

Documentation | EN

EP2534-0002

4-channel PWM output, 24 V DC, 2 A, M12, current-controlled



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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.

The documentation and the following notes and explanations must be complied with when installing and commissioning the components.

The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been compiled 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 notice.

Claims to modify products that have already been supplied may not be made on the basis of the data, diagrams, and descriptions in this documentation.

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1.2 For your safety

Safety regulations

Read the following explanations for your safety.

Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are 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 technology who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER

Hazard with high risk of death or serious injury.

⚠ WARNING

Hazard with medium risk of death or serious injury.

⚠ CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example: recommendations for action, assistance or further information on the product.

1.3 Documentation issue status

Version	Comment
1.0	• First release

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: [Version identification of EtherCAT devices \[► 53\]](#).

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.

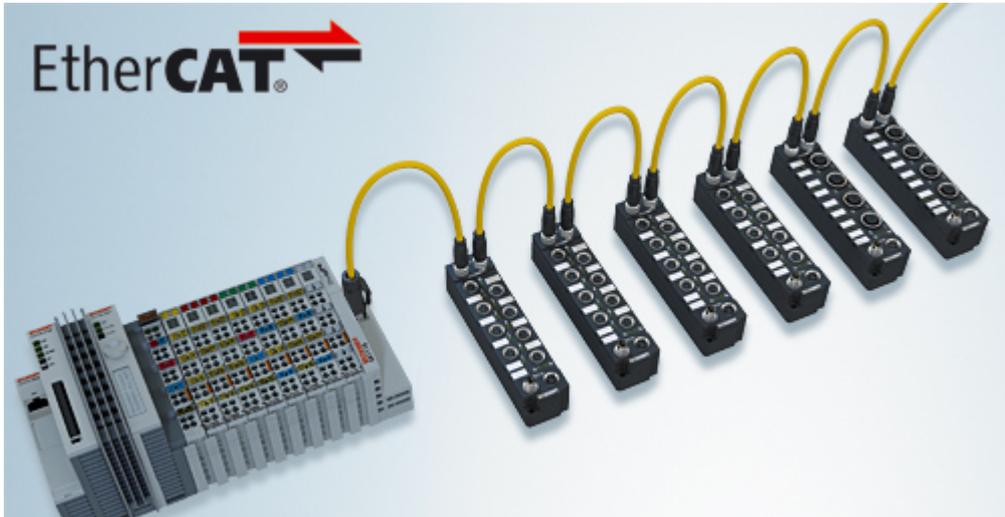


Fig. 1: EtherCAT Box Modules within an EtherCAT network

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 μ s)
- 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



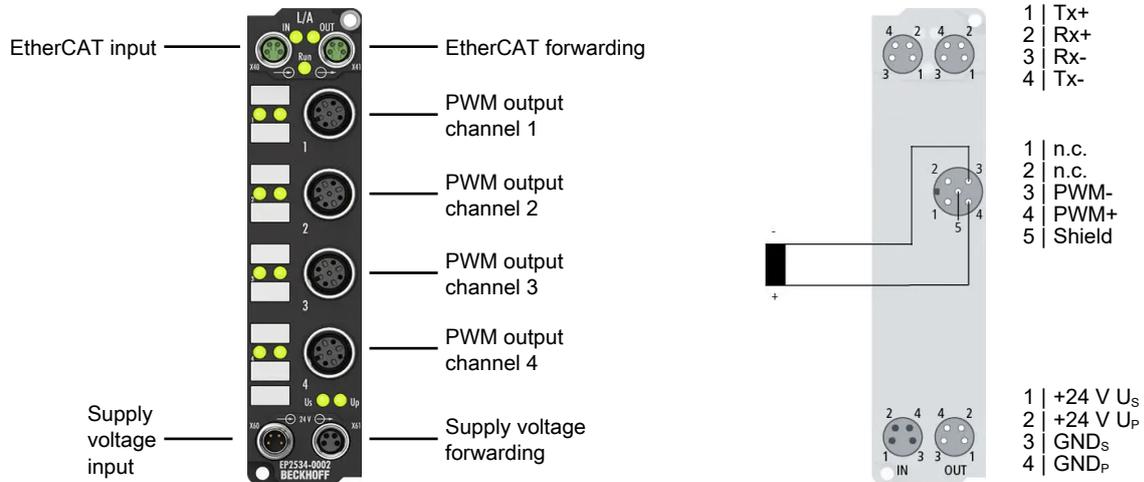
Fig. 3: EtherCAT Box with M12 connections for sensors/actuators

● Basic EtherCAT documentation

i 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



The EP2534-0002 EtherCAT Box regulates the output current by pulse width control of the peripheral voltage on four channels. The current values ranging from 0 to a maximum output current of 2 A are specified by the automation device through a 16 bit value.

The sum current of all outputs is limited to 4 A. The output stages are overload-proof. The signal state of the channels is indicated by LEDs. The signal interface is established via screw-type M12 connectors. One channel is available per M12 socket.

Quick links

[Technical data](#) [► 11]

[Commissioning and configuration](#) [► 26]

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, A-coded, shielded
Electrical isolation	500 V

Supply voltages	
Connection	Input: M8 connector, 4-pin, A-coded Forwarding: M8 socket, 4-pin, A-coded
U_S rated voltage	24 V _{DC} (-15 % / +20 %)
Current consumption from U_S	80 mA
U_S sum current: $I_{S,sum}$	max. 4 A
U_P rated voltage	24 V _{DC} (-15 % / +20 %)
Current consumption from U_P	30 mA + load
U_P sum current: $I_{P,sum}$	max. 4 A

PWM outputs	
Number	4
Connection	4x M12 socket, 5-pin, A-coded
Cable length	max. 30 m
Load type	Inductive loads with min. 1 mH (For ohmic loads, you must enable the operation mode "Voltage Control", see chapter Basic configuration [► 26]. This disables the current controller.)
Output current	max. 2 A per channel, max. 4 A in total.
Short-circuit current ¹⁾	max. 2.5 A in nominal operation. max. 4.0 A in the event of a fault.
PWM clock frequency	30 kHz
PWM resolution	16 bit
PWM duty cycle in Operation Mode "Voltage Control"	0 ... 97 %
Output driver supply	From the supply voltage U_P .

¹⁾ The EP2534-0002 is protected against the following types of short circuits:

- Short circuit between the PWM+ and PWM- contacts.
- Short circuit from one of these contacts to GND_p.

Housing data	
Dimensions W × H × D	30 mm × 126 mm × 26.5 mm (without connectors)
Weight	approx. 165 g
Installation position	variable
Material	PA6 (polyamide)

Environmental conditions	
Ambient temperature during operation	-25 ... +60 °C -25 ... +55 °C according to cURus
Ambient temperature during storage	-40 ... +85 °C
Vibration resistance, shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27 Additional tests [► 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 [► 24]

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

Additional tests

The devices have undergone the following additional tests:

Test	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 EP2534-0002 EtherCAT Box
- 1x protective cap for supply voltage input, M8, transparent (pre-assembled)
- 1x protective cap for supply voltage output, M8, black (pre-assembled)
- 2x protective cap for EtherCAT socket, M8, green (pre-assembled)
- 10x labels, blank (1 strip of 10)



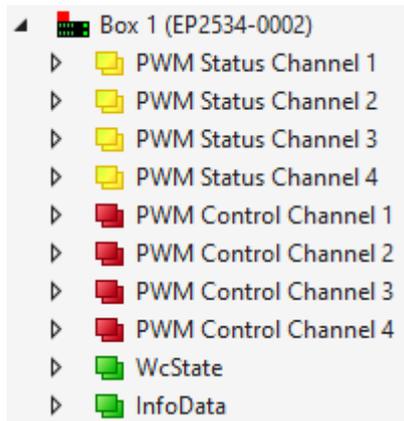
Pre-assembled protective caps do not ensure IP67 protection

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

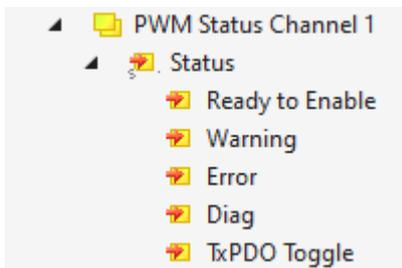
Ensure that the protective caps are correctly seated to ensure IP67 protection.

3.4 Process image

The process image contains the following process data objects in the delivery state:



PWM Status Channel n



Ready to Enable

All prerequisites for enabling the output are fulfilled. Enabling via the bit "Enable".

Warning

Warning message. To narrow down the cause, see chapter [Diagnostics \[▶ 35\]](#).

Error

Error message. As a result, the output was disabled. To narrow down the cause of the error, see chapter [Diagnostics \[▶ 35\]](#).

Once the cause of the error has been eliminated, you can re-enable the output with the bit "Reset".

Diag

Indicates that a new message is available in the Diag History.

TxPDO Toggle

Is inverted each time the respective higher-level process data object "PWM Status Channel n" is updated.

PWM Synchron Info Data Channel n



Info Data 1

Additional information, selectable via CoE parameter 8pp0:21 "Select Info Data 1".

In the delivery state: "Actual Current", i.e. the measured output current.

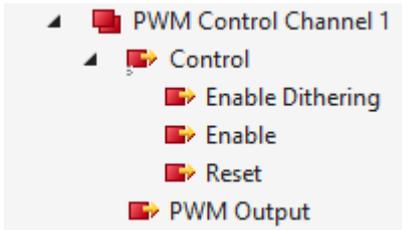
Info Data 2

Additional information, selectable via CoE parameter 8pp0:22 "Select Info Data 2".

In the delivery state: "Set Current", i.e. the output current setpoint.

