Your Global Automation Partner

TURCK

TBEN-L
Compact I/O Modules for Ethernet

Instructions for Use

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1 About these Instructions

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

1.1 Target Groups

These instructions are aimed at qualified personnel and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of Symbols

The following symbols are used in these instructions:



DANGER!

DANGER indicates an immediately dangerous situation, with high risk, the death or severe injury, if not avoided.



WARNING!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.



ATTENTION!

ATTENTION indicates a situation that may lead to property damage, if it is not avoided.



NOTE

In NOTES you find tips, recommendations and important information. The notes facilitate work, provide more information on specific actions and help to avoid overtime by not following the correct procedure.

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

↪ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3 Additional Documents

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

- Data sheet
- Quick Start Guide
- User manual TBEN-L1

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

These instructions apply to the compact multi-protocol I/O modules for Ethernet TBEN-L4 and TBEN-L5 (TBEN-Lx).

2.1.1 Scope of Delivery

- TBEN-L4 or respectively TBEN-L5 device
- Closure caps for 7/8" connectors
- Closure caps for M12 female connectors
- Quick Start Guide

2.1.2 Legal Requirements

The device falls under the following EU directives:

- 2014/30/EU (electromagnetic compatibility)

2.1.3 Manufacturer and Service

Hans Turck GmbH & Co. KG

Witzlebenstraße 7

45472 Muelheim an der Ruhr

Germany

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats. You can access the product database at the following address: **www.turck.de/products**

Should you have any further questions, please contact the sales and service team in Germany under the following telephone numbers:

Sales: +49 208 4952-380

Technology: +49 208 4952-390

Internet: **www.turck.com/support**

Outside Germany, please contact your local Turck representative.

3 For Your Safety

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

3.1 Intended Use

The devices are only intended for use in industrial applications.

Thanks to the Turck multiprotocol technology, the compact multiprotocol I/O modules for Ethernet can be operated in the three Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP. The modules detect the bus protocol automatically during the start-up.

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

The devices may only be used as described in this manual. Any other usage shall be considered improper and Turck shall not be held liable for any resulting damage.

3.2 General Safety Instructions

- The device may only be assembled, installed, operated and maintained by professionally trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device only meets the EMC requirements for industrial areas and is not suitable for use in residential areas.

4 Product Description

The devices are designed in a fully encapsulated housing with degree of protection IP65/IP67/IP69K. For the connection of digital sensors and actuators, the devices provide eight or respectively sixteen input or output channels or respectively sixteen freely configurable digital I/O channels which can be used as in- or output. The terminals for the digital I/Os are M12 sockets. Two M12 sockets are provided for the Ethernet connection. The power supply connectors are designed as 4-pole (TBEN-L4) or 5-pole (TBEN-L5) 7/8" connectors.

4.1 Device Overview

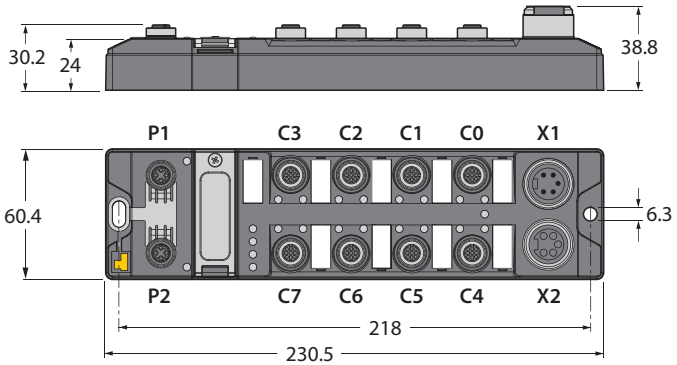


Fig. 1: Size

4.1.1 Indicator elements

The devices are provided with multi-color LEDs for displaying information:

- Supply voltage
- Group and bus errors
- Status
- Diagnostics

4.2 Properties and Features

- Multiprotocol: EtherNet/IP-Device, Modbus TCP-Slave, or PROFINET-Device
- Channel-related short-circuit diagnosis of outputs
- Slot-related short-circuit diagnosis of the sensor/actuator supply voltage
- Voltage supply via 7/8" connectors
  - TBEN-L5: 5-pole
  - TBEN-L4: 4-pole
- Two 4-pole M12-connectors for Ethernet
- Integrated Ethernet-switch for building up a line-topology.
- Transmission speed 10 Mbps/100 Mbps
- Integrated web server
- LED displays and diagnostics
- Fibre-glass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Degree of protection IP65/IP67/IP69K
- Programmable via ARGEE/FLC

4.3 Protocols

Multi Protocol Functionality

The compact I/O-devices of the TBEN-L product line combine the three Ethernet-protocols

- Modbus TCP (description page 49 ff.),
- EtherNet/IP (description page 65) and
- PROFINET (description page 99 ff.)

in one device.

A multi-protocol 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 start-up, after a power-on, the module runs in "snooping" mode and detects the Ethernet protocol which requests a link connection by listening the traffic.

If a protocol is detected, the device is set automatically to the respective protocol. After this an access to the device from other protocols is read-only.

4.3.1 Explicit/Manual Protocol Selection

The protocol can also be determined manually. This skips the snooping-phase and the device is permanently set to the selected protocol. An access to the device from other protocols is read-only.

The explicit protocol selection allows thus an additional locking mechanism.

4.3.2 Protocol Dependent Functions

PROFINET

- Fast Start-UP (FSU), see FSU - Fast Start-Up (prioritized startup), page 99
- Topology discovery
- Address assignment via LLDP
- MRP, see MRP (Media Redundancy Protocol), page 100

EtherNet/IP

- QuickConnect (QC), see QuickConnect in TBEN, page 68
- DLR (Device Level Ring), see Device Level Ring (DLR), page 69

5 Configuring

This chapter describes the configuration of the Ethernet-connection.

Details concerning the necessary protocol-specific configurations (Modbus TCP, EtherNet/IP, PROFINET) can be found in the respective sub-chapters

5.1 Device Configuration Files

The actual device configuration files for the devices can be downloaded from the Turck home page **www.turck.com**.

Information about the protocol-specific files can be found in the respective sub-chapters.

5.2 Address Assignment

Setting the address mode is done through the 3 rotary coding-switches on the gateway.

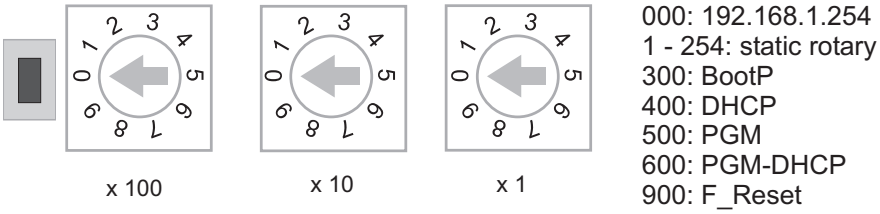


Fig. 2: Decimal rotary coding-switches for address setting

ATTENTION!

Protective cover opened

Protection class IP65/IP67/IP69K not guaranteed

➤ Screw the protective cover over the switches firmly

➤ Check if seal of the protective cover is correctly placed

NOTE

After every change of the address-mode, a voltage reset must be done.

5.2.1 Mode: Static Rotary

When using the rotary-mode, the last byte of the station's IP address can be set via the rotary coding switches.

- Switch position **000**: in TURCK devices used to reset the device to the default IP address (see **Resetting the IP Address, Switch Position "000", page 20**).
- Switch position **001**: normally reserved for the default-gateway
- Switch position **002…254**: valid IP address range
- Switch position **255**: normally used for broadcast messages in the subnet.

We therefore recommend addresses in the range of **002…254**.

5.2.2 Mode: BootP (300)

- Switch position: 300

Address setting is carried out by a BootP-server in the network after the start-up of the gateway.

NOTE

The IP address, as well as the default subnet mask assigned to the station by the BootP-server, are stored permanently in the station's EEPROM.

If the station is switched from BootP-mode to rotary- or PGM-mode, the settings carried out in BootP-mode (IP address, subnet mask, etc) will be read from the device's EEPROM.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

5.2.3 Mode: DHCP (400)

- Switch position: 400

Address setting is carried out by a DHCP-server in the network after the start-up of the device.

NOTE

The IP address, as well as the default subnet mask assigned to the station by the DHCP-server, are stored permanently in the station's EEPROM.

If the station is switched from DHCP-mode to rotary- or PGM-mode, the settings carried out in DHCP-mode (IP address, subnet mask, etc) will be read from the device's EEPROM.

DHCP supports three mechanisms for IP address allocation:

- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time, or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator. DHCP is used simply to convey the assigned address to the client.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

5.2.4 Mode: PGM (500)

- Switch position: 500

The PGM-mode enables access of the Turck DTMs to the device's network settings.

NOTE

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are send to the device's internal EEPROM and stored permanently.

5.2.5 Mode: PGM-DHCP (600)

- Switch position: 600

The device sends DHCP-requests until a IP address is assigned (DHCP-server, PROFINET-controller).

The assigned IP-address is stored to the device and the DHCP-client is stopped.

Even after a restart of the device, the device sends no further DHCP-requests.

PROFINET

This mode assures a PROFINET-compliant operation of the modules.

NOTE

If a DHCP-server is used within the network, problems may occur during IP-assignment.

In this case, both, the DHCP-server as well as the PROFINET-controller (via DCP), try an IP-address-assignment.

5.2.6 Resetting the IP Address, Switch Position "000"

With this setting the DIP-switches to "000" followed by a voltage reset, the device is set to the address 192.168.1.254 for IP-based services (see **Default Setting of the Device, page 21**).

NOTE

Setting "000" is no operation mode! After having reset the IP address to the default values, the device has to be set to another mode.

Default Setting of the Device

The default-settings are as follows:

IP address	192.168.1.254
Subnet mask	255.255.255.0
Default gateway	192.168.1.1

NOTE

The devices can be reset by the user to these default settings at any time.
To reset the module, set the three coding-switches on the gateway to "000" followed by a voltage reset.

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not guaranteed
➤ Screw the protective cover over the switches firmly
➤ Check if seal of the protective cover is correctly placed

5.2.7 Factory Reset (F_Reset), Switch Position "900"

F_Reset (Reset to factory setting)

Switch position: 900

This mode sets all device-settings back to the default values and deletes all data in the device's internal flash.

NOTE

Setting 900 is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not guaranteed
➤ Screw the protective cover over the switches firmly
➤ Check if seal of the protective cover is correctly placed

5.2.8 Functional Difference: Switch Position "000" and "900"

	Switch position	
	000	900
Reset of...		
IP address, subnet mask, gateway	✓	✓
Parameters	–	✓
PROFINET device name	–	✓

5.2.9 Address Setting via DTM

In a respective frame application e.g. PACTware, the Turck DTMs allow direct access to Ethernet.

The IP address, as well as the subnet mask of the Ethernet devices, can be changed according to the application by using the Busaddress Management function of the BL Service Ethernet interface (TCP/IP) in the DTM.

Further information about using the DTMs can be found in **chapter 14, Access via Turck DTMs in PACTware, page 123**.

5.2.10 Address Setting via Web Server

The device's network settings can be changed under "Network Configuration" only by users having administrator rights.

Further information concerning the web server of the TBEN-L devices and it's use can be found under **chapter 13, The Web Server, page 109**.

5.3 SET Button

The Set-button is placed left to the rotary coding switches under the cover at the device.

Pushing the Set-button causes a device-restart.

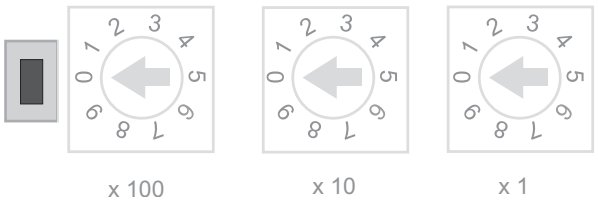


Fig. 3: SET button

ATTENTION!

Protective cover opened

Protection class IP65/IP67/IP69K not guaranteed

- ➤ Screw the protective cover over the switches firmly
- ➤ Check if seal of the protective cover is correctly placed

6 Mounting

The devices must be attached to a level, pre-drilled and grounded mounting surface.

➤ Attach the module to the mounting surface with two M6 screws. The maximum tightening torque for the screws is 1.5 Nm.

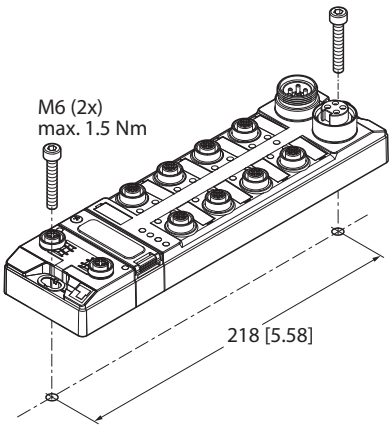


Fig. 4: Attaching the device to the mounting plate

6.1 Grounding the Device

6.1.1 Grounding and Shielding Concept

The grounding and shielding concept of the TBEN-L modules allows the fieldbus and I/O parts to be grounded separately.

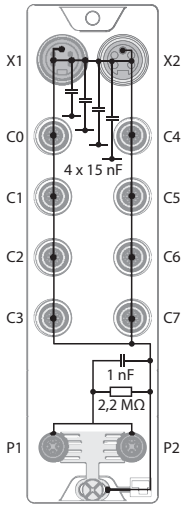


Fig. 5: Replacement wiring diagram, shielding concept

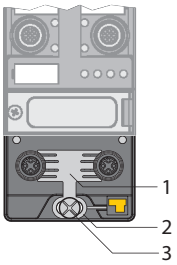


Fig. 6: Grounding components

The grounding clip (1) at the M12 connectors for the fieldbus connection (P1, P2) connects the shield of the fieldbus lines.

The grounding ring (2) is attached below the grounding clip and connects the functional ground of the 7/8" connector (pin 3) for the power supply with the functional ground of the M12 connector (pin 5) for connecting the sensors and actuators.

The grounding screw (3) connects the device with the system's reference potential.

6.1.2 Grounding the Device (FE)

The grounding clip and the metal ring are connected to each other. A mounting screw through the bottom mounting hole in the module connects the shielding of the fieldbus lines to the functional ground of the power supply and the connected devices and to the reference potential of the system.

If a common reference potential is not required, remove the grounding clip to disconnect the fieldbus shield or attach the module with a plastic screw.

Removing the Grounding Clip

➤ Use a flat standard screwdriver to lever the grounding clip upwards and remove it.

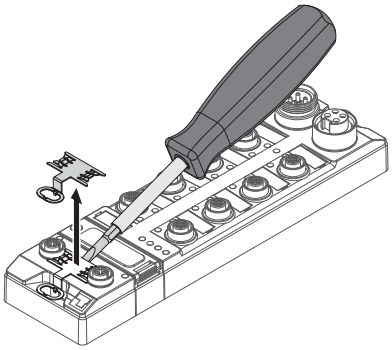


Fig. 7: Removing the grounding clip

Mounting the Grounding Clip

➤ Insert the grounding clip between the fieldbus connectors (using a screwdriver if necessary) so that it makes contact with the metal housing of the connector.

The shield of the fieldbus lines lies flush to the grounding clip.

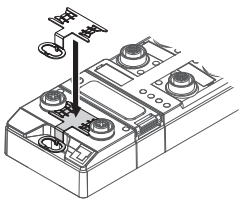


Fig. 8: Mounting the grounding clip

7 Connecting

7.1 Connecting the Devices to Ethernet

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

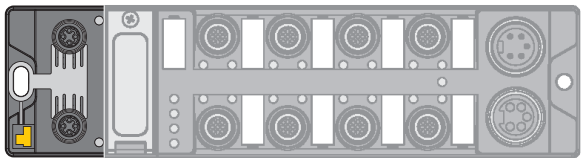


Fig. 9: M12 Ethernet sockets

➤ Connect the device to the field bus according to the pin assignment shown below.

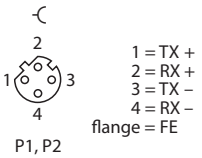


Fig. 10: Pin assignment Ethernet connectors

7.1.1 Ethernet-Connection for QC/FSU Applications

NOTE

Please observe the following for QuickConnect (QC)- and Fast Start-Up (FSU)-applications with TBEN-L:

– do **not** use a crossover-cable
– ETH1 = connector for **incoming** Ethernet-line
– ETH2 = connector for **outgoing E**thernet-line

Further information concerning QuickConnect and FSU can be found here:

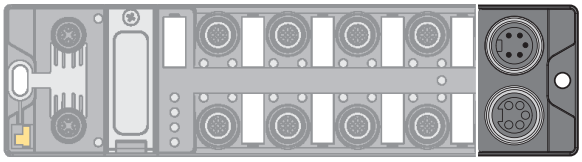
- **QC - QuickConnect, page 67**
- **FSU - Fast Start-Up (prioritized startup), page 99**

7.2 Connect Power Supply

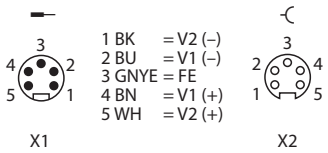
For the connection to the power supply and the feeding through of the power, the device has two 5-pin 7/8" connectors.
The power supply connectors are designed as 4-pole (TBEN-L4) or 5-pole (TBEN-L5) 7/8" connectors.
V1 and V2 are galvanically isolated. The maximum tightening torque is 0.8 Nm.

➤ Connect the device to the power supply according to the pin assignment shown below.

Supply voltage 7/8", 5-pole



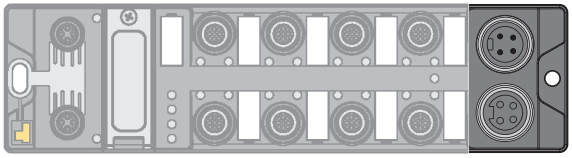
Pin assignment



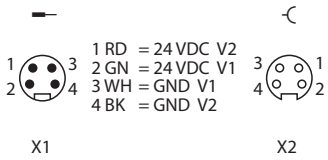
X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

Supply voltage 7/8", 4-pole



Pin assignment



X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

NOTE

V1 and V2 are fed and monitored separately. In case of an undercut of the admissible voltage, the connectors are switched-off according to the module's supply concept (see Supply concept (see **Supply Concept, page 29**).

In case of an undervoltage at V2, the "POWER" LED changes from green to red. In case of an undervoltage at V1, the "POWER" LED is turned off.
The behavior of the LED POWER can be configured via the parameter "LED-behavior (PWR) at V2 undervoltage)".

7.2.1 Supply Concept

All TBEN-S-devices are supplied via two separate voltages V1 and V2.

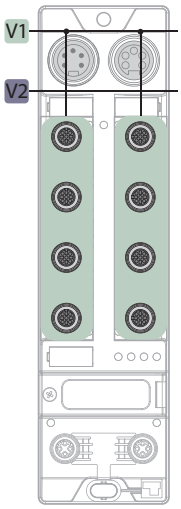
The I/O-channels are therefore consequently separated into the different potential groups "detachable I/O" (supplied through V2) and "non-detachable" I/O (supplied through V1).

This allows a safety shutdown of parts of an installation via emergency-off circuits even when using the highly flexible 16DXP-module variants.

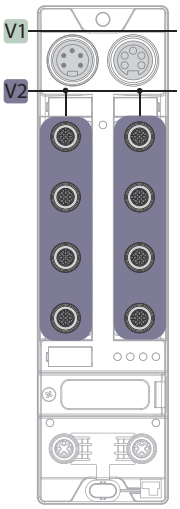
V1 = supply of module electronics and the respective connectors

V2 = supply of device electronics and the respective connectors (separately detachable)

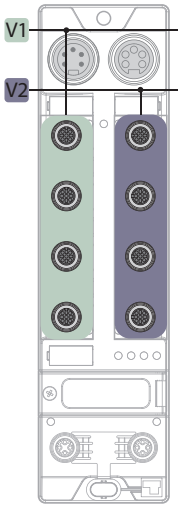
TBEN-Lx-16DIx



TBEN-Lx-16DOx



TBEN-L1x-8DIP-8DOx



TBEN-Lx-16DXx

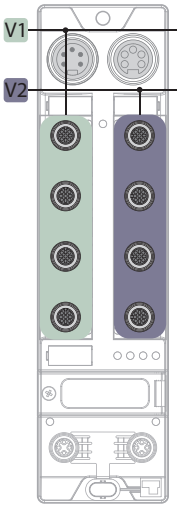


Fig. 11: Device supply – overview

7.3 Connecting Digital Sensors and Actuators

The device has eight 5-pin M12 connectors for connecting digital sensors and actuators. The maximum tightening torque is 0.8 Nm.

