Your Global Automation Partner

TURCK

BL...-4IOL
IO-Link Master Modules for BL20 and BL67

Operating instructions

Table of Contents

1 About these instructions

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

For all general information about the IO systems BL20 and BL67, please read the manuals for the product families (see **Additional Documents (page 6)**).

1.1 Target Groups

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

1.2 Explanation of Symbols Used

The following symbols are used in these instructions:

DANGER!

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

WARNING!

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

ATTENTION!

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

NOTE

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

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

➥ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3 Additional Documents

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

- Data sheet
- Manuals for the BL20 and BL67 I/O modules
- Manuals for the BL20 and BL67 gateways
- Approvals
- CAD data

1.4 Feedback about these instructions

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

2 Notes on the Product

2.1 Product Identification

This manual contains all information concerning the Turck IO-Link master modules of the modular I/O systems BL20 and BL67:

- BL20-E-4IOL
- BL20-E-4IOL-10
- BL67-4IOL

2.1.1 Legal Requirements

The device falls under the following EU directives:

- 2014/30/EU (electromagnetic compatibility)
- 2011/65/EU (RoHS II Directive)

2.1.2 Manufacturer and Service

Hans Turck GmbH & Co. KG

Witzlebenstraße 7

45472 Muelheim an der Ruhr

Germany

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

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

Sales: +49 208 4952-380

Technology: +49 208 4952-390

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

Outside Germany, please contact your local Turck representative.

3 For Your Safety

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

3.1 Intended Use

These devices are designed solely for use in industrial areas.

The Turck IO-Link master modules BL20-E-4IOL(-10) or respectively BL67-4IOL are technology modules of the modular I/O-systems BL20 and BL67. They can be connected to several fieldbus systems and Ethernet protocols via the respective gateways. They transmit signals of the connected IO-Link devices to the gateway which, depending on the type of gateway, communicates with the higher level controls via different fieldbus or Ethernet protocols.

3.2 General Safety Instructions

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

4 Product description

The Turck IO-Link master modules BL20-E-4IOL(-10) or respectively BL67-4IOL are technology modules of the modular I/O-systems BL20 and BL67. They can be connected to several fieldbus systems and Ethernet protocols via the respective gateways.

The IO-Link module provides 4 IO-Link master channels and 4 universal digital channels (PNP).

The four IO-Link channels can be parameterized independently and can optionally be operated in IO-Link mode (IOL) or in standard I/O mode (DI mode).

The four universal digital channels are designed as XSG-channels and can therefore be parameterized as in- or output.

4.1 Device Overview

Fig. 1: BL67-4IOL

Fig. 2: BL20-E-4IOL/BL20-E-4IOL-10

4.2 Properties and Features

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

4.3 Compatible gateways

4.3.1 Compatible BL20 gateways

- BL20-E-4IOL

Fieldbus	Gateway	Ident no.	support from gateway firmware version
PROFIBUS-DP	BL20-GW-DPV1	6827234	≥ V1.27
	BL20-E-GW-DP	6827250	≥ V1.27
CANopen	BL20-E-GW-CO	6827252	≥ V5.02
	BL20-GWBR-CANOPEN	6827167	≥ V5.02

Fieldbus	Gateway	Ident no.	support from gateway firmware version
DeviceNet	BL20-E-GW-DN	6827301	≥ V2.16
	BL20-GWBR-DNET	6827168	≥ V7.18
Multi protocol	BL20-E-GW-EN	6827239	≥ V3.2.9.0
	BL20-E-GW-EN/ET	6827338	≥ V3.2.9.0

- B20-E-4IOL-10

Fieldbus	Gateway	Ident no.	support from gateway firmware version
PROFIBUS-DP	BL20-GW-DPV1	6827234	≥ V1.30
	BL20-E-GW-DP	6827250	≥ V1.29
CANopen	BL20-E-GW-CO	6827252	–
	BL20-GWBR-CANOPEN	6827167	–
DeviceNet	BL20-E-GW-DN	6827301	–
	BL20-GWBR-DNET	6827168	–
Multi protocol	BL20-E-GW-EN	6827239	> V3.3.8.0
	BL20-E-GW-EN/ET	6827338	> V3.3.8.0

4.3.2 Compatible BL20 gateways, CODESSYS programmable

- BL20-E-4IOL

Fieldbus	Product	Ident no.	firmware version	CODESYS package
Multi protocol	BL20-PG-EN-V3	6827393	≥ 1.0.7.0	≥ 1.0.5.0

- BL20-E-4IOL-10
  not supported

4.3.3 Compatible BL67 gateways

- BL67-4IOL

Fieldbus	Gateway	Ident no.	supported from gateway firmware version
PROFIBUS-DP	BL67-GW-DPV1	6827232	≥ V1.27
CANopen	BL67-GW-CO	6827200	≥ V5.02
DeviceNet	BL67-GW-EN	6827183	≥ V7.18
Multi protocol	BL67-GW-EN	6827214	≥ V3.1.0.0

4.3.4 Compatible BL67 gateways, CODESYS programmable

- BL67-4IOL

Fieldbus	Product	Ident no.	Firmware version	CODESYS package
Multi protocol	BL67-PG-EN-V3	6827394	≥ V1.1.5.0	≥ V1.1.5.0

4.4 Technical data

NOTE

For all technical data that are specific for the product lines, please read the I/O-manuals of the respective product family (BL20: **D300717** and BL67: **D300529**).

	BL20-E-4IOL/ BL20-E-4IOL-10	BL67-4IOL
Power supply		
Module bus current I_{MB}	Max. < 40 mA	Max. < 40 mA
Nominal current from field supply	< 50 mA	< 50 mA
Inverse-polarity protection	Yes	Yes
Power loss	< 2,6 W	< 2,6 W
Galvanic isolation		
U_{sys}/U_L/FE	500 VDC	500 VDC
Bridging power failure		
Time	10 ms	10 ms
Repeat rate	1/s	1/s
Sensor supply	From moU_L: 24 V DC (20.4 VDC…30 VDC)	From V_{sens}: 24 V DC (20.4 VDC…30 VDC)
Short-circuit protection	-	yes, 4 A via the gateway
Output current I_A	0.5 A	
I_{AMAX}	0,6 A, according to IEC 6 11 31-2	
Operating temperature	0…+55 °C	-40…+70 °C **Restriction:** IO-Link ports as DI: -40…+55 °C
Connection technology	Push-in tension clamp terminals	M12
Inputs		
Number of inputs	4	4
Input type	Digital pnp inputs, type 1 according to EN 61 131-2:2007	Digital pnp inputs, type 1 according to EN 61 131-2:2007
Low level signal voltage	< 5 V	< 5 V
High-level signal voltage	> 11 V	> 11 V
Low level signal current	< 1,5 mA XSG/ < 5 mA (IO-Link port as DI)	< 1,5 mA XSG/ < 5 mA (IO-Link port as DI)
High-level signal current	2,1…3,7 mA XSG/ 6…12 mA (IO-Link port as DI)	2,1…3,7 mA XSG/ 6…12 mA (IO-Link port as DI)
Potential isolation	Electronic to field	Electronic to field

	BL20-E-4IOL/ BL20-E-4IOL-10	BL67-4IOL
Outputs		
Number of outputs	4	4
Output type	pnp	pnp
Output current per channel	0.5 A	0.5 A
Output delay	1 ms	1 ms
Load type	Ohmic, inductive lamp load	Ohmic, inductive lamp load
Resistive load	> 48 Ω	> 48 Ω
Load impedance, inductive	< 1,2 H	< 1,2 H
Lamp load	< 3 W	< 3 W
Switching frequency, resistive	< 200 Hz	< 200 Hz
Switching frequency, inductive	< 2 Hz	< 2 Hz
Switching frequency, lamp load	< 20 Hz	< 20 Hz
Potential isolation	Electronic to field	Electronic to field
IO-Link		
Number of ports	4	4
IO-Link specification	V1.0, V1.1 according to IEC 61 131-9	V1.0, V1.1 according to IEC 61 131-9
IO-Link port type	Class A	Class A
Frame type	Supports all specified frame types	Supports all specified frame types
Supported devices	– BL20-E-4IOL: Maximum 14 byte input/ 14 byte output – BL20-E-4IOL-10: Maximum 30 byte input/ 30 byte output	Maximum 14 byte input/ 14 byte output
Transmission rate	4,8 kbps (COM 1) 38,4 kbps (COM 2) 230,4 kbps (COM 3)	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	Length: max. 20 m standard cables, 3- or 4-wire (depending on the application), unshielded

4.5 Connecting

ATTENTION!

Wrong supply of IO-Link devices

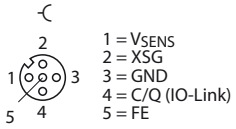
Damage to the electronics

➤ The IO-Link devices must only be supplied with the voltage provided at the supply terminals

BL67: V_{sens} (pin 1 and 3)

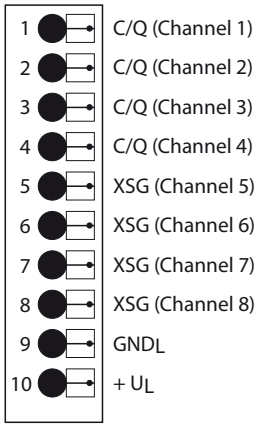
BL20: U_L(terminal 9 and 10)

4.5.1 BL67-wiring diagram

Base module	Wiring diagram
BL67-B-4M12	

➤ Connect a maximum of 4 IO-Link devices to Pin 4 of the four M12 connectors. The universal XSG-channel (in-or output) is provided at pin 2.

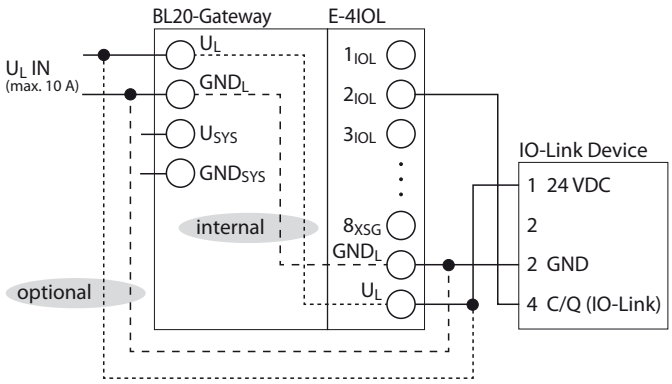
4.5.2 BL20-wiring diagram

Wiring diagram


.

➤ Connect a maximum of 4 IO-Link devices to terminals 1…4.
The universal XSG-channel (in-or output) is provided at terminals 5…8.

Special notes for supplying the IO-Link devices for BL20



ATTENTION!

Insufficient fuse protection of U_L

Damage to the electronics

➤ U_L has to be protected by a fuse with max. 8 A/10A (depending on type of gateway). More information can be found in the respective gateway manuals.

ATTENTION!

Wrong ground potential

Damage to the electronics

➤ The IO-Link devices must be supplied with the same potential as U_L of the gateway or the BR/PF module (if used).

5 Function description

5.1 Process image

The 4IOL-modules provide a maximum of 16 or respectively 32 byte of process input data (incl. 2 byte status information) and a maximum of 16 or respectively 32 byte of process output data (incl. 2 byte control data) in total for all 4 for channels.

The process image can be adapted application-specifically via the module's parameterization, see **Process Data Mapping (Seite 19)**.

Device	Process input data	Process output data
BL20-E-4IOL	16 byte	16 byte
BL67-4IOL	16 byte	16 byte
BL20-E-4IOL-10	32 byte	32 byte

5.1.1 Process input data

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	XSG8	XSG7	XSG6	XSG5	DI4	DI3	DI2	DI1
	1	OC8	OC7	OC6	OC5	DVS4	DVS3	DVS2	DVS1
Process input data	2 to 15/31	Mapped process input data							

Name	Value	Meaning
DIx	Digital input	
	0	No signal at DI
	1	Input signal at DI
XSGx	XSG input	
	0	No input signal at XSG
	1	Input signal at XSG
DVSx	Input value valid (Data Valid Signal)	
	0	IO-Link data invalid Possible causes: – Sensor supply is below the admissible range, – IO-Link port is parameterized as simple digital input, – No device connected to the masters, – 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	IO-Link data valid

Name	Value	Meaning
OCx	Overcurrent XSG channel	
	0	No overcurrent
	1	Overcurrent at the output (if the XSG channel is used as output)
Mapped process input data		
Process input data of the connected device It depends on the parameterization of the channel which data are shown in which order (see parameter "process input data length" and "process input data mapping").		

5.1.2 Process output data

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control	0	XSG8	XSG7	XSG6	XSG5	DD4	DD3	DD2	DD1
	1	reserved							
Process output data	2 to 15/31	Mapped process output data							

Name	Value	Meaning	
DDx	Deactivate diagnostics		
	0	no	Diagnostic messages are sent depending on the setting of the parameter “Deactive diagnostics”.
	1	Yes	All diagnostic messages are suppressed. Possible application: Deactivation and activation of the diagnostic messages by means of a program via the process data. In case of tool changing applications, no diagnostic data are sent which otherwise would lead to machine downtimes.
XSGx	XSG output		
	0	off	Output inactive
	1	on	Output active, max. output current 0.6 A
Process output data			
Mapped process output data of the connected device. It depends on the parameterization of the channel which data are shown in which order (see parameter "process output data length" and "process output data mapping").			

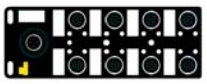
5.1.3 Process Data Mapping

The mapping of process data can be adapted application-specifically via the 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" "process output data mapping", "process input data length" and "process output data length" (see **Parameters (Seite 20)**).

Example: mapping for field buses with Little Endian-format:

Mapping by Master → field bus→ PLC			**Process input data mapping IO-Link device**		**Devices at channel 1... 4**	**Channel parameterization** (s. S. 23)
		Byte A		**Byte A**		
Byte 0	Status					
Byte 1	Control					
Byte 2	Distance	Low byte	Distance	High byte		2 byte process data (swap 16 bit)
Byte 3		High byte		Low byte		
Byte 4	Digital signal	1... 8	Digital signal	1... 8		2 byte process data (direct)
Byte 5	Digital signal	9...15	Digital signal	9 ...15		
Byte 6	Angle x-axis	Low byte	Angle x-axis	High byte		4 byte process data (swap 16 bit)
Byte 7		High byte		Low byte		
Byte 8	Angle y-axis	Low byte	Angle y-axis	High byte		
Byte 9		High byte		Low byte		
Byte 10	Diagnosis		Counter/ position value	MSByte		4 byte process data (swap all)
Byte 11	Counter/ position value	Low byte		High byte		
Byte 12		High byte		Low byte		
Byte 13		MSByte	Diagnosis			
Byte 14	reserved					
Byte 15	reserved					

A *Low byte, the lowest byte Low-Byte*
High byte High-Byte
MSByte: Most Significant Byte

5.2 Parameters

5.2.1 Parameters for BL20-E-4IOL and BL67-4IOL

The module provides 16 byte parameter data, 4 byte per port:

Channel	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Channel 1	0	Activate output	Quick Start-Up	Data storage mode		Operation mode			
	1	Cycle time							
	2	Process input data mapping		Process input data mapping		Deactivate diagnostics		Process input data invalid	Revision
	3	Process output data length				Process input data length			
Channel 2	4 - 7	assignment similar to port 1							
Channel 3	8 - 11	assignment similar to port 1							
Channel 4	12 - 15	assignment similar to port 1							

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

Name Value	Meaning	
Mode		
0000	**IO-Link without validation**	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated in IO-Link mode. The master does not check if the connected device matches the configured one
0010	IO-Link with compatible device	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated in IO-Link mode. The master checks if the device type (vendor-ID and device-ID) of the connected device matches the device type 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.
0011	IO-Link with identical device	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) 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.

Name Value	Meaning	
0100	DI (with parameter access)	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is generally operated as simple digital input. However, 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 DI-mode. The port remains in DI mode 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-mode).
1000	DI	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated as simple digital input. Data storage is **not** supported!

NOTE

Parameter “Mode", "DI (with parameter access)“:
In case of a parameter access, the IO-Link communication at the port is started.
Switching signals are interrupted!

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}, see **Diagnostic data (Seite 33)**). In this case select option "11 = deactivated, clear" in order to clear the data buffer of the device.

00	**Activated**	Synchronization of parameter data activated. The most actual data (master or device) serve as the reference data.
01	Overwrite	Synchronization of parameter data activated, the data in the master serve as reference data.
10	Read in	Synchronization of parameter data activated. The data in the connected IO-Link device serve as reference data.
11	Deactivated, clear	Synchronization of parameter data deactivated. The data set in the master is deleted.

NOTE

IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. In this case the data storage has to be deactivated (data storage mode: 11 = deactivated, clear).

Name	Meaning	
Value		
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.		
00	**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.
01	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.
Activate output		
00	**No**	BL67: The output at pin 2 of the respective connector/port is deactivated. BL20: The output at the respective terminal (5 to 8) is deactivated.
01	Yes	BL67: The output at pin 2 of the respective connector/port is activated. BL20: The output at the respective terminal (5 to 8) is activated.
Cycle time		
00	**Automatic**	The Master reads the minimum cycle time from the connected device.
00000001 - 11001111 (0×01 - 0×BF)	0.8 to 132.8 ms	Settable in steps of 0.8 or 1.6 ms. (see **Values for the parameter "cycle time" [ms]** (Seite 29))
Revision		
00	**Automatic**	The Master defines the IO-Link-revision automatically.
01	V1.0	IO-Link-Revision V 1.0 is used.
Process input data invalid		
00	**Diagnostics generated**	If the process data are invalid, a respective diagnostic message is generated.
01	No diagnostics generated	Invalid process data do not cause a diagnostic message.

Name	Meaning	
Value		
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.		
00	No	The master transmits all IO-Link Events to the fieldbus.
01	Notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
10	**Notifications and warnings**	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
11	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 I/O-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side.		
00	Direct	The process data are not swapped.
01	**Swap 16 bit**	The process data are swapped word-wise.
10	Swap 32 bit	The process data are swapped double word-wise.
11	Swap all	All bytes are swapped.
Process output data mapping		
see above "Process input data mapping"		
Process input data length		
Defines the length of the process input data which are mapped to the fieldbus for this port.		
0000	0 byte	
0001	1 byte	
0010	**2 byte**	
0011	4 byte	
0100	6 byte	
0101	8 byte	
0110	10 byte	
0111	12 byte	
1000 - 1110	reserved	
1111	14 byte	

Name Value	Meaning
Process output data length	
Defines the length of the process output data which are mapped to the fieldbus for this port.	
0000	0 byte
0001	1 byte
0010	**2 byte**
0011	4 byte
0100	6 byte
0101	8 byte
0110	10 byte
0111	12 byte
1000 - 1110	reserved
1111	14 byte

5.2.2 Parameters for BL20-E-4IOL-10

The module provides 32 byte parameter data, 8 byte per port:

Channel	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Channel 1	0	XSG10		Data storage mode		Quick Start-Up	Operation mode		
	1	Cycle time							
	2	Process input data mapping		Process input data mapping		Deactivate diagnostics		Process input data invalid	Revision
	3	Process output data length				Process input data length			
	4	Device ID (LSB)							
	5	Device ID							
	6	Device ID							
	7	Device ID (MSB)							
Channel 2	8…15	Assignment similar to port 1							
Channel 3	16…23	Assignment similar to port 1							
Channel 4	24…31	Assignment similar to port 1							

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

Name Value	Meaning	
Operation mode		
000	**IO-Link without validation**	The respective terminal 1/2/3 or 4 is operated in IO-Link mode. The master does not check if the connected device matches the configured one
010	IO-Link with compatible device	The respective terminal 1/2/3 or 4 is operated in IO-Link mode. The master checks if the device type (vendor-ID and device-ID) of the connected device matches the device type 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.
011	IO-Link with identical device	The respective terminal 1/2/3 or 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.
100	DI (with parameter access)	The respective terminal 1/2/3 or 4 is operated as simple digital input. However, 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 DI-mode. The port remains in DI mode 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-mode).
101	DI	The respective terminal 1/2/3 or 4 is operated as simple digital input. Data storage is **not** supported!

