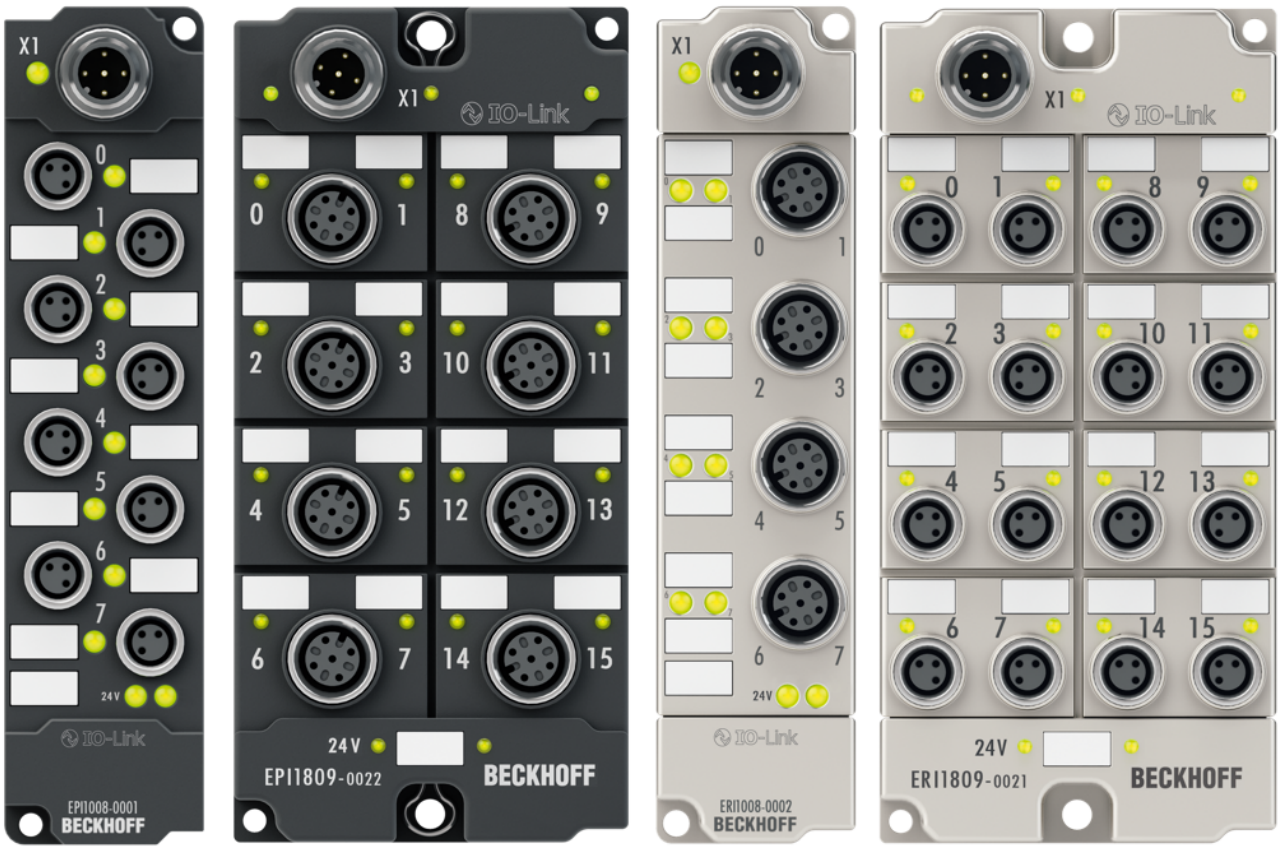

Documentation

EPI3xxx, ERI3xxx

IO-Link Box Modules with analog inputs

Version: 1.2
Date: 2018-07-10

BECKHOFF

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

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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, DE102004044764, DE102007017835 with corresponding applications or registrations in various other countries.

The TwinCAT Technology is covered, including but not limited to the following patent applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

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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	Modifications
1.2	• Chapter "Process data" added
1.1	• Update connection assignment • Update structure • Update chapter "Connection IO-Link Master"
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

WW - week of production (calendar week)
YY - year of production
FF - firmware version
HH - hardware version

Example with D No. 29 10 02 01:

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 EPI3xxx, ERI3xxx

Analog input modules, 24 V_{DC}

Module	Number of analog inputs	Signal connection	Housing	Comment
EPI3174-0002 [▶ 8]	4	4 x M12	Industrial housing	four configurable analog differential inputs
ERI3174-0002 [▶ 8]	4	4 x M12	Die-cast zinc housing	four configurable analog differential inputs

2.2 EPI3174-0002, ERI3174-0002

2.2.1 Introduction

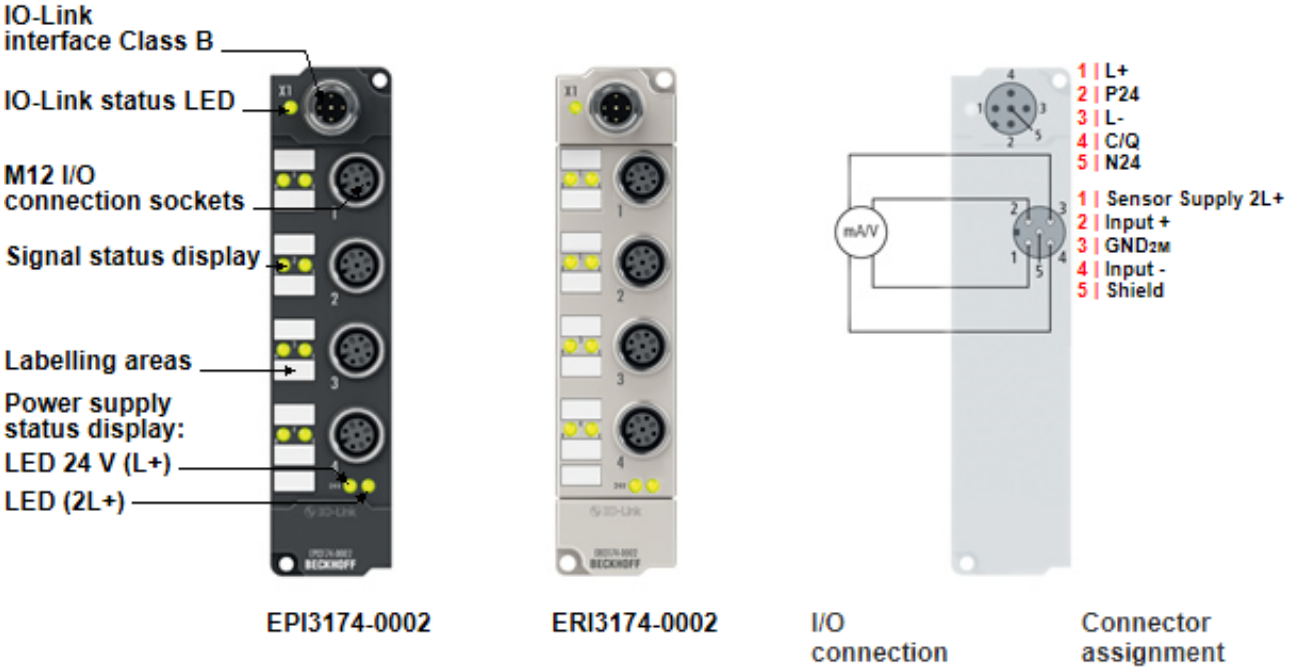


Fig. 1: EPI3174-0002, ERI3174-0002

IO-Link box with four configurable analog differential inputs

The EP3174-0002 and ERI3174-0002 IO-Link boxes have four analog inputs which can be individually parameterized, so that they process signals either in the -10 V to +10 V range or the 0/4 mA…20 mA range. The voltage or input current is digitized with a resolution of 16 bits, and is transmitted (electrically isolated) to the higher-level automation device.

The four input channels have differential inputs and possess a common, internal ground potential. The input filter and therefore the conversion times are configurable in a wide range. The inputs can, if required, be scaled differently, and automatic limit value monitoring is also available. Parameterization is done via IO-Link. The parameters are stored in the module.

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.

2.2.2 Technical data

Technical data	EPI3174-0002	ERI3174-0002
Communication	IO-Link	
Data transfer rate	230.4 kBaud (COM 3)	
IO-Link connection	1 x M12 connector, a-coded	
Specification version	IO-Link V1.1, Class B	
Requirements for IO-Link master	V1.1	
Number of inputs	4	
Input connections [▶ 22]	4 x M12 socket, screwable	
Connection technology	two-wire, four-wire	
Signal type	Configurable: 0 V…+10 V -10 V…+10 V 0 mA…20 mA 4 mA…20 mA	
Internal resistance	> 200 kΩ (typ. 85 Ω + diode voltage)	
Common-mode voltage U_{CM}	max. 35 V	
Resolution	16 bit (including sign)	
Input filter	Configurable	
Input filter limit frequency	5 kHz	
Conversion time	~ 100 µs	
Measuring error	< ±0.3 % (relative to full scale value)	
Number of outputs	0	
Current consumption of the module circuitry	typically 100 mA from L_+	
Supply of the module electronics	L_+	
Sensor supply	$2L_+$, DC, freely selectable up to 30 V	
Process image	Inputs: 4 x 16 bit, status: 4 x 16 bit	
Electrical isolation	$L_+/2L_+$: yes	
Housing	Industrial housing (polyamide PA6)	Die-cast zinc housing
Weight	typ. 165 g	typ. 250 g
Permissible ambient temperature during operation	-25°C ... +60°C	
Permissible ambient temperature during storage	-40°C ... +85°C	
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP65, IP66, IP67 (conforms to EN 60529) See also chapter General operating conditions [▶ 94]	
Installation position	variable	
Approvals	CE, UL	

2.2.3 Process image

Channel 1 Status and Channel 1 Value

The IO-Link device is connected to IO-Link port1 of the IO-Link master (EP6224-2022).

- Under **Channel 1 Status** you will find the status information (16 bits) of the first analog channel. (here as an example the process image of the EPI3174-0002).
- Under **Channel 1 Value** you will find the analog value (16 bits) of the first analog channel.
- **Channels 2 to 4**
  The data of analog channels 2 to 4 have the same structure as those of the 1st channel.

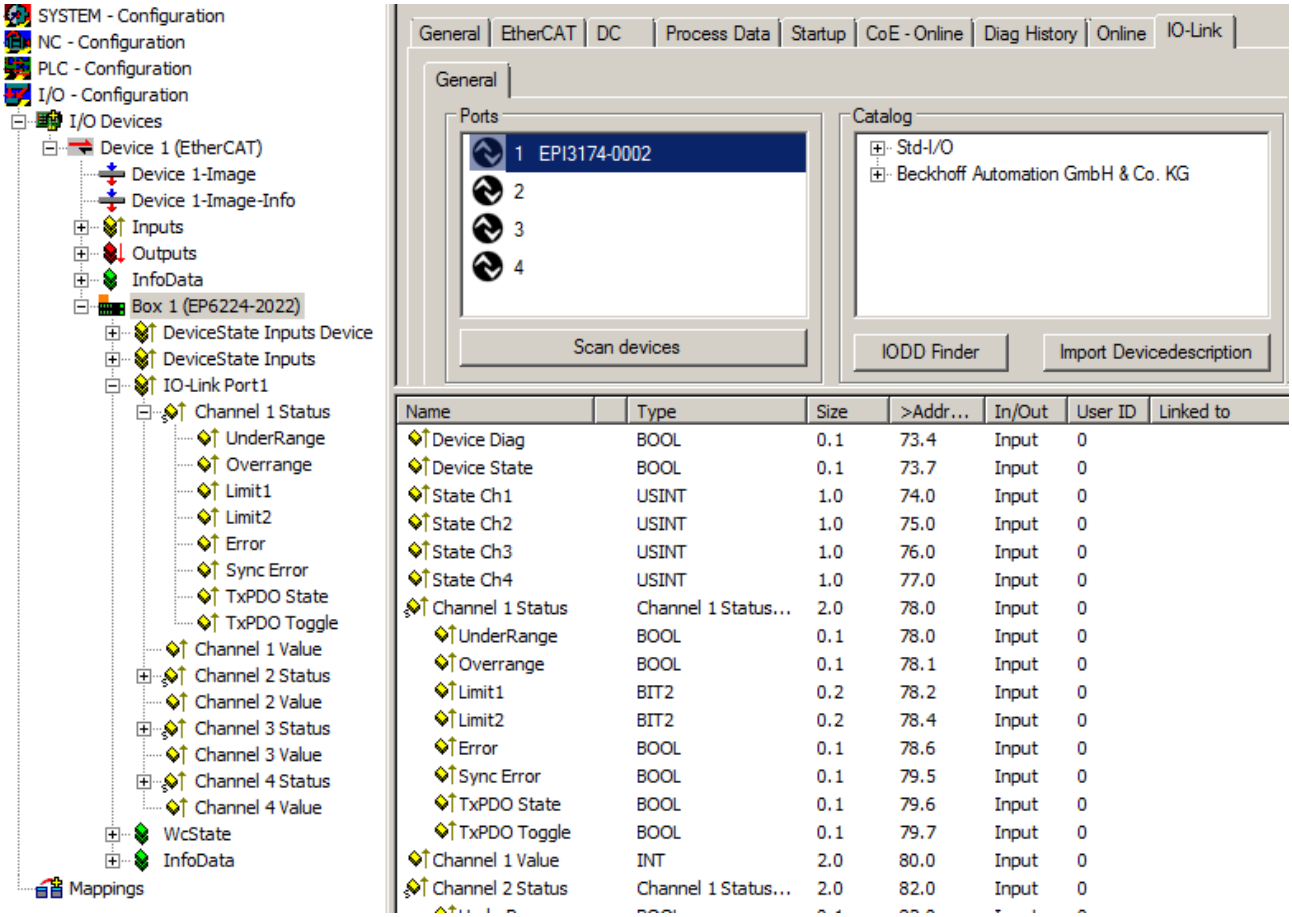


Fig. 2: EPI3174-0002 - Process image in tree and list view

Also see about this

EPI3xxx, ERI3xxx - Process data [▶ 60]

3 IO-Link basics

IO-Link represents a communication system for the connection of intelligent sensors and actuators to an automation system in the IEC 61131-9 standard under the designation "Single-drop digital communication interface for small sensors and actuators" (SDCI).
The electrical connection data and the communication protocol are standardized and summarized in the IO-Link specification.

IO-Link specification

The development of the EP6224-xxxxxx was based on IO-Link specification 1.1. At the time of the preparation of this documentation, the IO-Link specification is entering the IEC standardization and will be adopted in extended form as IEC 61131-9. The new designation SDCI will be introduced at the same time. As a member of the respective committee, Beckhoff supports the development of IO-Link and reflects changes to the specification in its products.

3.1 IO-Link system configuration

An IO-Link system consists of an IO-Link master, one or more IO-Link devices and sensors or actuators. The IO-Link master provides the interface to the higher-level controller and controls the communication with the connected IO-Link devices. The EP6224-xxxx IO-Link master module from Beckhoff has four IO-Link ports, each of which can be connected to an IO-Link-Device. IO-Link is therefore not a fieldbus, but a peer-to-peer connection (see figure below).

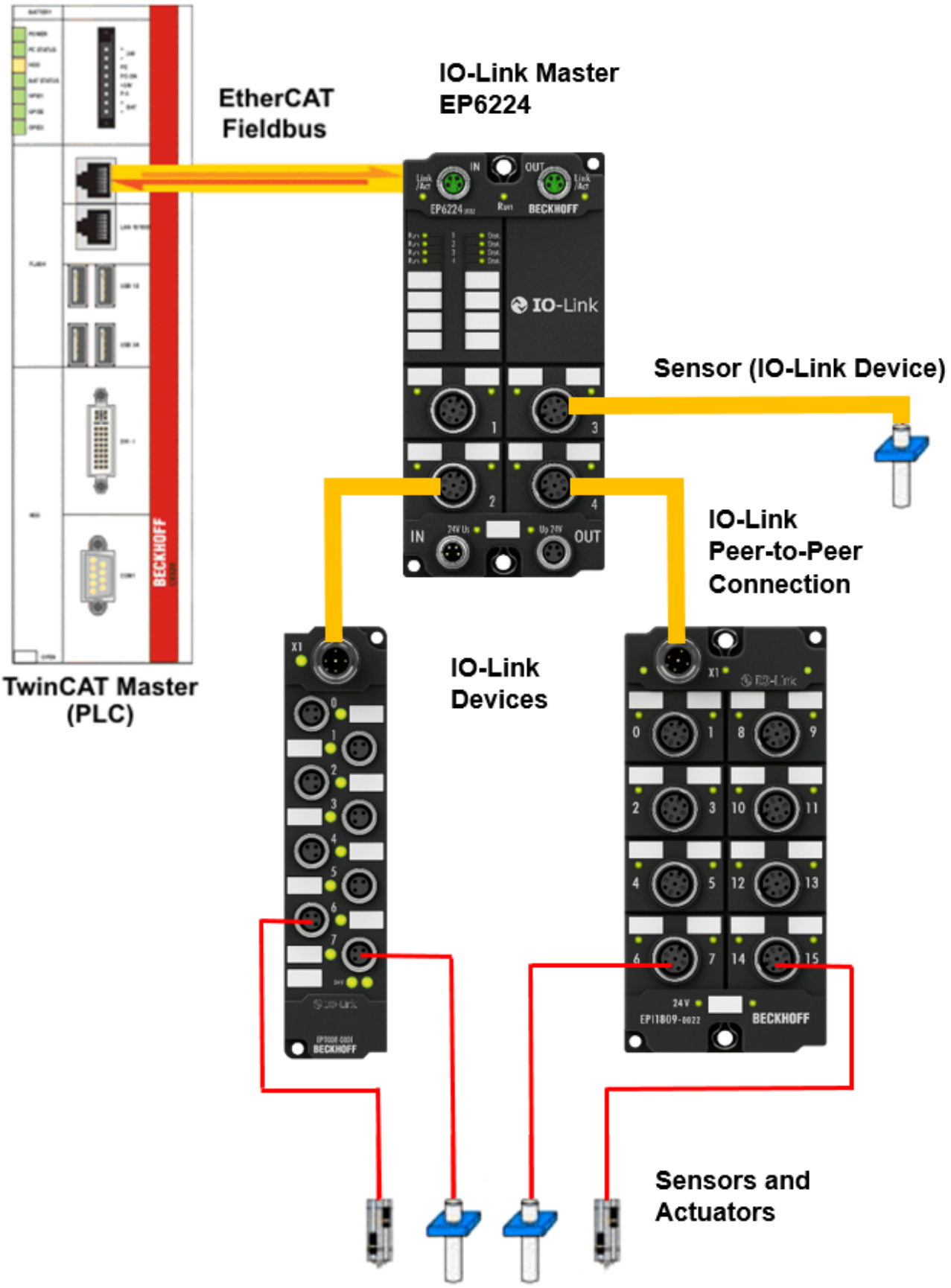


Fig. 3: IO-Link overview: Peer-to-peer communication

The connected IO-Link devices have individual parameter information, which is detected during automatic scanning with TwinCAT and transferred to the System Manager (see chapter "Basic function principles", integration of IO-Link devices). Module-specific information can be imported offline in the form of an IO-Link Device Description (IODD) and transferred to TwinCAT.

- How to manually configure (physically non-existent) IO-Link masters and devices in TwinCAT is described under the following two links: Offline configuration settings - TwinCAT (master) [▶ 26], 1. Importing the device description IODD [▶ 53]
- How to configure physically existent IO-Link masters and devices in TwinCAT is described under the following two links: Online configuration settings - TwinCAT (master) [▶ 32], 2. Automatic scanning of the IO-Link ports [▶ 56]

3.2 Establishment of IO-Link communication

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 [▶ 56] the IO-Link port.

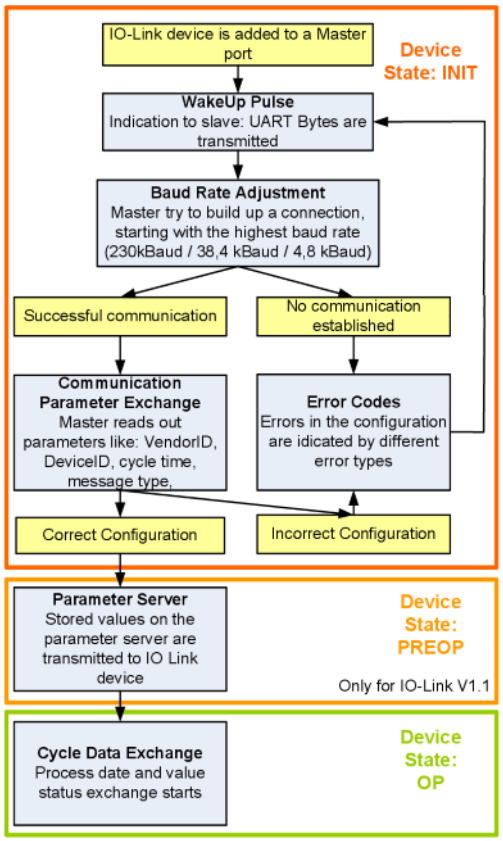


Fig. 4: Establishment of IO-Link communication

- If an IO-Link device is connected to a master port, the master attempts to establish communication. A defined signal level, the **WakeUp pulse**, signals to the slave that UART bytes are to be sent from now on.
  From this point on, all data will be interpreted by the IO-Link slave as UART bytes.
- The master runs through all baud rates [▶ 15], starting with the fastest baud rate (COM3 = 230 kbaud). A successful connection has been established when the slave responds to the WakeUp 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 slave, 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 [▶ 14] 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 slave.

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 [▶ 56] with TwinCAT and adopted in the System Manager (cf. integration of the IO-Link devices).

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 [▶ 62]. The Beckhoff IO-Link master supports specification V1.1 from FW 07.

- 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 & 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 & 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 via the Master's special event. 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.
  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 types and automatically adjusts the data transfer rate to that of the IO-Link device.
An IO-Link device usually supports only one data transfer rate. IO-Link devices with different data transfer rate 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

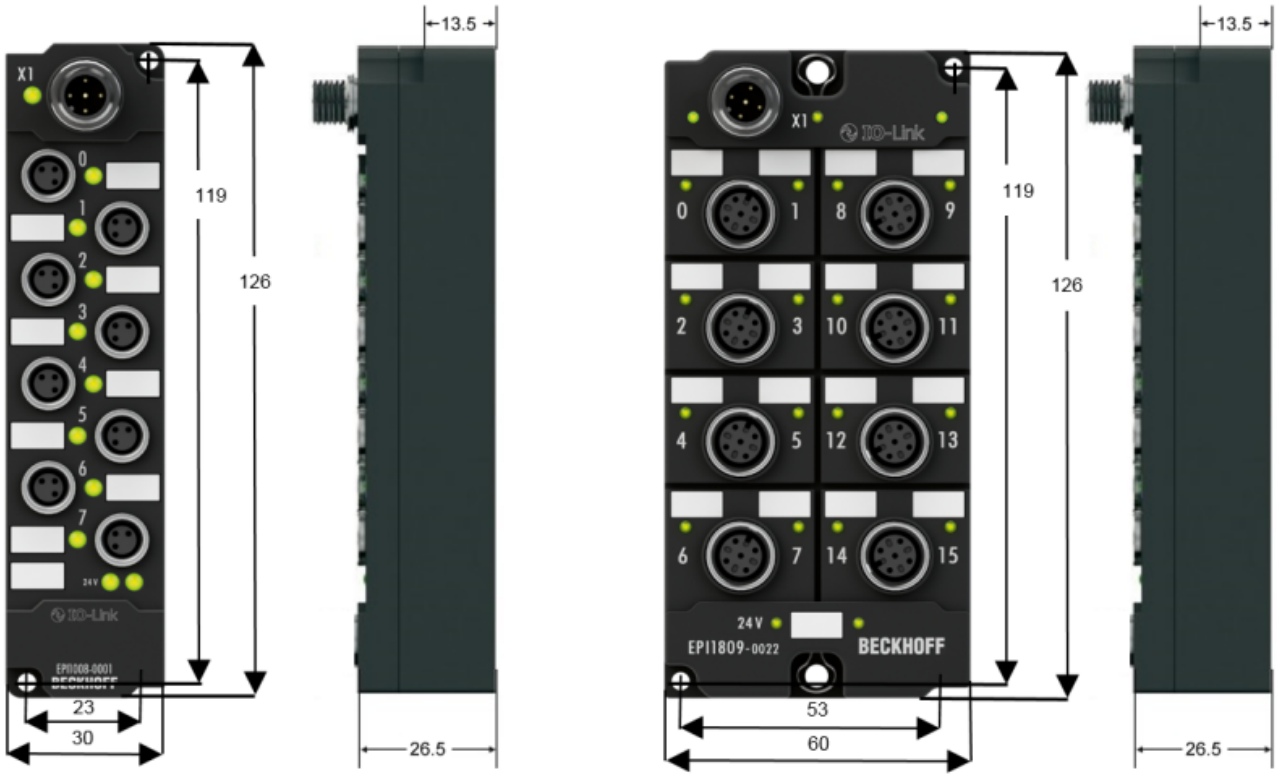


Fig. 5: Dimensions of the IO-Link box modules

All dimensions are given in millimeters.

Housing features

IO-Link box modules	Narrow housing	Wide housing
Housing material	PA6 (polyamide) for EPIxxxx or die-cast zinc for ERIxxxx	
Sealing compound	Polyurethane	
Mounting	two fastening holes Ø 3 mm for M3	two fastening hole Ø 3 mm for M3 two fastening holes Ø 4.5 mm for M4
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	approx. 126 x 60 x 26.5 mm
Weight	approx. 125 g, depending on module type	approx. 250 g, depending on module type

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.

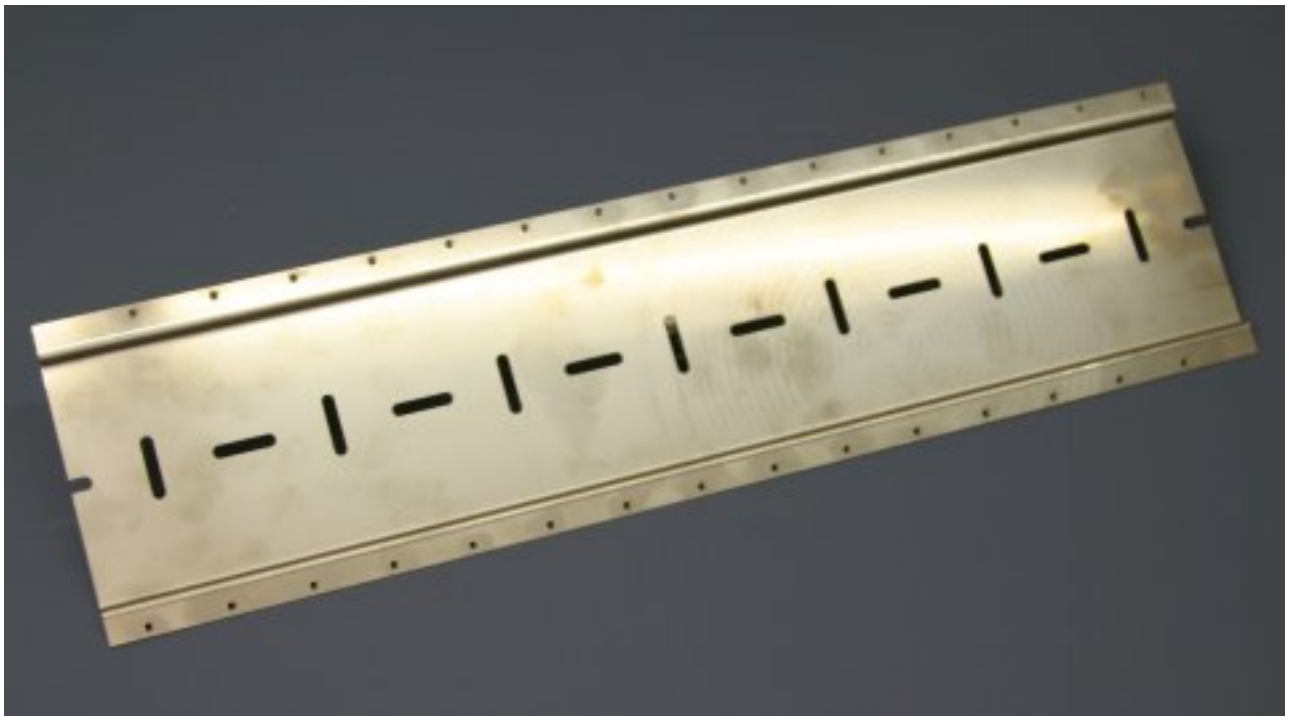


Fig. 6: Mounting Rail ZS5300-000

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 torque for connectors

M8 connector

We recommend fastening the M8 connector with a torque of 0.4 Nm.