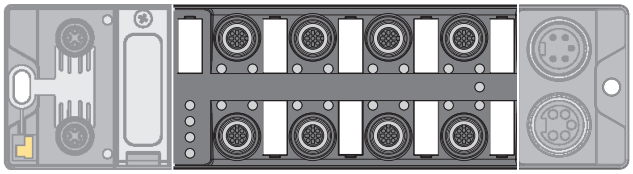
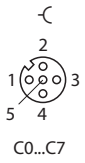


Fig. 12: M12 connector for connecting digital sensors and actuators

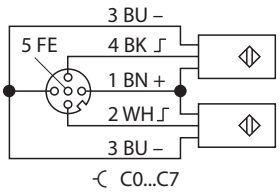
7.3.1 Inputs

➤ Connect the digital sensors to the device according to the pin assignment shown below.

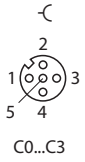
TBEN-Lx-16DIP/TBEN-L4-16DIN



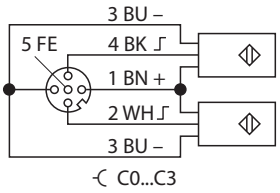
1 = $V_{aux}1$
2 = Signal In
3 = GND V1
4 = Signal In
5 = FE



TBEN-Lx-8DIP-8DOP



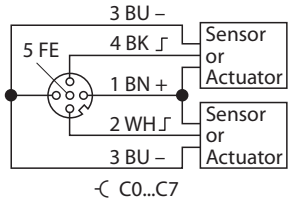
1 = $V_{aux}1$
2 = Signal In
3 = GND V1
4 = Signal In
5 = FE

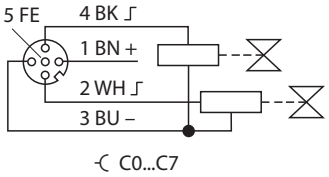


7.3.2 Outputs

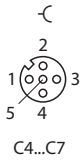
➤ Connect the digital actuators to the device according to the pin assignment shown below.

TBEN-Lx-16DOP/TBEN-L4-16DON

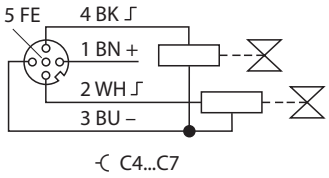




TBEN-Lx-8DIP-8DOP



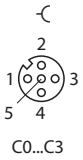
1 = $V_{aux}2$
2 = Signal Out
3 = GND V2
4 = Signal Out
5 = FE



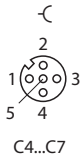
7.3.3 In- and Outputs

Connect the digital sensors and actuators to the device according to the pin assignment shown below.

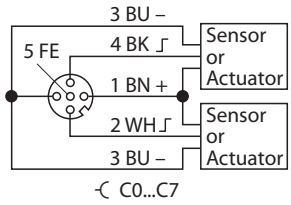
TBEN-Lx-16DXP/TBEN-Lx-16DXN



1 = $V_{aux}1$
2 = Signal In/Out
3 = GND V1
4 = Signal In/Out
5 = FE



1 = $V_{aux}2$
2 = Signal In/Out
3 = GND V2
4 = Signal In/Out
5 = FE



8 Device Characteristics

8.1 Block Diagrams

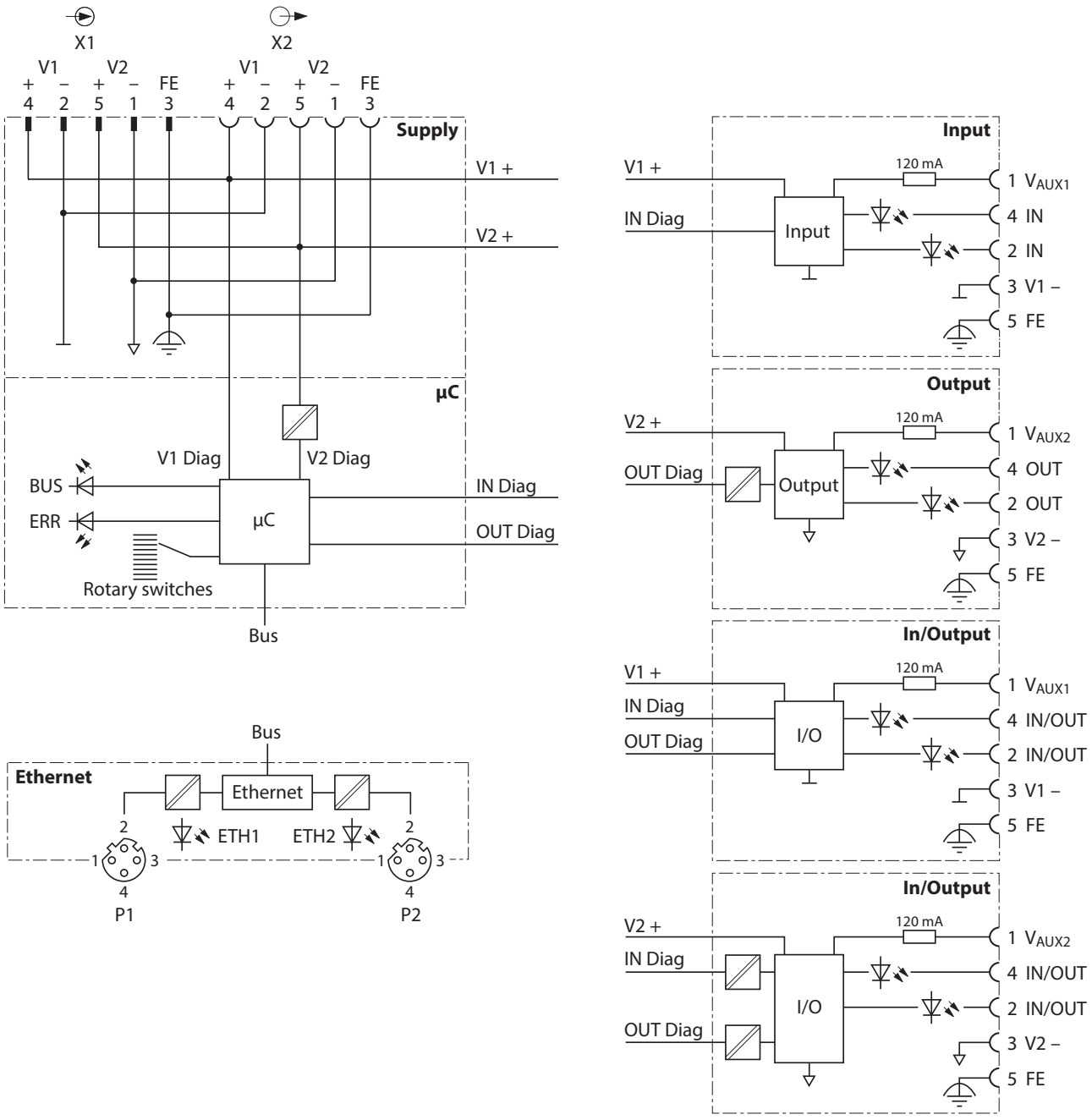


Fig. 13: Block diagrams

8.2 General Technical Data

Supply voltage	
V1 (incl. electronics supply)	24 V DC
Permissible range	18 … 30 V DC
V2	24 V DC
Permissible range	18 … 30 V DC
Potential isolation	Galvanic isolation of V1 and V2
Connectors	
Ethernet	2 x M12-connector (OUT), 4-pole, D-coded
power supply	
– TBEN-L4	7/8" connector, 4-pole
– TBEN-L5	7/8" connector, 5-pole
In-/outputs	M12 connector, 5-pole
Permissible torques	
– Ethernet	0.6 Nm
– I/O channels/supply.	0.8 Nm
– Mounting (M6 screws)	1.5 Nm
– Protective cap	0.5 Nm
Isolation voltages	
V1 to V2	≥ 500 V AC
V1/V2 to the field bus	≥ 500 V AC
Protocol properties	
Modbus TCP	
Address assignment	Static IP (rotary coding switches), BOOTP, DHCP
Supported Function Codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of connections	8
EtherNet/IP	
Address assignment	according to EtherNet/IP standard
Quick Connect (QC)	< 150 ms
Device Level Ring (DLR)	supported
Number of connections	3
PROFINET	
Address assignment	DCP
MinCycleTime	1 ms
Fast Start-Up (FSU)	< 150 ms
Diagnostics	according to PROFINET Alarm Handling
Topology detection	supported
Automatic address assignment	supported
Media Redundancy Protocol (MRP)	supported

Mounting	
Mounting	2 mounting holes, ? 6.3 mm
Mounting distance device to device	≥ 50 mm Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting). At low simultaneity factors and low ambient temperatures, mounting distances of < 50 mm may be possible.
Tests	
Vibration test	according to EN 60068-2-6/ IEC 68-2-47, acceleration up to 20 g
Drop and topple	according to IEC 60068-2-31/IEC 60068-2-32 1
Shock test	according to EN 60068-2-27
EMC	according to EN 61131-2
Ambient conditions	
Temperature range	
– Operating temperature	- 40 °C to + 70 °C
– Storage/transport	- 40 °C to + 85°C
Operating altitude	max. 5000 m
Protection class	IP65/IP67/IP69K
Housing	
Size	60.4 × 230.4 × 24 mm (w × l ×h)
Material	Fibre-glass reinforced Polyamide (PA6-GF30)
Window material	Lexan
Screw material	303 Stainless Steel
halogen-free	yes

8.3 TBEN-Lx-16DIP/TBEN-L4-16DIN

TBEN-Lx-16DIP offers sixteen digital inputs for 3-wire PNP sensors.

TBEN-Lx-16DIN offers sixteen digital inputs for 3-wire NPN sensors.

8.3.1 Technical Data

power supply	
Nominal value	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operational current (from V_1)	< 150 mA
Sensor/actuator supply $VAUX_1$	Supply connector C0-C7 from V1 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	16
Input type	
– TBEN-Lx-16DIP	PNP
– TBEN-L4-16DIN	NPN
Switching threshold	EN 61131-2 type 3, PNP or NPN
Signal voltage, low level	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Switch-on delay	2.5 ms
Type of input diagnosis	channel diagnostics
Potential isolation	galvanic isolation to the field bus

8.3.2 Wiring Diagram

→ **Connecting the Devices to Ethernet, page 27**

→ **Connect Power Supply, page 28**

→ **Connecting Digital Sensors and Actuators, page 30**

8.3.3 Parameters for I/O Channels

Parameter name	Value	Description
Digital input Invert digital input (Inv. DIx)	**0 = no**	
	1 = yes	Inverts the digital input signal.
Pulse stretching input	0 - 255	The input signal is stretched to a time between 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) Example: 10 = pulse of 100 ms

Further information about the parameters can be found in the fieldbus specific chapters.

- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- PROFINET: **Parameters, page 105**

8.3.4 Diagnostic Messages

Diagnostics	Description
SCSx	Short-circuit at the supply voltage for the respective connector.

Please find more detailed information about the diagnostic data mapping in the fieldbus-specific chapters:

- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- PROFINET: **PROFINET-diagnostics, page 101**

8.4 TBEN-Lx-16DOP/TBEN-L4-16DON

TBEN-Lx-16DOP offers sixteen digital PNP outputs for DC actuators.

TBEN-Lx-16DON offers sixteen digital NPN outputs for DC actuators.

8.4.1 Technical Data

power supply	**24 V DC from operating voltage**
Nominal value	
Permissible range	18 … 30 V DC
Operational current (from V_1)	< 150 mA
Sensor/actuator supply $VAUX_2$	Supply connector C0-C7 from V2 120 mA per connector, short-circuit proof
Digital outputs	
Number of channels	16
Output type	
– TBEN-Lx-16DOP	PNP
– TBEN-L4-16DON	NPN
Output voltage	24 VDC from potential group
Output current per channel	
– TBEN-Lx-16DOP	2 A, short-circuit proof, max. 2 A per connector
– TBEN-L4-16DON	1 A, short-circuit proof, max. 2 A per connector
Load type	ohmic, inductive, lamp load
Simultaneity factor	0.28 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnosis
Potential isolation	galvanic isolation to the field bus

8.4.2 Wiring Diagram

→ **Connecting the Devices to Ethernet, page 27**

→ **Connect Power Supply, page 28**

→ **Connecting Digital Sensors and Actuators, page 30**

8.4.3 Parameters for I/O Channels

Parameter name	Value	Description
Manual output reset after overcurrent (SROx)	**0 = no**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off after an overload until a new set-command is given (rise and fall).

Further information about the parameters can be found in the fieldbus specific chapters.

- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- PROFINET: **Parameters, page 105**

8.4.4 Diagnostic Messages

Diagnostics	Description
SCSx	Short-circuit at the supply voltage for the respective connector.
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- PROFINET: **PROFINET-diagnostics, page 101**

8.5 TBEN-Lx-8DIP-8DOP

The station offers eight digital inputs for 3-wire PNP-sensors and eight digital PNP outputs for DC actuators.

8.5.1 Technical Data

power supply	
Nominal value	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operating current	< 150 mA
Sensor/actuator supply V_{AUX1}/V_{AUX2}	supply of connectors C0 - C3 from V1 C4 - C7 from V2 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	8
Input type	PNP
Switching threshold	EN 61131-2 type 3, PNP
Low level signal voltage	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Switch-on delay	2.5 ms
Type of input diagnosis	channel diagnostics
Digital outputs	
Number of channels	8
Output type	PNP
Output voltage	24 VDC from potential group
Load type	ohmic, inductive, lamp load
Simultaneity factor	0.56 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnosis
Potential isolation	galvanic isolation to the field bus

8.5.2 Wiring Diagram

→ **Connecting the Devices to Ethernet, page 27**

→ **Connect Power Supply, page 28**

→ **Connecting Digital Sensors and Actuators, page 30**

8.5.3 Parameters for I/O Channels

Parameter name	Value	Description
Digital input Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	Inverts the digital input signal.
Pulse stretching input	0 - 255	The input signal is stretched to a time between 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) Example: 10 = pulse of 100 ms
Manual output reset after overcurrent (SROx)	**0 = no**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off after an overload until a new set-command is given (rise and fall).

Further information about parameters can be found in the fieldbus specific chapters.

- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- PROFINET: **Parameters, page 105**

8.5.4 Diagnostic Messages

Diagnostics	Description
SCSx	Short-circuit at the supply voltage for the respective connector.
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- PROFINET: **PROFINET-diagnostics, page 101**

8.6 TBEN-Lx-16DXP/TBEN-L4-16DXN

The device provides sixteen channels, which can be configured individually, depending on the specific application requirements.

Up to sixteen 3-wire PNP sensors or sixteen DC actuators can be connected to TBEN-Lx-16DXP.

Up to sixteen 3-wire NPN sensors or sixteen DC actuators can be connected to TBEN-L4-16DXN.

8.6.1 Technical Data

power supply	
Nominal value	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operating current	< 150 mA
Sensor/actuator supply V_{AUX1}/V_{AUX2}	supply of connectors C0 - C3 from V1 C4 - C7 from V2 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	16
Input type	
– TBEN-Lx-16DXP	PNP
– TBEN-L4-16DXN	NPN
Switching threshold	EN 61131-2 type 3, PNP or NPN
Signal voltage, low level	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Input resistance	4 kΩ
Switch-on delay	2.5 ms
Input frequency	100 Hz
Type of input diagnostics	channel diagnostics
Digital outputs	
Number of channels	16, DC actuators
Output type	
– TBEN-Lx-16DXP	PNP
– TBEN-L4-16DXN	NPN
Output voltage	24 VDC from potential group
Output current per channel	
– TBEN-Lx-16DXP	2 A, short-circuit proof, max. 2 A per connector
– TBEN-L4-16DXN	1 A, short-circuit proof, max. 2 A per connector
Load type	ohmic, inductive, lamp load
Simultaneity factor	0.56 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnosis
Potential isolation	galvanic isolation to the field bus

8.6.2 Wiring Diagram

→ **Connecting the Devices to Ethernet, page 27**

→ **Connect Power Supply, page 28**

→ **Connecting Digital Sensors and Actuators, page 30**

8.6.3 Parameters for I/O Channels

Parameter name	Value	Description
Digital input Invert digital input (Inv. DIx)	**0 = no**	
	1 = yes	The digital input signal is inverted.
Pulse stretching input	0 - 255	The input signal is stretched to a time between 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) Example: 10 = pulse of 100 ms
Manual output reset at overcurrent (SROx)	**0 = no**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off and on again.
Activate output (EN DOx)	0 = no	
	1 = yes	

Further information about parameters can be found in the fieldbus specific chapters.

- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- PROFINET: **Parameters, page 105**

8.6.4 Diagnostic Messages

Diagnostics	Description
SCSx	Short-circuit at the supply voltage for the respective connector.
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- Modbus TCP: **Register Mapping of the TBEN-L Devices, page 57** ff.
- EtherNet/IP: **Digital Versatile Module Class (VSC117), page 94** ff.
- PROFINET: **PROFINET-diagnostics, page 101**

8.7 Module Status

8.7.1 LED Behavior

The following table describes the protocol-independent behavior of the module LEDs.

The description of protocol-specific LED-behavior can be found in the respective sub-chapters.

LED	Color	Status	Meaning	Remedy
PWR				
TBEN-Lx-16DIP/ TBEN-L4-16DIN	Green	off	V1 missing or < 18 V DC	Check V1
		on	V1 OK	
TBEN-Lx-16DOP/ TBEN-L4-16DON TBEN-Lx-8DIP-8DOP TBEN-Lx-16DXP/ TBEN-L4-16DXN	Green	off	V1 missing or < 18 V DC	Check V1
		on	V1 and V2 OK	–
	Red	on	V2 missing or < 18 V DC	Check V2
ETHx	Green	on	Active link,100 Mbps	
		blinking	Ethernet Traffic, 100 Mbps	
	Yellow	on	Active link,10 Mbps	
		blinking	Ethernet Traffic, 10 Mbps	
		off	No Ethernet link.	Check the Ethernet connection.
ERR	Green	on	No diagnostic message available	
	Red	on	Diagnostic message pending	
BUS	Green	on	Active connection to a master	–
		blinking	Device is ready for operation	–
	Red	on	IP address conflict or restore mode or timeout	control IP addresses in the network wait for the device to be ready for operation
		blinking	Blink-/wink-command active	–
	Red/ green	on	Autonegotiation and/or waiting for DHCP-/BootP-address assignment.	

LED	Color	Status	Meaning	Remedy
0 to 15				
TBEN-Lx-16DIP/ TBEN-L4-16DIN	Green	on **A**	Input active, 24 V at input	
	Red	blinking **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are blinking	Check the sensor supply
		off	Input active	
TBEN-Lx-16DOP/ TBEN-L4-16DON	Green	on **A**	Output active	
	Red	on	Output active, Overload/short-circuit at output	
		blinking **A**	Short-circuit at the supply voltage for the respective connector. Both LEDs at the connector are blinking	Check the sensor supply
		off	Output inactive	
TBEN-Lx-16DXP/ TBEN-L4-16DXN	Green	on **A**	Output or input active	
	Red	on	output active, overload/overcurrent at output	
		blinking **A**	Short-circuit at the supply voltage for the respective connector. Both LEDs at the connector are blinking	Check the sensor supply
		off	Output or input active	
0 to 7				
TBEN-Lx-8DIP-8DOP	Green	on **A**	Input active, 24 V at input	
	Red	blinking **A**	Short-circuit at the supply voltage for the respective connector. Both LEDs at the connector are blinking	Check the sensor supply
		off		
8 to 15				
TBEN-Lx-8DIP-8DOP	Green	on **A**	Output active	
	Red	on	Output active, Overload/short-circuit at output	
		blinking **A**	Short-circuit at the supply voltage for the respective connector. Both LEDs at the connector are blinking	Check the sensor supply
		off	Output inactive	

A*Can also occur in combination*

8.7.2 Status and Control Word of the TBEN-L Devices

The Status as well as the Control Word are mapped into the module's process data.

- EtherNet/IP
  In EtherNet/IP, the mapping can be disabled (see**Gateway Class (VSC 100)**, **GW Status Register, page 92** and **GW Control Register, page 92**).



ATTENTION!

Activate/deactivate the Status and Control Word in EtherNet/IP

Changes in the process data mapping

➤ Observe that activating/deactivating the Status and Control Word causes changes in the process data mapping.

