BECKHOFF New Automation Technology

Documentation | EN

EP6090-0000

Display box with navigation switch and operating hours counter

Table of contents

BECKHOFF

Version: 1.1

1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

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

Patent Pending

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

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

Copyright

1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Description of instructions

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

⚠ **DANGER**
Serious risk of injury!
Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ **WARNING**
Risk of injury!
Failure to follow this safety instruction endangers the life and health of persons.

⚠ **CAUTION**
Personal injuries!
Failure to follow this safety instruction can lead to injuries to persons.

NOTE
Damage to environment/equipment or data loss
Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.1	• Housing data updated
	• Special characters updated
1.0	• First release Derived from the documentation for EL6090, Version 2.5.

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

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

Example with D no. 29 10 02 01:

29 - week of production 29
10 - year of production 2010
02 - firmware version 02
01 - hardware version 01

Further information on this topic:

2   EtherCAT Box - Introduction

The EtherCAT system has been extended with EtherCAT Box modules with protection class IP67. 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.
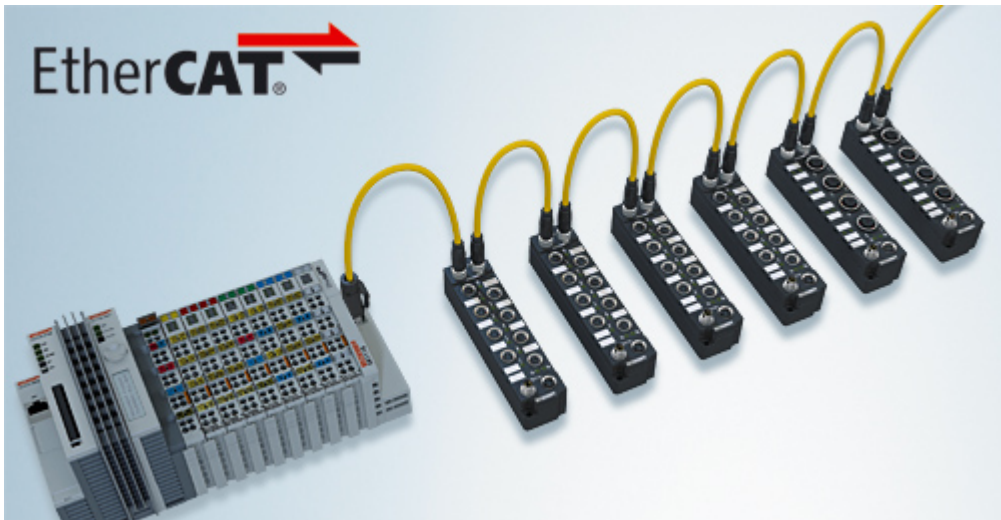
Fig. 1: EtherCAT Box Modules within an EtherCAT network

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.

---

3 Product overview

3.1 Introduction

EtherCAT input

EtherCAT downstream connection

Display

Navigation switch

Supply voltage input

Supply voltage downstream connection

FE

FE

1 | Tx+
2 | Rx+
3 | Rx-
4 | Tx-

1 | +24 V Us
2 | +24 V Up
3 | GNDs
4 | GNDp
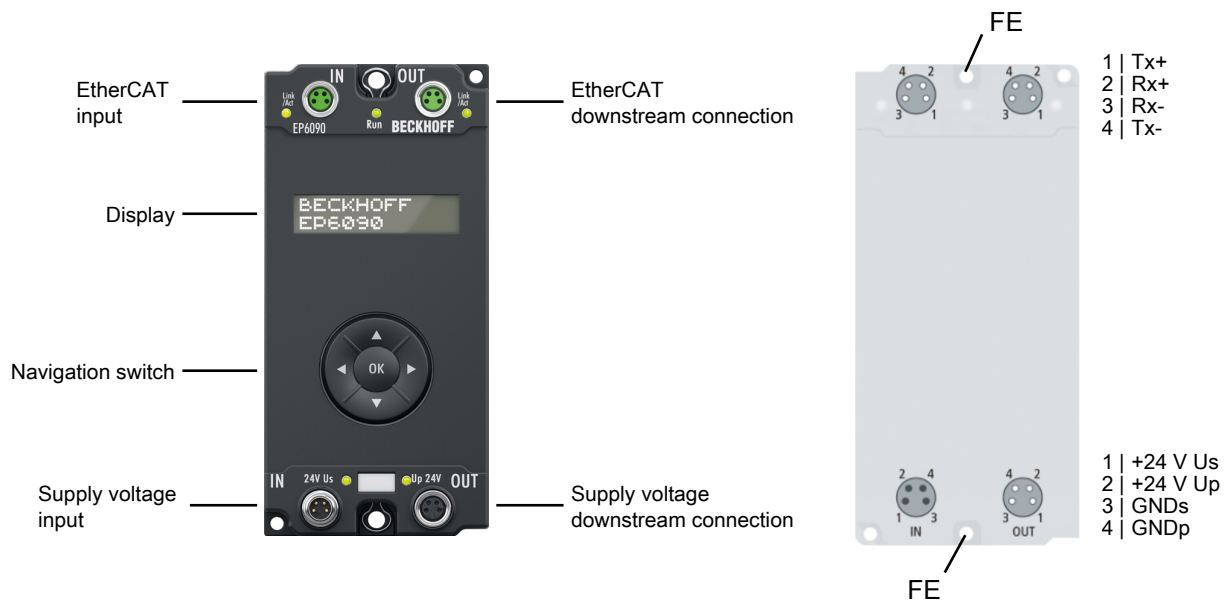
The EP6090-0000 display box has an illuminated, low-reflection LC display with two rows of 16 characters. It can be used, for example, for displaying status messages or diagnostic information. A non-resettable operating hour counter is integrated and can be displayed and also read out via the controller.

Via the user program dynamic and static application-specific texts can be displayed, e.g. "Production counter: (count value)". If the output text is longer than 16 characters, the box automatically switches to scrolling text mode. Two special characters can be defined via a 5x8 pixel matrix.

The statuses of the navigation switch – up, down, left, right and Enter – are transmitted to the controller as binary variables and can be used to control the display.

Quick links

Technical data [▶ 11]
Process image [▶ 13]
Commissioning [▶ 24]

3.2   Technical data

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

EtherCAT	
Connection	2 x M8 socket, 4-pin, green
Electrical isolation	500 V

Supply voltages	
Connection	Input: M8 connector, 4-pin
	Downstream connection: M8 socket, 4-pin, black
U_S nominal voltage	24 V_{DC} (-15 % / +20 %)
U_S sum current: $I_{S,sum}$	max. 4 A
Current consumption from U_S	120 mA
Rated voltage U_P	24 V_{DC} (-15 % / +20 %)
U_P sum current: $I_{P,sum}$	max. 4 A
Current consumption from U_P	None. U_P is only forwarded.

Display	
Type	LCD
Number of characters	2 rows, each with 16 characters.
	Scrolling text mode for texts up to 80 characters.
Character set	7-bit ASCII, supplemented by German special characters and two user-defined special characters
User-defined special characters	2 special characters, each with 5 x 8 pixels
Backlight	yes, switchable

Navigation switch	
Buttons	up, down, left, right, OK

Operating hour counter	
Bits	32 bits
Resolution	1 second
Overflow	after 136 years
Secure data management	Dependent on the number of accesses to the memory.
	At least 100 years if access to the memory is restricted to the automatic saving interval of 15 minutes.
Automatic saving interval	Every 15 minutes
Accuracy	± 50 ppm

Timers and counters	
Number of timers	4
Number of counters	4
Bits of a timer	32 bits
Bits of a counter	32 bits
Resolution of a timer	1 second

Housing data	
Dimensions W x H x D	60 mm x 126 mm x 26.5 mm (without plug connectors)
Weight	approx. 230 g
Installation position	variable
Material	PA6 (polyamide)

Environmental conditions	
Ambient temperature during operation	-25…+60 °C -25…+55 °C according to cURus The display is only readable to a limited extent below 0 °C.
Ambient temperature during storage	-40…+85 °C
Vibration resistance, shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27 Additional checks [▶ 12]
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)

Approvals / markings	
Approvals / markings *)	CE, cURus [▶ 22]

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

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

3.3 Scope of supply

Make sure that the following components are included in the scope of delivery:

- 1x EP6090-0000
- 2x protective cap for EtherCAT socket, M8, green (pre-assembled)
- 1x protective cap for supply voltage input, M8, transparent (pre-assembled)
- 1x protective cap for supply voltage output, M8, black (pre-assembled)
- 10x labels, blank (1 strip of 10)

Pre-assembled protective caps do not ensure IP67 protection

Protective caps are pre-assembled at the factory to protect connectors during transport. They may not be tight enough to ensure IP67 protection.