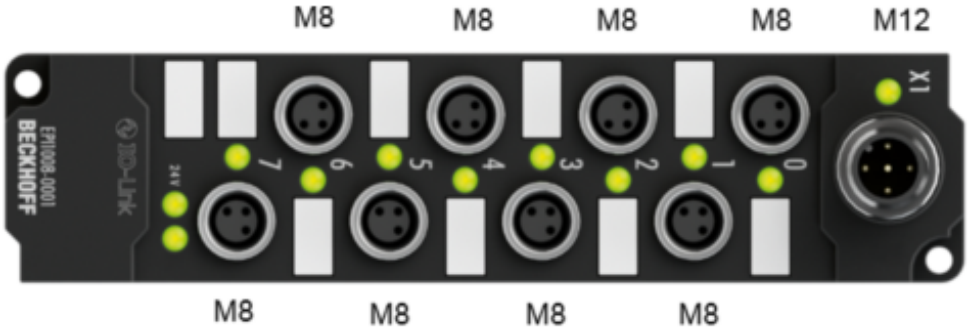


Fig. 7: IO-Link box with M8 and M12 connectors

M12 connector

We recommend fastening the M12 connector with a torque of 0.6 Nm.

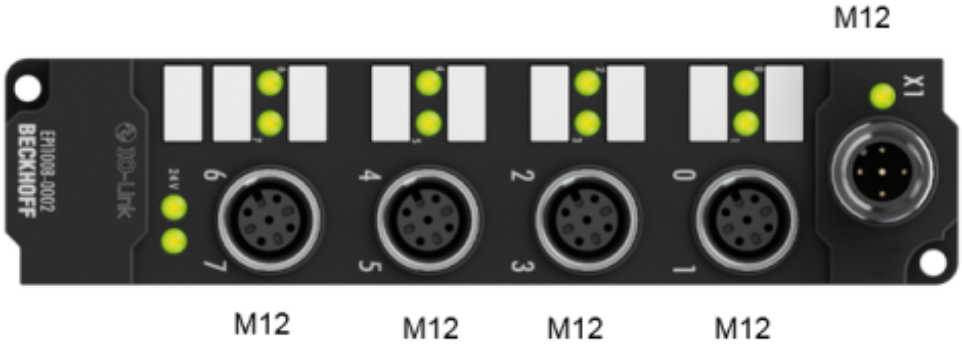


Fig. 8: IO-Link box with M12 connectors

Torque wrench

Fig. 9: Torque wrench, ZB8801

Ensure the proper torque is used

Use the torque wrenches available from Beckhoff to tighten the plug connectors! You will find them under the following link.

IP67 Box - Accessories [▶ 95]

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".

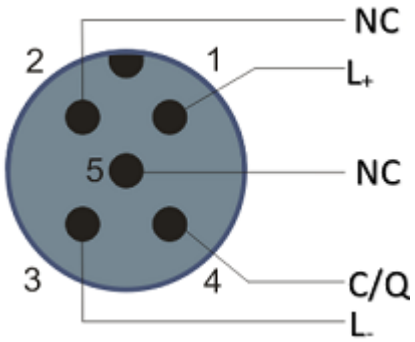


Fig. 10: Pin assignment Port Class A, Pin 2 not connected

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

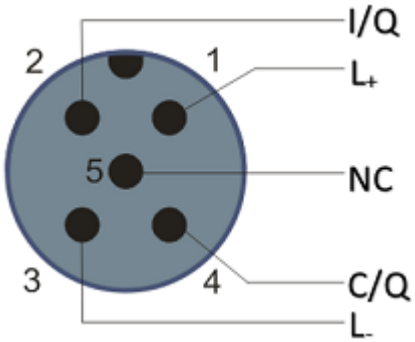


Fig. 11: Pin assignment Port Class A, Pin 2 connected

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

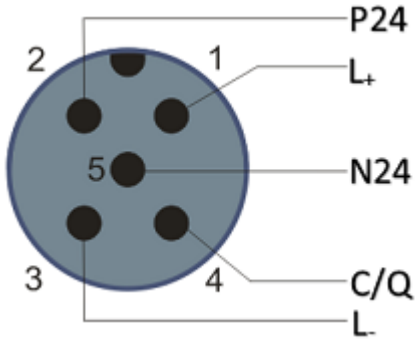


Fig. 12: Pin assignment Port Class B

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

Fig. 13: 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. 14: Example IO-Link cable: male to female

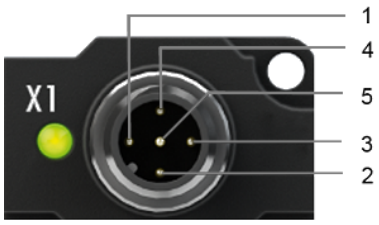
The cables available from Beckhoff for the IO-Link system can be found under the following link under "Accessories": https://beckhoff.de/english/fieldbus_components_accessories/m12_sensor_5w.htm?id=51657421126830456

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 [▶ 90]) is described in the section Object description and parameterization.

Fig. 15: 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 $2L_+$ ok
	off	Voltage $2L_+$ too low, short-circuit

4.4 Signal connection

Analog voltage inputs M12, -10 V to +10 V

The input voltage is measured as a differential signal. One differential input is available for each socket.

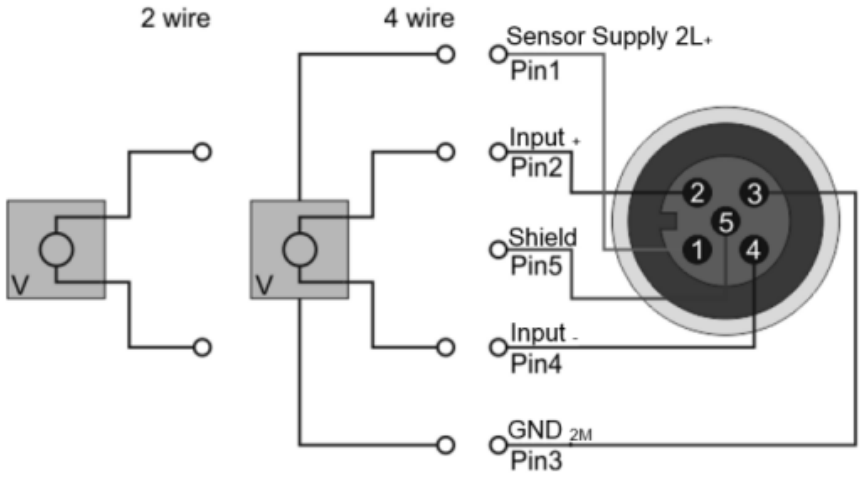


Fig. 16: Pin assignment, analog voltage inputs M12

Analog current inputs M12, 0 mA to 20 mA or 4 mA to 20 mA

The input current is measured as a differential signal. One differential input is available for each socket.

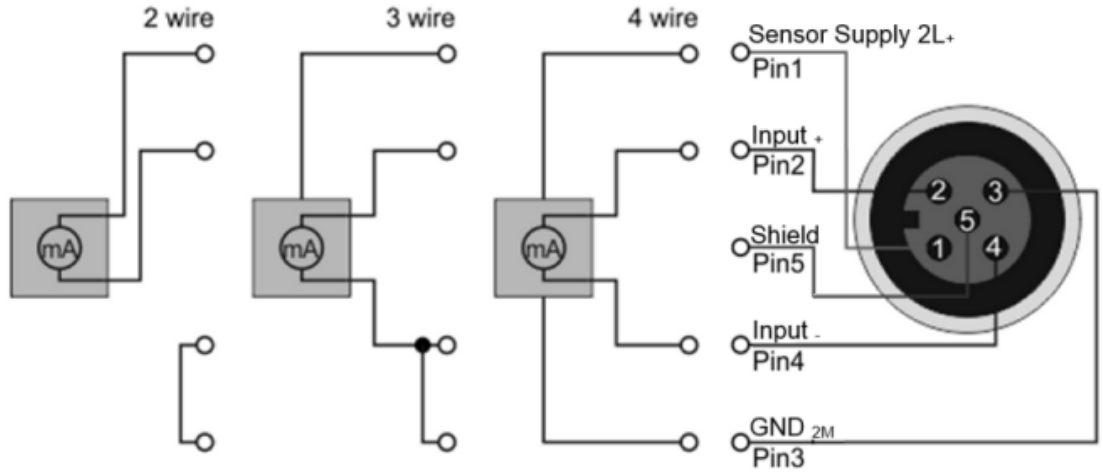


Fig. 17: Pin assignment, analog current inputs M12

GND connections

If several sensors are connected to a box whose GND connections are not electrically isolated, GND must be connected to GND $_{2M}$.

Status LEDs on M12 connections 1 to 4 (inputs)

Fig. 18: Status LEDs - M12 connections, analog input

Connec-tion	LED	Display	Meaning
M12 socket 1-4	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: Broken wire or measured value outside the measuring range

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

4.5 UL Requirements

The installation of UL-certified IP67 Box modules must meet the following requirements.

Supply voltage

⚠ CAUTION

CAUTION!

- from an isolated source protected by a fuse of max. 4 A (according to UL248) or
- from a voltage supply complying with *NEC class 2*.
  An *NEC class 2* voltage source must not be connected in series or parallel with another *NEC class 2* voltage source!

⚠ CAUTION

CAUTION!

In order to comply with UL requirements, the IP67 Box modules must not be connected to unlimited voltage sources!

Networks

⚠ CAUTION

CAUTION!

In order to comply with UL requirements, the IP67 Box modules must not be connected to telecommunications networks!

Ambient temperature

⚠ CAUTION

CAUTION!

In order to comply with UL requirements, the IP67 Box modules must only be operated in an ambient temperature range between 0 and 55 °C!

Marking for UL

All UL (Underwriters Laboratories) certified IP67 Box modules have the following markings.

Fig. 19: UL marking

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 under the following link: https://beckhoff.de/english/ethercat-box/ethercat_box_cables.htm?id=690338951657421

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 [▶ 19]

Fig. 20: Example IO-Link cable: male to female

Sensor cable

Fig. 21: Selection of sensor cables available from Beckhoff

5 Commissioning/configuration of IO-Link master/ device

5.1 IO-Link master

5.1.1 Offline configuration settings - TwinCAT (master)

In this part of the documentation is the manual configuration of the IO-Link master in TwinCAT described.

Distinction between Online and Offline

The distinction between online and offline refers to the presence of the actual I/O environment (drives, terminals, box-modules).

- **Offline**
  If the configuration is to be prepared in advance of the system configuration as a programming system, e.g. on a laptop, this is only possible in “Offline configuration” mode. In this case all components have to be entered manually in the configuration, e.g. based on the electrical design (as described under 1. Importing the device description IODD [▶ 53]).
- **Online**
  If the designed control system is already connected to the EtherCAT system and all components are energized and the infrastructure is ready for operation, the TwinCAT configuration can simply be generated through “scanning” from the runtime system. This is referred to as online configuration. In any case, during each startup the EtherCAT master/ IO-Link master checks whether the devices it finds match the configuration. This test can be parameterized in the extended device settings.

To take advantage of the current features/settings of the master, the latest version of the ESI file should always be downloaded. Therefore it is necessary to consider the following note first.

Installation of the latest ESI-XML device description

The TwinCAT System Manager needs the device description files for the devices to be used in order to generate the configuration in online or offline mode. The device description is contained in the so-called ESI files (EtherCAT Slave Information) in XML format. These files can be requested from the respective manufacturer and are made available for download. The ESI files for Beckhoff EtherCAT devices are available on the Beckhoff website. The ESI files should be saved in the TwinCAT installation directory (default: C:\TwinCAT\IO\EtherCAT). The files are read (once) when a new System Manager window is opened. A TwinCAT installation includes the set of Beckhoff ESI files that was current at the time when the TwinCAT build was created. For TwinCAT 2.11 and higher, the ESI directory can be uploaded from the System Manager, if the programming PC is connected to the internet (TwinCAT → EtherCAT-Devices → Update Device Description…) see following figure.

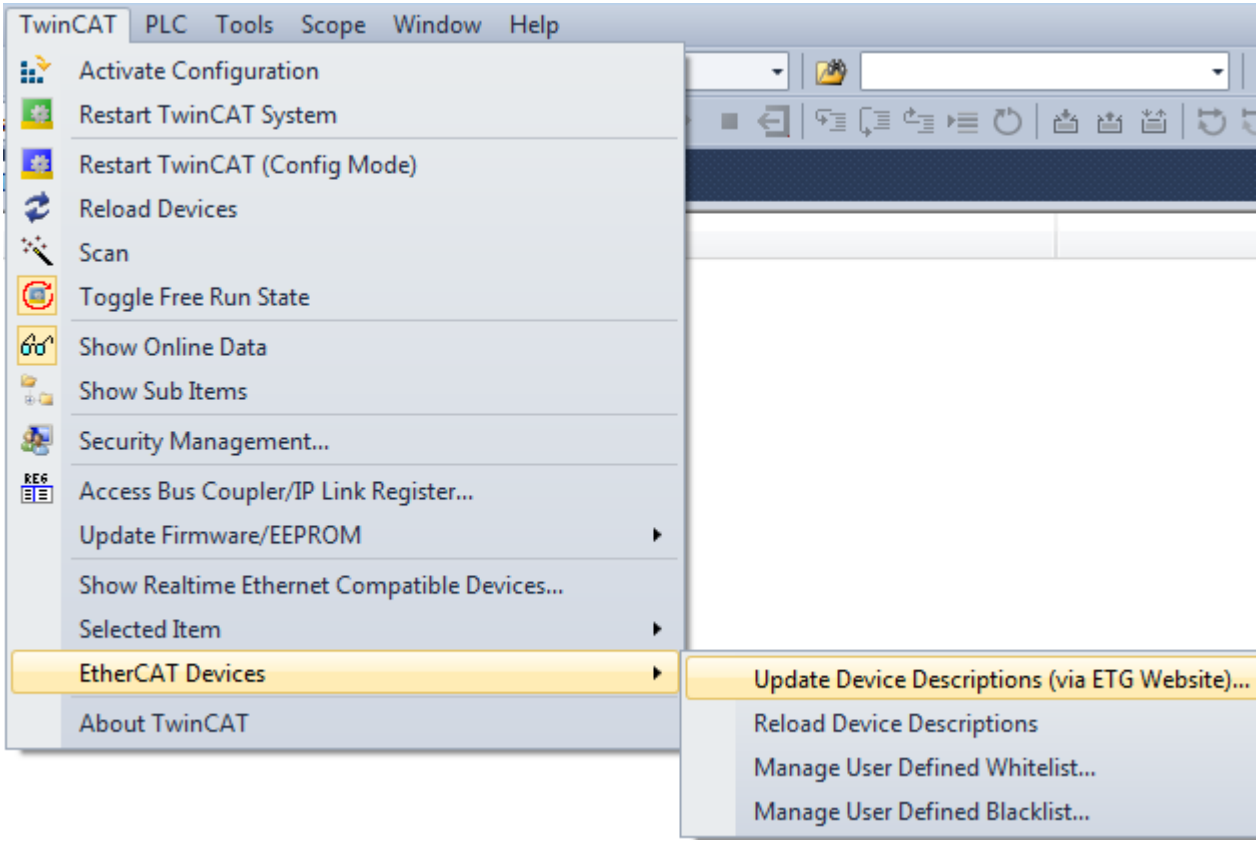


Fig. 22: Update Device Descriptions

Appending a module manually

- The EtherCAT system must be in a safe, de-energized state before the EtherCAT modules are connected to the EtherCAT network!
- Switch on the operating voltage, open the TwinCAT System Manager [▶ 38] (Config mode)
- Append a new I/O device. In the dialog that appears select the device *EtherCAT (Direct Mode),* and confirm with *OK*.

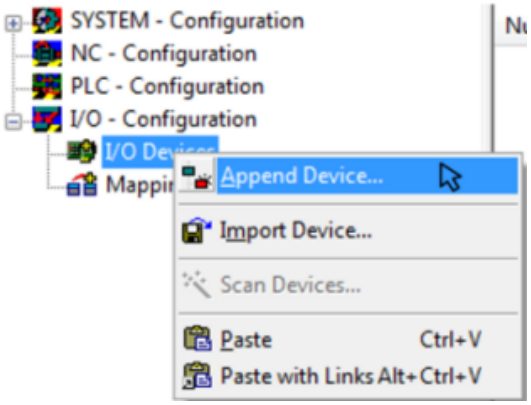


Fig. 23: Appending a new I/O device (I/O Devices -> right-click -> Append Device...)

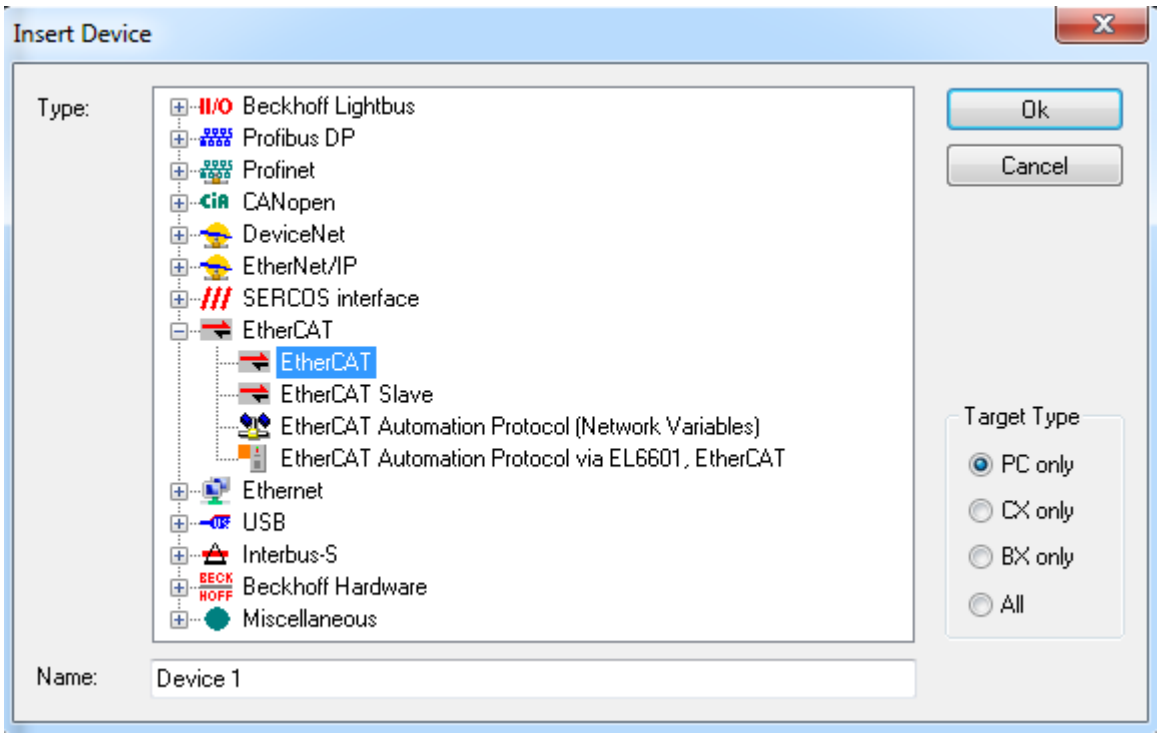


Fig. 24: Selecting the device EtherCAT

- Append a new box.

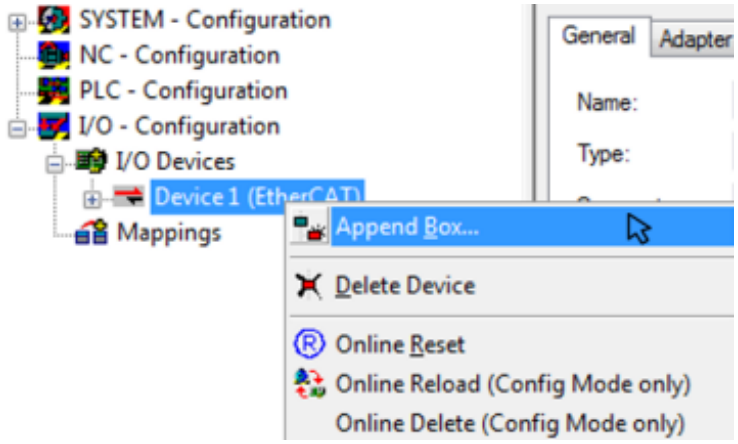


Fig. 25: Appending a new box (Device -> right-click -> Append Box...)

- In the dialog that appears select the desired box (e.g. EP6224-2022), and confirm with *OK*.

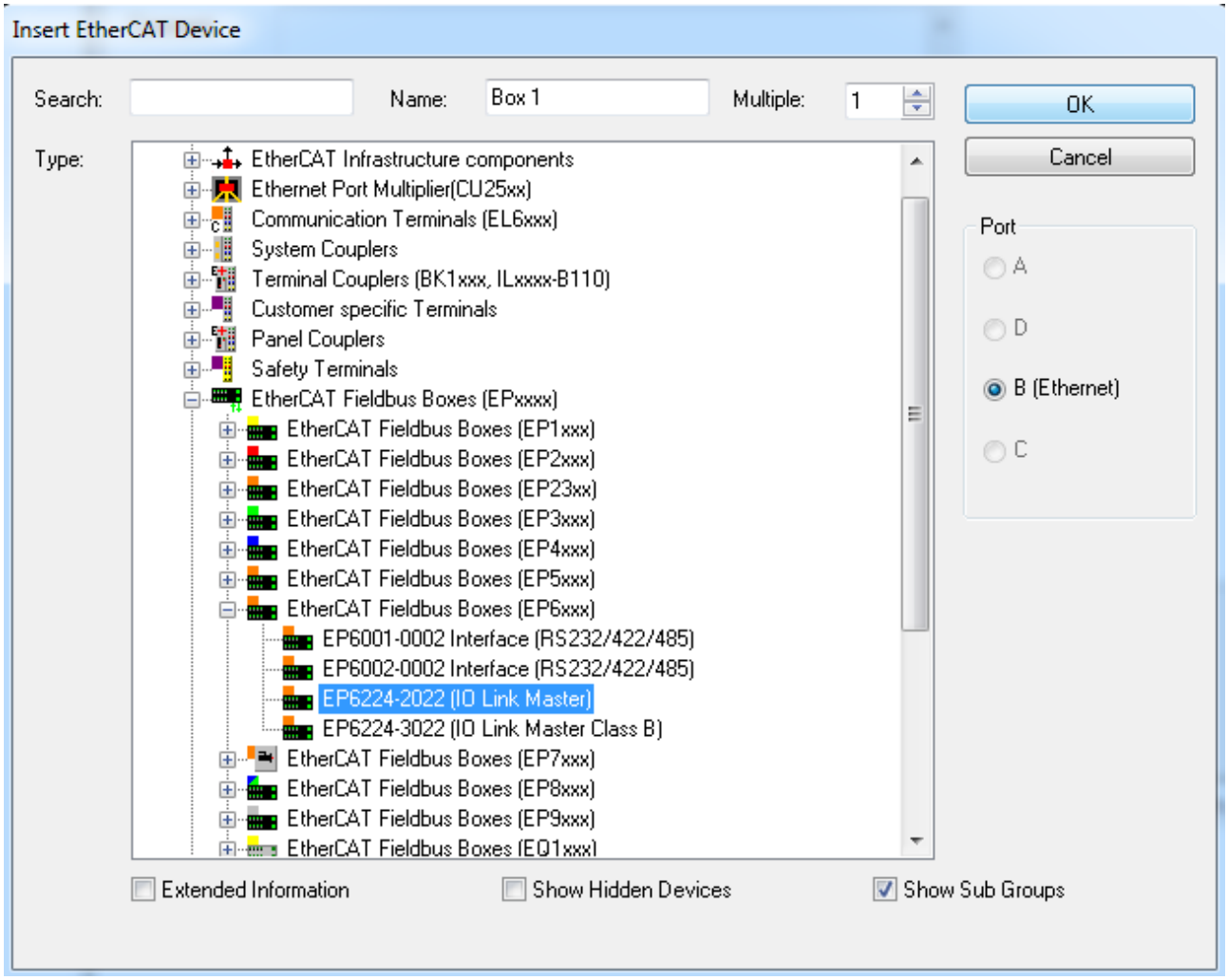


Fig. 26: Selecting a Box (e.g. EP6224-2022)

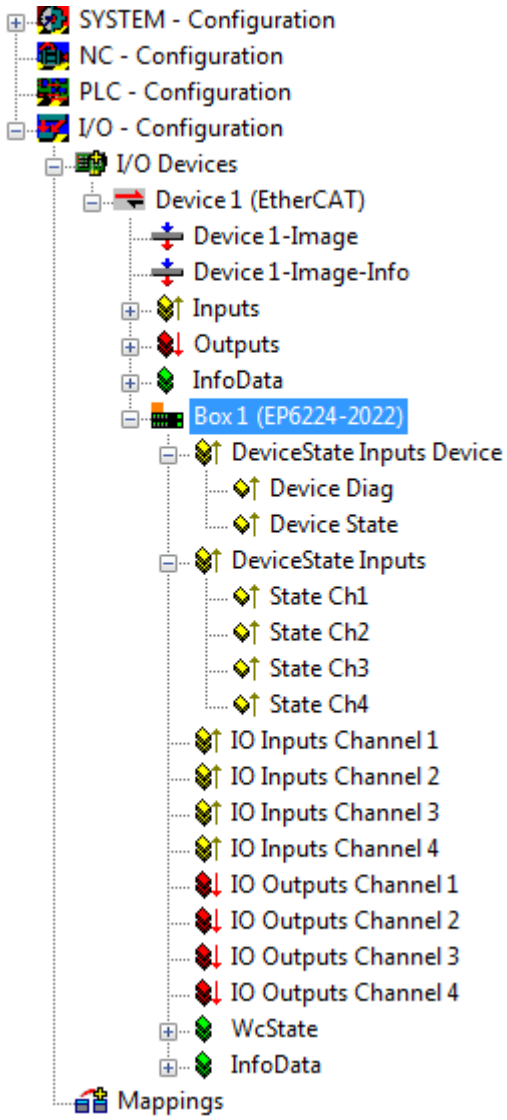


Fig. 27: Appended Box in the TwinCAT tree

In this section is described, how to configure the IO-Link master in TwinCAT and the integration of IO-Link devices.

Configuration of the IO-Link master

Configuration of the IO-Link master requires a plug-in, which is usually supplied with the TwinCAT installation. When the IO-Link master is added to the TwinCAT System Manager (see section Offline [▶ 26] / Online [▶ 32] configuration settings - TwinCAT (master)) an additional tab called IO-Link is created (see following figure). If the tab is not displayed, the associated System Manager extension is missing. You can install it separately. Please contact support [▶ 96].

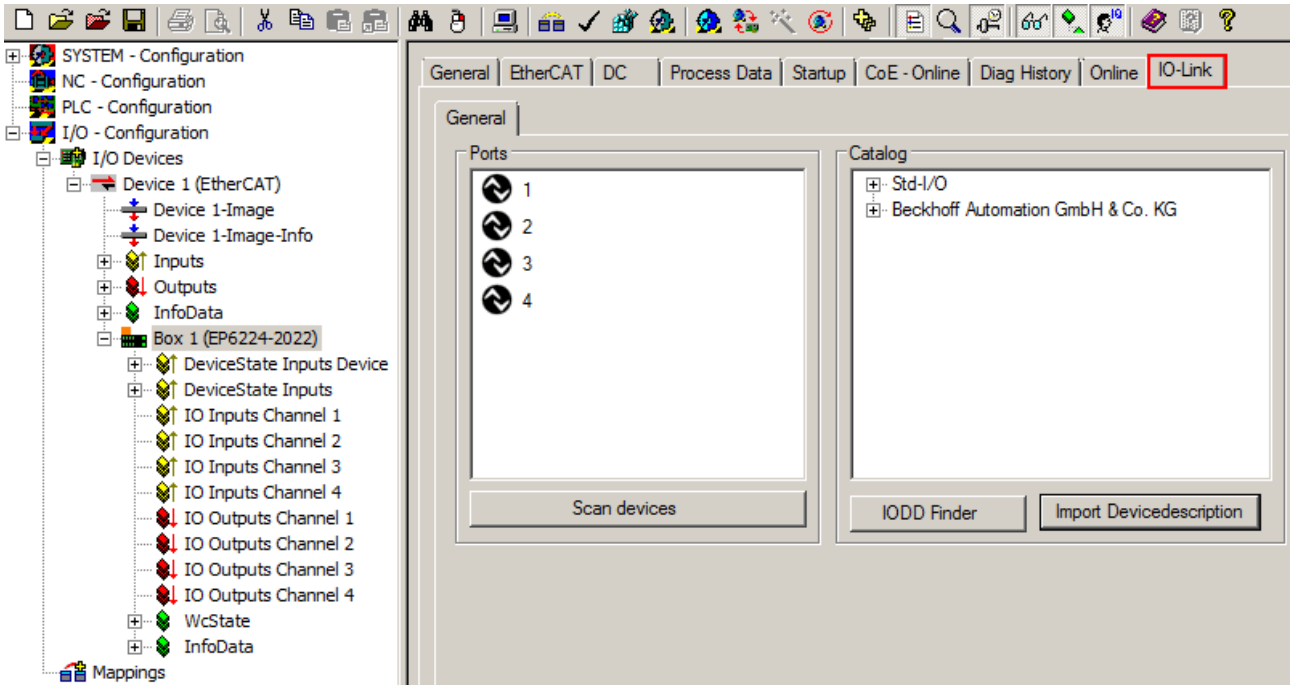


Fig. 28: "IO-Link" tab

5.1.2 Online configuration settings - TwinCAT (master)

In this part of the documentation is the configuration of a physically existing IO-Link master in TwinCAT described.