- Modbus TCP
  → see **Register 0x100C: Station Status, page 61**
- PROFINET
  → see **PROFINET-diagnostics, page 101**

Status Word

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V2	–	-	-	-	-	-	Diag Warn
	1	–	FCE	–	-	CFG	COM	V1	–

Meaning of the status bits

Name	Meaning
Diag Warn	Group diagnostics of the device. At least 1 channel sends diagnostics.
V2	V2 too low (< 18 V DC).
V1	V1 too low (< 18 V DC).
COM	Error in the device, the internal communication is disturbed.
CFG	The I/O-configuration has be changed and is no longer compatible.
FCE	Force Mode Active Error The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.

Control Word

- The Control word is reserved.

9 ARGEE/FLC

The ARGEE/FLC programming software can be downloaded from the download area at the Turck homepage.

The Zip archive "SW_ARGEE_Environment_Vx.x.zip" contains the software and the documentation for the programming environment.

10 Modbus TCP

10.1 General Modbus Description

NOTE

The following description of the Modbus protocol is taken from the Modbus Application Protocol Specification V1.1 of Modbus-IDA.

Modbus is an application layer messaging protocol, positioned at level 7 of the OSI model, that provides client/server communication between devices connected on different types of buses or networks.

The industry's serial de facto standard since 1979, Modbus continues to enable millions of automation devices to communicate. Today, support for the simple and elegant structure of Modbus continues to grow.

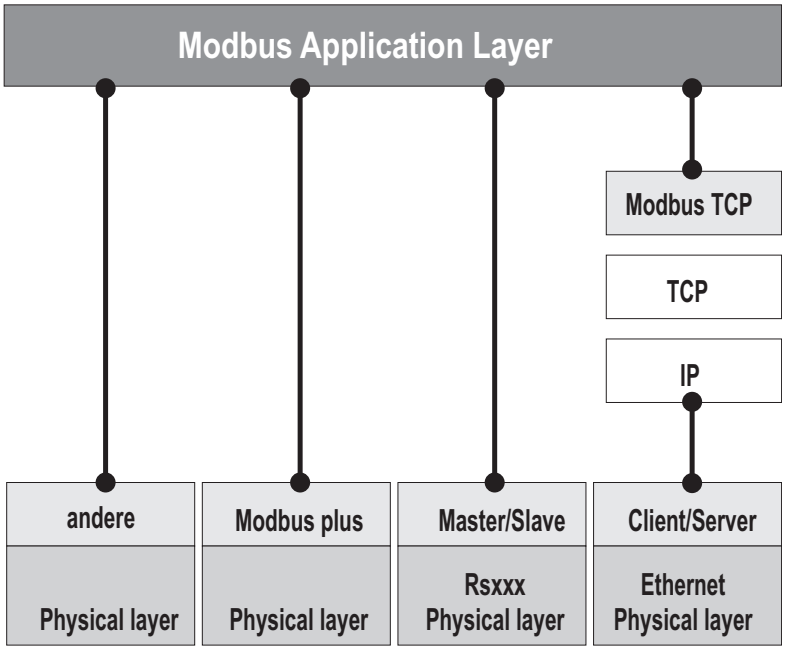
The Internet community can access Modbus at a reserved system port 502 on the TCP/IP stack.

Modbus is a request/reply protocol and offers services specified by function codes. Modbus function codes are elements of Modbus request/reply PDUs (Protocol Data Unit).

Currently, the following sub protocols are implemented:

- TCP/IP over Ethernet. (used for the TBEN-L modules and described in the following)
- Asynchronous serial transmission over a variety of media (wire: RS232, RS422, RS485, optical: fiber, radio, etc.)
- Modbus PLUS, a high speed token passing network.

Schematic representation of the Modbus Communication Stack (according to Modbus Application Protocol Specification V1.1 of Modbus-IDA):



10.1.1 Protocol Description

The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers.

The mapping of Modbus protocol on specific buses or network can introduce some additional fields on the application data unit (ADU).

The Modbus application data unit is built by the client that initiates a Modbus transaction.

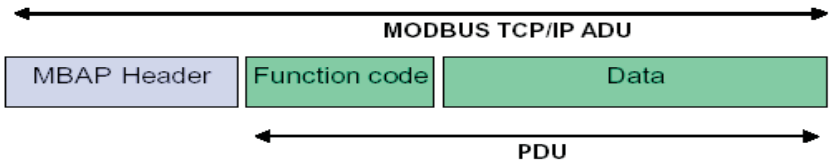
The function code indicates to the server what kind of action to perform.

The Modbus application protocol establishes the format of a request initiated by a client.

The field function code of a Modbus data unit is coded in one byte. Valid codes are in the range of 1... 255 decimal (128 – 255 reserved for exception responses).

When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid.

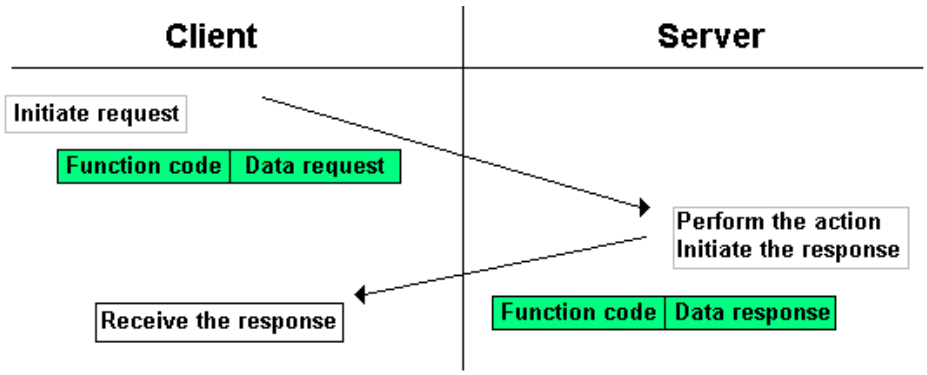
Sub-function codes are added to some function codes to define multiple actions.



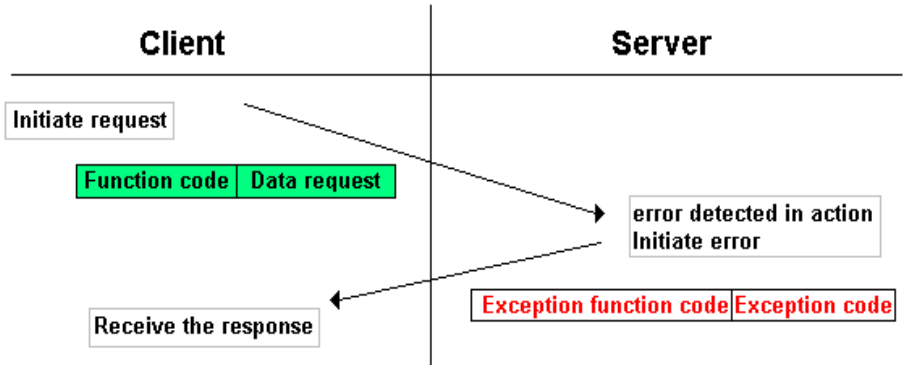
The data field of messages sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the data field.

The data field may be non-existent (= 0) in certain kinds of requests, in this case the server does not require any additional information. The function code alone specifies the action.

If no error occurs related to the Modbus function requested in a properly received Modbus ADU the data field of a response from a server to a client contains the data requested. #



If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.



Data model

The data model distinguishes four basic data types:

Data type	Object type	Access	Comment
Discrete Inputs	Bit	Read	This type of data can be provided by an I/O system.
Coils	Bit	read/write	This type of data can be alterable by an application program.
Input registers	16-bit (Word)	Read	This type of data can be provided by an I/O system.
Holding registers	16-bit (Word)	read/write	This type of data can be alterable by an application program.

For each of these basic data types, the protocol allows individual selection of 65536 data items, and the operations of read or write of those items are designed to span multiple consecutive data items up to a data size limit which is dependent on the transaction function code.

It's obvious that all the data handled via Modbus (bits, registers) must be located in device application memory.

Access to these data is done via defined access-addresses (see „Modbus Registers“, page 54).

The example below shows the data structure in a device with digital and analog in- and outputs.

TBEN-L devices have only one data block, which can be accessed via different Modbus functions. The access can be carried out either via registers (16-bit-access) or, for some of them, via single-bit-access.

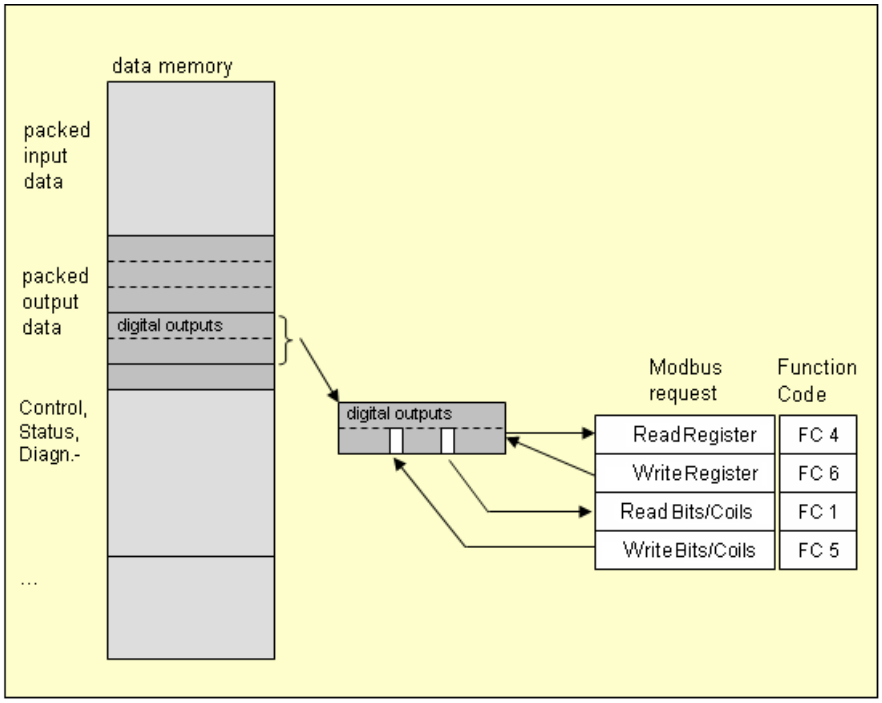


Fig. 14: Picture of the data memory of the TBEN-L modules

10.2 Implemented Modbus Functions

The TBEN-L stations for Modbus TCP support the following functions for accessing process data, parameters, diagnostics and other services.

Function codes	
No.	**Function**
	Description
1	**Read Coils**
	Reading multiple output bits.
2	**Read Discrete Inputs**
	Reading multiple input bits.
3	**Read Holding Registers**
	Reading multiple output registers.
4	**Read Input Registers**
	Reading multiple input registers.
5	**Write Single Coil**
	Writing a single output bit.
6	**Write Single Register**
	Writing a single output register.
15	**Write Multiple Coils**
	Writing multiple output bits.
16	**Write Multiple Registers**
	Writing multiple output registers.
23	**Read/Write Multiple Registers**
	Reading and writing of multiple registers

10.3 Modbus Registers

NOTE

For the register mapping of the different Modbus addressing methods see (siehe page 55).

Address (hex.)	Access ro = read only rw = read/ write	Description
0x0000 to 0x01FF	ro	Packed process data of outputs (process data length of devices, see Data Width of the I/O-Modules in the Modbus-Register Area, page 56)
0x0800 to 0x09FF	rw	Packed process data of outputs (process data length of devices, see Data Width of the I/O-Modules in the Modbus-Register Area, page 56)
0x1000 to 0x1006	ro	Station Identifier
0x100C	ro	Stations-Status (siehe page 61)
0x1012	ro	Process image length in bit for the digital output modules
0x1013	ro	Process image length in bit for the digital input modules
0x1017	ro	Register mapping revision Register mapping revision (always 1, if not, mapping is incompatible with this description)
0x1020	ro	Watchdog, actual time [ms]
0x1120	rw	Watchdog predefined time [ms] (default: 0) see Error Behavior (Watchdog), page 64
0x1130	rw	Modbus connection mode register (siehe page 62)
0x1131	rw	Modbus connection timeout in sec. (default: 0 = never) (siehe page 62)
0x113C to 0x113D	rw	Modbus Parameter Restore (siehe page 63) (reset of parameters to default values)
0x113E to 0x113F	rw	Modbus Parameter Save (siehe page 63) (permanent storing of parameters)
0x1140	rw	Deactivate protocol Deactivates explicitly the selected Ethernet-protocol: Bit 0 = EtherNet/IP Bit 1 = Modbus TCP Bit 2 = PROFINET Bit 15 = web server
0x1141	ro	Active protocol Bit 0 = EtherNet/IP Bit 1 = Modbus TCP Bit 2 = PROFINET Bit 15 = web server
0x1150	rw	LED behavior (PWR) at V2 undervoltage Bit 0: 0 = red 1 = green blinking

Address (hex.)	Access ro = read only rw = read/ write	Description
0x2400	ro	V1 [mV]: 0 at < 18 V
0x2401	ro	V2 [mV]: 0 at < 18 V
0x8000 to 0x8400	ro	Process data inputs (32 registers per device)
0x9000 to 0x9400	rw	Process data outputs (32 registers per device)
0xA000 to 0xA400	ro	Diagnostics (32 registers per device)
0xB000 to 0xB400	rw	Parameters (32 registers per device)

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

Description	Hex	Decimal	5-digit	Modicon
Packed inputs	0x0000 to 0x01FF	0 to 511	40001 to 40512	400001 to 400512
Packed outputs	0x0800 to 0x09FF	2048 to 2549	42049 to 42560	402049 to 402560
Station Identifier	0x1000 to 0x1006	4096 to 4102	44097 to 44103	404097 to 404103
Module status	0x100C	4108	44109	404109
Process image length in bit for the digital output modules	0x1012	4114	44115	404115
process image length in bit for the digital input modules	0x1013	4115	44116	404116
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 sec.	0x1131	4401	44402	404402
Modbus parameter restore,	0x113C to 0x113D	4412 to 4413	44413 to 44414	404413 to 404414
Modbus parameter save,	0x113E to 0x113F	4414 to 4415	44415 to 44416	404415 to 404416
Deactivate protocol	0x1140	4416	44417	404417
Active protocol	0x1141	4417	44418	404418
LED behavior (PWR) at V2 undervoltage	0x1150	4432	44433	404433
V1 [mV]:	0x2400	9216	49217	409217
V2 [mV]:	0x2401	9217	49218	409218
Process data inputs (32 registers per device)	0x8000 to 0x8400	32768 to 32792	–	432769 to 432793

Description	Hex	Decimal	5-digit	Modicon
Process data outputs (32 registers per device)	0x9000 to 0x9400	36864 to 37888	–	436865 to 437889
Diagnostics (32 registers per device)	0xA000 to 0xA400	40960 to 41984	–	440961 to 441985
Parameters (32 registers per device)	0xB000 to 0xB400	45056 to 46080	–	445057 to 446081

10.4 Data Width of the I/O-Modules in the Modbus-Register Area

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

Device	Process input data	Process output data	Alignment
TBEN-Lx-16DIP TBEN-L4-16DIN	16 Bit	–	bit by bit
TBEN-Lx-16DOP TBEN-L4-16DON	–	16 Bit	bit by bit
TBEN-Lx-8DIP-8DOP	8 Bit	8 Bit	bit by bit
TBEN-Lx-16DXP TBEN-L4-16DXN	16 Bit	16 Bit	bit by bit

10.5 Register Mapping of the TBEN-L Devices

10.5.1 TBEN-Lx-16DIP/TBEN-L4-16DIN

Register	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
0x0001 Status word	Byte 0	–	-	-	-	-	-	-	Diag Warn
	Byte 1	–	FCE	–	-	CFG	COM	V_1	–
0x0002 group diag-nostics	Byte 0	–	-	-	-	-	-	-	I/O Diag
	Byte 1	–	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnostics									
0xA000	Byte 0	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	Byte 1	–	-	-	-	-	-	-	-
Parameters									
0xB000	Byte 0	–	-	-	-	-	-	-	-
	Byte 1	–	-	-	-	-	-	-	-
0xB001	Byte 0	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
	Byte 1	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
0xB002	Byte 0	reserved							
	Byte 1	Pulse stretching input 0							
0xB003	Byte 0	Pulse stretching input 1							
	Byte 1	Pulse stretching input 2							
0xB004	Byte 0	Pulse stretching input 3							
	Byte 1	Pulse stretching input 4							
…		…							
0xB009	Byte 0	Pulse stretching input 13							
	Byte 1	Pulse stretching input 14							
0xB00A	Byte 0	Pulse stretching input 15							
	Byte 1	reserved							

→ **Meaning of the Register Bits, page 61.**

10.5.2 TBEN-Lx-16DOP/TBEN-L4-16DON

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Status word	Byte 0	V_2	–	-	-	-	-	-	Diag Warn
	Byte 1	–	FCE	–	-	CFG	COM	V_1	–
0x0001 group diag-nostics	Byte 0	–	-	-	-	-	-	-	I/O Diag
	Byte 1	–	-		-	-	-	-	-
Packed output data									
0x0800	Byte 0	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	Byte 1	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Outputs									
0x9000	Byte 0	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	Byte 1	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Diagnostics									
0xA000	Byte 0	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	Byte 1	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
0xA001	Byte 0	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	Byte 1	–	-	-	-	-	-	-	-
Parameters									
0xB000	Byte 0	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
	Byte 1	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
0xB000	Byte 0								
	Byte 1								

→ **Meaning of the Register Bits, page 61**.

10.5.3 TBEN-Lx-8DIP-8DOP

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	–	-		-	-	-	-	-
0x0001 Status word	Byte 0	V_2	–	-	-	-	-	-	Diag Warn
	Byte 1	–	FCE	–	-	CFG	COM	V_1	–
0x0002 group diag-nostics	Byte 0	–	-	-	-	-	-	-	I/O Diag
	Byte 1	–	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	–	-		-	-	-	-	-
Packed output data									
0x0800	Byte 0	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
	Byte 1	–	-	-	-	-	-	-	-
Outputs									
0x9000	Byte 0	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
	Byte 1	–	-	-	-	-	-	-	-
Diagnostics									
0xA000	Byte 0	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	Byte 1	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
Parameters									
0xB000	Byte 0	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
	Byte 1	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
0xB001	Byte 0	reserved							
	Byte 1								
	Byte 0								
0xB002	Byte 0	reserved							
	Byte 1	Pulse stretching input 0							
0xB003	Byte 0	Pulse stretching input 1							
	Byte 1	Pulse stretching input 2							
0xB004	Byte 0	Pulse stretching input 3							
	Byte 1	Pulse stretching input 4							
0xB005	Byte 0	Pulse stretching input 5							
	Byte 1	Pulse stretching input 6							
0xB006	Byte 0	Pulse stretching input 7							
	Byte 1	reserved							

→ **Meaning of the Register Bits, page 61**.

10.5.4 TBEN-Lx-16DXP/TBEN-L4-16DXN

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
0x0001 Status word	Byte 0	V_2	–	-	-	-	-	-	Diag Warn
	Byte 1	–	FCE	–	-	CFG	COM	V_1	–
0x0002 group diag-nostics	Byte 0	–	-	-	-	-	-	-	I/O Diag
	Byte 1	–	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	Byte 1	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Packed output data									
0x0800		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Outputs									
0x9000	Byte 0	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	Byte 1	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Diagnostics									
0xA000	Byte 0	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	Byte 1	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
0xA001	Byte 0	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	Byte 1	–	-	-	-	-	-	-	-
Parameters									
0xB000		reserved							
0xB001	Byte 0	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
	Byte 1	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
0xB002	Byte 0	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
	Byte 1	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
0xB003	Byte 0	EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1	EN DO0
	Byte 1	EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9	EN DO8
0xB004	Byte 0	reserved							
	Byte 1	Pulse stretching input 0							
0xB005	Byte 0	Pulse stretching input 1							
	Byte 1	Pulse stretching input 2							
…	Byte 0	…							
	Byte 1								
0xB00B	Byte 0	Pulse stretching input 13							
	Byte 1	Pulse stretching input 14							
0xB00C	Byte 0	Pulse stretching input 15							
	Byte 1	reserved							

→ **Meaning of the Register Bits, page 61**.