Ensure that the protective caps are correctly seated to ensure IP67 protection.

3.4 Process image

The scope of the process image is adjustable. Not all process data objects are enabled in the factory settings. Configure the process image [▶ 24] according to your requirements.

DIS Inputs

"DIS Inputs" contains the input variables of the navigation switch.

▲ 🗀 DIS Inputs
　▲ 🔹 Status
　　　🔸 Up
　　　🔸 Down
　　　🔸 Left
　　　🔸 Right
　　　🔸 Enter
　　　🔸 TxPDO Toggle

Status

- **Up**: Up button
- **Down**: Down button
- **Left**: Left button
- **Right**: Right button
- **Enter**: "OK" button
- **TxPDO Toggle**: This bit is inverted every time the states of the buttons are read.

DIS Outputs

"DIS Outputs" contains variables for numerical values that can be shown on the display.

▲ 🗀 DIS Outputs
　　🔸 Value row 1
　　🔸 Value row 2

Value row 1: Variable for the upper row of the display.
Value row 2: Variables for the lower row of the display.

UCP Input Channel n

The "UCP Input Channel *n*" contain variables for the evaluation of the timer and counter.

These process data objects are disabled in the factory settings. Enable [▶ 24]

▲ 🗀 UCP Input Channel 1
　　🔸 Input cycle counter
　　🔸 Timer
　　🔸 Counter

Input cycle counter: A 2-bit counter. It is incremented every time the variables "Timer" or "Counter" are updated.

Timer: the current value of the timer.
Unit: seconds.

Counter: the current value of the counter.

UCP Outputs Channel *n*

The "UCP Outputs Channel *n*" contain variables for controlling the timer [▶ 34] and counter [▶ 35].

These process data objects are disabled in the factory settings. Enable [▶ 24]

▲ 🗀 UCP Outputs Channel 1
　▲ 🔹 Ctrl
　　　🔸 Timer start
　　　🔸 Timer reset
　　　🔸 Counter clk
　　　🔸 Counter reset

Ctrl

- **Timer start**: set this bit to "1" to start the timer. The timer runs as soon as this bit is "1".
- **Timer reset**: a rising edge sets the timer to zero.
- **Counter clk**: a rising edge increments the counter by 1.
- **Counter reset**: a rising edge sets the counter to zero.

UCP Inputs operating time

"UCP Inputs operation time" contains variables for evaluation the operating hour counter.

This process data object is disabled in the factory settings.

Input cycle counter: A 2-bit counter. It is incremented every time the variable "Operating time" is updated.

Operating time: The counter value of the operating hour counter. Unit: seconds.

4   Mounting and connections

4.1   Mounting

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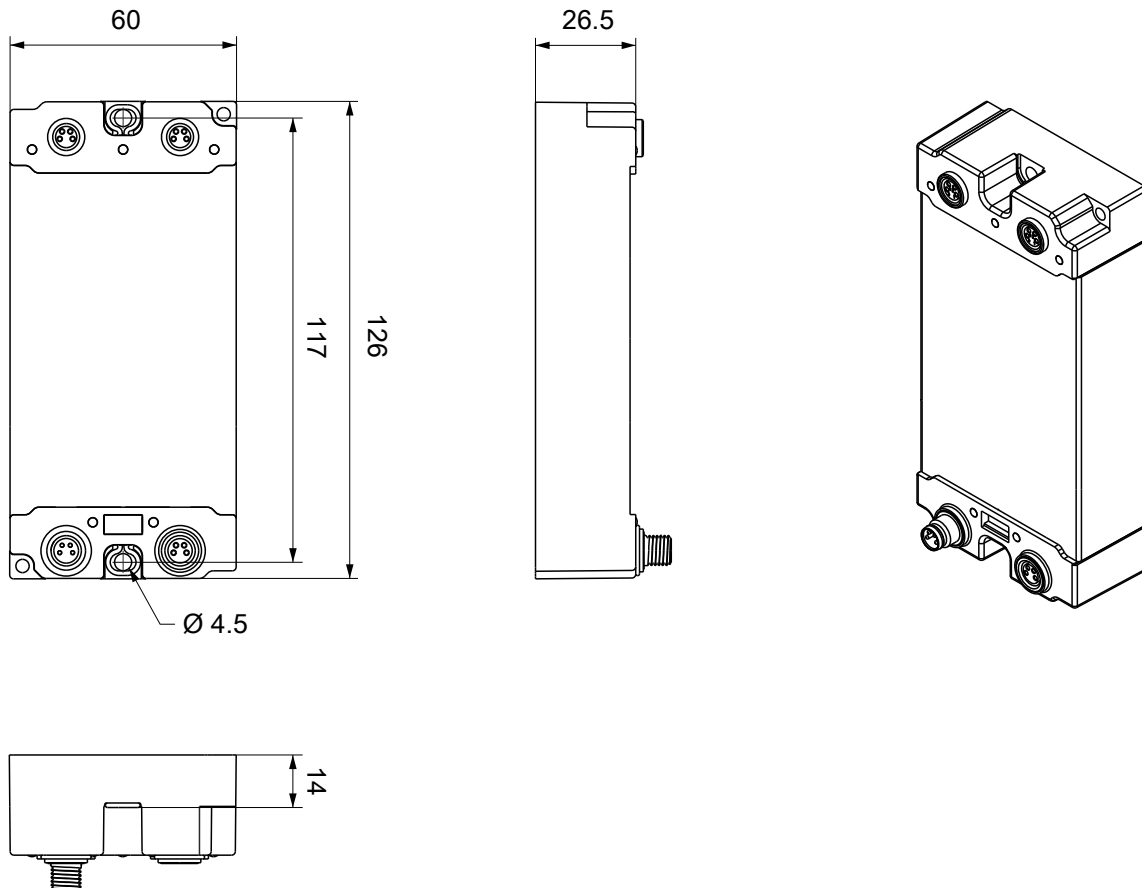
All dimensions are given in millimeters.
The drawing is not true to scale.

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two fastening holes Ø 4.5 mm for M4
Metal parts	brass, nickel-plated
Contacts	CuZn, gold-plated
Installation position	variable
Protection class	IP65, IP66, IP67 (conforms to EN 60529) when screwed together
Dimensions (H x W x D)	approx. 126 x 60 x 26.5 mm (without connectors)

4.1.2   Fixing

NOTE

Dirt during assembly

Dirty connectors can lead to malfunctions. Protection class IP67 can only be guaranteed if all cables and connectors are connected.

 • Protect the plug connectors against dirt during the assembly.

Mount the module with two M4 screws in the centrally located fastening holes.

4.2   Functional earth (FE)

The Fixing [▶ 16] also serve as connections for the functional earth (FE).

Make sure that the box is earthed with low impedance via both fastening screws. You can achieve this, for example, by mounting the box on a grounded machine bed.

4.3   Connections

4.3.1   EtherCAT

4.3.1.1   Connectors

NOTE
Risk of confusion: supply voltages and EtherCAT
Defect possible through incorrect insertion.

• Observe the color coding of the connectors:
    black: Supply voltages
    green: EtherCAT

EtherCAT Box Modules have two green M8 sockets for the incoming and downstream EtherCAT connections.

Fig. 4: EtherCAT connectors

Connection
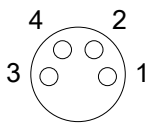
Fig. 5: M8 socket

EtherCAT	M8 connector	Core colors		
Signal	Contact	ZB9010, ZB9020, ZB9030, ZB9032, ZK1090-6292, ZK1090-3xxx-xxxx	ZB9031 and old versions of ZB9030, ZB9032, ZK1090-3xxx-xxxx	TIA-568B
Tx +	1	yellow[1]	orange/white	white/orange
Tx -	4	orange[1]	orange	orange
Rx +	2	white[1]	blue/white	white/green
Rx -	3	blue[1]	blue	green
Shield	Housing	Shield	Shield	Shield

[1] Core colors according to EN 61918

Adaptation of core colors for cables ZB9030, ZB9032 and ZK1090-3xxxx-xxxx

For standardization, the core colors of the ZB9030, ZB9032 and ZK1090-3xxx-xxxx cables have been changed to the EN61918 core colors: yellow, orange, white, blue. So there are different color codes in circulation. The electrical properties of the cables have been retained when the core colors were changed.