Online configuration “Scan” (TwinCAT 3.x)

Distinction between Online and Offline

The distinction between online and offline refers to the presence of the actual I/O environment (drives, terminals, box-modules).

- **Offline**
  If the configuration is to be prepared in advance of the system configuration as a programming system, e.g. on a laptop, this is only possible in “Offline configuration” mode. In this case all components have to be entered manually in the configuration, e.g. based on the electrical design (as described under 1. Importing the device description IODD [▶ 53]).
- **Online**
  If the designed control system is already connected to the EtherCAT system and all components are energized and the infrastructure is ready for operation, the TwinCAT configuration can simply be generated through “scanning” from the runtime system. This is referred to as online configuration. In any case, during each startup the EtherCAT master/ IO-Link master checks whether the devices it finds match the configuration. This test can be parameterized in the extended device settings.

To take advantage of the current features/settings of the master, the latest version of the ESI file should always be downloaded. Therefore it is necessary to consider the following note first.

Installation of the latest ESI-XML device description

The TwinCAT System Manager needs the device description files for the devices to be used in order to generate the configuration in online or offline mode. The device description is contained in the so-called ESI files (EtherCAT Slave Information) in XML format. These files can be requested from the respective manufacturer and are made available for download. The ESI files for Beckhoff EtherCAT devices are available on the Beckhoff website. The ESI files should be saved in the TwinCAT installation directory (default: C:\TwinCAT\IO\EtherCAT). The files are read (once) when a new System Manager window is opened. A TwinCAT installation includes the set of Beckhoff ESI files that was current at the time when the TwinCAT build was created. For TwinCAT 2.11 and higher, the ESI directory can be uploaded from the System Manager, if the programming PC is connected to the internet (TwinCAT → EtherCAT-Devices → Update Device Description…) see following figure.

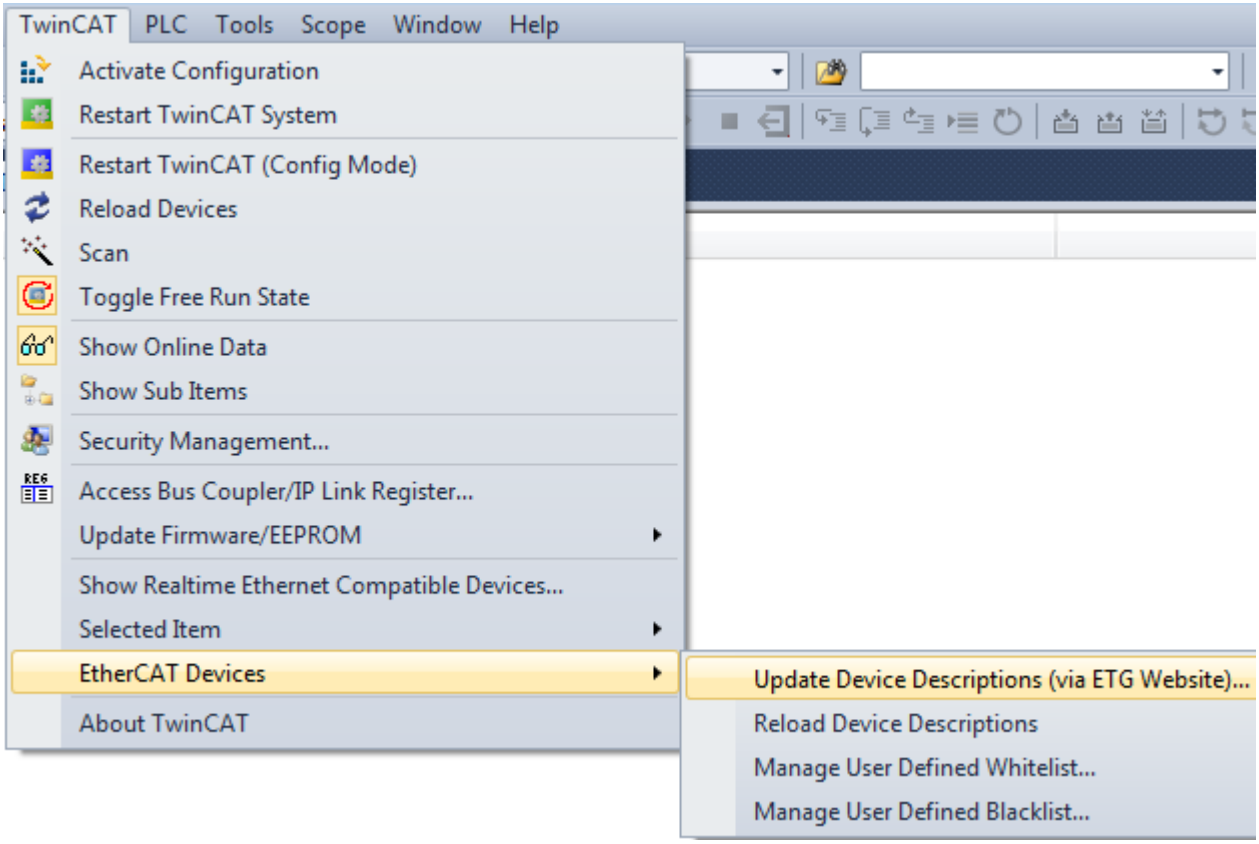


Fig. 29: Update Device Descriptions

The following conditions must be met before a configuration can be set up:

- the real EtherCAT and IO-Link hardware (devices, couplers, drives) must be present and installed
- the master/devices must be connected via EtherCAT cables and IO-Link cables in the same way as they are intended to be used later
- the devices/modules be connected to the power supply and ready for communication
- TwinCAT must be in CONFIG mode on the target system.

The online scan process consists of:

- detecting the EtherCAT device (Ethernet Port at the IPC)
- detecting the connected EtherCAT devices. This step can be carried out independent of the preceding step.
- troubleshooting

The scan with existing configuration can also be carried out for comparison.

Detecting/scanning of the EtherCAT device

The online device search can be used if the TwinCAT system is in CONFIG mode (blue TwinCAT icon or blue indication in the System Manager).

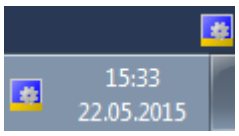


Fig. 30: TwinCAT CONFIG mode display

Online scanning in Config mode

The online search is not available in RUN mode (production operation).

Note the differentiation between TwinCAT programming system and TwinCAT target system. The TwinCAT icon next to the Windows clock always shows the TwinCAT mode of the local IPC. The System Manager window shows the TwinCAT state of the target system.

Right-clicking on “I/O Devices” in the configuration tree opens the search dialog.

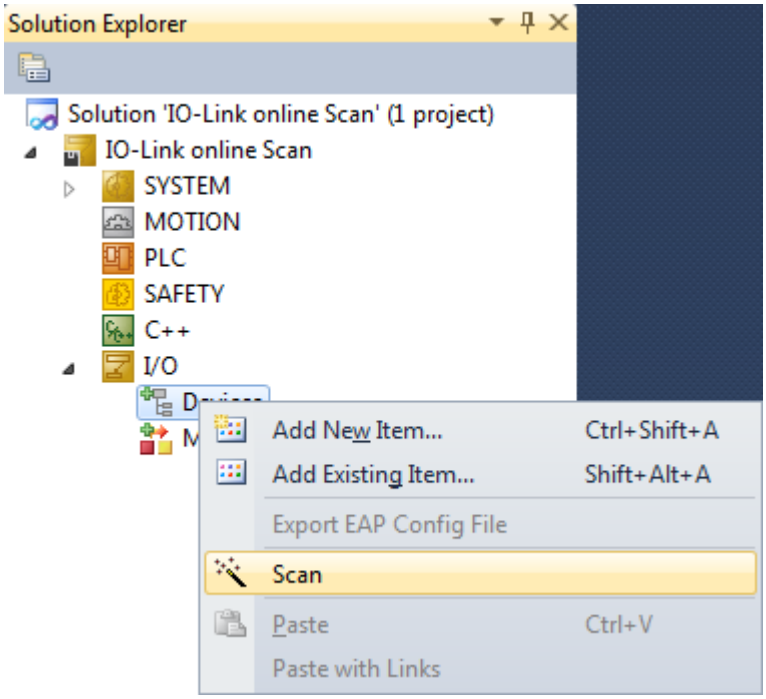


Fig. 31: Scan Devices

This scan mode not only tries to find EtherCAT devices (or Ethernet ports that can be used as such), but also NOVRAM, fieldbus cards, SMB etc. Not all devices can be found automatically.

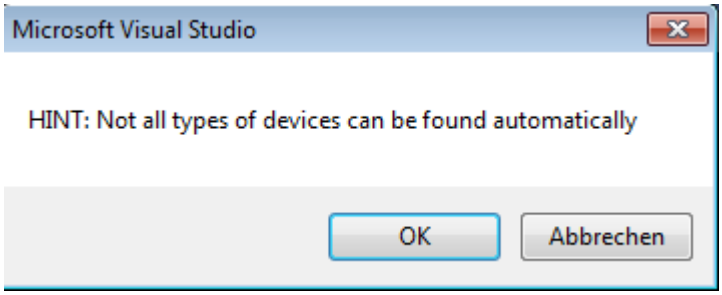


Fig. 32: note for automatic device scan

Ethernet ports with installed TwinCAT real-time driver are shown as “RT Ethernet” devices. An EtherCAT frame is sent to these ports for testing purposes. If the scan agent detects from the response that an EtherCAT slave is connected, the port is shown immediately as an “EtherCAT Device”.

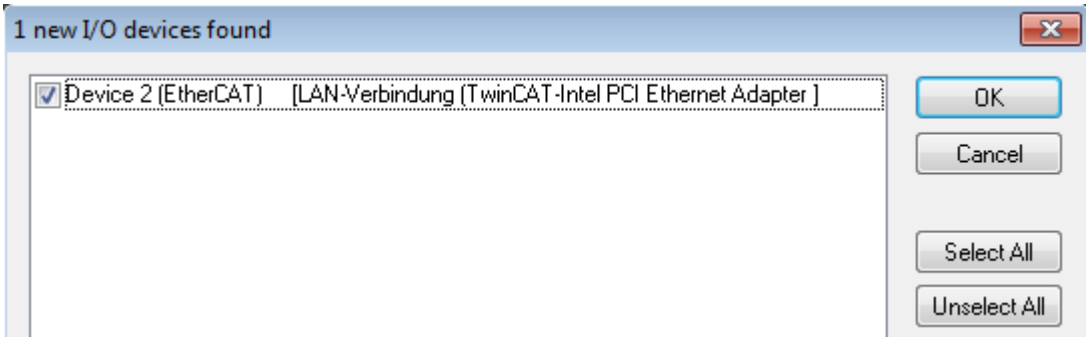


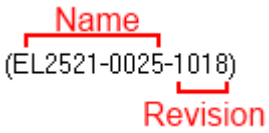
Fig. 33: detected Ethernet devices

After confirmation with “OK” a device scan is suggested for all selected devices, see following figure.

Detecting/Scanning the EtherCAT devices

Online scan functionality

During a scan the master queries the identity information of the EtherCAT slaves from the slave EEPROM. The name and revision are used for determining the type. The respective devices are located in the stored ESI data and integrated in the configuration tree in the default state defined



there.

If an EtherCAT device was created in the configuration (manually or through a scan), the I/O field can be scanned for devices/slaves.

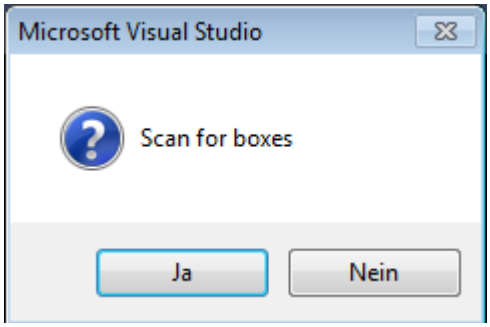


Fig. 34: scan query after automatic creation of an EtherCAT device

The configuration has been build and directly shifted into the online state (OPERATIONAL). The EtherCAT system should then be in a functional cyclic state, as shown in the following figure.

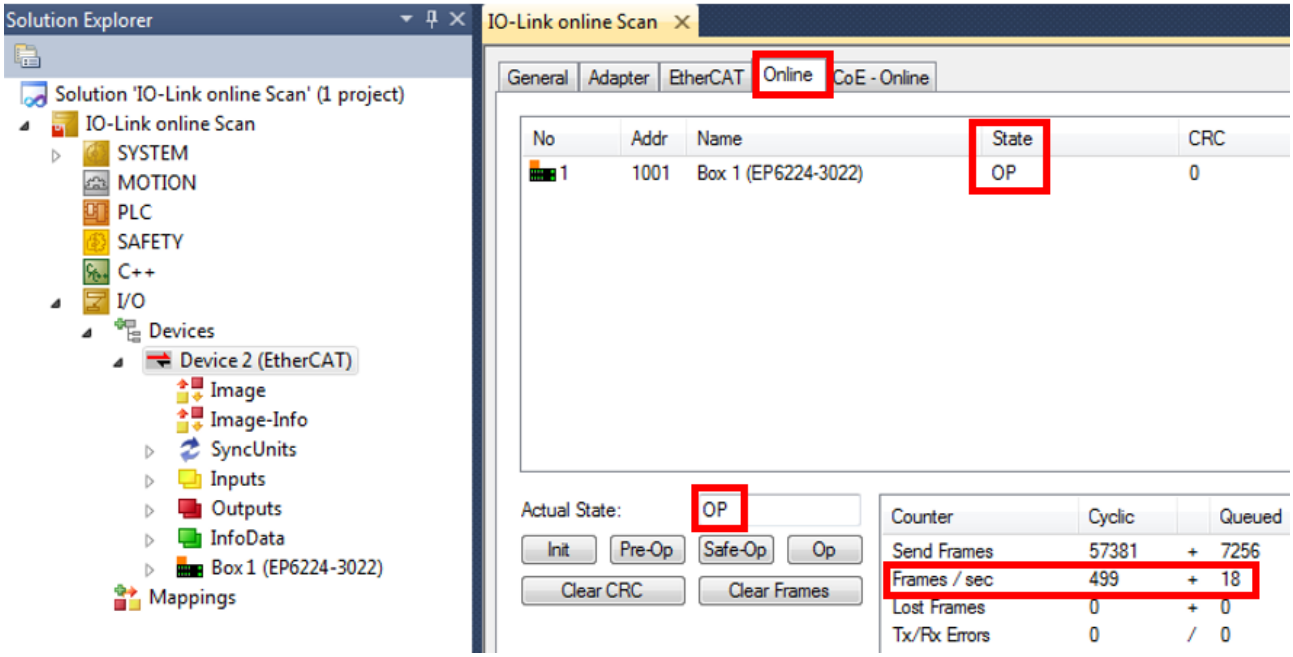


Fig. 35: online display example

Please note:

- all slaves should be in OP state
- the EtherCAT master should be in “Actual State” OP
- “frames/sec” should match the cycle time taking into account the sent number of frames
- no excessive “LostFrames” or CRC errors should occur

The configuration is now complete. It can be modified as described under the offline procedure.

The connected IO-Link master (EP6224-2022) is displayed in the TwinCAT structure as you can see in the figure below.

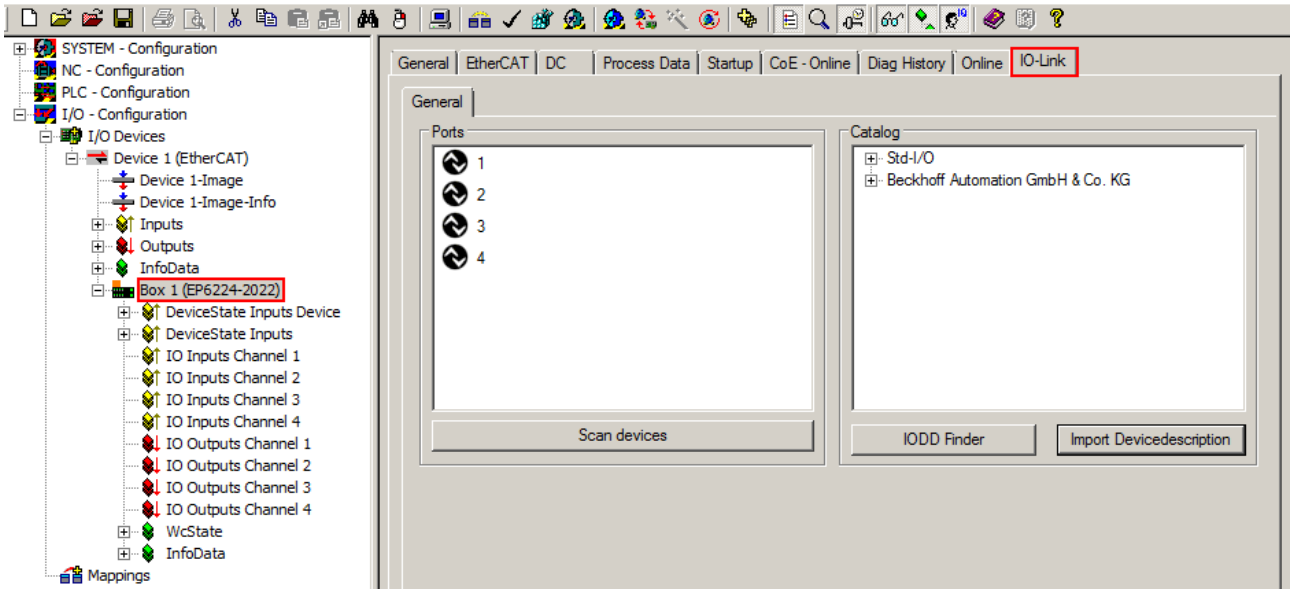


Fig. 36: Master display after scan for boxes

Troubleshooting

Various effects may occur during scanning.

- An **unknown device** is detected, i.e. an EtherCAT slave for which no ESI XML description is available. In this case the System Manager offers to read any ESI that maybe stored in the device.

- **Devices are not detected properly**
  Possible reasons include:
  - faulty data links, resulting in data loss during the scan
  - slave has invalid device description

    The connections and devices should be checked in a targeted manner, e.g. via the emergency scan.
    Then re-run the scan.

Scan over existing configuration

If a scan is initiated for an existing configuration, the actual I/O environment may match the configuration exactly or it may differ. This enables the configuration to be compared.

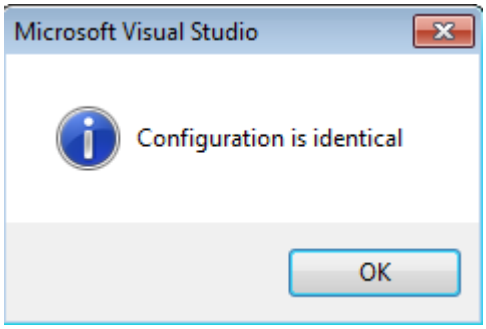


Fig. 37: identical configuration

If differences are detected, they are shown in the correction dialog, so that the user can modify the configuration as required.

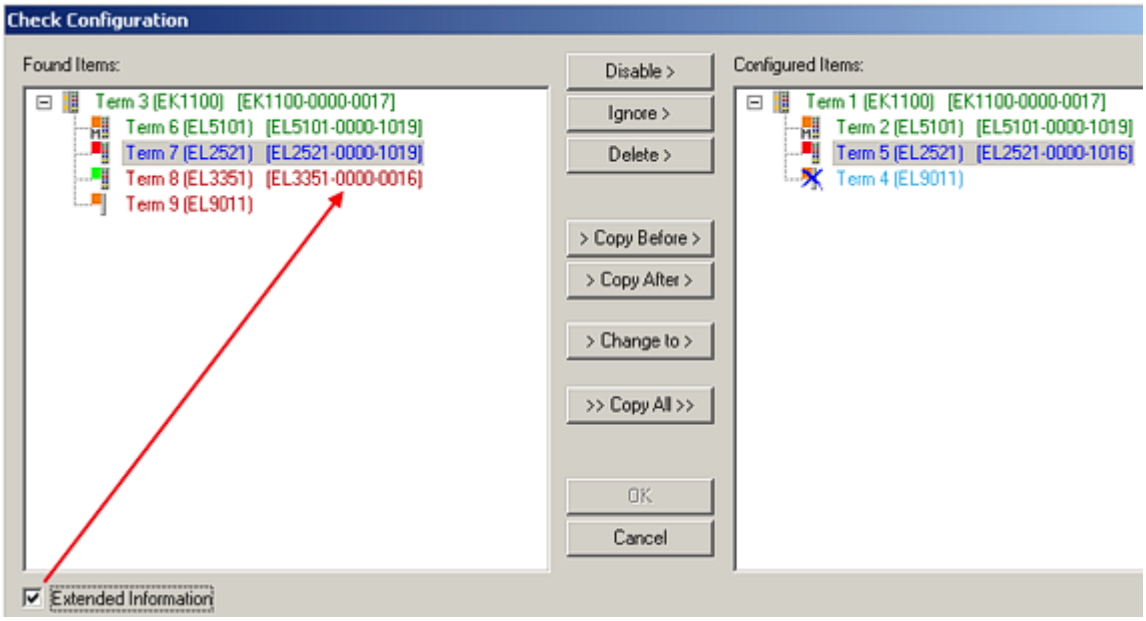


Fig. 38: correction dialog

It is advisable to tick the “Extended Information” check box to reveal differences in the revision.

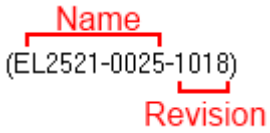
Colour	Explanation
green	This EtherCAT slave matches the entry on the other side. Both type and revision match.
blue	This EtherCAT slave is present on the other side, but in a different revision. If the found revision is higher than the configured revision, the slave maybe used provided compatibility issues are taken into account. If the found revision is lower than the configured revision, it is likely that the slave cannot be used. The found device may not support all functions that the master expects based on the higher revision number.
light blue	This EtherCAT slave is ignored („Ignore“ button).
red	This EtherCAT slave is not present on the other side.

Device selection based on revision, compatibility

The ESI description also defines the process image, the communication type between master and slave/device and the device functions, if applicable. The physical device (firmware, if available) has to support the communication queries/settings of the master. This is backward compatible, i.e. newer devices (higher revision) should be supported if the EtherCAT master addresses them as an older revision. The following compatibility rule of thumb is to be assumed for Beckhoff EtherCAT Terminals/Boxes:

device revision in the system >= device revision in the configuration

This also enables subsequent replacement of devices without changing the configuration (different specifications are possible for drives). Example: If an EL2521-0025-**1018** is specified in the configuration, an EL2521-0025-**1019** or higher (-**1020**, -**1021**) can be used in practice.



If current ESI descriptions are available in the TwinCAT system, the last revision offered in the selection dialog matches the Beckhoff state of production. It is recommended to use the last device revision when creating a new configuration, if current Beckhoff devices are used in the real application. Older revisions should only be used if older devices from stock are to be used in the application.

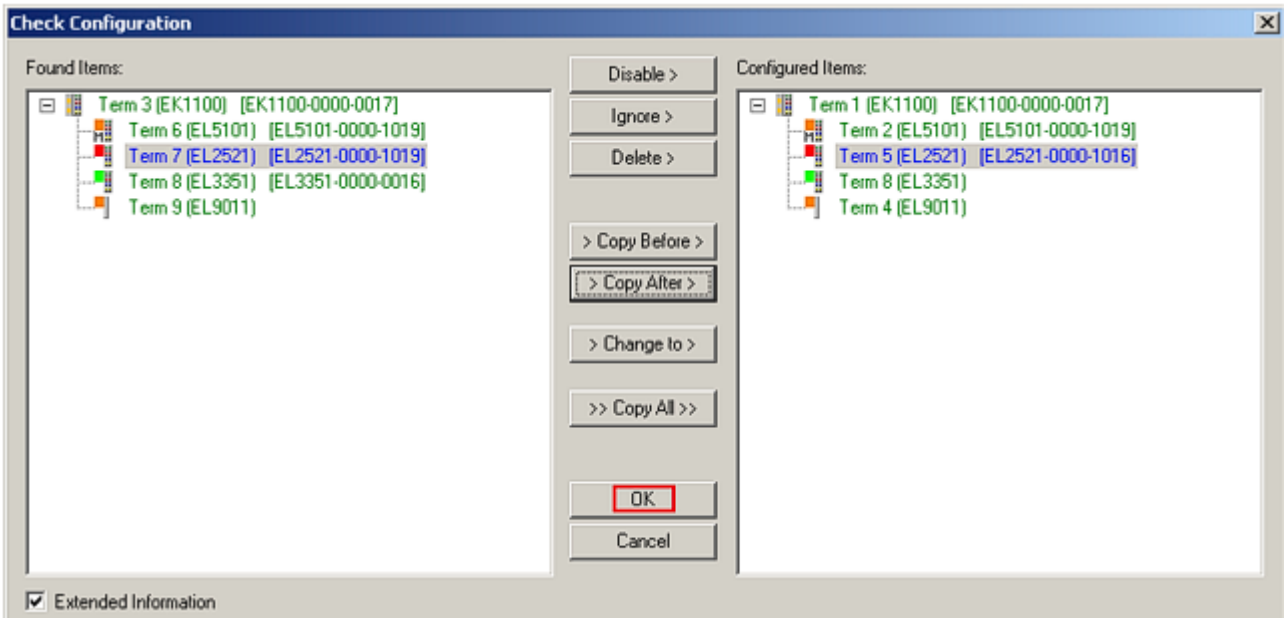


Fig. 39: correction dialog with modifications

Once all modifications have been saved or accepted, click “OK” to transfer them to the real *.tsm configuration.

5.1.3 Configuration via TwinCAT - explanation tabs

In the left-hand window of the TwinCAT System Manager, click on the IO-Link Box branch you wish to configure.

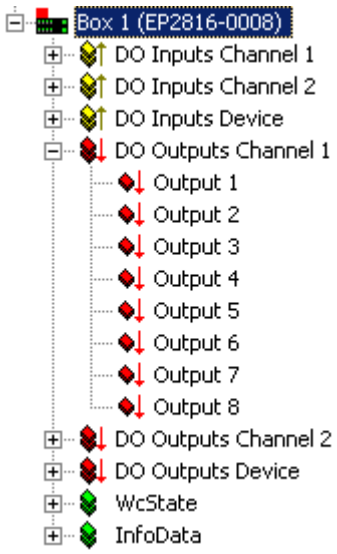


Fig. 40: Branch of the IO-Link Box to be configured

In the right-hand window of the TwinCAT System Manager various tabs for configuring the IO-Link Box are now available.

General tab

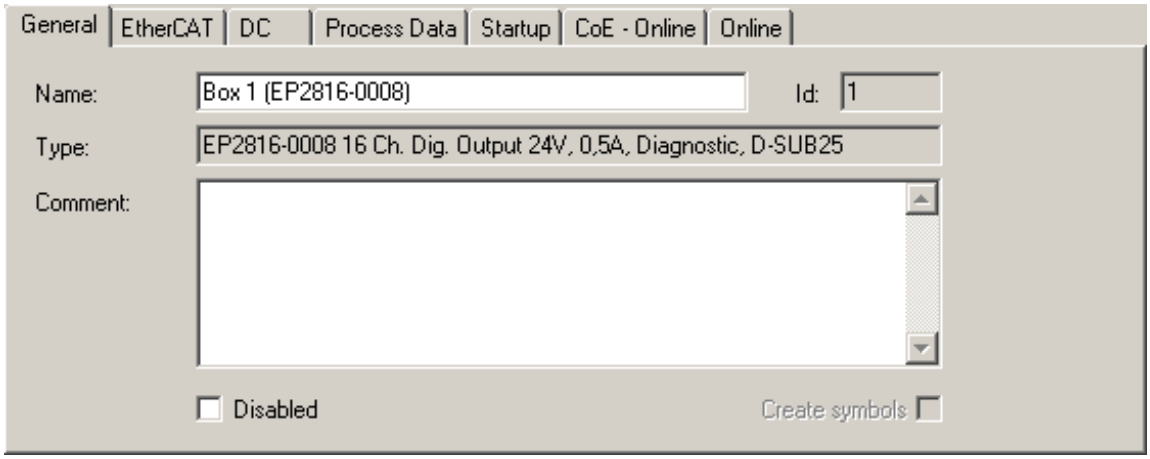


Fig. 41: General tab

Name	Name of the IO-Link master
Id	Number of the IO-Link master
Type	IO-Link master type
Comment	Here you can add a comment (e.g. regarding the system).
Disabled	Here you can deactivate the IO-Link master.
Create symbols	Access to this IO-Link master via ADS is only available if this control box is activated.

