TURCK

Your Global Automation Partner

# TBEN-LL-4FDI-4FDX Multiprotocol I/O modules with Turck Safe Link

Safety Manual — Translation

# Table of Contents

# 1 About this manual

This safety manual contains all information that is required by users to operate the device in functional safety systems.

Read this manual carefully before using the device. This document addresses only functional safety according EN ISO 13849-1 and IEC 61508. Other issues are not considered.

All instructions must be followed in order to assure functional safety.

Always make sure that this is the latest version of the safety manual at www.turck.com.
The German version is considered the definitive document. Every care was taken in the production of the translations of this document. If any uncertainties arise in the interpretation of the description, reference the German version of the Safety Manual or contact Turck.

## 1.1 Scope

This safety manual applies to the following Turck multi-protocol module with Turck Safe Link:

- TBEN-LL-4FDI-4FDX

## 1.2 Explanation of symbols

The following symbols are used in these instructions:

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

## 1.3 Additional documents

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

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

# 2 For your safety

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

## 2.1 General safety notes

- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The Performance Level as well as the safety category according to EN ISO 13849-1 depend on the external wiring, the application, the choice of the control devices as well as their arrangement on the machine.
- The user has to execute a risk assessment according to EN ISO 12100:2010.
- Based on the risk assessment a validation of the complete plant/machine has to be done in accordance with the relevant standards.
- Operating the device beyond the specification can lead to malfunctions or to the destruction of the device. The installation instructions must be observed.
- For trouble-free operation, the device must be properly transported, stored, installed and mounted.
- For the release of safety circuits in accordance with EN IEC 60204-1, EN ISO 13850 only use the output circuits of connectors C4… C7 or X4…X7.

## 2.2 Residual risks (EN ISO 12100:2010)

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

Residual risks remain, if

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

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

## 2.3 Warranty and liability

Any warranty and liability is excluded for:

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

## 2.4 Notes on Ex protection

- When using the device in Ex areas, the user must have knowledge of explosion protection (IEC/EN 60079-14 etc.).
- Observe national and international regulations for explosion protection.
- Only use the device within the permissible operating and ambient conditions (see certification data and Ex approval specifications).

## 2.5 Requirements for Ex approval

- Only use the device in an area with no more than pollution degree 2.
- Only disconnect and connect circuits when there is no potentially explosive atmosphere or when the power supply is switched off
- Only operate the switches when there is no potentially explosive atmosphere or when the power supply is switched off.
- Connect the metal protective cover to the equipotential bonding in the Ex area (cable cross-section: 4 $mm^2$).
- Ensure impact resistance in accordance with EN IEC 60079-0 – alternative measures:
  - Install the device in the TB-SG-L protective housing (available in the set with Ultem window: ID 100014865) and replace the Lexan service window with the Ultem window.
  - Install the device in an area offering impact protection (e.g. in the robot arm) and attach a warning sign: "DANGER: Do not connect or disconnect circuits under live conditions. Do not actuate the switch under live conditions".
- Do not install the device in areas critically exposed to UV light.
- Prevent risks caused by electrostatic charge.
- Provide unused male connectors with suitable sealing or blanking caps in order to ensure degree of protection IP65, IP67 or IP69K The tightening torque for the M4 screws is 0.5 Nm.

# 3 Safety Integrity Level/Performance Level/Category

The devices are rated for applications rated to:

- SIL3 according to EN 61508 and EN 62061
- Category 4/PLe according to EN ISO 13849-1

# 4 Product description

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

The device provides four safety SIL3-inputs (FDI) to connect 1- and 2-channel mechanical safety switches and electronic safety sensors (OSSD). Four further SIL3-channels (FDX) can be freely used as inputs (FDI) or outputs (FDO). The safety-related outputs are used for the safety-related disconnection of loads (resistive up to 2 A).

## 4.1 Intended use

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

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

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

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

The devices are specified for the operation in industrial environment. If used in residential or mixing areas, radio interference may occur.