4.3.1.2   Status LEDs

Fig. 6: EtherCAT Status LEDs

L/A (Link/Act)

A green LED labelled "L/A" is located next to each EtherCAT socket. The LED indicates the communication state of the respective socket:

LED	Meaning
off	no connection to the connected EtherCAT device
lit	LINK: connection to the connected EtherCAT device
flashes	ACT: communication with the connected EtherCAT device

Run

Each EtherCAT slave has a green LED labelled "Run". The LED signals the status of the slave in the EtherCAT network:

LED	Meaning
off	Slave is in "Init" state
flashes uniformly	Slave is in "Pre-Operational" state
flashes sporadically	Slave is in "Safe-Operational" state
lit	Slave is in "Operational" state

Description of the EtherCAT slave states

4.3.1.3   Cables

For connecting EtherCAT devices only shielded Ethernet cables that meet the requirements of at least category 5 (CAT5) according to EN 50173 or ISO/IEC 11801 should be used.

EtherCAT uses four wires for signal transmission.
Thanks to automatic line detection ("Auto MDI-X"), both symmetrical (1:1) or cross-over cables can be used between Beckhoff EtherCAT.

Detailed recommendations for the cabling of EtherCAT devices

4.3.2 Supply voltages

⚠ WARNING
Power supply from SELV/PELV power supply unit!
SELV/PELV circuits (Safety Extra Low Voltage, Protective Extra Low Voltage) according to IEC 61010-2-201 must be used to supply this device.
Notes:
• SELV/PELV circuits may give rise to further requirements from standards such as IEC 60204-1 et al, for example with regard to cable spacing and insulation.
• A SELV (Safety Extra Low Voltage) supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor,   a PELV (Protective Extra Low Voltage) supply also requires a safe connection to the protective conductor.

⚠ CAUTION
Observe the UL requirements
• When operating under UL conditions, observe the warnings in the chapter <u>UL Requirements</u> [▶ <u>22</u>].

The EtherCAT Box has one input for two supply voltages:

- **Control voltage U_S**
  The following sub-functions are supplied from the control voltage U_S:
  - the fieldbus
  - the processor logic
  - typically the inputs and the sensors if the EtherCAT Box has inputs.
- **Peripheral voltage U_P**
  For EtherCAT Box modules with digital outputs the digital outputs are typically supplied from the peripheral voltage U_P. U_P can be supplied separately. If U_P is switched off, the fieldbus function, the function of the inputs and the supply of the sensors are maintained.

The exact assignment of U_S and U_P can be found in the pin assignment of the I/O connections.

Redirection of the supply voltages

The power IN and OUT connections are bridged in the module. Hence, the supply voltages U_s and U_p can be passed from EtherCAT Box to EtherCAT Box in a simple manner.

NOTE
Note the maximum current!
Ensure that the permitted current for the connectors is not exceeded when routing the supply voltages U_S and U_P:
M8 connector: max. 4 A   7/8" connector: max 16 A

NOTE
Unintentional cancellation of the electrical isolation of GND_S and GND_P possible.
In some types of EtherCAT Box modules the ground potentials GND_S and GND_P are connected.
• If several EtherCAT Box modules are supplied with the same electrically isolated voltages, check whether there is an EtherCAT Box among them in which the ground potentials are connected.

4.3.2.1 Connectors

NOTE
Risk of confusion: supply voltages and EtherCAT
Defect possible through incorrect insertion.
• Observe the color coding of the connectors: 　　black: Supply voltages 　　green: EtherCAT

Fig. 7: Connectors for supply voltages
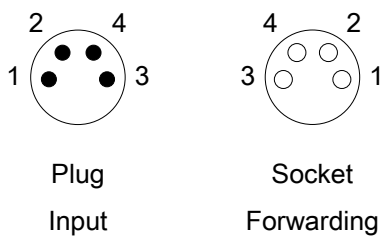
Fig. 8: M8 connector

Contact	Function	Description	Core color [1]
1	U_S	Control voltage	Brown
2	U_P	Peripheral voltage	White
3	GND_S	GND to U_S	Blue
4	GND_P	GND to U_P	Black

[1] The core colors apply to cables of the type: Beckhoff ZK2020-3xxx-xxxx

4.3.2.2 Status LEDs

Fig. 9: Status LEDs for the supply voltages

LED	Display	Meaning
U_S (control voltage)	off	Supply voltage U_S is not present
	green illuminated	Supply voltage U_S is present
U_P (peripheral voltage)	off	Supply voltage U_P is not present
	green illuminated	Supply voltage U_P is present

4.3.2.3 Conductor losses

Take into account the voltage drop on the supply line when planning a system. Avoid the voltage drop being so high that the supply voltage at the box lies below the minimum nominal voltage.
Variations in the voltage of the power supply unit must also be taken into account.

Voltage drop on the supply line
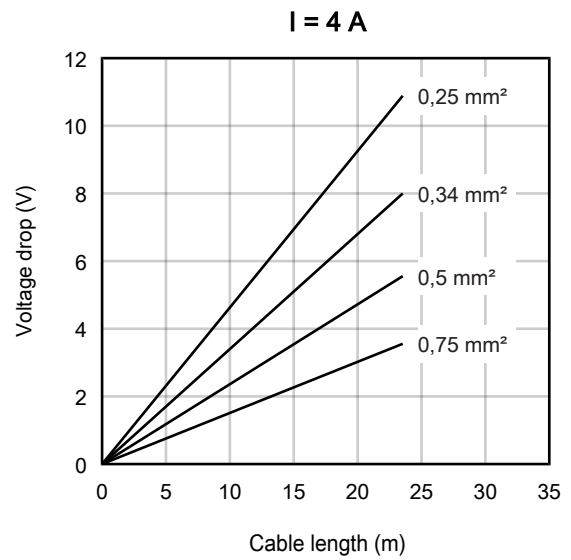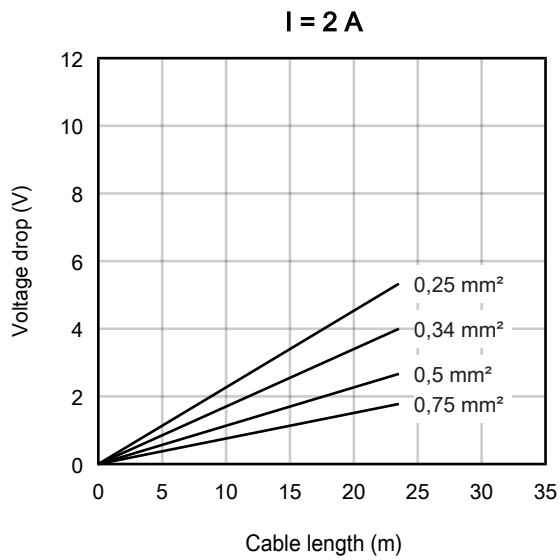
4.4   UL Requirements

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 -25 °C to +55 °C!

Marking for UL

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

Fig. 10: UL label

4.5   Disposal

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

5 Commissioning and configuration

5.1 Integrating into a TwinCAT project

The procedure for integration in a TwinCAT project is described in these Quick start guide.