EtherCAT tab

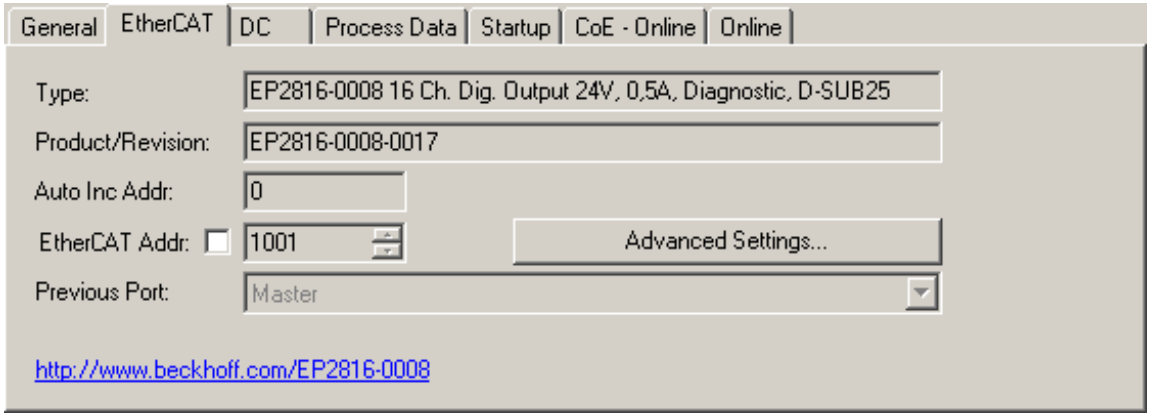


Fig. 42: EtherCAT tab

Type	IO-Link master device type
Product/Revision	Product and revision number of the IO-Link master
Auto Inc Addr.	Auto increment address of the IO-Link master. The auto increment address can be used for addressing each EtherCAT device or each IO-Link master in the communication ring through its physical position. Auto increment addressing is used during the start-up phase when the IO-Link master allocates addresses to the EtherCAT devices or IO-Link masters. With auto increment addressing the first EtherCAT device in the ring has the address 0000_{hex}. For each further slave the address is decremented by 1 ($FFFF_{hex}$, $FFFE_{hex}$ etc.).
EtherCAT Addr.	Fixed address of an EtherCAT device/IO-Link master. This address is allocated by the EtherCAT device/IO-Link master during the start-up phase. Tick the control box to the left of the input field in order to modify the default value.
Previous Port	Name and port of the EtherCAT device/IO-Link master to which this device is connected. If it is possible to connect this device with another one without changing the order of the EtherCAT devices/IO-Link masters in the communication ring, then this combination field is activated and the EtherCAT device or the IO-Link master to which this device is to be connected can be selected.
Advanced Settings	This button opens the dialogs for advanced settings.

The link at the bottom of the tab points to the product page for this IO-Link master on the web.

Process Data tab

Indicates the configuration of the process data. The input and output data of the IO-Link master are represented as CANopen process data objects (PDO). The user can select a PDO via PDO assignment and modify the content of the individual PDO via this dialog, if the IO-Link master supports this function.

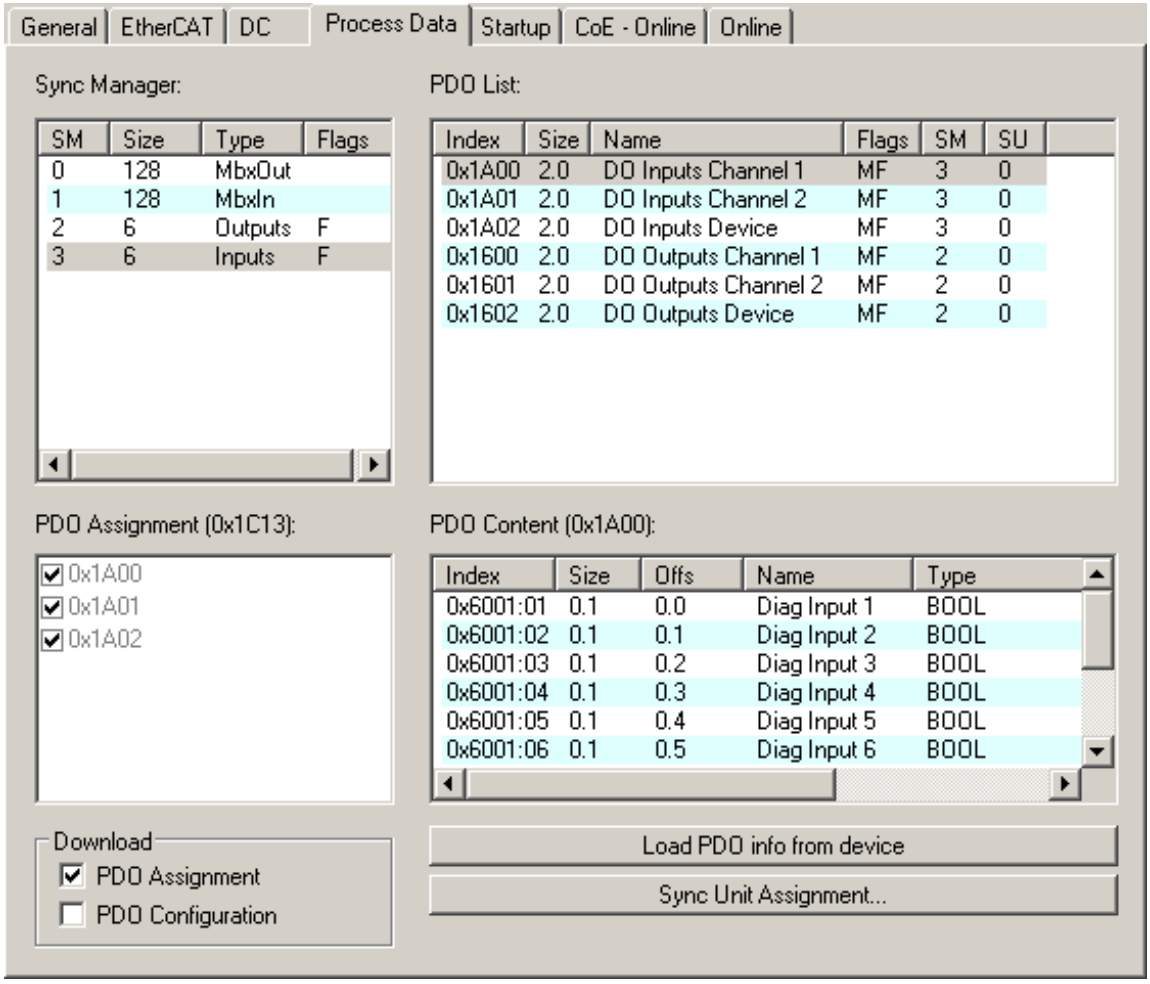


Fig. 43: Process Data tab

Sync Manager

Lists the configuration of the Sync Manager (SM).
If the IO-Link master has a mailbox, SM0 is used for the mailbox output (MbxOut) and SM1 for the mailbox input (MbxIn).
SM2 is used for the output process data (outputs) and SM3 (inputs) for the input process data.

If an input is selected, the corresponding PDO assignment is displayed in the *PDO Assignment* list below.

PDO Assignment

PDO assignment of the selected Sync Manager. All PDOs defined for this Sync Manager type are listed here:

- If the output Sync Manager (outputs) is selected in the Sync Manager list, all RxPDOs are displayed.
- If the input Sync Manager (inputs) is selected in the Sync Manager list, all TxPDOs are displayed.

The selected entries are the PDOs involved in the process data transfer. In the tree diagram of the System Manager these PDOs are displayed as variables of the IO-Link master. The name of the variable is identical to the *Name* parameter of the PDO, as displayed in the PDO list. If an entry in the PDO assignment list is deactivated (not selected and greyed out), this indicates that the input is excluded from the PDO assignment. In order to be able to select a greyed out PDO, the currently selected PDO has to be deselected first.

Activation of PDO assignment

- the IO-Link master has to run through the PS status transition cycle (from pre-operational to safe-operational) once (see Online tab [▶ 46]),
- and the System Manager has to reload the IO-Link master (button)

PDO list

List of all PDOs supported by this IO-Link master. The content of the selected PDOs is displayed in the *PDO Content* list. The PDO configuration can be modified by double-clicking on an entry.

Column	Description	
Index	PDO index.	
Size	Size of the PDO in bytes.	
Name	Name of the PDO. If this PDO is assigned to a Sync Manager, it appears as a variable of the slave with this parameter as the name.	
Flags	F	Fixed content: The content of this PDO is fixed and cannot be changed by the System Manager.
	M	Mandatory PDO. This PDO is mandatory and must therefore be assigned to a Sync Manager! Consequently, this PDO cannot be deleted from the *PDO Assignment* list
SM	Sync Manager to which this PDO is assigned. If this entry is empty, this PDO does not take part in the process data traffic.	
SU	Sync unit to which this PDO is assigned.	

PDO Content

Indicates the content of the PDO. If flag F (fixed content) of the PDO is not set the content can be modified.

Download

If the device is intelligent and has a mailbox, the configuration of the PDO and the PDO assignments can be downloaded to the device. This is an optional feature that is not supported by all IO-Link masters.

PDO Assignment

If this check box is selected, the PDO assignment that is configured in the PDO Assignment list is downloaded to the device on startup. The required commands to be sent to the device can be viewed in the Startup [▶ 42] tab.

PDO Configuration

If this check box is selected, the configuration of the respective PDOs (as shown in the PDO list and the PDO Content display) is downloaded to the IO-Link master.

Startup tab

The *Startup* tab is displayed if the IO-Link master has a mailbox and supports the *CANopen over EtherCAT* (CoE) or *Servo drive over EtherCAT* protocol. This tab indicates which download requests are sent to the mailbox during startup. It is also possible to add new mailbox requests to the list display. The download requests are sent to the master in the same order as they are shown in the list.

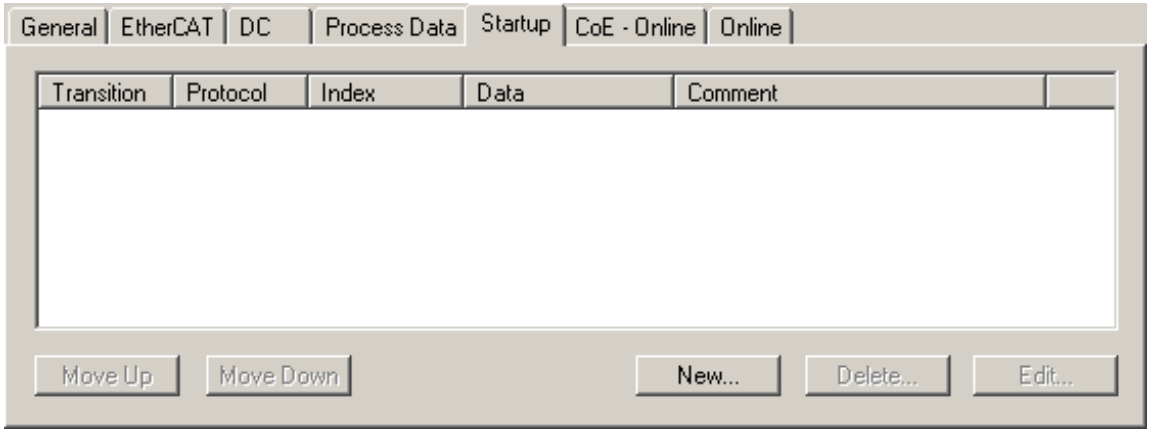


Fig. 44: Startup tab

Column	Description
Transition	Transition to which the request is sent. This can either be • the transition from pre-operational to safe-operational (PS), or • the transition from safe-operational to operational (SO). If the transition is enclosed in "<>" (e.g. <PS>), the mailbox request is fixed and cannot be modified or deleted by the user.
Protocol	Type of mailbox protocol
Index	Index of the object
Data	Date on which this object is to be downloaded.
Comment	Description of the request to be sent to the mailbox

Move Up	This button moves the selected request up by one position in the list.
Move Down	This button moves the selected request down by one position in the list.
New	This button adds a new mailbox download request to be sent during startup.
Delete	This button deletes the selected entry.
Edit	This button edits an existing request.

CoE - Online tab

The additional *CoE - Online* tab is displayed if the IO-Link master supports the *CANopen over EtherCAT* (CoE) protocol. This dialog lists the content of the object list of the slave (SDO upload) and enables the user to modify the content of an object from this list. Details for the objects of the individual IO-Link devices can be found in the device-specific object descriptions.

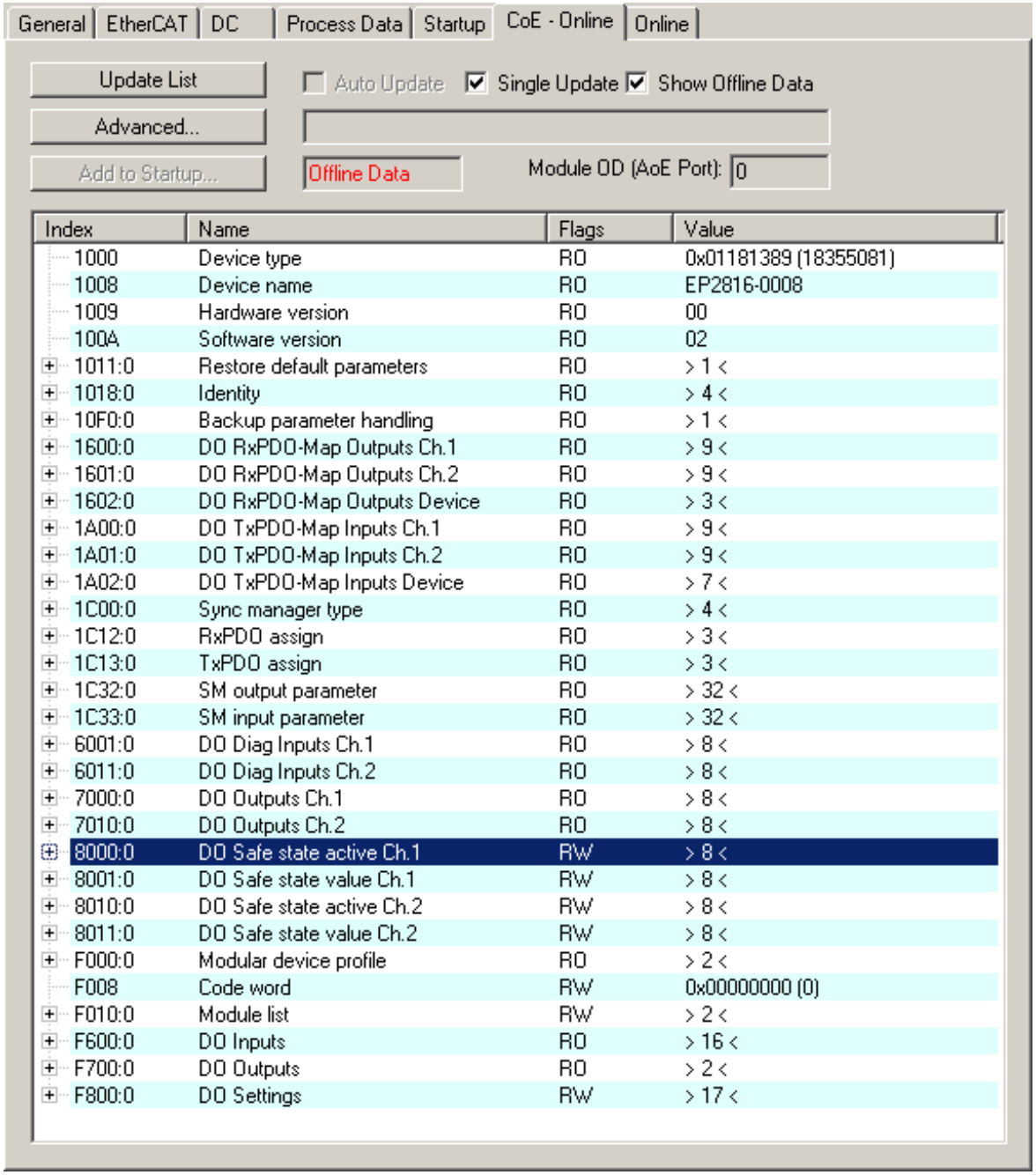


Fig. 45: CoE - Online tab

Object list display

Column	Description	
Index	Index and sub-index of the object	
Name	Name of the object	
Flags	RW	The object can be read, and data can be written to the object (read/write)
	RO	The object can be read, but no data can be written to the object (read only)
	P	An additional P identifies the object as a process data object.
Value	Value of the object	

Update List The *Update list* button updates all objects in the displayed list

Auto Update If this check box is selected, the content of the objects is updated automatically.

Advanced The *Advanced* button opens the *Advanced Settings* dialog. Here you can specify which objects are displayed in the list.

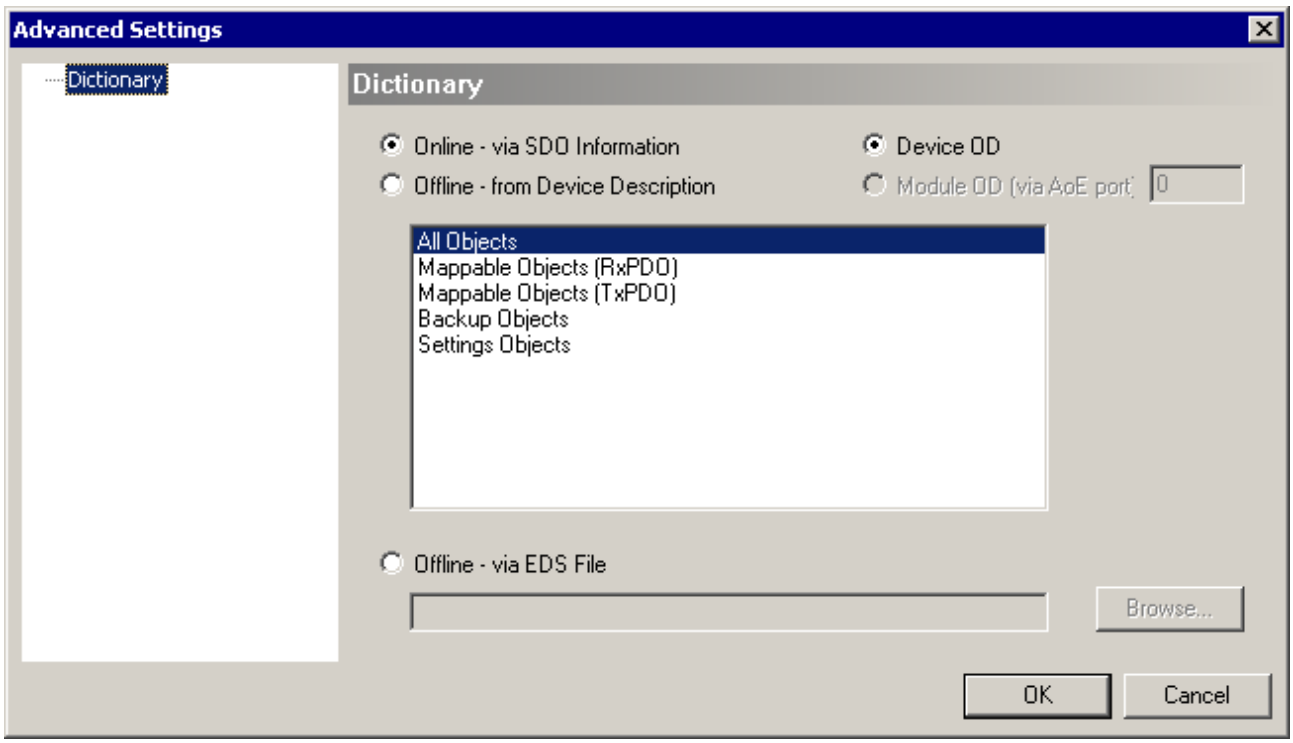


Fig. 46: Advanced Settings

Online - via SDO Information
If this option button is selected, the list of the objects included in the object list of the device is uploaded from the master via SDO information. The list below can be used to specify which object types are to be uploaded.

Offline - via EDS File
If this option button is selected, the list of the objects included in the object list is read from an EDS file provided by the user.

Diag History tab

Logged diagnosis messages from the controller protocol can be read out on the "Diag History" tab. The diagnosis buffer operates as a ring buffer with a current maximum size of 1000 entries.

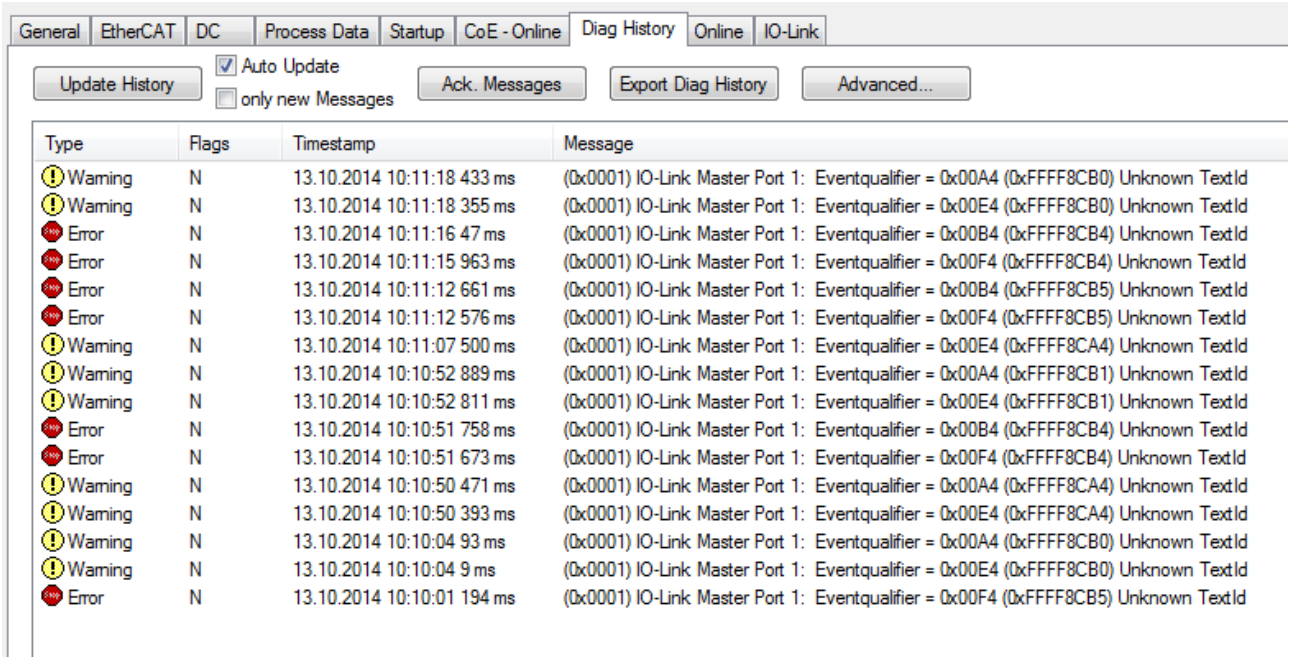


Fig. 47: DiagHistory tab

Any events that occur are categorized according to type (information, warning, error), flag (N = unconfirmed, Q = confirmed), time stamp and message (port number & event code).
The meaning of the individual messages can be taken from the vendor documentation. The IO-Link device can be directly allocated on the basis of the port number. The events occurring can be managed using the various buttons.

- **Update History:** if the "Auto Update" field is not selected, then the current events can be displayed via the "Update History" button
- **Auto Update:** if this field is selected, then the list of events occurring is automatically updated
- **Only new Messages:** if this field is selected, then only those messages that have not yet been confirmed are displayed
- **Ack. Messages:** an event is reported via the Device Diag bit (Index 0xF101:10). Confirming the message will reset the bit to 0.
- **Export Diag History:** the events that have occurred can be exported as a "txt" file and thus archived.
- **Advanced:** This field has no function for the IO-Link master terminals/boxes.

Online tab

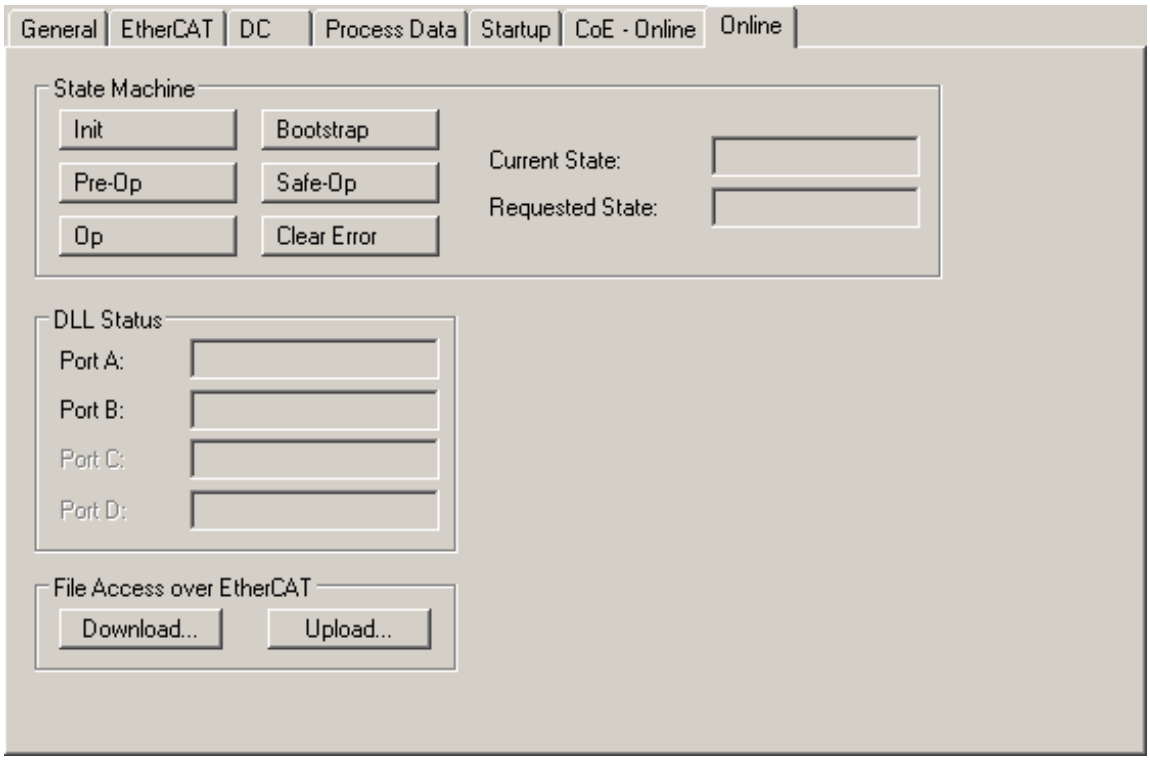


Fig. 48: Online tab

Table 1: State Machine

Init	This button attempts to set the IO-Link master to the *Init* state.
Pre-Op	This button attempts to set the IO-Link master to the *pre-operational* state.
Op	This button attempts to set the IO-Link master to the *operational* state.
Bootstrap	This button attempts to set the IO-Link master to the *Bootstrap* state.
Safe-Op	This button attempts to set the IO-Link master to the *safe-operational* state.
Clear Error	This button attempts to delete the fault display. If an IO-Link master fails during change of state it sets an error flag. Example: An IO-Link master is in PREOP state (pre-operational). The master now requests the SAFEOP state (safe-operational). If the master fails during change of state it sets the error flag. The current state is now displayed as ERR PREOP. When the *Clear Error* button is pressed the error flag is cleared, and the current state is displayed as PREOP again.
Current State	Indicates the current state of the IO-Link master.
Requested State	Indicates the state requested for the IO-Link master.

