BECKHOFF New Automation Technology

Documentation | EN

EPI4xxx, ERI4xxx

IO-Link box with 2 analog inputs + 2 analog outputs

2022-08-29 | Version: 1.6

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.6	• Product images updated • Structure update
1.5	• Technical data updated
1.4	• Dimensions updated • UL requirements updated
1.3	• Figure in chapter “introduction” updated
1.2	• Front page updated
1.1	• Chapter "Process data" added
1.0	• First publication
0.5	• First preliminary version

Firm and hardware version

The documentation refers to the firm and hardware status that was valid at the time it was prepared.

The properties of the modules are subject to continuous development and improvement. Modules having earlier production statuses cannot have the same properties as modules with the latest status. Existing properties, however, are always retained and are not changed, so that these modules can always be replaced by new ones.

The firmware and hardware version (delivery state) can be found in the batch number (D number) printed at the side of the IO-Link box module.

Syntax of the batch number (D-number)

D: WW YY FF HH	Example with D no. 29 10 02 01:
WW - week of production (calendar week) YY - year of production FF - firmware version HH - hardware version	29 - week of production 29 10 - year of production 2010 02 - firmware version 02 01 - hardware version 01

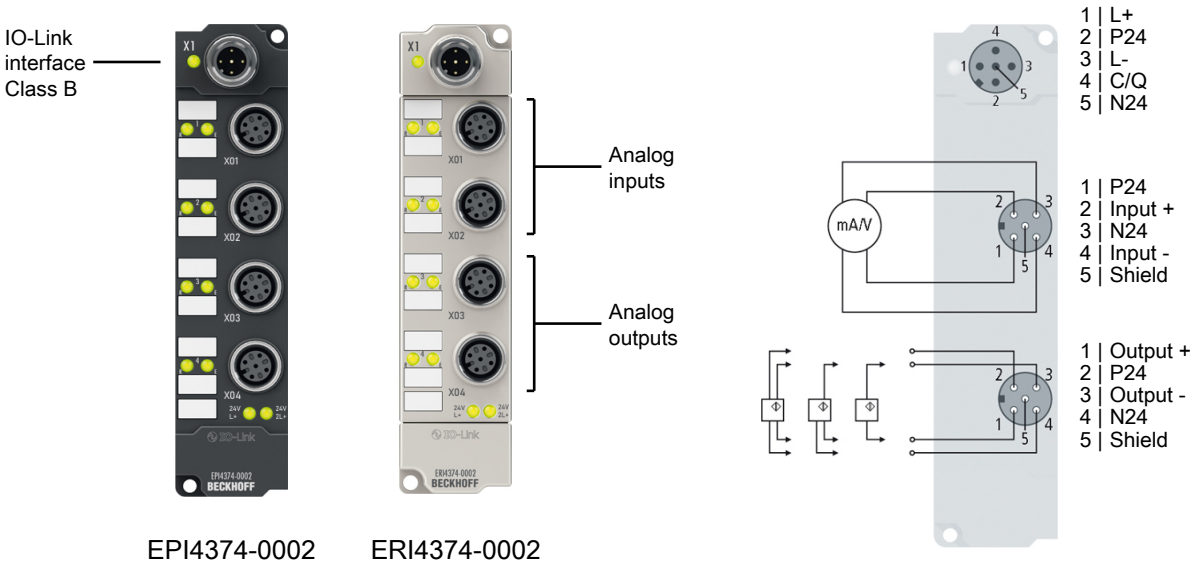
2 Product overview

2.1 Module overview: EPI4xxx, ERI4xxx

Module	Number of analog		Signal connection	Housing	Comment
	Inputs	Outputs			
EPI4374-0002	2	2	4 x M12	Industrial housing	two configurable analog inputs and two configurable analog outputs
ERI4374-0002	2	2	4 x M12	Die-cast zinc housing	two configurable analog inputs and two configurable analog outputs

2.2 EPI4374-0002, ERI4374-0002

2.2.1 Introduction



EPI4374-0002 ERI4374-0002

2-channel analog input + 2-channel analog output ±10 V or 0/4...20 mA, parameterizable, 16-bit

The EPI4374-0002 and ERI4374-0002 IO-Link box modules have two analog inputs and two analog outputs, which can be parameterized individually, so that they process or generate signals either in the -10 to +10 V range or the 0/4 to 20 mA range. The resolution for the current and voltage signals is 16 bit (signed).

For the outputs the voltage or output current is fed to the process level, electrically isolated with a resolution of 15 bit (default). The two output channels and the 24 V_{DC} supply have a common ground potential.

The EPI4374-0002 and the ERI4374-0002 are Class B devices, i.e. a 5-core cable is required for connection.

The IO-Link box modules with die-cast zinc housing (ERI series) can be used in extremely challenging industrial and process environments. The fully sealed design and the metal surface of the ERI series make it ideal for applications requiring enhanced load capacity and protection against welding spatter, for example.

Quick links

Technical data [▶ 10]
Signal connection [▶ 23]
Commissioning [▶ 28]

2.2.2 Technical data

All values are typical values over the entire temperature range, unless stated otherwise.

IO-Link	
Connection	1 x M12 plug, 5-pin, A-coded
Data transfer rate	230.4 kbaud (COM 3)
Specification version	IO-Link V1.1, Class B
Requirements for IO-Link master	V1.1
Current consumption from L+	100 mA
Current consumption from P24	Current for sensor supply Current for actuator supply
Electrical isolation L+ / P24	yes

Analog inputs	
Number	2
Connection	2 x M12 socket, 5-pin
Input type	Differential
Measuring range	Adjustable: • -10 … +10 V (factory setting) • 0 … 10 V • 0 … 20 mA • 4 … 20 mA
Specifications of the measuring ranges [▶ 11]	
Sensor supply	24 V_{DC} from P24, not short-circuit proof

Analog outputs	
Number	2
Connection	2 x M12 socket, 5-pin
Output signal range	Adjustable: • -10 … +10 V (factory setting) • 0 … 10 V • 0 … 20 mA • 4 … 20 mA
Specifications of the output signal ranges [▶ 11]	
Actuator supply	24 V_{DC} from P24, not short-circuit proof

Housing data	EPI4374-0002	ERI4374-0002
Dimensions W x H x D	30 mm x 126 mm x 26.5 mm (without plug connectors)	
Weight	approx. 165 g	approx. 250 g
Installation position	variable	
Material	PA6 (polyamide)	Die-cast zinc

Environmental conditions	
Ambient temperature during operation	-25 … +60 °C -25 … +55 °C according to cURus
Ambient temperature during storage	-40 … +85 °C
Vibration resistance, shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27 Additional checks
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)

Approvals/markings	
Approvals/markings *)	CE, cURus [▶ 25]

*) Real applicable approvals/markings see type plate on the side (product marking).

2.2.2.1 Measuring ranges

Analog inputs

The measuring range can be switched during operation. The following table shows the electrical specifications depending on the selected measuring range.

Technical data	Measuring range			
	-10…10 V	0…10 V	0…20 mA	4…20 mA
Input type	Differential			
Input resistance	> 200 kΩ	> 200 kΩ	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Digital resolution	16-bit	15-bit	15-bit	15-bit
Measuring error	< 0.3 % relative to full scale value			
Conversion time	approx. 100 µs			
Input filter limit frequency	5 kHz			
Value of the least significant bit	approx. 305 µV	approx. 305 µV	approx. 610 µA	approx. 488 µA

The analog inputs and outputs have a common analog ground potential. The analog ground potential is electrically isolated from all other ground potentials in the box.

2.2.2.2 Output signal ranges

Analog outputs

The output signal range can be switched during operation. The following table shows the electrical specifications depending on the selected output signal range.

Technical data	Output signal range			
	-10…10 V	0…10 V	0…20 mA	4…20 mA
Load resistor / load	> 5 kΩ	> 5 kΩ	< 500 Ω	< 500 Ω
Digital resolution	16-bit	15-bit	15-bit	15-bit
Output error	< 0.1 % (ambient temperature 0…+55 °C) < 0.2 % (ambient temperature < 0 °C or > 55 °C) related to the final value.			
Conversion time	approx. 40 µs			
Value of the least significant bit	approx. 305 µV	approx. 305 µV	approx. 610 µA	approx. 488 µA

The analog inputs and outputs have a common analog ground potential. The analog ground potential is electrically isolated from all other ground potentials in the box.

2.2.3 Process image

Channel 1 Status and Channel 1 Value

The IO-Link device is connected to IO-Link port2 of the IO-Link master (EP6224-2022).

- The status information (16-bit) of the 1st analog input channel can be found under **Channel 1 Status**. Here as an example the process image of the EPI4374-0002.
- The analog value (16-bit) of the 1st analog input channel can be found under **Channel 1 In Value**.
- **Channel 2**
  The data of the 2nd analog input channel is structured identically to that of the 1st channel.

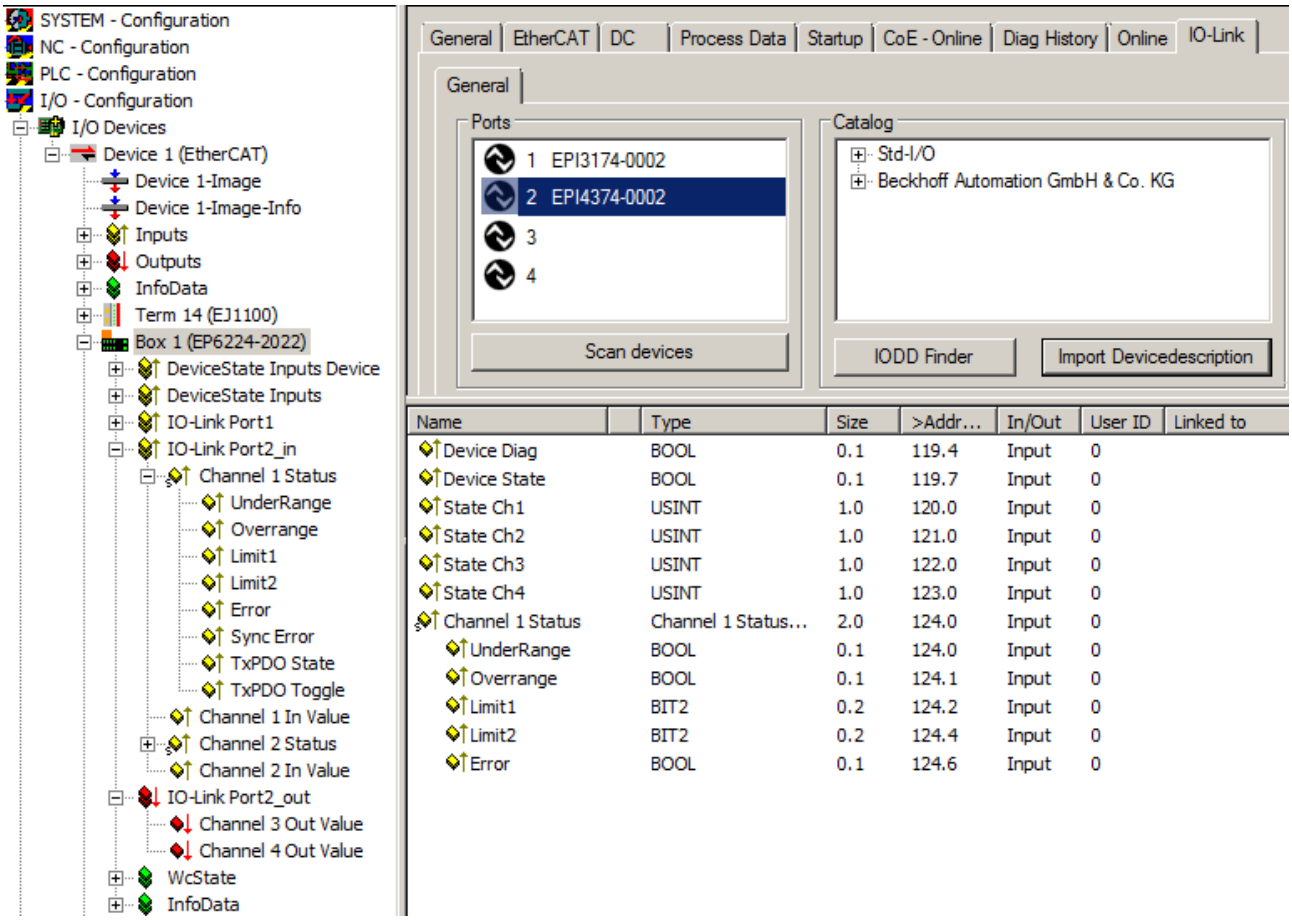


Fig. 1: EPI4374-0002 - Process image in the tree view

Underrange: Value of the analog input is less than 0/4 mA or -10/0 V
Overrange: Value of the analog input is greater than 20 mA or +10 V
Limit 1 / Limit 2: with activated Limit 1 (object 80x0:07 = 1)/ Limit 2 (object 80x0:08 = 1)
1: means value < Limit 1 (set in object 0x80x0:13) / Limit 2 (set in object 0x80x0:14)
2: means value > Limit 1 (set in object 0x80x0:13) / Limit 2 (set in object 0x80x0:14)
3: means value = Limit 1 (set in object 0x80x0:13) / Limit 2 (set in object 0x80x0:14)
Error: This bit is set if overrange or underrange was detected.

Channel 3 Out Value, Channel 4 Out Value

- The data of the two analog output channels (channel 3 and channel 4) can be found under **Channel 3 Out Value and Channel 4 Out Value**

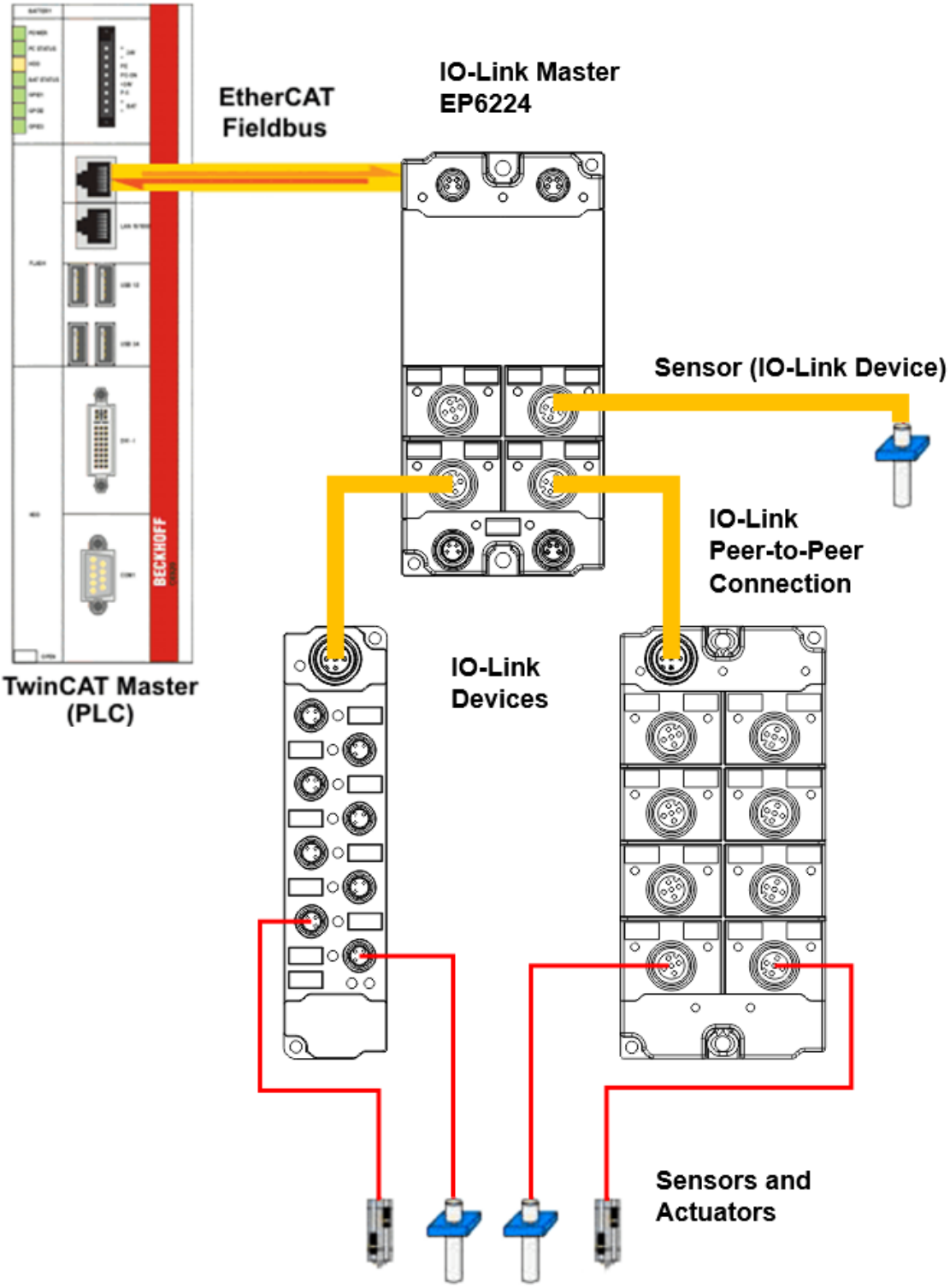
3 IO-Link basics

IO-Link is a communication system for connecting intelligent sensors and actuators to an automation system. The IEC 61131-9 standard specifies IO-Link under the designation "Single-drop digital communication interface for small sensors and actuators" (SDCI).

Both the electrical connection data and the communication protocol are standardized and summarized in the IO-Link Spec.

3.1 IO-Link system layout

An IO-Link system consists of an IO-Link master and one or more IO-Link devices, i.e. sensors or actuators. The IO-Link master provides the interface to the higher-level controller and controls communication with the connected IO-Link devices.
The IO-Link masters from Beckhoff have several IO-Link ports, to each of which one IO-Link device can be connected. IO-Link is not a fieldbus, but rather a point-to-point connection.



⚠ CAUTION

Risk of device damage

The IO-Link devices must be supplied from the 24 V power supply of the IO-Link master provided for this purpose. Otherwise, damage to the IO-Link port is possible.

3.2 Establishment of IO Link communication

The establishment of the IO-Link communication is illustrated in Fig. *Establishment of IO-Link communication.* This illustrates in particular the sequence when automatically scanning [▶ 34] the IO-Link port.

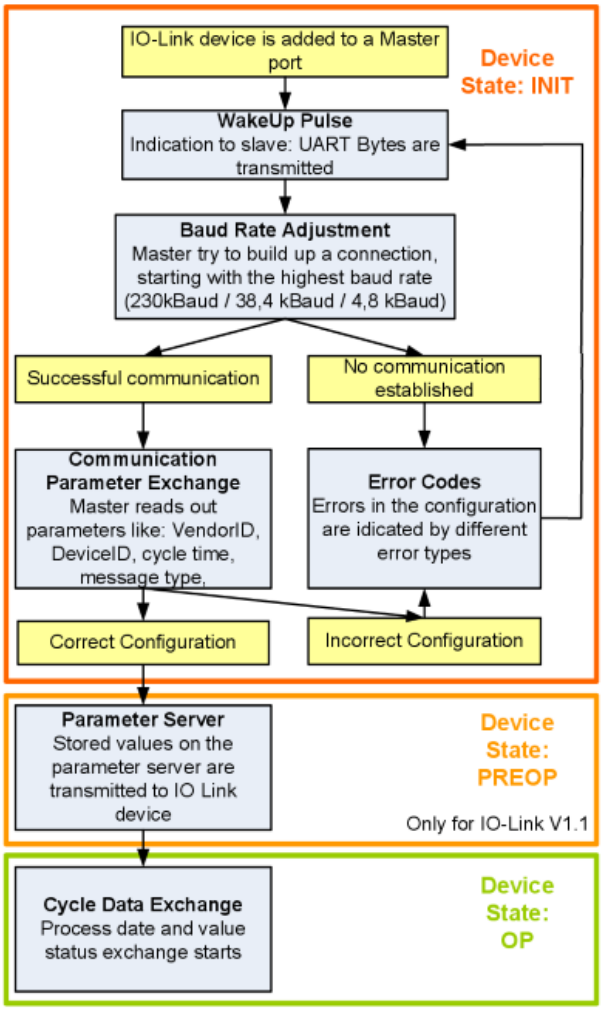


Fig. 2: Establishment of IO Link communication

- If an IO-Link device is connected to a master port, the master attempts to establish communication. A defined signal level, the **wake-up pulse**, signals to the device that UART bytes are to be sent from now on.
  From this point on, all data will be interpreted by the IO-Link device as UART bytes.
- The master runs through all baud rates [▶ 17], starting with the fastest baud rate (COM3 = 230 kbaud). A successful connection has been established when the slave responds to the wake-up pulse.
- First of all the master reads the **basic parameters** (Vendor ID, Device ID, process data length, telegram type and cycle time) and compares them with the existing configuration.
- If no connection could be established to the device, or if the saved parameters differ from those read, the corresponding error is output.
- If the saved parameters differ from those read, the IO-Link device changes to the PREOP state.
  If the IO-Link device specification is V1.1, the parameter server [▶ 17] is now executed. If the IO-Link device specification is V1.0, this step is omitted and the device changes directly to OP.
- Finally the cycle time is written and the device changes to OP. After that the master cyclically exchanges data with the device.

3.3 Device description IODD

IO-Link devices possess individual system information in the form of an IO device description (IODD), which contains:

- Communication features
- Device parameters with value range and default values
- Identification, process and diagnostic data
- Device data
- Text description
- Picture of the device
- Vendor's logo

If the IODD is imported, then the device data are automatically detected during automatic scanning [▶ 34] with TwinCAT and adopted in the System Manager.

3.4 Parameter server

In order to be able to use the functionality of the parameter server, both the IO-Link master and the IO-Link device must be specified to V1.1. The IO-Link revision of the device can be read for the individual port under Settings [▶ 41]. All IO-Link masters from Beckhoff with current firmware support the IO-Link specification V1.1.

- The parameter server in the IO-Link master contains parameter data that are saved in the IO-Link device. The memory capacity is max. 2 kbyte (including header).
  If the IO-Link device is exchanged, then the data are loaded from the parameter server into the new device. The requirement for this is that the device is of the same type (VendorID and DeviceID must be the same).
- If a new IO-Link device is configured, then the IO-Link master loads the parameters from the IO-Link device into the parameter server when starting for the first time.
  Data from other IO-Link devices that are already configured (VendorID and DeviceID do not correspond to the configured device) are overwritten.
- At each further start the IO-Link master uses a checksum to check whether the data in the parameter server correspond to those on the IO-Link device and if necessary downloads them to the device.
- If the parameters change during the device runtime, this can be reported to the Master via the store button [▶ 49] (ParamDownloadStore [▶ 50]). The master then starts the parameter server with an upload.
- By default the event is not set each time the parameters are written, therefore the end of the parameterization procedure has to be reported to the IO-Link device via the store button [▶ 49] (ParamDownloadStore [▶ 50]).
  The IO-Link device then sends the corresponding event to the master. The data are loaded into the parameter server.
- In the case of a pre-programmed IO-Link device, no download takes place from the parameter server to the device.

3.5 Data transfer rate

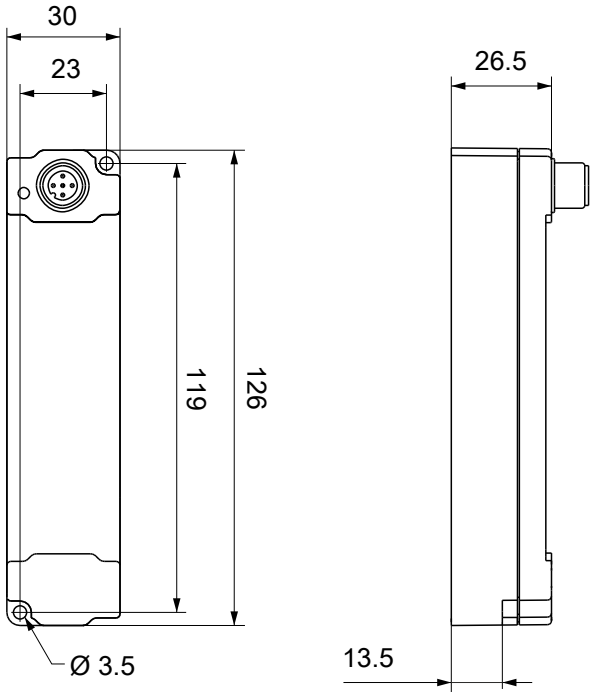
An IO-Link master according to specification V1.1 supports all three transmission methods and automatically adjusts the baud rate to that of the IO-Link device.
An IO-Link device usually supports only one baud rate. IO-Link devices with different baud rates can be connected to the various ports of the master.

- COM1 = 4.8 kbaud
- COM2 = 38.4 kbaud
- COM3 = 230.4 kbaud

4 Mounting and connection

4.1 Mounting

4.1.1 Dimensions



All dimensions are given in millimeters.
The drawing is not true to scale.

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two mounting holes Ø 3.5 mm for M3
Metal parts	brass, nickel-plated
Contacts	CuZn, gold-plated
Installation position	variable
Protection class	IP65, IP66, IP67 (conforms to EN 60529) when screwed together
Dimensions (H x W x D)	approx. 126 x 30 x 26.5 mm (without connectors)

4.1.2 Fixing

Protect connectors against soiling

Protect all connections from contamination during module installation! Protection class IP65 can only be guaranteed if all cables and connectors are connected! Unused connections must be protected with the appropriate connectors! Connector sets see catalog.

Modules with narrow housing are installed with two M3 screws.
Modules with wide housing are installed with two M3 screws in the mounting holes in the corners or two M4 screws in the central fastening holes.

The bolts must be longer than 15 mm. The fastening holes in the modules have no thread.

Note when mounting that the overall height is increased further by the fieldbus connections. See the Accessories section.

Mounting Rail ZS5300-0001

The mounting rail ZS5300-0001 (500 mm x 129 mm) allows the time saving assembly of modules.

The rail is made of stainless steel, 1.5 mm thick, with already pre-made M3 threads for the modules. The rail has got 5.3 mm slots to mount it via M5 screws to the machine.

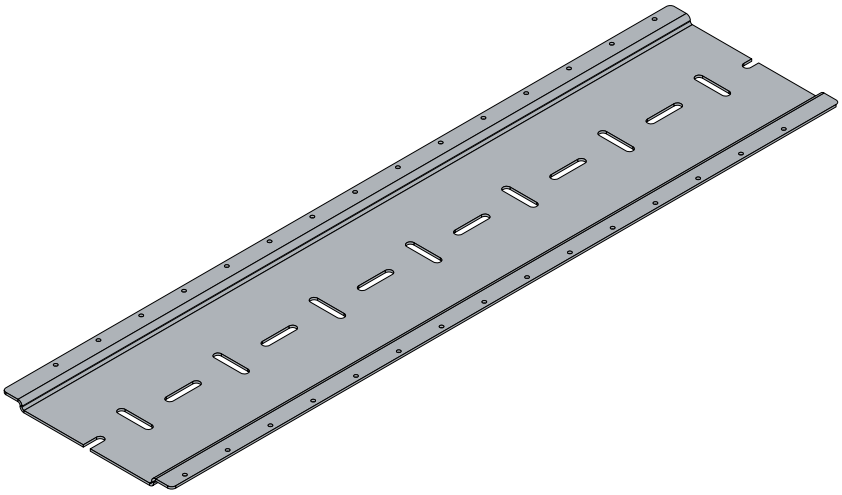


Fig. 3: Mounting Rail ZS5300-000

The mounting rail is 500 mm long, that way 15 narrow modules can be mounted with a distance of 2 mm between two modules. The rail can be cut to length for the application.