5.2 Configuring the process image

In the factory settings, only the process data objects for the following functions are enabled in the process image [▶ 13]:

- Display
- Navigation switch

If you need further functions for your application, enable the corresponding process data objects:
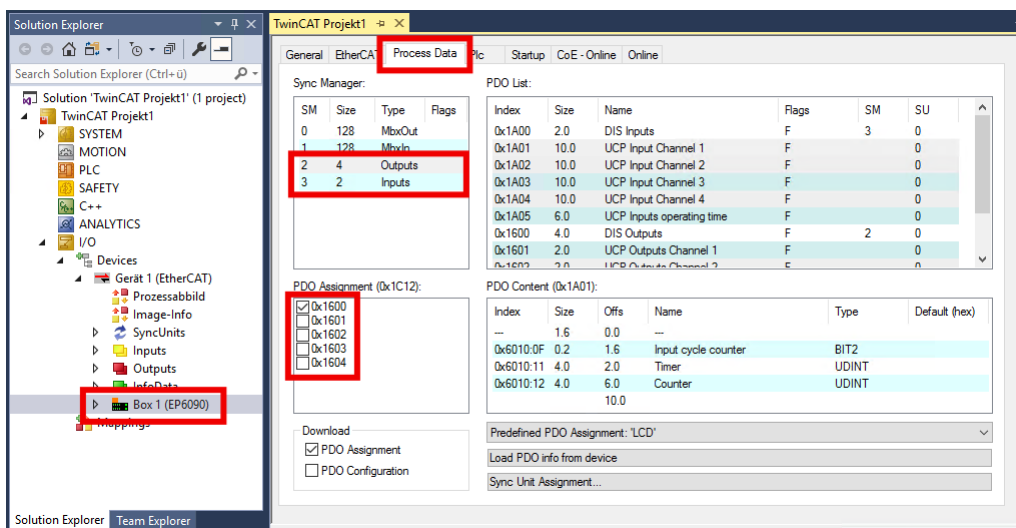
1. Double-click EP6090-0000 in the "Solution Explorer".
2. Click on the "Process Data" tab.
3. In the "Sync Manager" box, click "Outputs".
4. In the "PDO Assignment" box, check the checkboxes next to all required process data objects 0x16… . See table below, "Outputs" column.
5. In the "Sync Manager" box, click "Inputs"
6. In the "PDO Assignment" box, check the checkboxes next to all required process data objects 0x1A… . See table below, "Inputs" column.

Function	Required process data objects			
	Outputs		Inputs	
Display	0x1600	DIS Outputs [▶ 13]	-	-
Navigation switch	-	-	0x1A00	DIS inputs [▶ 13]
Operating hour counter	-	-	0x1A05	UCP Inputs operating time [▶ 14]
Timer 1, Counter 1	0x1601	UCP Outputs Channel 1 [▶ 13]	0x1A01	UCP Input Channel 1 [▶ 13]
Timer 2, Counter 2	0x1602	UCP Outputs Channel 2 [▶ 13]	0x1A02	UCP Input Channel 2 [▶ 13]
Timer 3, Counter 3	0x1603	UCP Outputs Channel 3 [▶ 13]	0x1A03	UCP Input Channel 3 [▶ 13]
Timer 4, Counter 4	0x1604	UCP Outputs Channel 4 [▶ 13]	0x1A04	UCP Input Channel 4 [▶ 13]

5.3   Open the parameter directory (CoE)
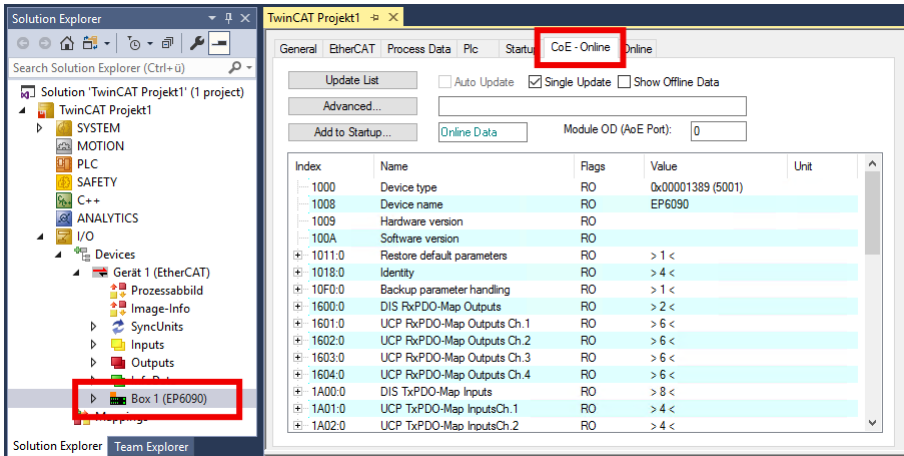
1. In the Solution Explorer: Double-click EP6090.

2. Click on the "CoE - Online" tab.

⇨ You will see the CoE directory of the EP6090-0000. Here you can check and change parameter values.

ⓘ   **Resetting parameters to factory settings**

If you do not know whether parameters have already been changed by the present EP6090-0000, you can <u>reset all parameters to the factory settings [▶ 36]</u>.

5.4 Display

5.4.1 Displaying text

In the following CoE parameter, write the text that you want to be displayed:

Row	CoE parameters
Top row	8008:11$_{hex}$ "Row 1"
Bottom row	8008:12$_{hex}$ "Row 2"

The text of a row can be 80 characters long at the most. If the text in a row is longer than 16 characters, it will be displayed as scrolling text.

If the EtherCAT status changes from "OP" to another status, the text is overwritten with the default text [▶ 31]. Therefore, this also happens when the power supply is switched off. Subsequently, the text must be written again in the CoE parameter mentioned above.
Recommendations:

- Use the "Startup" tab in TwinCAT to have your text written automatically in the CoE parameters.
- Use the function block "FB_CoEWrite" to write the text from a PLC program into the CoE parameters.
- Use the option to change the default text [▶ 31].

5.4.1.1 Variables in the text

You can display one variable per row in the text. This could be, for example, a measured value.

Procedure:

1. Insert a placeholder in any place you like in your text. The format of a placeholder is described below.
2. Link the variable "Value row *x*" (process data object Process image [▶ 13]) with variables in a PLC program.
3. Assign values to the variables in the PLC program.
⇨ The display shows the values of the variables instead of the placeholders.

Format of a placeholder

% .1 i

Placeholder start sign ———

Position of the comma (optional) ———

Data type identifier ———
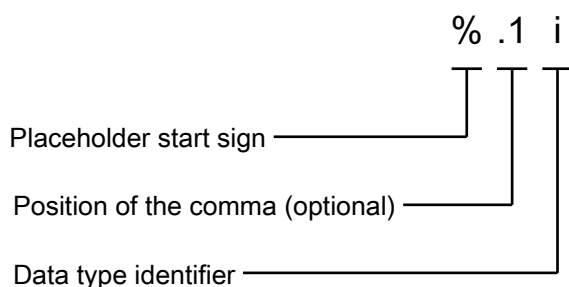
The data type identifier specifies which data type the contents of the variables are to be interpreted as:

Data type identifier	Data type	Value range
i	Signed integer	-32768 … 32767
d		
u	Unsigned integer	0 … 65535

Examples

In the following examples, the variable "Value row 1" contains the value: -123 (FF85$_{hex}$).

Input: Parameter "Row 1"	Output: Text on the display
`Temp: %i`	Temp: -123
`Temp: %.1i`	Temp: -12.3
`Temp: %.3i`	Temp: -0.123
`Temp: %u`	Temp: 65413

Note: the length of the text displayed changes with the size of the variable. If the value of a variable increases during operation, the text may be longer than 16 characters as a result. It is then displayed as scrolling text. This is often not desired for the display of values.

Predefined placeholders

In addition, there are two predefined placeholders that you can use in the text:

Placeholder	Output
`%o`	The counter value of the operating hour counter. Unit: Hours.
`%e`	The current EtherCAT status: • INIT • PRE-OP • SAFE-OP • OP

5.4.1.2 Character set

Character set

The character set essentially matches the 7-bit ASCII character set. The upper part of the table was complemented with special German characters (according to ISO 8859-1).

	0..	0x1...	0x2...	0x3...	0x4...	0x5...	0x6...	0x7...	0x8...	0x9...	0xA...	0xB...	0xC...	0xD...	0xE...	0xF...
...0		_	Space	0	@	P	`	p	_	_	_	_	_	_	_	_
...1	User specific character 1	_	!	1	A	Q	a	q	_	_	_	_	_	_	_	_
...2	User specific character 2	_	"	2	B	R	b	r	_	_	_	_	_	_	_	_
...3	_	_	#	3	C	S	c	s	_	_	_	_	_	_	_	_
...4	_	_	$	4	D	T	d	t	_	_	_	_	Ä	_	ä	_
...5	_	_	%	5	E	U	e	u	_	_	_	_	_	_	_	_
...6	_	_	&	6	F	V	f	v	_	_	_	_	_	ö	_	ö
...7	_	_	'	7	G	W	g	w	_	_	_	_	_	_	_	_
...8	_	_	(	8	H	X	h	x	_	_	_	_	_	_	_	_
...9	_	_	)	9	I	Y	i	y	_	_	_	_	_	_	_	_
...A	_	_	*	:	J	Z	j	z	_	_	_	_	_	_	_	_
...B	_	_	+	;	K	[	k	{	_	_	_	_	_	_	_	_
...C	_	_	,	<	L	\	l	|	_	_	_	_	_	ü	_	ü
...D	_	_	-	=	M	]	m	}	_	_	_	_	_	_	_	_
...E	_	_	.	>	N	^	n	~	_	_	_	_	_	_	_	_
...F	_	_	/	?	O	_	o		_	_	_	_	_	ß	_	_

5.4.1.3 Special characters

The character set contains two user-defined characters. Each character consists of a 5x8 pixel matrix. Each of the eight rows are consolidated to a byte and then stored in objects 0x8008:1C or 0x8008:1D.