5.1.4 Restoring the delivery state of an EtherCAT device

To restore the delivery state for backup objects of the EP6224-xxxx (IO-Link Master), the CoE object “Restore default parameters”, “Subindex 001” can be selected in the TwinCAT System Manager (Config mode) (see following figure).

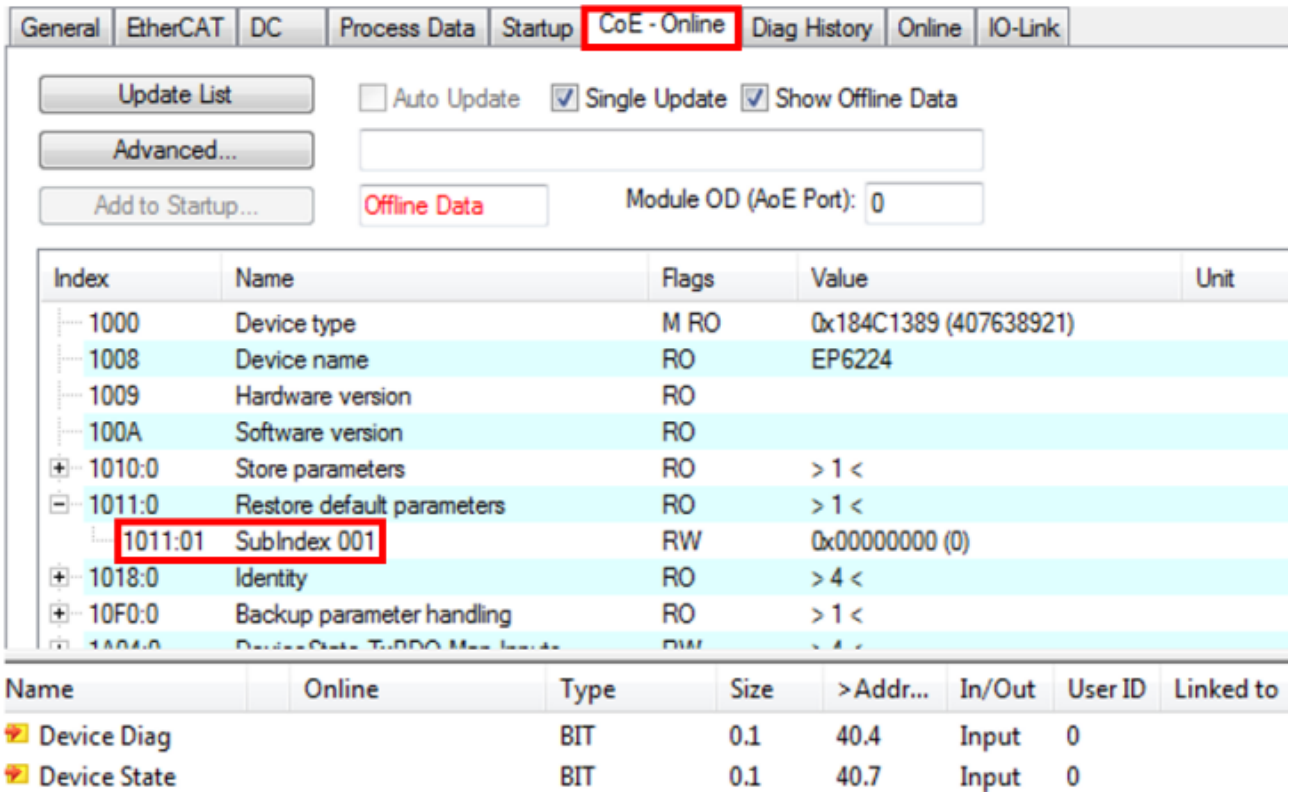


Fig. 49: Selecting the Restore default parameters PDO

Double-click on “SubIndex 001” to enter the “Set Value dialog” (see following figure). Enter the value **1684107116** in field “Dec” or the value **0x64616F6C** in field “Hex” and confirm with OK.

All backup objects are reset to the delivery state.

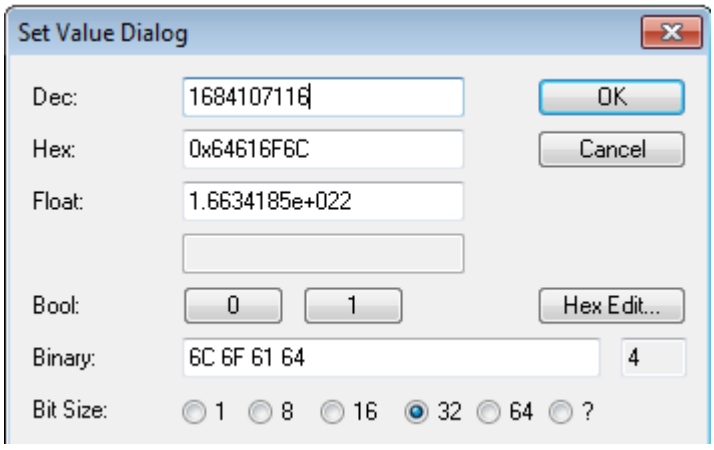


Fig. 50: Entering a restore value in the Set Value Dialog

5.2 Accessing IO-Link 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).

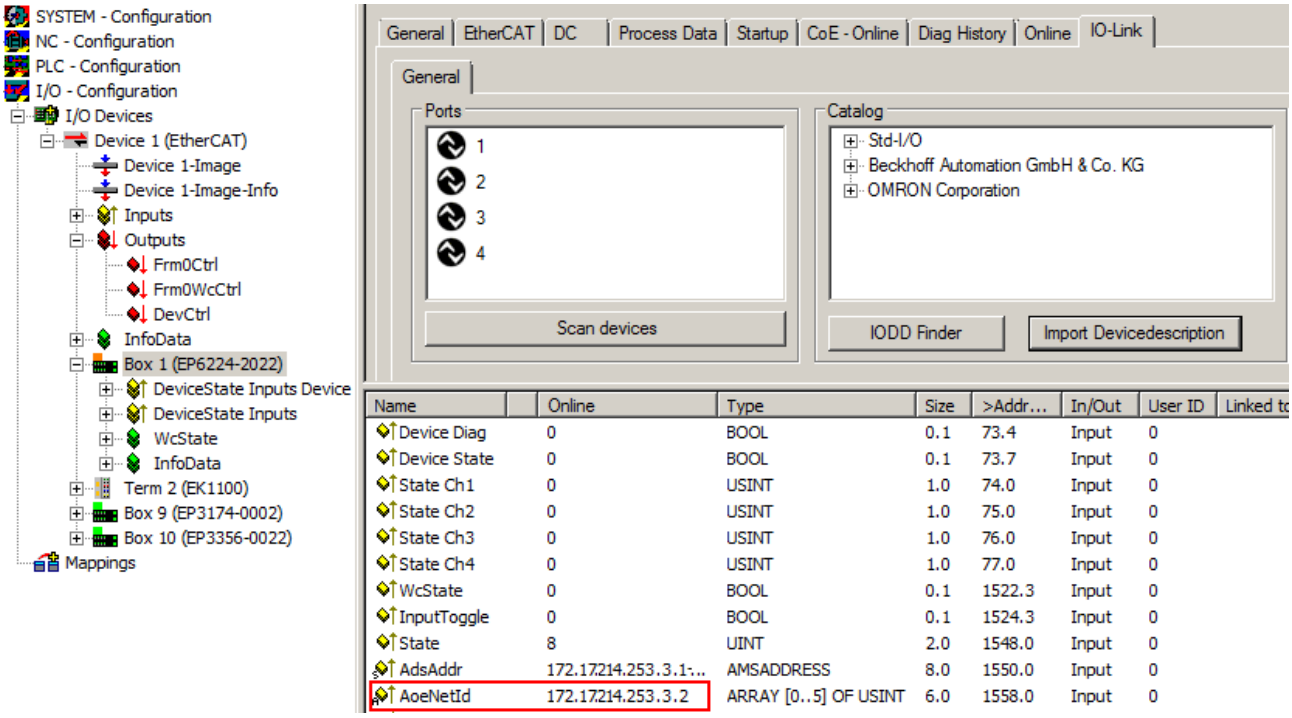


Fig. 51: AoE-NetID allocation

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).

