Documentation

EP3752-0000

EtherCAT Box with 2 x 3-axis accelerometers

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BECKHOFF

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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
1.1	• Corrections • "Resolution" section added ("Technical data" chapter)
1.0	• First release
0.3	• Corrections
0.2	• Corrections
0.1	• First preliminary version

Firmware and hardware versions

This documentation refers to the firmware and hardware version that was applicable at the time the documentation was written.

The module features are continuously improved and developed further. Modules having earlier production statuses cannot have the same properties as modules with the latest status. However, existing properties are retained and are not changed, so that older modules can always be replaced with new ones.

The firmware and hardware version (delivery state) can be found in the batch number (D-number) printed on the side of the EtherCAT Box.

Syntax of the batch number (D-number)

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

2 Product overview

2.1 EtherCAT Box - Introduction

The EtherCAT system has been extended with EtherCAT Box modules with protection class IP 67. Through the integrated EtherCAT interface the modules can be connected directly to an EtherCAT network without an additional Coupler Box. The high-performance of EtherCAT is thus maintained into each module.

The extremely low dimensions of only 126 x 30 x 26.5 mm (h x w x d) are identical to those of the Fieldbus Box extension modules. They are thus particularly suitable for use where space is at a premium. The small mass of the EtherCAT modules facilitates applications with mobile I/O interface (e.g. on a robot arm). The EtherCAT connection is established via screened M8 connectors.

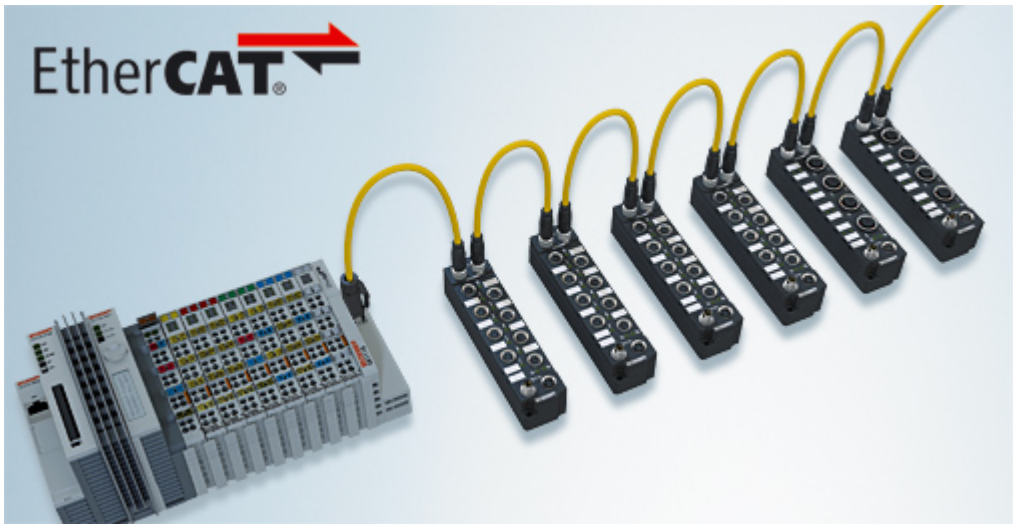

Fig. 1: EtherCAT Box Modules within an EtherCAT network

The robust design of the EtherCAT Box modules enables them to be used directly at the machine. Control cabinets and terminal boxes are now no longer required. The modules are fully sealed and therefore ideally prepared for wet, dirty or dusty conditions.

Pre-assembled cables significantly simplify EtherCAT and signal wiring. Very few wiring errors are made, so that commissioning is optimized. In addition to pre-assembled EtherCAT, power and sensor cables, field-configurable connectors and cables are available for maximum flexibility. Depending on the application, the sensors and actuators are connected through M8 or M12 connectors.

The EtherCAT modules cover the typical range of requirements for I/O signals with protection class IP67:

- digital inputs with different filters (3.0 ms or 10 µs)
- digital outputs with 0.5 or 2 A output current
- analog inputs and outputs with 16 bit resolution
- Thermocouple and RTD inputs
- Stepper motor modules

XFC (eXtreme Fast Control Technology) modules, including inputs with time stamp, are also available.

Fig. 2: EtherCAT Box with M8 connections for sensors/actuators

Fig. 3: EtherCAT Box with M12 connections for sensors/actuators

Basic EtherCAT documentation

You will find a detailed description of the EtherCAT system in the Basic System Documentation for EtherCAT, which is available for download from our website (www.beckhoff.com) under Downloads.

EtherCAT XML Device Description

You will find XML files (XML Device Description Files) for Beckhoff EtherCAT modules on our website (www.beckhoff.com) under Downloads, in the Configuration Files area.

2.2 EP3752-0000

2.2.1 Introduction

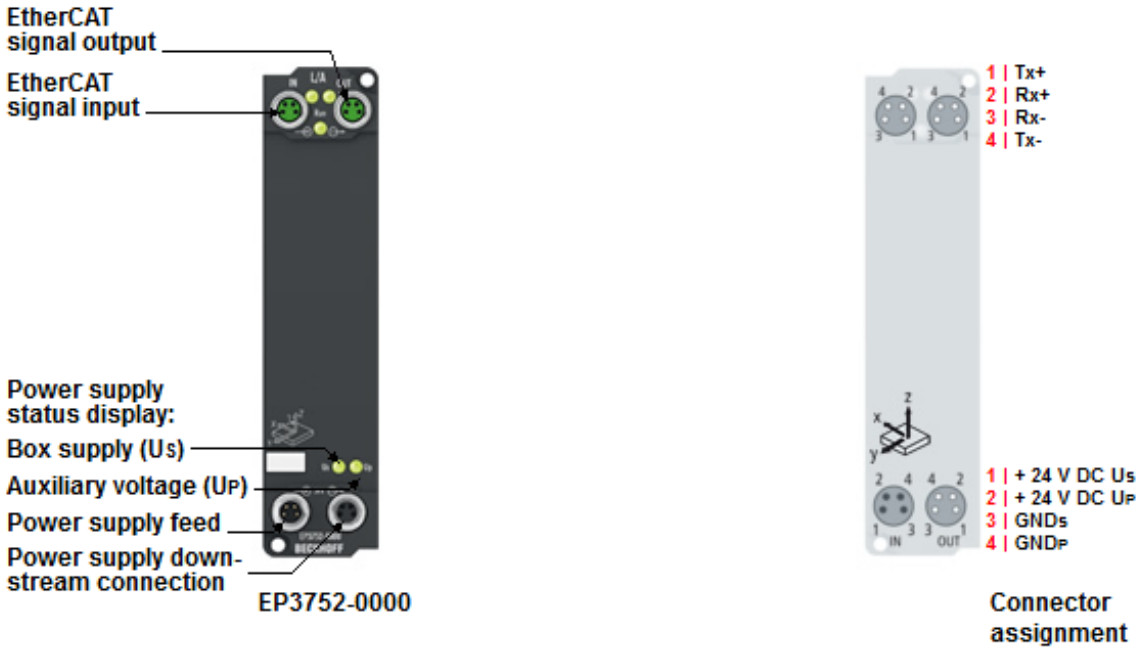

Fig. 4: EP3752-000

EtherCAT Box with 2 x 3G accelerometers

The EP3752-0000 EtherCAT Box has two internal 3-axis accelerometers with 10-bit resolution and a selectable measuring range of ±2 g, ±4 g, ±8 g and ±16 g. The maximum sampling rate is 5 kHz. The measured values can be digitally filtered. Without filters the box operates cycle-synchronously.

Possible applications include the recording of vibrations and shocks/oscillations, but inclination measurements in all three axes are also possible.

Through the measurement using sensors offset by 90°, the controller can carry out a plausibility check of the data. Extended integrated filter functions enable the pre-processing and scaling of the acquired data in order to filter out faults and relieve the controller.

2.2.2 Technical data

Technical data	EP3752-0000
Fieldbus	EtherCAT
Fieldbus connection	2 x M8 socket (green)
Minimum cycle time	200 µs
Supply of the module electronics	from the control voltage U_s
Current consumption of the module electronics	typically 120 mA
Electrical isolation	500 V (fieldbus / supply voltages)
Special features	extended filter functions, inclination measurement
Permissible ambient temperature during operation	-25°C ... +60°C 0°C ... +55°C (according to cURus, see UL requirements)
Permissible ambient temperature during storage	-40°C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27; see also Additional checks [▶ 12].
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (according to EN 60529)
Mounting position	variable
Approvals	CE, cURus

Technical data	Accelerometers
Sensor type	Two 3-axis sensors / offset by 90°
Resolution[1) 2)]	Measured values: 4 mg (default) Raw values: 10-bit (default)
Representation[1)]	Measured values: 1 mg / LSB Raw values: 10-bit in 16-bit (left-aligned)
Measuring range[1)]	±2 g / ±4 g / ±8 g / ±16 g selectively
Sampling rate	200 Hz to 5 kHz

[1)] Unit of measurement: 1 g = 9.81 m/s² (acceleration of gravity). 1 mg = 1/1000 g.
[2)] The resolution depends on the parameterization of the box. See section Resolution [▶ 11].

Resolution

The resolution of measured values and raw values depends on the parameters "Measuring range" and "Sampling rate". The table below shows how these parameters influence the resolution:

Measuring range	Sampling rate / EtherCAT cycle time	Resolution	
		Raw values	Measured values
±2 g	≤ 1 kHz / ≥ 1 ms	10-bit	4 mg
±4 g			8 mg
±8 g			16 mg
±16 g			48 mg
±2 g	> 1 kHz / < 1 ms	8-bit	16 mg
±4 g			32 mg
±8 g			64 mg
±16 g			192 mg

The setting of the "Measuring range" and "Sampling rate" parameters is described in the chapter Acceleration measurement [▶ 41].

Additional checks

The boxes have been subjected to the following checks:

Verification	Explanation
Vibration	10 frequency sweeps in 3 axes
	5 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 g, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	35 g, 11 ms

2.2.3 Process image

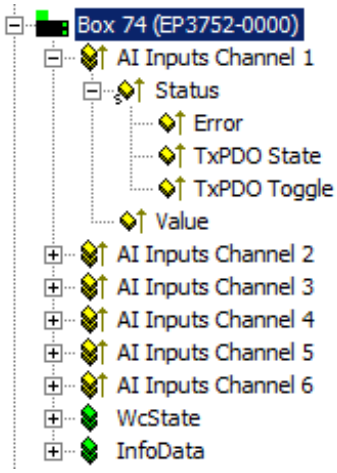

Fig. 5: EP3752-0000, process image, A Inputs Channel 1

The data for the two accelerometers can be found under **AI Inputs Channel**.

- Status Error: An error occurred during communication with the accelerometer.
- Value: 16-bit acceleration value

The assignment of the process values to the sensor axes can be found in the chapter Accelerometers [▶ 14].

2.2.4 Accelerometers

2 x 3G accelerometers

The EP3752-0000 EtherCAT Box has two 3-axis accelerometers. These are attached to the underside of the PCB, each offset by 90°.

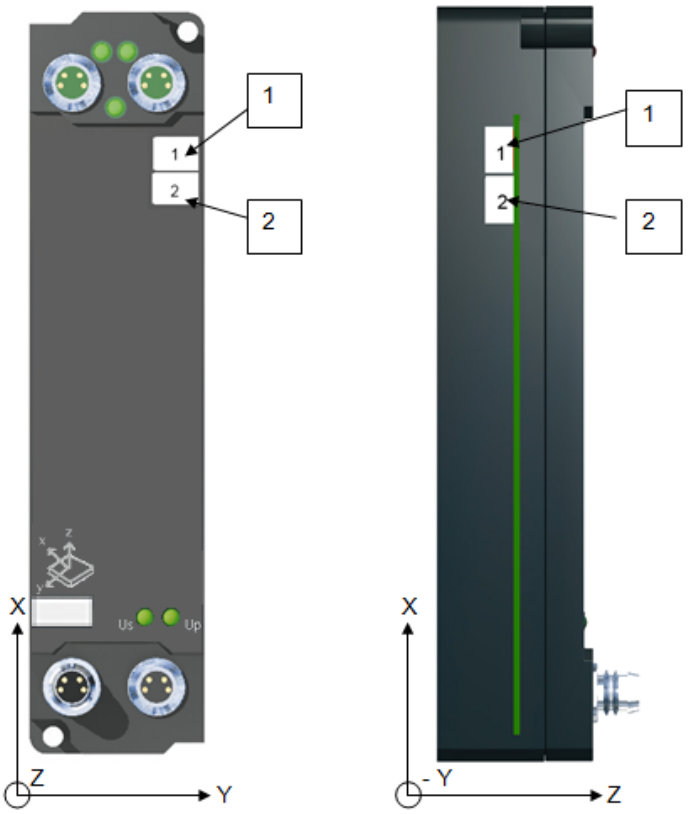

Fig. 6: Location of the accelerometers

The image shows a top view and a side view of the EtherCAT Box. The position of the accelerometers is shown inside the box:

- Green indicates the position of the PCB.
- The accelerometers are numbered 1 and 2. They are mounted on the underside of the PCB.

Due to the position of the sensors on the underside, an acceleration (e.g. the earth's gravitational force) on a flat, even surface (e.g. when testing on the laboratory bench) is displayed as a negative value.

Process values	Allocated acceleration value	Data type
AI Inputs Channel1 value	Sensor 1, +X axis	INT
AI Inputs Channel2 value	Sensor 1, +Y axis	INT
AI Inputs Channel3 value	Sensor 1, -Z axis	INT
AI Inputs Channel4 value	Sensor 2, +Y axis	INT
AI Inputs Channel5 value	Sensor 2, -X axis	INT
AI Inputs Channel6 value	Sensor 2, -Z axis	INT

3 Mounting and cabling

3.1 Mounting

3.1.1 Dimensions

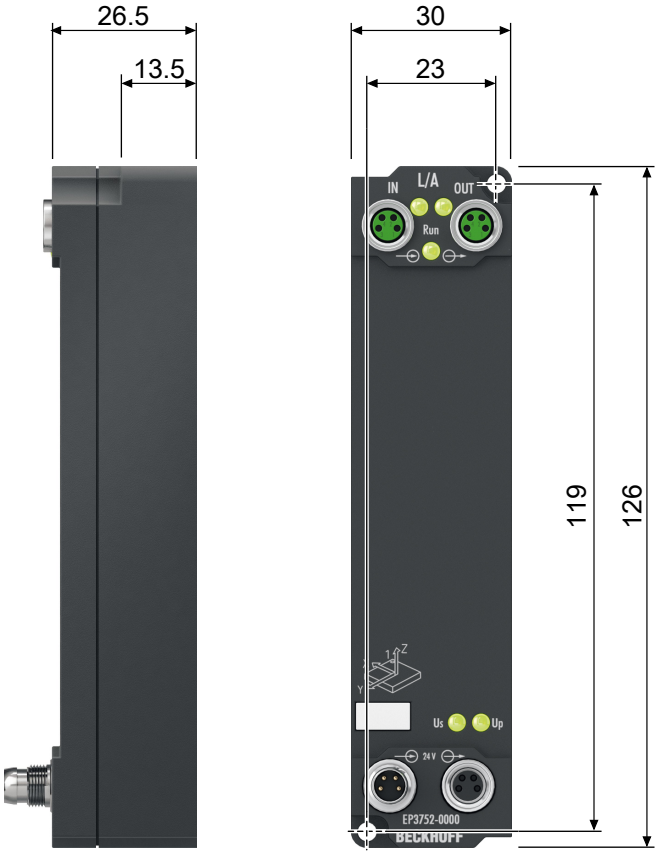

Fig. 7: Dimensions

All dimensions are given in millimeters.

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two fastening holes Ø 3 mm for M3
Metal parts	Brass, nickel-plated
Contacts	CuZn, gold-plated
Current transfer	max. 4 A
Mounting 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

3.1.2 Fixing

Protection of connectors against contamination!

While mounting the modules, protect all connectors, especially the IP-Link, against contamination! Only with connected cables or plugs the protection class IP67 is guaranteed! Unused connectors have to be protected with the right plugs! See for plug sets in the catalogue.

Modules with narrow housing are mounted with two M3 bolts.
Modules with wide housing are mounted with two M3 bolts to the fixing holes located at the corners or mounted with two M4 bolts to the fixing holes located centrally.

The bolts must be longer than 15 mm. The fixing holes of the modules are not threaded.

When assembling, remember that the fieldbus connectors increases the overall height. See chapter accessories.

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.

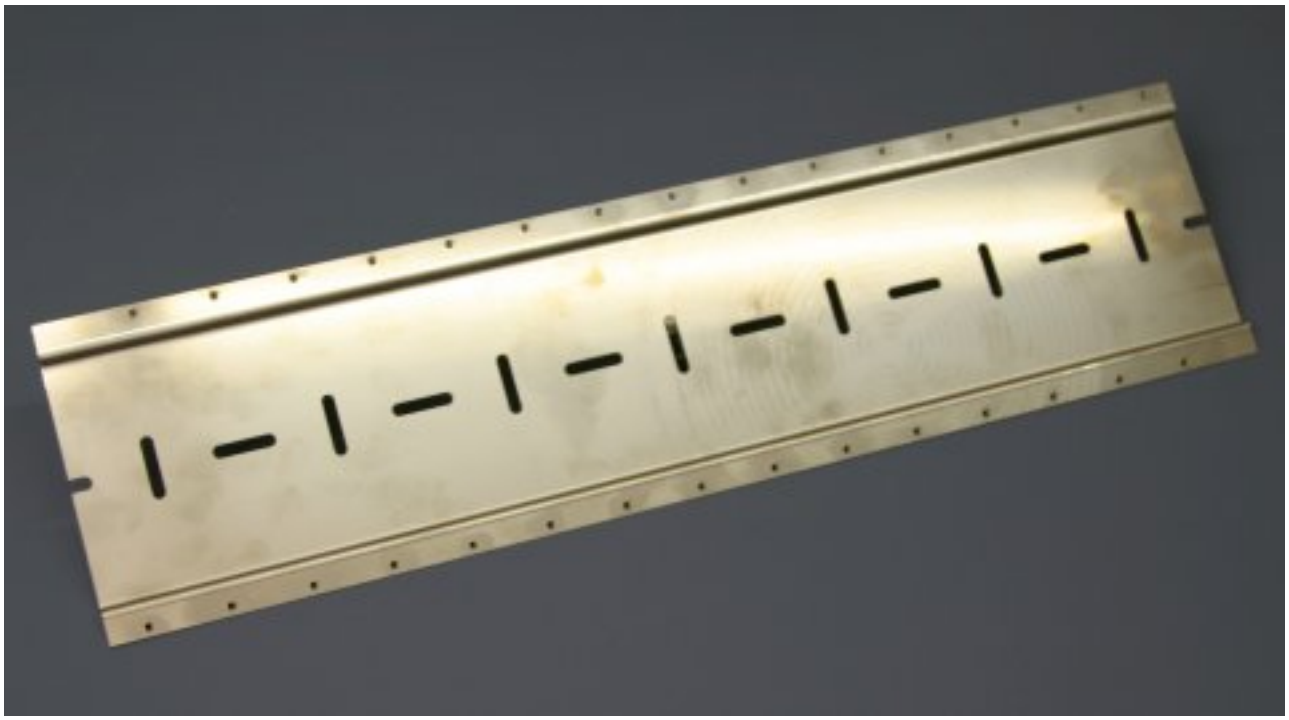

Fig. 8: Mounting Rail ZS5300-000

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.