The standard character set uses only 7 of the 8 rows. The bottom row is reserved for an underscore cursor. It should only be used if the cursor is not used.

The first special character (0x8008:1C) is allocated ASCII code 0x01. The second the code 0x02.

16	8	4	2	1	sum
					0x00
		■			0x04
	■	■	■		0x0E
		■			0x04
					0x00
	■	■	■		0x0E
					0x00
					0x00

Fig. 11: User-defined character in 5 x 8 matrix

Frequently used special characters

Character	Code
±	00 04 0E 04 00 0E 00 00
µ	00 11 11 13 1D 10 10 00
π	00 1F 0A 0A 0A 11 00 00
Ω	00 0E 11 11 0A 1B 00 00
Σ	1F 10 08 04 08 10 1F 00
€	07 08 1E 08 1E 08 07 00
ℓ	06 09 0A 0C 18 09 06 00
°	07 05 07 00 00 00 00 00
←	00 04 0C 1F 0C 04 00 00
→	00 04 06 1F 06 04 00 00
↑	04 0E 1F 04 04 04 04 00
↓	04 04 04 04 1F 0E 04 00
↵	01 01 05 0D 1F 0C 04 00

Example

The output text should be "Temp: 23.5 °C".

To this end object 0x8008:1C with special characters '°' is loaded (07 05 07 00 00 00 00 00)

The following ST code is required in the PLC program:

```
VAR
Text : STRING;
pData : POINTER TO BYTE;
END_VAR

---------------------------------

Text := 'Temp: 23.5 xC'; (* Text to display *)
pData := ADR(Text); (* Get Adr of Text *)
pData := pData + 11; (* Move pointer to position of x *)
pData^ := 1; (* replace x with user specific character 1 *)
```

5.4.2   Displaying a cursor

You can have a cursor shown on the display.

The cursor is disabled in the factory settings.

Enabling and configuring a cursor

Set the CoE parameter 8008:19 "Cursor" to one of the following values:

Value	Enum	Cursor on the display
0 (factory setting)	"off"	Cursor disabled
1	"on"	The cursor is displayed as a horizontal line under a character.
2	"blink"	The cursor is displayed as a blinking rectangle.

Positioning the cursor

Position the cursor on the display by writing the coordinates in the following CoE parameter:

Coordinates	CoE parameters
x	$8008:1A_{hex}$ "Cursor pos x"
y	$8008:1B_{hex}$ "Cursor pos y"

If x = 0 and y = 0, the cursor is in the top left corner of the display.

5.4.3   Switching the backlight

The backlight is switched on in the factory settings.

Switch the backlight on or off by writing one of the following values in the CoE parameter $8000:11_{hex}$:

- off: 00_{hex}
- on: FF_{hex}

5.4.4   Setting the default text

If the EtherCAT status changes from "OP" to another status, the text is overwritten with the default text.

Saving the default text in the memory

NOTE
The lifetime of the memory is reduced with each saving operation
After a certain number of saving operations, the memory is defective.
• Do not change the default text more often than is necessary.

1. Write and configure the text as described in the chapter <u>Displaying text [▶ 26]</u>.
2. Write the value 2 in the CoE parameter FB00:01$_{hex}$ "Request".
3. Check the value of the CoE parameter FB00:02$_{hex}$ "Status".
    ⇨ Value 255: the saving operation is running.
    ⇨ Value 1: the saving operation was successfully completed.
⇨ Result: the values of all parameters in the CoE object 8008 "DIS CHR Settings" were saved in non-volatile memory.

BECKHOFF

5.5   Navigation switch

There is a variable in the process data object <u>DIS Inputs [▶ 13]</u> for every button of the navigation switch.

Suggestions for use of the navigation switch:

- Moving the cursor on the display.
- Switching between different contents on the display.
- Scrolling through longer texts on the display.

5.6   Operating hour counter

ⓘ   **The EP6090-0000 may not be used for billing purposes**

The EP6090-0000 was not developed with the aim of maximum tamper-proofness.

The operating hour counter can be regarded as being similar to the milometer of a car.

The operating hour counter starts as soon as the supply voltage is applied. The counter value cannot be changed or set to zero.

The counter value is saved in a non-volatile memory every 15 minutes. After applying the supply voltage, the operating hour counter resumes counting from the saved counter value.

Reading the counter value

The current counter value is located in the variable "Operating time" in the process data object Process image [▶ 14].

Showing the counter value on the display

Insert the placeholder `%o` in any place you like in your Displaying text [▶ 26]. The counter value is shown on the display instead of the placeholder. Unit: Hours.

Saving counter values manually

When the machine is shut down in a controlled manner, it is a good idea to save all counter values beforehand.

- Operating hour counter
- Timer
- Counter

As the counter values are only saved every 15 minutes, 15 minutes could otherwise be lost.

NOTE
The lifetime of the memory is reduced with each saving operation
After a certain number of saving operations, the memory is defective.
• Do not save the counter values manually more often than is necessary.

Use this procedure to save all counter values in the non-volatile memory:

1. Write the value 1 in the CoE parameter FB00:01$_{hex}$ "Request".
2. Check the value of the CoE parameter FB00:02$_{hex}$ "Status":
   - ⇨ Value 255: The saving operation is running.
   - ⇨ Value 1: The saving operation was successfully completed.

5.7 Timer

In addition to the operating hour counter [▶ 33], four independent timers are available.

The process data objects for controlling and evaluating the timers are disabled in the factory settings. Enabling [▶ 24].

The counter values of the timers are saved every 15 minutes in a non-volatile memory at the same time as the operating hour counter. The saved counter values are retained even after switching the supply voltage off and on again.

Starting a timer

Set the variable "Timer start" in the process data object UCP Outputs Channel n [▶ 13] to 1.

Stopping a timer

Set the variable "Timer start" to 0.

Reading the counter value of a timer

The counter value is located in the variable "Timer" in the process data object UCP Inputs Channel n [▶ 13]. Unit: seconds.

Setting a timer to zero

Apply a rising edge to the variable "Timer reset" in the process data object UCP Outputs Channel n [▶ 13].

Saving counter values manually

When the machine is shut down in a controlled manner, it is a good idea to save all counter values beforehand.

- Operating hour counter
- Timer
- Counter

As the counter values are only saved every 15 minutes, 15 minutes could otherwise be lost.

NOTE
The lifetime of the memory is reduced with each saving operation
After a certain number of saving operations, the memory is defective.
• Do not save the counter values manually more often than is necessary.

Use this procedure to save all counter values in the non-volatile memory:

1. Write the value 1 in the CoE parameter $FB00:01_{hex}$ "Request".
2. Check the value of the CoE parameter $FB00:02_{hex}$ "Status":
   ⇨ Value 255: The saving operation is running.
   ⇨ Value 1: The saving operation was successfully completed.

5.8   Counter

Four independent counters are available. The counters can be used, for example, for counting numbers of items.

The process data objects for controlling and evaluating the counters are disabled in the factory settings. Enabling [▶ 24].

The counter values of the counters are saved every 15 minutes in a non-volatile memory at the same time as the operating hour counter. The saved counter values are retained even after switching the supply voltage off and on again.

Incrementing a counter

A rising edge on the variable "Counter clk" increments the counter by 1. (Process data object UCP Outputs Channel n [▶ 13])

Reading the counter value of a counter

The counter value of a counter is located in the variable "Counter" in the process data object UCP Inputs Channel n [▶ 13].

Setting a counter to zero

Apply a rising edge to the variable "Counter reset" in the process data object UCP Outputs Channel n [▶ 13].

Saving counter values manually

When the machine is shut down in a controlled manner, it is a good idea to save all counter values beforehand.

- Operating hour counter
- Timer
- Counter

As the counter values are only saved every 15 minutes, 15 minutes could otherwise be lost.

