets. Two D-coded M12 sockets are provided for the Ethernet connection.

For connecting the supply voltage, the device has 5-pin, L-coded M12 connectors.

The multiprotocol device can be operated with the four Ethernet protocols PROFINET, EthernNet/IP, Modbus TCP and CC-Link field Basic by automatic protocol detection without user intervention

4.1 Device overview

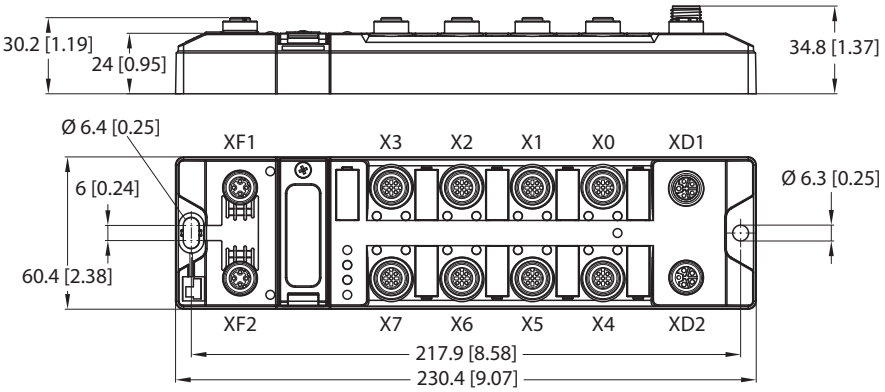

Fig. 1: Dimensions TBEN-LL-…

4.1.1 Operating elements

The device has the following operating elements:

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

4.1.2 Indication elements

The device is provided with the following LEDs:

- Power supply voltage
- Group and bus error
- Status
- Diagnostics

4.1.3 Block diagram

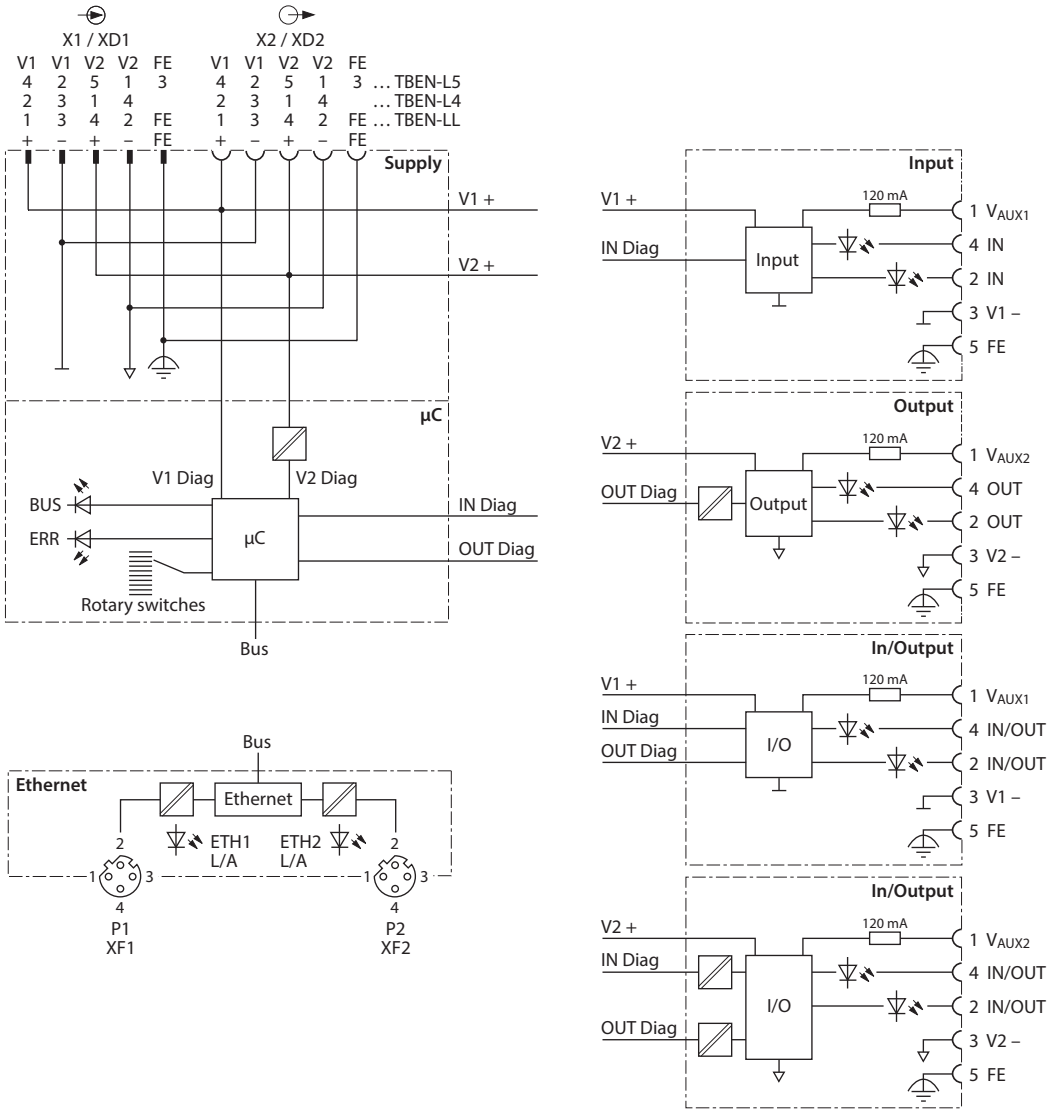

Fig. 2: Block Diagram

4.2 Properties and features

- Fiber-glass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Degree of protection IP65/IP67/IP69K
- UV-resistant according to DIN EN ISO 4892-2
- Metal connectors
- Channel-related short-circuit diagnosis of outputs
- Connector-related short-circuit diagnosis of the sensor/actuator supply voltage
- Separated power groups for safety shutdown
- Integrated Ethernet-switch for building up a line-topology
- Transmission speed 10 Mbps/100 Mbps
- Integrated web server
- Up to 16 digital in-/outputs
- Multiprotocol: PROFINET device, EtherNet/IP device, Modbus TCP server, CC-Link IE Field Basic server
- ARGEE functionality
- PROFINET:
  - Conformance Class B PA
  - Conformity according to PROFINET specification V2.35
  - System redundancy S2
  - Network load class 3
- EtherNet/IP:
  - Predefined in- and output assemblies

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
- CC-Link IE Field Basic

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

- QuickConnect (QC)
- 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 Digital modules – extended digital functions

In PROFINET, the extended digital functions are configured via device parameterization via GSDML file. In EtherNet/IP, the functions are provided in special catalog files for RSLogix from Rockwell Automation. In Modbus TCP the extended functions are configured via Modbus registers. In addition to that, the functions are configurable via the device's web server or the device DTMs.

The digital TBEN modules provide the following extended digital functions:

Impulse stretch

The function "impulse stretch" allows a detection of short input signals in longer PLC cycle times by means of signal extension.

4.3.3 Backplane Ethernet Extension Protocol (BEEP)

BEEP (Backplane Ethernet Extension Protocol) is a technology that is available in many digital Turck multi protocol block I/O modules. BEEP allows a network, of up to 33 participants (one controller and 32 devices) or 480 bytes of data, to appear to the PLC as a single device on a single connection using a single IP address.

Detailed information about BEEP can be found in the document "BEEP – Backplane Ethernet Extension Protocol" (ID **100002454**).

4.3.4 Turck Field Logic Controller function (FLC ARGEE)

The device supports logic processing via the "Turck Field Logic Controller (FLC ARGEE)" function. This enables the device to implement small to medium-sized control tasks in order to reduce the load of the central controller. The FLCs can be programmed in the ARGEE engineering environment.

The ARGEE programming software can be downloaded free of charge from **www.turck.com**.

The "SW_ARGEE_Environment_Vx.x.zip" file also contains the documentation for the programming environment as well as the software.

4.4 Possible Ethernet network structures

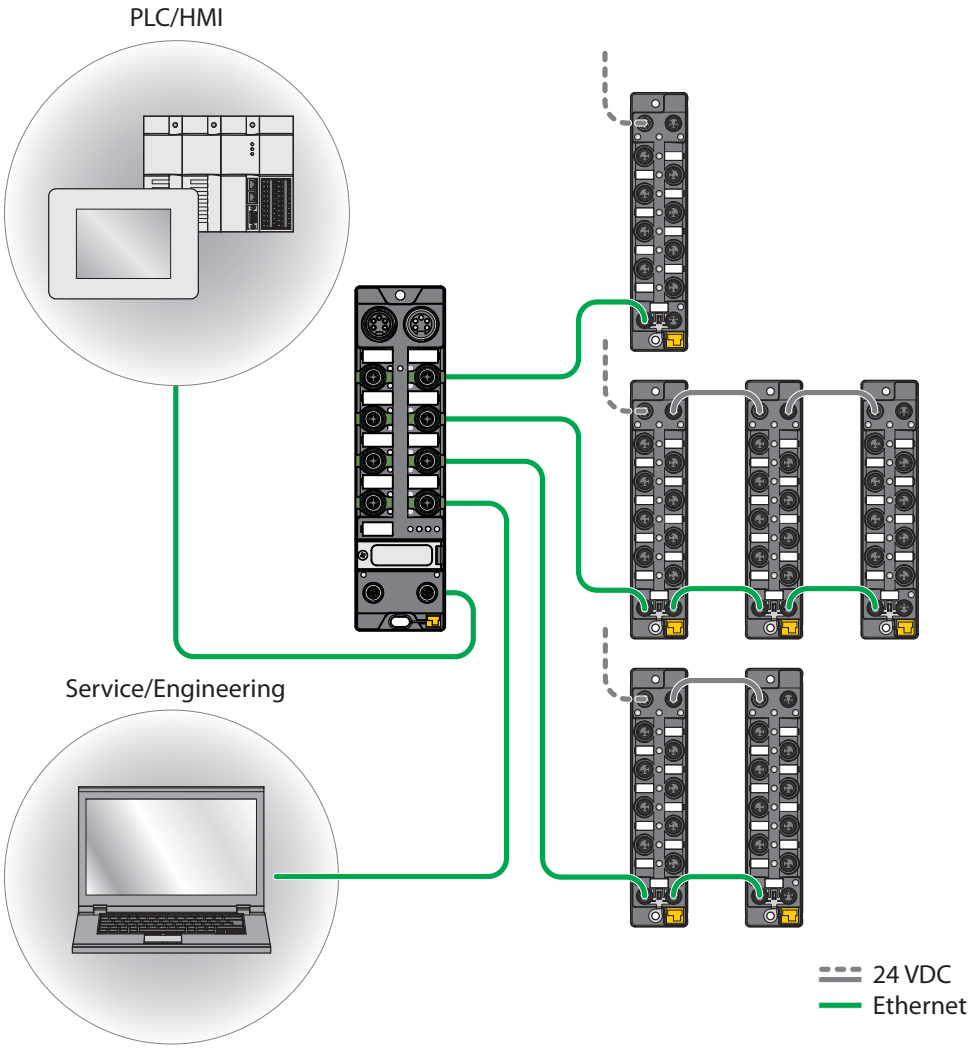

Fig. 3: Network structure, example 1

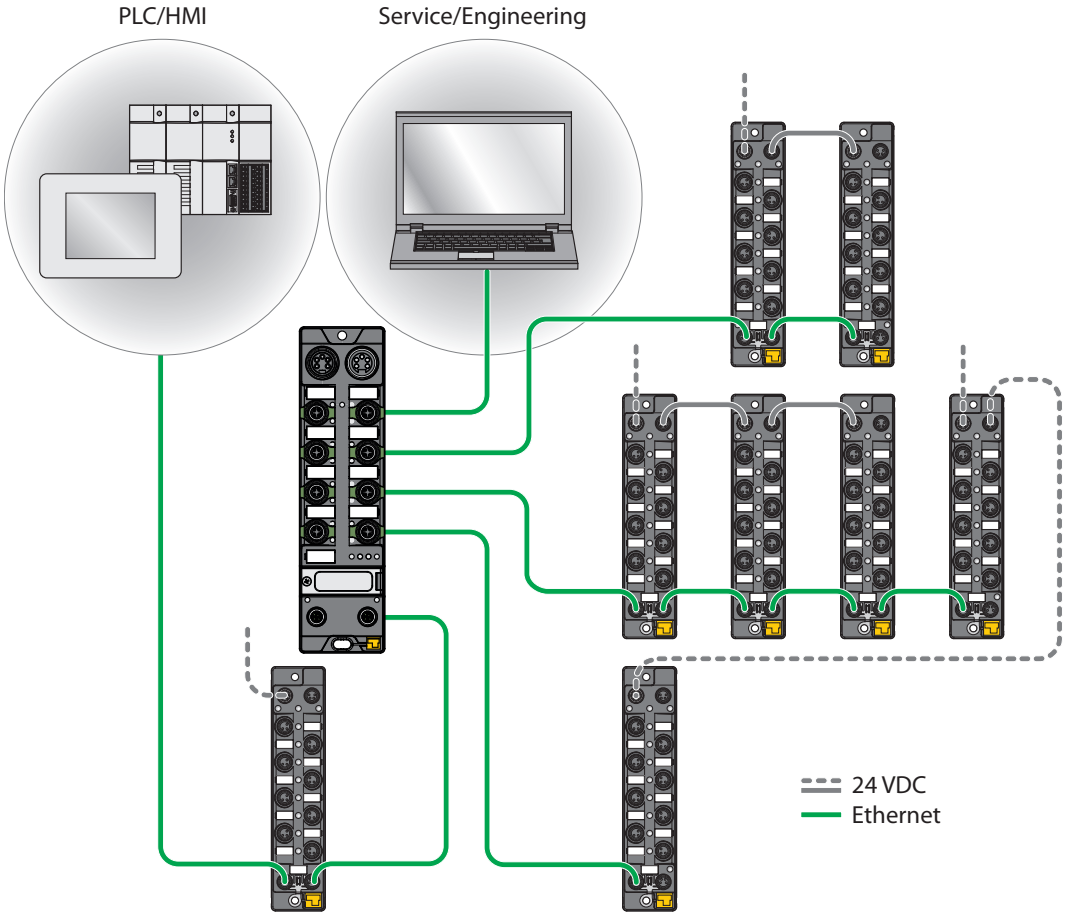

Fig. 4: Network structure, example 2

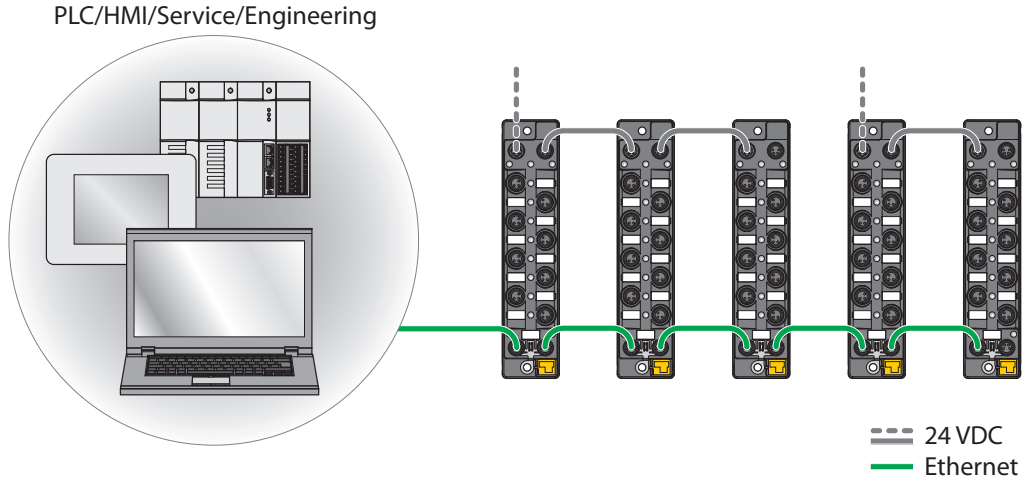

Fig. 5: Network structure, example 3

4.4.1 Ethernet daisy chain - max. number of connected modules

Prerequisites:

- Optimized network Only TBEN-L-modules in the daisy chain, no additional switches, no third-party devices
- Exchange of pure cyclical process data, no acyclical data

Cycle time	Maximum number of TBEN-L modules
1 ms	21
2 ms	42

NOTE
Deviations from the specification above may lead to a reduction of possible TBEN-L modules connected to one daisy chain.

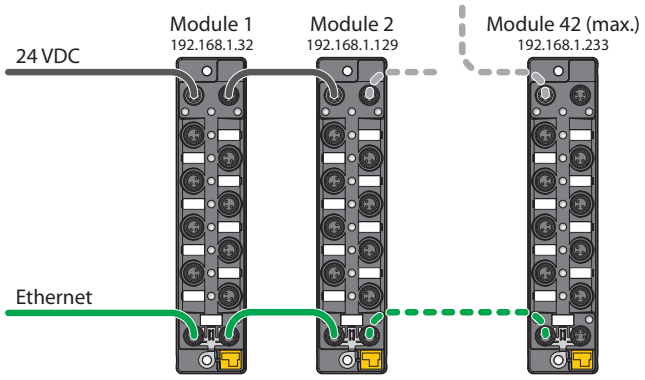

Fig. 6: Daisy chain

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 fasten both together on the mounting plate, see [▷ 18].
- ▶ Connect the device, see [▷ 21].
- ▶ 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.

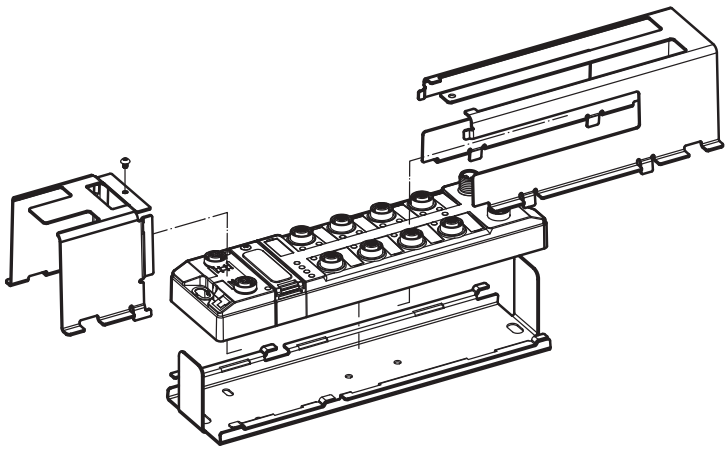

Fig. 7: Installing the device in the TB-SG-L protective housing

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.

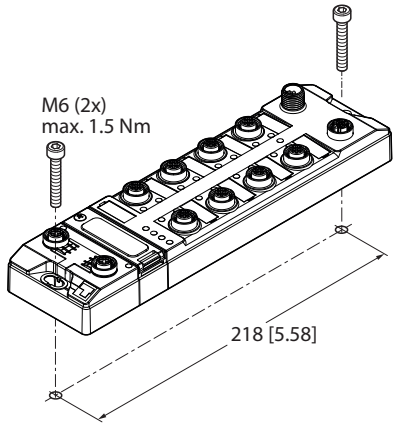

Fig. 8: Mounting the device onto a mounting plate

5.3 Outdoor device installation

The device is UV resistant in accordance with DIN EN ISO 4892-2. Direct sunlight may cause material wear and changes in color. The mechanical and electrical properties of the device are not impaired.

- ▶ To prevent material wear and color changes: Protect the device from direct sunlight with protective panels.

5.4 Grounding the device

5.4.1 Equivalent wiring diagram and shielding concept

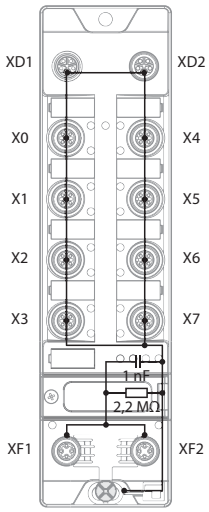

Fig. 9: TBEN-LL-16D…, TBEN-LL-8DIP-8DOP – equivalent wiring diagram and shielding concept

5.4.2 Shielding of the fieldbus and I/O level

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

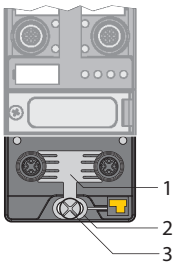

Fig. 10: Grounding clip (1), grounding ring (2) and metal screw (3)

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.

5.4.3 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.

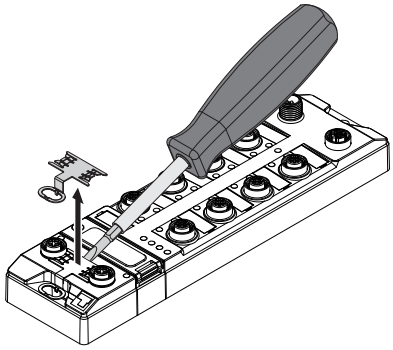

Fig. 11: Removing the grounding clamp

5.4.4 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.

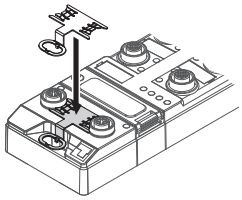

Fig. 12: Mounting the grounding clip

5.4.5 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

NOTICE
Penetration of liquids or foreign objects due to leaking connections
Loss of degree of protection IP65/IP67/IP69K possible

- Tighten M12 male connectors with a tightening torque of 0.6 Nm.
- Only use accessories that guarantee the protection class.
- Provide unused male connectors with suitable sealing or blanking caps. The tightening torque for the M4 screws 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 device in safety applications

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 0.6 Nm.
- Provide unused male connectors with suitable sealing or blanking caps. The tightening torque for the M4 screws is 0.5 Nm.

6.3 Connecting the device to Ethernet

For the connection to Ethernet the device has an integrated auto-crossing switch with two 4-pin, D-coded M12 x 1-Ethernet-connectors. The maximum tightening torque is 0.6 Nm.

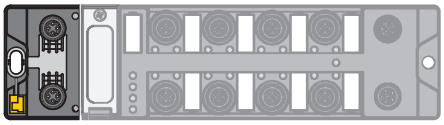

Fig. 13: M12 Ethernet connector

- 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. 14: Pin assignment Ethernet connectors

6.3.1 Applications with QuickConnect (QC) and Fast Start Up (FSU)

- Do not use crossover cables in applications with QuickConnect (QC) and and Fast Start Up (FSU) applications.
- Connect incoming Ethernet cables to XF1.
- Connect outgoing Ethernet cables to XF2.

6.4 Connecting the power supply

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

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

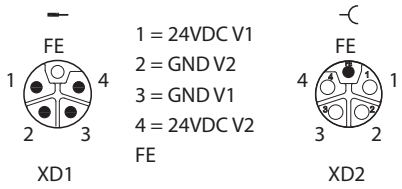

Fig. 15: Pin assignment power supply connectors

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

Voltage	Function
V1	System voltage: power supply 1 (incl. supply of electronics)
V2	Load voltage: power supply 2

NOTE
The system voltage (V1) and the load voltage (V2) are supplied and monitored separately. If the permissible supply voltages are undershot, the voltages at the connectors are switched off according to the supply concept of the module type. If V2 is undershot, the PWR LED changes from green to green flashing or red (depending on the configuration). If V1 is undershot, the PWR LED extinguishes.

6.4.1 Supply concept

The devices are supplied via two separate voltages V1 and V2.

V1 = supply of the module electronics and the respective connectors
V2 = supply of the respective connectors (can be switched-off separately)

The supply concept enables the safety-related shutdown of parts of the plant via emergency stop circuits by externally switching off the V2 supply.

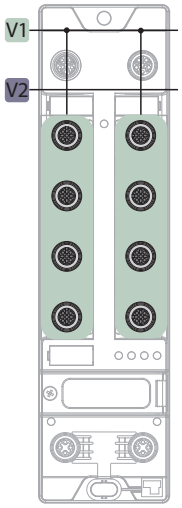

Fig. 16: Power supply of TBEN-LL-16DIP

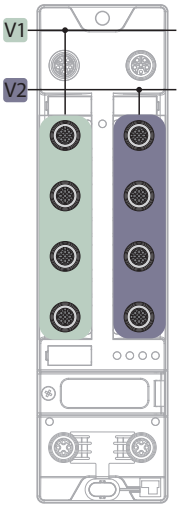

Fig. 17: Power supply of TBEN-LL-16DXP and TBEN-LL-8DIP-8DOP

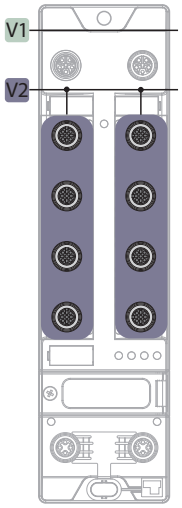

Fig. 18: Power supply of TBEN-LL-16DOP

6.5 Connecting digital sensors and actuators

The device has eight 5-pin M12 connectors for connecting digital sensors and actuators. The maximum tightening torque is 0.6 Nm.

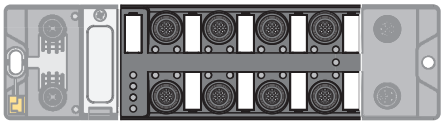

Fig. 19: M12 connectors for connecting digital sensors and actuators

6.5.1 TBEN-LL-16DIP

- Connect digital 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.

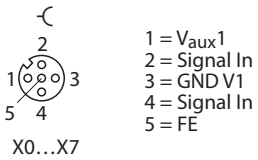

Fig. 20: Connectors for digital sensors – pin assignment

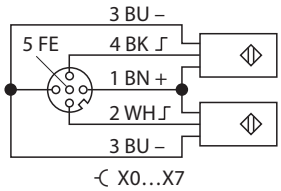

Fig. 21: Connectors for digital sensors – wiring diagram

6.5.2 TBEN-LL-16DOP

- Connect digital 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.

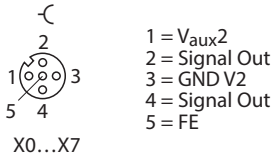

Fig. 22: Connectors for digital actuators – pin assignment

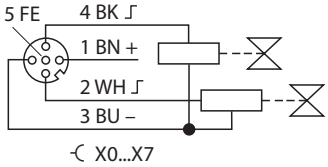

Fig. 23: Connectors for digital actuators – wiring diagram

6.5.3 TBEN-LL-8DIP-8DOP

- Connect digital 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.

Inputs

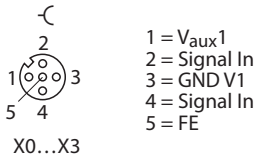

Fig. 24: Connectors for digital sensors – pin assignment

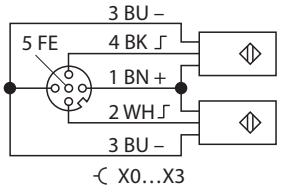

Fig. 25: Connectors for digital sensors – wiring diagram

Outputs

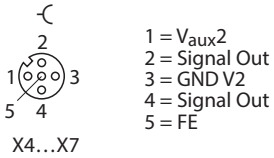

Fig. 26: Connectors for digital actuators – pin assignment

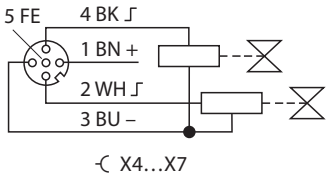

Fig. 27: Connectors for digital actuators – wiring diagram

6.5.4 TBEN-LL-16DXP

- Connect digital 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.

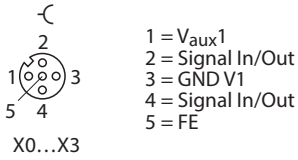

Fig. 28: Connectors for digital sensors and actuators – pin assignment

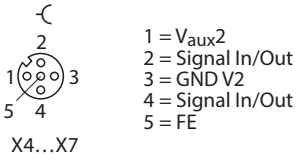

Fig. 29: Connectors for digital sensors and actuators – pin assignment

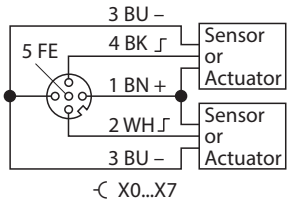

Fig. 30: Connectors for digital sensors and actuators – wiring diagram

7 Commissioning

7.1 Using the device in safety applications

The device is designed in accordance with EN ISO 13849- 1 “Safety of machinery - Safety-related parts of control systems”.

Performance Level (PL)/SIL Level

Due to the galvanic isolation of load and operating voltage, the design of the devices allows the fault exclusion of voltage carry-over to safely disconnected equipment with a single fault safety of category 3 for safety functions up to performance level d (according to EN ISO 13849). The maximum achievable Safety Integrity Level is SIL CL2 (according to EN 62061:2016, section 6.7.7).

The device is part of a safety-related overall system. The overall system must always be evaluated as a whole with regard to the requirements of EN ISO 13849-1 and EN 62061.

7.1.1 Safety function

The safety function is executed by the higher-level system.

Passive safety - galvanically isolated load voltage

The following slots of the devices, incl. inputs and outputs, are supplied by the VAUX2 supply voltage:

- TBEN-LL-16DOP: X0…X7
- TBEN-LL-8DIP-8DOP: X4…X7
- TBEN-LL-16DXP: X4…X7

VAUX2 is supplied from the supply voltage V2 (load voltage) of the device (s. ”Connecting” → „Supply concept”).

In the safe state, the VAUX2 supply and the outputs supplied via V2 are voltage-free. The load voltage is switched off externally in the higher-level system via an external safety relay or a safety control system.

Safety characteristic data for the galvanic isolation

Characteristic data	Value	
MTTF	See ”Technical data”	
Lifetime	20 years	
Diagnostic coverage	0…99 %	Determination via FMEA according to ISO 13849-2: 2013

NOTE
The calculation of $MTTF_D$ data of electronic components is done according to ISO 13849-1:201, Annex C.5: "$MTTF_D$ data of electrical components" and D.1: "Parts count method".

7.1.2 Safety planning

The operator is responsible for the safety planning.

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.

7.1.3 Safe commissioning

Installing connecting cables safely

NOTICE
Incorrect connection of connecting cables
Danger of cross connections
- Install and connect the cables safely and separately in accordance with EN 60204-1.
- Install cables with cross-circuit protection if the safe installation of the cables is not possible.

Switch off supply voltage safely

WARNING
1-pole switch-off the supply voltage
Safe separation not guaranteed
- Always switch-off the supply voltage on both poles.

Connecting sensors and actuators

WARNING
External feed
Deactivation of the galvanic isolation
- If the galvanic isolation is used, ensure on the application side that no external feed can occur.
- DXP channels that operate with safe disconnectable potential must be supplied by the corresponding conenctor.

7.1.4 Cited Standards

Standard	Title
DIN EN ISO 13849-1:2016	Safety of machinery – Safety-related parts of control systems
DIN EN 62061:2005 + A1:2013 IEC 62061:2005	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
DIN EN 61508:2011 IEC 61508:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems
DIN EN 61131-2:2008 IEC 61131-2:2007	Programmable controllers
EN ISO/ISO 12100	Safety of machinery – General principles for design – Risk assessment and risk reduction

7.2 Adjusting network settings and operation mode

NOTE
Changes to network settings and operating mode are only applied after restarting the device.

Adjusting network settings

The network settings can be adapted via three rotary coding switches on the device, via TAS (Turck Automation Suite), the web server, the DTM a DHCP server or PROFINET DCP.

The setting is made during commissioning of the device and is necessary to establish a connection between the PLC and the device.

Configuring the operating mode

The operating mode of the device (Rotary, BootP, PGM-DHCP etc.) can only be adjusted using the decimal rotary coding switches on the device.

7.2.1 Adjusting network settings and operation mode via rotary coding switches

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

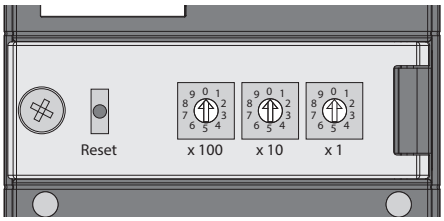

Fig. 31: Service window

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

Switch positions

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

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

Switch position	Mode	Description
000	Network reset	The Network reset resets the following 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.
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.
701…899	Name	The "Name" mode is used to set the DNS name of the device in Ethernet/IP networks. This mode is mainly used for DNS-based addressing in Schneider Electric controllers. The IP address is assigned automatically. The devices are addressed via the prefix "TBEN" and the address set on the rotary coding switches as follows: ■ Switch position 701: TBEN_701 … ■ Switch position 899: TBEN_899

Switch position	Mode	Description
900	Factory reset	The factory reset resets all settings to the default values: ■ Network setting (IP address, subnet mask, gateway) ■ PROFINET device name ■ Device parameters

7.2.2 Adjusting network settings via TAS (Turck Automation Suite)

In the delivery state the device has the IP address 192.168.1.254. The IP address can be set via TAS (Turck Automation Suite). TAS is available free of charge at www.turck.com.

- ▶ Connect the device to a PC via the Ethernet interface.
- ▶ Open TAS.
- ▶ Click **Scan network**.

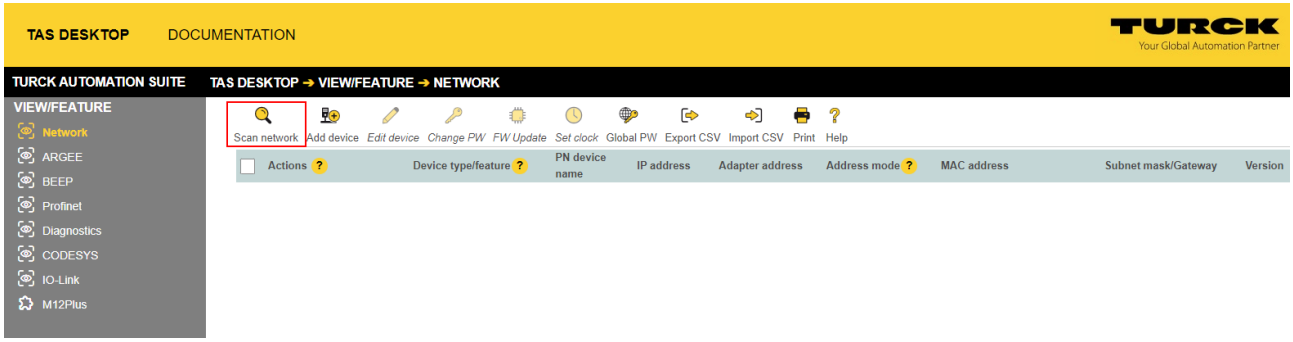

Fig. 32: Home screen in TAS

⇨ TAS shows the connected devices.

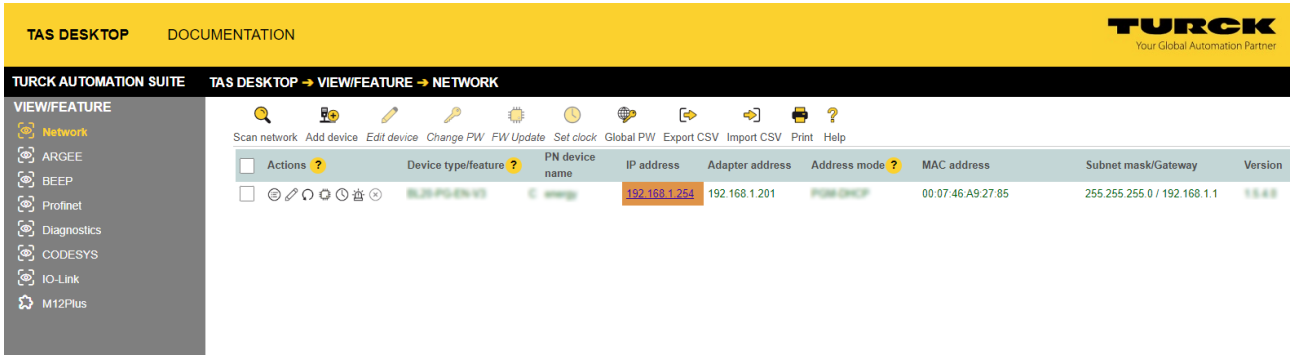

Fig. 33: Found devices in TAS

- ▶ Select the relevant device (check box).
- ▶ Click **Edit device**.