Mounting Rail ZS5300-0011

The mounting rail ZS5300-0011 (500 mm x 129 mm) has in addition to the M3 treads also pre-made M4 treads to fix 60 mm wide modules via their middle holes.

Up to 14 narrow or 7 wide modules may be mixed mounted.

4.1.3 Tightening torques for plug connectors

Screw M12 connectors tight with a torque wrench. (e.g. ZB8801 from Beckhoff)
Torque: 0.6 Nm.

4.2 IO-Link connection

4.2.1 IO-Link master connection

IO-Link interface

The IO-Link specification defines various IO-Link pin assignment, which are described in the following section.

The switching and communication line is marked with (C/Q).

Port Class A (type A): The function of pin 2 and pin 5 is not preset. The vendor can assign an additional digital channel to pin 2. Port Class B (type B): Pin 2 and Pin 5 are used for an additional power supply. The information regarding the pin assignment of your module can be found in the chapter "Introduction".

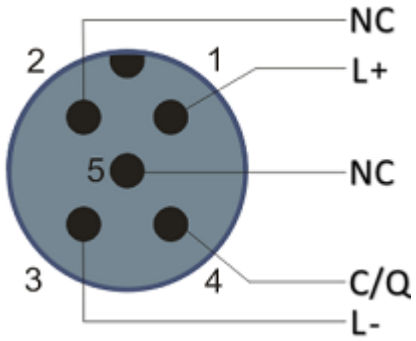


Fig. 4: Pin assignment Port Class A, Pin 2 not connected

In the case of Class A modules an additional digital input or output (I/Q) can be connected to Pin 2.

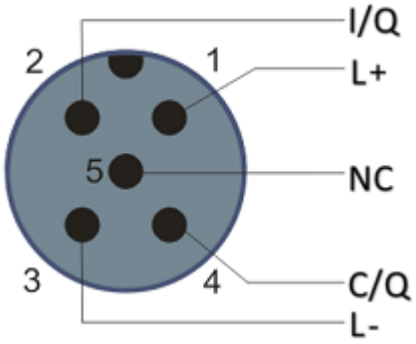


Fig. 5: Pin assignment Port Class A, Pin 2 connected

Port Class B (type B): For devices with higher current demand, an additional power supply is provided via pin 2 and pin 5.

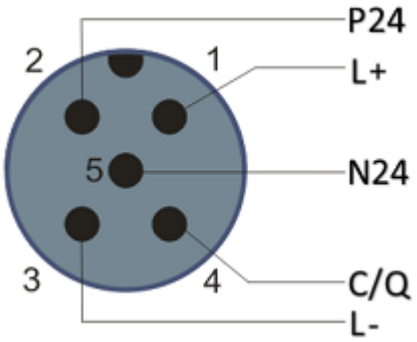


Fig. 6: Pin assignment Port Class B

The IO-Link master (EP622x-xxxx) has an A-coded M12 socket for the outgoing IO-Link connection.

Fig. 7: IO-Link connection, master

Wire colors

The wire colors of the IO-Link cable with corresponding pin assignment of the IO-Link connector:

Pin	Wire color
1	brown
2	white
3	blue
4	black
5	grey

IO-Link cable

Fig. 8: Example IO-Link cable: male to female

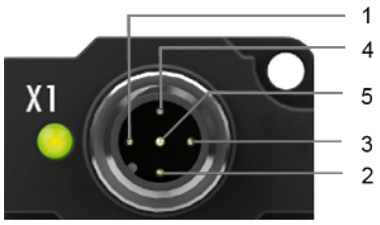
The cables available from Beckhoff for the IO-Link system can be found in the chapter Accessories [▶ 79].

IO-Link cable

A 3-core IO-Link cable may be sufficient for Class A masters/devices from Beckhoff. A Class B master/device requires a 5-wire IO-Link cable.

4.2.2 Connection IO-Link Device

The IO-Link box (EPIxxxx,ERIxxxx) has an A-coded M12 connector for the incoming IO-Link connection.



IO-Link connection, Device (narrow housing)

IO-Link connection, Device (wide housing)

4.2.3 IO-Link status LED

IO-Link Device status LED (narrow housing)

IO-Link Device status LED (wide housing)

LED display

LED	Display	Meaning
IO-Link status LED (X1)	off	IO-Link communication inactive
	flashes green (1Hz)	IO-Link communication active
	red illuminated	Short circuit on C/Q line or overheating

4.3 Status LEDs for power supply

The IO-Link module contains 2 diagnostic LEDs for the power supply and a Diagnostic object (0x0A00) for more accurate diagnosis. The description of the diagnostic parameters (Index 0x0A00 [▶ 76]) is described in the section Object description and parameterization.

Fig. 9: Status LEDs for power supply

LED display

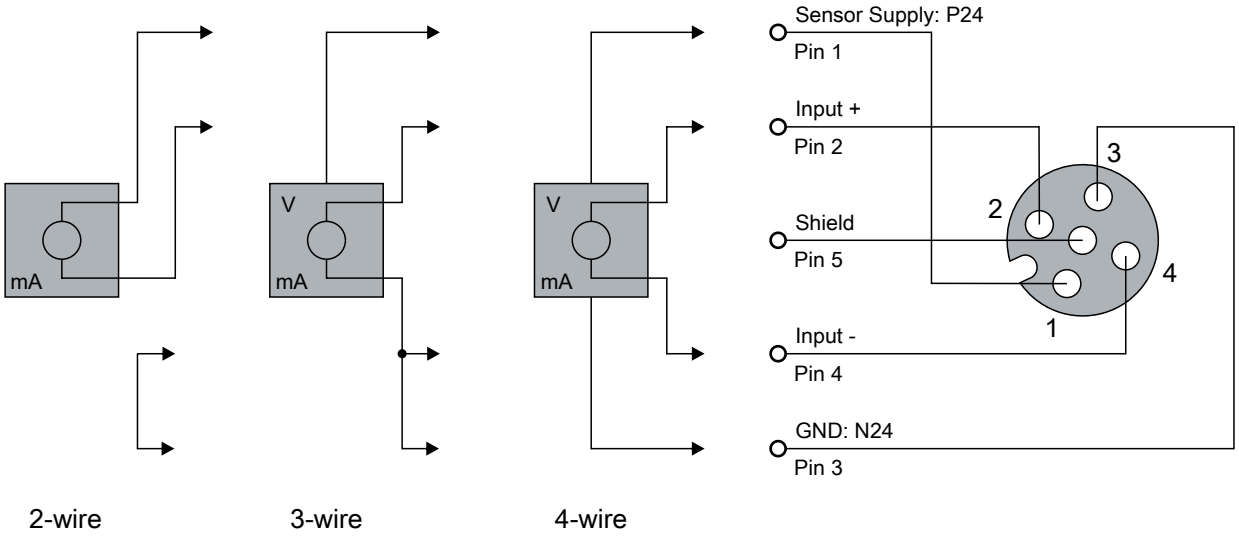
LED	Display	Meaning
24 V	off	Voltage L_+ non-existent
	green	voltage L_+ ok
	red	Voltage L_+ too low
right LED	green	Voltage P24 ok
	off	Voltage P24 too low, short-circuit

4.4 Signal connection

Analog inputs

M12 sockets X01 and X02.

There is one analog input per M12 socket. The input can measure either voltage or current. The measuring ranges can be found in the chapter Technical data [▶ 10].



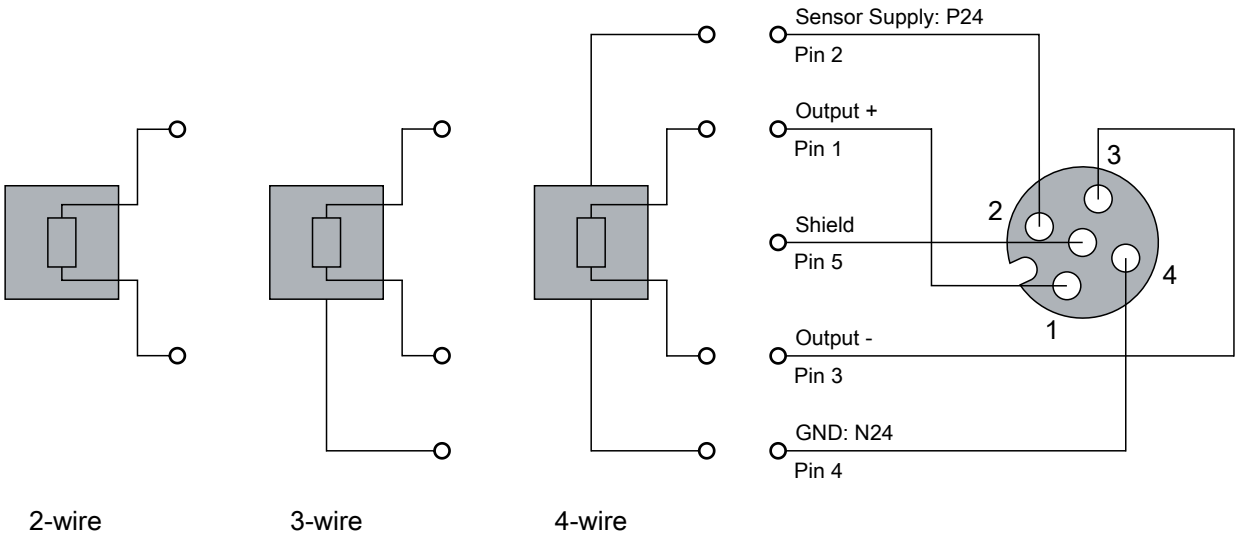
2-wire 3-wire 4-wire

The sensor is connected via Input+ and Input-. The sensor can optionally be operated/supplied with 24 V_{DC}.

Analog outputs

M12 sockets X03 and X04.

There is one analog output per M12 socket. The output can output either voltage or current. The measuring ranges can be found in the chapter Technical data [▶ 10].



2-wire 3-wire 4-wire

The actuator is connected via output +/- and output GND. The actuator can optionally be operated/supplied with 24 V_{DC}.

Status LEDs at M12 connections (inputs and outputs)

Fig. 10: EPIxxxx-0002 - signal connection

Status LEDs at M12 connections 1 and 2 (inputs)			
Connection	**LED**	**Display**	**Meaning**
M12 socket 1 and 2	R left	off	No data transfer to the A/D converter
		green	Data transfer to A/D converter
	E right	off	Function OK
		red	Error: Open circuit or measured value outside of the measuring range (smaller than 3.5 mA/-11 V or larger than 21 mA/11 V)

Correct function is indicated if the green Run LED is on and the red Error LED is off.

Status LEDs at M12 connections 3 and 4 (outputs)			
Connection	**LED**	**Display**	**Meaning**
M12 socket 3 and 4	R left	off	No data transfer to the D/A converter
		green	Data transfer to the D/A converter

4.5 UL Requirements

The installation of the EtherCAT Box Modules certified by UL has to meet the following requirements.

Supply voltage

⚠ CAUTION

CAUTION!

This UL requirements are valid for all supply voltages of all marked EtherCAT Box Modules!
For the compliance of the UL requirements the EtherCAT Box Modules should only be supplied

- by a 24 V_{DC} supply voltage, supplied by an isolating source and protected by means of a fuse (in accordance with UL248), rated maximum 4 Amp, or
- by a 24 V_{DC} power source, that has to satisfy *NEC class 2*.
  A *NEC class 2* power supply shall not be connected in series or parallel with another (class 2) power source!

⚠ CAUTION

CAUTION!

To meet the UL requirements, the EtherCAT Box Modules must not be connected to unlimited power sources!

Networks

⚠ CAUTION

CAUTION!

To meet the UL requirements, EtherCAT Box Modules must not be connected to telecommunication networks!

Ambient temperature range

⚠ CAUTION

CAUTION!

To meet the UL requirements, EtherCAT Box Modules has to be operated only at an ambient temperature range of -25 °C to +55 °C!

Marking for UL

All EtherCAT Box Modules certified by UL (Underwriters Laboratories) are marked with the following label.

Fig. 11: UL label

4.6 Cabling

A list of EtherCAT cables, power cables, sensor cables, IO-Link cables, Ethernet/EtherCAT connectors and field-configurable connectors can be found in the chapter Accessories [▶ 79].

IO-Link cable

The IO-Link master is connected to the IO-Link device by an unshielded 3, 4 or 5-core (type A) or 5-core (type B) cable with a maximum length of 20 m. The IO-Link cables are available as straight and angled versions. Further information about the IO-Link connection can be found under: IO-Link master connection [▶ 20]

Fig. 12: Example IO-Link cable: male to female

Sensor cable

Fig. 13: Selection of sensor cables available from Beckhoff

4.7 Disposal

Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

5 Commissioning and configuration

5.1 Configuration of the IO link master

EtherCAT XML device description and configuration files

The display matches that of the CoE objects from the EtherCAT XML Device Description. We recommend downloading the latest XML file from the download area of the Beckhoff website and installing it according to installation instructions.

When adding the IO-Link master (see chapter Integrating into a TwinCAT project) in the TwinCAT System Manager, an additional tab called "IO-Link" is created (fig. *IO-Link tab*). A detailed description can be found in chapter Configuration of the IO-Link devices [▶ 29]

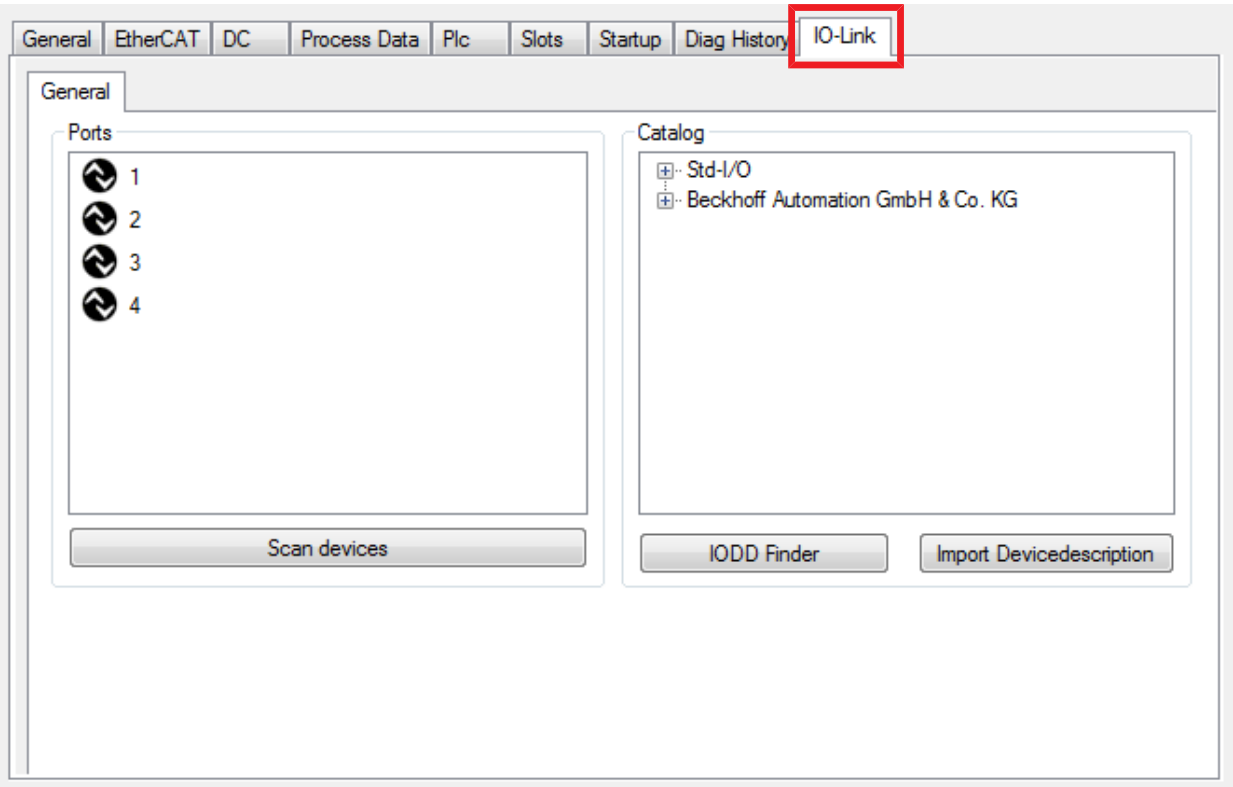


Fig. 14: "IO Link" tab

IO-Link Extension

If the tab “IO-Link” is not displayed, the associated System Manager extension is missing. The System Manager extension is required for TwinCAT version 2.10, build 1325 to 1330.

- If your System Manager version or TwinCAT3 does not yet provide this support, it can be installed later if necessary. Please contact our Support [▶ 80].

5.2 Configuration of the IO-Link devices

The configuration of the IO link devices is carried out in the IO link configuration tool. Configure the IO link device as described below.

✓ Requirement: an IO-Link master has been added in the Solution Explorer under the "I/O" entry.

1. Open the IO link configuration tool [▶ 29].
2. Import the IODD file of the IO link device [▶ 33].
3. Assign devices to ports.
   ⇨ Assign a device to a port [▶ 30].
   ⇨ Configure a port as digital in- or output [▶ 33].
4. Remove a device from a port [▶ 39].
5. Activate the IO link configuration [▶ 40], so that changes become effective.

5.2.1 Open the IO link configuration tool

✓ Requirement: an IO-Link master has been added in the Solution Explorer under the "I/O" entry.

1. Double-click on the IO-Link master.
   ⇨ A device editor for the IO-Link master opens.
2. Click on the "IO-Link" tab.
   ⇨ The IO-Link configuration tool opens. The configuration tool contains two fields:

- „Ports“
  The left-hand field "Ports" shows a list of the ports of the IO-Link master. If a device has been assigned to a port, the device designation is shown next to the port.
- „Catalog“
  The right-hand field "Catalog" shows the device catalog.
  The device catalog contains an alphabetically sorted list of the IO-Link devices for which a device description (IODD) exists in the local TwinCAT installation.
  The IODDs for the EPIxxxx, ERIxxxx IO-Link Box modules from Beckhoff can be downloaded via the Download finder. The downloaded zip file contains the IODD device description files for the Beckhoff EPIxxxx, ERIxxxx IO-Link Box modules.

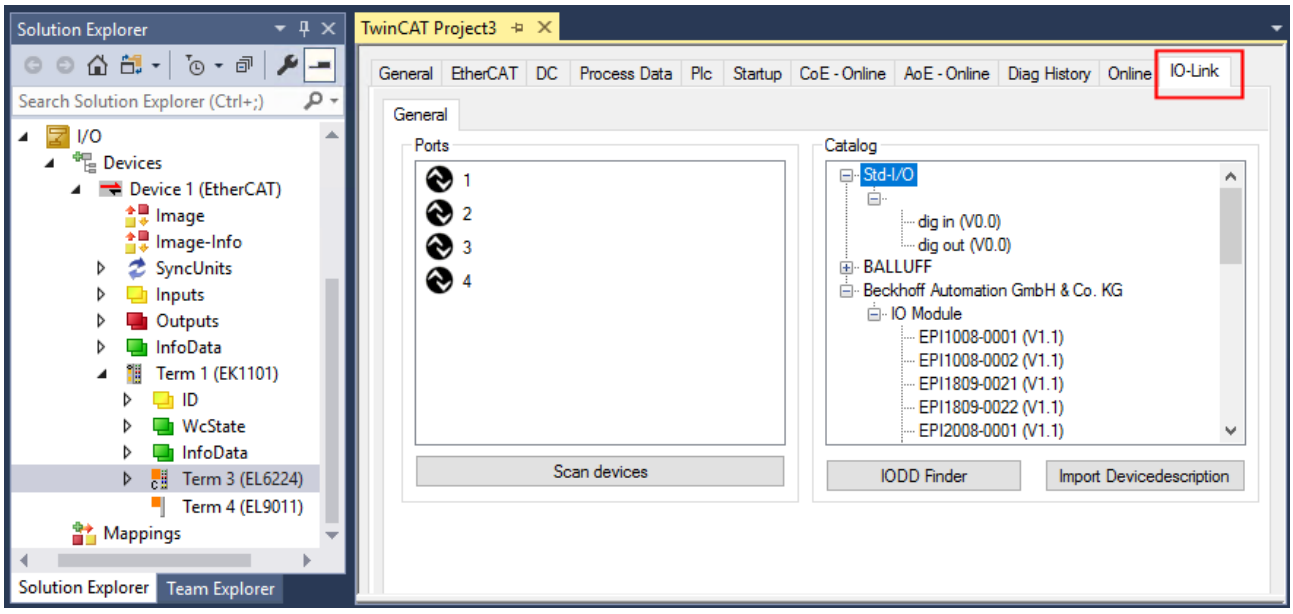


Fig. 15: IO-Link configuration tool

5.2.2 Integrating IO-Link devices

The integration of the IODD file should always be the first step, since this enables the breakdown of the individual process data of the IO-Link devices as well as the display of the parameters.

There are several ways of integrating an IO-Link device:

1. Importing the IODD file (offline and online) via
   - ⇨ button Import Devicedescription [▶ 31] (A) or
   - ⇨ button IODD Finder [▶ 31] (B)
2. Select the device in the "Catalog" field and assign it to a port [▶ 33].
3. Automatic scanning of the IO-Link ports (online) via
   - ⇨ button Scan devices [▶ 34] (C)
4. Manual insertion (offline and online) via
   - ⇨ menu Create Device [▶ 38] (D)

Application note

- If the IODD is not available,
  the IO-Link device should be integrated online by scanning.
- Manual integration of the IO-Link devices via “Create Device” should only be carried out if the IODD of the vendor and the IO-Link device are not available at the time of project creation.

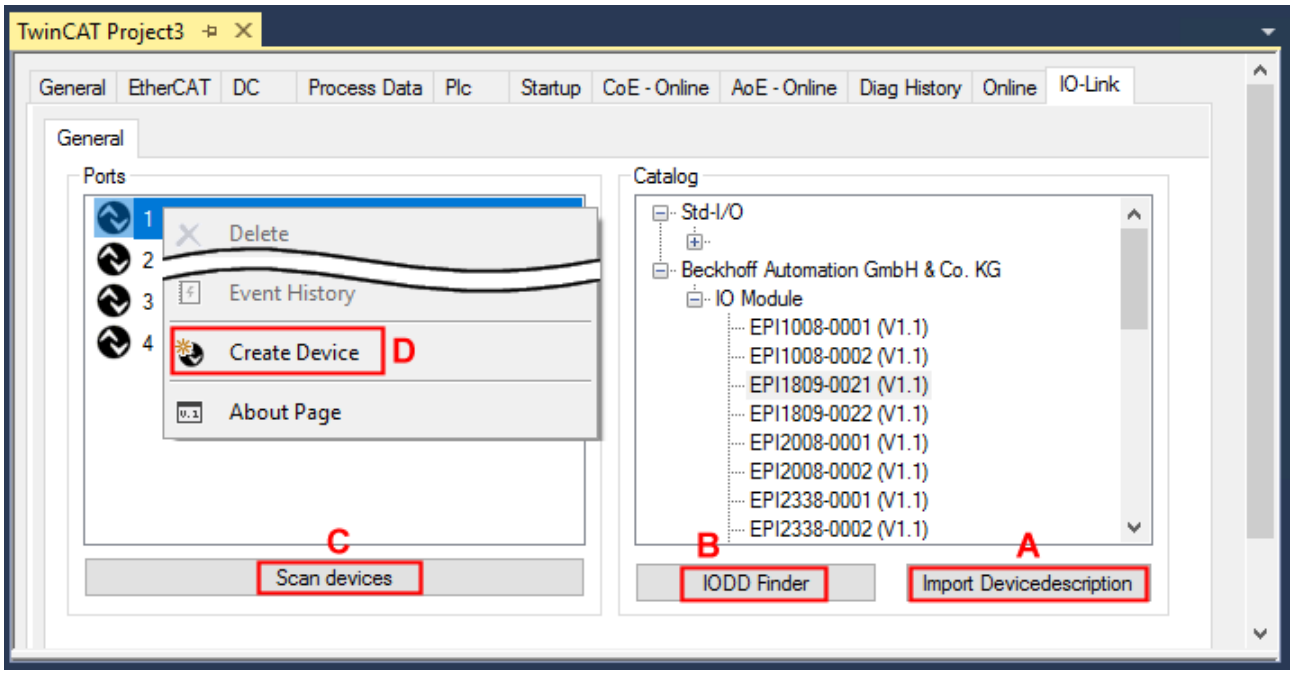


Fig. 16: Creating IO-Link devices

5.2.2.1 1. Importing the device description IODD

Importing the device description simplifies the integration of the IO-Link devices. The individual process data are broken down, enabling simple parameterization of the sensor. The IODD only needs to be imported during the initial commissioning of a new IO-Link device. The import is port-independent. Proceed as follows to import the IODD:

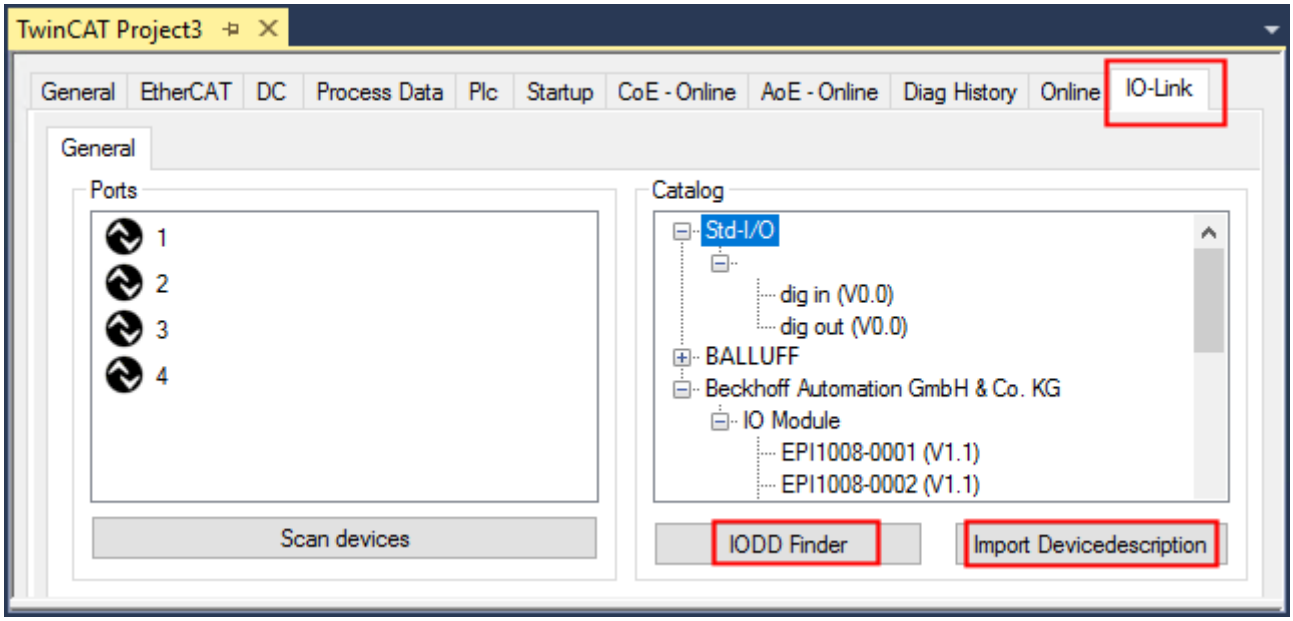


Fig. 17: Import of the IODD device description via “IODD Finder” or “Import Devicedescription”

Button "Import Devicedescription“

1. Press the “Import Devicedescription” button in the “IO-Link” tab
2. Select the .xml file of the desired sensor.
3. After pressing the Open button, the imported files are stored in the following folder:
   - for TwinCAT 2.x: \TwinCAT\IO\IOLink
   - for TwinCAT 3.x: \TwinCAT\3.X\Config\IO\IOLink.