NOTE

Parameter “Mode", "DI (with parameter access)“:
In case of a parameter access, the IO-Link communication at the port is started.
Switching signals are interrupted!

Name	Meaning	
Value		
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}, see **Diagnostic data (Seite 33)**). In this case select option "11 = deactivated, clear" in order to clear the data buffer of the device.		
00	**Activated**	Synchronization of parameter data activated. The most actual data (master or device) serve as the reference data.
01	Overwrite	Synchronization of parameter data activated, the data in the master serve as reference data.
10	Read in	Synchronization of parameter data activated. The data in the connected IO-Link device serve as reference data.
11	Deactivated, clear	Synchronization of parameter data deactivated. The data set in the master is deleted.

NOTE

IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. In this case the data storage has to be deactivated (data storage mode: 11 = deactivated, clear).

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.		
00	**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.
01	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.
XSG output		
00	**Off**	The output is deactivated.
01	Reserved	
10	Switchable	The output is switchable via the process data.
11	24 VDC	The output is switched to 24 VDC and provides the sensor supply for an IO-Link port.
Cycle time		
00	**Automatic**	The Master reads the minimum cycle time from the connected device.
00000001 - 11001111 (0×01 - 0×BF)	0.8 to 132.8 ms	Settable in steps of 0.8 or 1.6 ms. (see **Values for the parameter "cycle time" [ms]** (Seite 29))
Revision		

Name	Meaning	
Value		
00	**Automatic**	The Master defines the IO-Link-revision automatically.
01	V1.0	IO-Link-Revision V 1.0 is used.
Process input data invalid		
00	**Diagnostics generated**	If the process data are invalid, a respective diagnostic message is generated.
01	No diagnostics generated	Invalid process data do not cause a diagnostic message.
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.		
00	No	The master transmits all IO-Link Events to the fieldbus.
01	Notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
10	**Notifications and warnings**	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
11	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 I/O-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side.		
00	Direct	The process data are not swapped.
01	**Swap 16 bit**	The process data are swapped word-wise.
10	Swap 32 bit	The process data are swapped double word-wise.
11	Swap all	All bytes are swapped.
Process output data mapping		
see above "Process input data mapping"		
Process input data length		
Defines the length of the process input data which are mapped to the fieldbus for this port.		
0000	0 byte	
0001	1 byte	
0010	**2 byte**	
0011	4 byte	
0100	6 byte	
0101	8 byte	
0110	10 byte	

Name	Meaning
Value	
0111	12 byte
1000	14 byte
1001	16 byte
1010	18 byte
1011	20 byte
1100	22 byte
1101	24 byte
1110	28 byte
1111	30 byte
Process output data length	
Defines the length of the process output data which are mapped to the fieldbus for this port.	
0000	0 byte
0001	1 byte
0010	**2 byte**
0011	4 byte
0100	6 byte
0101	8 byte
0110	10 byte
0111	12 byte
1000	14 byte
1001	16 byte
1010	18 byte
1011	20 byte
1100	22 byte
1101	24 byte
1110	28 byte
1111	30 byte
Device ID	
4 byte	Device ID of the connected IO-Link device for the port configuration check Value range: 0…FFFFFF (24 bit, Little Endian format)

Values for the parameter "cycle time" [ms]

Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
0.0	**auto**	15.2	0×56	30.4	0×7C	59.2	0×91	89.6	0×A4	120	0×B7
0.8	0×08	16	0×58	31.2	0×7E	60.8	0×92	91.2	0×A5	121.6	0×B8
1.6	0×10	16.8	0×5A	32	0×80	62.4	0×93	92.8	0×A6	132.2	0×B9
2.4	0×18	17.6	0×5C	33.6	0×81	64	0×94	94.4	0×A7	124.8	0×BA
3.2	0×20	18.4	0×5E	35.2	0×82	65.6	0×95	96	0×A8	126.4	0×BB
4	0×28	19.2	0×60	36.8	0×83	67.2	0×96	97.6	0×A9	128	0×BC
4.8	0×30	20	0×62	38.4	0×84	68.8	0×97	99.2	0×AA	129.6	0×BD
5.6	0×38	20.8	0×64	40	0×85	70.4	0×98	100.8	0×AB	131.2	0×BE
6.4	0×40	21.6	0×66	41.6	0×86	72	0×99	102.4	0×AC	132.8	0×BF
7.2	0×42	22.4	0×68	43.2	0×87	73.6	0×9A	104	0×AD	-	-
8	0×44	23.2	0×6A	44.8	0×88	75.2	0×9B	105.6	0×AE	-	-
8.8	0×46	24.0	0×6C	46.4	0×89	76.8	0×9C	107.2	0×AF	-	-
9.6	0×48	24.8	0×6E	48	0×8A	78.4	0×9D	108.8	0×B0	-	-
10.4	0×4A	25.6	0×70	49.6	0×8B	80	0×9E	110.4	0×B1	-	-
11.2	0×4C	26.4	0×72	51.2	0×8C	81.6	0×9F	112	0×B2	-	-
12.0	0×4E	27.2	0×74	52.8	0×8D	83.2	0×A0	113.6	0×B3	-	-
12.8	0×50	28	0×76	54.4	0×8E	84.8	0×A1	115.2	0×B4	-	-
13.6	0×52	28.8	0×78	56	0×8F	86.4	0×A2	116.8	0×B5	-	-
14.4	0×54	29.6	0×7A	57.6	0×90	88	0×A3	118.4	0×B6	-	-

Automatic: The lowest cycle time supported by the device is taken from the table.

5.2.3 Special DTM functions

The TURCK DTMs offer, besides the normal parameters of the IO-Link master modules, special function for configuring the master module.

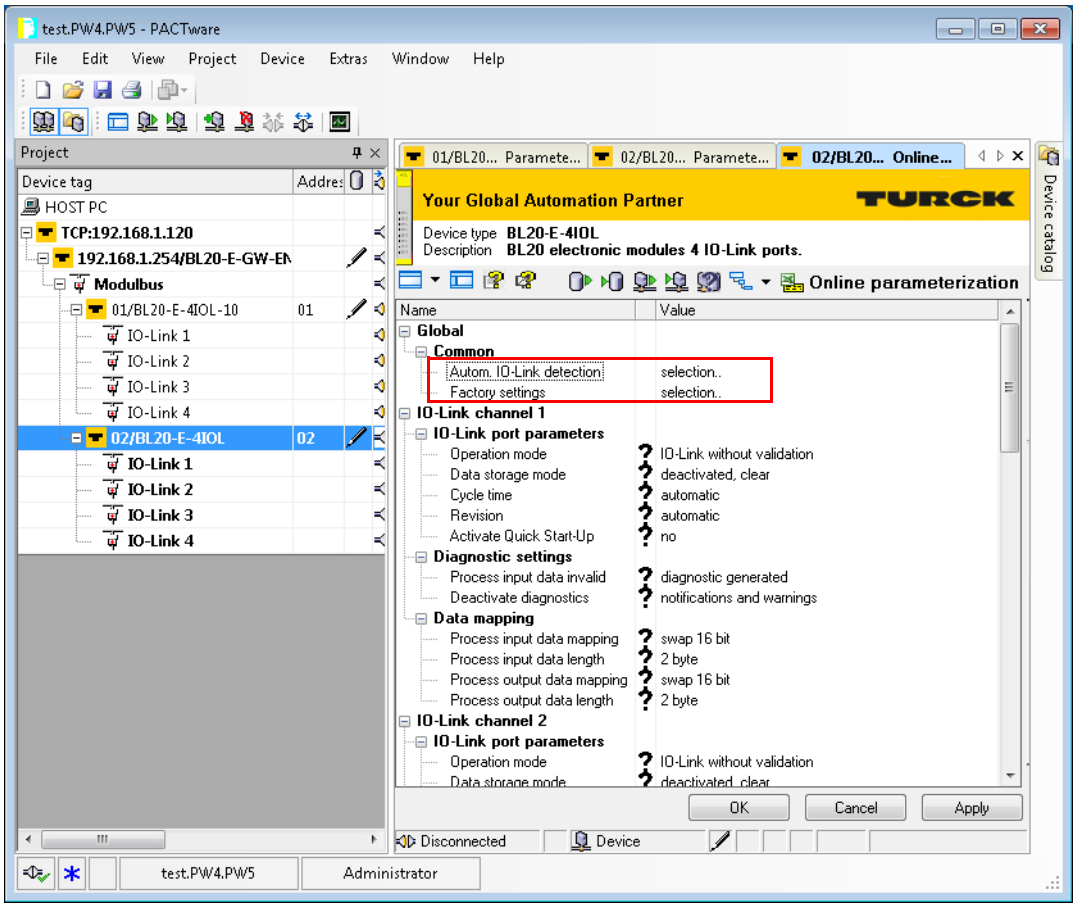


Fig. 3: Special DTM functions

Automatic IO-Link detection
The data of the connected device/ the connected devices are read-in by the master.
Factory settings
The master is set back to its factory settings.

5.3 Diagnostic and status messages

5.3.1 LED displays

This module provides the following LEDs for status displays:

- DIA: Monitors the module status
- Channel LEDs
  - BL67:
    0 - 3: Status display for the IO-Link- or respectively DI-channels at Pin 4 of the M12 connectors
    4 - 7: Status display for the XSG-channels at Pin 2 of the M12 connectors
  - BL20:
    1 -4: Status display for the IO-Link- or respectively DI-channels at terminal 1 - 4.
    5 - 8: Status display for the XSG-channels at terminal 5 - 8.

LED	Color	Status	Meaning	Remedy
D/DIA	Red	on	Module bus communication disturbed or/and no field voltage connected.	– Check if more than two ad-joining electronics modules have been pulled. This concerns modules located between this module and the gateway. – Check the field supply.
		flashing, 0.5 Hz	Module diagnostics pending	– see **Diagnostic data (Seite 33)**
0 - 3 (BL67) or resp. **1 - 4** (BL20)	**Channel in IO-Link-mode**			
	Green	off	No IO-Link communication, diagnostics deactivated	– connect an IO-Link device – Parameterize the channel as DI if necessary.
		flashing	IO-Link communication active, valid process data	-
	Red	on	No IO-Link communication and/or module error, invalid process data	Possible causes: – Sensor supply is below the admissible range, – IO-Link port is parameterized as simple digital input, – No device connected to the masters,

LED	Color	Status	Meaning	Remedy
0 - 3 (BL67) or resp. **1 - 4** (BL20)	Red	flashing	IO-Link communication active and module error, invalid process data	– 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), – connected device sends an error: "process data invalid". see also: **Start-up problems - frequently failure causes (Seite 88)**
	Channel in DI-mode			–
	Green	off	Status of channel x = „0“ (OFF)	
	Green	on	Status of channel x = „1“ (ON)	–
4 - 7 (BL67) or resp. **5 - 8** (BL20)	Green	off	Status of channel x = „0“ (OFF)	
	Green	on	Status of channel x = „1“ (ON)	–
	Red	blinking, 0.5 Hz	Short circuit at output of the respective channel	

5.3.2 Diagnostic data

There are different types of diagnostic messages, master and device diagnostics.
The „$PD_{invalid}$" diagnostic (process data invalid) can be sent from both devices, IO-Link master or IO-Link device.

Master diagnostics

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

Device diagnostics

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 about the IO-Link Event codes and their meaning can be found in the IO-Link specification or in the documentation of the connected IO-Link devices.

Diagnostic telegram

Channel	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Device diagnostics				**Master diagnostics**			
Channel 1	0	EVT_{D1}	EVT_{D2}	$PD_{invalid}$	HW_{ERR}	DS_{ERR}	CFG_{ERR}	res.	OC
	1	Gen_{ERR}	OLD	OV	UV	OFLW	UFLW	OTemp	$Param_{ERR}$
Channel 2	2 + 3	Assignment similar to port 1							
Channel 3	4 + 5	Assignment similar to port 1							
Channel 4	6 + 7	Assignment similar to port 1							

Bit	Meaning	Remedy
Master diagnostics		
OC	Overcurrent	
	Overcurrent at the XSG-channel if it is parameterized as output.	
CFG_{ERR}	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 (see **Mode (Seite 20)**).	Change the parameterization of the IO-Link port at the master. Correct the vendor-ID, device-ID, etc. The parameterization can be done by teaching the master via IOL_CALL using the port function **Subindex 67: Teach Mode (Seite 43)** or via a manual port parameterization.

Bit	Meaning	Remedy
DS_{ERR}	Data storage error	
	Possible causes:	
	– Data storage mismatch	IO-Link device in accordance with IO-Link V1.0 connected. Deactivate the data storage. To do so, set parameter "**Data storage mode (Seite 21)**" to "deactivated, clear",
		The data storage buffer contains data of another device. Clear the data storage buffer of the master. To do so, set the parameter "**Data storage mode (Seite 21)**" to "deactivated, clear" and reactivate the data storage if necessary.
	– Overflow of the data storage buffer	Clear the data storage buffer of the master. To do so, set the parameter "**Data storage mode (Seite 21)**" to "deactivated, clear" and reactivate the data storage if necessary.
	– Parameter access for data storage not possible	The connected device may be locked for parameter changes or for data storage. Check the status of the IO-Link index "Device Access Locks" (index 0×C) of the connected device and unlock the device.
Master/device diagnostics		
$PD_{invalid}$	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 sources: The connected device does not match the configured one, additional diagnostic message **Wrong or missing device (Seite 33)**.
		Certain IO-Link devices send a "process input data invalid"-diagnosis if the process value cannot be measured. Deactivate the sending of the "process input data invalid"-diagnosis for the respective port. To do so, change the parameter "**Process input data invalid (Seite 22)**" to "no diagnostics generated".
Device diagnostics		
For the exact specification of the device diagnostics, please read the device documentation of the device manufacturer.		
HW Error	Hardware error	
	General hardware error or device malfunction.	
EVTD2	Out-of-specification events	
	An Out-of-Specification Event in accordance with the IO-Link specification occurred.	

Bit	Meaning	Remedy
EVTD1	Maintenance events	
	A Maintenance Event in accordance with the IO-Link specification occurred, maintenance necessary.	
$Param_{ERR}$	Parameterization error	
	The connected device reports a parameterization error (loss of parameters, no parameter initialization, etc.).	
OTemp	Overtemperature	
	Temperature diagnostic message at the connected device.	
UFLW	Lower limit value underrun	
	The process value lies under the parameterized measurement range or the chosen measurement range has been chosen too high.	
OFLW	Upper limit value exceeded	
	The process value exceeds the parameterized measurement range or the chosen measurement range has been chosen too low.	
UV	Undervoltage	
	One of the voltages at the connected device is below the defined range.	
OV	Overvoltage	
	One of the voltages at the connected device is below the defined range.	
OLD	Overload	
	The connected device detected an overload.	
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.	

5.4 The principle of the data storage mechanism

5.4.1 General

Data storage enables a user to change an IO-Link device when maintenance is required without any configuration or parameterization.

The IO-Link master, as well as the IO-link device, store the device parameters. The data storage mechanism serves for synchronizing these different data storage buffers.

In case of a device change, the master writes the stored device parameters to the new device. The application can be re-started without any further intervention using a configuration tool or similar.

In the BL20/BL67 IO-Link masters, the data storage mode can be set using the parameter "data storage mode" (see **Parameters (Seite 20)**).

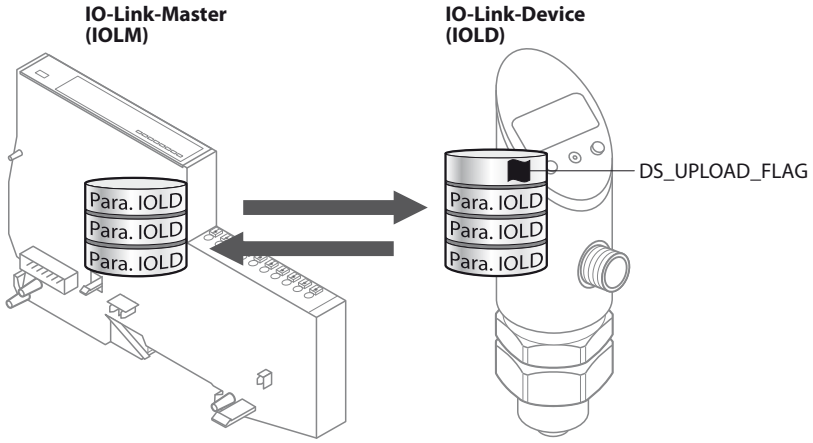
Data storage mode

00 = activated (s. **S. 37**)

01 = overwrite (s. **S. 38**)

10 = read in (s. **S. 39**)

11 = deactivated, clear (s. **S. 39**)



Para. IOLD = parameter data of the IO-Link device

Fig. 4: General principle of the data storage mechanism

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

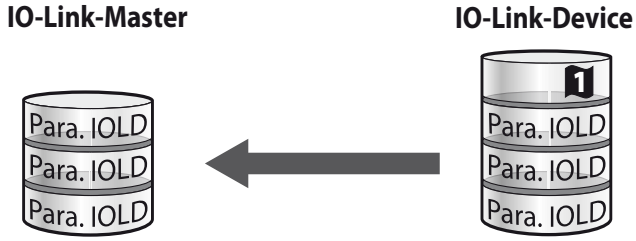
DS_UPLOAD_FLAG:
0 = no changes in the device's parameter set
1 = changes in the device's parameter set (e. g. via DTM, at the device, etc.)

5.4.2 Parameters: Data storage mode = activated

- The synchronization of the parameter sets is bidirectional.
- The most actual data set (master or device) is valid:
  This means:
  - 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

Parameterizing a device in the installation:
A device, which is already used in the installation, is for example parameterized via a DTM.

DS_UPLOAD_FLAG = 1
→ Changes in the device's parameter see

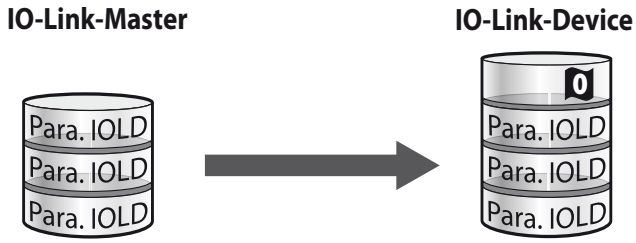


The IO-Link device is already connected to the master.

Para. IOLD = parameter data of the IO-Link device

Maintenance - exchange device in delivery status:
A defective device is replaced by a device in delivery status.

DS_UPLOAD_FLAG = 0
→ no changes in the device's parameter set

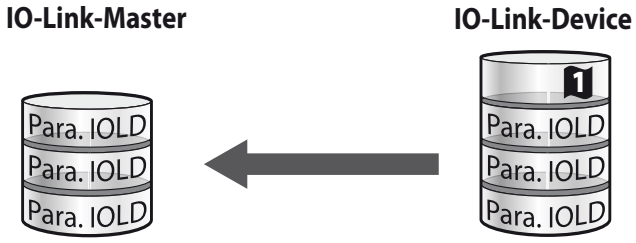


The IO-Link device has not been connected to the master before.

Para. IOLD = parameter data of the IO-Link device

Maintenance - exchange device with eventually modified parameter set:
A defective device is replaced by a device with a parameter set that was already changed before (for example via DTM).

DS_UPLOAD_FLAG = 1
→Changes in the device's parameter set



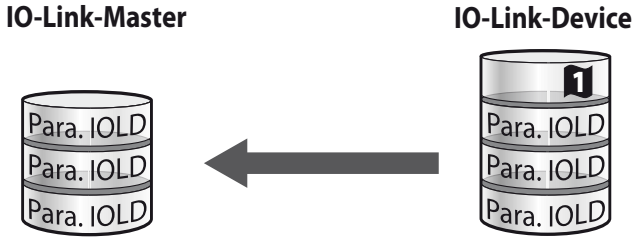
The IO-Link device has not been connected to the master before.