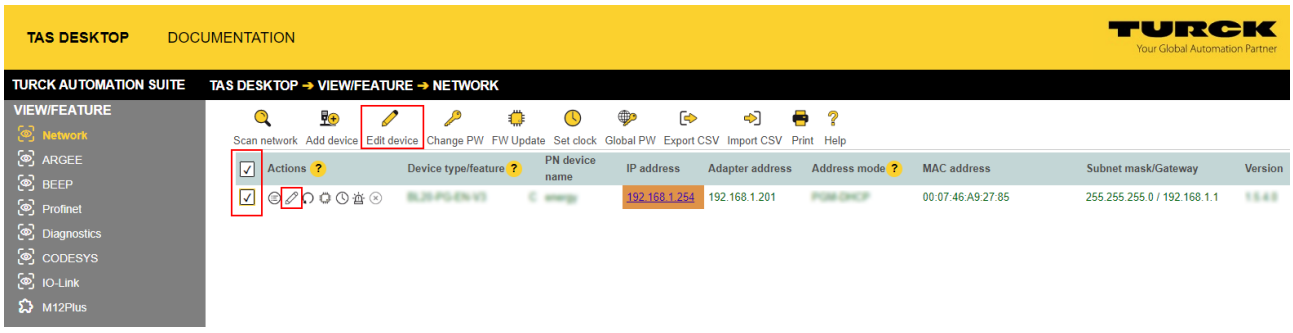

Fig. 34: Selecting the device in TAS

NOTE
By clicking on the IP address of the device, the configuration view of the device can be opened either in TAS or on the device website.

- Change the device name, the IP address and the network mask if necessary.
- Save changes by clicking on **APPLY** .

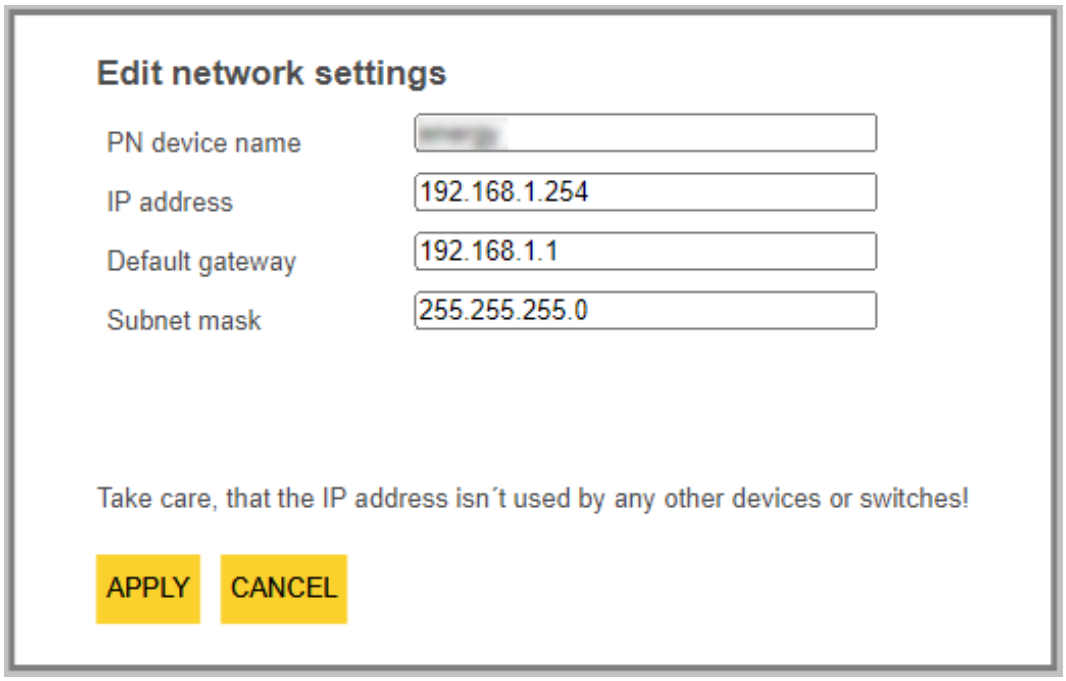

Fig. 35: Changing network settings in TAS

7.2.3 Adjusting network settings via the web server

A login is required to edit settings via the web server. The default password is "password".

NOTE
Turck recommends changing the password after the first login for security reasons.

- Open the device's web server.
- Enter **Username** and **Password**.
- Click **Login**

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

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

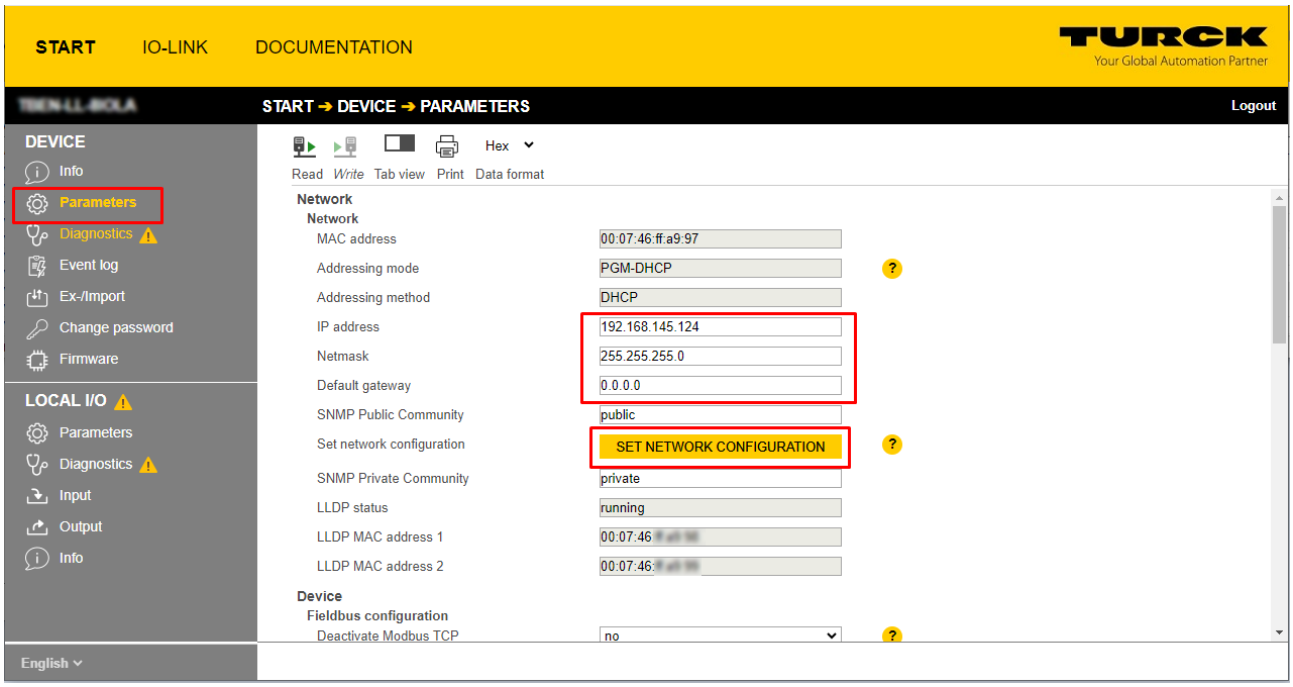

Fig. 36: Web server – adjusting network settings

7.3 Commissioning the device in PROFINET

7.3.1 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 can also be used outside PROFINET, e.g. in IPC operating systems (Windows, Linux). DCP 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 names are assigned via DCP. 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 or "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.

7.3.2 FSU – Fast Start-Up (prioritized startup)

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

NOTE
For the correct cabling in FSU applications please observe the note in the chapter "Connecting the Device to Ethernet" [▶ 22].

Fast Start-Up (FSU) in TBEN

The devices support the prioritized start-up (FSU).

Activating FSU

In order to enable FSU, the fieldbus nodes have to be configured respectively, for example in TIA-Portal (Siemens).

Auto negotiation:	deactivated
Transmission medium/duplex:	Set to a fixed value

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

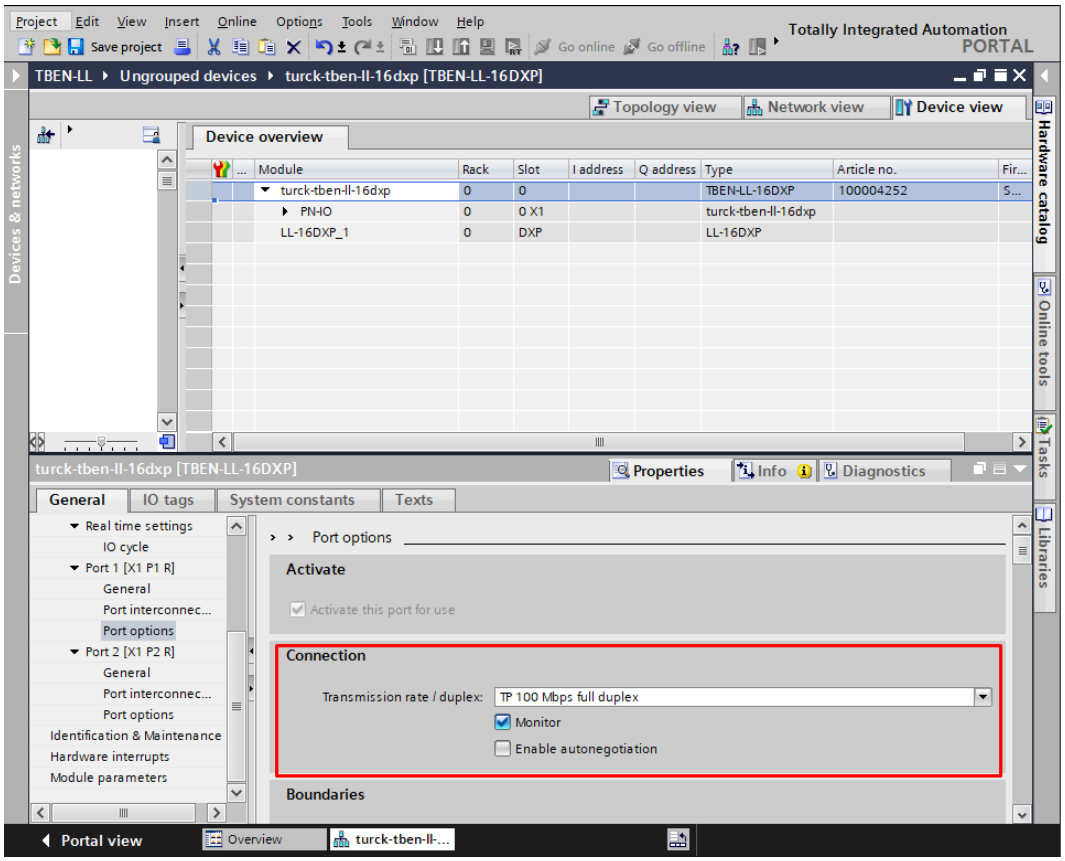

Fig. 37: TIA-Portal – port-settings for FSU

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

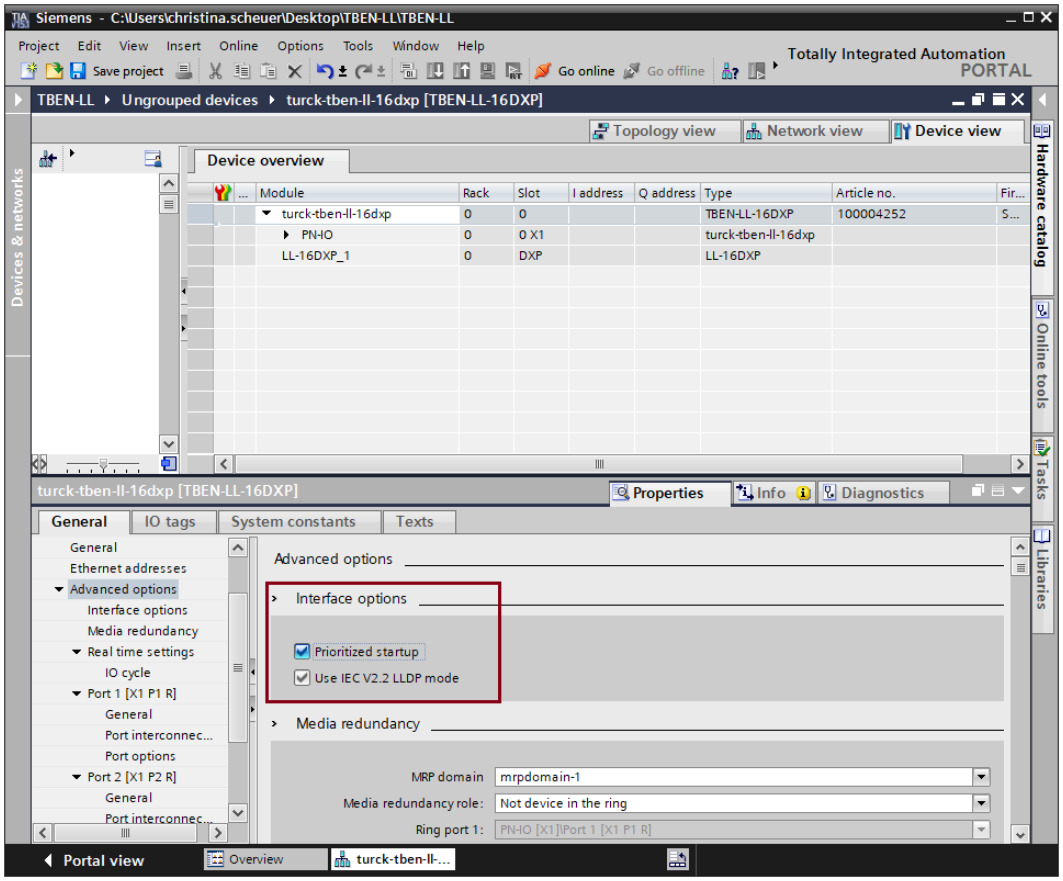

Fig. 38: TIA-Portal – prioritized start-up, activation at the I/O device

7.3.3 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.

7.3.4 User data for acyclic services

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

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

Acyclic device user data

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

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

Acyclic I/O channel user data

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

7.4 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.

7.4.1 Installing the GSDML-file

The GSDML file is available for free at www.turck.com.

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

▶ Installing the GSDML file: Define the source path for the GSDML-file and click **Install**.

⇨ The device is added to the hardware catalog.

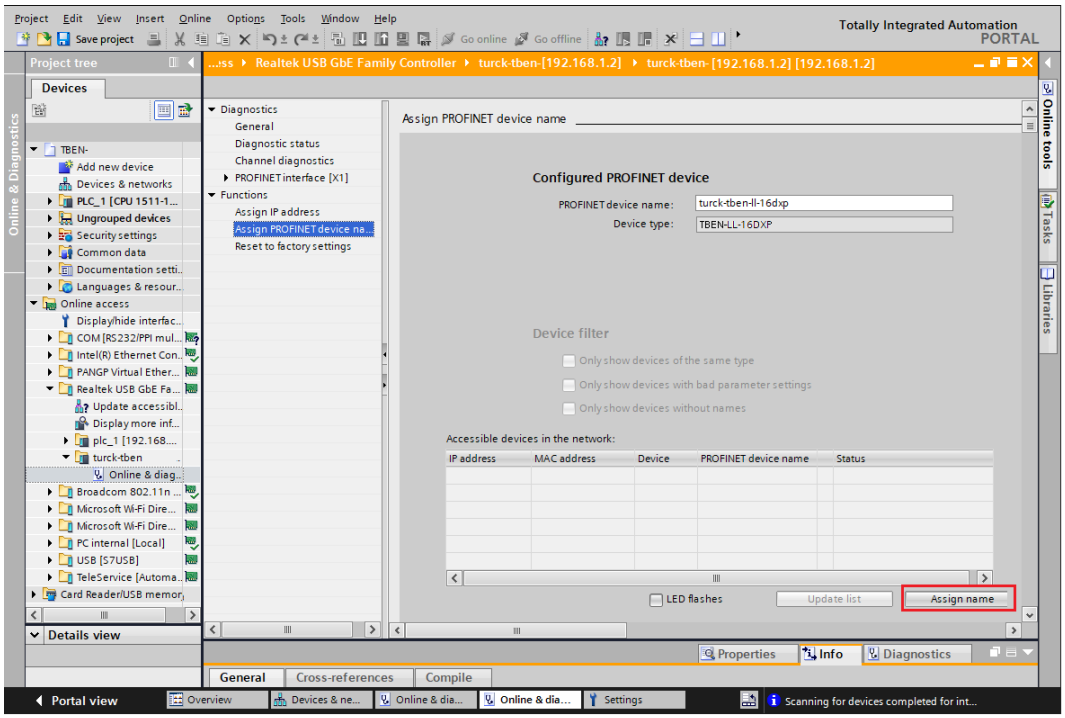

Fig. 39: Installing the GSDML file in TIA Portal

7.4.2 Assigning the PROFINET device name

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

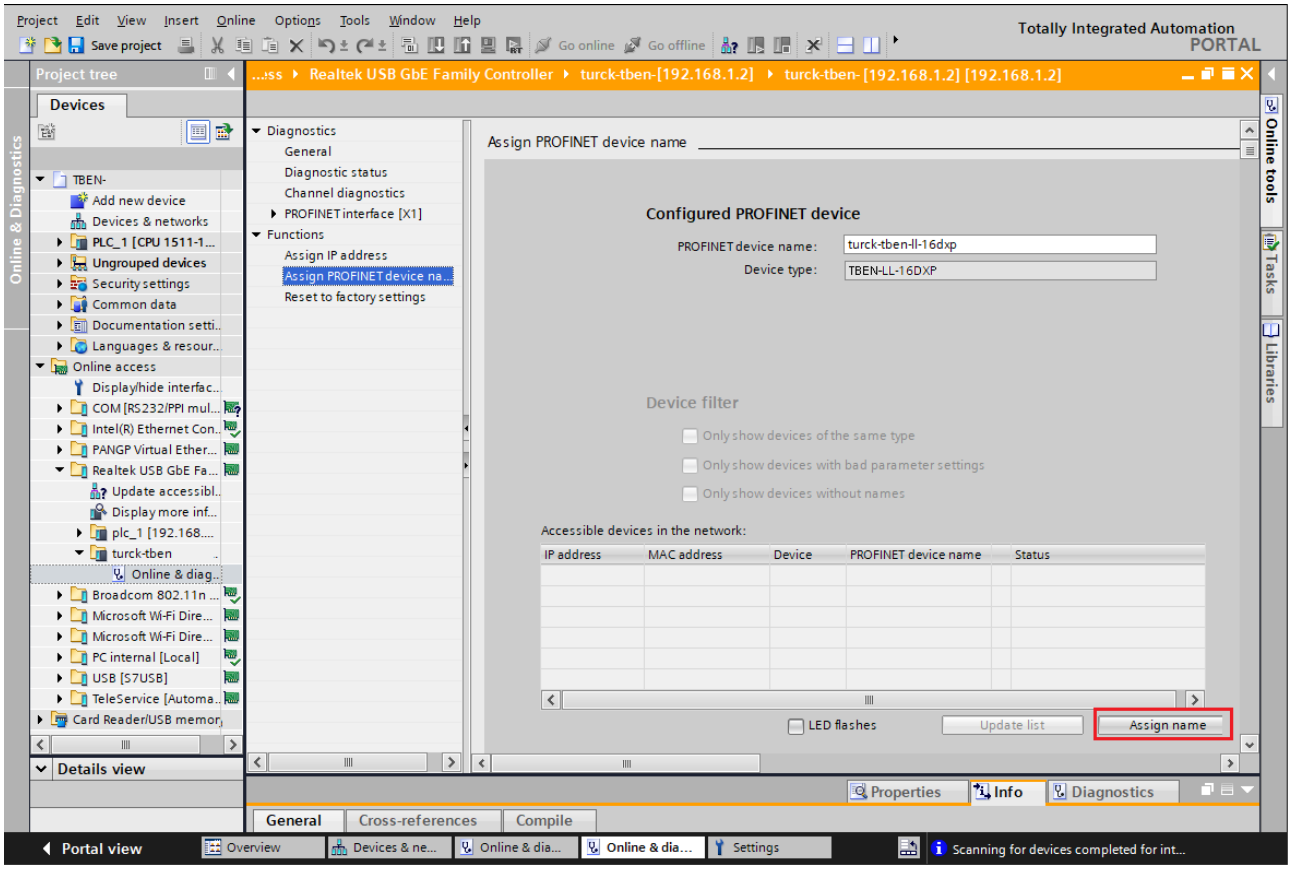

Fig. 40: TIA-Portal: Assigning the PROFINET device name

7.4.3 Setting the IP address in TIA Portal

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

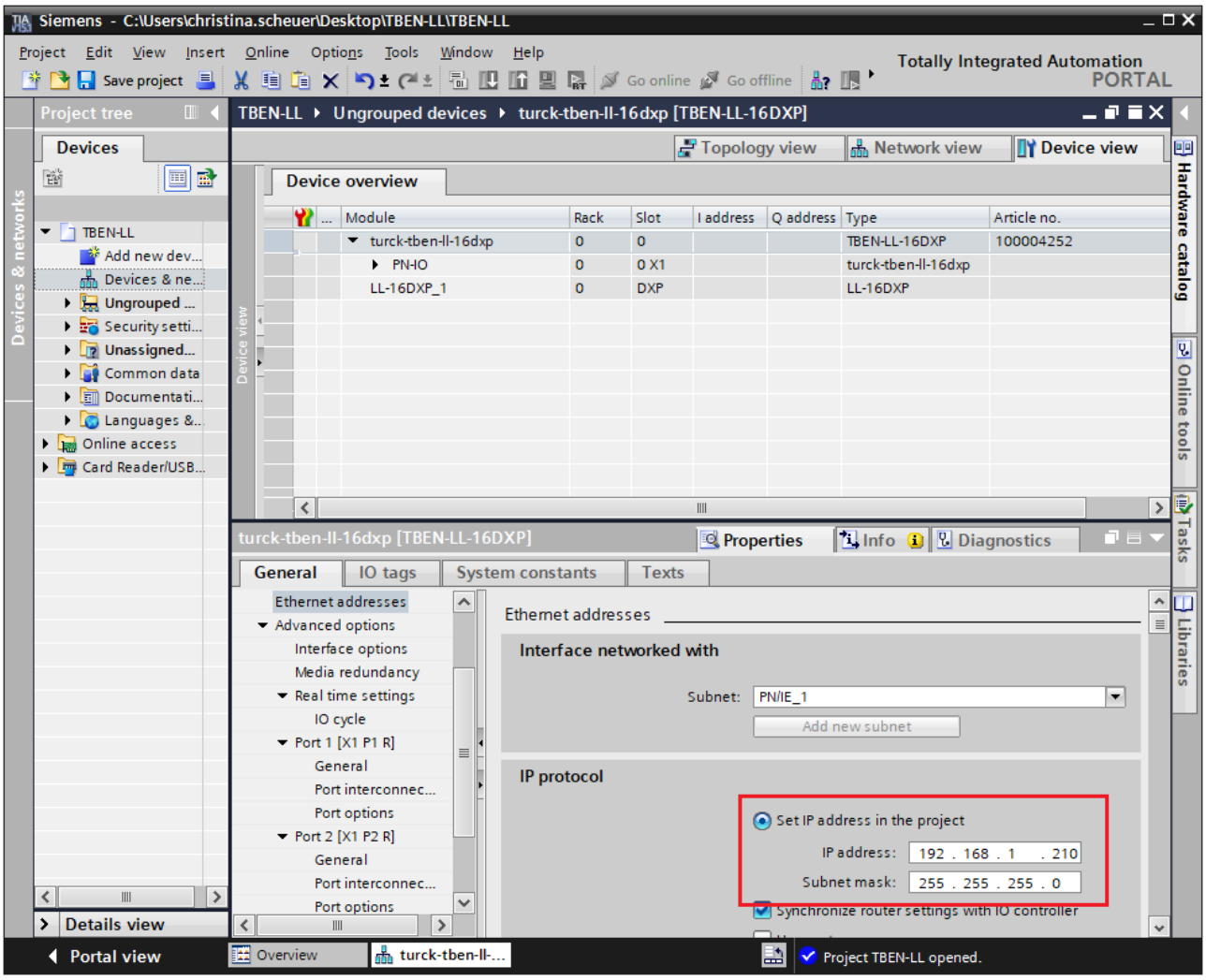

Fig. 41: TIA-Portal: Assigning the IP address

7.4.4 Setting module parameters

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

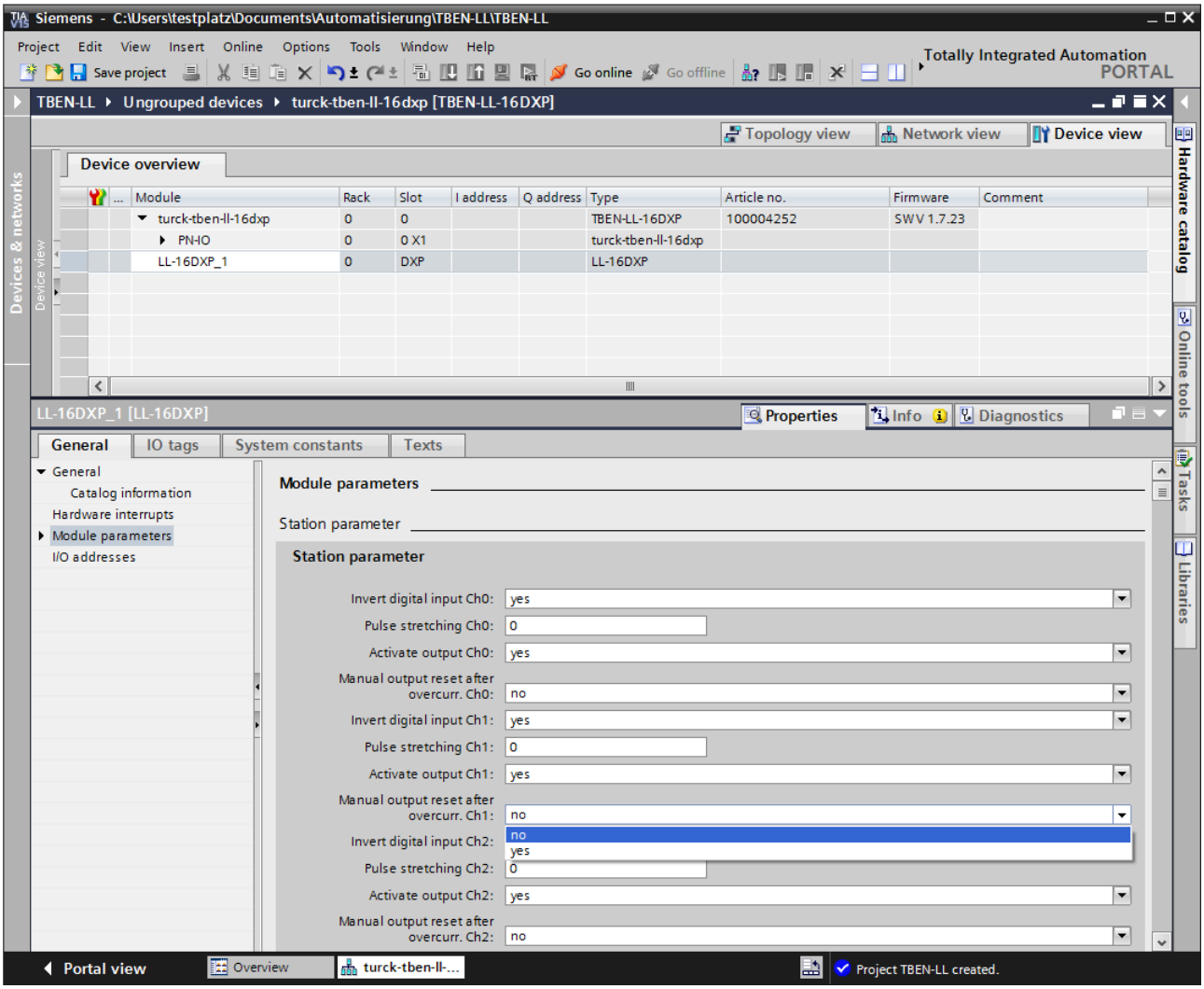

Fig. 42: Setting Module Parameters

7.4.5 Connecting the device online with the controller

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

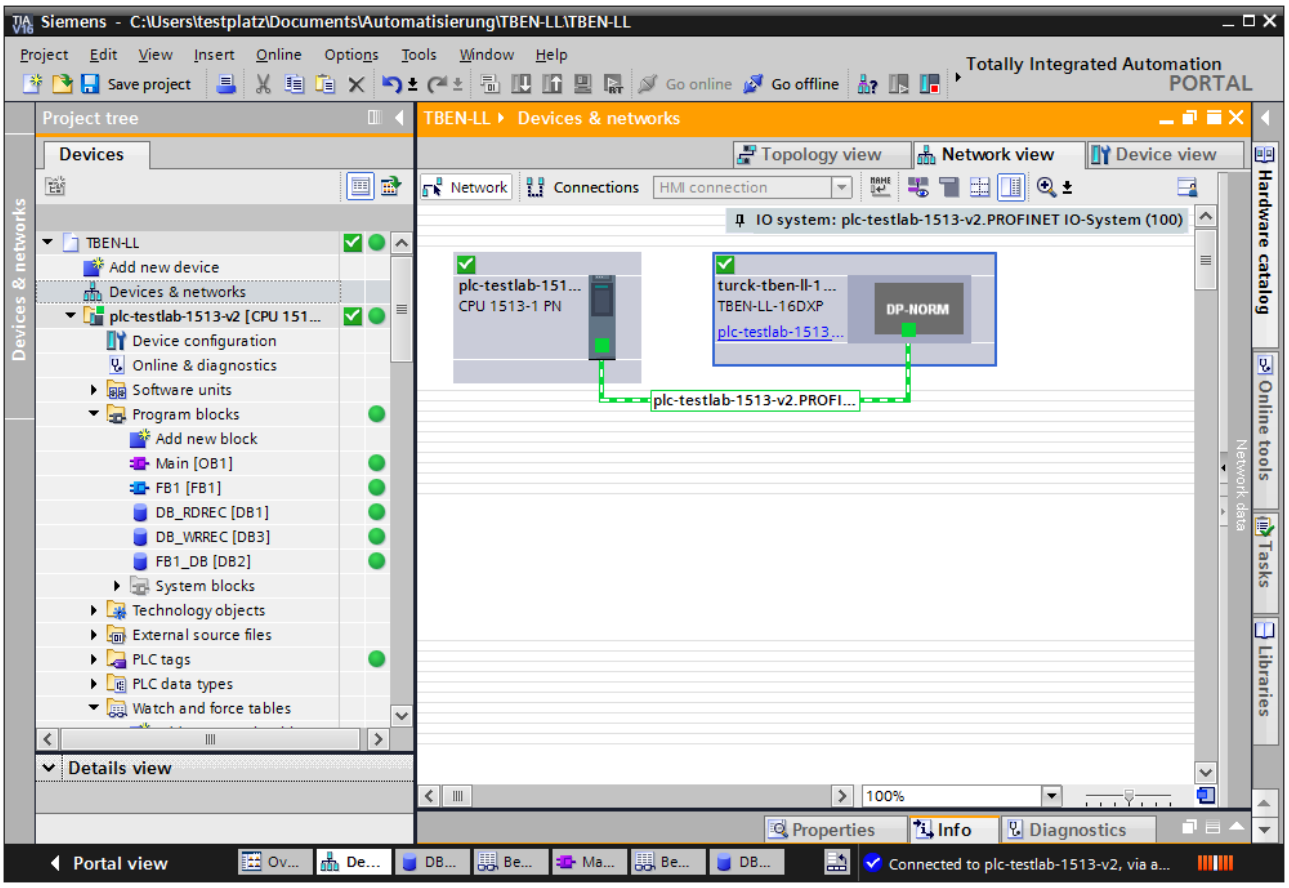

Fig. 43: TIA-Portal: Online mode

7.5 Commissioning the device in Modbus TCP

7.5.1 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

7.5.2 Modbus registers

Address	Access	Meaning
0x0000… 0x01FF	read only	Process data of the inputs (identical to registers 0x8000… 0x8400)
0x0800… 0x09FF	read/write	Process data of the outputs (identical to registers 0x9000…0x9400)
0x1000… 0x100B	read only	Module identifier, contains the first 24 characters of the device type
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. (default: 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
0x1150	read only	LED behavior (PWR) at V2 undervoltage Bit 0: 0 = red 1 = green flashing
0x2400	read only	V1 in mV: 0 at undervoltage

Address	Access	Meaning
0x2401	read only	V2 in mV: 0 at undervoltage
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	Parameters

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

Description	Hex	Decimal	5 digit	Modicon
Process data of the inputs	0x0000… 0x01FF	0…511	40001…40512	400001…400512
Process data of the 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
LED behavior (PWR) at V2 undervoltage	0x1150	4432	44433	404433
V1 in mV	0x2400	9216	49217	409217
V2 in mV	0x2401	9217	49218	409218
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.

7.5.3 Data width of the I/O-modules

The following table shows the data width of the TBEN-L… modules within the Modbus register area and the type of data alignment.