3.1.3 Nut torque for connectors

M8 connectors

It is recommended to pull the M8 connectors tight with a nut torque of **0.4 Nm**. When using the torque control screwdriver ZB8800 is also a max. torque of **0.5 Nm** permissible.

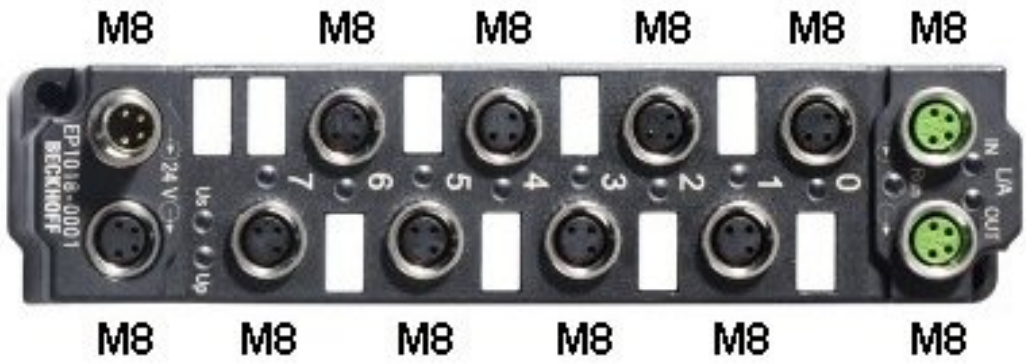

Fig. 9: EtherCAT Box with M8 connectors

Torque socket wrenches

Fig. 10: ZB8801 torque socket wrench

Ensure the right torque

Use the torque socket wrenches available by Beckhoff to pull the connectors tight (ZB8800, ZB8801-0000)!

3.2 EtherCAT

3.2.1 EtherCAT connection

For the incoming and ongoing EtherCAT connection,

- the EtherCAT Box (EPxxxx) has two M8 sockets, marked in **green**
- the Coupler Box (FBB-x110) has two M12 sockets

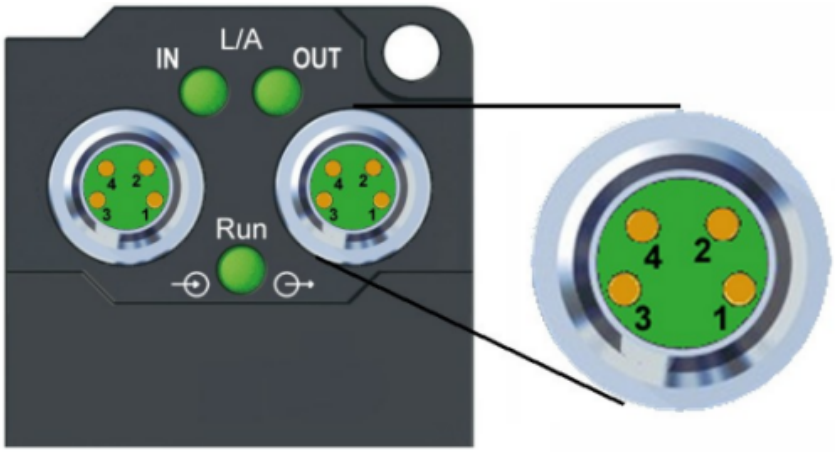

Fig. 11: EtherCAT Box: M8, 30 mm housing

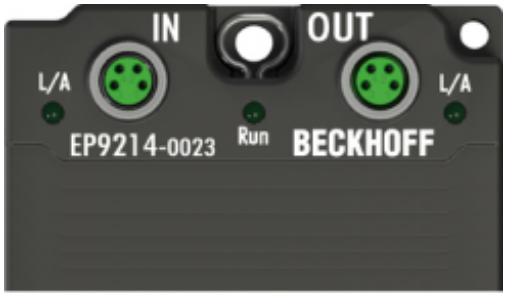

Fig. 12: EtherCAT Box: M860 mm housing (example: EP9214)

Fig. 13: Coupler Box: M12

Assignment

There are various different standards for the assignment and colors of connectors and cables for Ethernet/ EtherCAT.

Ethernet/EtherCAT		Plug connector			Cable		Standard
Signal	**Description**	**M8**	**M12**	**RJ45[1]**	**ZB9010, ZB9020, ZB9030, ZB9032, ZK1090-6292, ZK1090-3xxx-xxxx**	**ZB9031 and old versions of ZB9030, ZB9032, ZK1090-3xxx-xxxx**	**TIA-568B**
Tx +	Transmit Data+	Pin 1	Pin 1	Pin 1	yellow[2]	orange/white[3]	white/orange
Tx -	Transmit Data-	Pin 4	Pin 3	Pin 2	orange[2]	orange[3]	orange
Rx +	Receive Data+	Pin 2	Pin 2	Pin 3	white[2]	blue/white[3]	white/green
Rx -	Receive Data-	Pin 3	Pin 4	Pin 6	blue[2]	blue[3]	green
Shield	Shield	Housing		Shroud	Screen	Screen	Screen

[1]) colored markings according to EN 61918 in the four-pin RJ45 connector ZS1090-0003
[2]) wire colors according to EN 61918
[3]) wire colors

Assimilation of color coding for cable ZB9030, ZB9032 and ZK1090-3xxxx-xxxx (with M8 connectors)

For unification the prevalent cables ZB9030, ZB9032 and ZK1090-3xxx-xxxx this means the pre assembled cables with M8 connectors were changed to the colors of EN61918 (yellow, orange, white, blue).So different color coding exists. But the electrical properties are absolutely identical.

EtherCAT connector

The following connectors can be supplied for use in Beckhoff EtherCAT systems.

Name	Connector	Comment
ZS1090-0003	RJ45	four-pole, IP20, field-configurable
ZS1090-0004	M12, male	four-pin, IP67, for field assembly
ZS1090-0005	RJ45	eight-pole, IP20, field-configurable, suitable for gigabit Ethernet
ZS1090-0006	M8 plug connector	four-pole, IP67, field-configurable, for cable type ZB903x
ZS1090-0007	M8 socket	four-pole, IP67, field-configurable, for cable type ZB903x
ZS1090-1006	M8 plug connector	four-pole, IP67, field-configurable up to OD = 6.5 mm
ZS1090-1007	M8 socket	four-pole, IP67, field-configurable up to OD = 6.5 mm

3.2.2 EtherCAT - Fieldbus LEDs

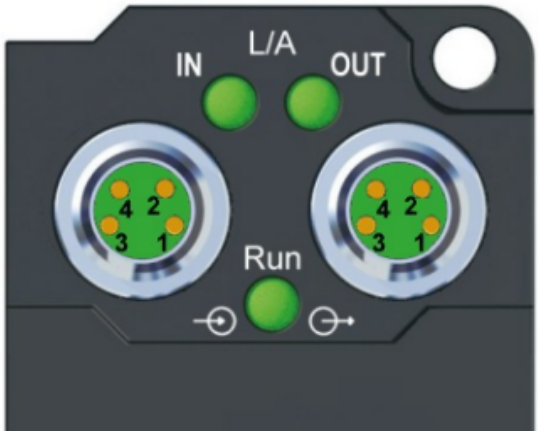

Fig. 14: EtherCAT-LEDs

LED display

LED	Display	Meaning
IN L/A	off	no connection to the preceding EtherCAT module
	Lit	LINK: connection to the preceding EtherCAT module
	flashing	ACT: Communication with the preceding EtherCAT module
OUT L/A	off	no connection to the following EtherCAT module
	Lit	LINK: connection to the following EtherCAT module
	flashing	ACT: Communication with the following EtherCAT module
Run	off	Status of the EtherCAT module is Init
	flashes quickly	Status of the EtherCAT module is pre-operational
	flashes slowly	Status of the EtherCAT module is safe-operational
	Lit	Status of the EtherCAT module is operational

EtherCAT statuses

The various statuses in which an EtherCAT module may be found are described in the Basic System Documentation for EtherCAT, which is available for download from our website (www.beckhoff.com) under Downloads.

3.3 Power supply

3.3.1 Power Connection

The feeding and forwarding of supply voltages is done via two M8 connectors at the bottom end of the modules:

- IN: left M8 connector for feeding the supply voltages
- OUT: right M8 connector for forwarding the supply voltages

Fig. 15: EtherCAT Box, Connectors for power supply

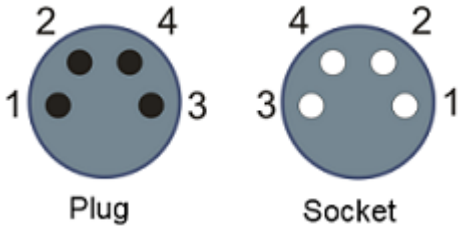

Fig. 16: Pin assignment M8, Power In and Power Out

PIN assignment

Pin	Voltage	
1	Control voltage Us, +24 V_{DC}	
2	Auxiliary voltage Up, +24 V_{DC}	
3	GNDs*	*) may be connected internally to each other depending on the module: see specific module descriptions
4	GNDp*	

The pins M8 connectors carry a maximum current of 4 A.

Two LEDs display the status of the supply voltages.

NOTE

Don't confuse the power connectors with the EtherCAT connectors!

Never connect the power cables (M8, 24 V_{DC}) with the green marked EtherCAT sockets of the EtherCAT Box Modules! This can damage the modules!

Control voltage Us: 24 V_{DC}

Power is supplied to the fieldbus, the processor logic, the inputs and the sensors from the 24 V_{DC} control voltage Us. The control voltage is electrically isolated from the fieldbus circuitry.

Auxiliary voltage Up 24 V_{DC}

The Auxiliary voltage Up supplies the digital outputs; it can be brought in separately. If the load voltage is switched off, the fieldbus functions and the power supply and functionality of the inputs are retained.

Redirection of the supply voltages

The IN and OUT power connections are bridged in the module (not IP204x-Bxxx and IE204x). The supply voltages Us and Up can thus easily be transferred from EtherCAT Box to EtherCAT Box.

NOTE

Pay attention to the maximum permissible current!

Pay attention also for the redirection of the supply voltages Us and Up, the maximum permissible current for M8 connectors of 4 A must not be exceeded!

Supply via EP92x4-0023 PowerBox modules

If the machine requires higher current or if the EtherCAT Box Modules are installed far away from the control cabinet with included power supply, the usage of four cannel power distribution modules EP9214 or EP9224 (with integrated data logging, see www.beckhoff.com/EP9224) is recommended.

With these modules intelligent power distribution concepts with up to 2 x 16 A and a maximum of 2.5 mm² cable cross-section can be realized.

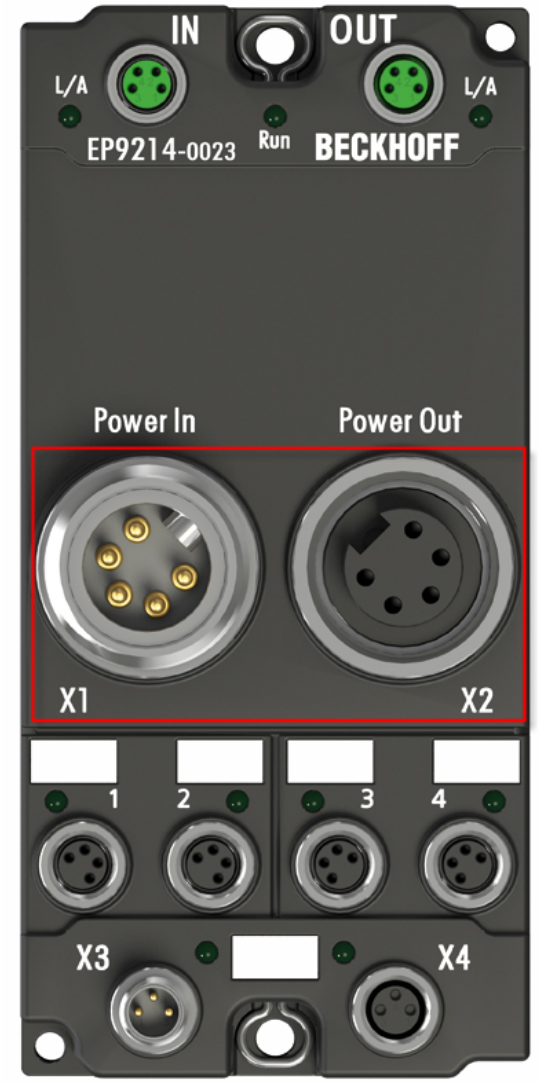

Fig. 17: EP92x4-0023, Connectors for Power In and Power Out

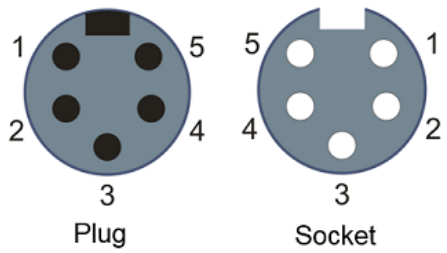

Fig. 18: Pin assignment 7/8”, Power In and Power Out

Electrical isolation

Digital modules

In the digital input/output modules, the grounds of the control voltage (GNDs) and the auxiliary voltage (GNDp) are connected to each other!

Check this at the documentation of each used EtherCAT Box.

Analog modules

In the analog input/output modules the grounds of the control voltage (GNDs) and the auxiliary voltage (GNDp) are separated from each other in order to ensure electrical isolation of the analog signals from the control voltage.

In some of the analog modules the sensors or actuators are supplied by Up - this means, for instance, that in the case of 0...10 V inputs, any reference voltage (0...30 V) may be connected to Up; this is then available to the sensors (e.g. smoothed 10 V for measuring potentiometers).

Details of the power supply may be taken from the specific module descriptions.

NOTE

Electrical isolation may be cancelled!

If digital and analog fieldbus boxes are connected directly via four-core power leads, the analog signals in the fieldbus boxes may be no longer electrically isolated from the control voltage!

3.3.2 Status LEDs for power supply

Fig. 19: Status LEDs for power supply

LED display

LED	Display	Meaning
Us (Control voltage)	off	The power supply voltage Us is not present
	green illuminated	The power supply voltage Us is present
	red illuminated	Because of overload (current > 0.5 A) the sensor supply generated from power supply voltage Us was switched off for all sensors fed from this.
Up (Auxiliary voltage)	off	The power supply voltage Up is not present
	green illuminated	The power supply voltage Up is present

3.3.3 Power cable conductor losses M8

The ZK2020-xxxx-yyyy power cables should not exceed the total length of 15 m at 4 A (with continuation). When planning the cabling, note that at 24 V nominal voltage, the functionality of the module can no longer be assured if the voltage drop reaches 6 V. Variations in the output voltage from the power supply unit must also be taken into account.

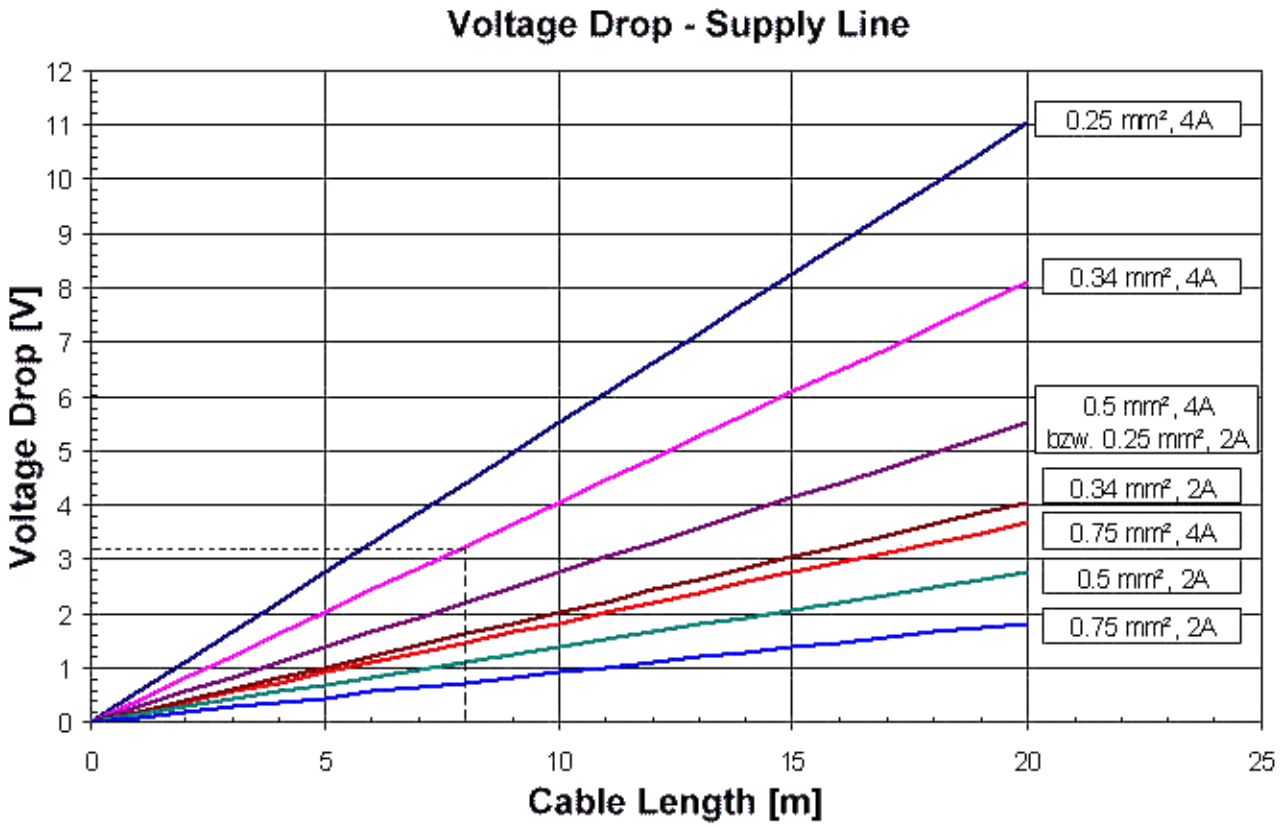

Fig. 20: Power cable conductor losses

Example

8 m power cable with 0.34 mm² cross-section has a voltage drop of 3.2 V at 4 A.

EP92x4 Power Distribution Modules

With EP9214 and EP9224 Power Distribution Modules intelligent concepts for voltage supply are available. Further information may be found under www.beckhoff.com/EP9224.

3.4 UL Requirements

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

Supply voltage

⚠ CAUTION

CAUTION!

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

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

⚠ CAUTION

CAUTION!

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

Networks

⚠ CAUTION

CAUTION!

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

Ambient temperature range

⚠ CAUTION

CAUTION!

To meet the UL requirements, EtherCAT Box Modules has to be operated only at an ambient temperature range of 0 to 55°C!

Marking for UL

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

Fig. 21: UL label

3.5 Cabling

A list of EtherCAT cables, power cables, sensor cables, Ethernet/EtherCAT connectors and field-configurable connectors can be found under the following link: https://beckhoff.de/english/fieldbus_box/ethercat_box_accessories_overview.htm?id=25525466903389

The corresponding data sheets can be found under the following link:

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

EtherCAT cables

Fig. 22: ZK1090-3131-0xxx

For connecting EtherCAT devices, only use shielded Ethernet cables with a minimum specification of **category 5 (CAT5) according to EN 50173 or ISO/IEC 11801**.

Wiring recommendations

Detailed recommendations for EtherCAT cabling can be found in the documentation "Design recommendations for EtherCAT/Ethernet infrastructure", which is available for download from www.beckhoff.de.

EtherCAT uses four cable wires for signal transmission.
Due to automatic cable detection (auto-crossing) symmetric (1:1) or cross-over cables can be used between EtherCAT devices from Beckhoff.

