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TBPN-L...-FDIO1-2IOL Safety Block I/O Module with PROFIsafe

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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. These instructions contain rules for the use of the devices in Safety Instrumented Systems (SIS). The assessment of the safety related values is based on IEC 61508, ISO 13849-1 and IEC 62061.

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

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

1.2 Explanation of symbols

The following symbols are used in these instructions:



DANGER

DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.



CAUTION

CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.



NOTICE

CAUTION indicates a situation which, if not avoided, may cause damage to property.



NOTE

NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.



MANDATORY ACTION

This symbol denotes actions that the user must carry out.



RESULT OF ACTION

This symbol denotes the relevant results of an action.

1.3 Additional documents

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

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

1.4 Feedback about these instructions

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

2 Notes on the product

2.1 Product identification

These instructions apply for the following Safety safety module with PROFIsafe:

- TBPN-L1-FDIO1-2IOL
- TBPN-LL-FDIO1-2IOL

2.2 Scope of delivery

The scope of delivery includes:

- TBPN-L...-FDIO1-2IOL
- Memory stick
- M12 closure caps
- 7/8" blind caps (not suitable to guarantee IP67/IP69K)

2.3 TURCK service

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

For the contact details of our branches worldwide, please see page [▶ 158].

3 For your safety

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

3.1 Intended use

TBPN-L...-FDIO1-2IOL is a decentralized safety module for PROFIsafe. The module collects field signals and forwards them safely to a PROFIsafe master. Due to the temperature range from -40...+70 °C and IP67/IP69K protection, the module can be used directly on the machine.

The module serves for controlling signal devices as for example emergency stop buttons, position switches or OSSDs which are used to ensure human, material or machine protection.

For non-safety relevant functions, the Safety hybrid module has additional universal input channels as well as two IO-Link master channels for the connection of IO-Link sensors and IO-Link hubs for expansion to up to 32 I/O signals.

TBPN-L...-FDIO1-2IOL can be used in the following applications:

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

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

3.1.1 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.

3.2 General safety notes

- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The Performance Level as well as the safety category according to EN ISO 13849-1 depend on the external wiring, the application, the choice of the control devices as well as their arrangement on the machine.
- The user has to execute a risk assessment according to EN ISO 12100:2010.
- Based on the risk assessment a validation of the complete plant/machine has to be done in accordance with the relevant standards.
- Operating the device beyond the specification can lead to malfunctions or to the destruction of the device. The installation instructions must be observed.
- For trouble-free operation, the device must be properly transported, stored, installed and mounted.
- For the release of safety circuits in accordance with EN/IEC 60204-1, EN ISO/ISO 13850 only use the output circuits of connectors C2, C3, C4, C5 and C7 or respectively X2, X3, X4, X5 and X7.
- For connecting sensors and actuators in safety related applications only use the connectors C0...C3 or X0...X3.
- Change the default password of the integrated web server after the first login. TURCK recommends the use of a secure password.

3.3 Residual risks (EN ISO 12100:2010)

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

Residual risks remain, if

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

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

3.4 Warranty and liability

Any warranty and liability is excluded for:

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

3.5 Notes on Ex protection

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

3.6 Requirements for Ex approval

- Only use the device in an area with no more than pollution degree 2.
- Only disconnect and connect circuits when there is no potentially explosive atmosphere or when the power supply is switched off
- Only operate the switches when there is no potentially explosive atmosphere or when the power supply is switched off.
- Connect the metal protective cover to the equipotential bonding in the Ex area (cable cross-section: 4 mm²).
- Ensure impact resistance in accordance with EN IEC 60079-0 – alternative measures:
 - Install the device in the TB-SG-L protective housing (available in the set with Ultem window: ID 100014865) and replace the Lexan service window with the Ultem window.
 - Install the device in an area offering impact protection (e.g. in the robot arm) and attach a warning sign: "DANGER: Do not connect or disconnect circuits under live conditions. Do not actuate the switch under live conditions".
- Keep the service window of the devices closed during operation in order to comply with the IP protection.
- Do not install the device in areas critically exposed to UV light.
- Prevent risks caused by electrostatic charge.
- Provide unused male connectors with suitable sealing or blanking caps in order to ensure degree of protection IP65, IP67 or IP69K The tightening torque for the M4 screws is 0.5 Nm.

4 Product description

The TBPN-L...-FDIO1-2IOL is a hybrid safety block I/O module for PROFIsafe via PROFINET. The device has two 2-channel digital safety inputs (FDI) for the connection of different safety sensors as for example light barriers or emergency stop buttons. Two further safety channels (FDX) can be freely used as inputs (FDI) or outputs (FDO).

The configuration of the safe I/Os and their function is realized by means of a software tool the TURCK Safety Configurator.

Non-safety related signals can be connected to the four universal digital inputs/outputs of the device. The device also has two IO-Link master channels. In combination with TURCK I/O hubs, up to 32 I/Os can be connected. Both the standard and the IO-Link channels of the TBPN-L...-FDIO1-2IOL can be safely switched off internally.

4.1 Device overview

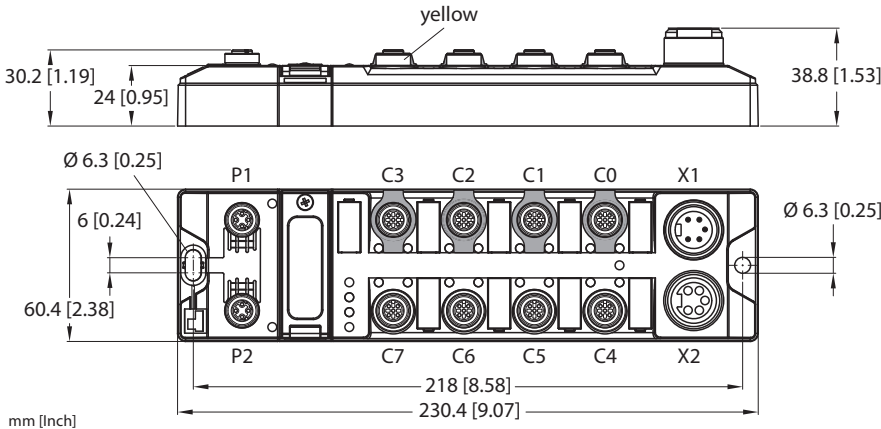


fig. 1: TBPN-L1-FDIO1-2IOL

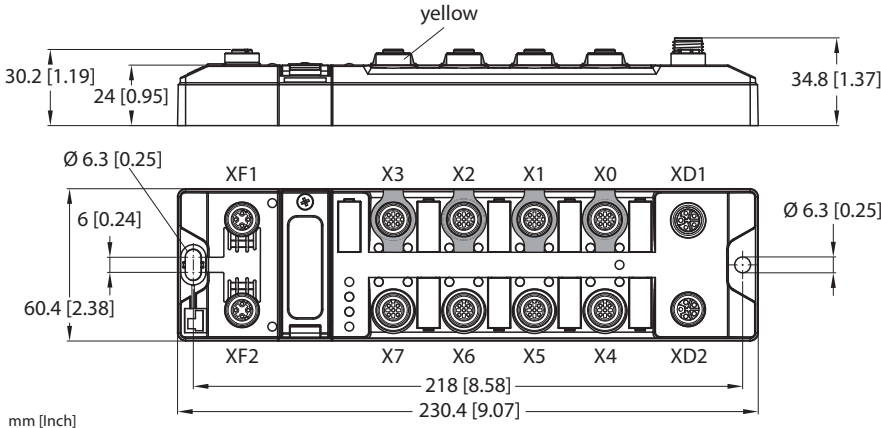


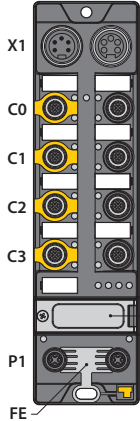
fig. 2: TBPN-LL-FDIO1-2IOL

4.2 Properties and features

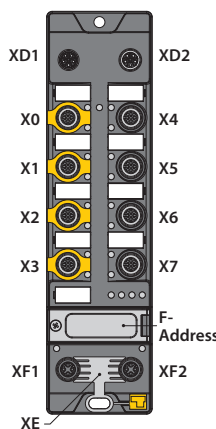
- Two safety-related SIL3 inputs FDI
- Two safety-related SIL3 In-/outputs FDX
- Four non-safety in-/outputs DXP
- Two IO-Link master ports (IOL)
- Safe shutdown of the standard channels and one I/O-Link channel
- Safe PP/PM-switching of the actuator power supply
- Up to 2 A per output
- Usable in SIL CL3 according to EN 62061 or PLe according to DIN EN ISO 13849-1
- 7/8" power supply connectors:
TBPN-L1-FDIO1-2IOL
- M12 power supply connector, L coded:
TBPN-LL-FDIO1-2IOL
- Two 4-pin M12-connectors for Ethernet
- Multiple LEDs for status indication
- Integrated Ethernet switch, allows line topology
- Integrated web server
- Transmission rate 10 Mbps and 100 Mbps
- Fiberglass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Protection class IP65/IP67/IP69K

4.2.1 Switches and connectors

TBPN-L1-FDIO1-2IOL

	Designation	Meaning
	X1	Power IN
	X2	Power OUT
	C0	FDI0/1, safety-related input
	C1	FDI2/3, safety-related input
	C2	FDX4/5, safety-related input
	C3	FDX6/7, safety-related input
	C4	DXP8/9, standard in-/outputs (safe shutdown via FSO0 possible)
	C5	DXP10/11, standard in-/outputs (safe shutdown via FSO0 possible)
	C6	IOL, IO-Link port 1
	C7	IOL, IO-Link port 2 (safe shutdown via FSO 1 possible)
	F-Address	Rotary coding switch for address setting for PROFI-safe (F-address setting)
	P1	Ethernet 1
	P2	Ethernet 2
	FE	Functional earth

TBPN-LL-FDIO1-2IOL

	Designation	Meaning
	XD1	Power IN
	XD2	Power OUT
	X0	FDI0/1, safety-related input
	X1	FDI2/3, safety-related input
	X2	FDX4/5, safety-related input
	X3	FDX6/7, safety-related input
	X4	DXP8/9, standard in-/outputs (safe shutdown via FSO0 possible)
	X5	DXP10/11, standard in-/outputs (safe shutdown via FSO0 possible)
	X6	IOL, IO-Link port 1
	X7	IOL, IO-Link port 2 (safe shutdown via FSO 1 possible)
	F-Address	Rotary coding switch for address setting for PROFI-safe (F-address setting)
	XF1	Ethernet 1
	XF2	Ethernet 2
	FE	Functional earth

4.2.2 Block diagram

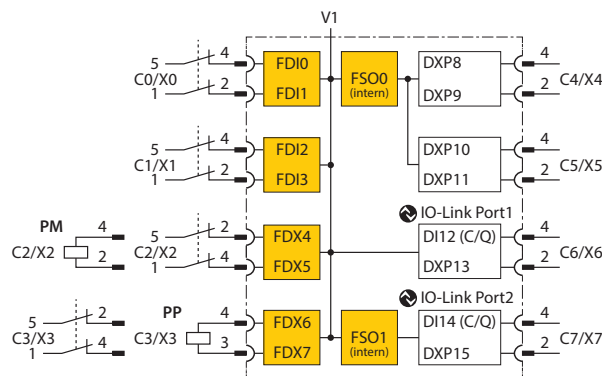


fig. 3: Block diagram TBPN-L...-FDIO1-2IOL

4.3 Functions and operating modes

4.3.1 Safety function

The TBPN-L...-FDIO1-2IOL provide two safe digital SIL3 inputs (FDI) and two 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 two safe SIL3 outputs can be used PP- or PM-switching.

Safe Status

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

Fatal Error

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

4.3.2 Safety inputs (FDI)

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

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

Error detection and diagnostics

Internal:

- Device self test: Diagnosis of internal device errors

External:

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

Parameters

For each input the following types can be selected:

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

4.3.3 Safety outputs (FDO)

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

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

Error detection and diagnostics

Internal:

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

External:

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

Parameters

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

4.3.4 Universal standard I/Os

The function description of the non safe universal I/Os can be found in the second part of these instructions :

TBPN-L...-FDIO1-2IOL – Standard I/O channels [► 108]

4.3.5 IO-Link master channels

The function description of the non safe IO-Link master channels can be found in the third part of these instructions:

TBPN-L...-FDIO1-2IOL – Standard IO-Link master channels [► 117]

4.3.6 Configuration memory

A pluggable memory stick is included in the scope of delivery of TBPN-L...-FDIO1-2IOL. It serves for storing the safety function configured via TURCK Safety Configurator. It allows to transfer the configuration of one device to another device, e. g. for device exchange.

5 Installing

5.1 Installing a device in zone 2 and zone 22

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



DANGER

Potentially explosive atmosphere

Risk of explosion due to spark ignition

Operation in zone 2 or zone 22:

- ▶ Only install the device if there is no potentially explosive atmosphere present.
- ▶ Observe the requirements for Ex approval.

- ▶ Screw on the housing. Use a Torx T8 screwdriver.
- ▶ Replace the service window with the supplied Ultem window.
- ▶ Place the device on the base plate of the protective housing and fasten both together on the mounting plate [▶ 23].
- ▶ Connect the device, [▶ 26].
- ▶ Fit the housing cover and screw on as shown in the following figure. The tightening torque for the Torx T8 screw is 0.5 Nm.

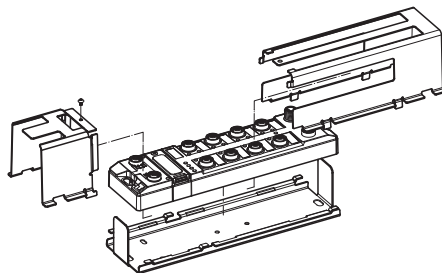


fig. 4: Installing the device in the TB-SG-L protective housing

5.2 Mounting onto a mounting plate



NOTICE

Mounting on uneven surfaces

Device damage due to stresses in the housing

► Attach the device to the mounting plate with two M6 screws.

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

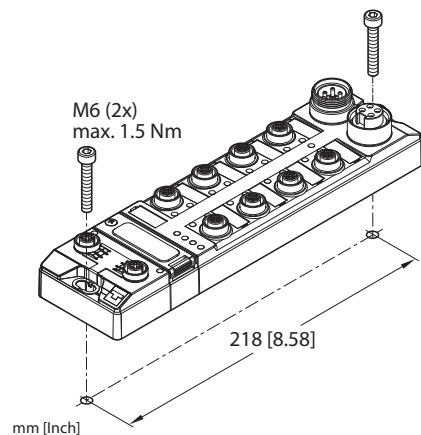


fig. 5: Mounting the device onto a mounting plate

5.3 Grounding the device

5.3.1 Equivalent wiring diagram and shielding concept

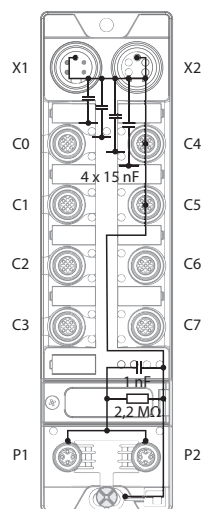


fig. 6: Equivalent wiring diagram and shielding concept – TBPN-L1-FDIO1-2IOL

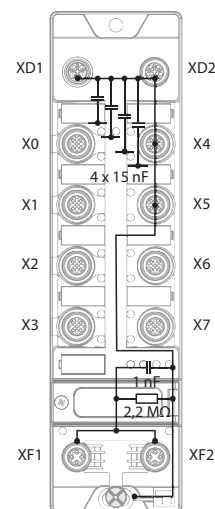


fig. 7: Equivalent wiring diagram and shielding concept – TBPN-LL-FDIO1-2IOL

5.3.2 Shielding of the fieldbus and I/O level

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

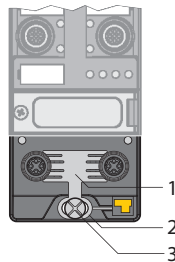


fig. 8: Grounding clip (1), grounding ring (2) and metal screw (3)

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

I/O level shielding

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

Fieldbus level shielding

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

In the delivery state, the grounding clip is mounted.

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

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

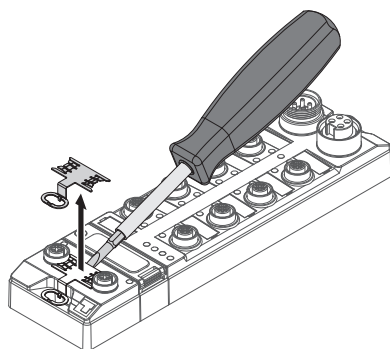


fig. 9: Removing the grounding clamp

5.3.4 Grounding the fieldbus level directly: inserting the grounding clip

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

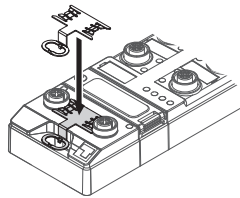


fig. 10: Mounting the grounding clip

5.3.5 Grounding the device – mounting on a mounting plate

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

6 Connecting



WARNING

Intrusion of liquids or foreign bodies through leaking connections

Danger to life due to failure of the safety function

- ▶ Tighten 7/8" male connectors with a tightening torque of 0.8 Nm.
- ▶ Only use accessories that guarantee the degree of protection (IP65, IP67, IP69K).
- ▶ Close unused M12 connectors with the supplied screw caps. The tightening torque for the screw caps is 0.5 Nm.

6.1 Connecting a device in zone 2 and zone 22



DANGER

Explosive atmosphere

Explosion due to ignitable sparks

For use in Zone 2 and Zone 22:

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

6.2 Connecting the M12 connectors

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



fig. 11: Torque screwdriver

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

6.3 Connecting the device to Ethernet

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

TBPN-L1

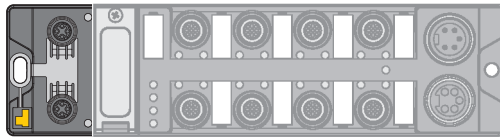


fig. 12: M12 Ethernet connector

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

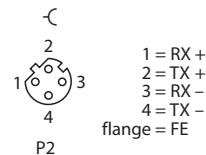
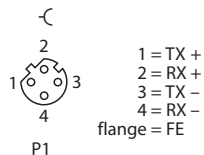


fig. 13: Pin assignment Ethernet connectors

TBPN-LL

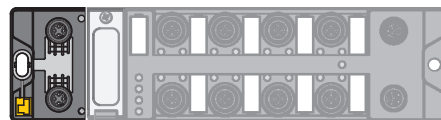


fig. 14: M12 Ethernet connector

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

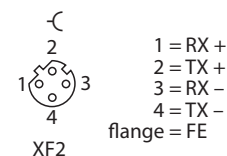
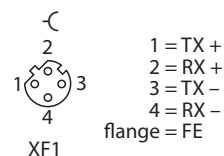


fig. 15: Pin assignment Ethernet connectors

6.4 Connecting the power supply



NOTE

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

TBPN-L1



NOTE

We recommend the use of pre-assembled 5-pole power supply cables TURCK type 52 (e.g. RKM52-1-RSM52). Suitable cables can be found on www.turck.com.

For the connection to the power supply, the device has two 5-pin 7/8" connectors. V1 and V2 are galvanically isolated. The maximum tightening torque is 0.8 Nm.

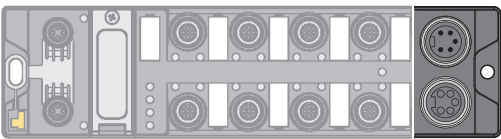


fig. 16: 7/ 8" connector for connecting the supply voltage

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



fig. 17: Pin assignment power supply connectors

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

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

TBPN-LL



NOTE

We recommend the use of pre-assembled 5-pole power supply cables e.g. RKP56PLB-1-RSP56PLB/TXG (not suitable for Ex use). Suitable cables can be found on www.turck.com.

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

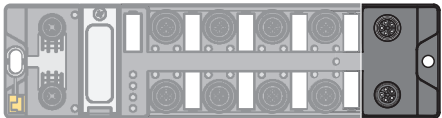


fig. 18: M12 connector for connecting the supply voltage

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

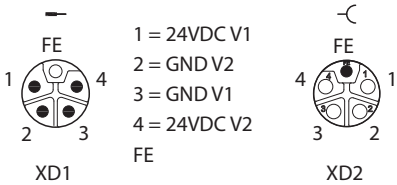


fig. 19: Pin assignment power supply connectors

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

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

6.4.1 24 V supply (SELV/PELV)



WARNING

Use of incorrect or defective power supply unit

Danger to life due to dangerous voltages on touchable parts

- Only use for SELV or PELV power supplies in accordance with EN ISO 13849-2, which allow a maximum of 60 VDC or 25 VAC in the event of a fault.
-

External supply of sensors and actuators

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

Decoupling of external electrical circuits

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



WARNING

Potential differences

Dangerous additions of voltages

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

6.5 Connecting safe sensors and actuators



NOTE

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



DANGER

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

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

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

Safety inputs (FDI)

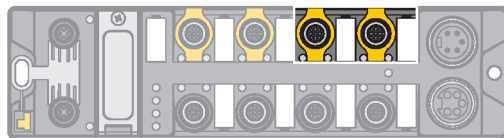


fig. 20: M12 connector, safety inputs (FDI)

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

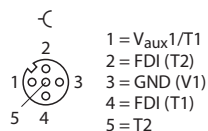


fig. 21: Pin assignment FDI at C0...C1 or X0...X1

Signal	Meaning
VAUX1/T1	Sensor supply/test pulse 1
FDI (T2)	Digital input 2
GND (V1)	Ground V1
FDI (T1)	Digital input 1
T2	Test pulse 2

Safe in- and outputs (FDX)

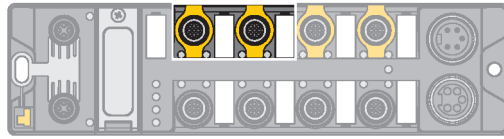


fig. 22: M12 connector, safety in-/outputs (FDX)

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

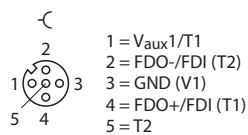


fig. 23: Pin assignment FDX at C2...C3 or X2...X3

Signal	Meaning
VAUX1/T1	Sensor supply/test pulse 1
FDO-/FDI (T2)	Digital output (M)/digital input 2
GND (V1)	Ground V1
FDO+/FDI (T1)	Digital output (P)/digital input 1
T2	Test pulse 2



DANGER

Connection of fast reacting loads

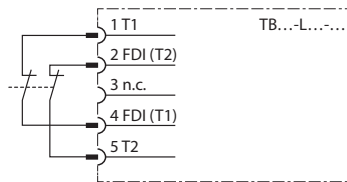
Danger to life due to connection failures

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

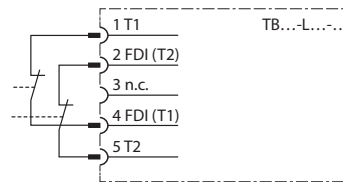
6.6 Switching examples

6.6.1 Inputs

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

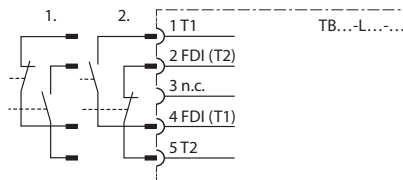


Connected in the switch



Two individual switches switching simultaneously via one application

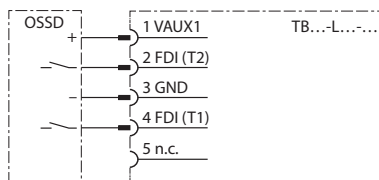
Safe antivalent input for potential-free contacts (normally closed/normally open)



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)

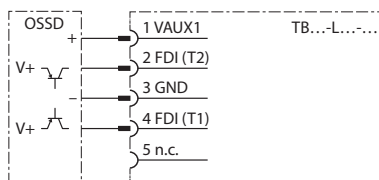


With this connection and corresponding parameterization, the pulsing of pins 1 and 5 is switched off. The supply voltage at pin 5 remains switched on.

Note:

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

Safe electronic input (OSSD) antivalent switching



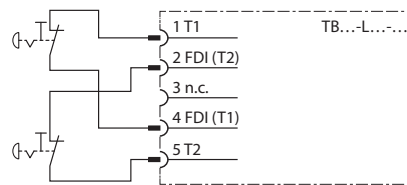
With this connection and corresponding parameterization, the pulsing of pins 1 and 5 is switched off. The supply voltage at pin 5 remains switched on. The NC contact is connected to pin 2 in order to receive a release when it is actuated.

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.

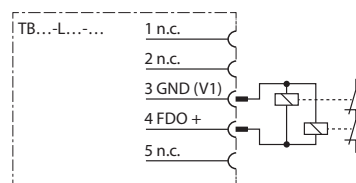
6.6.2 Outputs



NOTE

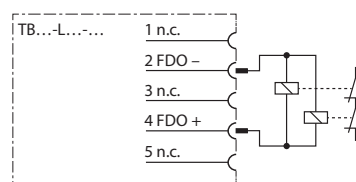
Any change in the test pulse interval of the outputs will change the performance level. The software and the online help of the software contain further information.

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 Commissioning

7.1 Initial commissioning

7.1.1 Mounting and electrical installation

- ▶ Set the F address at the device [▶ 37].
- ▶ Please assure the proper closing of the protective cover over the rotary coding switches.
- ▶ Mount the device according to the instructions [▶ 22].
- ▶ Connect Ethernet cables according to the instructions [▶ 27].
- ▶ Wire the in- and outputs depending on their use [▶ 31], [▶ 33].
- ▶ Seal unused connectors with the respective protection caps [▶ 26].

Connecting the supply voltage

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

7.1.2 Configuring in TURCK Safety Configurator

- ▶ Configure the device as described in chapter “Configuring” [▶ 44].

7.1.3 Commissioning the device at the PLC

- ▶ Configure the device in the PLC.
- ▶ Configure the device in the configuration software [▶ 69].
- ▶ Load parameterization and configuration data via the PLC into the device.
- ▶ Execute a functional test.
- ▶ Check if the device works according to the configuration and if all safety functions react as expected.

7.2 Safety planning

The operator is responsible for the safety planning.

7.2.1 Prerequisites

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

7.2.2 Reaction time

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

In addition to the reaction time in the device, reaction times of the further Safety components have to be system considered eventually. Please find the respective information in the technical data of the respective devices.

Further information about the reaction time can be found in the online help for the TURCK Safety Configurator.

7.2.3 Safety characteristic data

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

Max. reaction time in case of shutdown	Value	Standard
TBPN-L...-FDIO1-2IOL		
PROFIsafe > local output	25 ms	EN 61508
Local input > PROFIsafe	20 ms	
Local input <> local output	35 ms	

7.3 Addressing the device

7.3.1 Setting the F address at the device

Setting the F address via rotary coding switches

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



DANGER

Intrusion of liquids or foreign bodies through open cover

Danger to life due to failure of the safety function

- ▶ Tightly close the cover above the switches.

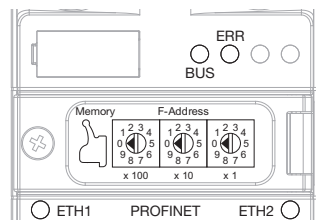


fig. 24: Rotary coding switches at the device

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

Switch position	Meaning
000	Delivery state, no valid F-address
1...899	F address, accept setting by restarting the device
900	Factory Reset: Resets device to factory settings
901	Erase Memory: Deletes the content of the configuration memory

Setting the IP address via the web server

To set the IP address via the web server, the device must be in PGM mode.

- ▶ Open the web server.
- ▶ Log on to the device as administrator. The default password for the web server is "password".



NOTE

The password is transmitted in plain text.



NOTICE

Insufficiently secured devices

Unauthorized access to sensitive data

- ▶ Change your password after your 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.
- ▶ If necessary, activate settings for password complexity and password validity.

- ▶ Click **Station** → **Network Configuration**.
- ▶ Change the IP address and, if necessary, the subnet mask and the default gateway.
- ▶ Write the new IP address, the subnet mask and the default gateway via **Submit** into the device.

TURCK.COM For comments or questions, please email TURCK Support

TURCK

TBPN-L1-FDIO1-2IOL LOGOUT [ADMIN@192.168.1.47]

STATION >

Station Information

Station Diagnostics

Event Log

Ethernet Statistics

Links

Station Configuration

Network Configuration

Change Admin Password

Safety Information

Webserver Printf Log

BASIC >

SAFETY STATUS >

IO-LINK PORT 1 >

IO-LINK PORT 2 >

DIAGNOSTICS >

IO-LINK EVENTS >

Network Configuration

Network Settings

Ethernet Port 1 setup Autonegotiate

Ethernet Port 2 setup Autonegotiate

IP Address 192.168.1.2

Netmask 255.255.255.0

Default Gateway 0.0.0.0

MAC Address 00:07:46:08:59:0f

LLDP MAC Address 1 00:07:46:08:59:10

LLDP MAC Address 2 00:07:46:08:59:11

Submit Reset

fig. 25: Webserver — Network configuration TBPN-L...-2FDIO-2IOL

7.3.2 Address setting in PROFINET

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



NOTE

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

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

The address is assigned in two steps:

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

PROFINET naming convention

The device name is checked for correct spelling during input. The following rules apply to the use of the device name in accordance with PROFINET specification V2.3.

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

7.3.3 Addressing the device at PROFINET

In the delivery state or after a device reset to factory settings, neither a device name nor an IP address is set in the device .

PROFINET name

In PROFINET, the connected device is not identified by its IP address, but recognized and addressed by its device name. The device name can be freely chosen.

- Default device name (from GSDML): tben-l1-fdio1-2iol

Assigning the IP address

The devices IP address is usually set through the PROFINET controller. In the delivery state, the device can be accessed via the IP address 192.168.1.254.

The start page of the device web server can be accessed via <http://192.168.1.254/info.html> to make initial settings. For this, the PC used for configuration must be in the same IP network as the device itself.

7.4 Installing and licensing the TURCK Safety Configurator (TSC)

7.4.1 Downloading the software



NOTE

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

- Enter the code.

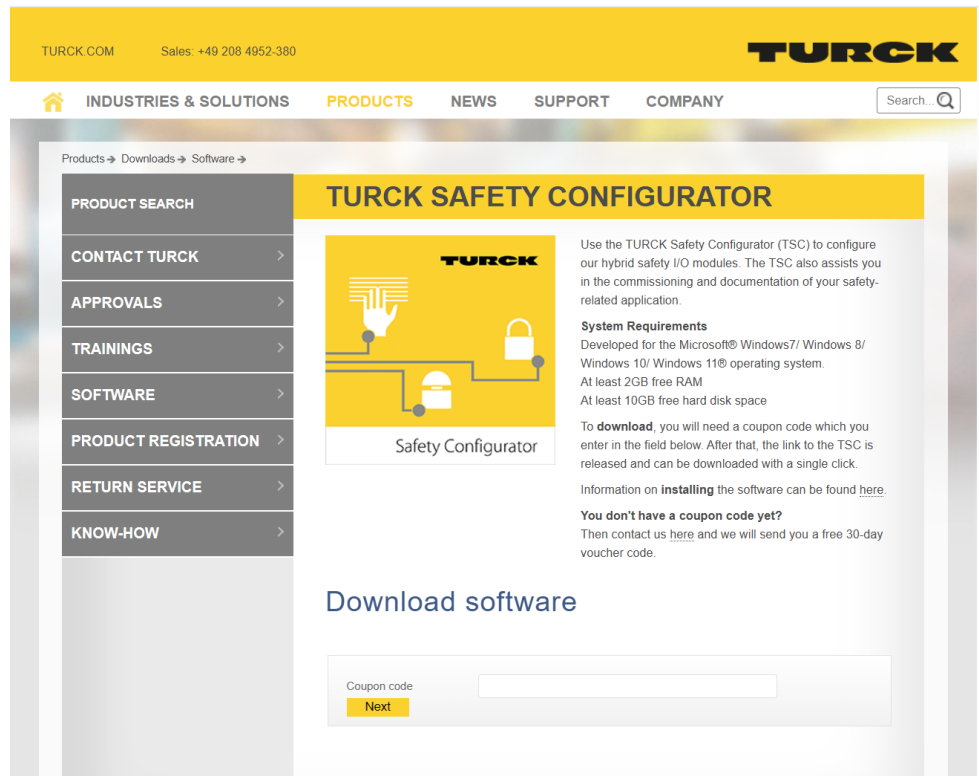


fig. 26: TURCK Safety Configurator: Entering the coupon code

- Download the software. TURCK recommends to always use the latest software.