Module	Process input data	Process output data	Alignment
TBEN-LL-16DIP	16 bit	-	Bit by bit
TBEN-LL-16DOP	-	16 bit	Bit by bit
TBEN-LL-16DXP	16 bit	16 bit	Bit by bit
TBEN-LL-8DIP-8DOP	8 bit	8 bit	Bit by bit

7.5.4 Register mapping of the devices

TBEN-LL-16DIP – input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	DI15 X7 P2	DI14 X7 P4	DI13 X6 P2	DI12 X6 P4	DI11 X5 P2	DI10 X5 P4	DI9 X4 P2	DI8 X4 P4	DI7 X3P2	DI6 X3P4	DI5 X2P2	DI4 X2P4	DI3 X1P2	DI2 X1P4	DI1 X0P2	DI0 X0P4
0x0001	-	-	-	-	-	-	-	-	VERR V1 X7 Ch14/15	VERR V1 X6 Ch12/13	VERR V1 X5 Ch10/11	VERR V1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1
0x0002	-	-	-	-	-	-	-	AR-GEE	DIAG	FCE	-	-	-	-	V1	-

TBEN-LL-16DIP – diagnostic registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xA000	-	-	-	-	-	-	-	-	VERR V1 X7 Ch14/15	VERR V1 X6 Ch12/13	VERR V1 X5 Ch10/11	VERR V1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1

TBEN-LL-16DIP – parameter registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xB000	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI2	Inv. DI0
0xB001	IST DI1								IST DI0							
…																
0xB008	IST DI15								IST DI14							
0xB009	reserved								reserved							

TBEN-LL-16DOP – input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14 /15	VERR V2 P1 X6 Ch12 /13	VERR V2 P1 X5 Ch10 /11	VERR V2 P1 X4 Ch8/9	VERR V2 P1 X3 Ch6/7	VERR V2 P1 X2 Ch4/5	VERR V2 P1 X1 Ch2/3	VERR V2 P1 X0 Ch0/1
0x0801	ERR 15	ERR 14	ERR 13	ERR 12	ERR 11	ERR 10	ERR9	ERR8	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
0x0802	V2	-	-	-	-	-	-	AR-GEE	DIAG	FCE	-	-	-	-	V1	-

TBEN-LL-16DOP – output registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	DO15 X7P2	DO14 X7P4	DO13 X6P2	DO12 X6P4	DO11 X5P2	DO10 X5P4	DO9 X4P2	DO8 X4P4	DO7 X3P2	DO6 X3P4	DO5 X2P2	DO4 X2P4	DO3 X1P2	DO2 X1P4	DO1 X0P2	DO0 X0P4

TBEN-LL-16DOP – diagnostic registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xA000	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14/15	VERR V2 P1 X6 Ch12/13	VERR V2 P1 X5 Ch10/11	VERR V2 P1 X4 Ch8/9	VERR V2 1 X3 Ch6/7	VERR V2 P1 X2 Ch4/5	VERR V2 P1 X1 Ch2/3	VERR V2 P1 X0 Ch0/1
0xA001	ERR 15	ERR 14	ERR 13	ERR 12	ERR 11	ERR 10	ERR 9	ERR 8	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0

TBEN-LL-16DOP – parameter registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xB000	SRO DO15	SRO DO14	SRO DO13	SRO DO12	SRO DO11	SRO DO10	SRO DO9	SRO DO8	SRO DO7	SRO DO6	SRO DO5	SRO DO4	SRO DO3	SRO DO2	SRO DO1	SRO DO0

TBEN-LL-16DXP – input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	DI15 X7 P2	DI14 X7 P4	DI13 X6 P2	DI12 X6 P4	DI11 X5 P2	DI10 X5 P4	DI9 X4 P2	DI8 X4 P4	DI7 X3P2	DI6 X3P4	DI5 X2P2	DI4 X2P4	DI3 X1P2	DI2 X1P4	DI1 X0P2	DI0 X0P4
0x0001	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14 /15	VERR V2 P1 X6 Ch12 /13	VERR V2 P1 X5 Ch10 /11	VERR V2 P1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1
0x0002	ERR 15	ERR 14	ERR 13	ERR 12	ERR 11	ERR 10	ERR9	ERR8	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
0x0003	V2	-	-	-	-	-	-	AR-GEE	DIAG	FCE	-	-	-	-	V1	-

TBEN-LL-16DXP – output registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	DO 15 X7P2	DO 14 X7P4	DO 13 X6P2	DO 12 X6P4	DO 11 X5P2	DO 10 X5P4	DO9 X4P2	DO8 X4P4	DO7 X3P2	DO6 X3P4	DO5 X2P2	DO4 X2P4	DO3 X1P2	DO2 X1P4	DO1 X0P2	DO0 X0P4

TBEN-LL-16DXP – diagnostic registers

Re-gister no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xA000	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14/15	VERR V2 P1 X6 Ch12/13	VERR V2 P1 X5 Ch10/11	VERR V2 P1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1

TBEN-LL-16DXP – parameter registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xB000	SRO DO15	SRO DO14	SRO DO13	SRO DO12	SRO DO11	SRO DO10	SRO DO9	SRO DO8	SRO DO7	SRO DO6	SRO DO5	SRO DO4	SRO DO3	SRO DO2	SRO DO1	SRO DO0
0xB001	EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9	EN DO8	EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1	EN DO0
0xB002	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
0xB003	IST DI1								IST DI0							
…																
0xB00A	IST DI15								IST DI14							
0xB00B	Reserved															

TBEN-LL-8DIP-8DOP – input registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input data																
0x0000	-	-	-	-	-	-	-	-	DI7 X3P2	DI6 X3P4	DI5 X2P2	DI4 X2P4	DI3 X1P2	DI2 X1P4	DI1 X0P2	DI0 X0P4
0x0001	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14/15	VERR V2 P1 X6 Ch12/13	VERR V2 P1 X5 Ch10/11	VERR V2 P1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1
0x0002	ERR 15	ERR 14	ERR 13	ERR 12	ERR11	ERR10	ERR 9	ERR 8	-	-	-	-	-	-	-	-
0x0003	V2	-	-	-	-	-	-	AR-GEE	DIAG	FCE	-	-	-	-	V1	-

TBEN-LL-8DIP-8DOP – output registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	DO15 X7P2	DO14 X7P4	DO13 X6P2	DO12 X6P4	DO11 X5P2	DO10 X5P4	DO9 X4P2	DO8 X4P4	-	-	-	-	-	-	-	-

TBEN-LL-8DIP-8DOP – diagnostic registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xA000	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14/15	VERR V2 P1 X6 Ch12/13	VERR V2 P1 X5 Ch10/11	VERR V2 P1 X4 Ch8/9	VERR V1 X3 Ch6/7	VERR V1 X2 Ch4/5	VERR V1 X1 Ch2/3	VERR V1 X0 Ch0/1
0xA001	ERR 15	ERR 14	ERR 13	ERR 12	ERR 11	ERR10	ERR9	ERR8	-	-	-	-	-	-	-	-

TBEN-LL-8DIP-8DOP – parameter registers

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0xB000	SRO DO15	SRO DO14	SRO DO13	SRO DO12	SRO DO11	SRO DO10	SRO DO9	SRO DO8	-	-	-	-	-	-	-	-
0xB001	-	-	-	-	-	-	-	-	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
0xB002	IST DI1								IST DI0							
…																
0xB005	IST DI7								IST DI6							
0xB006	reserved															

Meaning of the register bits

Designation	Meaning
In-/output data	
DI…	Digital input
DO…	Digital output
DXP…	DXP channel
P…	Pin
X…	Connector
Module status	
ARGEE	ARGEE program running in the device
DIAG	Diagnostics available at the device.
FCE	The DTM Force Mode is activated. The actual output values may not match the ones defined and sent by the fieldbus.
V1	System voltage too low
V2	V2 too low
Parameters	
The chapter "Parameterizing and Configuring" [▶ 126] contains a detailed parameter description.	
EN DO	Activate digital output
IST DI1	Pulse stretching of the input signal
Inv. DI	Invert digital input
SRO	Manual output reset after overcurrent
Diagnostics	
The chapter ”Operating” [▶ 133]contains a detailed parameter description.	
ERR	Overcurrent output
VERR V1 X… K…	Overcurrent supply VAUX1
VERR V2 P1 X… K…	Overcurrent supply VAUX2 at pin 1

7.5.5 Error behavior (watchdog)

Behavior of outputs

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

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

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

Behavior of the BUS LED

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

Behavior of the device in case of loss of Modbus communication

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

7.6 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.

Used hardware

The following hardware components are used in this example:

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

Used software

The following software tools are used in this example:

- CODESYS 3.5.18.2 (can be downloaded for free under www.turck.com).

Prerequisites

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

7.6.1 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)**.

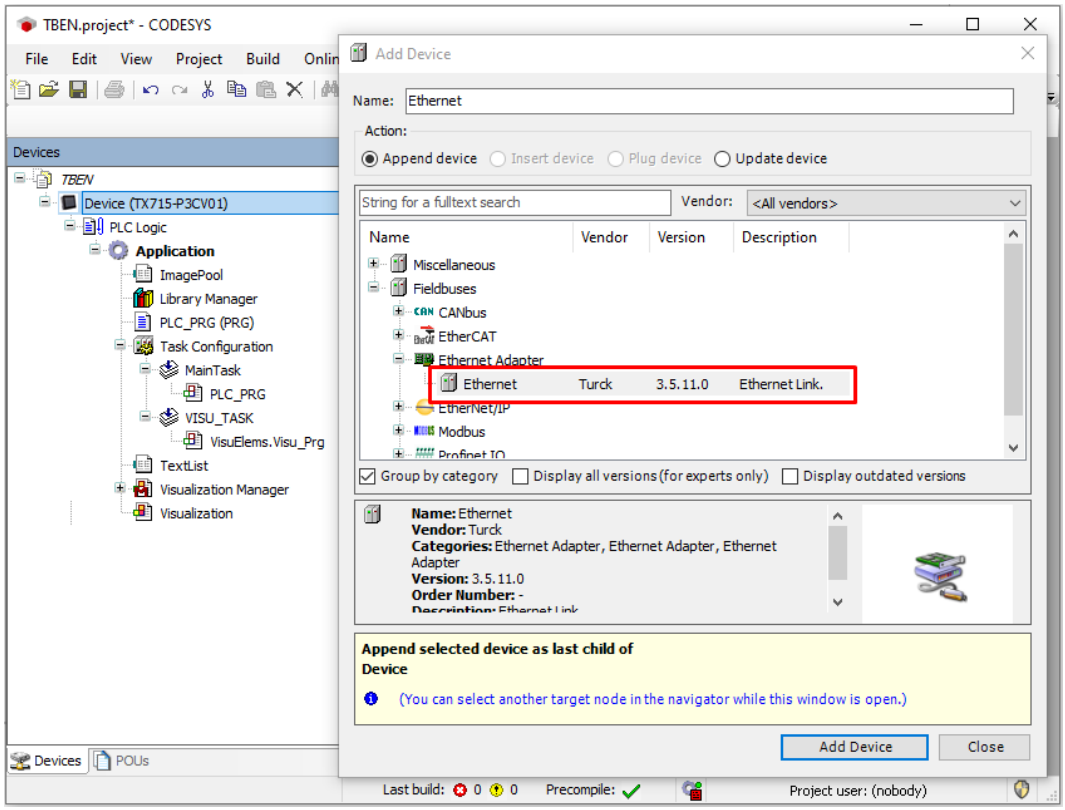

Fig. 44: Adding the Ethernet Adapter

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.

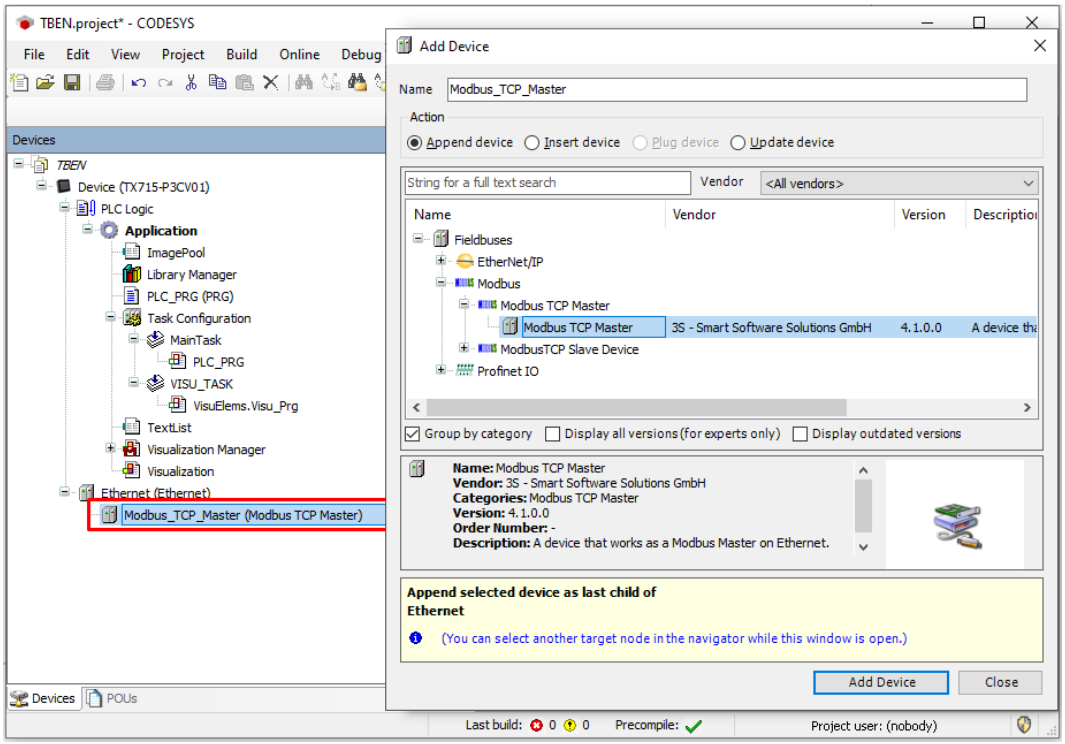

Fig. 45: Adding the Modbus TCP Master

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.

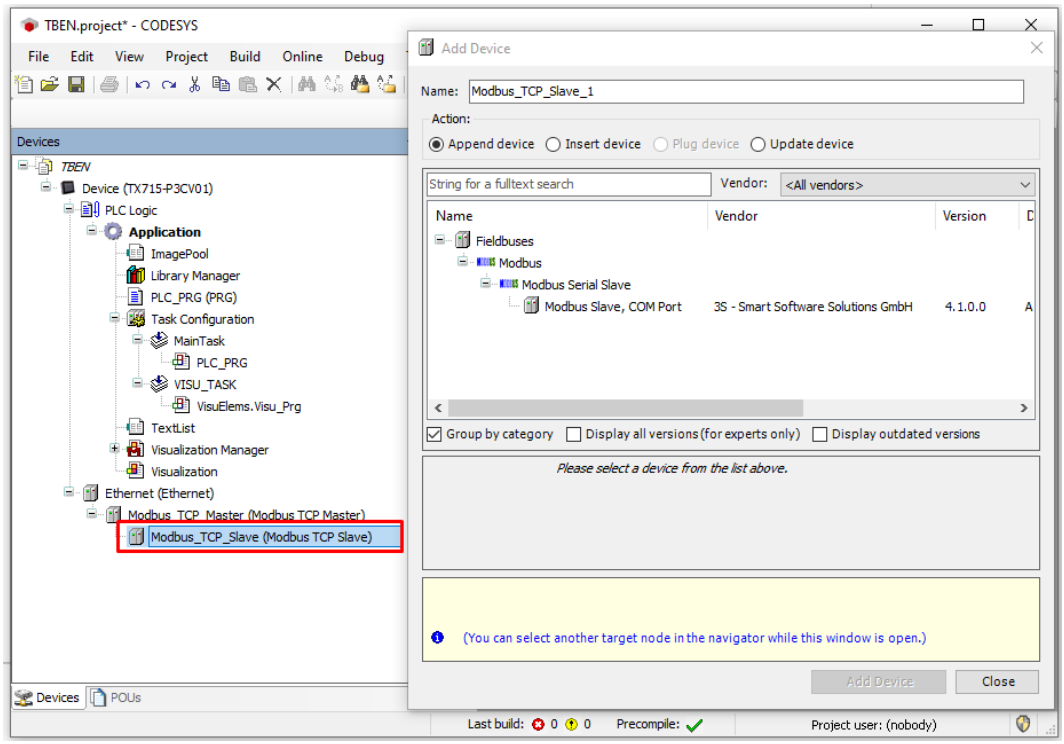

Fig. 46: Adding the Modbus TCP Slave

7.6.2 Configuring the Network Interface

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

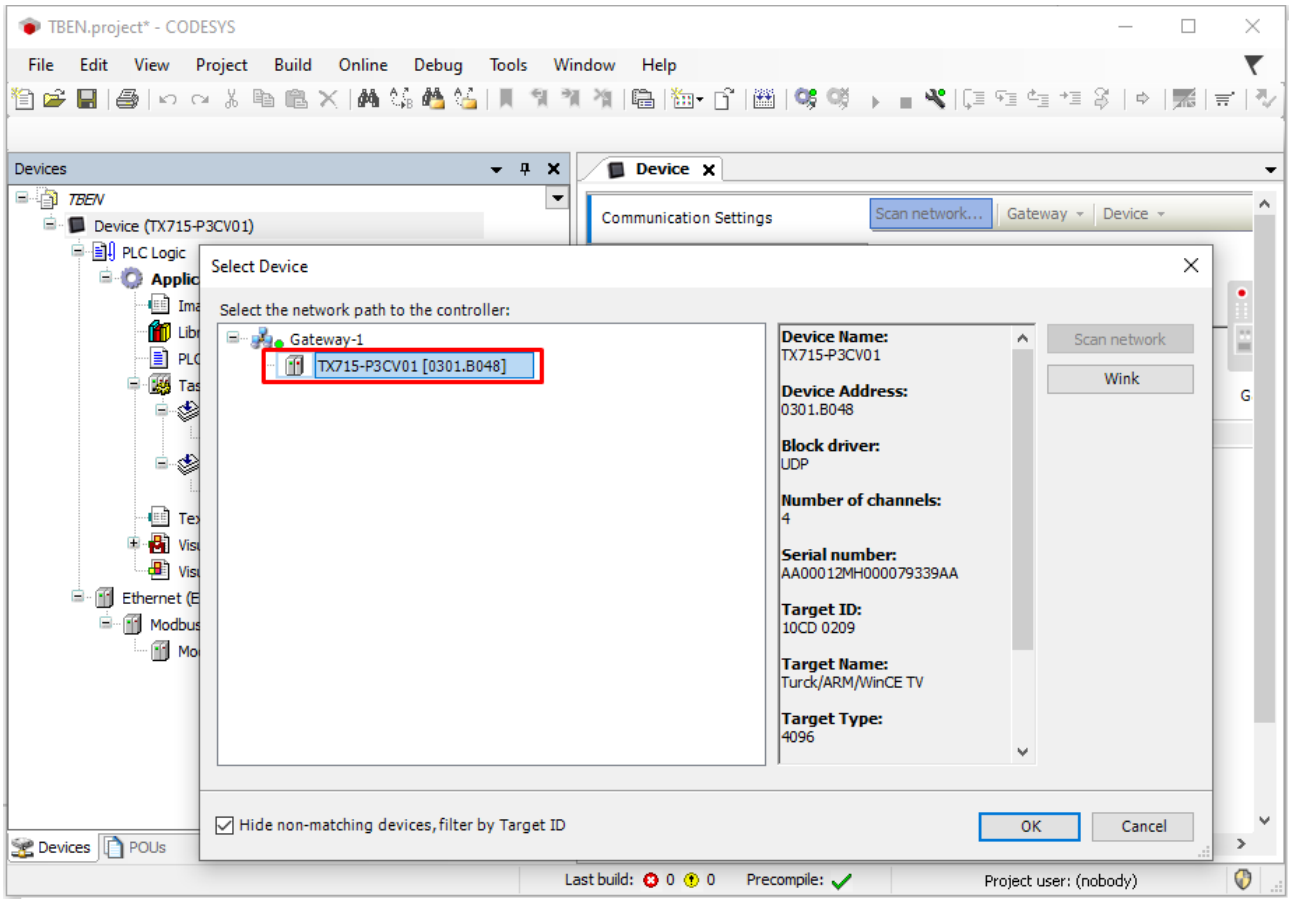

Fig. 47: Configuring the network interface

- 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)

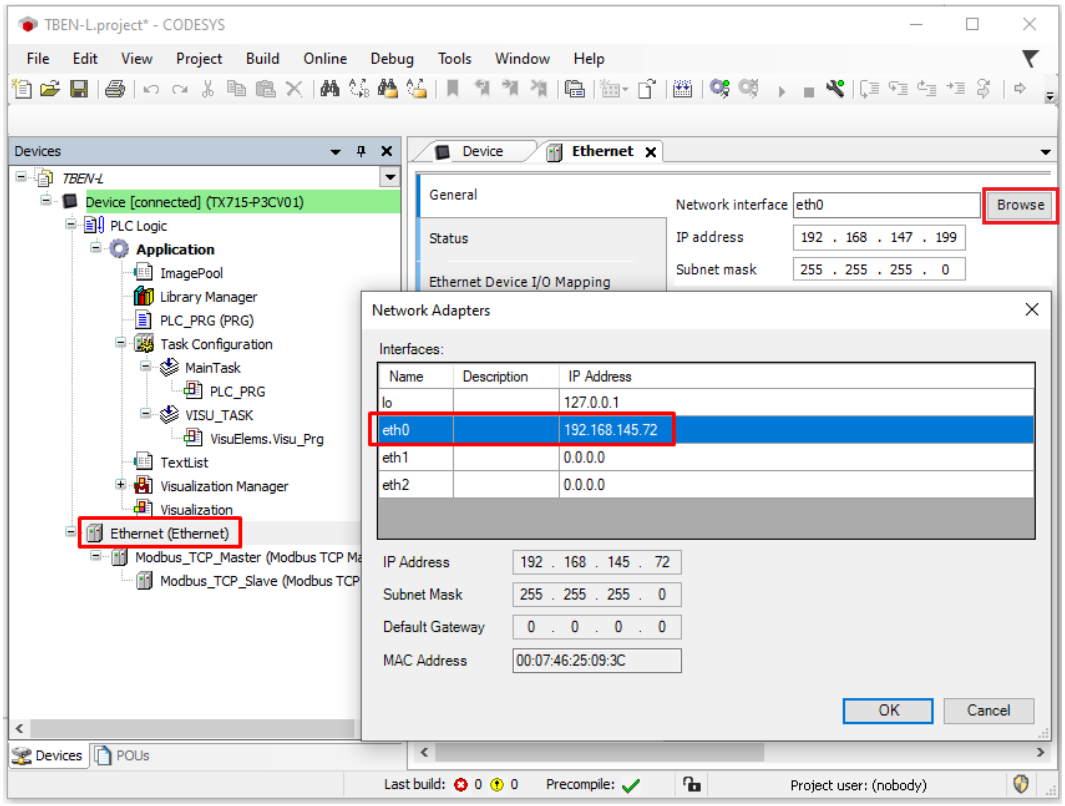

Fig. 48: Selecting the interface

7.6.3 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).

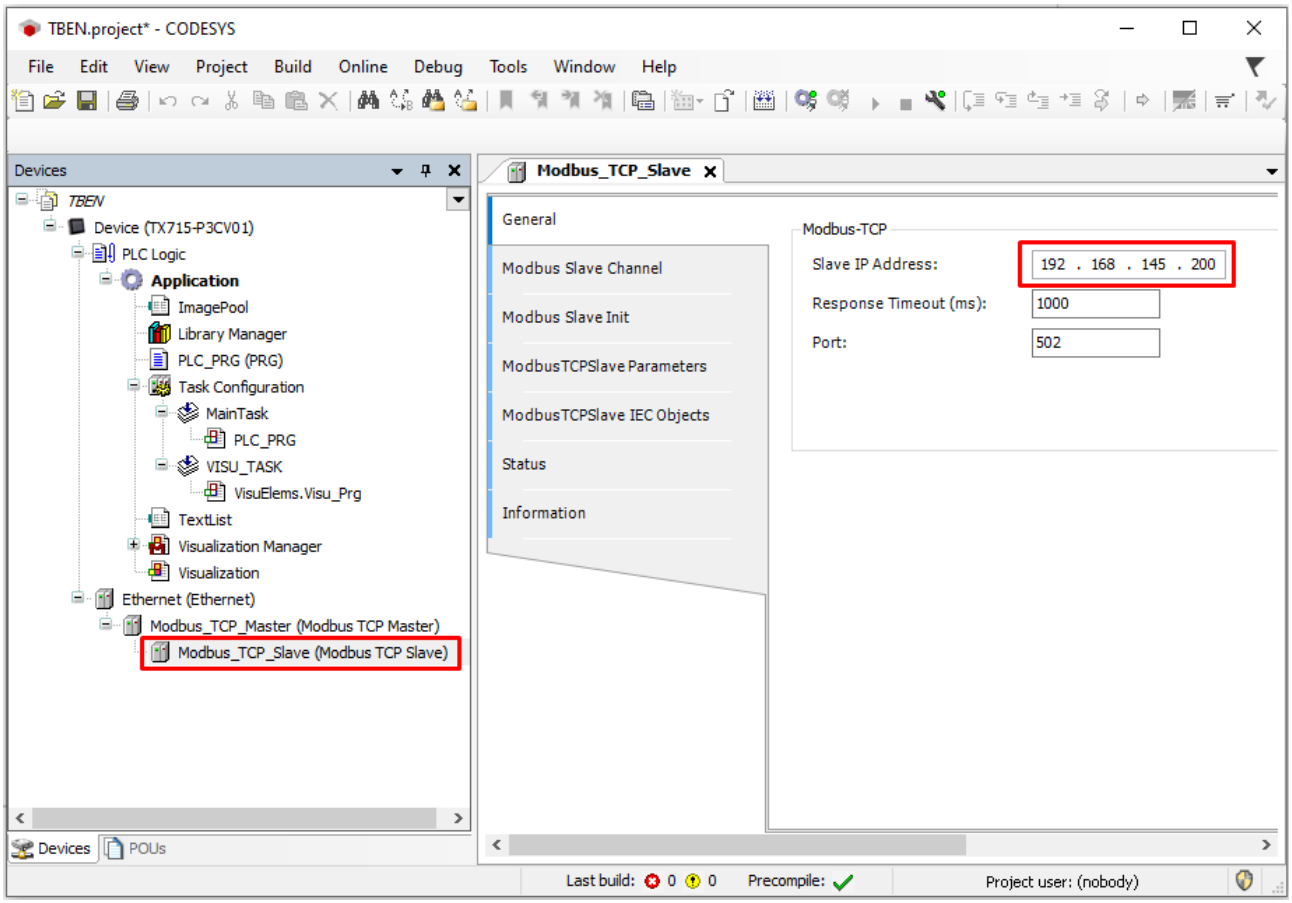

Fig. 49: Modbus TCP Slave: Setting the IP address

7.6.4 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.

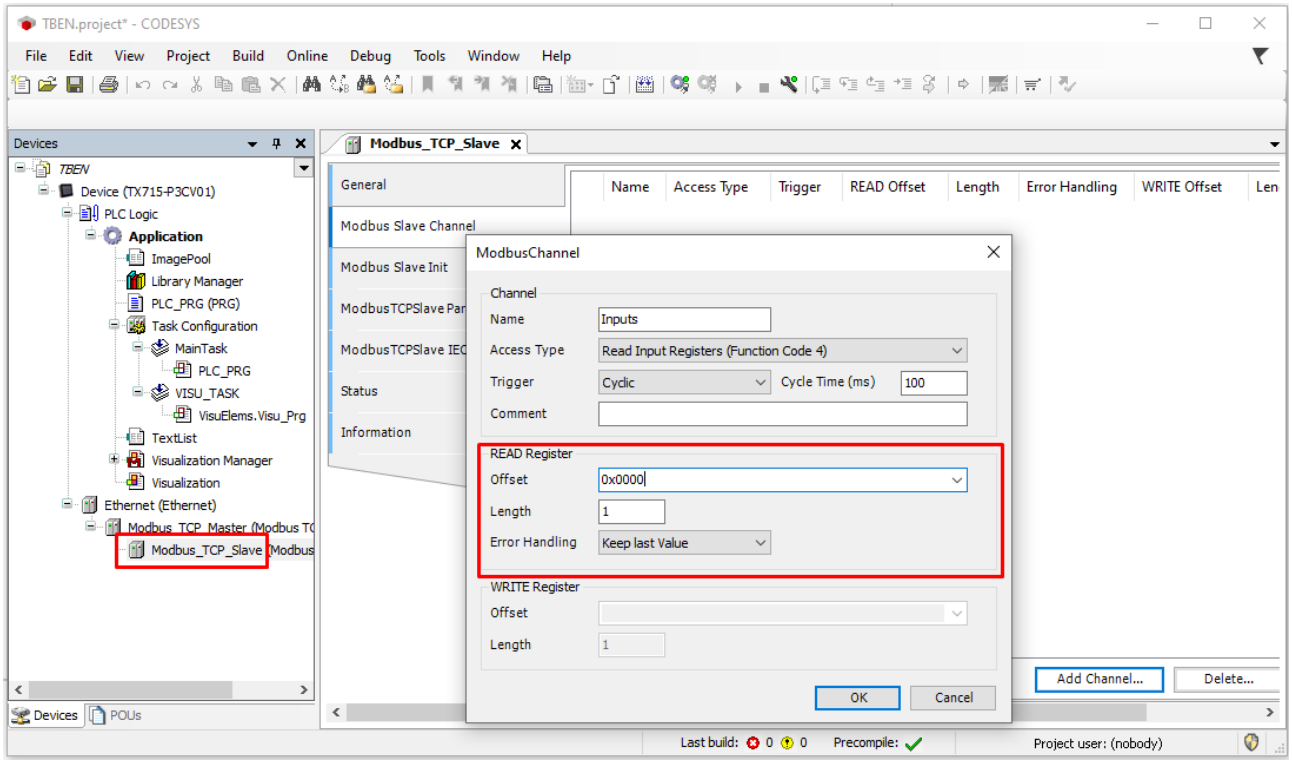

Fig. 50: Defining the input register

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.

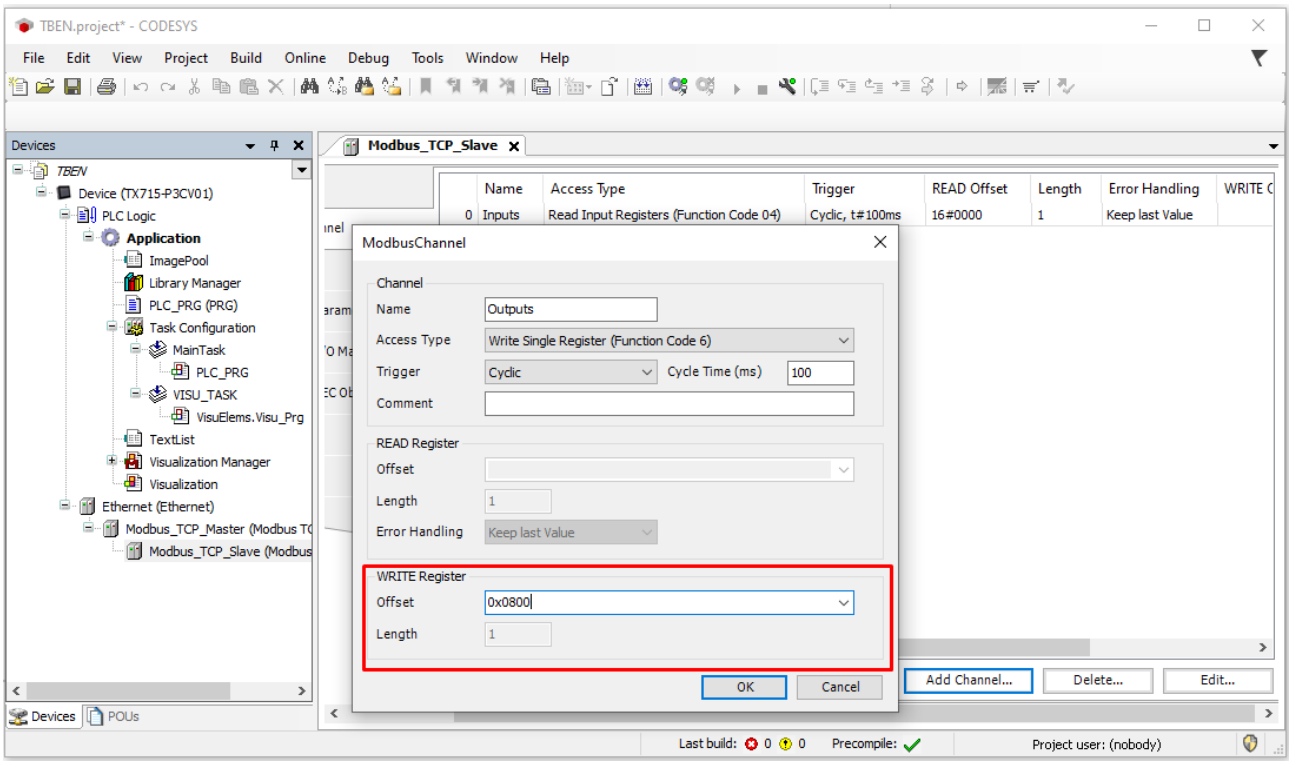

Fig. 51: Defining the output data register

7.6.5 Going online with the PLC

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

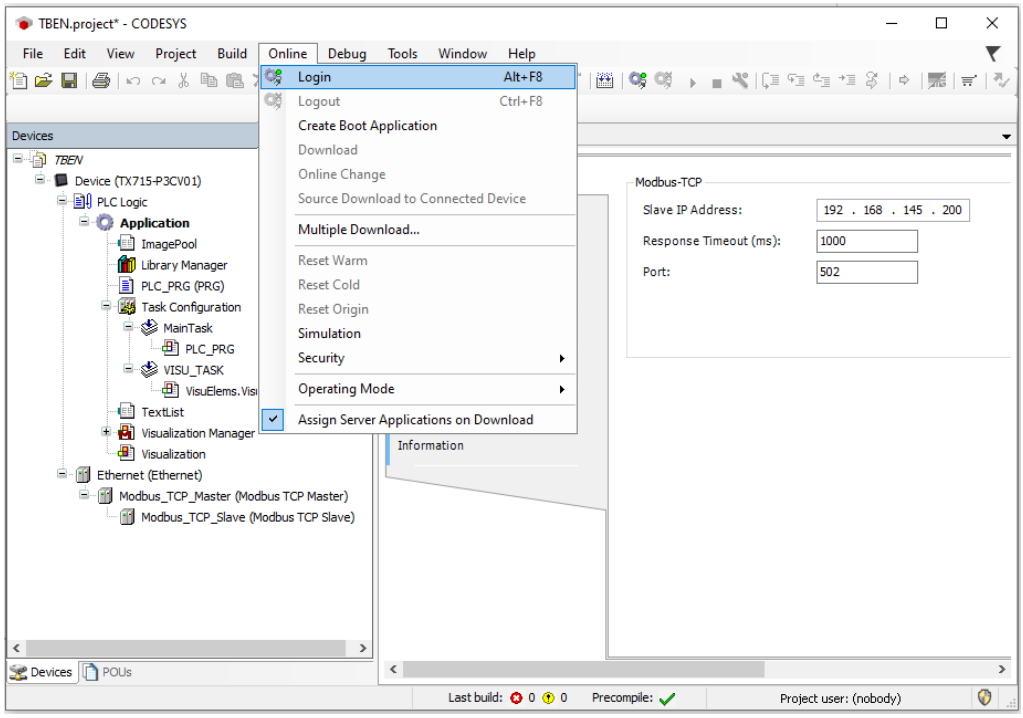

Fig. 52: Login

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

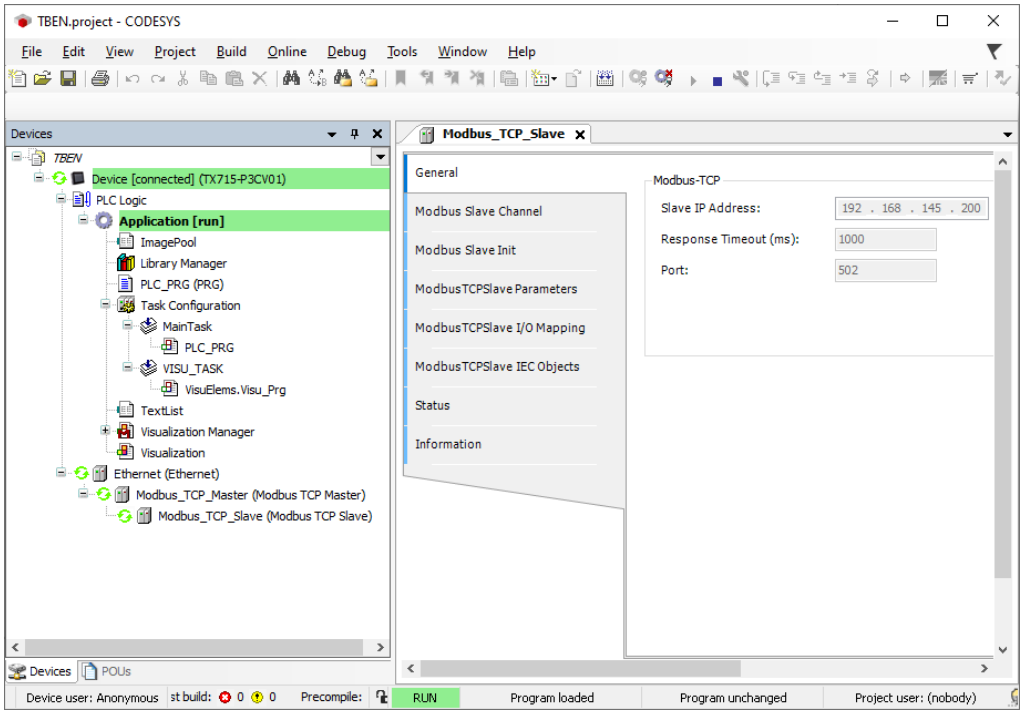

Fig. 53: Modbus TCP communication

7.6.6 Reading process data

The process data can be interpreted by means of the mapping [▶ 51] If the device is online with the PLC.

The process data can be interpreted by means of the mapping (Register Mapping) if the device is connected to the PLC.

- ▶ 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.

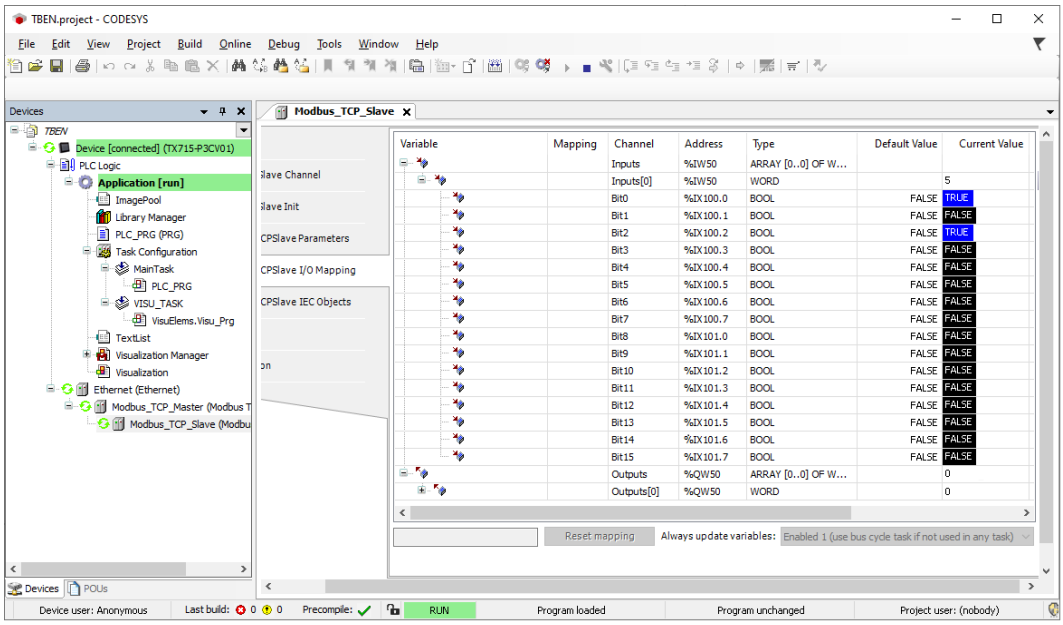

Fig. 54: Process data

7.7 Commissioning the device in EtherNet/IP

7.7.1 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

7.7.2 EDS files and catalog files

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

- TBEN-L_ETHERNETIP.zip

7.7.3 QuickConnect (QC)

The devices support QuickConnect.