Power cable

Fig. 23: ZK2020-3132-0xxx

Sensor cables

Fig. 24: Selection of Beckhoff sensor cables

4 Commissioning/Configuration

4.1 Inserting into the EtherCAT network

Installation of the latest XML device description

Please ensure that you have installed the latest XML device description in TwinCAT. This can be downloaded from the Beckhoff website (http://www.beckhoff.de/english/download/elconfg.htm?id=1983920606140) and installed according to the installation instructions.

At the Beckhoff TwinCAT System Manager the configuration tree can be build in two different ways:

- by scanning [▶ 29] for existing hardware (called "online") and
- by manual inserting/appending [▶ 29] of fieldbus devices, couplers and slaves.

Automatic scanning in of the box

- 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 [▶ 32] (Config mode), and scan in the devices (see Fig. 1). Acknowledge all dialogs with "*OK*", so that the configuration is in "FreeRun" mode.

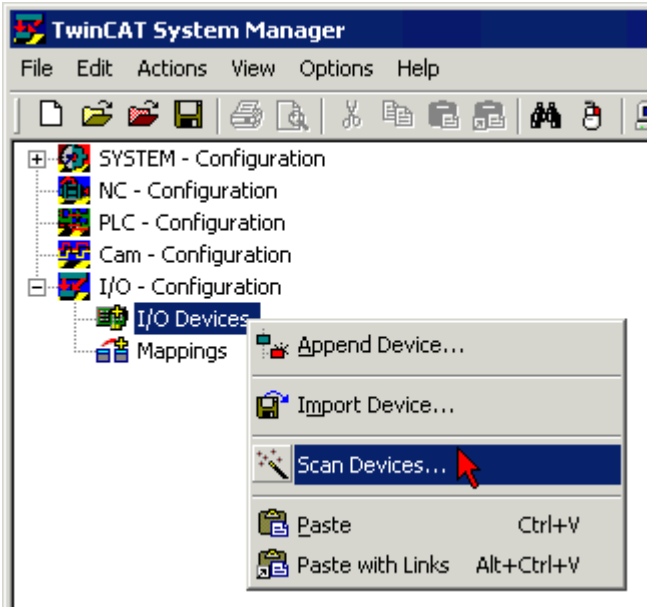

Fig. 25: Scanning in the configuration (I/O Devices -> right-click -> Scan Devices...)

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 [▶ 32] (Config mode)
- Append a new I/O device. In the dialog that appears select the device *EtherCAT (Direct Mode),* and confirm with *OK*.

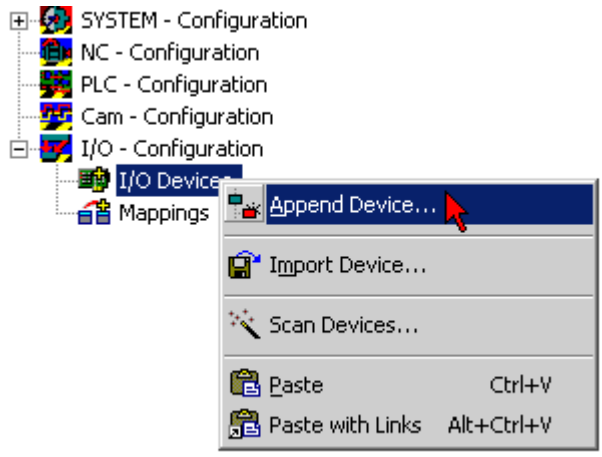

Fig. 26: Appending a new I/O device (I/O Devices -> right-click -> Append Device...)

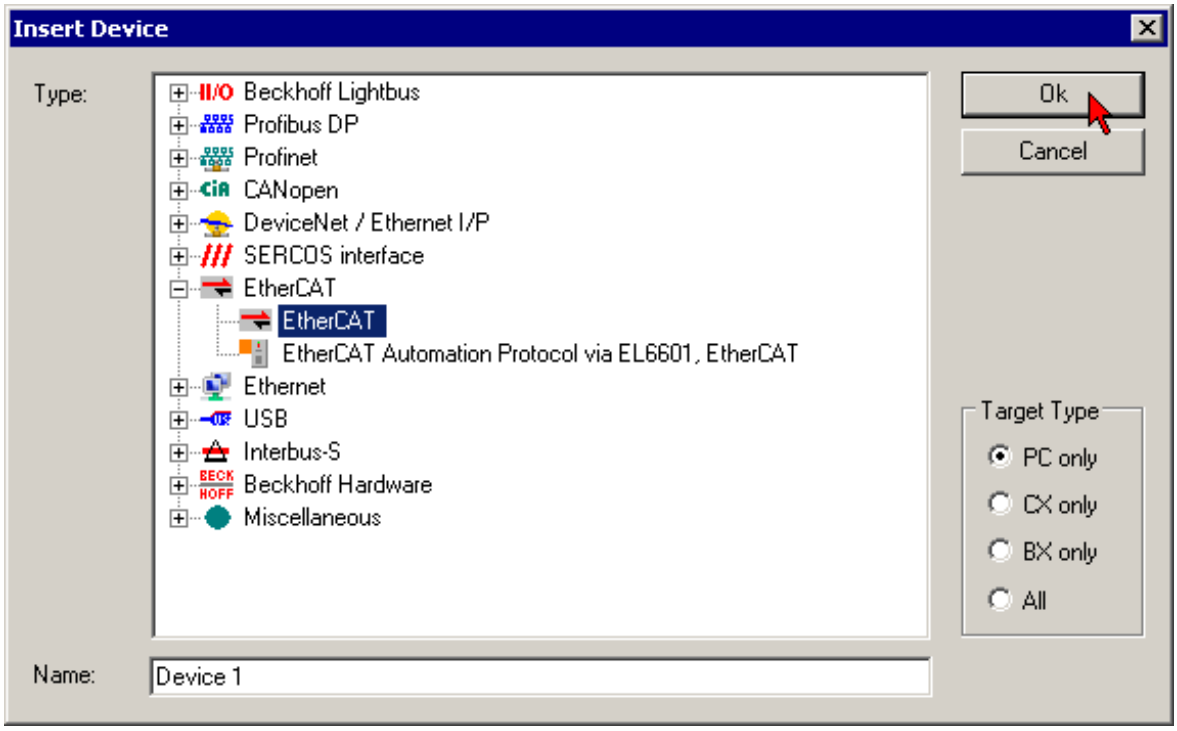

Fig. 27: Selecting the device EtherCAT

- Append a new box.

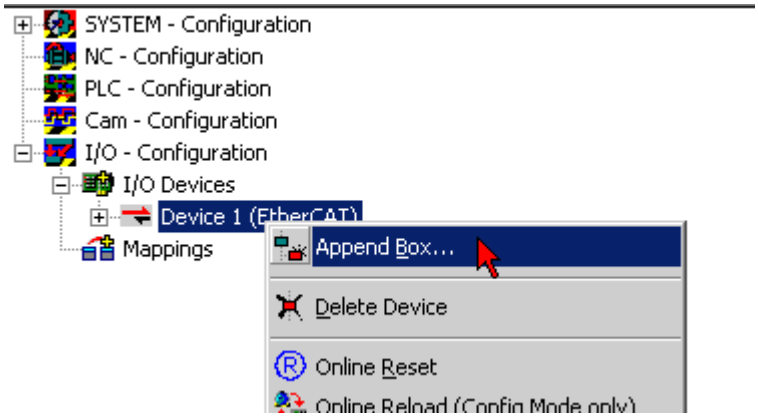

Fig. 28: Appending a new box (Device -> right-click -> Append Box...)

- In the dialog that appears select the desired box (e.g. EP2816-0008), and confirm with *OK*.

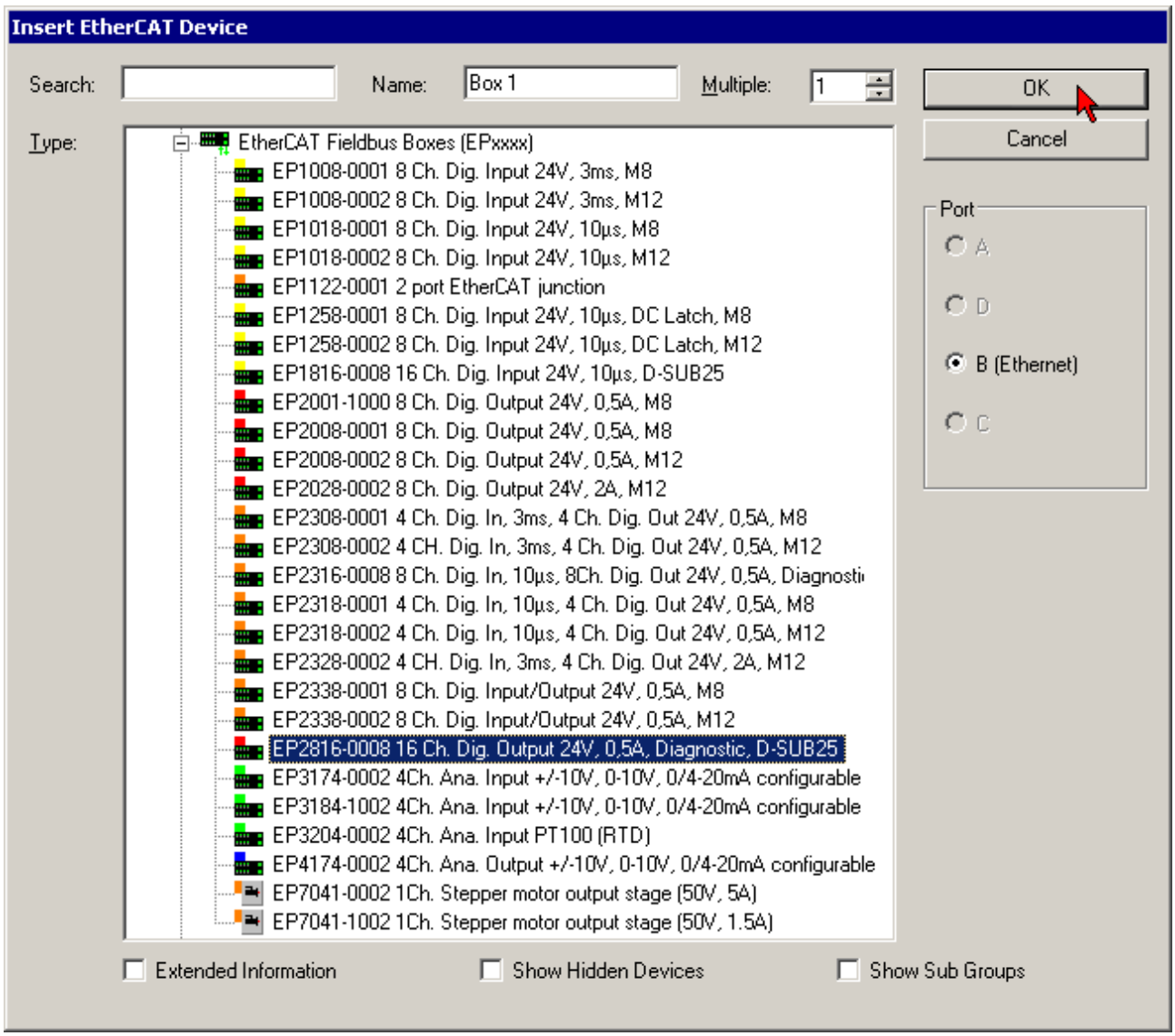

Fig. 29: Selecting a Box (e.g. EP2816-0008)

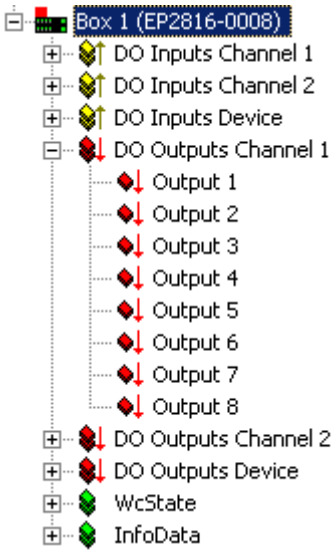

Fig. 30: Appended Box in the TwinCAT tree

4.2 Configuration via TwinCAT

In the left-hand window of the TwinCAT System Manager, click on the branch of the EtherCAT Box you wish to configure (EP2816-0008 in this example).

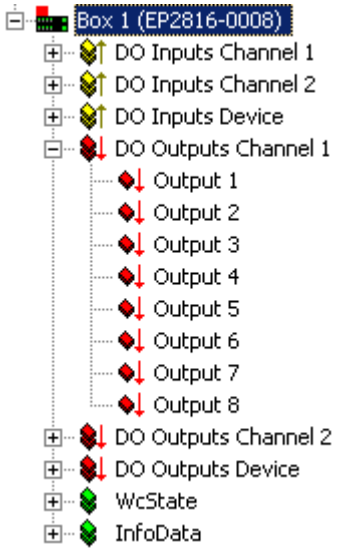

Fig. 31: Branch of the EtherCAT box to be configured

In the right-hand window of the TwinCAT System manager, various tabs are now available for configuring the EtherCAT Box.

General tab

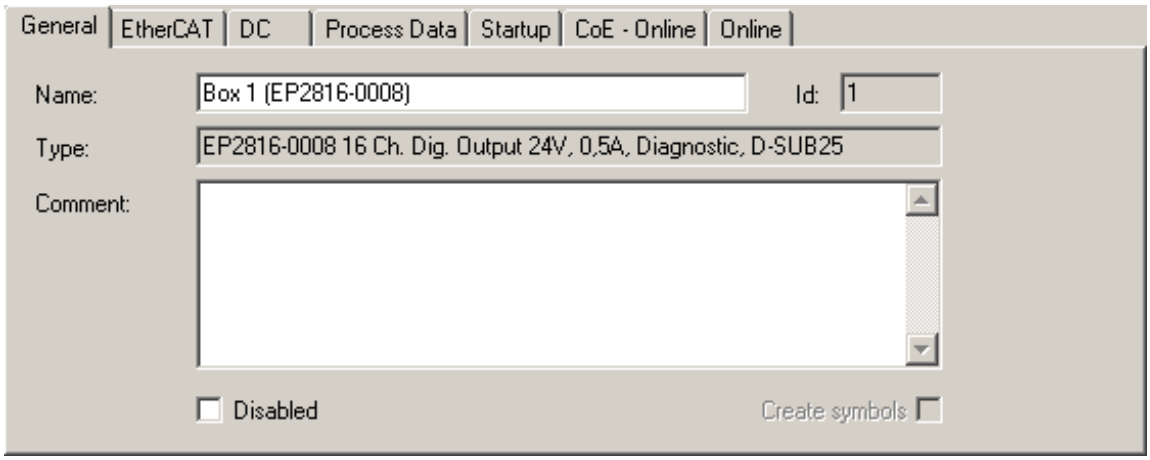

Fig. 32: General tab

Name	Name of the EtherCAT device
Id	Number of the EtherCAT device
Type	EtherCAT device type
Comment	Here you can add a comment (e.g. regarding the system).
Disabled	Here you can deactivate the EtherCAT device.
Create symbols	Access to this EtherCAT slave via ADS is only available if this checkbox is activated.

EtherCAT tab

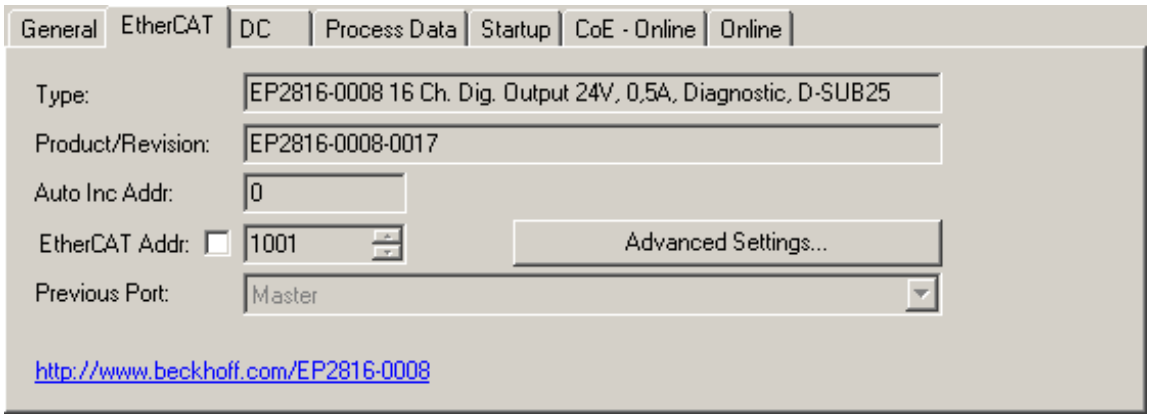

Fig. 33: EtherCAT tab

Type	EtherCAT device type
Product/Revision	Product and revision number of the EtherCAT device
Auto Inc Addr.	Auto increment address of the EtherCAT device. The auto increment address can be used for addressing each EtherCAT device in the communication ring through its physical position. Auto increment addressing is used during the start-up phase when the EtherCAT master allocates addresses to the EtherCAT devices. With auto increment addressing the first EtherCAT slave 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 slave. This address is allocated by the EtherCAT master during the start-up phase. Tick the checkbox to the left of the input field in order to modify the default value.
Previous Port	Name and port of the EtherCAT device 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 in the communication ring, then this combobox is activated and the EtherCAT device 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 EtherCAT device on the web.

Process Data tab

Indicates the configuration of the process data. The input and output data of the EtherCAT slave 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 EtherCAT slave supports this function.

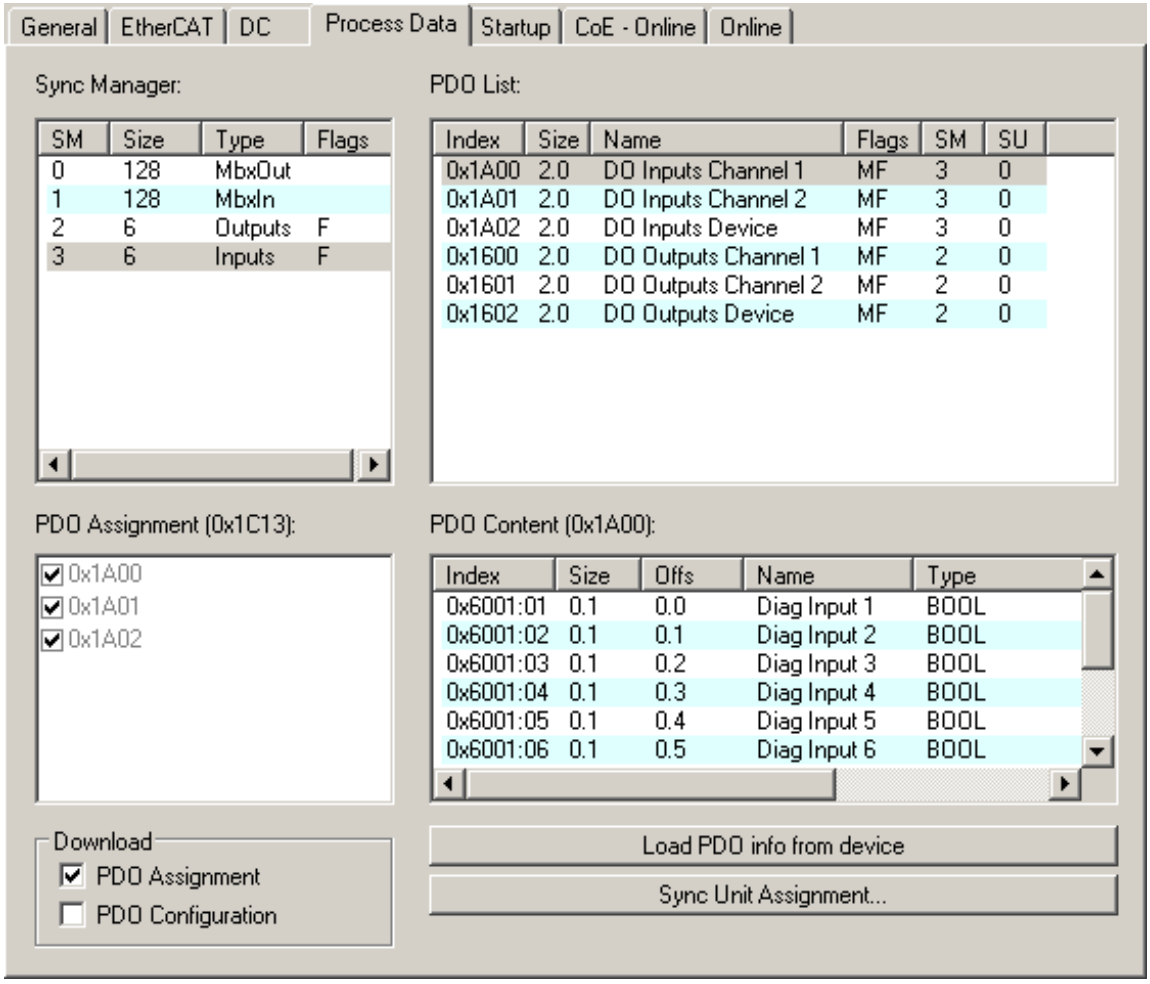

Fig. 34: Process Data tab

Sync Manager

Lists the configuration of the Sync Manager (SM).
If the EtherCAT device 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 EtherCAT device. 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 do select a greyed out PDO, the currently selected PDO has to be deselected first.