10.5.5 Meaning of the Register Bits

Name	Meaning
I/O data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = pin
Diagnostics	
DiagWarn	see **Register 0x100C: Station Status, page 61**
V_1	
V_2	
COM	
CFG	
FCE	
I/O Diag	Group diagnostics of I/Os
SCSx	Short-circuit at the supply voltage for the respective connector.
SCOx	Overcurrent at the respective output
Parameters	→ See "parameters"-section for the respective module type in **chapter 8**.

10.6 Register 0x100C: Station Status

This register contains a general module status.

Bit	Name	Description
Device		
15	–	-
14	FCE	The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.
13	–	-
12	–	-
Module bus		
11	CFG	Configuration error
10	COM	Internal communication disturbed
Voltage errors		
9	V_1	System power supply too low (< 18 V DC).
8	–	-
7	V_2	V2 too low (< 18 V DC).
6	–	-
5	–	-
4	–	-

Bit	Name	Description
Warnings		
3	–	-
2	–	-
1	–	-
0	DiagWarn	Diagnostics available at the device.

10.7 Register 0x1130: Modbus Connection Mode

This register defines the behavior of the Modbus connections:

Bit	Name – Description
15 to 2	reserved
1	**MB_ImmediateWritePermission** – **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 don't (only if bit 0 = 1).
0	**MB_OnlyOneWritePermission** – **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.

10.8 Register 0x1131: Modbus Connection Timeout

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

10.8.1 Behavior of the BUS LED

In case of a Connection Timeout the BUS LED's behavior is as follows:

Connection-Timeout	BUS-LED
time-out	green, blinking

10.9 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.

For this purpose, write 0x6C6F to register 0x113C. 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 service resets the parameters without saving them. This can be achieved by using a following "save" service.

10.10 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.

For this purpose, write 0x7361 to register 0×113E. To activate the saving of the registers, write 0x7665 ("save") within 30 seconds in register 0x113F.

Both registers can also be written with one single request using the function codes FC16 and FC23.

10.11 Bit Areas: Mapping of Input Discrete- and Coil-Areas

As described before, the digital in and outputs can be read and, in case of outputs, be written in the data area for the packed in- and output data.

NOTE

In the packed process data, the digital I/O data are stored following the variable in- and output data area of the intelligent I/Os, which means they are stored with a variable offset, depending on the station's I/O-configuration.

In order to set for example a single output (single coil), the following functions are available for reading and writing single bits:

- FC1 ("Read Coils"),
- FC2 ("Read Discrete Inputs"),
- FC 5 ("Write Single Coil")
- FC15 ("Write Multiple Coils")

Data mapping of input discrete and coil areas:

- Mapping: input discrete area
  Contains all digital inputs starting with offset "0".
- Mapping: coil area
  Contains all digital outputs starting with offset "0".

10.12 Error Behavior (Watchdog)

10.12.1 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, page 54):

- Watchdog = 500 ms (default)
  → outputs hold the momentary value in case of an error
- Watchdog > 0 ms
  → outputs switch to **0** after the watchdog time has expired (setting in register 0×1120).

NOTE

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

10.12.2 Behavior of the BUS LED

If the Watchdog has tripped, the BUS LED behaves as follows:

Watchdog	BUS-LED
tripped	constantly red

10.13 Parameters and Diagnostic Messages of the I/O Channels

NOTE

Please find explanations regarding parameters and diagnostic messages in the section **Register Mapping of the TBEN-L Devices, page 57**.

11 EtherNet/IP

11.1 The EtherNet/IP Communications Profile

EtherNet/IP is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices.

Communication between the nodes in the EtherNet/IP network can be carried out either via I/O Messages or Explicit Messages.

I/O Messages

I/O Messages serve to exchange high priority process and application data over the network.

Communication between the slaves in the EtherNet/IP network is carried out according to the Server/Client Model,

which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit Messages

Explicit Messages are used to transmit low-priority configuration data, general management data or diagnostic data between two specific devices. This is a point-to-point connection in a Server/Client System that requires a request from a client always to be confirmed by a response from the server.

- Message Router Response
  Consists of a service code, path size value, a message router path and service data. An EPATH is used in the message router path to indicate the target object.
- Message Router Response
  Consists of a service field with the most significant bit set. This is an echo of the service code in the request message with the most significant bit set. A reserved byte follows the service code, which is followed by the General Status code.

11.1.1 Communications Profile for TBEN-L

TBEN-L behaves as an EtherNet/IP Server in the network; the scanner of the higher-level controller operates as a EtherNet/IP Client.

The following EtherNet/IP communications types are supported:

- Unicast
- Multicast
- Cyclic Connection
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

Unicast

A point-to-point connection that exists between two nodes only.

Multicast

A packet with a special destination address, which multiple nodes on the network may be willing to receive.

COS I/O Connection

COS (Change Of State) I/O Connections establish event-controlled connections. This means that the EtherNet/IP devices generate messages as soon as a change of status occurs.

Cyclic I/O Connection

Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

UCMM

The EtherNet/IP gateway offers the option of establishing explicit messaging via the UCMM port (Unconnected Message Manager Port).

UCMM-based explicit messaging is normally used for random, non-periodic requests.

It is not recommended for frequent messaging because the UCMM input queue in a product is typically limited to just a few messages. Once this limit is reached, subsequent requests are ignored and must be retried.

Connected Explicit Messaging

CIP is a connection-based system. For most communications between nodes, a connection is used.

A connection is a path or a virtual circuit between two or more end points in a system. The purpose is to transfer data in the most efficient manner possible.

The Connection ID is a number that is associated with a communication relationship. Receiving nodes decode this key to know whether they must accept the data or not. Receiving nodes decode this key to know whether they must accept the data or not.

11.2 EDS-File

The actual EDS-files for TBEN-L can be downloaded from the Turck home page **www.turck.com**.

Device	ZIP-file
TBEN-Lx-16DIP/ TBEN-L4-16DIN	TBEN-L45_ETHERNETIP.zip
TBEN-Lx-16DOP/ TBEN-L4-16DON	
TBEN-Lx-8DIP-8DOP	
TBEN-Lx-16DXP/ TBEN-L4-16DXN	

11.3 Diagnostic Messages via Process Data

Besides the evaluation of diagnostic data via Explicit Messages, TBEN-L with EtherNet/IP offers the possibility of mapping diagnostic data into the process data (see also the devices' process data mappings (page 77 ff.).

2 different forms of diagnostic data handling are provided:

- Summarized diagnostics
- Scheduled diagnostics (manufacturer specific)

11.3.1 Summarized Diagnostics

The summarized diagnostic data mode will send back the bit "I/O Diag" which indicates that one of the device channels sends a diagnosis.

This bit will be "0" if there are no diagnostic flags set on the device. This bit is set to "1" if there are diagnostics pending.

Bit "I/O Diag"

0 = OK, no diagnostics present

1 = At least 1 channel sends diagnostics

11.3.2 Scheduled Diagnostics (Manufacturer Specific)

The scheduled diagnostics feature (Process Data Class (VSC102), page 92) is used for mapping the channel diagnostic bits into the device's process data (siehe page 77) ff..

Bit "SchedDiag"

0 = no mapping of channel diagnostics into the process data

1 = mapping of channel diagnostics into the process data activated

11.4 QC - QuickConnect

QuickConnect enables a PLC to build up connections to EtherNet/IP nodes in less than 300 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.

The TBEN-L-devices support FSU with a start-up time of < 150 ms.

Ethernet-Cabling for TBEN-L in QC-Applications

Please read Ethernet-Connection for QC/FSU Applications, page 27 for information about the correct Ethernet-cabling in QC-applications with TBEN-L.

11.4.1 QuickConnect in TBEN

Turck TBEN-L devices support QuickConnect.

QuickConnect is activated:

- via the device's web server
- via the configuration data in the PLC program via
  Assembly Class 0x04, Configuration Assembly 106, bit 0 = 1

  or
- via Class Instance Attribute in
  TCP/IP Interface Object 245 (0×F5), instance 1, attribute 12 (0×C0)

NOTE

Activating QuickConnect also activated the automatic setting of all necessary port-properties:

Auto-negotiation	= deactivated
Transmission speed	= 100BaseT
Duplex	= Full duplex
Topology	= linear
AutoMDIX	= deactivated

QuickConnect via Configuration Assembly

The Configuration Assembly is part of the Assembly Class of the device and is defined during the device's configuration in the RS Logix-software tool by Rockwell Automation.

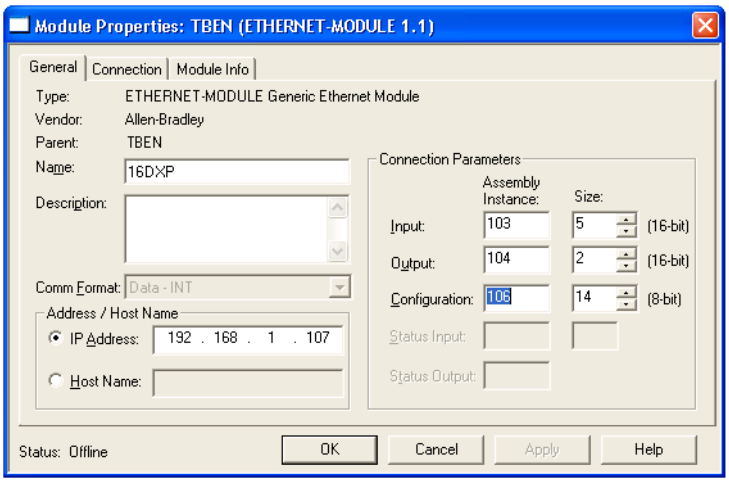


Fig. 15: Configuration Assembly

Quick Connect via Class Instance Attribute

Activate QuickConnect via Class Instance Attribute with the following settings:

Class	Instance	Attribute	Value
245 (0xF5)	1 (0x01)	12 (0x0C)	0 = deactivated (default) 1= activated

QuickConnect via Web Server

QuickConnect can also be activated or deactivated using the device's web server, see also **chapter 13.12, Station Configuration, page 120**.

11.5 Device Level Ring (DLR)

The Device Level Ring (DLR)-redundancy protocol is used to increase the stability of EtherNet/IP networks.

DLR-capable products provide an integrated switch and can thus be integrated into a ring topology.

The DLR-protocol is used to recognize a ring fault. In case of an interruption of the data line, data are sent through an alternative network section, so that the network can be reconfigured as soon as possible.

DLR-capable network nodes are provided with extended diagnostic functions which enable the devices to localize errors and thus decrease the time for error search and maintenance.

11.6 EtherNet/IP Standard Classes

The TBEN-L stations support the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Class Code	Object name
01 (0x01)	**Identity Object (0x01)**
04 (0x04)	**Assembly Object (0x04)**
06 (0x06)	**Connection Manager Object (0x06)**
245 (0xF5)	**TCP/IP Interface Object (0xF5)**
246 (0xF6)	**Ethernet Link Object (0xF6)**

11.6.1 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 TBEN-L.

Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
6 (0x06)	MAX CLASS ATTRIBUTE	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	7

Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	VENDOR	G	UINT	Contains the vendor ID. TURCK = 48
2 (0x02)	PRODUCT TYPE	G	UINT	Shows the general product type. Communications Adapter 12_{dec} = 0x0C
3 (0x03)	PRODUCT CODE	G	UINT	Identifier for a specific product of a device type. default: 27247_{dec} = 6A6F
4 (0x04)	REVISION Major Minor	G	STRUCT OF: USINT USINT	Revision of the item the Identity Object is representing. 0x01 0x06

5 (0x05)	DEVICE STATUS	G	WORD	See page 71
6 (0x06)	SERIAL NUMBER	G	UDINT	Contains the ident-no. of the product (3 last bytes of the MAC-ID).
7 (0x07)	PRODUCT NAME LENGTH NAME	G	STRUCT OF: USINT STRING [13]	e. g.: TBEN-L5-16DXP

Device Status

Bit	Name	Definition
0 to 1	reserved	default = 0
2	Configured	TRUE = 1 → The application of the device has been configured (≠ default-settings).
3	reserved	default = 0
4 to 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 to 15	reserved	default = 0

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined list of the object's attributes.
05 (0x05)	no	yes	Reset Starts the reset service for the device.
14 (0x0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.
16 (0x10)	no	no	Set_Attribute_Single Modifies a single attribute.

11.6.2 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 TBEN-L.

Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	2
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	104

Instance Attributes

Attr. No.	Attribute name	Get / Set	Type	Description
3 (0x03)	DATA	S	ARRAY OF BYTE	
4 (0x04)	SIZE	G	UINT	Number of bytes in attr. 3 256 or variable

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	no	yes	Get_Attribute_Single

Configuration Assembly

The modules support Configuration Assembly.

Instance 106

The Configuration Assembly contains:

10 byte configuration data

+ x byte parameter data of the respective device

- Configuration Assembly (TBEN-Lx-16DIP/TBEN-L4-16DIN)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Module configuration data, see Module Configuration Data, page 76								
0 to 8	Reserved							
9	-	-	-	-	LED behavior (PWR) at V2 undervoltage	Eth 2 Port Setup	Eth 1 Port Setup	Quick Connect
Parameters of the I/O channels, see Parameters for I/O Channels, page 37								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
10	Reserved							
11								
12	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
13	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
14	Reserved							
15	Pulse stretching input 0							
16	Pulse stretching input 1							
17	Pulse stretching input 2							
18	Pulse stretching input 3							
19	Pulse stretching input 4							
20	Pulse stretching input 5							
21	Pulse stretching input 6							
22	Pulse stretching input 7							
23	Pulse stretching input 8							
24	Pulse stretching input 9							
25	Pulse stretching input 10							
26	Pulse stretching input 11							
27	Pulse stretching input 12							
28	Pulse stretching input 13							
29	Pulse stretching input 14							
30	Pulse stretching input 15							
31	Reserved							
…								
33								

- Configuration Assembly (TBEN-Lx-16DOP/TBEN-L4-16DON)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Module configuration data, see Module Configuration Data, page 76								
0 to 8	Reserved							
9	-	-	-	-	LED behavior (PWR) at V2 under-voltage	Eth 2 Port Setup	Eth 1 Port Setup	Quick Connect
Parameters of the I/O channels, see Parameters for I/O Channels, page 39								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
10	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
11	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
12	Reserved							
13								

- Configuration Assembly (TBEN-Lx-8DIP-8DOP)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Module configuration data, see Module Configuration Data, page 76								
0 to 8	Reserved							
9	-	-	-	-	LED behavior (PWR) at V2 under-voltage	Eth 2 Port Setup	Eth 1 Port Setup	Quick Connect
Parameters of the I/O channels, see Parameters for I/O Channels, page 41								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
10	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
11	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
12	Reserved							
13								
14								
15	Pulse stretching input 0							
16	Pulse stretching input 1							
17	Pulse stretching input 2							
18	Pulse stretching input 3							
19	Pulse stretching input 4							
20	Pulse stretching input 5							
21	Pulse stretching input 6							
22	Pulse stretching input 7							
23	Reserved							
…								
25								

■ Configuration Assembly (TBEN-Lx-16DXP/TBEN-L4-16DXN)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Module configuration data, see Module Configuration Data, page 76								
0 to 8	Reserved							
9	-	-	-	-	LED behavior (PWR) at V2 under-voltage	Eth 2 Port Setup	Eth 1 Port Setup	Quick Connect
Parameters of the I/O channels, see Parameters for I/O Channels, page 43								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
10	Reserved							
11								
12	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
13	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
14	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
15	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
16	EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1	EN DO0
17	EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9	EN DO8
18	Reserved							
19	Pulse stretching input 0							
20	Pulse stretching input 1							
21	Pulse stretching input 2							
22	Pulse stretching input 3							
23	Pulse stretching input 4							
24	Pulse stretching input 5							
25	Pulse stretching input 6							
26	Pulse stretching input 7							
27	Pulse stretching input 8							
28	Pulse stretching input 9							
29	Pulse stretching input 10							
30	Pulse stretching input 11							
31	Pulse stretching input 12							
32	Pulse stretching input 13							
33	Pulse stretching input 14							
34	Pulse stretching input 15							
35	Reserved							
…								
41								

Module Configuration Data

Parameter name	Value	Meaning
Quick Connect	0 = controlled recovery	
	1 = activated	
ETH x Port Setup	0 = **Autonegotiation**	The port is set to autonegotiation.
	1 = 100BT/FD	Fix setting of the communication parameters for the Ethernet port to: – 100BaseT – Full duplex
LED behavior (PWR) at V2 undervoltage	0 = red	PWR-LED constant red at V2 undervoltage.
	1 = **green**	PWR-LED is blinking green at V2 undervoltage.

Default values are printed in bold.

11.6.3 Process Data Instances

Instance 101

Contains the device's input data (static length 256 bytes).

2 Bytes status information

+ process data

Instance 102

Contains the device's output data (static length 256 bytes).

2 bytes control data (mapped, but not defined)

+ process data

Instance 103 and Instance 104

In- and output assembly instances with variable assembly sizes. The assembly size is pre-calculated to support the stations I/O-configuration, enabled diagnostics, etc.

- Input Assembly Instance: 103
- Output Assembly Instance: 104

The effective size of the Assembly Instance can be determined using the Assembly Object (instance 0×67, attribute 0x04) and can be from 2 to 496 bytes large.

Process Data Mapping TBEN-Lx-16DIP/TBEN-L4-16DIN

- Scheduled diagnostic data mode
  Default setting, see page 67

IN = 8 byte
OUT = 2 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnos-tics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	7	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of the Process Data Bits, page 83.

- No diagnostics,
  status- and control-word can be deactivated, see page 44.

IN = 4 byte
OUT = 2 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	-	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ **Meaning of the Process Data Bits, page 83**.

Process Data Mapping TBEN-Lx-16DOP/TBEN-L4-16DON

- Scheduled diagnostic data mode
  default setting, see also page 67.

IN = 8 byte
OUT = 4 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Diagnos-tics	2	-	-	-	-	-	-	-	I/O Diag
	3	-	-	Sched Diag	-	-	-	-	-
	4	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	5	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
	6	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	7	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ **Meaning of the Process Data Bits, page 83**.

- No diagnostics,
  status- and control-word can be deactivated, see page 44.

IN = 2 byte
OUT = 4 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of the Process Data Bits, page 83.

Process Data Mapping TBEN-Lx-8DIP-8DOP

- Scheduled diagnostic data mode
  Default setting, see page 67

IN = 8 byte
OUT = 4 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	-	-	-	-	-	-	-	-
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	7	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
	3	-	-	-	-	-	-	-	-

→ Meaning of the Process Data Bits, page 83.

- No diagnostics,
  status- and control-word can be deactivated, seepage 44.

IN = 4 byte
OUT = 4 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
	3	-	-	-	-	-	-	-	-

→ **Meaning of the Process Data Bits, page 83**.

Process Data Mapping TBEN-Lx-16DXP/TBEN-L4-16DXN

- Scheduled diagnostic data mode
  Default setting, see page 67

IN = 10 byte
OUT = 4 byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnos-tics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	7	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
	8	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	9	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ **Meaning of the Process Data Bits, page 83**.

- No diagnostics,
  status- and control-word can be deactivated, see page 44.

IN = 4 byte
OUT = 4 byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of the Process Data Bits, page 83.

Meaning of the Process Data Bits

Name	Meaning
I/O data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = pin
Diagnostics	
DiagWarn	See VSC 100, attr. 109 (0x6D), **Status register 2, page 91**
V_2	
V_1	
COM	
CFG	
FCE	
I/O Diag	Group diagnostics of in-/outputs
SchedDiag	The mapping of input and output diagnostics is activated
SCSx	Overcurrent at sensor supply of the respective connector
SCOx	Overcurrent at output

11.6.4 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 TBEN-L.

Common Services

Service code	Class	Instance	Service name
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

11.6.5 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 TBEN-L.

Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
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.	Attribute name	Get/ Set	Type	Description
1 (0x01)	STATUS	G	DWORD	Interface status (siehe page 85)
2 (0x02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag (siehe page 85)
3 (0x03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag (siehe page 85)
4 (0x04)	PHYSICAL LINK OBJECT	G	STRUCT	
	Path size		UINT	Number of 16 bit words: 0x02
	Path:		Padded EPATH	0x20, 0xF6, 0x24, 0x01
5 (0x05)	INTERFACE CONFIGURATION	G	Structure of:	TCP/IP Network Interface Configuration (siehe page 85)
	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		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 (siehe page 86)
12 (0x0C)	Quick Connect	G/S	BOOL	0 = deactivate 1 = activate

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
02 (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.
  Refer to the state diagram,**Fig. 16: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)**
  for a description of object states as they relate to the Status attribute.