Para. IOLD = parameter data of the IO-Link device

NOTE
If a device change is necessary when data storage is activated, the following has to be observed:
An IO-Link exchange device with unknown parameter data should be reset to factory defaults before connecting it to the master.
This prevents unknown device parameter settings to be downloaded to the master when establishing the connection.
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.

5.4.3 Parameters: 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.

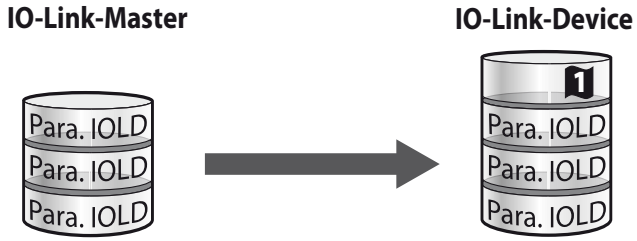


Para. IOLD = parameter data of the IO-Link device

Fig. 5: “Data storage mode" = read in

5.4.4 Parameters: Data storage mode = overwrite

- The data set in the master is **alwrtrtzjays** 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.



Para. IOLD = parameter data of the IO-Link device

Fig. 6: "Data storage mode" = overwrite

5.4.5 Parameters: Data storage mode =deactivated, clear

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

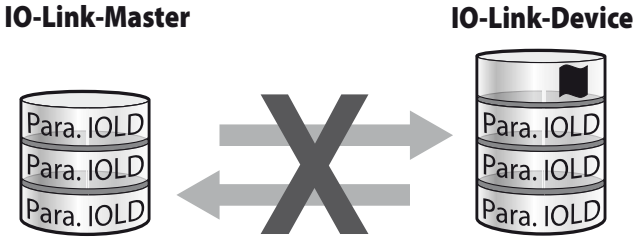


Fig. 7: "Data storage mode" = deactivated, clear

5.4.6 Data storage in tool changing applications

NOTE

The data storage mechanism overwrites the Application Specific Tag in the IO-Link device. It is thus important to deactivate the function in such applications.

5.5 Functions for the acyclic communication via IO-Link CALL

The acyclic access to the data of IO-Link devices is realized via IO-Link CALLs.

Therefore it is necessary to distinguish between data of an IO-Link master or of an IO-Link device.

The addressing of the IO-Link CALL is realized via the so called Entity_Port- It defines which device is addressed via the CALL:

Entity_Port 0 = IO-Link master module (IOLM - BL20/BL67-4IOL)

Entitiy_Port 1 = IO-Link device at 1st channel

Entitiy_Port 2 = IO-Link device at 2nd channel

Entitiy_Port 3 = IO-Link device at 3rd channel

Entitiy_Port 4 = IO-Link device at 4th channel

5.5.1 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

This object serves for writing a defined configuration of the IO-Link ports into the master. The master stores the data for the IO-Link device expected at the port and only accepts a device at the port which has exactly the same data (Vendor-ID, Device-ID and Serial Number).

The usage of Master Port Validation Configuration is only reasonable if the parameter **Mode (Seite 20)** is set to a value with validation ("IO-Link with family compatible device", "IO-Link with compatible device", "IO-Link with identical device").

Entity_ Port	IO-Link subindex	Read Write	Length
0	64	w	max. 96 byte

Struture 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	

	Content	Size	Format	Comment
IOL3	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	
IOL3	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

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	65	r	255 byte	This object serves for reading the IO-Link events.

NOTE

On "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.
- Byte 0 is followed by 4 byte per Diagnostic Event which clearly assign and specify the diagnostic message.
  A maximum of 14 Events per IO-Link port are shown.

Byte	**Bit**								
	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
				x					PD_Valid input port 3
			x						PD_Valid output port 3
		x							PD_Valid input port 4
	x								PD_Valid output port 4
1	Qualifier								Defines the type of the Event (Warning, Notification, Single Shot Event, etc.) in accordance with IO-Link specification „IO-Link Interface and System“.
2	Port								Indication of the IO-Link port which sends an Event.
3	Event Code high byte								High or respectively low byte of the Event Code sent.
4	Event Code low byte								
...									
222	Qualifier								see byte 1 - 4
223	Port								
224	Event Code high byte								
225	Event Code low byte								

Subindex 66: Set Default Parameterization

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	66	w	4 byte	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.

Structure of the reset command:

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

Subindex 67: Teach Mode

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	67	w	1 byte	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.

Structure of the Teach command:

Byte 0	
0x00	Teaching all 4 ports
0x01	Teaching port 1
0x02	Teaching port 2
0x03	Teaching port 3
0x04	Teaching port 4
0x05 - 0xFF	reserved

Subindex 68: Master Port Scan Configuration

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	68	r	max. 120 byte	This object serves for reading the configuration of the IO-Link devices connected to the IO-Link master.

28 byte are returned per IO-Link port.

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	String	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		UINT8	Cycle time of the connected device
Port 2	Structure similar to port 1			
Port 3				
Port 4				

Subindex 69: Extended Port Diagnostics

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	69	r	max. 8 byte	This object serves for reading the Extended Port Diagnostics.

Structure of the Extended Port Diagnostics:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	NO_SIO	TCYC	-	-	DS_F	NO_DS	-	-
Byte 1	-	WD	MD	PDI_H	-	PDI_E	NO_PD	-
Byte 3								
Byte 4	Device status according to IO-Link specification (see **Device Status**)							

Diagnostic bit	Meaning
NO_DS	The parameterized port mode (see **Parameters (Seite 20)**) 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 mode (see parameter **Mode (Seite 20)**). Remedy: – Select the IO-Link mode for this port.
NO_PD	No process data available The connected device is not ready for operation. Remedy: – Checking 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.

Diagnostic bit	Meaning
WD	Wrong device detected: one or more parameters of the connected device (device-ID, vendor-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 (see parameter Mode (Seite 20))

Device Status

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

6 The IO-Link function block: IOL_CALL

6.1 General

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"".

NOTE

Depending on the PLC manufacturer, the IO-Link CALL function block can differ from the specification (for example in the representation or the use of variables).

6.2 IOL_CALL in accordance with IO-Link specification

The following figure shows the function block as it is defined in the specification:

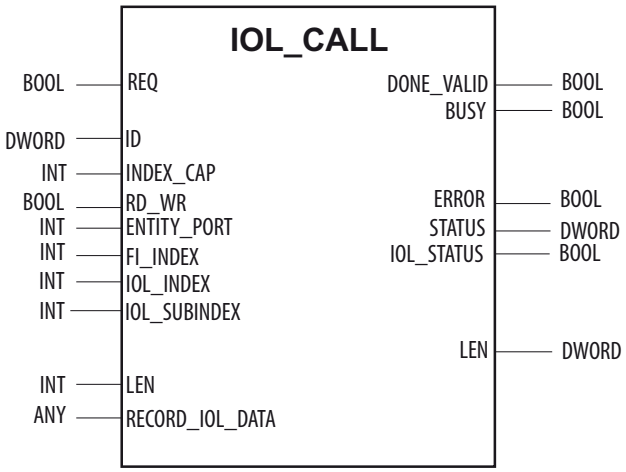


Fig. 8: IOL_CALL in accordance with IO-Link specification

6.3 Turck IO-Link Function Blocks

Turck offers the following IO-Link modules for its own systems:

Turck IO-Link CALL	Compatible programmable devices	from version
IO-Link CALL Local IO	BL20-PG-EN-V3	≥ 1.0.5.0
	BL67-PG-EN-V3	≥ 1.0.5.0
IO-Link CALL PROFINET	TBEN-L…-PLC-…	≥ 1.0.3.0
	TX500	≥ 1.0.4.0
	IO-Link Call function block for PROFINET according to PNO or respectively PI specification The function block is supported by all Turck IO-Link masters with mutiprotocol functionality. The use of the function block for third-party IO-Link masters is also possible, provided that the devices comply with the PNO or PI specification.	
IO-Link CALL Ethernet IP	TBEN-L…-PLC-…	≥ 1.0.3.0
	TX500	≥ 1.0.4.0
	Proprietary IO-Link call function block for EtherNet/IP from Turck. The function block is supported by all Turck IO-Link masters with mutiprotocol functionality.	
IO-Link CALL Modbus TCP	BL20-PG-EN-V3	≥ 1.0.5.0
	BL67-PG-EN-V3	≥ 1.0.5.0
	TBEN-L…-PLC-…	≥ 1.0.3.0
	TX500	≥ 1.0.4.0
	Proprietary IO-Link call function block for Modbus TCP from Turck. The function block is supported by all Turck IO-Link masters with mutiprotocol functionality.	

Overview of the Turck mutliprotocol Ethernet IO-Link masters.

- BL20-E-GW-EN (with 4IOL master module)
- BL67-GW-EN (with 4IOL master module)
- TBEN-S2-4IOL
- TBEN-Lx-8IOL
- BLCEN-xxxx-4IOL
- FEN20-4IOL

6.3.1 IO-Link CALL (Turck)

Input variables

Variable	Data type	Meaning
xREQ	BOOL	A rising edge triggers the send command.
Address assignement of the IO-Link master module	The address assignment of the IO-Link master module depends on the fieldbus/ Ethernet protocol used and varies depending on the module used, see **Address assignment of the IO-Link master module** (Seite 49).	
iIndexCap	INT	Function block instance: 251 to 254
xRD_WR	BOOL	0 = read access 1 = write access
usiEntityPort	USINT	Address of the IO-Link port to be accessed. IO-Link master = EntityPort0 IO-Link port 1…4 = EntityPort 0…4
uiIOL_Index	UINT	Fix value (65098): defines the access to be an IO-Link CALL
usiIOL_Subndex	USINT	Number of the IO-Link index which has to be written or read.
pbyRecord_IOL_Data	Pointer to byte	Definition of a possible sub index.
iLen	INT	Length of the data to be read or written. For the write access, define the exact length if the data to be written.

Address assignment of the IO-Link master module

IO-Link CALL	Variable	Data type	Definition
Local IO	itfModule		Instance of the IO-Lin master, e.g. BL67-4IOL
PROFINET	ID	DWORD	ID of the PROFINET slave The ID can be read using the “GetID” method. Example: PROFINET Slave: BL67 gateway with IO-Link master at slot 2. – Instance of the BL… gateway. BL67_GW_EN – API: always "0" – SLOT 2 – Subslot: always "1" → dwId:= BL67_GW_EN.GetID(API:= 0, SLOT:= 2, SUBSLOT:=1)
EtherNet/IP	EtherNetIP Device	STRING	Instance of the EtherNet/IP slave, e.g.: "Ethernet_IP_Slave"
	Slot	USINT	Slot number of the IO-Link module in the BLxx station
Modbus TCP	Slot	USINT	Slot number of the IO-Link module in the BLxx station
	Slave	STRING	Instance of the Modbus TCP slave, e.g.: "Modbus_TCP_Slave"

Output variables

Variable	Data type	Meaning
xDone_Valid	BOOL	The read or write access has been executed.
xBusy	BOOL	The read or write access is actually in progress.
xError	BOOL	Error while executing the read or write access.
dwStatus	DWORD	Communication error status Status of the acyclic communication. → see **STATUS - communication error status (Seite 51)**
dwIOL_Stauts	DWORD	IO-Link error messages (in accordance with "IO-Link Integration Part 1-Technical Specification for PROFIBUS and PROFINET" and "IO-Link Interface and System"), which concern the communication between IO-Link master and connected devices. → see **IOL_STATUS (Seite 52)**
iLEN	INT	Length of the data which were read.

6.3.2 STATUS - 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)	0×80 Specifies the error as an error of acyclic communication.	Error code	Vendor specific identifier (not always applicable)

Status Code	Name	Meaning
0×FF000000	TIMEOUT	Internal error in the communication with the module
0×00FFFF00	INVALID_HANDLE	
0×00FFFE00	HANDLE_OUT_OF_BUFFERS	
0×00FFFD00	HANDLE_DESTINATION_UNAVAILABLE	
0×00FFFC00	HANDLE_UNKNOWN	
0×00FFFB00	HANDLE_METHOD_INVALID	
0×xx80A0xx	MASTER_READ_ERROR	Error reading
0×xx80A1xx	MASTER_WRITE_ERROR	Error writing
0×xx80A2xx	MASTER_MODULE_FAILURE	Failure of the BLxx-gateway, or respectively bus failure.
0×xx80A6xx	MASTER_NO_DATA	No data received
0×xx80A7xx	MASTER_BUSY	BL20/BL67 gateway busy.
0×xx80A9xx	MASTER_FEATURE_NOT_SUPPORTED	BL20/BL67 gateway does not support the function.
0×xx80AAxx	MASTER_RESOURCE_UNAVAILABLE	BL20/BL67-Gateway nicht verfügbar.
0×xx80B0xx	ACCESS_INVALID_INDEX	Index invalid, wrong INDEX_CAP used
0×xx80B1xx	ACCESS_WRITE_LENGTH_ERROR	Length of data to be written can not be handled from the module, possible wrong module accessed
0×xx80B2xx	ACCESS_INVALID_DESTINATION	Wrong slot accessed
0×xx80B03xx	ACCESS_TYPE_CONFLICT	IOL_CALL invalid
0×xx80B5xx	ACCESS_STATE_CONFLICT	Error in IOL_CALL sequence
0×xx80B6xx	ACCESS_DENIED	IOL-Link master module refuses the access
0×xx80C2xx	RESOURCE_BUSY	The IO-Link master module is busy or is waiting for an answer of the connected IO-Link device
0×xx80C3xx	RESOURCE_UNAVAILABLE	
0×xx8901xx	INPUT_LEN_TOO_SHORT	The index to be read contains more data than defined in the input variable "LEN"

6.3.3 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_Codes → **IOL-M Error Codes** according to "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET"		Error Types → **IOL Error Types** according to "IO-Link Interface and System"	

IOL-M Error Codes

Error code	Name acc. to spec.	Meaning
0×0000	No error	no error
0×7000	IOL_CALL conflict	Unexpected write-request, read request expected
0×7001	Wrong IOL_CALL	Decoding error
0×7002	Port blocked	The accessed port is occupied by another task
...	reserved	-
0×8000	Timeout	Timeout, IOL master or IOL device port busy
0×8001	Wrong index	Error: IOL index < 32767 or > 65535 selected
0×8002	Wrong port address	Port address not available
0×8003	Wrong port function	Port function not available
...	reserved	-

IOL Error Types

Error code	Name acc. to spec.	Meaning
0×1000	COM_ERR	Communication loss Possible sources: Possible cause: the addressed port is parameterized as DI and is not in IO-Link mode
0×1100	I_SERVICE_TIMEOUT	Timeout in communication, device does not respond in time
0×5600	M_ISDU_CHECKSUM	Master reports checksum error, access to device not possible
0×5700	M_ISDU_ILLEGAL	Device can not respond to master request
0×8000	APP_DEV	Application error in the device
0×8011	IDX_NOTAVAIL	Index not available
0×8012	SUBIDX_NOTAVAIL	Sub index not available
0×8020	SERV_NOTAVAIL	Service temporarily not available

Error code	Name acc. to spec.	Meaning
0×8021	SERV_NOTAVAIL_LOCCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device at the device active)
0×8022	SERV_NOTAVAIL_DEVCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device via DTM/ PLC etc. active)
0×8023	IDX_NOT_WRITEABLE	Access denied, index not writable
0×8030	PAR_VALOUTOFRNG	Parameter value out of range
0×8031	PAR_VALGTLIM	Parameter value above the upper limit
0×8032	PAR_VALLTLIM	Parameter value below the lower limit
0×8033	VAL_LENOVRRUN	Length of data to be written does not match the length defined for this parameter
0×8034	VAL_LENUNDRUN	
0×8035	FUNC_NOTAVAIL	Function not available in the device
0×8036	FUNC_UNAVAILTEMP	Function temporarily not available in the device
0×8040	PARA_SETNVALID	Invalid parameter: Parameters not consistent with other parameters in the device
0×8041	PARA_SETINCONSIST	Inconsistent parameters
0×8082	APP_DEVNOTRDY	Application not ready, device is busy
0×8100	UNSPECIFIC	Vendor specific, according to device documentation
0×8101 to 0×80FF	VENDOR_SPECIFIC	

7 Step 7 (PROFIBUS-DP/PROFINET): IOL_CALL (FB102)

7.1 Example project

7.1.1 Used Hardware

- Siemens S7, CPU 315-2 PN/DP, 6ES7-2EH13-0AB0 with PROFINET
- Turck multiprotocol gateway BL20-E-GW-EN (VN03-00)
  - IO-Link Master BL20-E-4IOL with
    IO-Link port 1: Turck temperature sensor,TS-500-LUUPN8X-H1141
    IO-Link port 2: not used
    IO-Link port 3: not used
    IO-Link port 4: Turck I/O hub, TBIL-M1-16DIP

7.1.2 Used Software

- SIMATIC Manager, Step 7, version 5.5, SP2

7.2 Configuration

7.2.1 Configuration of the IO-Link master

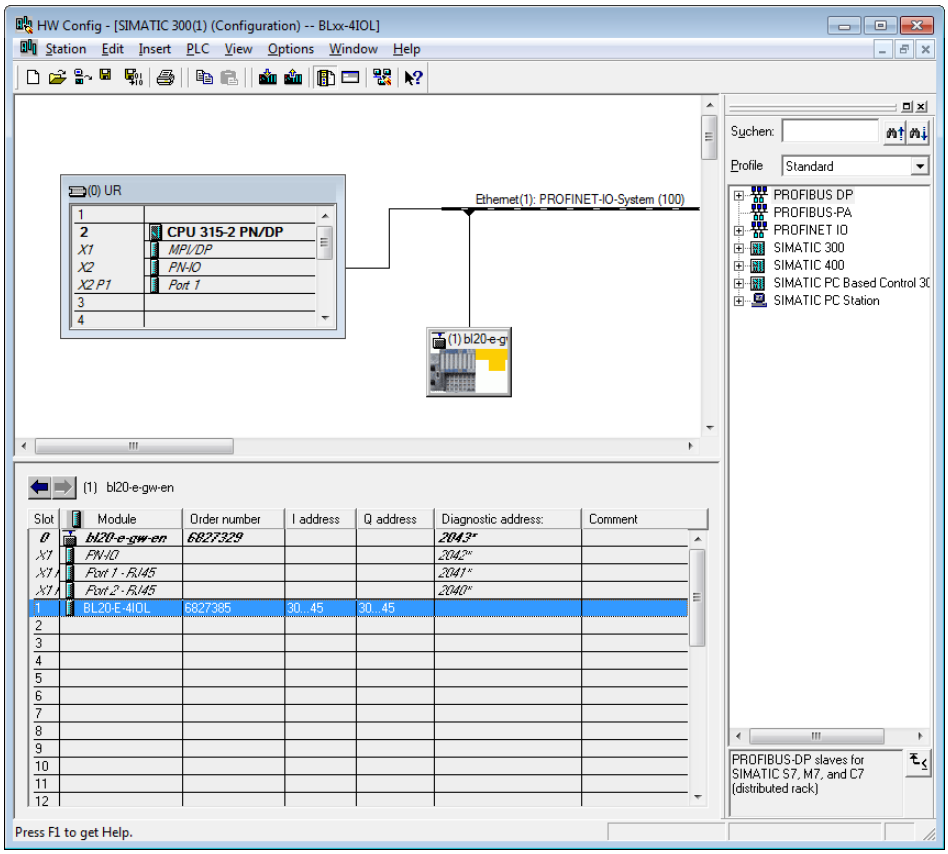


Fig. 9: Configuration of the IO-Link master

7.2.2 Configuration of the IO-Link ports

The 4 ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in DI mode (see also parameter **Operation mode (Seite 25)**).