⇨ The imported device descriptions are listed in a tree structure in the “Catalog” field, sorted by vendor.

No manual copying of the XML files

Do not copy the files directly into the folder; read them in via *Import Devicedescription* instead! Important checks will otherwise be bypassed!

Button "IODD Finder“

1. Press the “IODD Finder” button in the “IO-Link” tab
2. Searching for the desired IO-Link sensor/device by entering them in the search mask; see the figure below (1)
3. Selecting the desired IO-Link sensor/device. Move the mouse pointer over the figure of the desired IO-Link sensor/device. A blue download icon appears, see the following figure (2).

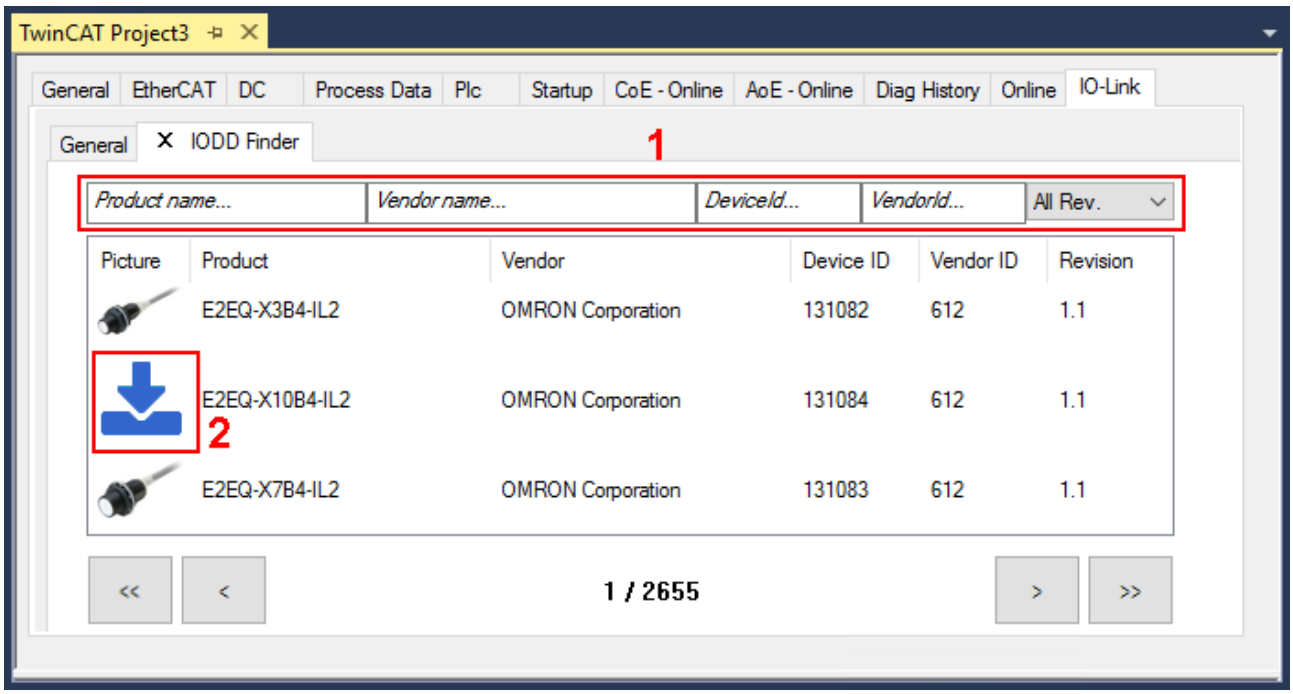


Fig. 18: IODD Finder, selection and import of the .xml-file

4. After clicking the download symbol, the .xml file of the selected IO-Link sensor/device is imported and stored in the following folder:
   - for TwinCAT 2.x: \TwinCAT\IO\IOLink
   - for TwinCAT 3.x: \TwinCAT\3.X\Config\IO\IOLink
5. When moving the mouse pointer over the IO-Link sensor/device, a green icon now indicates (see the following figure (3)) that the .xml file already exists.

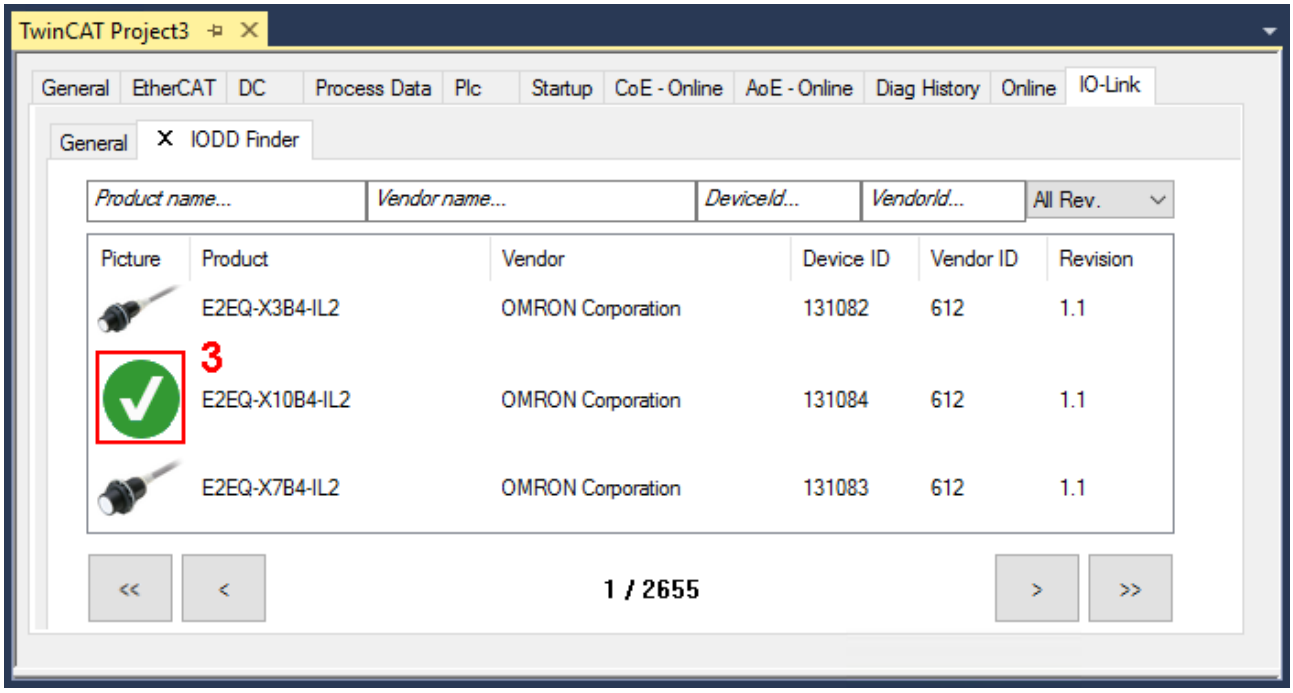


Fig. 19: IODD Finder, display of an already imported device description

⇨ The imported device descriptions are listed in a tree structure in the “Catalog” field of the IO-Link tab, sorted by vendor.

5.2.2.2 2. Assigning IO-Link device to port n

Online configuration

✓ Requirement: The IO-Link device is connected.

1. Press the button Scan devices (see chapter Automatic scanning [▶ 34])

⇨ The device is automatically detected and created with the corresponding parameters. If several devices are stored in the IODD file, the first entry is always selected here. Grouping in the IODD is usually carried out by the vendor if the process data are the same and there are only mechanical differences (e.g. other material).

Offline configuration

The *Catalog* field shows the IO-Link device catalog, which lists the already imported device descriptions in a tree structure, sorted by vendor.

1. Select the desired IO-Link device from the *Catalog* field
   - via drag and drop or
   - by right-clicking on the product with "Add to Port n".

Activating the configuration

2. Activate the IO link configuration [▶ 40], so that changes become effective.

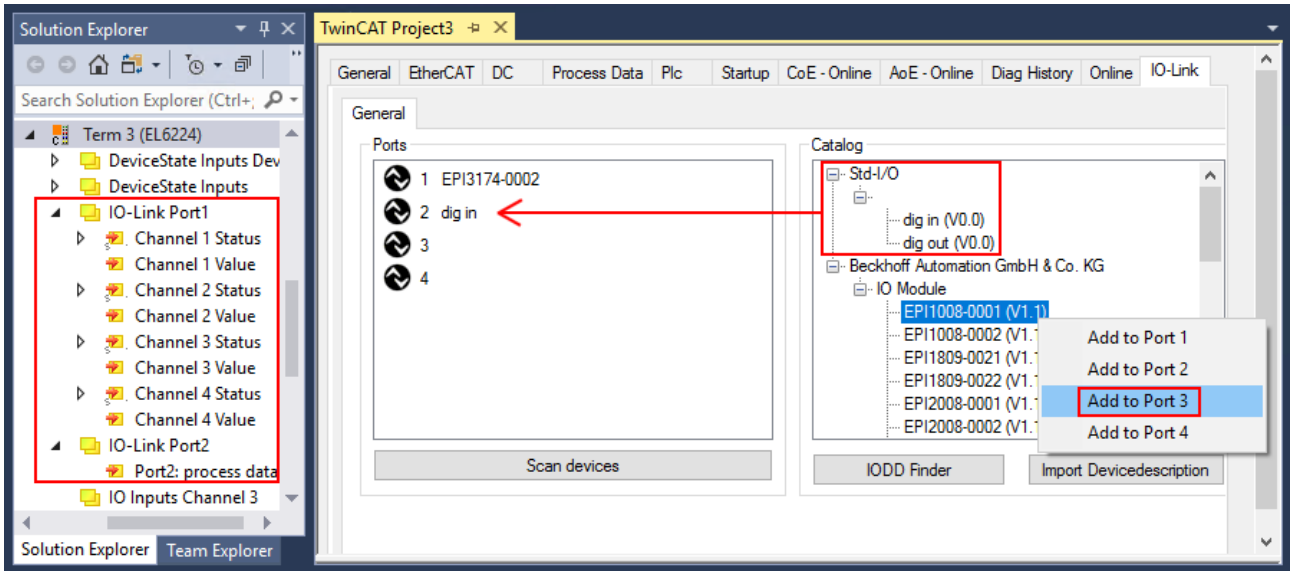
⇨ The IO-Link devices are displayed, and the process data are created. If an error is found when integrating the IO-Link device, e.g. wrong VendorID or no device connected, then this is indicated via the status of the port (object state Ch.n 0xF100:0n).

Configuration of the IO-Link ports as digital in- or output

IO-Link ports can also be configured as digital inputs or digital outputs. This allows digital sensors and actuators having no IO-Link functionality to be connected to IO-Link ports.

1. Expand the "Std-I/O" tree node in the "Catalog" field.
   ⇨ The operating modes "dig in" and "dig out" appear.
2. Configure the desired port. There are two ways to do this:
   - Drag-and-drop: pull "dig in" or "dig out" onto the port in the "Ports" field or
   - Right-click on "dig in" or "dig out" and click on "Add to Port n“.

Example of port assignment on the IO link master EL6224



Port1:
EPI3174-0002 is assigned

Port2:
is configured as digital input

Port3:
EPI1008-0001 will be assigned

Process data of Port1 and Port2 are displayed in the Solution Explorer.

5.2.2.3 3. Automatic scanning of the IO-Link ports

This part of the documentation describes the configuration of the physically available IO-Link devices in TwinCAT.

During automatic scanning of the IO-Link ports, the steps “WakeUp pulse”, “Baud rate setting”, “Reading of the communication parameters”, plus “Parameter server” and “Cyclic data exchange”, if applicable, are performed, see Establishing the IO-Link communication [▶ 16]. The corresponding IO-Link device must be connected to the IO-Link port for this.

The connected devices are automatically detected, configured and a search is performed for the associated IODD.

Finding connected IO-Link devices

✓ Requirement: the master and the devices are cabled and supplied with voltage.

1. Click on the “Scan devices” button (see the following figure).

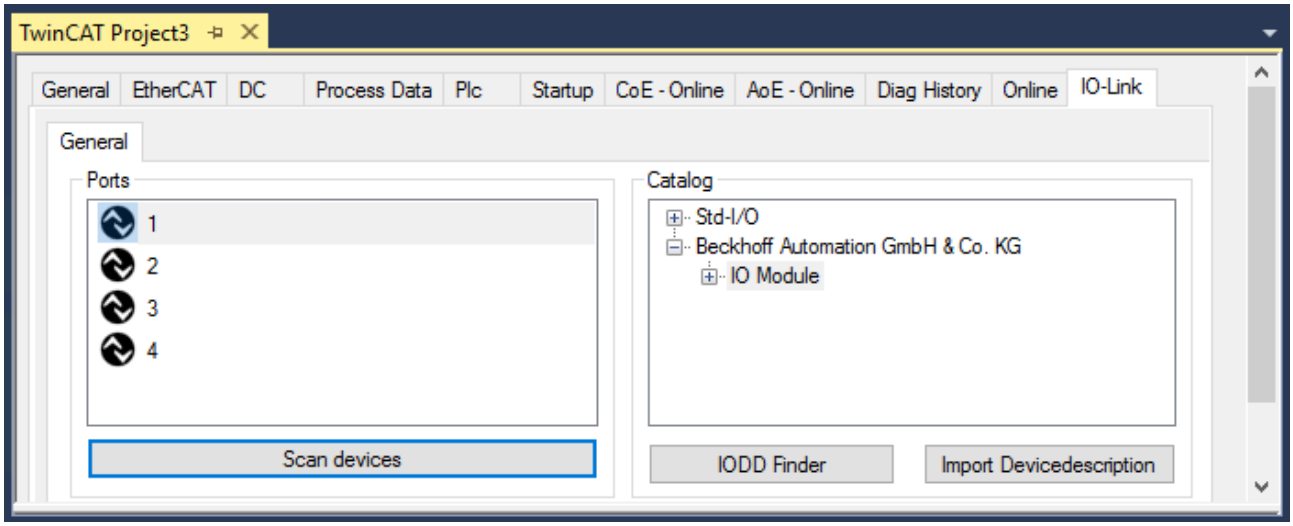


Fig. 20: Scan devices

⇨ The connected IO-Link devices can be found.

⇨ The information window lists the connected device for each of the four ports. Only port2 of the master is assigned an IO-Link device.

⇨ Confirm with the *OK* button.

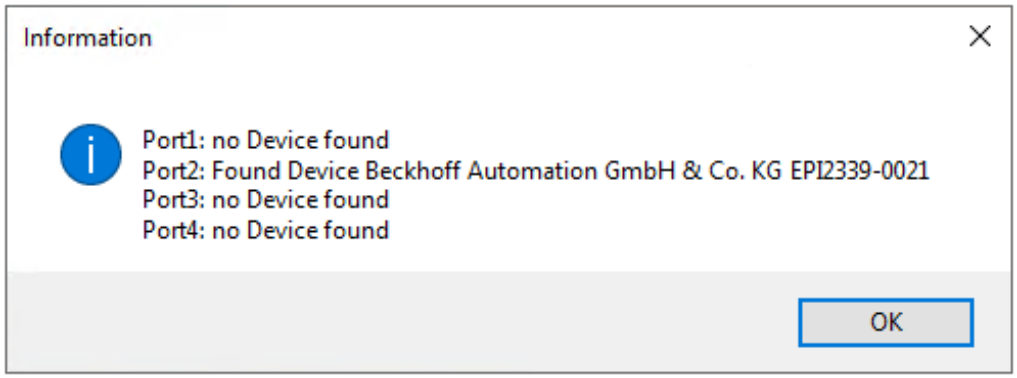


Fig. 21: Information “Scan devices”

2. To be able to work with the devices, the button “Reload Devices” must be clicked. 

The IO-Link devices are now entered in the *General* display. The Port2 “Details” field displays information about the connected device. Additionally the tabs Settings [▶ 36] and Parameter [▶ 37] can be opened.

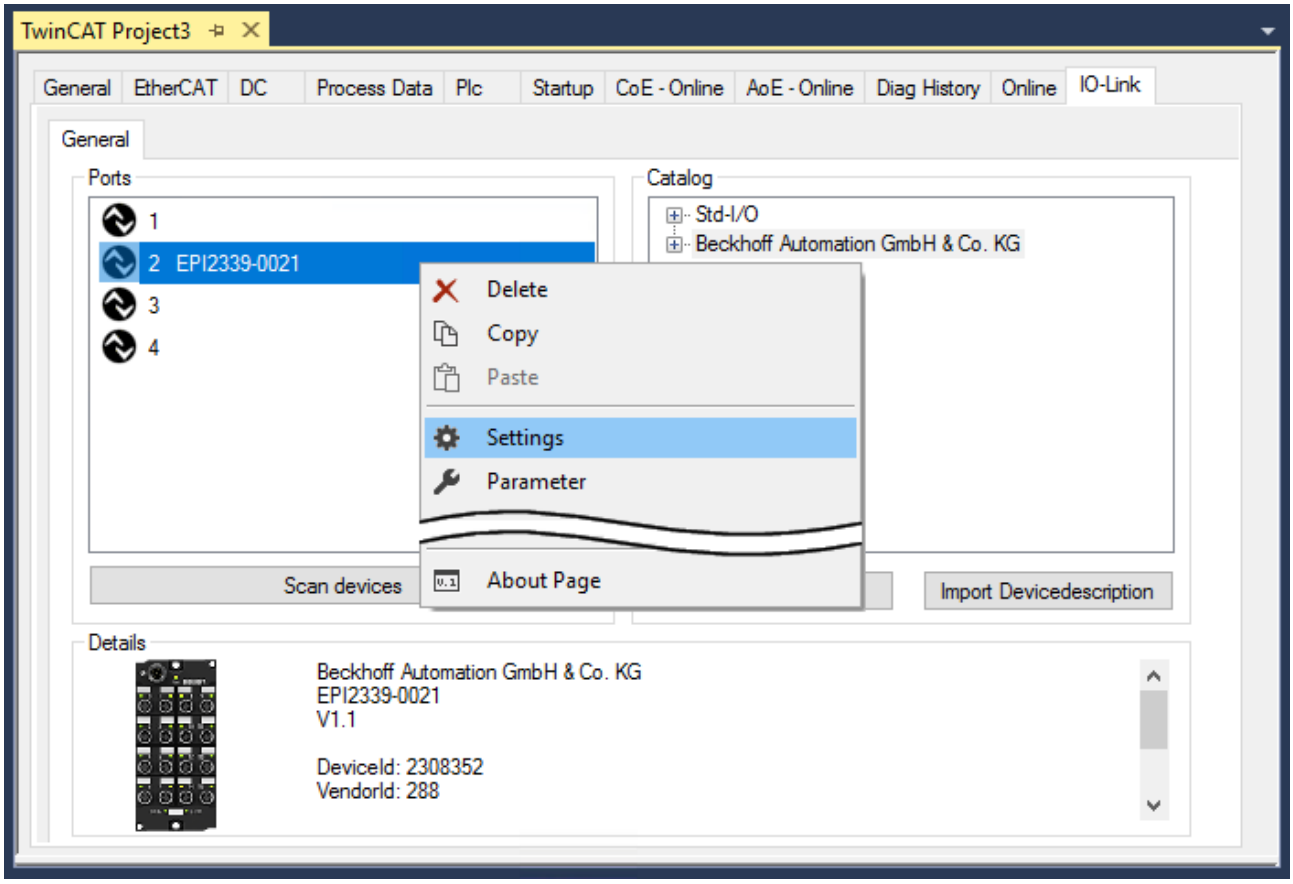


Fig. 22: Device at Port2, Display “Details”, open tabs “Settings” and “Parameter”

Show settings of the device

3. Right-click on port2, to display more details in dialog “Settings”.
4. If necessary, change the settings as described in chapter Settings of the IO-Link devices [▶ 41].

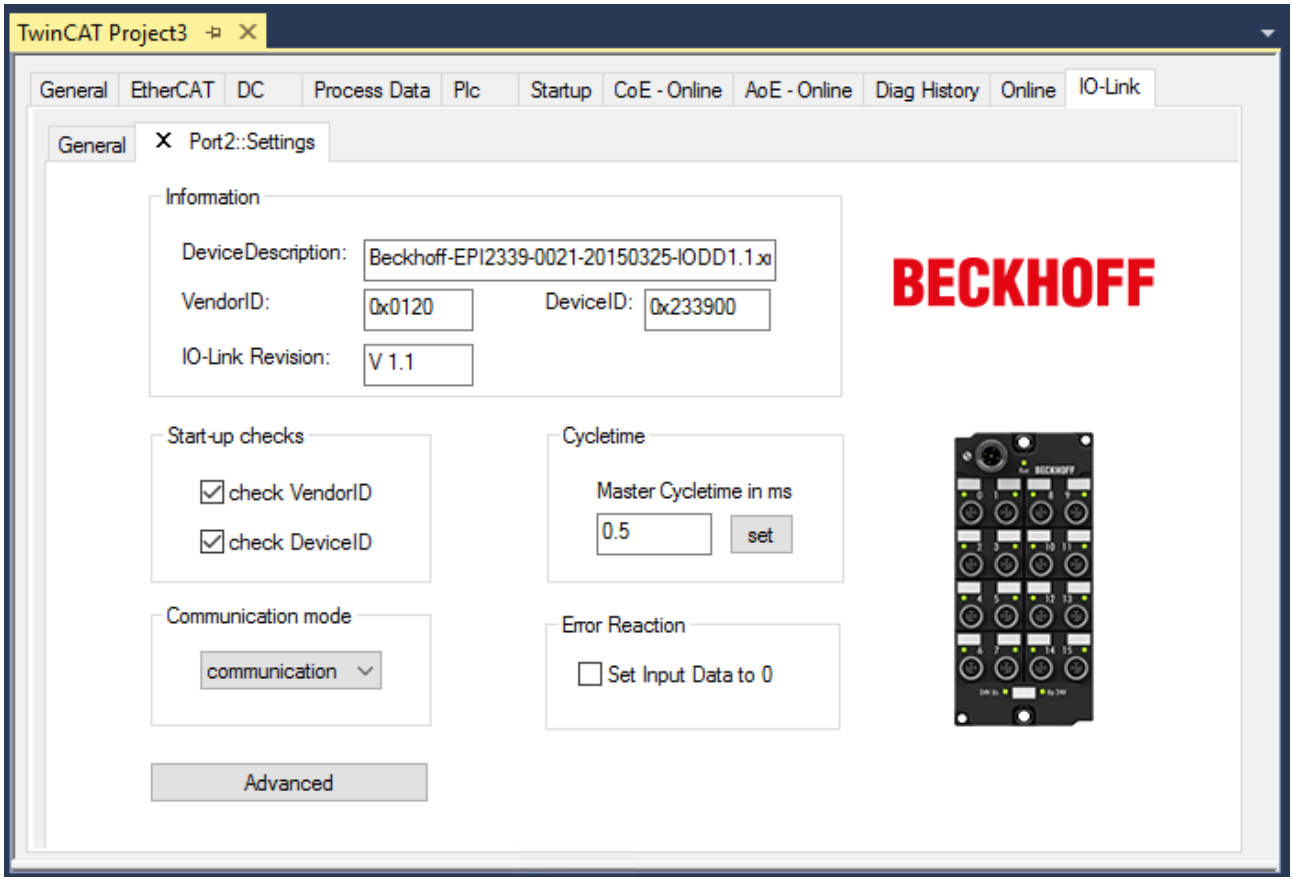


Fig. 23: Settings of the device assigned to port2

Show parameters of the device

5. Open the Parameter tab via
   - double-click on Port2 or
   - richt-click on Port2 and select “Parameter” in the menu.

   ⇨ The Parameters of of the respective IO link device are listed.
6. Parameterize the device as described in chapter EPIxxxx, ERIxxxx - Setting of the IO-Link device parameters [▶ 43].

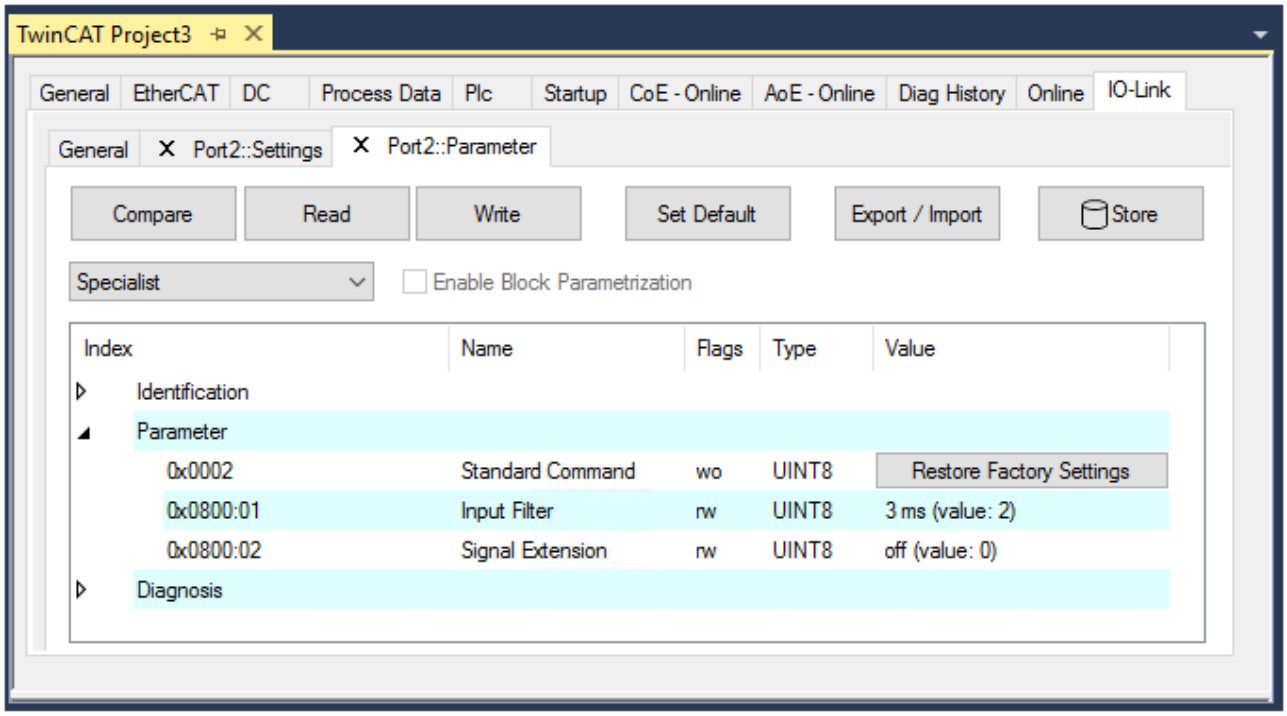


Fig. 24: Parameter of the device assigned to port2

5.2.2.4 4. Manual insertion via Create Device

This part of the documentation describes the manual configuration of the IO-Link devices in TwinCAT.