### 4.1.1 Reasonably foreseeable misuse

The devices are not suitable for:

- Outdoor use
- The permanent use in liquids
- The use in Zone 0 and Zone 1

#### Modifications to the device

The device must not be modified either constructionally or technically.

## 4.2 Device overview

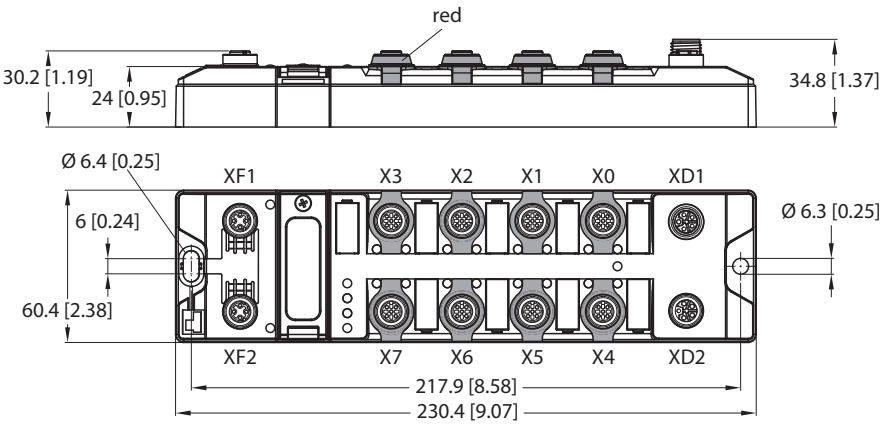



Fig. 1: TBEN-LL-4FDI-4FDX

### 4.2.1 Type label

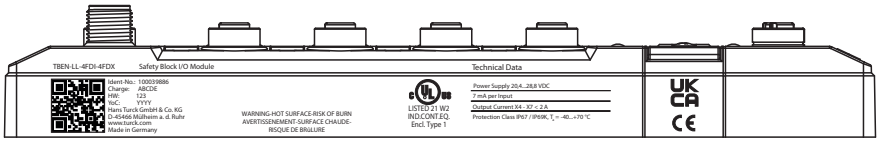
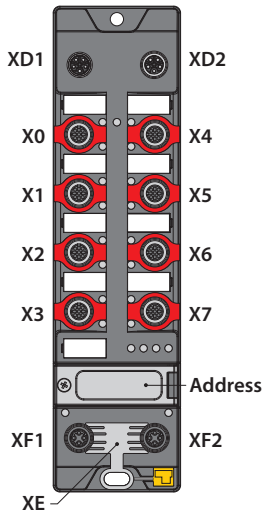



Fig. 2: Type plate – TBEN-LL-4FDI-4FDX

## 4.3 Switches and connectors




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

## 4.4 Block diagram

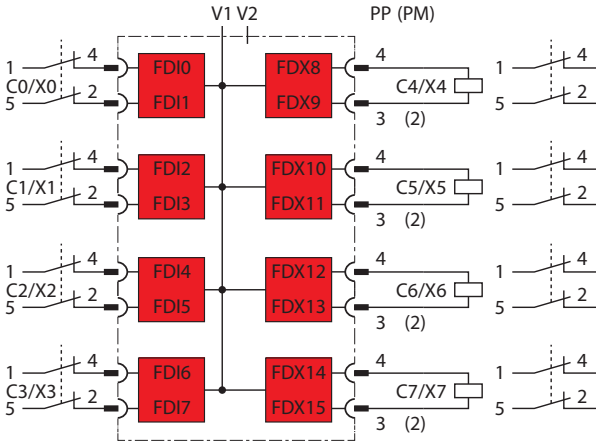



Fig. 3: Block diagram TBEN-LL-4FDI-4FDX

# 5 Safety function

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

The following devices can be connected to the safety inputs:

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

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

## Safe Status

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

## Fatal Error

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

# 6 Safety planning

The operator is responsible for the safety planning.

## 6.1 Prerequisites

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

## 6.2 Reaction time

If the device is operated with higher availability, the max. reaction time is extended (see "Safety Characteristic Data" [▷ 12]).