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

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

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

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

For information on the correct connection of Ethernet cables in QuickConnect applications, please refer to the chapter Connecting [▶ 22].

Activating QuickConnect via Configuration Assembly

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

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

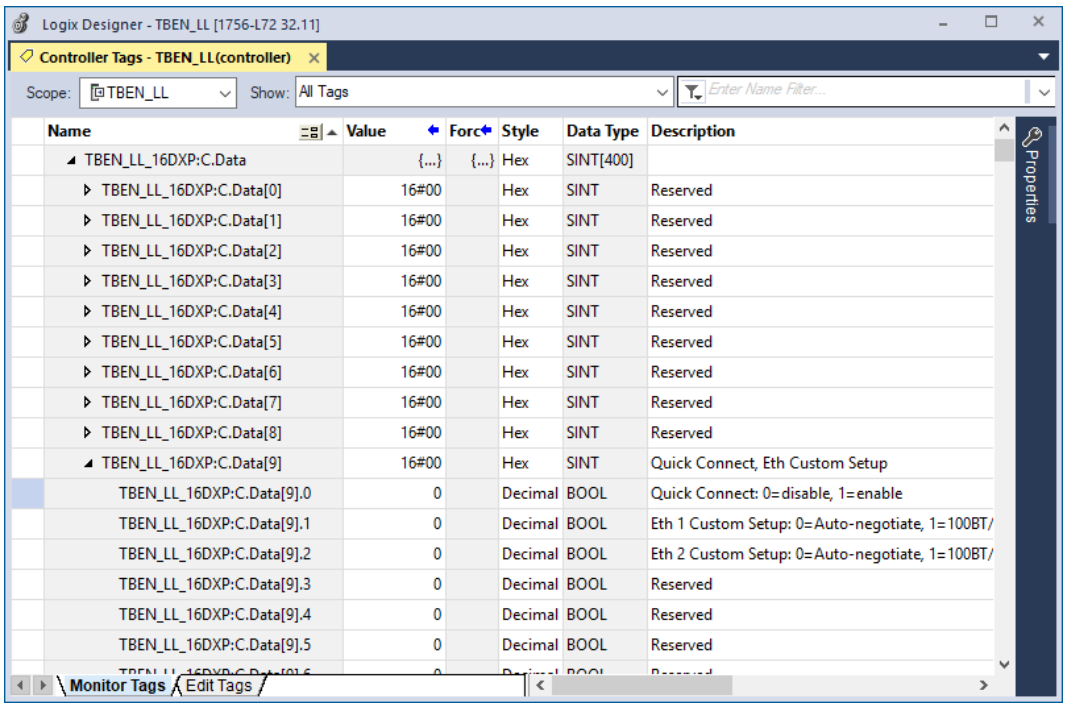

Fig. 55: Configuring QuickConnect in RSLogix

Activating Quick Connect via Class Instance Attribute

- ▶ Activate Quick Connect via Class Instance Attribute as follows:

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

Activating QuickConnect via the Webserver.

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

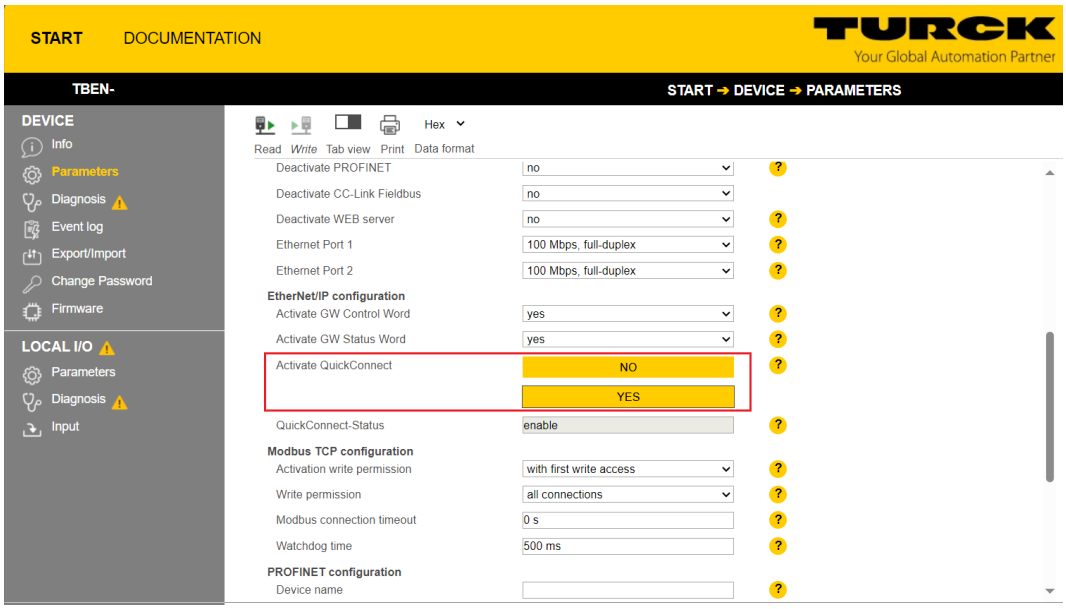

Fig. 56: Activating Quick Connect in the web server

7.7.4 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.

7.7.5 Diagnostic messages via process data

The diagnostic messages are directly mapped into the process data [▶ 128].

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

Byte 1 (MSB)								Byte 0 (LSB)							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	FCE	-	-	-	-	V1	-	V2	-	-	-	-	-	AR-GEE	DIAG

7.7.6 EtherNet/IP standard classes

The modules support the following EtherNet/IP standard classes in accordance with the CIP specification.

Class code		Object name
Dec.	Hex.	
01	0x01	Identity Object [▶ 71]
04	0x04	Assembly Object [▶ 73]
06	0x06	Connection Manager Object [▶ 81]
245	0xF5	TCP/IP Interface Object [▶ 81]
246	0xF6	Ethernet Link Object [▶ 83]

Identity Object (0x01)

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

Instance attributes

Attr. no.		Attribute name	Get/Set	Type	Value
Dec.	Hex.				
1	0x01	Vendor	G	UINT	Contains the manufacturer ID. Turck = 0x30
2	0x02	Product type	G	UINT	Shows the general product type. Communications Adapter 12_{dez} = 0x0C
3	0x03	Product code	G	UINT	Identifies a special product in a device type. default: 27247_{dec} = 0x6A6F
4	0x04	Revision ■ Major ■ Minor	G	STRUCT OF: ■ USINT ■ USINT	Revision of the device which is represented by the Indentity Object. ■ 0x01 ■ 0x06
5	0x05	Device status	G	WORD	WORD
6	0x06	Serial number	G	UDINT	Contains the last 3 bytes of the MAC ID
7	0x07	Product name	G	STRUCT OF: USINT STRING [13]	i.e.: TBEN-LL-16DXP

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
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 bytes module configuration data (EtherNet/IP specific)

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

Device configuration data

Default values are shown in **bold**.

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

■ Configuration Assembly – TBEN-LL-16DIP

Byte no.		Bit no.							
Dec.	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Device Configuration Data [▶ 74]									
0…9	0x00…0x09	-					Eth2 Port-Setup	Eth1 Port-Setup	Quick Connect
Parameter data [▶ 126]									
10	0x0A	-	-	-	-	-	-	-	Inv. DI0
11	0x0B	-	-	-	-	-	-	-	Inv. DI1
…	…								
24	0x18	-	-	-	-	-	-	-	Inv. DI14
25	0x19	-	-	-	-	-	-	-	Inv. DI15
26	0x1A	IST DI0							
27	0x1B	IST DI1							
…	…								
10	0x28	IST DI14							
41	0x29	IST DI15							

■ Configuration Assembly – TBEN-LL-16DXP

Byte no.		Bit no.							
Dec.	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Device Configuration Data [▶ 74]									
0…9	0x00…0x09	-					Eth2 Port-Setup	Eth1 Port-Setup	Quick Connect
Parameter data [▶ 126]									
10	0x0A	-	-	-	-	-	-	-	Inv. DI0
11	0x0B	-	-	-	-	-	-	-	Inv. DI1
…	…								
24	0x18	-	-	-	-	-	-	-	Inv. DI14
25	0x19	-	-	-	-	-	-	-	Inv. DI15
26	0x1A	IST DI0							
27	0x1B	IST DI1							
…	…								
40	0x28	IST DI14							
41	0x29	IST DI15							
42	0x2A	-	-	-	-	-	-	-	EN DO0
43	0x2B	-	-	-	-	-	-	-	EN DO1
…	…								
56	0x38	-	-	-	-	-	-	-	EN DO14
57	0x39	-	-	-	-	-	-	-	EN DO15
58	0x3A	-	-	-	-	-	-	-	SRO0
59	0x3B	-	-	-	-	-	-	-	SRO1
…	…								
72	0x48	-	-	-	-	-	-	-	SRO14
73	0x49	-	-	-	-	-	-	-	SRO15

■ Configuration Assembly – TBEN-LL-8DIP-8DOP

Byte no.		Bit no.							
Dec.	Hex.	7	6	5	4	3	2	1	0
Device Configuration Data [▶ 74]									
0…9	0x00…0x09	-					Eth2 Port-Setup	Eth1 Port-Setup	Quick Connect
Parameter data [▶ 126]									
10	0x0A	-	-	-	-	-	-	-	Inv. DI0
11	0x0B	-	-	-	-	-	-	-	Inv. DI1
…	…								
16	0x11	-	-	-	-	-	-	-	Inv. DI6
17	0x11	-	-	-	-	-	-	-	Inv. DI7
18	0x12	IST DI0							
19	0x13	IST DI1							
…	…								
24	0x18	IST DI6							
25	0x19	IST DI7							
26	0x1A	-	-	-	-	-	-	-	SRO8
27	0x1B	-	-	-	-	-	-	-	SRO9
…	…								
32	0x20	-	-	-	-	-	-	-	SRO14
33	0x21	-	-	-	-	-	-	-	SRO15

■ Configuration Assembly – TBEN-LL-16DOP

Byte no.		Bit no.							
Dec.	Hex.	7	6	5	4	3	2	1	0
Device configuration data [▶ 74]									
0…9	0x00…0x09	-					Eth2 port setup	Eth1 port setup	Quick Connect
Parameter data [▶ 126]									
10	0x0A	-	-	-	-	-	-	-	SRO8
11	0x0B	-	-	-	-	-	-	-	SRO9
…	…								
24	0x18	-	-	-	-	-	-	-	SRO14
25	0x19	-	-	-	-	-	-	-	SRO15

Process data instances

Instance 103 and Instance 104

Instances 103 and 104 are input and output instances with variable size. The size of the assembly data is calculated exactly beforehand to ensure the station configuration, diagnostics etc.

- Input Assembly Instance 103

Device	Input data
TBEN-LL-16DIP	6 bytes
TBEN-LL-16DXP	8 bytes
TBEN-LL-8DIP-8DOP	8 bytes
TBEN-LL-16DOP	2 bytes

- Output Assembly Instance 104

Device	Output data
TBEN-LL-16DIP	2 bytes
TBEN-LL-16DXP	4 bytes
TBEN-LL-8DIP-8DOP	4 bytes
TBEN-LL-16DOP	4 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.

- **Input data – TBEN-LL-16DIP**
  status word + 2 words

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status																
0x0000	-	FCE	-	-	-	COM	V1	-	-	-	-	-	-	-	AR-GEE	DIAG
IN																
0x0001	DI15 X7 P2	DI14 X7 P4	DI13 X6 P2	DI12 X6 P4	DI11 X5 P2	DI10 X5 P4	DI9 X4 P2	DI8 X4 P4	DI7 X3 P2	DI6 X3 P4	DI5 X2 P2	DI4 X2 P4	DI3 X1 P2	DI2 X1P4	DI1 X0 P2	DI0 X0P4
0x0002	-	-	-	-	-	-	-	-	VERR V1 X7 Ch14 Ch15	VERR V1 X6 Ch12 Ch13	VERR V1 X5 Ch10 Ch11	VERR V1 X4 Ch8 Ch9	VERR V1 X3 Ch6 Ch7	VERR V1 X2 Ch4 Ch5	VERR V1 X1 Ch2 Ch3	VERR V1 X0 Ch0 Ch1

- **Output data – TBEN-LL-16DIP**
  control word

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control																
0x0000	Reserved															

- **Input data – TBEN-LL-16DXP**
  status word + 3 words

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status																
0x0000	-	FCE	-	-	-	COM	V1	-	V2	-	-	-	-	-	AR-GEE	DIAG
IN																
0x0001	DI15 X7 P2	DI14 X7 P4	DI13 X6 P2	DI12 X6 P4	DI11 X5 P2	DI10 X5 P4	DI9 X4 P2	DI8 X4 P4	DI7 X3 P2	DI6 X3 P4	DI5 X2 P2	DI4 X2 P4	DI3 X1 P2	DI2 X1P4	DI1 X0 P2	DI0 X0P4
0x0002	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14 Ch15	VERR V2 P1 X6 Ch12 Ch13	VERR V2 P1 X5 Ch10 Ch11	VERR V2 P1 X4 Ch8 Ch9	VERR V1 X3 Ch6 Ch7	VERR V1 X2 Ch4 Ch5	VERR V1 X1 Ch2 Ch3	VERR V1 X0 Ch0 Ch1
0x0003	ERR 15	ERR 14	ERR 13	ERR 12	ERR 11	ERR 10	ERR9	ERR8	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0

- Output data – TBEN-LL-16DOP
  control word + 1 word

Word no.	Bit no.															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Control																
0x0000	Reserved															
OUT																
0x0001	DO15 X7 P2	DO14 X7 P4	DO13 X6 P2	DO12 X6 P4	DO11 X5 P2	DO10 X5P4	DO9 X4P2	DO8 X4P4	DO7 X3P2	DO6 X3 P4	DO5 X2 P2	DO4 X2 P4	DO3 X1 P2	DO2 X1 P4	DO1 X0P2	DO0 X0 P4

- **Input data – TBEN-LL-8DIP-8DOP**
  status word + 3 word

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status																
0x0000	-	FCE	-	-	-	COM	V1	-	V2	-	-	-	-	-	AR-GEE	DIAG
IN																
0x0001	-	-	-	-	-	-	-	-	DI7 X3 P2	DI6 X3 P4	DI5 X2 P2	DI4 X2 P4	DI3 X1 P2	DI2 X1P4	DI1 X0 P2	DI0 X0P4
0x0002	-	-	-	-	-	-	-	-	VERR V2 P1 X7 Ch14 Ch15	VERR V2 P1 X6 Ch12 Ch13	VERR V2 P1 X5 Ch10 Ch11	VERR V2 P1 X4 Ch8 Ch9	VERR V1 X3 Ch6 Ch7	VERR V1 X2 Ch4 Ch5	VERR V1 X1 Ch2 Ch3	VERR V1 X0 Ch0 Ch1
0x0003	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8	-	-	-	-	-	-	-	-

- **Input data – TBEN-LL-8DIP-8DOP**
  status word + 1 word

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control																
0x0000	Reserved															
OUT																
0x0001	-	-	-	-	-	-	-	-	DO15 X7 P2	DO14 X7 P4	DO13 X6 P2	DO12 X6 P4	DO11 X5 P2	DO10 X5P4	DO9 X4P2	DO8 X4P4

- Input data – TBEN-LL-16DOP
  status word

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status																
0x0000	-	FCE	-	-	-	COM	V1	-	V2	-	-	-	-	-	AR-GEE	DIAG

- Output data – TBEN-LL-16DOP
  control word + 1 word

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Control																
0x0000	Reserved															
OUT																
0x0001	DO15 X7 P2	DO14 X7 P4	DO13 X6 P2	DO12 X6 P4	DO11 X5 P2	DO10 X5P4	DO9 X4P2	DO8 X4P4	DO7 X3P2	DO6 X3 P4	DO5 X2 P2	DO4 X2 P4	DO3 X1 P2	DO2 X1 P4	DO1 X0P2	DO0 X0 P4

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

Attr. no.		Designation	Get/Set	Type	Value
Dec.	Hex.				
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 auto negotiation 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) automatically 1 = device requires a Reset service to be issued to its Identity Object in order to adapt the changes.	0
6	Local Hardware Fault	0 = interface detects no local hardware fault 1 = local hardware error detected	0

Common services

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

7.7.7 VSC-Vendor Specific Classes

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	Applies to:
Dec.	Hex.			
100	0x64	Gateway	Data and parameters for the fieldbus specific part of the device.	all
102	0x66	Process data	Process data	
126	0x7E	Miscellaneous Parameters	Describes the EtherNet/IP port properties	
192	0xC0	LL-8DIP-8DOP		TBEN-LL-8DIP-8DOP
193	0xC1	LL-16DIP		TBEN-LL-16DIP
194	0xC2	LL-16DOP		TBEN-LL-16DOP
195	0xC3	LL-16DXP		TBEN-LL-16DXP

Gateway Class (VSC 100)

This class contains all information concerning the whole device.

Object Instance 2, Gateway Instance

Class 192 (0xC0) – LL-8DIP-8DOP

Applies to:

- TBEN-LL-8DIP-8DOP

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
Parameters					
1	0x01	DI 0 – invert digital input	G	USINT	0: No
					1: Yes
2	0x02	DI 1 – invert digital input	G	USINT	0: No
					1: Yes
…	…	…			
7	0x07	DI 6 – invert digital input	G	USINT	0: No
					1: Yes
8	0x08	DI 7 – invert digital input	G	USINT	0: No
					1: Yes
9	0x09	DI 0 – pulse stretching	G/S	USINT	
10	0x0A	DI 1 – pulse stretching	G/S	USINT	
…	…	…			
15	0x0F	DI 6 – pulse stretching	G/S	USINT	
16	0x10	DI 7 – pulse stretching	G/S	USINT	
17	0x09	DO 8 – manual reset after over-curr.	G/S	USINT	0: No
					1: Yes
18	0x12	DO 9 – manual reset after over-curr.	G/S	USINT	0: No
					1: Yes

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
…	…	…			
23	0x0C	DO 14 – manual reset after over-curr.	G/S	USINT	0: No 1: Yes
24	0x18	DO 15 – manual reset after over-curr.	G/S	USINT	0: No 1: Yes
25	0x19	DO 8 – overcurrent output	G	USINT	0: - 1: Active
26	0x1A	DO 9 – overcurrent output	G	USINT	0: - 1: Active
…	…	…			
31	0x1F	DO 14 – overcurrent output	G	USINT	0: - 1: Active
32	0x20	DO 15 – overcurrent output	G	USINT	0: - 1: Active
33	0x21	Overcurrent VAUX1 X0 (Ch0/1)	G	USINT	0: - 1: Active
34	0x22	Overcurrent VAUX1 X1 (Ch2/3)	G	USINT	0: - 1: Active
35	0x23	Overcurrent VAUX1 X2 (Ch4/5)	G	USINT	0: - 1: Active
36	0x24	Overcurrent VAUX1 X3 (Ch6/7)	G	USINT	0: - 1: Active
37	0x25	Overcurrent VAUX2 pin1 X4 (Ch8/9)	G	USINT	0: - 1: Active
38	0x26	Overcurrent VAUX2 pin1 X5 (Ch10/11)	G	USINT	0: - 1: Active
39	0x27	Overcurrent VAUX2 pin1 X6 (Ch12/13)	G	USINT	0: - 1: Active
40	0x28	Overcurrent VAUX2 pin1 X7 (Ch14/15)	G	USINT	0: - 1: Active
41	0x29	Input value	G	BYTE	Bit 0: input value Ch0 Bit 1: input value Ch1 … Bit 6: input value Ch6 Bit 7: Input value Ch7
42	0x2A	Output value	G	BYTE	Bit 0: output value Ch0 Bit 1: output value Ch1 … Bit 6: output value Ch6 Bit 7: output value Ch7

Class 193 (0xC1) – LL-16DIP

Applies to:

- TBEN-LL-16DIP

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
Parameter					
1	0x01	DI 0 – invert digital input	G	USINT	0: no
					1: yes
2	0x02	DI 1 – invert digital input	G	USINT	0: no
					1: yes
…	…	…			
15	0x0F	DI 14 – invert digital input	G	USINT	0: no
					1: yes
16	0x10	DI 15 – invert digital input	G	USINT	0: no
					1: yes
17	0x11	DI 0 – pulse stretching	G/S	USINT	
18	0x12	DI 1 – pulse stretching	G/S	USINT	
…	…	…			
31	0x1F	DI 14 – pulse stretching	G/S	USINT	
32	0x20	DI 15 – pulse stretching	G/S	USINT	
33	0x21	Overcurrent VAUX1 Pin1 X0 (Ch0/1)	G	USINT	0: -
					1: active
34	0x22	Overcurrent VAUX1 X1 (Ch2/3)	G	USINT	0: -
					1: active
35	0x23	Overcurrent VAUX1 X2 (Ch4/5)	G	USINT	0: -
					1: active
36	0x24	Overcurrent VAUX1 X3 (Ch6/7)	G	USINT	0: -
					1: active
37	0x25	Overcurrent VAUX1 X4 (Ch8/9)	G	USINT	0: -
					1: active
38	0x26	Overcurrent VAUX1 Pin1 X5 (Ch10/11)	G	USINT	0: -
					1: active
39	0x27	Overcurrent VAUX1 X6 (Ch12/13)	G	USINT	0: -
					1: active
40	0x28	Overcurrent VAUX1 X7 (Ch14/15)	G	USINT	0: -
					1: active
41	0x29	Input value	G	BYTE	Bit 0: input value Ch0 Bit 1: input value Ch1 … Bit 14: input value Ch14 Bit 15: input value Ch15

Class 194 (0xC1) – LL- 16DOP

Applies to:

- TBEN-LL-16DOP

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
1	0x01	DO 0 – manual reset after overcurr.	G/S	USINT	0: no 1: yes
2	0x02	DO 1 – manual reset after overcurr.	G/S	USINT	0: no 1: yes
…	…	…			
15	0x0F	DO 14 – manual reset after overcurr.	G/S	USINT	0: no 1: yes
16	0x10	DO 15 – manual reset after overcurr.	G/S	USINT	0: no 1: yes
17	0x11	DO 0 – overcurrent output	G	USINT	0: - 1: active
18	0x12	DO 1 – overcurrent output	G	USINT	0: - 1: active
…	…	…			
31	0x1F	DO 14 – overcurrent output	G	USINT	0: - 1: active
32	0x20	DO 15 – overcurrent output	G	USINT	0: - 1: active
33	0x78	DO 0 – overcurrent VAUX2 pin1 X0 (Ch0/1)	G	USINT	0: - 1: active
34	0x79	DO 1 – overcurrent VAUX2 pin1 X1 (Ch2/3)	G	USINT	0: - 1: active
…	…	…			
39	0x27	DO 6 – overcurrent VAUX2 pin1 X6 (Ch12/13)	G	USINT	0: - 1: active
40	0x28	DO 7 – overcurrent VAUX2 pin1 X7 (Ch14/15)	G	USINT	0: - 1: active
41	0x29	16DOP – output value 0	G	WORD	Bit 0: output value Ch0 Bit 1: output value Ch1 … Bit 14: output value Ch14 Bit 15: output value Ch15

Class 195 (0xC1) – LL-16DXP

Applies to:

- TBEN-LL-16DXP

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
Parameter					
1	0x01	DXP 0 – invert digital input	G	USINT	0: no
					1: yes
2	0x02	DXP 1 – invert digital input	G	USINT	0: no
					1: yes
…	…	…			
15	0x0F	DXP 14 – invert digital input	G	USINT	0: no
					1: yes
16	0x10	DXP 15 – invert digital input	G	USINT	0: no
					1: yes
17	0x09	DXP 0 – pulse stretching	G/S	USINT	
18	0x12	DXP 1 – pulse stretching	G/S	USINT	
…	…	…	G/S	USINT	
31	0x1F	DXP 14 – pulse stretching	G/S	USINT	
32	0x20	DXP 15 – pulse stretching	G/S	USINT	
33	0x21	DXP 0 – Activate output	G/S	USINT	0: no
					1: yes
34	0x22	DXP 1 – Activate output	G/S	USINT	0: no
					1: yes
…	…	…			
47	0x2F	DXP 14 – Activate output	G/S	USINT	0: no
					1: yes
48	0x30	DXP 15 – Activate output	G/S	USINT	0: no
					1: yes
49	0x31	DXP 0 – manual reset after overcurr.	G/S	USINT	0: no
					1: yes
50	0x32	DXP 1 – manual reset after overcurr.	G/S	USINT	0: no
					1: yes
…	…	…			
63	0x3F	DXP 14 – manual reset after overcurr.	G/S	USINT	0: no
					1: yes
64	0x40	DXP 15 – manual reset after overcurr.	G/S	USINT	0: no
					1: yes
65	0x41	DXP 0 – Overcurrent output	G	USINT	0: -
					1: active
66	0x42	DXP 1 – Overcurrent output	G	USINT	0: -
					1: active
…	…	…			

Attr. no.		Designation	Get/Set	Type	Meaning
Dec.	Hex.				
79	0x4F	DXP 14 – Overcurrent output	G	USINT	0: - 1: active
80	0x50	DXP 15 – Overcurrent output	G	USINT	0: - 1: active
81	0x51	Overcurrent VAUX1 Pin1 X0 (Ch0/1)	G	USINT	0: - 1: active
82	0x52	Overcurrent VAUX1 X1 (Ch2/3)	G	USINT	0: - 1: active
83	0x53	Overcurrent VAUX1 X2 (Ch4/5)	G	USINT	0: - 1: active
84	0x54	Overcurrent VAUX1 X3 (Ch6/7)	G	USINT	0: - 1: active
85	0x55	Overcurrent VAUX2 pin1 X4 (Ch8/9)	G	USINT	0: - 1: active
86	0x56	Overcurrent VAUX2 pin1 X5 (Ch10/11)	G	USINT	0: - 1: active
87	0x57	Overcurrent VAUX2 pin1 X6 (Ch12/13)	G	USINT	0: - 1: active
88	0x58	Overcurrent VAUX2 pin1 X7 (Ch14/15)	G	USINT	0: - 1: active
89	0x59	Input value	G	BYTE	Bit 0: input value Ch0 Bit 1: input value Ch1 … Bit 14: input value Ch14 Bit 15: input value Ch15
90	0x5A	Output value	G	BYTE	Bit 0: output value Ch0 Bit 1: output value Ch1 … Bit 14: output value Ch14 Bit 15: output value Ch15

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

Used hardware

The following hardware components are used in this example:

- Rockwell Contoller ControlLogix 1756-L72, Logix 5572
- Rockwell Scanner 1756-EN2TR
- Block module TBEN-LL-16DXP

Used software

The following software tools are used in this example:

- Rockwell Studio 5000
- Catalog-Datei für Turck-Kompaktstationen „TURCK_BLOCK_STATIONS_V24.L5K" als Teil der Datei „TBEN-…_ETHERNETIP.zip" (kostenfrei als Download erhältlich unter **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.

7.8.1 Adding the devices from the Catalog files to the new project

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

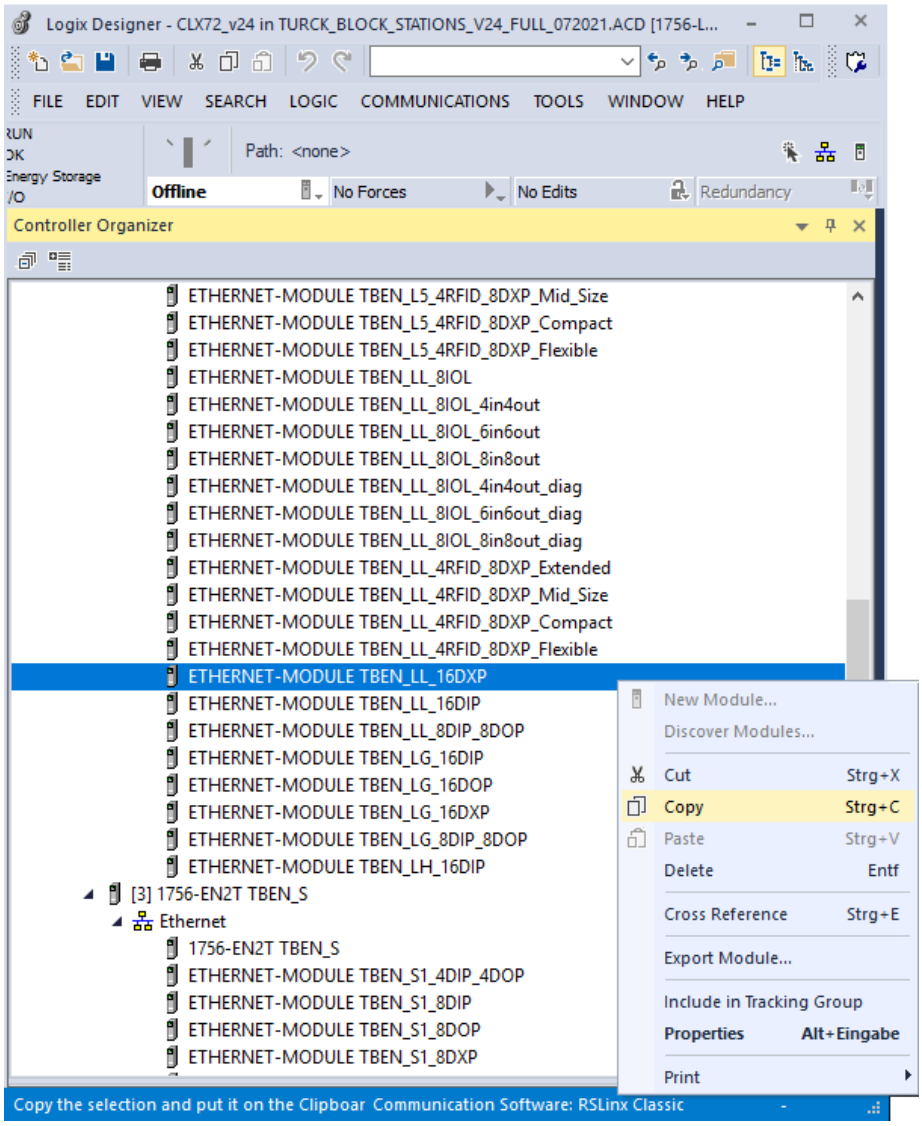

Fig. 57: RSLogix – copying the device entry from catalog file

- Right-click the EtherNet/IP Scanner in the 2nd instance of Logix Designer and add the device to the project via **Paste**.

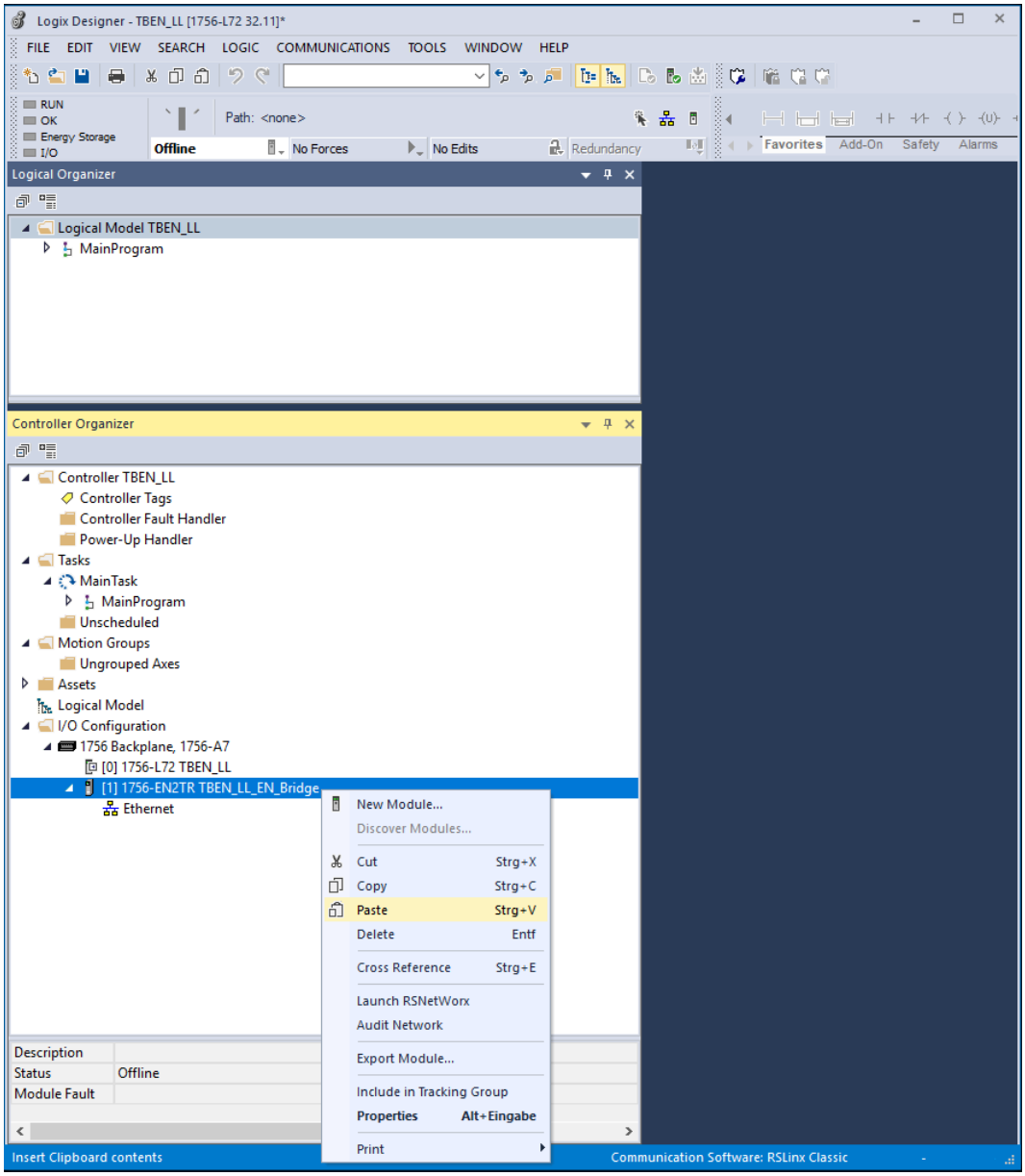

Fig. 58: RS Logix - adding the device to the project

7.8.2 Configuring the device in Logix Designer

- Open the device entry by double-clicking.
- Assign a module name.
- Set the IP address of the device (example: 192.168.145.181).