This process data object is disabled in the factory settings. To enable, see [Enabling additional process data \[▶ 15\]](#).

PWM Control Channel n



Enable Dithering

Enables dithering, see chapter [Dithering \[► 30\]](#).

Prerequisite: The CoE parameter 8pp0:03 "Enable Dithering" must be TRUE.

Enable

Enables the output. No PWM output as long as this bit has the value 0.

Precondition: The bit "Ready to Enable" has the value 1.

Notice Configure the output before enabling, see chapter [Basic configuration \[► 26\]](#)

Reset

Acknowledges an error and re-enables the output.

PWM output

Output setpoint.

Value range: 0 to 32767 (data type INT)

- In the "Current Control" operation mode, the value range corresponds to an output current of 0 to "Max Current" (parameter 80n0:10; default: 100 % corresponding to 2 A).
- In operation mode "Voltage Control", the value range corresponds to a duty cycle of 0 ... 100 % ¹⁾ or an output voltage of 0 to $U_P = 24 V_{DC}$.

¹⁾ The upper limit of the duty cycle is 97 %. If you set a higher value (i.e. higher than 31784), the box will still only output 97 %.

3.4.1 Enabling additional process data

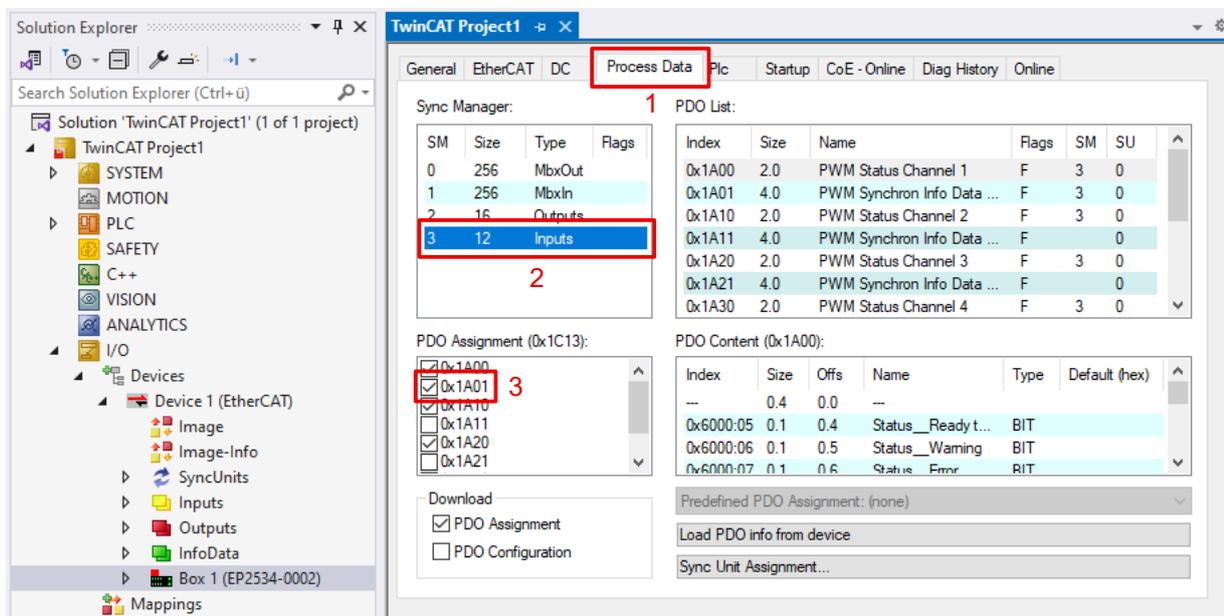
Only the process data that is actually required for operation is enabled in the delivery state. You can optionally enable further process data that provides additional information and measured values.

1. Open the tab "Process Data".
2. In the "Sync Manager" field, select "Inputs".
3. In the "PDO Assignment (0x1C13)" field, enable one or more of the following process data objects depending on the desired channel:

Channel	Index	Name of the process data object
1	0x1A01	PWM Synchronous Info Data Channel 1
2	0x1A11	PWM Synchronous Info Data Channel 2
3	0x1A21	PWM Synchronous Info Data Channel 3
4	0x1A31	PWM Synchronous Info Data Channel 4

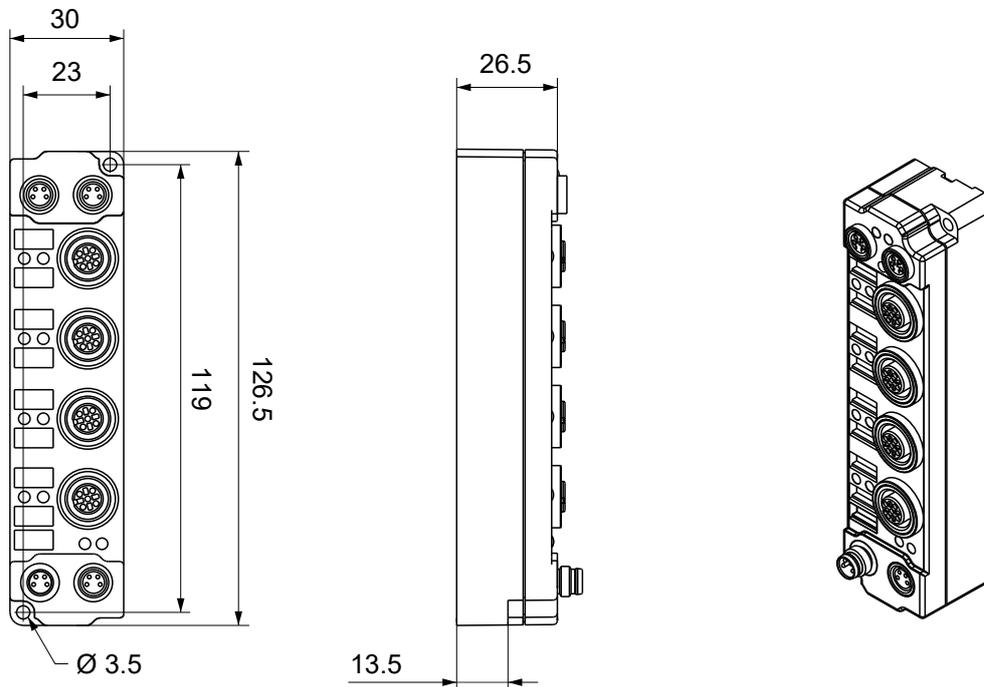
The content of the process data objects is described in chapter [Process image](#) [13].

Example for "PWM Synchron Info Data Channel 1"



4 Mounting and connection

4.1 Dimensions



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

Housing features

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

4.2 Fixing

NOTICE

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 M3 screws on the mounting holes in the corners of the module. The mounting holes have no thread.

4.3 Tightening torques for plug connectors

Screw connectors tight with a torque wrench. (e.g. ZB8801 from Beckhoff)

Connector diameter	Tightening torque
M8	0.4 Nm
M12	0.6 Nm

4.4 Functional earth (FE)

The upper mounting holes also serves as a connection for functional earth (FE).

Make sure that the box is grounded to low impedance via the functional earth (FE) connection. You can achieve this, for example, by mounting the box on a grounded machine bed.



4.5 EtherCAT

4.5.1 Connectors

NOTICE

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.



Connection

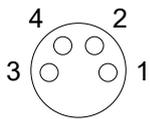


Fig. 4: M8 socket

EtherCAT	M8 socket	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

i 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.

4.5.2 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

4.5.3 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

4.6 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 supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor, a PELV 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 [UL Requirements](#) [► 24].

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.

NOTICE

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

NOTICE

Unintentional cancellation of the electrical isolation 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.

4.6.1 Connectors

NOTICE

Risk of confusion: supply voltages and EtherCAT

Defect possible through incorrect insertion.

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

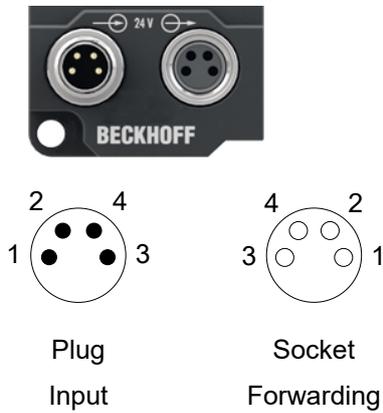


Fig. 5: M8 connector

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

4.6.2 Status LEDs

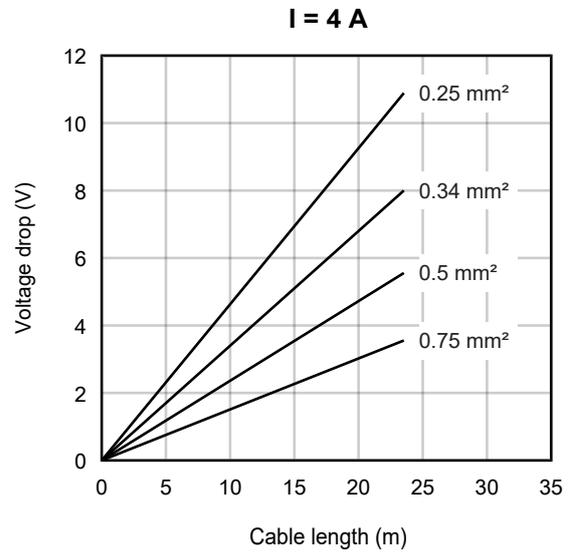
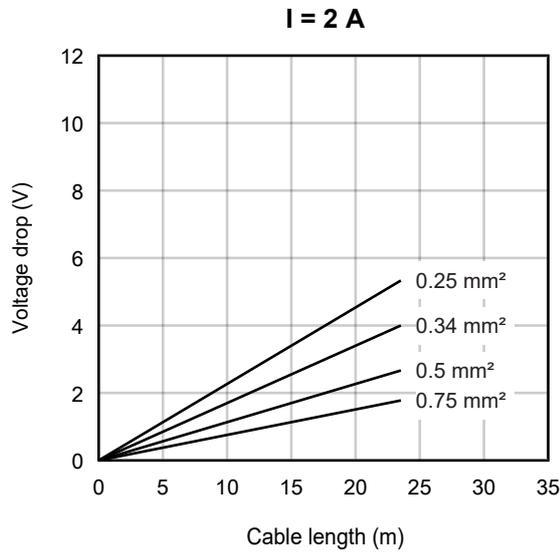


LED	Display	Meaning
U _S (control voltage)	off	The supply voltage U _S is not available.
	green illuminated	The supply voltage U _S is available.
U _P (peripheral voltage)	off	The supply voltage U _P is not available.
	green illuminated	The supply voltage U _P is available.