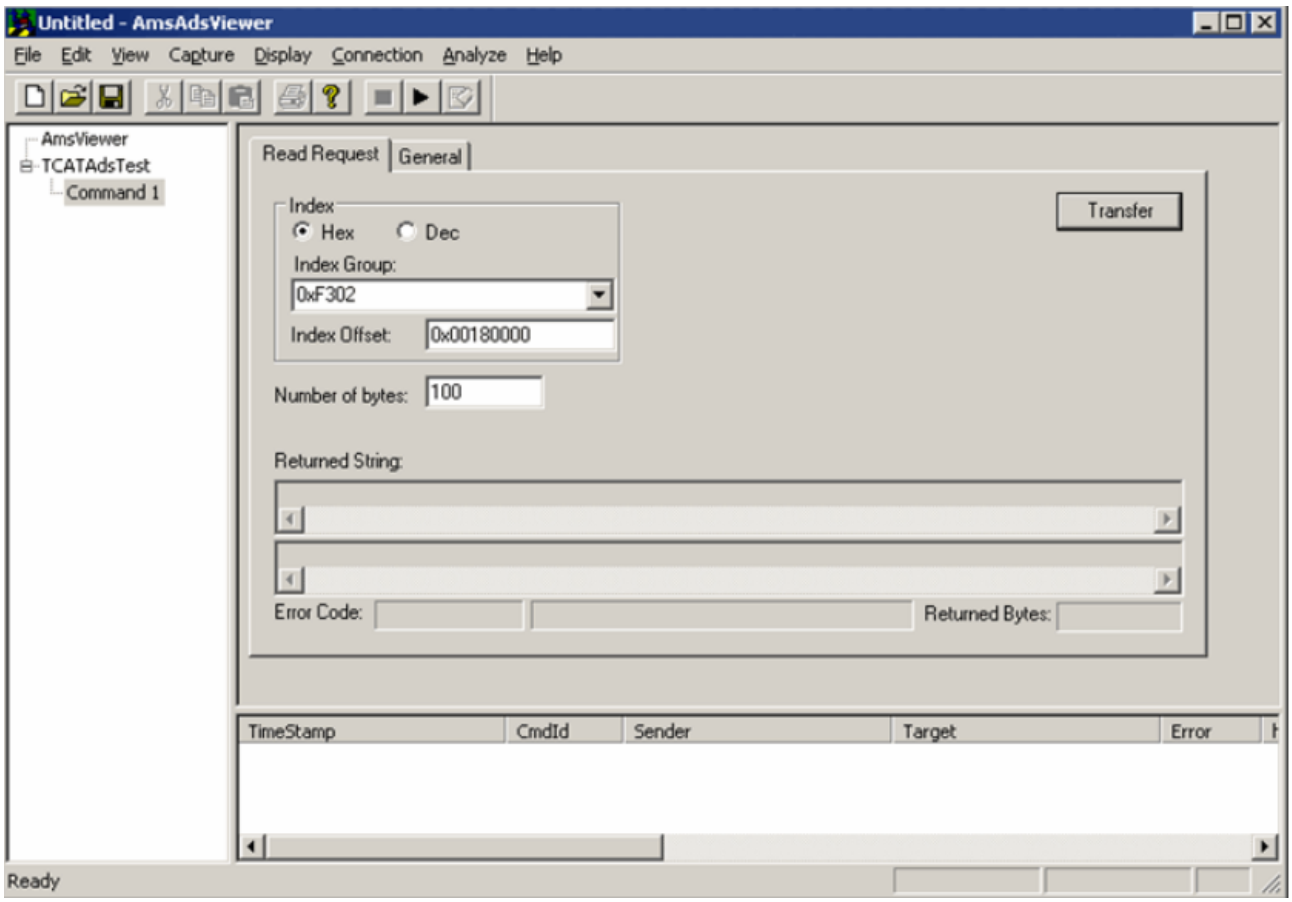


Fig. 52: Reading of the Application-Specific Name

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);
```

5.3 IO-Link device

5.3.1 Configuration of the IO-Link devices

IO-Link extension

The IO-Link extension for the EP6224-xxxxxx can be used from TwinCAT version 2.10, build 1325 and is required up to version 2.10, build 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. [▶ 96]

Integrating IO-Link devices

The catalog supports the IO-Link device description (IODD). The IODDs for the EPIxxxx, ERIxxxx IO-Link Box modules from Beckhoff can be downloaded via the following link: Download IODD. The downloaded zip file contains the IODD device description files for the Beckhoff EPIxxxx, ERIxxxx IO-Link Box modules.

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!

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 & online) via
   - button Import Devicedescription [▶ 53] (A) or
   - button IODD Finder [▶ 53] (B)
2. Automatic scanning of the IO-Link ports (online) via
   - button Scan devices [▶ 56] (C)
3. Manual insertion (offline & online) via
   - menu Create Device [▶ 59] (D)

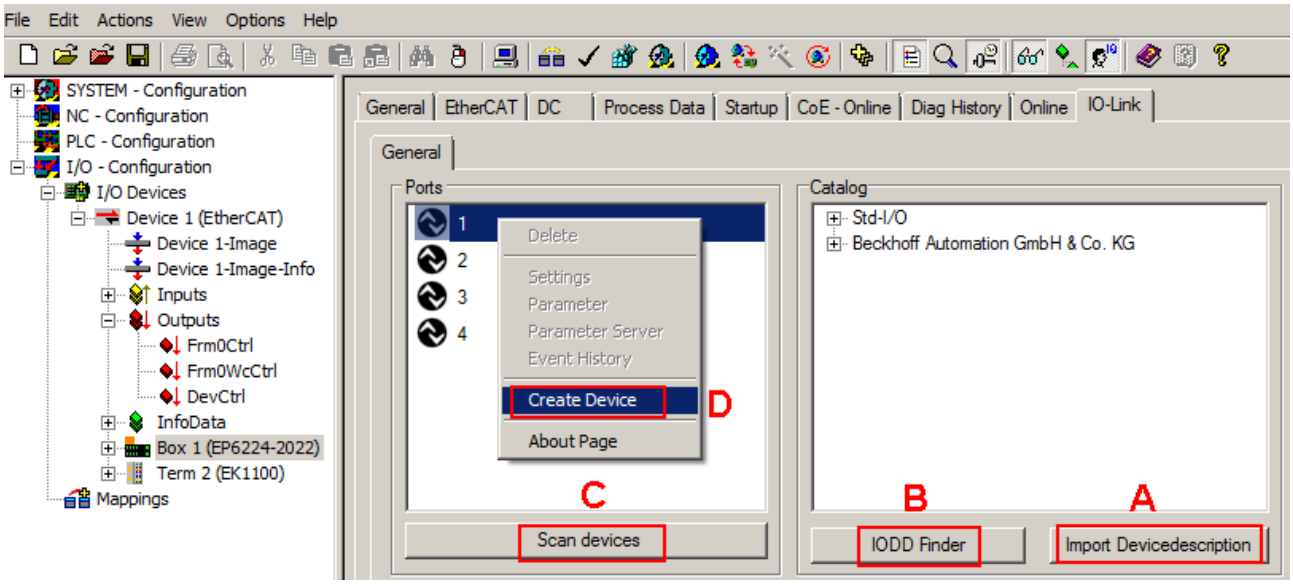


Fig. 53: Creating IO-Link devices

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.

Configuration of the IO-Link ports as digital inputs/outputs

If the IO-Link port is to be used as a simple digital input or output, the selection "Std-I/O" -> "dig in" or "dig out" can be made in the *IO-Link Device Catalog.* After restarting the EtherCAT system or reloading the configuration in Config mode (F4), the corresponding process data are created.

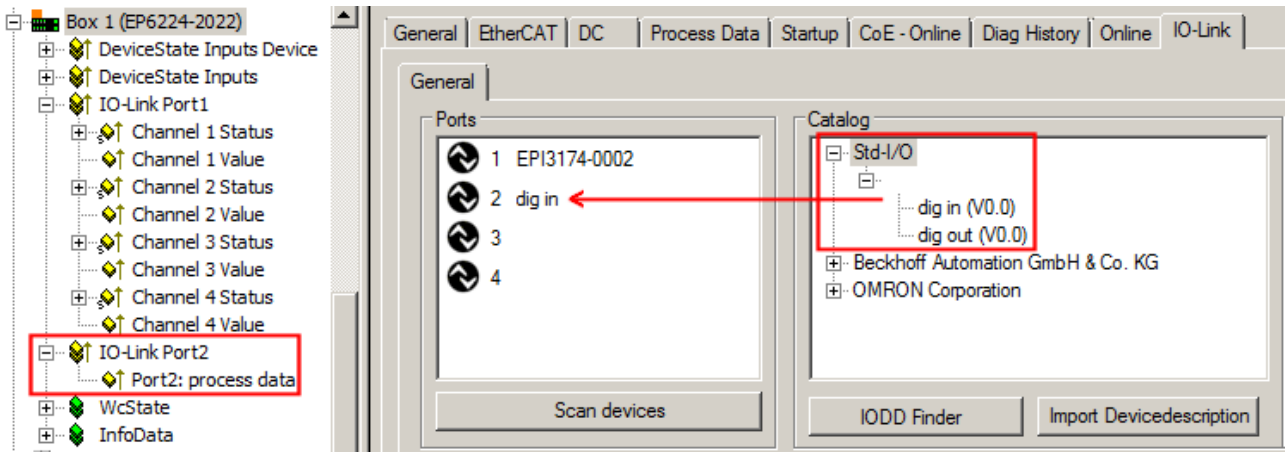


Fig. 54: Configuration of Port 2 as digital input

Removal of the IO-Link devices

To remove a previously configured IO-Link device, right-click to open the context menu and select *Delete*. After restarting the EtherCAT system or reloading the configuration in Config mode (F4), the already created process data are removed.

5.3.1.1 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:

- **Button "Import Devicedescription“**
  - Press the *Import Devicedescription* button in the *IO-Link* tab
  - Select the .xml file of the desired sensor.
  - 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“**
  - Press the *IODD Finder* button in the *IO-Link* tab
  - Searching for the desired IO-Link sensor/device by entering them in the search mask; see the figure below (1)
  - 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).

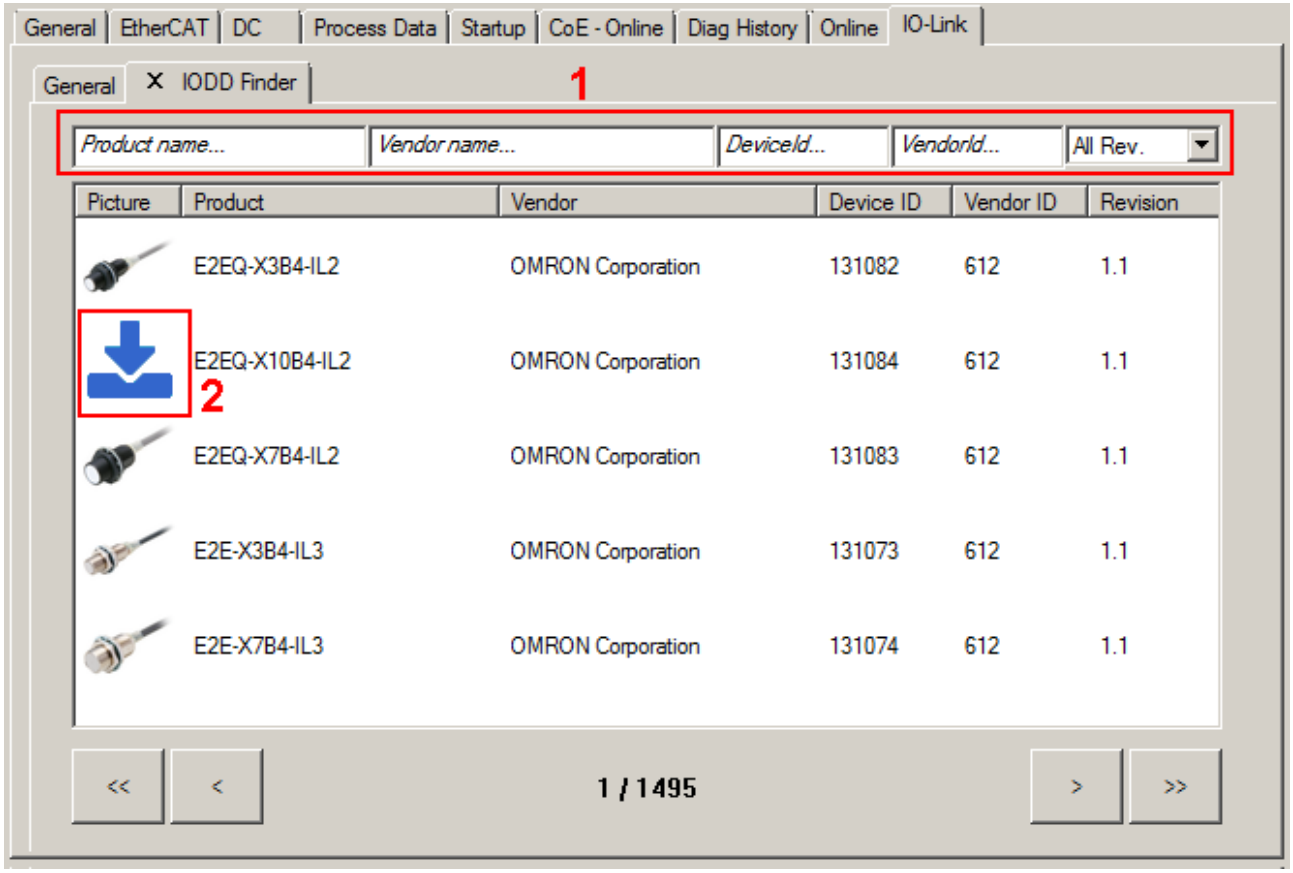


Fig. 55: IODD Finder, selection and import of the .xml file

- 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
- 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.

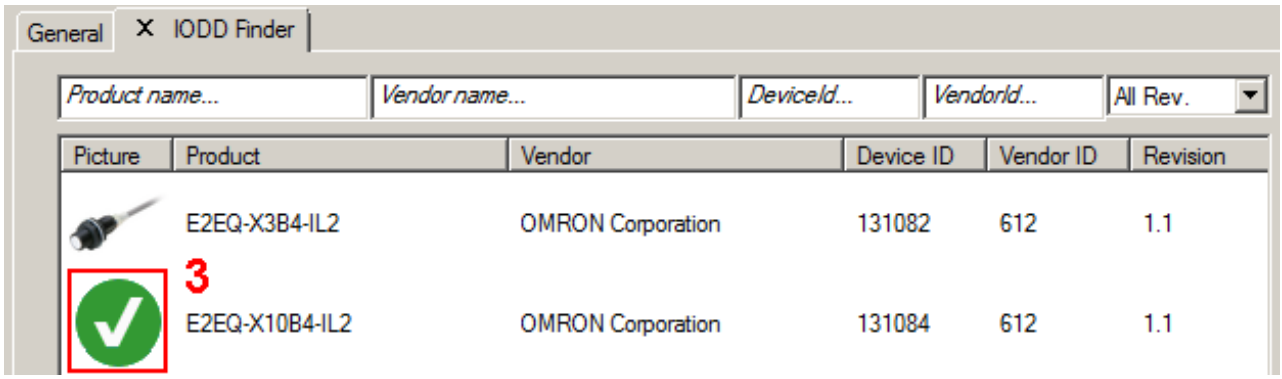


Fig. 56: IODD Finder, display of an already imported device description

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

- Online configuration: once the IO-Link device has been connected, it is automatically detected and created with the corresponding parameters by pressing the *Scan devices* button.
  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. The IO-Link device can be selected via drag & drop or by right-clicking on the product with "Add to Port n".

- Restart the EtherCAT system or reload the configuration in Config mode (F4).
- 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).

5.3.1.2 2. 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 [▶ 13]. The corresponding IO-Link device must be connected to the IO-Link port for this.

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

Finding connected IO-Link devices

The connected IO-Link devices can be found by clicking the *Scan devices* button (see the following figure (C)).

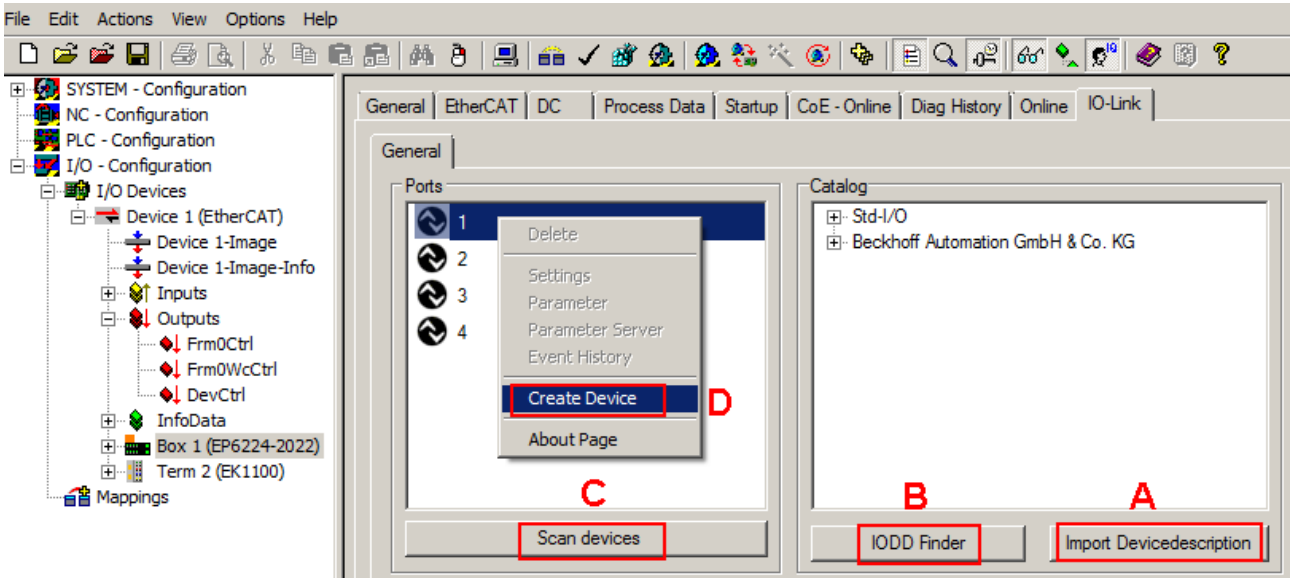


Fig. 57: Scan devices (C)

The information window lists the connected device for each of the four ports. Only port 2 of the master is assigned an IO-Link device. Confirm with the *OK* button.

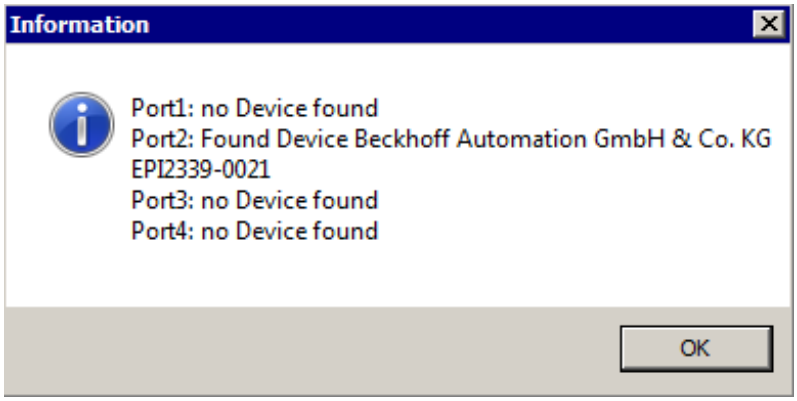


Fig. 58: Information *Scan devices*

To be able to work with the devices, the button *Reload Devices* (F4) must be clicked.

Fig. 59: Button: *Reload Devices*

The IO-Link devices are now entered in the General display. The Port 2 Details field displays information about the connected device.

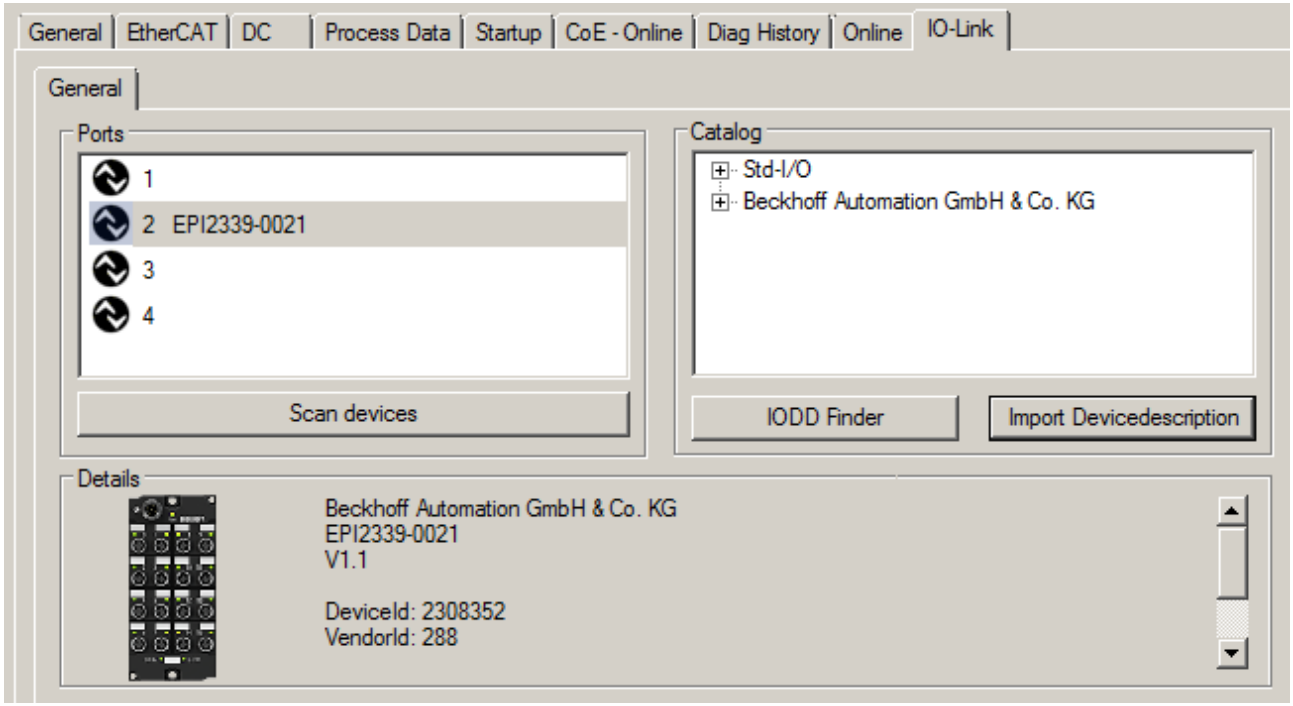


Fig. 60: Device at Port 2

Further details can be shown by right-clicking Port 2 in the *Settings* dialog (see also chapter Settings of the IO-Link devices [▶ 62]).

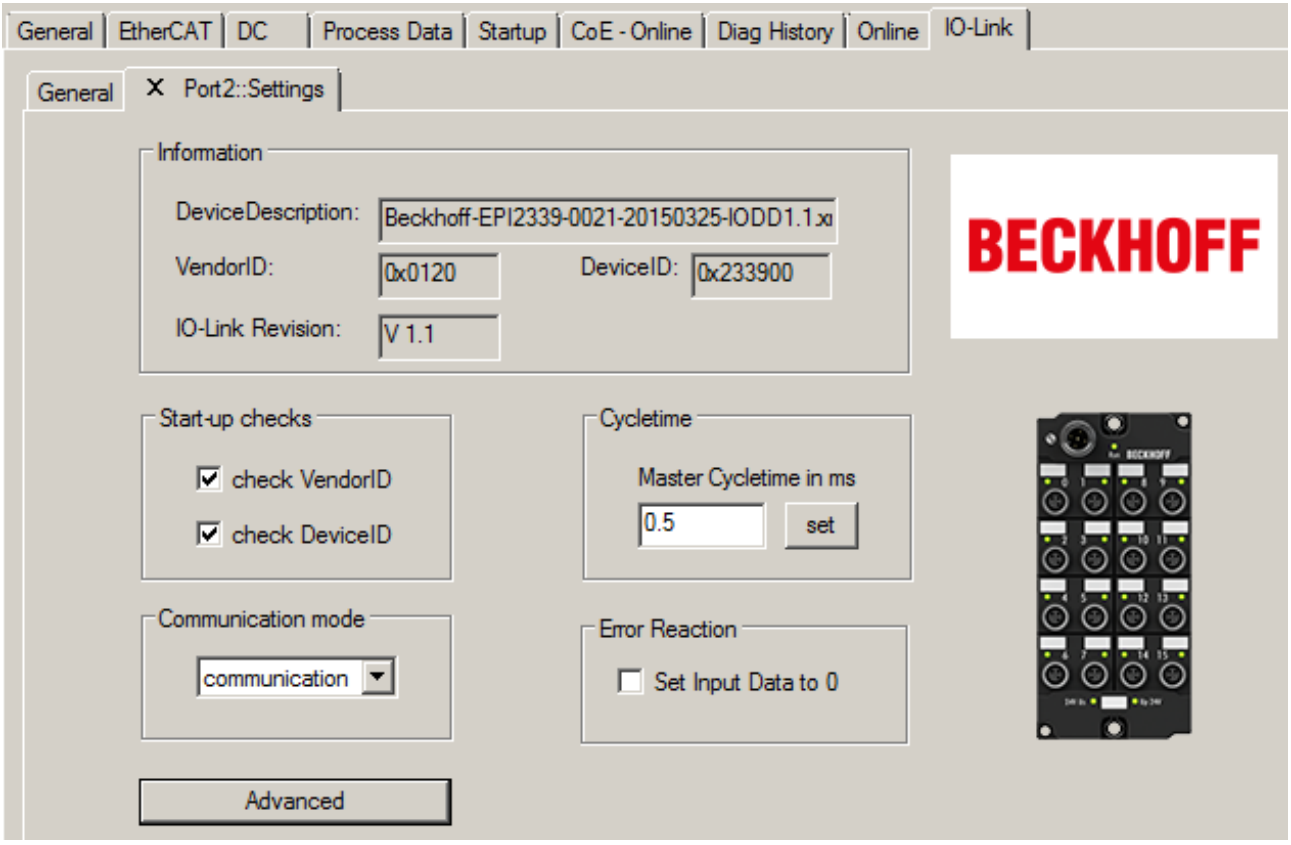


Fig. 61: Device Port2 settings

After double-clicking Port 2 the *Parameters* tab is displayed. The parameters of the respective IO-Link device are listed here (see also chapter EPIxxxx, ERIxxxx - Setting the IO-Link device parameters [▶ 68]).

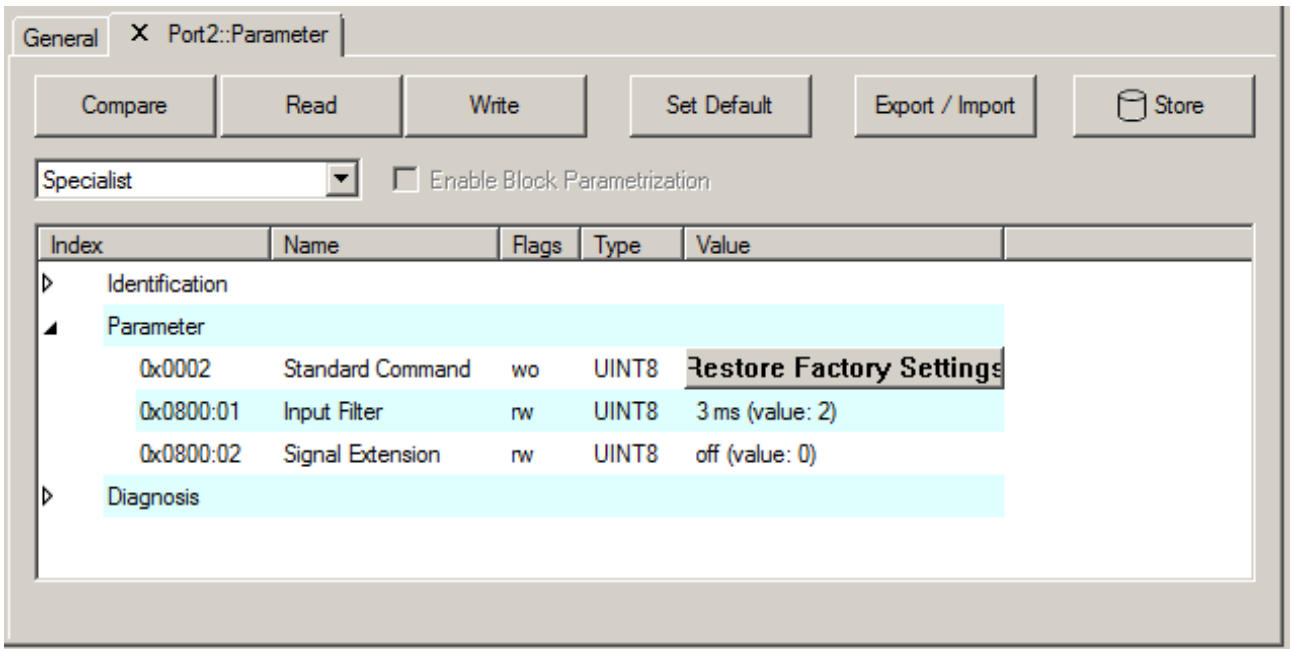


Fig. 62: Parameter IO-Link device

5.3.1.3 3. 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.
The configuration can then be carried out manually. 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:
- If the corresponding IODD of the IO-Link device is already present, the corresponding device can be selected in the catalog (see the diagram below (A)), sorted by the vendor
- If no IODD is available, the device can be manually added. These data are not saved in the catalog and must be manually entered for each port.
- Right-click on the port to open the context menu (see the figure below (B)) and select *Create Device*.
- 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 (D). 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.
- If the IO-Link device version is 1.1, then the parameter server is activated by the selection of the field.
- Restart the EtherCAT system or reload the configuration in Config mode (F4)

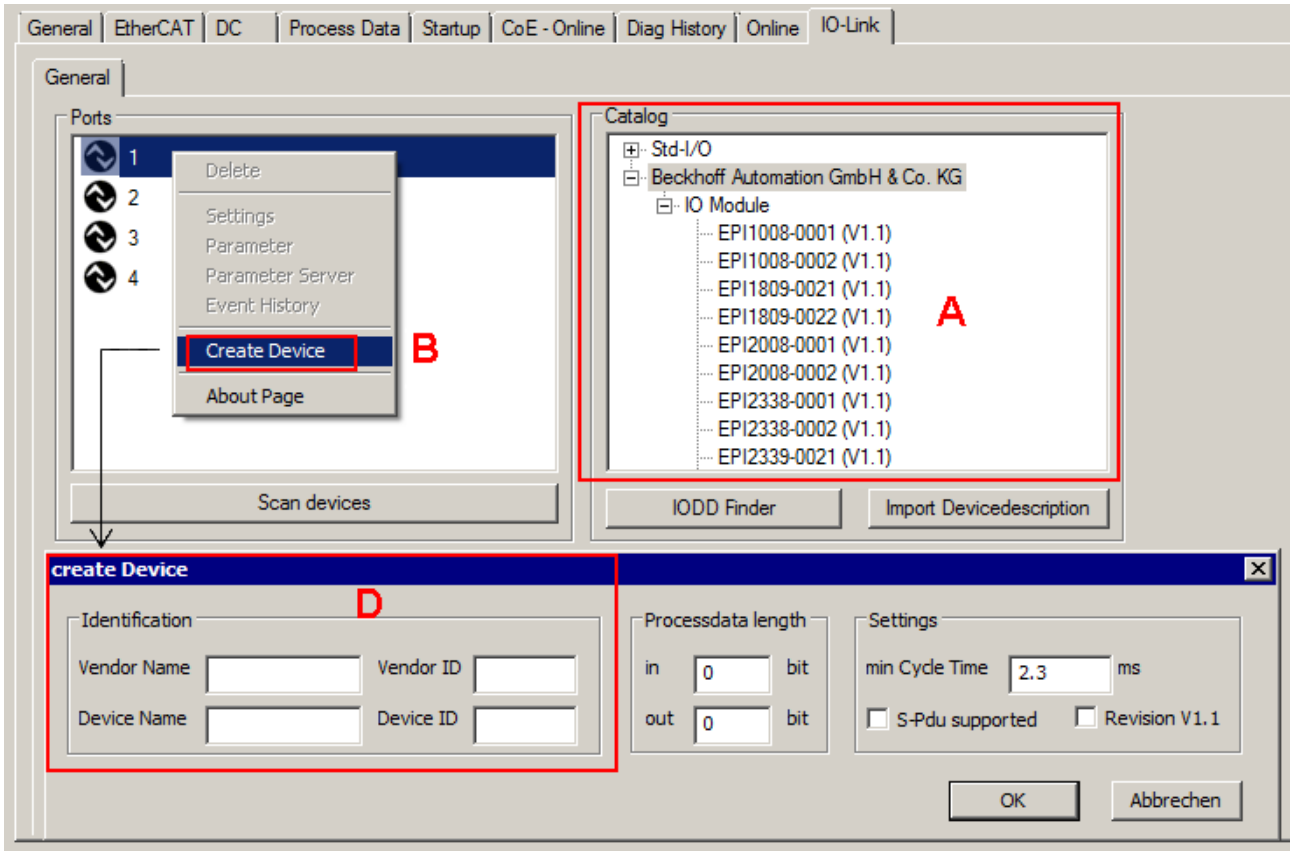


Fig. 63: Manual creation of an IO-Link device via the "Create Device" dialog (D)

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.

If the IO-Link device is created manually, some device settings can be implemented in the settings of the IO-Link devices (see Settings of the IO-Link devices) [▶ 62]

5.3.2 EPI3xxx, ERI3xxx - Process data

The System Manager shows the EPI3xxx/ERI3xxx process data which are arranged in the tree structure under the associated Port (A) (in the following example EPI3174-0002 is connected to port 1).

The EPI3174-0002/ERI3174-0002 offer 16-bit status information and the analog value (16 bit) per channel (B) for transmission.

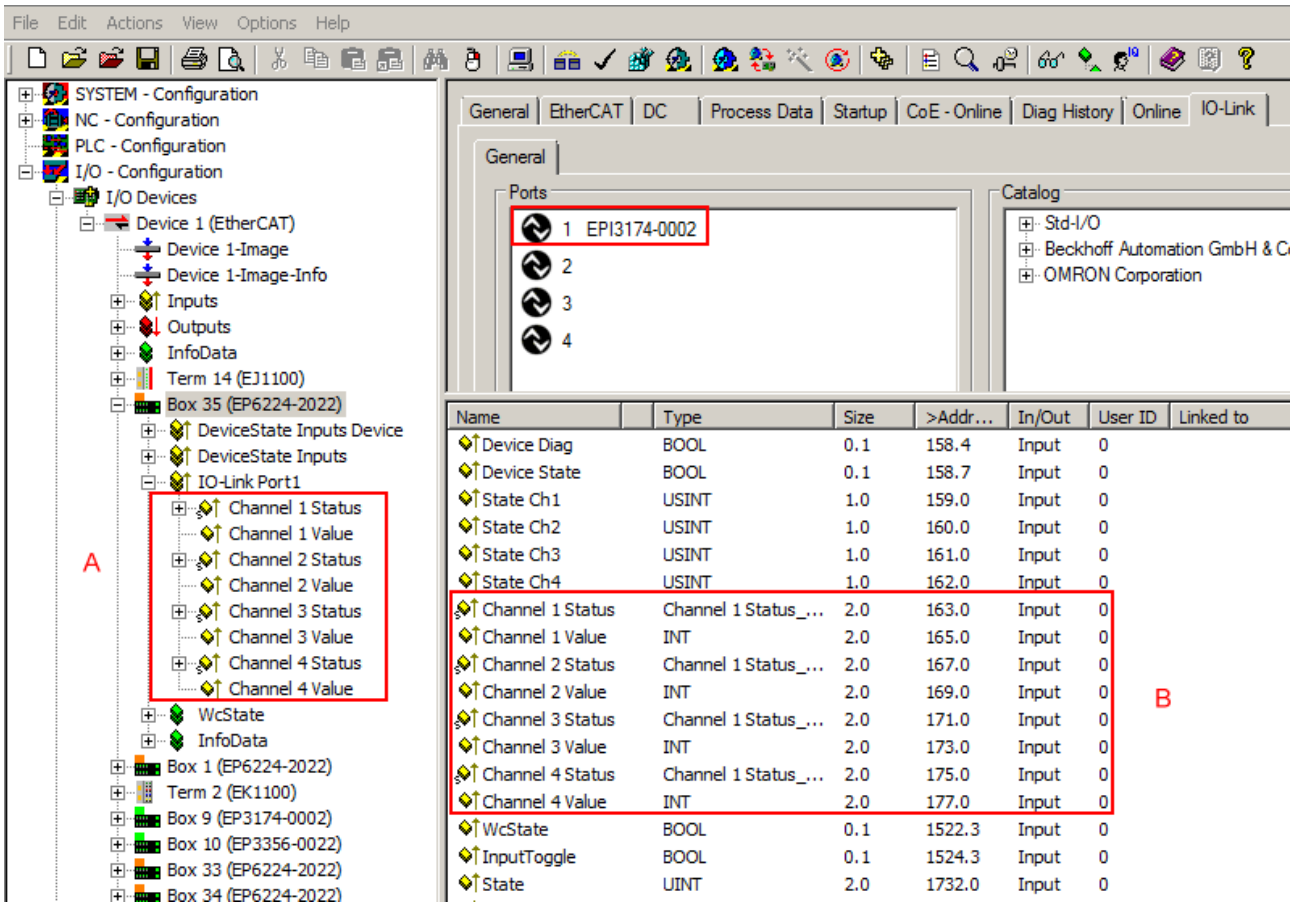


Fig. 64: Default process data of EPI3174-0002

A detailed representation of the structure is obtained by opening the tree structure of the *Channel 1 status* (see A in the following figure).

Activation of the *Show Sub Variables* button (C) displays the detailed view of the different bit meanings (see B in the following illustration). The plain text display of the bit meanings is particularly helpful not only in commissioning, but also for linking to the PLC program.

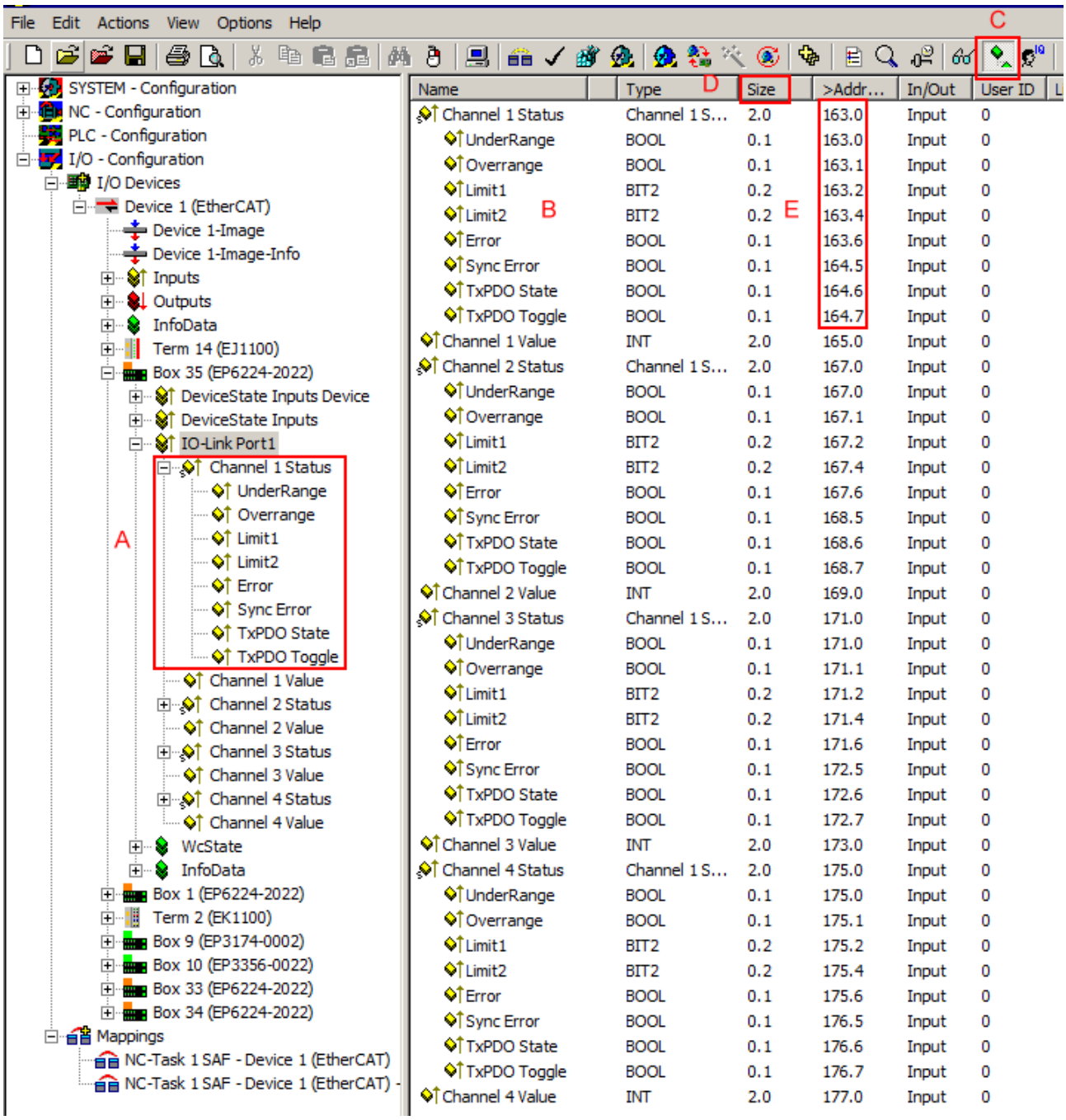


Fig. 65: Process data of EPI3174-0002 represented with sub variables

By right-clicking on the Status variable in the configuration tree (A), the structure can be opened for linking. Both the collective name e.g. *Channel 1 Status* and the individual bit variable e.g. *Overrange* can be linked, but not both at the same time.

The bit meaning i.e. offset position can then be taken from the memory assignment display (E) on the basis of the point notation, also taking into account the variable size (D).

Example:

163.1 means here that the 1st bit (counting method 0, 1, etc.) or 2nd bit (counting method 1, 2, etc.) in the status word indicates the *Overrange*. The user requires this information in the PLC if the status word is to be divided into its bit meanings.

Control/status word

Status word

The status word (SW) is located in the input process image, and is transmitted from terminal to the controller.

Bit	SW.15	SW.14	SW.13	SW.12	SW.11	SW.10	SW.9	SW.8
Name	TxPDO Toggle	TxPDO State	Sync error	-	-	-	-	-

Bit	SW.7	SW.6	SW.5	SW.4	SW.3	SW.2	SW.1	SW.0
Name	-	ERROR	Limit 2		Limit 1		Overrange	Underrange

Key

Bit	Name	Description	