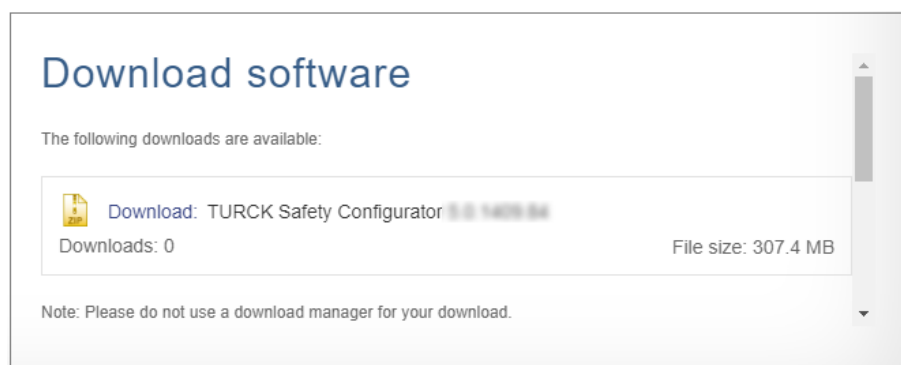


fig. 27: TURCK Safety Configurator: download

- Unpack the zip archive and install TURCK Safety Configurator.

7.4.2 Installing the Software

Prerequisites:

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

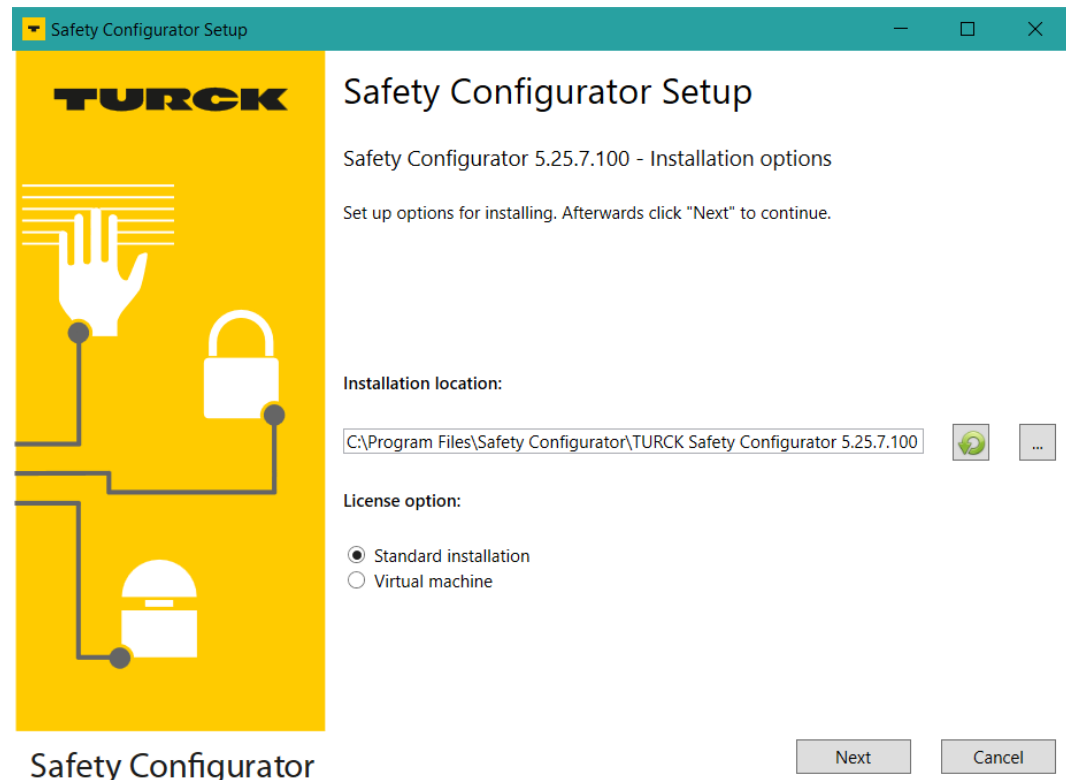


fig. 28: License options



NOTE

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

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

- ▶ If the TURCK Safety Configurator is to be opened directly from TIA Portal or Step7 later on: select the **Register in TIA/Step7** option in the **Installation options** step.

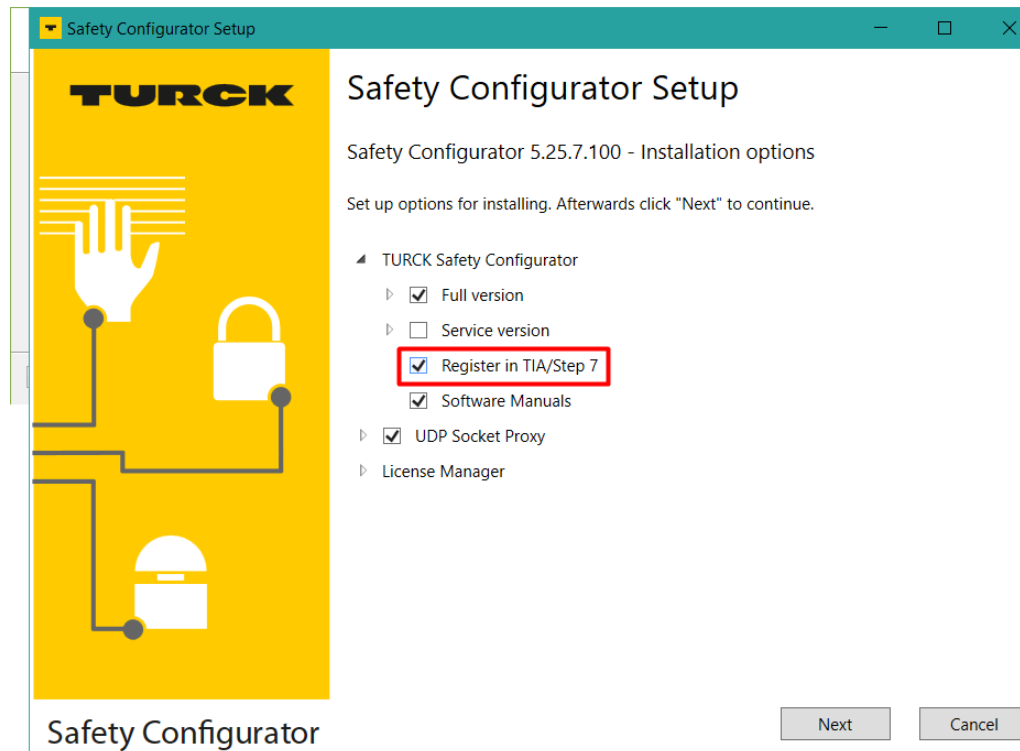


fig. 29: Register the TSC in TIA/Step7

- ▶ Click **Next** and start the installation.

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

7.4.3 Licensing the Software

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

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

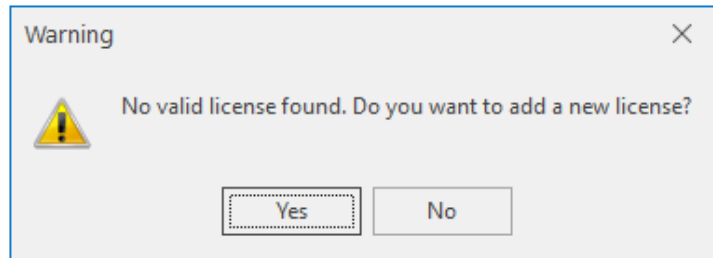


fig. 30: Dialog box: no valid license found

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

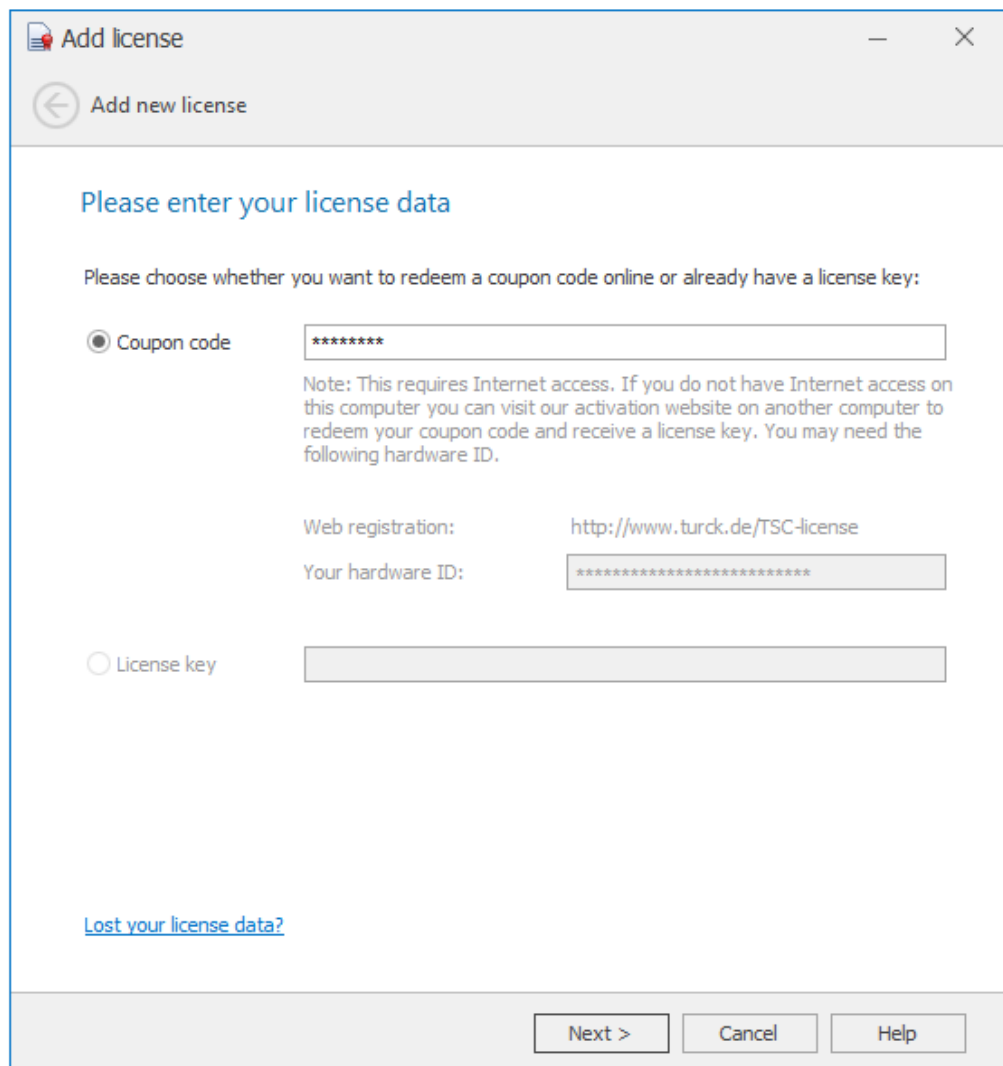


fig. 31: Entering the coupon code

8 Configuring

8.1 Creating a configuration with the TSC Commissioning wizard

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

8.1.1 Creating a new workspace

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

8.1.2 Selecting a master and creating a basic configuration

- ▶ Select the used device in the **Select master** dialog and confirm with **OK**.

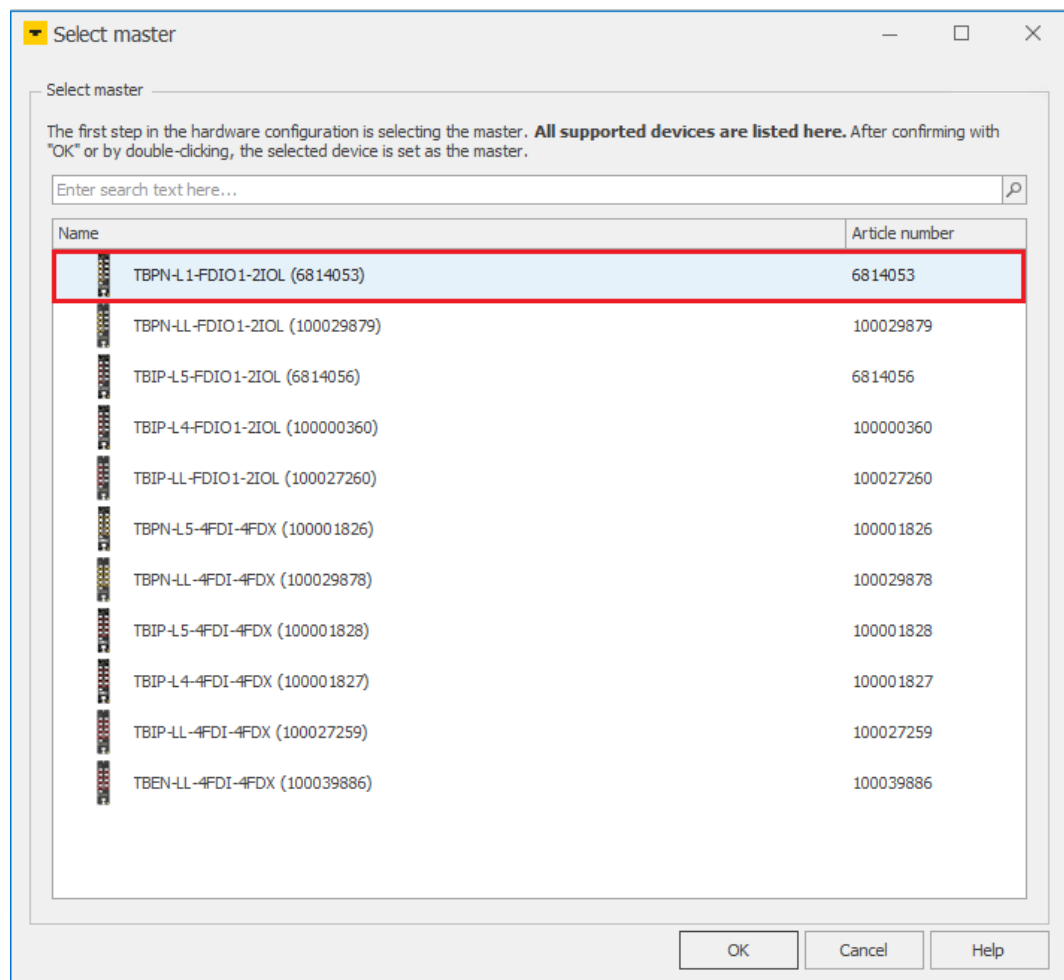


fig. 32: TSC – selecting a master

- ⇒ The dialog box **Properties – TB...** is opened.

The safe slots of the device can be configured in the **Local I/O** tab [► 47].

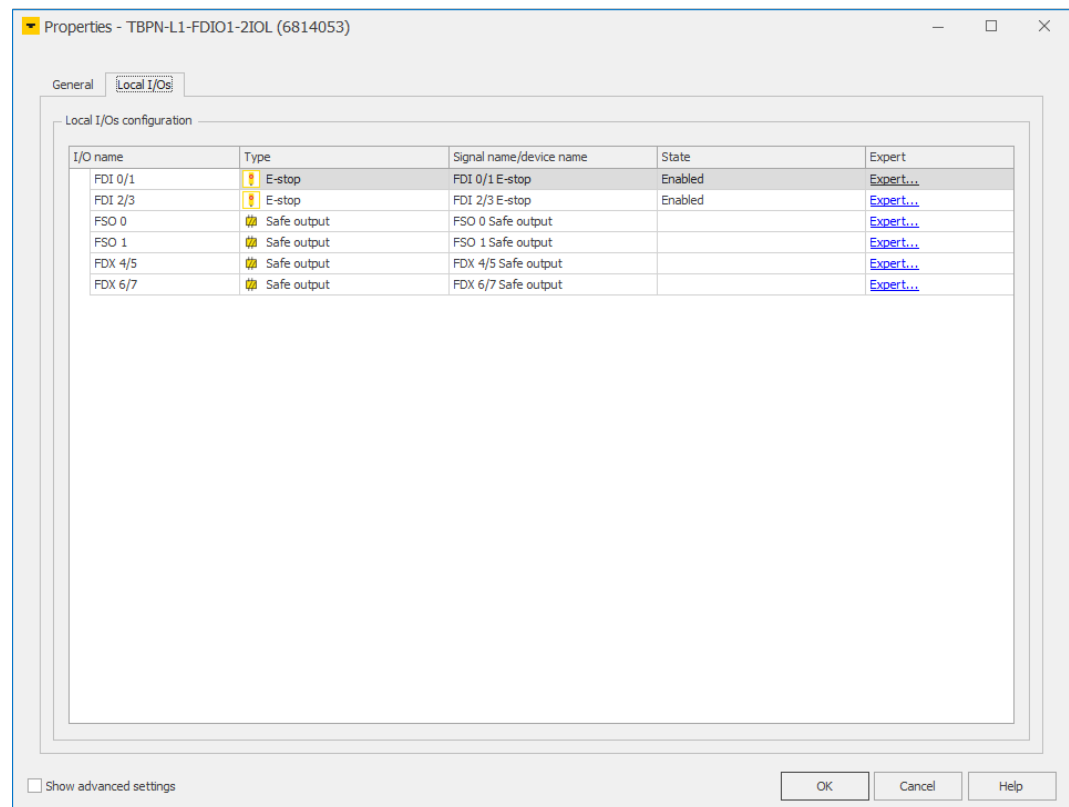


fig. 33: TSC – hardware configuration

Basic configuration

In the basic configuration, the safe inputs (FDI) at C0...C1 are defined as double channel forced, safe inputs (dry contact). The safe in-/outputs (FDX) at C2...C3 are configured as safe outputs according to PLe.

Channel	Type designation	I/O name	Device name
FDI0/1	E-stop	Safe input (dry contact)	Double channel forced
FDI2/3	E-stop	Safe input (dry contact)	Double channel forced
FSO0	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FSO1	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FDX4/5	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)
FDX6/7	Safe output	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)

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

Release circuits (OSSDs) of the basic configuration

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

Release circuit (OSSD)	Channels
OSSD 1	FSO0
OSSD 2	FSO1
OSSD 3	FDX4/5
OSSD 4	FDX6/7
...	...
OSSD 63	Input F-CPU 1-6
OSSD 64	Input F-CPU 1-7

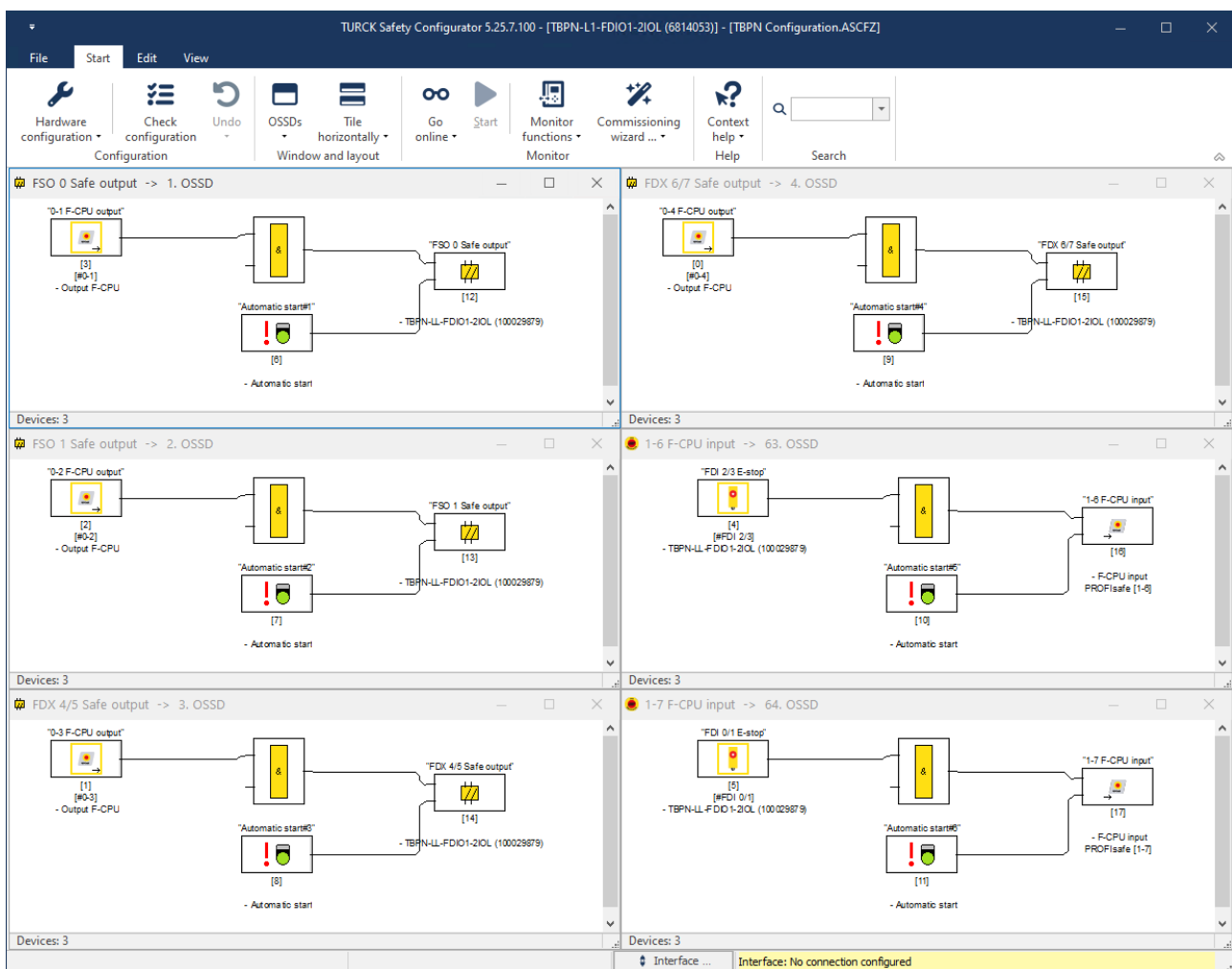


fig. 34: TSC – release circuits (OSSDs) of the basic configuration

8.1.3 Adapting the configuration of the safe channels

The channels of the device are configured in the register tab **Local I/Os** → **Expert** to meet the requirements of the respective applications.

Configuration options

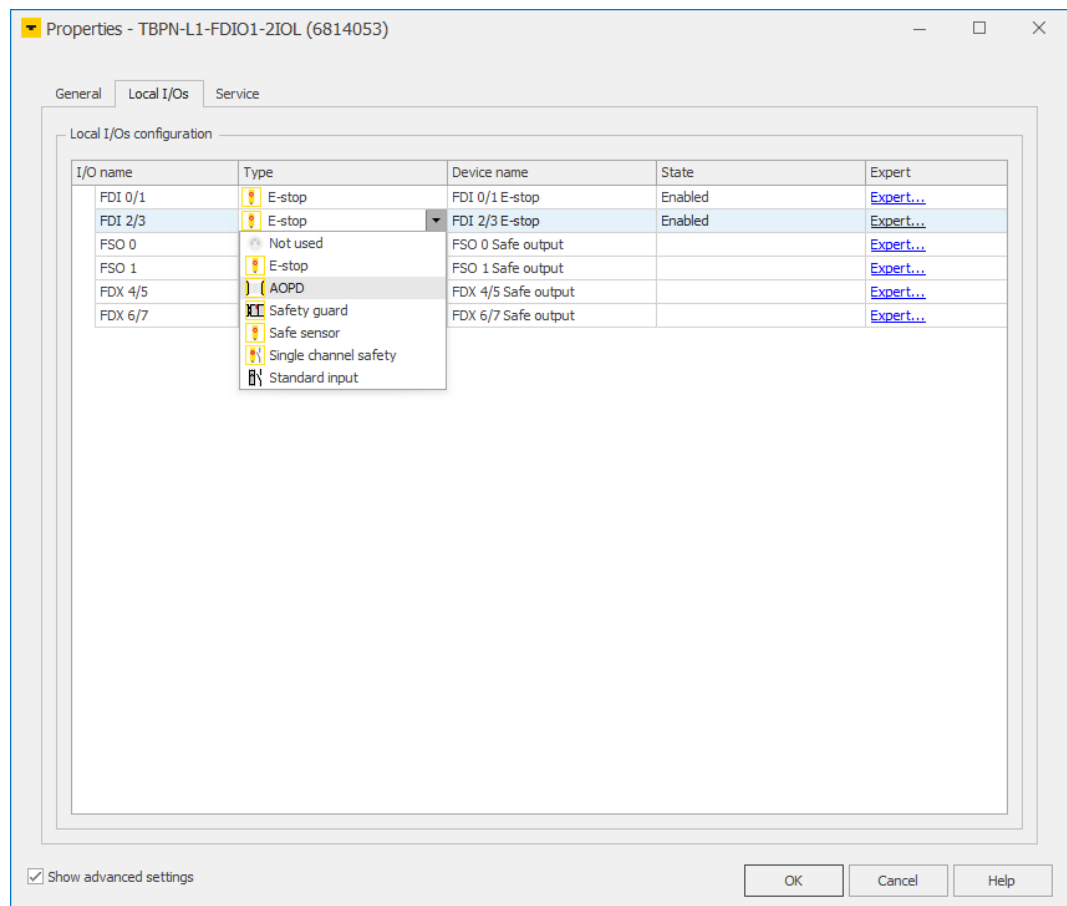


fig. 35: TSC – configuration of I/Os

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

The image displays two side-by-side screenshots of the 'Expert settings' dialog box in the TURCK Safety Configurator. The left window is configured for an 'E-stop' safe input, showing fields for Type name, Graphic, I/O type, Test pulse length, Device type, and checkboxes for Startup test, Local acknowledgment/reset, and Acknowledge also after startup. The right window is configured for a 'Safe output', showing fields for Type name, I/O type, Test pulse interval, Assignment, Switch-off delay, and Auxiliary signals (Error unlock and Restart). Both windows include 'Restore defaults', 'OK', 'Cancel', and 'Help' buttons at the bottom.

fig. 36: TSC – expert settings



NOTE

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

Example configuration

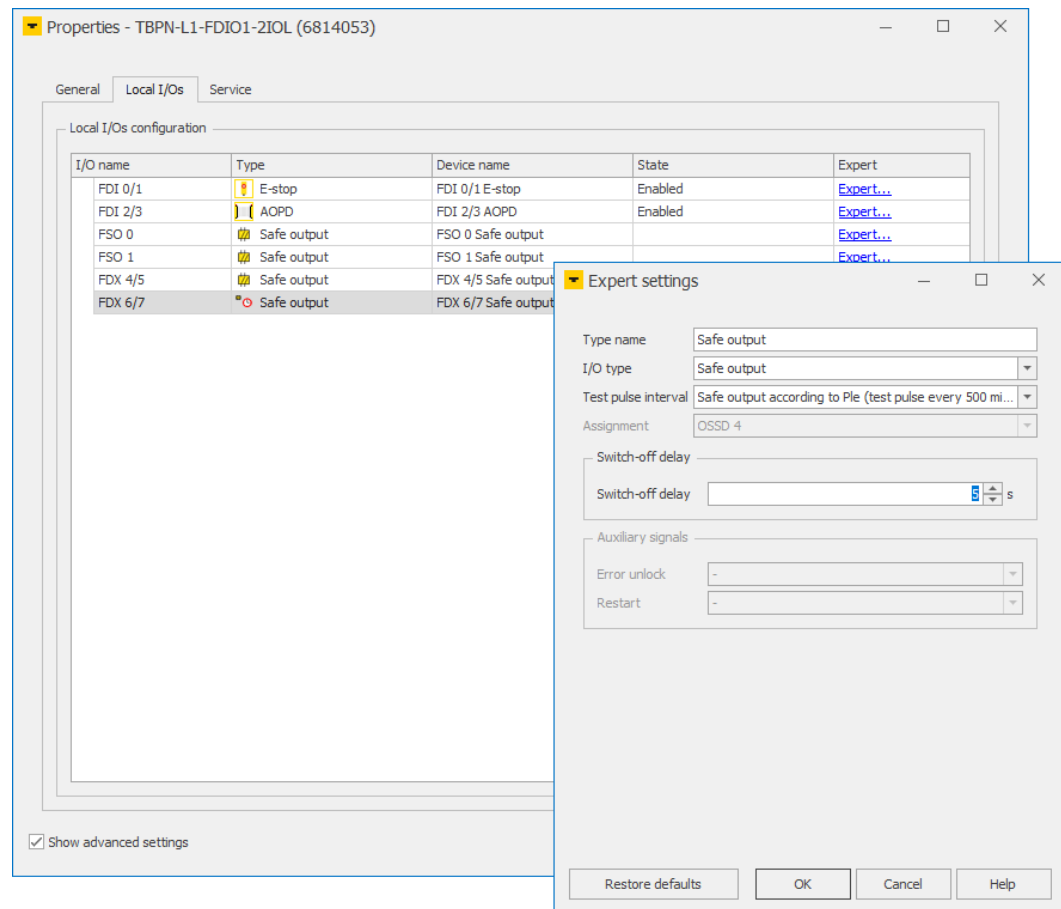


fig. 37: TSC – expert settings (example configuration)

Connector at device	Channels	Type	I/O type (Expert setting)	Later function (see application example [59])
C0	FDI0/1	E-stop	Safe input (dry contact), double channel forced	Safely switches off output at FDX4/5.
C1	FDI2/3	Light grid (AOPD)	Safe input (OSSD), double channel depending	Safely switches off output at FDX4/5.
-	FSO0	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)	Internal safe outputs The non-safe channels at C4... C7 remain permanently on via the internal safe outputs.
-	FSO1	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)	
C2	FDX4/5	Safe output	Safe output according to PLe (test pulse every 500 milliseconds)	Is safely switched off when output FDX4/5 switches, signal forwarding to the F-CPU
C3	FDX6/7	Safe output, switch-off delay	Safe output (plus and minus switching, no test pulses)	Is safely switched off when output FDX4/5 switches, signal forwarding to the F-CPU
C4...C7		Non-safe channels		

- Adapt the expert settings and close with **OK**.