4.6.3 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



4.7 PWM outputs

NOTICE

EMC due to PWM

If unshielded cables are used, the permissible limit values for emitted interference due to radiation may be exceeded.

- Use shielded M12 cables. Integration of the cable shield via pin 5 ("Shield").

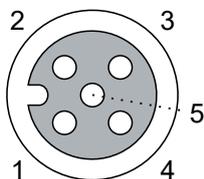
NOTICE

Current-controlled PWM only with inductive loads >1 mH

If the inductance of the load is too low, the output current does not correspond to the specified output current.

- Only connect inductive loads with an inductance of at least 1 mH.
- Alternatively, change the operation mode to "Voltage Control", see chapter [Basic configuration](#) [► 26]. You can also connect ohmic loads with "Voltage Control".

The PWM outputs are 5-pin M12 sockets.



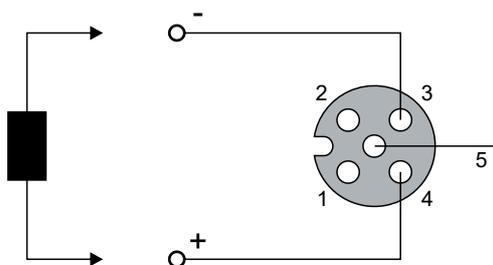
Pin	Function
1	n.c.
2	n.c.
3	PWM-
4	PWM+
5	Shield

The PWM+ and PWM- pins must not be connected to external potentials. Connections with the PWM+ and PWM- of other channels are also not permitted.

Accessories

Suitable connection cables and connectors can be found on the product website <https://www.beckhoff.com/ep2534-0002> under the "Accessories" tab.

Connection diagram



4.8 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. 6: UL label

4.9 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 Basic configuration

Each channel can be configured individually. The parameters can be found in the following CoE objects:

Channel	CoE object
1	0x8000
2	0x8010
3	0x8020
4	0x8030

Take particular care when setting the following parameters before operation:

Maximum output current

CoE parameter 0x8pp0:10 "Max Current". Factory setting: 100 % corresponding to 2 A.

Set the parameter to a value less than or equal to the maximum permissible current $I_{L,max}$ of the connected load. The specification is in percent of the maximum possible output current of 2 A:

$$\text{Max Current} = \frac{I_{L,max}}{2A} \times 100$$

Example: For a load with a rated current of 0.5 A, the parameter "Max Current" must be set to 25 or lower. (corresponding to 25 % of 2 A)

Operation mode

CoE parameter 8pp0:07 "Operation Mode"

You can choose between the operation modes "Current Control" and "Voltage Control" for each channel. You can enable or disable the current controller by selecting the operation mode.

- "Current Control": current controller enabled.
In this operation mode, you specify the current intensity. The current controller regulates the PWM duty cycle so that the specified current flows through the load.
The prerequisite for this operation mode is an inductive load with at least 1 mH.
- "Voltage Control:" current controller disabled.
In this operation mode, you specify the PWM duty cycle directly. The current controller is disabled.

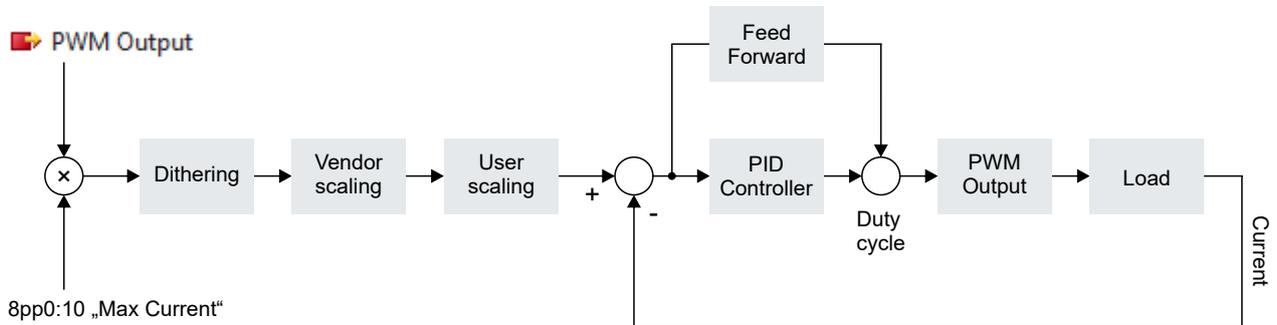
A graphical representation of the signal flows of the operation modes can be found in the chapter [Signal flow](#) [► 27].

In the factory setting, the operation mode "Current Control" is pre-set; the current controller is enabled. For inductive loads, "Current Control" is generally the correct operation mode.

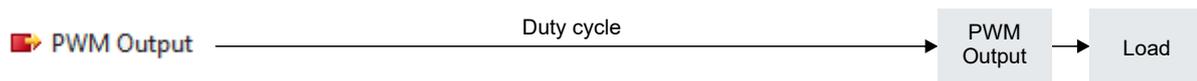
5.3 Signal flow

The internal signal flow depends on the selected operation mode. The selection of the operation mode is described in the chapter [Basic configuration](#) [▶ 26].

Operation mode "Current Control"



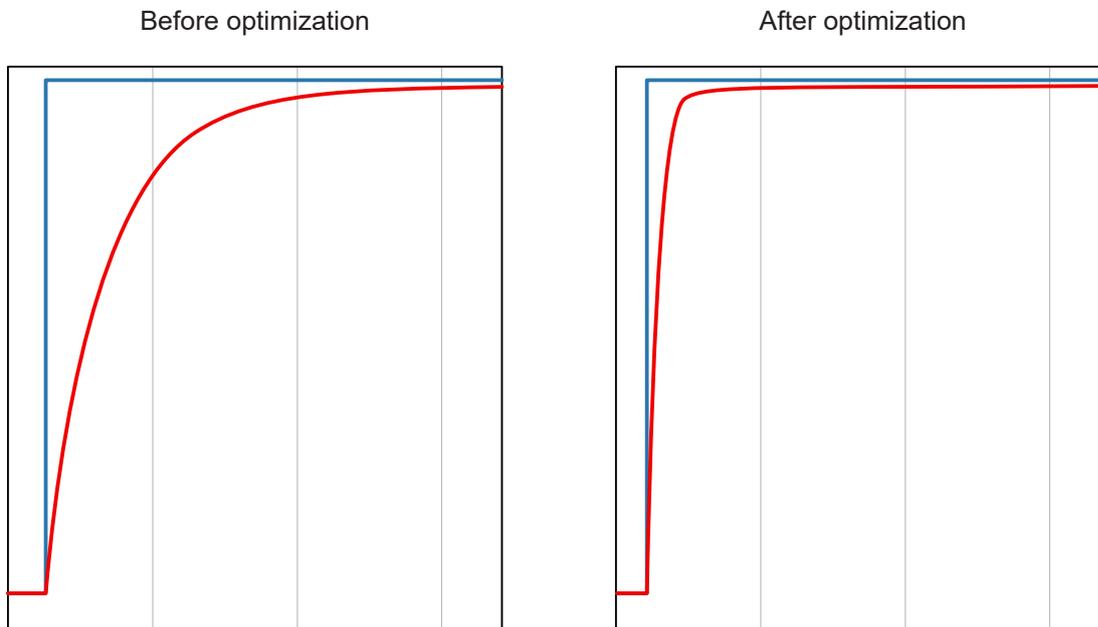
Operation mode "Voltage Control"



5.4 Current controller optimization

The current controller is a PID controller. The controller parameters of the current controller are set ex factory so that the current controller is compatible with as many different loads as possible. However, the control behavior can be significantly optimized by adapting the controller parameters to your specific load.

Example: step response



Horizontal scaling: 20 ms/div

Blue: current setpoint

Red: actual current value

Controller parameters

The controller parameters can be found in the following CoE parameters:

Index ¹⁾	Name	Description
8pp0:13	Kp Factor	Proportional component
8pp0:14	Ki Factor	Integral part
8pp0:15	Kd Factor	Differential component

¹⁾ pp = 00...03 for channel 1...4

Current controller optimization with TwinCAT

You can perform the optimization with the TwinCAT Scope View as follows:

1. Make sure that the following CoE parameters are in the factory setting:
 - 8pp0:07 "Operation Mode" (factory setting "Current Control")
 - 8pp0:09 "Enable Feedforward" (factory setting "FALSE")
 - 8pp0:21 "Select info data 1" (factory setting "Actual current")
 - 8pp0:22 "Select info data 2" (factory setting "Set current")
2. Enable the process data object 0x1Ap1 "PWM Synchron Info Data Channel n", see chapter [Enabling additional process data](#) [► 15].
3. Set a low cycle time to achieve a high temporal resolution of the measured values.¹⁾
4. Display "Info Data 1" and "Info Data 2" from the process data object "PWM Synchron Info Data Channel n" in a Scope View.
5. Enter a setpoint step-change to the variable "PWM Output".