NOTE
The lifetime of the memory is reduced with each saving operation
After a certain number of saving operations, the memory is defective.
• Do not save the counter values manually more often than is necessary.

Use this procedure to save all counter values in the non-volatile memory:

1. Write the value 1 in the CoE parameter $FB00:01_{hex}$ "Request".
2. Check the value of the CoE parameter $FB00:02_{hex}$ "Status":
   - ⇨ Value 255: The saving operation is running.
   - ⇨ Value 1: The saving operation was successfully completed.

5.9 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).
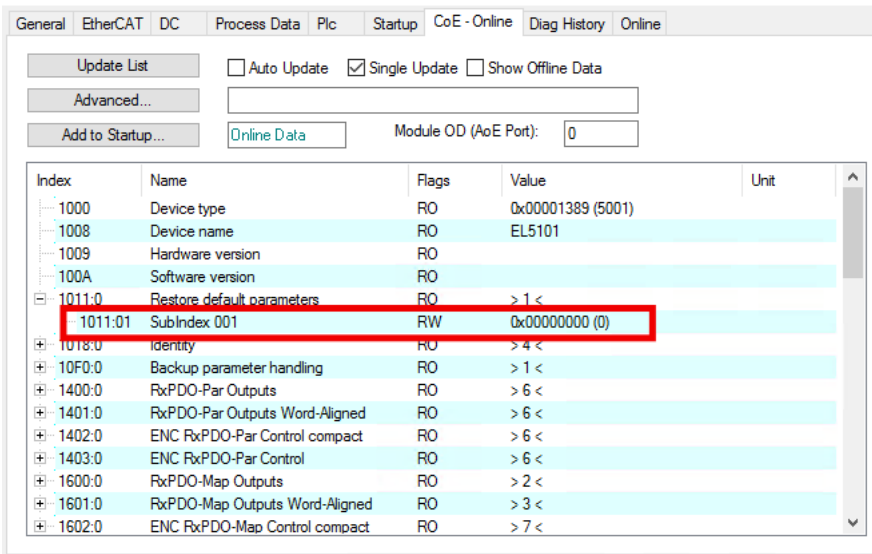
Fig. 12: Selecting the Restore default parameters PDO

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.
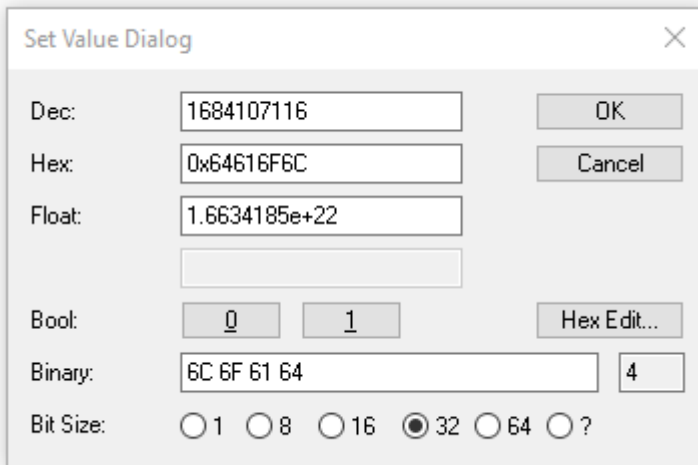
Fig. 13: Entering a restore value in the Set Value dialog

● **Alternative restore value**

i 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.

---

6 CoE parameters

ℹ **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.

ℹ **Parameterization via the CoE list (CAN over EtherCAT)**

The EtherCAT device is parameterized via the CoE-Online tab (double-click on the respective object) or via the Process Data tab (allocation of PDOs). Please note the following general CoE notes when using/manipulating the CoE parameters:

- Keep a startup list if components have to be replaced
- Differentiation between online/offline dictionary, existence of current XML description
- use "CoE reload" for resetting changes

Introduction

The CoE overview contains objects for different intended applications:

- Objects for the display, 2 x 16 characters, backlight, special characters, cursor
- Objects for the Navi switch [▶ 38], up, down, right, left buttons
- Objects for the counters and time measurement [▶ 38], four counters and four chronometers
- Objects for the display of process data in the display via placeholders [▶ 38]
- Objects for activating and resetting the counters and time values [▶ 39]
- Objects for the operating hours counter [▶ 39]
- Command object [▶ 39], for saving the counters, time values and operating hours counter
- Profile-specific objects [▶ 43], for general status displays of the inputs and outputs.

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

6.1 Restore object

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	Restore default parameters	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})

6.2 Objects for the display

Index 8000 DIS settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	DIS settings	Display settings	UINT8	RO	0x11 (17_{dec})
8000:11	Display Backlight Intensity	Display Backlight Intensity (0x0..0xFE OFF, 0xFF ON)	UINT8	RW	0xFF (255_{dec})

BECKHOFF

Index 8008 DIS CHR settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8008:0	DIS CHR settings	Character settings	UINT8	RO	0x1D (29$_{dec}$)
8008:11	Row 1	Characters row 1	STRING(80)	RW	EP6090
8008:12	Row 2	Characters row 2	STRING(80)	RW	State: %o
8008:19	Cursor	Cursor 0 OFF, 1 ON, 2 flash	UINT32	RW	0x00 (0$_{dec}$)
8008:1A	Cursor pos x	x position cursor (0 to 15)	UINT8	RW	0x00 (0$_{dec}$)
8008:1B	Cursor pos y	y position cursor (0..1)	UINT8	RW	0x00 (0$_{dec}$)
8008:1C	DIS CHR settings	Special characters 1	ARRAY[0..7] OF BYTE	RW	0x00 00 00 00 00 00 00 00
8008:1D	DIS CHR settings	Special characters 2	ARRAY[0..7] OF BYTE	RW	0x00 00 00 00 00 00 00 00

6.3 Objects for the NAVI switch

Index 6000 DIS inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	DIS inputs	Display inputs	UINT8	RO	0x10 (16$_{dec}$)
6000:03	Up	Up button	BOOLEAN	RO	-
6000:04	Down	Down button	BOOLEAN	RO	-
6000:05	Left	Left button	BOOLEAN	RO	-
6000:06	Right	Right button	BOOLEAN	RO	-
6000:07	Enter	Enter button	BOOLEAN	RO	-
6000:10	TxPDO Toggle	Toggle bit	BOOLEAN	RO	-

6.4 Objects for the counters and time measurement

Index 60n0: UCP inputs (for n = 1 to 4)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	UCP inputs	Time and counter values	UINT8	RO	0x12 (18$_{dec}$)
60n0:0F	Input cycle counter	Cycle counter	UINT2	RO	0x00 (0$_{dec}$)
60n0:11	Timer	Time value n in [s]	UINT32	RW*	0x00000000 (0$_{dec}$)
60n0:12	Counter	Counter n	UINT32	RW*	0x00000000 (0$_{dec}$)

●
ⓘ **Writing data to the objects 0x60n0:11 and 0x60n0:12**

Writing data to the objects 0x60n0:11 and 0x60n0:12 (RW) is supported from firmware 02*, ESI -0017.
Therefore, data is written to the EEPROM. For this reason, this procedure must not be executed cyclically!