Bit(s)	Name	Definition
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 to 15: reserved
4 to 31	reserved	

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

Bit(s)	Name	Definition	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(s)	Name	Definition
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 to 3: reserved
4	DNS Enable	Always 0
5-31	reserved	Set to 0

- **Interface Configuration**
  This attribute contains the configuration parameters required to operate as a TCP/IP node.
  To modify the Interface Configuration attribute, get the Interface Configuration attribute first, change the desired parameters, then 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.

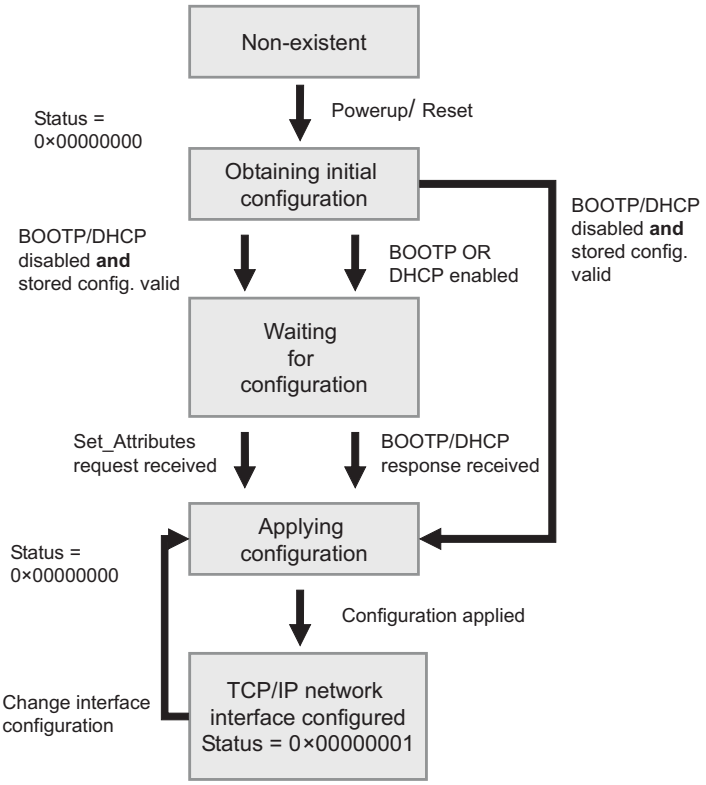


Fig. 16: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)

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11.6.6 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 TBEN-L.

Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
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.	Attribute name	Get / Set	Type	Description
1 (0x01)	INTERFACE SPEED	G	UDINT	Speed in Mbit/s (e. g. 10, 100, 1000, etc.)
2 (0x02)	INTERFACE FLAGS	G	DWORD	
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		2 WORD	Allows port-wise changes of the Ethernet-settings
7 (0x07)	INTERFACE TYPE			(siehe page 88)
10 (0x0A)	INTERFACE LABEL			

Interface Flags

Bits	Name	Definition	Default value
0	Link Status	Indicates whether or not the Ethernet 802.3 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, Duplex bit cannot be defined.	Depends on application
2 to 4	Negotiation Status	Indicates the status of the automatic Duplex detection (autonegotiation) 0 = autonegotiation running 1 = autonegotiation and speed detection failed Using default values for speed and duplex (10Mbps/half duplex). 2 = autonegotiation failed but detected speed (default: half duplex). 3 = successfully negotiated speed and duplex. 4 = autonegotiation not attempted. 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 = a local hardware fault is detected	0

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
76 (0x4C)	no	yes	Enetlink_Get_and_Clear

11.7 VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the TBEN-L stations support the vendor specific classes described in the following.

Class Code dec. (hex.)	Name	Description
100 (0x64)	Gateway Class, page 90	Contains data and settings concerning the field bus-specific part of the TBEN-L stations.
102 (0x66)	Process Data Class, page 92	contains the process data
117 (0x75)	Digital Versatile Module Class, page 94	Describes the I/O channels
126 (0x1A)	Miscellaneous Parameters Class, page 96	Describes the EtherNet/IP-Port properties

11.7.1 Class Instance of the VSCs

NOTE

The class instance attributes are the same for each Vendor Specific Class.

The class-specific Object Instances and the corresponding attributes are explained in the paragraphs for the different VSC.

The general VSC - class instance attributes are defined as follows.

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (0x64)	Class revision	G	UINT	Contains the revision number of the class (maj. rel. *1000 + min. rel.).
101 (0x65)	Max. instance	G	USINT	Contains the number of the highest instance of an object created on this level in the class hierarchy.
102 (0x66)	# of instances	G	USINT	Contains the number of Object Instances created in this class.
103 (0x67)	Max. class attribute	G	USINT	Contains the number of the last class attribute to be implemented.

11.7.2 Gateway Class (VSC 100)

This class contains all information concerning the whole module not the different I/O channels.

Class Instance

NOTE

Please refer to section Class Instance of the VSCs, page 89 for the description of the class instance for the VSC.

Object Instance 1

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (0x64)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (0x65)	Hardware revision	G	STRUCT	Contains the hardware revision number of the module (USINT Maj./USINT Min.)
102 (0x66)	Firmware revision	G	STRUCT	Contains the revision number of the boot firmware (Maj./Min.).
103 (0x67)	Service tool ident number	G	UDINT	Contains the BOOT ID number that serves as an identification number for the DTM.
104 (0x68)	Hardware Info	G	STRUCT	Contains module hardware information (UINT): – count (number of the following entries) – CLOCK FREQUENCY (kHz) – MAIN FLASH (in kB) – MAIN FLASH SPEED (ns) – SECOND FLASH (kB) – RAM (kB), – RAM SPEED (ns), – RAM data WIDTH (bit), – SERIAL EEPRPOM (kbit) – RTC SUPPORT (in #) – AUTO SERVICE BSL SUPPORT (BOOL) – HDW SYSTEM

Object Instance 2

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (0x6D)	Status register 2	G	STRUCT	The Status Word contains general station status information, **Device** – Bit 15: reserved – Bit 14: "Force Mode Active Error" The Force Mode is activated (FCE). – Bit 13: reserved – Bit 12: reserved **Internal bus** – Bit 11: "I/O Cfg Modified Error" (CFG) Configuration error – Bit 10: "I/O Communication Lost Error" (COM) Internal communication disturbed **Voltage errors** – Bit 09: "V1 too low" V1 < 18 V DC – Bit 08: reserved – Bit 07: "V2 too low" V2 < 18 V DC – Bit 06: reserved – Bit 05: reserved – Bit 04: reserved **Warnings** – Bit 03: reserved – Bit 02: reserved – Bit 01: reserved – Bit 00: "I/O Diags Active Warning" (DiagnWarn) At least one I/O-channel sends active diagnostics.
115 (0x73)	ON IO CONNECTION TIMEOUT	G/S	ENUM USINT	Reaction to the I/O connection exceeding the time limit. SWITCH IO FAULTED (0): The channels are switched to substitute value. SWITCH IO OFF (1): The outputs are switched to 0. SWITCH IO HOLD (2): No further changes to the I/O-data. The outputs are held.

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
138 (0x8A)	GW Status Register	Get/set	DWORD	Activates or deactivates the mapping of the status word into the device's input data.
139 (0x8B)	GW Control Register	Get/set	DWORD	Activates or deactivates the mapping of the status word into the device's input data.
140 (0x8C)	Disable Protocols	Get/set	UINT	Deactivation of the used Ethernet protocol. bit assignment Bit 0 = EtherNet/IP (can not be disabled via EtherNet/IP-interface) Bit 1 = Modbus/TCP Bit 2 = PROFINET Bit 3 - 14 = reserved Bit 15 = web server

11.7.3 Process Data Class (VSC102)

This class contains the process-relevant information.

Class Instance

NOTE

Please refer to section **Class Instance of the VSCs, page 89** for the description of the class instance for the VSC.

Object instance 1, standard output process data (compressed)

This instance is not supported.

Object instance 2, standard output process data (compressed)

This instance is not supported.

Object Instance 3, diagnostic instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
104 (0x68)	GW Summarized diagnostics)	G/S	BOOL	0 = inactive 1 = active: 1 bit of diagnosis mapped at the end of the input data image (**page 67**). Changes become valid after a start-up!
105 (0x69)	GW scheduled diagnostics (manufacturer specific diagnostics)	G/S	BOOL	0 = inactive 1 = activated: Used for activating the mapping of the channel-specific diagnostic bits into the process input data (**page 67**). Changes become valid after a start-up!
106 (0x6A)	reserved			-

Object Instance 4, COS/CYCLIC instance

Attr. No. dec. (hex.)	Attribute name	**G**et/ **S**et	Type	Description
104 (0x68)	COS data mapping	G/S	ENUM USINT	The actual data are loaded to the non-volatile memory of the device. Changes become valid after a start-up! 0 = standard: Data of COS message → input data. 1 = process input data (only the process data input image is transferred to scanner) 2 to 7: reserved

11.7.4 Digital Versatile Module Class (VSC117)

This class contains all information and parameters for the device's I/O channels.

Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (0x64)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (0x65)	reserved			-
102 (0x66)	reserved			-
103 (0x67)	Module ID	G	DWORD	Contains the device ID
104 (0x68)	Module order number	G	UDINT	Contains the ident number of the device.
105 (0x69)	Module order name	G	SHORT STRING	Contains the device name
106 (0x6A)	Module revision	G	USINT	Contains the revision number of the device
107 (0x6B)	Module type ID	G	ENUM USINT	Describes the device type: 0x01: digital device
108 (0x6C)	Module command interface	G/S	ARRAY	The device's command interface. ARRAY OF: BYTE: Control byte sequence
109 (0x6D)	Module response interface	G	ARRAY	The device's response interface. ARRAY OF: BYTE: Response byte sequence
110 (0x6E)	Module registered index	G	ENUM USINT	Contains the index numbers specified in all the station lists.
111 (0x6F)	Module input channel count	G	USINT	Contains the number of input channels supported by the station.
112 (0x70)	Module output channel count	G	USINT	Contains the number of output channels supported by the station.

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
Input data				
113 (0x71)	Module input_1	G	DWORD	Input data of the respective I/Os.
114 (0x72)	Module input_2	G	DWORD	Input data of the respective I/Os.
Output data				
115 (0x73)	Module output_1	G	DWORD	Output data of the respective I/Os.
116 (0x74)	Module output_2	G	DWORD	Output data of the respective I/Os.
...				
Diagnostics				
119 (0x77)	Short circuit output error_1	G	DWORD	Overcurrent at output
120 (0x78)	Short circuit output error_2	G	DWORD	Overcurrent at output
121 (0x79)	Short circuit V_{AUX} error_1	G	DWORD	Overcurrent at sensor/actuator supply
122 (0x7A)	Short circuit V_{AUX} error_2	G	DWORD	Overcurrent at sensor/actuator supply
...				
Parameter data				
127 (0x7F)	Invert input data_1	G/S	DWORD	The input signal is inverted (channel 0 to 15).
...				
133 (0x85)	Auto recovery output_1,	G/S	DWORD	The outputs switch on automatically after an overload (output 0 to 15).
...				
137 (0x89)	Re-triggered recovery output_1	G/S	DWORD	The outputs (channel 0 to 15) have to be re-triggered in case of an overload.
...				
139 (0x8b)	Enable high side output driver_1	G/S	DWORD	Enables the high side output driver of channels (channel 0 to 15).
...				
149 (0x95) to 164 (0xA4)	Pulse stretching input x	G/S	Byte	The input signal is stretched to a time between 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard signal = 2,5 ms) Example: 10 = signal of 100 ms

11.7.5 Miscellaneous Parameters Class (VSC 126)

Instance 1/Instance 2

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (0x6D)	Ethernet port Parameters	G/S	DWORD	0 = autonegotiate, autoMDIX **A** 1 = 10BaseT, half duplex, linear topology (AutoMDIX disabled) 2 = 100BaseT, full duplex, linear topology (AutoMDIX disabled) 3 = 100BaseT, half duplex, linear topology (AutoMDIX disabled) 4 = 100BaseT, full duplex, linear topology (AutoMDIX disabled)
112 (0x70)	IO Controller Software revision	G	DWORD	The number of instances of this parameter depends on the number of I/O controllers.

12 PROFINET

PROFINET is the innovative open standard for the implementation of end-to-end integrated automation solutions based on Industrial Ethernet. With PROFINET, simple distributed I/O and time-critical applications can be integrated into Ethernet communication just as well as distributed automation system on an automation component basis.

Distributed I/O with PROFINET IO

Distributed I/O is connected into communication through PROFINET. Here, the familiar I/O view of PROFIBUS is retained, in which the peripheral data from the field devices are periodically transmitted into the process model of the control system.

Device Model

PROFINET IO describes a device model oriented to the PROFIBUS framework, consisting of places of insertion (slots) and groups of I/O channels (sub slots). The technical characteristics of the field devices are described by the so-called GSD (General Station Description) on an XML basis.

Fieldbus integration

PROFINET offers a model for integration of existing field buses like PROFIBUS, AS-Interface, and INTERBUS.

This allows the construction of arbitrarily mixed systems consisting of fieldbus- and Ethernet-based segments. Thus a smooth technology transition is possible from fieldbus-based systems to PROFINET. The large number of fieldbus systems makes it necessary to support their simple integration into PROFINET for reasons of investment protection.

The integration is done with so-called "proxies". A proxy is a device which connects an underlying fieldbus with PROFINET. The proxy concept allows the device manufacturer, the plant and machine builder as well as the end user a high degree of investment protection.

Communication in PROFINET

Communication in PROFINET contains different levels of performance:

The non-time-critical transmission of parameters, configuration data, and switching information occurs in PROFINET in the standard channel based on UDP and IP. This allows the connection of the automation level with other networks (MES, ERP).

For the transmission of time critical process data within the production facility, there is a Real-Time channel (RT) available.

For particularly challenging tasks, the hardware based communication channel Isochronous Real-Time (IRT) can be used for example in case of Motion Control Applications and high performance applications in factory automation.

UDP/IP communication

For non-time-critical processes, PROFINET uses communications with the standard Ethernet mechanisms over UDP/IP which follow the international standard IEEE 802.3.

Similar to standard Ethernet, PROFINET field devices are addressed using a MAC and an IP address. In UDP/IP communications, different networks are recognized based on the IP address. Within a network, the MAC address is a unique criterion for the addressing of the target device. PROFINET field devices can be connected to the IT world without limitations. A prerequisite for this is that the corresponding services, for instance file transfer, must be implemented in the field device involved. This can differ from manufacturer to manufacturer.

Real-time communication (RT)

A data communication over the UDP/IP channel is provided with a certain amount of administrative and control information for addressing and flow control, all of which slows data traffic.

To enable Real-Time capability for cyclical data exchange, PROFINET abandons partially IP addressing and flow control over UDP for RT communications. The communication mechanisms of the Ethernet (Layer 2 of the ISO/OSI model) are very suitable for this. RT communications can always run in parallel with NRT communications.

The services of PROFINET IO

- Cyclic data exchange
  For the cyclic exchange of process signals and high-priority alarms, PROFINET IO uses the RT channel.
- Acyclic data exchange (record data)
  The reading and writing of information (read/write services) can be performed acyclically by the user. The following services run acyclically in PROFINET:
  - parameterization of individual submodules during system boot
  - reading of diagnostic information
  - reading of identification information according to the "Identification and Maintenance (I&M) functions"
  - reading of I/O data

Address assignment

In IP-based communications, all field devices are addressed by an IP address.

PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.

In the delivery state each device amongst others has a MAC address. This information is enough to assign each field device a unique name (appropriate to the installation).

Address assignment is performed in two steps:

- Assignment of a unique plant specific name to the field device.
- Assignment of the IP address by the IO-Controller before system boot based on the plant specific (unique) name.

12.1 GSDML-File

The actual GSDML-file for TBEN-L "TBEN-L45_PROFINET.zip" can be downloaded from the Turck home page **www.turck.com**.

12.2 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. The fast start-up is necessary for fast tool changing applications at robot arms for example in the automobile industry.

The TBEN-L-devices support FSU with a start-up time of < 150 ms.

12.2.1 Ethernet-Cabling for TBEN-L in FSU Applications

Please read **Connecting the Devices to Ethernet, page 27** for information about the correct Ethernet-cabling in FSU applications with TBEN-L.

12.2.2 FSU in TBEN-L

Turck TBEN-L devices support the prioritized start-up (FSU).

In order to enable FSU, the field bus nodes have to be configured respectively in HW Config in the Step 7-software (Siemens).

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

Please observe, during configuration, that the neighboring devices do also support FSU and that the settings for the ports of neighboring devices are identical.

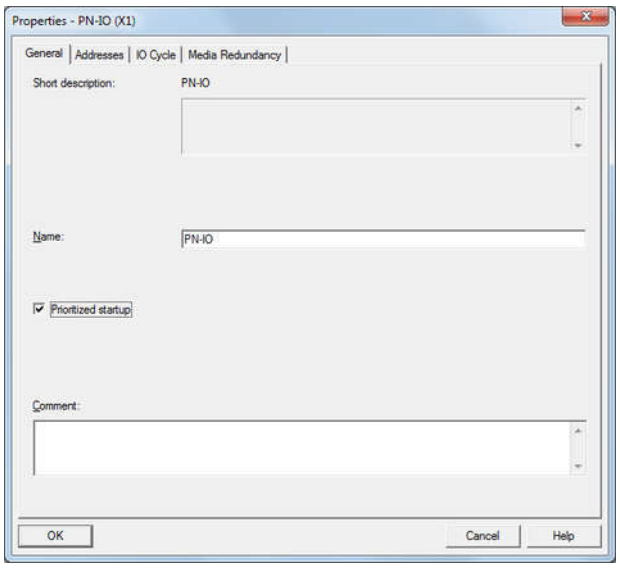


Fig. 17: HW Config - Prioritized stat-up, activation at PNIO slot

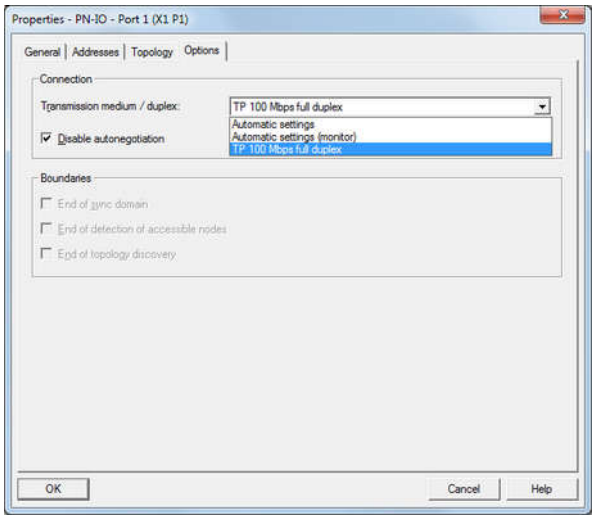


Fig. 18: HW Config - Port setting (at one example port)

12.3 MRP (Media Redundancy Protocol)

MRP is a standardized protocol according to IEC 62439.

It describes a mechanism for media redundancy in ring topologies.

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).

NOTE

Detailed information about MRP in PROFINET can be found on the homepage of the PROFIBUS
user organization under www.profibus.com.