6. Record the step response/square wave signal in the scope and optimize the controller parameters (see above) using one of the usual methods for PID controllers.

¹⁾ The minimum possible cycle time depends on the number of enabled channels. You can measure it by setting parameter 1C32:08 to TRUE, then reading 1C32:05 "Minimum cycle time".

5.5 Dithering

Dithering reduces the influence of static friction when controlling an actuator. The actuator is constantly moved back and forth with a small amplitude so that no static friction occurs even when stationary. This prevents jerking during the transition from static friction to sliding friction.

The continuous movement of the actuator is achieved by a square wave signal that is modulated onto the PWM signal.

Configuration

You can enable and configure dithering with the following parameters:

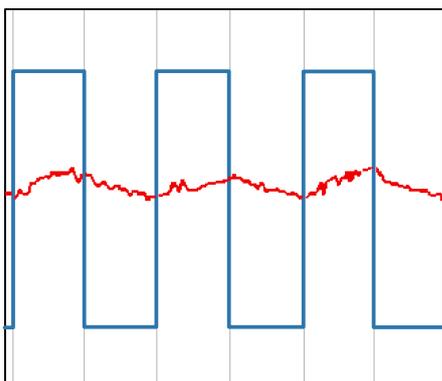
Index ¹⁾	Name	Description
0x8pp0:03	Enable Dithering	Enables dithering
0x8pp0:1E	Dithering frequency	Frequency of the square wave signal in Hz
0x8pp0:1F	Dithering amplitude	Amplitude of the square wave signal. Specified as a percentage of the maximum output current configured via "Max Current". (See chapter Basic configuration [▶ 26])
		$I_{Dither} = \frac{\text{Dithering amplitude}}{100} \times \frac{\text{Max Current}}{100} \times 2A$ $= \frac{(0x8pp0 : 1F)}{100} \times \frac{(0x8pp0 : 10)}{100} \times 2A$

¹⁾ pp = 00...03 for channel 1...4

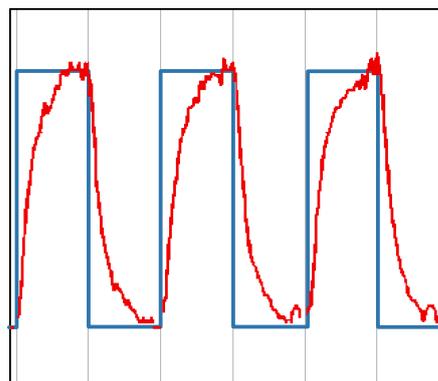
For dithering to work, the current must be able to follow the square wave signal sufficiently. This is achieved by a suitable combination of dithering parameters and current controller parameters. See also Chapter [Current controller optimization](#) [▶ 28].

Example

Poor configuration



Good configuration



Dithering frequency: 100 Hz
 Dithering amplitude: 10 %
 Horizontal scaling: 5 ms/div
 Blue: current setpoint
 Red: actual current value

The figures show a dither of 10 % of the rated current at 100 Hz.

The controller therefore has a time of 5 ms to compensate for a current pulse of 10 %. The steepness of the current rise is limited by the controller parameters and the inductance of the load.

5.6 Behavior on EtherCAT failure: watchdog

If EtherCAT communication is interrupted, the box no longer receives any default values from the controller. In this case, the watchdog intervenes and sets the respective output to a defined value.

You can enable and configure the watchdog individually for each output. There is one CoE parameter 8pp0:05 "Watchdog" per channel with the following options:

Value	Behavior on EtherCAT failure
0 "Default Watchdog Value"	The output value is set to the value specified in the parameter 0x8pp0:0D "Default Output".
1 "Watchdog Ramp Active"	The output value is moved linearly with the ramp time set in parameter 0x8pp0:0E "Default Output Ramp" to the value specified in parameter 0x8pp0:0D "Default Output". The unit of the parameter "Default Output Ramp" is [digits/ms]. Example: With "Default Output Ramp" = 100 and "Default Output" = 0, it takes 327 ms (32767/100) for the output value to reach the value "Default Output" from the maximum value (32767) in the event of an error.
2 "Last Output Value Active"	The last output value received from the controller before the EtherCAT failure is still output in the .

5.7 User calibration

The intended purpose of the user calibration is to calibrate the device, for example, in a smaller output signal range than that calibrated by the vendor. As a result, a higher accuracy can be attained for the smaller output signal range.

The internal calibration function is:

$$Y_U = \frac{G_U}{2^{16}} \times (X_U - O_U)$$

- Y_U: Output value after user calibration
- X_U: Output value before user calibration
- G_U: Gain
- O_U: Offset [mA]

Set calibration coefficients

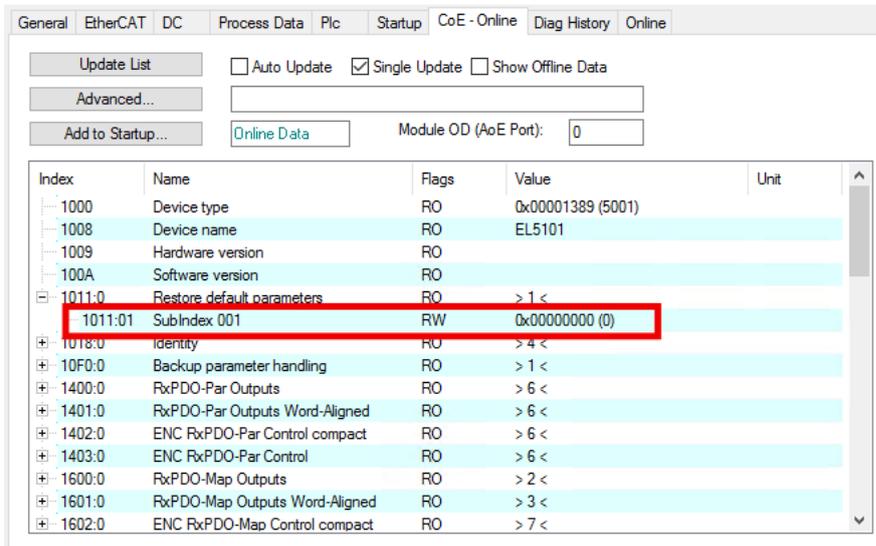
Set the calibration coefficients via the CoE parameters "Offset" and "Gain".

Channel	"Offset" [mA]	"Gain"
1	0x8000:0B	0x8000:0C
2	0x8010:0B	0x8010:0C
3	0x8020:0B	0x8020:0C
4	0x8030:0B	0x8030:0C

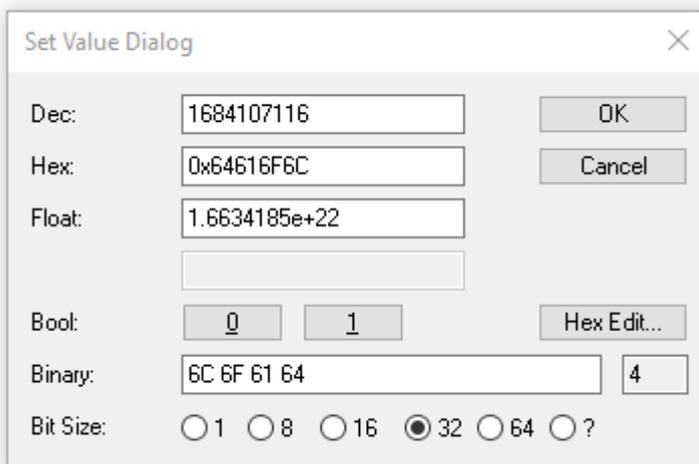
5.8 Restore the delivery state

You can restore the delivery state of the backup objects as follows:

1. Ensure that TwinCAT is running in Config mode.
2. In CoE object 1011:0 "Restore default parameters" select parameter 1011:01 "Subindex 001".



3. Double-click on "Subindex 001".
⇒ The "Set Value Dialog" dialog box opens.
4. Enter the value 1684107116 in the "Dec" field.
Alternatively: enter the value 0x64616F6C in the "Hex" field.



5. Confirm with "OK".
⇒ All backup objects are reset to the delivery state.

i Alternative restore value

With some older modules the backup objects can be changed with an alternative restore value:

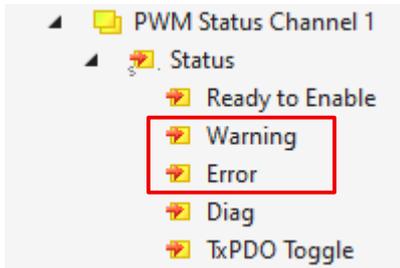
Decimal value: 1819238756

Hexadecimal value: 0x6C6F6164

An incorrect entry for the restore value has no effect.

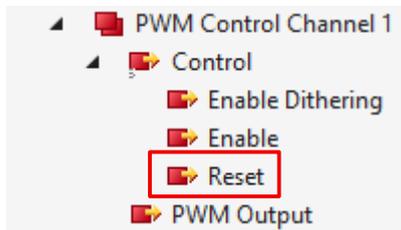
6 Diagnostics

Errors and warnings are reported channel by channel in the process data via the status bits "Warning" and "Error". Example for channel 1:



Difference between warnings / errors

- Warnings are purely informative. The box continues to function without restriction.
- Errors lead to shutdown of the affected output. To re-enable the output, you must acknowledge the error via the bit "Reset".



Narrow down the cause of the error

If a warning or error is reported on a channel, you can narrow down the cause using the CoE object 0xApp0 "PWM Diag Data Ch.n" of the respective channel. (0xA000 for channel 1, 0xA010 for channel 2, etc.)