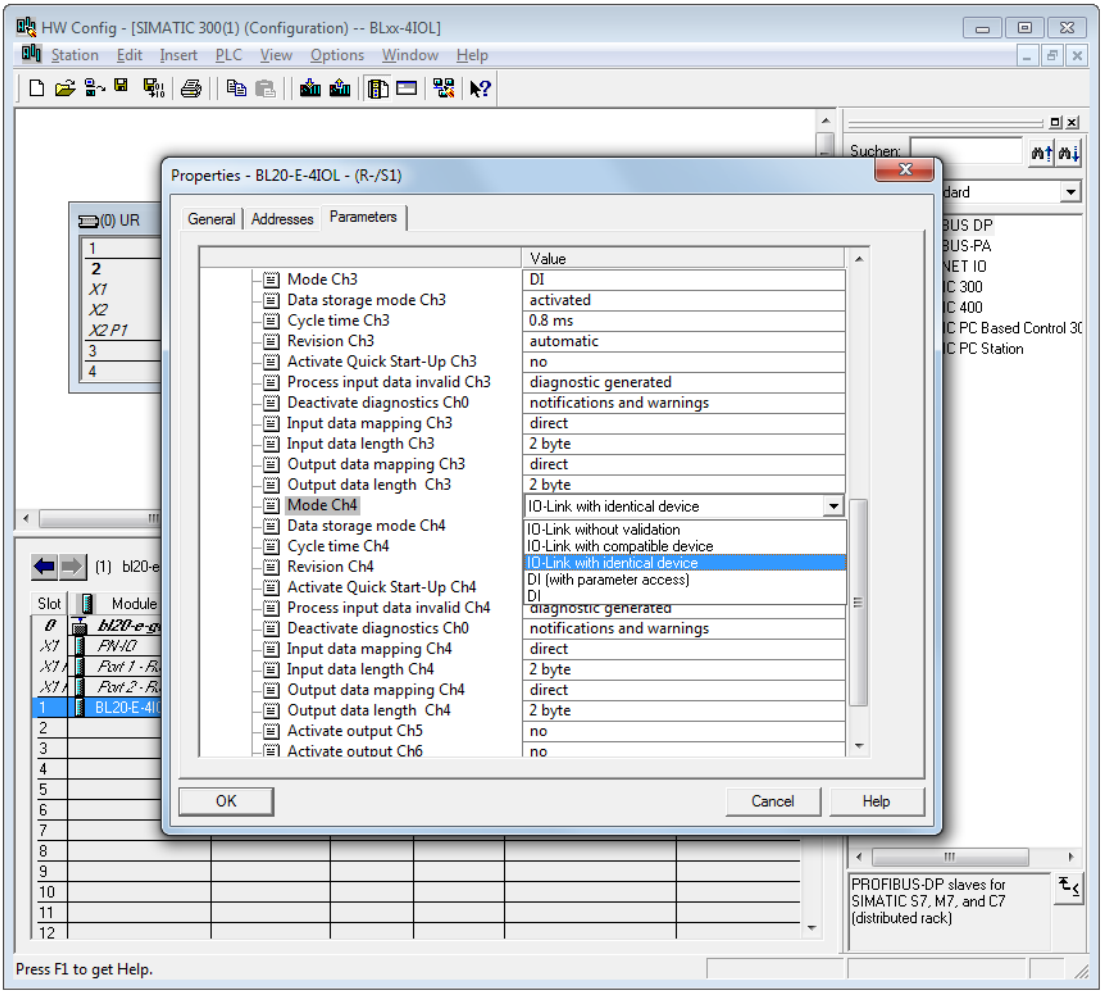


Fig. 10: Configuration of the IO-Link ports

- **Port in IO-Link mode (with identical device, with compatible device, etc.)**
  In "process input data length" and "process output data length" enter the length of process data of the connected device which have to be mapped to the field bus for this port, see also **Parameters**, s. **S. 24**.
- **Port in DI mode (DI with parameter access, DI)**
  It is reasonable to set the "process input data length" and "process output data length" to 0, in order not to block bytes with digital data in the process data mapping on the fieldbus.

Port configuration in the example project

Port 1:

- **IO-Link with identical device** → Only an identical exchange device is accepted in case of a device exchange (check of vendor-ID, device-ID, etc., see also **Parameters (Seite 20)**, →).
- Device:
  Turck temperature sensor,
  TS-500-LUUPN8X-H1141,
  2 byte process data

Port 2 and port 3:

- configured as DI

Port 4:

- **IO-Link without validation** →Every IO-Link device will be accepted as exchange device i case of a device exchange **Parameters (Seite 20)**, →.
- Device:
  Turck I/O hub,
  TBIL-M1-16DIP,
  2 byte process data

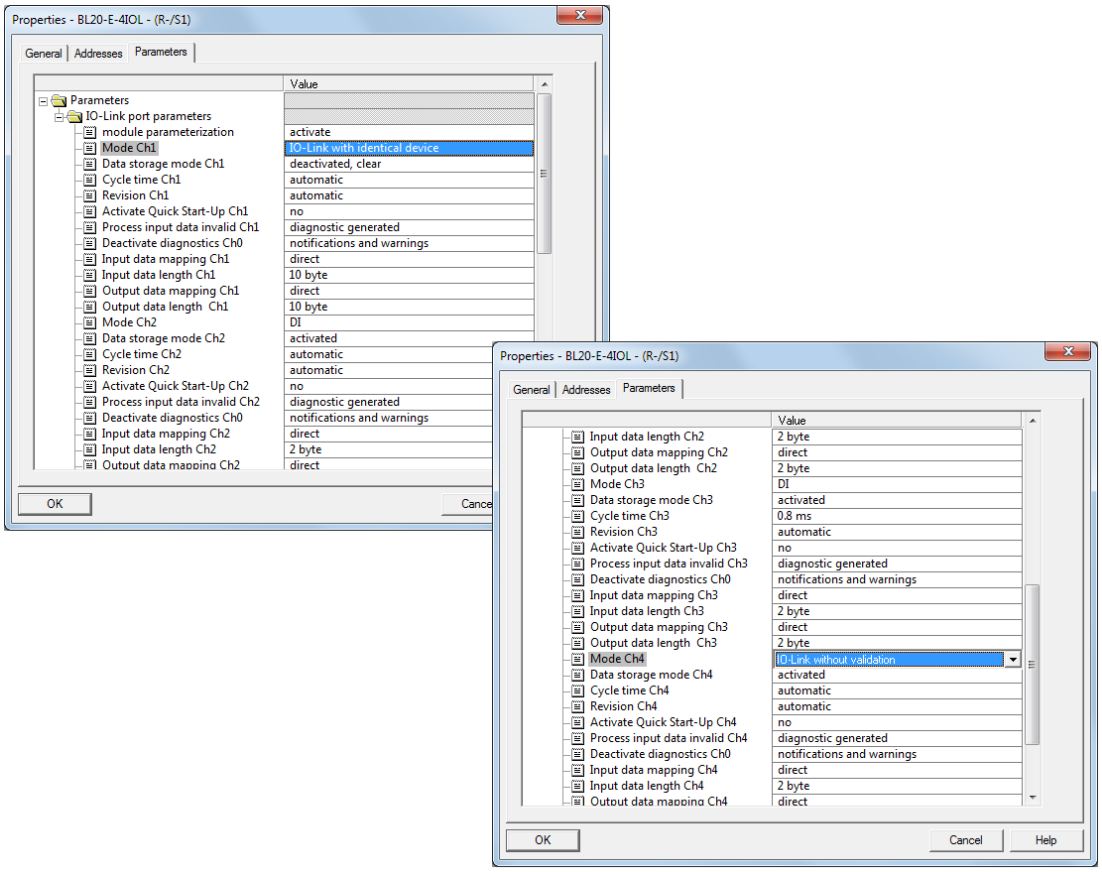


Fig. 11: Configuration of the IO-Link ports (example project)

7.3 Usage of the function block in Step 7

Kapitel 6 contains a general description of the function block and its in and output variables. **The IO-Link function block: IOL_CALL**.

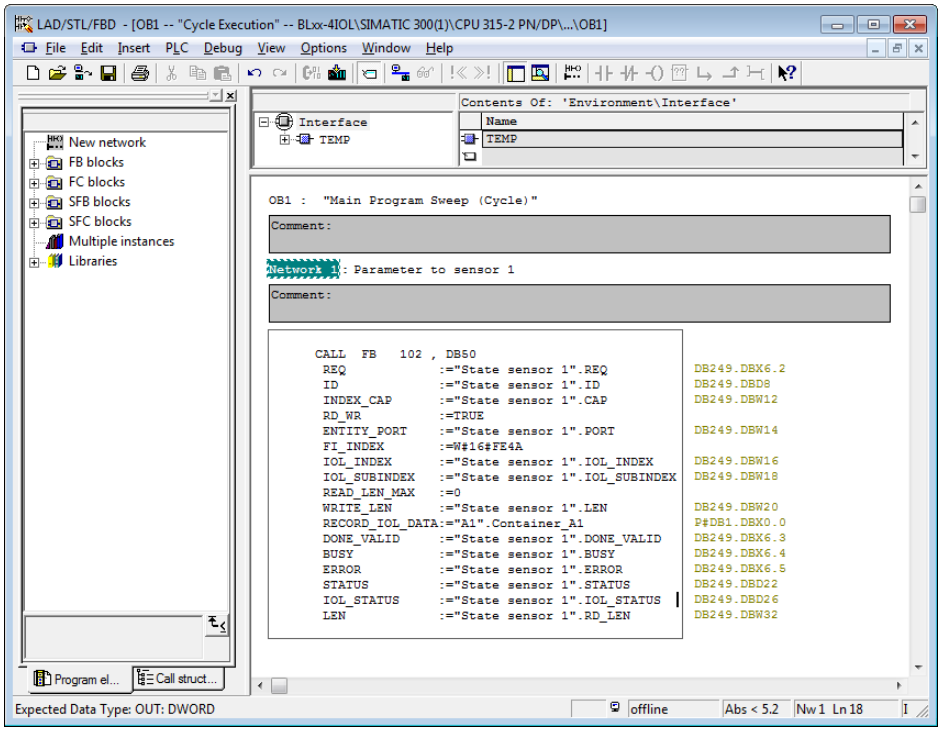


Fig. 12: Example of Siemens FB IO-Link-CALL (FB102) in OB1

7.3.1 Example accesses with IOL_CALL

In this example, the variable table "HMI" serves to visualize the procedure of the read and write access via IOL_CALL. The devices' process data are shown in the variable tables "Sensor1" or "Sensor2".

The assignment of the SPDU-indices of IO-Link devices can be found in the respective device documentation.

read access

Reading out the product name (product name, index 0x12) of the Turck IO-Link I/O-hub TBIL-M1-16DIP at IO-Link port 4.

➤ Write the input variables as follows (description see above):

Variable	Value	Meaning
RD_WR	0	read access
ID	30	Start address of the module's input data according to the configuration in HW Config
CAP (INDEX_CAP)	251	Function block instance
PORT (ENTITY_PORT)	4	The IO-Link device is connected to port 4.
IOL_INDEX	0×12	Index for product name

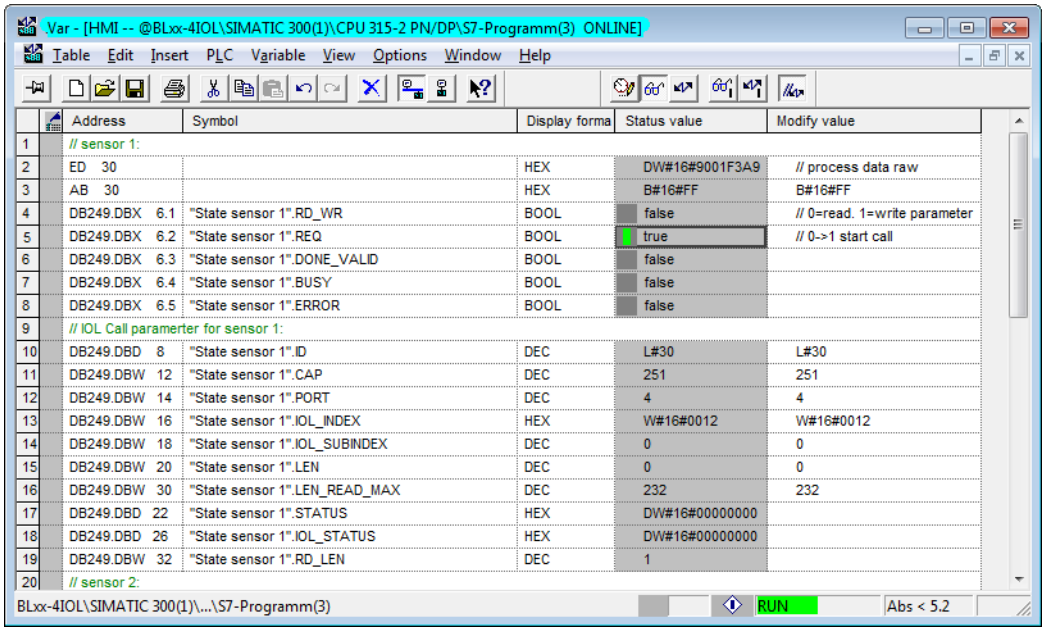


Fig. 13: Input variables for read access

➤ Activate the read access via a rising edge at "REQ":

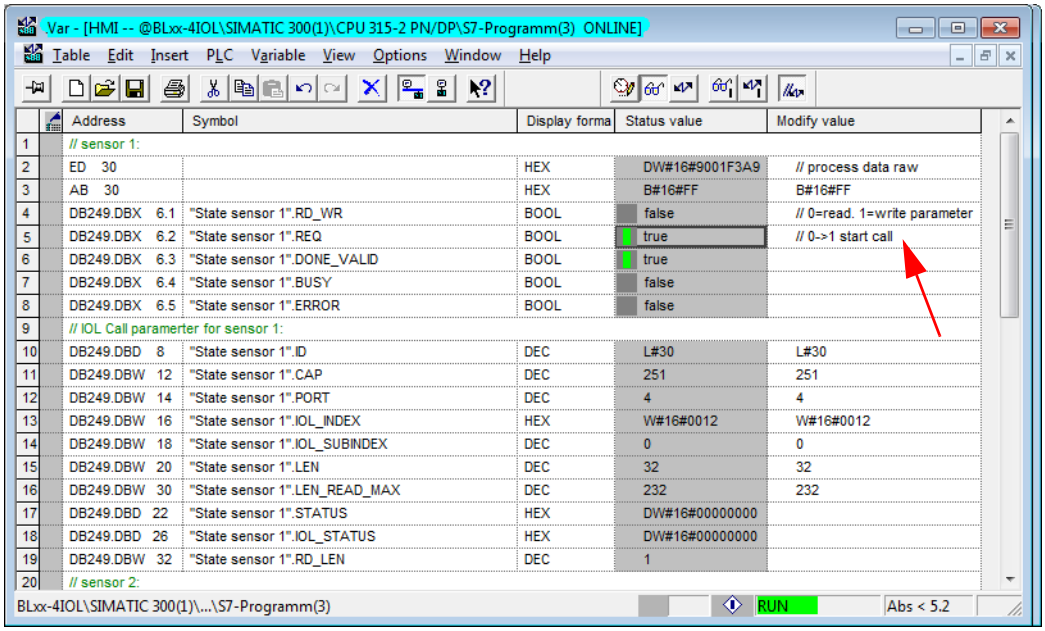


Fig. 14: Activating the read access

➥ In this example, the result of this request can be seen in the process data table VAT "Sensor 1".

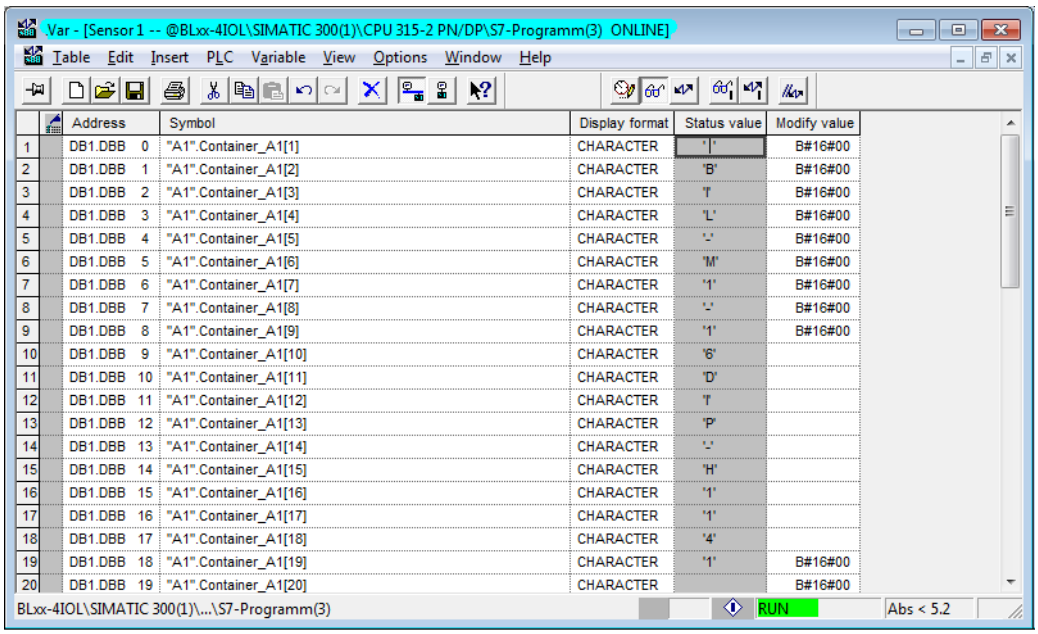
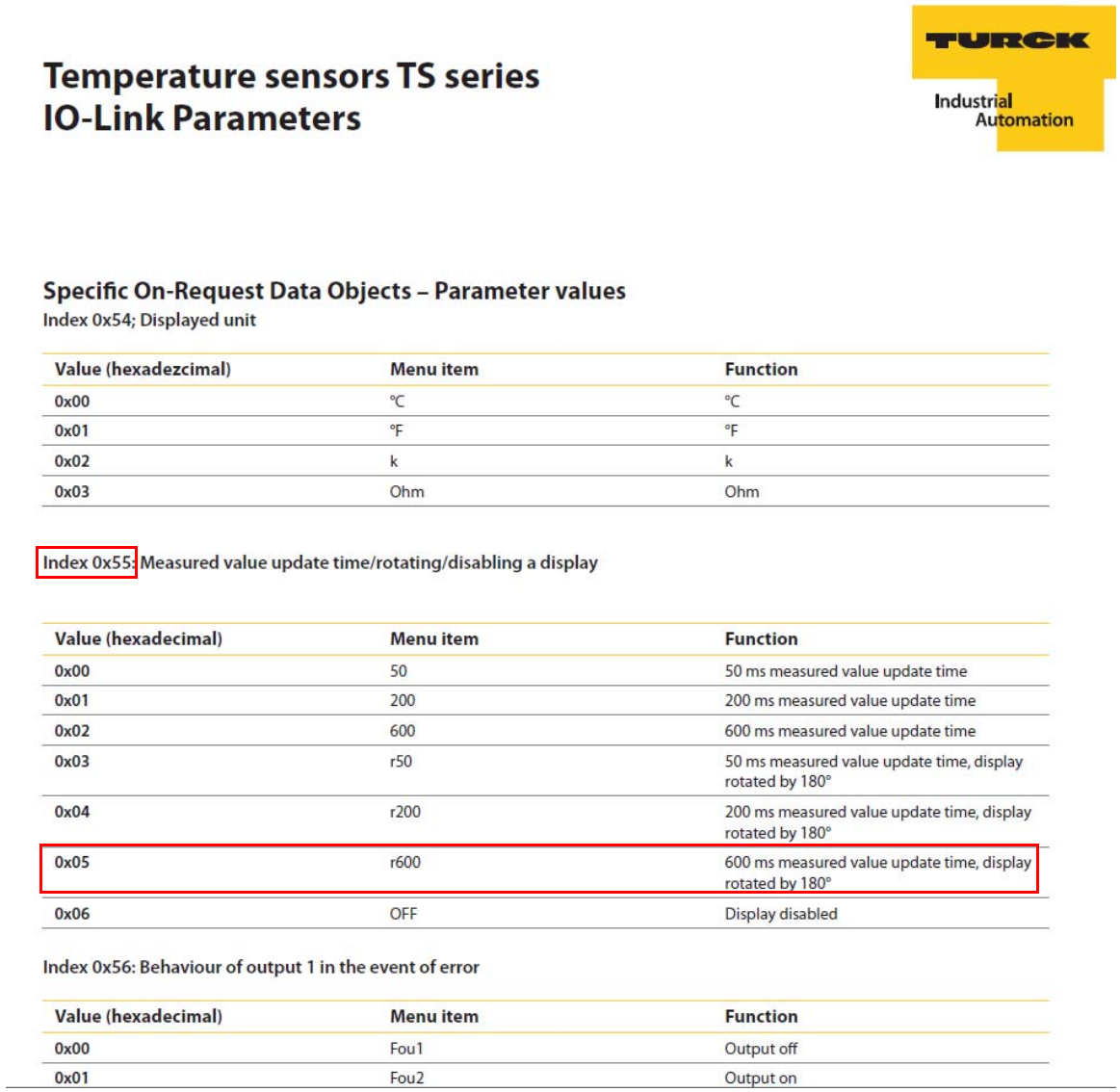


Fig. 15: Process data of the sensor

Write access

Changing the parameter "Measured value update time/rotating/disabling a display" (index 55) to the value 0x05 (600 ms measured value update time, display rotated by 180°) for the TURCK temperature sensor TS-500-LUUPN8X-H1141 at IO-Link port 1.