The manual insertion of the IO-Link device should only be carried out if the IODD from the vendor and the IO-Link device are not available. By saving the project, the settings for the individual ports are saved. The devices that were created are **not** stored in the “Catalog” (see the figure below (A)). To insert the IO-Link devices manually via “Create Device”, proceed as follows:

1. The IODD of the IO link device is already available:
   Select the respective device from the “Catalog” field sorted by manufacturer (see following figure (A)).
2. No IODD is available:
   Add the device can be manually via “Create Device”. These data are **not** saved in the “Catalog” field and must be manually entered for each port.
3. Right-click on the port to open the context menu (see the figure below (B)) and select “Create Device”.
4. In the “Create Device” dialog an IO-Link device with the basic communication parameters can be created. The mandatory fields here are: For Vendor ID, Device ID and process data length see the figure below (C). The values VendorID and DeviceID can be entered both in hexadecimal notation (input format: 0xnnnn) and as decimal numbers (nnnn).
   The communication parameters to be entered can be found in the information provided by the device vendor.
5. If the IO-Link device version is 1.1, then the parameter server is activated by the selection of the check box “Revision V1.1” (see following figure (D)).
6. Activate the IO link configuration [▶ 40], so that changes become effective.

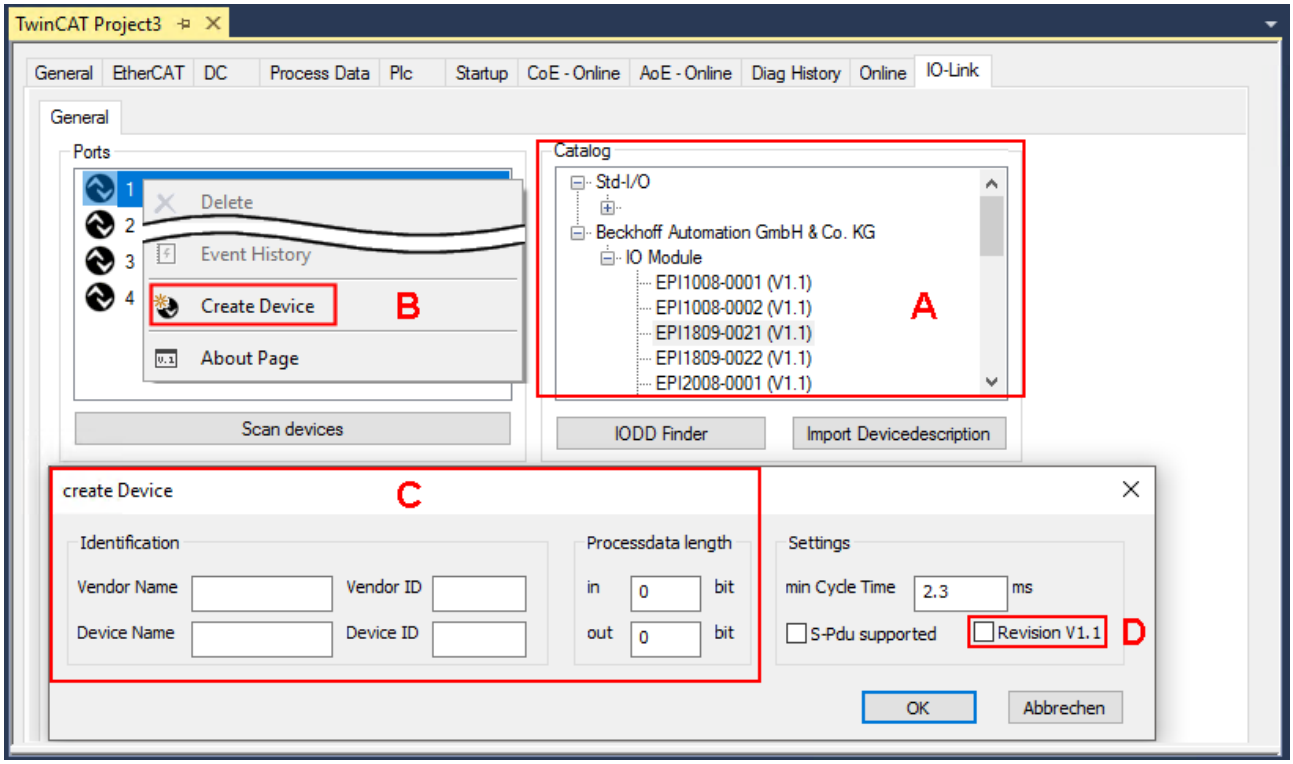


Fig. 25: Manual creation of an IO-Link device via the "Create Device" dialog (C)

Reading the IODD

Even when manually creating and scanning, the IODD should always be read in as well in order to display further sensor-specific information.

7. In the “Settings” tab of the IO link devices further settings can be made as described in chapter Settings of the IO-Link devices [▶ 41].

5.2.3 Removal of IO-Link devices

To remove a device that has already been inserted, proceed as follows.

1. Right-click on the port to open the context menu and select “Delete”.

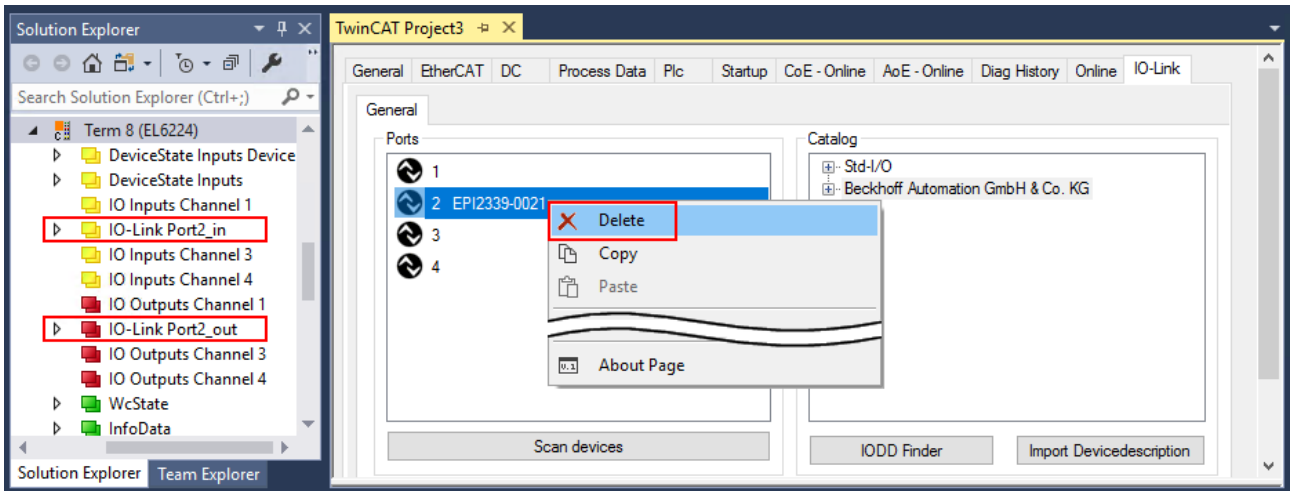


Fig. 26: Remove the device from port2

2. Activate the IO link configuration [▶ 40], so that changes become effective.

⇨ The already create process data are removed.

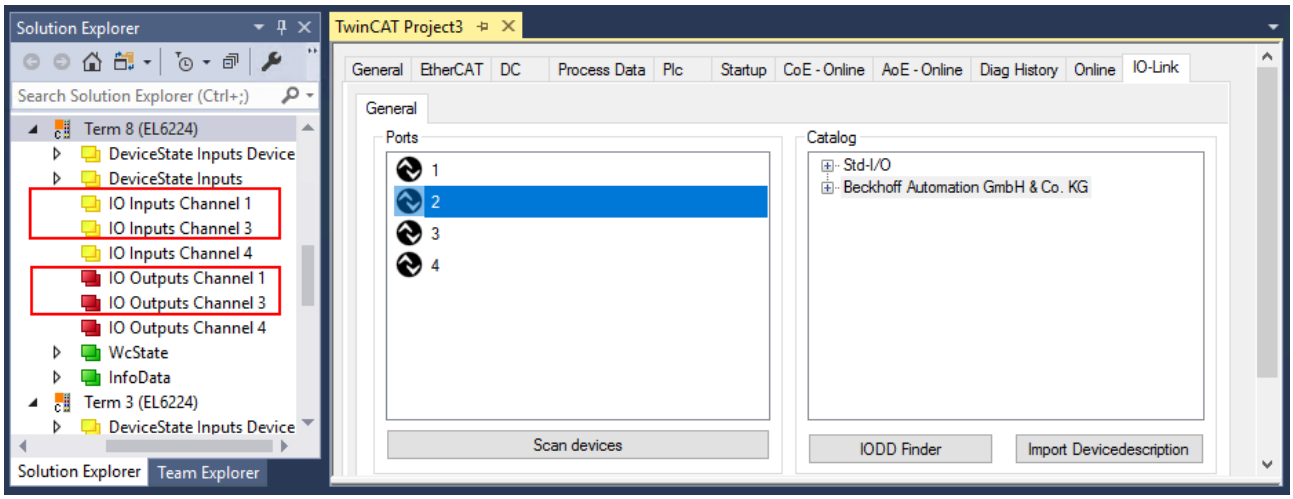


Fig. 27: The device was removed from the port2, the process data no longer displayed in the tree.

5.2.4 Activating the configuration

Changes in the IO-Link configuration tool only become effective when you activate the IO-Link configuration.

There are two ways to activate the IO-Link configuration:

- Click on the "Reload Devices" button

- Activate the TwinCAT configuration:
  Click on the "Activate Configuration" button

5.3 Settings of the IO-Link devices

To find the basic settings of the devices for each port, proceed as follows.

1. right-click on the port to open the context menu and select “Settings”.

⇨ A new tab “Portx:: Settings” opens where the settings described below can be made.

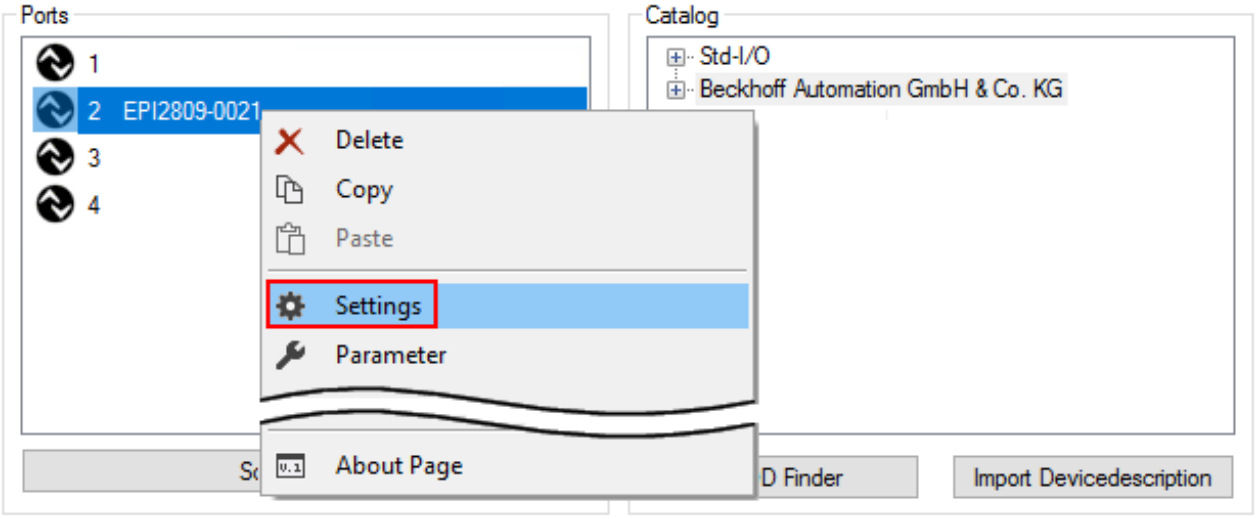


Fig. 28: Context menu - Settings

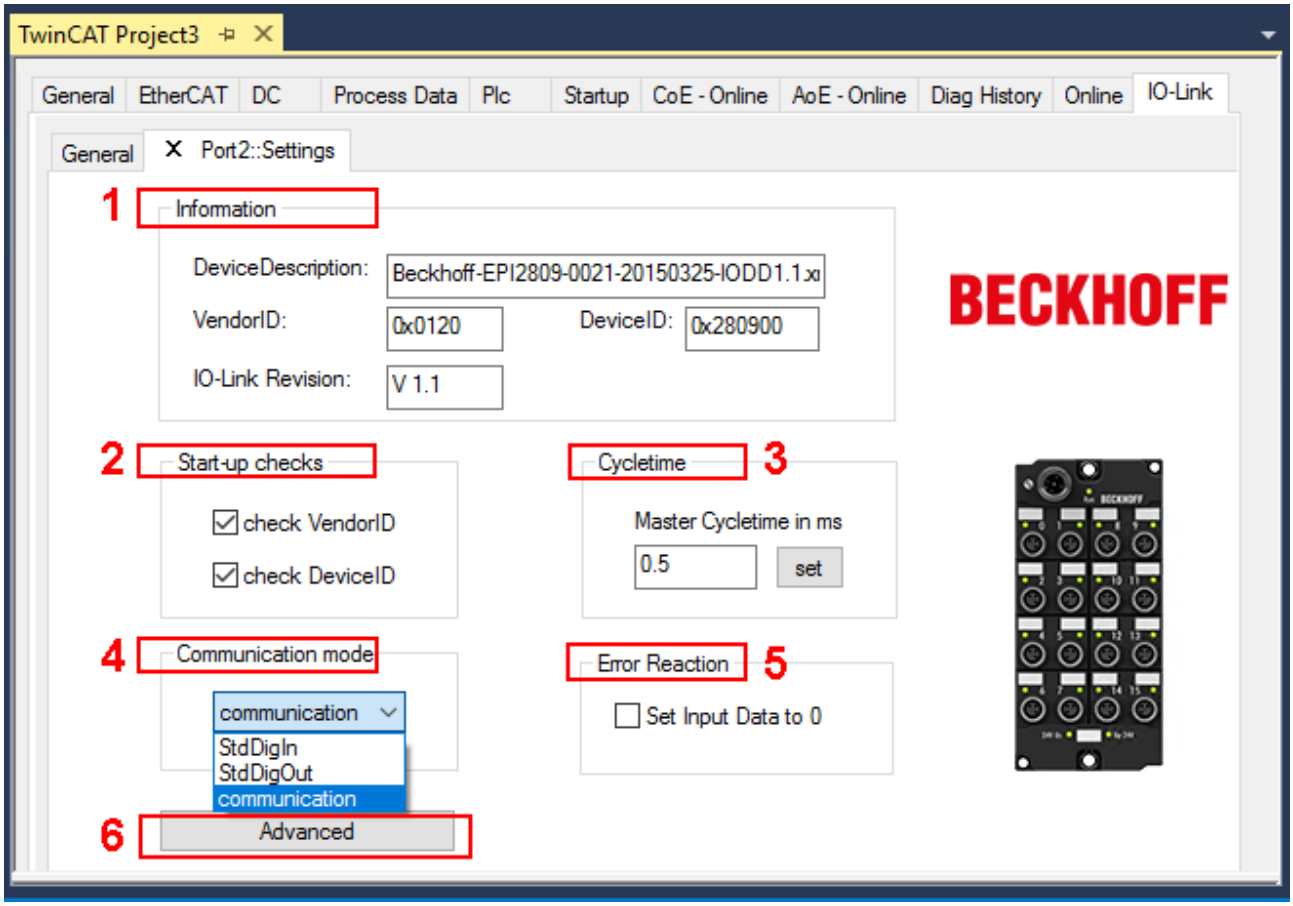
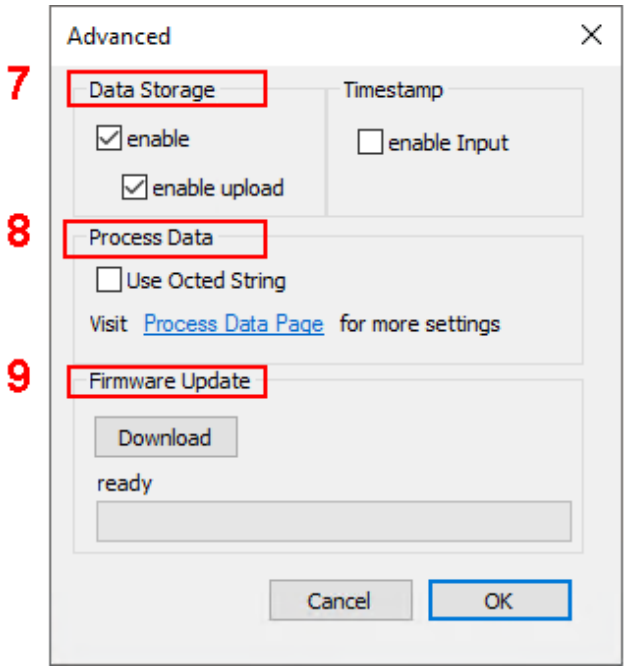


Fig. 29: Settings of the IO-Link devices

1. **Information**
   This field is for information only; the IODD that was read in is displayed under Device Description. Furthermore, the VendorID, DeviceID and the IO-Link revision (V1.0 or V1.1) of the IO-Link devices are displayed. If the device is an IO-Link device V1.1, then the parameter server [▶ 17] function is supported.

The following settings can be made in the settings for the IO-Link devices (see figure above):

2. **Start-up checks**
   This parameter can be used to specify that the Vendor ID and Device ID should be checked when the IO-Link device starts up.
   ⇨ This avoids errors when exchanging IO-Link devices.
3. **CycleTime**
   Specifies the cycle time for the IO-Link master
4. **Communication mode**
   Selection of the mode in which the IO-Link port is to be operated.
   ⇨ “Communication”: Default mode for IO-Link devices
   ⇨ “StdDigIn / StdDigOut”: Mode for non-IO-Link devices, automatically selected if the port is configured as a digital input or output [▶ 33].
5. **Error Reaction**
   If the “Set Input Data to 0” field is activated:
   ⇨ input data are set to 0 in case of error
   ⇨ Status display: “Error”
6. **Button "Advanced"**
7. **Data Storage**
   Pay attention to the sensor version:
   ⇨ V1.0 -> data storage is not supported
   ⇨ V1.1 -> data are stored in the parameter server (preset)
8. **Process Data Format**
   Adaptation of the process data format
   If Field “Use Octet String” is selected
   ⇨ complex data types (process data) are created as octet strings.
   Advantage: simple further processing in the PLC
9. **Firmware Update of the Beckhoff IO-Link devices**
   For a firmware update use the “Download” button.
   Observe the description in the documentation of EPIxxxx boxes in chapter Firmware Update des IO-Link Devices.



5.4 EPIxxxx, ERIxxxx - Setting of the IO-Link device parameters

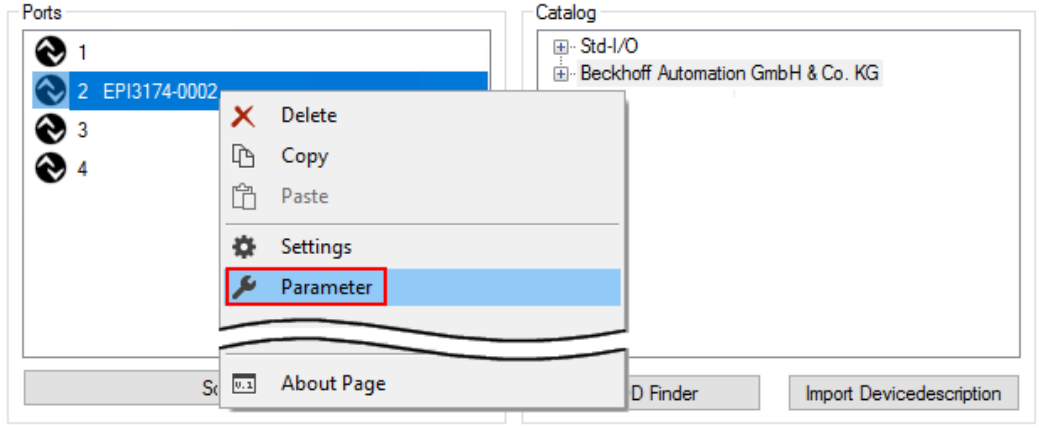
This chapter explains how to read out and set the IO-Link device parameters.

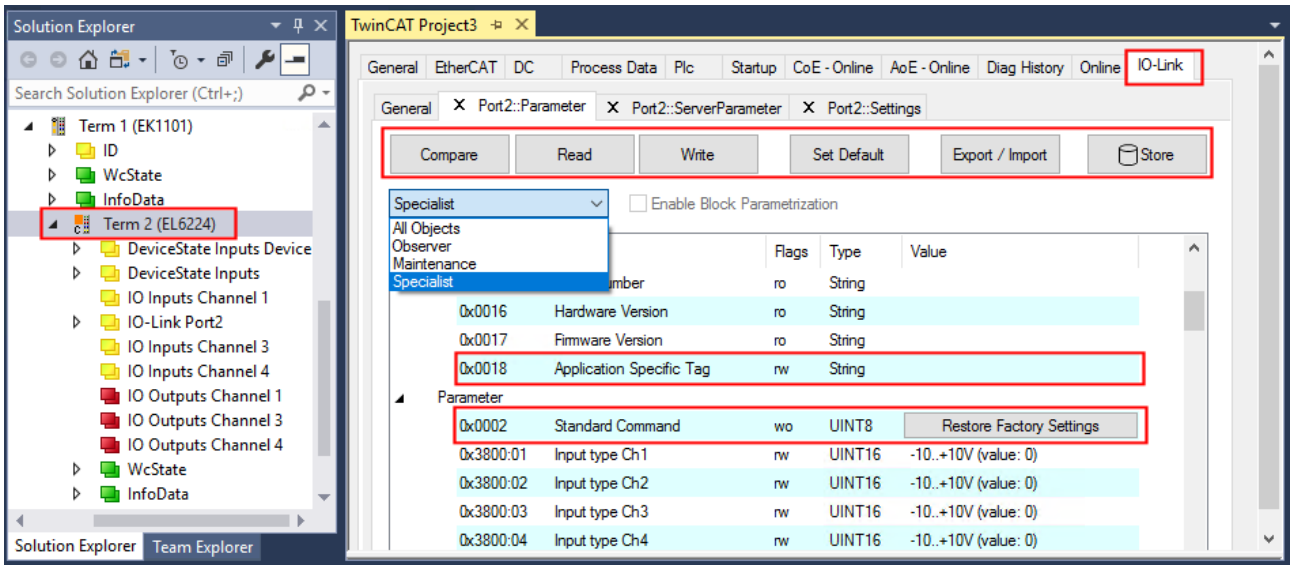
The number and type of the objects shown on the “Parameters” tab vary according to the type of sensor. The default settings as stored in the IODD can initially be seen.

To open the “Parameter” tab

1. Click the IO-Link master in the TwinCAT tree structure.
2. Click the “IO-Link” tab.
3. Select the port to which the IO-Link device is connected,
4. Double-click or by right-click to the port and select “Parameter”.

⇨ The “Parameter” tab is opened.





The device parameters are listed in the tab. The buttons Compare [▶ 44], Read, Write [▶ 46], Set Default [▶ 47], Export/Import [▶ 48] and Store [▶ 49] are located at the top of the tab. The “Read”, “Write” and “Store” buttons are used to read out the parameters stored in the IO-Link device, load them and store them in the parameter server of the master.

Different user roles can be selected from the drop-down menu. The default user role is “Specialist”. The parameters are displayed in different representations and scopes.

Restarting the IO link device or restoring of the application parameters is possible via the parameter Standard Command [▶ 52].

Application specific information can be specified in parameter (0x0018) Application Specific Tag [▶ 53].

“Compare” button

1. Press the “Compare” button.
   ⇨ the parameter data of the configuration are compared with the parameter sets in the sensor.

⇨ The result is displayed in the “Parameter” tab see following figures.

Conformity of configuration and sensor data

The match is confirmed by a green tick in front of the index. Matching values are displayed in the “Value” field (see index 0x0018 “Application Specific Tag”).

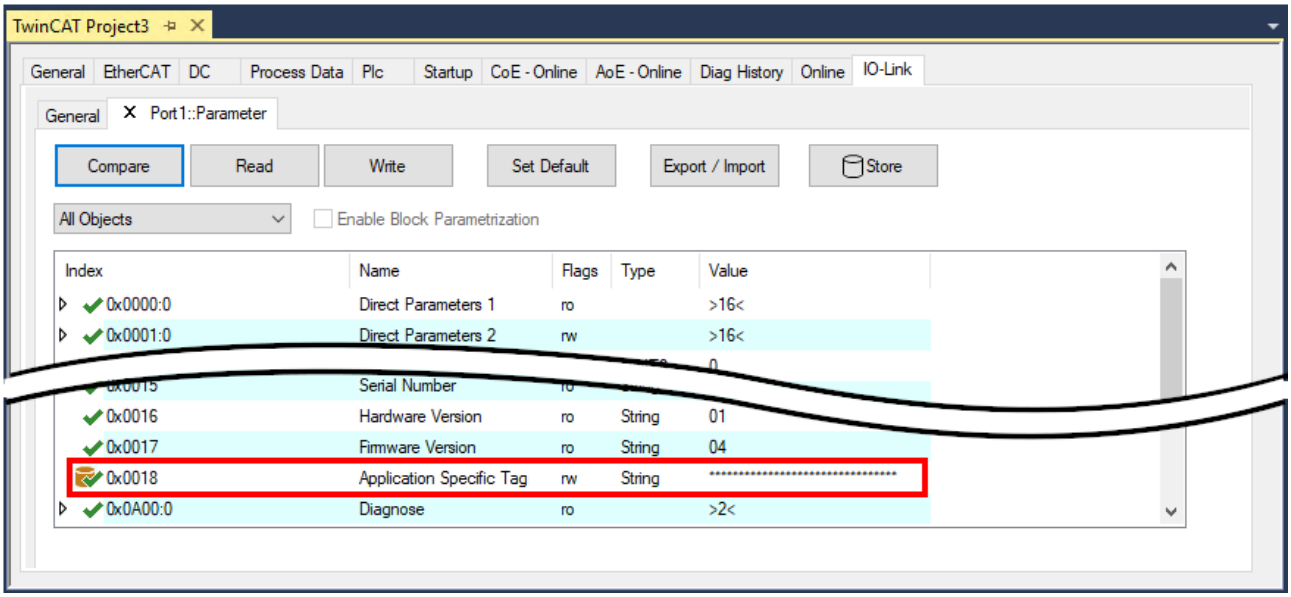


Fig. 30: Display of matching data in the “Parameter” tab

Deviations between configuration and sensor data

Deviations are indicated by a pen-symbol in front of the index. If there are different values in the “Value” field, the value “Compare” is displayed (see Index 0x0018 “Application Specific Tag”).