Activation of PDO assignment

- the EtherCAT slave has to run through the PS status transition cycle (from pre-operational to safe-operational) once (see Online tab [▶ 38]),
- and the System Manager has to reload the EtherCAT slaves ( button)

PDO list

List of all PDOs supported by this EtherCAT device. 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 EtherCAT slaves.

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 [▶ 35] 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 EtherCAT slave.

Startup tab

The *Startup* tab is displayed if the EtherCAT slave 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 slave in the same order as they are shown in the list.

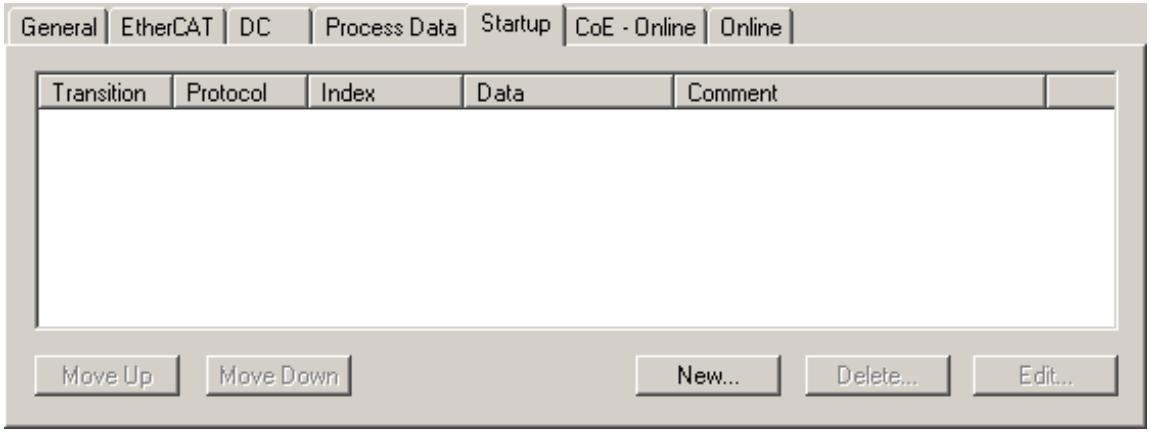

Fig. 35: Startup tab

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 EtherCAT slave supports the *CANopen over EtherCAT* (CoE) protocol. This dialog lists the content of the object directory 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 EtherCAT devices can be found in the device-specific object descriptions.

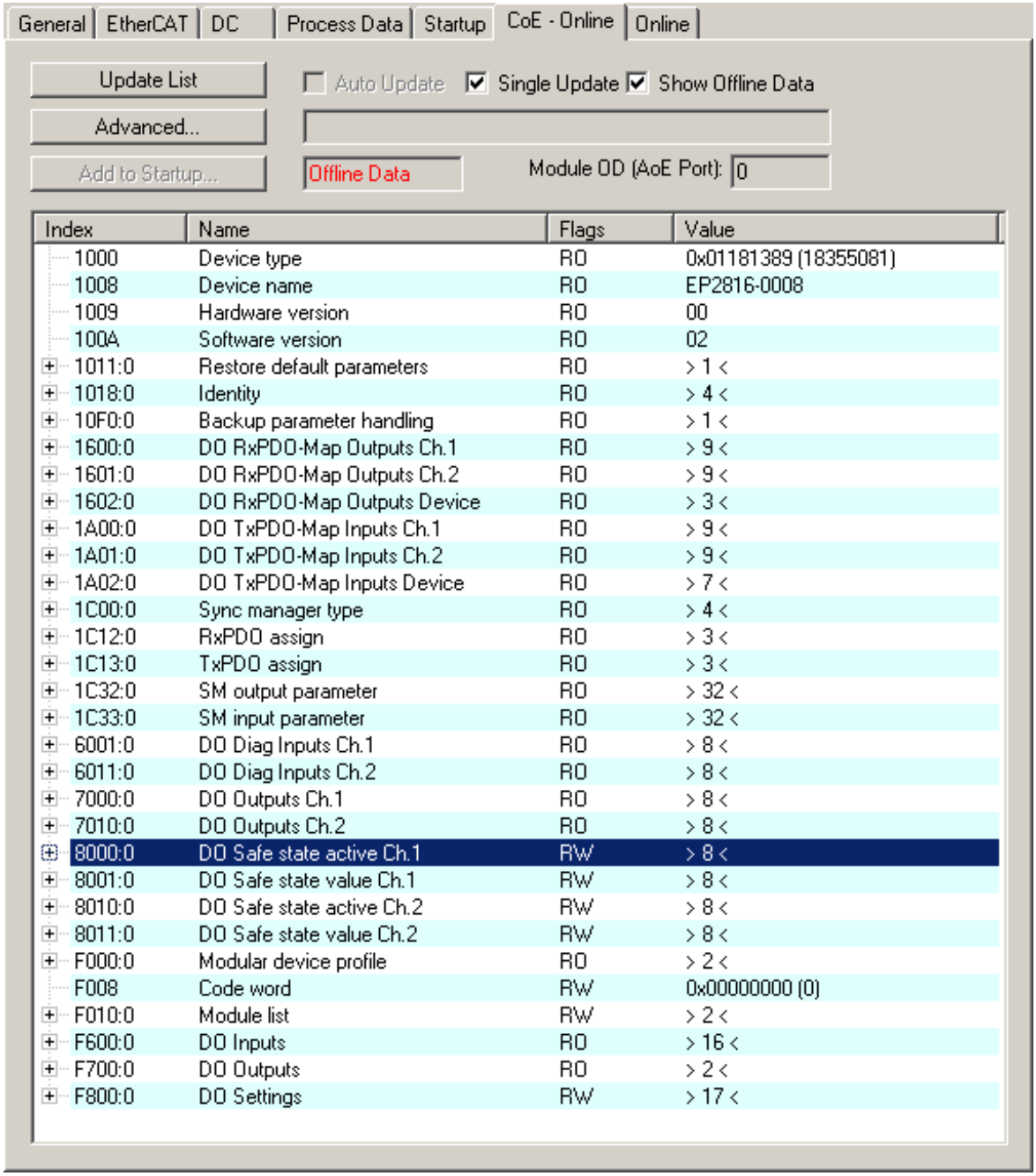

Fig. 36: CoE - Online tab

Object list display

Column	Description	
Index	Index and subindex 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.

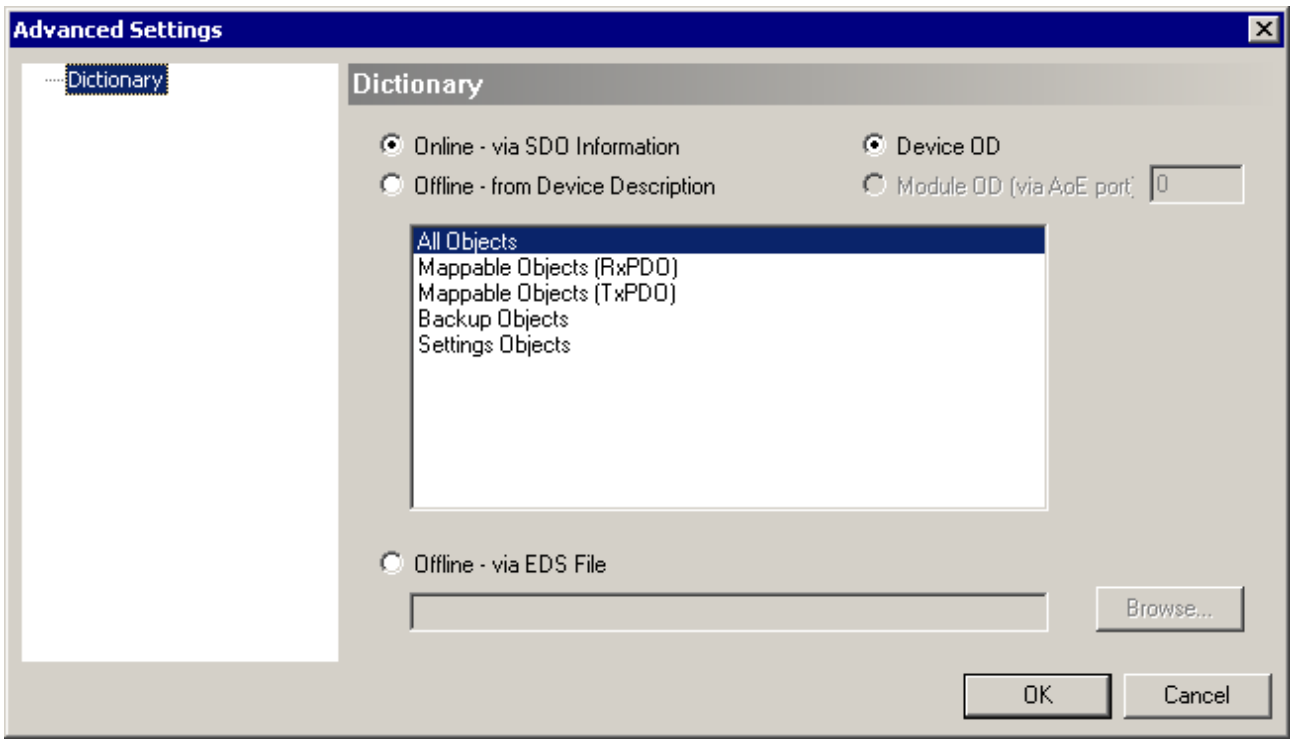

Fig. 37: Advanced settings

Online - via SDO information	If this option button is selected, the list of the objects included in the object directory of the slave is uploaded from the slave 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 directory is read from an EDS file provided by the user.

Online tab

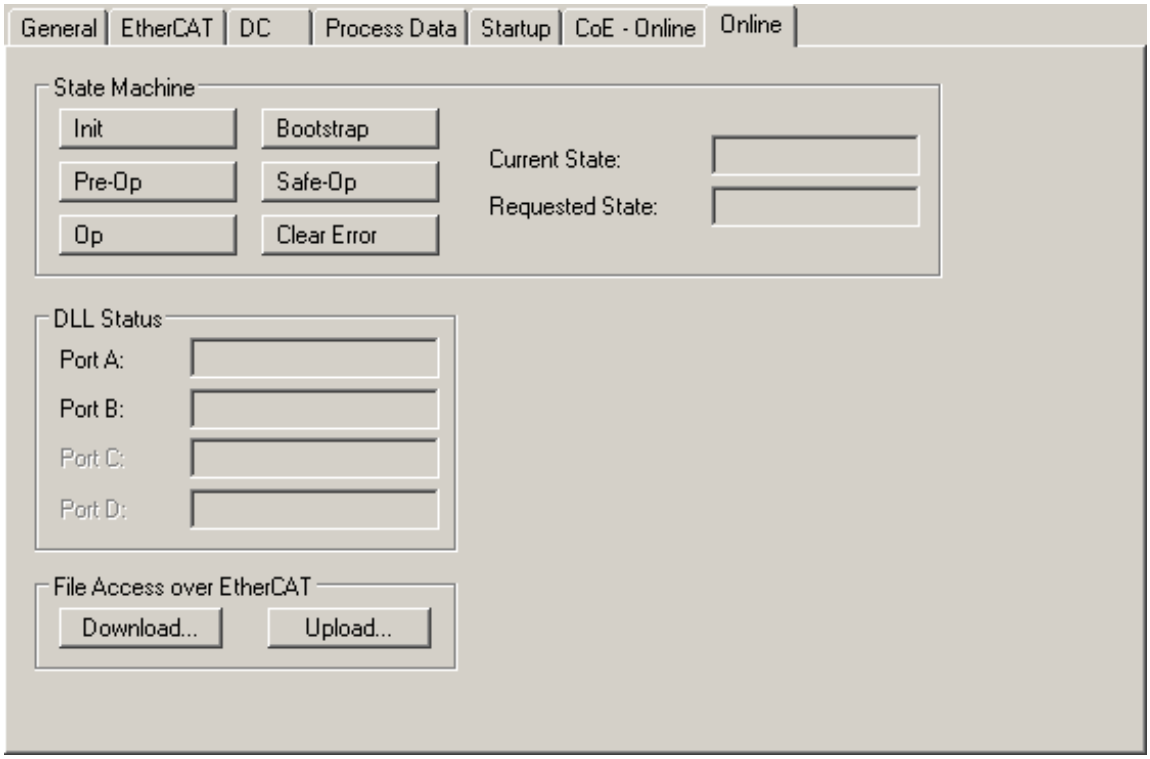

Fig. 38: Online tab

State Machine

Init	This button attempts to set the EtherCAT device to the *Init* state.
Pre-Op	This button attempts to set the EtherCAT device to the *pre-operational* state.
Op	This button attempts to set the EtherCAT device to the *operational* state.
Bootstrap	This button attempts to set the EtherCAT device to the *Bootstrap* state.
Safe-Op	This button attempts to set the EtherCAT device to the *safe-operational* state.
Clear Error	This button attempts to delete the fault display. If an EtherCAT slave fails during change of state it sets an error flag. Example: An EtherCAT slave is in PREOP state (pre-operational). The master now requests the SAFEOP state (safe-operational). If the slave 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 EtherCAT device.
Requested State	Indicates the state requested for the EtherCAT device.

DLL Status

Indicates the DLL status (data link layer status) of the individual ports of the EtherCAT slave. The DLL status can have four different states:

Status	Description
No Carrier / Open	No carrier signal is available at the port, but the port is open.
No Carrier / Closed	No carrier signal is available at the port, and the port is closed.
Carrier / Open	A carrier signal is available at the port, and the port is open.
Carrier / Closed	A carrier signal is available at the port, but the port is closed.

File Access over EtherCAT

Download	With this button a file can be written to the EtherCAT device.
Upload	With this button a file can be read from the EtherCAT device.

4.3 EP3752-0000 – Functional principle

4.3.1 Acceleration measurement

Scaling of the measured values

The measured values from the accelerometers – X, Y and Z-axis in each case - are output by default scaled to 1 mg / LSB. This representation is preferable, as the measured values are always scaled the same as a result (irrespective of the other settings in the CoE).

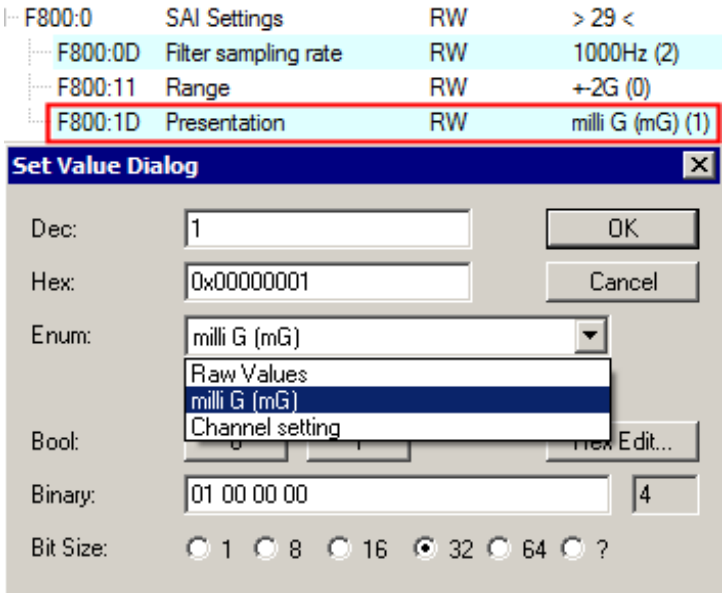

Fig. 39: Index 0xF800:1D (default)

The data can also be output as raw values, i.e. just as they are transmitted from the sensors. The relevant setting needs to be made in index 0xF800:1D in order to do this.

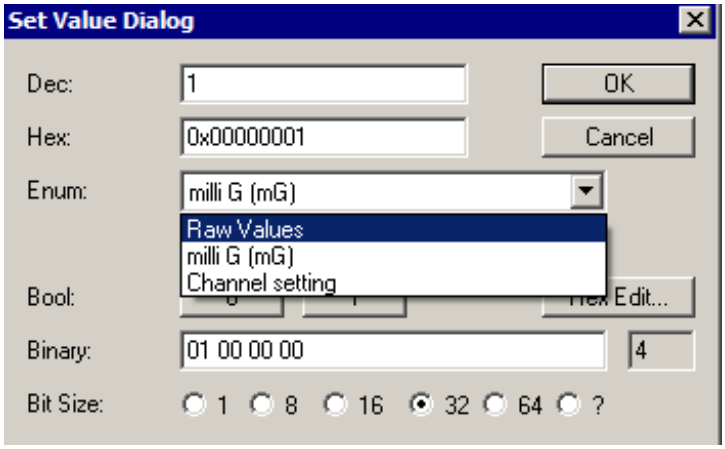

Fig. 40: Setting of the representation via index 0xF800:0D "Presentation"

When selecting "Channel setting" in index 0xF800:0D, the representation is set individually for each axis via the indices 0x80n0:1A.

Measuring range

The measuring range can be selected in index 0xF800:11 "Range".