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

## 6.3 Safety characteristic data

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

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

# 7 Operating instructions

- With safety-related applications, the device has to be registered online at www.turck.com/SIL.
- Only allow trained and qualified personnel to assemble, install, commission and service the devices.
- The devices are not specified for a certain application. Make sure that application-specific aspects are considered.
- Replace the devices before the expiration of the permissible duration of use (see "Safety Characteristic Data").
- Execute a functional test every 12 months.
- Do not repair devices. If problems occur with regard to functional safety, Turck must be notified immediately and the devices must be returned immediately to:
  Hans Turck GmbH & Co. KG
  Witzlebenstraße 7
  45472 Mülheim an der Ruhr
  Germany
- In case of device errors which lead to the safe state, take measures to guarantee the safe state while continuing to operate the overall control system.
- Dangerous failures to be reported immediately to Turck.

## 7.1 Before operation

The operator of the machine or the plant in which the safety related system is used, is responsible for the correct and safe overall function of every single safety component.

- Carry out a validation of the safety category for the complete system depending on the selection of the used safety components.

### 7.1.1 Mounting

#### Mounting the device in Zone 2 and Zone 22

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

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

- Unscrew the housing. Use Torx T8 screwdriver.
- Replace the service window with the enclosed Ultem window.
- Place the device on the base plate of the protective housing and fasten both together on the mounting plate [▷ 15].
- Connect the device [▷ 16].
- Mount and screw the housing cover according to the following figure. The tightening torque for the screws is 0.5 Nm.

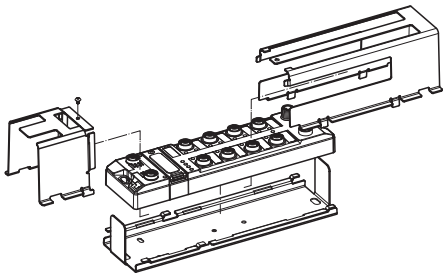


Fig. 4: Installing the device in the TB-SG-L protective housing

## Mounting onto a mounting plate

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

The device can be screwed onto a flat mounting plate.

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

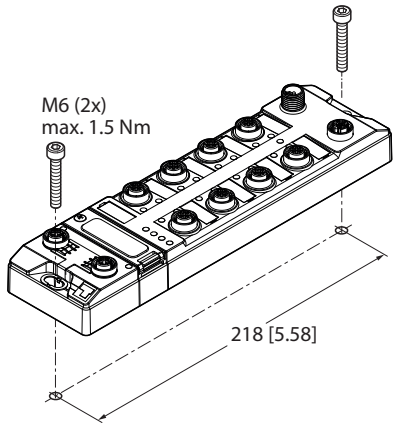



Fig. 5: Mounting the device onto a mounting plate

### 7.1.2 Connecting: pin assignments

#### Connecting the device in Zone 2 and Zone 22

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

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

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

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

## Connecting Ethernet

▶ Connect the device to Ethernet according to the pin assignment.

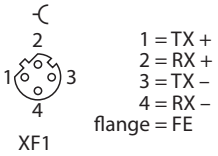



Fig. 6: Pin assignment Ethernet connector XF1

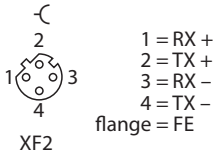



Fig. 7: Pin assignment Ethernet connector XF2

## Connecting the power supply

The externally connectable circuits have to be securely disconnected from the mains supply.

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

▶ Connect the device to the supply voltage according to the pin assignment.

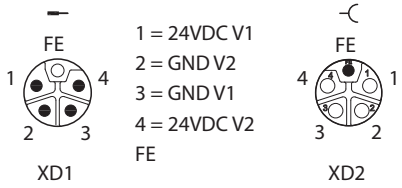



Fig. 8: Pin assignment voltage supply connectors, M12, 5-pin

The female connectors at the device have the following function:
X1 or XD1: Voltage IN
X2 or XD2: Conduct voltage to next node

## Connecting sensors and actuators

**DANGER**
Wrong supply of sensors and actuators
**Danger to life due to external supply**

- ▶ Exclude external supply.
- ▶ Guarantee that the inputs are only supplied through the same 24 V source as the device itself.