12.4 PROFINET-diagnostics

12.4.1 TBEN-Lx-16DIP/TBEN-L4-16DIN – Diagnostic Data Mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error code**	**Chan-nel**
Undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error code**	**Chan-nel**
Overcurrent power supply at connector (SCSx)			*Overcurrent VAUX*	
SCS0	E1.0	C0	0x001A	0
	E1.1			
SCS1	E1.2	C1	0x001A	1
	E1.3			
SCS2	E1.4	C2	0x001A	2
	E1.5			
SCS3	E1.6	C3	0x001A	3
	E1.7			
SCS4	E1.8	C4	0x001A	4
	E1.9			
SCS5	E1.10	C5	0x001A	5
	E1.11			
SCS6	E1.12	C6	0x001A	6
	E1.13			
SCS7	E1.14	C7	0x001A	7
	E1.15			

A *Slot in configuration toll (e.g. Siemens HW Config)*

12.4.2 TBEN-Lx-16DOP/TBEN-L4-16DON – Diagnostic Data Mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error code**	**Chan-nel**
Undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error code**	**Chan-nel**
Overcurrent power supply at connector (SCSx)			*Overcurrent VAUX*	
SCS0	E1.0	C0	0x001A	0
	E1.1			
SCS1	E1.2	C1	0x001A	1
	E1.3			
SCS2	E1.4	C2	0x001A	2
	E1.5			
SCS3	E1.6	C3	0x001A	3
	E1.7			
SCS4	E1.8	C4	0x001A	4
	E1.9			
SCS5	E1.10	C5	0x001A	5
	E1.11			
SCS6	E1.12	C6	0x001A	6
	E1.13			
SCS7	E1.14	C7	0x001A	7
	E1.15			
Overcurrent at output (SCOx)			*Overcurrent*	
SCO0	A1.0	C0P4	0x0001	0
SCO1	A1.1	C0P2	0x0001	1
SCO2	A1.2	C1P4	0x0001	2
SCO3	A1.3	C1P2	0x0001	3
SCO4	A1.4	C2P4	0x0001	4
SCO5	A1.5	C2P2	0x0001	5
SCO6	A1.6	C3P4	0x0001	6
SCO7	A1.7	C3P2	0x0001	7
SCO8	A1.8	C4P4	0x0001	8
SCO9	A1.9	C4P2	0x0001	9
SCO10	A1.10	C5P4	0x0001	10
SCO11	A1.11	C5P2	0x0001	11
SCO12	A1.12	C6P4	0x0001	12
SCO13	A1.13	C6P2	0x0001	13
SCO14	A1.14	C7P4	0x0001	14
SCO15	A1.15	C7P2	0x0001	15

A *Slot in configuration toll (e.g. Siemens HW Config)*

12.4.3 TBEN-Lx-8DIP-8DOP – Diagnostic Data Mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error code**	**Chan-nel**
Undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error code**	**Chan-nel**
Overcurrent power supply at connector (SCSx)			*Overcurrent VAUX*	
SCS0	E1.0	C0	0x001A	0
	E1.1			
SCS1	E1.2	C1	0x001A	1
	E1.3			
SCS2	E1.4	C2	0x001A	2
	E1.5			
SCS3	E1.6	C3	0x001A	3
	E1.7			
SCS4	E1.8	C4	0x001A	4
	E1.9			
SCS5	E1.10	C5	0x001A	5
	E1.11			
SCS6	E1.12	C6	0x001A	6
	E1.13			
SCS7	E1.14	C7	0x001A	7
	E1.15			
Overcurrent at output (SCOx)			*Overcurrent*	
SCO8	A1.0	C4P4	0x0001	0
SCO9	A1.1	C4P2	0x0001	1
SCO10	A1.2	C5P4	0x0001	2
SCO11	A1.3	C5P2	0x0001	3
SCO12	A1.4	C6P4	0x0001	4
SCO13	A1.5	C6P2	0x0001	5
SCO14	A1.6	C7P4	0x0001	6
SCO15	A1.7	C7P2	0x0001	7

A *Slot in configuration toll (e.g. Siemens HW Config)*

12.4.4 TBEN-Lx-16DXP/TBEN-L4-16DXN – Diagnostic Data Mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error code**	**Chan-nel**
Undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error code**	**Chan-nel**
Overcurrent power supply at connector (SCSx)			*Overcurrent VAUX*	
SCS0	A1.0	C0	0x001A	0
	A1.1			
SCS1	A1.2	C1	0x001A	1
	A1.3			
SCS2	A1.4	C2	0x001A	2
	A1.5			
SCS3	A1.6	C3	0x001A	3
	A1.7			
SCS4	A1.8	C4	0x001A	4
	A1.9			
SCS5	A1.10	C5	0x001A	5
	A1.11			
SCS6	A1.12	C6	0x001A	6
	A1.13			
SCS7	A1.14	C7	0x001A	7
	A1.15			
Overcurrent at output (SCOx)			*Overcurrent*	
SCO0	A1.0	C0P4	0x0001	0
SCO1	A1.1	C0P2	0x0001	1
SCO2	A1.2	C1P4	0x0001	2
SCO3	A1.3	C1P2	0x0001	3
SCO4	A1.4	C2P4	0x0001	4
SCO5	A1.5	C2P2	0x0001	5
SCO6	A1.6	C3P4	0x0001	6
SCO7	A1.7	C3P2	0x0001	7
SCO8	A1.8	C4P4	0x0001	8
SCO9	A1.9	C4P2	0x0001	9
SCO10	A1.10	C5P4	0x0001	10
SCO11	A1.11	C5P2	0x0001	11
SCO12	A1.12	C6P4	0x0001	12
SCO13	A1.13	C6P2	0x0001	13
SCO14	A1.14	C7P4	0x0001	14
SCO15	A1.15	C7P2	0x0001	15

A *Slot in configuration toll (e.g. Siemens HW Config)*

12.5 Parameters

Two types of parameters have to be distinguished for the TBEN-L stations, the PROFINET parameters of a station and the specific parameters of the I/O-channels.

12.5.1 General Device Parameters (turck-tben)

Parameter name	Value	Meaning
Output behavior at communication loss	**00 = set to 0**	The device switches the outputs to "0". No error information is transmitted.
	10 = keep last value	The device maintains the actual output data.
Deactivate all diagnostics deactivate web server	**0 = no**	Diagnostic messages and alarms are generated.
	1 = yes	Diagnostic messages and alarms are generated.
Deactivate load voltage diagnostics Deactivate diagnostics	**0 = no**	Monitoring of voltage V2 is activated.
	1 = yes	An undervoltage at V2 is not monitored.
LED behavior (PWR) at V2 undervoltage	0 = red	
	1 = green	
Deactivate I/O-ASSISTANT Force Mode	**0 = no**	The single fieldbus protocols can be deactivated.
	1 = yes	
Deactivate EtherNet/IP	**0 = no**	
	1 = yes	
Deactivate Modbus TCP	**0 = no**	
	1 = yes	
Deactivate WEB Server	**0 = no**	
	1 = yes	

12.5.2 Parameters for I/O Channels

Parameter name	Value	Meaning
Digital input Invert digital input (Inv. DIx)	**0 = no**	
	1 = yes	The input signal is inverted.
Manual output reset after overcurrent (SROx)	**0 = no**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off and on again.
Activate output (EN DOx)	0 = no	
	1 = yes	
Pulse stretching input (*10 ms)	The input signal is stretched. The time can be set from 0 to 2550 ms in steps of 10 ms. Default setting: 0 = pulse stretching deactivated (standard signal = 2,5 ms) Example: 10 = signal of 100 ms	

12.6 Description of User Data for Acyclic Services

The acyclic data exchange is done via Record Data CRs (CR ® Communication Relation).

Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data
- 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)

12.6.1 Description of the Acyclic Device User Data

Index (dec.)	Name	Data type	r/w	Comment
1	Device parameters	WORD	r/w	Parameter data of the device (slot 0)
2	Device designation	STRING	r	Designation assigned to the device (slot 0)
3	Device revision	STRING	r	Firmware revision of the device
4	Vendor ID	WORD	r	Ident no. for Turck
5	Device name	STRING	r	The device name assigned to the device
6	Module type	STRING	r	Device type
7	Device-ID	WORD	r	Ident number of the device
8 to 23	reserved			
24	Device diagnosis	WORD	r	Diagnostic data of the device (slot 0)
25 to 31	reserved			
32	Input list	Array of BYTE	r	List of all device input channels
33	Module output list	Array of BYTE	r	List of all device output channels
34	Diag. list	Array of BYTE	r	List of all I/O-channel diagnostics
35 (0x23)	Parameter list	Array of BYTE	r	List of all I/O-channel parameters
36 to 45039	reserved			
45040 (0xAFF0)	I&M0-functions		r	Identification & Maintaining services
45041 (0xAFF1)	I&M1-functions	STRING [54]	r/w	I&M tag Function and location
45042 (0xAFF2)	I&M2-functions	STRING [16]	r/w	I&M tag Function and location
45043 (0xAFF3)	I&M3-functions	STRING [54]		

Index (dec.)	Name	Data type	r/w	Comment
45044 (0xAFF4)	I&M4-functions	STRING [54]		
45045 (0xAFF5) to 45055 (0xAFFF)	I&M5 to I&M15-functions			not supported
0x7000	Station parameters	WORD	r/w	Activate active field bus protocol

12.6.2 Description of the Acyclic I/O-Channel User Data

Index (dec.)	Name	Data type	r/w	Comment
1	Device parameters	specific	r/w	Device parameters
2	Module type	ENUM UINT8	r	Contains the device type
3	Module version	UINT8	r	Firmware version of the I/O-channels
4	Module ID	DWORD	r	Ident number of the I/Os
5 to 9	reserved			
10	Slave controller version	UINT8 array [8]	r	Version no. of the slave controller
11 to 18	reserved			
19	Input data	specific	r	Input data of the respective I/O channel
20 to 22	reserved			
23	Output data	specific	r/w	Output data of the respective I/O channel

13 The Web Server

13.1 Safety in the Web Server

In the web server, a default-password is assigned for the administrator access (see also **Change Admin Password, page 117**).

In order to make misuse by third parties more difficult, it can be necessary to change the password.

This should be done in the context of the network security concept for the complete facility in which the modules are placed.

13.1.1 Web Server Logout

In order to disconnect a logged in user/PC with administrator rights from the web server, a logout is necessary.

If only the web browser is closed, the last active access is reactivated when opening the web server again from the same PC, which means, possibly with all administrator rights.

13.2 IP Address

In the delivery status, neither an IP address nor a PROFINET name is stored into the devices.

In order to be able to access the device via web server, the web server can be opened using the IP address 192.168.1.254.

If the PC used for the configuration is part of the same IP network, the page

http://192.168.1.254

can be opened in order to initially change some settings.

13.3 Start Page of the Web Server (Home)

The start page of the web server shows general device information, network settings etc..

A read access to the items "Station Diagnostics", "Ethernet Statistics", "Event Log", "EtherNet/IP Memory Map", "Modbus TCP Memory Map" and "Links" as well as to the process data of the local I/Os is possible without administrator login.

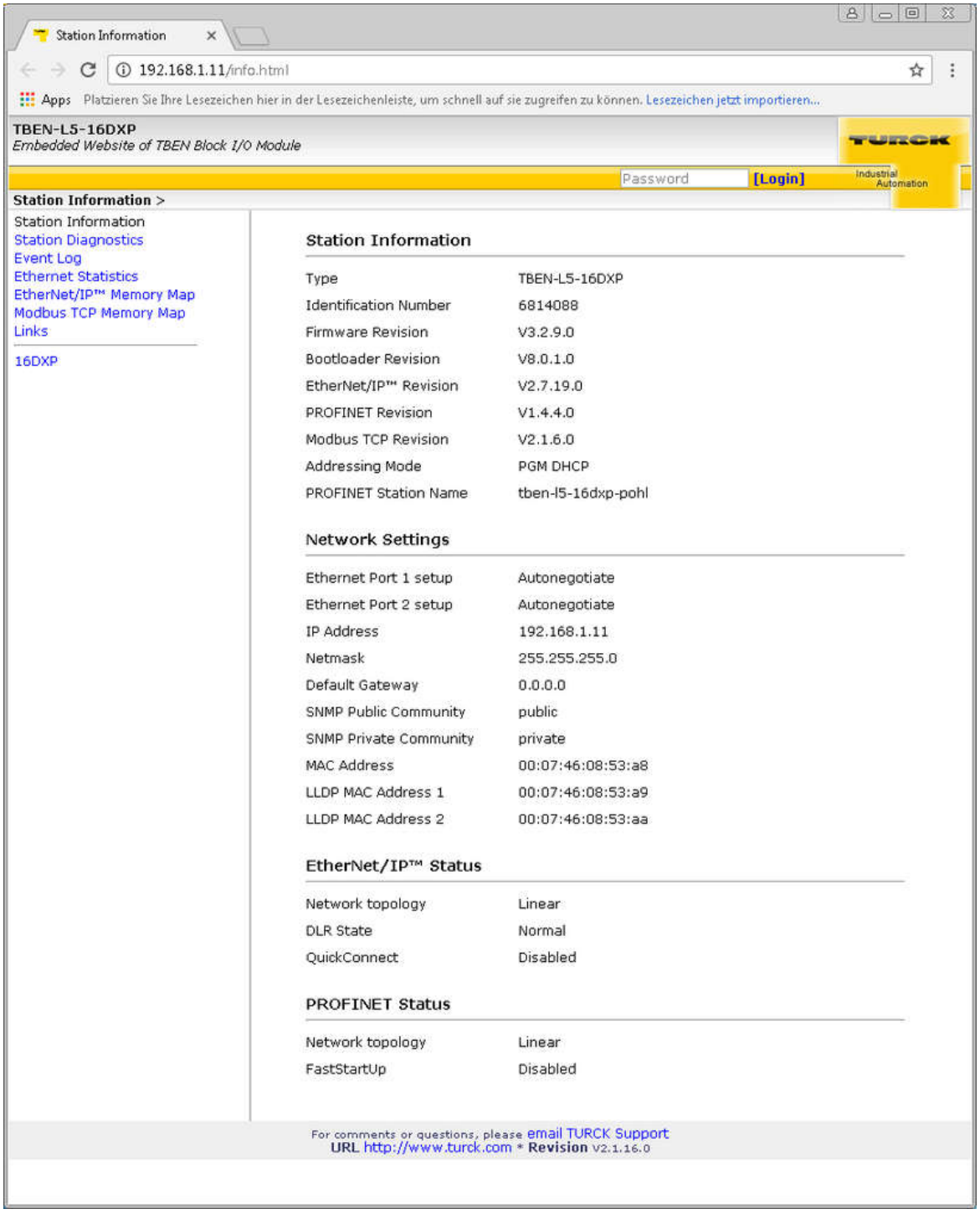


Fig. 19: Start page of the web server (Home)

13.4 Station Diagnostics

Diagnostic messages of the device are displayed on the "Station Diagnostics"-page.

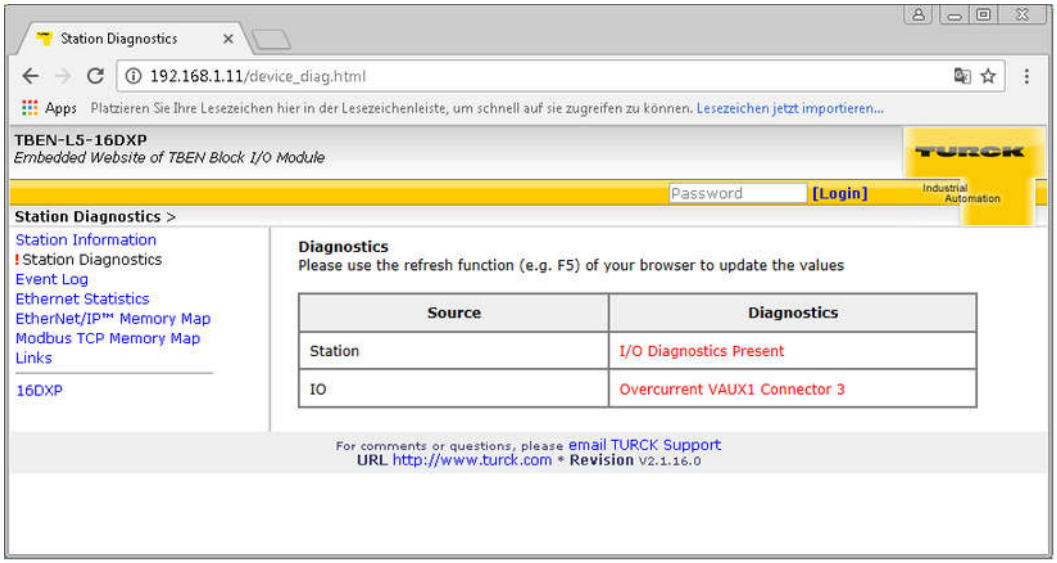


Fig. 20: Diagnostics in the web server

13.5 Ethernet Statistics

The page "Ethernet Statistics" shows information like the port-status, telegram and error counters etc. The page can above all be useful for analyzing network problems.

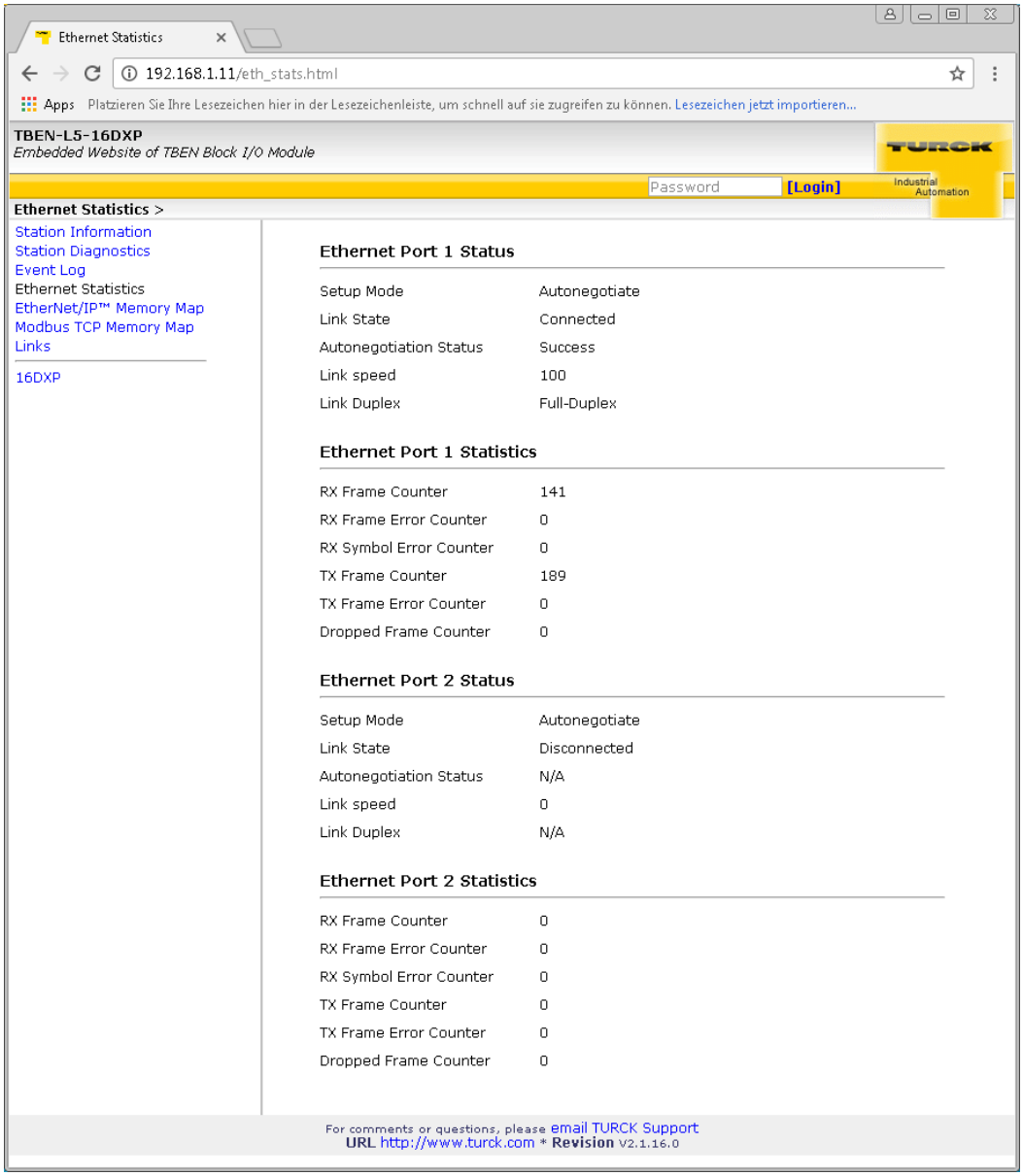


Fig. 21: Ethernet Statistics

13.6 Event Log

The Event Log shows the login information as well as the diagnostic information for the device.