Advanced settings – Global error unlock

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

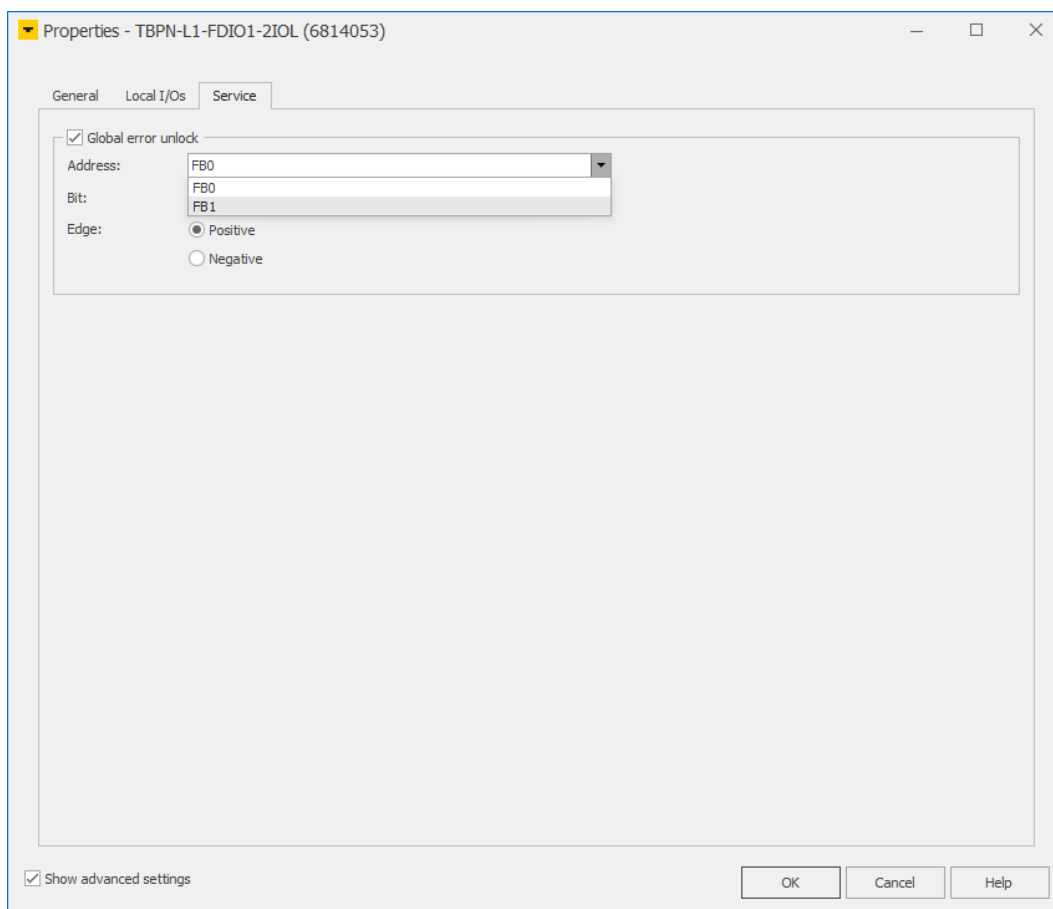


fig. 38: TSC – advanced settings, global error unlock

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



NOTE

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

Complete the hardware configuration in the start assistant

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

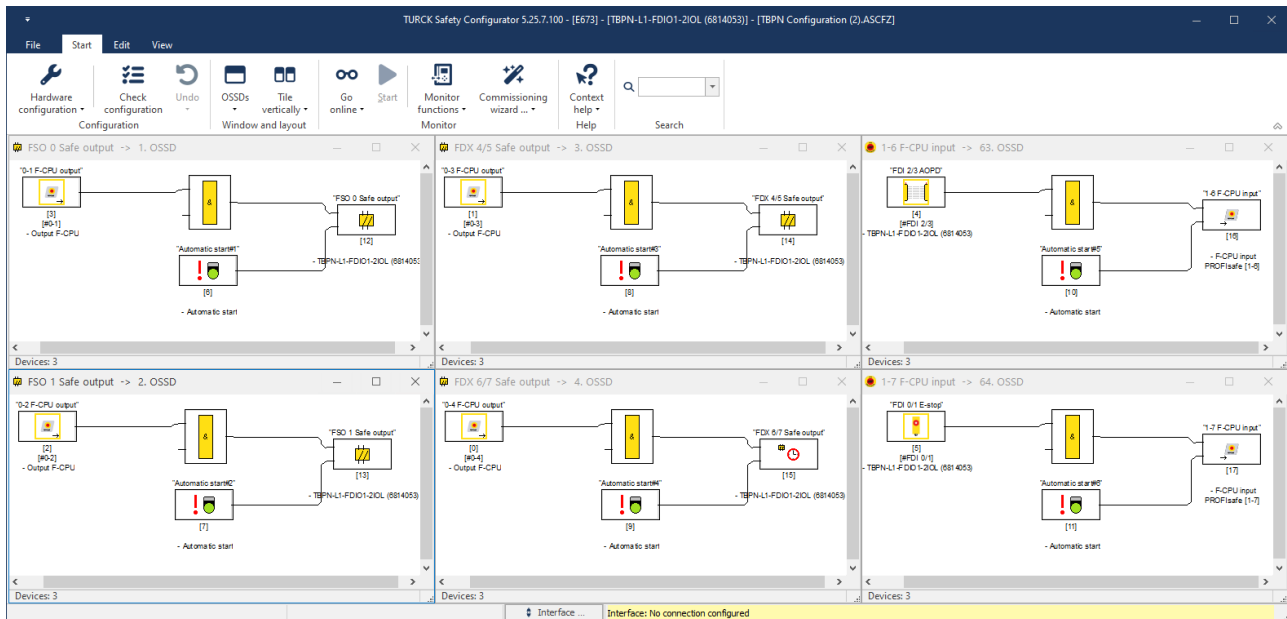


fig. 39: TSC – release circuits (example configuration)

Channels	Type	OSSD	Adaptation
FDI0/1	E-stop	64. OSSD	unchanged
FDI2/3	Light grid (AOPD)	63. OSSD	unchanged
FSO0	Safe output	1. OSSD	unchanged
FSO1	Standard input	2. OSSD	unchanged
FDX4/5	Safe output	3. OSSD	The state of OSSD 64 and 63 leads to switch-off this OSSD, monitored (see “Switch off FDX4/5 (1. OSSD)”)
FDX6/7	Safe output, switch-off delay	4. OSSD	The state of OSSD 3 leads to switch-off this (see “Switch off FDX6/7 (4. OSSD)”)

8.2 Loading the configuration with the TSC commissioning wizard

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

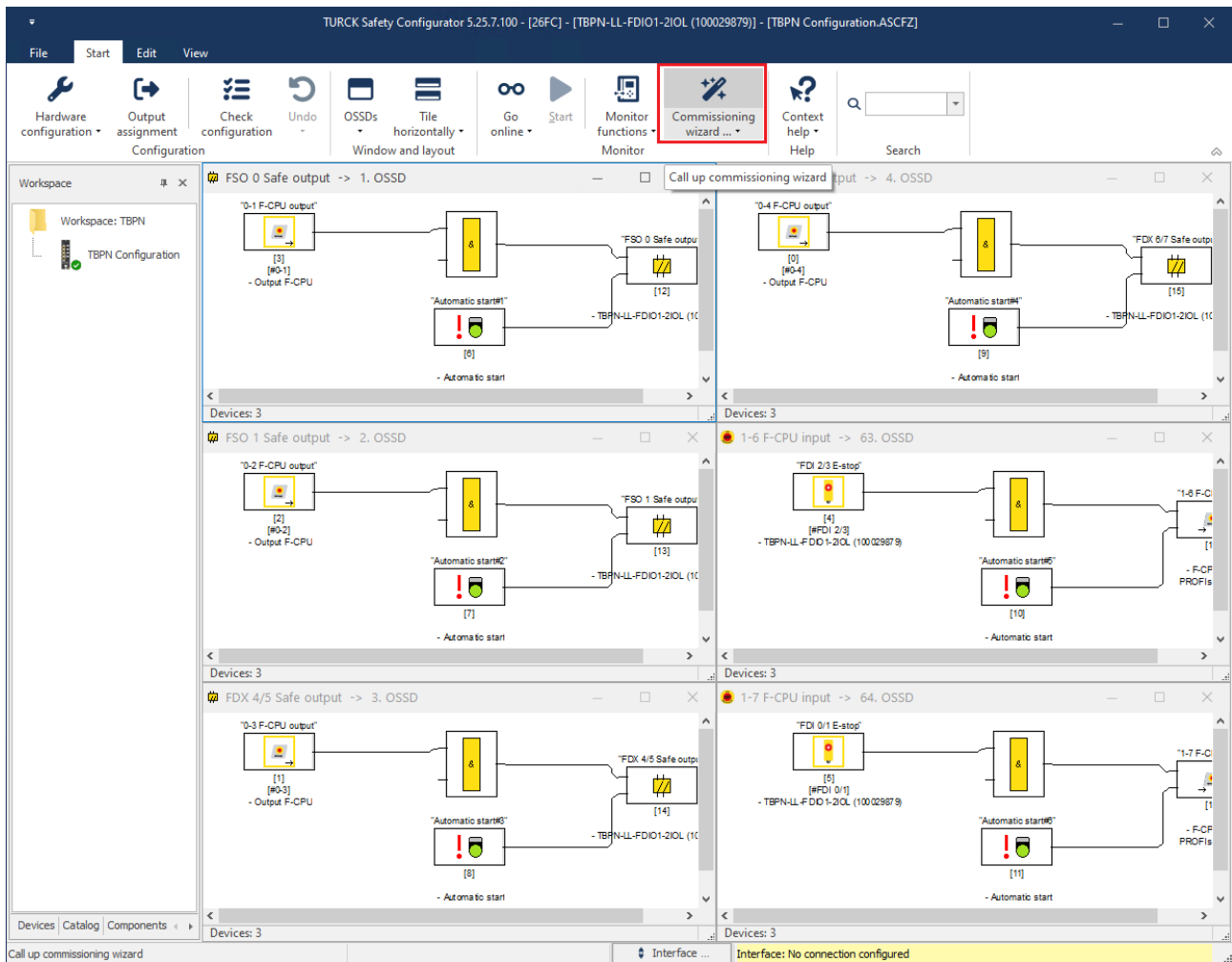
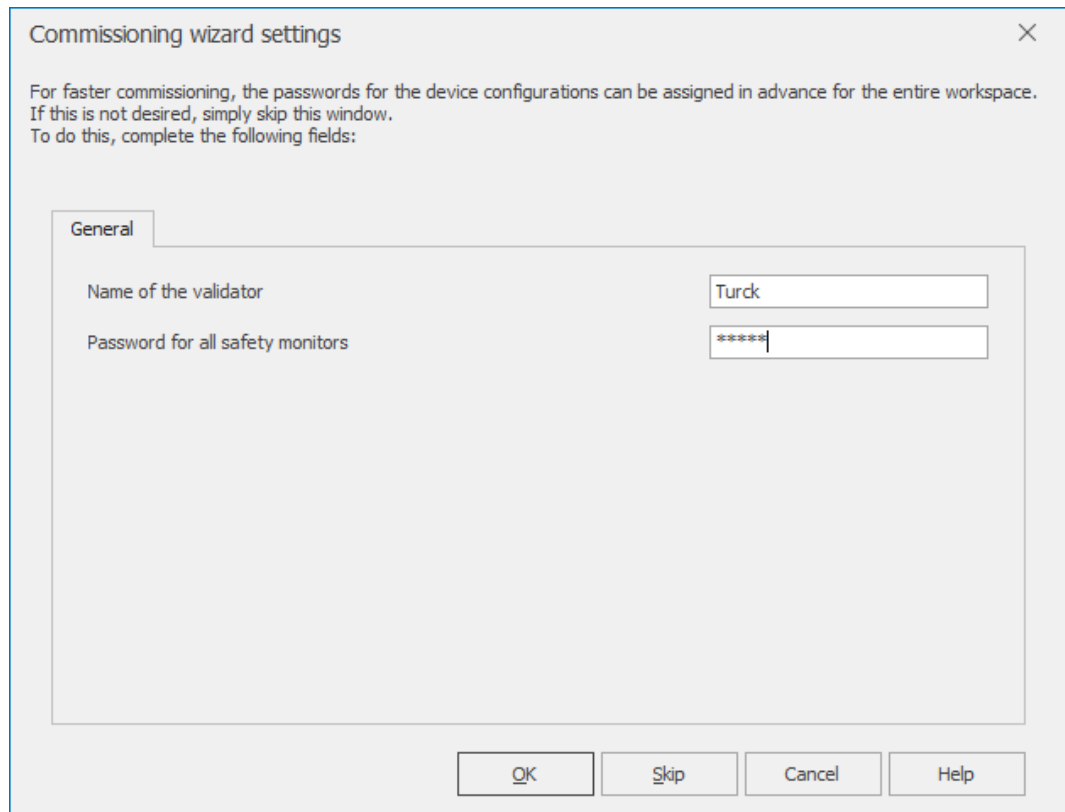


fig. 40: TSC – start the commissioning wizard

- Optional: Passwords can be defined for the entire workspace. In the dialog **Commissioning wizard settings**, enter the **Name of the validator** and the **Password for safety monitors (release password)** and confirm with **OK**.



Commissioning wizard settings

For faster commissioning, the passwords for the device configurations can be assigned in advance for the entire workspace. If this is not desired, simply skip this window. To do this, complete the following fields:

General

Name of the validator: Turck

Password for all safety monitors: *****

OK Skip Cancel Help

fig. 41: TSC – commissioning wizard, assigning a password

- ⇒ The first connected TBPN-L...-FDIO1-2IOL is prepared for the configuration download.

- **Optional:** If the TBPN-L...-FDIO1-2IOL is not found, enter the device's IP address under **Ethernet** or scan the network for the connected device.

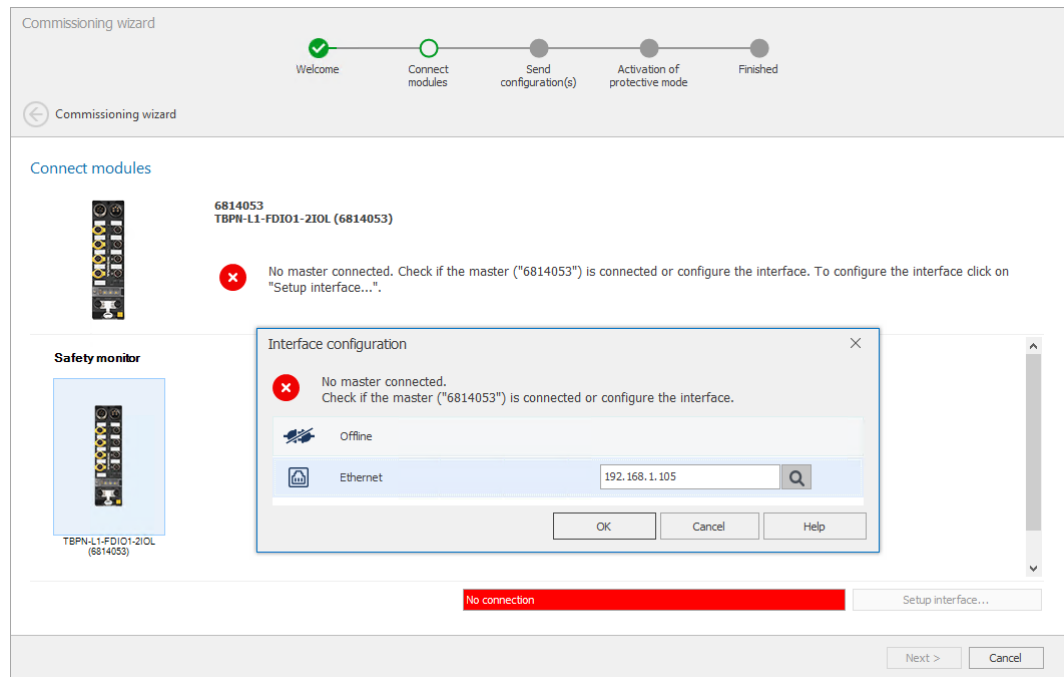


fig. 42: TSC – interface configuration

- Confirm with **OK** and store the setting in the project (**store the interface in the workspace**).
- ⇒ The configuration is sent to the TBPN-L...-FDIO1-2IOL. This process may take a few seconds.
- ⇒ The first step is to create a configuration log for review.

- Check the configuration using the configuration protocol and confirm the check.

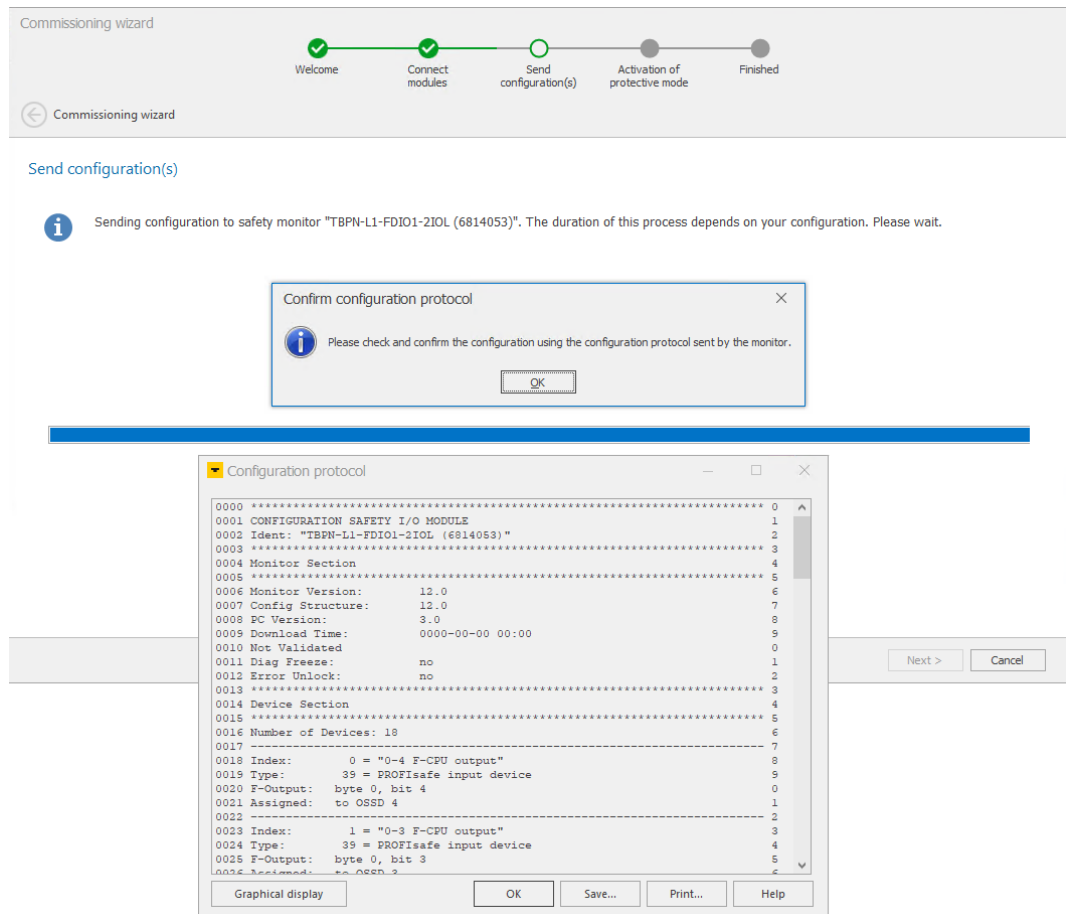


fig. 43: TSC – confirming check of the configuration protocol

Release configuration

- Enter the name of the person releasing the configuration and the release password in the **Release Configuration** window, then release the configuration.

fig. 44: TSC – release configuration

- ⇒ The configuration is released and the configuration log is saved with the release code and the data of the person who released it.

After approval, the final configuration log (including the name of the approver and approval code) is created.

fig. 45: TSC – release configuration

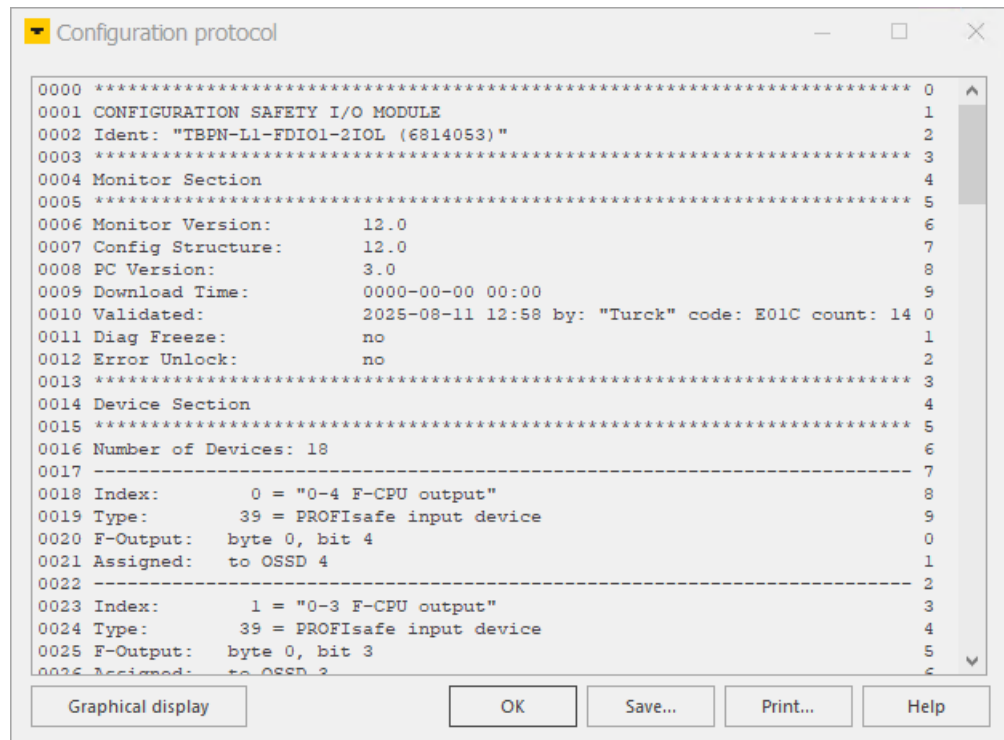
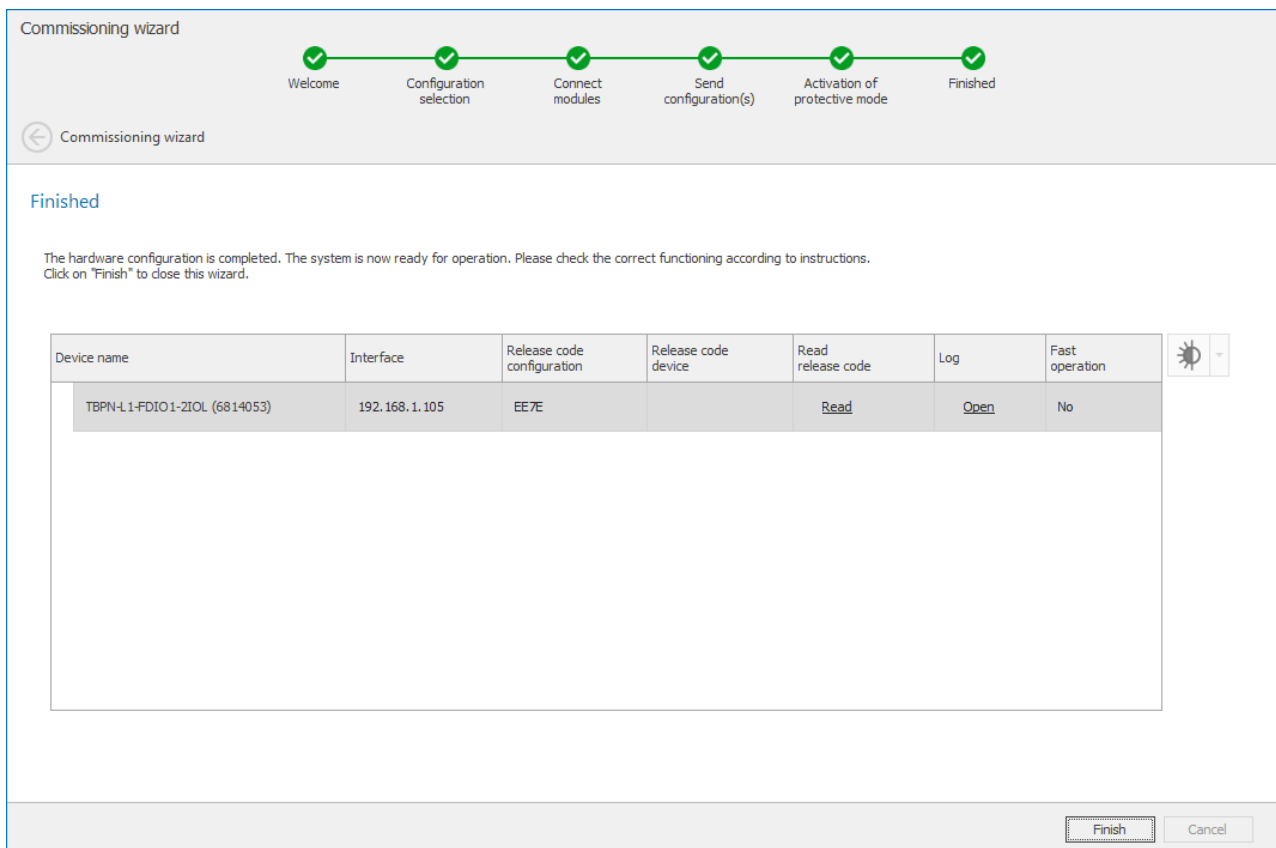


fig. 46: TSC – commissioning wizard configuration protocol

- ▶ Optional: Save the configuration log.
 - ▶ Complete the configuration with **OK**.
- ⇒ After the **activation of the protection mode**, all hardware configurations are listed.



- Complete commissioning via **Finish**.
- ⇒ The TURCK Safety Configurator changes to the online mode and opens the diagnostics configuration.

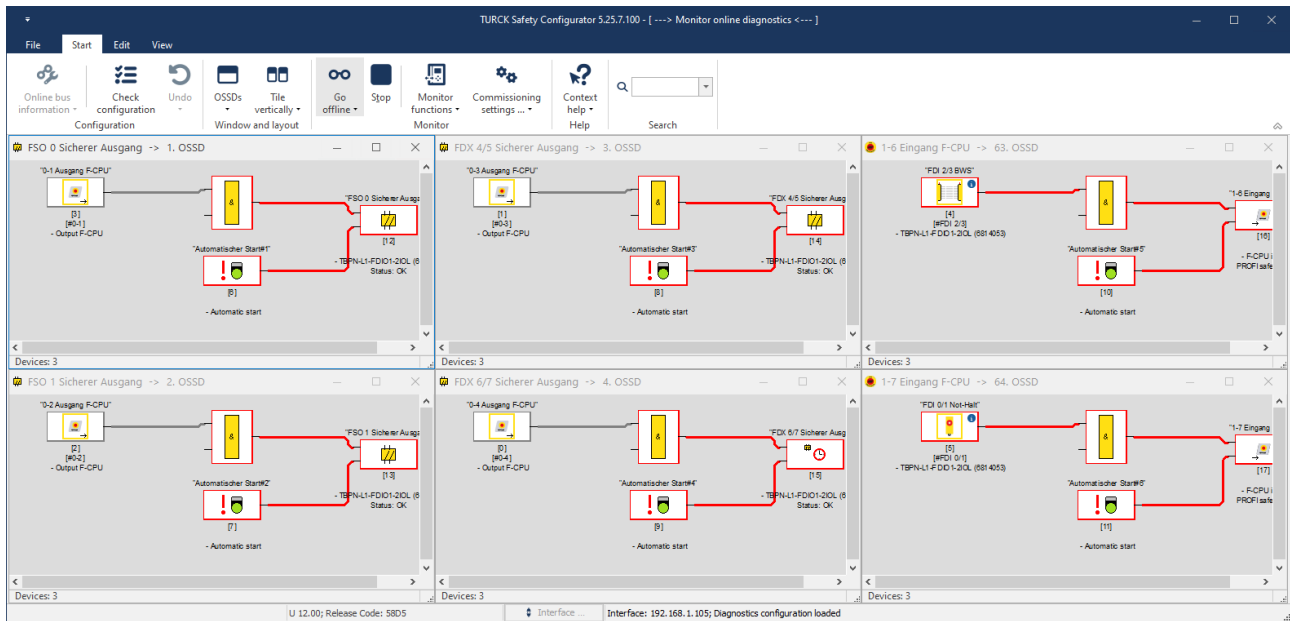


fig. 47: TSC – Diagnostics configuration (online, no communication to safety PLC)

8.3 Application example – configuring a safety function in TSC

The following safety function is realized with the example configuration:

- Output FDX4/5 at C2 (3. OSSD) switches off when the emergency stop at FDI0/1 (64. OSSD) and/or the light grid at FDI2/3 (63. OSSD) are activated.
- Output FDX6/7 at C5 (4. OSSD), if output FDX4/5 is switched. Signal forwarding to F-CPU.
- Non-safe channels at C4...C7 remain permanently on via the internal safe outputs (FSO0 and FSO1).
- The complete safety function is released via a release bit in the F-CPU (3. (OSSD).
- The state of output FDX4/5 is monitored via a PROFIsafe bit in the F-CPU.

Safely switch off FDX4/5 (3. OSSD)

Output FDX4/5 at C4 (3. OSSD) has to be switched off as soon as the emergency shutdown at FDI0/1 (64. OSSD) or the light grid at FDI2/3 (63. are activated. This means, the state of the OSSDs 63 and 64 controls the state of output FDX4/5.

- ▶ Delete **output F-CPU** in 3. OSSD.
- ▶ Select the device **State of output switching element** from the device library and place it at the function input. In the dialog box **State of output switching element x** select OSSD 64 under **Assignment**.

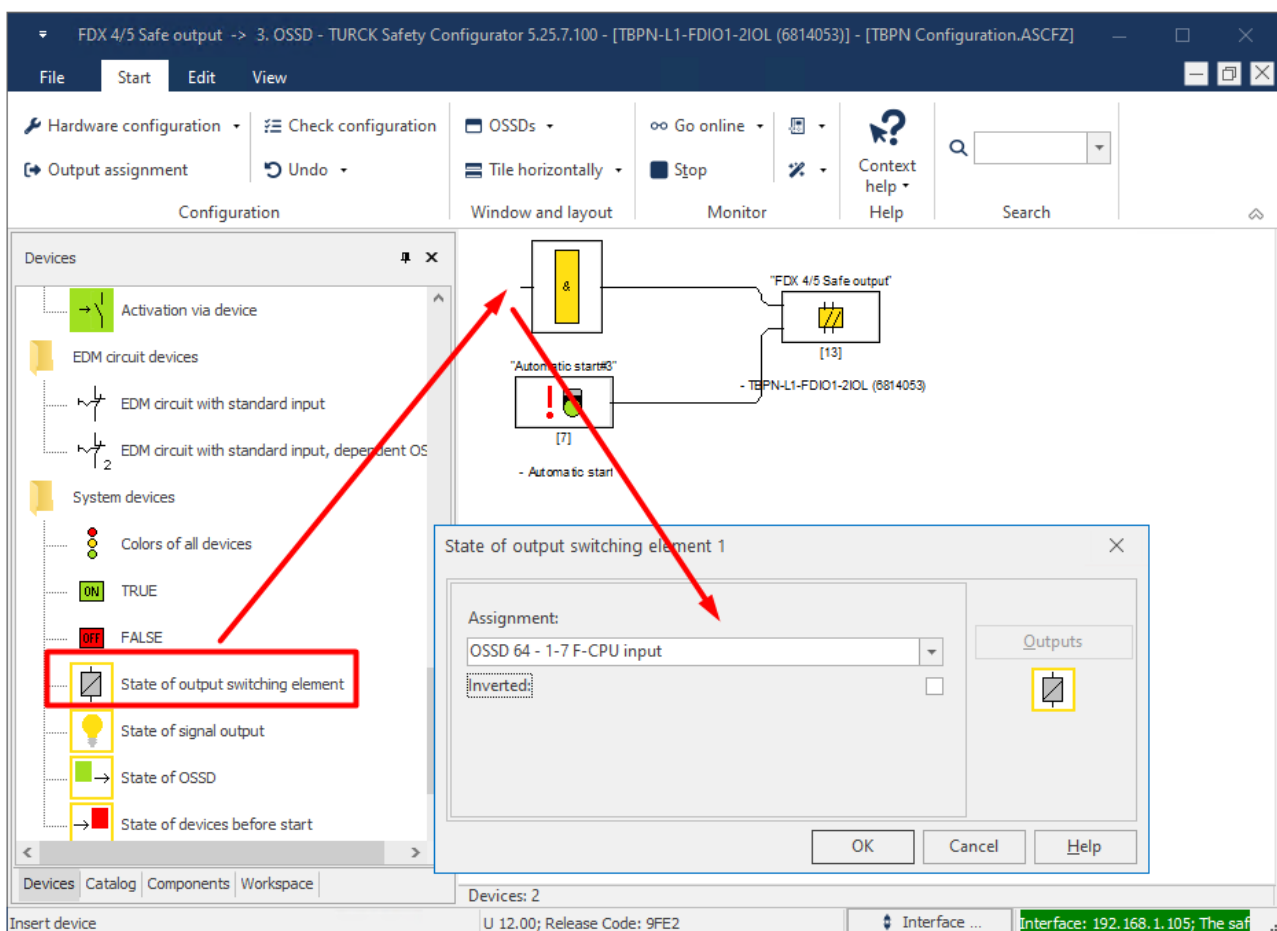


fig. 48: TSC – 3. OSSD, state of output switching element OSSD 63

- Select the device **State of output switching element** from the device library and place it at the function input. In the dialog box **State of output switching element x** select OSSD 64 under **Assignment**.