SW.15	TxPDO Toggle	1_{bin}	Toggles with each new analog process value
SW.14	TxPDO State	1_{bin}	TRUE in the case of an internal error
SW.13	Sync error	1_{bin}	TRUE (DC mode): a synchronization error occurred in the expired cycle.
SW.6	ERROR	1_{bin}	General error bit, is set together with overrange and underrange
SW.5	Limit 2	1_{bin}	See Limit [▶ 75]
SW.4		1_{bin}	0: Limit function is not active 1: Value < Limit value in Index 0x08n0:13 2: Value > Limit value in Index 0x08n0:13 3: Value = Limit value in Index 0x08n0:13
SW.3	Limit 1	1_{bin}	See Limit [▶ 75]
SW.2		1_{bin}	0: Limit function is not active 1: Value < Limit value in Index 0x08n0:14 2: Value > Limit value in Index 0x08n0:14 3: Value = Limit value in Index 0x08n0:14
SW.1	Overrange	1_{bin}	Analog input signal lies above the upper permissible threshold for this terminal
SW.0	Underrange	1_{bin}	Analog input signal lies under the lower permissible threshold for this terminal

Control word

The EPI3xxx/ERI3xxx boxes have no control word

5.3.3 Settings of the IO-Link devices

To find the basic settings of the devices for each port, right-click the port and select *Settings*. A new tab *Portx:: Settings* opens.

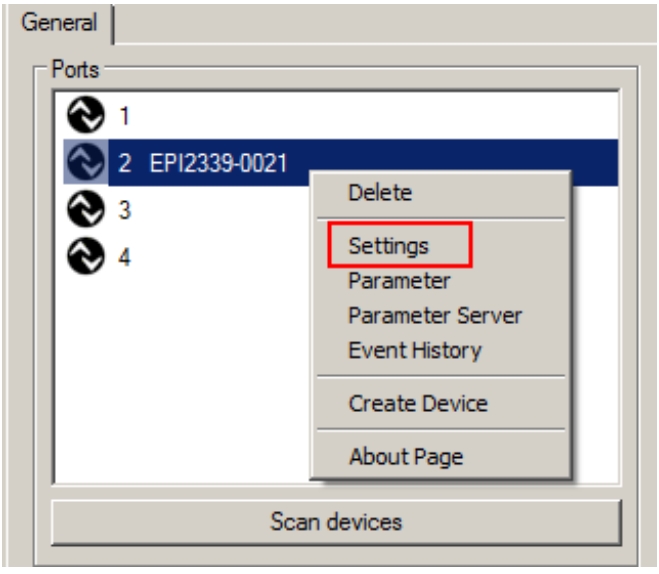


Fig. 66: Context menu - Settings

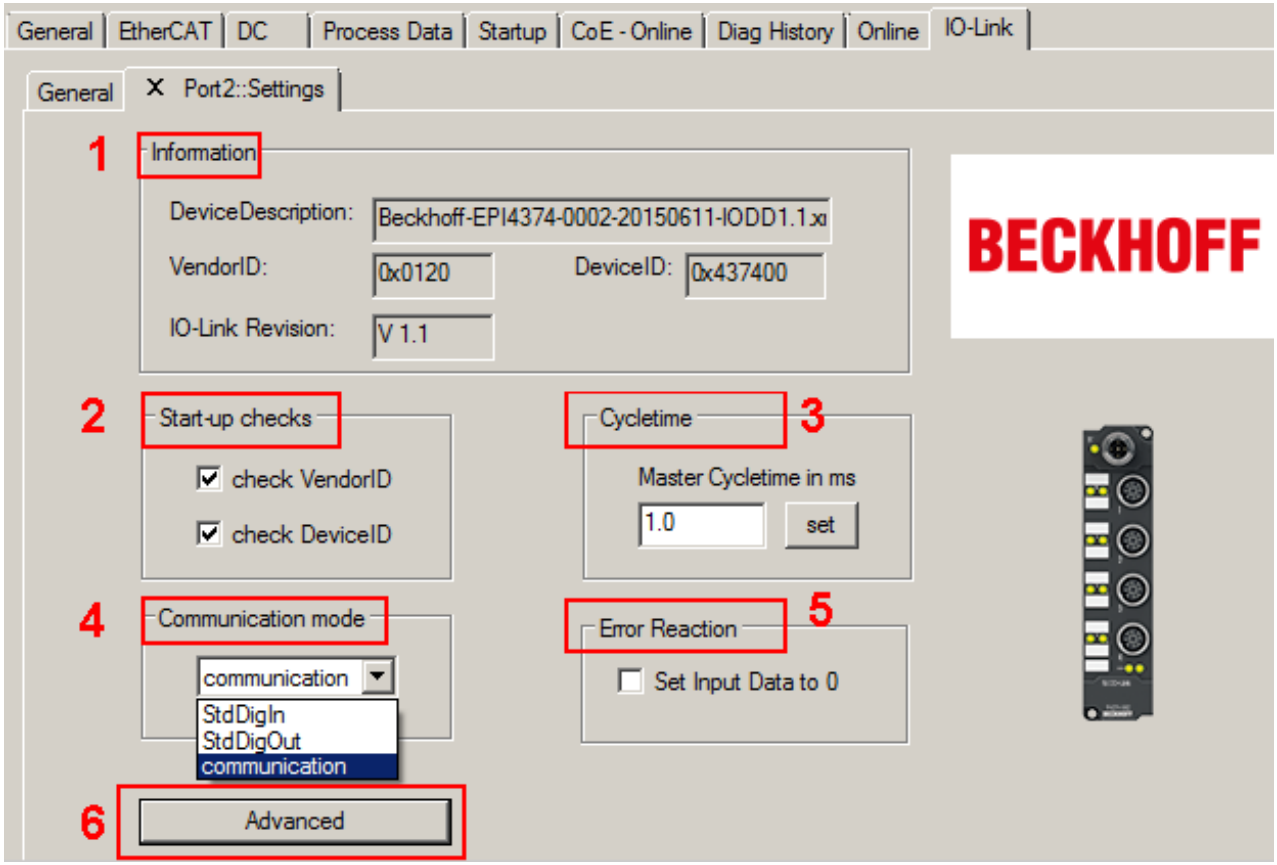


Fig. 67: Settings of the IO-Link devices

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(V 1.0 or V 1.1) of the IO-Link devices are displayed. If the device is an IO-Link device V1.1, then the parameter server [▶ 14] 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 [▶ 52]
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"**

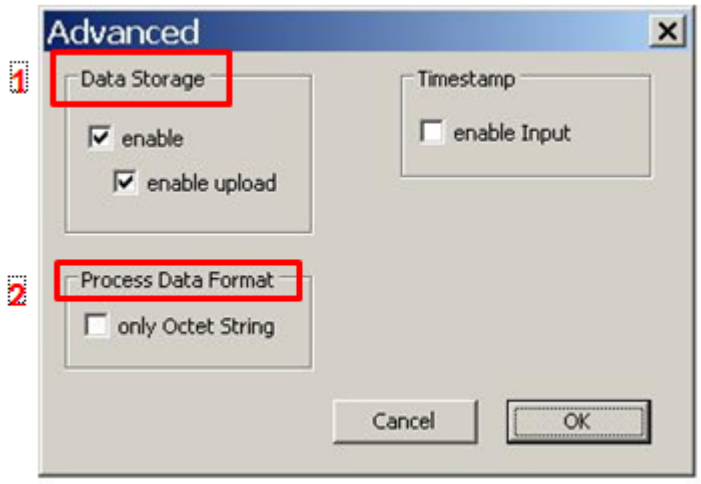


Fig. 68: Advanced settings

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
   - Field *only Octet String* selected
     -> complex data types (process data) are created as octet strings
     -> Advantage: simple further processing in the PLC

5.3.4 Data stream and correction calculation

Data stream

The following flow chart illustrates the data stream of the EPI31xx, ERI31xx (processing of raw data).

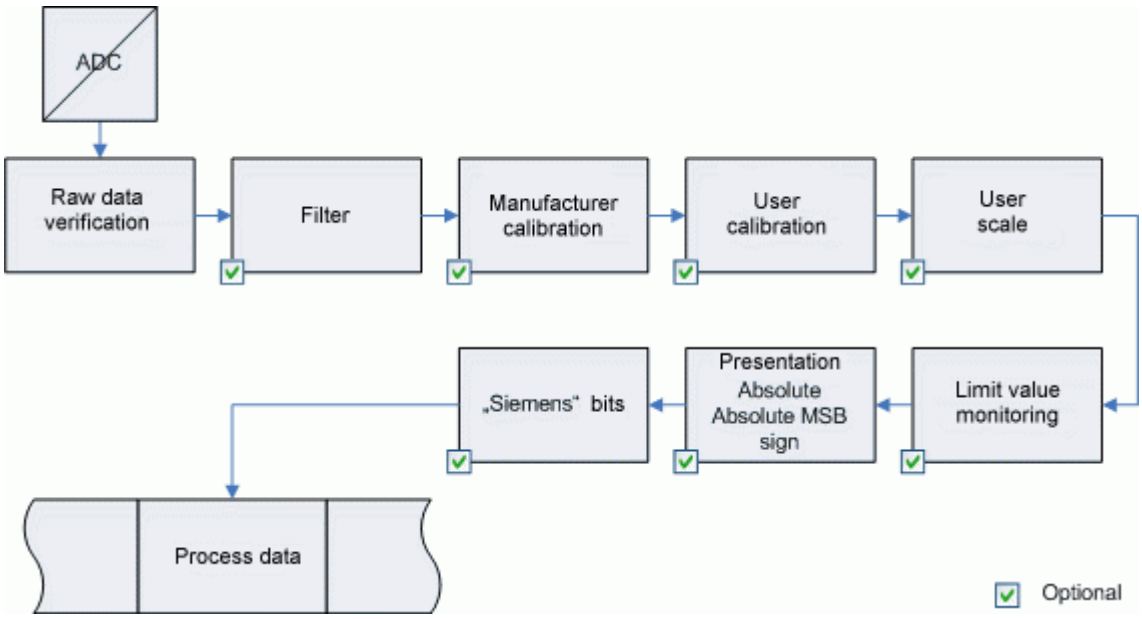


Fig. 69: Diagram showing the data stream in the EPI31xx, ERI31xx

Correction calculation

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)

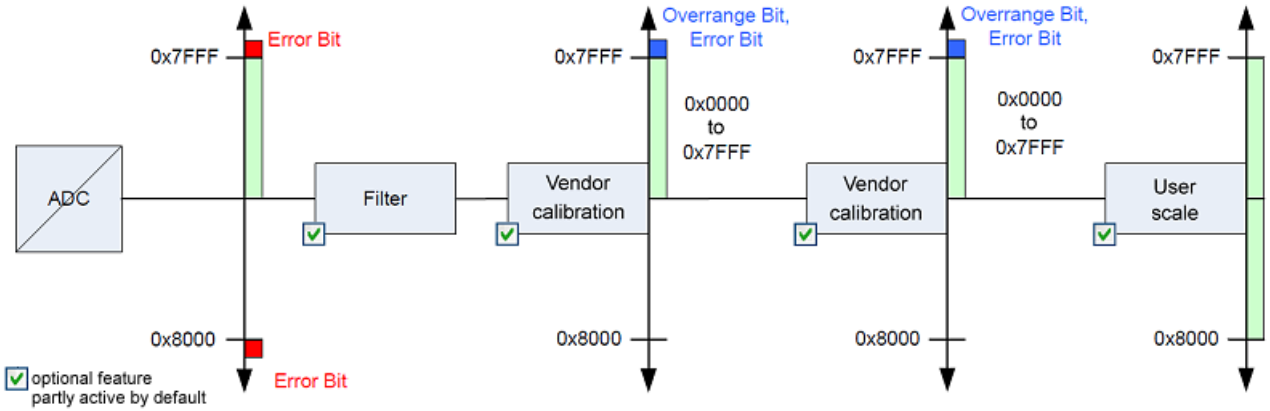


Fig. 70: Data flow with correction calculation for +/- 10 V or +/- 10 mA

(0…20 mA)

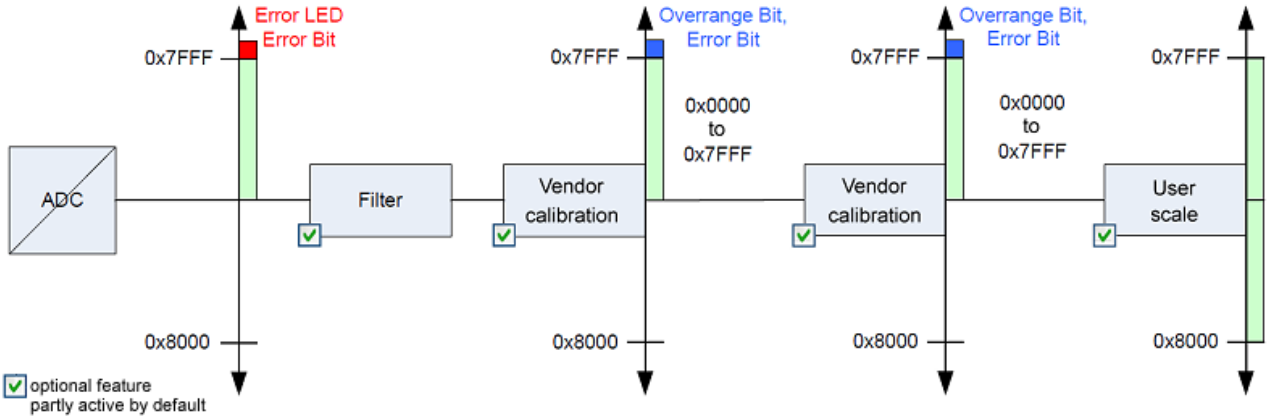


Fig. 71: Data flow with correction calculation for 0…20 mA

(4…20 mA)

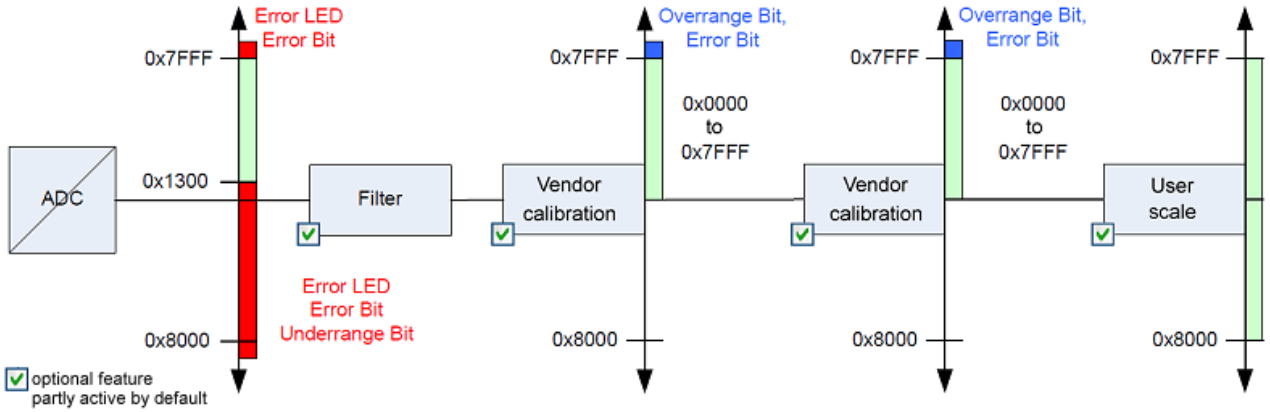


Fig. 72: Data flow with correction calculation for 4…20 mA

(0…10 V)

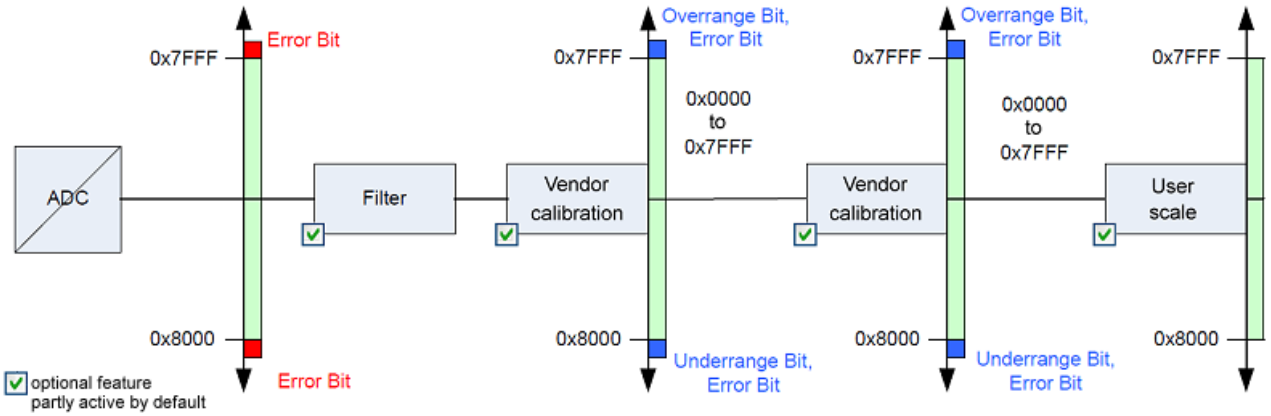


Fig. 73: Data flow with correction calculation for 0…10 V

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	-

5.3.5 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

- click the IO-Link master (EP6224-xxxx) in the TwinCAT tree structure,
- click the *IO-Link* tab,
- select the port to which the IO-Link device is connected,
- open the *Parameters* tab by double-clicking or
- by right-clicking and selecting *Parameters*.

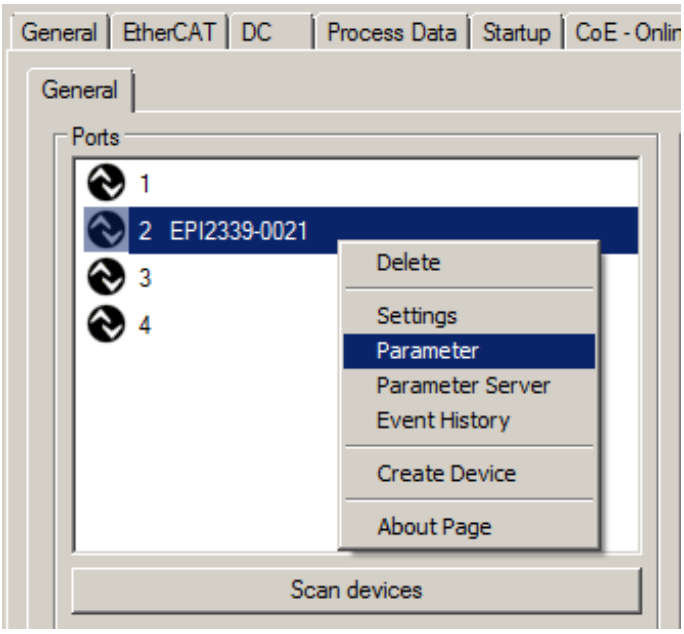


Fig. 74: Opening the *Parameters* tab

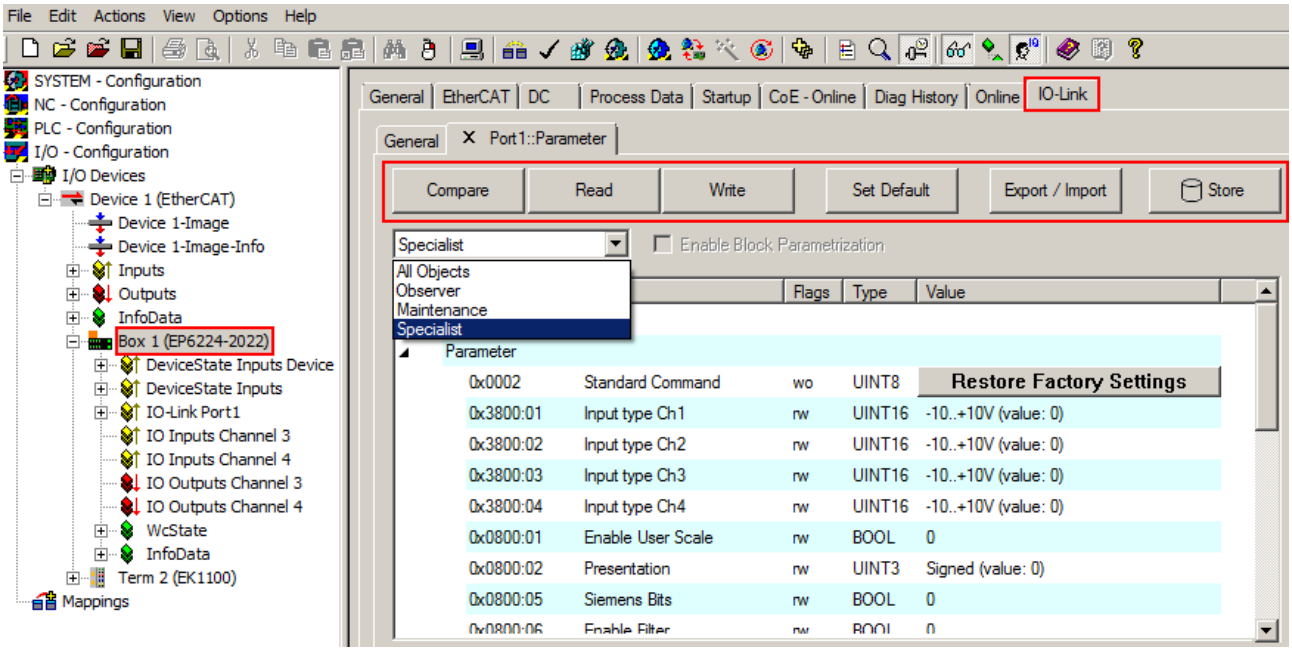


Fig. 75: Parameters IO-Link device

The device parameters are listed in the tab. The buttons *Compare, Read, Write, Set Default, Export/Import* and *Store* 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.

Compare button

- By pressing the Compare button, the parameter data of the configuration are compared with the parameter sets in the sensor and in the parameter server.

Read button

- The default values from the IODD file are always preset
- The current parameter values are not read until the *Read* button is pressed

Write button

- The default values from the IODD file are always preset
- Enter the desired value under *Value*
- The values are accepted by pressing the Enter key
- Press the *Write* button to write data to the device (offline configuration is possible)

Set Default button

- Pressing the *Set Default* button sets all parameter values to the default settings.

Export / Import button

- The set parameter values can be exported as a .vbs file and restored later via Import.
- Pressing the *Export / Import* button (see the diagram below (1)) opens the Import / Export dialog
- 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.
- 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.
- Press the *Export* or *Import* button

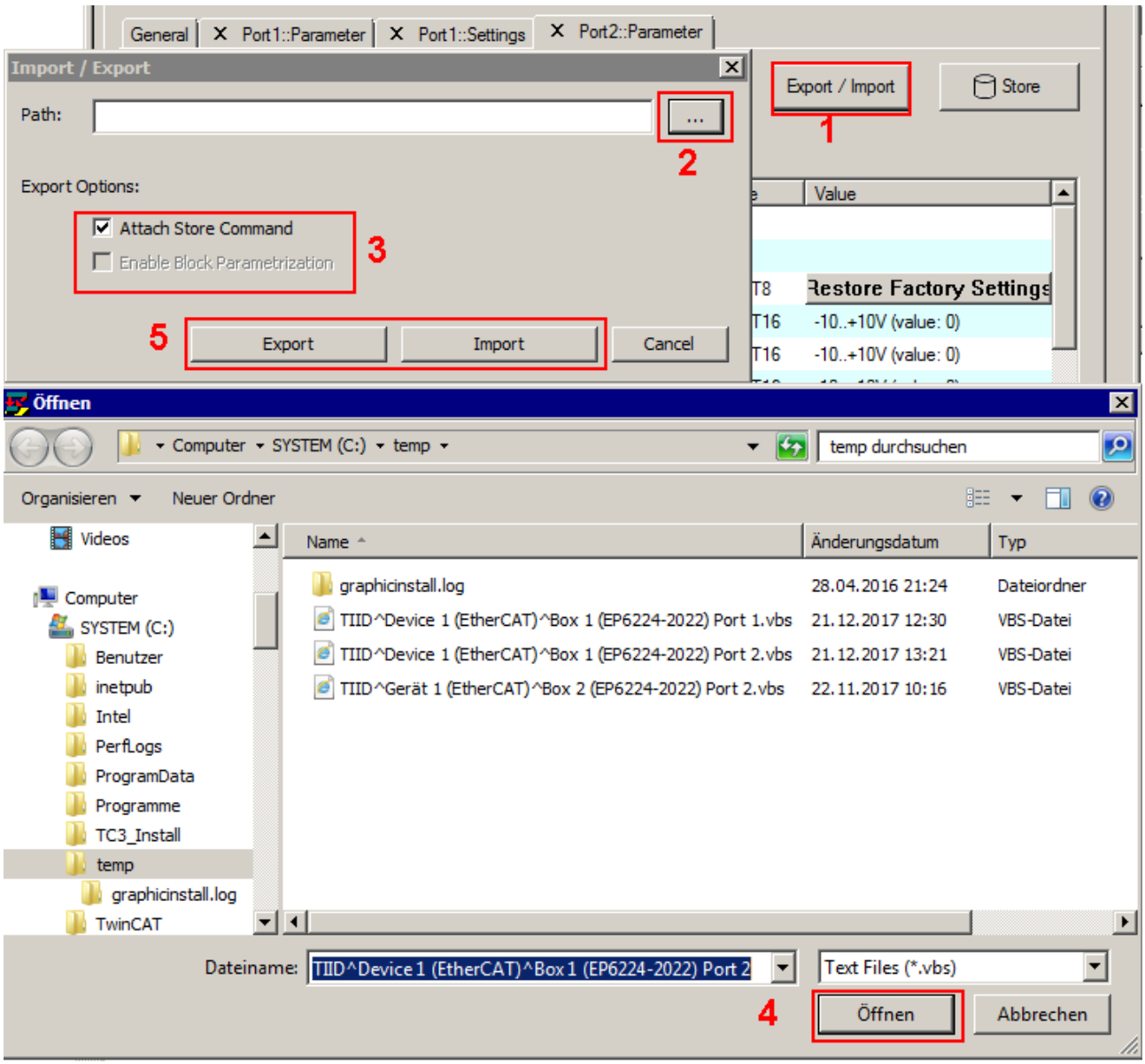


Fig. 76: Parameterization IO-Link device - Export / Import

Store button

- Click *Store* (data storage): The Beckhoff EP6224-xxxx IO-Link master (from firmware 10) stores the parameters (0x0018) *Application-Specific Tag*, (0x08n0) *Settings* and 0x3800 *Range Settings*. If the IO-Link device is exchanged for a similar module, the device can be restored.

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). In the parameter list of the *All Objects* user role, click *Standard Command*, then double-click *Standard Command* in the right-hand field. Select the desired value from the list of different options and use the *Write* button (as described above).

Device Reset: Restarts the IO-Link device.

Application Reset: No function.

Restore Factory Settings: Restoring the application parameters, i.e. the Settings parameter (0x0800).

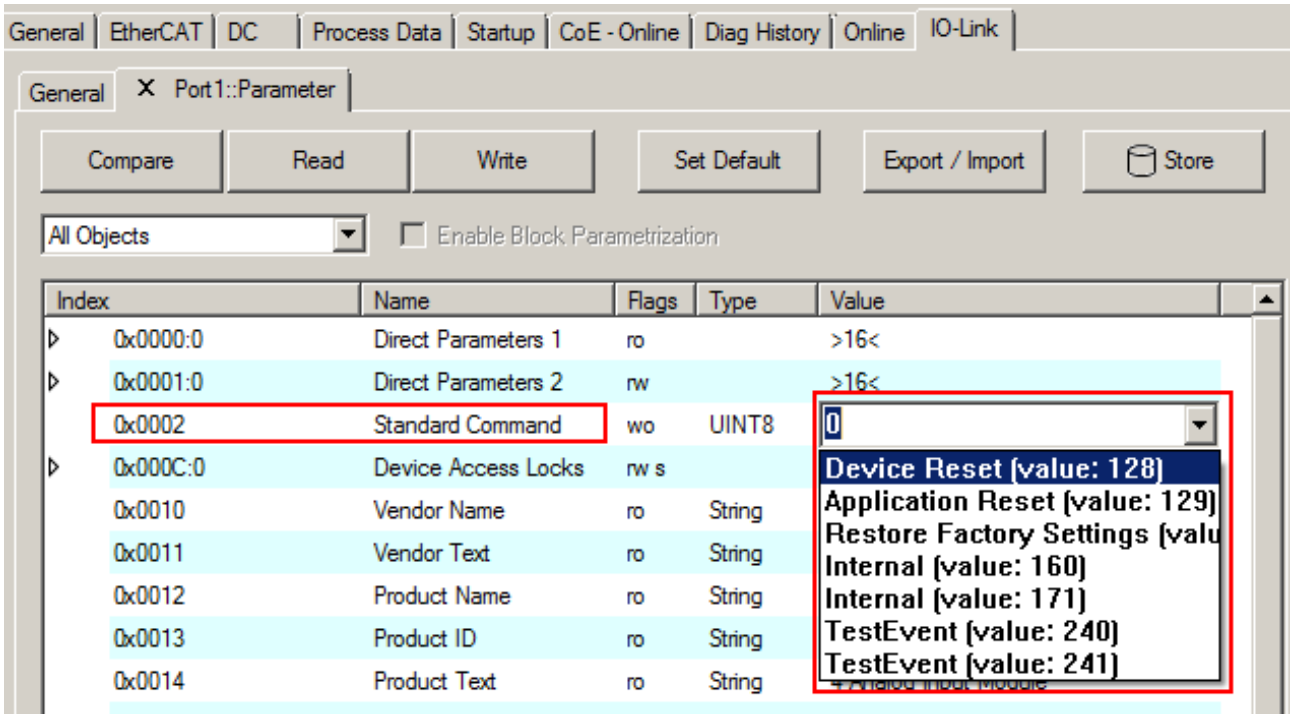


Fig. 77: Parameters IO-Link device Standard Command

Application Specific Tag (Index 0x0018)

Application-specific information can be entered and stored here. Click *Application-Specific Tag* in the parameter list, then double-click *Application-Specific Tag* in the right-hand field. Enter application-specific information and use the *Write* button and the *Store* button, if required (as described above).

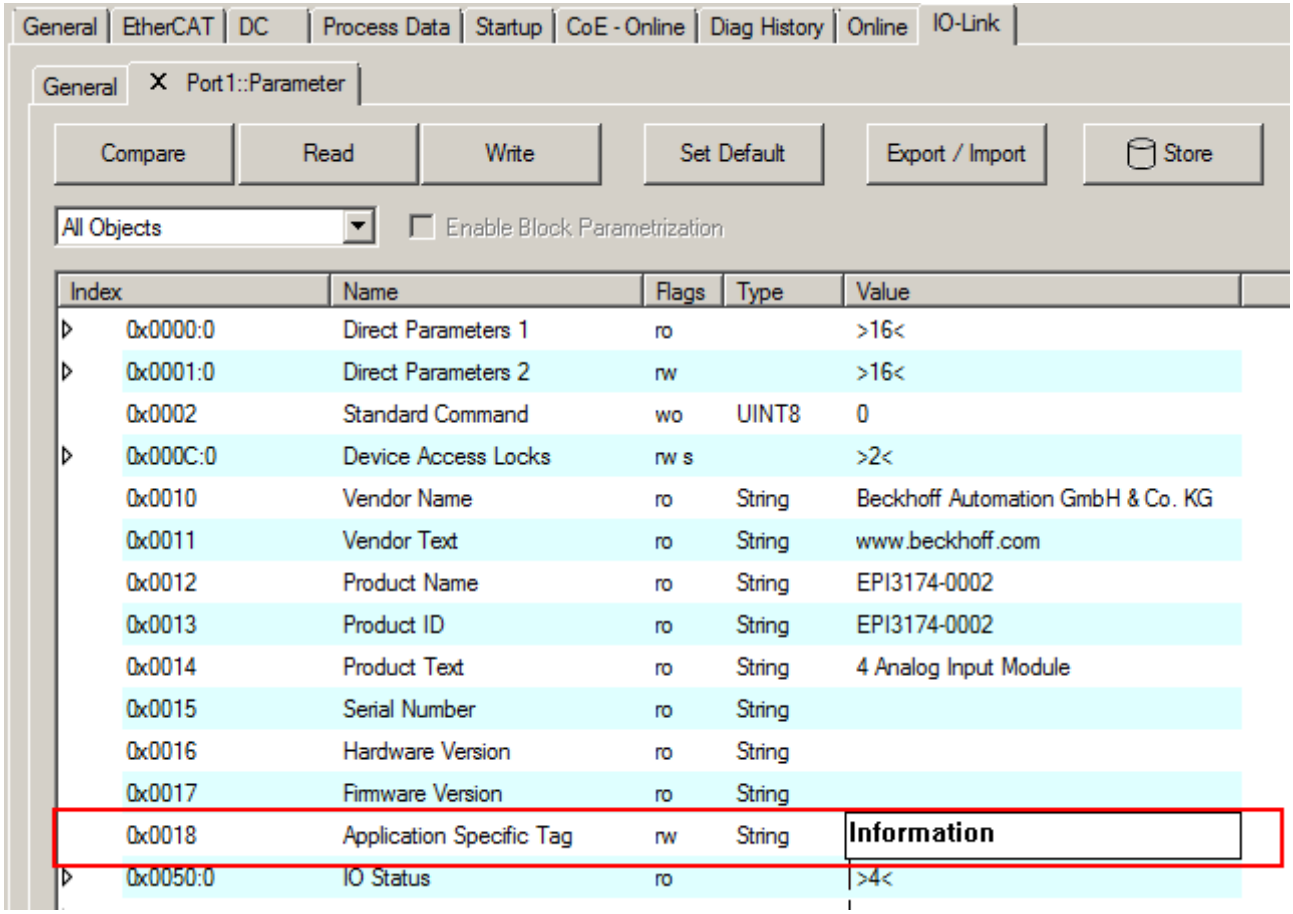


Fig. 78: Parameters IO-Link device: Application Specific Tag

5.3.6 EPI31xx, ERI31xx - Setting of the IO-Link device parameters

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

In delivery state, all channels of the EPI31x4, ERI31x4 are set for analog voltage measurement (-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.

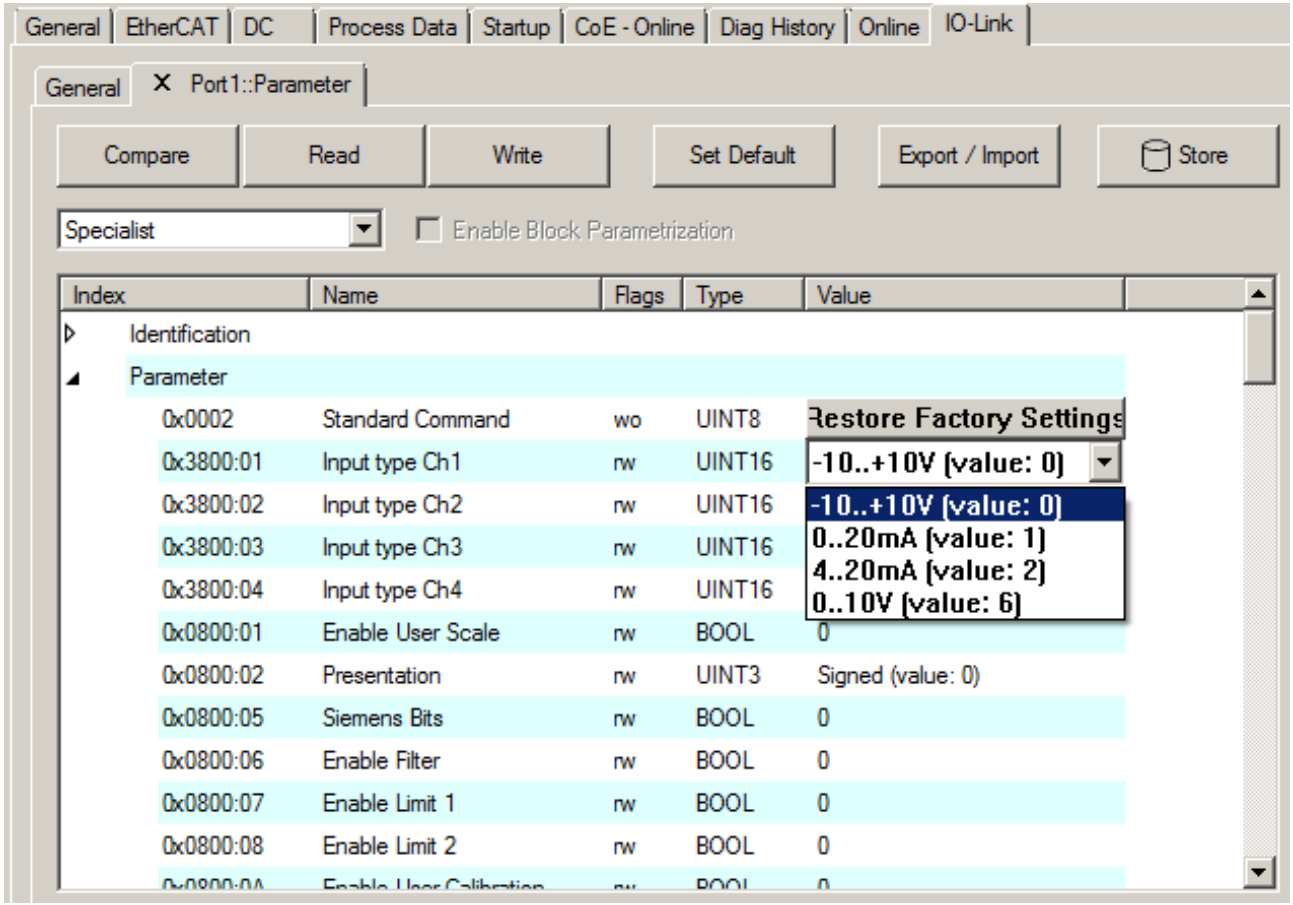


Fig. 79: Selection of the analog signal type

5.3.6.2 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.

5.3.6.3 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.

5.3.6.4 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

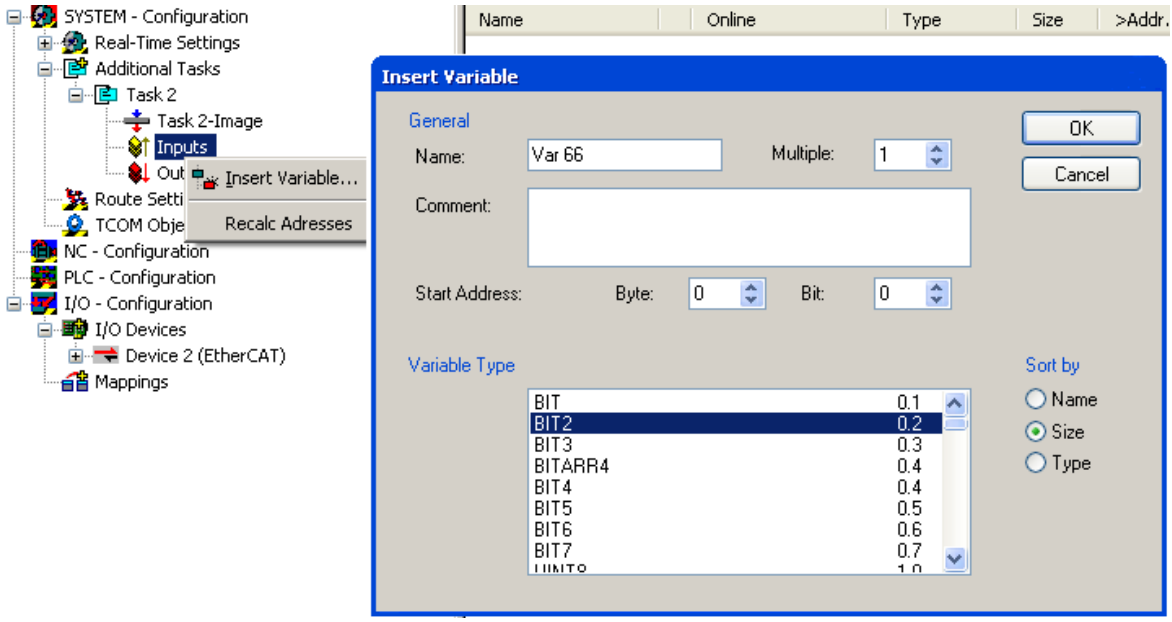
The limit information consists of 2 bits. *Limitn* can be linked to the PLC or a task in the System Manager:

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

5.3.6.5 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.

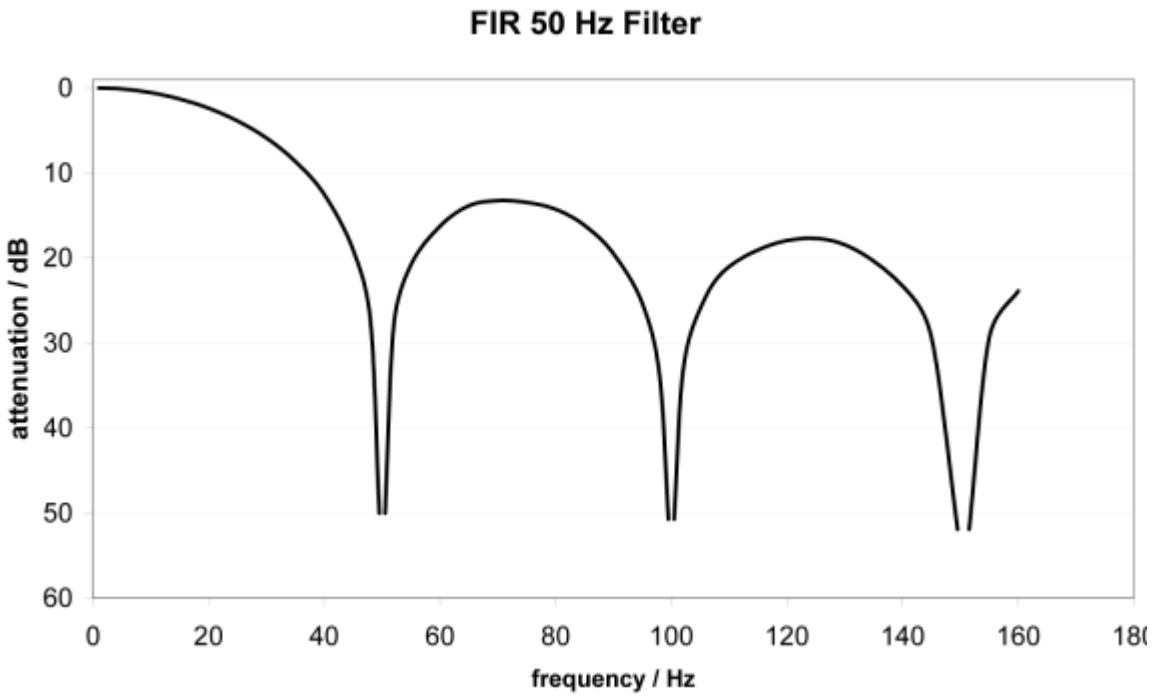


Fig. 80: typ. attenuation curve notch.filter at 50 Hz

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

5.3.6.6 Diagnosis (Index 0x0A00)

The *Diagnosis* parameters vary between the different devices. The meaning of *Diagnosis* parameters (Index 0x0A00 [▶ 90]) can be read in the respective chapter *Object description and parameterization*.

The *Diagnosis* parameters of the EPI3174-0002 are presented in the figure below.

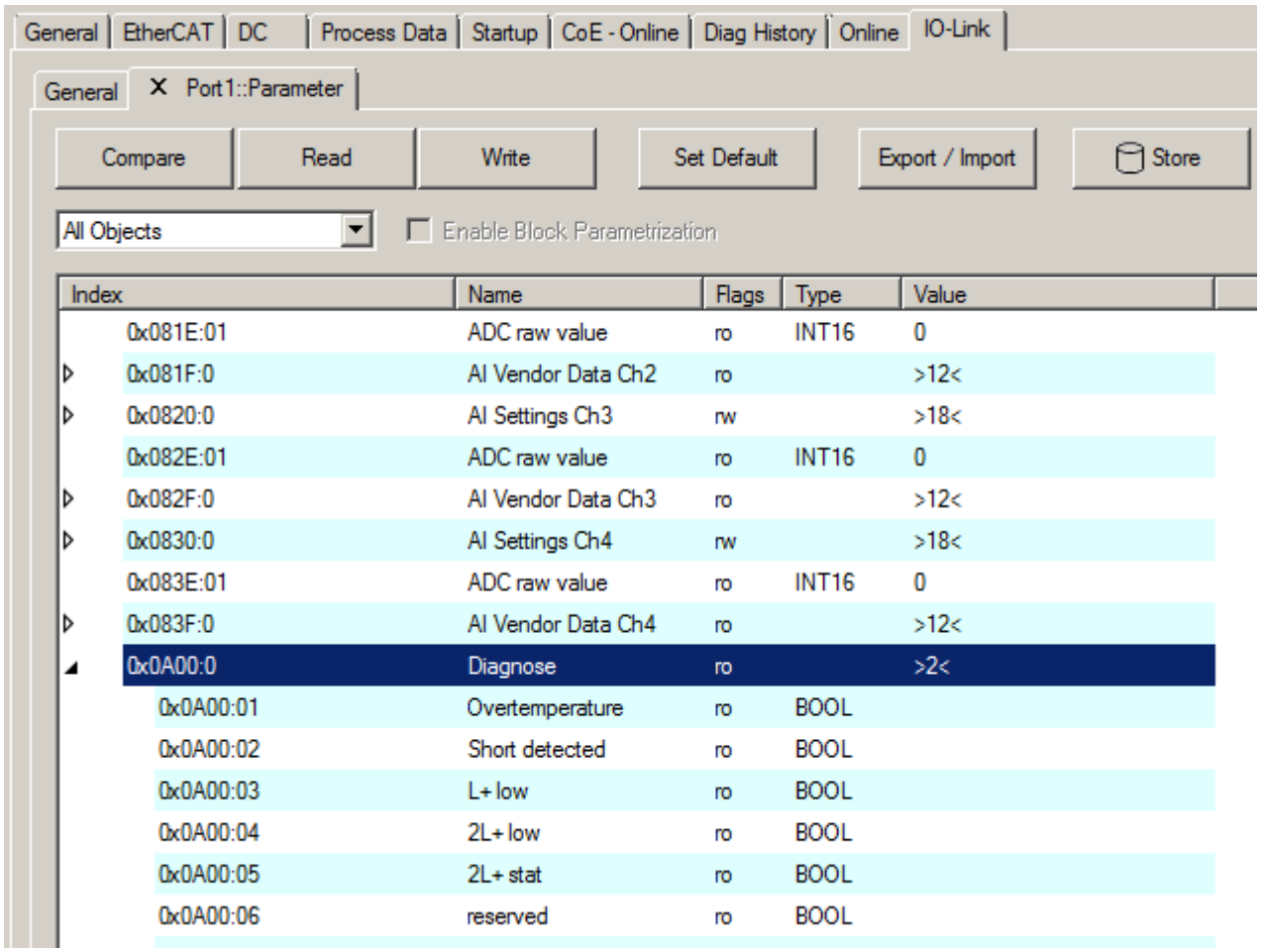


Fig. 81: IO-Link Device Parameter: showing Diagnosis EPI3174-0002

5.3.7 Object overview - EPI3174-0002, ERI3174-0002

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 tables show the object overview of EPI3174-0002, ERI3174-002.

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	EPI3174-0002, ERI3174-0002
0x0013	Product ID	RO	EPI3174-0002, ERI3174-0002
0x0014	Product Text	RO	4 AI 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	**AI Settings Ch. 3**	RW	18
0x0820:01	Enable User Scale	RW	0x00 (0_{dec})
0x0820:02	Presentation	RW	Signed
0x0820:05	Siemens bits	RW	0x00 (0_{dec})
0x0820:07	Enable Limit 1	RW	0x00 (0_{dec})
0x0820:08	Enable Limit 2	RW	0x00 (0_{dec})
0x0820:0A	Enable User Calibration	RW	0x00 (0_{dec})
0x0820:0B	Enable Vendor Calibration	RW	0x01 (1_{dec})
0x0820:0E	Swap Limit Bits	RW	0x00 (0_{dec})
0x0820:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0820:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0820:13	Limit 1	RW	0x0000 (0_{dec})