The following table shows the meaning of different combinations of status bits and CoE parameters.

	Warning	Error
0xApp0:02 "Overtemperature"	Internal temperature above 75 °C.	Internal temperature above 85 °C.
0xApp0:04 "Undervoltage"	Supply voltage U_P below 20.4 V _{DC} .	Supply voltage U_P below 12 V _{DC} .
0xApp0:05 "Overvoltage"	Supply voltage U_P above 28.8 V _{DC} .	Supply voltage U_P above 30 V _{DC} .
0xApp0:06 "Short Circuit"	--	The output current was at least 2.5 A for more than 660 µs.

(pp = 00...03 for channel 1...4)



"Overtemperature", "Undervoltage" and "Overvoltage" are not channel-specific and are always reported for all channels simultaneously.

Examples:

- If the bit "Warning" of channel 1 has the value 1 and the CoE parameter 0xA000:04 "Undervoltage" is set to TRUE, the supply voltage U_P is currently below the threshold value of 20.4 V.
- If the bit "Error" of channel 3 has the value 1 and the CoE parameter 0xA020:06 "Short Circuit" is TRUE, the cause of the error is an overcurrent or short circuit on channel 3.

7 CoE parameters

Index (hex)	Name
1000	Device type [▶ 41]
1008	Device name [▶ 41]
1009	Hardware version [▶ 41]
100A	Software version [▶ 41]
100B	Bootloader version [▶ 41]
1011	Restore default parameters [▶ 41]
1018	Identity [▶ 41]
10E2	Manufacturer-specific Identification Code [▶ 41]
10F0	Backup parameter handling [▶ 42]
10F3	Diagnosis History [▶ 42]
10F8	Timestamp Object [▶ 43]
1600	PWM RxPDO-Map Control Ch.1 [▶ 43]
1610	PWM RxPDO-Map Control Ch.2 [▶ 43]
1620	PWM RxPDO-Map Control Ch.3 [▶ 43]
1630	PWM RxPDO-Map Control Ch.4 [▶ 43]
1A00	PWM TxPDO-Map Status Ch.1 [▶ 44]
1A01	PWM TxPDO-Map Synchronous Info Data Ch.1 [▶ 44]
1A10	PWM TxPDO-Map Status Ch.2 [▶ 44]
1A11	PWM TxPDO-Map Synchronous Info Data Ch.2 [▶ 44]
1A20	PWM TxPDO-Map Status Ch.3 [▶ 44]
1A21	PWM TxPDO-Map Synchronous Info Data Ch.3 [▶ 45]
1A30	PWM TxPDO-Map Status Ch.4 [▶ 45]
1A31	PWM TxPDO-Map Synchronous Info Data Ch.4 [▶ 45]
1C00	Sync manager type [▶ 45]
1C12	RxPDO assign [▶ 45]
1C13	TxPDO assign [▶ 46]
1C32	SM output parameter [▶ 46]
1C33	SM input parameter [▶ 47]
6000	PWM Inputs Ch.1 [▶ 49]
6010	PWM Inputs Ch.2 [▶ 49]
6020	PWM Inputs Ch.3 [▶ 49]
6030	PWM Inputs Ch.4 [▶ 49]
7000	PWM Outputs Ch.1 [▶ 50]
7010	PWM Outputs Ch.2 [▶ 50]
7020	PWM Outputs Ch.3 [▶ 50]
7030	PWM Outputs Ch.4 [▶ 50]
8000	PWM Settings Ch.1 [▶ 38]
800F	PWM Vendor Data Ch.1 [▶ 40]
8010	PWM Settings Ch.2 [▶ 38]
801F	PWM Vendor Data Ch.2 [▶ 40]
8020	PWM Settings Ch.3 [▶ 38]
802F	PWM Vendor Data Ch.3 [▶ 40]
8030	PWM Settings Ch.4 [▶ 38]
803F	PWM Vendor Data Ch.4 [▶ 40]
A000	PWM Diag Data Ch.1 [▶ 40]
A010	PWM Diag Data Ch.2 [▶ 40]
A020	PWM Diag Data Ch.3 [▶ 40]
A030	PWM Diag Data Ch.4 [▶ 40]
F000	Modular Device Profile [▶ 47]

Index (hex)	Name
F008	Code word [▶ 47]
F900	PWM Info Data [▶ 40]
FB00	PWM Command [▶ 48]

7.1 Configuration objects

8pp0 PWM Settings Ch.n

- Channel 1: Index 8000
- Channel 2: Index 8010
- Channel 3: Index 8020
- Channel 4: Index 8030

Subindex (hex)	Name	Meaning	Data type	Flags	Default
0	PWM Settings Ch.n		USINT	RO	0x22 (34 _{dec})
03	Enable Dithering	Enables dithering. Dithering is a square wave signal that is modulated onto the current signal. See chapter Dithering [► 30] .	BOOL	RW	00
05	Watchdog	Enables the watchdog. The watchdog sets the output to a defined value if EtherCAT communication is interrupted. See chapter Behavior on EtherCAT failure: watchdog [► 32] . Possible values: <ul style="list-style-type: none"> • 0_{dec}: Default Watchdog Value • 1_{dec}: Watchdog Ramp Active • 2_{dec}: Last Output Value Active 	USINT	RW	0x0 (0 _{dec})
07	Operation Mode	Operation mode. Possible values: <ul style="list-style-type: none"> • 0: "Current Control" The output operates as a PWM-controlled current output. Use "PWM Output" to specify the output current. • 1: "Voltage Control" The output operates as a regular PWM output. Use "PWM Output" to specify the duty cycle. 	USINT	RW	0x0 (0 _{dec})
09	Enable Feedforward	Enables the feedforward pre-control for the ohmic resistance of the load. Before enabling, set the parameter 8pp0:19 "Coil Resistance" correctly.	BOOL	RW	00
0B	Offset	User calibration offset in [mA].	INT	RW	0x0 (0 _{dec})
0C	Gain	User calibration gain.	DINT	RW	0x10000 (65536 _{dec})
0D	Default Output	Parameter for the watchdog. See chapter Behavior on EtherCAT failure: watchdog [► 32] .	INT	RW	0x0 (0 _{dec})
0E	Default Output Ramp	Parameter for the watchdog. See chapter Behavior on EtherCAT failure: watchdog [► 32] .	UINT	RW	0xFFFF (65535 _{dec})
10	Max Current	Maximum output current. Specification in % of the parameter 8ppF:06 "Nominal Current" (2 A)	USINT	RW	0x64 (100 _{dec})
12	Kp Factor	Proportional component of the current controller.	UINT	RW	0xFA (250 _{dec})
13	Ki Factor	Integral component of the current controller.	UINT	RW	0x4 (4 _{dec})
14	Kd Factor	Differential component of the current controller.	UINT	RW	0x0 (0 _{dec})
19	Coil Resistance	The ohmic resistance of the connected inductance in [0.01 Ohm]. Must only be set when using feedforward pre-control (8pp0:09).	UINT	RW	0xFA (250 _{dec})
1E	Dithering Frequency	Frequency of the dither in [Hz].	UINT	RW	0x64 (100 _{dec})
1F	Dithering Amplitude	Amplitude of the dither. Specified as a percentage of the maximum current configured via 8pp0:10.	USINT	RW	0xA (10 _{dec})

Subindex (hex)	Name	Meaning	Data type	Flags	Default
21	Select Info Data 1	Possible values: <ul style="list-style-type: none"> • 0_{dec}: Actual Current • 1_{dec}: Set Current • 2_{dec}: Duty Cycle • 3_{dec}: Supply Voltage 	USINT	RW	0x0 (0 _{dec})
22	Select Info Data 2	Possible values: <ul style="list-style-type: none"> • 0_{dec}: Actual Current • 1_{dec}: Set Current • 2_{dec}: Duty Cycle • 3_{dec}: Supply Voltage 	USINT	RW	0x1 (1 _{dec})

7.2 Information objects

8ppF PWM Vendor Data Ch.n

- Channel 1: Index 800F
- Channel 2: Index 801F
- Channel 3: Index 802F
- Channel 4: Index 803F

Subindex (hex)	Name	Meaning	Data type	Flags	Default
0	PWM Vendor Data Ch.n		USINT	RO	0x6 (6 _{dec})
01	Offset	Offset of the vendor calibration	INT	RW	-
02	Gain	Gain of the vendor calibration	INT	RW	-
06	Nominal Current	Rated output current per output	UINT	RW	-

App0 PWM Diag Data Ch.n

- Channel 1: Index A000
- Channel 2: Index A010
- Channel 3: Index A020
- Channel 4: Index A030

Subindex (hex)	Name	Meaning	Data type	Flags	Default
0	PWM Diag Data Ch.n		USINT	RO	0x6 (6 _{dec})
02	Overtemperature	For error messages and warnings see chapter Diagnostics [► 35].	BOOL	RO	-
04	Undervoltage		BOOL	RO	-
05	Overvoltage		BOOL	RO	-
06	Short Circuit		BOOL	RO	-

F900 PWM Info Data

Index (hex)	Name	Meaning	Data type	Flags	Default
F900:0	PWM Info Data		USINT	RO	0x2 (2 _{dec})
F900:01	Voltage	-	UINT	RO	-
F900:02	Temperature	-	USINT	RO	-

7.3 Standard objects

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 used CoE profile (5001). The Hi-Word contains the module profile according to the modular device profile.	UDINT	RO	0x8913FB00 (2299788032 _{dec})

1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING(11)	RO	EP2534-0002

1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING(2)	RO	-

100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING(2)	RO	-

100B Bootloader version

Index (hex)	Name	Meaning	Data type	Flags	Default
100B:0	Bootloader version	Bootloader version of the EtherCAT slave	STRING(32)	RO	-