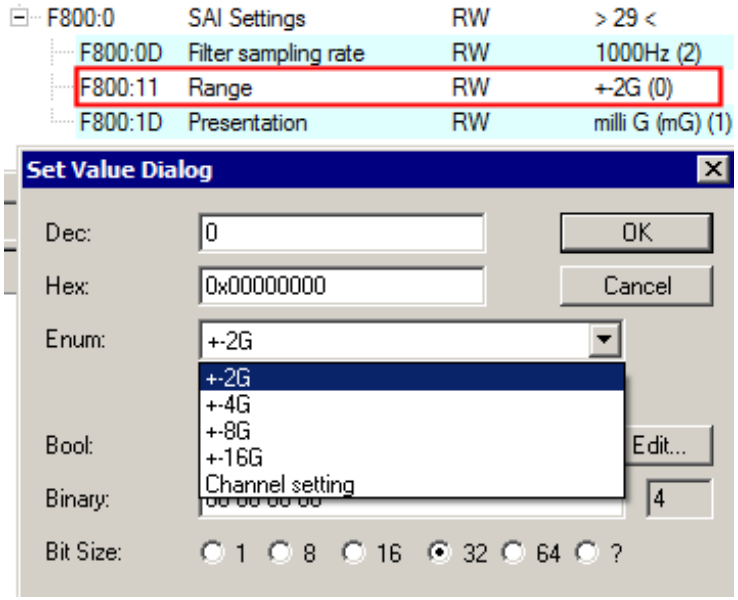

Fig. 41: Setting the measuring range via index 0xF800:11 "Range"

When selecting "Channel setting" in index 0xF800:11, the measuring range is set individually for each sensor:

- Measuring range for sensor 1: Index 0x8000:19 "Range"
- Measuring range for sensor 2: Index 0x8030:19 "Range"

This setting applies to all axes of the respective sensor. An individual setting for individual axes is not possible.

Sampling rate and synchronization modes

The sampling rate depends on whether the box's filters are activated. The filters are deactivated by default. They are described in the chapter Filter [▶ 42].

- The box operates SM-synchronously
  if no filters are active. In this mode the EtherCAT cycle time determines the sampling rate: The measured values are read from the sensors in each EtherCAT cycle.
  The sensor operates internally with 10-bit resolution up to a cycle time of 1 ms. Below that the resolution is reduced to 8-bit. The minimum cycle time is 200 µs.
- If at least one filter is active,
  the box runs in free run with a sampling rate set by CoE index 0xF800:0D "Filter sampling rate".
  The resolution is reduced to 8-bit if the sampling rate is increased to 2500 Hz or 5000 Hz.

4.3.2 Filter

Filter mode (FIR and IIR)

The EP3752-0000 EtherCAT Box is equipped with digital filters which, depending on their settings, can adopt the characteristics of a *F*inite *I*mpulse *R*esponse filter (*FIR filter*), or of an *I*nfinite *I*mpulse *R*esponse filter (*IIR-Filter*). The filters are deactivated by default. The activation takes place

- individually for each channel via the indices 0x80n0:06 [▶ 49] from Firmware 02.
- centrally via the 1st channel (index 0x8000:06 [▶ 49]) with Firmware 01.

The filter characteristic is selected individually for each channel via the indices 0x80n0:15 "Filter Settings":

FIR
The mean value of the last 32 measurements is calculated. The internal sampling rate (time interval between the individual measured values) can be parameterized via index 0xF800:0D "Filter sampling rate".

IIR1…8
The filter with IIR characteristic can be set to one of 8 levels. The higher the level, the higher the attenuation of the present signal by the filter. The internal sampling rate can be set via index 0xF800:0D "Filter sampling rate" (unlike other analog boxes in which a fixed cycle time of 1 ms is specified).

Setting of the internal sampling rate via index 0xF800:0D

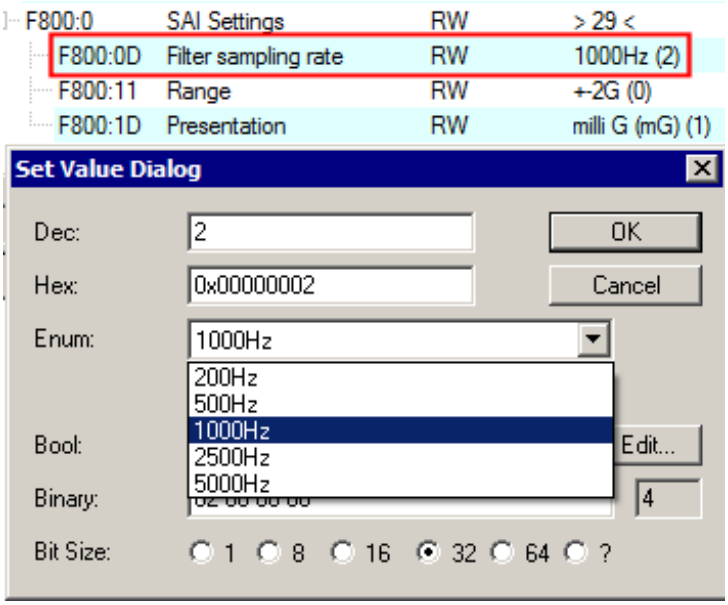

Fig. 42: Setting of the internal sampling rate (index 0xF8000:0D)

The internal sampling rate with filters switched on is set via the index 0xF800:0D. On delivery this is set to 1000 Hz.

Changing the update rate at 2000 Hz and 5000 Hz

The resolution is reduced to 8-bit if the rate is increased to 2500 Hz or 5000 Hz. This is necessary due to the sensors used.

4.3.3 Inclination measurement

The calculation of an angle with higher resolution and accuracy should take place on a PC. The sensors used are capable of an accuracy of less than 0.1°.

Since the angle values are derived from the acceleration values, which are subject to certain noise, they have to be filtered via suitable algorithms.

In simple cases this could be a sliding average value, for example.

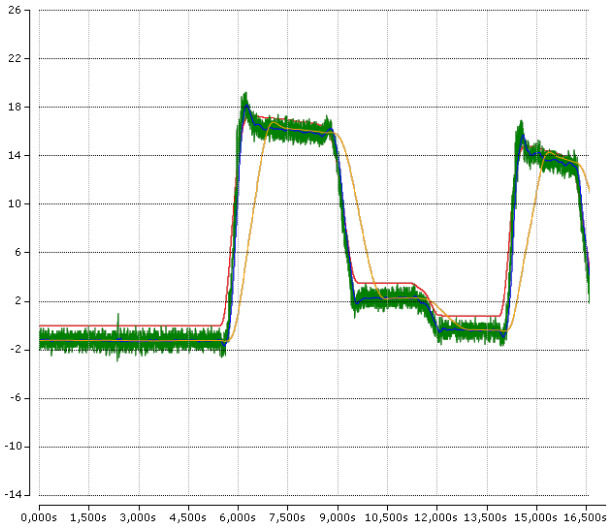

Fig. 43: Angle measurement, process data as acceleration values, calculation on a PC

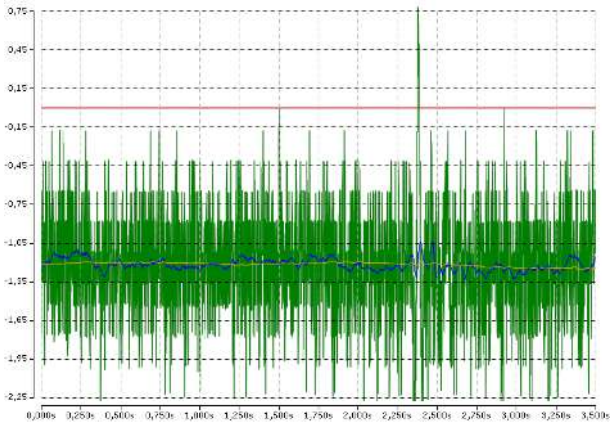

Fig. 44: Signal noise in detail

Color	Meaning
Red	Angle measured with 1024-step encoder / 4-way analysis for reference
Green	Angle trigonometrically calculated on a PC, without noise suppression
blue	Fast algorithm
yellow	Arithmetic mean (1000 sliding values)

Sample

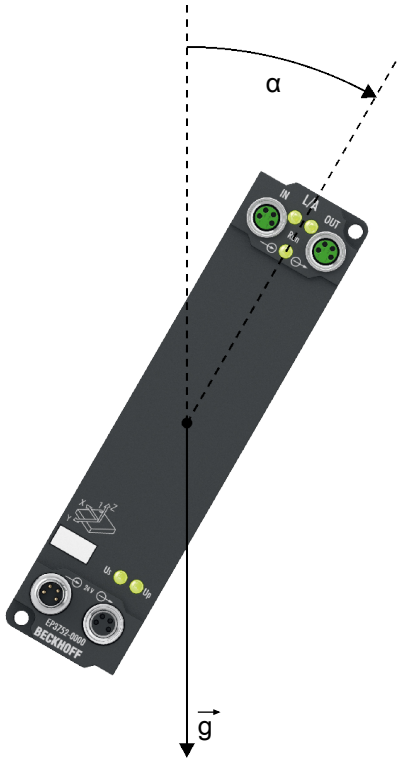

Fig. 45: EP3752: Sample of inclination measurement

Equation for calculating the angle α:

$$\alpha = \tan^{-1}\left(\frac{a_{y1}}{\sqrt{a_{x1}^2 + a_{z1}^2}}\right) \times \frac{360^\circ}{2\pi}$$

Implementation in TwinCAT:

```
alpha := ATAN(a_y1 / (SQRT(a_x1 * a_x1 + a_z1 * a_z1))) * 360/(2*3.14);
```

Sample Program

NOTE

Using the sample program

This document contains sample applications of our products for certain areas of application. The application notices provided here are based on typical features of our products and only serve as samples. The notices contained in this document explicitly do not refer to specific applications. The customer is therefore responsible for assessing and deciding whether the product is suitable for a particular application. We accept no responsibility for the completeness and correctness of the source code contained in this document. We reserve the right to modify the content of this document at any time and accept no responsibility for errors and missing information.

To download the sample program from this documentation please click on the following link:

(https://infosys.beckhoff.com/content/1033/ep3752/Resources/zip/3626380299.zip)

4.4 EP3752-0000 - Object overview

EtherCAT XML Device Description

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

Index (hex)		Name	Flags	Default value
1000 [▶ 53]		Device type	RO	0x00001389 (5001$_{dec}$)
1008 [▶ 53]		Device name	RO	EP3752-0000
1009 [▶ 53]		Hardware version	RO	00
100A [▶ 53]		Software version	RO	00
1011:0 [▶ 48]	**Subindex**	Restore default parameters	RO	0x01 (1$_{dec}$)
	1011:01	SubIndex 001	RW	0x00000000 (0$_{dec}$)
1018:0 [▶ 53]	**Subindex**	Identity	RO	0x04 (4$_{dec}$)
	1018:01	Vendor ID	RO	0x00000002 (2$_{dec}$)
	1018:02	Product code	RO	0x0EA84052 (245907538$_{dec}$)
	1018:03	Revision	RO	0x00100002 (1048578$_{dec}$)
	1018:04	Serial number	RO	0x00000000 (0$_{dec}$)
10F0:0 [▶ 53]	**Subindex**	Backup parameter handling	RO	0x01 (1$_{dec}$)
	10F0:01	Checksum	RO	0x00000000 (0$_{dec}$)
1A00:0 [▶ 54]	**Subindex**	AI TxPDO-Map Inputs Ch.1	RO	0x06 (6$_{dec}$)
	1A00:01	SubIndex 001	RO	0x0000:00, 6
	1A00:02	SubIndex 002	RO	0x6000:07, 1
	1A00:03	SubIndex 003	RO	0x0000:00, 7
	1A00:04	SubIndex 004	RO	0x6000:0F, 1
	1A00:05	SubIndex 005	RO	0x6000:10, 1
	1A00:06	SubIndex 006	RO	0x6000:11, 16
1A01:0 [▶ 54]	**Subindex**	AI TxPDO-Map Inputs Ch.2	RO	0x06 (6$_{dec}$)
	1A01:01	SubIndex 001	RO	0x0000:00, 6
	1A01:02	SubIndex 002	RO	0x6010:07, 1
	1A01:03	SubIndex 003	RO	0x0000:00, 7
	1A01:04	SubIndex 004	RO	0x6010:0F, 1
	1A01:05	SubIndex 005	RO	0x6010:10, 1
	1A01:06	SubIndex 006	RO	0x6010:11, 16
1A02:0 [▶ 54]	**Subindex**	AI TxPDO-Map Inputs Ch.3	RO	0x06 (6$_{dec}$)
	1A02:01	SubIndex 001	RO	0x0000:00, 6
	1A02:02	SubIndex 002	RO	0x6020:07, 1
	1A02:03	SubIndex 003	RO	0x0000:00, 7
	1A02:04	SubIndex 004	RO	0x6020:0F, 1
	1A02:05	SubIndex 005	RO	0x6020:10, 1
	1A02:06	SubIndex 006	RO	0x6020:11, 16
1A03:0 [▶ 54]	**Subindex**	AI TxPDO-Map Inputs Ch.4	RO	0x06 (6$_{dec}$)
	1A03:01	SubIndex 001	RO	0x0000:00, 6
	1A03:02	SubIndex 002	RO	0x6030:07, 1
	1A03:03	SubIndex 003	RO	0x0000:00, 7
	1A03:04	SubIndex 004	RO	0x6030:0F, 1
	1A03:05	SubIndex 005	RO	0x6030:10, 1
	1A03:06	SubIndex 006	RO	0x6030:11, 16
1A04:0 [▶ 55]	**Subindex**	AI TxPDO-Map Inputs Ch.5	RO	0x06 (6$_{dec}$)
	1A04:01	SubIndex 001	RO	0x0000:00, 6
	1A04:02	SubIndex 002	RO	0x6040:07, 1
	1A04:03	SubIndex 003	RO	0x0000:00, 7
	1A04:04	SubIndex 004	RO	0x6040:0F, 1
	1A04:05	SubIndex 005	RO	0x6040:10, 1
	1A04:06	SubIndex 006	RO	0x6040:11, 16

Index (hex)		Name	Flags	Default value
1A05:0 [▶ 55]	**Subindex**	AI TxPDO-Map Inputs Ch.6	RO	0x06 (6_{dec})
	1A05:01	SubIndex 001	RO	0x0000:00, 6
	1A05:02	SubIndex 002	RO	0x6050:07, 1
	1A05:03	SubIndex 003	RO	0x0000:00, 7
	1A05:04	SubIndex 004	RO	0x6050:0F, 1
	1A05:05	SubIndex 005	RO	0x6040:10, 1
	1A05:06	SubIndex 006	RO	0x6050:11, 16
	1A05:02	AI TxPDO-Map Inputs Ch.5	RO	0x06 (6_{dec})
1C00:0 [▶ 55]	**Subindex**	Sync manager type	RO	0x04 (4_{dec})
	1C00:01	SubIndex 001	RO	0x01 (1_{dec})
	1C00:02	SubIndex 002	RO	0x02 (2_{dec})
	1C00:03	SubIndex 003	RO	0x03 (3_{dec})
	1C00:04	SubIndex 004	RO	0x04 (4_{dec})
1C12:0 [▶ 55]	**Subindex**	RxPDO assign	RW	0x00 (0_{dec})
1C13:0 [▶ 55]	**Subindex**	TxPDO assign	RW	0x06 (6_{dec})
	1C13:01	SubIndex 001	RW	0x1A00 (6656_{dec})
	1C13:02	SubIndex 002	RW	0x1A02 (6658_{dec})
	1C13:03	SubIndex 003	RW	0x1A03 (6659_{dec})
	1C13:04	SubIndex 004	RW	0x1A04 (6660_{dec})
	1C13:05	SubIndex 005	RW	0x1A05 (6661_{dec})
	1C13:06	SubIndex 006	RW	0x1A06 (6662_{dec})
1C33:0 [▶ 56]	**Subindex**	SM input parameter	RO	0x20 (32_{dec})
	1C33:01	Sync mode	RW	0x0022 (34_{dec})
	1C33:02	Cycle time	RW	0x000F4240 (1000000_{dec})
	1C33:03	Shift time	RO	0x00000000 (0_{dec})
	1C33:04	Sync modes supported	RO	0x0003 (3_{dec})
	1C33:05	Minimum cycle time	RO	0x00030D40 (200000_{dec})
	1C33:06	Calc and copy time	RO	0x00000000 (0_{dec})
	1C33:07	Minimum delay time	RO	0x00000000 (0_{dec})
	1C33:08	Command	RW	0x0000 (0_{dec})
	1C33:09	Maximum Delay time	RO	0x00000000 (0_{dec})
	1C33:0B	SM event missed counter	RO	0x0000 (0_{dec})
	1C33:0C	Cycle exceeded counter	RO	0x0000 (0_{dec})
	1C33:0D	Shift too short counter	RO	0x0000 (0_{dec})
	1C33:20	Sync error	RO	0x00 (0_{dec})
6000:0 [▶ 57]	**Subindex**	AI Inputs Ch.1	RO	0x11 (17_{dec})
	6000:07	Error	RO	0x00 (0_{dec})
	6000:0F	TxPDO State	RO	0x00 (0_{dec})
	6000:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6000:11	Value	RO	0x0000 (0_{dec})
6010:0 [▶ 57]	**Subindex**	AI Inputs Ch.2	RO	0x11 (17_{dec})
	6010:07	Error	RO	0x00 (0_{dec})
	6010:0F	TxPDO State	RO	0x00 (0_{dec})
	6010:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6010:11	Value	RO	0x0000 (0_{dec})
6020:0 [▶ 57]	**Subindex**	AI Inputs Ch.3	RO	0x11 (17_{dec})
	6020:07	Error	RO	0x00 (0_{dec})
	6020:0F	TxPDO State	RO	0x00 (0_{dec})
	6020:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6020:11	Value	RO	0x0000 (0_{dec})
6030:0 [▶ 57]	**Subindex**	AI Inputs Ch.4	RO	0x11 (17_{dec})
	6030:07	Error	RO	0x00 (0_{dec})
	6030:0F	TxPDO State	RO	0x00 (0_{dec})
	6030:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6030:11	Value	RO	0x0000 (0_{dec})
6040:0 [▶ 57]	**Subindex**	AI Inputs Ch.5	RO	0x11 (17_{dec})
	6040:07	Error	RO	0x00 (0_{dec})
	6040:0F	TxPDO State	RO	0x00 (0_{dec})

Index (hex)		Name	Flags	Default value
	6040:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6040:11	Value	RO	0x0000 (0_{dec})
6050:0 [▶ 57]	**Subindex**	AI Inputs Ch.6	RO	0x11 (17_{dec})
	6050:07	Error	RO	0x00 (0_{dec})
	6050:0F	TxPDO State	RO	0x00 (0_{dec})
	6050:10	TxPDO Toggle	RO	0x00 (0_{dec})
	6050:11	Value	RO	0x0000 (0_{dec})
8000:0 [▶ 49]	**Subindex**	AI Settings Ch.1	RW	0x1A (26_{dec})
	8000:06	Enable filter	RW	0x00 (0_{dec})
	8000:15	Filter settings	RW	0x0002 (2_{dez})
	8000:19	Range	RW	0x0000 (0_{dez})
	8000:1A	Presentation	RW	0x0001 (1_{dez})
8010:0 [▶ 49]	**Subindex**	AI Settings Ch.2	RW	0x1A (26_{dec})
	8010:06	Enable filter	RW	0x00 (0_{dec})
	8010:15	Filter settings	RW	0x0002 (2_{dez})
	8010:19	Range	RW	0x0000 (0_{dez})
	8010:1A	Presentation	RW	0x0001 (1_{dez})
8020:0 [▶ 50]	**Subindex**	AI Settings Ch.3	RW	0x1A (26_{dec})
	8020:06	Enable filter	RW	0x00 (0_{dec})
	8020:15	Filter settings	RW	0x0002 (2_{dez})
	8020:19	Range	RW	0x0000 (0_{dez})
	8020:1A	Presentation	RW	0x0001 (1_{dez})
8030:0 [▶ 50]	**Subindex**	AI Settings Ch.4	RW	0x1A (26_{dec})
	8030:06	Enable filter	RW	0x00 (0_{dec})
	8030:15	Filter settings	RW	0x0002 (2_{dez})
	8030:19	Range	RW	0x0000 (0_{dez})
	8030:1A	Presentation	RW	0x0001 (1_{dez})
8040:0 [▶ 51]	**Subindex**	AI Settings Ch.5	RW	0x1A (26_{dec})
	8040:06	Enable filter	RW	0x00 (0_{dec})
	8040:15	Filter settings	RW	0x0002 (2_{dez})
	8040:19	Range	RW	0x0000 (0_{dez})
	8040:1A	Presentation	RW	0x0001 (1_{dez})
8050:0 [▶ 51]	**Subindex**	AI Settings Ch.6	RW	0x1A (26_{dec})
	8050:06	Enable filter	RW	0x00 (0_{dec})
	8050:15	Filter settings	RW	0x0002 (2_{dez})
	8050:19	Range	RW	0x0000 (0_{dez})
	8050:1A	Presentation	RW	0x0001 (1_{dez})
8060:0 [▶ 52] (FW01)	**Subindex**	SAI Settings	RW	0x1D (29_{dec})
	8060:0D	Filter sampling rate	RW	0x0002 (2_{dez})
	8060:11	Range	RW	0x0000 (0_{dez})
	8060:1D	Presentation	RW	0x0001 (1_{dez})
F000:0 [▶ 58]	**Subindex**	Modular device profile	RO	0x02 (2_{dec})
	F000:01	Module index distance	RO	0x0010 (16_{dec})
	F000:02	Maximum number of modules	RO	0x0002 (2_{dec})
F008 [▶ 58]		Code word	RW	0x00000000 (0_{dec})
F010:0 [▶ 58]	**Subindex**	Module list	RW	0x02 (2_{dec})
	F010:01	SubIndex 001	RW	0x00000258 (600_{dec})
	F010:02	SubIndex 002	RW	0x00000258 (600_{dec})
F800:0 [▶ 52] (from FW02)	**Subindex**	SAI Settings	RW	0x1D (29_{dec})
	F800:0D	Filter sampling rate	RW	0x0002 (2_{dec})
	F800:11	Range	RW	0x0000 (0_{dec})
	F800:1D	Presentation	RW	0x0001 (1_{dec})

Key

Flags:

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

RW (Read/Write): This object can be read and written to.