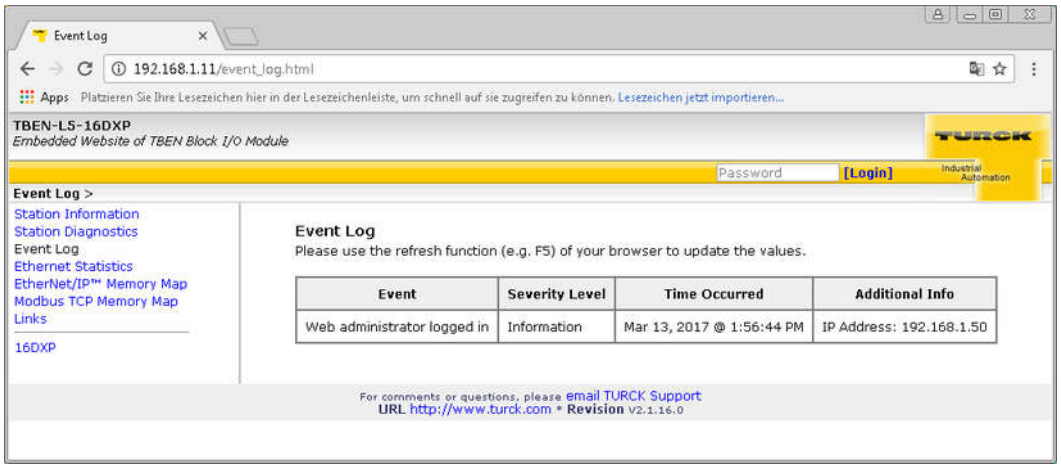


Fig. 22: Event Log

13.7 EtherNet/IP/Modbus TCP Memory Map

EtherNet/IP and Modbus TCP Memory Map show the protocol specific mapping of the devices.

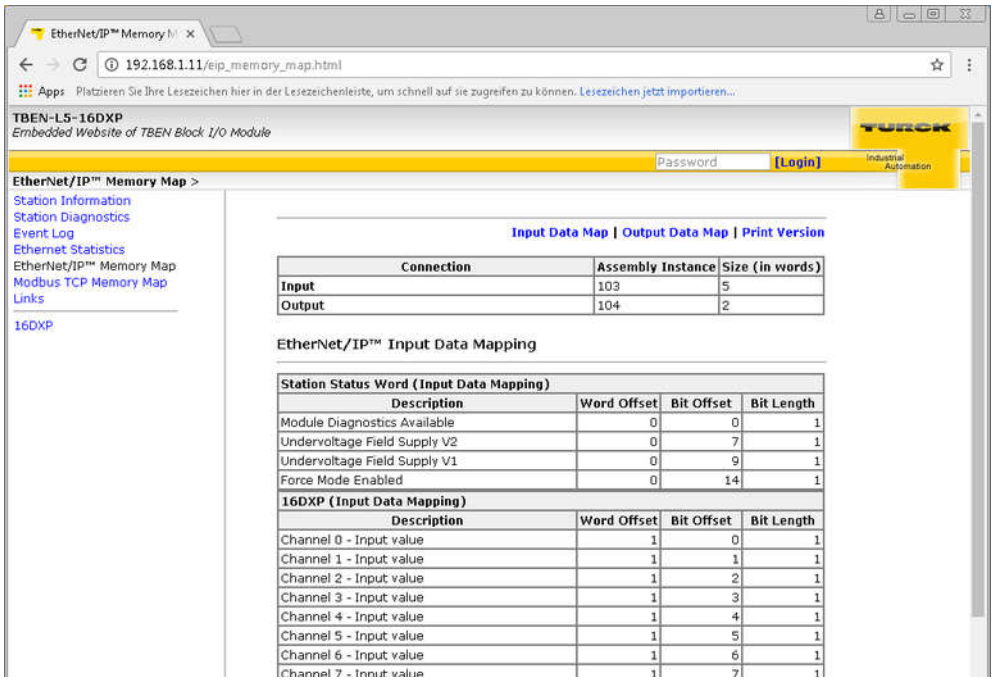


Fig. 23: EtherNet/IP Memory Map

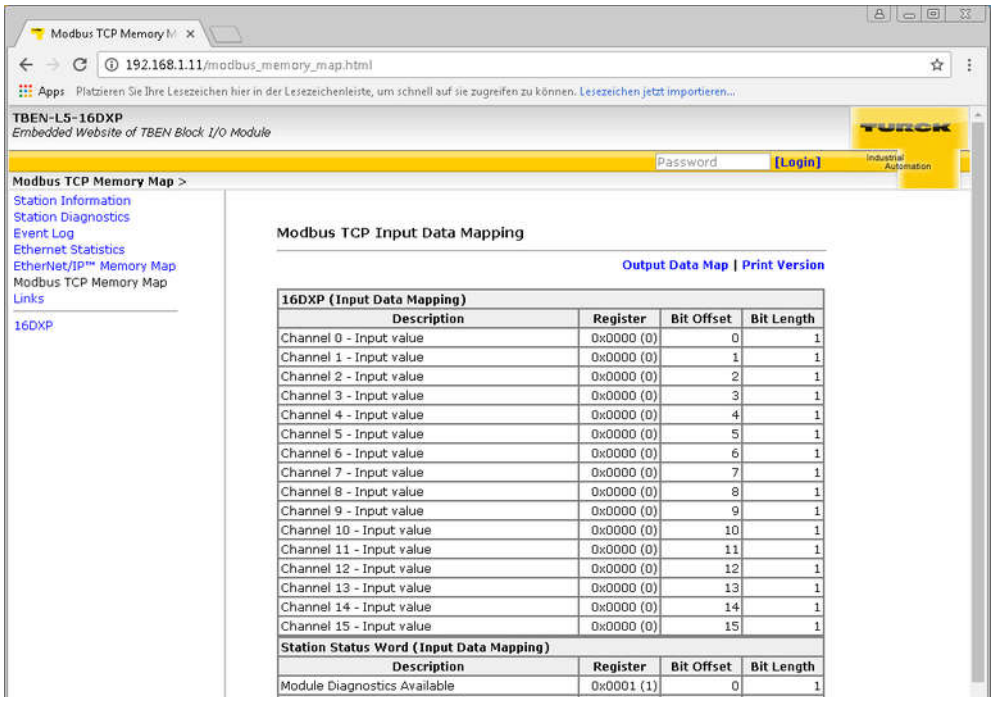


Fig. 24: Modbus TCP Memory Map

13.8 Links

This page contains for example a link to the product page on the Turck homepage.

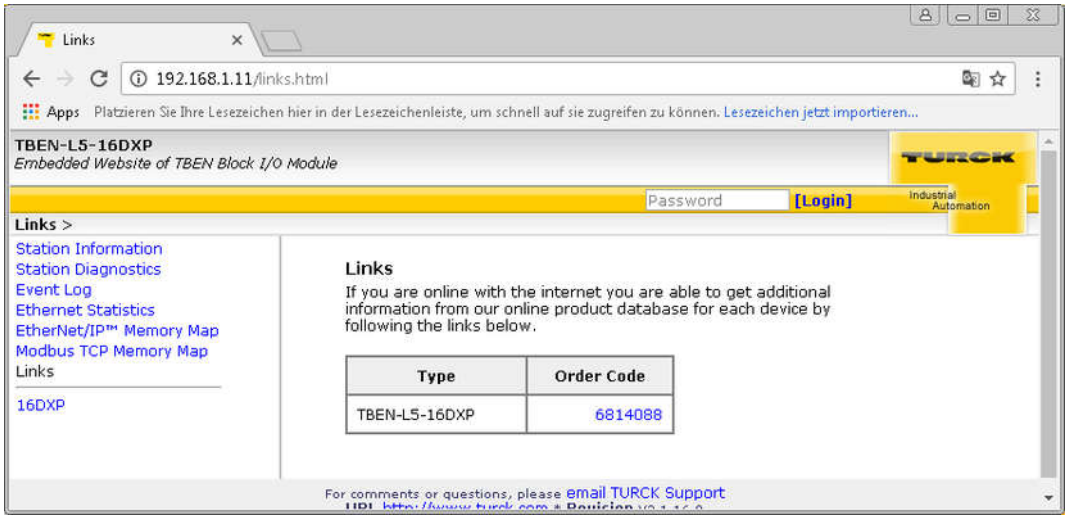


Fig. 25: Links

13.9 Login/Password

In order to get access to the extended functions of the web server (Network Configuration, Station Configuration, etc.), you have to log-in to the web server as administrator.

For the first login use the default password "password".

The default-password should be be changed by the administrator. To do so, please follow the instructions under **Change Admin Password, page 117**.

NOTE

A reset of the device to the default-settings using the switch position 900 "F_Reset" also causes a reset of the password to "password".

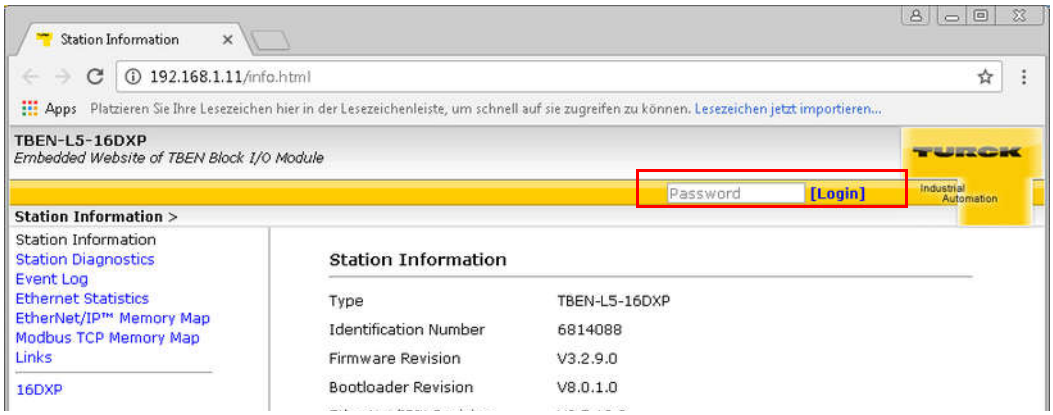


Fig. 26: Web server "home" page

13.10 Change Admin Password

NOTE

For security aspects when working with the web server, please observe the notes under **Safety in the Web Server, page 109**.

Please define an individual password for administrator rights.

Default password "password"

NOTE

A reset of the device to the default-settings using the switch position 900 "F_Reset" (see also **Factory Reset (F_Reset), Switch Position "900", page 21**) or the Button "Reset to Factory Defaults" (see also **Reset to Factory Defaults, page 121**) also resets the password to "password".

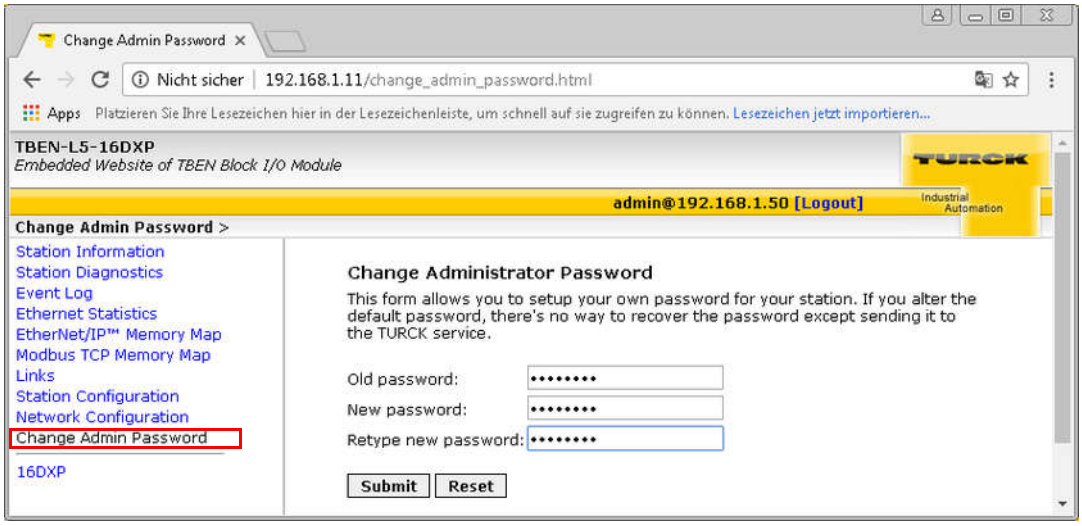


Fig. 27: Change Admin Password

Change password

➤ Change the password for the device in the web server.

➤ Write the changes into the device via "Submit".

➤ Restart the device (power cycle or pressing the SET button for approx. 3 seconds).

➥ The device has accepted the new settings, the settings have become active.

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

13.11 Network Configuration

On the "Network Configuration"-page, network-relevant settings can be changed.

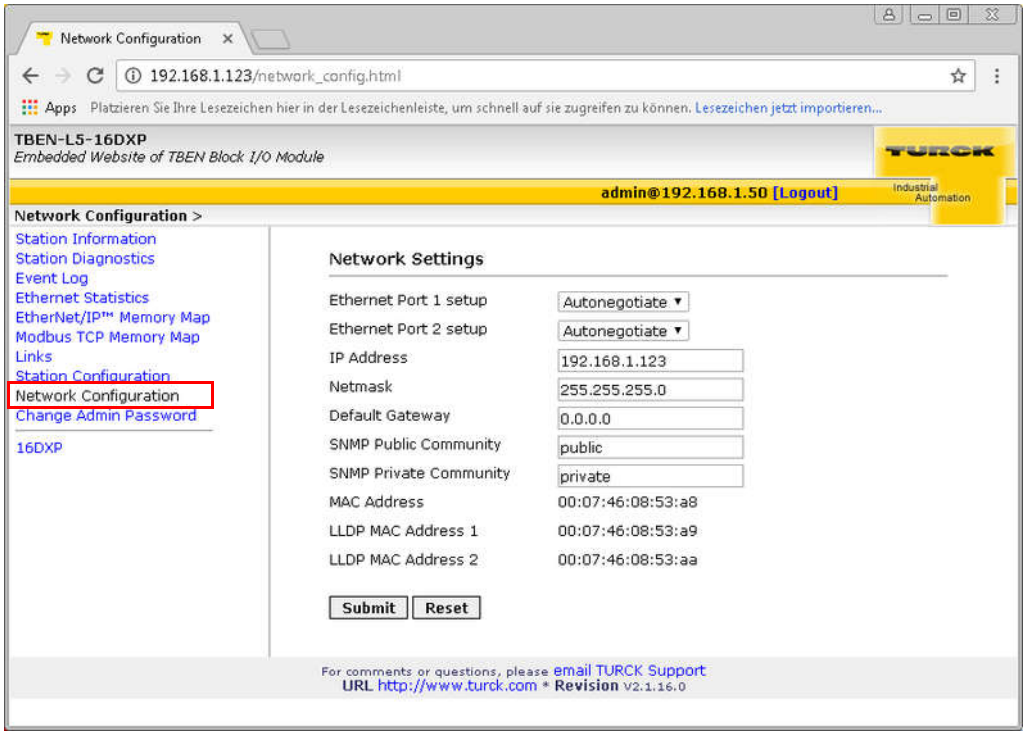


Fig. 28: Web server "Network Configuration"

13.11.1 Change Network Parameters (Port Settings, IP Address, etc.)

The device's network settings can be changed under "Network Configuration" only by users having administrator rights.

NOTE

The access of the web server to the station is only possible, if the station already has an IP address, **Address Assignment, page 18**.

The address setting via the web server is only possible if the device is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode.

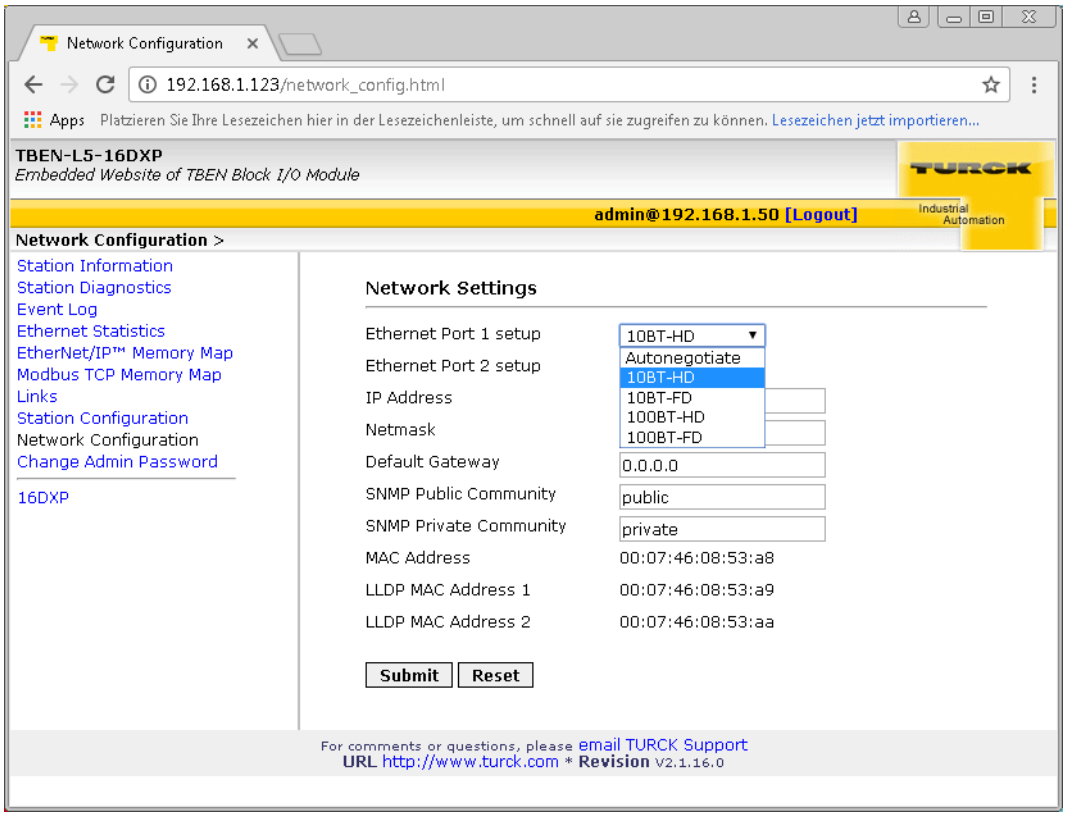


Fig. 29: Web server with Network Configuration

Change network parameters

➤ Change the network parameters in the web server.

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings are active.

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

13.12 Station Configuration

13.12.1 Configuring the Ethernet Interface

The "Station Configuration"-page serves for parameterizing the device's Ethernet interface.

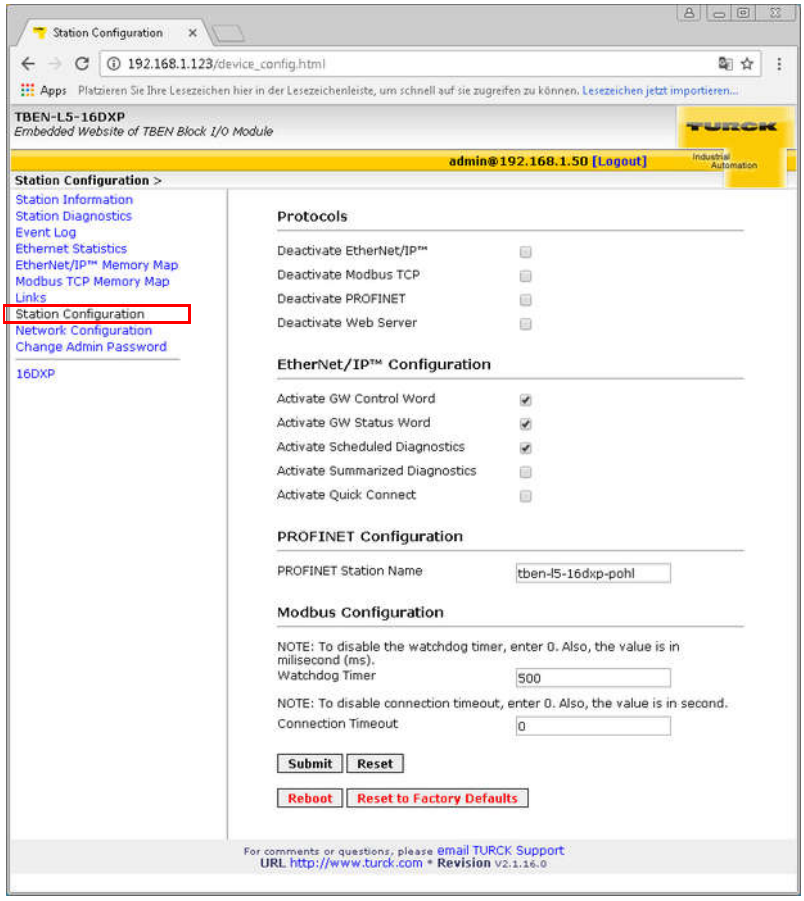


Fig. 30: Web server "Station Configuration"

Station configuration

➤ Change the configuration in the web server.

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings have become active.

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

Reboot

"Reboot" executes a power-cycle at the device.

Reset to Factory Defaults

This function corresponds to switch position 900, see also **Factory Reset (F_Reset), Switch Position "900", page 21**.