**DANGER**
Connection of fast reacting loads
**Danger to life due to connection failures**

- ▶ Use loads with mechanical or electrical inertia. Positive and negative test pulses have to be tolerated.

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

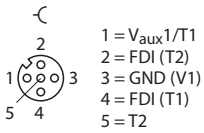



Fig. 9: Pin assignment X0…X3, FDI

**NOTE**
For PM-switching outputs, connect the negative pole of the load to the M-connector of the respective output (pin 2) Outputs.

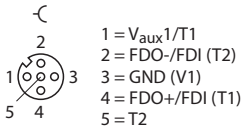
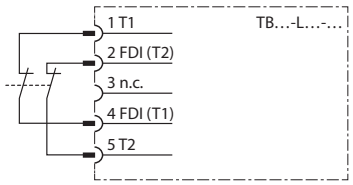



Fig. 10: Pin assignment X4…X7, FDX

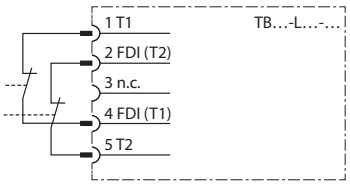
## 7.1.3 Connecting: switching examples

### Inputs

**Safe equivalent input for potential-free contacts (normally closed/normally closed)**

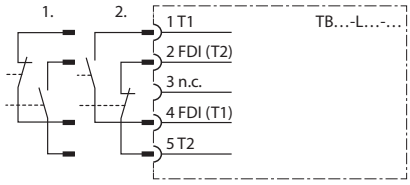



Connected in the switch




Two individual switches switching simultaneously via one application

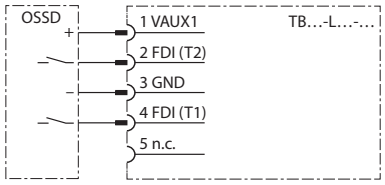
**Safe antivalent input for potential-free contacts (normally closed/normally open)**




In the antivalent circuit, switches can be connected in different ways. The decisive factor for enabling is where the normally closed contact is connected.

- Example 1: The LEDs of the inputs are off when not actuated and light up when actuated. Use: e.g. for door monitoring with magnetic reed contacts
- Example 2: The LEDs of the inputs are off when actuated and light up when not actuated. Use: as programming for two-hand switches with two separate contacts

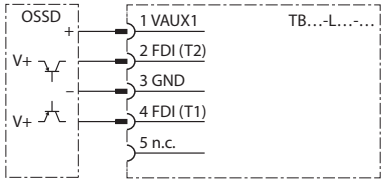
**Safe electronic input (OSSD)**




With this connection and corresponding parameterization, the pulsing of pins 1 and 5 is switched off. The supply voltage at pin 5 remains switched on.
Note:

▶ To avoid errors, do not use 5-pole cables to the sensor.

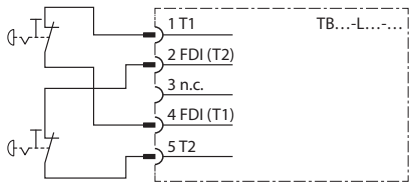
**Safe electronic input (OSSD) antivalent switching**




With this connection and corresponding parameterization, the pulsing of pins 1 and 5 is switched off. The supply voltage at pin 5 remains switched on. The NC contact is connected to pin 2 in order to receive a release when it is actuated.
Connection example: Banner STB Touch
Note:

▶ To avoid errors, do not use 5-pole cables to the sensor.

**Safe inputs with single-channel mechanical contacts**




Inputs can be queried 1-channel.

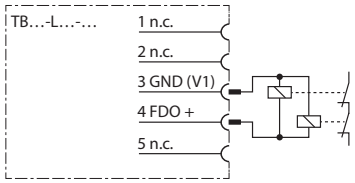
- Connect sensors via two connection cables and a Y-plug (i.e. ID: 6634405) to the M12 sockets of the modules.