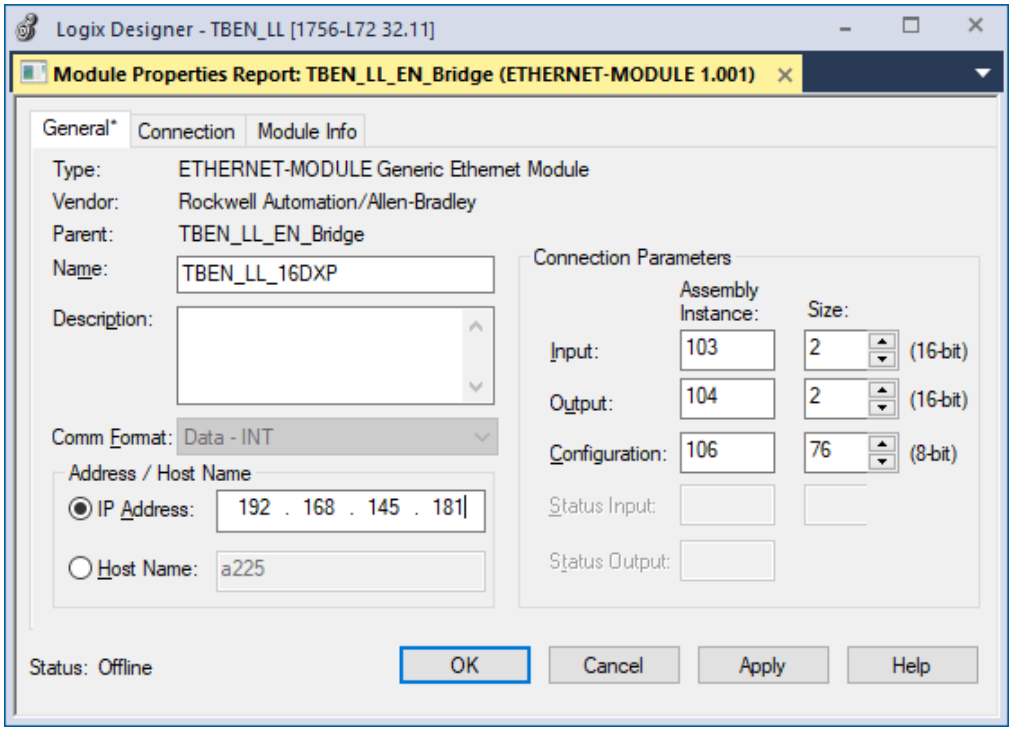

Fig. 59: Setting module name and IP address

- Optional: Set the connection parameters.

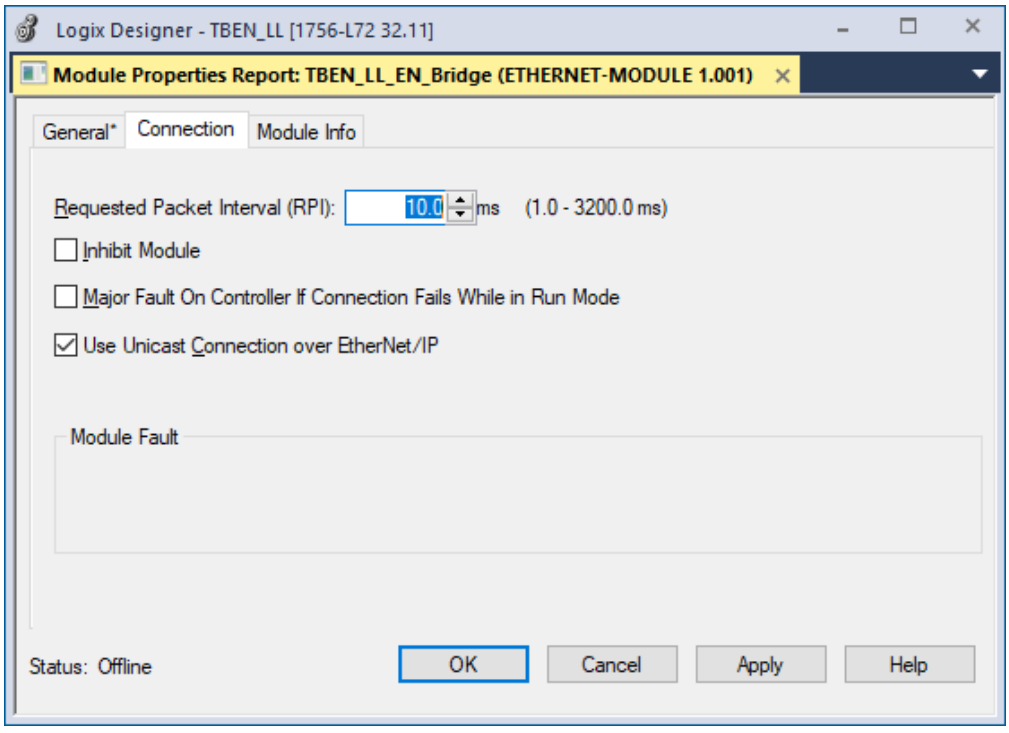

Fig. 60: Setting the connection parameters

7.8.3 Parameterizing the device

- Open the Controller Tags of the device.
- Parameterize the device via the Controller Tags **TBEN-LL-16DXP:C.**

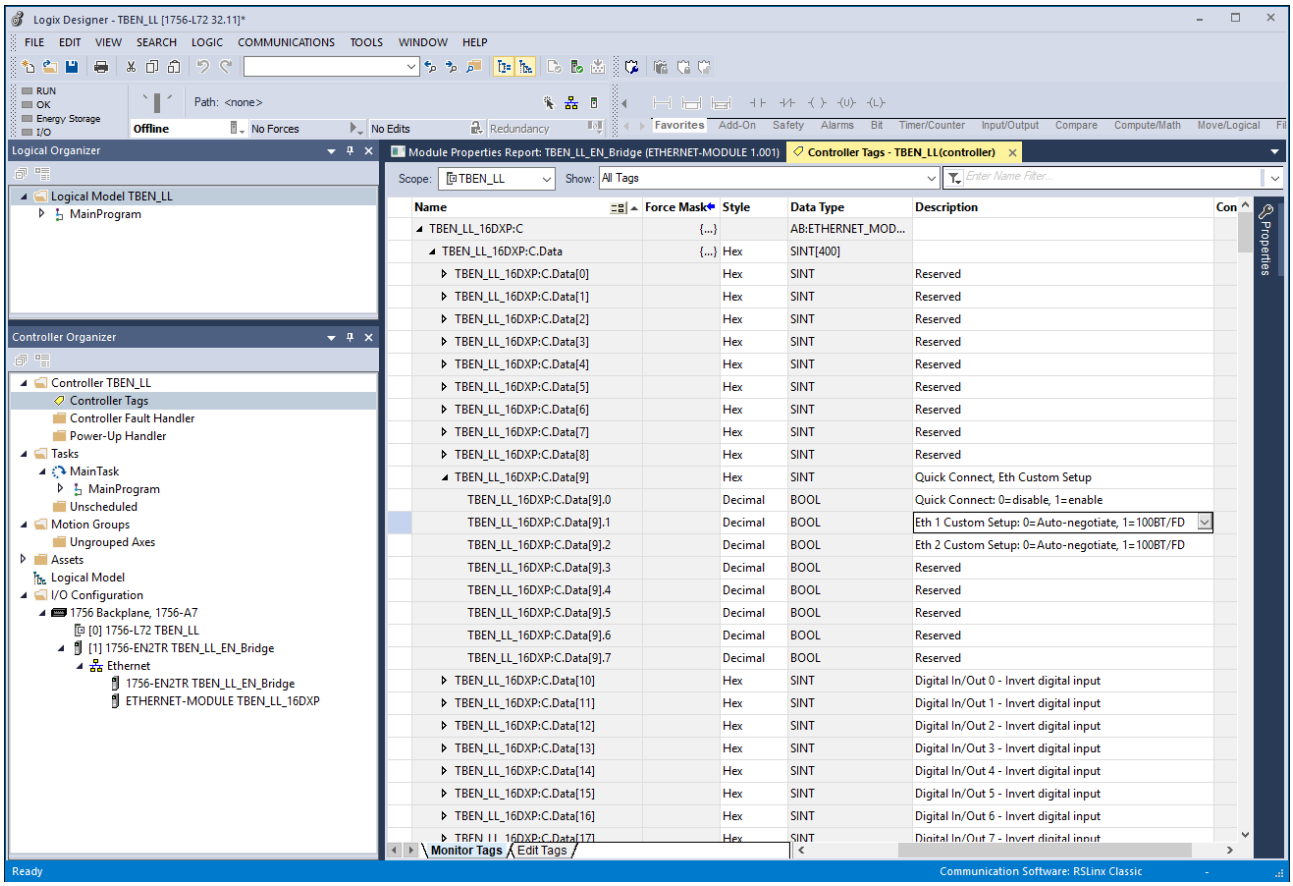

Fig. 61: Parameterizing the device

7.8.4 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.

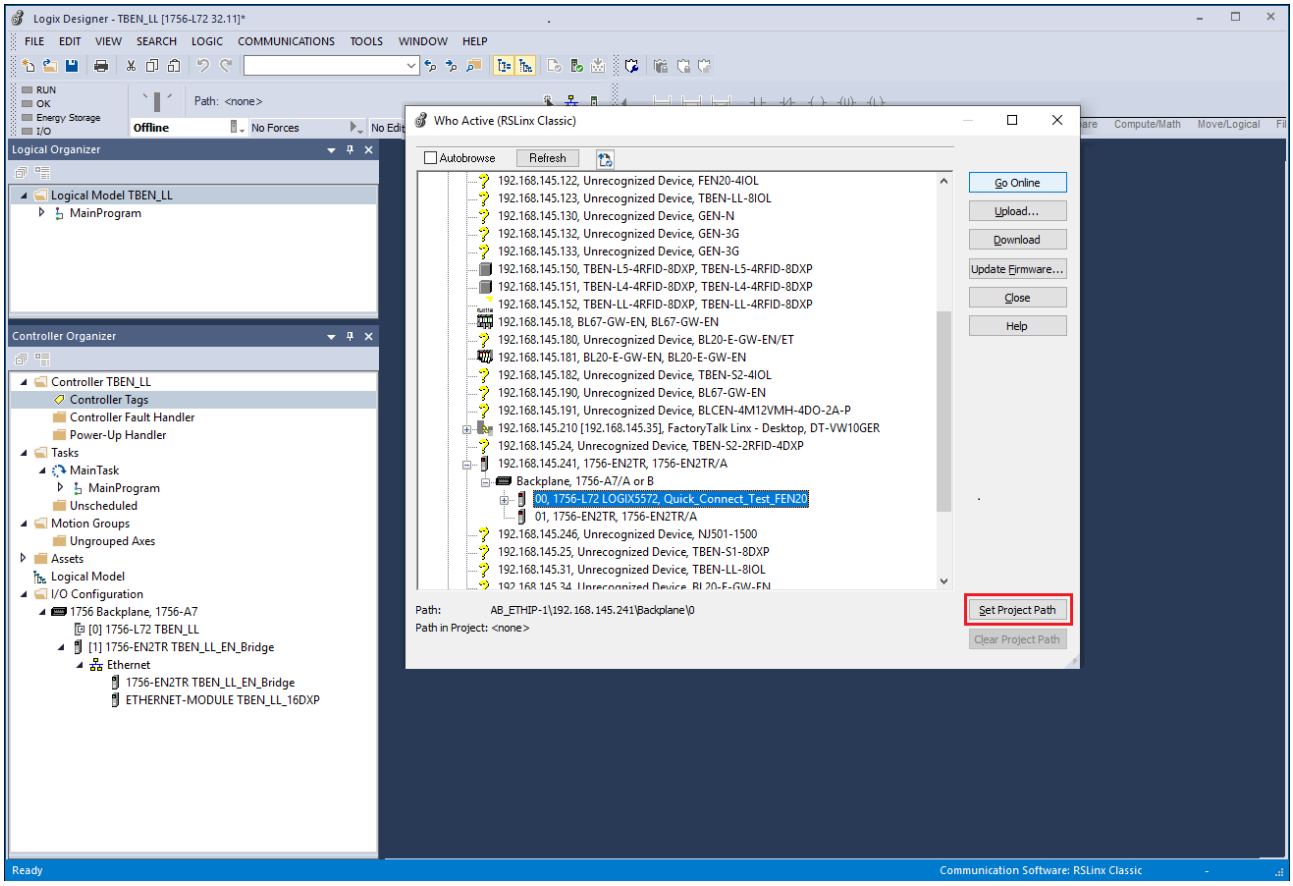

Fig. 62: Setting the communication path

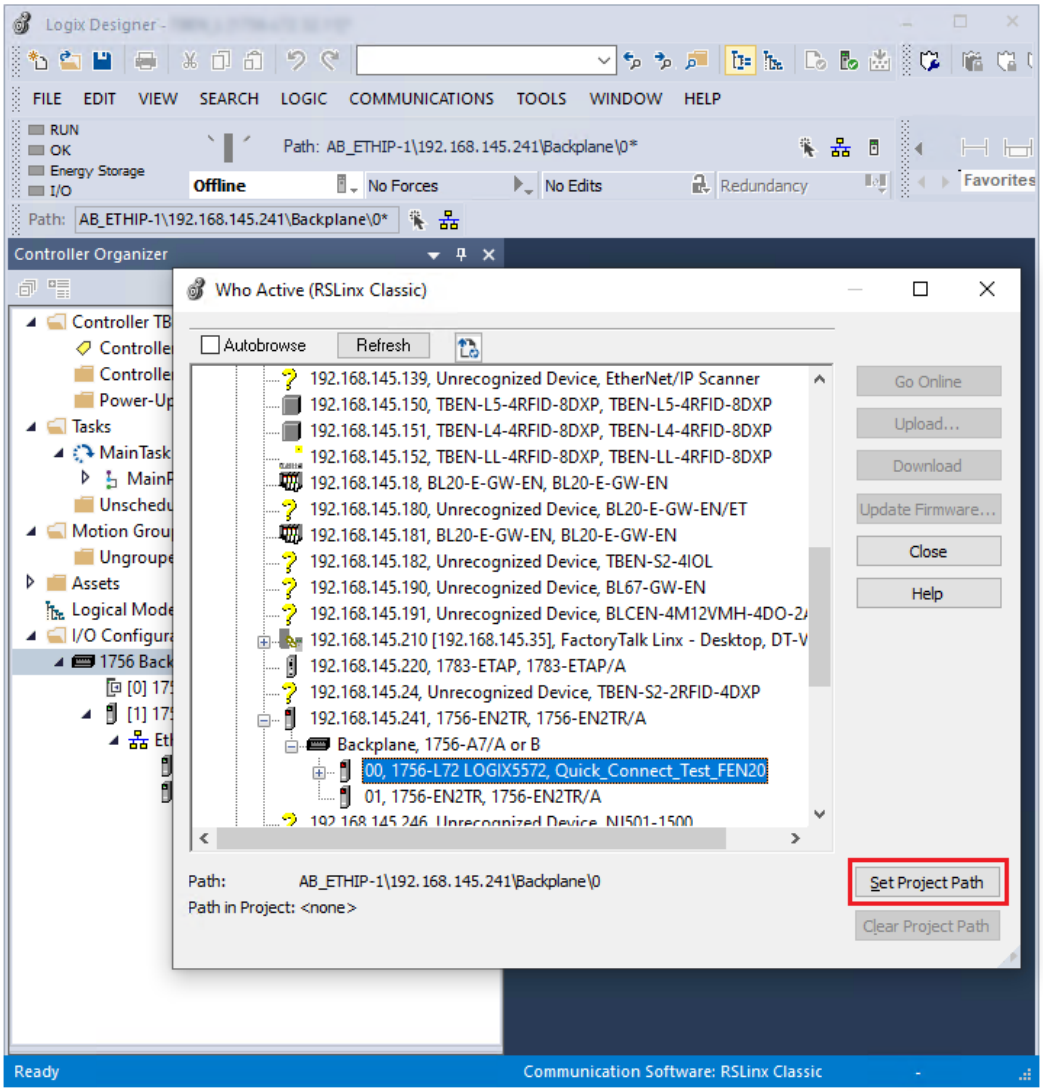

Fig. 63: Setting the communication path

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

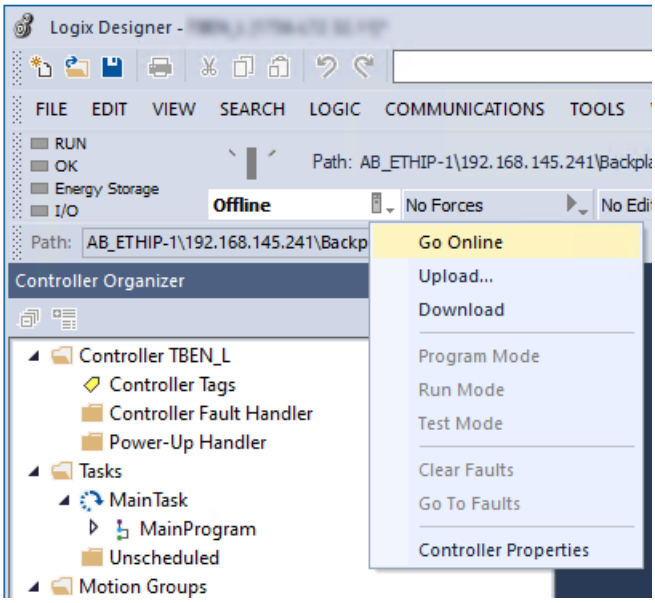

Fig. 64: Going online with the device

- ▶ 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.

7.8.5 Reading process data

- ▶ Open the Controller Tags in the project tree by double-clicking the entry.
- ⇨ The access to the input data (**TBEN-LL-16DXP:I**) and output data (**TBEN-LL-16DXP:O**) is possible.

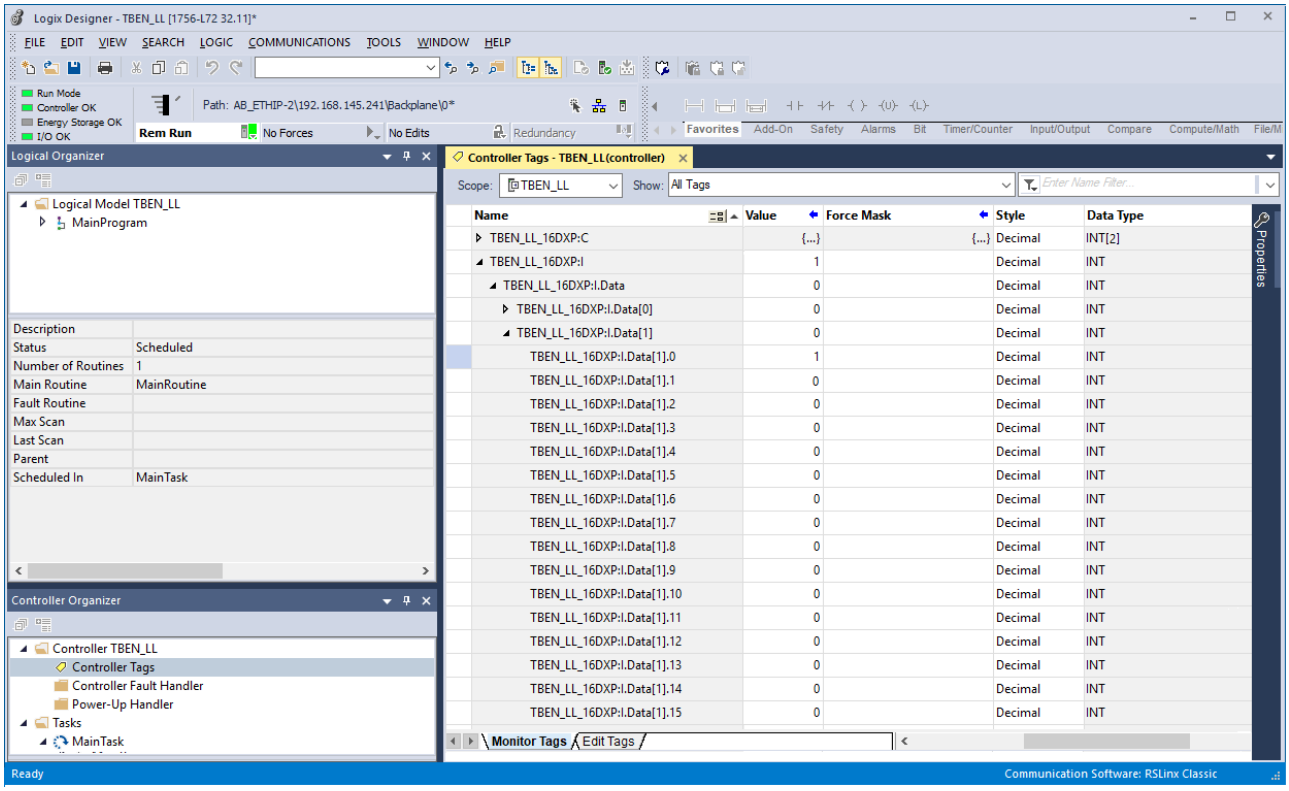

Fig. 65: Controller Tags in the project tree

7.9 Commissioning the devices in CC-Link IE Field Basic

7.9.1 General features CC-Link IE Field Basic

CC-Link IE Field Basic works with a client/server communication model. A maximum data width of 64 × 64 bits is available for communication between a client station and several server stations, whereby a unit of 64 bits is referred to as an occupied station. A CC-Link Field Basic network can consist of a maximum of 64 occupied stations. I/O modules can occupy one or more of the 64 occupied stations, depending on their complexity and data width.

CC-Link IE Field Basic		
Maximum number of stations in a network	max. 64 occupied stations	An I/O module can occupy several occupied stations.
Group	max. 16 occupied stations	To optimize process data traffic, devices can be combined into groups according to their function. A group can consist of a maximum of 16 occupied stations.
Cyclic data		Cyclical data is mapped bit by bit or word by word in registers.
	RX	Register for bit-by-bit access to digital inputs (DI)
	RY	Register for bit-by-bit access to digital outputs (DO)
	RWr	Register for word-by-word, read access to process data (e.g. IO-Link)
	RWw	Register for word-by-word, write access to process data (e.g. IO-Link)
Port numbers	61450 (cyclic data)	
	61451 (port number of server station for NodeSearch and IPAddressSet)	

7.9.2 CSP+ files

The CSP+ files can be downloaded free of charge at www.turck.com.

7.9.3 Cyclic data transmission

The cyclic process image of the devices is divided into a bit area and a word area. The bit area [▶ 102] contains the input and output data of the digital channels, the channel diagnostics and the module status (status word), see [▶ 128] or [▶ 133]. The word area does not contain any data for the digital TBEN modules.

Input data			Output data		
Bit area RX	**Word area RWr**	**Access**	**Bit area RY**	**Word area RWw**	**Access**
TBEN-LL-16DIP					
Input data DI0…DI15	-	RO	-	-	RW
Diagnostics digital channels					
VAUX1 diagnostics					
Module status					
TBEN-LL-16DOP					
Diagnostics digital channels	-	RO	Output data DO0… DO15	-	RW
VAUX1 diagnostics					
Module status					
TBEN-LL-8DIP-8DOP					
Input data DI0…DI7	-	RO	Output data DO8…DO15	-	RW
Diagnostics digital channels					
VAUX1/VAUX2 diagnostics					
Module status					
TBEN-LL-16DXP					
Input data DXP0…DXP15	-	RO	Output data DXP0…DXP15	-	RW
Diagnostics digital channels					
VAUX1/VAUX2 diagnostics					
Module status					

7.9.4 Occupied Stations

Device	Occupied Stations
TBEN-LL-8DIP	1
TBEN-LL-8DOP	1
TBEN-LL-8DIP-8DOP	1
TBEN-LL-16DXP	1

7.9.5 Bit area

TBEN-LL-16DIP

RX	Signal
Digital channels [▶ 128]	
RX0	DI0 X0P4
RX1	DI1 X0 P2
RX2	DI2 X1P4
RX3	DI3 X1 P2
RX4	DI4 X2 P4
RX5	DI5 X2 P2
RX6	DI6 X3 P4
RX7	DI7 X3 P2
RX8	DI8 X4 P4
RX9	DI9 X4 P2
RXA	DI10 X5 P4
RXB	DI11 X5 P2
RXC	DI12 X6 P4
RXD	DI13 X6 P2
RXE	DI14 X7 P4
RXF	DI15 X7 P2
VAUX1 diagnostics [▶ 128]	
RX10	VAUX1 X0 (Ch0/1)
RX11	VAUX1 X1 (Ch2/3)
RX12	VAUX1 X2 (Ch4/5)
RX13	VAUX1 X3 (Ch6/7)
RX14	VAUX1 X4 (Ch8/9)
RX15	VAUX1 X5 (Ch10/11)
RX16	VAUX1 X6 (Ch12/13)
RX17	VAUX1 X7 (Ch14/15)
Module status (status word) [▶ 133]	
RX20	DIAG
RX21	ARGEE
…	-
RX29	V1
RX2A	Internal error
…	-
RX2E	FCE
RX2F	-

X0…X7 = connector at the device, P… = pin

TBEN-LL-16DOP

- Input data

RX	Signal
VAUX2 diagnostics [▶ 128]	
RX0	VERR V2 Pin 1 X0 Ch0Ch1
RX1	VERR V2 Pin 1 X1 Ch2Ch3
RX2	VERR V2 Pin 1 X2 Ch4Ch5
RX3	VERR V2 Pin 1 X3 Ch6Ch7
RX4	VERR V2 Pin 1 X4 Ch8Ch9
RX5	VERR V2 Pin 1 X5 Ch10Ch11
RX6	VERR V2 Pin 1 X6 Ch12Ch13
RX7	VERR V2 Pin 1 X7 Ch14Ch15
Overcurrent diagnostics of outputs [▶ 128]	
RX10	ERR0
RX11	ERR1
RX12	ERR2
RX13	ERR3
RX14	ERR4
RX15	ERR5
RX16	ERR6
RX17	ERR7
RX18	ERR8
RX19	ERR9
RX1A	ERR10
RX1B	ERR11
RX1C	ERR12
RX1D	ERR13
RX1E	ERR14
RX1F	ERR15
Module status (status word) [▶ 133]	
RX20	DIAG
RX21	ARGEE
…	
RX27	V2
…	-
RX29	V1
RX2A	Internal error
…	-
RX2E	FCE
RX2F	-

X0…X7 = connector at the device, P… = pin

- Output data

RY	Signal
Digital outputs [▶ 131]	
RY0	DX0 X0 P4
RY1	DX1 X0P2
RY2	DX2 X1 P4
RY3	DX3 X1 P2
RY4	DX4 X2 P4
RY5	DX5 X2 P2
RY6	DX6 X3 P4
RY7	DX7 X3 P2
RY8	DX8 X4P4
RY9	DX9 X4P2
RYA	DX10 X5 P4
RYB	DX11 X5 P2
RYC	DX12 X6 P4
RYD	DX13 X6 P2
RYE	DX14 X7 P4
RYF	DX15 X7 P2

X0…X7 = connector at the device, P… = pin

TBEN-LL-16DXP

- Input data

RX	Signal
Digital inputs [▶ 128]	
RX0	DX0 X0 P4
RX1	DX1 X0P2
RX2	DX2 X1 P4
RX3	DX3 X1 P2
RX4	DX4 X2 P4
RX5	DX5 X2 P2
RX6	DX6 X3 P4
RX7	DX7 X3 P2
RX8	DX8 X4P4
RX9	DX9 X4P2
RXA	DX10 X5 P4
RXB	DX11 X5 P2
RXC	DX12 X6 P4
RXD	DX13 X6 P2
RXE	DX14 X7 P4
RXF	DX15 X7 P2
VAUX1/VAUX2 diagnostics [▶ 128]	
RX10	VAUX1 X0 (Ch0/1)
RX11	VAUX1 X1 (Ch2/3)
RX12	VAUX1 X2 (Ch4/5)
RX13	VAUX1 X3 (Ch6/7)
RX14	VAUX2 pin 1 X4 (Ch8/9)
RX15	VAUX2 pin 1 X5 (Ch10/Ch11)
RX16	VAUX2 pin 1 X6 (Ch12/Ch13)
RX17	VAUX2 pin 1 X7 (Ch14/Ch15)
Overcurrent diagnostics of outputs [▶ 128]	
RX20	ERR0
RX21	ERR1
RX22	ERR2
RX23	ERR3
RX24	ERR4
RX25	ERR5
RX26	ERR6
RX27	ERR7
RX28	ERR8
RX29	ERR9
RX2A	ERR10
RX2B	ERR11
RX2C	ERR12

RX	Signal
RX2D	ERR13
RX2E	ERR14
RX2F	ERR15
Module status (status word) [▶ 133]	
RX30	DIAG
RX31	ARGEE
…	
RX37	V2
…	-
RX39	V1
RX3A	Internal error
…	-
RX3E	FCE
RX3F	-

X0…X7 = connector at the device, P… = pin

- Output data

RY	Signal
Digital outputs [▶ 131]	
RY0	DX0 X0 P4
RY1	DX1 X0P2
RY2	DX2 X1 P4
RY3	DX3 X1 P2
RY4	DX4 X2 P4
RY5	DX5 X2 P2
RY6	DX6 X3 P4
RY7	DX7 X3 P2
RY8	DX8 X4P4
RY9	DX9 X4P2
RYA	DX10 X5 P4
RYB	DX11 X5 P2
RYC	DX12 X6 P4
RYD	DX13 X6 P2
RYE	DX14 X7 P4
RYF	DX15 X7 P2

X0…X7 = connector at the device, P… = pin

TBEN-LL-8DIP-8DOP

- Input data

RX	Signal
Digital inputs [▶ 128]	
RX0	DI0 X0P4
RX1	DI1 X0 P2
RX2	DI2 X1P4
RX3	DI3 X1 P2
RX4	DI4 X2 P4
RX5	DI5 X2 P2
RX6	DI6 X3 P4
RX7	DI7 X3 P2
VAUX1/VAUX2 diagnostics [▶ 128]	
RX10	VAUX1 X0 (Ch0/1)
RX11	VAUX1 X1 (Ch2/3)
RX12	VAUX1 X2 (Ch4/5)
RX13	VAUX1 X3 (Ch6/7)
RX14	VAUX2 pin 1 X4 (Ch8/9)
RX15	VAUX2 pin 1 X5 (Ch10/Ch11)
RX16	VAUX2 pin 1 X6 (Ch12/Ch13)
RX17	VAUX2 pin 1 X7 (Ch14/Ch15)
Overcurrent diagnostics of outputs [▶ 128]	
RX28	ERR8
RX29	ERR9
RX2A	ERR10
RX2B	ERR11
RX2C	ERR12
RX2D	ERR13
RX2E	ERR14
RX2F	ERR15
Module status (status word) [▶ 133]	
RX30	DIAG
RX31	ARGEE
…	
RX37	V2
…	-
RX39	V1
RX3A	Internal error
…	-
RX3E	FCE
RX3F	-

X0…X7 = connector at the device, P… = pin

- Output data

RY	Signal
Digital outputs [▶ 131]	
RY0	DX8 X4P4
RY1	DX9 X4P2
RY2	DX10 X5 P4
RY3	DX11 X5 P2
RY4	DX12 X6 P4
RY5	DX13 X6 P2
RY6	DX14 X7 P4
RY7	DX15 X7 P2

X0…X7 = connector at the device, P… = pin

7.9.6 Word area

The word area does not contain any data for the digital TBEN-L… devices.

7.9.7 Parameter mapping

The chapter "parameterizing and configuring" [▶ 126] contains a detailed parameter description.

TBEN-LL-16DIP

Parameter ID	Offset	Parameter name	Channel	Value	Meaning
B000	0.0	Invert digital input Ch0	0	0	No
				1	Yes
	…	…	…	…	
	0F	Invert digital input Ch15	15	0	No
				1	Yes
	1.0	Impulse stretch (*10 ms) Ch…	0	0…254	
	1.8		1		
	2.0		2		
	2.8		3		
	…		…		
	8.0		14		
	8.8		15		

TBEN-LL-16DOP

Parameter ID	Offset	Parameter name	Channel	Value	Meaning
B000	0.0	Manual output reset after overcurrent Ch0	0	0	No
				1	Yes
	…	…	…	…	
	0F	Manual output reset after overcurrent Ch15	15	0	No
				1	Yes

TBEN-LL-16DXP

Parameter ID	Offset	Parameter name	Channel	Value	Meaning
B000	0.0	Manual output reset after overcurrent Ch0	0	0	No
				1	Yes
	…	…	…	…	
	0F	Manual output reset after overcurrent Ch15	15	0	No
				1	Yes
	1.0	Activate output Ch0	0	0	No
				1	Yes
	…	…	…	…	
	1.F	Activate output Ch15	15	0	No
				1	Yes
	2.0	Invert digital input Ch0	0	0	No
				1	Yes
	…	…	…	…	
	2.F	Invert digital input Ch15	15	0	No
				1	Yes
	3.0	Impulse stretch (*10 ms) Ch…	0	0…254	
	3.8		1		
	…		…		
	A.0		14		
	A.8		15		

TBEN-LL-8DIP-8DOP

Parameter ID	Offset	Parameter name	Channel	Value	Meaning
B000	0.8	Manual output reset after overcurrent Ch0	8	0	No
				1	Yes
	…	…	…	…	
	0F	Manual output reset after overcurrent Ch15	15	0	No
				1	Yes
	1.0	Invert digital input Ch0	0	0	No
				1	Yes
	…	…	…	…	
	1.7	Invert digital input Ch15	7	0	No
				1	Yes
	2.0	Impulse stretch (*10 ms) Ch…	0	0…254	
	2.8		1		
	3.0		2		
	3.8		3		
	4.0		4		
	4.8		5		
	5.0		6		
	5.8		7		

7.9.8 Acyclic communication via SLMP – supported functions

The devices support acyclical access via SLMP command Device Read (0x0401) and Device Write (0x1401).

Supported Device Codes

Device Code	Description
0x0011	Device information (vendor ID, device code, device name, etc.)
0x00AC	Acyclic communication
0x00D8	Input data
0x00D9	Output data
0x00DD	Diagnostic data

Supported End Codes

End Code	Description
0x0000	Command successfully executed
0xC059	Command/subcommand: not supported command or subcommand
0xC05C	Wrong data: data content does not fit to the command data content does not fit to the command
0xC061	Data length: data length does not fit to the command

Read device information (Device Code 0x0011)

Address (Add)	Content	Access type	Data length in word (Len)	Description
0x0001	Vendor code	ro	1	Vendor ID Turck: 0x3355
0x0002	Model code	ro	2	ID of the device
0x0003	Model name	ro	2	Device name
0x0004	FW version	ro	2	Firmware version of the device
0x0005	Stack version	ro	2	Version of the CC-Link component

Acyclic I/O communication (Device Code 0x00AC)

Address (Add)	Read access	Write access	Data length in word (Len)	Content	Description
0xACAC	Open Connection		1	0xAD00… 0xADFF, 0x0000	A read access to this address opens an acyclic connection or returns an error. A valid connection handle is 0xAD00…0xADFF, or 0 in case of failure.
0xACAC		Close Connection	1	0xAD00… 0xADFF, 0xFFFF	Write access to this address closes an acyclic connection. Writing a previously opened connection address (0xAD00…0xADFF) closes this connection. If the value -1 (0xFFFF) is written, all acyclic connections opened for CC-Link are closed.

Address (Add)	Read access	Write access	Data length in word (Len)	Content	Description
0xAD00 … 0xADFF			1…240	Acyclic data	

Example access:

1. **Open Connection**:
   Device Read (0x0401)
   Device Code = 0xAC
   Add = 0xACAC
   Len =1
   Result: 0xAD00 = Connection address: must be used for the following connection accesses, like read, write and close.

2. **Read Connection:**Device Read (0x0401)
   Device Code = 0xAC
   Add = 0xAD00
   Len =1
   Result: n words of received frame. The requested length is the maximum buffer size. If the available acyclic data does not fit in the buffer, the exceeding data is truncated.

3. **Write Connection**:
   Device Read (0x1401)
   Device Code = 0xAC
   Add = 0xAD00
   Len =1
   Result: n words of data to be sent.

4. **Close Connection**:
   Device Write (0x1401)
   Device Code = 0xAC
   Add=0xACAC,
   Len=1
   Data: 0xADxx (address of the previously used Open Connection)

Read input data (Device Code 0x00D8)

Address (Add)	Access type	Data length in word (Len)	Description
0x0000	ro	1…n	Access to all input data of the device regardless of profiles and restrictions due to the number of occupied stations, order: 1. Data from RWr area 2. Data from RX area
0x0001 … 0x00…	ro	1…n	Accesses the input data of one (sub)module. Data is structured in the native order of that (sub)module.

Write output data (Device Code 0x00D9)

Address (Add)	Access type	Data length in word (Len)	Description
0x0000	rw	1…n	Access to all output data of the device regardless of profiles and restrictions due to the number of occupied stations, order: 1. Data from RWw area 2. Data from RY area
0x0001 … 0x00…	rw	1…n	Accesses the output data of one (sub)module. Data is structured in the native order of that (sub)module.