13.13 Parameters

13.13.1 Parameterization of the In-/ Outputs

The "Parameters"-page is used to parameterize the device's in- and outputs.

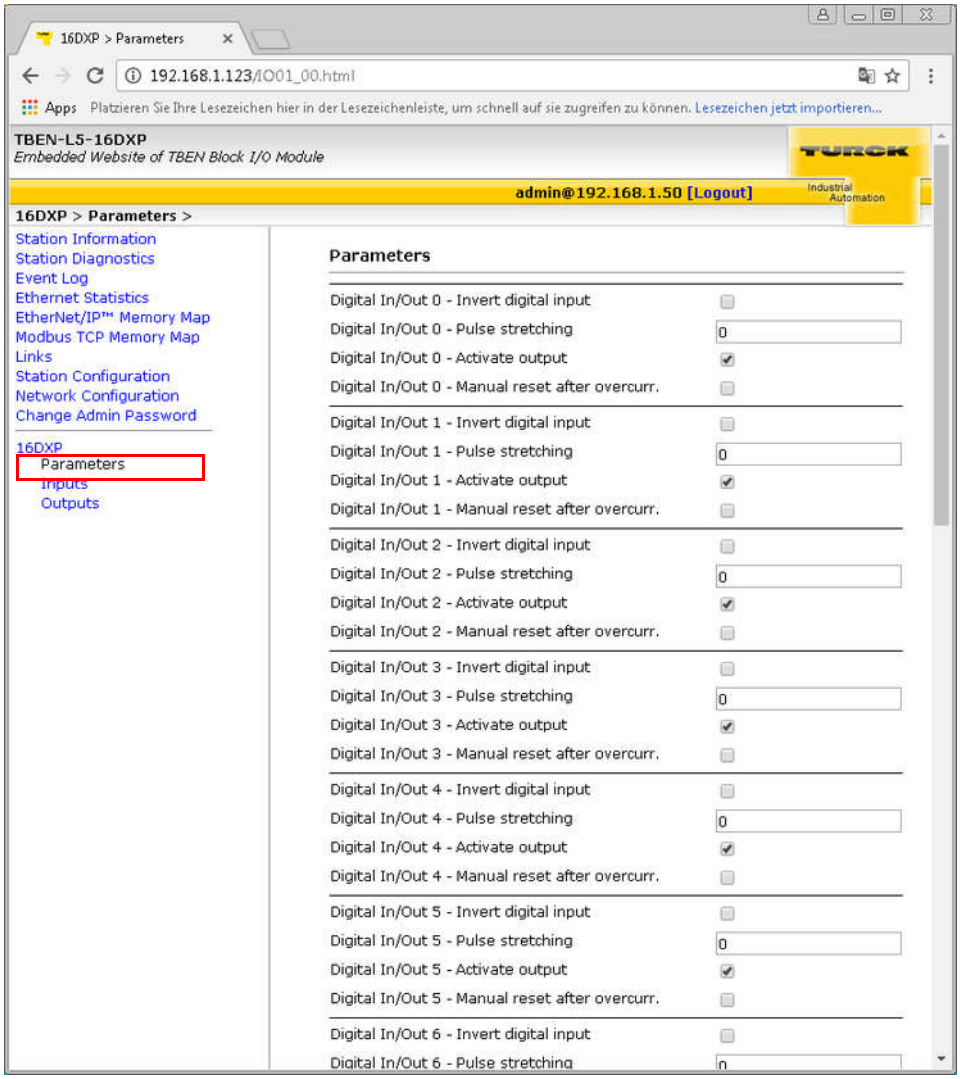


Fig. 31: Web server "Parameters"

Change parameters

➤ Change the parameters for the device in the web server.

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings are active.

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

13.14 Using Mobile Devices

The internal web server has a responsive design. This means, the web functions can also be executed using a mobile device, e.g. a smartphone.

The web content is automatically adapted to the smaller display in order to assure an optimized web server representation.

The Turck device and the mobile device have to be nodes of the same network. Please assure therefore that the IP addresses of both devices are part of the same subnet (e.g. 255.255.255.0).

In addition to that, a network access has to be available for the mobile device.

13.15 Web Server Logout

In order to disconnect a logged in user/PC with administrator rights from the web server, a logout is necessary.

NOTE

If the web browser is closed without a logout, the last active access is reactivated when opening the web server again from the same PC within 30 minutes,
which means, the access to the device with all administrator rights may be possible.

13.16 Deactivating the Web Server

NOTE

If, for safety reasons, the web serves has to be deactivated completely, this is possible via the device parameters in CODESYS or in the web server itself.
If the web server is deactivated using the web server itself, further access to it is only possible following a device reset to the factory settings (see page 21).

14 Access via Turck DTMs in PACTware

14.1 General

The access to the TBEN-L modules using the Turck DTMs is done via Ethernet.

14.1.1 Address Setting via DTM

In a respective frame application e.g. PACTware, the Turck DTMs allow direct access to Ethernet.

The IP address, as well as the subnet mask of the Ethernet devices, can be changed according to the application by using the Busaddress Management function of the BL Service Ethernet interface (TCP/IP) in the DTM.

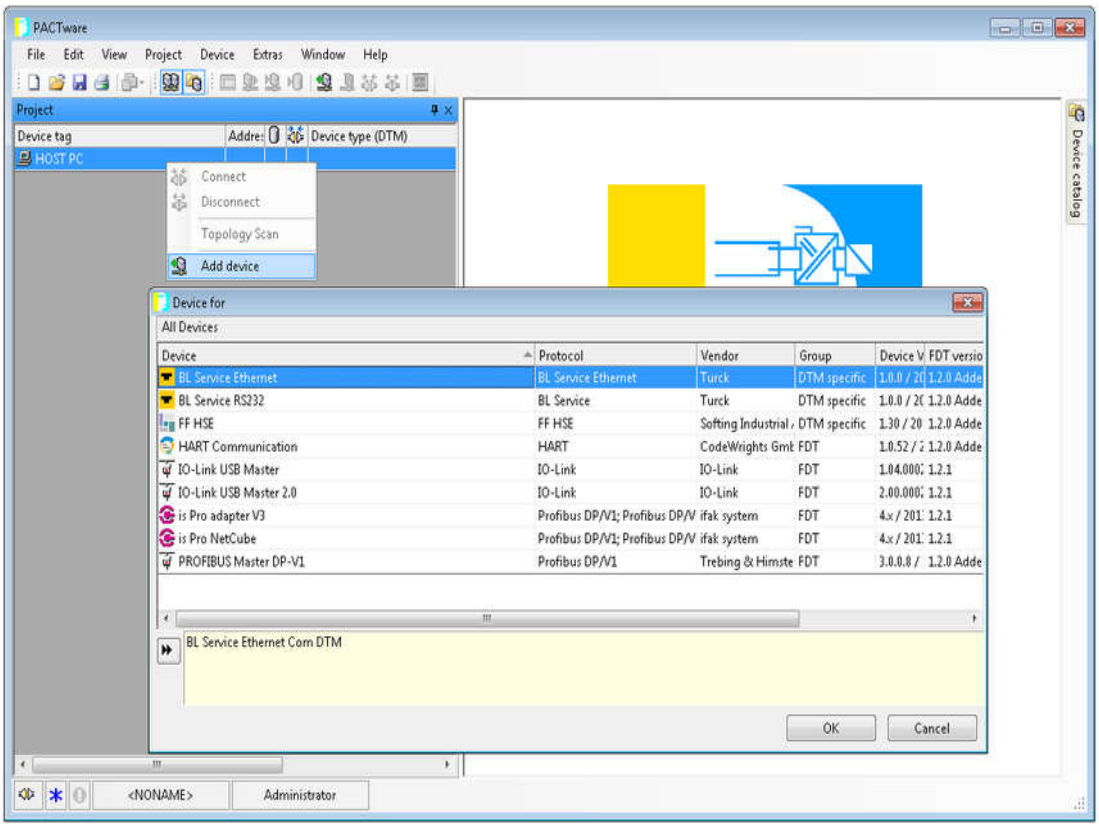


Fig. 32: BL Service Ethernet

1 Open the Busaddress management via right-click onto the TCP/IP interface using "Additional functions→ Busaddress management".

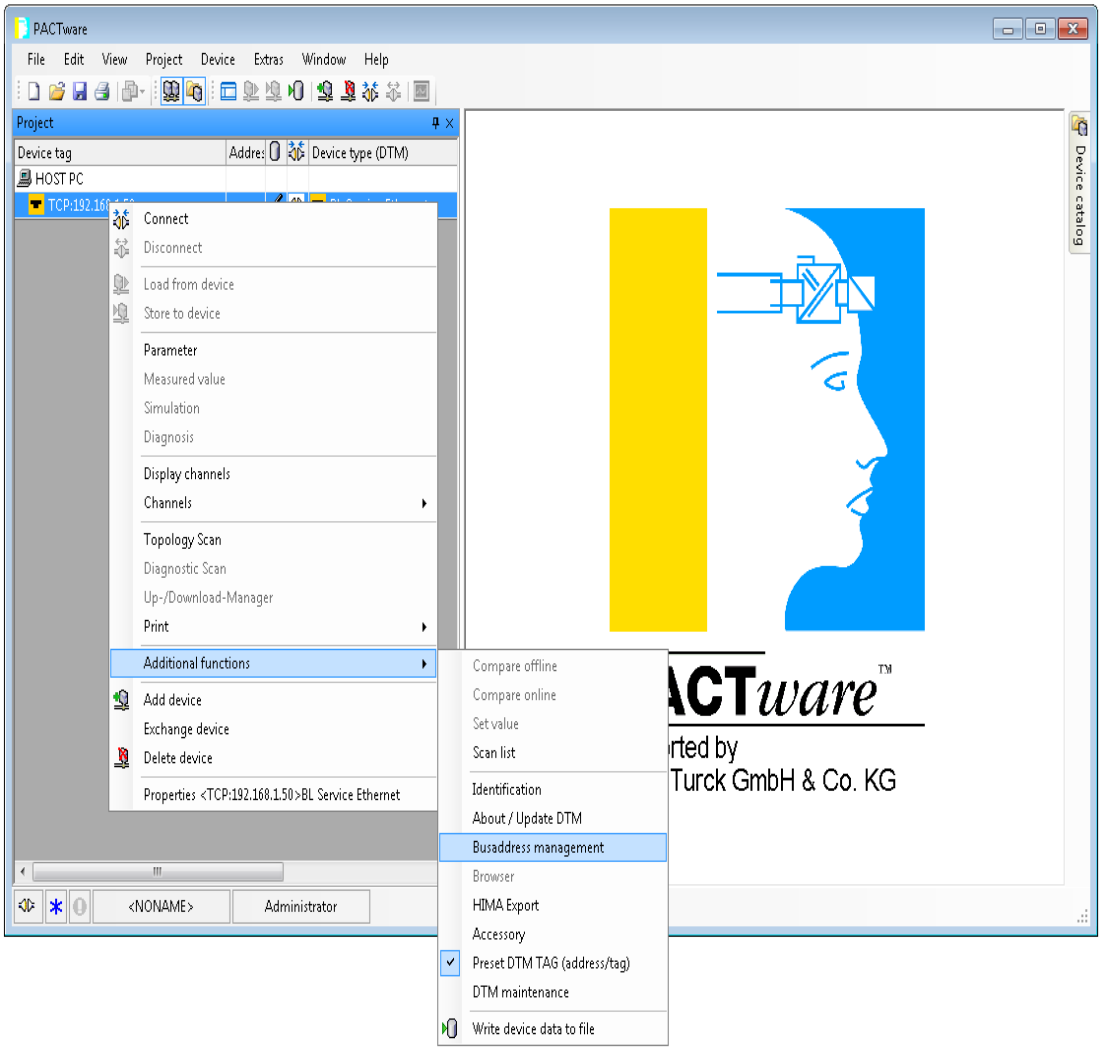


Fig. 33: Busaddress management

2 The "search" function in the busaddress management searches the network for Turck Ethernet devices.

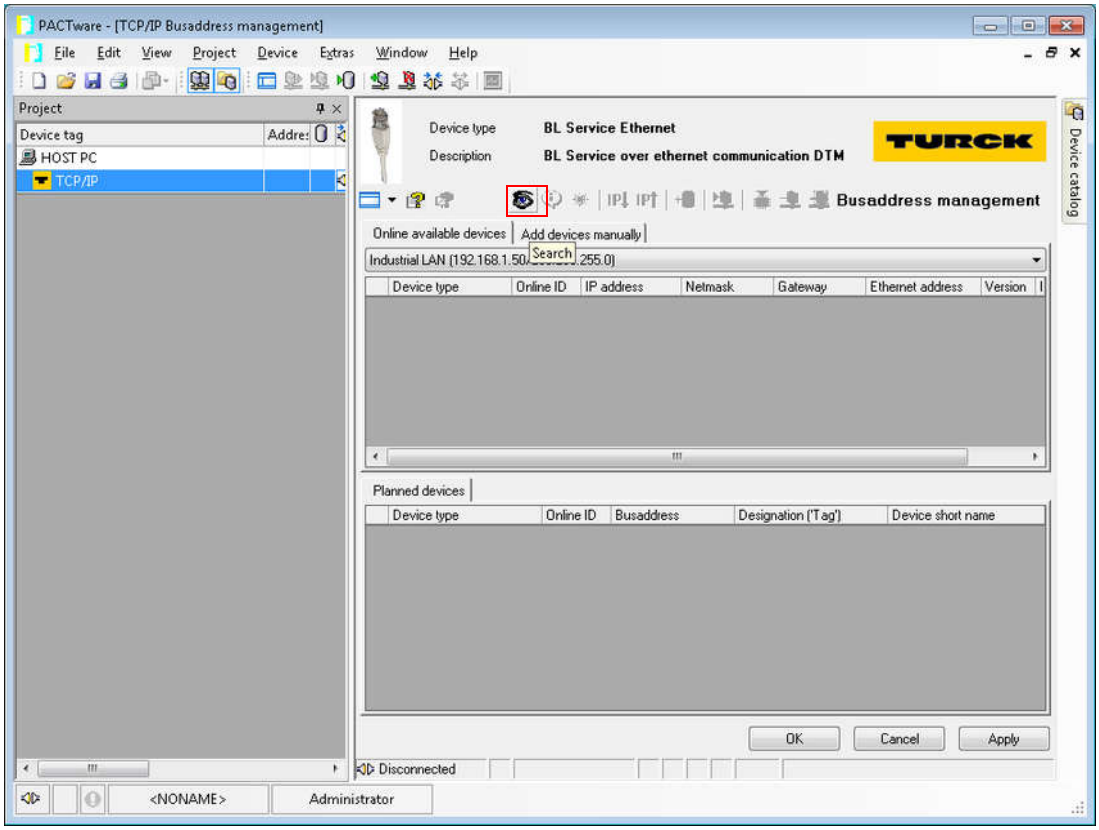


Fig. 34: Searching for network nodes in the Busaddress Management

NOTE

The access of the DTMs to the station is only possible, if the station already has an IP-address (see **Address Assignment, page 18**).

The address setting via the DTM is only possible if the device is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode.

3 Assign the desired IP address to the node and write it down to the device using the "Apply" button.

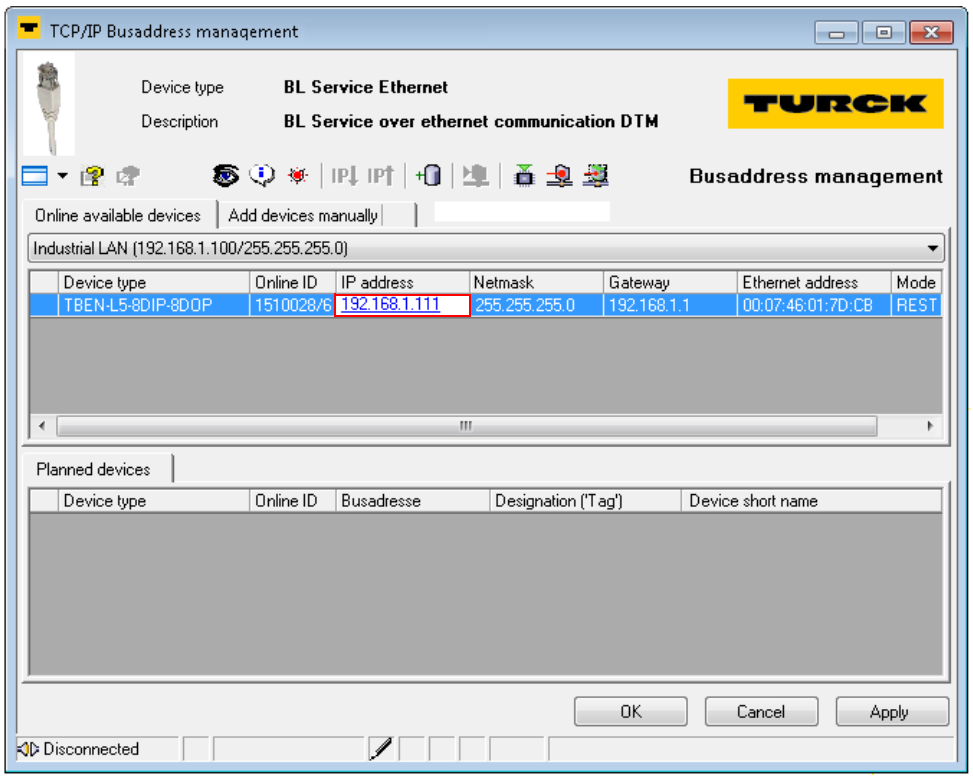


Fig. 35: Changing the IP address

NOTE

When using Windows XP as operating system, difficulties may occur with system-integrated firewall.

It may inhibit the access of PACTware to the Ethernet-network. In this case, please adapt your firewall respectively.

3 Assign the desired IP address to the node and write it down to the device using the "Apply" button.

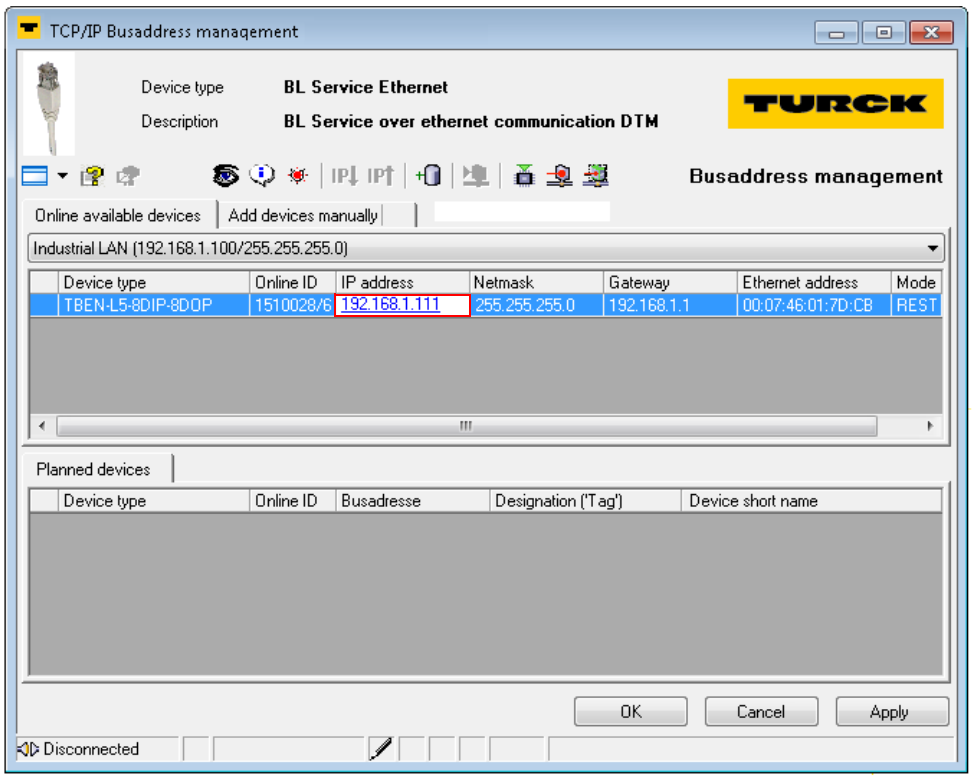


Fig. 35: Changing the IP address

NOTE

When using Windows XP as operating system, difficulties may occur with system-integrated firewall.

It may inhibit the access of PACTware to the Ethernet-network. In this case, please adapt your firewall respectively.

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