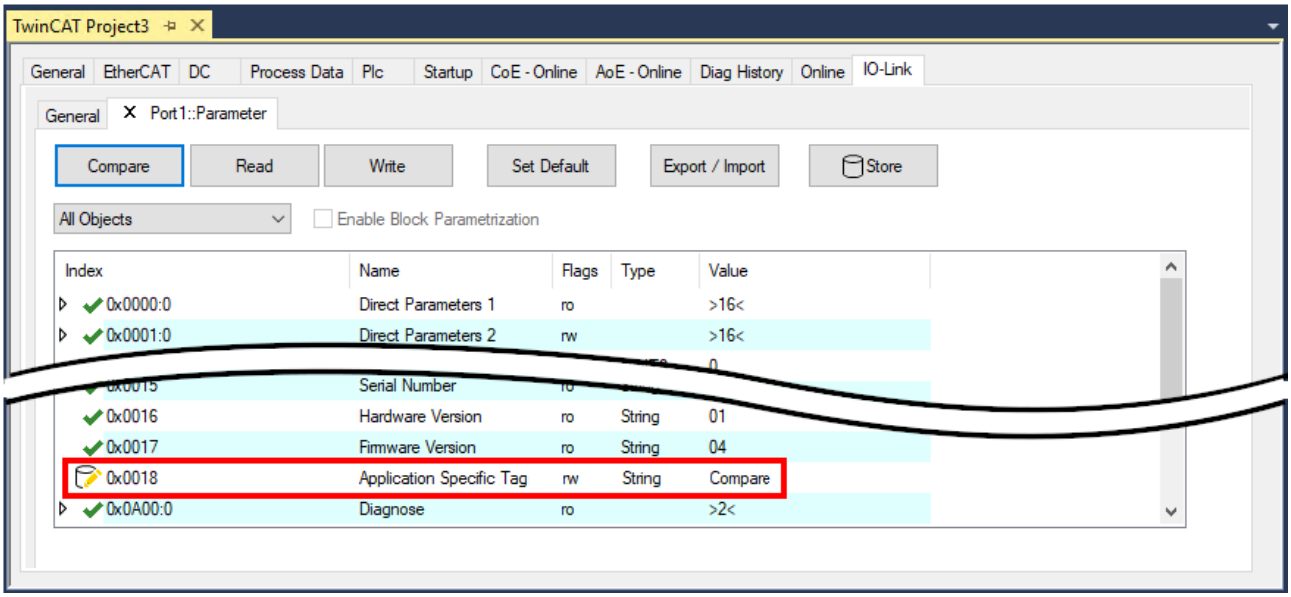


Fig. 31: Display of deviating data in the “Parameter” tab

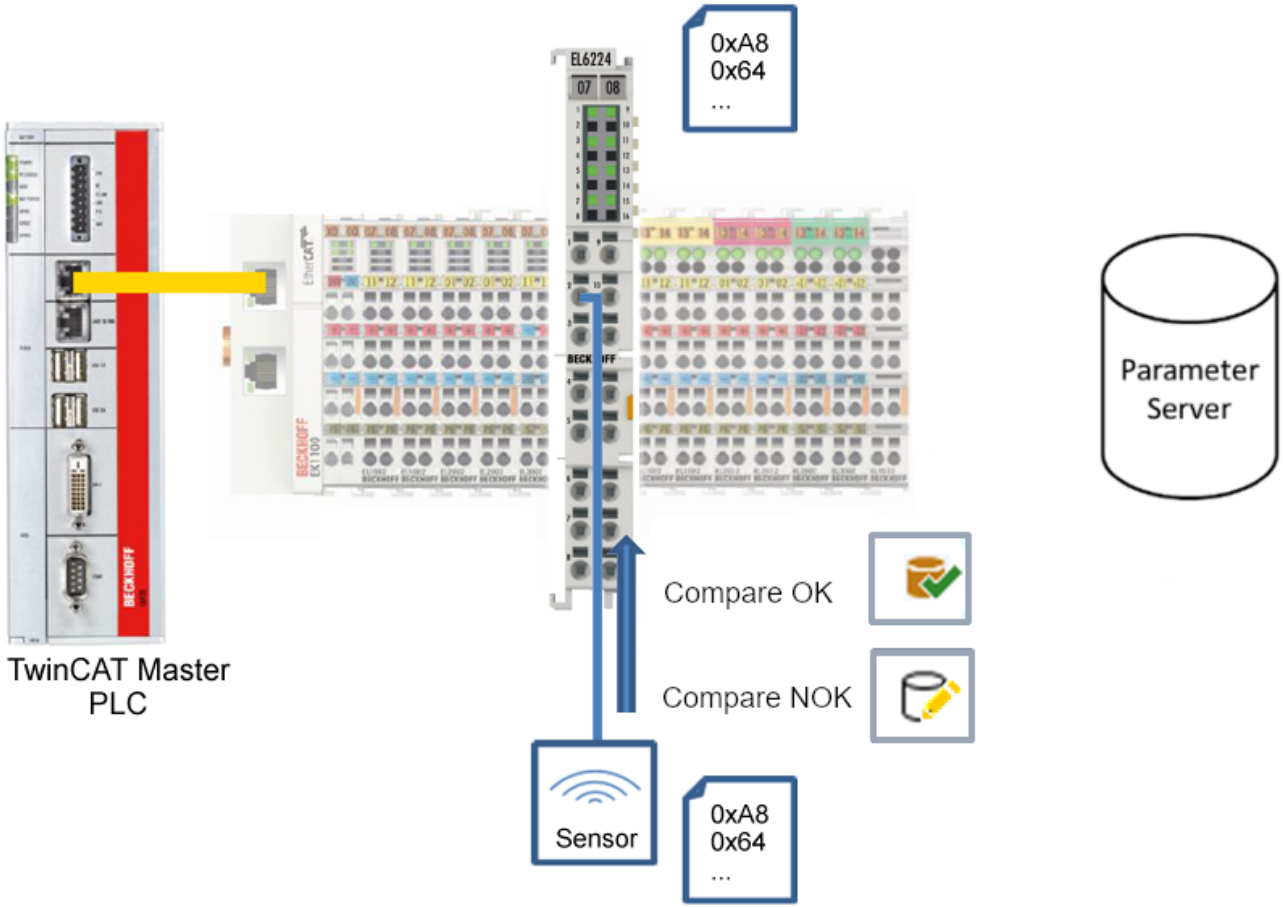


Fig. 32: Compare configuration and sensor data

“Read” button

The default values from the IODD file are always preset

1. Press the “Read” button

⇨ The current parameter values of the sensor are read. The successful reading of the data is confirmed with a green tick in front of the index.

“Write” button

The default values from the IODD file are always preset

1. Enter the desired value under “Value”.
2. Press the Enter key.
   ⇨ The values are accepted.
3. Press the “Write” button.

⇨ The data is written to the device (offline configuration is possible). The successful writing process is confirmed via a storing symbol in front of the index.

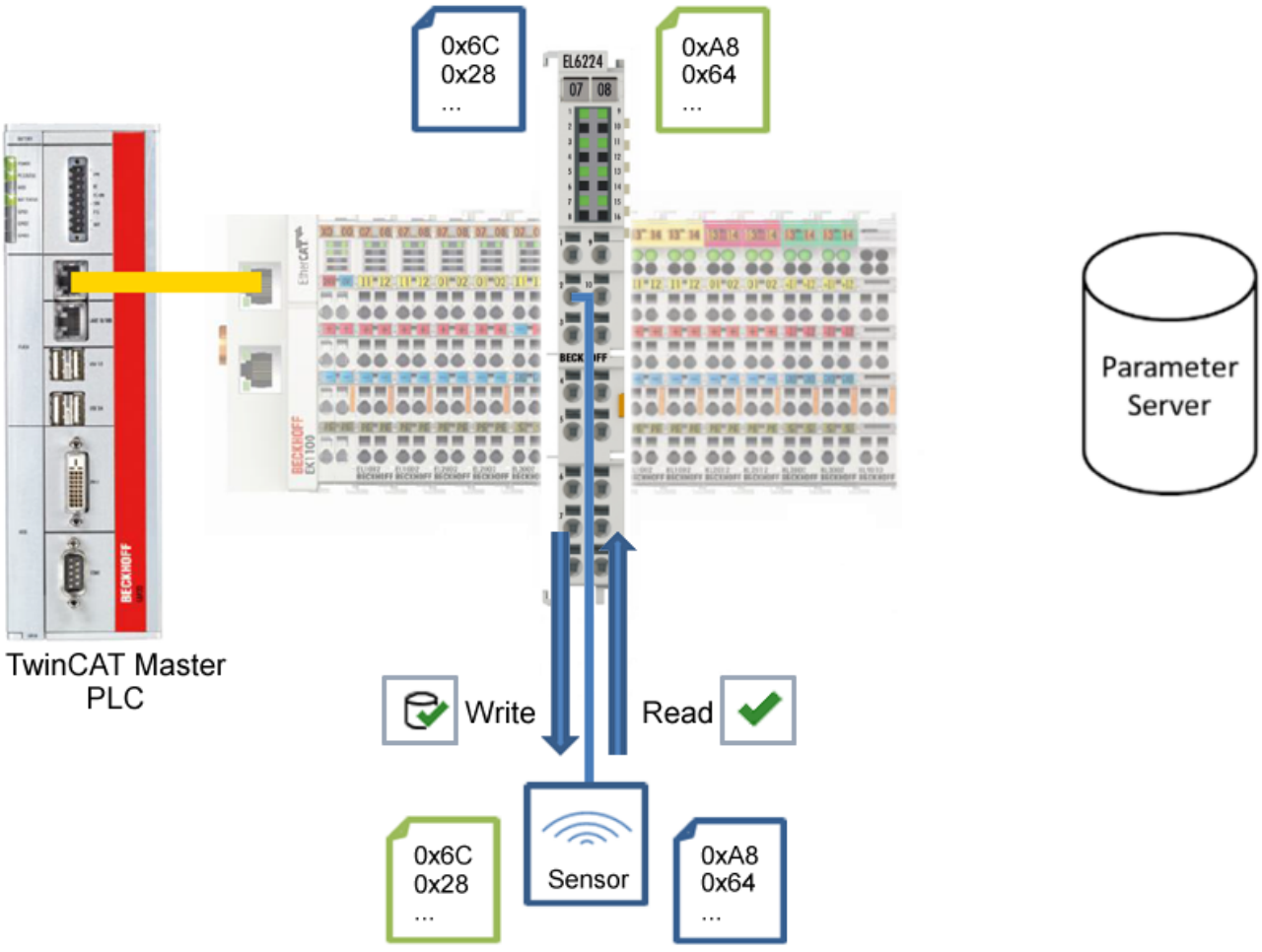


Fig. 33: Write parameter data to the sensor, read parameter data from the sensor.

“Set Default” button

1. Press the “Set Default” button.

⇨ All parameter values are set to the default settings.

Write default-values to the sensor

Note that the default-values must also be written to the device via the “Write” button.

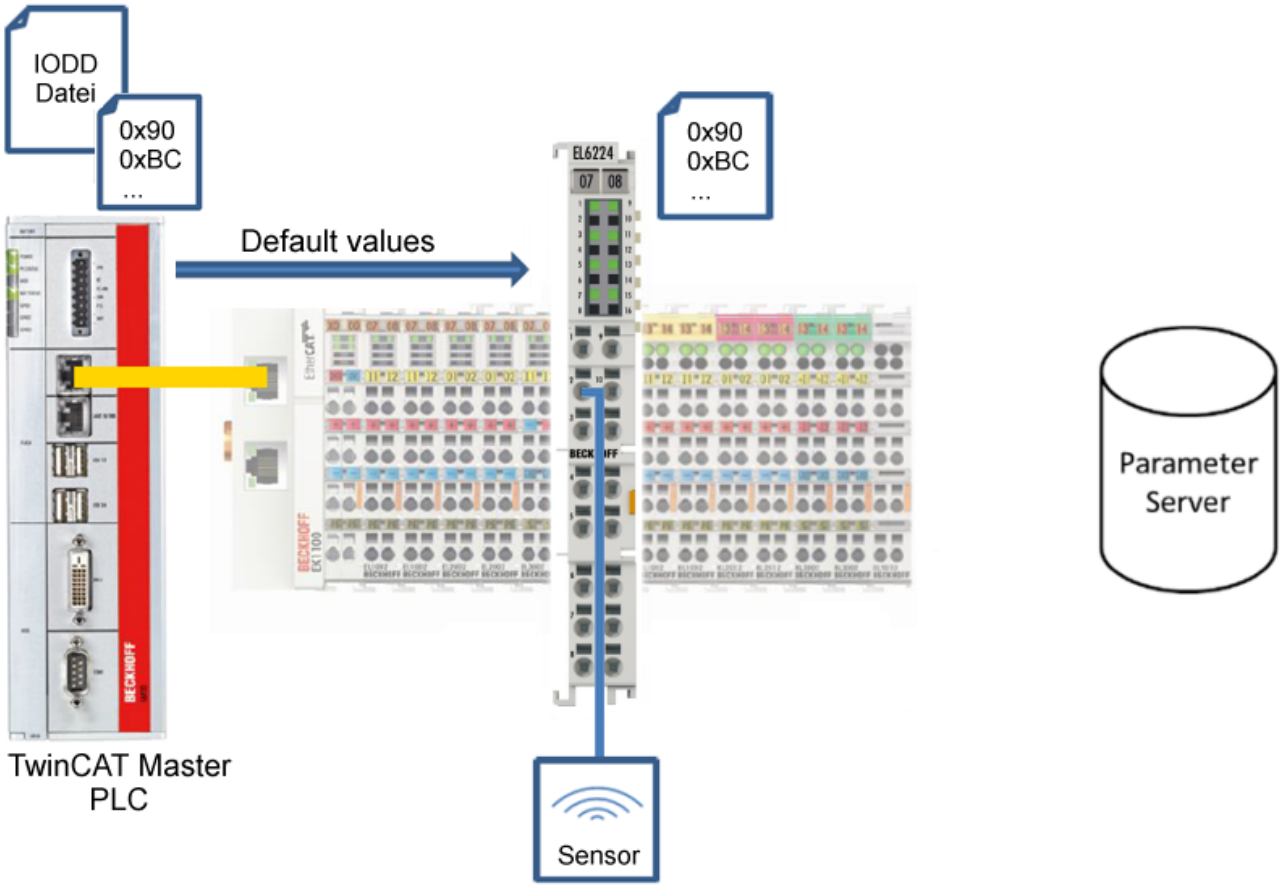


Fig. 34: Reset parameter values to default

“Export / Import” button

The set parameter values can be exported as a .vbs file and restored later via Import.

1. Press the “Export / Import” button (see the diagram below (1)).
   ⇨ The Import / Export dialog is opened
2. Specify the path under which you want to export or import the .vbs file, see fig. (2) below and confirm with the “Open” button, see fig. (4) below.
3. In addition, the export options “Attach Store Command” and “Enable Block Parametrization” can be selected as shown in fig. (3) below.
   ⇨ “Attach Store Command”: The parameters are loaded into the parameter server after the script has written all values.
   ⇨ “Enable Block Parametrization”: Block parameterization is enabled. For some sensors, writing is only possible when block parameterization is enabled.
4. Press the “Export” or “Import” button
   ⇨ The parameters are adopted from the imported file. The change of parameters is marked with a pencil symbol.
5. Write the new parameter values to the sensor via “Write” button.

⇨ The data is written to the device (offline configuration is possible). The successful writing process is confirmed via a storing symbol in front of the index.

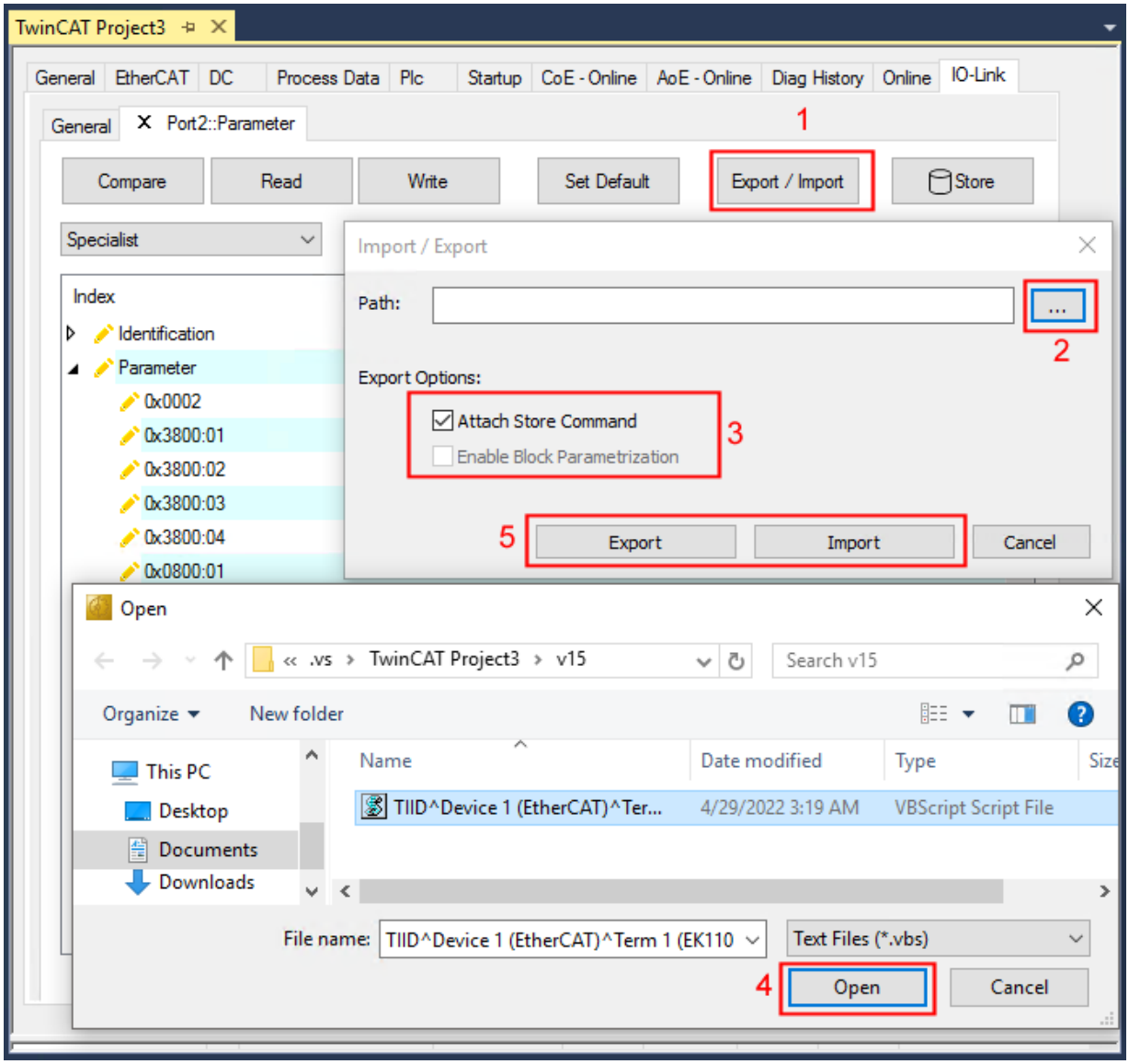


Fig. 35: Parameterization IO-Link device - Export / Import

“Store” button

1. Click “Store” (data storage):
   ⇨ The Beckhoff IO-Link master stores sensor-dependent-data, e. g. the following parameters
   (0x0018) “Application-Specific Tag”,
   (0x08n0) “Settings” and
   0x3800 “Range Settings”.
   The success of storing process is marked with the storing symbol.
   ⇨ If the IO-Link device is exchanged for a similar module, the device can be restored.

The stored values are displayed in the “ServerParameter” tab

2. Right-click on the device and select “Parameter Server” from the menu.

⇨ The stored values are displayed.

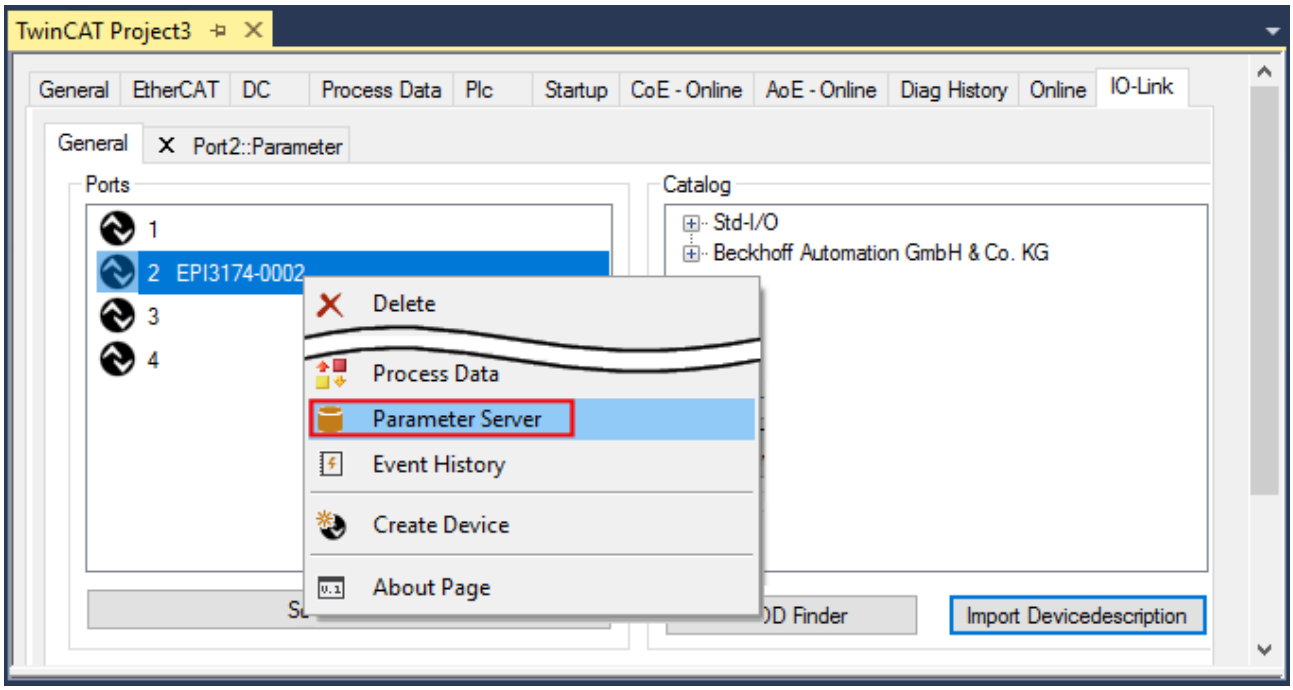


Fig. 36: Open the “ServerParameter” tab

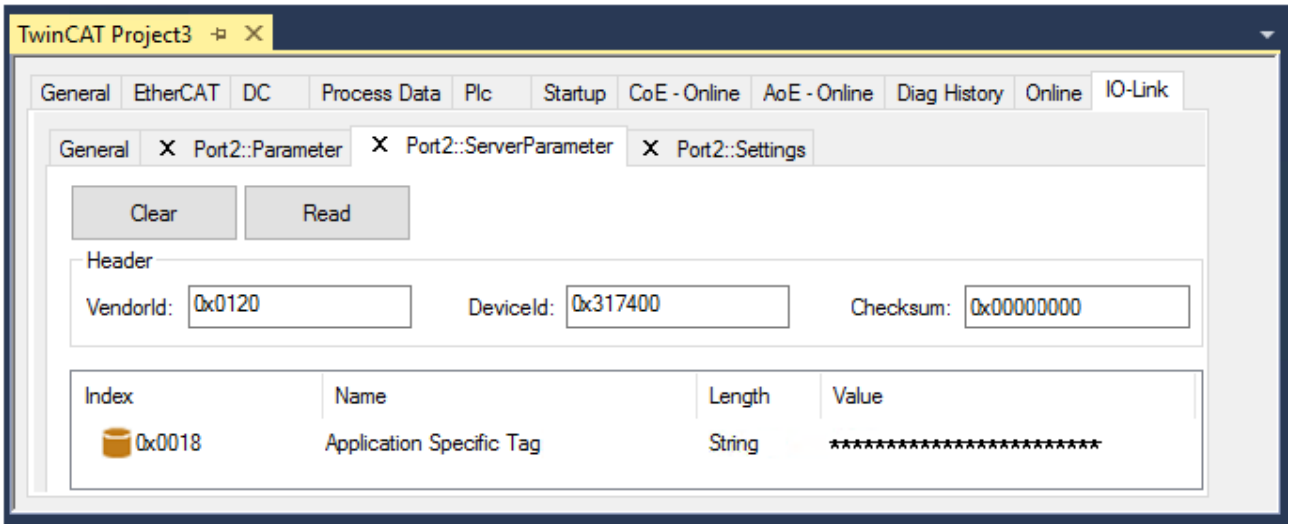


Fig. 37: „ServerParameter“ tab

Activate store button via PLC

As for CoE, the Indexgroup of an ADS command is specified as **0xF302** for the IO link data channel.

According to the IO-Link specification devices with ISDU support shall use index **0x0002** to receive the SystemCommand. The following list displays coding examples for system commands (ISDU), the complete table “Coding of SystemCommand (ISDU)” can be found in the IO-Link specification.

Command (hex)	Command (dec)	Name of the command	Definition
….			
0x01	1	ParamUploadStart	Start Parameter Upload
0x02	2	ParamUploadEnd	Stop Parameter Upload
0x03	3	ParamDownloadStart	Start Parameter Download
0x04	4	ParamDownloadEnd	Stop Parameter Download
0x05	**5**	**ParamDownloadStore**	**Finalize parameterization and start Data Storage**
0x06	6	ParamBreak	Cancel all Param commands
….			