Read Diagnostic data data (Device Code 0x00DD)

Address (Add)	Access type	Data length in word (Len)	Description
0x0000	ro	1…n	Access to all diagnostic data of the device regardless of profiles and restrictions due to the number of occupied stations
0x0001 … 0x00…	ro	1…n	Accesses the diagnostic data data of one (sub)module. Data is structured in the native order of that (sub)module.

7.10 Connecting devices to a CC-Link IE Field Basic client with GX Works3

Naming convention

Turck uses the terms "client" and "server". The following description uses the terms "Master Station" (client) and "Slave Station" (server) only because of the naming in Melsoft GX Works.

Used hardware

The following hardware components are used in this example:

- Mitsubishi MELSEC iQ-R controller
- Mitsubishi CPU 04ENCPU with local CC-Link IOs
- TBEN modules (as example)
  - TBEN-LL-8DIP-8DOP (IP address: 192.168.3.10)
  - TBEN-S2-4IOL (IP address: 192.168.3.12)

Used software

The following software tools are used in this example:

- Melsoft GX Works3

Prerequisites

- The GX Works3 software is open and a new project has been created.
- The controller including CPU and local IOs is configured in GX Works3.

7.10.1 Register the CSP+ files in GXWorks3

▶ Select and register CSP+ files via **Tools** → **Profile Management** → **Register**.
Note: CSP+ files can only be registered in GX Works3 if no project is open.

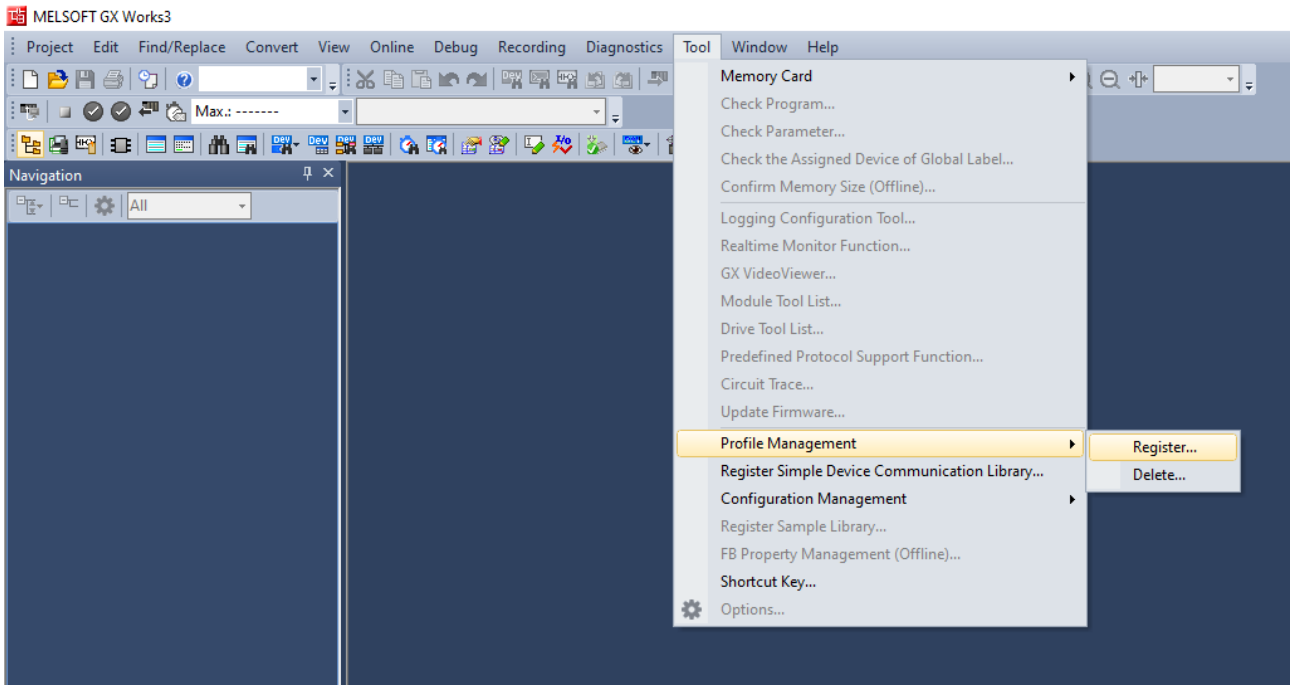

Fig. 66: Profile Management, Register Profile

7.10.2 Configuring the network settings

The network settings are configured at the CPU used under **Parameter → used CPU** (here: R04ENCPU) → **Module Parameters**.

Setting the IP address of the CPU

- Set the IP address of the CPU under **Own Node Settings → IP Address**.

Activate CC-Link Field Basic

The CC-Link IEF Basic protocol must be activated in the CPU.

- Under **CC-Link IEF Baisc Settings**, set the option **To Use or Not to Use CC-Link IEF Basic Setting** to **Use** in order to activate

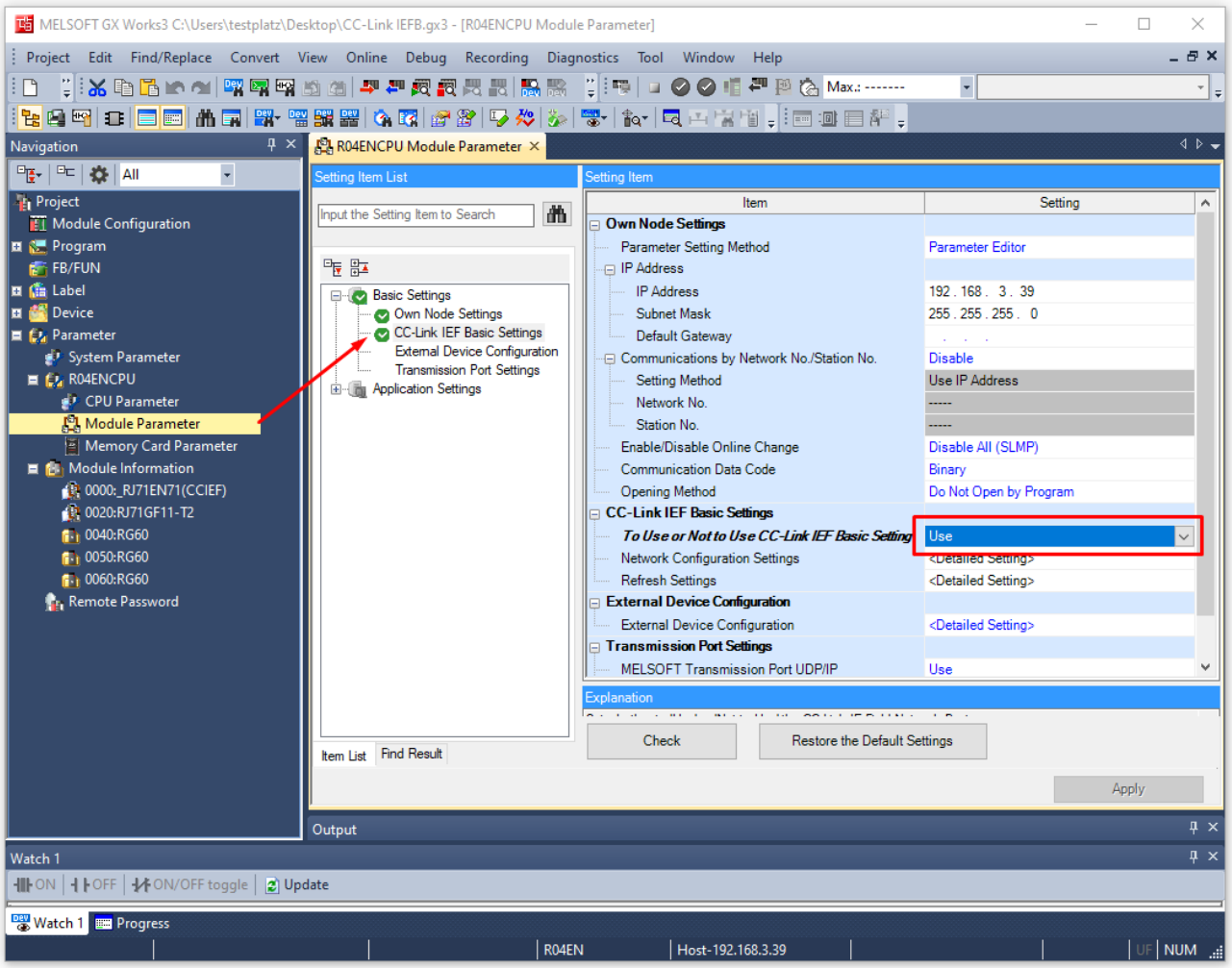

Fig. 67: GX Works3: Activate CC-Link IEF Basic on CPU

7.10.3 Configuring the CC-Link IE Field Basic network

Scanning the network

- Under **Module Parameters → CC-Link IEF Basic Settings** open the function **Network Configuration Settings.**

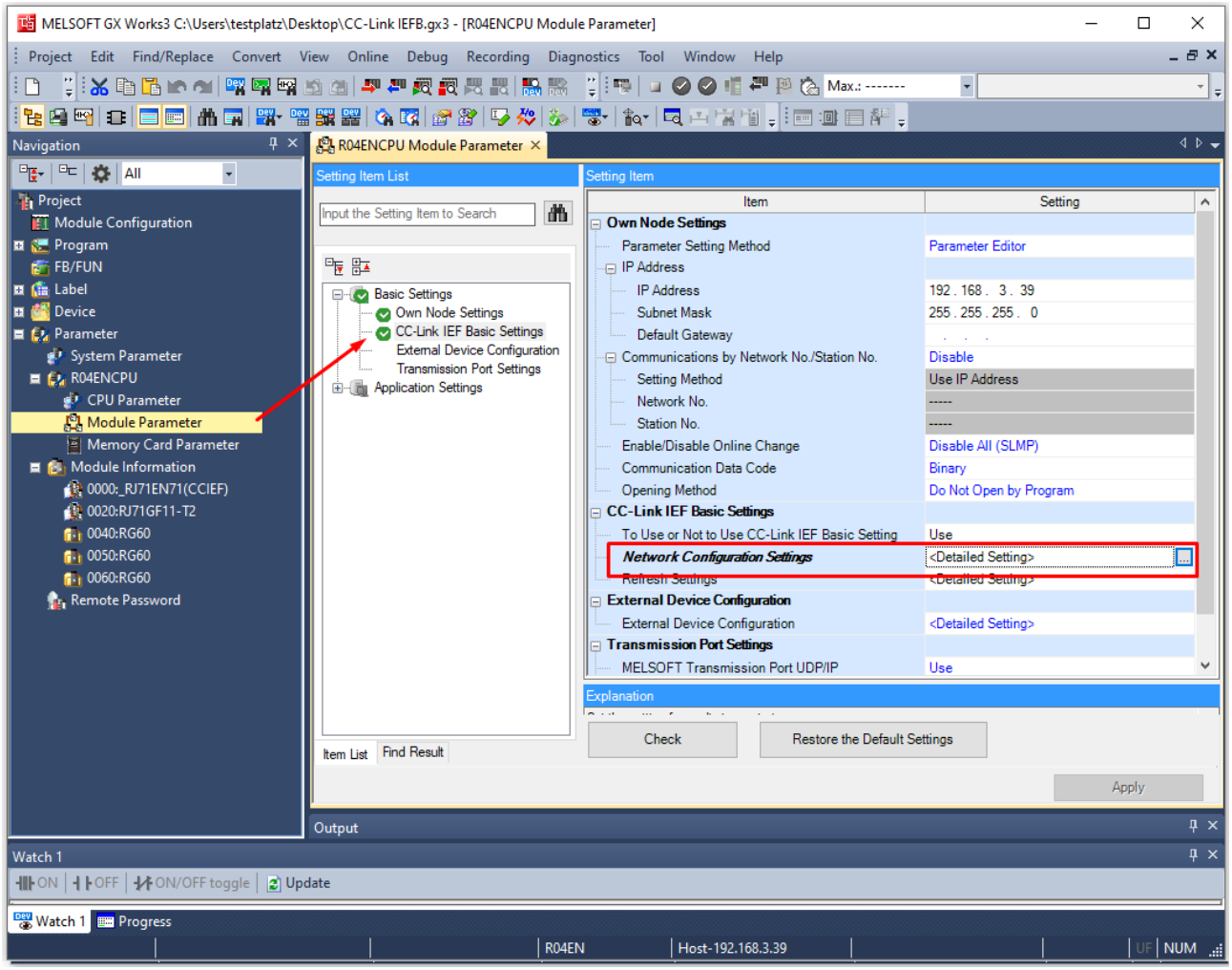

Fig. 68: GX Works3: Network Configuration Settings

▶ Scan the CC-Link IEF Basic network under **CC-Link IEF Basic Configuration** via **Detect Now**.

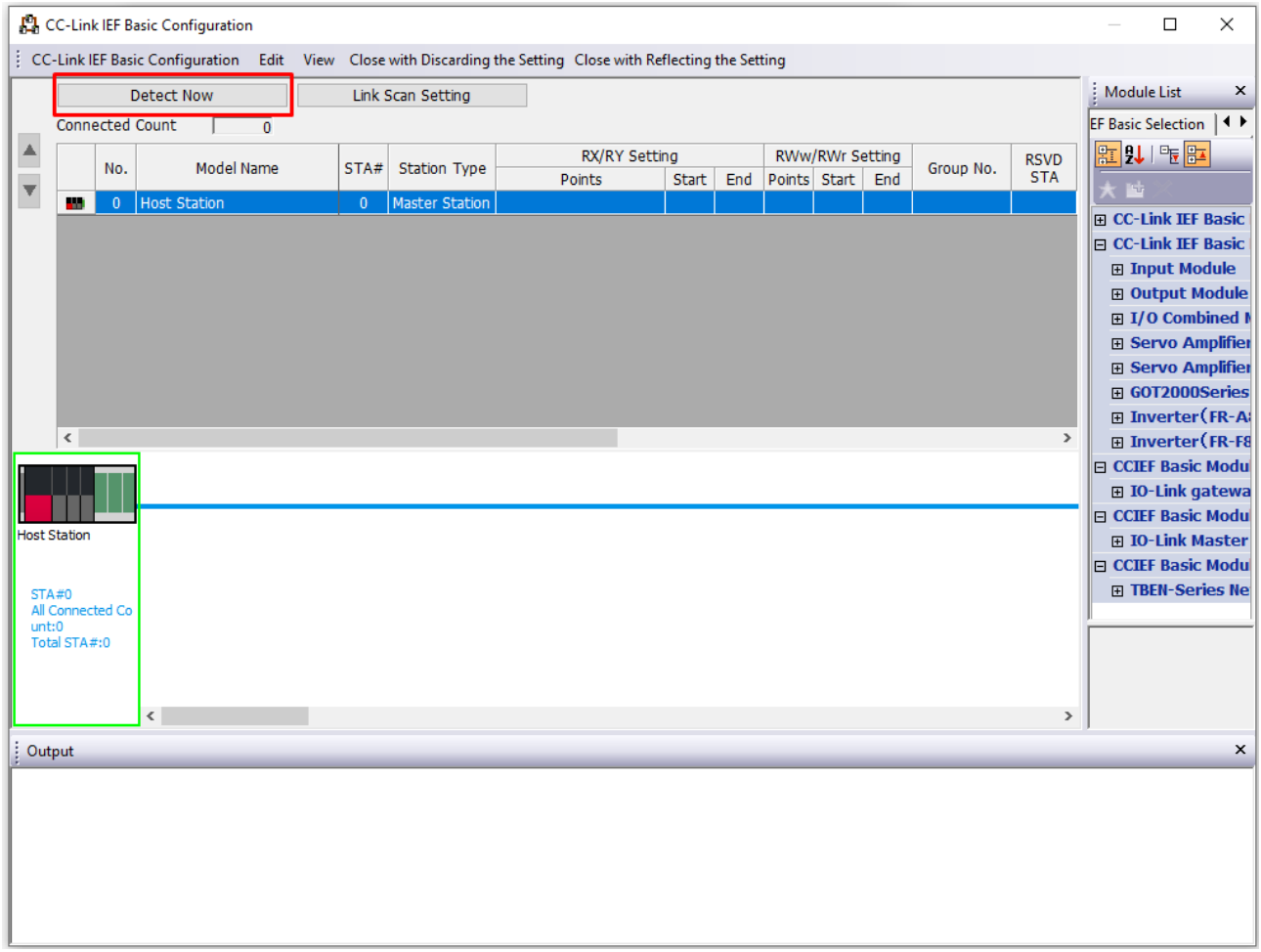

Fig. 69: GX Works3: scanning the CC-Link IEF Basic network

⇨ All CC-Link devices found in the Ethernet network are displayed in the order in which they are integrated in the network.

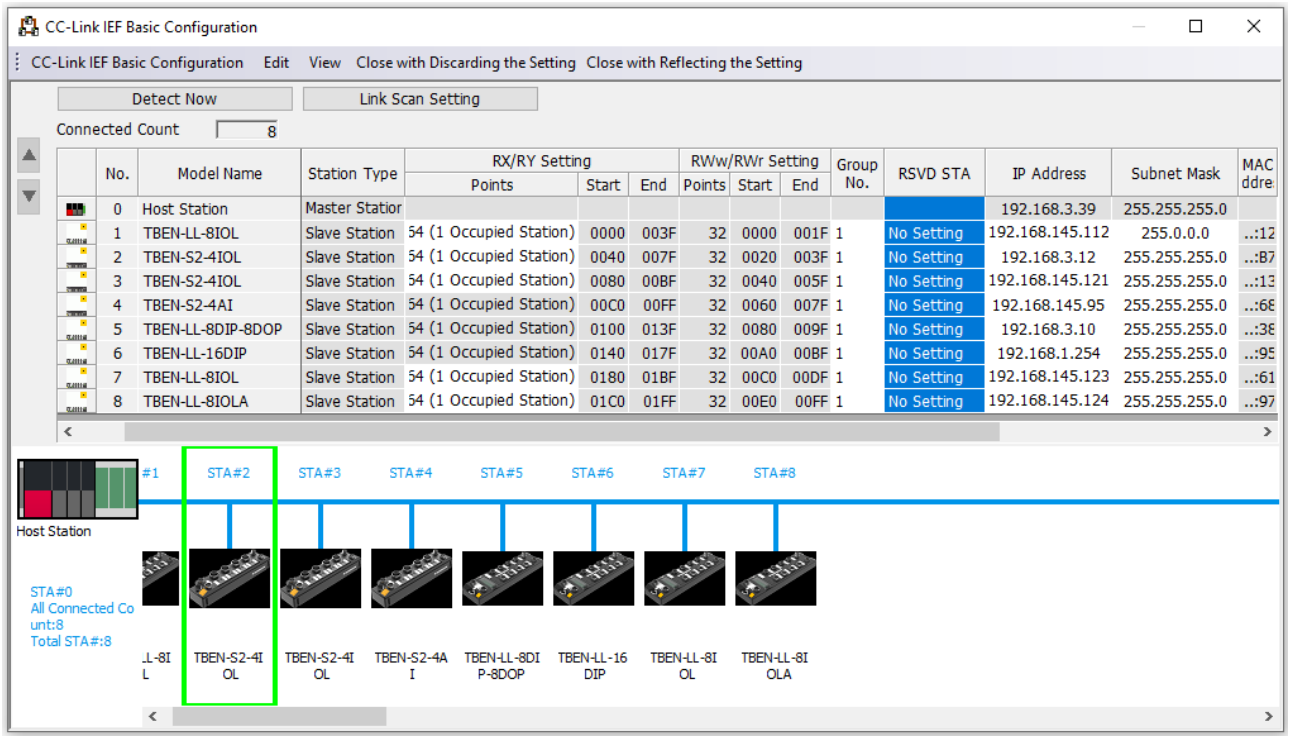

Fig. 70: GX Works3: Devices in the CC-Link IEF Basic network

Devices that do not match the IP address range of the controller cannot be added to the project.

- ▶ Delete the devices with an IP address outside the IP address range of the control unit by right-clicking on the device → **Delete** from the list of network nodes or change the devices' IP address in the **IP address column.**
- ▶ For devices that can be integrated with different process data variables (profiles) (here: TBEN-S2-4IOL): select the requested profile under **Station Type**.

Parameterizing CC-Link nodes

- Right-click on the device to be parameterized and select the device parameters via **Online → Parameter Processing of Slave Station**.

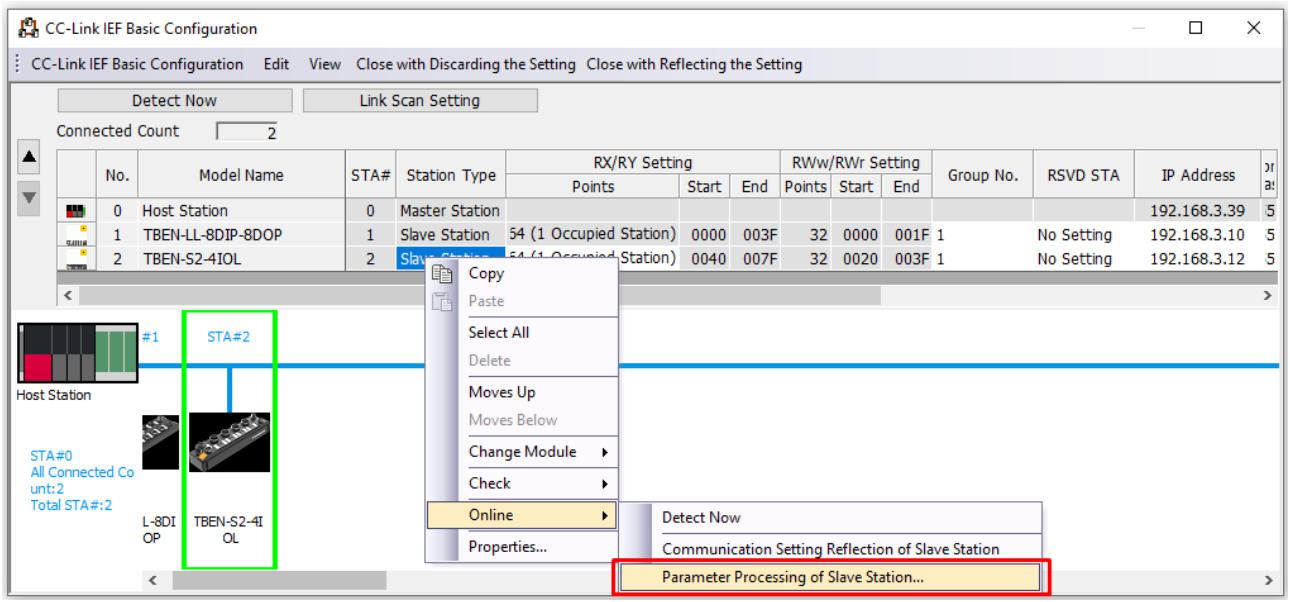

Fig. 71: GX Works3: Opening parameterization

- Activate the writing of parameters via **Method selection → Parameter write**.

NOTE
All parameters for one slot (in the example below: Slot 1) must be set. It is not possible to set individual parameters for a slot.

▶ Set the parameters and store the settings via **Execute**.

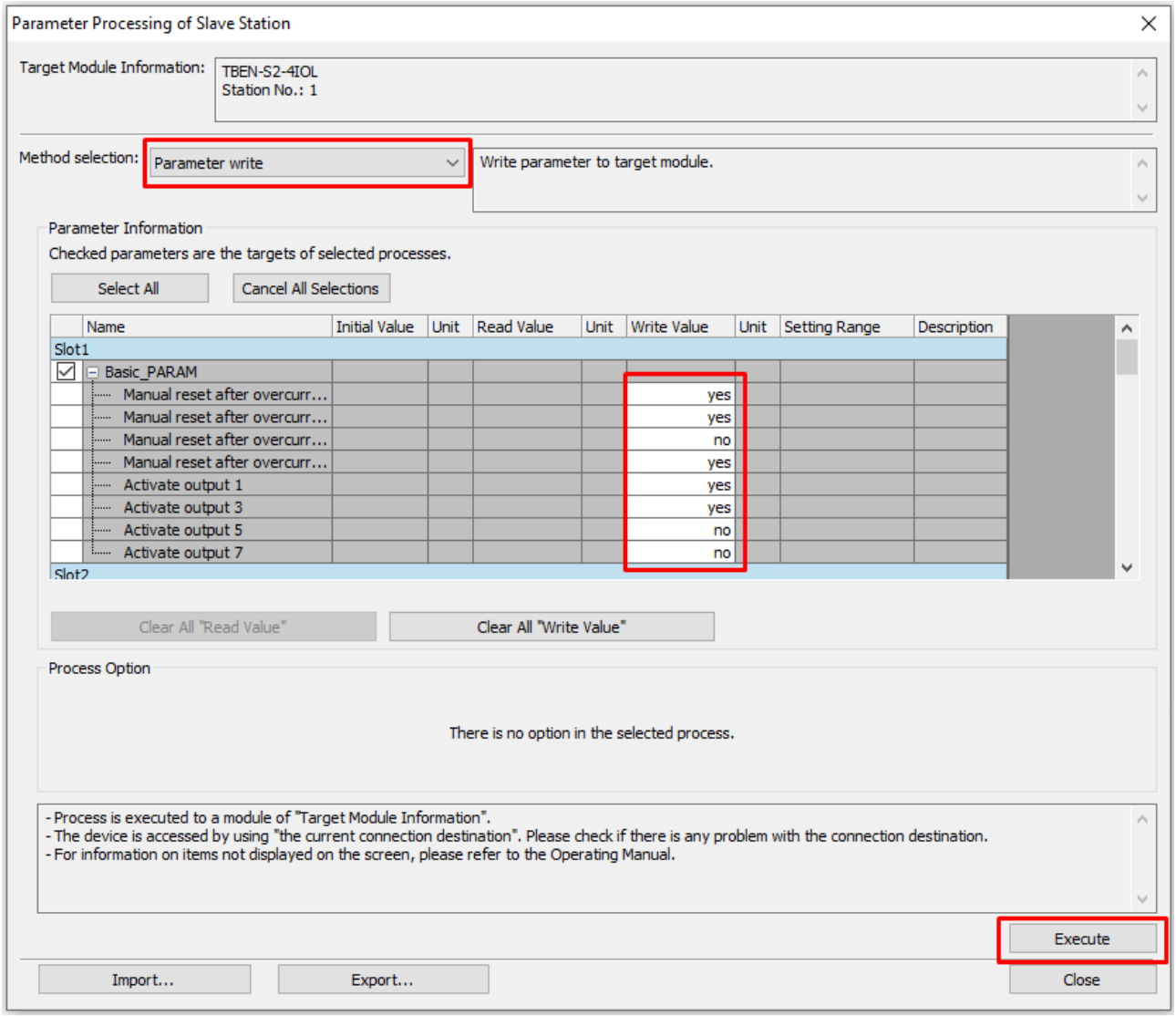

Fig. 72: GX Works3: Parameterizing the device

- Optional: Export the parameter settings under **Method selection** → **Parameter read** as CSV file and re-import the file under **Method selection** → **Parameter write** in order to fill the column **Write Values** with the actual parameter settings and then to be able to change sinlge parameters.
- Close the window **CC-Link IEF Basic Configuration** via **Close with Reflecting the Setting** and store the network structure.

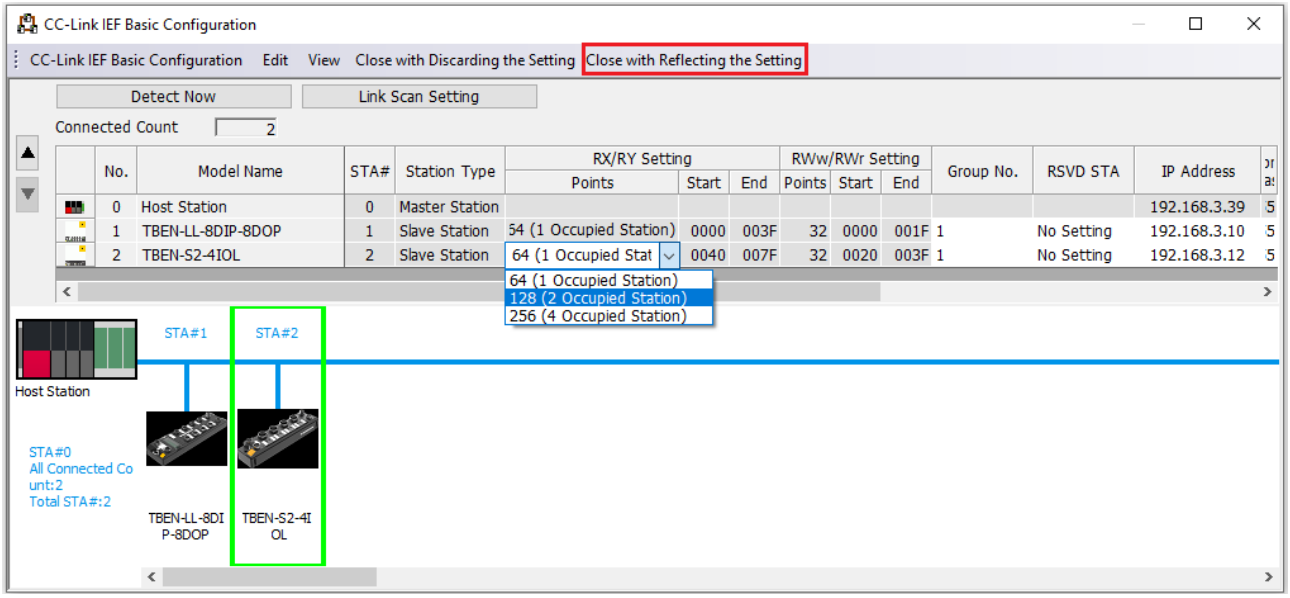

Fig. 73: GX Works3: Storing the network structure

- Accept the changes in the network structure under **Module Parameters** with **Apply**.

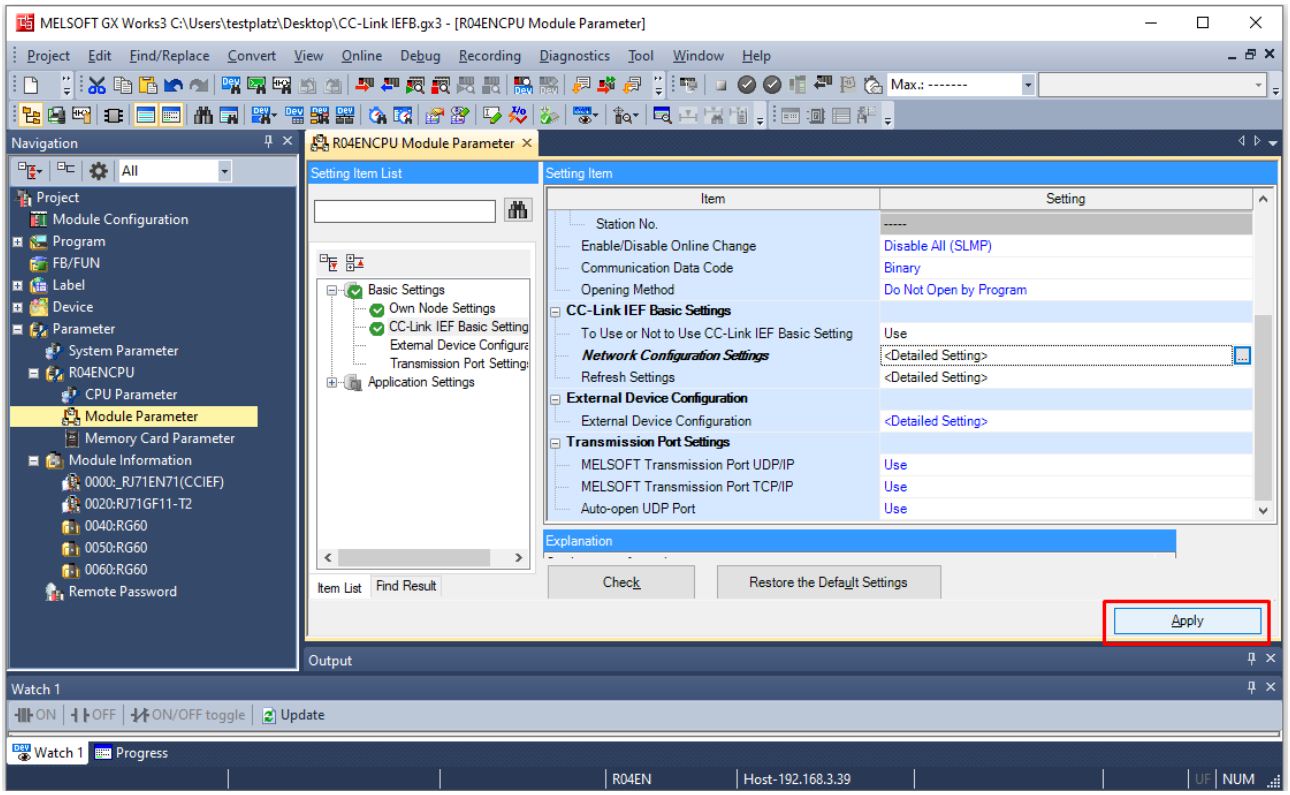

Fig. 74: GX Works3: Module Parameters, accept changes

7.10.4 Defining the process data mapping for CC-Link devices in the network

The start addresses of the process data for the devices that follow the **Master Station (Client)** (controller + local IOs) in the network are defined under **Module Parameters → CC-Link IEF Basic Settings** using the **Refresh Settings** function.

- Open the **Refresh Settings** function under **Module Parameters → CC-Link IEF Basic Settings**.
- Define the start addresses for the process data of the CC-Link devices in **CPU side**. **Check** can be used to verify whether the addresses are valid or overlap with the memory area occupied by the control unit.
- Accept the mapping settings with **Apply**.

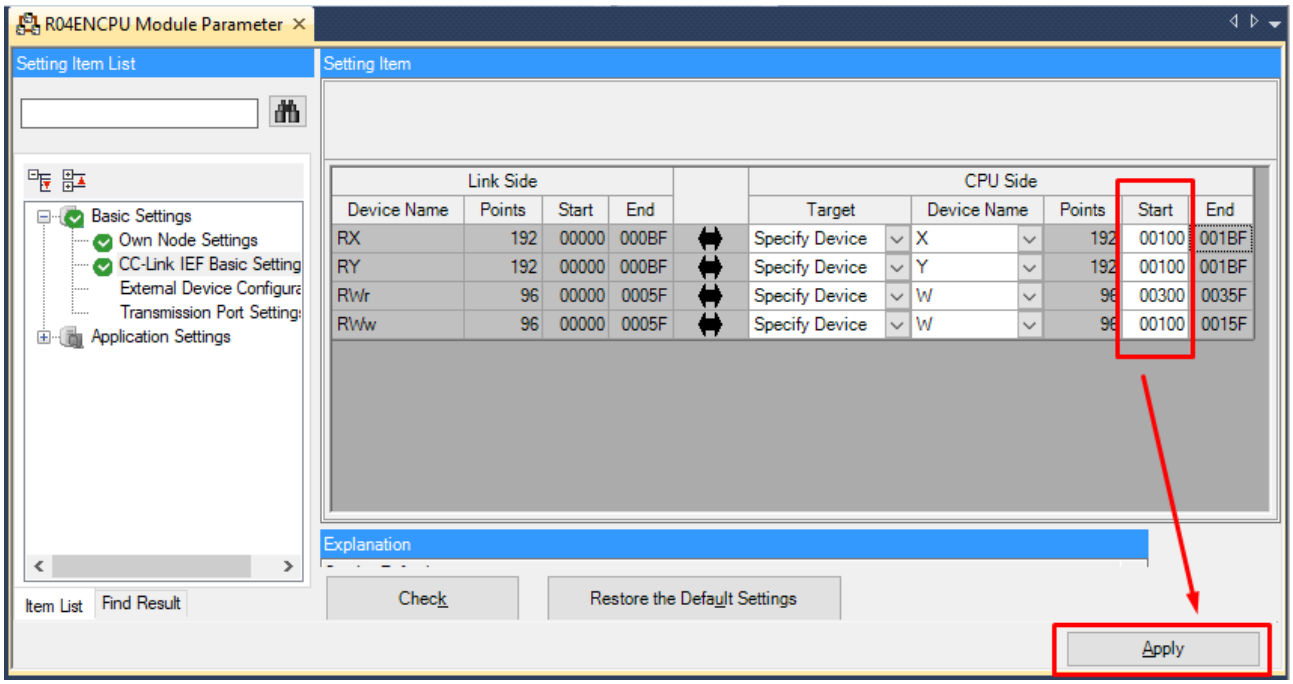

Fig. 75: GX Works3: Process data mapping in Refresh Settings

NOTE
Adjusting the mapping may require a voltage reset of the control unit.