4.5 EP3752-0000 - Object description and parameterization

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The EtherCAT device is parameterized via the CoE - Online tab [▶ 36] (double-click on the respective object) or via the Process Data [▶ 33] tab (allocation of PDOs).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 48] during commissioning
- Objects for indicating internal settings [▶ 53] (may be fixed)
- Further profile-specific objects [▶ 57] indicating inputs, outputs and status information

The following section first describes the objects required for normal operation, followed by a complete overview of missing objects.

Objects to be parameterized during commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	Restore default settings	UINT8	RO	0x01 (1_{dec})
1011:01	SubIndex 001	If this object is set to **"0x64616F6C"** in the Set Value Dialog, all backup objects are reset to their delivery state.	UINT32	RW	0x00000000 (0_{dec})

Index 8000 AI Settings Ch.1

Index (hex)	Name	Meaning		Data type	Flags	Default
8000:0	AI Settings Ch.1			UINT8	RO	0x1A (26_{dec})
8000:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8000:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8000:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8000:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8010 AI Settings Ch.2

Index (hex)	Name	Meaning		Data type	Flags	Default
8010:0	AI Settings Ch.2			UINT8	RO	0x1A (26_{dec})
8010:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8010:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8010:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8010:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8020 AI Settings Ch.3

Index (hex)	Name	Meaning		Data type	Flags	Default
8020:0	AI Settings Ch.3			UINT8	RO	0x1A (26_{dec})
8020:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8020:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8020:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8020:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8030 AI Settings Ch.4

Index (hex)	Name	Meaning		Data type	Flags	Default
8030:0	AI Settings Ch.4			UINT8	RO	0x11 (21_{dec})
8030:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8030:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8030:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8030:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8040 AI Settings Ch.5

Index (hex)	Name	Meaning		Data type	Flags	Default
8040:0	AI Settings Ch.5			UINT8	RO	0x1A (26_{dec})
8040:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8040:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8040:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8040:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8050 AI Settings Ch.6

Index (hex)	Name	Meaning		Data type	Flags	Default
8050:0	AI Settings Ch.6			UINT8	RO	0x1A (26_{dec})
8050:06	Enable filter	Activates the filter.		BOOLEAN	RW	0x00 (0_{dec})
8050:15	Filter settings	This object determines the filter settings of all channels of the module when it is activated via *Enable filter* index 0x80n0:06.		UINT16	RW	0x0002 (2_{dec})
		0	FIR			
		2	IIR1			
		3	IIR2			
		4	IIR3			
		5	IIR4			
		6	IIR5			
		7	IIR6			
		8	IIR7			
		9	IIR8			
8050:19	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G		UINT16	RW	0x0000 (0_{dec})
8050:1A	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)		UINT16	RW	0x0001 (1_{dec})

Index 8060 SAI Settings (Firmware 01)

The object with index 8060 is invisible in the object directory from Firmware 02. However, it can still be read and written via SDO access. This ensures backward compatibility with PLC programs that were written prior to the release of Firmware 02.
The content of index 8060 is mirrored in index F800 [▶ 52] from Firmware 02.

Index (hex)	Name	Meaning	Data type	Flags	Default
8060:0	SAI Settings		UINT8	RO	0x1D (29_{dec})
8060:0D	Filter sampling rate	Selection of the internal sampling rate: • 0_{dec}: 200 Hz • 1_{dec}: 500 Hz • 2_{dec}: 1000 Hz • 3_{dec}: 2500 Hz • 4_{dec}: 5000 Hz • The sensor resolution is reduced to 8-bit if the rate is increased to 2500 Hz or 5000 Hz.	UINT16	RW	0x0002 (2_{dec})
8060:11	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G	UINT16	RW	0x0000 (0_{dec})
8060:1D	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG)	UINT16	RW	0x0001 (1_{dec})

Index F800 SAI Settings (from Firmware 02)

Index (hex)	Name	Meaning	Data type	Flags	Default
F800:0	SAI Settings		UINT8	RO	0x1D (29_{dec})
F800:0D	Filter sampling rate	Selection of the internal sampling rate: • 0_{dec}: 200 Hz • 1_{dec}: 500 Hz • 2_{dec}: 1000 Hz • 3_{dec}: 2500 Hz • 4_{dec}: 5000 Hz • The sensor resolution is reduced to 8-bit if the rate is increased to 2500 Hz or 5000 Hz.	UINT16	RW	0x0002 (2_{dec})
F800:11	Range	Setting the measuring range: • 0_{dec}: +-2G • 1_{dec}: +-4G • 2_{dec}: +-8G • 3_{dec}: +-16G • 255_{dec}: Channel setting: The measuring range is set individually for each channel via the indices 0x80n0:19.	UINT16	RW	0x0000 (0_{dec})
F800:1D	Presentation	Representation of the data • 0_{dec}: Raw values • 1_{dec}: milli G (mG) • 255_{dec}: Channel setting: The representation is set channel-wise via the indices 0x80n0:1A.	UINT16	RW	0x0001 (1_{dec})

Additional objects

Standard objects (0x1000-0x1FFF)

The standard objects have the same meaning for all EtherCAT slaves.

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default
1000:0	Device type	Device type of the EtherCAT slave: The Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EP3752-0000

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	00

Index 100A Software Version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	00

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x0EA84052 (245907538_{dec})
1018:03	Revision	Revision number of the EtherCAT slave; the Low Word (bit 0-15) indicates the special terminal number, the High Word (bit 16-31) refers to the device description	UINT32	RO	0x00100002 (1048578_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave; the Low Byte (bit 0-7) of the Low Word contains the year of production, the High Byte (bit 8-15) of the Low Word contains the week of production, the High Word (bit 16-31) is 0	UINT32	RO	0x00000000 (0_{dec})

Index 10F0 Backup parameter handling

Index (hex)	Name	Meaning	Data type	Flags	Default
10F0:0	Backup parameter handling	Information for standardized loading and saving of backup entries	UINT8	RO	0x01 (1_{dec})
10F0:01	Checksum	Checksum across all backup entries of the EtherCAT slave	UINT32	RO	0x00000000 (0_{dec})

Index 1A00 AI TxPDO-Map Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	AI TxPDO-Map Inputs Ch.1	PDO Mapping TxPDO 1	UINT8	RO	0x06 (6_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (AI Inputs Ch.1), entry 0x07 (Error))	UINT32	RO	0x6000:07, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0000:00, 7
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (AI Inputs Ch.1), entry 0x0F (TxPDO State))	UINT32	RO	0x6000:0F, 1
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (AI Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (AI Inputs Ch.1), entry 0x11 (Value))	UINT32	RO	0x6000:11, 16

Index 1A01 AI TxPDO-Map Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	AI TxPDO-Map Inputs Ch.1	PDO Mapping TxPDO 2	UINT8	RO	0x06 (6_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (AI Inputs Ch.2), entry 0x07 (Error))	UINT32	RO	0x6010:07, 1
1A01:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0010:00, 7
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (AI Inputs Ch.2), entry 0x0F (TxPDO State))	UINT32	RO	0x6010:0F, 1
1A01:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (AI Inputs Ch.2), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A01:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (AI Inputs Ch.2), entry 0x11 (Value))	UINT32	RO	0x6010:11, 16

Index 1A02 AI TxPDO-Map Inputs Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	AI TxPDO-Map Inputs Ch.3	PDO Mapping TxPDO 3	UINT8	RO	0x06 (6_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (AI Inputs Ch.3), entry 0x07 (Error))	UINT32	RO	0x6020:07, 1
1A02:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0000:00, 7
1A02:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (AI Inputs Ch.3), entry 0x0F (TxPDO State))	UINT32	RO	0x6020:0F, 1
1A02:05	SubIndex 005	5. PDO Mapping entry (object 0x6020 (AI Inputs Ch.3), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6020:10, 1
1A02:06	SubIndex 006	6. PDO Mapping entry (object 0x6020 (AI Inputs Ch.3), entry 0x11 (Value))	UINT32	RO	0x6020:11, 16

Index 1A03 AI TxPDO-Map Inputs Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	AI TxPDO-Map Inputs Ch.4	PDO Mapping TxPDO 4	UINT8	RO	0x06 (6_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (AI Inputs Ch.4), entry 0x07 (Error))	UINT32	RO	0x6030:07, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0000:00, 7
1A03:04	SubIndex 004	4. PDO Mapping entry (object 0x6030 (AI Inputs Ch.4), entry 0x0F (TxPDO State))	UINT32	RO	0x6030:0F, 1
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6030 (AI Inputs Ch.4), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6030:10, 1
1A03:06	SubIndex 006	6. PDO Mapping entry (object 0x6030 (AI Inputs Ch.4), entry 0x11 (Value))	UINT32	RO	0x6030:11, 16

Index 1A04 AI TxPDO-Map Inputs Ch.5

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	AI TxPDO-Map Inputs Ch.5	PDO Mapping TxPDO 5	UINT8	RO	0x06 (6_{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6040 (AI Inputs Ch.5), entry 0x07 (Error))	UINT32	RO	0x6040:07, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0000:00, 7
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6040 (AI Inputs Ch.5), entry 0x0F (TxPDO State))	UINT32	RO	0x6040:0F, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6040 (AI Inputs Ch.5), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6040:10, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6040 (AI Inputs Ch.5), entry 0x11 (Value))	UINT32	RO	0x6040:11, 16

Index 1A05 AI TxPDO-Map Inputs Ch.6

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	AI TxPDO-Map Inputs Ch.6	PDO Mapping TxPDO 5	UINT8	RO	0x06 (6_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (6 bit align)	UINT32	RO	0x0000:00, 6
1A05:02	SubIndex 002	2. PDO Mapping entry (object 0x6050 (AI Inputs Ch.6), entry 0x07 (Error))	UINT32	RO	0x6050:07, 1
1A05:03	SubIndex 003	3. PDO Mapping entry (7 bit align)	UINT32	RO	0x0000:00, 7
1A05:04	SubIndex 004	4. PDO Mapping entry (object 0x6050 (AI Inputs Ch.6), entry 0x0F (TxPDO State))	UINT32	RO	0x6050:0F, 1
1A05:05	SubIndex 005	5. PDO Mapping entry (object 0x6050 (AI Inputs Ch.6), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6050:10, 1
1A05:06	SubIndex 006	6. PDO Mapping entry (object 0x6050 (AI Inputs Ch.6), entry 0x11 (Value))	UINT32	RO	0x6050:11, 16

Index 1C00 Sync manager type

Index (hex)	Name	Meaning	Data type	Flags	Default
1C00:0	Sync manager type	Using the Sync Managers	UINT8	RO	0x04 (4_{dec})
1C00:01	SubIndex 001	Sync-Manager Type Channel 1: Mailbox Write	UINT8	RO	0x01 (1_{dec})
1C00:02	SubIndex 002	Sync-Manager Type Channel 2: Mailbox Read	UINT8	RO	0x02 (2_{dec})
1C00:03	SubIndex 003	Sync-Manager Type Channel 3: Process Data Write (Outputs)	UINT8	RO	0x03 (3_{dec})
1C00:04	SubIndex 004	Sync-Manager Type Channel 4: Process Data Read (Inputs)	UINT8	RO	0x04 (4_{dec})

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x04 (4_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C13:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchron with SM 2 Event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: Synchron with SM 2 Event is supported (outputs available) • Bit 1: Synchron with SM 3 Event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: Input Shift through local event (outputs available) • Bit 4-5 = 10: Input Shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 or 0x1C33:08)	UINT16	RO	0x0003 (3_{dec})
1C33:05	Minimum cycle time	Minimum cycle time supported (in ns)	UINT32	RO	0x0003D040 (20000_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	With this entry the real required process data provision time can be measured. 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Maximum Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

The profile-specific objects have the same meaning for all EtherCAT slaves that support the profile 5001.

Index 6000 AI Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	AI Inputs Ch.1		UINT8	RO	0x11 (17_{dec})
6000:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6000:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6000:11	Value		INT16	RO	0x0000 (0_{dec})

Index 6010 AI Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	AI Inputs Ch.2		UINT8	RO	0x11 (17_{dec})
6010:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6010:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6010:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6010:11	Value		INT16	RO	0x0000 (0_{dec})

Index 6020 AI Inputs Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	AI Inputs Ch.3		UINT8	RO	0x11 (17_{dec})
6020:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6020:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6020:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6020:11	Value		INT16	RO	0x0000 (0_{dec})

Index 6030 AI Inputs Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
6030:0	AI Inputs Ch.4		UINT8	RO	0x11 (17_{dec})
6030:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6030:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6030:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6030:11	Value		INT16	RO	0x0000 (0_{dec})

Index 6040 AI Inputs Ch.5

Index (hex)	Name	Meaning	Data type	Flags	Default
6040:0	AI Inputs Ch.5		UINT8	RO	0x11 (17_{dec})
6040:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6040:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6040:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6040:11	Value		INT16	RO	0x0000 (0_{dec})

Index 6050 AI Inputs Ch.6

Index (hex)	Name	Meaning	Data type	Flags	Default
6050:0	AI Inputs Ch.6		UINT8	RO	0x11 (17_{dec})
6050:07	Error		BOOLEAN	RO	0x00 (0_{dec})
6050:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6050:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6050:11	Value		INT16	RO	0x0000 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index distance of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0002 (2_{dec})

Index F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default
F008:0	Code word		UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list		UINT8	RW	0x02 (2_{dec})
F010:01	SubIndex 001		UINT32	RW	0x00000258 (600_{dec})
F010:02	SubIndex 002		UINT32	RW	0x00000258 (600_{dec})

4.6 Restoring the delivery state

To restore the delivery state for backup objects in ELxxxx terminals / EPxxxx- and EPPxxxx boxes, the CoE object *Restore default parameters, SubIndex 001* can be selected in the TwinCAT System Manager (Config mode).

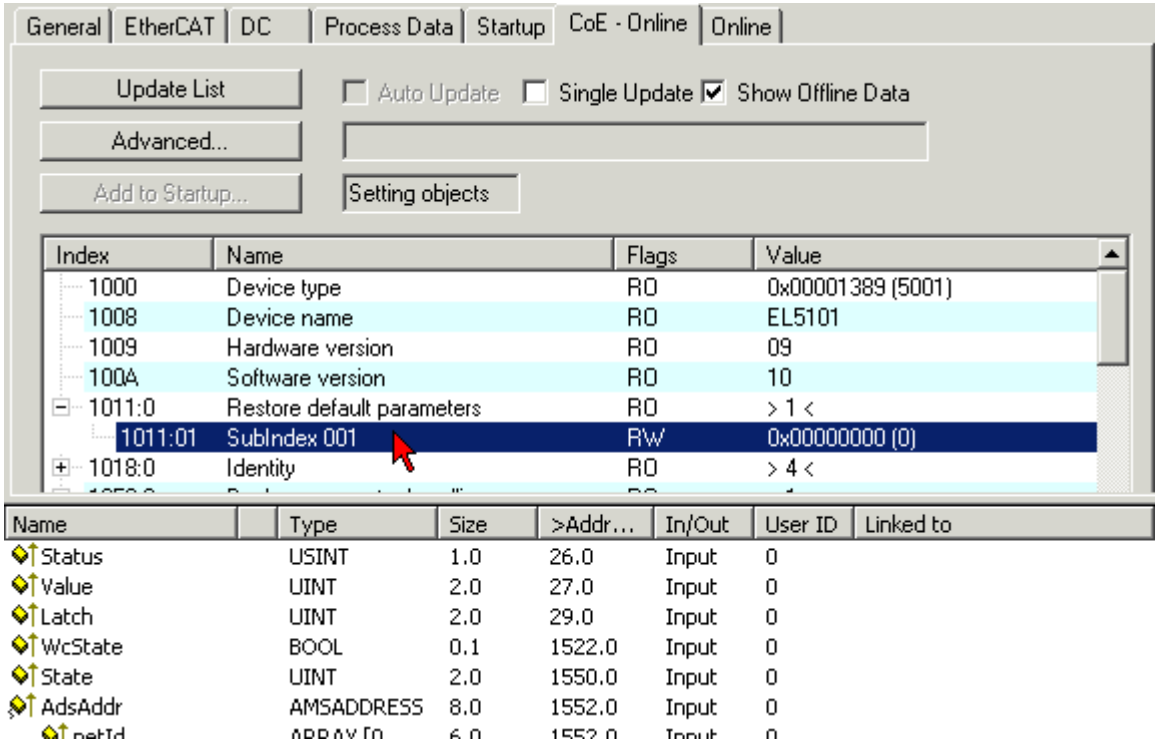

Fig. 46: Selecting the Restore default parameters PDO

Double-click on *SubIndex 001* to enter the Set Value dialog. 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.

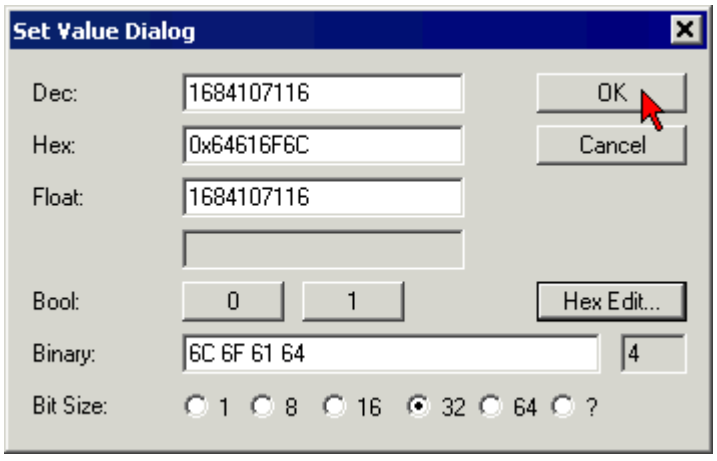

Fig. 47: Entering a restore value in the Set Value dialog

Alternative restore value

In some older terminals / boxes the backup objects can be switched with an alternative restore value:
Decimal value: 1819238756
Hexadecimal value: 0x6C6F6164

An incorrect entry for the restore value has no effect.