6.5 Objects for the display of process data in the display via placeholders

Index 7000 DIS outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	IO Info data	Max. subindex	UINT8	RO	0x12 (18$_{dec}$)
7000:11	Value row 1	Value for display row 1	UINT16	RO	0x0000 (0$_{dec}$)
7000:12	Value row 2	Value for display row 2	UINT16	RO	0x0000 (0$_{dec}$)

6.6 Objects for activating and resetting the counters and time values

Index 70n0 UCP outputs (for n = 1 to 4)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	IO Info data	Max. subindex	UINT8	RO	0x9 (9_{dec})
70n0:01	Timer start	Start timer n	BOOLEAN	RO	-
70n0:02	Timer reset	Reset timer n	BOOLEAN	RO	-
70n0:08	Counter clk	Counter n incremented on rising edge	BOOLEAN	RO	-
70n0:09	Counter reset	Reset counter n	BOOLEAN	RO	-

6.7 Objects for the operating hours counter

Index F600 UCP inputs operating time

Index (hex)	Name	Meaning	Data type	Flags	Default
F600:0	UCP inputs	Inputs operating time	UINT8	RO	0x11 (17_{dec})
F600:0F	Input cycle time	Cycle counter	UINT2	RO	0x00 (0_{dec})
F600:11	Operating mode	Operating hours counter in [sec]	UINT32	RO	0x00000000 (0_{dec})

6.8 Command object

Index FB00 CMD command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	Info data	CMD command	UINT8	RO	0x03 (3_{dec})
FB00:01	Request	Request	UINT16	RW	0x00 (0_{dec})
FB00:02	Status	Status	UINT8	RO	0x00 (0_{dec})
FB00:03	Response	Answer	ARRAY[0..5] OF UINT8	RO	0x00 0x00 0x00 0x00 0x00 0x00

6.9 Standard objects

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	EP6090

Index 1009 Hardware version

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

Index 100A Software version

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

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	0x17CA4051 (399130705_{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	0
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	variable

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	variable

Index 1600 IO RxPDOPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	IO RxPDOPDO-Map	PDO Mapping RxPDO 1	UINT8	RO	0x02 (2_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (16 bits align)	UINT32	RO	0x7000:11, 16
1600:02	SubIndex 001	2. PDO Mapping entry (16 bits align)	UINT32	RO	0x7000:12, 16

Index 1601..1604 IO RxPDOPDO-Map n = Ch.1..4

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	IO RxPDOPDO-Map Ch.1	PDO Mapping RxPDO	UINT8	RO	0x06 (6_{dec})
160n:01	SubIndex 001	Timer n start	UINT32	RO	0x70n0:01, 1
160n:02	SubIndex 002	Timer n reset	UINT32	RO	0x70n0:02, 1
160n:03	SubIndex 003	Padding bits	UINT32	RO	0x0000:00, 5
160n:04	SubIndex 004	Counter n clk	UINT32	RO	0x70n0:08, 1
160n:05	SubIndex 005	Counter n reset	UINT32	RO	0x70n0:09, 1
160n:06	SubIndex 006	Padding bits	UINT32	RO	0x0000:00, 7

Index 1A00 IO TxPDOPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	IO TxPDOPDO-Map Ch.1	PDO Mapping TxPDO 1	UINT8	RO	0x08 (8_{dec})
1A00:01	SubIndex 001	Padding bits	UINT32	RO	0x0000:00, 2
1A00:02	SubIndex 002	Up	UINT32	RO	0x6000:03, 1
1A030:03	SubIndex 003	Down	UINT32	RO	0x6000:04, 1
1A00:04	SubIndex 004	Left	UINT32	RO	0x6000:05, 1
1A00:05	SubIndex 005	Right	UINT32	RO	0x6000:06, 1
1A00:06	SubIndex 006	Enter	UINT32	RO	0x6000:07, 1
1A00:07	SubIndex 007	Padding bits	UINT32	RO	0x0000:00, 8
1A00:08	SubIndex 008	Toggle bit	UINT32	RO	0x6000:10, 1

Index 1A01..1A04 IO TxPDOPDO-Map n = Ch.1..4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	IO TxPDOPDO-Map Ch.2	PDO Mapping TxPDO 2	UINT8	RO	0x04 (4_{dec})
1A0n:01	SubIndex 001	Padding bits	UINT32	RO	0x0000:00, 14
1A0n:02	SubIndex 002	Input cycle counter	UINT32	RO	0x60n0:0F, 2
1A0n:03	SubIndex 003	Timer n	UINT32	RO	0x60n0:11, 32
1A0n:04	SubIndex 004	Counter n	UINT32	RO	0x60n0:12, 32

Index 1A05 UCP TxPDOe Map Inputs operating time

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	TxPDOeState Tx-PDO-Map Device	PDO Mapping TxPDO 5	UINT8	RO	0x03 (3_{dec})
1A05:01	SubIndex 001	Padding bits	UINT32	RO	0x0000:00, 14
1A05:02	SubIndex 002	Input cycle counter	UINT32	RO	0xF600:0F, 2
1A05:03	SubIndex 003	Operating mode	UINT32	RO	0xF600:11, 32

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	0x05 (5_{dec})
1C32:01	SubIndex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	SubIndex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1601 (5633_{dec})
1C12:03	SubIndex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1602 (5634_{dec})
1C12:04	SubIndex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1603 (5635_{dec})
1C12:05	SubIndex 005	5. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1604 (5636_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x05 (5_{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})
1C32:06	SubIndex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A05 (6661_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32$_{dec}$)
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 2 event • 2: DC-Mode - Synchronous with SYNC0 Event • 3: DC-Mode - Synchronous with SYNC1 event	UINT16	RW	0x0000 (0$_{dec}$)
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000186A0 (100000$_{dec}$)
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0$_{dec}$)
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchron with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 [▶ 42])	UINT16	RO	0xC007 (49159$_{dec}$)
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000186A0 (100000$_{dec}$)
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0$_{dec}$)
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03 [▶ 42], 0x1C32:05 [▶ 42], 0x1C32:06 [▶ 42], 0x1C32:09 [▶ 42], 0x1C33:03 [▶ 43], 0x1C33:06 [▶ 42], 0x1C33:09 [▶ 43] are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0$_{dec}$)
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0$_{dec}$)
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0$_{dec}$)
1C32:0C	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$_{dec}$)
1C32:0D	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$_{dec}$)
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0$_{dec}$)

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	0x0000 (0_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 42]	UINT32	RW	0x000186A0 (100000_{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: Synchronous with SM 2 Event is supported (outputs available) • Bit 1: Synchronous 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 [▶ 42] or 0x1C33:08 [▶ 43])	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 42]	UINT32	RO	0x000186A0 (100000_{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})
1C33:08	Command	as 0x1C32:08 [▶ 42]	UINT16	RW	0x0000 (0_{dec})
1C33:09	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	as 0x1C32:11	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x11C32:32	BOOLEAN	RO	0x00 (0_{dec})

6.10 Profile-specific objects

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

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	0x0005 (5_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Max. subindex	UINT8	RW	0x05 (5_{dec})
F010:01	SubIndex 001	-	UINT32	RW	0x00000320 (0800_{dec})
F010:02	SubIndex 002	-	UINT32	RW	0x00000097 (0151_{dec})
F010:03	SubIndex 003	-	UINT32	RW	0x00000097 (0151_{dec})
F010:04	SubIndex 004	-	UINT32	RW	0x00000097 (0151_{dec})
F010:05	SubIndex 005	-	UINT32	RW	0x00000097 (0151_{dec})

7 Decommissioning

⚠ WARNING
Risk of electric shock!
Bring the bus system into a safe, de-energized state before starting disassembly of the devices!

Disposal

In order to dispose of the device, it must be removed.

In accordance with the WEEE Directive 2012/19/EU, Beckhoff takes back old devices and accessories in Germany for proper disposal. Transport costs will be borne by the sender.

Return the old devices with the note "for disposal" to:

Beckhoff Automation GmbH & Co. KG
Service Department
Stahlstraße 31
D-33415 Verl

8 Appendix

8.1 General operating conditions

Protection degrees (IP-Code)

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

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø 50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø 12.5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø 2.5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø 1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.

2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water!

Chemical Resistance

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

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

Key

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

8.2 Accessories

Mounting

Ordering information	Description	Link
ZS5300-0011	Mounting rail	Website

Cables

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

Ordering information	Description	Link
ZK1090-3xxx-xxxx	EtherCAT cable M8, green	Website
ZK1093-3xxx-xxxx	EtherCAT cable M8, yellow	Website
ZK2020-3xxx-xxxx	Power cable M8, 4-pin	Website

Labeling material, protective caps

Ordering information	Description
ZS5000-0010	Protective cap for M8 sockets, IP67 (50 pieces)
ZS5100-0000	Inscription labels, unprinted, 4 strips of 10
ZS5000-xxxx	Printed inscription labels on enquiry

ℹ️ **Further accessories**

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

8.3 Version identification of EtherCAT devices

8.3.1 General notes on marking

Designation

A Beckhoff EtherCAT device has a 14-digit designation, made up of

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal (12 mm, non-pluggable connection level)	3314 (4-channel thermocouple terminal)	0000 (basic type)	0016
ES3602-0010-0017	ES terminal (12 mm, pluggable connection level)	3602 (2-channel voltage measurement)	0010 (high-precision version)	0017
CU2008-0000-0000	CU device	2008 (8-port fast ethernet switch)	0000 (basic type)	0000

Notes

- The elements mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.