Use an ADS Write function block for activating the store-function via the plc. The following figure shows a sample code for activation of the store-Button (command 0x05 “ParamDownloadStore”)

```
Case_Write:
    AdsWrite_EL6224( WRITE := FALSE );
    AdsWrite_EL6224.IDXGRP   := EL6224_Ch_iGrp;
    AdsWrite_EL6224.IDXOFFS  := EL6224_Ch_iOffWri;
    AdsWrite_EL6224.LEN      := SIZEOF(EL6224_bywrite);
    AdsWrite_EL6224.SRCADDR  := ADR(EL6224_bywrite);
    AdsWrite_EL6224( Write := TRUE);
    eSwitch1 := Case_WriBu;

EL6224_AoePortCh   : UINT  := 16#1001;
EL6224_Ch_iGrp     : UDINT := 16#F302;
EL6224_Ch_iOffManu : UDINT := 16#00100000;
EL6224_Ch_iOffPro  : UDINT := 16#00140000;
EL6224_Ch_iOffWri  : UDINT := 16#00020000;
EL6224_sManu       : STRING;
EL6224_sPro        : STRING;
EL6224_bywrite      : BYTE := 16#5;
```

Fig. 38: Sample code for activation of the store-function via the plc

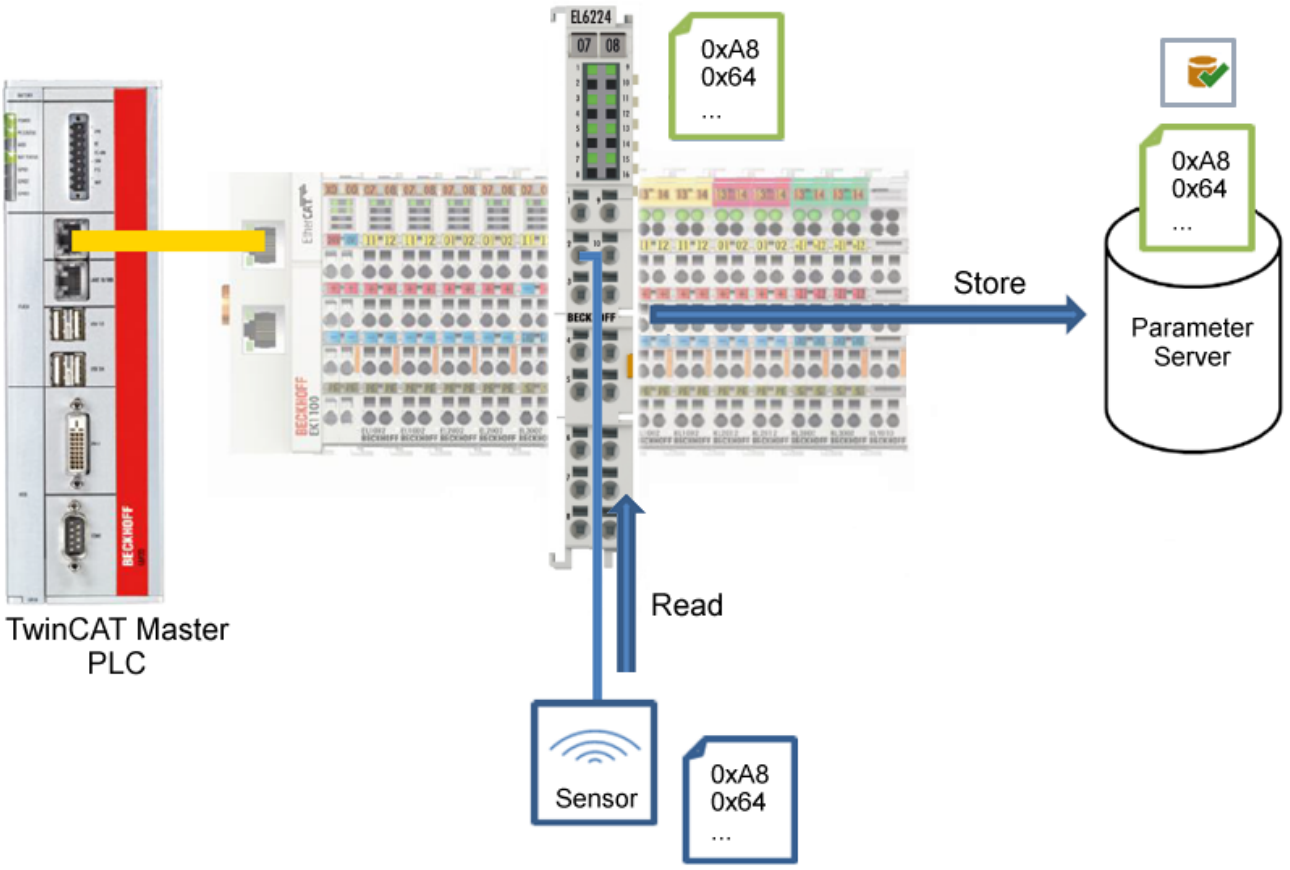


Fig. 39: Store parameters

Standard Command (Index 0x0002)

The IO-Link master writes various IO-Link-specific commands to the “Standard Command” during startup. Some of these commands are available in the TwinCAT interface (see figure below).

1. Click “Standard Command” in the parameter list of the “All Objects” user role, then double-click “Standard Command” in the right-hand field.
2. Select the desired value from the list of different options and
   - “Device Reset”: Restarts the IO-Link device.
   - “Application Reset”: No function.
   - “Restore Factory Settings”: Restoring the application parameters, i.e. the Settings parameter (0x0800).
3. Use the “Write” button (as described above [▶ 46]).

⇨ The data is written to the device (offline configuration is possible). The successful writing process is confirmed via a storing symbol in front of the index.

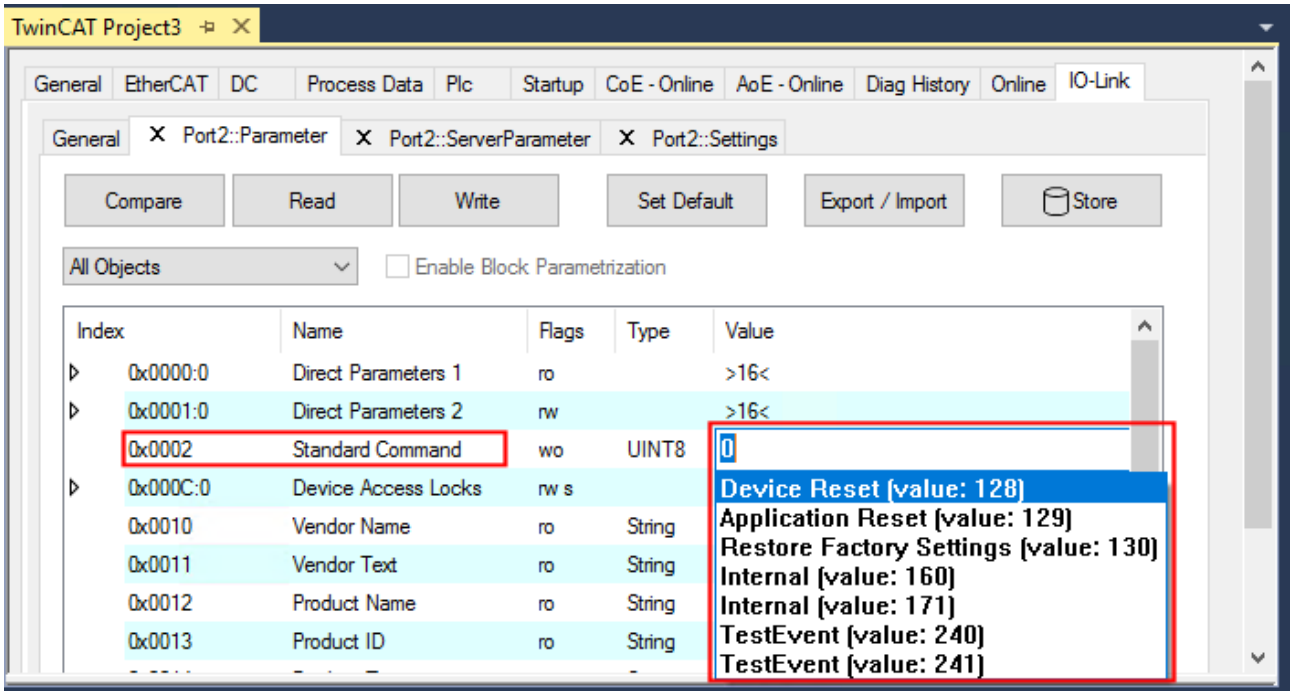


Fig. 40: Parameters IO-Link device “Standard Command”

“Application Specific Tag” (Index 0x0018)

Application-specific information can be entered and stored here.

1. Click “Application-Specific Tag” in the parameter list, then double-click “Application-Specific Tag” in the right-hand field.
2. Enter application-specific information and confirm with the Enter key.
3. Use the Write [▶ 46] button and the Store [▶ 49] button, if required (as described above).

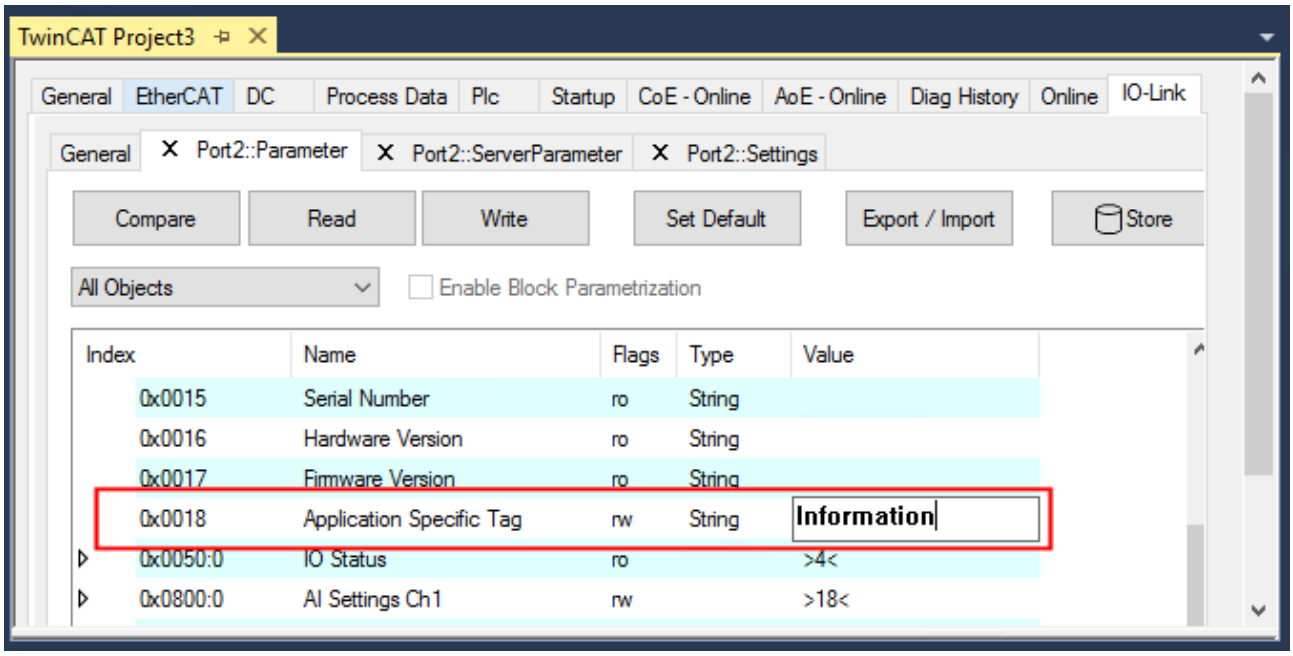


Fig. 41: Parameters IO-Link device: “Application Specific Tag”

5.5 ADS access to device parameters

The exchange of the acyclic data takes place via a specified index and subindex range that is device-specific and can be read about in the corresponding vendor documentation.

Parameter data exchange

An intelligent IO-Link sensor/actuator (in the previous figure marked "Sensor (IO-Link Device)") can support parameterization by SPDU (Service Protocol Data Units). The PLC must explicitly query or, when marked as such, send these acyclic service data.

SPDU access

TwinCAT supports access via ADS and via the EP6224-xxxxxx CoE directory.

The respective parameter is addressed via the so-called SPDU index. The following ranges are available:

Name	Index range
System	0x00 … 0x0F
Identification	0x10 … 0x1F
Diagnostic	0x20 … 0x2F
Communication	0x30 … 0x3F
Preferred Index	0x40 … 0xFE
Extended Index	0x0100 … 0x3FFF
	the range 0x4000 … 0xFFFF is reserved

The use of the implementation of these ranges is the responsibility of the sensor/actuator vendor. In the interest of clarity, only a few possible indices with names are listed here. Please refer to the corresponding chapter "Object description and parameterization".

Index	Name
0010	Vendor Name
0011	Vendor Text
0012	Product Name
0013	Product ID
0015	Serial Number
0016	Hardware Revision
0017	Firmware Revision
...	...

ADS

Communication relating to IO-Link demand data is initiated via an ADS command. An ADS address always consists of a NetID and PortNo. TwinCAT forwards an ADS command to the EP6224 Box module via AoE (ADS over EtherCAT). From where the command is relayed to the IO-Link master section and therefore to the data channel.

AoE-NetID

The EP6224 is assigned a dedicated AoE-NetID for communication with the IO-Link master section. This is assigned by the configuration tool (see the figure below).

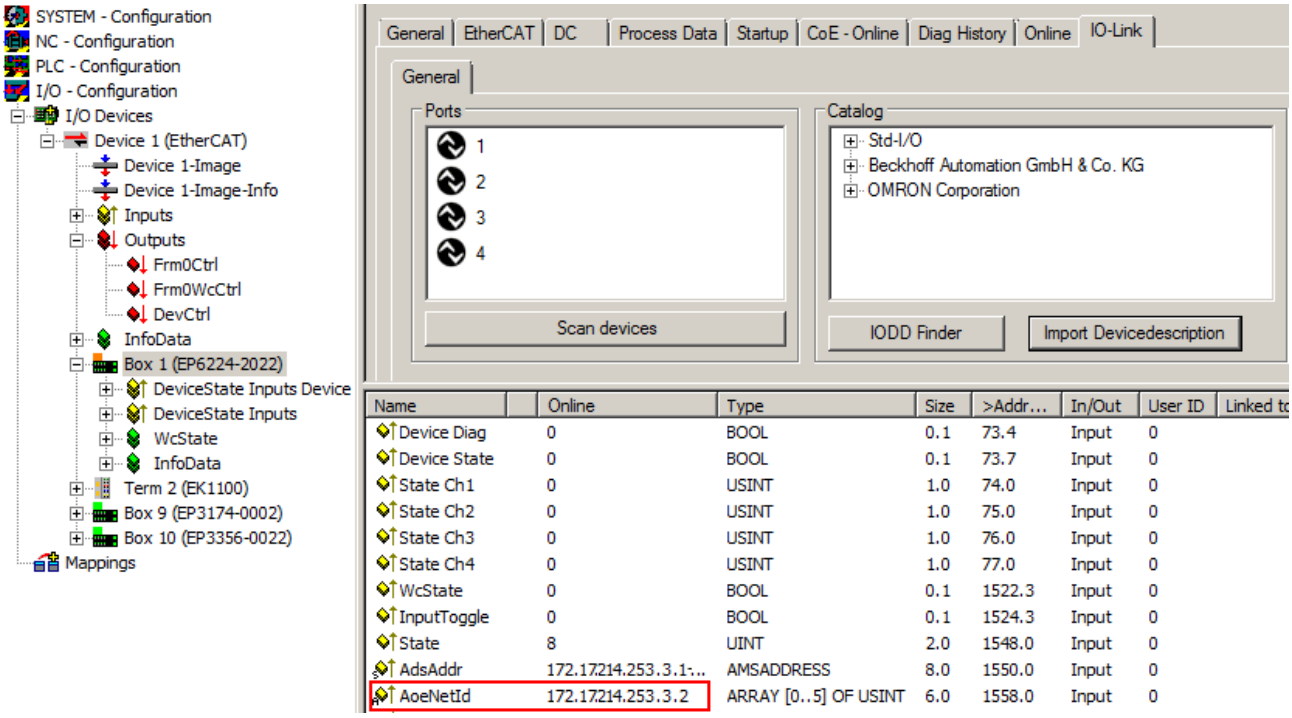


Fig. 42: AoE-NetID allocation

PortNo

The individual IO-Link ports for the master are allocated via the port number. The port numbers are allocated in ascending order from 0x1000. I.e. IO-Link Port1 === PortNo 0x1000 and IO-Link Portn === PortNo 0x1000 + n-1.
The following specification applies for the EP6224 (4-port IO-Link master):
IO-Link Port1 === PortNo 0x1000
IO-Link Port2 === PortNo 0x1001
IO-Link Port3 === PortNo 0x1002
IO-Link Port4 === PortNo 0x1003

ADS Indexgroup

As for CoE, the Indexgroup of an ADS command is specified as 0xF302 for the IO link data channel.

ADS Indexoffset

The IO link addressing with index and subindex is coded in the Indexoffset. The Indexoffset has a size of 4 bytes and is subdivided as follows: 2-byte index, 1-byte reserve, 1-byte subindex.

- Example: Indexoffset 0x12340056 corresponds to index 0x1234 and subindex 56

Example with ADS monitor

Reading of the Application-Specific Name, index 0x0018 subindex 0x00 (see figure below).

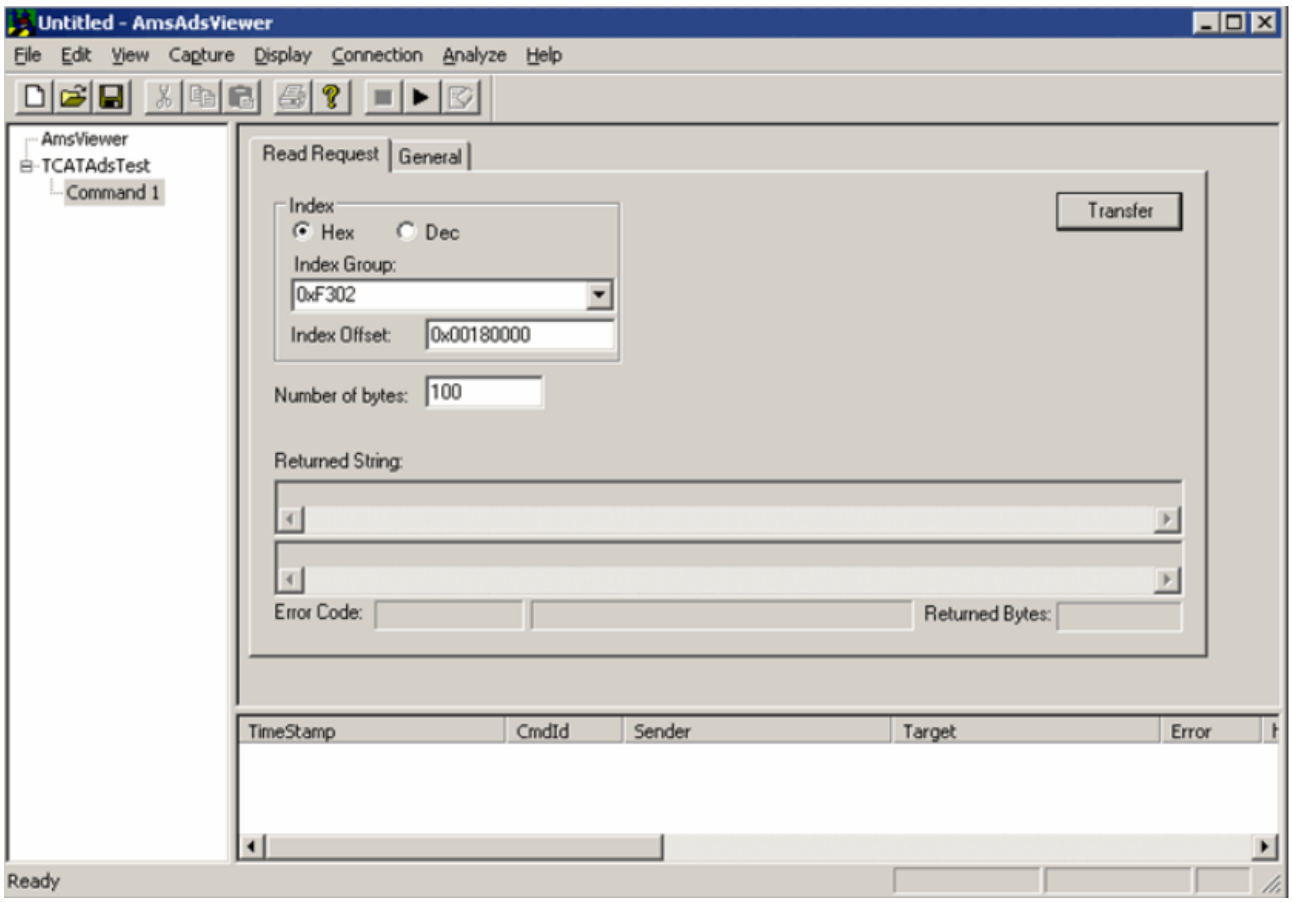


Fig. 43: Reading of the Application-Specific Name

Example showing the principle in the code

Reading of Application-Specific Name, index 0x0018 subindex 0x00 at IO-Link Port2.

```
AmsAddr adsAdr;
adsAdr.netId.b[0] = 0x0A; //AoE-NetID of EP6224
adsAdr.netId.b[1] = 0x03; //AoE-NetID of EP6224
adsAdr.netId.b[2] = 0x02; //AoE-NetID of EP6224
adsAdr.netId.b[3] = 0x16; //AoE-NetID of EP6224
adsAdr.netId.b[4] = 0x02; //AoE-NetID of EP6224
adsAdr.netId.b[5] = 0x03; //AoE-NetID of EP6224
adsAdr.port = 0x1001; //IO-Link Port2
errCode = AdsSyncReadReq(&adsAdr, 0xF302, 0x00180000, 100, &pReadBuffer);
```

5.6 Data stream and correction calculation

Data stream

The following flow chart illustrates the data stream of the EPI43xx (processing of raw data).

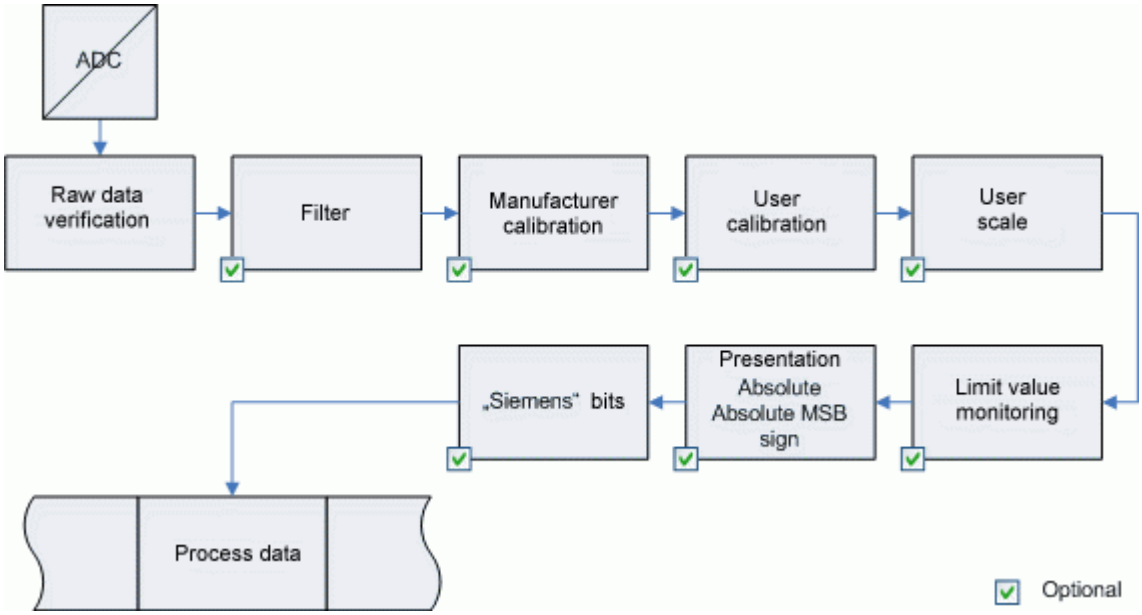


Fig. 44: Illustration of the EPI43xx data stream

Correction calculation EPI43xx

The diagrams at the bottom show the correction calculation between the raw values and the output values if the limit ranges are exceeded.