Temperature sensors TS series
IO-Link Parameters

TURCK Industrial Automation

Specific On-Request Data Objects – Parameter values

Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

Index 0x56: Behaviour of output 1 in the event of error

Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

Fig. 16: Extract from the documentation for Turck temperature sensors

➤ Write the input variables as follows (description see above):

Variable	Value	Meaning
RD_WR	1	Write access
ID	30	Start address of the module's output data according to the configuration in HW Config
CAP (INDEX_CAP)	251	Function block instance
PORT (ENTITY_PORT)	1	The IO-Link device is connected to port 1.

Variable	Value	Meaning
IOL_INDEX	0×55	Index for "Measured value update time/rotating/ disabling a display", see above.
LEN_READ	1	1 byte is written.

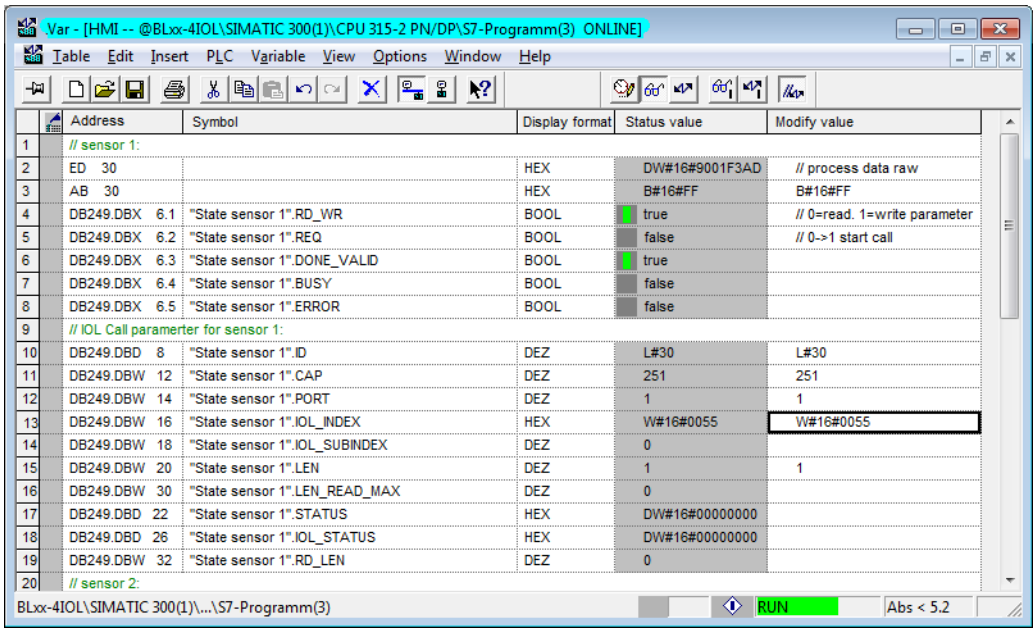


Fig. 17: Input variables for write access

➤ The value to be written (0x05) is entered as control value in the variable table (VAT) and is then written.

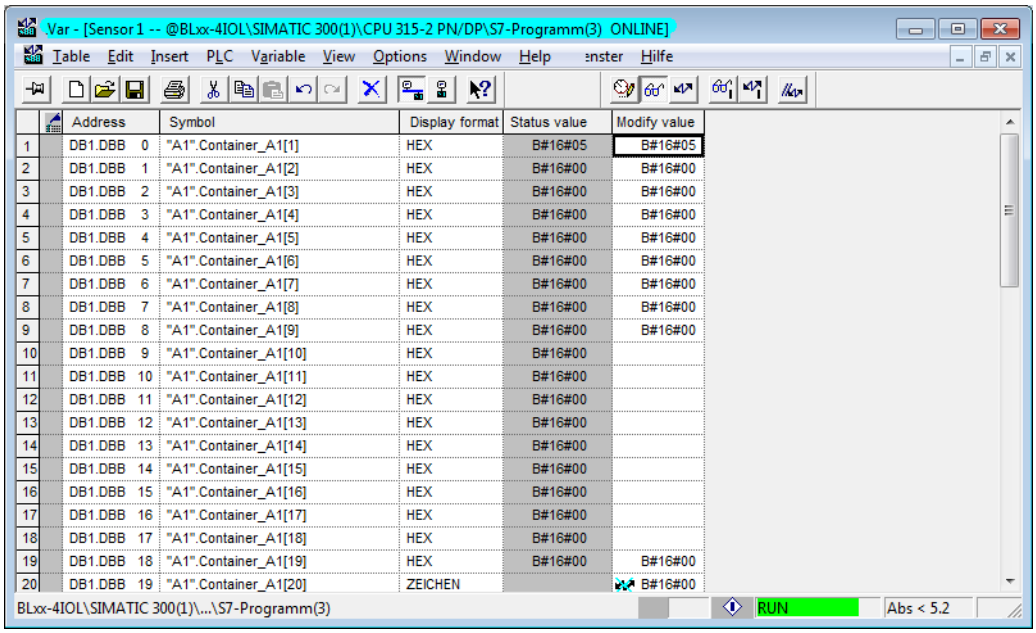


Fig. 18: Control value for index 0×55

➤ Activate the read access via a rising edge at "REQ":

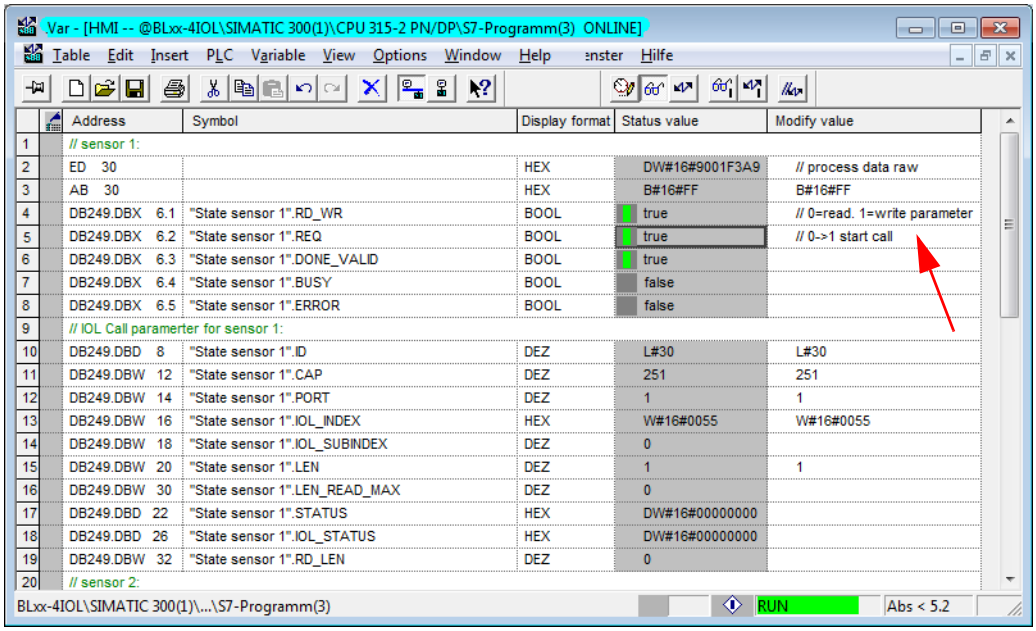


Fig. 19: Activating the write access

➥ The sensor's display is now rotated for about 180°, the update time is set to 600 ms.

8 TIA Portal: IOL_DEVICE

8.1 Example project

8.1.1 Used Hardware

- Siemens S7, CPU 1511-1 PN
- BL67-GW-EN with IO-Link master module BL67-4IOL at slot 1 of the BL67 station
- IO-Link device at BL67-4IOL:

Port 1	Turck temperature sensor, TS-530-LI2UPN8X-..., IO-Link V1.0
Port 2	DI
Port 3	DI
Port 4	Turck I/O hub: TBIL-M1-16DXP, IO-Link V1.1

8.1.2 Used Software

- Totally Integrated Automation Portal, V15

8.2 Hardware configuration

8.2.1 Configuration of the IO-Link master

➤ Install the GSDML file for the IO-Link master and add it to the “PROFINET-IO-System (100)”.

➤ Add the BL67-GW-EN to the project and insert the IO-Link master module BL67-4IOL at slot 1 of the BL67 station

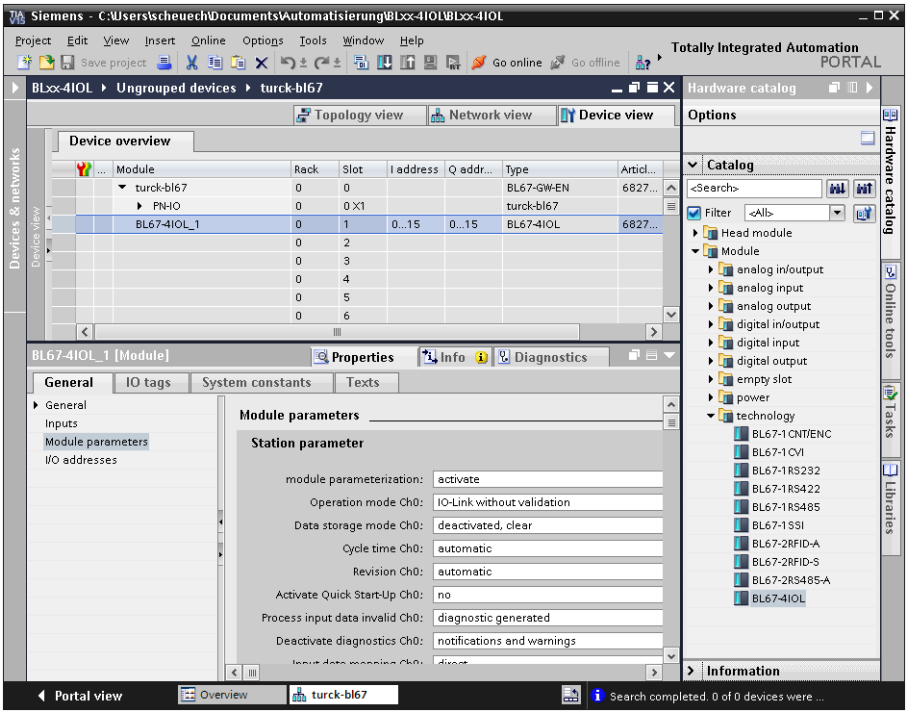


Fig. 20: BL67-GW-EN with BL67-4IOL

The 4 ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in DI mode (see also parameter **Operation mode (Seite 25)**).

- **Port in IO-Link mode (with identical device, with compatible device, etc.)**
  In "process input data length" and "process output data length" enter the length of process data of the connected device which have to be mapped to the field bus for this port, see also **Parameters (Seite 20)**.
- **Port in DI mode (DI with parameter access, DI)**
  It is reasonable to set the "process input data length" and "process output data length" to 0, in order not to block bytes with digital data in the process data mapping on the fieldbus.

8.2.2 Configuration of the IO-Link ports

Port configuration in the example project

Port 1:

- **IO-Link without validation** → Every IO-Link device will be accepted as exchange device in case of a device exchange, see also **Parameters (Seite 20)**.
- Device:
  Turck temperature sensor,
  TS-500-LUUPN8X-H1141,
  2 byte process data

Port 2 and port 3:

- configured as DI

Port 4:

- **IO-Link without validation** →Every IO-Link device will be accepted as exchange device i case of a device exchange **Parameters (Seite 20)**, →.
- Device:
  Turck I/O hub,
  TBIL-M1-16DIP,
  2 byte process data

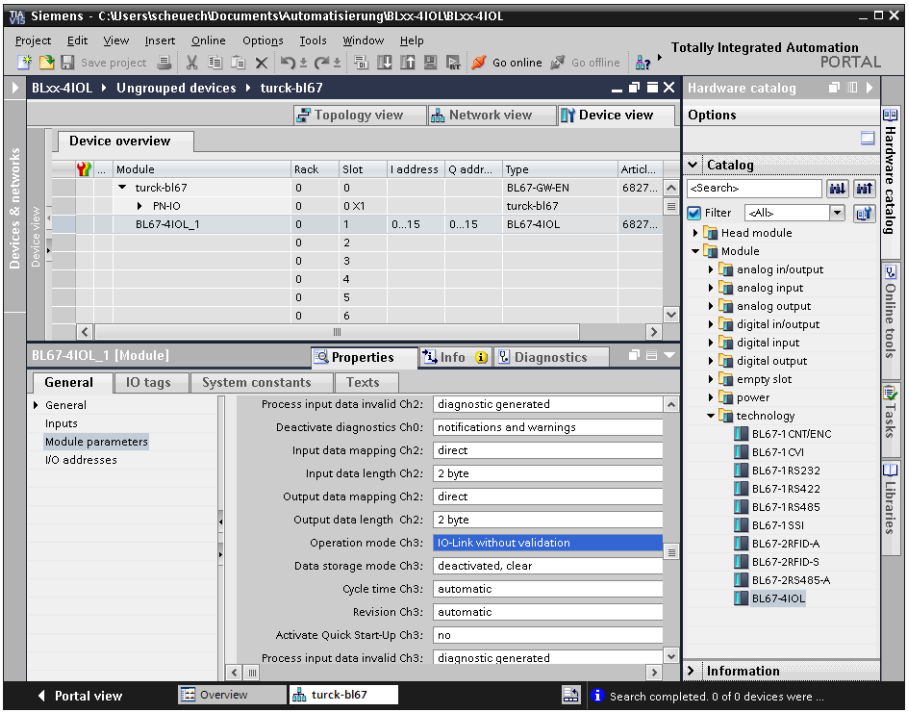


Fig. 21: Configuration of the IO-Link ports

8.3 Use the IO_LINK_DEVICE function block in TIA Portal

The IO_LINK_DEVICE function block is based on the IOL_CALL function block according to the IO-Link specification. **Kapitel 6: The IO-Link function block: IOL_CALL** contains a general description of the function block and its in and output variables.

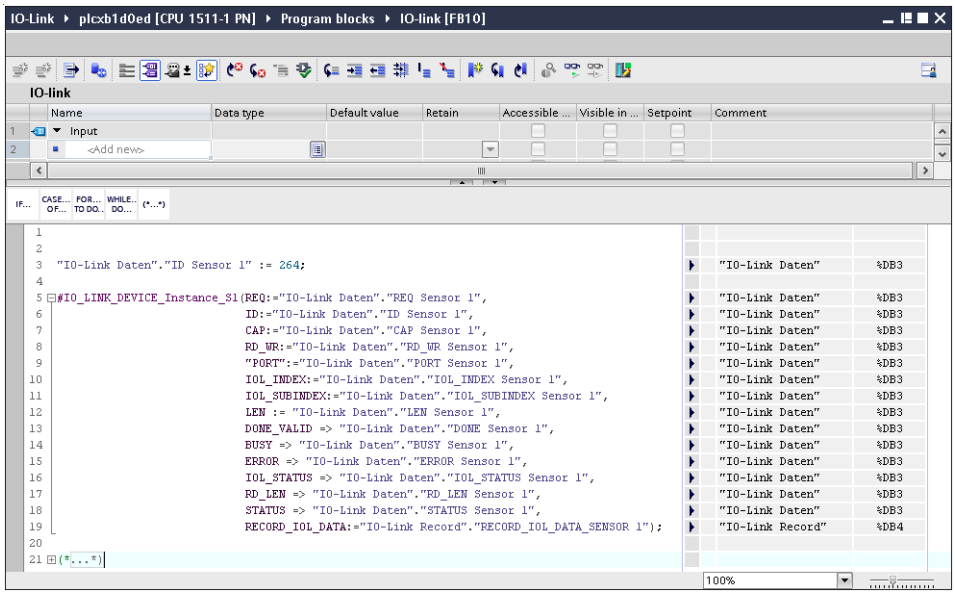


Fig. 22: Example call of Siemens FB "IO_LINK_DEVICE"

NOTE

The access to the Port0-functions of the TBEN-Lx-8IOL with an IOL_INDEX of 65535 (see **Port functions for port 0 (IO-Link master) (Seite 40)**) is not possible with the actual version (V3.0.2) of the Siemens IO_LINK_DEVICE block.
In TIA-Portal V13, the old IOL_CALL function block can be used to access these functions. Siemens provides it as “Archive.zip” for TIA Portal users under**https://support.industry.siemens.com**.

8.3.1 Example accesses with IO_LINK_DEVICE

In this example, the watch table "Sensor1" serves to visualize the procedure of the read and write access via IO_LINK_DEVICE.

The assignment of the SPDU-indices of IO-Link devices can be found in the respective device documentation.

NOTE

The function block access to the device an the connected sensors is done via the input variable "ID". The value which has to be set as ID depends on the used CPU:

– Hardware identifier of the IO-Link module, like in the example (with CPU 1511-PN)

– Start address of the input data of the IO-Link module (e.g. at a CPU 315)

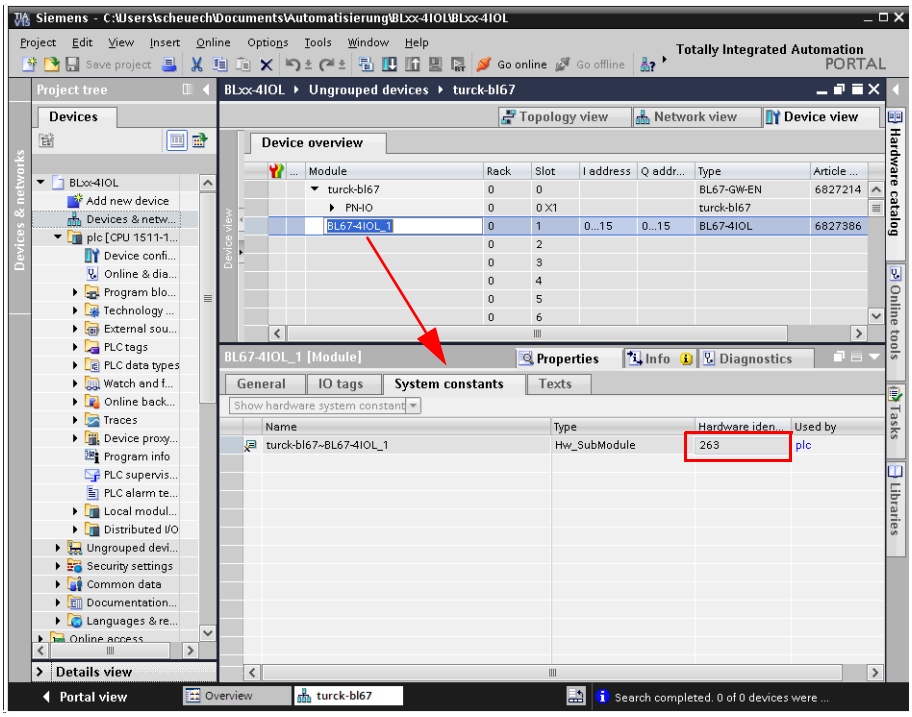


Fig. 23: HW identifier of BL67-4IOL

Read access

Reading out the product name (index 0x12) of the Turck IO-Link I/O-hub TBIL-M1-16DIP at IO-Link port 6.