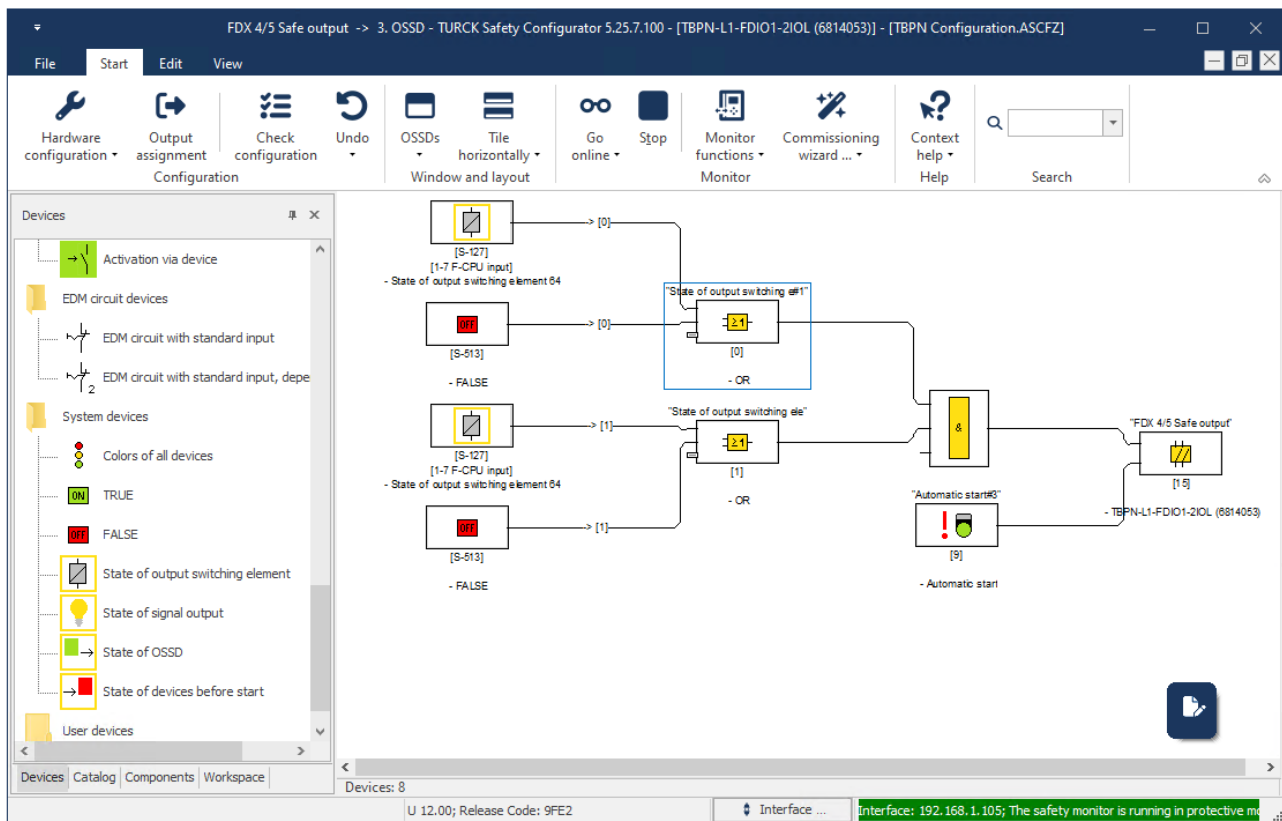


fig. 49: TSC – 3. OSSD, state of output switching element OSSD 63 and OSSD 64

- ⇒ The activation of the emergency shutdown at FDI0/1 or the light grid at FDI2/3 switches off output FDX4/5.

Safely switch off FDX6/7 (4. OSSD)

Output FDX6/7 at C5 (4. OSSD) has to be switched off as soon as the emergency shutdown at FDX4/5 (3. OSSD) switches. This means, the state of the OSSD 3 controls the state of output FDX6/7.

- ▶ Delete **output F-CPU** in 4. OSSD.
- ▶ Select the device **State of output switching element** from the device library and place it at the function input. In the dialog box **State of output switching element x** select OSSD 3 under **Assignment**.

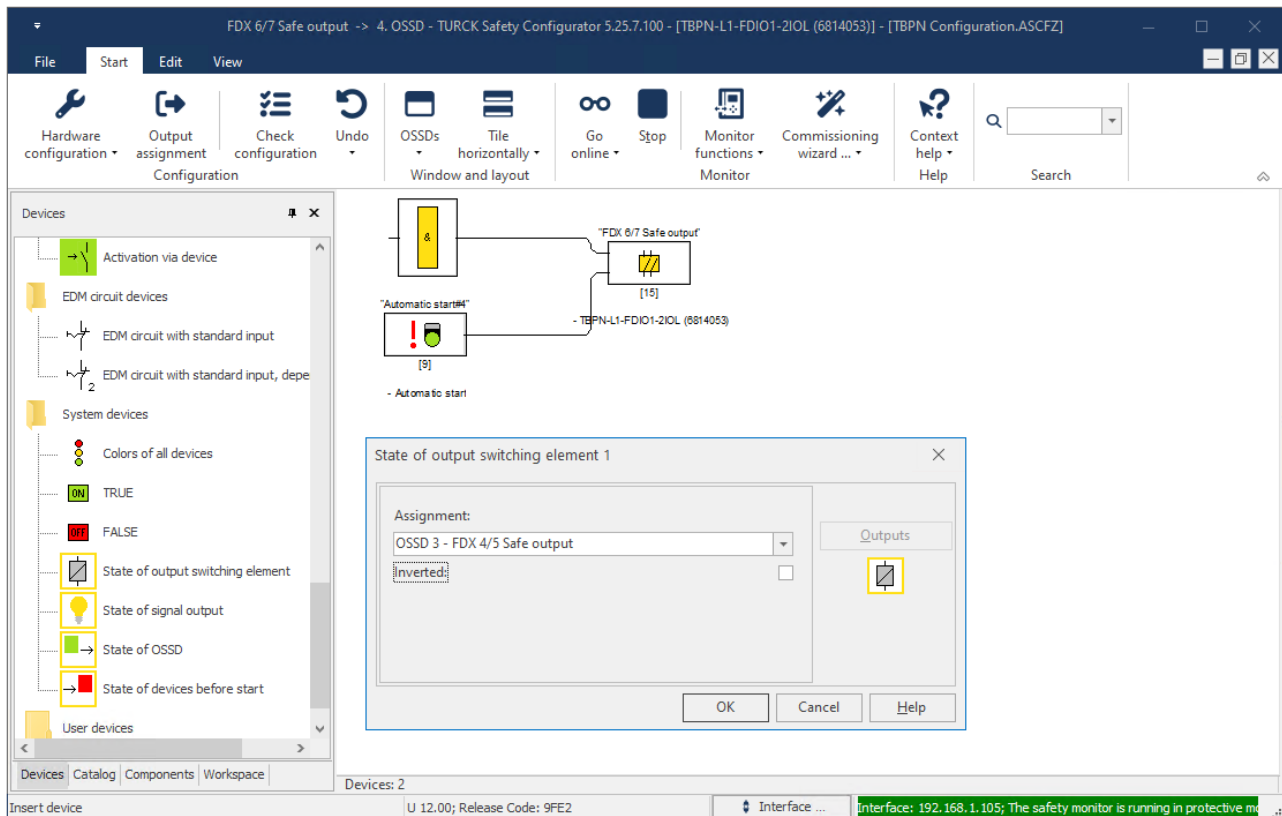


fig. 50: TSC – 4. OSSD, state of output switching element OSSD 3

⇒ The state of OSSD 3 controls the output FDX6/7 in OSSD 4.

Release of the safety function via a release bit in the F-CPU

The release of the safety function is done using a release bit in the F-CPU. Therefore, an output bit of the F-CPU is assigned to the output function in the 3. OSSD.

- ▶ Select the element "Output F-CPU" in the device library and place it at the third input of the function.

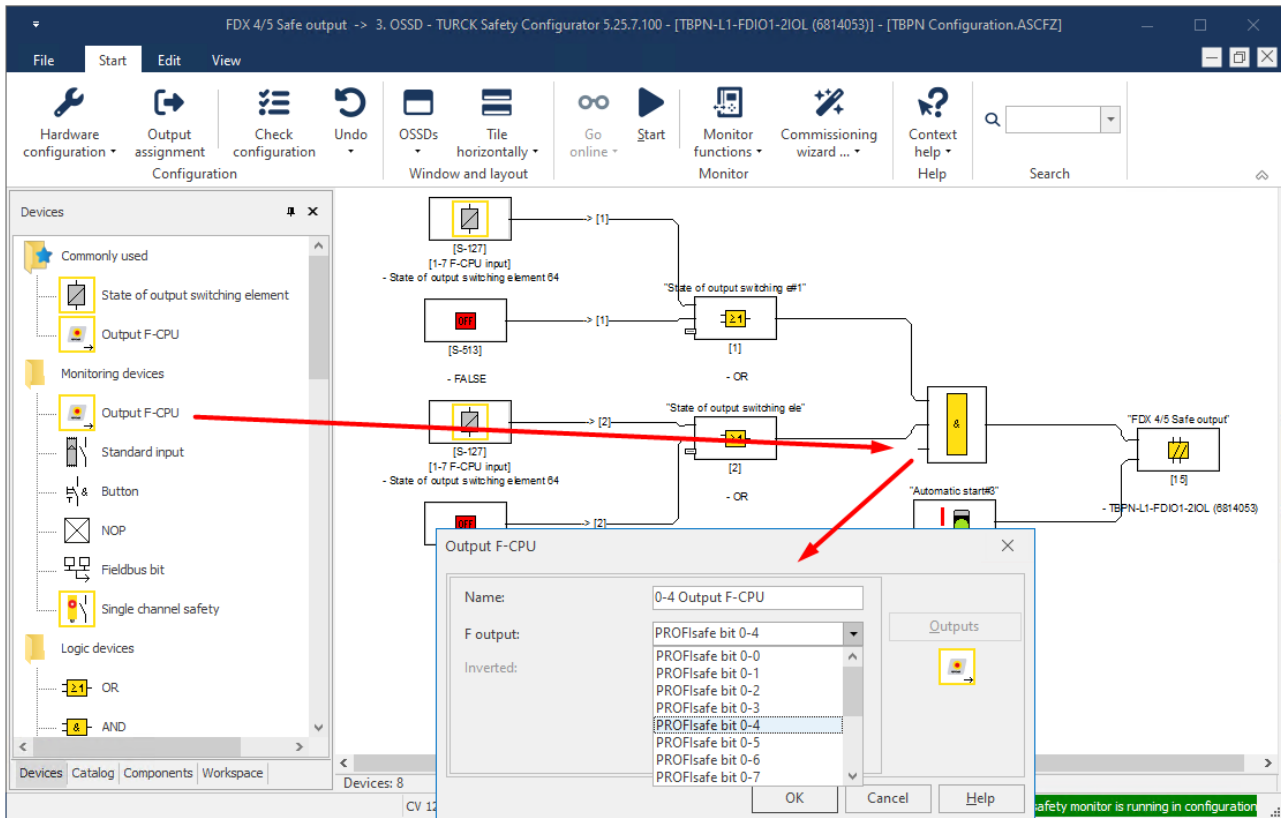


fig. 51: TSC – release of the safety function via a release bit from the F-CPU

- ⇒ After an error, the safety function will only restart if the emergency shutdown as well as the light grid are error free and the release bit in the F-CPU is set.

Monitoring an output in the F-CPU

The state of the output is monitored via a PROFIsafe bit in the F-CPU.

- Open the **Output assignment** and assign a PROFIsafe bit to output FDX4/5.

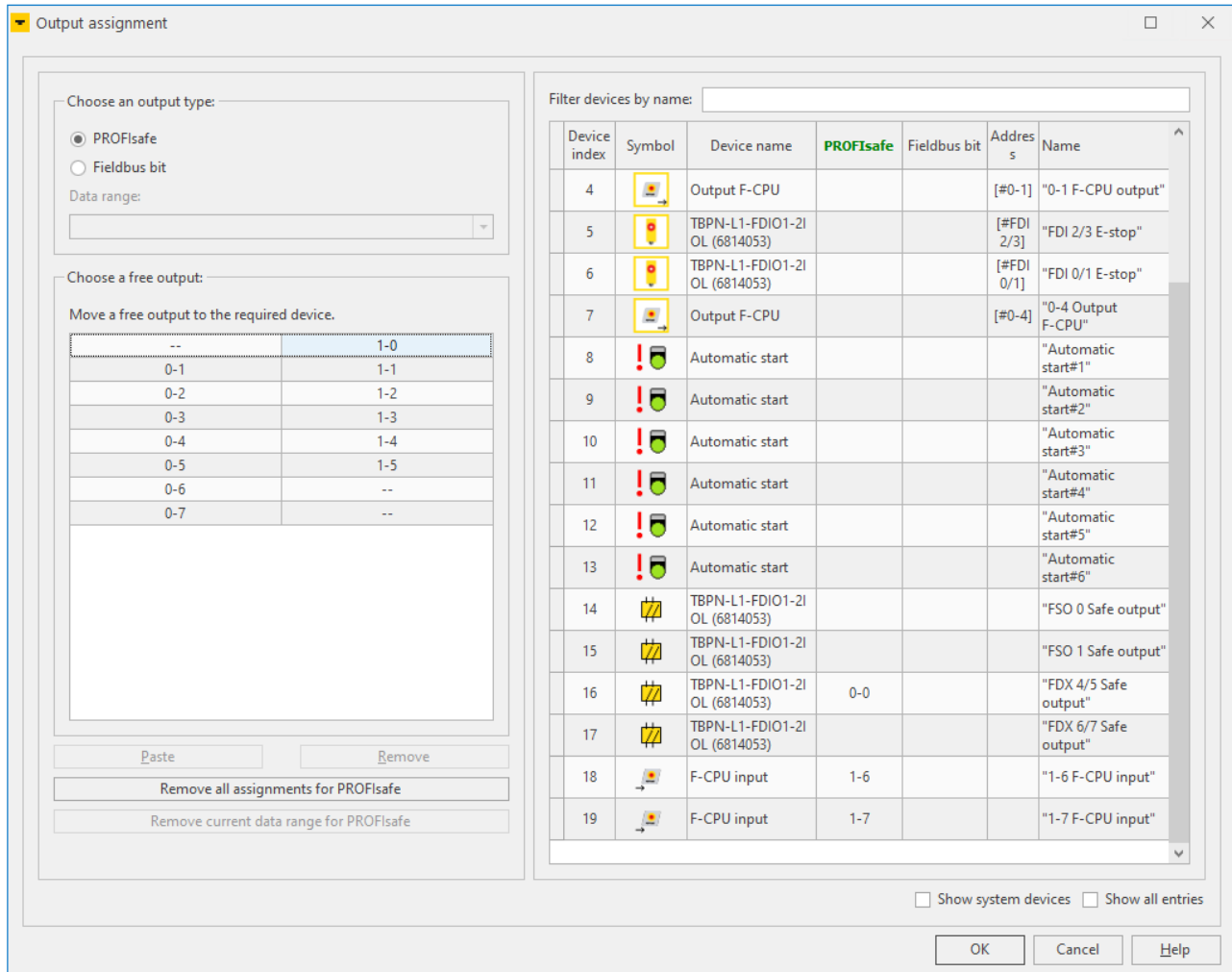


fig. 52: TSC – output assignment PROFIsafe bit

8.3.1 Checking and loading the configuration

The TURCK Safety Configurator checks the created configuration for logical errors, which means the logical wiring of the single components in the release circuits is checked. The configuration check does not consider double allocation etc.

- Start the check using the **Check configuration** button.

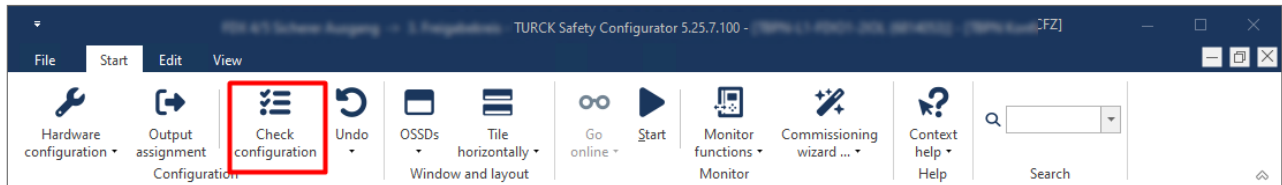


fig. 53: Checking the Configuration

- Load the configuration via the commissioning wizard [► 52] or the PC → **Monitor** function into the device.

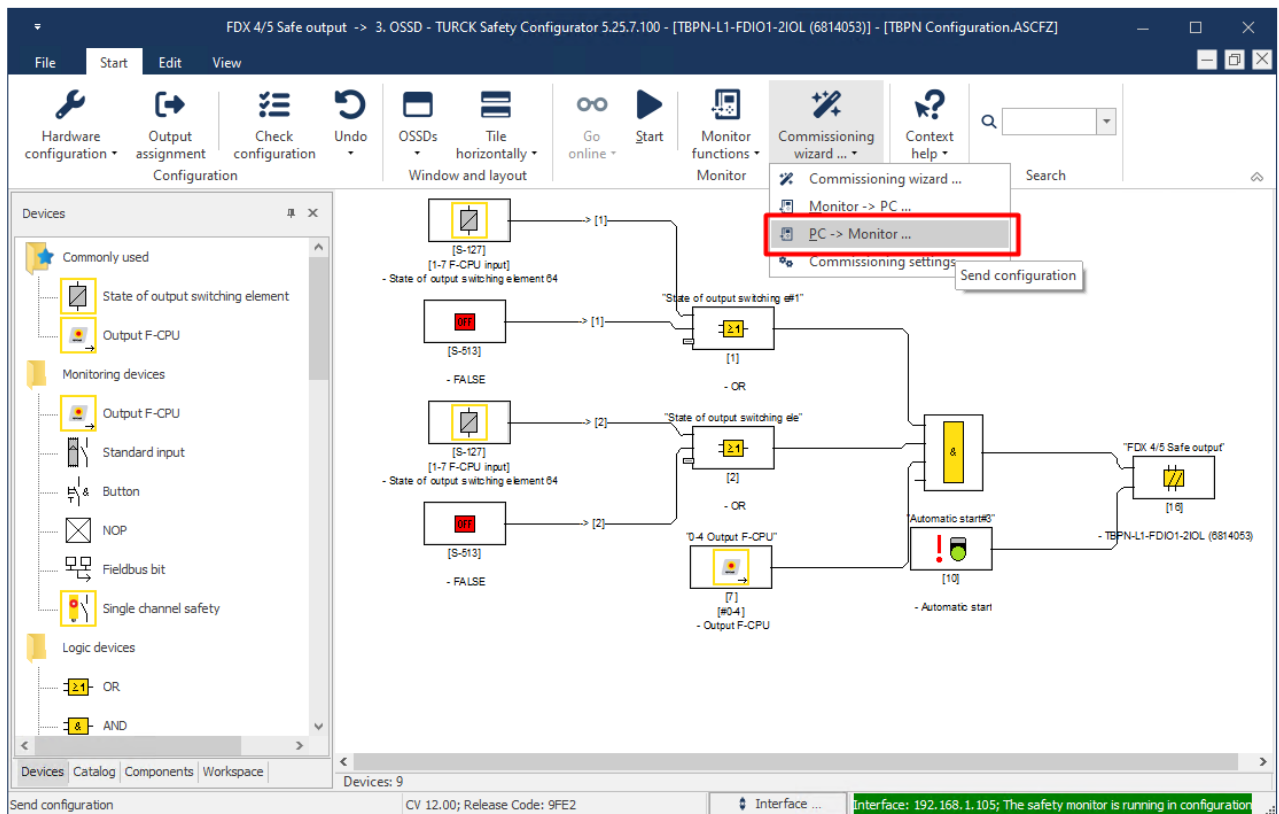


fig. 54: TSC – sending the configuration

8.4 Configuring single channel safety sensors

If a slot is configured as **Single channel safety** in TURCK Safety Configurator, then the double channel function for the slot is disabled.

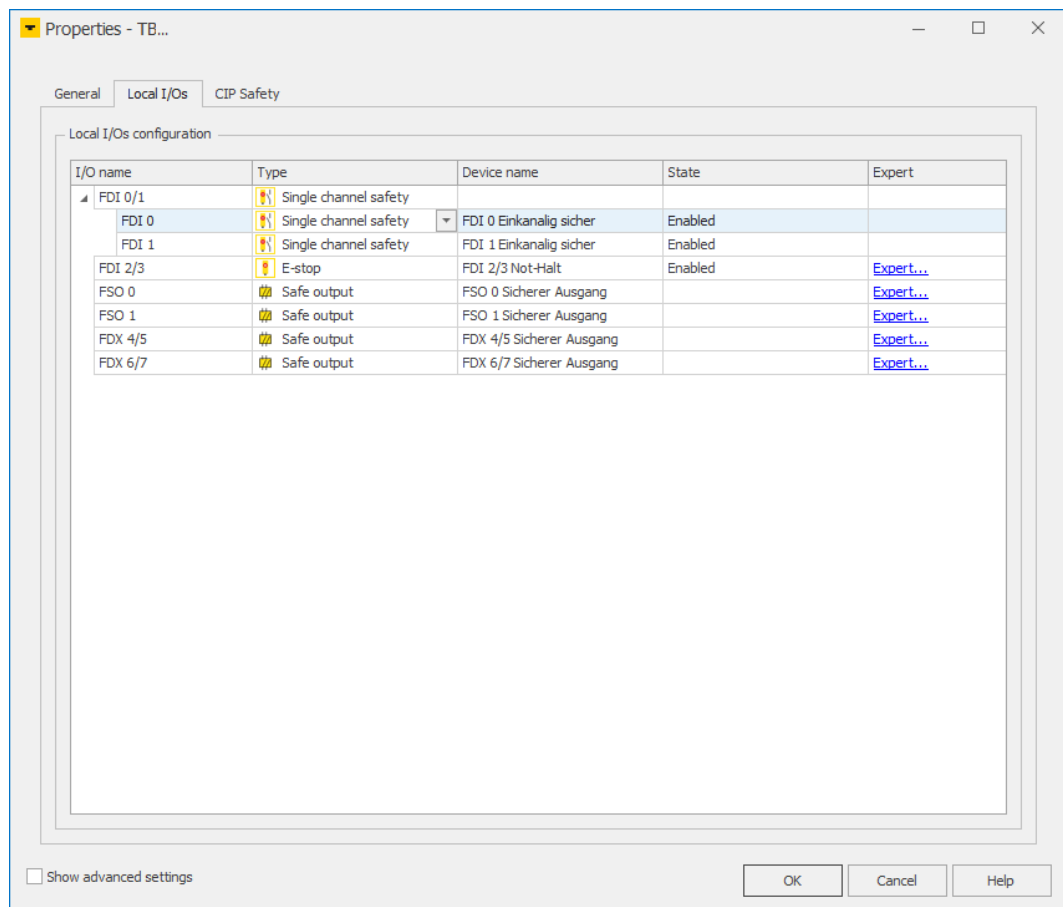


fig. 55: TSC – single channel inputs

No release circuits are generated for the single channel inputs. The OSSDs have to be created manually.

- Use OSSDs → Create new OSSD to create a new OSSD.

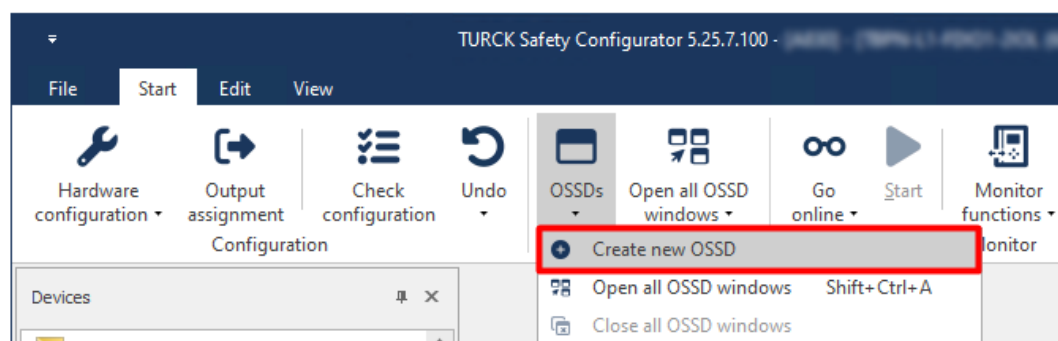


fig. 56: TSC – creating a new OSSD

- Drag the single-channel safe input from the catalog into the new window. Unused channels are displayed in **bold**.

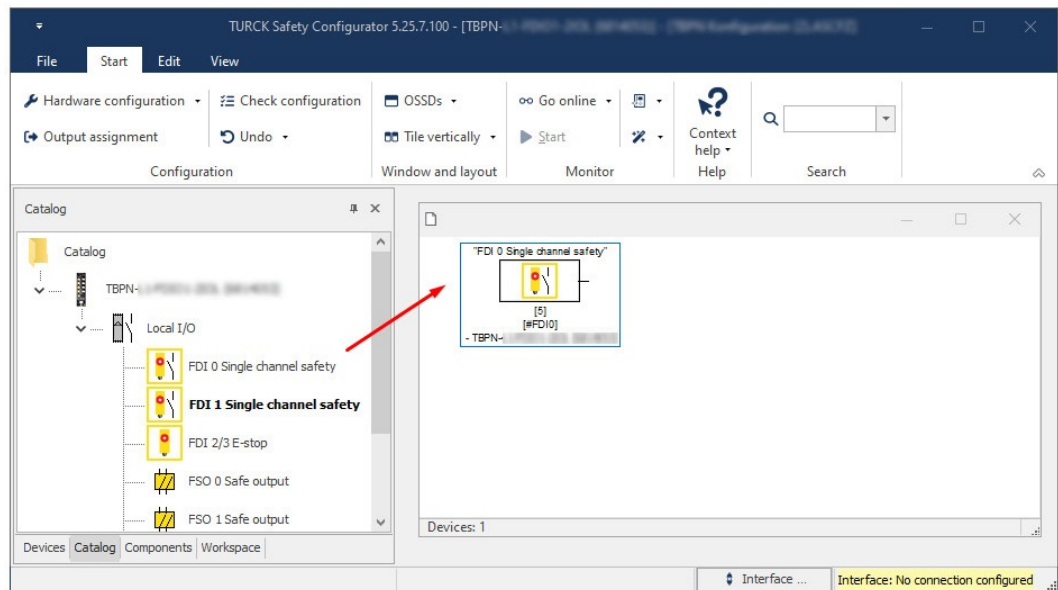


fig. 57: TSC – configuring an OSSD for a single channel safety input

- Link the single channel safe input with an Input F-CPU.

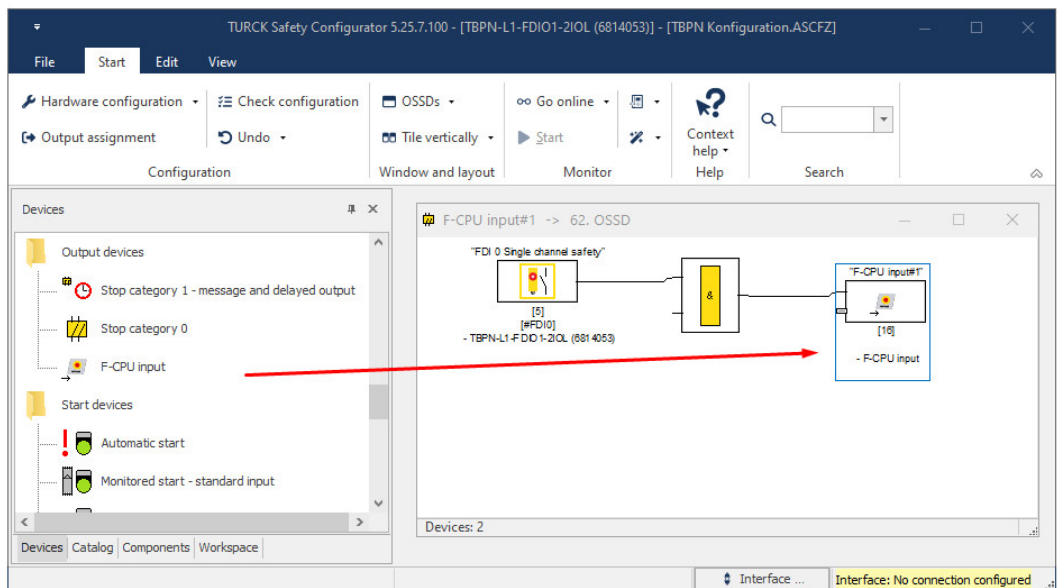


fig. 58: TSC – linking a single channel safe input with the PLC

- Add an automatic start and assign a PROFIsafe bit in order to be able to monitor the single channel sensor from the PLC.

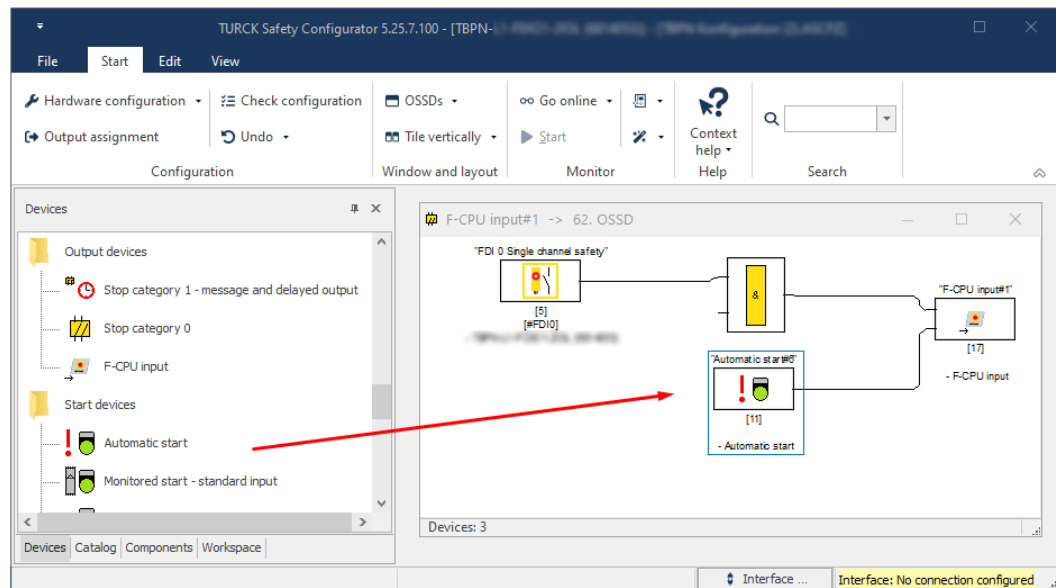


fig. 59: TSC – automatic start

- Double-click input F-CPU and open the output assignment via Outputs.

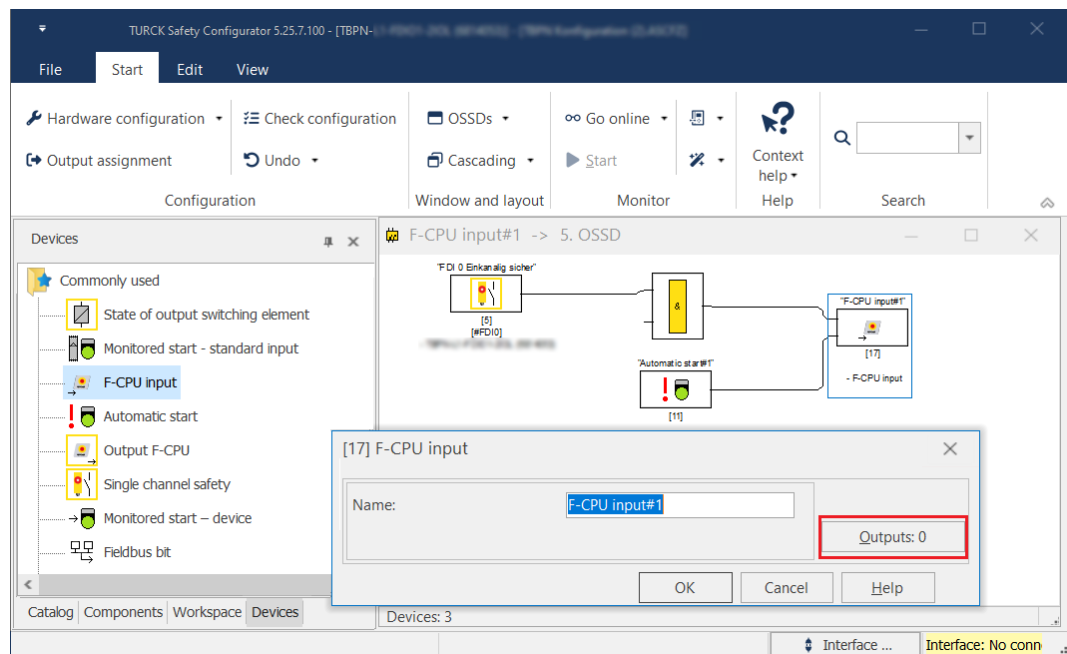


fig. 60: TSC – input F/CPU

- Link a free PROFIsafe bit in the output assignment to the input F-CPU .