- EL3314-0000 is the order identifier, in the case of "-0000" usually abbreviated to EL3314. "-0016" is the EtherCAT revision.

- The **order identifier** is made up of
  - family key (EL, EP, CU, ES, KL, CX, etc.)
  - type (3314)
  - version (-0000)

- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. *"EL5021 EL terminal, standard IP20 IO device with batch number and revision ID (since 2014/01)"*.

- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

8.3.2 Version identification of EP/EPI/EPP/ER/ERI boxes

The serial number/ data code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules of a batch.

Structure of the serial number: **KK YY FF HH**

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

Example with serial number 12 06 3A 02:

12 - production week 12
06 - production year 2006
3A - firmware version 3A
02 - hardware version 02

Exceptions can occur in the **IP67 area**, where the following syntax can be used (see respective device documentation):

Syntax: D ww yy x y z u

D - prefix designation
ww - calendar week
yy - year
x - firmware version of the bus PCB
y - hardware version of the bus PCB
z - firmware version of the I/O PCB
u - hardware version of the I/O PCB

Example: D.22081501 calendar week 22 of the year 2008 firmware version of bus PCB: 1 hardware version of bus PCB: 5 firmware version of I/O PCB: 0 (no firmware necessary for this PCB) hardware version of I/O PCB: 1
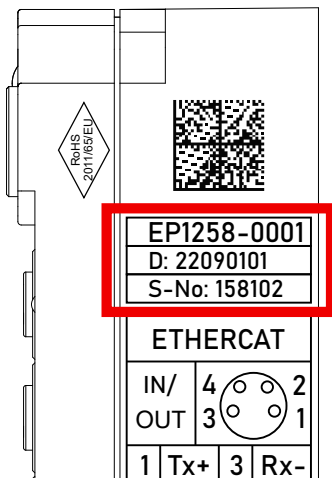

Fig. 14: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

8.3.3 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.
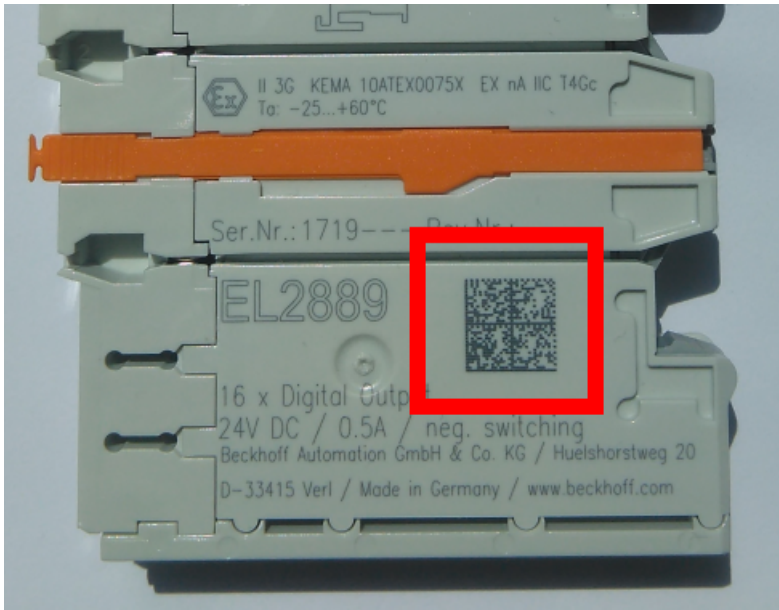

Fig. 15: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Posi-tion	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN**)**	**Unique serial number, see note below**	SBTN	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30PF971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:

Fig. 16: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTE
This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this information.

8.3.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

The Beckhoff Identification Code (BIC) is applied to the outside of Beckhoff products in a visible place. If possible, it should also be electronically readable.

Decisive for the electronic readout is the interface via which the product can be electronically addressed.

K-bus devices (IP20, IP67)

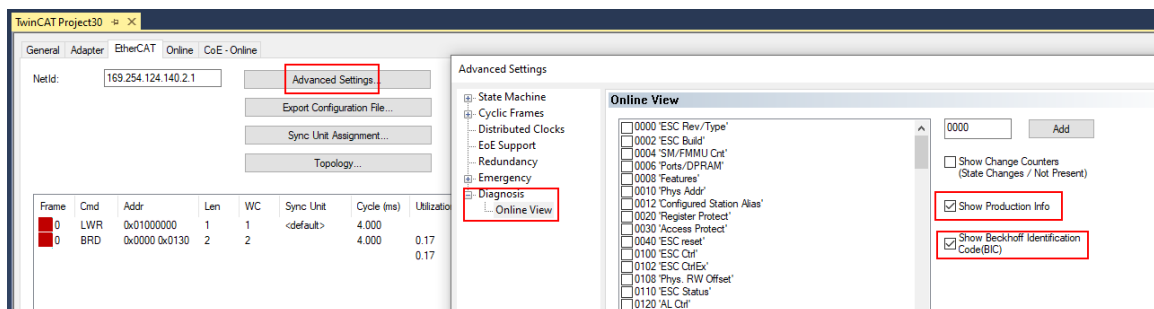Currently, no electronic storage and readout is planned for these devices.

EtherCAT devices (IP20, IP67)

All Beckhoff EtherCAT devices have a so-called ESI-EEPROM, which contains the EtherCAT identity with the revision number. Stored in it is the EtherCAT slave information, also colloquially known as ESI/XML configuration file for the EtherCAT master. See the corresponding chapter in the EtherCAT system manual (Link) for the relationships.

The eBIC is also stored in the ESI-EEPROM. The eBIC was introduced into the Beckhoff I/O production (terminals, boxes) from 2020; widespread implementation is expected in 2021.

The user can electronically access the eBIC (if existent) as follows:

- With all EtherCAT devices, the EtherCAT master (TwinCAT) can read the eBIC from the ESI-EEPROM
  - From TwinCAT 3.1 build 4024.11, the eBIC can be displayed in the online view.
  - To do this,
    check the checkbox "Show Beckhoff Identification Code (BIC)" under
    EtherCAT → Advanced Settings → Diagnostics:

  - The BTN and its contents are then displayed:

  - Note: as can be seen in the illustration, the production data HW version, FW version and production date, which have been programmed since 2012, can also be displayed with "Show Production Info".
  - From TwinCAT 3.1. build 4024.24 the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC and further eBIC auxiliary functions are available in the Tc2_EtherCAT Library from v3.3.19.0.
- In the case of EtherCAT devices with CoE directory, the object 0x10E2:01 can additionally by used to display the device's own eBIC; the PLC can also simply access the information here:

◦ The device must be in SAFEOP/OP for access:

Index	Name	Flags	Value		
1000	Device type	RO	0x015E1389 (22942601)		
1008	Device name	RO	ELM3704-0000		
1009	Hardware version	RO	00		
100A	Software version	RO	01		
100B	Bootloader version	RO	J0.1.27.0		
1011:0	Restore default parameters	RO	> 1 <		
1018:0	Identity	RO	> 4 <		
10E2:0	Manufacturer-specific Identification C...	RO	> 1 <		
10E2:01	SubIndex 001	RO	1P158442SBTN0008jekp1KELM3704	Q1	2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <		
10F3:0	Diagnosis History	RO	> 21 <		
10F8	Actual Time Stamp	RO	0x170bfb277e		

◦ the object 0x10E2 will be introduced into stock products in the course of a necessary firmware revision.

◦ From TwinCAT 3.1. build 4024.24 the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC and further eBIC auxiliary functions are available in the Tc2_EtherCAT Library from v3.3.19.0.

• Note: in the case of electronic further processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.

• Technical background
The new BIC information is additionally written as a category in the ESI-EEPROM during the device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored with the help of a category according to ETG.2010. ID 03 indicates to all EtherCAT masters that they must not overwrite these data in case of an update or restore the data after an ESI update.
The structure follows the content of the BIC, see there. This results in a memory requirement of approx. 50..200 bytes in the EEPROM.

• Special cases

◦ If multiple, hierarchically arranged ESCs are installed in a device, only the top-level ESC carries the eBIC Information.

◦ If multiple, non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC Information.

◦ If the device consists of several sub-devices with their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

Profibus/Profinet/DeviceNet... Devices

Currently, no electronic storage and readout is planned for these devices.

8.4   Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Beckhoff Support

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

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

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

Beckhoff Service

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

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

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

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

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

More Information:
www.beckhoff.com/ep6090-0000