Note:
Changes to the preset properties of the inputs directly affect the performance level to be achieved. For more information, see the online help of the Turck Safety Configurator.

## Outputs

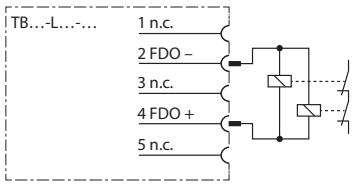
**NOTE**
Any change in the test pulse interval of the outputs will change the performance level. The software and the online help of the software contain further information.

**Safe output PP-switching**




- For PP-switching outputs, connect the negative pole of the load to the GND connector of the respective output (pin 3).
- Do not connect the negative pole of the load to the ground of the power supply at a different location.
- The wiring has to allow an exclusion of faults (e.g. cross connection to external potential).

**Safe output PM-switching**




- For PM-switching outputs, connect the negative pole of the load to the M connector of the respective output (pin 2).

### 7.1.4 Addressing

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

#### Setting the IP Address via rotary coding switches

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

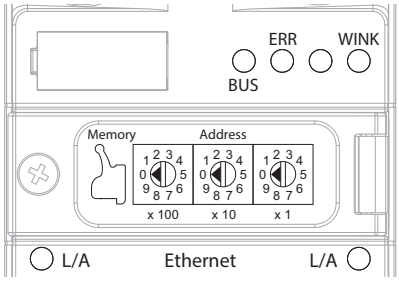



Fig. 11: Rotary coding switches at the device

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

| Switch position | Meaning |
|---|---|
| 000 | 192.168.1.254 |
| 1…254 | Rotary mode (Static rotary)<br>Sets the last byte of first IP address, accept the setting with a device restart |
| 300 | BOOTP |
| 400 | DHCP |
| 500 | PGM |
| 600 | PGM-DHCP |
| 900 | Factory Reset: Resets device to factory settings |
| 901 | Erase Memory: Deletes the content of the memory chip |
| **Safe Link** | Teaching-in the network for device replacement (without Turck Safety Configurator TSC), number of TBEN-modules, which are read-in: |
| 921 | 1 module |
| 922 | 2 modules |
| 923 | 3 modules |
| 924 | 4 modules |
| 925 | More than 4 modules |

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

### Addressing the devices in Safe Link

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

## 7.1.5 Web server login

- ▶ Open the web server.
- ▶ Log on to the device as administrator. The default user for the web server is "admin", the default password is "password".
- ▶ Enter user name and password in the login field on the start page of the web server.
- ▶ Click **Login**.

**NOTE**
The password is transmitted in plain text.

### Secure device access with password

**NOTICE**
Inadequately secured devices
**Unauthorized access to sensitive data**
- ▶ Change password after first login. Turck recommends using a secure password.
- ▶ Adapt the password to the requirements of the network security concept of the system in which the devices are installed.

## 7.1.6 Configuring

The safety function of the safe channels can only be configured via Turck Safety Configurator.

Once the configuration of a Safe Link module has been completed in TSC, the software creates a basic configuration regardless of the number and configuration of the other Safe Link modules in the application. The basic configuration serves as a sample configuration. The user can adapt the sample configuration for the other devices in the network according to the specific application. The Safe Link network can be expanded to up to 31 modules in the TSC. One Safe Link module of the network is defined as Safe Link manager.

After creating the individual module configurations and downloading the configurations to the network modules, the user initiates the read-in of the network configuration at the Safe Link manager. Each module in the Safe Link network generates a configuration log, which is checked and approved by the user. After approval, the application can be started.

The configuration of the safe I/O channels downloaded via Turck Safety Configurator is automatically stored in each module and on the memory stick (included in the scope of delivery) inserted in the module. When replacing a device, the device configuration can be transferred to another device via the memory stick.

Further information on the Turck Safety Configurator can be found in the online help.