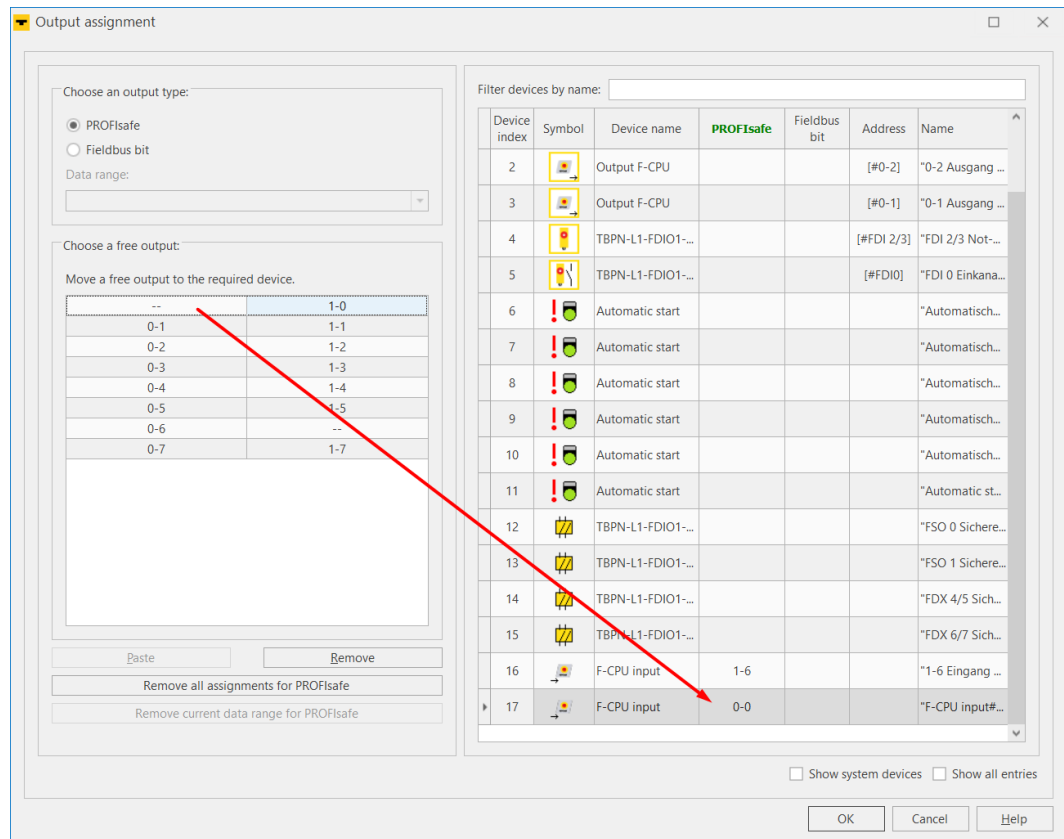


fig. 61: TSC – output assignment input F/CPU

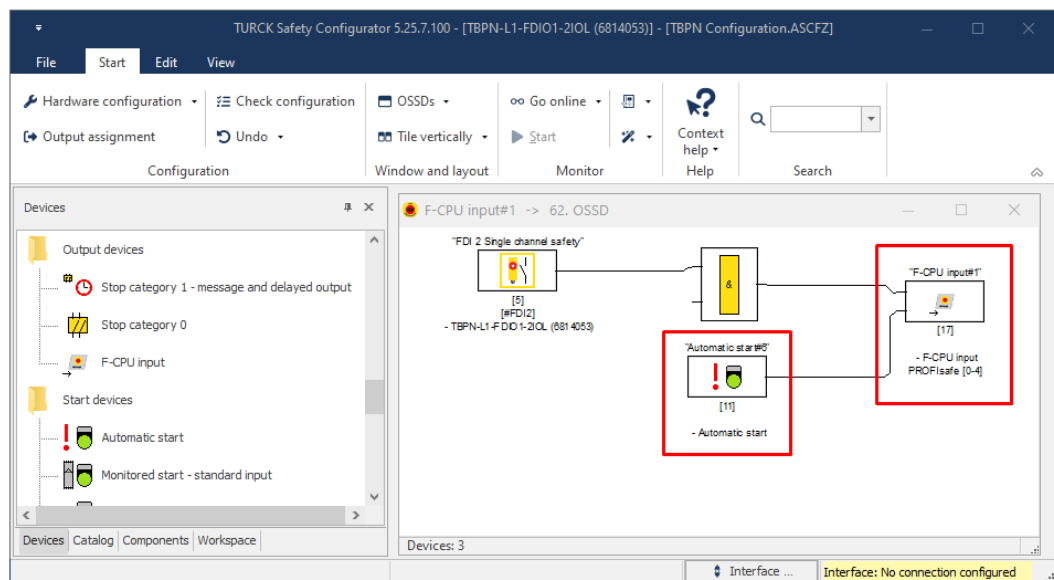


fig. 62: TSC – single channel safe input with automatic start and PROFIsafe assignment

8.5 Configuring the device at PROFINET/PROFIsafe in TIA Portal

8.5.1 FSU - Fast Start-Up (prioritized startup)

Fast Start-Up is not supported by the device.

8.5.2 Adding the device via GSDML

- ▶ Install the device's GSDML-file.
- ▶ Add device to **PROFINET-IO-System (100)**.

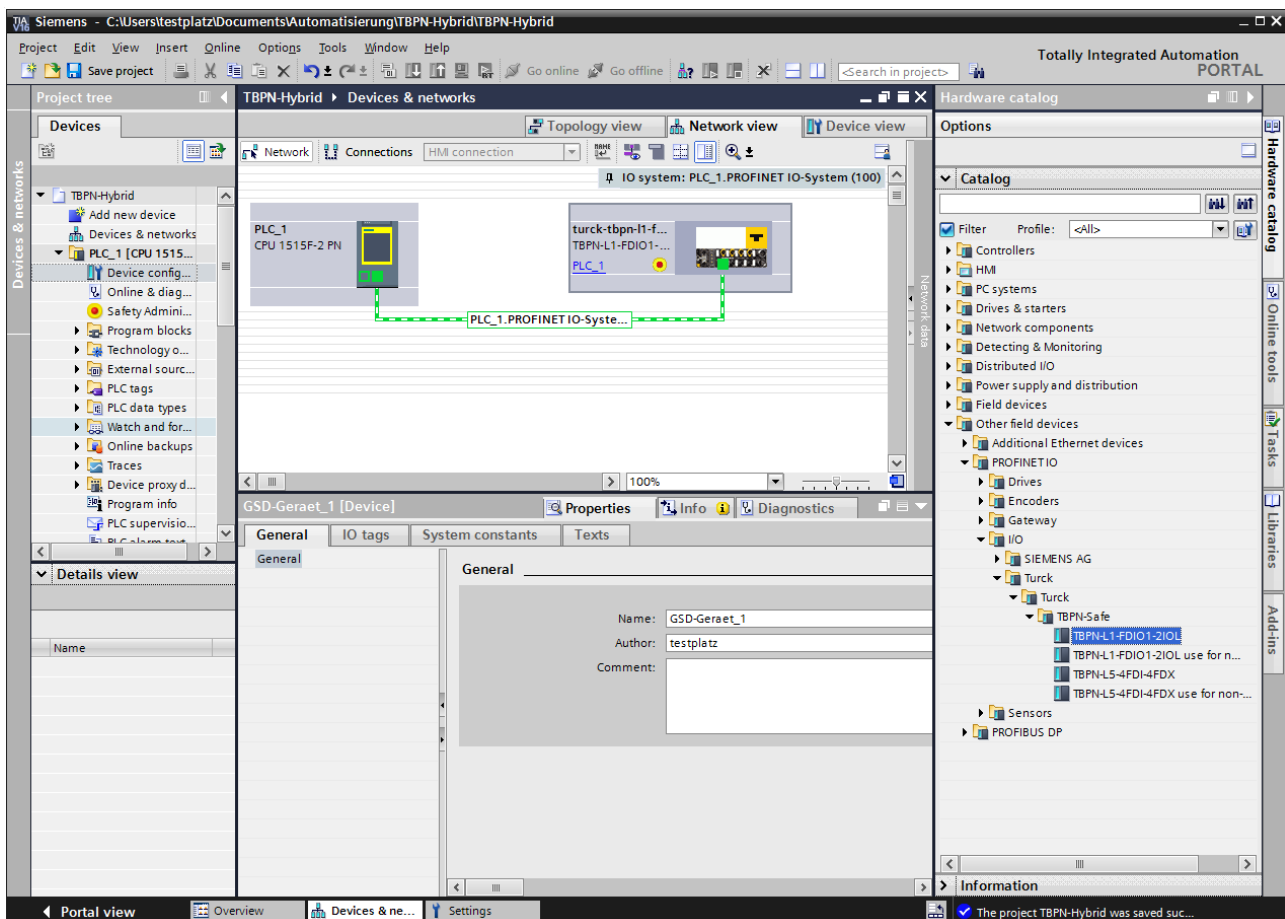


fig. 63: Adding the TBPN-L...-FDIO1-2IOL to PROFINET.

⇒ The TBPN-L...-FDIO1-2IOL appears as a modular slave with eight virtual slots.

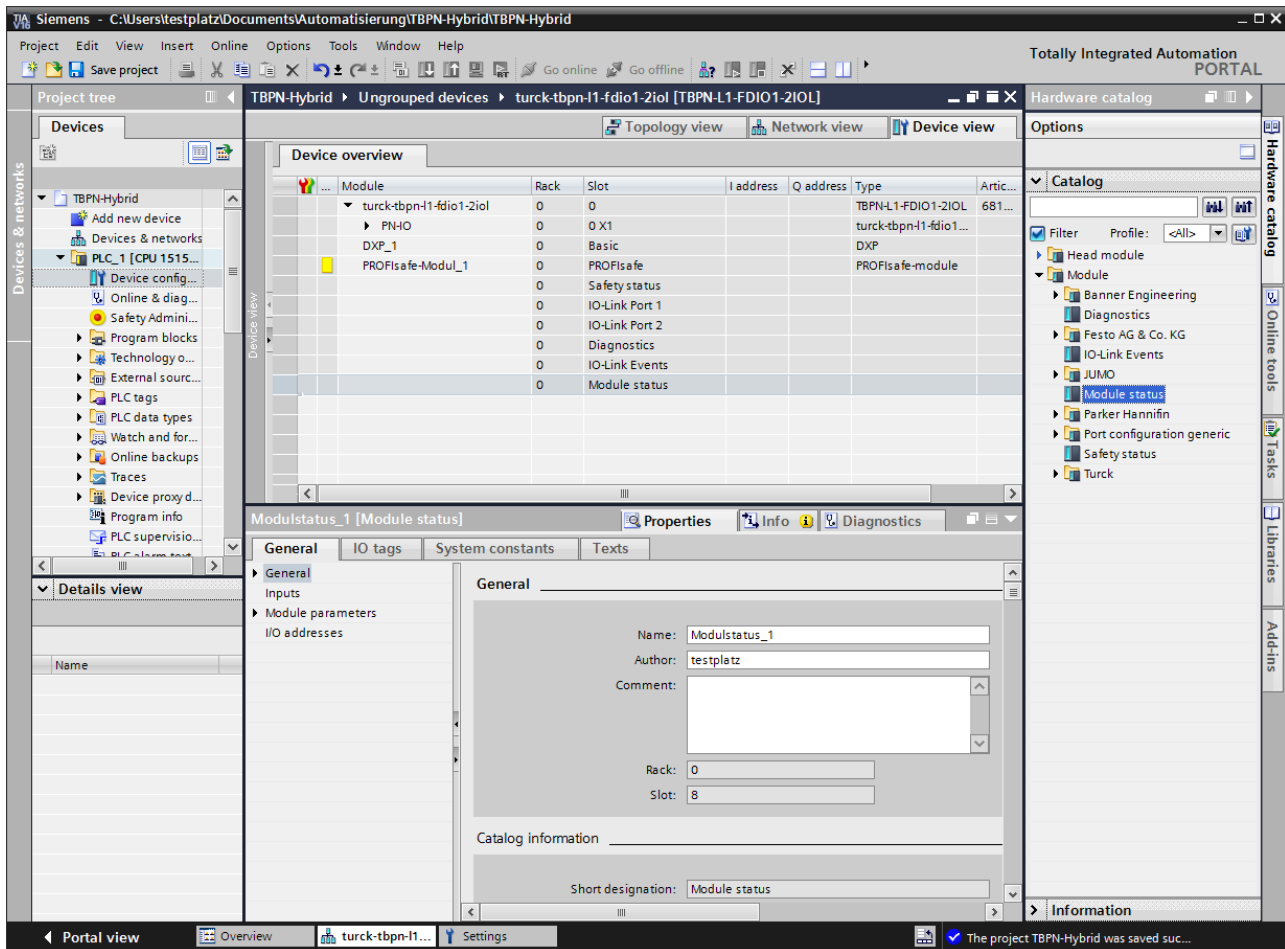


fig. 64: Slots of the TBPN-L...-FDIO1-2IOL

The function of these slots is either pre-defined via GSDML or can only be used for a specific purpose.

Module	Name
turck-tbpn-l1-fdio1-2iol	Main module, parameterization of parameters (deactivation of protocols, etc.) which concern the complete device.
PN-IO	Parameterization of PROFINET functions (MRP, etc.) and the Ethernet port properties (topology, connection options, etc.)
DXP	DXP channels of the device
PROFIsafe module	Process data of the safety channels Note: Starting with firmware version Vxx.xx, the GSDML file provides fifteen pre-configured modules (PROFIsafe module configurations) [▶ 73].
Safety-Status	Status information of the safety channels
IO-Link port 1 IO-Link port 2	Configuration of the two IO-Link ports with generic port configuration for IO-Link devices or with SIDI entries of pre-configured IO-Link devices.
Diagnostics	Diagnostics (IO-Link and DXP diagnostics), mapped optionally
IO-Link Events	IO-Link Events, mapped optionally
Module status	Module status, optionally mapped

8.5.3 Configuring the device

- ▶ Select Device view → Device overview.
- ▶ Drag modules (safety status, safety fieldbus bits, and module status) from the hardware catalog to the slots in the device.

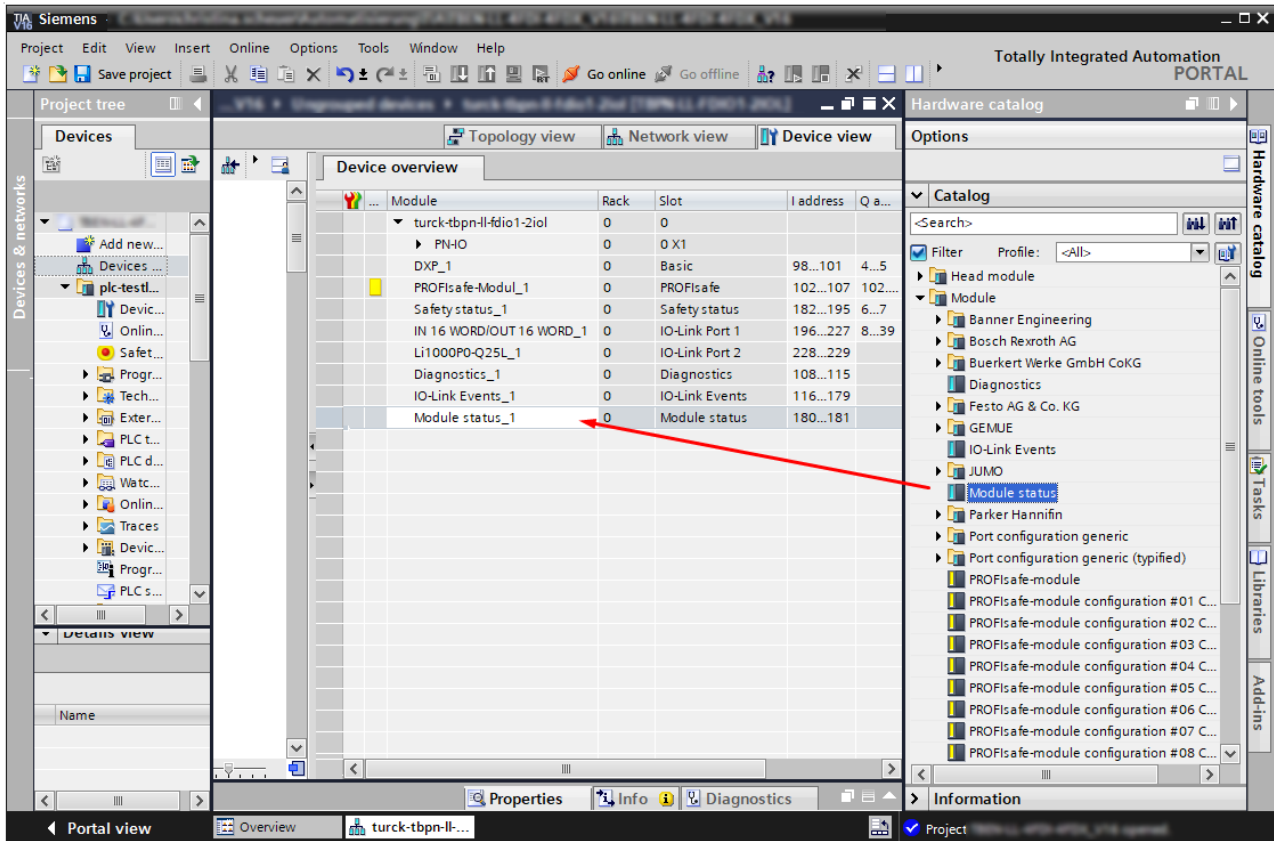


fig. 65: TIA Portal: configuring the device slots

- If one of the predefined configurations [► 73] is to be used instead of the standard PROFIsafe module:
Delete the PROFIsafe module from the slot and drag one of the predefined configurations into the slot.

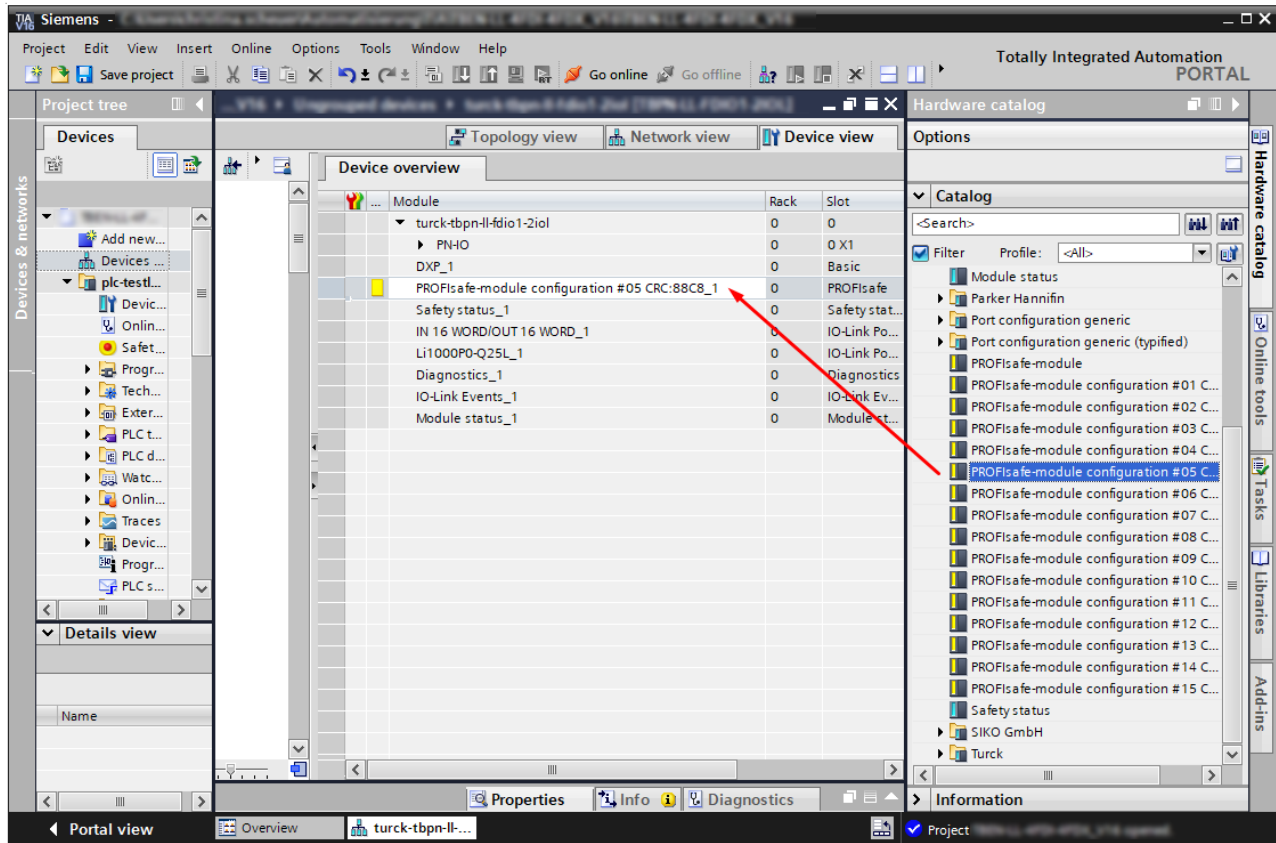


fig. 66: TIA Portal: configuring the PROFIsafe module

PROFIsafe module configurations

Configuration 1: E93E

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	mech.	dep.	0.1									
2						4/2	1oo2	mech.	dep.	0.1				
3						4/2	1oo2	mech.	dep.	0.1				
In- ternal											FSO0	PP	Off	TRUE
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0/1	0-0	1							
1	2/3	0-1	3							
2					4/5	0-2	5		4/5	
3					6/7	0-3	7		6/7	
In- ternal									FSO0	TRUE
In- ternal									FSO1	TRUE

Configuration 2: 5716

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	OSSD	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2						4/2	1oo2	mech.	dep.	0.1				
3						4/2	1oo2	mech.	dep.	0.1				
In- ternal											FSO0	PP	Off	TRUE
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0/1	0-0	1							
1	2/3	0-1	3							
2					4/5	0-2	5		4/5	
3					6/7	0-3	7		6/7	
In- ternal									FSO0	TRUE
In- ternal									FSO1	TRUE

Configuration 3: FA7E

■ Hardware configuration

C.../ X...	Inputs										Outputs			
	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	OSSD	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2						4/2	1oo2	OSSD	dep.	0.1				
3						4/2	1oo2	OSSD	dep.	0.1				
In- ternal											FSO0	PP	Off	TRUE
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0/1	0-0	1							
1	2/3	0-1	3							
2					4/5	0-2	5		4/5	
3					6/7	0-3	7		6/7	
In- ternal									FSO0	TRUE
In- ternal									FSO1	TRUE

Configuration 4: 12D3

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	mech.	dep.	0.1									
2						4/2	1oo2	mech.	dep.	0.1				
3						4/2	1oo2	OSSD	dep.	0.1				
In- ternal											FSO0	PP	Off	TRUE
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs									Outputs	
C.../ X...	FDI	PROFIsafe bit	FDI 1oo1	PROFIsafe bit	FDX as input	PROFIsafe bit	FDX as input 1oo1	PROFIsafe bit		FDX as output	PROFIsafe bit
0	0/1	0-0	1								
1	2/3	0-1	3								
2					4/5	0-2	5			4/5	
3					6/7	0-3	7			6/7	
In- ternal										FSO0	TRUE
In- ternal										FSO1	TRUE

Configuration 5: 88C8

■ Hardware configuration

C.../ X...	Inputs										Outputs			
	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	OSSD	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2						4/2	1oo2	OSSD	dep.	0.1				
3						4/2	1oo2	mech.	dep.	0.1				
In- ternal											FSO0	PP	Off	TRUE
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

C.../ X...	Inputs								Outputs	
	FDI	PROFIsafe bit	FDI 1oo1	PROFIsafe bit	FDX as input	PROFIsafe bit	FDX as input 1oo1	PROFIsafe bit	FDX as output	PROFIsafe bit
0	0/1	0-0	1							
1	2/3	0-1	3							
2					4/5	0-2	5		4/5	
3					6/7	0-3	7		6/7	
In- ternal									FSO0	TRUE
In- ternal									FSO1	TRUE

Configuration 6: 944D

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	mech.	dep.	0.1									
2											4/3	PP	0.5	
3											4/3	PP	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	0.5	Safe bit

■ Bit assignment

	Inputs								Outputs					
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit				
0	0/1	0-0	1											
1	2/3	0-1	3											
2											4/5	5	4/5	0-2
3											6/7	7	6/7	0-3
In- ternal									FSO0	0-0				
In- ternal									FSO1	0-1				

Configuration 7: 86E4

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	OSSD	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2											4/3	PP	0.5	
3											4/3	PP	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	0.5	Safe bit

■ Bit assignment

	Inputs								Outputs					
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit				
0	0/1	0-0	1											
1	2/3	0-1	3											
2											4/5	5	4/5	0-2
3											6/7	7	6/7	0-3
In- ternal									FSO0	0-0				
In- ternal									FSO1	0-1				

Configuration 8: B03E

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2											4/3	PP	0.5	
3											4/3	PP	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	0.5	Safe bit

■ Bit assignment

	Inputs								Outputs					
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit				
0	0/1	0-0	1											
1	2/3	0-1	3											
2											4/5	5	4/5	0-2
3											6/7	7	6/7	0-3
In- ternal									FSO0	0-0				
In- ternal									FSO1	0-1				

Configuration 9: DF0A

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	mech.	dep.	0.1									
2											4/2	PM	0.5	
3											4/2	PM	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	0.5	Safe bit

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1001	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1001	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0/1	0-0	1							
1	2/3	0-1	3							
2					4/5		5		4/5	0-2
3					6/7		7		6/7	0-3
In- ternal									FSO0	0-0
In- ternal									FSO1	0-1

Configuration 10: EABB

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	OSSD	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2											4/2	PM	0.5	
3											4/2	PM	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0/1	1-7	1							
1	2/3	1-6	3							
2					4/5		5		4/5	0-1
3					6/7		7		6/7	0-2
In- ternal									FSO0	0-0
In- ternal									FSO1	TRUE

Configuration 11: 6541

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4/2	1oo2	mech.	dep.	0.1									
1	4/2	1oo2	OSSD	dep.	0.1									
2						4/2	1oo2	OSSD	dep.	0.1				
3														
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs									Outputs	
C.../ X...	FDI	PROFIsafe bit	FDI 1oo1	PROFIsafe bit	FDX as input	PROFIsafe bit	FDX as input 1oo1	PROFIsafe bit		FDX as output	PROFIsafe bit
0	0/1	1-7	1								
1	2/3	1-6	3								
2					4/5	1-1	5			4/5	
3					6/7		7			6/7	0-4
In- ternal										FSO0	0-1
In- ternal										FSO1	TRUE

Configuration 12: FC4F

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4	1oo1	mech.	indep.	-									
	2	1oo1	mech.	indep.	-									
1	4/2	1oo2	mech.	dep.	0.1									
2						4	1oo1	OSSD	indep.	-				
						2	1oo1	OSSD	indep.	-				
3											4/2	PM	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

C.../ X...	Inputs									Outputs	
	FDI	PROFIsafe bit	FDI 1oo1	PROFIsafe bit	FDX as input	PROFIsafe bit	FDX as input 1oo1	PROFIsafe bit		FDX as output	PROFIsafe bit
0	0	0-0	1	0-1							
1	2/3	0-2	3								
2											
3					4/5	0-3	5			4/5	
					6/7		7			6/7	0-1
In- ternal										FSO0	0-0
In- ternal										FSO1	TRUE

Configuration 13: 803 A

■ Hardware configuration

	Inputs										Outputs							
C.../ X...	FDI					FDX as FDI					FDX as FSO							
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature				
0	4	1oo1	mech.	indep.	-													
	2	1oo1	mech.	indep.	-													
1	4/2	1oo2	OSSD	antiv.	0.5													
2															4/2	PM	0.5	
3															4/2	PM	0.5	
In- ternal											FSO0	PP	0.5	Safe bit				
In- ternal											FSO1	PP	Off	TRUE				

■ Bit assignment

	Inputs								Outputs		
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit	
0	0	0-0	1	0-1							
1	2/3	0-2	3								
2					4/5	5	4/5	0-1			
3					6/7	7	6/7	0-2			
In- ternal									FSO0	0-0	
In- ternal									FSO1	TRUE	

Configuration 14: 820C

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4	1oo1	mech.	indep.	-									
	2	1oo1	mech.	indep.	-									
1	4/2	1oo2	OSSD	antiv.	1									
2											4/2	PM	0.5	
3											4/2	PM	0.5	
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0	0-0	1	0-1						
1	2/3	0-2	3							
2					4	0-3	5	0-4	4/5	
3					6		7		6/7	0-1
In- ternal									FSO0	0-0
In- ternal									FSO1	TRUE

Configuration 15: 5675

■ Hardware configuration

	Inputs										Outputs			
C.../ X...	FDI					FDX as FDI					FDX as FSO			
	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Pulse	Feature	Sync. time in ms	Pin	Type	Test pulse in ms	Feature
0	4	1oo1	mech.	indep.	-									
	2	1oo1	mech.	indep.	-									
1	4	1oo1	mech.	indep.	-									
	2	1oo1	mech.	indep.	-									
2						4	1oo1	mech.	indep.	-				
						2	1oo1	mech.	indep.	-				
3						4	1oo1	mech.	indep.	-				
						2	1oo1	mech.	indep.	-				
In- ternal											FSO0	PP	0.5	Safe bit
In- ternal											FSO1	PP	Off	TRUE

■ Bit assignment

	Inputs								Outputs	
C.../ X...	FDI	PROFI-safe bit	FDI 1oo1	PROFI-safe bit	FDX as input	PROFI-safe bit	FDX as input 1oo1	PROFI-safe bit	FDX as output	PROFI-safe bit
0	0	0-0	1	0-1						0-1
1	2	0-2	3	0-3						
2					4	0-4	5	0-5	4/5	
3					6	0-6	7	0-7	6/7	
In- ternal									FSO0	0-0
In- ternal									FSO1	TRUE

Meaning of the abbreviations

Abbreviation	Meaning
1oo1	1-channel
1oo2	2-channel
dep.	Dependent
antiv.	Antivalent
C.../X...	Connector at device
mech.	Mechanical
PM	PM switching
PP	PP switching
Sync. time	Synchronization time of the channels
indep.	Independent

8.5.4 Setting the F_parameters

Set the F_parameters of TBPN-L...-FDIO1-2IOL at slot **PROFISAFE-Modul_1**:

F_parameters Meaning

F_Dest_Add F address of TBPN-L...-FDIO1-2IOL, in this example: address **105**

F_iPar_CRC CRC from the protocol in the TURCK Safety Configurator, in this example: **9263**.

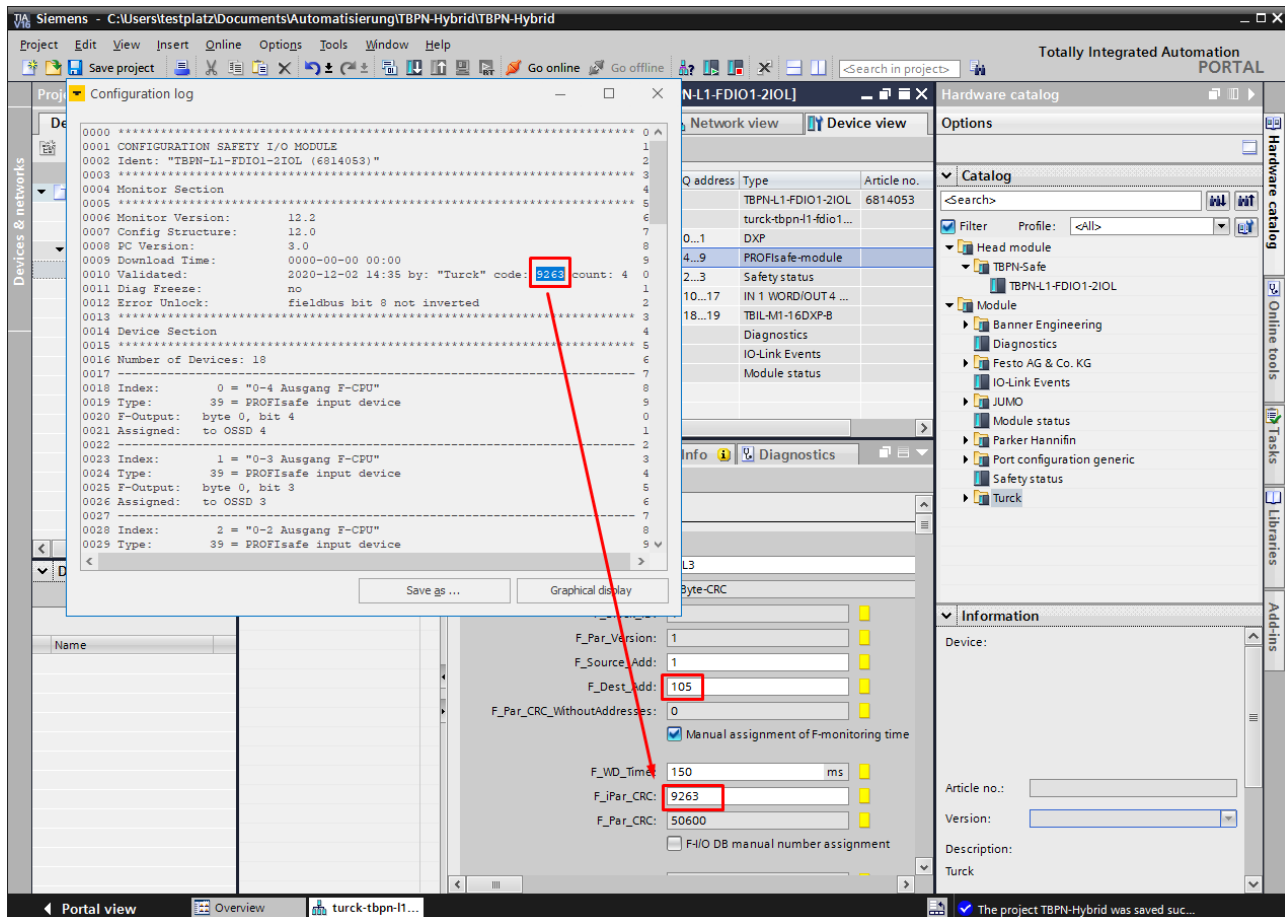


fig. 67: F_parameters of TBPN-L...-FDIO1-2IOL

8.5.5 Starting the TURCK Safety Configurator from TIA Portal



NOTE

The TURCK Safety Configurator can only be started directly from TIA Portal if the option was activated during installation [► 42].