4.7 Firmware Update EL/ES/EM/EPxxxx

This section describes the device update for Beckhoff EtherCAT slaves from the EL/ES, EM, EK and EP series. A firmware update should only be carried out after consultation with Beckhoff support.

Storage locations

An EtherCAT slave stores operating data in up to 3 locations:

- Depending on functionality and performance EtherCAT slaves have one or several local controllers for processing I/O data. The corresponding program is the so-called **firmware** in *.efw format.
- In some EtherCAT slaves the EtherCAT communication may also be integrated in these controllers. In this case the controller is usually a so-called **FPGA** chip with *.rbf firmware.
- In addition, each EtherCAT slave has a memory chip, a so-called **ESI-EEPROM**, for storing its own device description (ESI: EtherCAT Slave Information). On power-up this description is loaded and the EtherCAT communication is set up accordingly. The device description is available from the download area of the Beckhoff website at (http://www.beckhoff.de). All ESI files are accessible there as zip files.

Customers can access the data via the EtherCAT fieldbus and its communication mechanisms. Acyclic mailbox communication or register access to the ESC is used for updating or reading of these data.

The TwinCAT System Manager offers mechanisms for programming all 3 parts with new data, if the slave is set up for this purpose. Generally the slave does not check whether the new data are suitable, i.e. it may no longer be able to operate if the data are unsuitable.

NOTE

Risk of damage to the device!

Note the following when downloading new device files
• Firmware downloads to an EtherCAT device must not be interrupted
• Flawless EtherCAT communication must be ensured. CRC errors or LostFrames must be avoided.
• The power supply must adequately dimensioned. The signal level must meet the specification.
In the event of malfunctions during the update process the EtherCAT device may become unusable and require re-commissioning by the manufacturer.

Device description ESI file/XML

NOTE

Notice regarding update of the ESI description/EEPROM

Some slaves have stored calibration and configuration data from the production in the EEPROM. These are irretrievably overwritten during an update.

The ESI device description is stored locally on the slave and loaded on start-up. Each device description has a unique identifier consisting of slave name (9 characters/digits) and a revision number (4 digits). Each slave configured in the System Manager shows its identifier in the EtherCAT tab:

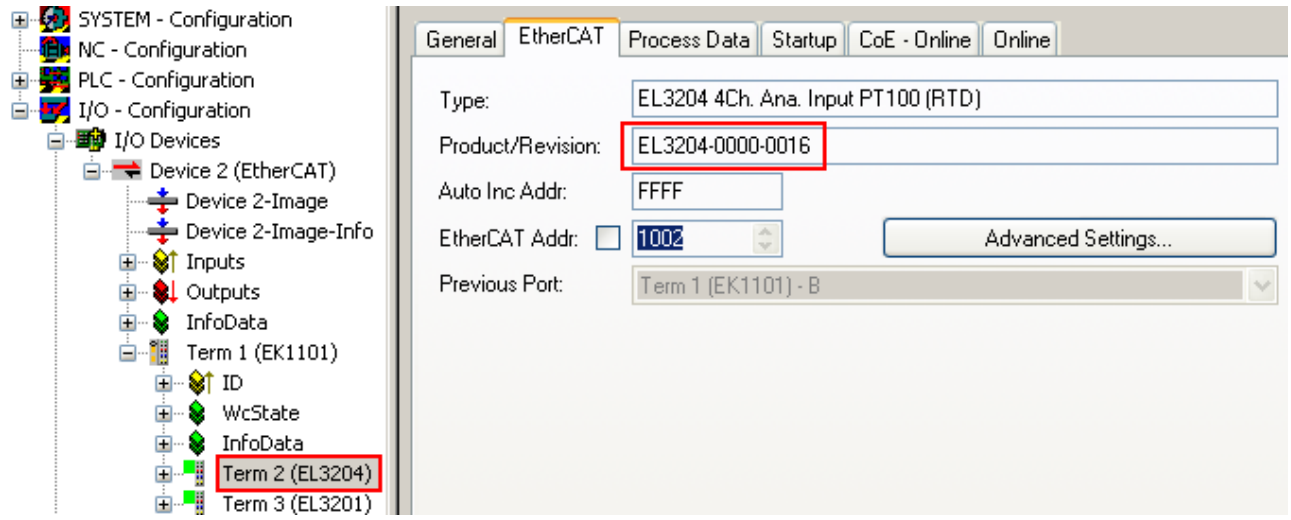

Fig. 48: Device identifier consisting of name EL3204-0000 and revision -0016

The configured identifier must be compatible with the actual device description used as hardware, i.e. the description which the slave has loaded on start-up (in this case EL3204). Normally the configured revision must be the same or lower than that actually present in the terminal network.

For further information on this, please refer to the EtherCAT system documentation.

Update of XML/ESI description

The device revision is closely linked to the firmware and hardware used. Incompatible combinations lead to malfunctions or even final shutdown of the device. Corresponding updates should only be carried out in consultation with Beckhoff support.

Display of ESI slave identifier

The simplest way to ascertain compliance of configured and actual device description is to scan the EtherCAT boxes in TwinCAT mode Config/FreeRun:

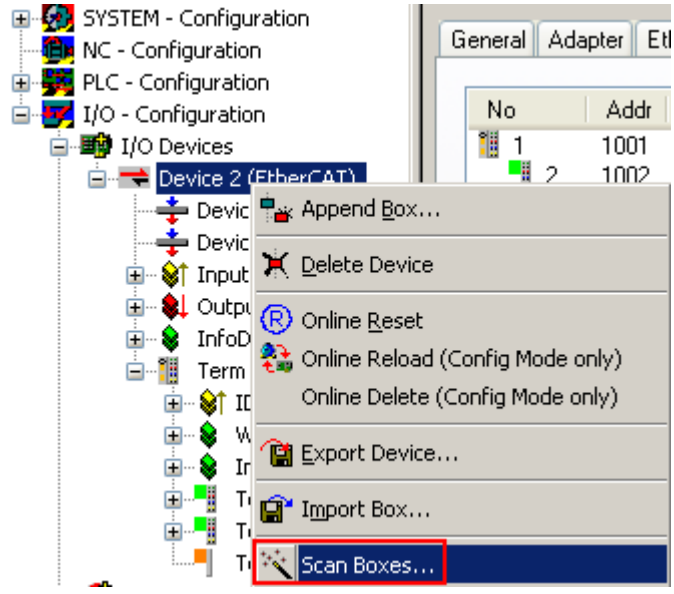

Fig. 49: Scan Boxes

Scan the subordinate field by right-clicking on the EtherCAT device in Config/FreeRun mode

If the found field matches the configured field, the display shows

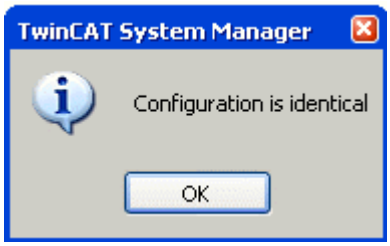

Fig. 50: Configuration is identical

otherwise a change dialog appears for entering the actual data in the configuration.

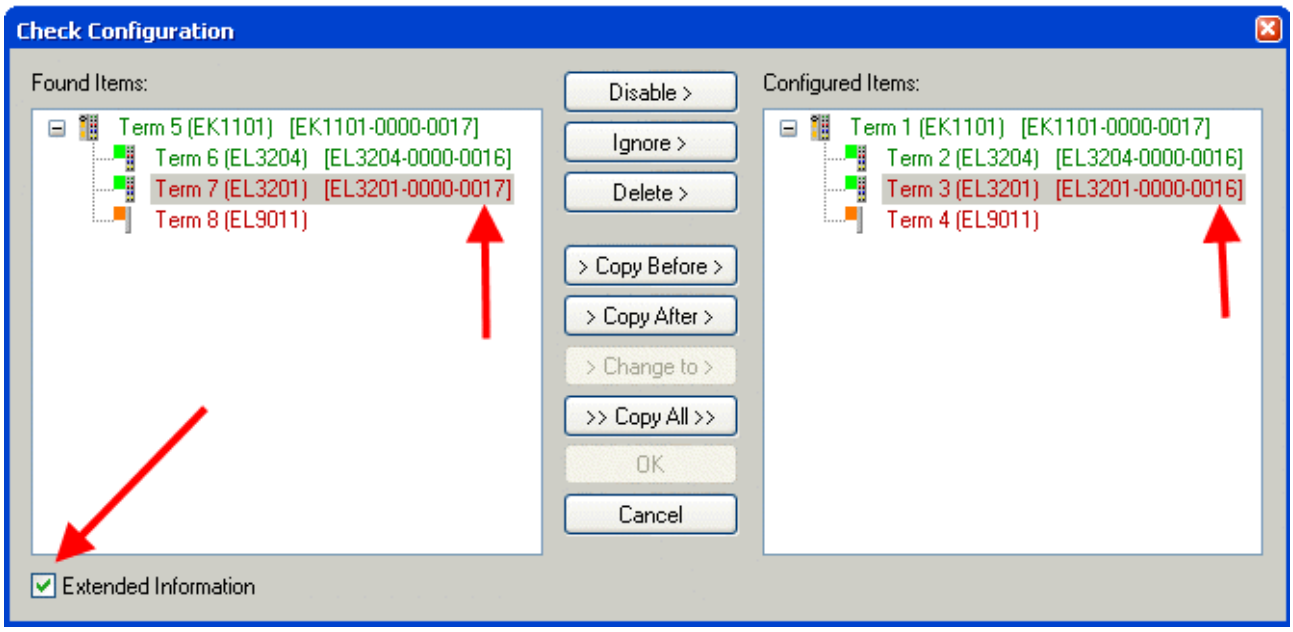

Fig. 51: Change dialog

In this example in Fig. *Change dialog*, an EL3201-0000-**0017** was found, while an EL3201-0000-**0016** was configured. In this case the configuration can be adapted with the *Copy Before* button. The *Extended Information* checkbox must be set in order to display the revision.

Changing the ESI slave identifier

The ESI/EEPROM identifier can be updated as follows under TwinCAT:

- Trouble-free EtherCAT communication must be established with the slave.
- The state of the slave is irrelevant.
- Right-clicking on the slave in the online display opens the *EEPROM Update* dialog, Fig. *EEPROM Update*

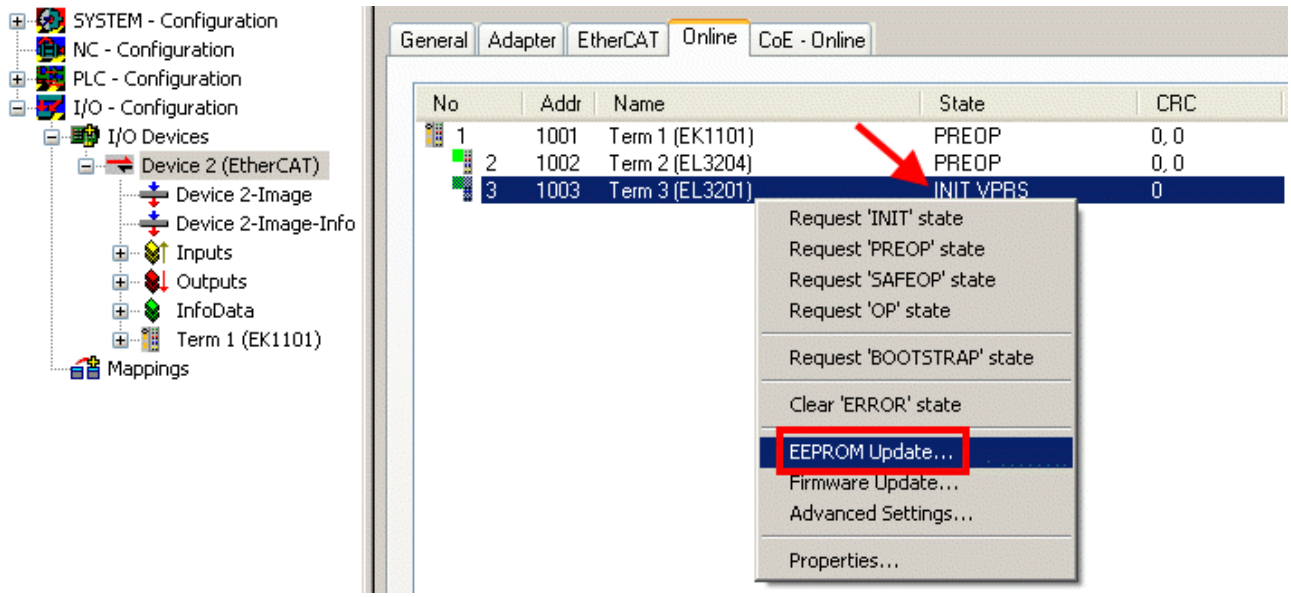

Fig. 52: EEPROM Update

The new ESI description is selected in the following dialog, see Fig. *Selecting the new ESI.* The checkbox *Show Hidden Devices* also displays older, normally hidden versions of a slave.

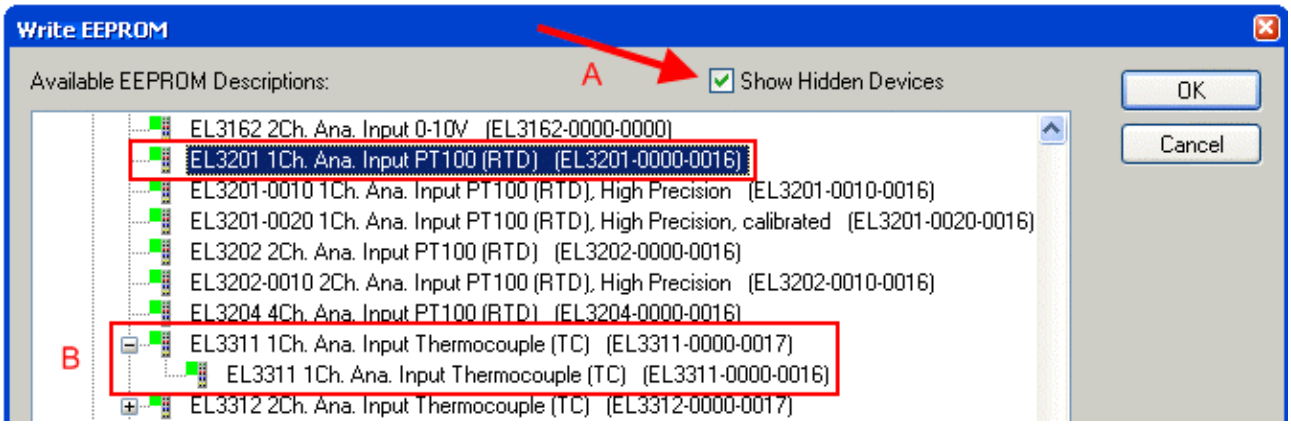

Fig. 53: Selecting the new ESI

A progress bar in the System Manager shows the progress. Data are first written, then verified.

The change only takes effect after a restart.

Most EtherCAT devices read a modified ESI description immediately or after startup from the INIT. Some communication settings such as distributed clocks are only read during power-on. The EtherCAT slave therefore has to be switched off briefly in order for the change to take effect.

Determining the firmware version

Determining the version on laser inscription

Beckhoff EtherCAT Box feature batch numbers (D number) applied by laser. The D-number has the following structure: **KK YY FF HH**

KK - week of production (CW, calendar week)
YY - year of production
FF - firmware version
HH - hardware version

Example with D-no.: 12 10 03 02:

12 - week of production 12
10 - year of production 2010
03 - firmware version 03
02 - hardware version 02

Determining the version via the System Manager

The TwinCAT System Manager shows the version of the controller firmware if the master can access the slave online. Click on the E-Bus Terminal whose controller firmware you want to check (in the example terminal 2 (EL3204)) and select the tab *CoE Online* (CAN over EtherCAT).

> **CoE Online and Offline CoE**
>
> Two CoE directories are available:
> • **online**: This is offered in the EtherCAT slave by the controller, if the EtherCAT slave does supported it. This CoE directory can only be displayed if a slave is connected and operational.
> • **offline**: The EtherCAT Slave Information ESI/XML may contain the default content of the CoE. This CoE directory can only be displayed if it is included in the ESI (e.g. Beckhoff EL5xxx.xml). The Advanced button must be used for switching between the two views.

In Fig. *Display of EL3204 firmware version* the firmware version of the selected EL3204 is shown as 03 in CoE entry 0x100A.

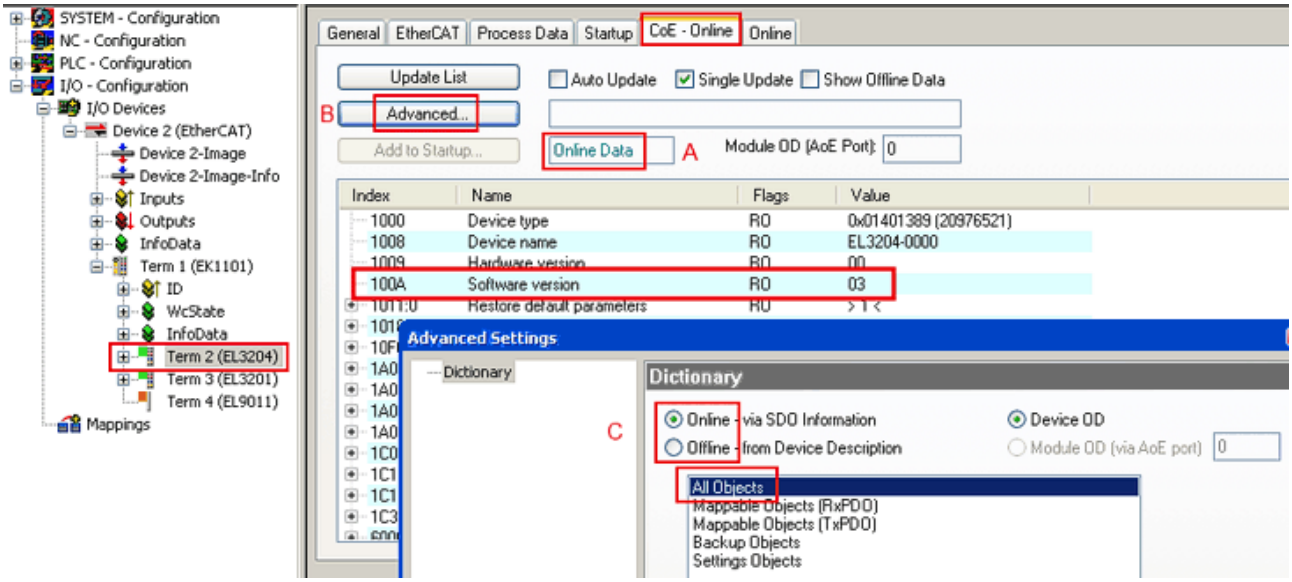

Fig. 54: Display of EL3204 firmware version

In (A) TwinCAT 2.11 shows that the Online CoE directory is currently displayed. If this is not the case, the Online directory can be loaded via the *Online* option in Advanced Settings (B) and double-clicking on *AllObjects*.

Updating controller firmware *.efw

> **CoE directory**
>
> The Online CoE directory is managed by the controller and stored in a dedicated EEPROM, which is generally not changed during a firmware update.