## 7.2 Operating

### 7.2.1 LED displays

The device is provided with the following LEDs:

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

| LED PWR | Meaning |
|---|---|
| Off | No voltage connected or under voltage at V1 |
| Green | Voltage V1 and V2 OK |
| Red | No valid state, device switches to the safe state |
| Red/green | No valid state, device switches to the safe state |

| LED 0…7 | Meaning |
|---|---|
| Off | Input not active |
| Green | Input active |
| Green flashing | Self-test input |
| Red flashing | Cross-circuit |
| Red | Discrepancy |

| LED 8…15 | Meaning | |
|---|---|---|
| | Channel is input | Channel is output |
| Off | Input not active | Output not active |
| Green | Input active | Output active |
| Green flashing | Self-test input | - |
| Red flashing | Cross-circuit | - |
| Red | Discrepancy | Overload |

| LED 0…15 | Meaning |
|---|---|
| Red flashing, all alternating | Fatal Error |

| LED BUS | Meaning |
|---|---|
| Off | No voltage supply |
| Green | Active connection to a master |
| Green flashing | Device ready for operation |
| Red | IP address conflict, restore mode or F_reset active |
| Red flashing | Wink command active |
| Red/green, 1 Hz | Autonegotiation and/or waiting for DHCP-/BootP-address assignment |

| LED ERR | Meaning |
|---|---|
| Off | No voltage connected or under voltage at V1 |
| Green | No diagnostics |
| Green flashing, 4 Hz | Safe Link manager and Safe Link node:<br>Safe Link network is read in, initialization, configuration transfer from memory stick is running |
| Green flashing, 1 Hz | Safe Link manager and Safe Link node:<br>Safe Link network is read in, initialization, configuration transfer from memory stick completed |
| Red | Diagnostics pending<br>■ Safe Link node:<br>No connection to the Safe Link manager or to the Safe Link network, no Safe Link manager found<br>■ Safe Link manager:<br>No connection to the Safe Link node |
| Red flashing, 2 Hz | Safe Link manager and Safe Link node:<br>Error when reading in the Safe Link network, error during initialization or during configuration transfer from the memory stick |
| Red flashing, 1 Hz | ■ Safe Link node:<br>The Safe Link manager has not recognized or read the node correctly<br>■ Safe Link manager:<br>Unknown/not read node in the Safe Link network |
| Red flashing, 4 Hz | Wrong setting at the rotary coding switch (address > 920) during device start.<br>▶ Set the rotary coding switch to a valid IP address. |
| Red/green | No valid state, device switches to the safe state |

| LED WINK | Meaning |
|---|---|
| White flashing | Helps to localize the module if the Blink/Wink command is active |

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

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

### 7.2.2 Shut-down behavior

The validation protocol that is created for each module in the Turck Safety Configurator contains a worst-case calculation for the switch-off behavior of the safe outputs.

A fatal error in a module leads to the immediate switch-off of the outputs (<10 ms).

### 7.2.3 Replacing the device

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

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

#### Read in the Safe Link network at the Safe Link manager

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

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

### 7.2.4 Decommissioning

The decommissioning is described in the user manual:

- TBEN-L…-4FDI-4FDX (100047771)

# 8 Appendix: designations and abbreviations

| Abbreviation | Meaning |
|---|---|
| DC | Diagnostic Coverage |
| HFT | Hardware failure tolerance |
| $MTTF_D$ | Mean Time To Failure Dangerous |
| PFD | Probability of dangerous failure on demand |
| $PFH_D$ | Average frequency of dangerous failure per hour |
| PL | Performance Level |
| SIL | Safety Integrity Level |

# 9 Appendix: function tests

Ensure that the function test is only carried out by qualified personnel. A suggested function test consists of the following steps:

| Step | Action |
|---|---|
| 1 | Switch every safety related input at least once a year. |
| 2 | Control the switching behavior by monitoring the output circuits. |
| 3 | Observe the maximum duty cycle and the total operation time depending on the selected PFD value. |
| 4 | If the maximum duty cycle is reached: Request the shutdown function in order to check the function of the safety system. |

Once the test has been completed, document and archive the results.