Starting the TURCK Safety Configurator from TIA Portal

- Right click the TBPN-L...-FDIO1-2IOL and open TURCK Safety Configurator via **Start device tool** in TIA-Portal.

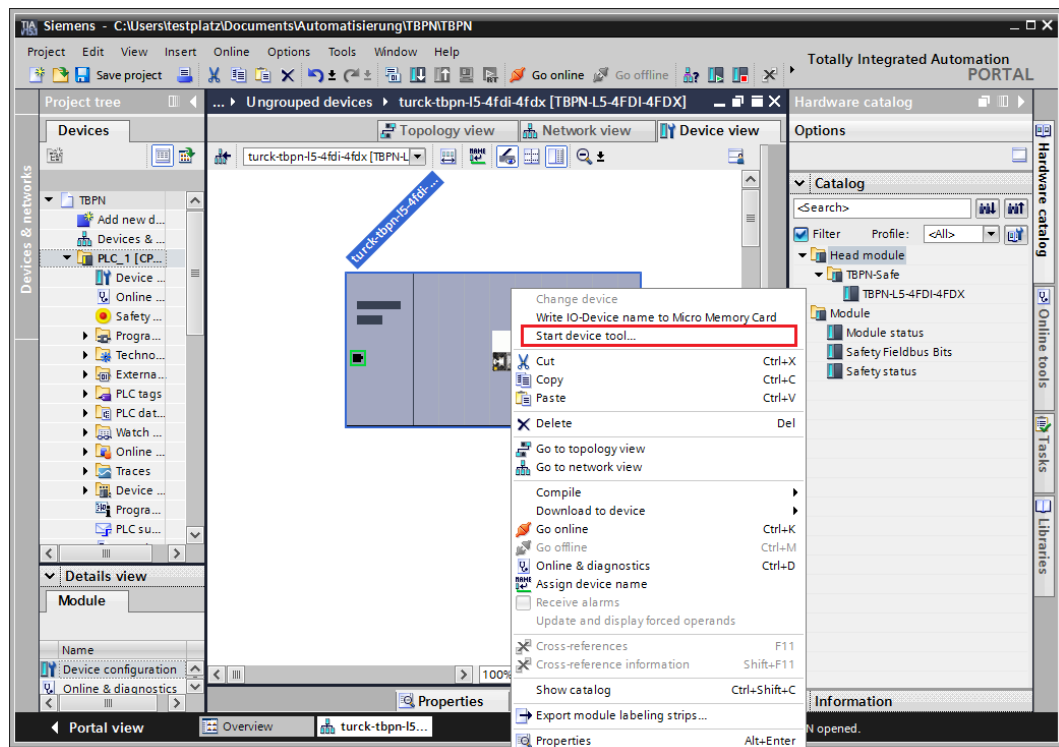


fig. 68: Starting the TURCK Safety Configurator from TIA

9 Operating

9.1 LED displays

The device has the following LED indicators:

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

LED PWR	Meaning
Off	No voltage connected or under voltage at V1
Green	Voltage 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...3 (C0...C1 or X0...X1)	Meaning
Off	Input active
Green	Input active
Green flashing	Self-test input
Red flashing	Cross Connection
Red	Discrepancy

LED 4...7 (C2...C3 or X2...X3)	Meaning	
	Channel is input	Channel is output
Off	Input active	Output inactive
Green	Input active	Output active
Green flashing	Self-test input	-
Red flashing	Cross Connection	-
red	Discrepancy	Overload

LED 0...7	Meaning
Red flashing, all alternating	Fatal Error

LED BUS	Meaning
Off	No voltage supply
Green	Active connection to a master
Green flashing, 1 Hz	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 supply
Green	No diagnostics
Green flashing, 4 Hz	Initialization, configuration transfer from memory chip running
Red	Diagnostics pending
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 active

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

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

9.2 Status- and control word

Status word

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	-	-	-	-	-	-	-	DIAG
Byte 0	-	FCE	-	-	-	COM	V1	-

Bit	Description
COM	Internal error The device-internal communication is disturbed.
DIAG	Diagnostic message at the device
FCE	The DTM Force Mode is activated. The actual output values may no match the ones defined and sent by the field bus.
V1	V1 too low (< 18 VDC)

Control word

The control word is not in use.

9.3 Process input data

This chapter contains the description of the process input data of the safe I/O channels. The process input data of the IO-Link channels and the universal standard I/O channels are not safety-relevant and are only presented for the sake of completeness. The detailed description of the process data of the non-safety relevant channels can be found in the second and third parts of the operating manual.

9.3.1 Overview - complete module

The process input data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Basic							
n ... n + 3	Status messages for standard I/O channels [► 113] and IO-Link master channels [► 147]							
	PROFIsafe module							
n + 4... n + 5	Process input data Safe I/O channels [► 93]							
	Safety-Status							
n + 6... n + 19	Safe Unit Status [► 94]							
n + 20... n + 23	Reserved							
	IO-Link channels							
n + 24 ... n + 87	IO-Link process input data [► 147]							
	Diagnostics							
n + 88 ... n + 89	Overcurrent diagnostics [► 113]							
n + 90... n + 91	DXP diagnostics [► 113]							
n + 92... n + 95	IO-Link port diagnostics [► 147]							
	IO-Link Events							
n + 96... n + 159	IO-Link Events [► 147]							
	Module status							
n + 160... n + 161	Module status [► 91]							

9.3.2 Process input data – safe I/O channels

The safe inputs and outputs occupy 16 bytes of the process input image.

Byte no.	Bit no.							
	7	6	5	4	3	2	1	0
	PROFIsafe module							
n... n + 1	PROFIsafe input data (assignment depends on the configuration of the channels in TURCK Safety Configurator)							
n + 2	PROFIsafe Status Byte [► 94]							
n + 3... n + 5	PROFIsafe checksum (CRC)							
	Safety-Status							
n + 6	Safe Unit Status [► 94]							
	-	-	-	-	-	SUMM	SUCM	SUPM
n + 7	PROFINET input data – status of the safe unit (field bis bits)							
	FBO 07	FBO 06	FBO 05	FBO 04	FBO 03	FBO 02	FBO 01	FBO 00
	PROFIsafe Error Codes [► 95]							
n + 8	71	70	69	68	67	66	65	64
n + 9	-	-	-	-	-	-	75	72
	Memory and F-Config Status [► 95]							
n + 10	FERR	-	-	COMLO	-	CNFMM	NCNF	PMS
n + 11	-	-	-	-	-	-	-	-
	Safe Status [► 96]							
n + 12	Connector C0/X0							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
n + 13	Safe Status connector C1/X1							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
...	...							
n + 19	Connector C7/X7							
	OVL	-	TC CH1	TC CH0	ERR FIN	TEST	WAIT	RGG
n + 20... n + 23	Reserved							

PROFIsafe status byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Cons_nr_R	Toggle_d	FV activated	WD time-out	CE_CRC	Device error	iPar_OK

Name	Meaning
iPar_OK	The bit is set if new parameter values have been assigned to TBPN-L...-FDIO1-2IOL.
Device error	The bit is set by the device for at least two message cycles if there is a malfunction in the TBPN-L...-FDIO1-2IOL.
CE_CRC	The bit is set if the TBPN-L...-FDIO1-2IOL detects a communication error (CRC error). This bit information enables the F-Host to count all faulty messages within a defined time period and to trigger a configured safe state of the system if the number exceeds a certain limit (maximum residual error rate).
WD time-out	The bit is set if the TBPN-L...-FDIO1-2IOL detects an F communication error, i.e. If the watchdog time in the device is exceeded.
FV activated	This bit is set during a device restart and in case of an communication error. The outputs of TBPN-L...-FDIO1-2IOL are set to the failsafe values.
Toggle_d	Toggle bit in TBPN-L...-FDIO1-2IOL that requests a trigger to increment the virtual serial number within the F-Host (Vconsnr_h) Together with the control bit "Toggle_h" in the master, the bit serves as an acknowledgment mechanism for monitoring the runtimes between sender and receiver.
Cons_nr_R	The bit is set if the TBPN-L...-FDIO1-2IOL the device has reset its counter for consecutive numbers (Vconsnr_h).

Safe Unit Status

Name	Value	Meaning
SUPM	Safe Unit Protective Mode	
	0	Not active
	1	Active
SUCM	Safe Unit Configuration Mode	
	0	Not active
	1	Active
SUUM	Safe Unit Unknown Mode	
	0	Not active
	1	Active

PROFIsafe Error Codes

Code	Name	Meaning	Remedy
64 (0x40)	Destination Address Mismatch	The set PROFIsafe address does not match the parameterized destination address (F_DEST_ADDR).	► Check parameterization. ► Restart the device.
65 (0x41)	Invalid Destination Address	The set destination address (F_DEST_ADDR) is not valid. Addresses 0x0000 and 0xFFFF are not allowed.	
66 (0x42)	Invalid Source Address	The set source address (F_SOURCE_ADDR) is not valid. Addresses 0x0000 and 0xFFFF are not allowed.	
67 (0x43)	Invalid Watchdog Time Value	Invalid value for watchdog time (F_WD_Time, F_WD_Time 2). A watchdog time of 0 ms is not allowed.	
68 (0x44)	SIL Value Exceeded	The required SIL level is not supported by the device.	
69 (0x45)	Invalid Length of CRC2	The required CRC length and the CRC length generated by the device do not match.	► Check parameterization.
70 (0x46)	Invalid PROFIsafe version	The version of the F_parameter set is invalid.	
71 (0x47)	CRC1 Mismatch	The CRC1 generated by the device does not match the CRC1 in the parameter telegram	► Check the configuration in PROFIsafe.
72 (0x48)	Invalid PROFIsafe Parameters	Device specific or undefined diagnostic information	
75 (0x4B)	Wrong iParameter CRC	The iParCRC from the device and the iParCRC in the PROFIsafe configuration do not match.	► Check the configuration in PROFIsafe.

Safety configuration integrity (Memory and F-Config Status)

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

Safe-Status (connector 0...7)

Name	Code	Meaning
RGG	-	Normal State
WAIT	528	Wait for input signal
TEST	544	Test input
ERRFIN	560	Error at input
TCCH0	576	Cross-circuit channel 0
TCCH1	592	Cross-circuit channel 1

PROFINET input data – status of the safe unit

Name	Meaning
FBO0-0... FBO0-7	Status output bits of the TBPN-L...-FDIO1-2IOL which can be used as input signals for the non part of the higher level control. These bits have to be configured by the user in TURCK Safety Configurator.

9.4 Process output data

This chapter contains the description of the process output data of the safe I/O channels. The process output data of the IO-Link channels and the universal standard I/O channels are not safety-relevant and are only presented for the sake of completeness. The detailed description of the process data of the non-safety relevant channels can be found in the second and third parts of the operating manual.

9.4.1 Overview - complete module

The process output data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n + 0... n + 1	Basic							
	Control: DXP channels [► 114]							
n + 2... n + 7	PROFIsafe module							
	Process output data safe I/O channels [► 97]							
n + 8... n + 9	Safety-Status							
	Unlock Safe Unit [► 98]							
n + 10... n + 73	IO-Link channels							
	IO-Link process output data [► 149]							

9.4.2 Process output data – safe I/O channels

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n + 2... n + 3	PROFIsafe output data (assignment depends on the configuration of the channels in TURCK Safety-)							
n + 4	PROFIsafe control byte [► 98]							
n + 5... n + 7	PROFIsafe checksum (CRC)							
n + 8	Unlock Safe Unit [► 98]							
	-	-	-	-	-	-	-	UNLK
n + 9	PROFINET output data							

PROFIsafe control byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Reserved	Toggle_h	Activate_FV	Reserved	R_cons_nr	OA_Req	iPar_EN

Name	Meaning
iPar_EN	The bit is set by the application of the TBPN-L...-FDIO1-2IOL needs new parameters.
OA_Req	The bit is set by the TBPN-L...-FDIO1-2IOL for at least two message cycles if there is a malfunction in the device.
R_cons_nr	The bit is set if a communication error is detected. The counter of the virtual consecutive number (Vconsnr_d) in the TBPN-L...-FDIO1-2IOL is set to "0". The bit is reset if the error has been eliminated. Then the consecutive numbering (Vconsnr_d) is started again.
Activate_FV	The bit activates the forcing of outputs to the failsafe values at TBPN-L...-FDIO1-2IOL.
Toggle_h	Toggle bit in the master that requests the incrementation of the virtual serial number within the F-Device (Vconsnr_d). Together with the control bit "Toggle_d" in the TBPN-L...-FDIO1-2IOL, the bit serves as an acknowledgment mechanism for monitoring the runtimes between sender and receiver.

Unlock Safe Unit

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

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

PROFINET output data (to TBPN-L1-FDIO1-2IOL)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
FBI 0-7	FBI 0-6	FBI 0-5	FBI 0-4	FBI 0-3	FBI 0-2	FBI 0-1	FBI 0-0

Name	Meaning
FIB 0-0... FBI0-7	These four bits are sent via the field bus to the TBPN-L...-FDIO1-2IOL and can be configured in the TURCK Safety Configurator as field bus bits (inputs).

9.5 Using the configuration memory

9.5.1 Storing a configuration

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

Storing the configuration during module start

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

Storing the configuration during operation

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

9.5.2 Loading a configuration from the memory chip

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

9.5.3 Deleting the memory chip (Erase Memory)

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

Deleting the configuration via rotary switch setting (901)

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

Deleting the configuration via TURCK Safety Configurator

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

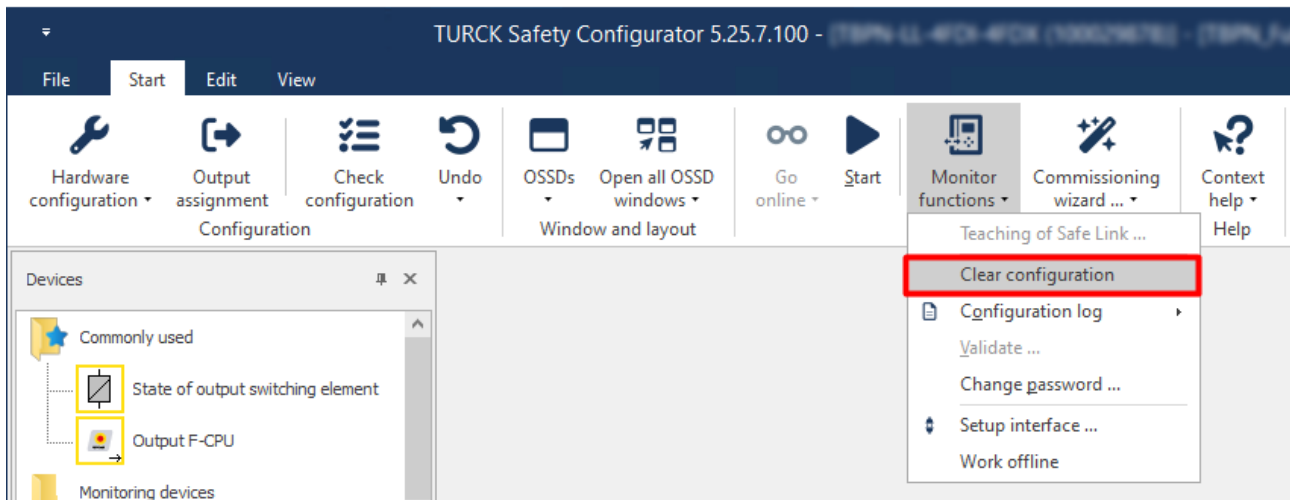


fig. 69: Deleting the configuration via TURCK Safety Configurator

- ⇒ The configuration on the memory chip is deleted. The procedure completed as soon as the ERR LED stops flashing.

9.5.4 Configuration transfer and module behavior

Configuration			Module behavior	Diagnostics
In device	External memory	Device/ memory		
Invalid/ none	Invalid/ none	-	Device start → Device not running	No configuration available , s. "Memory and F-Config Status" [► 95]
Invalid/ none	Valid	-	Device start → Device running → Loading the configuration from the memory to the device	-
Valid	Invalid/ none	-	Device start → Device running → Loading the configuration from the device to the memory	-
Valid	Valid	equal	Device start → Device running	-
Valid	Valid	unequal	Device start → Device running	Configuration mismatch, s. "Memory and F-Config Status" [► 95]
Valid	No memory chip plugged	-	Device start → Device not running	No memory chip plugged, s. "Memory and F-Config Status" [► 95]
Valid	Memory chip pulled	-	During operation	No memory chip plugged, s. "Memory and F-Config Status" [► 95]
changed during operation	Valid	unequal	During operation → The new configuration is checked. → Loading the configuration from the memory to the device	-

9.6 Reset the device to factory settings (factory reset)



NOTE

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

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

10 Restarting after device exchange or modification

10.1 Changing a device



DANGER

Mounting or unmounting under voltage

Personal damage due to unintentional machine start

- ▶ Mount or unmount the device only in a de-energized condition.

10.1.1 Prerequisites for device replacement

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

Observe for device replacement:

- ▶ The parameterization and the configuration of the exchange devices exactly matches the parameterization and the configuration of the device to be changed.
- ▶ Please follow the description under "Procedure for device replacement" to transfer an existing configuration from the configuration memory of the original device into the exchange device.

10.1.2 Procedure for device replacement

- ▶ Dismount the device to be exchanged: Take devices out of operation according to chapter "Decommissioning" [▶ 103].
- ▶ Mount the replacement device as described in chapter "Mounting" [▶ 22].
- ▶ Commission the replacement device as described under "Commissioning" → "Initial commissioning" [▶ 35].
- ▶ Defective or faulty devices must not, in any event, be put back into circulation. Dispose of the devices as described in the chapter "Disposal" [▶ 103].

11 Maintenance

The TBPN-L...-FDIO1-2IOL is maintenance-free for the duration of use of 20 years.

Used cables as well as connected sensors and actuators have to be tested according to vendor specifications during the duration of use of TBPN-L...-FDIO1-2IOL.

12 Decommissioning

The machine manufacturer is responsible for decommissioning the TBPN-L...-FDIO1-2IOL. The operator must ensure that the device is used for its intended purpose.

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

13 Disposal



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

14 Technical data

14.1 General technical data

Devices	
TBPN-L1-FDIO1-2IOL	
■ ID	6814053
■ YoC	According to device labeling
TBPN-LL-FDIO1-2IOL	
■ ID	100029879
■ YoC	According to device labeling
Power supply	
V1 (incl. electronics supply)	24 VDC
V2	24 VDC, only through connected
Current feedthrough	
■ X1 to X1 (7/8")	9 A
■ XD1 tot XD2 (M12)	16 A
Permissible range	20.4...28.8 VDC
Total current	9 A
Isolation voltages	≥ 500 VAC
Connector	
■ TBPN-L1-FDIO1-2IOL	7/8", 5-pin
■ TBPN-LL-FDIO1-2IOL	M12, L coded, 5-pin
Interfaces	
Ethernet	2 × M12, 4-pin, D coded
Service interface	Ethernet
Times	
Internal delay time (for calculating the watch-dog time)	10 ms
Response times	See Safety Characteristic Data ► 36]
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... +70 °C
■ Ex derating	-25... +60 °C S. document "Notes on Use in Ex zone 2 and 22" (100022986)
Storage temperature	-40... +85 °C
Operating altitude	Max. 5000 m

General technical data

Degree of protection	IP65, IP67, IP69K The degree of protection is only guaranteed if unused connections are closed with suitable screw caps or blind caps.
Housing material	Fibre-glass reinforced Polyamide (PA6-GF30)
Housing color	black
Material connectors	brass, nickel-plated
Window material	Lexan
Material screw	303 stainless steel
Material label	Polycarbonate
Halogen-free	Yes
Mounting	2 mounting holes, Ø 6.3 mm

Approvals and certificates

CE
 UKCA
 ATEX, CCC-Ex Appendix: approvals and markings
 FCC statement
 UV-resistant according to DIN EN ISO 4892-2A (2013)

14.2 Technical data – safety inputs

Safety inputs for OSSD

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

Safety inputs for potential free contacts

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

14.3 Technical data – safety outputs

Safety outputs

Suitable for inputs according to EN 61131-2,
 type 1

Output level in OFF-state	< 5 V
Output level in OFF-state	< 1 mA
Test pulse resistive load, max.	0.5 ms
Test pulse, max.	1.25 ms
Interval between two test pulses, typical	500 ms
Interval between two test pulses, minimum	250 ms
Actuator supply	Supply VAUX1/T1, max. 2 A, observe derating Derating
Max. total current for device	9 A
Max. output current	2 A (resistive) 2 A (DC load) 1 A (inductive)
Ex derating	S. document "Notes on Use in Ex zone 2 and 22" (100022986)
The user have to provide an additional overcurrent protection on site.	

TBPN-L...-FDIO1-2IOL – Standard DXP Channels

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15 Description of the Standard DXP Channels

The TBPn-L...-FDIO1-2IOL has two standard DXP channels.

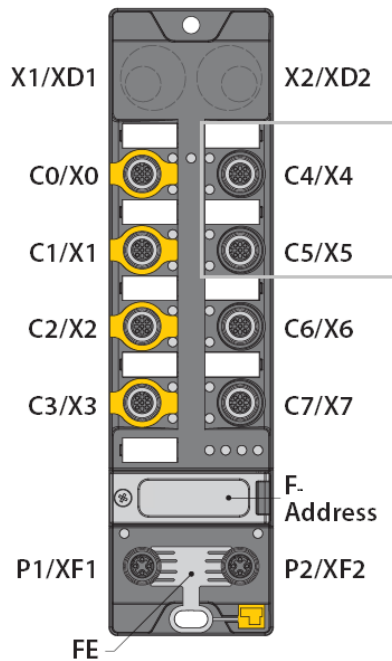


fig. 70: Device structure – DXP channels

TBPn-L1	TBPn-LL	Meaning
X1	XD1	Power IN
X2	XD2	Power OUT
C0	X0	FDIO1, safety-related input
C1	X1	FDI2/3, safety-related input
C2	X2	FDX4/5, safety-related input
C3	X3	FDX6/7, safety-related input
C4	X4	DXP8/9, standard in-/outputs (safe shutdown via FSO0 possible)
C5	X5	DXP10/11, standard in-/outputs (safe shutdown via FSO0 possible)
C6	X6	IOL, IO-Link port1
C7	X7	IOL, IO-Link port2 (safe shutdown via FSO 1 possible)
F Address	F Address	Rotary coding switch for address setting for PROFIsafe (F-address setting)
P1	XF1	Ethernet 1
P2	XF2	Ethernet 2
FE	FE	Functional earth

15.1 Functions and operating modes

The universal digital DXP channels can be used as inputs or outputs depending on the application requirements. Up to four 3-wire PNP sensors or four PNP DC actuators with a maximum total output current of 2 A can be connected.

15.1.1 DXP channel supply

The two DXP channels are supplied via the internal safe output FSO0. The supply of the DXP channels via FSO0 enables the safety-related shutdown of the slots C4 and C5 Ethernet or respectively C4 and C5 or X4 and X5.



NOTE

The supply of the DXP channels via FSO0 is done by a pulsed voltage. The pulsed voltage can influence the function of connected sensors. To prevent this, the test pulse can be changed or switched off completely in the TURCK Safety Configurator via the expert settings at the FSO0 output.

16 Connecting



WARNING

Intrusion of liquids or foreign bodies through leaking connections

Danger to life due to failure of the safety function

- ▶ Tighten 7/8" male connectors with a tightening torque of 0.8 Nm.
- ▶ Only use accessories that guarantee the degree of protection (IP65, IP67, IP69K).
- ▶ Close unused M12 connectors with the supplied screw caps. The tightening torque for the screw caps is 0.5 Nm.

16.1 Connecting a device in zone 2 and zone 22



DANGER

Explosive atmosphere

Explosion due to ignitable sparks

For use in Zone 2 and Zone 22:

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

16.2 Connecting digital sensors and actuators

The device has two female M12 connectors for connecting standard digital sensors and actuators. The maximum tightening torque is 0.6 Nm.

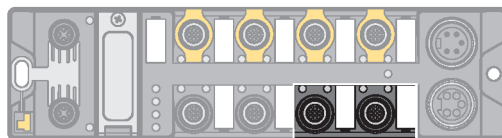


fig. 71: M12 connector, DXP channels C4...C5 or X4...X5

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

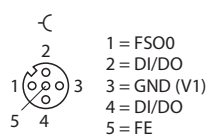


fig. 72: Pin assignment C4...C5 or X4...X5

17 Configuring

17.1 Parameters

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

Parameter name	Value	Meaning	Description
Manual output reset after overcurrent (SRO...)	0	No	The output switches on automatically after an overload.
	1	Yes	After an overcurrent, the output switches on again only after resetting and switching on again.
Activate output (EN DO...)	0	No	
	1	Yes	

18 Operating

18.1 LED displays – DXP channels

LED DXP 8...11 (C4...C5 or X4...X5)	Meaning (input)	Meaning (output)
Off	Input inactive	Output inactive
Green	Input active	Output active
Green/red flashing	Input active, overload at supply	-
Red flashing	Input inactive, overload at supply	Overload of the supply voltage
Red	-	Output active with overload or short circuit

18.2 Process input data

18.2.1 Overview - complete module

The process input data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Basic							
n ... n + 3	Status messages for standard I/O channels [► 113] and IO-Link master channels [► 147]							
	PROFIsafe module							
n + 4... n + 5	Process input data Safe I/O channels [► 93]							
	Safety-Status							
n + 6... n + 19	Safe Unit Status [► 94]							
n + 20... n + 23	Reserved							
	IO-Link channels							
n + 24 ... n + 87	IO-Link process input data [► 147]							
	Diagnostics							
n + 88 ... n + 89	Overcurrent diagnostics [► 113]							
n + 90... n + 91	DXP diagnostics [► 113]							
n + 92... n + 95	IO-Link port diagnostics [► 147]							
	IO-Link Events							
n + 96... n + 159	IO-Link Events [► 147]							
	Module status							
n + 160... n + 161	Module status [► 91]							

18.2.2 Process input data – standard DXP channels

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Basic							
n	-	-	-	-	-	-	-	-
n + 1	-	-	-	-	DXP11 FBI1-3 C5/X5P2	DXP10 FBI1-2 C5/X5P4	DXP9 FBI1-1 C4/X4P2	DXP8 FBI1-0 C4/X4P4
...	...							
	DXP diagnostics							
n + 88	Overcurrent sensor supply							
	-	VERRV1 K1213	VERRV1 K1011	VERRV1 K89				
n + 89	-	-	-	-	-	-	-	-
	Overcurrent output							
n + 90	-	-	-	-	-	-	-	-
n + 91		-	-	-	SCO11	SCO10	SCO9	SCO8

Meaning of the process data bits

Bit	Value	Meaning
DXP...	0	Input active
C...P...	1	Input
		C... = connector C0...C7 (TBEN-L4 or TBEN-L5) X0...X7 (TBEN-LL) P... = pin
VERRV1	0	-
Ch...	1	Overcurrent supply VAUX1 at channel
SCO...	0	-
	1	Overcurrent at output

18.3 Process output data

18.3.1 Overview - complete module

The process output data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n + 0...	Basic							
n + 1	Control: DXP channels [► 114]							
n + 2...	PROFIsafe module							
n + 7	Process output data safe I/O channels [► 97]							
n + 8...	Safety-Status							
n + 9	Unlock Safe Unit [► 98]							
n + 10...	IO-Link channels							
n + 73	IO-Link process output data [► 149]							

18.3.2 Process output data – standard DXP channels

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Basic							
n + 0	-	-	-	-	-	-	-	-
n + 1	-	-	-	-	DXP11 C5/X5P2	DXP10 C5/X5P4	DXP9 C4/X4P2	DXP8 C4/X4P4

Meaning of the process data bits

Bit	Value	Meaning
DXP...	0	Output inactive
C...P...	1	Output active

C... = connector
C0...C7 (TBEN-L4 or TBEN-L5)
X0...X7 (TBEN-LL)
P ...= pin

19 Technical data – DXP channels

The first section of the operating instructions contains the general technical data of the device [► 104].

Technical data

Digital inputs

Number of channels	4
Input type	PNP
Switching threshold	EN 61131-2 type 3, PNP
Operating current	< 100 mA
Signal voltage low level	< 5 V
Signal voltage high level	> 11 V
Signal current low level	< 1.5 mA
Signal current high level	> 2 mA
Input delay	0.2 ms
Input frequency	400 Hz
Sensor supply	■ C4/X4, C5/X5: FSO 0 max. 2 A; 500 mA per input ■ C6/X6: VAUX1 max. 2 A ■ C7/X7: FSO1 max. 2 A Derating [► 106]
Potential isolation	Galvanic isolation to P1/P2, voltage proof up to 500 VAC

Digital outputs

Number of channels	4, DC actuators
Output type	PNP
Output voltage	24 VDC
Load type	Ohmic
Output current per channel	0.5 A, short-circuit proof, max. 2 A (ohmic) 1 A (inductive) over all standard outputs
Simultaneity factor	1 for the complete module Total current max. 2 A at FSO0
Actuator supply	■ C4/X4, C5/X5: FSO 0 max. 2 A; 500 mA per output ■ C6/X6: VAUX1 max. 2 A ■ C7/X7: FSO1 max. 2 A Derating [► 106]
Potential isolation	Galvanic isolation to P1/P2, voltage proof up to 500 VAC

TBPN-L...-FDIO1-2IOL – Standard IO-Link Channels

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20 Description of the IO-Link Channels

The TBPn-L...-FDIO1-2IOL provides two IO-Link ports at the connectors C6 and C7 (TBPn-L1) or X6 and X7 (TBPn-LL).

- 2-channel IO-Link master according to specification V1.1
- two universal digital channels, PNP, channel diagnostics, 0,5 A

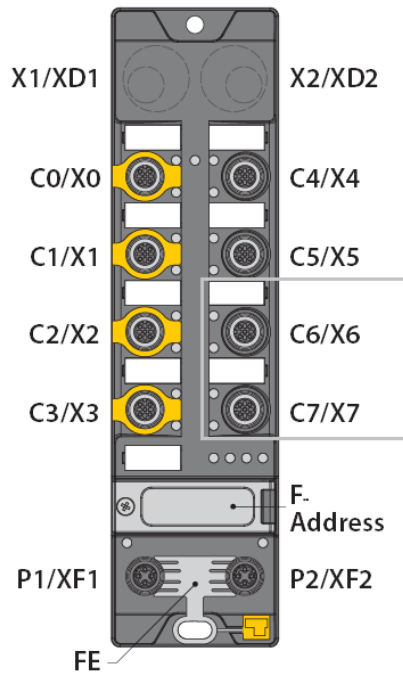


fig. 73: Device structure – IO-Link channels

TBPn-L1	TBPn-LL	Meaning
X1	XD1	Power IN
X2	XD2	Power OUT
C0	X0	FDIO1, safety-related input
C1	X1	FDI2/3, safety-related input
C2	X2	FDX4/5, safety-related in-/output
C3	X3	FDX6/7, safety-related in-/output
C4	X4	DXP8/9, standard in-/outputs (safe shutdown via FSO0 possible)
C5	X5	DXP10/11, standard in-/outputs (safe shutdown via FSO0 possible)
C6	X6	IOL, IO-Link port 1
C7	X7	IOL, IO-Link port2 (safe shutdown via FSO 1 possible)
F Address	F Address	Rotary coding switch for address setting for PROFI-safe (F-address setting)
P1	XD1	Ethernet 1
P2	XD2	Ethernet 2
FE	FE	Functional earth

20.1 Functions and operating modes

The TBPN-L...-FDIO1-2IOL has two Class A IO-Link ports at slots C6 and C7 or X6 and X7.