Switch to the *Online* tab to update the controller firmware of a slave, see Fig. *Firmware Update.*

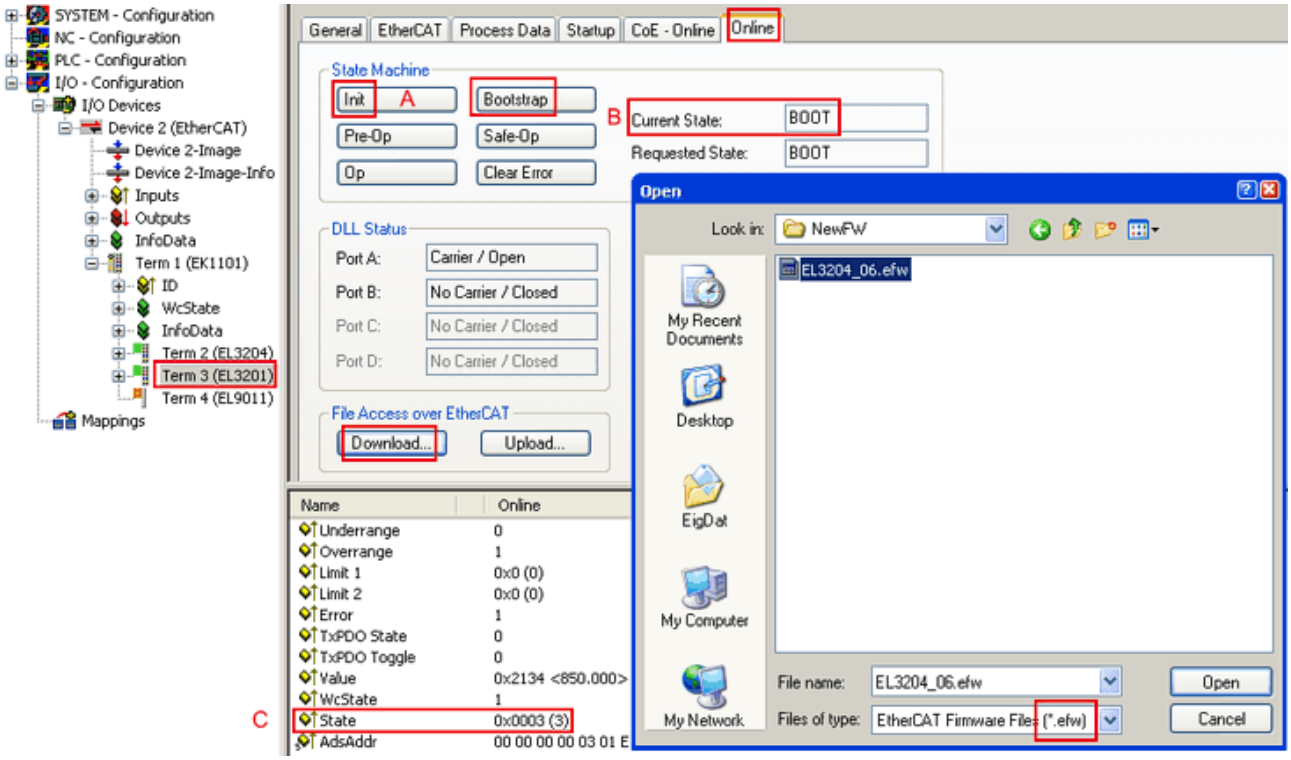

Fig. 55: Firmware Update

Proceed as follows, unless instructed otherwise by Beckhoff support.

- Switch slave to INIT (A)
- Switch slave to BOOTSTRAP
- Check the current status (B, C)
- Download the new *efw file
- After the download switch to INIT, then OP
- Switch off the slave briefly

FPGA firmware *.rbf

If an FPGA chip deals with the EtherCAT communication an update may be accomplished via an *.rbf file.

- Controller firmware for processing I/O signals
- FPGA firmware for EtherCAT communication (only for terminals with FPGA)

The firmware version number included in the terminal serial number contains both firmware components. If one of these firmware components is modified this version number is updated.

Determining the version via the System Manager

The TwinCAT System Manager indicates the FPGA firmware version. Click on the Ethernet card of your EtherCAT strand (Device 2 in the example) and select the *Online* tab.

The *Reg:0002* column indicates the firmware version of the individual EtherCAT devices in hexadecimal and decimal representation.

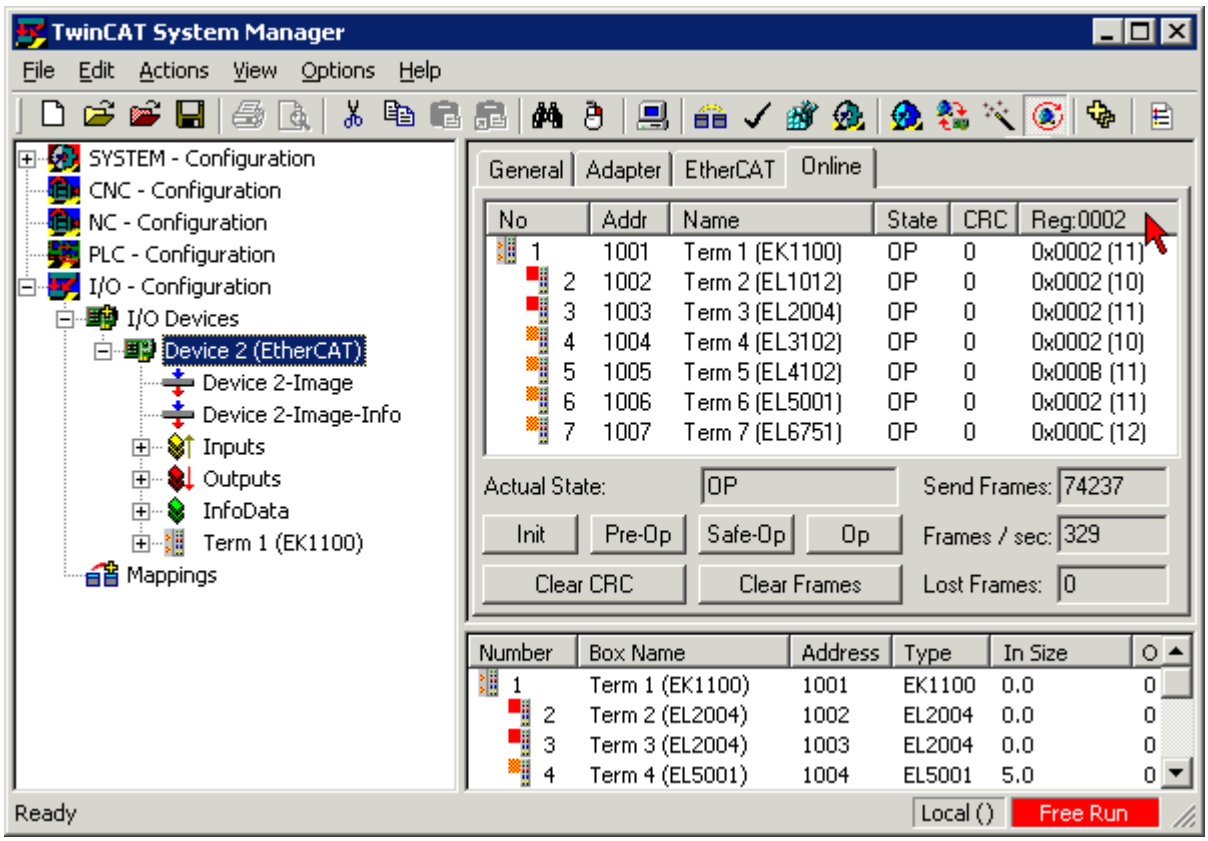

Fig. 56: FPGA firmware version definition

If the column *Reg:0002* is not displayed, right-click the table header and select *Properties* in the context menu.

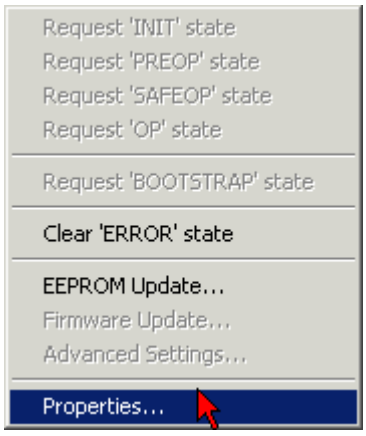

Fig. 57: Context menu *Properties*

The *Advanced Settings* dialog appears where the columns to be displayed can be selected. Under *Diagnosis/***Online View** select the *'0002 ETxxxx Build'* check box in order to activate the FPGA firmware version display.

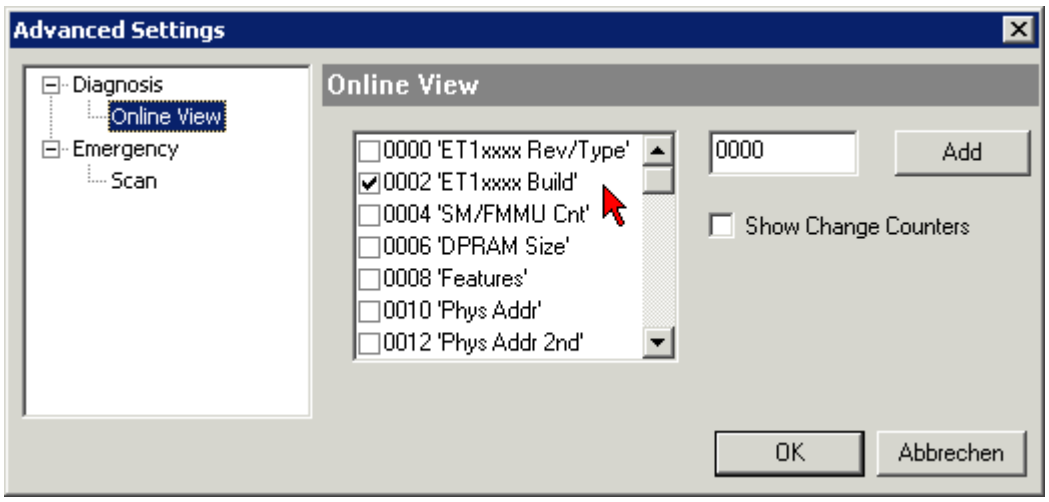

Fig. 58: Dialog *Advanced Settings*

Update

For updating the FPGA firmware

- of an EtherCAT coupler the coupler must have FPGA firmware version 11 or higher;
- of an E-Bus Terminal the terminal must have FPGA firmware version 10 or higher.

Older firmware versions can only be updated by the manufacturer!

Updating an EtherCAT device

In the TwinCAT System Manager select the terminal for which the FPGA firmware is to be updated (in the example: Terminal 5: EL5001) and click the *Advanced Settings* button in the *EtherCAT* tab.

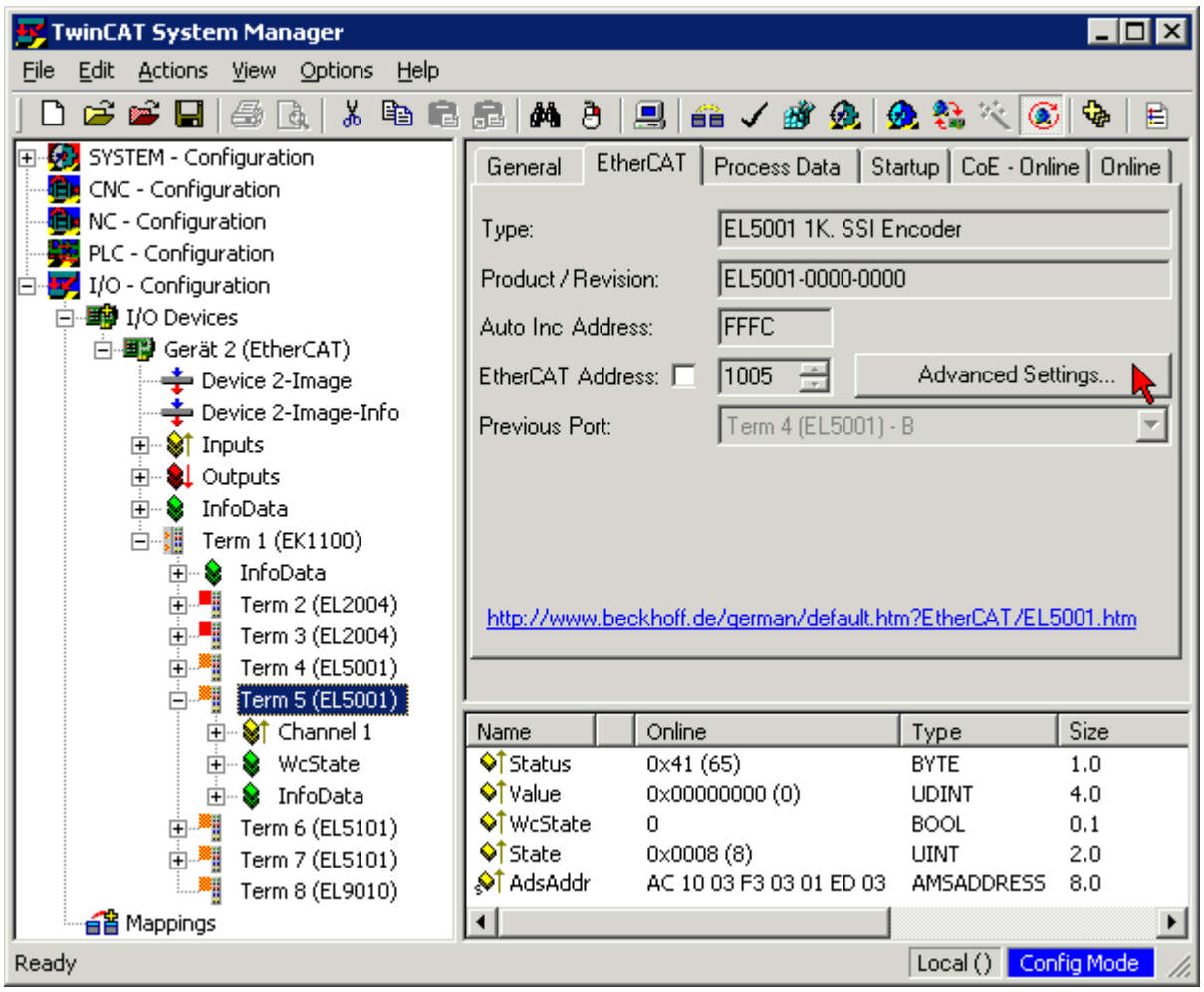

Fig. 59: Select dialog *Advanced Settings*

The *Advanced Settings* dialog appears. Under *ESC Access/E²PROM/***FPGA** click on *Write FPGA* button,

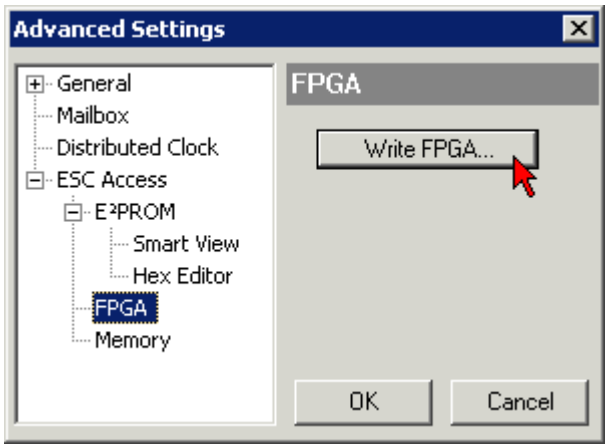

Fig. 60: Select dialog *Write FPGA*

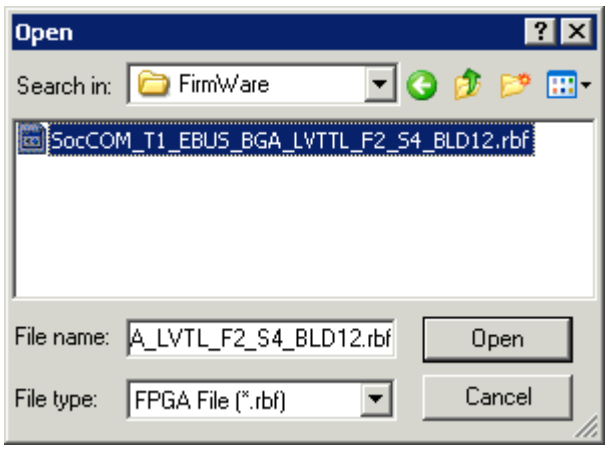

Fig. 61: Select file

Select the file (*.rbf) with the new FPGA firmware, and transfer it to the EtherCAT device.

NOTE

Risk of damage to the device!

A firmware download to an EtherCAT device must never be interrupted! If this process is cancelled, the supply voltage switched off or the Ethernet connection interrupted, the EtherCAT device can only be recommissioned by the manufacturer!

In order to activate the new FPGA firmware a restart (switching the power supply off and on again) of the EtherCAT device is required.

Simultaneous updating of several EtherCAT devices

The firmware and ESI descriptions of several devices can be updated simultaneously, provided the devices have the same firmware file/ESI.

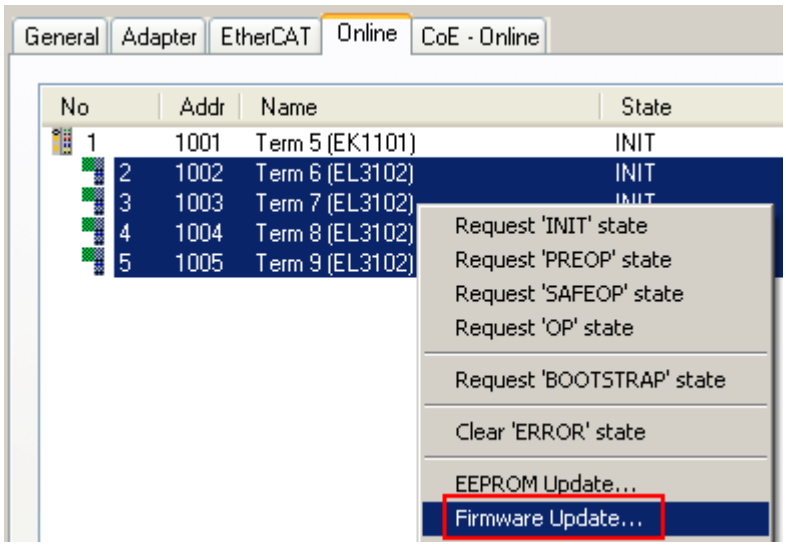

Fig. 62: Multiple selection and firmware update

Select the required slaves and carry out the firmware update in BOOTSTRAP mode as described above.

5 Appendix

5.1 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 IP 67 modules and the used metal parts. In the table below you will find some typical resistance.

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

Key

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

5.2 EtherCAT Box- / EtherCAT P 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 wrench for M8 cables with knurl, incl. ratchet
ZB8800-0001	M12 ratchet for torque wrench ZB8800
ZB8800-0002	M8 ratchet (field assembly) for torque wrench ZB8800
ZB8801-0000	torque wrench for hexagonal plugs, adjustable
ZB8801-0001	torque cable key, M8/wrench size 9, for torque wrench ZB8801-0000
ZB8801-0002	torque cable key, M12/wrench size 13, for torque wrench ZB8801-0000
ZB8801-0003	torque cable key, M12 field assembly/wrench size 13, for torque wrench ZB8801-0000

Further accessories

Further accessories may be found at the price list for Beckhoff fieldbus components and at the internet under https://www.beckhoff.com

5.3 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.

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