7.10.5 Going online with the PLC

▶ Write the configuration to the PLC via **Online → Write to PLC**.

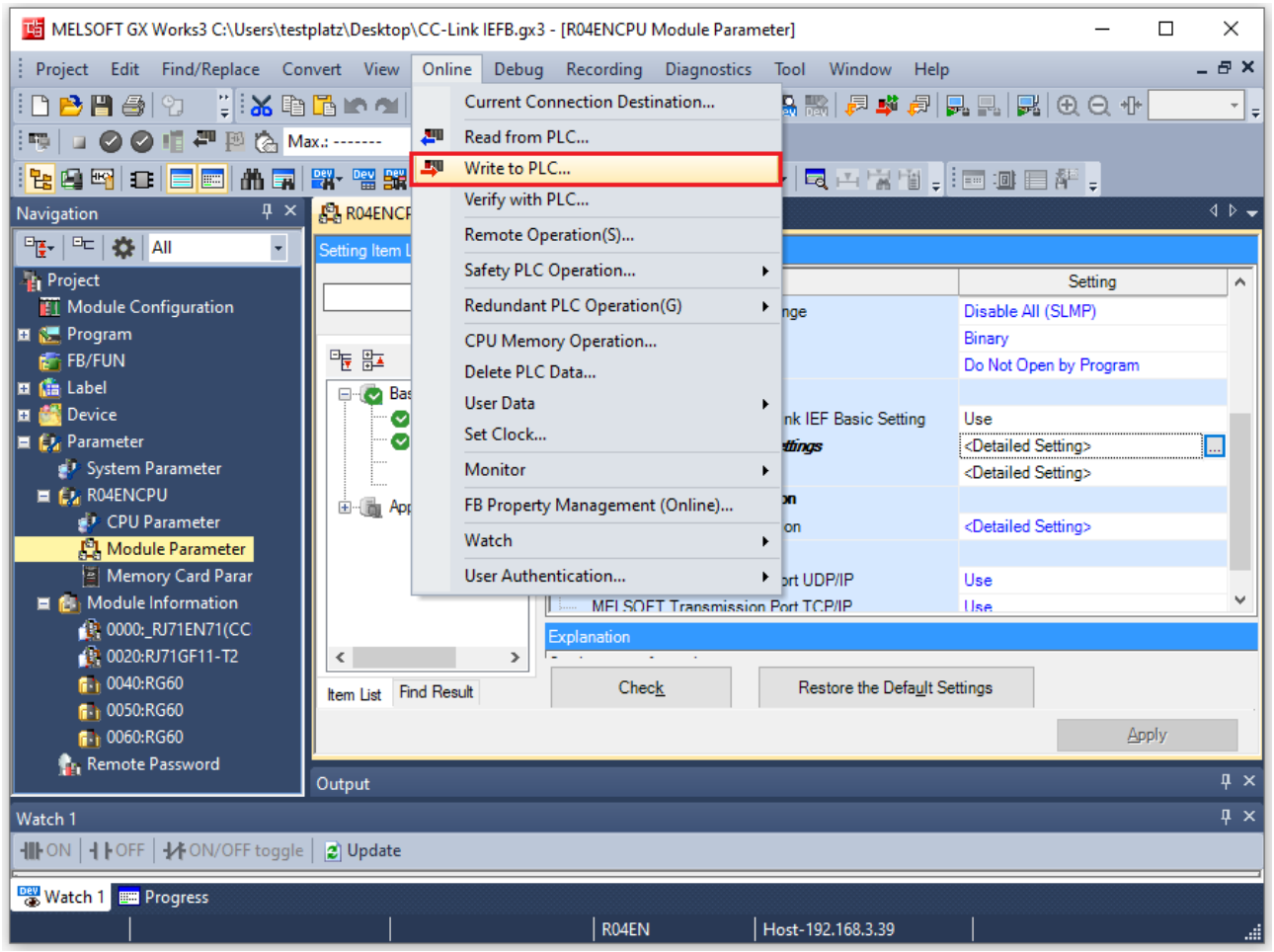

Fig. 76: GX Works3: Writing the configuration to the PLC

▶ If necessary, define which data have to be written and press **Execute**.

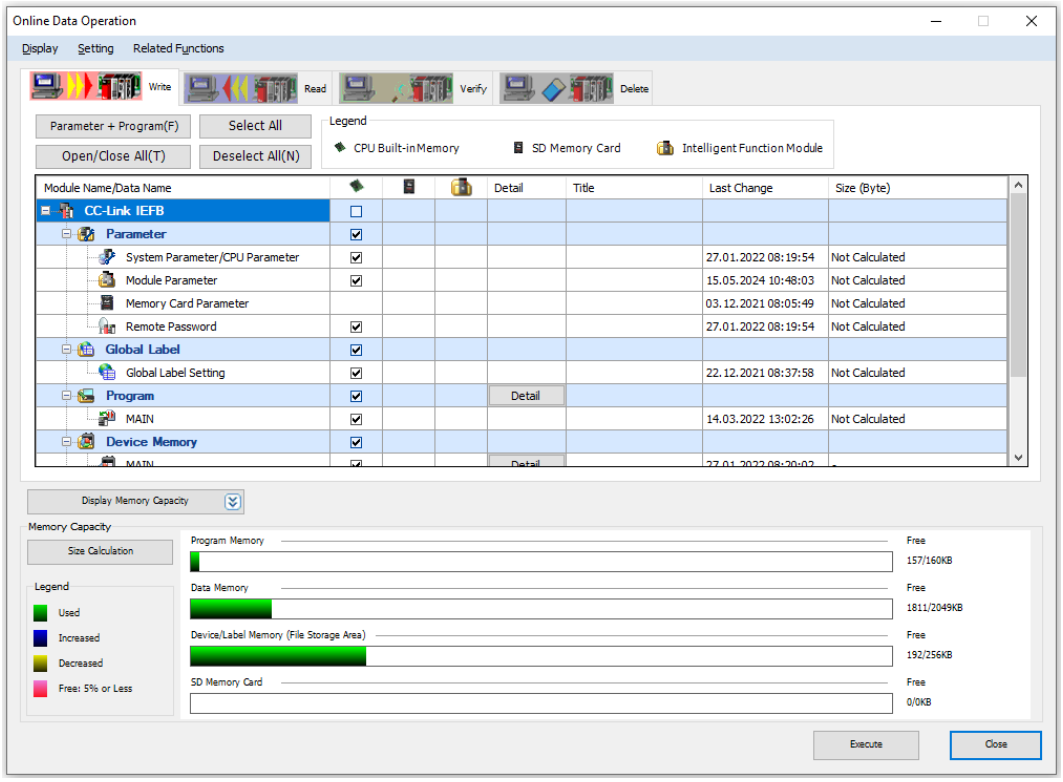

Fig. 77: GX Works3: Selecting data to be written

7.10.6 Reading process data

The monitoring of process data is done in the **Device/Buffer Memory Batch Monitor**.

▶ Open the monitoring via **Online** → **Monitor** → **Device/Buffer Memory Batch Monitor**.

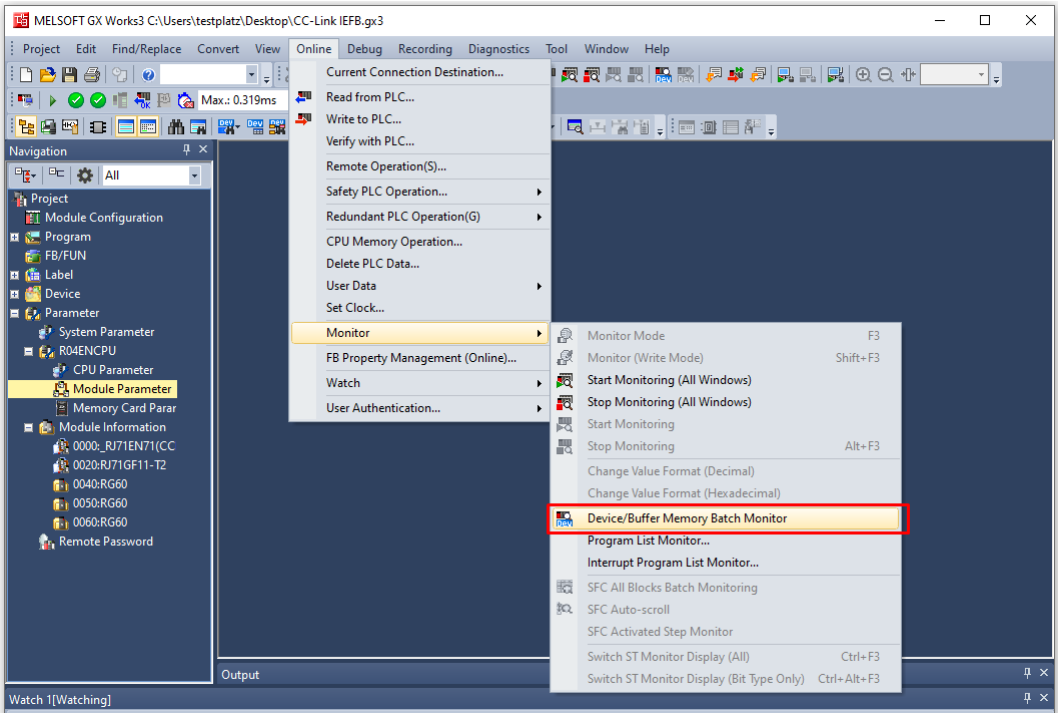

Fig. 78: GX Works3: Starting the monitoring of process data

▶ Enter the address of the process data to be read under **Device Name**. According to the defined process data mapping [▷ 122] **X100** is selected as start address.

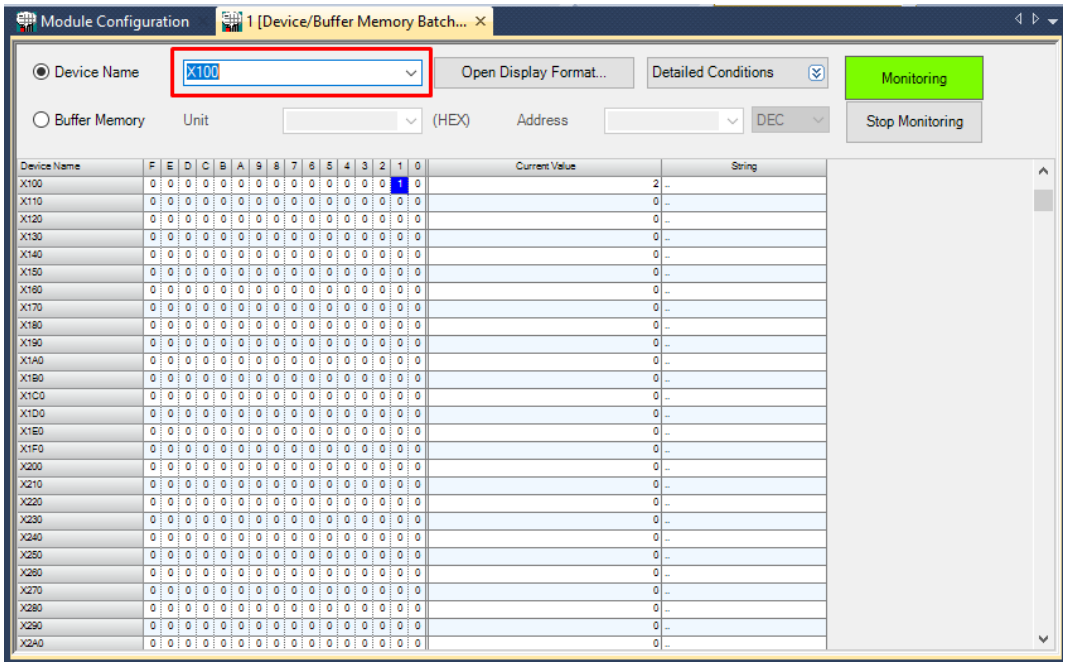

Fig. 79: GX Works3: Monitoring of process data

⇨ The mapping shows a signal at the 2nd Digital input of the 1st CC-Link device (station address 2, TBEN-LL-8DIP-8DOP) [▷ 116].

8 Parameterizing and configuring

8.1 Parameters – overview

8.1.1 I/O channel parameters

Parameters – Digital modules

Default values are shown in **bold**.

Parameter name		Value		Meaning	Description
		Dec.	Hex.		
EN DO	Activate output Ch…	**0**	**0x00**	**Yes**	Activates or deactivates the output function of the digital channel.
		1	0x01	No	
InvDI…	Invert digital input	**0**	**No**		-
		1	Yes		The digital input signal is inverted.
IST	Pulse stretching (*10 ms)	**0**…254	**0x00**… 0xFF		Configures the duration of pulse stretching of digital input edges from 10 to 2550 ms in multiples of 10 ms. 10 = pulse of 100 ms 0 = pulse stretching deactivated
SRO	Manual reset after overcurrent Ch…	**0**	**0x00**	**No**	Defines if a manual reset is necessary after an overcurrent occurred at the digital channel.
		1	0x01	Yes	
VAUX1/VAUX2 pin1 Xx (Ch…/…)		**0**	**0x00**	**24 VDC**	The 24 VDC sensor/actuator supply at pin1 of the connector is switched on.
		1	0x01	switchable	The 24 VDC sensor/actuator supply at pin1 of the connector is switchable via the process data.
		2	0x02	Off	The 24 VDC sensor/actuator supply at pin1 of the connector is switched off.

8.2 PROFINET parameters

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

PROFINET device parameters

Default values are shown in **bold**.

Parameter name	Value	Meaning	Description
Output behavior at communication loss	**0**	**Set to 0**	The device switches the outputs to "0". No error information is sent.
	1	Hold current value	The device keeps the current data at the outputs.
Deactivate all diagnostics	**0**	**No**	Diagnostic and alarm messages are generated.
	1	Yes	Diagnostic and alarm messages are suppressed.
Disable output power diagnosis	**0**	**No**	Monitoring of voltage V2 is activated.
	1	Yes	The sending of the diagnosis is deactivated.
LED behavior (PWR) at V2 undervoltage	**0**	**Red**	The PWR LED lights up red in the event of an undervoltage at V2.
	1	Green	The PWR LED is flashes green in the event of an undervoltage at V2.
Deactivate I/O-ASSISTANT Force Mode	**0**	**No**	
	1	Yes	The Force Mode of the DTM is deactivated.
Deactivate EtherNet/IP	**0**	**No**	Explicit disabling of the Ethernet protocols or the web server
	1	Yes	
Deactivate Modbus TCP	**0**	**No**	
	1	Yes	
Deactivate web server	**0**	**No**	
	1	Yes	

9 Operating

9.1 Process input data

TBEN-LL-16DIP

Word no.		Byte no.		Bit no.							
Dec.	**Hex.**	**Dec.**	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Inputs											
0	0x00	0	0x00	DI7 X3 P2	DI6 X3 P4	DI5 X2 P2	DI4 X2 P4	DI3 X1 P2	DI2 X1P4	DI1 X0 P2	DI0 X0P4
		1	0x01	DI15 X7 P2	DI14 X7 P4	DI13 X6 P2	DI12 X6 P4	DI11 X5 P2	DI10 X5 P4	DI9 X4 P2	DI8 X4 P4
Diagnostics											
1	0x01	0	0x00	VAUX1 X7 (Ch14/15)	VAUX1 X6 (Ch12/13)	VAUX1 X5 (Ch10/11)	VAUX1 X4 (Ch8/9)	VAUX1 X3 (Ch6/7)	VAUX1 X2 (Ch4/5)	VAUX1 X1 (Ch2/3)	VAUX1 X0 (Ch0/1)
		1	0x01	Reserved							
Module status (device status)											
2	0x2	0	0x00	-	FCE	-	-	-	COM	V1	-
		1	0x01	-	-	-	-	-	-	ARGEE	DIAG

TBEN-LL-16DOP

Word no.		Byte no.		Bit no.							
Dec.	**Hex.**	**Dec.**	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Diagnostics											
0	0x00	0	0x00	VAUX2 pin 1 X7 (Ch14/15)	VAUX2 pin 1 X6 (Ch12/13)	VAUX2 pin 1 X5 (Ch10/11)	VAUX2 pin 1 X4 (Ch8/9)	VAUX2 Pin1 X3 (Ch6/7)	VAUX2 Pin1 X2 (Ch4/5)	VAUX2 Pin1 X1 (Ch2/3)	VAUX2 Pin1 X0 (Ch0/1)
		1	0x01	Reserved							
1	0x01	0	0x00	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
		1	0x01	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8
Module status (device status)											
2	0x2	0	0x00	-	FCE	-	-	-	COM	V1	-
		1	0x01	V2	-	-	-	-	-	ARGEE	DIAG

TBEN-LL-16DXP

Word no.		Byte no.		Bit no.							
Dec.	**Hex.**	**Dec.**	**Hex.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Inputs											
0	0x00	0	0x00	DX7 X3 P2	DX6 X3 P4	DX5 X2 P2	DX4 X2 P4	DX3 X1 P2	DX2 X1 P4	DX1 X0P2	DX0 X0 P4
		1	0x01	DX15 X7 P2	DX14 X7 P4	DX13 X6 P2	DX12 X6 P4	DX11 X5 P2	DX10 X5 P4	DX9 X4P2	DX8 X4P4
Diagnostics											
1	0x01	0	0x00	VAUX2 pin 1 X7 (Ch14/15)	VAUX2 pin 1 X6 (Ch12/13)	VAUX2 pin 1 X5 (Ch10/11)	VAUX2 pin 1 X4 (Ch8/9)	VAUX1 X3 (Ch6/7)	VAUX1 X2 (Ch4/5)	VAUX1 X1 (Ch2/3)	VAUX1 X0 (Ch0/1)
		1	0x01	Reserved							
2	0x2	0	0x00	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
		1	0x01	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8
Module status (device status)											
3	0x3	0	0x00	-	FCE	-	-	-	COM	V1	-
		1	0x01	V2	-	-	-	-	-	ARGEE	DIAG

TBEN-LL-8DIP-8DOP

Word no.		Byte no.		Bit no.							
Dec.	Hex.	Dec.	Hex.	7	6	5	4	3	2	1	0
Inputs											
0	0x00	0	0x00	DI7 X3 P2	DI6 X3 P4	DI5 X2 P2	DI4 X2 P4	DI3 X1 P2	DI2 X1P4	DI1 X0 P2	DI0 X0P4
		1	0x01	Reserved							
Sensor and actuator supply and digital channels (diagnostics)											
1	0x01	0	0x00	VAUX2 pin 1 X7 (Ch14/15)	VAUX2 pin 1 X6 (Ch12/13)	VAUX2 pin 1 X5 (Ch10/11)	VAUX2 pin 1 X4 (Ch8/9)	VAUX1 X3 (Ch6/7)	VAUX1 X2 (Ch4/5)	VAUX1 X1 (Ch2/3)	VAUX1 X0 (Ch0/1)
		1	0x01	Reserved							
2	0x2	0	0x00	Reserved							
		1	0x01	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8
Module status (device status)											
3	0x3	0	0x00	-	FCE	-	-	-	COM	V1	-
		1	0x01	V2	-	-	-	-	-	ARGEE	DIAG

Meaning of the process data bits

Name	Meaning
I/O data	
DI…	Digital input
DO…	Digital output
DX…	DXP channel
Ch…	Channel
P…	Pin
X…	Connector
Diagnostics	
VERR V1 X… K…	Overcurrent VAUX1 at connector
VERR V2 Pin 1 X… K…	Overcurrent VAUX2 (pin 1) at connector
ERR…	Overcurrent at output
Module status	
ARGEE	ARGEE program running in the device
COM	Internal error, device replacement may be necessary
DIAG	Diagnostic message at the device
FCE	Force mode activated
V1	V1 too low
V2	V2 too low

9.2 Process output data

TBEN-LL-16DOP

Word no.		Byte no.		Bit no.							
Dec.	Hex.	Dec.	Hex.	7	6	5	4	3	2	1	0
Outputs											
0	0x00	0	0x00	DO7 X3 P2	DO6 X3 P4	DO5 X2 P2	DO4 X2 P4	DO3 X1 P2	DO2 X1 P4	DO1 X0 P2	DO0 X0 P4
		1	0x01	DO15 X7 P2	DO14 X7 P4	DO13 X6 P2	DO12 X6 P4	DO11 X5 P2	DO10 X5 P4	DO9 X4 P2	DO8 X4 P4

TBEN-LL-16DXP

Word no.		Byte no.		Bit no.							
Dec.	Hex.	Dec.	Hex.	7	6	5	4	3	2	1	0
Outputs											
0	0x00	0	0x00	DX7 X3 P2	DX6 X3 P4	DX5 X2 P2	DX4 X2 P4	DX3 X1 P2	DX2 X1 P4	DX1 X0 P2	DX0 X0 P4
		1	0x01	DX15 X7 P2	DX14 X7 P4	DX13 X6 P2	DX12 X6 P4	DX11 X5 P2	DX10 X5 P4	DX9 X4 P2	DX8 X4 P4

TBEN-LL-8DIP-8DOP

Word no.		Byte no.		Bit no.							
Dec.	Hex.	Dec.	Hex.	7	6	5	4	3	2	1	0
Outputs											
0	0x00	0	0x00	DO15 X7 P2	DO14 X7 P4	DO13 X6 P2	DO12 X6 P4	DO11 X5 P2	DO10 X5 P4	DO9 X4 P2	DO8 X4 P4
		1	0x01	Reserved							

Meaning of the process data bits

Name	Meaning
DO…	Digital output
DX…	DXP channel
P…	Pin
X…	Connector

9.3 LED displays

The device is provided with the following LEDs:

- Power supply voltage
- Group and bus error
- Status
- Diagnostics

The Ethernet ports XF1 and XF2 each have an LED L/A.

LED L/A	Meaning
Off	No Ethernet connection
Green	Ethernet connection established, 100 Mbps
Yellow	Ethernet connection established, 10 Mbps
Green flashing	Data transfer, 100 Mbps
Yellow flashing	Data transfer, 10 Mbps

BUS LED	Meaning
Off	No voltage present
Green	Connection to a master active
Flashing 3 × green in 2 s	ARGEE active
Green flashing (1 Hz)	Device is operational
Red	IP address conflict, Restore mode active, F_Reset active or Modbus connection timeout
Red flashing	Wink command active
Red/green (1 Hz)	Autonegotiation and/or wait for IP address allocation in DHCP or BootIP mode

ERR LED	Meaning
Off	No voltage present
Green	No diagnostics
Red	Diagnostics present

LED PWR	Meaning
Off	No voltage connected or under voltage at V1
Green	Voltage V1 and V2 OK
Green flashing	No voltage or under voltage at V2 (depending on the configuration of the parameter **LED behavior (PWR) at V2 undervoltage**)
Red	

Channel-LEDs	Meaning (input)	Meaning (output)
Off	No input signal	Output inactive or V2 undervoltage
Green	Input signal is present	Output active
Red	–	Actuator overload
Red flashing (1 Hz)	Overload of the sensor and actuator supply In devices with group diagnostics, all connector LEDs of the supply group flash simultaneously in case of an error.	

LED WINK (without designation on the device)	Meaning
White flashing	Wink command active

9.4 Software diagnostic messages

The device provides the following software diagnostic messages:

- Diagnostics of the digital sensors

9.4.1 Status- and control word

Status word

Ether-Net/IP/ Modbus	PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Byte 1	V2	-	-	-	-	-	ARGEE	DIAG
Byte 1	Byte 0	-	FCE	-	-	-	COM	V1	-

Bit	Description
ARGEE	ARGEE program running
COM	Internal error, device replacement may be necessary
DIAG	Diagnostic message at the device
FCE	The DTM Force Mode is activated. The actual output values may no match the ones defined and sent by the field bus.
V1	V1 or V2 too low
V2	

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

NOTE
In EtherNet/IP the mapping can be deactivated via the Gateway Class (VSC 100). Activating or deactivating the status and control word modifies the process data mapping.

Control Word

The control word has no function.

9.4.2 Diagnostic telegram

Diagnostic data mapping – TBEN-LL-16DIP

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	VERR V1 X7 Ch14Ch15	VERR V1 X6 Ch12Ch13	VERR V1 X5 Ch10Ch11	VERR V1 X4 Ch8Ch9	VERR V1 X3 Ch6Ch7	VERR V1 X2 Ch4Ch5	VERR V1 X1 Ch2Ch3	VERR V1 X0 Ch0Ch1
1	-	-	-	-	-	-	-	-

Diagnostic data mapping – TBEN-LL-16DOP

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	VERR V2 P1 X7 Ch14Ch15	VERR V2 P1 X6 Ch12Ch13	VERR V2 P1 X5 Ch10Ch11	VERR V2 P1 X4 Ch8Ch9	VERR V2 pin 1 X3 Ch6Ch7	VERR V2 pin 1 X2 Ch4Ch5	VERR V2 pin 1 X1 Ch2Ch3	VERR V2 pin 1 X0 Ch0Ch1
1	-	-	-	-	-	-	-	-
2	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
3	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8

Diagnostic data mapping – TBEN-LL-16DXP

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	VERR V2 P1 X7 Ch14Ch15	VERR V2 P1 X6 Ch12Ch13	VERR V2 P1 X5 Ch10Ch11	VERR V2 P1 X4 Ch8Ch9	VERR V1 X3 Ch6Ch7	VERR V1 X2 Ch4Ch5	VERR V1 X1 Ch2Ch3	VERR V1 X0 Ch0Ch1
1	-	-	-	-	-	-	-	-
2	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0
3	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8

Diagnostic data mapping – TBEN-LL-8DIP-8DOP

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	VERR V2 P1 X7 Ch14Ch15	VERR V2 P1 X6 Ch12Ch13	VERR V2 P1 X5 Ch10Ch11	VERR V2 P1 X4 Ch8Ch9	VERR V1 X3 Ch6Ch7	VERR V1 X2 Ch4Ch5	VERR V1 X1 Ch2Ch3	VERR V1 X0 Ch0Ch1
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8

Meaning of Diagnostic Bits

Bit	Meaning
ERR	Overcurrent output
VERR V1 X… K…	Overcurrent VAUX1 (pin 1) at connector/channel group
VERR V2 P1 X… K…	Overcurrent VAUX2 (pin 1) at connector/channel group

9.4.3 PROFINET diagnostics

TBEN-LL-16DIP

I/O diagnostics (slot 1 according to configuration tool)		PROFINET diagnostics	
Diagnostics	Connector/pin	**Error code**	**Channel**
Overcurrent supply VAUX1		Overcurrent VAUX1 (ChyChz)	
VERR V1 X0 Ch0Ch1	X0	0x0600	0
VERR V1 X1 Ch2Ch3	X1	0x0601	0
VERR V1 X2 Ch4Ch5	X2	0x0602	0
VERR V1 X3 Ch6Ch7	X3	0x0603	0
VERR V1 X4 Ch8Ch9	X4	0x0604	0
VERR V1 X5 Ch10Ch11	X5	0x0605	0
VERR V1 X6 Ch12Ch13	X6	0x0606	0
VERR V1 X7 Ch14Ch15	X7	0x0607	0

TBEN-LL-16DOP

I/O diagnostics (slot 1 according to configuration tool)		PROFINET diagnostics	
Diagnostics	Connector/pin	**Error code**	**Channel**
Overcurrent supply VAUX2, pin 1		Overcurrent VAUX2 pin1 Xx (ChyChz)	
VERR V2 pin 1 X0 Ch0Ch1	X0P1	0x0630	0
VERR V2 pin 1 X1 Ch2Ch3	X1P1	0x0631	0
VERR V2 pin 1 X2 Ch4Ch5	X2P1	0x0632	0
VERR V2 pin 1 X3 Ch6Ch7	X3P1	0x0633	0
VERR V2 P1 X4 Ch8Ch9	X4P1	0x0634	0
VERR V2 P1 X5 Ch10Ch11	X5P1	0x0635	0
VERR V2 P1 X6 Ch12Ch13	X6P1	0x0636	0
VERR V2 P1 X7 Ch14Ch15	X7P1	0x0637	0
Short-circuit at output		Short-circuit	
ERR0	X0	0x0001	0
ERR1		0x0001	
…	…		…
ERR14	X7	0x0001	7
ERR15		0x0001	

TBEN-LL-16DXP

I/O diagnostics (slot 1 according to configuration tool)		**PROFINET diagnostics**	
Diagnostics	Connector/pin	**Error code**	**Channel**
Overcurrent supply VAUX1		Overcurrent VAUX1 Xx (ChyChz)	
VERR V1 X0 Ch0Ch1	X0	0x0600	0
VERR V1 X1 Ch2Ch3	X1	0x0601	0
VERR V1 X2 Ch4Ch5	X2	0x0602	0
VERR V1 X3 Ch6Ch7	X3	0x0603	0
Overcurrent supply VAUX2, pin 1		Overcurrent VAUX2 pin1 Xx (ChyChz)	
VERR V2 P1 X4 Ch8Ch9	X4P1	0x0634	0
VERR V2 P1 X5 Ch10Ch11	X5P1	0x0635	0
VERR V2 P1 X6 Ch12Ch13	X6P1	0x0636	0
VERR V2 P1 X7 Ch14Ch15	X7P1	0x0637	0
Short-circuit at output		Short-circuit	
ERR0	X0	0x0001	0
ERR1		0x0001	
…	…		…
ERR14	X7	0x0001	7
ERR15		0x0001	

TBEN-LL-8DIP-8DOP

I/O diagnostics (slot 1 according to configuration tool)		**PROFINET diagnostics**	
Diagnostics	Connector/pin	**Error code**	**Channel**
Overcurrent supply VAUX1		Overcurrent VAUX1 Xx (ChyChz)	
VERR V1 X0 Ch0Ch1	X0	0x0600	0
VERR V1 X1 Ch2Ch3	X1	0x0601	0
VERR V1 X2 Ch4Ch5	X2	0x0602	0
VERR V1 X3 Ch6Ch7	X3	0x0603	0
Overcurrent supply VAUX2, pin 1		Overcurrent VAUX2 pin1 Xx (ChyChz)	
VERR V2 P1 X4 Ch8Ch9	X4P1	0x0634	0
VERR V2 P1 X5 Ch10Ch11	X5P1	0x0635	0
VERR V2 P1 X6 Ch12Ch13	X6P1	0x0636	0
VERR V2 P1 X7 Ch14Ch15	X7P1	0x0637	0
Short-circuit at output		Short-circuit	
ERR8	X4	0x0001	4
ERR9		0x0001	
ERR10	X5	0x0001	5
ERR11		0x0001	
ERR12	X6	0x0001	6
ERR13		0x0001	
ERR14	X7	0x0001	7
ERR15		0x0001	

10 Troubleshooting

If the device does not function as expected, first check whether ambient interference is present. If there is no ambient interference present, check the connections of the device for faults.

If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

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

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

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

11 Maintenance

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

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

11.1 Updating the firmware via TAS

NOTICE
Interruption of the power supply during the firmware update
Risk of device damage due to faulty firmware update

- Do not interrupt the power supply during the firmware update.
- During the firmware update do not reset the power supply.
- Do not interrupt the Ethernet connection during the firmware update.

NOTE
The firmware update function in TAS is locked when the controller connection is active. The device must first be disconnected from the controller before performing the update.

Starting a firmware update for a device

- Open TAS.
- Open the network view.
- Select the device.
- Click **Firmware update**.

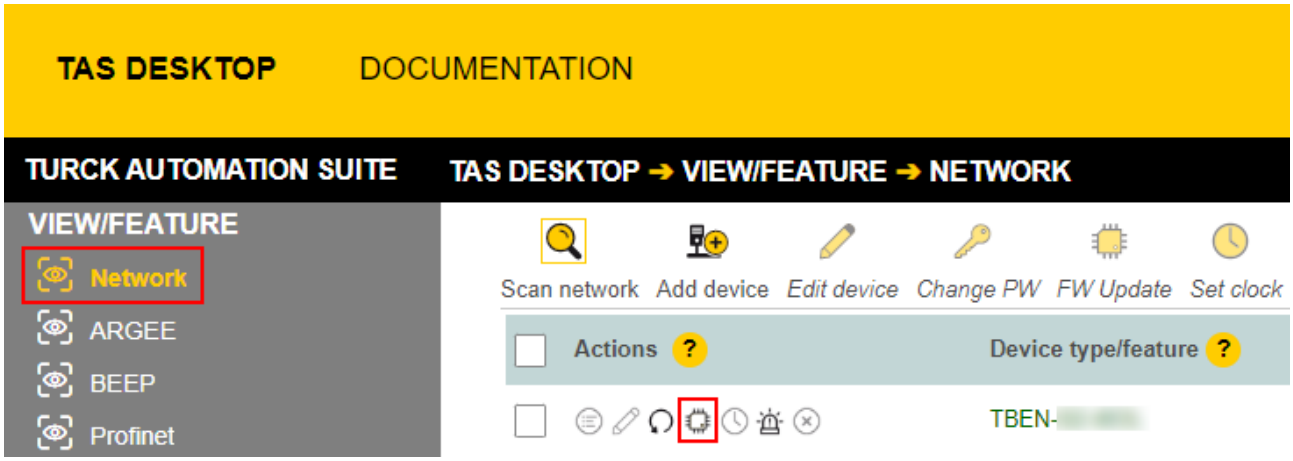

Fig. 80: Firmware update network view

As an alternative to selecting a single device, it is also possible to select multiple devices. To do so, all devices to be updated must correspond to the same device type and be in the same TCP network.

This enables a firmware update to be performed for multiple devices at once.

Starting a firmware update for multiple devices

- In the network view, check the box for all desired devices.
- Click **FW update** in the header.

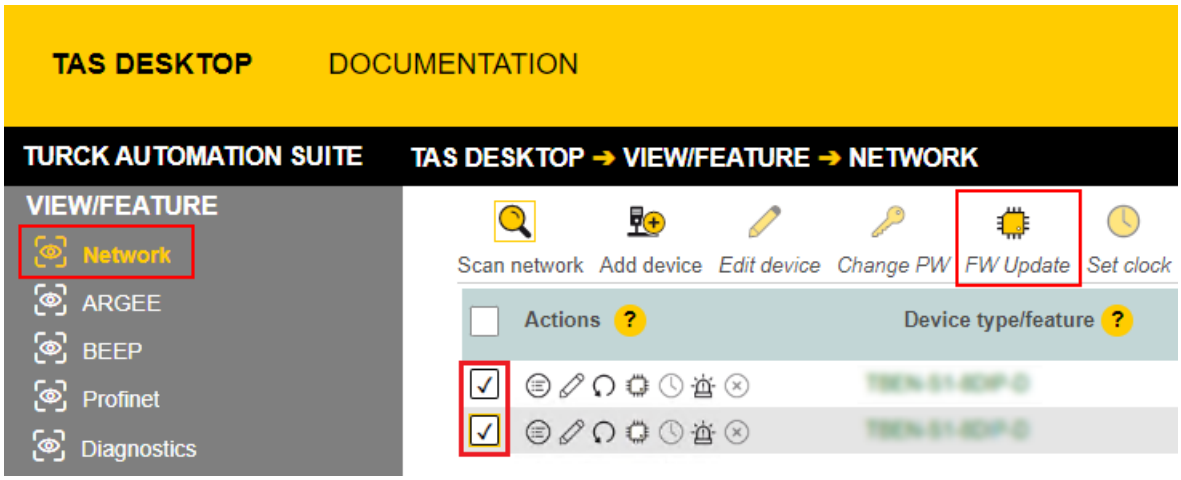

Fig. 81: Multiple selection in the firmware update network view

NOTE
For multiple devices of the same type, a global password can be set, which can be used to unlock all selected devices directly. This requires that all selected devices have the same device password and are in the same TCP network.

- Enter a global or device password. The default password is "password".
- Click **LOG IN**.
- Click **SELECT FILE**.
- Open the directory of the firmware file.