1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	See chapter Restore the delivery state [▶_34]	USINT	RO	0x1 (1 _{dec})

1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	USINT	RO	0x4 (4 _{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UDINT	RO	0x2 (2 _{dec})
1018:02	Product code	Product code of the EtherCAT slave	UDINT	RO	0x9E64052 (166084690 _{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	UDINT	RO	-
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	UDINT	RO	-

10E2 Manufacturer-specific Identification Code

Index (hex)	Name	Meaning	Data type	Flags	Default
10E2:0	Manufacturer-specific Identification Code		USINT	RO	0x1 (1 _{dec})

10F0 Backup parameter handling

Index (hex)	Name	Meaning	Data type	Flags	Default
10F0:0	Backup parameter handling		USINT	RO	0x1 (1 _{dec})
10F0:01	Checksum	Checksum across all backup entries of the EtherCAT slave	UDINT	RO	-

10F3 Diagnosis History

Index (hex)	Name	Meaning	Data type	Flags	Default
10F3:0	Diagnosis History		USINT	RO	0x15 (21 _{dec})
10F3:01	Maximum Messages	-	USINT	RO	-
10F3:02	Newest Message	-	USINT	RO	-
10F3:03	Newest Acknowledged Message	-	USINT	RW	-
10F3:04	New Messages Available	-	BOOL	RO	-
10F3:05	Flags	-	UINT	RW	-
10F3:06	Diagnosis Message 001	-	ARRAY [0..19] OF BYTE	RO	-
10F3:07	Diagnosis Message 002	-	ARRAY [0..19] OF BYTE	RO	-
10F3:08	Diagnosis Message 003	-	ARRAY [0..19] OF BYTE	RO	-
10F3:09	Diagnosis Message 004	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0A	Diagnosis Message 005	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0B	Diagnosis Message 006	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0C	Diagnosis Message 007	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0D	Diagnosis Message 008	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0E	Diagnosis Message 009	-	ARRAY [0..19] OF BYTE	RO	-
10F3:0F	Diagnosis Message 010	-	ARRAY [0..19] OF BYTE	RO	-
10F3:10	Diagnosis Message 011	-	ARRAY [0..19] OF BYTE	RO	-
10F3:11	Diagnosis Message 012	-	ARRAY [0..19] OF BYTE	RO	-
10F3:12	Diagnosis Message 013	-	ARRAY [0..19] OF BYTE	RO	-
10F3:13	Diagnosis Message 014	-	ARRAY [0..19] OF BYTE	RO	-
10F3:14	Diagnosis Message 015	-	ARRAY [0..19] OF BYTE	RO	-
10F3:15	Diagnosis Message 016	-	ARRAY [0..19] OF BYTE	RO	-

10F8 Timestamp Object

Index (hex)	Name	Meaning	Data type	Flags	Default
10F8:0	Timestamp Object	-	ULINT	RO	-

1600 PWM RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	PWM RxPDO-Map Control Ch.1		USINT	RO	0x6 (6 _{dec})
1600:01	SubIndex 001	PDO Mapping Entry for "Enable Dithering".	UDINT	RO	0x7000:01, 1
1600:02	SubIndex 002		UDINT	RO	0x0000:00, 4
1600:03	SubIndex 003	PDO Mapping Entry for "Enable".	UDINT	RO	0x7000:06, 1
1600:04	SubIndex 004	PDO Mapping Entry for "Reset".	UDINT	RO	0x7000:07, 1
1600:05	SubIndex 005		UDINT	RO	0x0000:00, 9
1600:06	SubIndex 006	PDO Mapping Entry for "PWM Output".	UDINT	RO	0x7000:11, 16

1610 PWM RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1610:0	PWM RxPDO-Map Control Ch.2		USINT	RO	0x6 (6 _{dec})
1610:01	SubIndex 001	PDO Mapping Entry for "Enable Dithering".	UDINT	RO	0x7010:01, 1
1610:02	SubIndex 002		UDINT	RO	0x0000:00, 4
1610:03	SubIndex 003	PDO Mapping Entry for "Enable".	UDINT	RO	0x7010:06, 1
1610:04	SubIndex 004	PDO Mapping Entry for "Reset".	UDINT	RO	0x7010:07, 1
1610:05	SubIndex 005		UDINT	RO	0x0000:00, 9
1610:06	SubIndex 006	PDO Mapping Entry for "PWM Output".	UDINT	RO	0x7010:11, 16

1620 PWM RxPDO-Map Control Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
1620:0	PWM RxPDO-Map Control Ch.3		USINT	RO	0x6 (6 _{dec})
1620:01	SubIndex 001	PDO Mapping Entry for "Enable Dithering".	UDINT	RO	0x7020:01, 1
1620:02	SubIndex 002		UDINT	RO	0x0000:00, 4
1620:03	SubIndex 003	PDO Mapping Entry for "Enable".	UDINT	RO	0x7020:06, 1
1620:04	SubIndex 004	PDO Mapping Entry for "Reset".	UDINT	RO	0x7020:07, 1
1620:05	SubIndex 005		UDINT	RO	0x0000:00, 9
1620:06	SubIndex 006	PDO Mapping Entry for "PWM Output".	UDINT	RO	0x7020:11, 16

1630 PWM RxPDO-Map Control Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
1630:0	PWM RxPDO-Map Control Ch.4		USINT	RO	0x6 (6 _{dec})
1630:01	SubIndex 001	PDO Mapping Entry for "Enable Dithering".	UDINT	RO	0x7030:01, 1
1630:02	SubIndex 002		UDINT	RO	0x0000:00, 4
1630:03	SubIndex 003	PDO Mapping Entry for "Enable".	UDINT	RO	0x7030:06, 1
1630:04	SubIndex 004	PDO Mapping Entry for "Reset".	UDINT	RO	0x7030:07, 1
1630:05	SubIndex 005		UDINT	RO	0x0000:00, 9
1630:06	SubIndex 006	PDO Mapping Entry for "PWM Output".	UDINT	RO	0x7030:11, 16

1A00 PWM TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	PWM TxPDO-Map Status Ch.1		USINT	RO	0x8 (8 _{dec})
1A00:01	SubIndex 001		UDINT	RO	0x0000:00, 4
1A00:02	SubIndex 002	PDO Mapping Entry for "Ready to Enable".	UDINT	RO	0x6000:05, 1
1A00:03	SubIndex 003	PDO Mapping Entry for "Warning".	UDINT	RO	0x6000:06, 1
1A00:04	SubIndex 004	PDO Mapping Entry for "Error".	UDINT	RO	0x6000:07, 1
1A00:05	SubIndex 005		UDINT	RO	0x0000:00, 5
1A00:06	SubIndex 006	PDO Mapping Entry for "Diag".	UDINT	RO	0x6000:0d, 1
1A00:07	SubIndex 007		UDINT	RO	0x0000:00, 2
1A00:08	SubIndex 008	PDO Mapping Entry for "TxPDO Toggle".	UDINT	RO	0x6000:10, 1

1A01 PWM TxPDO-Map Synchron Info Data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	PWM TxPDO-Map Synchron Info Data Ch.1		USINT	RO	0x2 (2 _{dec})
1A01:01	SubIndex 001	PDO Mapping Entry for "Info Data 1".	UDINT	RO	0x6000:11, 16
1A01:02	SubIndex 002	PDO Mapping Entry for "Info Data 2".	UDINT	RO	0x6000:12, 16

1A10 PWM TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A10:0	PWM TxPDO-Map Status Ch.2		USINT	RO	0x8 (8 _{dec})
1A10:01	SubIndex 001		UDINT	RO	0x0000:00, 4
1A10:02	SubIndex 002	PDO Mapping Entry for "Ready to Enable".	UDINT	RO	0x6010:05, 1
1A10:03	SubIndex 003	PDO Mapping Entry for "Warning".	UDINT	RO	0x6010:06, 1
1A10:04	SubIndex 004	PDO Mapping Entry for "Error".	UDINT	RO	0x6010:07, 1
1A10:05	SubIndex 005		UDINT	RO	0x0000:00, 5
1A10:06	SubIndex 006	PDO Mapping Entry for "Diag".	UDINT	RO	0x6010:0d, 1
1A10:07	SubIndex 007		UDINT	RO	0x0000:00, 2
1A10:08	SubIndex 008	PDO Mapping Entry for "TxPDO Toggle".	UDINT	RO	0x6010:10, 1

1A11 PWM TxPDO-Map Synchron Info Data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A11:0	PWM TxPDO-Map Synchron Info Data Ch.2		USINT	RO	0x2 (2 _{dec})
1A11:01	SubIndex 001	PDO Mapping Entry for "Info Data 1".	UDINT	RO	0x6010:11, 16
1A11:02	SubIndex 002	PDO Mapping Entry for "Info Data 2".	UDINT	RO	0x6010:12, 16

1A20 PWM TxPDO-Map Status Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
1A20:0	PWM TxPDO-Map Status Ch.3		USINT	RO	0x8 (8 _{dec})
1A20:01	SubIndex 001		UDINT	RO	0x0000:00, 4
1A20:02	SubIndex 002	PDO Mapping Entry for "Ready to Enable".	UDINT	RO	0x6020:05, 1
1A20:03	SubIndex 003	PDO Mapping Entry for "Warning".	UDINT	RO	0x6020:06, 1
1A20:04	SubIndex 004	PDO Mapping Entry for "Error".	UDINT	RO	0x6020:07, 1
1A20:05	SubIndex 005		UDINT	RO	0x0000:00, 5
1A20:06	SubIndex 006	PDO Mapping Entry for "Diag".	UDINT	RO	0x6020:0d, 1
1A20:07	SubIndex 007		UDINT	RO	0x0000:00, 2
1A20:08	SubIndex 008	PDO Mapping Entry for "TxPDO Toggle".	UDINT	RO	0x6020:10, 1