The IO-Link channels at pin 4 can be parameterized independently of each other and operated either in IO-Link mode or in SIO mode (DI in standard I/O mode).

The universal digital channels at pin 2 of the slots C6 and C7 or X6 and X7 are designed as DXP channels and can be freely used as input or output.

20.1.1 Power supply of the IO-Link ports

The IO-Link port IOL1 at C6 or X6 is supplied via V1. The IO-Link port IOL2 at C7 or X7 is supplied via the internal safe output FSO1.

IO-Link port	Connector	Power supply
IOL1	C6/X6	VAUX1
IOL2	C7/X7	FSO1 (clocked by test pulses)



NOTE

The supply of the IO channels IOL2 via FSO1 is done by a pulsed voltage. The pulsed voltage can influence the function of connected IO-Link devices to the device. To prevent this, the test pulse can be changed or switched off completely in the TURCK Safety Configurator via the expert settings at the FSO1 output.

20.1.2 Supply of connected IO-Link devices (Class A and Class B)

The IO-Link ports provide Class A power on pins 1 and 3 and Class B power on pins 2 and 5 for the connected IO-Link devices. The two supply voltages are not galvanically isolated.

Set the respective output (DXP13 or DXP15) in the process output data in order to activate the Class B supply.

21 Connecting



WARNING

Intrusion of liquids or foreign bodies through leaking connections

Danger to life due to failure of the safety function

- ▶ Tighten 7/8" male connectors with a tightening torque of 0.8 Nm.
- ▶ Only use accessories that guarantee the degree of protection (IP65, IP67, IP69K).
- ▶ Close unused M12 connectors with the supplied screw caps. The tightening torque for the screw caps is 0.5 Nm.

21.1 Connecting a device in zone 2 and zone 22



DANGER

Explosive atmosphere

Explosion due to ignitable sparks

For use in Zone 2 and Zone 22:

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

21.2 Connecting IO-Link Devices



NOTICE

Wrong supply of IO-Link devices (Class A)

Damage to the electronics

- ▶ Only supply IO-Link devices (Class A) with the voltage VAUX1 provided at the supply terminals.

The device has two M12 connectors for connecting IO-Link devices. The maximum tightening torque is 0.6 Nm.

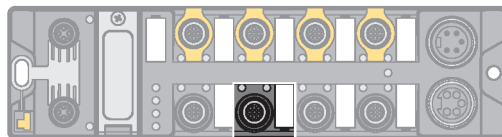


fig. 74: M12 connector, IO-Link channel IOL1, C6 or X6

- ▶ Connect the IO-Link devices to the device according to the pin assignment.

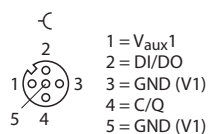


fig. 75: Pin assignment IO-Link port IOL1 (C6 or X6)

Pin	Signal	Meaning
1	V _{AUX} 1	Class A supply
2	DI/DO	Digital input or digital output/ Class B supply
3	GND (V1)	Ground V1
4	C/Q	IO-Link
5	GND (V1)	Functional earth

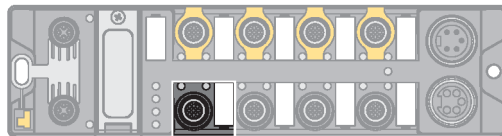


fig. 76: M12 connector, IO-Link channel IOL2, C7 or X7

- ▶ Connect the IO-Link devices to the device according to the pin assignment.

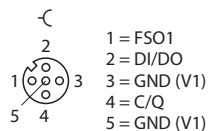


fig. 77: Pin assignment IO-Link port IOL2 (C7 or X7)

Pin	Signal	Meaning
1	FSO1	Class A supply (can be switched off safely)
2	DI/DO	Digital input or digital output/ Class B supply
3	GND (V1)	Ground V1
4	C/Q	IO-Link
5	GND (V1)	Functional earth

Connecting Inductive Coupler (Class A)

The IO-Link port IOL2 at C7 or X7 is supplied via the internal safe output FSO1. Inductive couplers (Class A) cannot be connected to port C7 or X7 due to the test pulses of the safe output.

- ▶ Only connect inductive couplers to port C6 or X6.
- ▶ Set the parameter "Cycle time" to a minimum value of 10.4 ms.

22 Commissioning

22.1 Commissioning IO-Link devices

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

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

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

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

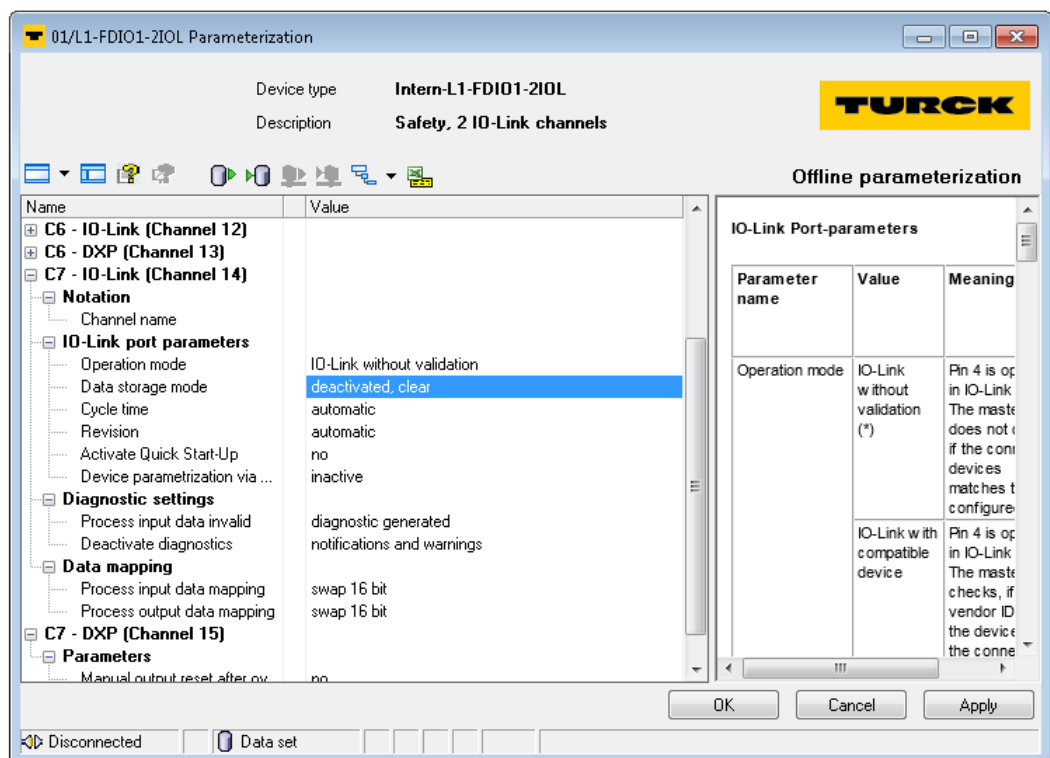


fig. 78: Deactivate or respectively delete the data storage mode with the DTM (example).

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

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

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

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

Resetting the master to factory settings with the DTM

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

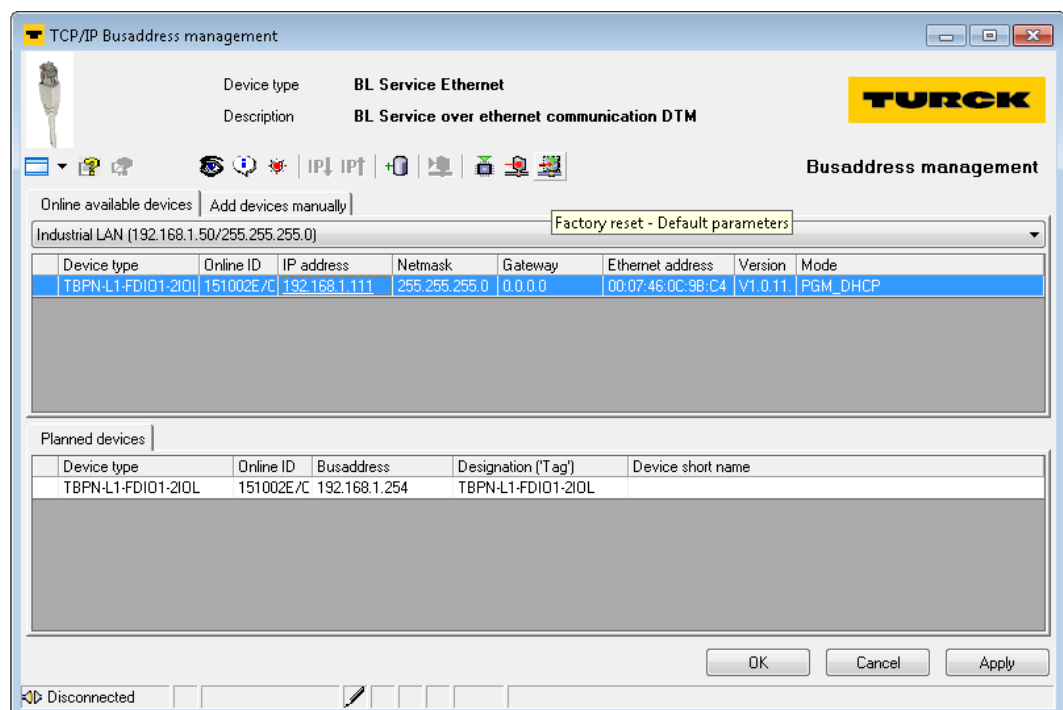


fig. 79: Reset device to factory settings via DTM (example)

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

Delete the data storage memory via parameters

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

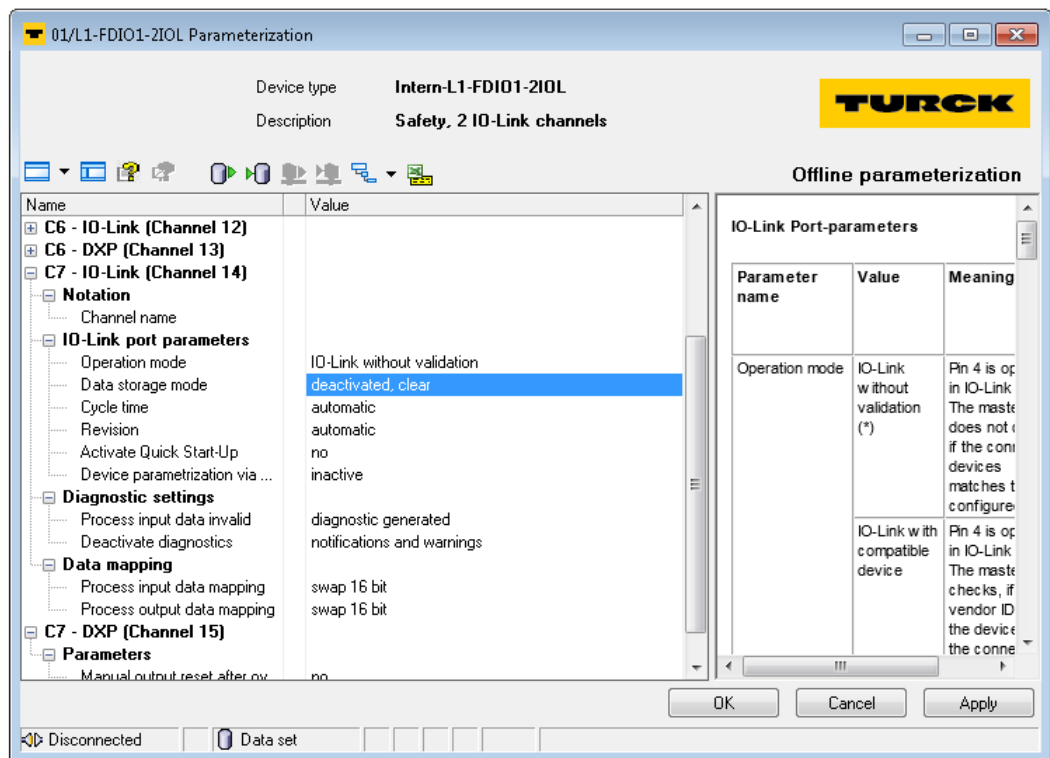


fig. 80: Deactivate or respectively delete the data storage mode with the DTM (example).

22.1.3 Commissioning IO-Link devices via SIDI

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

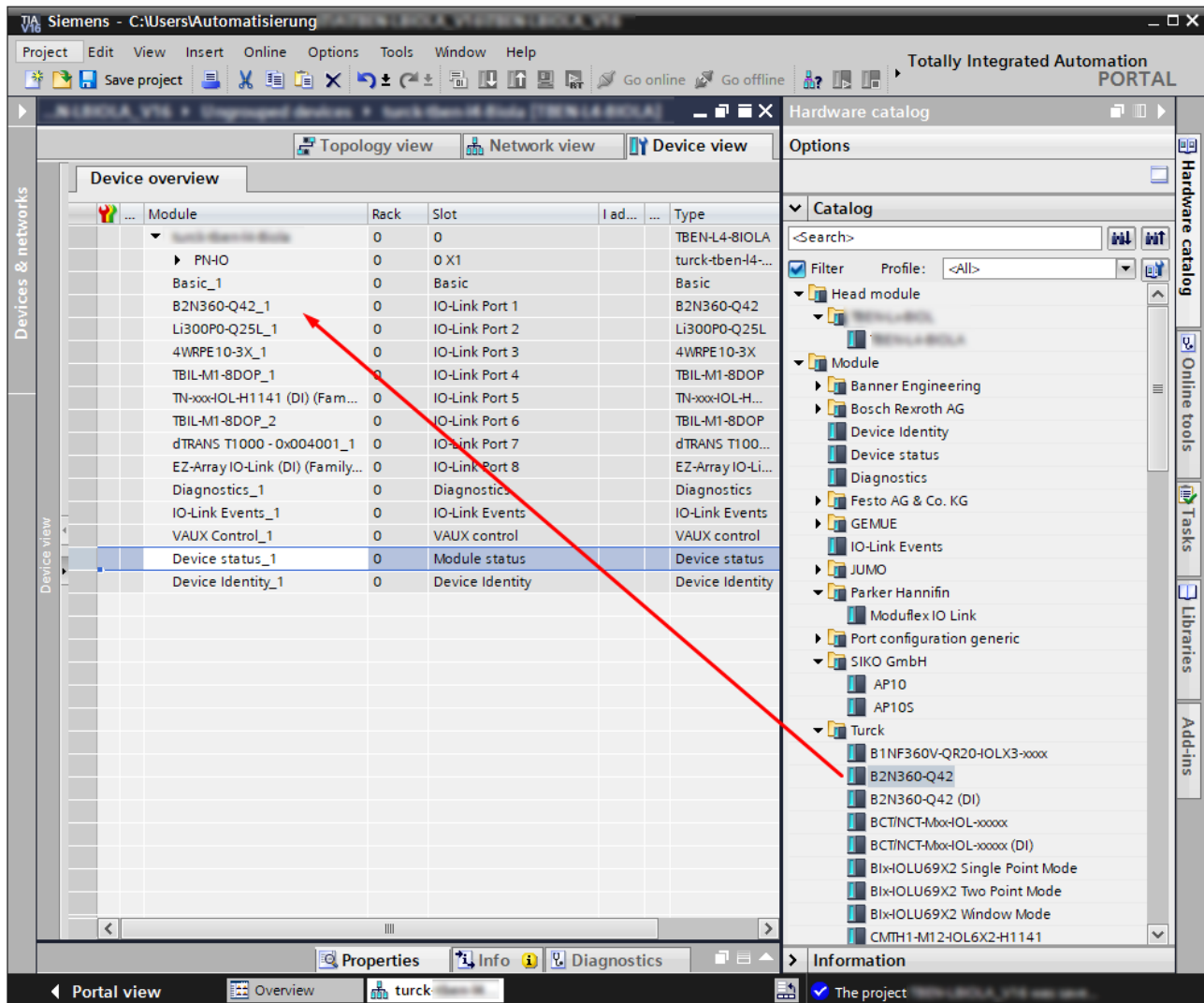


fig. 81: Example: TIA Portal, IO-Link device in hardware catalog (SIDI)

Parameterizing IO-Link devices via PROFINET engineering

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

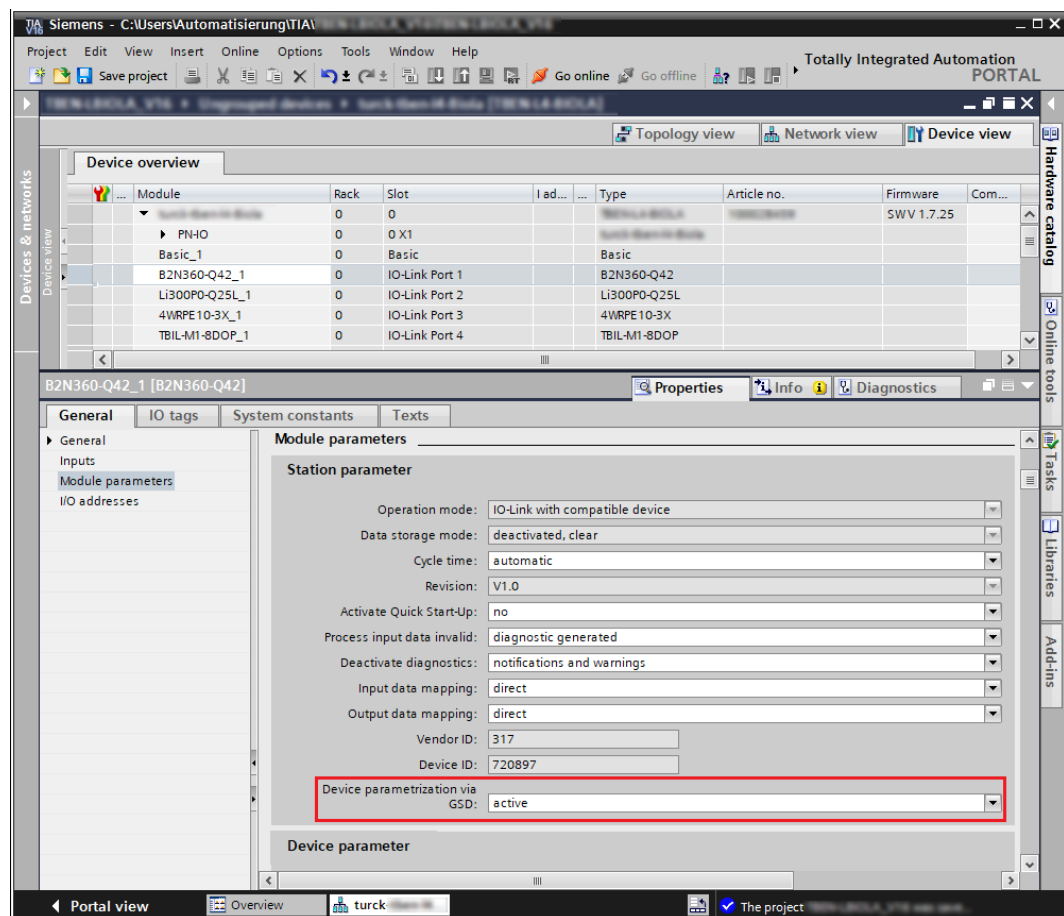


fig. 82: Example: TIA Portal, "Device parameterization via GSD" parameter

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

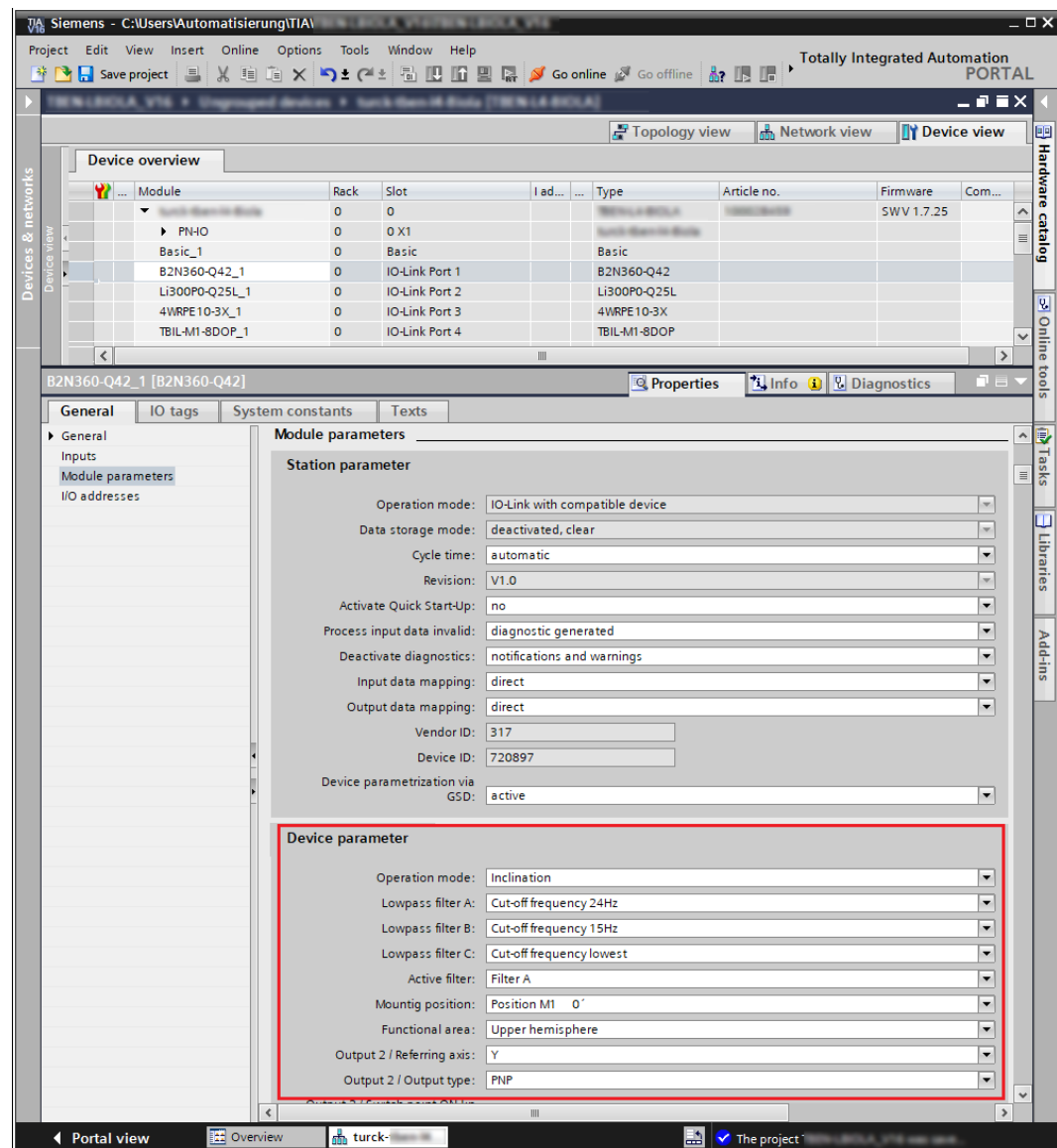


fig. 83: Example: TIA Portal, IO-Link device parameters via GSDML

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

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



NOTE

Data storage is not possible when configuring IO-Link devices with SIDI.

Parameterizing IO-Link devices via IO-Link mechanisms

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

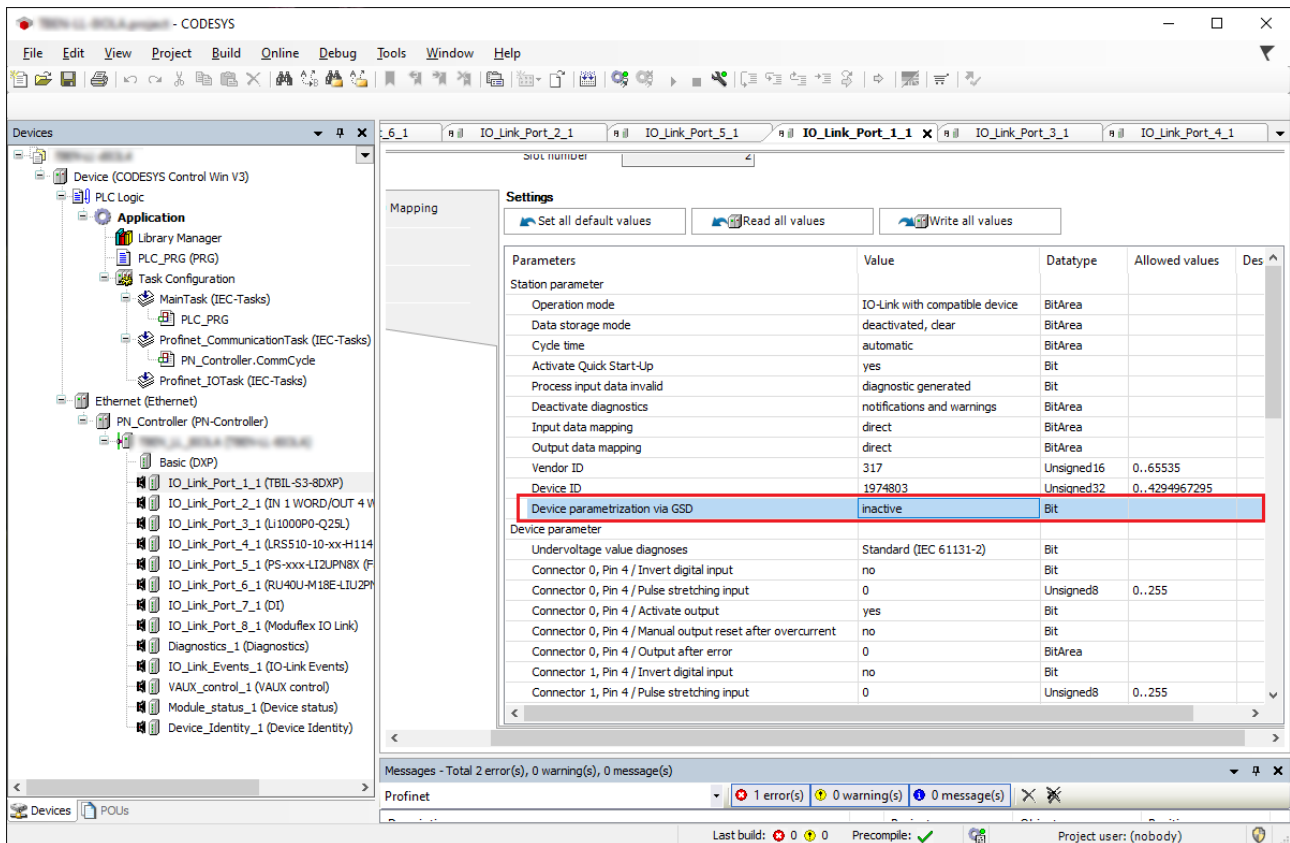


fig. 84: PROFINET engineering (CODESYS); Device parameterization via GSD inactive

The screenshot displays the CODESYS IDE interface for a project named 'TBEN-LL-8IOLA.project'. The left-hand 'Devices' pane shows a hierarchical tree of the device configuration, with 'IO_Link_Port_1_1 (TBIL-S3-8DXP)' selected under the 'Basic (DXP)' section. The right-hand pane shows the 'Find' window with a table of variables and their mappings.

Variable	Mapping	Channel	Address	Type	Unit	Desc
		Inputs	%IB 10			
		Process input data	%IB 10	USINT		
		Input 0	%IX 10.0	BOOL		
		Input 1	%IX 10.1	BOOL		
		Input 2	%IX 10.2	BOOL		
		Input 3	%IX 10.3	BOOL		
		Input 4	%IX 10.4	BOOL		
		Input 5	%IX 10.5	BOOL		
		Input 6	%IX 10.6	BOOL		
		Input 7	%IX 10.7	BOOL		
		Process input data	%IB 11	USINT		
		Process input data	%IB 12	USINT		
		Process input data	%IB 13	USINT		
		Inputs PS	%IB 14	Enumeration of BYTE		
		Process output data	%QB2	USINT		
		Output 0	%QX2.0	BOOL		
		Output 1	%QX2.1	BOOL		
		Output 2	%QX2.2	BOOL		
		Output 3	%QX2.3	BOOL		
		Output 4	%QX2.4	BOOL		
		Output 5	%QX2.5	BOOL		
		Output 6	%QX2.6	BOOL		
		Output 7	%QX2.7	BOOL		
		Outputs CS	%IB 15	Enumeration of BYTE		

Below the table, there are buttons for 'Reset mapping' and 'Always update variables: Use parent device setting'. At the bottom, there are icons for 'Create new variable' and 'Map to existing variable'.

fig. 85: PROFINET engineering (CODESYS): Process data structure IO-Link device with SIDI

22.2 User data for acyclic services (IO-Link)

Acyclic I/O channel user data

Index Dec.	Hex.	Name	Data type	Access	Comment
1	0x01	Module parameters	specific	read/ write	Parameters of the module
2	0x02	Module type	ENUM UINT8	read	Contains the module type
3	0x03	Module version	UINT8	read	Firmware version of I/O channels
4	0x04	Module ID	DWORD	read	Module ID of the I/O
5...9	0x05 ... 0x09	reserved	-	-	-
10	0x0A	Controller version	UINT8 array [8]	read	
11...18	0x0B... 0x12	reserved	-	-	-
19	0x13	Input data	specific	read	Input data of the respective I/O-channel
20...22	0x14 ... 0x16	reserved	-	-	-
23	0x17	Output data	specific	read/ write	Output data of the respective I/O-channel
...	...	reserved	-	-	-
251	0xFB	CAP 1	Record	read/ write	Client Access Point for PROFINET IO controller
252	0xFC	CAP 2	Record	read/ write	
253	0xFD	CAP 3	Record	read/ write	
254	0xFE	CAP 4	Record	read/ write	
255	0xFF	CAP 5	Record	read/ write	Client Access Point for PROFINET IO supervisor

22.3 The IO-Link function block IOL_CALL

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

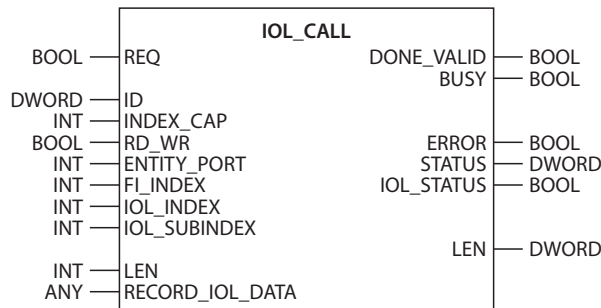


fig. 86: IOL_CALL in accordance with IO-Link specification



NOTE

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

Function block IOL_CALL – input variables

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

Name in accordance with IO-Link specification	Data type	Meaning
REQ	BOOL	0 → 1 → 0: Send command
ID	DWORD	Address of the IO-Link master module Siemens CPU 300, 400 (PROFIBUS/PROFINET): Start address of the input data of the IO-Link master module ■ 3S CODESYS: Slot number of the IO-Link master ■ Siemens CPU 1200, 1500 (PROFIBUS/PROFINET): Hardware identifier of the IO-Link master module ■ Siemens CPU 300, 400 (PROFIBUS/PROFINET): Start address of the input data of the IO-Link master module
ITFMODULE	DWORD	Device name of the IO-Link master
INDEX_CAP	INT	Function block instance: 247...254, 255
RD_WR	BOOL	0: Write access 1: Write access
ENTITY_PORT	INT	Address of the IO-Link port to be accessed.
FI_INDEX	INT	Constant value (65098): Defines the access as IO-Link function block IOL_CALL
IOL_INDEX	INT	Number of the IO-Link index which has to be read or written

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

Function block IOL_CALL: output variables

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

Name in accordance with IO-Link specification	Data type	Meaning
DONE_VALID	BOOL	0: Command was not executed. 1: Command was executed.
BUSY	BOOL	0: Command is currently not executed. 1: Command is currently executed.
ERROR	BOOL	0: No error present 1: Error while reading or writing.
STATUS	DWORD	Communication error status: status of the acyclic communication, s. "IOL_CALL – communication error status" [▶ 131]
IOL_STATUS	DWORD	IO-Link error message: Error in the communication between IO-Link master and IO-Link device [▶ 132]
LEN	INT	Length of the read data

IOL_CALL – communication error status

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

Byte 3	Byte 2	Byte 1	Byte 0
Manufacturer specific identifier (not always applicable)	0x80 Specifies the error as an error of acyclic communication.	Error code/ status code	Vendor specific identifier (not always applicable)

Status Code	Name	Meaning
0xFF000000	TIMEOUT	Internal error in the communication with the module
0x00FFF00	INVALID_HANDLE	
0x00FFE00	HANDLE_OUT_OF_BUFFERS	
0x00FFD00	HANDLE_DESTINATION_UNAVAILABLE	
0x00FFC00	HANDLE_UNKNOWN	
0x00FFB00	HANDLE_METHOD_INVALID	
0xFF80A0XX	MASTER_READ_ERROR	Error while reading
0xFF80A1XX	MASTER_WRITE_ERROR	Error while writing
0xFF80A2XX	MASTER_MODULE_FAILURE	Failure of the IO-Link master, bus failure possible

Status Code	Name	Meaning
0xXX80A6XX	MASTER_NO_DATA	No data received
0xXX80A7XX	MASTER_BUSY	IO-Link master busy
0xXX80A9XX	MASTER_FEATURE_NOT_SUPPORTED	Function not supported by IO-Link master.
0xXX80AAXX	MASTER_RESOURCE_UNAVAILABLE	IO-Link master not available.
0xXX80B0XX	ACCESS_INVALID_INDEX	Index invalid, wrong INDEX_CAP used
0xXX80B1XX	ACCESS_WRITE_LENGTH_ERROR	Length of data to be written can not be handled from the module, wrong module accessed.
0xXX80B2XX	ACCESS_INVALID_DESTINATION	Wrong slot accessed
0xXX80B3XX	ACCESS_TYPE_CONFLICT	IOL_CALL invalid
0xXX80B5XX	ACCESS_INVALID_INDEX	Error in IOL_CALL sequence
0xXX80B6XX	ACCESS_DENIED	IO-Link master module refuses the access.
0xXX80C2XX	RESOURCE_BUSY	The IO-Link master module is busy or is waiting for an answer of the connected IO-Link device.
0xXX80C3XX	RESOURCE_UNAVAILABLE	
0xXX8901XX	INPUT_LEN_TOO_SHORT	The index to be read contains more data than defined in the input variable "LEN".