(+/- 10 V or +/- 10 mA)

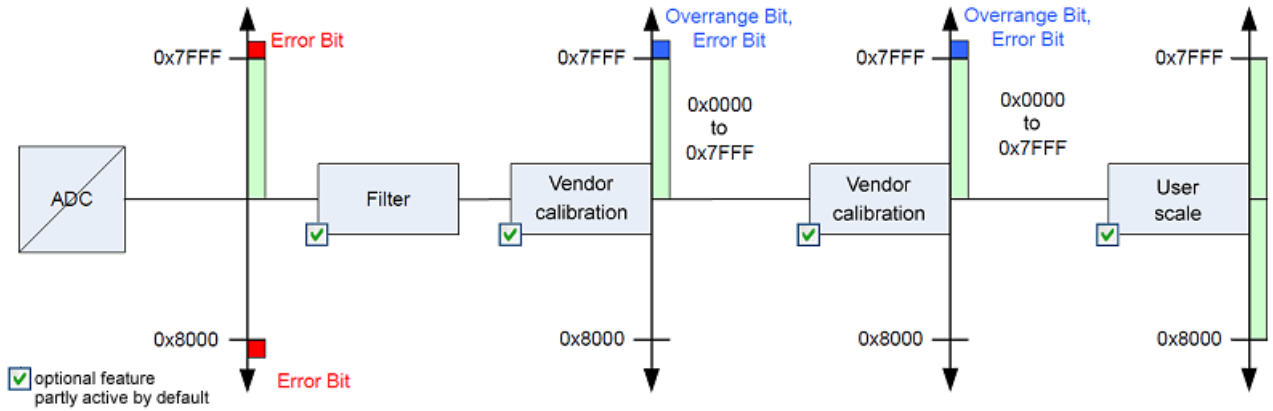


Fig. 45: Data flow with correction calculation for +/- 10 V or +/- 10 mA

(0...20 mA)

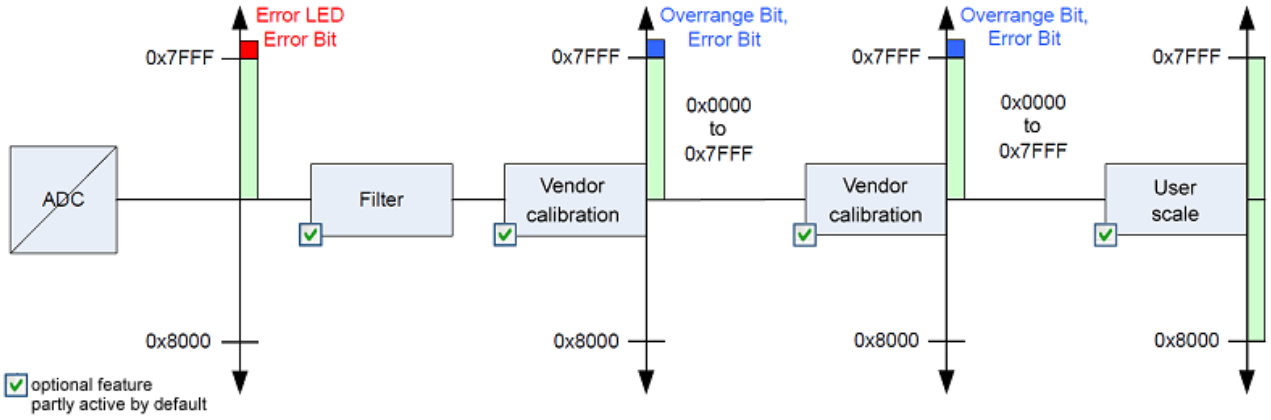


Fig. 46: Data flow with correction calculation for 0…20 mA

(4...20 mA)

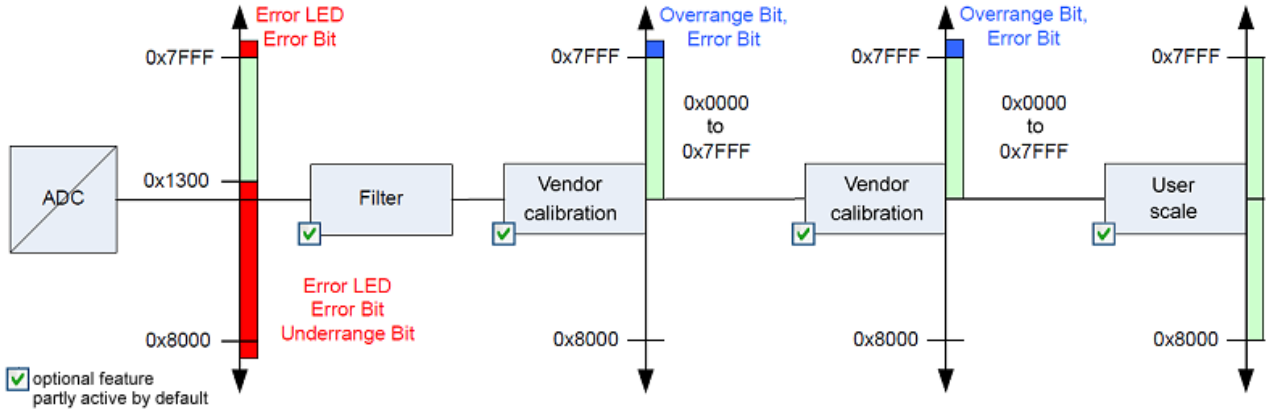


Fig. 47: Data flow with correction calculation for 4…20 mA

(0...10 V)

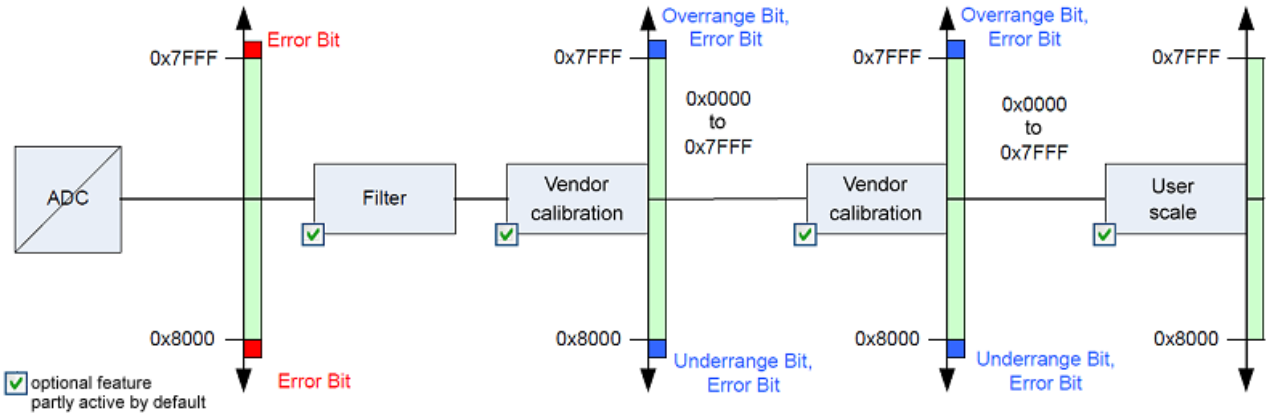


Fig. 48: Data flow with correction calculation for 0…10 V

Calibration

Vendor calibration, index 0x08n0:0B

Vendor calibration is enabled via index 0x0800:0B, with n = 0 (ch. 1), with n = 1 (ch. 2), …n = 3 (ch. 4). Parameterization takes place via the indices

- 0x08nF:01 vendor calibration: Offset

- 0x80nF:02 vendor calibration: Gain

User calibration, index 0x08n0:0A

The user calibration is enabled via index 0x80n0:0A. Parameterization takes place via the indices

- 0x08n0:17 user calibration: Offset
- 0x08n0:18 user calibration: Gain

User scaling, index 0x08n0:01

User scaling is enabled via index 0x08n0:01. Parameterization takes place via the indices

- 0x08n0:11 user scaling: Offset
- 0x08n0:12 user scaling: Gain

Vendor calibration

The vendor reserves the right to carry out the basic calibration of the terminal/box modules. Therefore, the vendor calibration cannot be changed.

Calculation of process data

The terminal/box continuously logs measured values and stores the raw values of its A/D converter in ADC raw value object 0x08nE:01. After each logging of the analog signal a correction is calculated via the vendor calibration values. This is followed (optionally) by user scaling:

$Y_H = (X_{ADC} - B_H) * A_H$ measured value after vendor calibration (corresponds to X_{ADC} if index 0x08n0:0B inactive)

$Y_A = (Y_H - B_A) * A_A$ measured value after user calibration (corresponds to Y_H if index 0x08n0:0A inactive)

$Y_S = Y_A * A_S * 2^{-16} + BS$ measured value after user scaling (corresponds to Y_A if index 0x08n0:01 is inactive)

Key

Name	Designation	Index
X_{ADC}	Output value of the A/D converter	0x8nE:01
B_H	Vendor calibration offset (only changeable if the object Producer codeword F008 is set)	0x08nF:01
A_H	Vendor calibration gain (can only be changed if the object Producer codeword F008 is set)	0x08nF:02
Y_H	Measured value after vendor calibration	-
B_A	User calibration offset	0x08n0:17
A_A	User calibration gain	0x08n0:18
Y_S	Measured value after user calibration	-
B_S	User scaling offset (can be activated via index 0x80n0:01)	0x08n0:11
A_S	User scaling gain (can be activated via index 0x80n0:01)	0x08n0:12
Y_S	Process data for control, measured value after user scaling	-

5.7 EPI43xx, ERI43xx - setting the IO-Link device parameters

5.7.1 Selection of the analog signal type, index 0x3800:0n

In the delivery state all analog input channels of the EPI4374 are set for analog voltage measurement (-10 V …+10 V). All analog outputs generate signals in the range from -10 V …+10 V.

Setting the correct signal type before connecting the sensors

Set the correct signal type before connecting the sensors!

This setting can be set individually for each channel in parameter 0x3800:0n (see the figure below). Changes become effective immediately after writing the parameter.

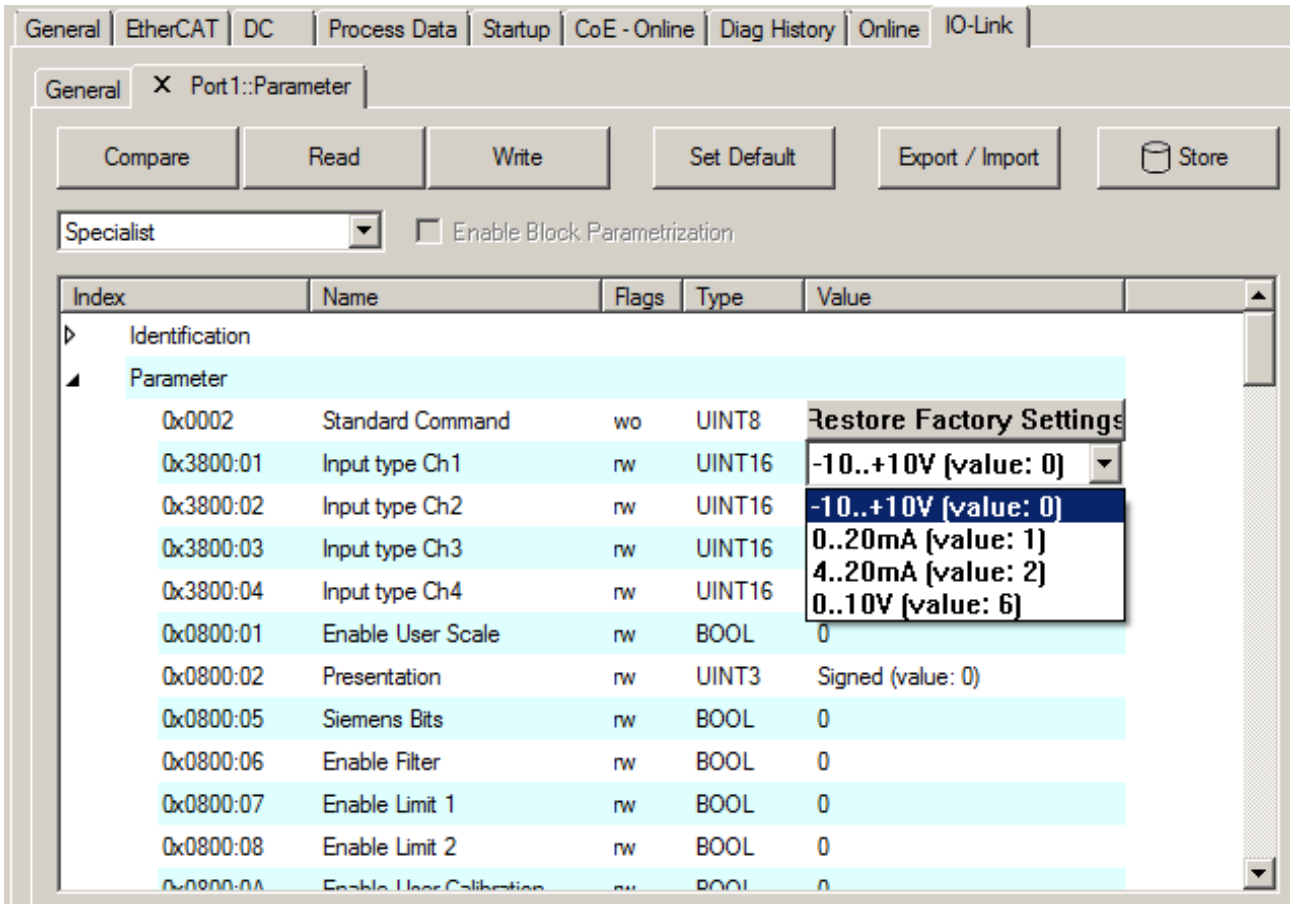


Fig. 49: Selection of the analog signal type

5.7.2 Presentation, index 0x08n0:02

The measured value output is set in factory to two's complement representation (signed integer). Index 0x80n0:02 offers the possibility to change the method of representation of the measured value.

Signed integer representation

The negative output value is represented in two's complement (negated + 1). Maximum representation range for 16 bits = -32768…+32767$_{dec}$

Input signal				Value	
+/- 10 V	0…20 mA	4…20 mA	0…10 V	Decimal	hexadecimal
10 V	20 mA	20 mA	10 V	32767	0x7FFF
5 V	10 mA	12 mA	5 V	16383	0x3FFF
0 V	4 mA	4 mA	0 V	0	0x0000
-5 V	-	-	-	-16383	0xC001
-10 V	-	-	-	-32767	0x8000

Overview of further representations

- **Unsigned integer representation**
  The output value is represented with 15-bit resolution without sign, therefore polarity detection is no longer possible. Maximum representation range for 16 bits = 0…+32767$_{dec}$
- **Absolute value with MSB as sign - representation**
  The output value is displayed in signed amount representation: MSB = 1 (highest bit) in the case of negative values. Maximum representation range for 16 bits = -32768…+32767$_{dec}$

Input signal (+/- 10 V)	Unsigned integer representation		Absolute value with MSB as sign - representation	
	dec	hex	dec	hex
10 V	32767	0x7FFF	32767	0x7FFF
5 V	16383	0x3FFF	16383	0x3FFF
0 V	0	0x0000	0	0x0000
-5 V	16384	0x4000	[-16384]	0xC000
-10 V	32767	0x7FFF	[-32767]	0xFFFF

Presentation types

The presentation types *Unsigned integer* and *Absolute value with MSB as sign* have no function for unipolar modules. There is no change in the presentation in the positive range.

5.7.3 Siemens bits, index 0x08n0:05

If this bit is set, status displays are superimposed on the lowest three bits. Bit 0 is set in the event of an *Overrange* or *Underrange* error.

5.7.4 Limit 1 (Index 0x08n0:13) and Limit 2 (Index 0x08n0:14), Swap Limit bits

Limit 1 (index 0x08n0:13) and Limit 2 (index 0x08n0:14)

Indices 0x08n0:07 and 0x08n0:08 are used to activate limit value monitoring.

If the limits of the values that can be entered in indices 0x08n0:13 and 0x80n0:14 are violated, the bits in the indices are set accordingly (see the table and the example below).

Channel	Index for Limit 1	Index for Limit 2
1	0x60p0:03	0x60p0:04
2	0x60p0:0C	0x60p0:0D
3	0x60p0:15	0x60p0:16
4	0x60p0:1E	0x60p0:1F

With p = 0 for Port1.... p = 3 for Port4
Limit output (2 bit):

0: Limit function not active
1: Value < limit value
2: Value > limit value
3: Value = limit value

Limit evaluation

The limit evaluation assumes a signed representation. The conversion to the desired representation (index 0x80n0:02) only takes place after the limit evaluation.

Example limit evaluation for EPI3174

Port1, channel 1; Limit 1 and Limit 2 enabled, Limit 1 = 2.8 V, Limit 2 = 7.4 V, representation: signed integer

Input in index 0x0800:13 (limit 1):

(2.8 V / 10 V) * 2^{16} / 2-1 = **9,174dec**

Input in index 0x0800:14 (limit 2):

(7.4 V / 10 V) * 2^{16} / 2-1 = **24,247dec**

Output:

Input channel 1	Limit1 index 0x6000:03	Limit2 index 0x6000:04
1.8 V	$0x01_{hex}$, (Limit 1, limit value undershot)	$0x01_{hex}$, (Limit 2, limit value undershot)
2.8 V	$0x03_{hex}$, (Limit 1, limit value reached)	$0x01_{hex}$, (Limit 2, limit value undershot)
4.2 V	$0x02_{hex}$, (Limit 1, limit value exceeded)	$0x01_{hex}$, (Limit 2, limit value undershot)
8.5 V	$0x02_{hex}$, (Limit 1, limit value exceeded)	$0x02_{hex}$, (Limit 2, limit value exceeded)

Swap Limit Index 0x80n0:0E

The limit function can be inverted by *SwapLimitBits* in index 0x80n0:0E.

Output n (2 bits):

SwapLimitBits setting	Value
FALSE (default setting)	• 0: not active • 1: Value < limit value • 2: Value > limit value • 3: Value = limit value
TRUE	• 0: not active • 1: Value > limit value • 2: Value < limit value • 3: Value = limit value

Linking in the PLC with 2-bit values

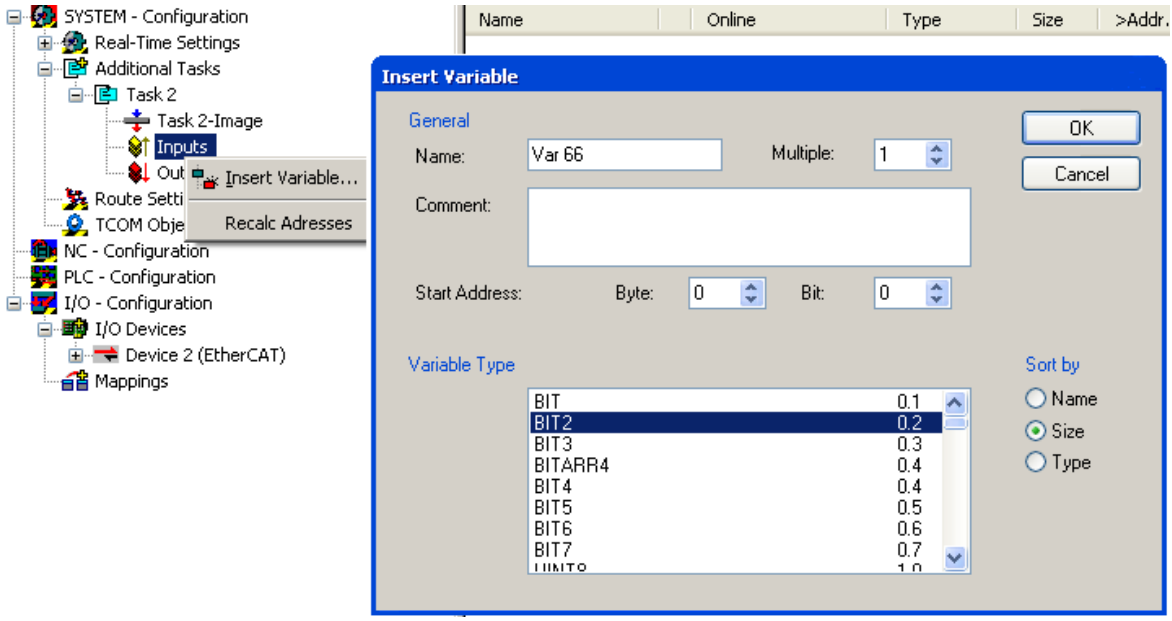
The limit information consists of 2 bits. *Limitn* can be linked to the PLC or a task in the System Manager:

PLC: IEC61131-PLC contains no 2-bit data type that can be linked with this process data directly. In order to transmit the limit information, therefore, define an input byte, e.g.

```
VAR
    byLimit1 AT %I*:BYTE;
END_VAR
```

Link the limit to an existing variable.

Additional task: 2-bit variables can be created in the System Manager.



Linking of 2-bit variable to additional task

5.7.5 Filter mode (FIR and IIR), Index 0x0800:06, 0x0800:15

The EPI31xx, ERI31xx and EPI4xxx, ERI4xxx modules are equipped with a digital filter, which, depending on the setting, can assume the characteristics of:

- a filter with finite impulse response (**F**inite **I**mpulse **R**esponse Filter, **FIR filter**) or
- a filter with infinite impulse response (**I**nfinite **I**mpulse **R**esponse Filter, **IIR filter**).

The filter is deactivated by default. Please observe the following note regarding activation with index 0x0800:06.

Activation of the filter with index 0x0800:06 and setting of the filter characteristics via index 0x0800:15

The filter frequencies are set centrally for all channels of the EPI3xxx, ERI31xx / EPI4xxx, ERI4xxx modules via index 0x0800:15 (channel 1).

- **FIR filter**
  The filter works as a notch filter and determines the conversion time of the module. It is parameterized via index 0x0800:15. The higher the filter frequency, the faster the conversion time. A 50 Hz and a 60 Hz filter are available.
  Notch filter means that the filter has zeros (notches) in the frequency response at the filter frequency and multiples thereof, i.e. it attenuates the amplitude at these frequencies.
  The FIR filter operates as a non-recursive filter.

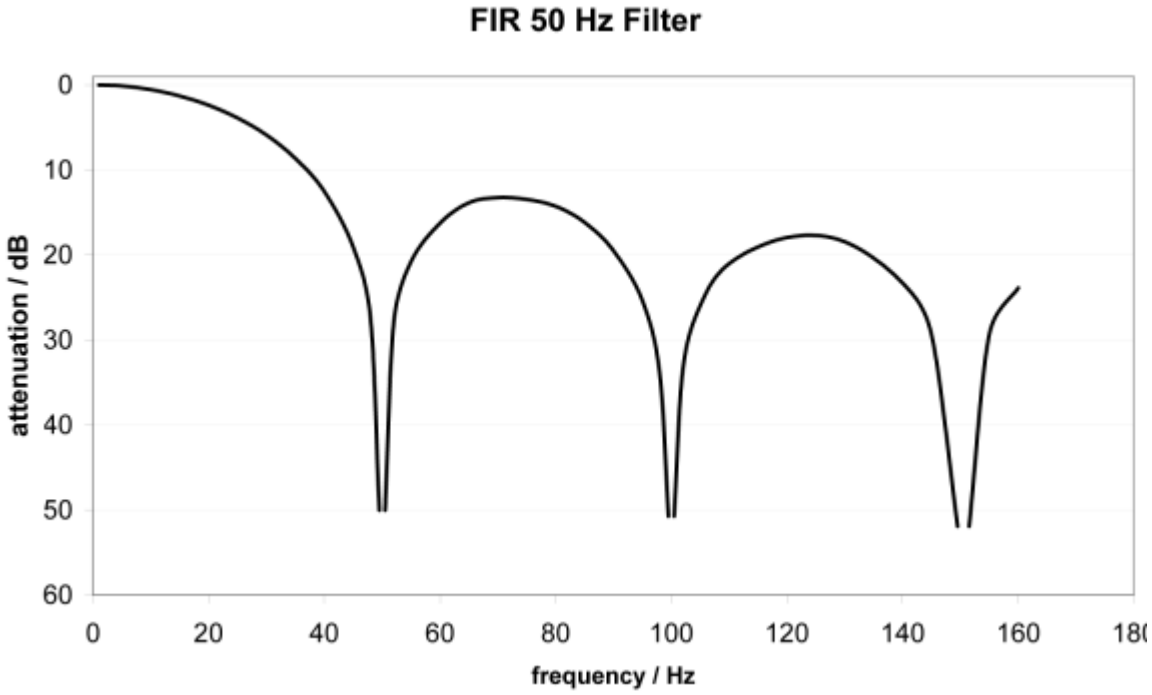


Fig. 50: typ. attenuation curve notch.filter at 50 Hz

Filter data FIR filter (1- to 4-channel modules)			
Filter	**Attenuation**	**Limit frequency (-3 dB)**	**Conversion time**
50 Hz FIR	> 50 dB	22 Hz	625 µs
60 Hz FIR	> 45 dB	26 Hz	521 µs

- **IIR filter**
  The filter with IIR characteristics is a discrete time, linear, time invariant filter that can be set to eight levels (level 1 = weak recursive filter, up to level 8 = strong recursive filter).
  The IIR can be understood to be a moving average value calculation after a low-pass filter.
  Filter characteristics for IIR filters

IIR filter	~3 dB limit frequency at 500 µs sampling time
IIR 1	400 Hz
IIR 2	220 Hz
IIR 3	100 Hz
IIR 4	50 Hz
IIR 5	24 Hz
IIR 6	12 Hz
IIR 7	6.2 Hz
IIR 8	3.0 Hz

5.7.6 Diagnostics (index 0x0A00)

The *Diagnosis* parameters vary between the different devices. The meaning of *Diagnosis* parameters (Index 0x0A00 [▶ 76]) can be read in the respective chapter *Object description and parameterization*.

The diagnostic parameters of the EPI4374-0002 are shown in the following illustration.

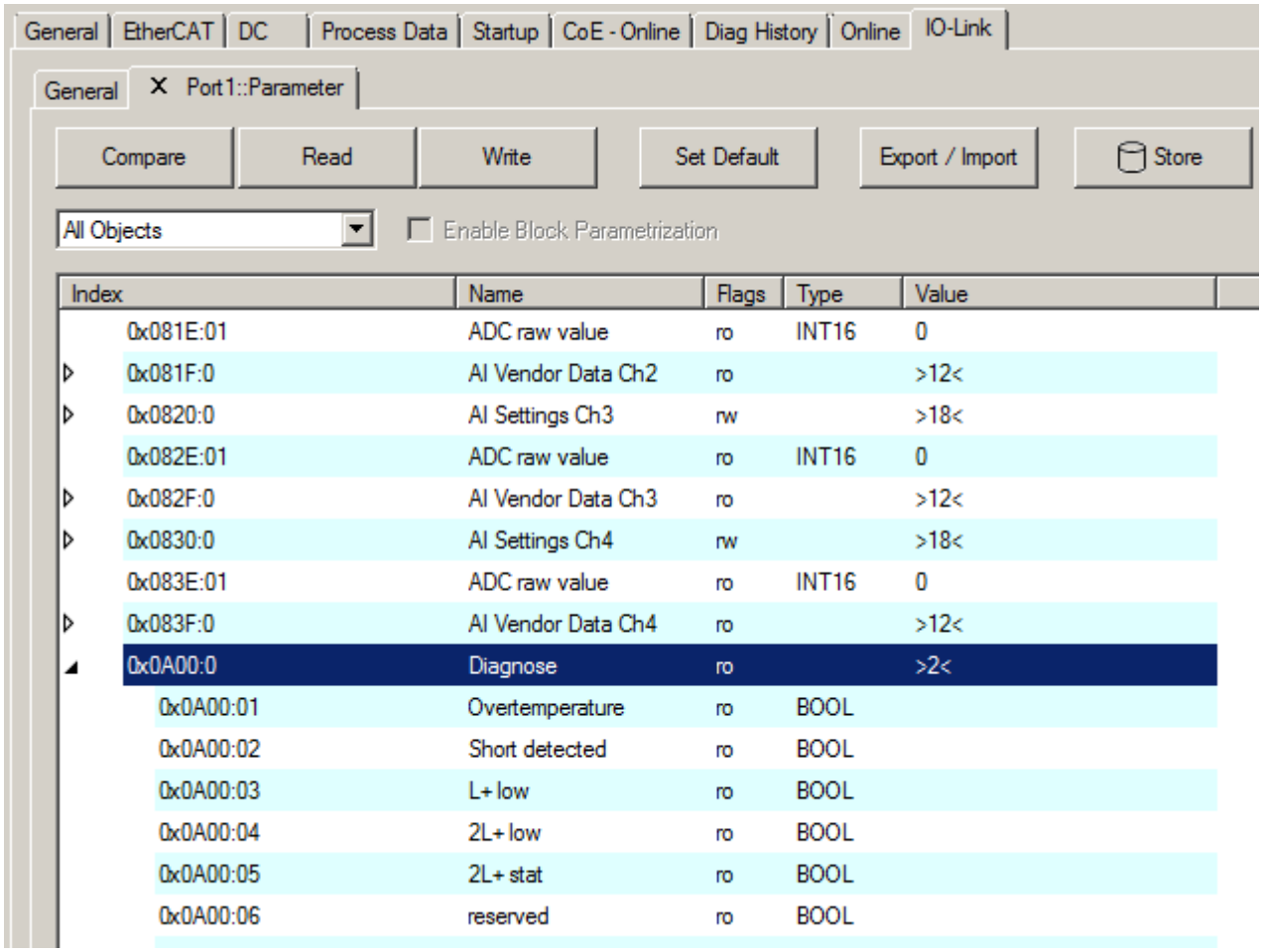


Fig. 51: Parameters IO-Link device: Diagnosis of the EPI4374-0002

6 Device parameters

6.1 Object overview

IO-Link IODD Device Description

The display corresponds to the display of the IO-Link device parameters. It is advisable to download the latest IO-Link IODD device description files from the Download section of the Beckhoff website and install them according to the installation instructions.

The following example shows the object overview of EPI4374-0002 as an example.