1A21 PWM TxPDO-Map Synchron Info Data Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
1A21:0	PWM TxPDO-Map Synchron Info Data Ch.3		USINT	RO	0x2 (2 _{dec})
1A21:01	SubIndex 001	PDO Mapping Entry for "Info Data 1".	UDINT	RO	0x6020:11, 16
1A21:02	SubIndex 002	PDO Mapping Entry for "Info Data 2".	UDINT	RO	0x6020:12, 16

1A30 PWM TxPDO-Map Status Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A30:0	PWM TxPDO-Map Status Ch.4		USINT	RO	0x8 (8 _{dec})
1A30:01	SubIndex 001		UDINT	RO	0x0000:00, 4
1A30:02	SubIndex 002	PDO Mapping Entry for "Ready to Enable".	UDINT	RO	0x6030:05, 1
1A30:03	SubIndex 003	PDO Mapping Entry for "Warning".	UDINT	RO	0x6030:06, 1
1A30:04	SubIndex 004	PDO Mapping Entry for "Error".	UDINT	RO	0x6030:07, 1
1A30:05	SubIndex 005		UDINT	RO	0x0000:00, 5
1A30:06	SubIndex 006	PDO Mapping Entry for "Diag".	UDINT	RO	0x6030:0d, 1
1A30:07	SubIndex 007		UDINT	RO	0x0000:00, 2
1A30:08	SubIndex 008	PDO Mapping Entry for "TxPDO Toggle".	UDINT	RO	0x6030:10, 1

1A31 PWM TxPDO-Map Synchron Info Data Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A31:0	PWM TxPDO-Map Synchron Info Data Ch.4		USINT	RO	0x2 (2 _{dec})
1A31:01	SubIndex 001	PDO Mapping Entry for "Info Data 1".	UDINT	RO	0x6030:11, 16
1A31:02	SubIndex 002	PDO Mapping Entry for "Info Data 2".	UDINT	RO	0x6030:12, 16

1C00 Sync manager type

Index (hex)	Name	Meaning	Data type	Flags	Default
1C00:0	Sync manager type		USINT	RO	0x4 (4 _{dec})
1C00:01	SubIndex 001		USINT	RO	0x1 (1 _{dec})
1C00:02	SubIndex 002		USINT	RO	0x2 (2 _{dec})
1C00:03	SubIndex 003		USINT	RO	0x3 (3 _{dec})
1C00:04	SubIndex 004		USINT	RO	0x4 (4 _{dec})

1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	USINT	RO	0x4 (4 _{dec})
1C12:01	SubIndex 001		UINT	RW	0x16 (22 _{dec})
1C12:02	SubIndex 002		UINT	RW	0x1016 (4118 _{dec})
1C12:03	SubIndex 003		UINT	RW	0x2016 (8214 _{dec})
1C12:04	SubIndex 004		UINT	RW	0x3016 (12310 _{dec})

1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	USINT	RO	0x4 (4 _{dec})
1C13:01	SubIndex 001		UINT	RW	0x1A (26 _{dec})
1C13:02	SubIndex 002		UINT	RW	0x101A (4122 _{dec})
1C13:03	SubIndex 003		UINT	RW	0x201A (8218 _{dec})
1C13:04	SubIndex 004		UINT	RW	0x301A (12314 _{dec})
1C13:05	SubIndex 005		UINT	RW	0x0 (0 _{dec})
1C13:06	SubIndex 006		UINT	RW	0x0 (0 _{dec})
1C13:07	SubIndex 007		UINT	RW	0x0 (0 _{dec})
1C13:08	SubIndex 008		UINT	RW	0x0 (0 _{dec})

1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	USINT	RO	0x20 (32 _{dec})
1C32:01	Sync mode	Current synchronization mode: <ul style="list-style-type: none"> • 0: Free Run • 1: Synchronous with SM 2 Event • 2: DC-Mode - synchronous with SYNC0 Event 3: DC-Mode - synchronous with SYNC1 Event 	UINT	RW	0x1 (1 _{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> • Free Run: cycle time of the local timer • Synchronous with SM 2 Event: cycle time of the master DC-Mode: SYNC0/SYNC1 Cycle Time	UDINT	RW	0xF4240 (1000000 _{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UDINT	RO	0x0 (0 _{dec})
1C32:04	Sync modes supported	Sync modes supported: <ul style="list-style-type: none"> • Bit 0 = 1: Free Run is supported • Bit 1 = 1: Synchronization with SM 2 Event is supported • Bit 2-3 = 01: DC-Mode is supported • Bit 4-5 = 10: Output Shift with SYNC1 Event (DC mode only) Bit 14 = 1: dynamic times (measurement through writing of 1C32:08)	UINT	RO	0x3 (3 _{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UDINT	RO	0x2BF20 (180000 _{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC Mode only)	UDINT	RO	0x0 (0 _{dec})
1C32:07	Minimum delay time		UDINT	RO	0x0 (0 _{dec})
1C32:08	Get Cycle Time	<ul style="list-style-type: none"> • 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started 	UINT	RW	0x0 (0 _{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UDINT	RO	0x0 (0 _{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC Mode only)	UINT	RO	-
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)	UINT	RO	-
1C32:0D	Shift too short counter	Number of intervals between SYNC0 and SYNC1 events that are too short (DC Mode only)	UINT	RO	-
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC Mode only)	BOOL	RO	-

1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	USINT	RO	0x20 (32 _{dec})
1C33:01	Sync mode	Current synchronization mode: <ul style="list-style-type: none"> • 0: Free Run • 1: Synchronous with SM 3 Event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event 34: Synchronous with SM 2 Event (outputs available)	UINT	RW	0x22 (34 _{dec})
1C33:02	Cycle time	as 1C32:02	UDINT	RW	0xF4240 (1000000 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC Mode only)	UDINT	RO	0x0 (0 _{dec})
1C33:04	Sync modes supported	Sync modes supported: <ul style="list-style-type: none"> • Bit 0: Free Run is supported • Bit 1: Synchronization with SM 2 Event is supported (outputs available) • Bit 1: Synchronization 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 1C32:08 or 1C33:08)	UINT	RO	0x3 (3 _{dec})
1C33:05	Minimum cycle time	as 1C32:05	UDINT	RO	0x2BF20 (180000 _{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and the inputs being available for the master (in ns, DC Mode only)	UDINT	RO	0x0 (0 _{dec})
1C33:07	Minimum delay time		UDINT	RO	0x0 (0 _{dec})
1C33:08	Get Cycle Time	as 1C32:08	UINT	RW	0x0 (0 _{dec})
1C33:09	Maximum delay time	Time between SYNC1 event and reading of the inputs (in ns, DC Mode only)	UDINT	RO	0x0 (0 _{dec})
1C33:0B	SM event missed counter	as 1C32:11	UINT	RO	-
1C33:0C	Cycle exceeded counter	as 1C32:12	UINT	RO	-
1C33:0D	Shift too short counter	as 1C32:13	UINT	RO	-
1C33:20	Sync error	as 1C32:32	BOOL	RO	-

F000 Modular Device Profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular Device Profile		USINT	RO	0x2 (2 _{dec})
F000:01	Index distance		UINT	RO	0x10 (16 _{dec})
F000:02	Maximum number of modules		UINT	RO	0x4 (4 _{dec})

F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default
F008:0	Code word	-	UDINT	RO	-

FB00 PWM Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	PWM Command		USINT	RO	0x3 (3 _{dec})
FB00:01	Request	-	ARRAY [0..1] OF BYTE	RW	-
FB00:02	Status	-	USINT	RO	-
FB00:03	Response	-	ARRAY [0..7] OF BYTE	RO	-

7.4 Profile-specific objects

6000 PWM Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	PWM Inputs Ch.1		USINT	RO	0x12 (18 _{dec})
6000:05	Ready to Enable	-	BOOL	RO	-
6000:06	Warning	-	BOOL	RO	-
6000:07	Error	-	BOOL	RO	-
6000:0D	Diag	-	BOOL	RO	-
6000:10	TxPDO Toggle	-	BOOL	RO	-
6000:11	Info Data 1	-	INT	RO	-
6000:12	Info Data 2	-	INT	RO	-

6010 PWM Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	PWM Inputs Ch.2		USINT	RO	0x12 (18 _{dec})
6010:05	Ready to Enable	-	BOOL	RO	-
6010:06	Warning	-	BOOL	RO	-
6010:07	Error	-	BOOL	RO	-
6010:0D	Diag	-	BOOL	RO	-
6010:10	TxPDO Toggle	-	BOOL	RO	-
6010:11	Info Data 1	-	INT	RO	-
6010:12	Info Data 2	-	INT	RO	-

6020 PWM Inputs Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	PWM Inputs Ch.3		USINT	RO	0x12 (18 _{dec})
6020:05	Ready to Enable	-	BOOL	RO	-
6020:06	Warning	-	BOOL	RO	-
6020:07	Error	-	BOOL	RO	-
6020:0D	Diag	-	BOOL	RO	-
6020:10	TxPDO Toggle	-	BOOL	RO	-
6020:11	Info Data 1	-	INT	RO	-
6020:12	Info Data 2	-	INT	RO	-

6030 PWM Inputs Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
6030:0	PWM Inputs Ch.4		USINT	RO	0x12 (18 _{dec})
6030:05	Ready to Enable	-	BOOL	RO	-
6030:06	Warning	-	BOOL	RO	-
6030:07	Error	-	BOOL	RO	-
6030:0D	Diag	-	BOOL	RO	-
6030:10	TxPDO Toggle	-	BOOL	RO	-
6030:11	Info Data 1	-	INT	RO	-
6030:12	Info Data 2	-	INT	RO	-