# 10 Appendix: document history

| Version | Date | Modifications |
|---|---|---|
| 1.01 | 12/16/2021 | Revised Version |
| 1.0 | 10/29/2024 | First Version |

# 11 Appendix: technical data

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

| Power supply | |
|---|---|
| V1 (incl. electronics supply) | 24 VDC |
| V2 | 24 VDC, only through connected |
| Current feed-through | |
| ■ XD1 tot XD2 (M12) | Max. 16 A per voltage group |
| Permissible range | 20.4…28.8 VDC |
| Total current | 9 A, observe derating [▶ 30] |
| ■ Ex derating | S. document "Notes on Use in Ex zone 2 and 22" (100022986) |
| Isolation voltages | ≥ 500 VAC |
| Connector | |
| ■ TBEN-LL-4FDI-4FDX | M12, L coded, 5-pin |
| Power loss | < 5 W |

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

| System and protocol data | |
|---|---|
| Transmission rate | 10 Mbps/100 Mbps |
| Protocol detection | Automatic |
| Web server | Integrated |
| Service interface | Ethernet via XF1 or XF2 |
| **Modbus TCP** | |
| Address assignment | Static IP, BOOTP, DHCP |
| Supported Function Codes | FC3, FC4, FC6, FC16, FC23 |
| Number of TCP connections | 8 |
| Input register, start address | 0 (0x0000) |
| Output register, start address | 2048 (0x0800) |
| **EtherNet/IP** | |
| Address assignment | According to EtherNet/IP standard |
| Device Level Ring (DLR) | Supported |
| Number of Class 3 connections (TCP) | 3 |
| Number of Class 1 connections (CIP) | 10 |
| Input Assembly Instance | 103 |
| Output Assembly Instance | 104 |
| Configuration Assembly Instance | 106 |

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

| Safety inputs for potential free contacts | |
|---|---|
| Loop resistance | < 150 Ω |
| Max. line capacity | max. 1 µF at 150 Ω, limited by line capacity |
| Test pulse typ. | 0.6 ms |
| Test pulse max. | 0.8 ms |
| Sensor supply | Supply VAUX1/T1<br>max. 2 A, observe derating [▶ 30] |
| Interval between two test pulses, minimum | 900 ms (for static inputs) |
| Connection to external potential | Not allowed |

| Safety inputs for OSSD | |
|---|---|
| Signal voltage, low level | IEC 61131-2, type 1 (< 5 V; < 0.5 mA) |
| Signal voltage high level | IEC 61131-2, type 1 (< 15 V; < 2 mA) |
| Max. OSSD supply per channel | 2 A per connector C0/X0…C7/X7<br>1.5 A at 70° C, observe derating [▶ 30] |
| Max. tolerated test pulse width | 1 ms |
| Min. interval between two test pulses | 12 ms at 1 ms test pulse width<br>8.5 ms at 0.5 ms test pulse width<br>7.5 ms at 0.2 ms test pulse width |

| Safety outputs | |
|---|---|
| Suitable for inputs according to EN 61131-2, type 1 | |
| Output level in OFF-state | < 5 V |
| Output level in OFF-state | < 1 mA |
| Test pulse resistive load, max. | 0.5 ms |
| Test pulse, max. | 1.25 ms |
| Interval between two test pulses, typical | 500 ms |
| Interval between two test pulses, minimum | 250 ms |
| Actuator supply | Supply VAUX1/T1,<br>max. 2 A, observe derating [▶ 30] |

| Safety outputs | |
|---|---|
| Max. total current for device | 9 A |
| Max. output current | 2 A (resistive)<br>2 A (DC load) |
| | 1 A (inductive) |
| Ex derating | S. document "Notes on Use in Ex zone 2 and 22" (100022986) |
| The user have to provide an additional overcurrent protection on site. | |

| Times | |
|---|---|
| Internal delay time (for calculating the watchdog time) | 10 ms |
| Response times | See Safety Characteristic Data [▶ 12] |