➤ Write the function block's input variables as follows (description see above):

Variable	Value	Meaning
REQ	TRUE	Send a request
ID	263	Hardware identifier of BL67-4IOL Fig. 23: HW identifier of BL67-4IOL.
CAP	251	Function block instance
PORT	4	The IO-Link device is connected to port 4.
IOL_INDEX	0x12	Index for product name

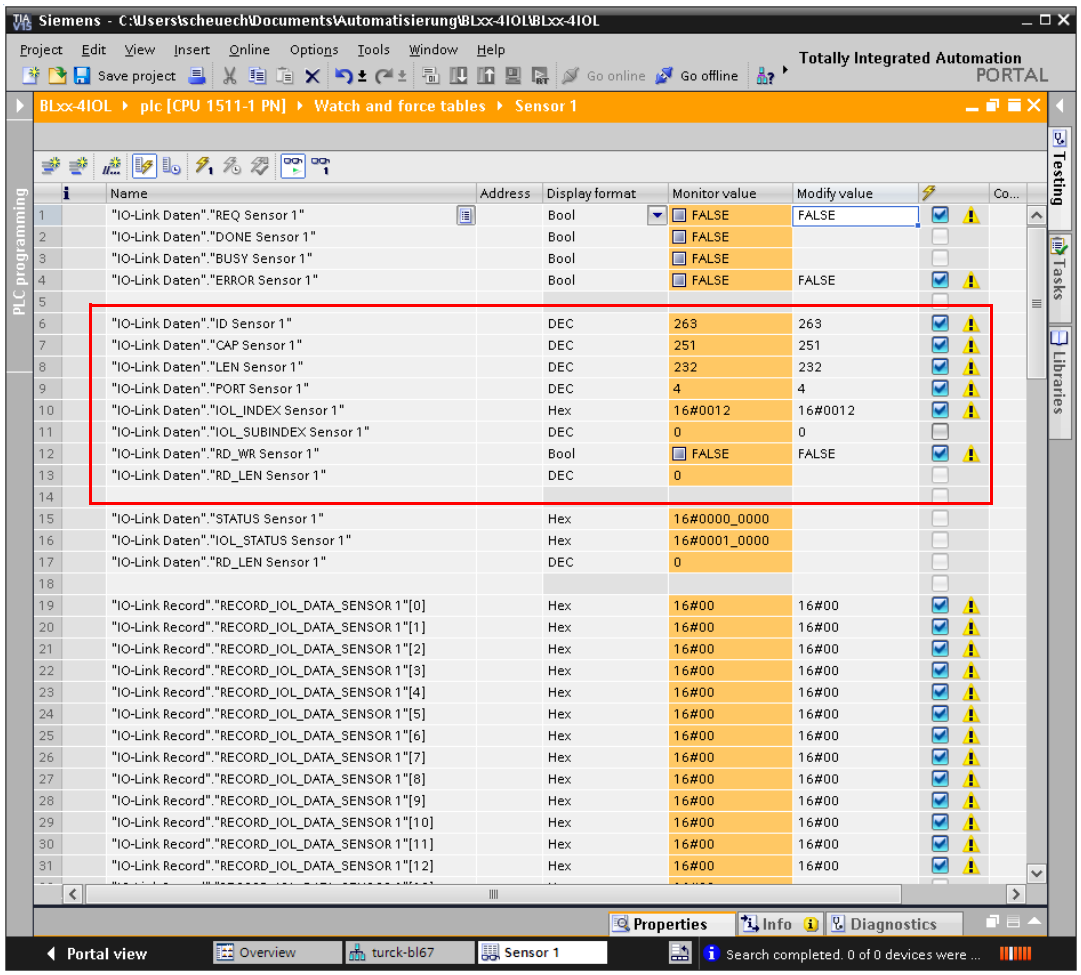


Fig. 24: Input variables for the read access

➤ Activate the read access via a rising edge at "REQ".

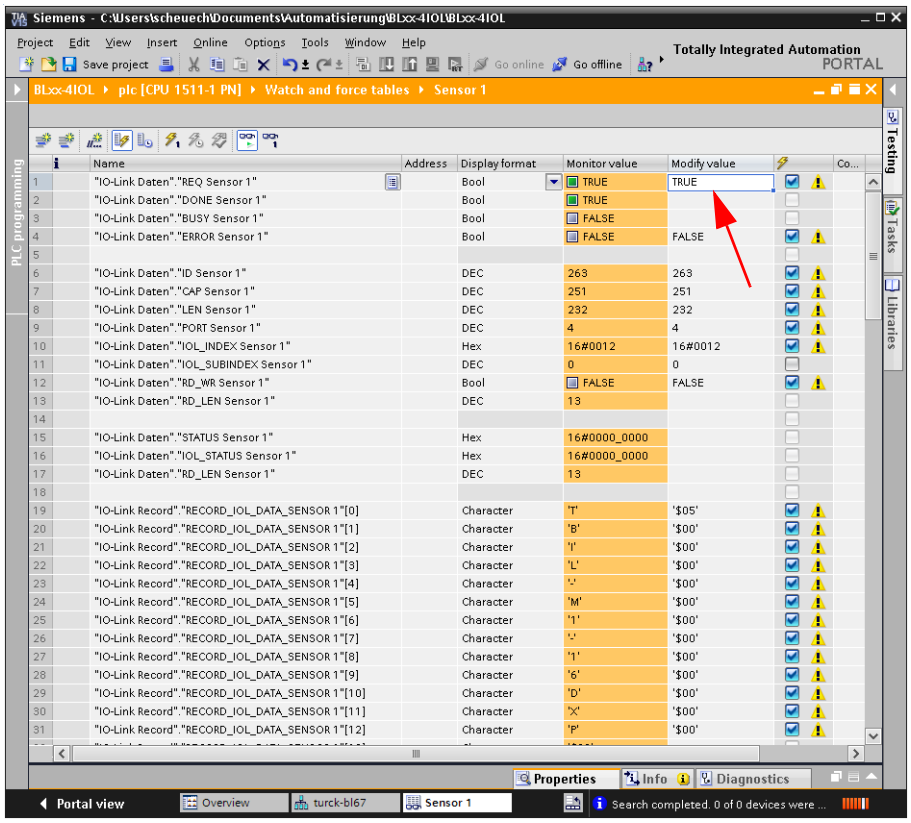


Fig. 25: Activating the read access

➥ In this example, the result of this request can be seen in the watch table (row 19 and following) in the "IO-Link Record".

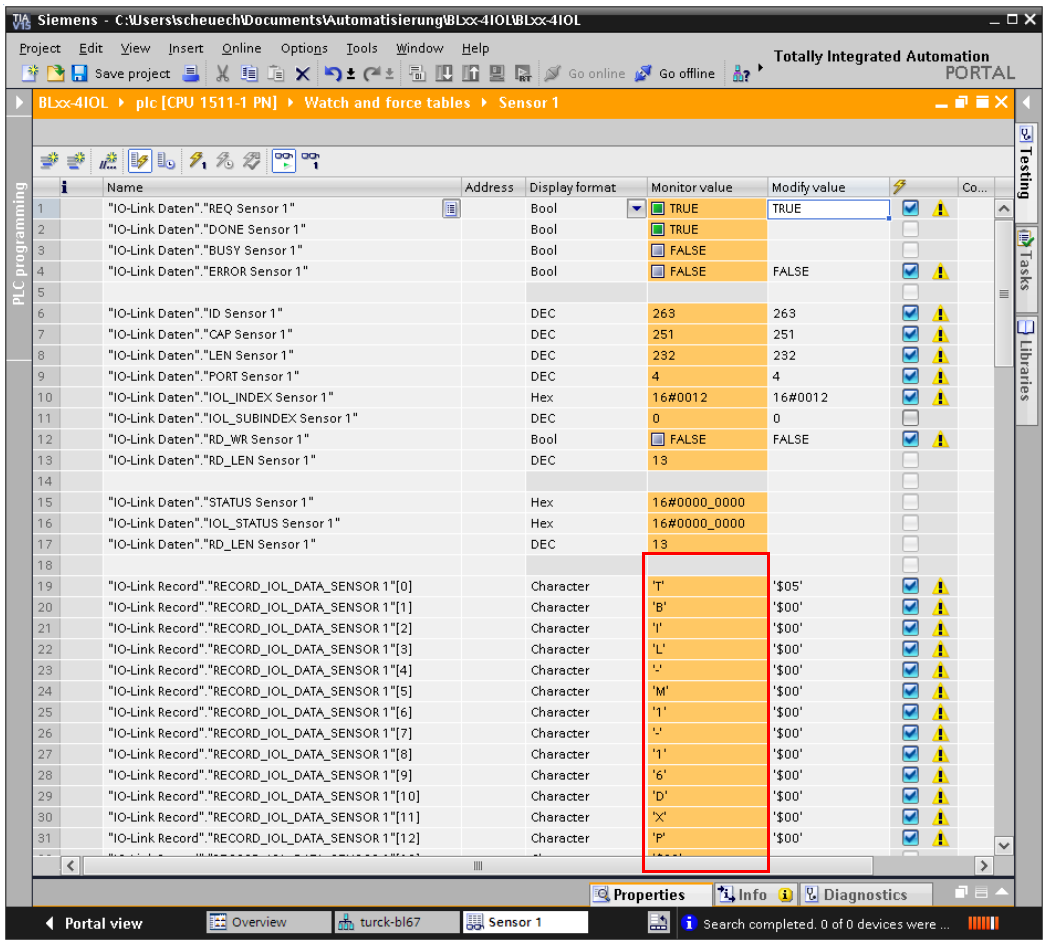
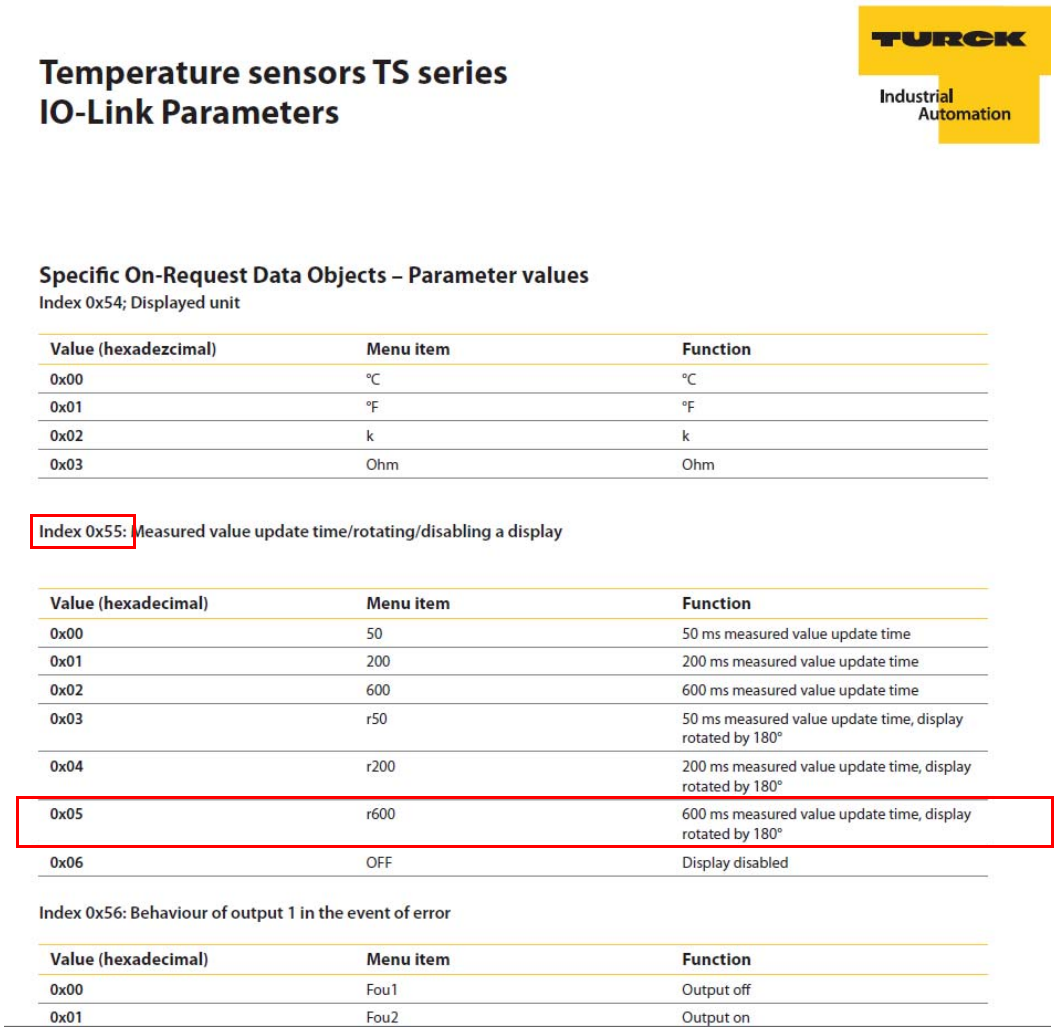


Fig. 26: Process data of the sensor

Write access

Changing the parameter "Measured value update time/rotating/disabling a display" (index 55) to the value 0x05 (600 ms measured value update time, display rotated by 180°) for the TURCK temperature sensor TS-500-LUUPN8X-H1141 at IO-Link port 1.



Temperature sensors TS series
IO-Link Parameters

TURCK Industrial Automation

Specific On-Request Data Objects – Parameter values
Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

Index 0x56: Behaviour of output 1 in the event of error

Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

Fig. 27: Extract from the documentation for Turck temperature sensors

➤ Write the function block's input variables as follows (description see above):

Variable	Value	Meaning
ID	263	Hardware identifier of BL67-4IOL Fig. 23: HW identifier of BL67-4IOL.
CAP	251	Function block instance
LEN	1	Length of the data to be written, 1 byte is written.
PORT	1	The IO-Link device is connected to port 1.
IOL_INDEX	0x55	Index for "Measured value update time/rotating/disabling a display", see above.

➤ Set the variable “RD_WR Sensor 1” to TRUE for activating the write access.

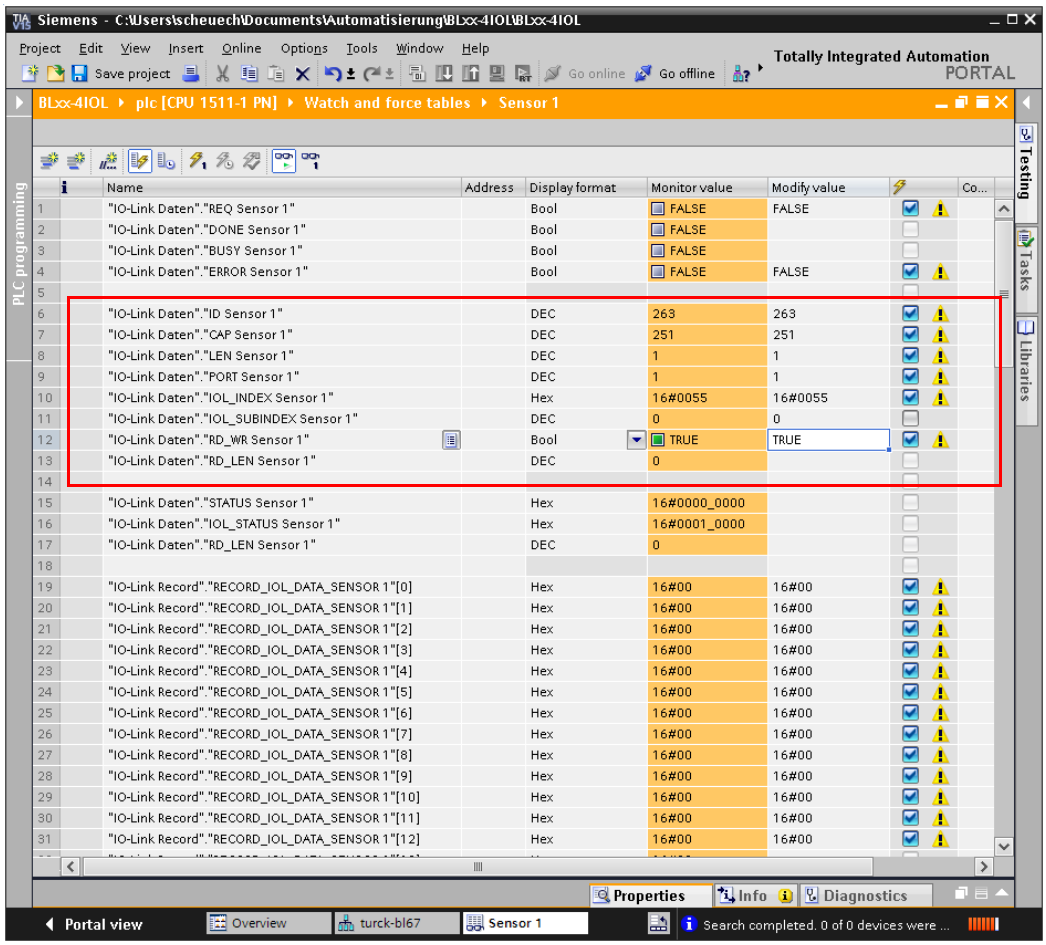


Fig. 28: Input variables for write access

➤ Set the value to be written (0x05) via the first word of "IO-Link Record" in the watch table.

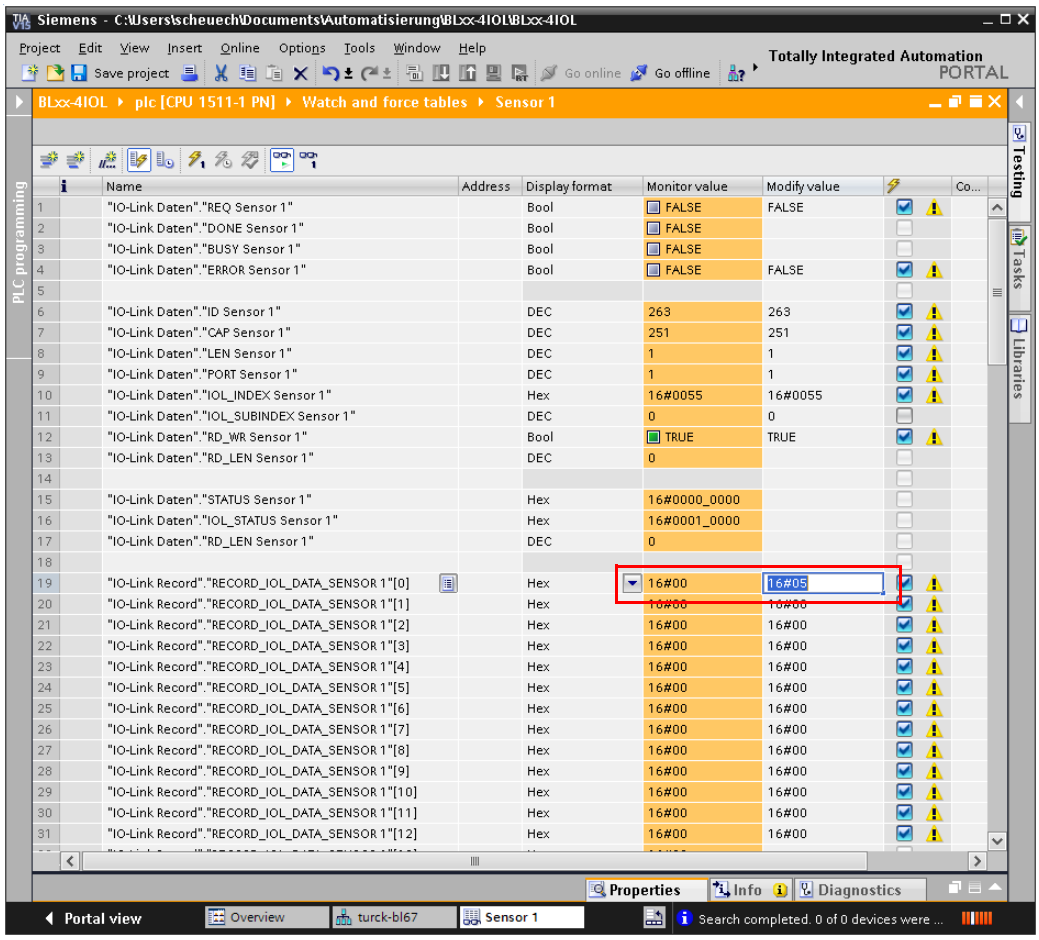


Fig. 29: Control value for index 0×55

➤ Activate the write access via a rising edge at "REQ".