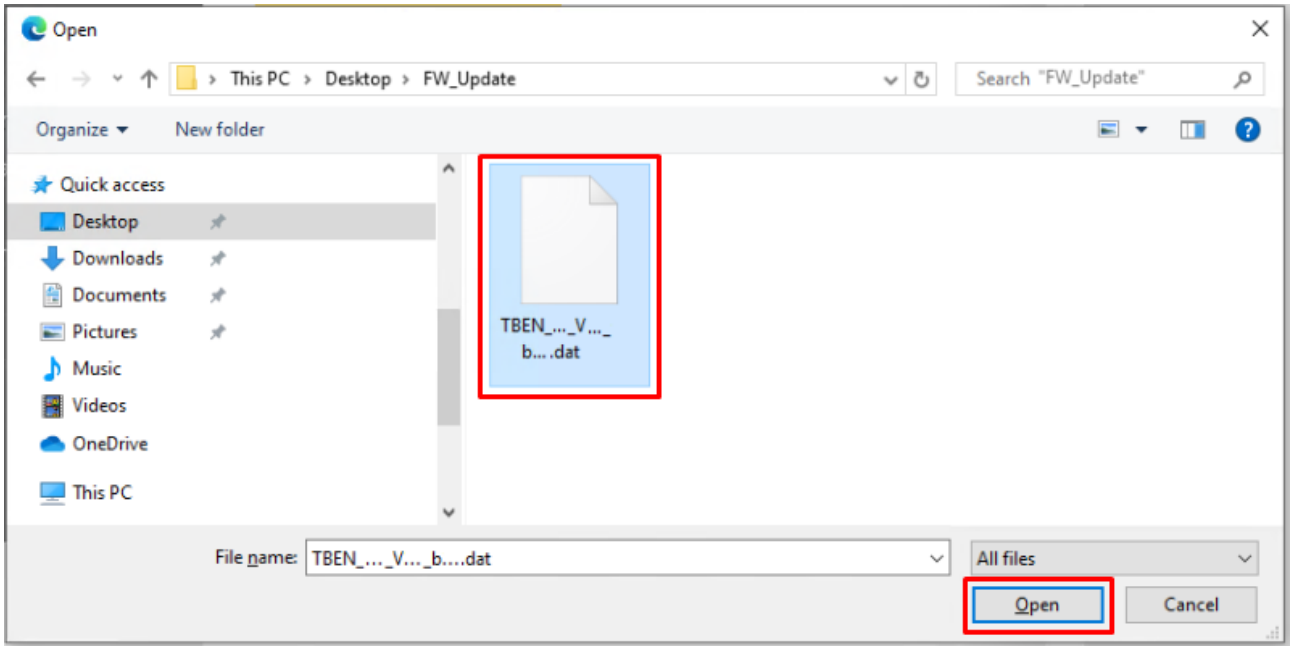

Fig. 82: Selecting a firmware file

- ▶ Select a new firmware file and load it by clicking **Open**.
- ▶ Click **START** to start the firmware update.

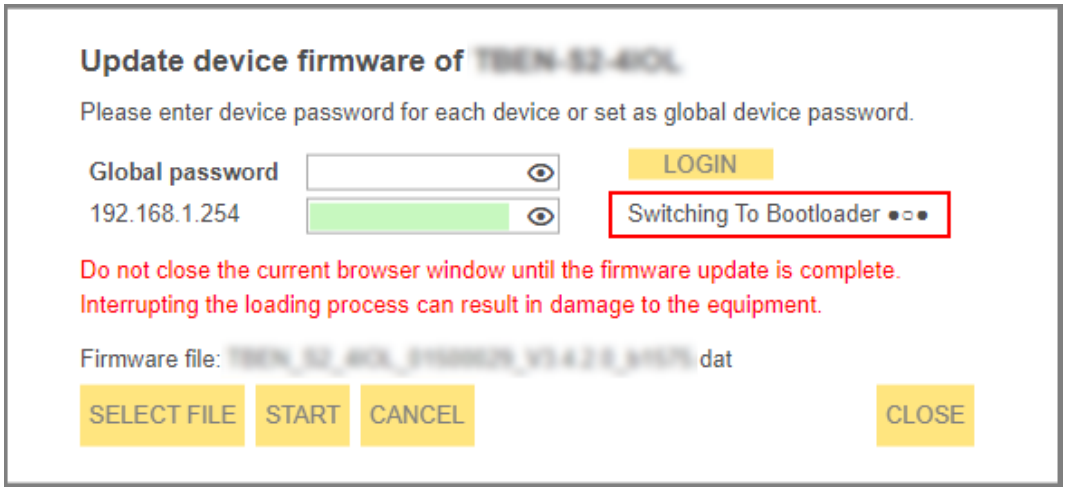

Fig. 83: Firmware update progress

➪ The progress of the firmware update is displayed.

11.2 Updating the firmware via web server

NOTICE
Interruption of the power supply during the firmware update
Risk of device damage due to faulty firmware update
- ▶ Do not interrupt the power supply during the firmware update.
- ▶ During the firmware update do not reset the power supply.
- ▶ Do not interrupt the Ethernet connection during the firmware update.

- ▶ Open the web server.
- ▶ Log on to the device as administrator. The default password for the web server is “password”.
- ▶ Click **Firmware** → **SELECT FIRMWARE FILE**
- ▶ Select the new firmware file and load it via **Open**.

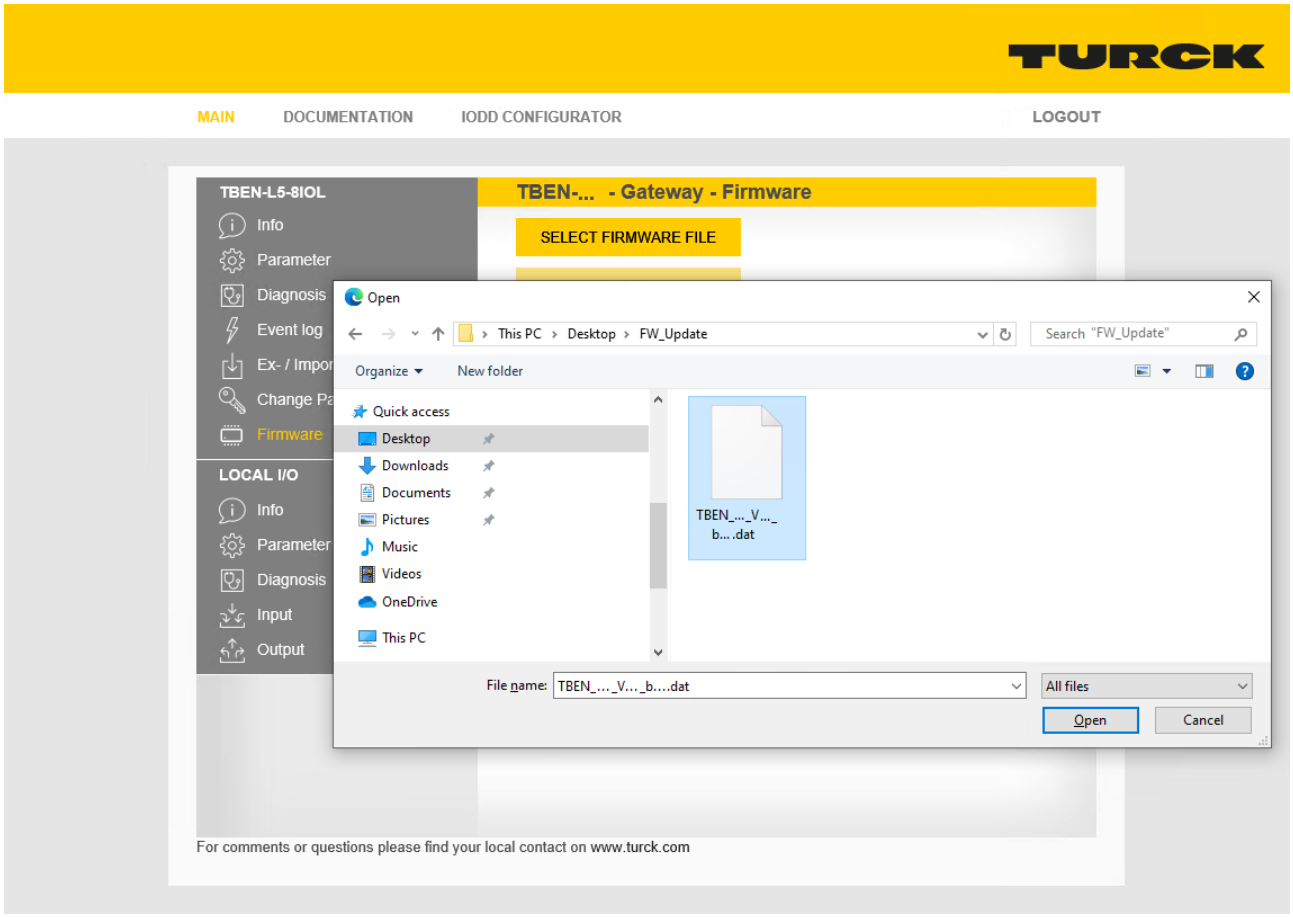

Fig. 84: Webserver – Selecting the firmware file

▶ Click **Update Firmware** and start the update.

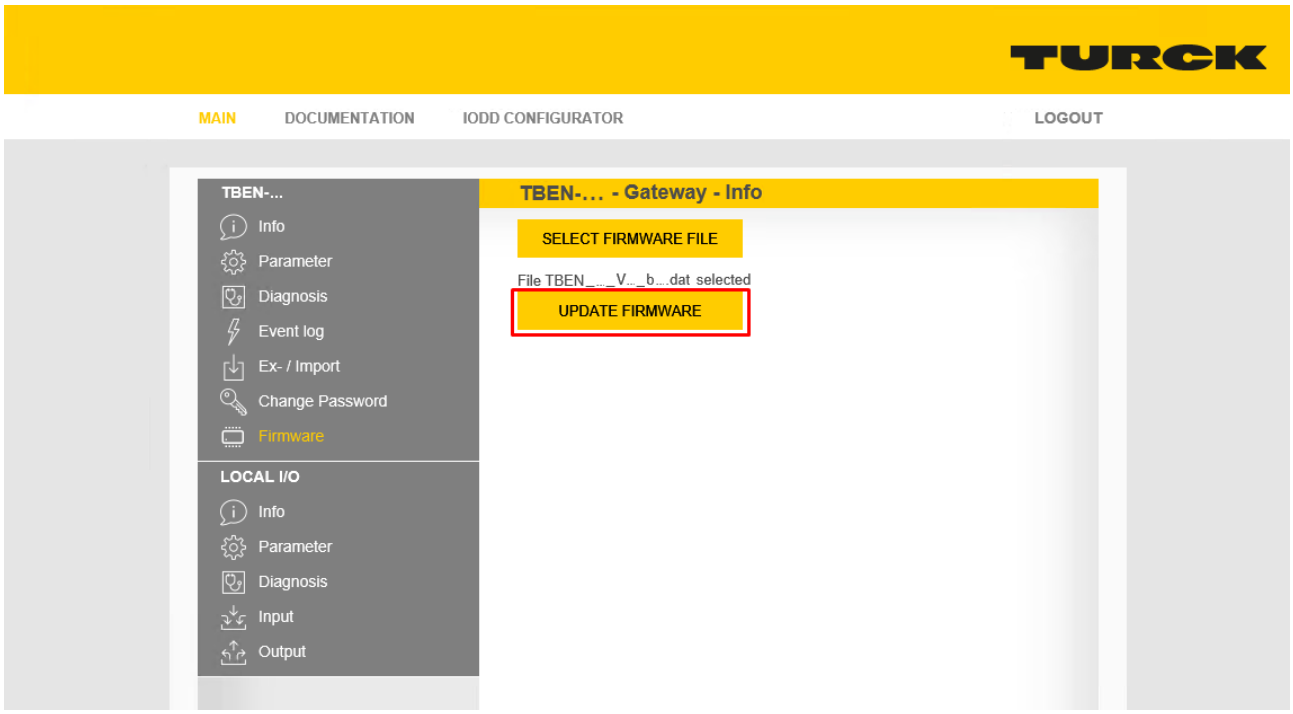

Fig. 85: Webserver – Starting the firmware update

➪ The progress of the firmware update is displayed.

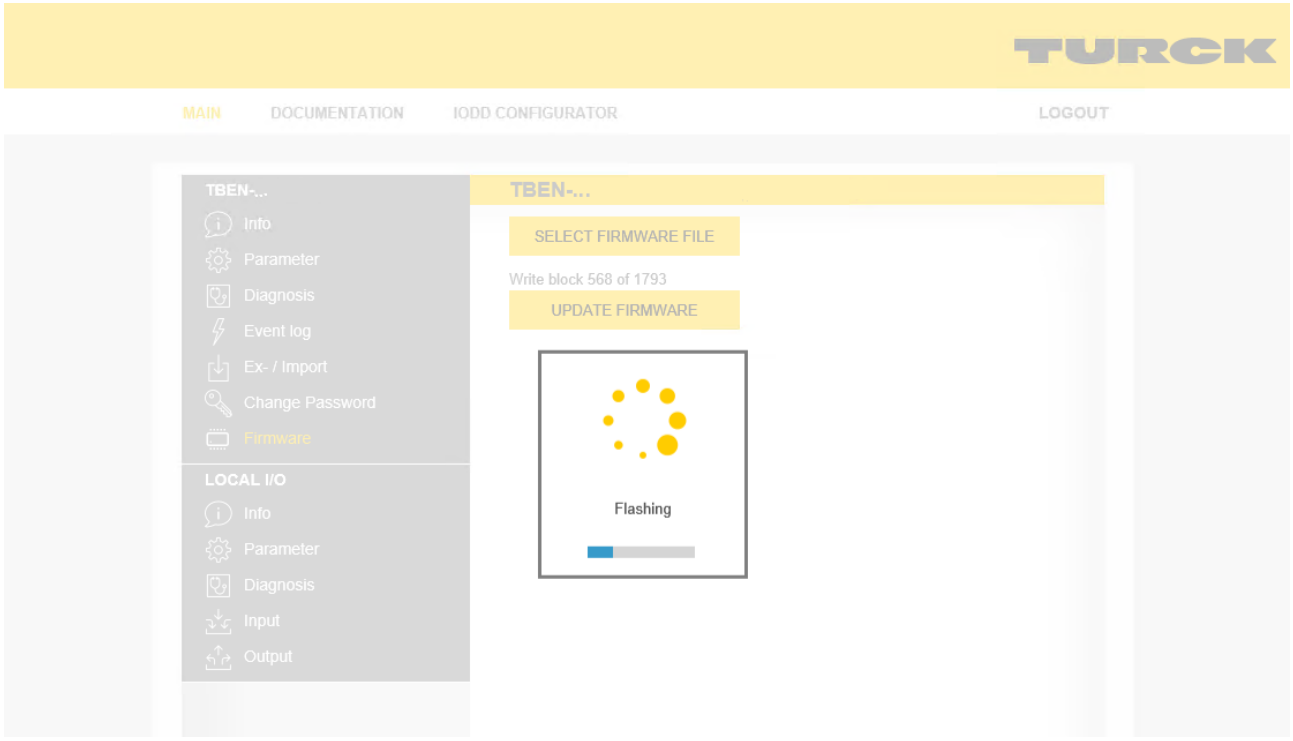

Fig. 86: Webserver – Firmware update running

▶ Restart the device after the update process has been completed.

11.3 Updating the firmware via FDT/DTM

The firmware of the device can be updated via FDT/DTM. The FDT frame-application can be downloaded free of charge from www.turck.com .

NOTICE
Interruption of the power supply during the firmware update
Risk of device damage due to faulty firmware update
- ▶ Do not interrupt the power supply during the firmware update.
- ▶ During the firmware update do not reset the power supply.
- ▶ Do not interrupt the Ethernet connection during the firmware update.

Example: Update the Firmware with the PACTware FDT Frame Application

- ▶ Launch PACTware.
- ▶ Right-click **HOST PC** → **Add device**.

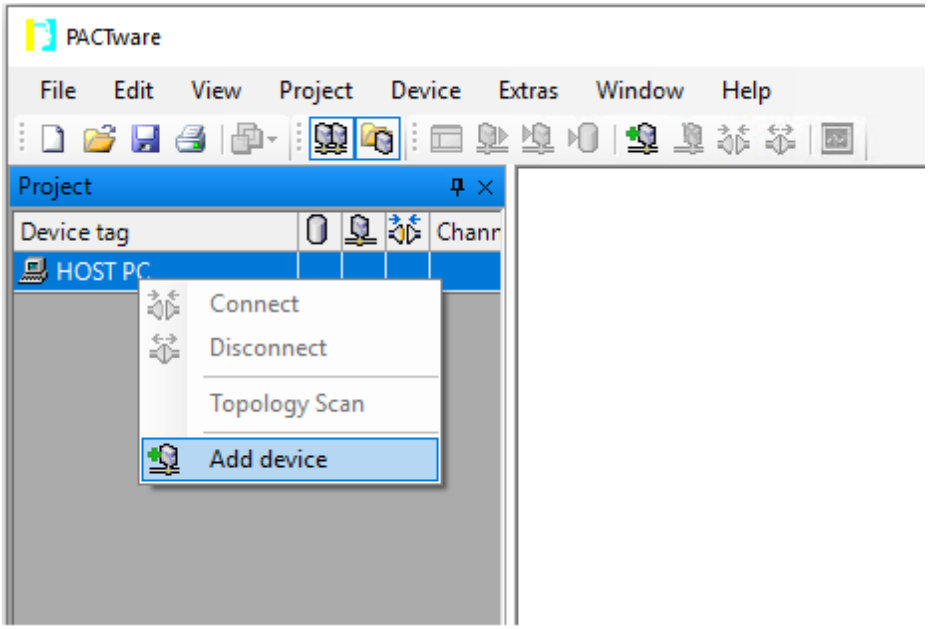

Fig. 87: Adding a device in PACTware

▶ Select **BL Service Ethernet** and confirm with **OK**.

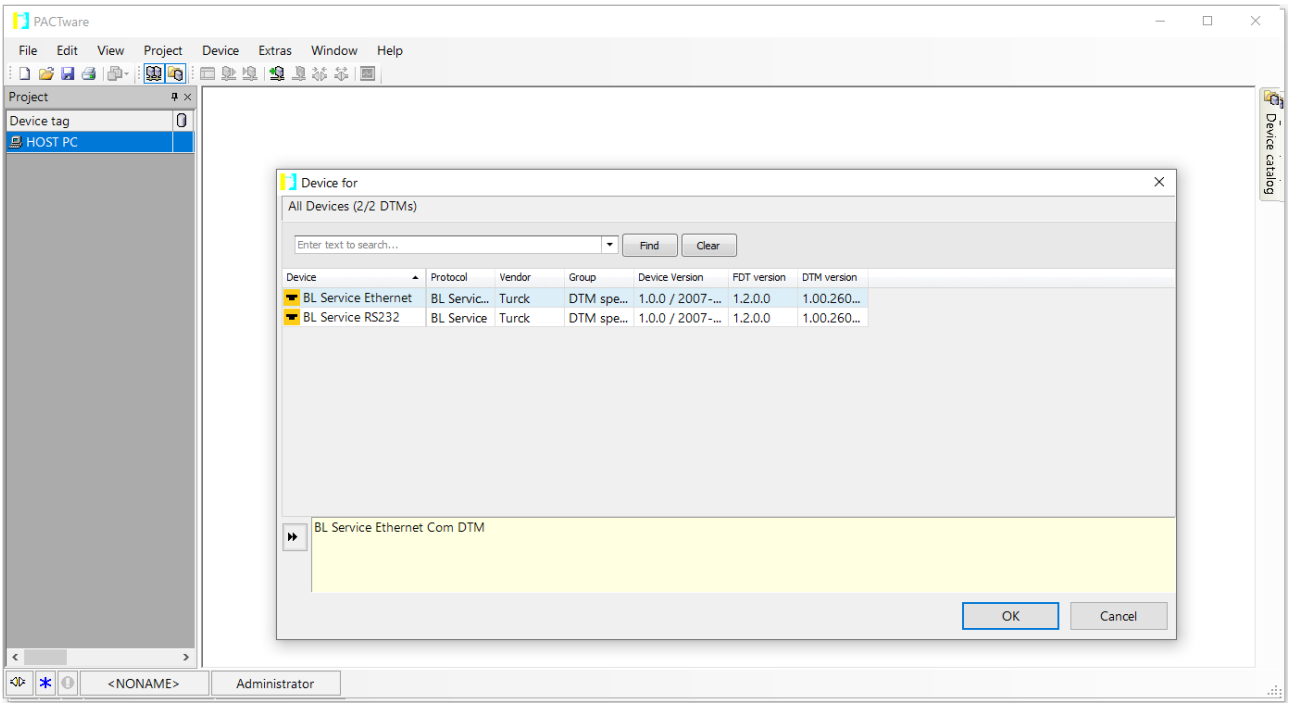

Fig. 88: Selecting the Ethernet interface

▶ Double-click the connected device.
⇨ PACTware opens the bus address management.

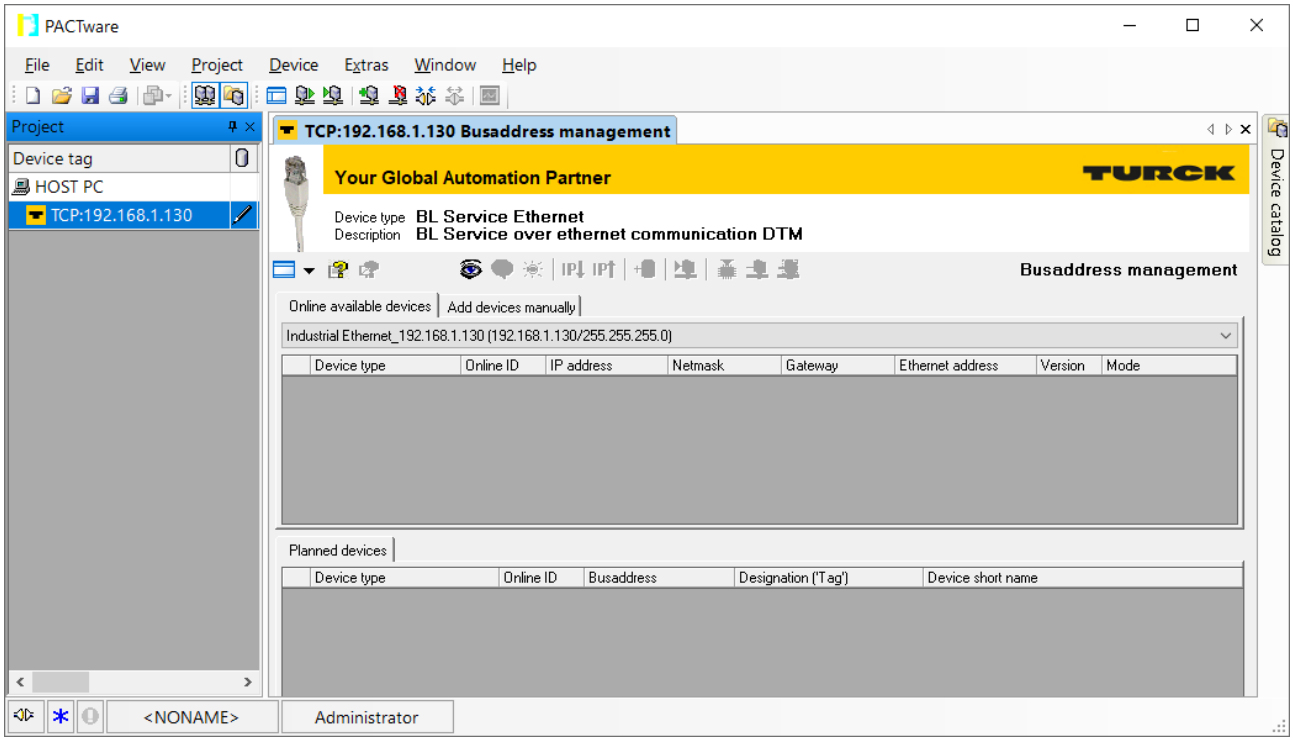

Fig. 89: Opening the busaddress management

- ▶ Search for connected Ethernet devices: Click the **Search** icon.
- ▶ Select the required device.

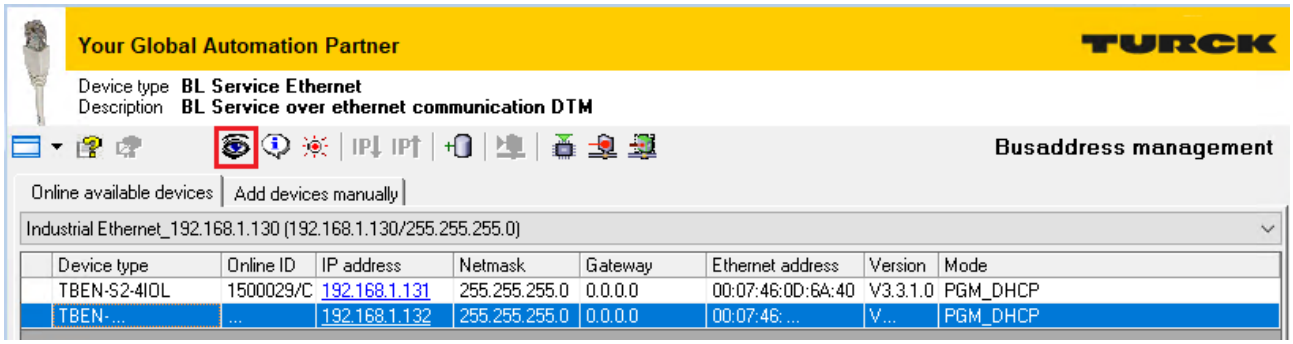

Fig. 90: Selecting the device

- ▶ Click **Firmware Download** to start the firmware update.

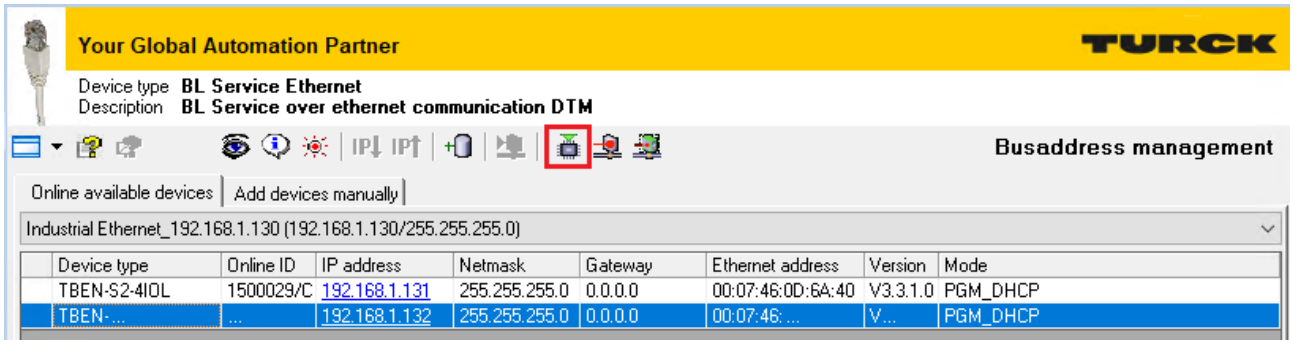

Fig. 91: Starting the firmware update

- ▶ Select the storage location and confirm with **OK**.
- ⇨ PACTware shows the progress of the firmware update with a green bar at the bottom of the screen.

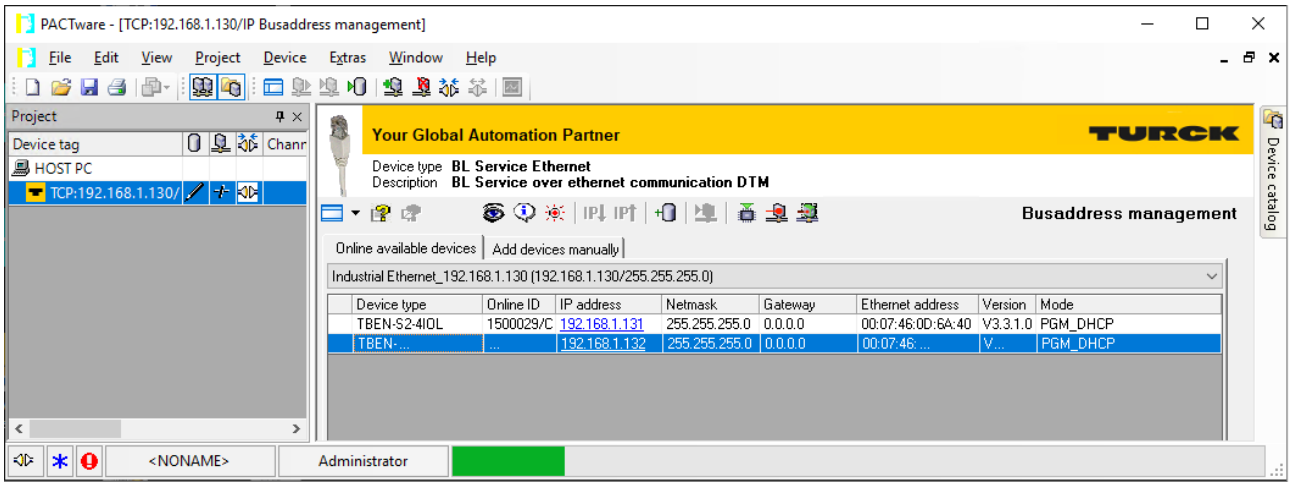

Fig. 92: Firmware update running

12 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. 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 Disposal

The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

14.1 General technical data

Technical data	
Power supply	
Supply voltage	24 VDC
Permisible range	18…30 VDC
Current feedthrough XD1 to XD2	Max. 16 A per voltage group
Total current	
■ TBEN-LL-16DIP	Max. 9 A per voltage group V1
■ TBEN-LL-16DXP, TBEN-LL-8DIP-8DIP	max. 9 A per voltage group total current V1 + V2: max. 11 A
■ UL derating	Operating temperature > 55 °C: max. 6 A per voltage group
■ Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (ID 100022986)
Threshold for undervoltage diagnostics V1 and V2 (if used in device)	According to IEC 61131 24 VDC - 15 %, with an accuracy of 5 %
Potential isolation	Galvanic isolation of V1 and V2 voltage groups
Connectors	
Ethernet	2 × M12, 4-pin, D coded
Power supply	2 × M12, 5-pin, L coded
Digital in-/outputs	M12, 5-pin, A coded
Permissible torques ■ Ethernet ■ I/O channels/supply ■ Mounting (M6 screws)	 0.6 Nm 0.8 Nm 1.5 Nm
Max. cable length	
■ Ethernet	100 m (per segment)
Isolation voltages	
V1 to V2	≥ 500 VAC
V1/V2 to fieldbus	≥ 500 VAC
System 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)
Local port	Port 502, fix setting

Technical data	
EtherNet/IP	
Address assignment	According to EtherNet/IP standard
Device Level Ring (DLR)	Supported
Quick Connect (QC)	< 150 ms
Min. RPI (Requested Packet Interval)	2 ms
Number of Class 3 connections (TCP)	3
Number of Class 1 connections (CIP)	10
Input Assembly Instances	103
Output Assembly Instances	104
Configuration Assembly Instance	106
PROFINET	
Address assignment	DCP
MinCycle Time	1 ms
Fast Start Up (FSU)	< 150 ms
Diagnostics	According to PROFINET alarm handling
Automatic address setting	Supported
Media Redundancy Protocol (MRP)	Supported
Standard/directive conformity	
Vibration test	According to EN 60068-2-6
Acceleration	Up to 20 g
Shock test	According to EN 60068-2-27
Drop and topple	According to IEC 60068-2-31/IEC 60068-2-32
Electromagnetic compatibility	According to EN 61131-2
Approvals and certificates	CE, UKCA, FCC statement UV-resistant according to DIN EN ISO 4892-2A (2013)
UL cond.	cULus LISTED 21 W2, Encl.Type 1 IND.CONT.EQ.
General information	
Dimensions (w × l × h)	60.4 × 230.4 × 39 mm
Operating temperature	-40…+70 °C
Storage temperature	-40…+85 °C
Operating height	Max. 5000 m
Degree of protection	IP65 IP67 IP69K
Housing material	PA6-GF30
Housing color	Black
Material screw	303 stainless steel
Material label	Polycarbonate
Halogen free	Yes
Mounting	2 mounting holes, Ø 6.3 mm

Note on FCC

NOTE
This device complies with the limit values for a Class A digital device in accordance with Part 15 of the FCC regulations. Operation of this device in a residential area may cause harmful interference. In this case users must rectify the interference at their own cost.

14.2 Technical data – TBEN-LL-16DIP

The device offers sixteen digital inputs for PNP sensors.

Technical data	
Supply	
Sensor/actuator supply V_{AUX1}	Supply connectors X0…X7 from V1, short-circuit proof, 120 mA per connector
Digital inputs	
No. of channels	16
Input type	PNP
Type of input diagnostics	Group diagnostics
Switching threshold	EN 61131-2 type 3, PNP
Signal voltage, low level	< 5 V
Signal voltage, high level	> 11 V
Signal current, low level	< 1.5 mA
Signal current, high level	> 2 mA
Input resistance	4 kΩ
Max input frequency	100 Hz (for fieldbus communication)
Input delay	2.5 ms
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
General information	
MTTF	193 years acc. to SN 29500 (Ed. 99) 20 °C

14.3 Technical data – TBEN-LL-16DXP

Technical data	
Supply	
Sensor/actuator supply V_{AUX1}	Supply connectors X0…X3 from V1, short-circuit proof, 120 mA per connector
Sensor/actuator supply V_{AUX2}	Supply connectors X4…X7 from V1, short-circuit proof, 120 mA per connector
Digital inputs	
No. of channels	16
Input type	PNP
Type of input diagnostics	Group diagnostics
Switching threshold	EN 61131-2 type 3, PNP
Signal voltage, low level	< 5 V
Signal voltage, high level	> 11 V
Signal current, low level	< 1.5 mA
Signal current, high level	> 2 mA
Input resistance	4 kΩ
Max input frequency	100 Hz (for fieldbus communication)
Input delay	2.5 ms
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
Digital outputs	
No. of channels	16
Output type	PNP
Type of output diagnostics	Channel diagnostics
Output voltage	24 VDC from potential group, max. 2 A per connector
Output current per channel	2 A, short-circuit-proof
■ Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (ID 100022986)
Output delay	1.3 ms
Load type	EN 60947-5-1: DC-13
Load type (UL)	Resistive, coil
Short-circuit protection	Yes
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
General information	
MTTF	134 years acc. to SN 29500 (Ed. 99) 20 °C

14.4 Technical data – TBEN-LL-16DOP

Technical Data	
Supply	
Sensor/actuator supply V_{AUX2}	Supply connectors X0…X7 from V2, short-circuit proof, 120 mA per connector
Digital outputs	
Number of channels	16
Output type	PNP
Type of output diagnostics	Channel diagnostics
Output voltage	24 VDC from potential group, max. 2 A per connector
Output current per channel	2 A, short-circuit-proof
■ Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (ID 100022986)
Output delay	1.3 ms
Load type	EN 60947-5-1: DC-13
Load type (UL)	Resistive, coil
Short-circuit protection	Yes
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
General information	
MTTF	165 years acc. to SN 29500 (Ed. 99) 20 °C

14.5 Technical data – TBEN-LL-8DIP-8DOP

Technical data	
Supply	
Sensor/actuator supply V_{AUX1}	Supply connectors X0…X3 from V1, short-circuit proof, 120 mA per connector
Sensor/actuator supply V_{AUX2}	Supply connectors X4…X7 from V1, short-circuit proof, 120 mA per connector
Digital inputs	
No. of channels	8
Input type	PNP
Type of input diagnostics	Group diagnostics
Switching threshold	EN 61131-2 type 3, PNP
Signal voltage, low level	< 5 V
Signal voltage, high level	> 11 V
Signal current, low level	< 1.5 mA
Signal current, high level	> 2 mA
Input resistance	4 kΩ
Max input frequency	100 Hz (for fieldbus communication)
Input delay	2.5 ms
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
Digital outputs	
No. of channels	8
Output type	PNP
Type of output diagnostics	Channel diagnostics
Output voltage	24 VDC from potential group, max. 2 A per connector
Output current per channel	2 A, short-circuit-proof
■ Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (ID 100022986)
Output delay	1.3 ms
Load type	EN 60947-5-1: DC-13
Load type (UL)	Resistive, coil
Short-circuit protection	Yes
Potential isolation	Galvanic isolation to XF1/XF2, voltage proof up to 500 VAC
General information	
MTTF	157 years acc. to SN 29500 (Ed. 99) 20 °C

15 Turck branches — contact data

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