0x0820:14	Limit 2	RW	0x0000 (0_{dec})
0x0820:17	User Calibration Offset	RW	0x0000 (0_{dec})
0x0820:18	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	**AI 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	**AI Settings Ch 4**	RW	18
0x0830:01	Enable User Scale	RW	0x00 (0_{dec})
0x0830:02	Presentation	RW	Signed
0x0830:05	Siemens bits	RW	0x00 (0_{dec})
0x0830:07	Enable Limit 1	RW	0x00 (0_{dec})
0x0830:08	Enable Limit 2	RW	0x00 (0_{dec})
0x0830:0A	Enable User Calibration	RW	0x00 (0_{dec})
0x0830:0B	Enable Vendor Calibration	RW	0x01 (1_{dec})
0x0830:0E	Swap Limit Bits	RW	0x00 (0_{dec})
0x0830:11	User Scale Offset	RW	0x0000 (0_{dec})
0x0830:12	User Scale Gain	RW	0x00010000 (65536_{dec})
0x0830:13	Limit 1	RW	0x0000 (0_{dec})
0x0830:14	Limit 2	RW	0x0000 (0_{dec})
0x0830:17	User Calibration Offset	RW	0x0000 (0_{dec})
0x0830:18	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	RO	0
0x0A00:05	$2L_+$ stat	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

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.

5.3.8 EPI3174-0002, ERI3174-0002 - 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 boxes 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 EPIxxxx, ERIxxxx - Setting of the IO-Link device parameters [▶ 68].

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	Product Name	Product designation	String	R	EPI3174-0002, ERI3174-0002

Index 0013 product ID

Index (hex)	Name	Meaning	Data type	Flags	Default
0013	Product ID	Product designation	String	R	EPI3174-0002, ERI3174-0002

Index 0014 product text

Index (hex)	Name	Meaning	Data type	Flags	Default
0014	Product Text	Product description	String	R	4 AI 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 AI Settings Ch.3 (parameterization of channel 3)

Index (hex)	Name	Meaning		Data type	Flags	Default
0820:0	AI Settings Ch3	Maximum subindex			RO	0x18 (24_{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	Siemens bits	1	Status indicators are displayed on the lowest 3 bits in the status word.	BOOLEAN	RW	0x00 (0_{dec})
0820:07	Enable Limit 1	1	Limit 1 enabled	BOOLEAN	RW	0x00 (0_{dec})
0820:08	Enable Limit 2	1	Limit 2 enabled	BOOLEAN	RW	0x00 (0_{dec})
0820:0A	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0820:0B	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0820:0E	Swap Limit Bits	1	Swaps the two limit bits, in order to achieve compatibility with older hardware versions.	BOOLEAN	RW	0x00 (0_{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	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0820:14	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0820:17	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0820:18	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 AI vendor data Ch3

Index (hex)	Name	Meaning	Data type	Flags	Default
082F:0	AI 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 AI Settings Ch.4 (parameterization of channel 4)

Index (hex)	Name	Meaning		Data type	Flags	Default
0830:0	AI Settings Ch4	Maximum subindex			RO	0x18 (24_{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	Siemens bits	1	Status indicators are displayed on the lowest 3 bits in the status word.	BOOLEAN	RW	0x00 (0_{dec})
0830:07	Enable Limit 1	1	Limit 1 enabled	BOOLEAN	RW	0x00 (0_{dec})
0830:08	Enable Limit 2	1	Limit 2 enabled	BOOLEAN	RW	0x00 (0_{dec})
0830:0A	Enable User Calibration	1	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
0830:0B	Enable Vendor Calibration	1	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
0830:0E	Swap Limit Bits	1	Swaps the two limit bits, in order to achieve compatibility with older hardware versions.	BOOLEAN	RW	0x00 (0_{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	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0830:14	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0_{dec})
0830:17	User Calibration Offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
0830:18	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})
083F:01	R0 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
083F:02	R0 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
083F:03	R1 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
083F:04	R1 gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})
083F:05	R2 offset	Offset (vendor calibration)	INT16	RW	0x0000 (0_{dec})
083F: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	Additional power supply too low (< 18 V)	BOOLEAN	RW	0x00 (0_{dec})
0A00:05	$2L_+$ stat	Additional power supply not available (< 8 V)	BOOLEAN	RW	0x00 (0_{dec})
0A00:06 - 0A00:10	Reserved	-	BOOLEAN	RW	0x00 (0_{dec})

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})

5.3.9 Firmware update of the IO-Link device

Firmware update only possible with EtherCAT IO-Link master products

The firmware update of the IO-Link device is only possible with the EP6224-xxxx, EP6228-xxxx and EL6224. A firmware update is not possible with the KL6224.

An update of the box firmware is currently supported via the EP622x-xxxx IO-Link master box and the TwinCAT System Manager from version 2.11 R3 build 2248 or TwinCAT 3.1 build 4018.

The firmware update is performed directly via the IO-Link interface. To this end the box must be connected to the EP622x-xxxx and in *Operational* state. The update is started in the *Advanced* dialog of the corresponding IO-Link port (see the two figures below).

1. Select the EP622x-xxxx Box in the System Manager,
2. in the *IO-Link* tab, right click on the appropriate port
3. open the *Settings* tab,
4. select the *Advanced* button
5. Select IO-Link firmware files via the *Download* button (use the file extension *.efw).
   The *Firmware Update* dialog is only displayed for supported Beckhoff IO-Link devices. Once the *.efw file has been checked, the firmware update starts automatically. This process must not be interrupted! After a successful update, the box is automatically restarted and therefore usually does not have to be de-energized. Device-specific settings (Appl. -Specific Tag, Settings) will not be lost.

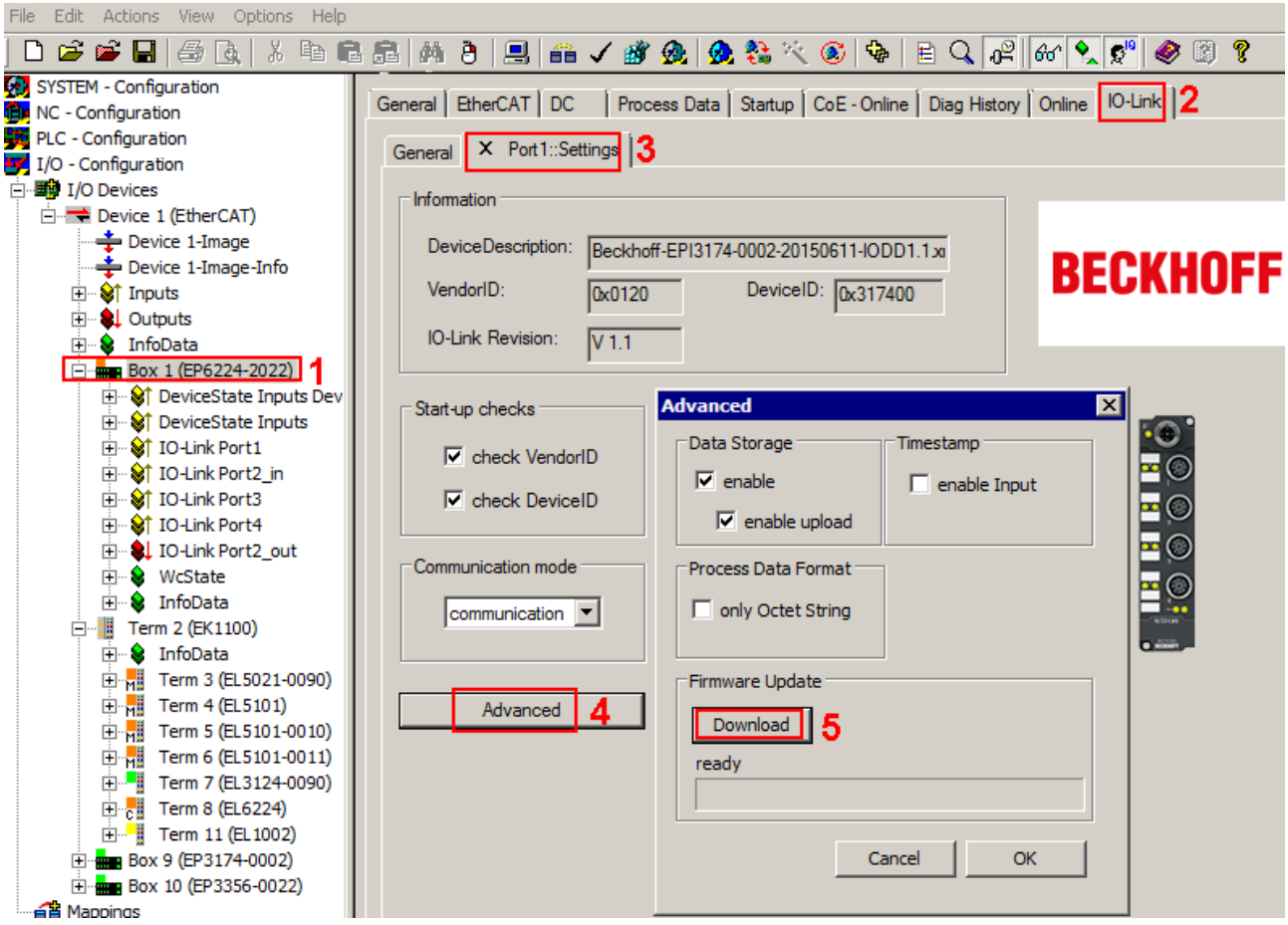


Fig. 82: IO-Link settings - download firmware update

The firmware version that is currently used can be obtained as follows (see the figure below):

1. Select the EP622x-xxxx Box in the System Manager,
2. In the *IO-Link* tab, right click on the appropriate port
3. open the *Parameter* tab,
4. select Index 0x017 (firmware version)
5. click the *Read* button
6. The firmware version is read out and displayed when IO-Link communication to the box is active.

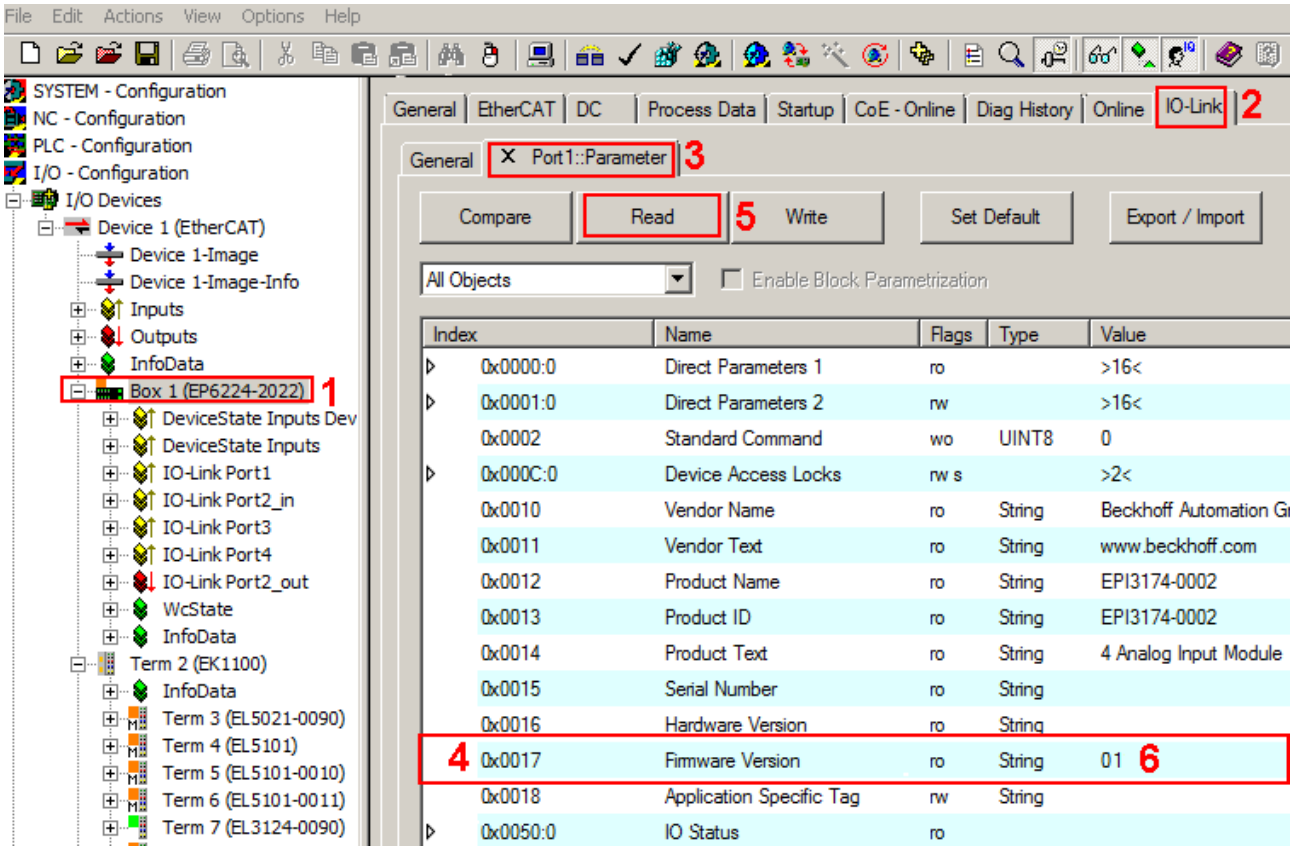


Fig. 83: IO-Link parameters - firmware version

6 Appendix

6.1 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 Fieldbus/EtherCAT Box 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

6.2 IP67 Box - Accessories

Fixing

Ordering information	Description
ZS5300-0001	Mounting rail (500 mm x 129 mm)

Marking material, plugs

Ordering information	Description
ZS5000-0000	Fieldbus Box set M8 (contact labels, plugs)
ZS5000-0002	Fieldbus Box set M12 (contact labels, plugs)
ZS5000-0010	plugs M8, IP67 (50 pieces)
ZS5000-0020	plugs M12, IP67 (50 pieces)
ZS5100-0000	marking labels, not printed, 4 stripes at 10 pieces
ZS5100-xxxx	printed marking labels, on request

Tools

Ordering information	Description
ZB8800	torque socket wrench with ratchet wrench for M8 connectors (over molded)
ZB8800-0001	ratchet wrench for M8 connectors (field assembly)
ZB8800-0002	ratchet wrench for M12 connectors (over molded)
ZB8801	torque wrench adjustable for M8 and M12 connectors
ZB8801-0001	ratched wrench for M8 connectors (over molded)
ZB8801-0002	ratched wrench for M8 connectors (field assembly) and M12 connectors (over molded)
ZB8801-0003	ratched wrench for M12 connectors (field assembly)

Further accessories

Further accessories may be found at the price list for Beckhoff fieldbus components and at the internet under http://www.beckhoff.de/english/fieldbus_box/data_sheets.htm?id=69033899254355.

6.3 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:
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You will also find further documentation for Beckhoff components there.

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List of illustrations