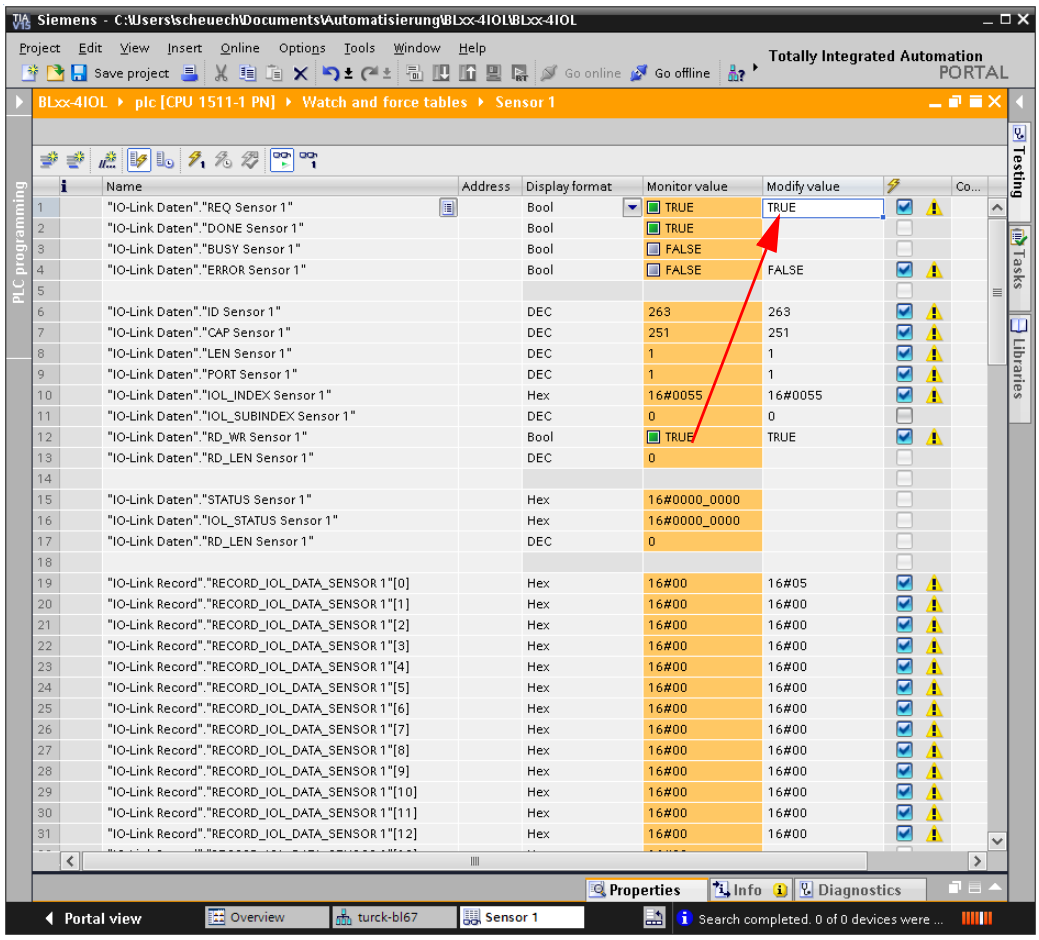


Fig. 30: Activating the write access

➥ The sensor's display is now rotated for about 180°, the update time is set to 600 ms.

9 CODESYS 2.3 (for programmable gateways): IOL_CALL

9.1 Example project

9.1.1 Used Hardware

- TURCK BL67-PG-EN-V3 (firmware version V1.1.5.0)
  - IO-Link Master BL67-4IOL with
    IO-Link port 1: Turck temperature sensor, TS-500-LUUPN8X-H1141
    IO-Link port 2: not used
    IO-Link port 3: not used
    IO-Link port 4: Turck I/O hub, TBIL-M1-16DIP

9.1.2 Used Software

- CODESYS V3.5.12.10
- IO-Link call function block

9.2 Configuration in CODESYS

9.2.1 Prerequisites

- The software has been started.
- A new project with the BL67-PG-EN-V3 was created.
- The BL67 IO-Link module has been added under Local_IO_BL67.

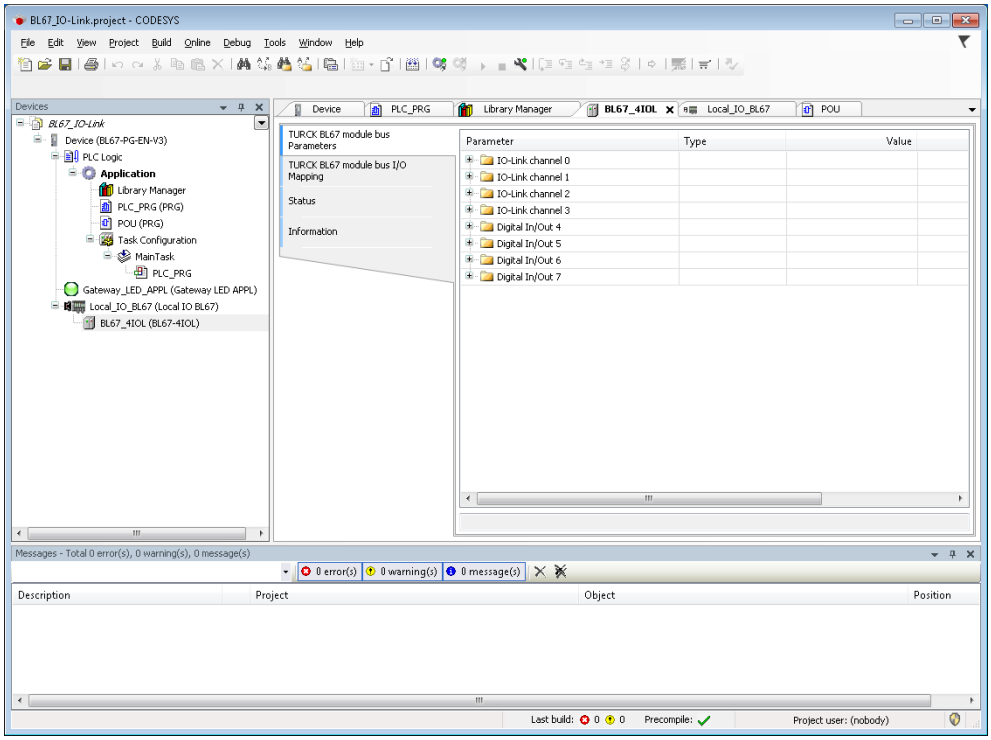


Fig. 31: CODESYS V3: Project with BL67-PG-EN-V3

9.2.2 Configuration of the IO-Link ports

The 4 ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in DI mode (see also parameter **Operation mode (Seite 25)**).

- **Port in IO-Link mode (with identical device, with compatible device, etc.)**
  In "process input data length" and "process output data length" enter the length of process data of the connected device which have to be mapped to the field bus for this port, see also **Parameters (Seite 20)**.
- **Port in DI mode (DI with parameter access, DI)**
  It is reasonable to set the "process input data length" and "process output data length" to 0, in order not to block bytes with digital data in the process data mapping on the fieldbus.

Port configuration in the example project

Port 0:

- **IO-Link with identical device** → Only an identical exchange device is accepted in case of a device exchange (check of vendor-ID, device-ID, etc., see **Parameters (Seite 20)**.
- Device:
  Turck temperature sensor,
  TS-500-LUUPN8X-H1141,
  2 byte process data

Port 1 and **Port 2**:

- configured as DI

Port 3:

- **IO-Link without validation** → Every IO-Link device will be accepted as exchange device in case of a device exchange, see **Parameters (Seite 20)**.
- Device:
  Turck I/O hub,
  TBIL-M1-16DIP,
  2 byte process data

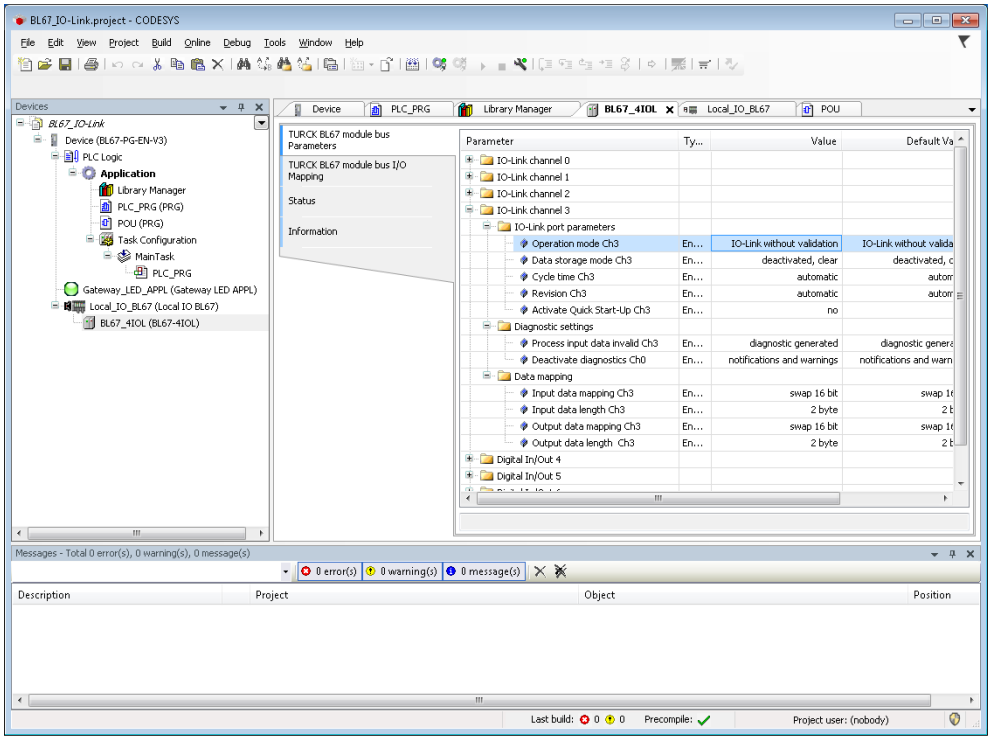


Fig. 32: Configuration of the IO-Link ports (example project)

9.3 Usage of the function block in CODESYS

Kapitel 6 contains a general description of the function block and its in and output variables. **The IO-Link function block: IOL_CALL**.

The IOL-CALL-FB is part of the Turck library „IO-Link CALL LocalIO“.

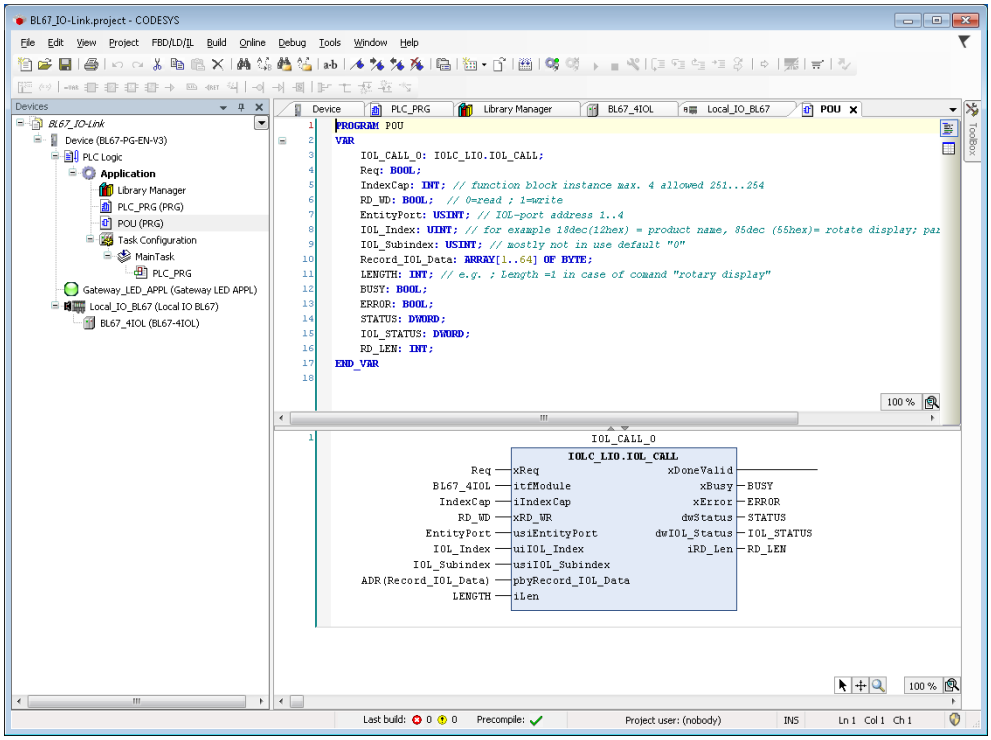


Fig. 33: Turck IO-Link call in CODESYS

9.3.1 Example accesses with IOL_CALL

The assignment of the sub indices of IO-Link devices can be found in the respective device documentation.

read access

Reading out the product name (product name, index 0x18) of the Turck IO-Link I/O-hub TBIL-M1-16DIP at IO-Link port 1.

➤ Write the input variables of the function block as follows:

Variable	Value (dec.)	Meaning
xRD_WR	0	read access
itfModule	1	Instance of the IO-Link module, Example: "BL67_4IOL"
iIndexCap	251	Function block instance
usiEntityPort	4	The IO-Link device is connected to port 4.
uiIOL_Index	18	Index for the product name according to IODD
usiIOL_Subindex	0	“0” in this example
iLEN	20	32 byte are read out Length of the data to be read, min. length = real length of the data, max. length = length of the defined data buffer

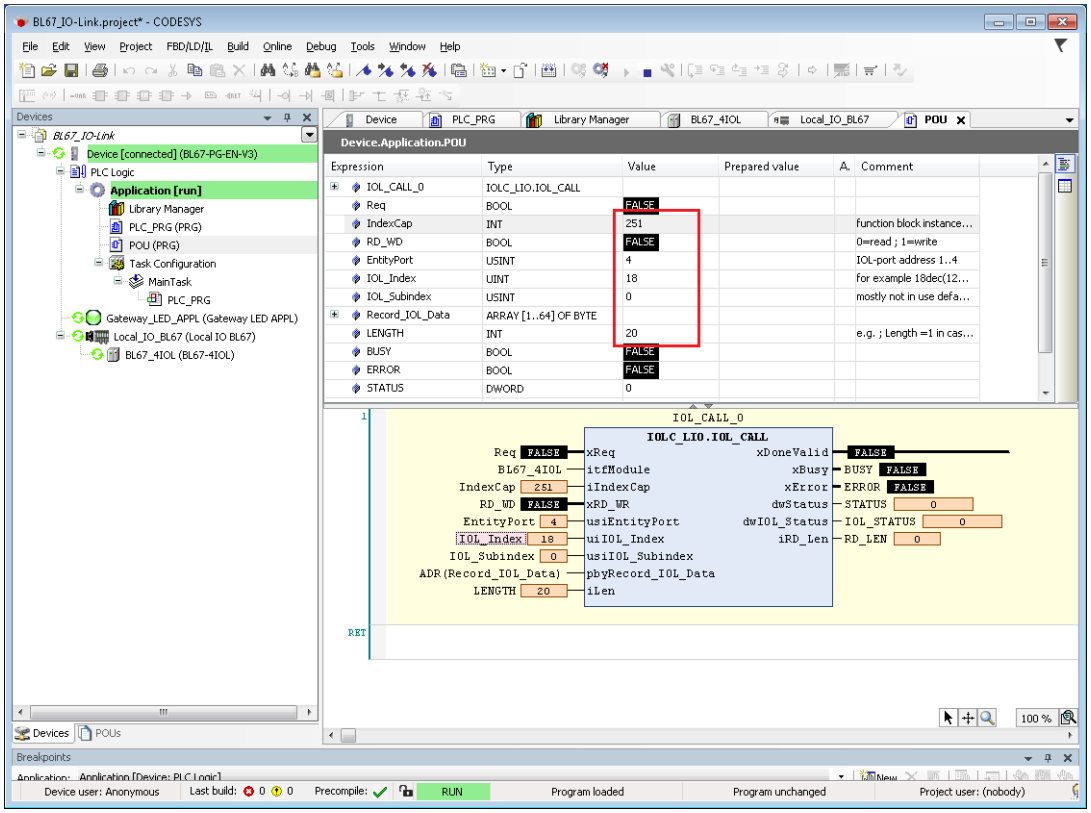


Fig. 34: Input variables for read access

➤ Activate the read access via a rising edge at "REQ":

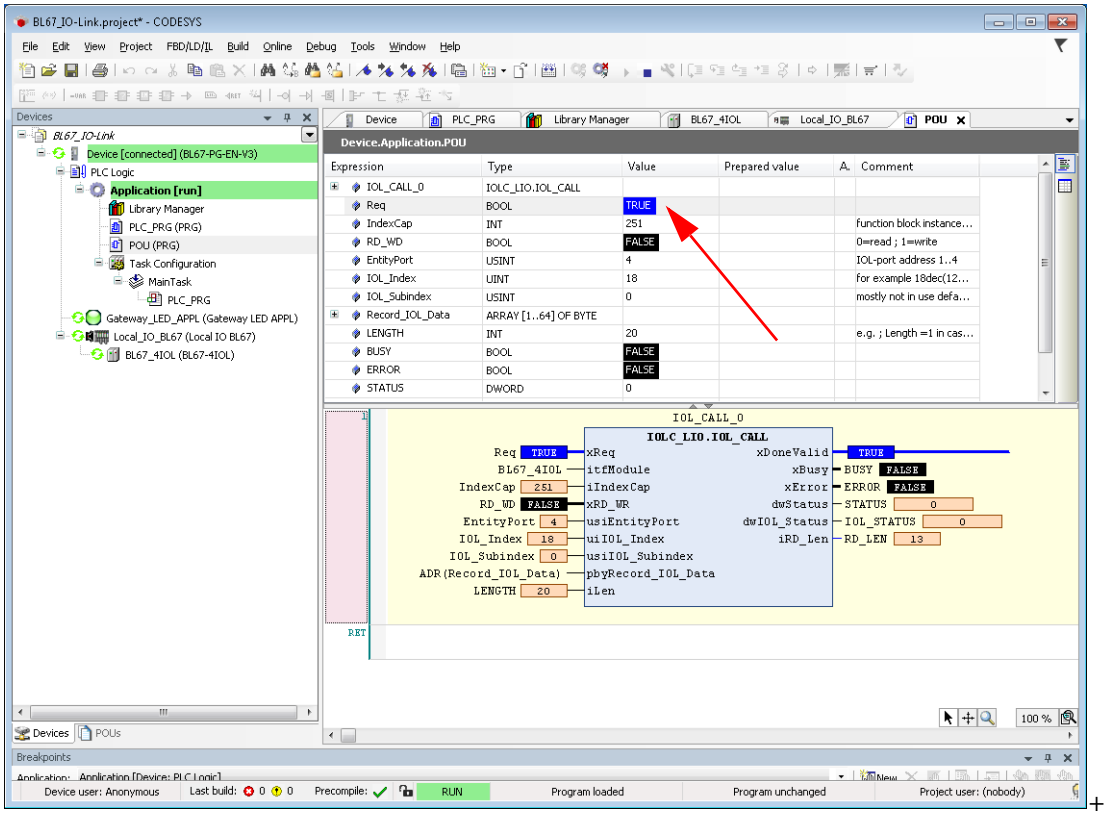


Fig. 35: Activating the read access

➥ In this example, the result of this request can be found in the data array „Record_IOL_Data“:

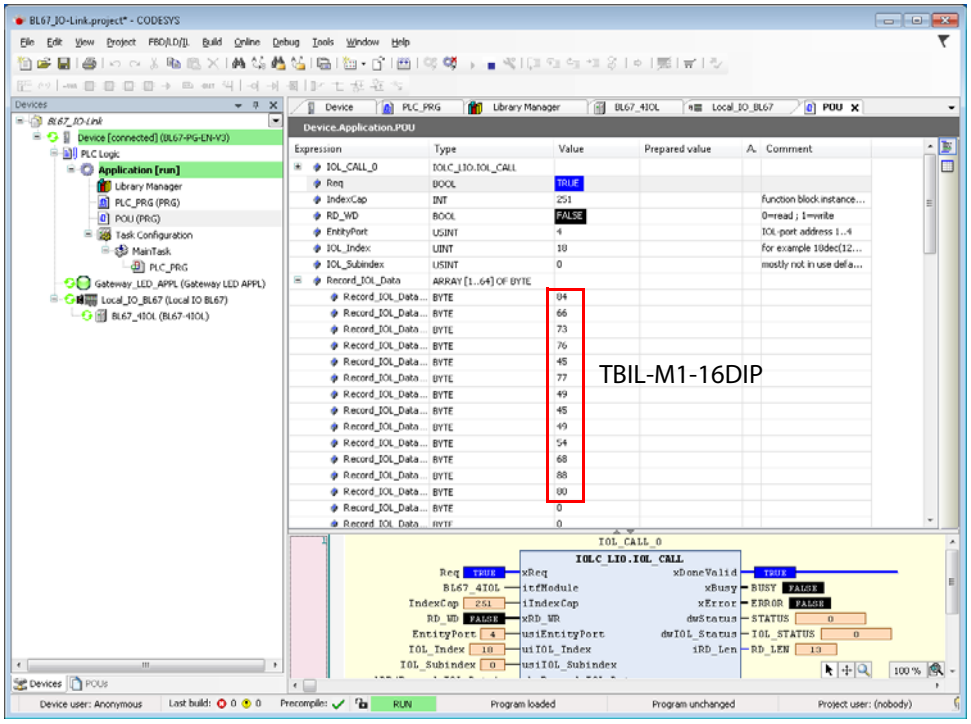
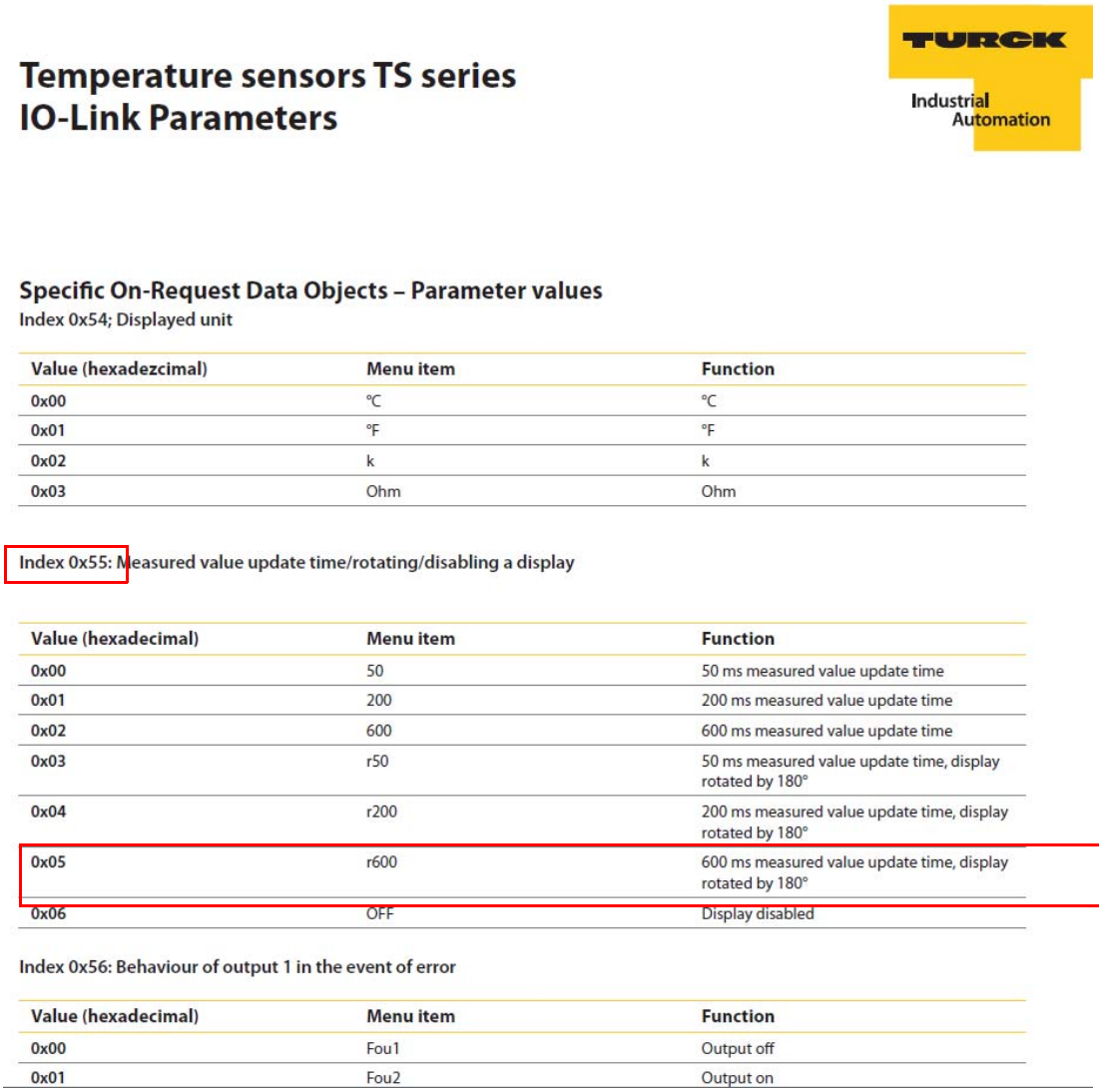


Fig. 36: Process data of the sensor

Write access

Changing the parameter "Measured value update time/rotating/disabling a display" (index 55) to the value 0x05 (600 ms measured value update time, display rotated by 180°) for the Turck temperature sensor TS-500-LUUPN8X-H1141 at IO-Link port 1.



Temperature sensors TS series
IO-Link Parameters

TURCK
Industrial Automation

Specific On-Request Data Objects – Parameter values
Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

Index 0x56: Behaviour of output 1 in the event of error

Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

Fig. 37: Extract from the documentation for Turck temperature sensors

➤ Write the input variables of the function block as follows:

Variable	Value	Meaning
xRD_WR	1	Write access
itfModule	1	Instance of the IO-Link module, Example: "BL67_4IOL"
iIndexCap	251	Function block instance
usiEntityPort	1	The IO-Link device is connected to port 1.

Variable	Value	Meaning
uiIOL_Index	85	Index for rotating the display according to IODD, in CODESYS V3 in decimal format
usiIOL_Subindex	0	“0” in this example
iLEN	1	1 byte is written For the write access, define the exact length if the data to be written.

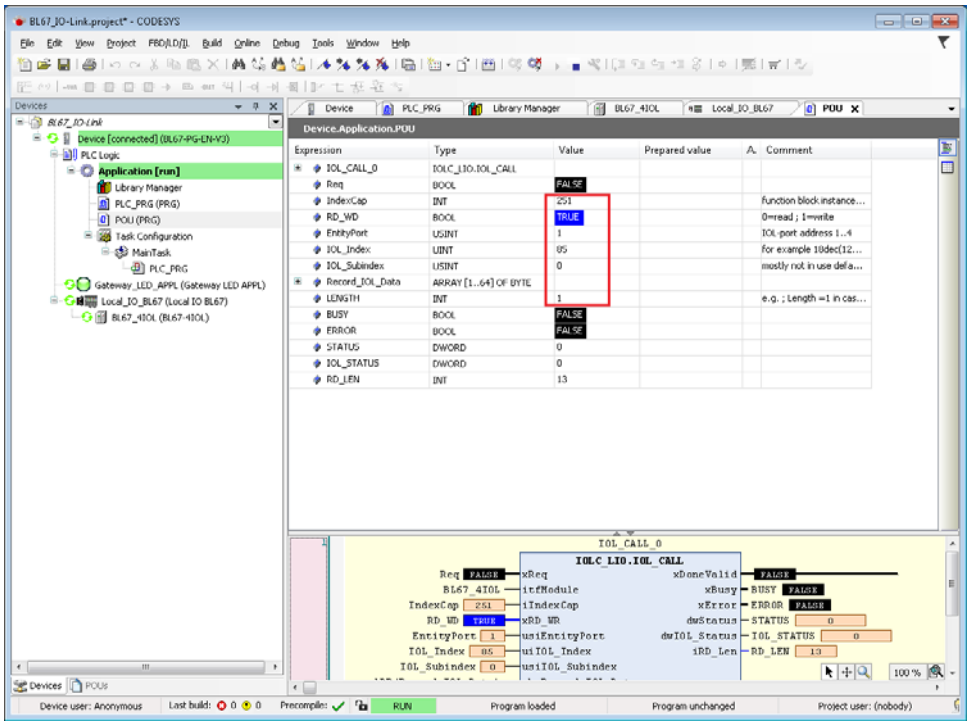


Fig. 38: Input variables for write access

➤ The value to be written ("05", s. S. 83) is entered in the data array „Record_IOL_Data“ and is then written.

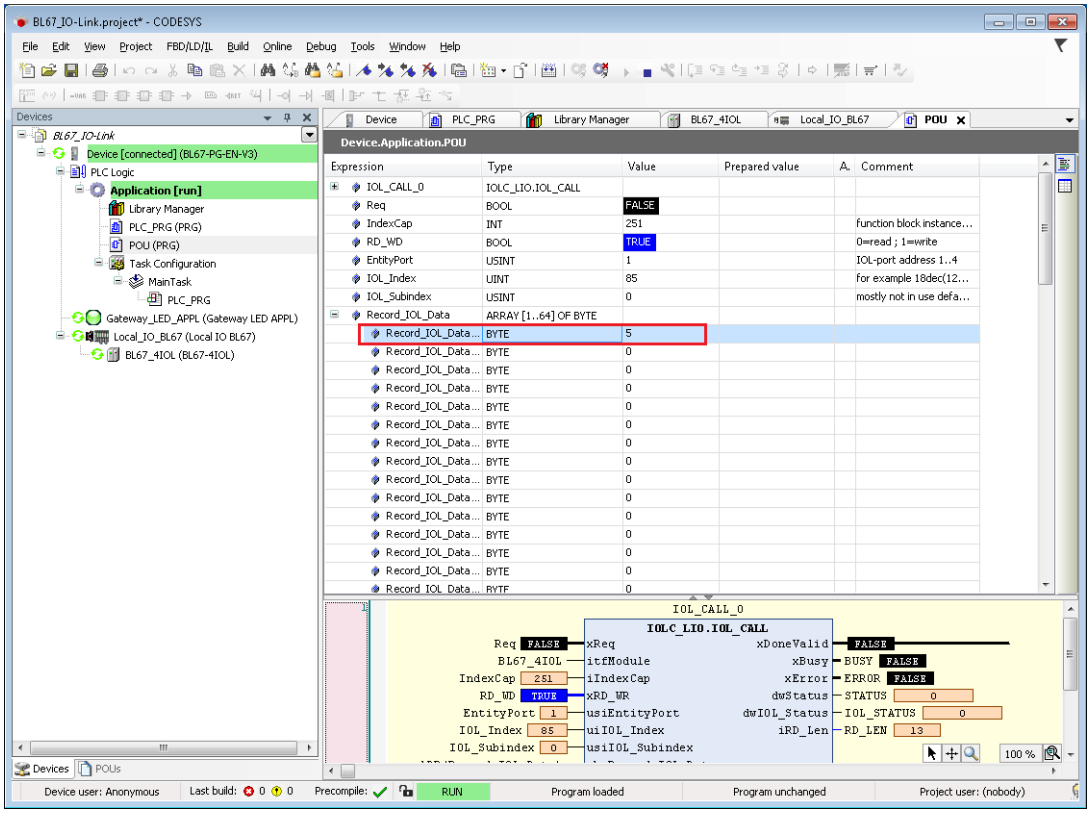


Fig. 39: Input value for write access

➤ Activate the read access via a rising edge at "REQ":

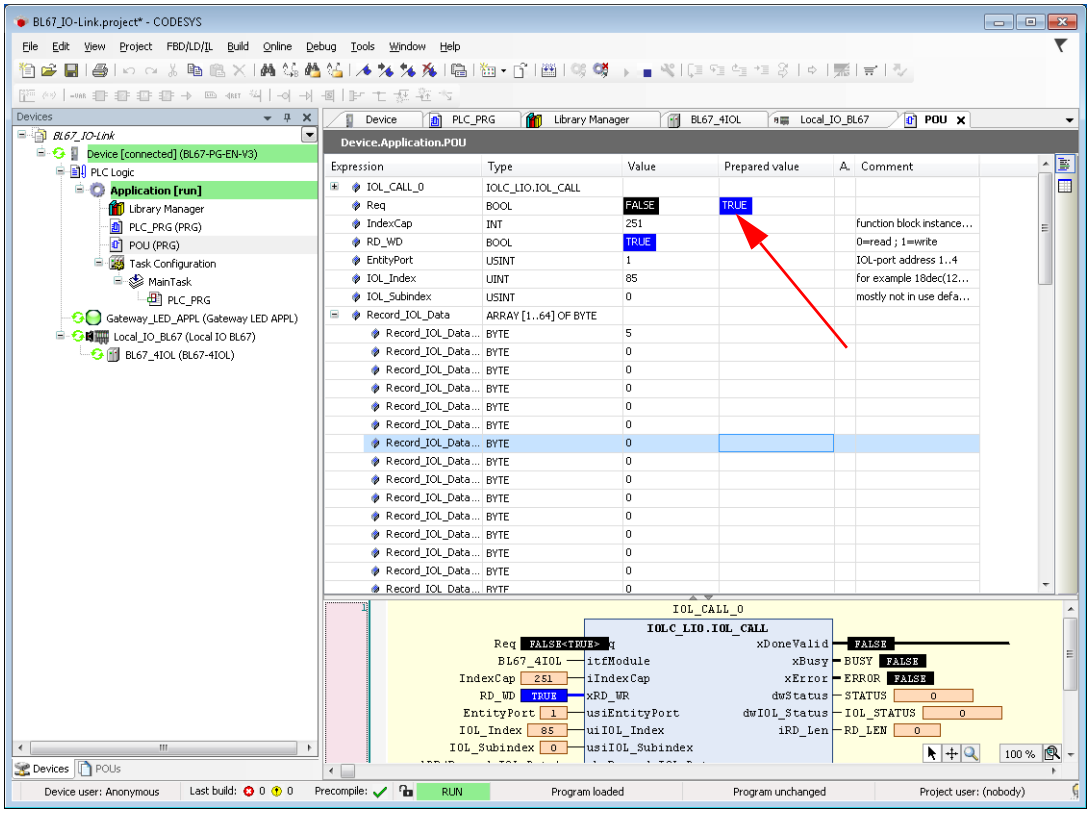


Fig. 40: Activating the write access

➥ The sensor's display is now rotated for about 180°, the update time is set to 600 ms.

10 Appendix

10.1 Start-up: IO-Link-Device with IO-Link V1.0

IO-Link devices in accordance with IO-Link specification V1.0 **do not support** data storage. This means, that the parameter "Data storage mode" has to be set to "deactivated/, clear" if an IO-Link V1.0 devices is used.

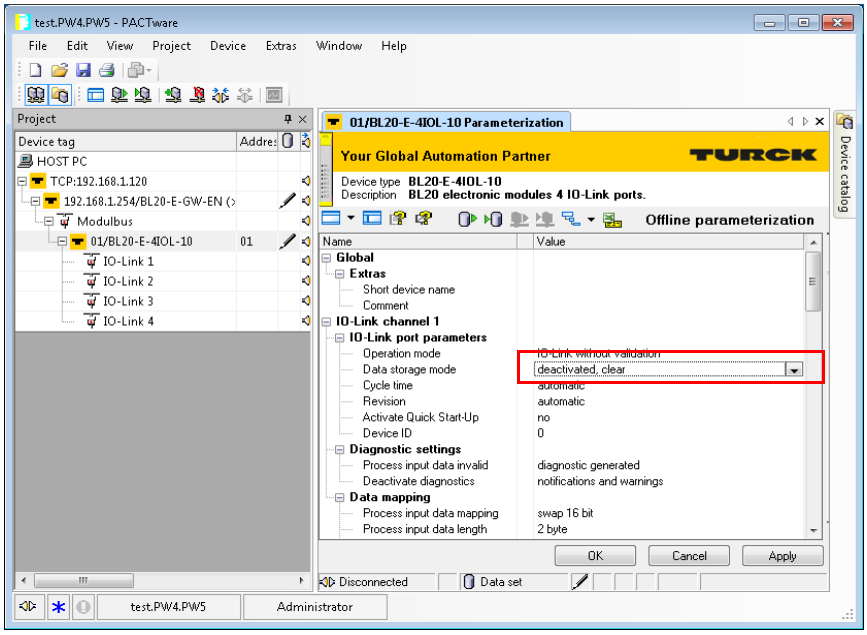


Fig. 41: Data storage mode deactivated, clear

Start-up

- ➤ Deactivate the data storage mode for the respective IO-Link port.
- ➤ Download the parameters into the device. All other default settings can be kept.
- ➤ Connect the IO-Link V1.0 device.
- ➥ LED „IOL“ = GREEN (for the respective port), IO-Link communication is active.

10.2 Start-up: IO-Link-Device with IO-Link V1.1

The data storage of the master should be cleared before a device with a different device type is connected to an IO-Link port which has already been used before.

Start-up

- ➤ Set the "data storage mode" to "deactivated,clear".
- ➤ Download the parameters into the device.
- ➤ Re-activate the data storage if required.
- ➤ Download the parameters into the device.
- ➤ Connect the IO-Link V1.1 device.
- ➥ LED „IOL“ = GREEN (for the respective port), IO-Link communication is active

10.3 Start-up problems - frequently failure causes

LED	Diagnostics	Possible causes	Explanation/solution
DIA and **IOL** red, flashing	Data storage error	IO-Link device in accordance with IO-Link V1.0 connected. IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage	Deactivate the data storage. To do so, set parameter "**Data storage mode (Seite 21)**" to "deactivated, clear".
		The data storage buffer contains data of another device.	Clear the data storage buffer of the master. To do so, set the parameter "**Data storage mode (Seite 21)**" to "deactivated, clear" and 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.).	Change the parameterization of the IO-Link port at the master. Correct the vendor-ID, device-ID, etc. The parameterization can be done by teaching the master via IOL_CALL using the port function **Subindex 67: Teach Mode (Seite 43)** or via a manual port parameterization.
	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 "process input data invalid"-diagnosis for the respective port. To do so, set parameter "**Process input data invalid (Seite 22)**" to "no diagnostic generated".

TURCK

30 subsidiaries and over
60 representations worldwide!

D301333 | 2018/10

www.turck.com