Subindex	Name	Flags	Default value
0x0000:0	**Direct Parameters 1**	RO	16
0x0000:01	Reserved	RO	0
0x0000:02	Master Cycle Time	RO	0
0x0000:03	Min Cycle Time	RO	0
0x0000:04	M-Sequence Capability	RO	0
0x0000:05	IO-Link Version ID	RO	0
0x0000:06	Process Data Input Length	RO	0
0x0000:07	Process Data Output Length	RO	0
0x0000:08	Vendor ID 1	RO	0
0x0000:09	Vendor ID 2	RO	0
0x0000:0A	Device ID 1	RO	0
0x0000:0B	Device ID 2	RO	0
0x0000:0C	Device ID 3	RO	0
0x0000:0D	Reserved	RO	0
0x0000:0E	Reserved	RO	0
0x0000:0F	Reserved	RO	0
0x0000:10	System Command	RO	0

Subindex	Name	Flags	Default value
0x0001:0	**Direct Parameters 2**	RW	16
0x0001:01	Device Specific Parameter 1	RW	0
0x0001:02	Device Specific Parameter 2	RW	0
0x0001:03	Device Specific Parameter 3	RW	0
0x0001:04	Device Specific Parameter 4	RW	0
0x0001:05	Device Specific Parameter 5	RW	0
0x0001:06	Device Specific Parameter 6	RW	0
0x0001:07	Device Specific Parameter 7	RW	0
0x0001:08	Device Specific Parameter 8	RW	0
0x0001:09	Device Specific Parameter 9	RW	0
0x0001:0A	Device Specific Parameter 10	RW	0
0x0001:0B	Device Specific Parameter 11	RW	0
0x0001:0C	Device Specific Parameter 12	RW	0
0x0001:0D	Device Specific Parameter 13	RW	0
0x0001:0E	Device Specific Parameter 14	RW	0
0x0001:0F	Device Specific Parameter 15	RW	0
0x0001:10	Device Specific Parameter 16	RW	0

Subindex	Name	Flags	Default value
0x0002	Standard Command	WO	0

Subindex	Name	Flags	Default value
0x000C:0	**Device Access Locks**	RW	2
0x000C:01	Parameter (write) Access Lock	RW	0
0x000C:02	Data Storage Lock	RW	0
0x000C:03	Local Parameterization Lock	RW	0
0x000C:04	Local User Interface Lock	RW	0

Index	Name	Flags	Default value
0x0010	Vendor Name	RO	Beckhoff Automation GmbH & Co. KG
0x0011	Vendor Text	RO	www.beckhoff.com
0x0012	Product Name	RO	EPI4374-0002
0x0013	Product ID	RO	EPI4374-0002
0x0014	Product Text	RO	2 analog input 2 analog output modules
0x0015	Serial Number	RO	00000000
0x0016	Hardware version	RO	00
0x0017	Firmware version	RO	00
0x0018	Application-Specific Tag	RW	0

Subindex	Name	Flags	Default value
0x0050:0	**IO Status**	RO	4
0x0050:01	State	RO	0x0000 (0_{dec})
0x0500:02	Status code	RO	0x0000 (0_{dec})

Subindex	Name	Flags	Default value
0x0800:0	**AI Settings Ch 1**	RW	18
0x0800:01	Enable User Scale	RW	0x00 (0_{dec})
0x0800:02	Presentation	RW	Signed
0x0800:05	Siemens bits	RW	0x00 (0_{dec})
0x0800:06	Enable filter	RW	0x01 (1_{dec})
0x0800:07	Enable Limit 1	RW	0x00 (0_{dec})
0x0800:08	Enable Limit 2	RW	0x00 (0_{dec})
0x0800:0A	Enable User Calibration	RW	0x00 (0_{dec})
0x0800:0B	Enable Vendor Calibration	RW	0x01 (1_{dec})
0x0800:0E	Swap Limit Bits	RW	0x00 (0_{dec})
0x0800:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0800:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0800:13	Limit 1	RW	0x0000 (0_{dec})
0x0800:14	Limit 2	RW	0x0000 (0_{dec})
0x0800:15	Filter Settings	RW	50 Hz FIR
0x0800:17	User Calibration Offset	RW	0x0000 (0_{dec})
0x0800:18	User Calibration Gain	RW	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x080E:01	**ADC raw value**	RO	0x0000 (0_{dec})

Subindex	Name	Flags	Default value
0x080F:0	**AI Vendor Data Ch 1**	RO	12
0x080F:01	R0 Offset	RO	0x0000 (0_{dec})
0x080F:02	R0 Gain	RO	0x4000 (16384_{dec})
0x080F:03	R1 Offset	RO	0x0000 (0_{dec})
0x080F:04	R1 Gain	RO	0x4000 (16384_{dec})
0x080F:05	R2 Offset	RO	0x0000 (0_{dec})
0x080F:06	R2 Gain	RO	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x0810:0	**AI Settings Ch 2**	RW	18
0x0810:01	Enable User Scale	RW	0x00 (0_{dec})
0x0810:02	Presentation	RW	Signed
0x0810:05	Siemens bits	RW	0x00 (0_{dec})
0x0810:07	Enable Limit 1	RW	0x00 (0_{dec})
0x0810:08	Enable Limit 2	RW	0x00 (0_{dec})
0x0810:0A	Enable User Calibration	RW	0x00 (0_{dec})
0x0810:0B	Enable Vendor Calibration	RW	0x01 (1_{dec})
0x0810:0E	Swap Limit Bits	RW	0x00 (0_{dec})
0x0810:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0810:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0810:13	Limit 1	RW	0x0000 (0_{dec})
0x0810:14	Limit 2	RW	0x0000 (0_{dec})
0x0810:17	User Calibration Offset	RW	0x0000 (0_{dec})
0x0810:18	User Calibration Gain	RW	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x081E:01	**ADC raw value**	RO	0x0000 (0_{dec})

Subindex	Name	Flags	Default value
0x081F:0	**AI Vendor Data Ch. 2**	RO	12
0x081F:01	R0 Offset	RO	0x0000 (0_{dec})
0x081F:02	R0 Gain	RO	0x4000 (16384_{dec})
0x081F:03	R1 Offset	RO	0x0000 (0_{dec})
0x081F:04	R1 Gain	RO	0x4000 (16384_{dec})
0x081F:05	R2 Offset	RO	0x0000 (0_{dec})
0x081F:06	R2 Gain	RO	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x0820:0	**AO Settings Ch. 3**	RW	16
0x0820:01	Enable User Scale	RW	0x00 (0_{dec})
0x0820:02	Presentation	RW	Signed
0x0820:05	Watchdog	RW	0x00 (0_{dec})
0x0820:07	Enable User Calibration	RW	0x00 (0_{dec})
0x0820:08	Enable Vendor Calibration	RW	0x00 (0_{dec})
0x0820:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0820:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0820:13	Default output	RW	0x0000 (0_{dec})
0x0820:14	Default output ramp	RW	0xFFFF (65535_{dec})
0x0820:15	User Calibration Offset	RW	0x0000 (0_{dec})
0x0820:16	User Calibration Gain	RW	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x082E:01	**ADC raw value**	RO	0x0000 (0_{dec})

Subindex	Name	Flags	Default value
0x082F:0	**OI Vendor Data Ch 3**	RO	12
0x082F:01	R0 Offset	RO	0x0000 (0_{dec})
0x082F:02	R0 Gain	RO	0x4000 (16384_{dec})
0x082F:03	R1 Offset	RO	0x0000 (0_{dec})
0x082F:04	R1 Gain	RO	0x4000 (16384_{dec})
0x082F:05	R2 Offset	RO	0x0000 (0_{dec})
0x082F:06	R2 Gain	RO	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x0830:0	**AO Settings Ch 4**	RW	18
0x0830:01	Enable User Scale	RW	0x00 (0_{dec})
0x0830:02	Presentation	RW	Signed
0x0830:05	Watchdog	RW	0x00 (0_{dec})
0x0830:07	Enable User Calibration	RW	0x00 (0_{dec})
0x0830:08	Enable Vendor Calibration	RW	0x00 (0_{dec})
0x0830:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0830:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0830:13	Default output	RW	0x0000 (0_{dec})
0x0830:14	Default output ramp	RW	0xFFFF (65535_{dec})
0x0830:15	User Calibration Offset	RW	0x0000 (0_{dec})
0x0830:16	User Calibration Gain	RW	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x083E:01	**ADC raw value**	RO	0x0000 (0_{dec})

Subindex	Name	Flags	Default value
0x083F:0	**AI Vendor Data Ch 4**	RO	12
0x083F:01	R0 Offset	RO	0x0000 (0_{dec})
0x083F:02	R0 Gain	RO	0x4000 (16384_{dec})
0x083F:03	R1 Offset	RO	0x0000 (0_{dec})
0x083F:04	R1 Gain	RO	0x4000 (16384_{dec})
0x083F:05	R2 Offset	RO	0x0000 (0_{dec})
0x083F:06	R2 Gain	RO	0x4000 (16384_{dec})

Subindex	Name	Flags	Default value
0x0A00:0	**Diagnostics**	RO	2
0x0A00:01	Overtemperature	RO	0
0x0A00:02	Short detected	RO	0
0x0A00:03	L+ low	RO	0
0x0A00:04	2L+ low [1)]	RO	0
0x0A00:05	2L+ stat [1)]	RO	0
0x0A00:06	Reserved	RO	0
0x0A00:07	Reserved	RO	0
0x0A00:08	Reserved	RO	0
0x0A00:09	Reserved	RO	0
0x0A00:0A	Reserved	RO	0
0x0A00:0B	Reserved	RO	0
0x0A00:0C	Reserved	RO	0
0x0A00:0D	Reserved	RO	0
0x0A00:0E	Reserved	RO	0
0x0A00:0E	Reserved	RO	0
0x0A00:10	Reserved	RO	0

[1)] „2L+“ was the original name for „P24” in the IO-Link specification

Subindex	Name		Flags	Default value
0x3800:0	**AI Range Settings**		RW	10
0x3800:01	Input type Ch1	0_{dec}: -10 V…+10 V 1_{dec}: 0 mA…20 mA 2_{dec}: 4 mA…20 mA 6_{dec}: 0 V…+10 V	RW	0x0000 (0_{dec})
0x3800:02	Input type Ch2		RW	0x0000 (0_{dec})
0x3800:03	Input type Ch3		RW	0x0000 (0_{dec})
0x3800:04	Input type Ch4		RW	0x0000 (0_{dec})

Key

Flags:

- RO (Read Only): this object can only be read.

- RW (Read/Write): this object can be read or written.

6.2 Object description and parameterization

IO-Link IODD Device Description

The display corresponds to the display of the IO-Link device parameters. It is advisable to download the latest IO-Link IODD device description files from the Download section of the Beckhoff website and install them according to the installation instructions.

Parameter server (data storage)

The IO-Link box modules support the data storage functionality according to protocol revision 1.1. The parameters 0x0018 (application-specific tag) and 0x08n0 (settings) are secured with the IO-Link master. In order to use this functionality, the IO-Link master must also support it. (e.g. with the Beckhoff EP6224-xxxx IO-Link master from firmware 10) Changes to these parameters are saved by the IO-Link master and restored when the box is replace with an identical IO-Link box. How to use the data storage functionality is explained in chapter Setting of the IO-Link device parameters.

Index 0000 direct parameters 1

Index (hex)	Name	Meaning	Data type	Flags	Default
0000:01	Reserved	-	UINT8	RO	0
0000:02	Master Cycle Time	IO-Link specific	UINT8	RO	0
0000:03	Min Cycle Time	IO-Link specific	UINT8	RO	0
0000:04	M-Sequence Capability	IO-Link specific	UINT8	RO	0
0000:05	IO-Link Version ID	IO-Link specific	UINT8	RO	0
0000:06	Process Data Input Length	IO-Link specific	UINT8	RO	0
0000:07	Process Data Output Length	IO-Link specific	UINT8	RO	0
0000:08	Vendor ID	Vendor ID 1	UINT8	RO	0
0000:09	Vendor ID	Vendor ID 2	UINT8	RO	0
0000:0A	Device ID	Device ID 1	UINT8	RO	0
0000:0B	Device ID	Device ID 2	UINT8	RO	0
0000:0C	Device ID	Device ID 3	UINT8	RO	0
0000:0D	Reserved	-	UINT8	RO	0
0000:0E	Reserved	-	UINT8	RO	0
0000:0F	Reserved	-	UINT8	RO	0
0000:10	System Command	IO-Link specific		RO	0

Index 0001 direct parameters 2

Index (hex)	Name	Meaning	Data type	Flags	Default
0001:01	Device Specific Parameter 1	IO-Link specific	UINT8	RW	0
0001:02	Device Specific Parameter 2	IO-Link specific	UINT8	RW	0
0001:03	Device Specific Parameter 3	IO-Link specific	UINT8	RW	0
0001:04	Device Specific Parameter 4	IO-Link specific	UINT8	RW	0
0001:05	Device Specific Parameter 5	IO-Link specific	UINT8	RW	0
0001:06	Device Specific Parameter 6	IO-Link specific	UINT8	RW	0
0001:07	Device Specific Parameter 7	IO-Link specific	UINT8	RW	0
0001:08	Device Specific Parameter 8	IO-Link specific	UINT8	RW	0
0001:09	Device Specific Parameter 9	IO-Link specific	UINT8	RW	0
0001:0A	Device Specific Parameter 10	IO-Link specific	UINT8	RW	0
0001:0B	Device Specific Parameter 11	IO-Link specific	UINT8	RW	0
0001:0C	Device Specific Parameter 12	IO-Link specific	UINT8	RW	0
0001:0D	Device Specific Parameter 13	IO-Link specific	UINT8	RW	0
0001:0E	Device Specific Parameter 14	IO-Link specific	UINT8	RW	0
0001:0F	Device Specific Parameter 15	IO-Link specific	UINT8	RW	0
0001:10	Device Specific Parameter 16	IO-Link specific	UINT8	RW	0

Index 0002 standard command

Index (hex)	Name	Meaning	Data type	Flags	Default
0002	Standard Command	IO-Link specific	UINT8	RW	0

Index 000C Device Access Locks

Index (hex)	Name	Meaning	Data type	Flags	Default
000C:01	Parameter (write) Access Lock	0: Write access for the parameters is enabled. 1: Write access for the parameters is disabled.	BOOL	RW	FALSE
000C:02	Data Storage Lock	0: The data storage function is enabled. 1: The data storage function is disabled.	BOOL	RW	FALSE
000C:03	Local Parameterization Lock	0: Local parameterization is enabled. 1: Local parameterization is disabled.	BOOL	RW	FALSE
000C:04	Local User Interface Lock	0: The local user interface is enabled. 1: The local user interface is disabled.	BOOL	RW	FALSE

Index 0010 vendor name

Index (hex)	Name	Meaning	Data type	Flags	Default
0010	Vendor Name	Vendor name	String	R	Beckhoff Automation GmbH & Co. KG

Index 0011 vendor text

Index (hex)	Name	Meaning	Data type	Flags	Default
0011	Vendor Text	Vendor-specific text	String	R	www.beckhoff.com

Index 0012 product name

Index (hex)	Name	Meaning	Data type	Flags	Default
0012:00	Product Name	Product designation	String	R	EPI43174-0002, ERI43174

Index 0013 product ID

Index (hex)	Name	Meaning	Data type	Flags	Default
0013	Product ID	Product designation	String	R	EPI43174-0002, ERI43174

Index 0014 product text

Index (hex)	Name	Meaning	Data type	Flags	Default
0014	Product Text	Product description	String	R	2 analog input 2 analog output modules

Index 0015 serial number

Index (hex)	Name	Meaning	Data type	Flags	Default
0015	Serial Number	Serial number	String	R	00000000

Index 0016 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
0016	Hardware version	Hardware version	String	R	00

Index 0017 firmware version

Index (hex)	Name	Meaning	Data type	Flags	Default
0017	Firmware version	Firmware version	String	R	00

Index 0018 application-specific tag

Index (hex)	Name	Meaning	Data type	Flags	Default
0018:00	Application Specific Tag	Application-specific description	String	RW	********** **********

Index 0050 IO status

Index (hex)	Name	Meaning	Data type	Flags	Default
0050:01	State	Indicates the status of the IO board.	UINT16	RO	0x0000 (0_{dec})
0050:02	Status code	The IO board is working properly if state = $8_{dec.}$ and status code = 0 Other values indicate an error on the IO board.	UINT16	RO	0x0000 (0_{dec})

Index 0800 AI Settings Ch.1 (parameterization of channel 1)

Index (hex)	Name	Meaning		Data type	Flags	Default
0800:00	AI Settings Ch1	Maximum subindex		UINT8	RO	0x18 (24_{dec})
0800:01	Enable User Scale	1	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
0800:02	Presentation	0	Signed presentation (default)	UINT3	RW	0x00 (0_{dec})
		1	Unsigned presentation			
		2	Absolute value with MSB as sign (signed amount representation)			
0800:05	Siemens bits	1	Status indicators are displayed on the lowest 3 bits in the status word.	BOOLEAN	RW	0x00 (0_{dec})
0800:06	Enable filter	1	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x01 (1_{dec})
0800:07	Enable Limit 1	1	Limit 1 enabled	BOOLEAN	RW	0x00 (0_{dec})
0800:08	Enable Limit 2	1	Limit 2 enabled	BOOLEAN	RW	0x00 (0_{dec})
0800:0A	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0800:0B	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0800:0E	Swap Limit Bits	1	Swaps the two limit bits, in order to achieve compatibility with older hardware versions.	BOOLEAN	RW	0x00 (0_{dec})
0800:11	User Scale Offset	User scale offset		INT16	RW	0x0000 (0_{dec})
0800:12	User Scale Gain	User scale gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535_{dec} ($0x00010000_{hex}$) and is limited to +/- 0x7FFFF		INT32	RW	0x00010000 (65536_{dec})
0800:13	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0800:14	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0800:15	Filter Settings	This object determines the digital filter settings **for all channels of the module**, if it is activated via Enable filter (index 0x80n0:06). The possible settings are sequentially numbered.		UINT16	RW	0x0000 (0_{dec})
		0	50 Hz FIR			
		1	60 Hz FIR			
		2	IIR 1			
		3	IIR 2			
		4	IIR 3			
		5	IIR 4			
		6	IIR 5			
		7	IIR 6			
		8	IIR 7			
		9	IIR 8			
0800:17	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0800:18	User Calibration Gain	User calibration: Gain		INT16	RW	0x4000 (16384_{dec})

Index 080E ADC raw value

Index (hex)	Name	Meaning	Data type	Flags	Default
080E:01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0_{dec})

Index 080F AI vendor data Ch1

Index (hex)	Name	Meaning	Data type	Flags	Default
080F:0	AI Vendor data Ch1	Maximum subindex		RO	0x0C (12_{dec})
080F:01	R0 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
08 F:02	R0 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
080F:03	R1 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
080F:04	R1 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
080F:05	R2 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
080F:06	R2 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})

Index 0810 AI Settings Ch.2 (parameterization of channel 2)

Index (hex)	Name	Meaning		Data type	Flags	Default
0810:0	AI Settings Ch2	Maximum subindex			RO	0x18 (24_{dec})
0810:01	Enable User Scale	1	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
0810:02	Presentation	0	Signed presentation (default)	UINT3	RW	0x00 (0_{dec})
		1	Unsigned presentation			
		2	Absolute value with MSB as sign (signed amount representation)			
0810:05	Siemens bits	1	Status indicators are displayed on the lowest 3 bits in the status word.	BOOLEAN	RW	0x00 (0_{dec})
0810:07	Enable Limit 1	1	Limit 1 enabled	BOOLEAN	RW	0x00 (0_{dec})
0810:08	Enable Limit 2	1	Limit 2 enabled	BOOLEAN	RW	0x00 (0_{dec})
0810:0A	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0810:0B	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0810:0E	Swap Limit Bits	1	Swaps the two limit bits, in order to achieve compatibility with older hardware versions.	BOOLEAN	RW	0x00 (0_{dec})
0810:11	User Scale Offset	User scale offset		INT16	RW	0x0000 (0_{dec})
0810:12	User Scale Gain	User scale gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535_{dec} ($0x00010000_{hex}$) and is limited to +/- 0x7FFFF		INT32	RW	0x00010000 (65536_{dec})
0810:13	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0810:14	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0810:17	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0810:18	User Calibration Gain	User calibration: Gain		INT16	RW	0x4000 (16384_{dec})

Index 081E ADC raw value

Index (hex)	Name	Meaning	Data type	Flags	Default
081E:01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0_{dec})

Index 081F AI vendor data Ch2

Index (hex)	Name	Meaning	Data type	Flags	Default
081F:0	AI Vendor data Ch2	Maximum subindex		RO	0x0C (12_{dec})
081F:01	R0 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
081F:02	R0 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
081F:03	R1 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
081F:04	R1 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
081F:05	R2 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
081F:06	R2 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})

Index 0820 AO Settings Ch.3 (parameterization of channel 3)

Index (hex)	Name	Meaning		Data type	Flags	Default
0820:0	AO Settings Ch3	Maximum subindex			RO	0x16 (22_{dec})
0820:01	Enable User Scale	1	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
0820:02	Presentation	0	Signed presentation (default)	UINT3	RW	0x00 (0_{dec})
		1	Unsigned presentation			
		2	Absolute value with MSB as sign (signed amount representation)			
0820:05	Watchdog	0	Default watchdog value The default value (index 0x8020:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp active The ramp (index 0x8020:14) for changing to the default value (index 0x8020:13) is active.			
		2	Last output value active In the event of a fault (watchdog drop) the last process data is issued.			
0820:07	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0820:08	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0820:11	User Scale Offset	User scale offset		INT16	RW	0x0000 (0_{dec})
0820:12	User Scale Gain	User scale gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535_{dec} ($0x00010000_{hex}$) and is limited to +/- 0x7FFFF		INT32	RW	0x00010000 (65536_{dec})
0820:13	Default output	Output value in watchdog case, if activated via index 0x8020:05		INT16	RW	0x0000 (0_{dec})
0820:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		INT16	RW	0xFFFF (65535_{dec})
0820:15	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0820:16	User Calibration Gain	User calibration: Gain		INT16	RW	0x4000 (16384_{dec})

Index 082E ADC raw value

Index (hex)	Name	Meaning	Data type	Flags	Default
082E:01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0_{dec})

Index 082F AO Vendor Data Ch3

Index (hex)	Name	Meaning	Data type	Flags	Default
082F:0	AO Vendor Data Ch3	Maximum subindex		RO	0x0C (12_{dec})
082F:01	R0 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:02	R0 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
082F:03	R1 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:04	R1 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
082F:05	R2 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:06	R2 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})

Index 0830 AO Settings Ch.4 (parameterization of channel 4)

Index (hex)	Name	Meaning		Data type	Flags	Default
0830:0	AO Settings Ch4	Maximum subindex			RO	0x16 (22_{dec})
0830:01	Enable User Scale	1	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
0830:02	Presentation	0	Signed presentation (default)	UINT3	RW	0x00 (0_{dec})
		1	Unsigned presentation			
		2	Absolute value with MSB as sign (signed amount representation)			
0830:05		0	Default watchdog value The default value (index 0x8030:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp active The ramp (index 0x8030:14) for changing to the default value (index 0x8030:13) is active.			
		2	Last output value active In the event of a fault (watchdog drop) the last process data is issued.			
0830:07	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0830:08	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0830:11	User Scale Offset	User scale offset		INT16	RW	0x0000 (0_{dec})
0830:12	User Scale Gain	User scale gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535_{dec} ($0x00010000_{hex}$) and is limited to +/- 0x7FFFF		INT32	RW	0x00010000 (65536_{dec})
0830:13	Default output	Output value in watchdog case, if activated via index 0x8030:05		INT16	RW	0x0000 (0_{dec})
0830:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		INT16	RW	0xFFFF (65535_{dec})
0830:15	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0830:16	User Calibration Gain	User calibration: Gain		INT16	RW	0x4000 (16384_{dec})

Index 083E ADC raw value

Index (hex)	Name	Meaning	Data type	Flags	Default
083E:01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0_{dec})

Index 083F AI vendor data Ch4

Index (hex)	Name	Meaning	Data type	Flags	Default
083F:0	AI Vendor Data Ch4	Maximum subindex		RO	0x0C (12_{dec})
082F:01	R0 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:02	R0 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
082F:03	R1 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:04	R1 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
082F:05	R2 Offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
082F:06	R2 Gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})

Index 0A00 diagnostics

Index (hex)	Name	Meaning	Data type	Flags	Default
0A00:0	Diagnostics	Maximum subindex		RO	0x02 (2_{dec})
0A00:01	Overtemperature	Overheating of the IO-Link module	BOOLEAN	RW	0x00 (0_{dec})
0A00:02	Short detected	Short circuit on the IO-Link C/Q data line	BOOLEAN	RW	0x00 (0_{dec})
0A00:03	L+ low	Power supply voltage too low (< 18 V)	BOOLEAN	RW	0x00 (0_{dec})
0A00:04	2L+ low [1)]	The supply voltage P24 is too low (< 18 V)	BOOLEAN	RW	0x00 (0_{dec})
0A00:05	2L+ stat [1)]	The supply voltage P24 is not available (< 8 V)	BOOLEAN	RW	0x00 (0_{dec})
0A00:06 - 0A00:10	Reserved	-	BOOLEAN	RW	0x00 (0_{dec})

[1)] „2L+“ was the original name for „P24” in the IO-Link specification.

Index 3800 AI range settings

Index (hex)	Name	Meaning	Data type	Flags	Default
3800:0	AI Range Settings	Maximum subindex		RW	0x0A (10_{dec})
3800:01	Input type Ch1	Input signal range for channel 1 0: -10 V...+10 V 1: 0 mA…20 mA 2: 4 mA…20 mA 3: 0 V…10 V	UINT16	RW	0x0000 (0_{dec})
3800:02	Input type Ch2	Input signal range for channel 2 (values see channel 1)	UINT16	RW	0x0000 (0_{dec})
3800:03	Input type Ch3	Input signal range for channel 3 (values see channel 1)	UINT16	RW	0x0000 (0_{dec})
3800:04	Input type Ch4	Input signal range for channel 4 (values see channel 1)	UINT16	RW	0x0000 (0_{dec})

7 Appendix

7.1 General operating conditions

Protection degrees (IP-Code)

The standard IEC 60529 (DIN EN 60529) defines the degrees of protection in different classes.

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø 50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø 12.5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø 2.5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø 1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.
2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water.

Chemical Resistance

The Resistance relates to the Housing of the IP67 modules and the used metal parts. In the table below you will find some typical resistance.

Character	Resistance
Steam	at temperatures >100°C: not resistant
Sodium base liquor (ph-Value > 12)	at room temperature: resistant > 40°C: not resistant
Acetic acid	not resistant
Argon (technical clean)	resistant

Key

- resistant: Lifetime several months
- non inherently resistant: Lifetime several weeks
- not resistant: Lifetime several hours resp. early decomposition

7.2 Accessories

Mounting

Ordering information	Description	Link
ZS5300-0011	Mounting rail	Website

Cables

A complete overview of pre-assembled cables for fieldbus components can be found here.

Ordering information	Description	Link
ZK2000-6xxx-xxxx	Sensor cable M12, 4-pin	Website
ZK2000-7xxx-0xxx	Sensor cable M12, 4-pin + shield	Website

Labeling material, protective caps

Ordering information	Description
ZS5000-0020	Protective cap for M12 sockets, IP67 (50 pcs.)
ZS5100-0000	Inscription labels, unprinted, 4 strips of 10
ZS5000-xxxx	Printed inscription labels on enquiry

Tools

Ordering information	Description
ZB8801-0000	Torque wrench for plugs, 0.4…1.0 Nm
ZB8801-0002	Torque cable key for M12 / wrench size 13 for ZB8801-0000
ZB8801-0003	Torque cable key for M12 field assembly / wrench size 18 for ZB8801-0000

Further accessories

Further accessories can be found in the price list for fieldbus components from Beckhoff and online at https://www.beckhoff.com.

7.3 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49 5246 963 157
Fax:	+49 5246 963 9157
e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
Fax:	+49 5246 963 479
e-mail:	service@beckhoff.com

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
Fax:	+49 5246 963 198
e-mail:	info@beckhoff.com
web:	https://www.beckhoff.com

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com