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

| Tests | |
|---|---|
| Vibration test | According to IEC 60068-2-6, IEC 60068-2-47, acceleration up to 20 g |
| Drop and topple | According to IEC 60068-2-31/IEC 60068-2-32 |
| Shock test | According to IEC 60068-2-27 |
| Electro magnetic compatibility | According to IEC 61131-2/IEC 61326-3-1 |

## 11.1 Derating

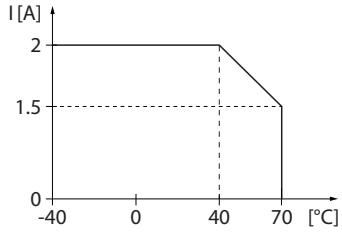



Fig. 12: Derating – output current

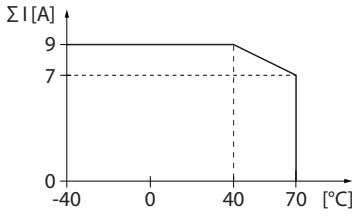



Fig. 13: Derating – total current

# 12 Appendix: directives and standards

## 12.1 National and international directives and standards

The following guidelines and regulations must be observed:

- 2006/42/EG (machine directive), SI 2008/1597
- 2014/34/EU (electromagnetic compatibility), SI 2016/1091
- 2011/65/EU (RoHS-Directive), SI 2012/3032
- 89/655/EWG (work equipment directive)
- Accident prevention regulation
- Safety rules and safety regulations according to the actual state of the art

## 12.2 Cited standards

| Standard | Title |
|---|---|
| DIN EN ISO 13849-1:2016-06 | Safety-related parts of control systems |
| EN 62061:2005 + Cor.:2010 + A1:2013 + A2:2015<br>IEC 62061:2005 + A1:2012 + A2:2015 | Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems |
| DIN EN 61508:2011<br>IEC 61508:2010 | Functional safety of electrical/electronic/ programmable electronic safety-related systems |
| DIN EN 61131-2:2008<br>IEC 61131-2:2007 | Programmable controllers |
| EN ISO 12100:2010<br>DIN EN ISO 12100:211-03 | Safety of machinery – General principles for design – Risk assessment and risk reduction |

# 13 Declaration of conformity (copy of the original)

**EG Konformitätserklärung Nr. 5523M**
EC Declaration of Conformity No.: / Déclaration CE de conformité n° / Declaración CE de conformidad n.° / Dichiarazione CE di conformità N. / deklaracji zgodności WE nr:

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to which this declaration relates are in conformity with the requirements of the following EU directives by compliance with the following standards: / concernés par la présente déclaration répondent aux exigences des directives européennes suivantes conformément aux normes suivantes: / a los que hace referencia esta declaración cumplen los requisitos de las siguientes directivas de la UE ya que son conformes a las siguientes normas: / cui la presente dichiarazione fa riferimento, soddisfano i requisiti delle seguenti direttive UE in conformità alle seguenti norme: / do których odnosi się ta deklarcja, spełniają wymagania następujących dyrektyw UE poprzez zgodność z następującymi normami

EMV-Richtlinie / EMC Directive / Directive EMC / Directiva CEM / Direttiva EMC (compatibilità elettromagnetica) / Dyrektywa EMC — 2014 / 30 / EU — 26/2/2014

EN 61000-6-2:2005 EN 61000-6-4:2007 + A1:2011 EN 61131-2:2007

Maschinenrichtlinie / Machinery directive / Directive machines / Directiva sobre máquinas / Direttiva macchine / Dyrektywa Maszynowa — 2006 / 42 / EC — 17/5/2006

EN ISO 13849-1:2023 EN ISO 13849-2:2012 EN IEC 62061:2021

RoHS Richtlinie / RoHS directive / Directive RoHS / Directiva RoHS / Direttiva RoHS / Dyrektywa RoHS — 2011 / 65 / EU — 08/6/2011

EN IEC 63000:2018

Weitere Normen, Bemerkungen
Additional standards, remarks / Autres normes, remarques / Otras normas, observaciones / Norme aggiuntive, osservazioni / Inne standardy, komentarze

EN 61326-3-1:2008 EN 61508-1…7:2010

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