IOL_CALL – IOL_STATUS

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

Byte 3	Byte 2	Byte 1	Byte 0
IOL_M-Error-Code		IOL-Error Type	
IOL_M Error Code	Designation acc. to specification	Meaning	
0x0000	No error	No error	
0x7000	IOL_CALL Conflict	Unexpected write-request, read request expected	
0x7001	Wrong IOL_CALL	Decoding error	
0x7002	Port blocked	The accessed port is occupied by another task	
...	reserved		
0x8000	Timeout	Timeout, IOL master or IOL device port busy	
0x8001	Wrong index	Error: IOL index < 32767 or > 65535 selected	
0x8002	Wrong port address	Port address not available	
0x8003	Wrong port function	Port function not available	
...	reserved		

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

23 Configuring

23.1 Parameters

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Basic							
	0	-	-	-	-	-	-	-	-
	1	DXP15_ SRO	-	DXP13_ SRO	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	DXP15_ ENDO	-	DXP14_ ENDO	-	-	-	-	-
		IO-Link							
IOL1	4	GSD	Quick Start-Up	data storage mode		Operation mode			
	5	Cycle time							
	6	Process output data mapping		Process input data mapping		Deactivate dia- gnostics		PDIN invalid	Revision
	7...11	-	-	-	-	-	-	-	-
	12	Vendor ID (LSB)							
	13	Vendor ID (MSB)							
	14	Device ID (LSB)							
	15	Device ID							
	16	Device ID							
	17	Device ID (MSB)							
	18	-	-	-	-	-	-	-	-
	19	-	-	-	-	-	-	-	-
IOL2	20...35	Assignment similar to IOL1 (byte 4 to 19)							

Meaning of parameter bits

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

Parameter name	Value Dec.	Hex.	Meaning	Description
Operation mode	0	0x00	IO-Link without validation	Pin 4 is operated in IO-Link mode. The master does not check if the connected device matches the configured one.
	1	0x01	IO-Link with family compatible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the MSB of the Device ID (this byte defines the product family) of the connected device match those of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	2	0x02	IO-Link with compatible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the Device ID of the connected device match those of the configured one. If the Vendor ID matches, but the Device ID not, then the master tries to write the Device ID to the device. If the writing is successful, then the device is a compatible one, process data exchange is possible. If writing the Device ID is not successful, then process data exchange is not possible. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	3	0x03	IO-Link with identical device	Pin 4 is operated in IO-Link mode. The master checks if the device type (Vendor ID and Device ID) and the serial number of the connected device match the data of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	4	0x04	DI (with parameter access)	Pin 4 is generally operated as simple digital input. An acyclic parameter access from the PLC or the DTM is possible. The IO-Link master starts the port in IO-link mode, parameterizes the device and sets the port back into SIO mode (DI). The port remains in SIO mode (DI) until a new IO-Link request is sent from the higher-level control. Data storage is not supported. Connected devices have to support the SIO mode (DI). In case of a parameter access, the IO-Link communication at the port is started. Switching signals are interrupted.
	8	0x08	DI	Pin 4 is operated as simple digital input. Data storage is not supported.

Parameter name	Value Dec.	Hex.	Meaning	Description
Data Storage Mode	Synchronization of parameter data of IO-Link devices (storing the parameter of the connected device in the master). If the synchronization is not possible, a diagnostic message is displayed (DS_ERR). In this case the data memory of the master must be deleted: ▶ Select option "deactivated, delete" to delete the data memory of the master IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. When using IO-Link devices with IO-Link V1.0: ▶ Select option "deactivated, delete" to deactivate data storage.			
	0	0x00	Activated	Synchronization of parameter data activated. The actual data (master or device) serve as the reference data.
	1	0x01	Overwrite	Synchronization of parameter data activated, the data in the master serve as reference data.
	2	0x02	Read in	Synchronization of parameter data activated. The data in the connected IO-Link device serve as reference data.
	3	0x03	Deactivated, clear	Synchronization of parameter data deactivated. The data set in the master is deleted.
Activate Quick Start-Up	For fast applications (e.g. tool changing applications) the start-up time of IO-Link devices can be shortened. The start-up time defined in the IO-Link specification (TSD = Device Detection Time) is reduced.			
	0	0x00	No	The start-up time is within the specified range (0.5 s). All IO-Link devices in accordance with the specification can be operated.
	1	0x01	Yes	The start-up time is reduced to approx. 100 ms. It is not supported by every IO-Link device. It can thus be necessary to check if the used IO-Link device starts in this mode.
Device parameterization via GSD (GSD)	0	0x00	Inactive	The port is generic or is not parameterized.
	1	0x01	Active	In PROFINET the port is parameterized with a specific device type from the GSDML-file (SIDI).
Cycle time	0	0x00	Automatic	The lowest cycle time supported by the device is taken from the table.
	16... 191	0x10 ... 0xBF	1.6 = 132,8 ms	Settable in steps of 0.8 or 1.6 ms.
	255	0xFF	Automatic, compatible	Compatibility mode The mode solves possible communication problems with sensors of the SGB family from IFM.
Revision	0	0x00	Automatic	The Master defines the IO-Link revision automatically.
	1	0x01	V1.0	IO-Link Revision V 1.0 is used.
Process input data invalid (PDIN invalid)	0	0x00	Diagnostic generated	If the process data are invalid, a respective diagnostic message is generated.
	1	0x01	No diagnostic generated	Invalid process data do not cause a diagnostic message.

Parameter name	Value Dec. Hex.	Meaning	Description
Deactivate diagnostics	Influences the sending of IO-Link-Events from the master to the fieldbus. Depending on the parameterization, the master transmits Events based on their priority to the fieldbus or not.		
	0	0x00 No	The master transmits all IO-Link Events to the fieldbus.
	1	0x01 Notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
	2	0x02 Notifications and warnings	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
	3	0x03 Yes	The master doesn't transmit any IO-Link Event to the fieldbus.
Process input data mapping	Optimization of the process data mapping for the used fieldbus: The IO-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side.		
	0	0x00 Direct	The process data are not swapped. i.e.: 0x0123 4567 89AB CDEF
	1	0x01 Swap 16 bit	The bytes are swapped per word. i.e.: 0x2301 6745 AB89 EFCD
	2	0x02 Swap 32 bit	The bytes are swapped per double word. i.e.: 0x6745 2301 EFCD AB89
	3	0x03 swap all	All bytes are swapped. i.e.: 0xEFCD AB89 6745 2301
Process output data mapping	see Process input data mapping		
Vendor ID	0...65535 0x0000...0xFFFF	Vendor ID for the port configuration check	
Device ID	0...16777215 0...0x0FFFFFFF	Device ID for the port configuration check, 24 bit value	

Values for the parameter "cycle time" in ms:

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

23.1.1 Adapting the process data mapping

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

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

Example mapping for field buses with Little Endian format

Mapping through IO Link master → field bus → PLC						
Byte	Device at IO-Link port	Device process data in IO-Link master		Parameters: Mapping process data	Device process data to field bus	
Byte 0		Status/control			Status/control	
Byte 1						
IO-Link port 1						
Byte 2	Temperature sensor TS...	Temperature	Low byte	swap 16 bit	temperature	High byte
Byte 3			High byte			Low byte
IO-Link port 2						
Byte 8		Diagnosis		swap all	Counter/ position value	Most Significant Byte
Byte 9	Rotary encoder RI...	Counter/ position value	Low byte			High byte
Byte 10			High byte			Low byte
Byte 11			Most Significant Byte		Diagnostics	

23.2 Specific configuration of the IO-Link ports via GSDML (SIDI)

Simple IO-Link Device Integration (SIDI)

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



NOTE

Data storage is not possible when configuring IO-Link devices with SIDI.

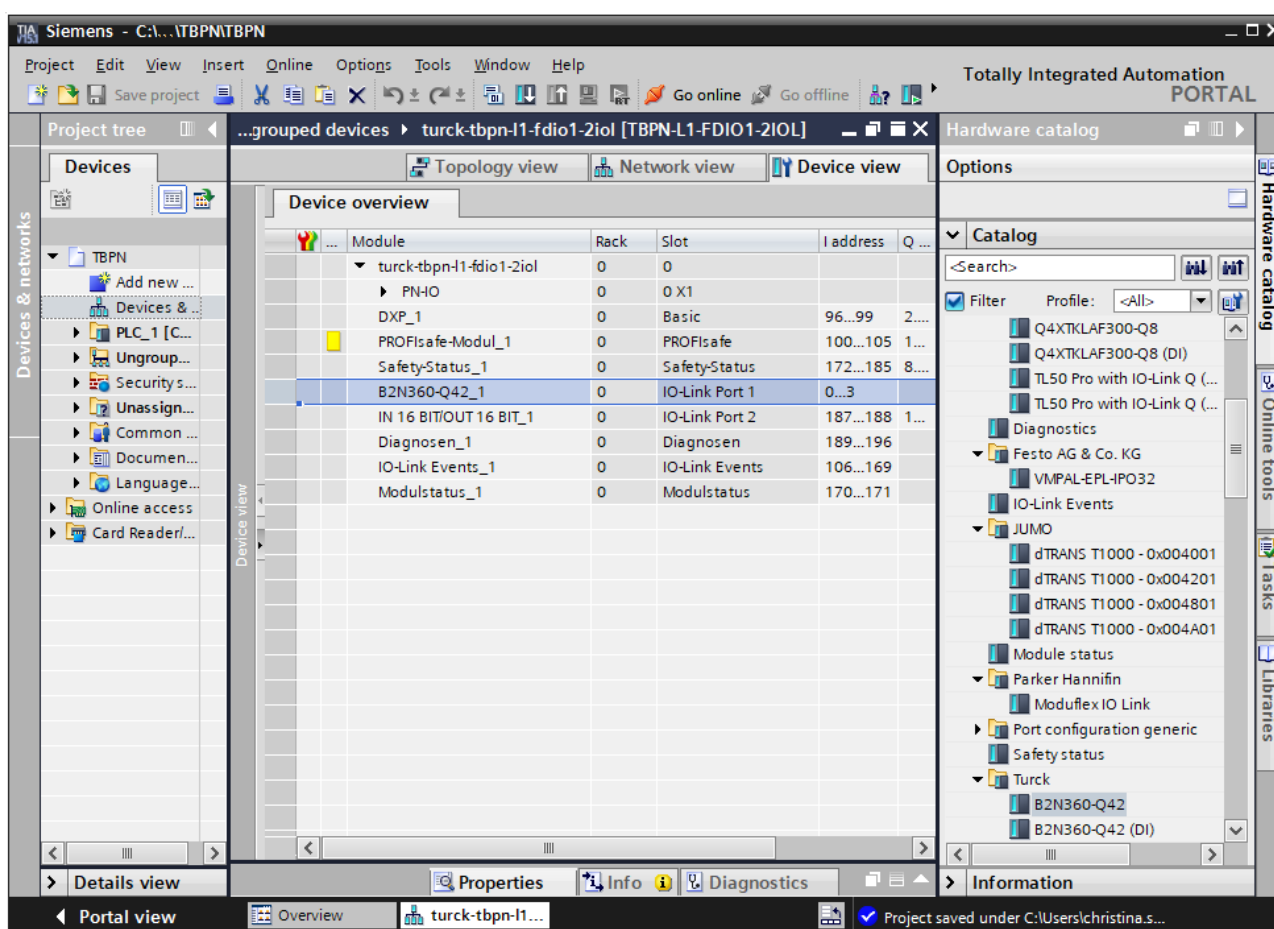


fig. 87: Specific configuration of the IO-Link ports via GSDML

23.3 IO-Link functions for acyclic communication

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

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

Addressing is done via the Entity_Port:

- Entity_Port 0 = IO-Link master module (IOLM)
- Entity_Port 1 = IO-Link device at IO-Link port 1
- Entity_Port 2 = IO-Link device at IO-Link port 2

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

IO-Link-Index (port function invocation)

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

Subindex 64: Master Port Validation Configuration

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

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

Entity_Port	IO-Link port sub index	Read/write	Length
0	64	Write	max. 72 byte

Structure of the command IOL_Port_Config:

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

Subindex 65: IO-Link Events

The object reads IO-Link Event diagnostics.

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



NOTE

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

Structure of the read data:

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

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

Subindex 66: Set Default Parameterization

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

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

Structure of the reset command:

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

Subindex 67: Teach Mode

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

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

Structure of the Teach command:

Byte 0	
0x00	Teach all ports
0x01	Teach port 1
0x02	Teach port 2
0x03...0xFF	Reserved

Subindex 68: Master Port Scan Configuration

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

28 byte are returned per IO-Link port

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

Structure of the answer telegram:

IO-Link-port	Content	Length	Format	Description
Port 1	Vendor ID	2 byte	UINT16	Vendor ID of the connected device
	Device ID	4 byte	UINT32	Device-ID of the connected device
	Function ID	2 byte	UINT16	Reserved
	Serial number	16 byte	UINT8	Serial number of the connected device
	COM_Revision	1 byte	UINT8	IO-Link version
	Proc_In_Length	1 byte	UINT8	Process input data length of the connected device
	Proc_Out_Length	1 byte	UINT8	Process output data length of the connected device
	Cycle time	1 byte	UINT8	Cycle time of the connected device
Port 2	Structure similar to port 1			

Subindex 69: Extended Port Diagnostics

The object reads the Extended Port Diagnostics.

Entity_Port	IO-Link port sub index	Read/write	Length
0	68	Read	max. 8 byte

Structure of the Extended Port Diagnostics:

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

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

Device Status

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

24 Operating

24.1 LED displays – IO-Link channels

LED IOL, LED 12 (C6/X6), LED 14 (C7/X7)		Meaning (Channel in IO-Link-mode)	
Off		Port inactive, no IO-Link communication, diagnostics deactivated	
Green flashing		IO-Link communication, process data valid	
Red flashing		IO-Link communication and module error, invalid process data	
Red		IO-Link supply error free, no IO-Link communication and/ or module error, process data invalid	
LED IOL, LED 12 (C6/X6), LED 14 (C7/X7)		Meaning (channel in SIO mode (DI))	
Off		No input signal	
Green		Digital input signal active	
LED DXP, LED 13 (C6/ X6), LED 15 (C7/X7)	Meaning (input)	Meaning (output)	
Off	Input inactive	Output inactive	
Green	Input active	Output active	
Red	–	Output active with overload or short circuit	

24.2 Process input data

24.2.1 Overview - complete module

The process input data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Basic							
n ... n + 3	Status messages for standard I/O channels [► 113] and IO-Link master channels [► 147]							
	PROFIsafe module							
n + 4... n + 5	Process input data Safe I/O channels [► 93]							
	Safety-Status							
n + 6... n + 19	Safe Unit Status [► 94]							
n + 20... n + 23	Reserved							
	IO-Link channels							
n + 24 ... n + 87	IO-Link process input data [► 147]							
	Diagnostics							
n + 88 ... n + 89	Overcurrent diagnostics [► 113]							
n + 90... n + 91	DXP diagnostics [► 113]							
n + 92... n + 95	IO-Link port diagnostics [► 147]							
	IO-Link Events							
n + 96... n + 159	IO-Link Events [► 147]							
	Module status							
n + 160... n + 161	Module status [► 91]							

24.2.2 Process input data – IO Link channels

Byte no.	Bit no.							
	7	6	5	4	3	2	1	0
Basic								
n	DXP15 C7/X7 P2	DI14 C7/X7 P4	DXP13 C6/X6 P2	DI12 C6/X6 P4	-	-	-	-
n + 1	-	-	-	-	-	-	-	-
n + 2	-	DVS14	-	DVS12	-	-	-	-
n + 3... n + 23	...							
	IO-Link process input data							
n + 24 ... n + 55	IOL1 process input data (C6/X6) structure depends on channel parameterization							
n + 26 ... n + 87	IOL2 process input data (C7/X7) structure depends on channel parameterization							
	Overcurrent diagnostics sensor supply (IOL1)							
n + 88	-	VERRV1 Ch12/13	-	-	-	-	-	-
n + 89... n + 90	...							
	Overcurrent output							
n + 91	SCO15	-	SCO13	-	-	-	-	-
	IO-Link port diagnostics – IOL1 (C6/X6, channel 12)							
n + 92	EVT1	EVT2	PDINV	HWERR	DSERR	CFGERR	PPE	-
n + 93	GENERR	OVL	VHIGH	VLOW	ULVE	LLVU	OTMP	PRMERR
	IO-Link port diagnostics – IOL2 (C7/X7, channel 14)							
n + 94	EVT1	EVT2	PDINV	HWERR	DSERR	CFGERR	PPE	-
n + 95	GENERR	OVL	VHIGH	VLOW	ULVE	LLVU	OTMP	PRMERR
	IO-Link Events							
n + 96	Qualifier (1st Event)							
n + 97	Port (1st Event)							
n + 98	Event code high byte (1st Event)							
n + 99	Event code low byte (1st Event)							
...								
n + 156	Qualifier (16th Event)							
n + 157	Port (16th Event)							
n + 158	Event code high byte (16th Event)							
n + 159	Event code low byte (16th Event)							

Meaning of the process data bits

Name	Value	Meaning
I/O data		
DXP...	Configurable digital channel (DXP channel)	
C.../X...P...	0	No input signal at DXP channel (pin 2)
	1	Input signal at DXP channel (pin 2)
DVS...	Input value valid (Data Valid Signal)	
	0	The IO-Link data are valid. Possible causes: ■ Sensor supply below the admissible range. ■ IO-Link port parameterized as simple digital input. ■ No device connected to the master. ■ No input data received from the connected device (only valid for devices with an input data length > 0). ■ No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0). ■ The connected device sends an error Process input data invalid.
	1	The IO-Link data are valid.
IO-Link process input data	Process input data of the connected device The order of the IO-Link process input data can be changed via the parameter Process input data mapping .	
Diagnostics		
SCO...	Overcurrent output	
	0	No overcurrent
	1	Overcurrent at output (DXP channel used as output)
IO-Link port diagnostics	s. "Software diagnostic messages", [► 150]	
IO-Link Events	s. "IO-Link Events", [► 141]	

24.3 Process output data

24.3.1 Overview - complete module

The process output data of TBPN-L...-FDIO1-2IOL are structured as follows:

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n + 0... n + 1	Basic							
	Control: DXP channels [► 114]							
n + 2... n + 7	PROFIsafe module							
	Process output data safe I/O channels [► 97]							
n + 8... n + 9	Safety-Status							
	Unlock Safe Unit [► 98]							
n + 10... n + 73	IO-Link channels							
	IO-Link process output data [► 149]							

24.3.2 Process output data – IO Link channels

Byte no.	Bit no.							
	7	6	5	4	3	2	1	0
	Basic							
n	-	-	-	-	-	-	-	-
n + 1	DXP15 C7/X7P2	-	DXP13 C6/X6P2	-	-	-	-	-
...	...							
	IO-Link process output data							
n + 10 ... n + 41	IOL1 (C6/X6, channel 12) structure depends on the channel parameterization (0...32 byte per channel)							
n + 42 ... n + 73	IOL2 (C7/X7, channel 14) structure depends on the channel parameterization (0...32 byte per channel)							

Meaning of the process data bits

Name	Value	Meaning
I/O data		
DXP...	0	Output inactive
C.../X...P...	1	Output active, max. output current 0.6 A
		C.../X... = connector C0...C7 (TBEN-L4 or TBEN-L5) X0...X7 (TBEN-LL) P ...= pin
IO-Link process output data	Process output data of the connected device The order of the IO-Link process output data can be changed via the parameter Process output data mapping .	

24.4 Software diagnostic messages

Diagnostic messages are divided into DXP, IO-Link master and IO-Link device diagnostics.

The "PDInvalid" diagnostic (process data invalid) can be sent from both devices, IO-Link master or IO-Link device.

- **DXP diagnostics:**

Diagnostic messages of the universal digital channels (DXP13 and DXP15)

- **IO-Link master diagnostics (M):**

The IO-Link-master reports problems within the IO-Link communication.

- **IO-Link device diagnostics (D):**

The device diagnostics map the IO-Link Event Codes (according to the IO-Link specification) sent from the IO-Link devices to the diagnostic telegram of the master.

Event codes can be read from the connected devices by using appropriate device tools (e.g. IODD Interpreter).

Further information concerning the IO-Link Event Codes and their meaning can be found in the IO-Link specification or in the documentation of the connected devices.

Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DXP diagnostics – overcurrent sensor supply								
0	-	VERR V1 Ch1213	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	SCO15	-	SCO13	-	-	-	-	-
IO-Link port 1 (channel 12)								
0	EVT1 (D)	EVT2 (D)	PDINV (D, M)	HWERR (D)	DSERR (M)	CFGERR (M)	PPE (M)	-
1	GENERR (D)	OVL (D)	VHIGH (D)	VLOW (D)	ULVE (D)	LLVU (D)	OTEMP (D)	PRMERR (D)
IO-Link port 2 (channel 14)								
2	EVT1 (D)	EVT2 (D)	PDINV (D, M)	HWERR (D)	DSERR (M)	CFGERR (M)	PPE (M)	-
3	GENERR (D)	OVL (D)	VHIGH (D)	VLOW (D)	ULVE (D)	LLVU (D)	OTEMP (D)	PRMERR (D)

Bit	Meaning
DXP diagnostics	
VERRV1 K1213	Overcurrent supply VAUX1 on channel 12/13
SCO...	Overcurrent at output (DXP channel used as output)
IO-Link master diagnostics	
CFGER	Wrong or missing device The connected device does not match the channel configuration or there is no device connected to the channel. This diagnostic message depends on the parameterization of the channel.

Bit	Meaning
DSER	Data storage error Possible causes: ■ Data storage mismatch: IO-Link device in accordance with IO-Link V1.0 connected. The data storage buffer contains data of another device. ■ Overflow of the data storage buffer ■ The connected device may be locked for parameter changes or for data storage.
PPE	Port parameterization The port parameters are inconsistent. The device parameterization via GSD is active, but not working. Possible causes: ■ The IO-Link-master did not receive GSDML parameters for a connected IO-Link device. The connected device was not parameterized by a PROFINET PLC via GSDML. ■ The port is in operation mode "IO-Link without validation" or "DI". These two modes do not allow parameterization via GSD. ■ The data storage mode is active. The parameter is not set to "deactivated, clear". A device parameterization via GSDML is not possible with activated data storage. ■ Vendor or device ID are "0". The connected device can not be identified and is thus not parameterizable.
IO-Link master/device diagnostics	
PDINV	Process input data invalid The IO-Link master or the IO-Link device report invalid process input data. The connected device is not in status "operate", which means, it is not ready for operation. Possible cause: ■ The connected device does not match the configured one, additional diagnostic message Wrong or missing device. ■ Process input data invalid diagnosis because the process value cannot be measured (depends on the IO-Link device).
IO-Link device diagnostics	
	The IO-Link device diagnostics depend on the IO-Link device used. Please refer to the documentation for the IO-Link device for more detailed information on the diagnostics.
EVT1	Maintenance events A Maintenance Event in accordance with the IO-Link specification occurred, maintenance necessary.
EVT2	Out-of-specification events An Out-of-Specification Event in accordance with the IO-Link specification occurred.
GENERR	Common error The device sends an error (device status 4, in accordance with IO-Link specification), which is not clearly specified. Read out the device event codes in order to be able to specify the error more precisely.
HWER	Hardware error General hardware error or device malfunction of the connected device
LLVU	Lower limit value underrun The process value lies under the parameterized measurement range or the chosen measurement range has been chosen too high.

Bit	Meaning
OVL	Overload The connected device detected an overload.
OTMP	Over temperature A temperature diagnosis is available on the connected device.
PRMERR	Parameterization error The connected device reports a parameterization error (loss of parameters, no parameter initialization, etc.)..
ULVE	Upper limit value exceeded The process value exceeds the parameterized measurement range or the chosen measurement range has been chosen too low.
VLOW	Undervoltage One of the voltages at the connected device is below the defined range.
VHIGH	Overvoltage One of the voltages at the connected device exceeds the defined range.

24.4.1 PROFINET diagnostics

I/O diagnostics (slot C6 and C7 or X6 and X7)			PROFINET diagnostics		
DXP diagnostics	Channel	Connector	Error code	Channel	Slot
Overcurrent output	DXP13	C6/X6	0x0004	13	1
	DXP15	C7/X7	0x0004	15	1
IO-Link diagnostics					
IO-Link port 1					
Undervoltage (VLOW)	DI12 (C/Q)	C6/X6	0x0002	12	4
Overvoltage (VHIGH)			0x0003		
Overload (OVL)			0x0004		
Overtemperature (OTMP)			0x0005		
Wrong or missing device (CFGER)			0x0006		
Upper limit value exceeded (ULVE)			0x0007		
Lower limit value underrun (LLVU)			0x0008		
Data storage error (DSER)			0x0009		
Process input data invalid (PDINV)					
Maintenance event (EVT1)					
Out-of-specification events (EVT2)					
Port parameterization error (PPE)			0x0010		
Parameterization error (PRMER)					
Hardware error (HWER)			0x0015		
IO-Link port 2					
Similar to IO-Link - port 1	DI14 (C/Q)	C7/X7		14	5

24.5 Using IO-Link data storage

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

Data storage mode



NOTE

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

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

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

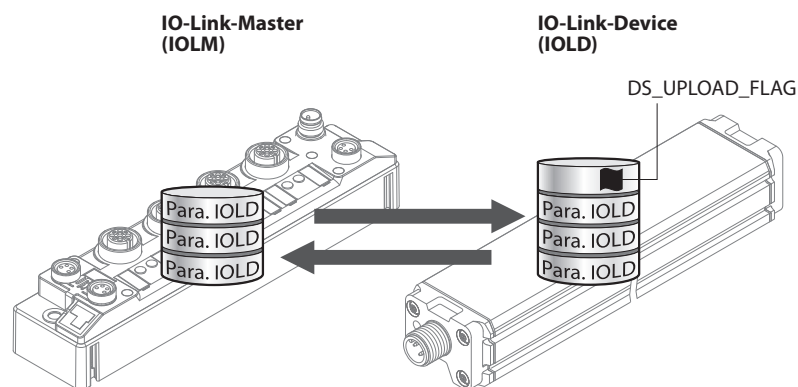


fig. 88: Data storage mode – general principle, Para. IOLD = parameters of the IO-Link device

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

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

24.5.1 Parameter "Data storage mode" = activated

The synchronization of the parameter sets is bidirectional.

The actual data set (master or device) is valid:

The following applies:

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

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

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

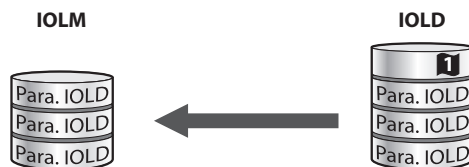


fig. 89: Data storage mode activated – parameter set in the device changed

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

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

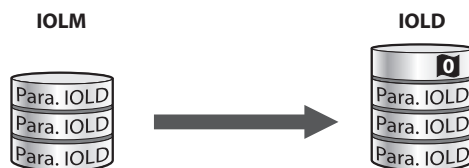


fig. 90: Data storage mode activated – parameter set in the device unchanged

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

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

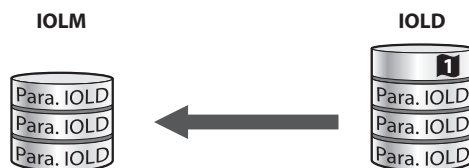


fig. 91: Data storage mode activated – parameter set in the device changed



NOTE

If device replacement is necessary when data storage is activated, an IO-Link replacement device with unknown parameter data should be reset to its factory settings before connection to the IO-Link master.

TURCK IO-Link devices can be reset to factory settings via a system command using a generic IO-Link DTM and the device specific IODD. For the reset of third party devices, please read the corresponding manufacturer documentation.

24.5.2 Parameter "Data storage mode" = read in

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

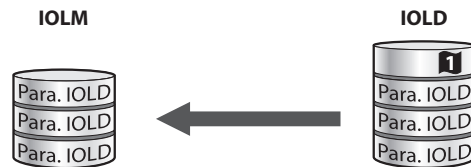


fig. 92: Data storage mode = read in – parameter set in the device changed

24.5.3 Parameter "Data storage mode" = overwrite

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

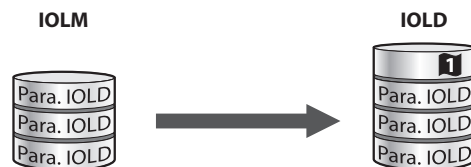


fig. 93: Data storage mode = overwrite – parameter set in the master changed

24.5.4 Parameter "Data storage mode" = deactivated, clear

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



fig. 94: Data storage mode deactivated – no synchronization

25 Troubleshooting

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

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

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

25.1 Eliminate parameterization errors in the IO-Link master

DXP channels

Error	Possible causes	Measure
DXP output not switching	The output is deactivated in the default setting of the device.	▶ Activate the output function via the Activate output parameter (DXP_EN_DO = 1).

IO-Link channels

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

26 Technical data – IO channels

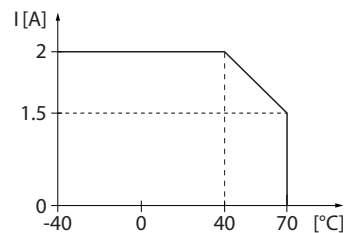
The first section of the operating instructions contains the general technical data of the device [► 104].

Technical data

Supply

Permissible range	20.4...28.8 VDC (acc. to IO-Link specification)
Operating current	< 120 mA
Power supply of the IO-Link ports	
IO-Link port 1 at C6 or X6	VAUX1, max. 2 A
IO-Link port 2 at C7 or X7	FSO1, max. 2 A

Derating



Potential isolation	≥ 500 V (V2 to Ethernet and V1)
IO-Link ports	
Ports	4
IO-Link specification	V1.0, V1.1 according to IEC 61131-9
Outputs IO-Link port type	Class A and Class B
Frame type	Supports all frame types
Process data for IO-Link device	
■ Input data	Max. 32 bytes per channel
■ Output data	Max. 32 bytes per channel
Transmission rate	4.8 kbps (COM 1) 38.4 kbps (COM 2) 230.4 kbps (COM 3)
Transmission cable	Length: max. 20 m, standard cables, 3- or 4-wire (depending on the application), unshielded

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