7000 PWM Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	PWM Outputs Ch.1		USINT	RO	0x11 (17 _{dec})
7000:01	Enable Dithering	-	BOOL	RO	-
7000:06	Enable	-	BOOL	RO	-
7000:07	Reset	-	BOOL	RO	-
7000:11	PWM Output	-	INT	RO	-

7010 PWM Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	PWM Outputs Ch.2		USINT	RO	0x11 (17 _{dec})
7010:01	Enable Dithering	-	BOOL	RO	-
7010:06	Enable	-	BOOL	RO	-
7010:07	Reset	-	BOOL	RO	-
7010:11	PWM Output	-	INT	RO	-

7020 PWM Outputs Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
7020:0	PWM Outputs Ch.3		USINT	RO	0x11 (17 _{dec})
7020:01	Enable Dithering	-	BOOL	RO	-
7020:06	Enable	-	BOOL	RO	-
7020:07	Reset	-	BOOL	RO	-
7020:11	PWM Output	-	INT	RO	-

7030 PWM Outputs Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	PWM Outputs Ch.4		USINT	RO	0x11 (17 _{dec})
7030:01	Enable Dithering	-	BOOL	RO	-
7030:06	Enable	-	BOOL	RO	-
7030:07	Reset	-	BOOL	RO	-
7030:11	PWM Output	-	INT	RO	-

8 Appendix

8.1 General operating conditions

Protection rating according to IP code

The degrees of protection are defined and divided into different classes in the IEC 60529 standard (EN 60529). Degrees of protection are designated by the letters "IP" and two numerals: **IPxy**

- Numeral x: Dust protection and contact protection
- Numeral y: Protection against water

x	Meaning
0	Not protected
1	Protected against access to dangerous parts with the back of the hand. Protected against solid foreign objects of 50 mm Ø
2	Protected against access to dangerous parts with a finger. Protected against solid foreign objects of 12.5 mm Ø
3	Protected against access to dangerous parts with a tool. Protected against solid foreign objects of 2.5 mm Ø
4	Protected against access to dangerous parts with a wire. Protected against solid foreign objects of 1 mm Ø
5	Protection against access to dangerous parts with a wire. Dust-protected. Ingress of dust is not prevented completely, although the quantity of dust able to penetrate is limited to such an extent that the proper function of the device and safety are not impaired
6	Protection against access to dangerous parts with a wire. Dust-tight. No ingress of dust

y	Meaning
0	Not protected
1	Protection against vertically falling water drops
2	Protection against vertically falling water drops when enclosure tilted up to 15°
3	Protection against spraying water. Water sprayed at an angle of up to 60° on either side of the vertical shall have no harmful effects
4	Protection against splashing water. Water splashed against the enclosure from any direction shall have no harmful effects
5	Protection against water jets.
6	Protection against powerful water jets.
7	Protected against the effects of temporary immersion in water. Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is immersed in water at a depth of 1 m for 30 minutes

Chemical resistance

The resistance refers to the housing of the IP67 modules and the metal parts used. In the table below you will find some typical resistances.

Type	Resistance
Water vapor	unstable at temperatures > 100 °C
Sodium hydroxide solution (ph value > 12)	stable at room temperature unstable > 40 °C
Acetic acid	unstable
Argon (technically pure)	stable

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 can be found on the Beckhoff website: [Link](#).

Ordering information	Description	Link
ZK1090-3xxx-xxxx	EtherCAT cable M8, green	Website
ZK1093-3xxx-xxxx	EtherCAT cable M8, yellow	Website
ZK2000-7xxx-0xxx	Sensor cable M12, 4-pin + shield	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)
ZS5000-0020	Protective cap for M12 sockets, IP67 (50 pcs.)
ZS5100-0000	Inscription labels, unprinted, 4 strips of 10
ZS5000-xxxx	Printed inscription labels on enquiry

Tools

Ordering information	Description
ZB8801-0000	Torque wrench for plugs, 0.4...1.0 Nm
ZB8801-0001	Torque cable key for M8 / wrench size 9 for ZB8801-0000
ZB8801-0002	Torque cable key for M12 / wrench size 13 for ZB8801-0000
ZB8801-0003	Torque cable key for M12 field assembly / wrench size 18 for ZB8801-0000



Further accessories

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

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. “EL2872 with revision 0022 and serial number 01200815”.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

8.3.2 Version identification of IP67 modules

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

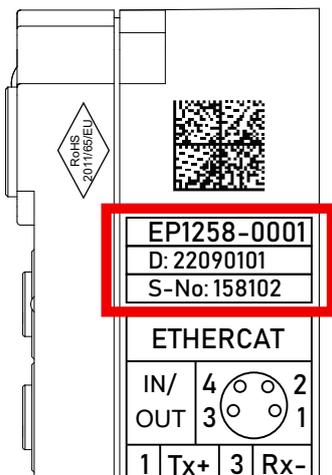


Fig. 7: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

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.

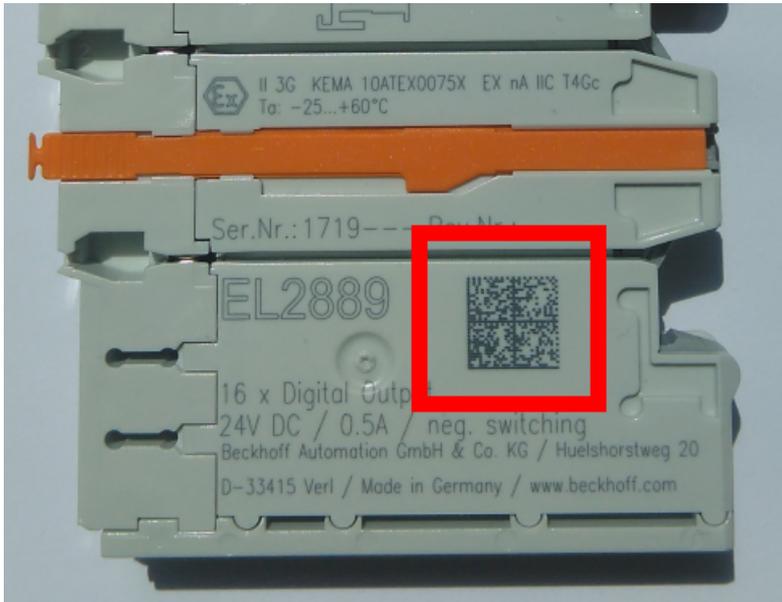


Fig. 8: BIC as data matrix code (DMC, code scheme ECC200)

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:

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	Beckhoff order number	1P	8	1P 072222
2	Beckhoff Traceability Number (BTN)	Unique serial number, see note below	SBTN	12	SBTN k4p562d7
3	Article description	Beckhoff article description, e.g. EL1008	1K	32	1KEL 1809
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	2P 401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S 678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	12	30P F971, 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**SBTN**k4p562d7**1KEL**1809 **Q1** **51S**678294

Accordingly as DMC:



Fig. 9: Example DMC **1P**072222**SBTN**k4p562d7**1KEL**1809 **Q1** **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.

NOTICE

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 documentation.

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.

The interface that the product can be electronically addressed by is crucial for the electronic readout.

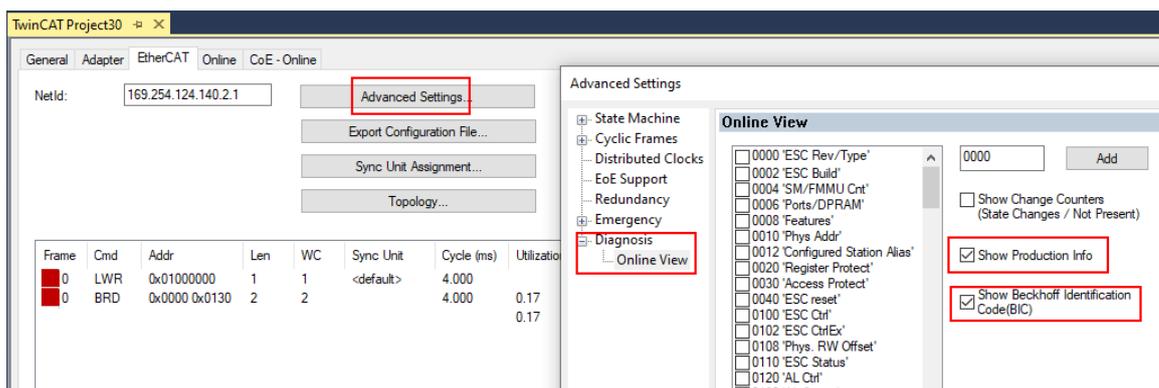
EtherCAT devices (IP20, IP67)

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

Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

The user can electronically access the eBIC (if present) 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 "Show Beckhoff Identification Code (BIC)" checkbox under EtherCAT → Advanced Settings → Diagnostics:



- The BTN and its contents are then displayed:

No	Addr	Name	State	CRC	Fw	Hw	Production Data	ItemNo	BTN	Description	Quantity	BatchNo	SerialNo
1	1001	Term 1 (EK1100)	OP	0,0	0	0	---						
2	1002	Term 2 (EL1018)	OP	0,0	0	0	2020 KW36 Fr	072222	k4p562d7	EL1809	1		678294
3	1003	Term 3 (EL3204)	OP	0,0	7	6	2012 KW24 Sa						
4	1004	Term 4 (EL2004)	OP	0,0	0	0	---	072223	k4p562d7	EL2004	1		678295
5	1005	Term 5 (EL1008)	OP	0,0	0	0	---						
6	1006	Term 6 (EL2008)	OP	0,0	0	12	2014 KW14 Mo						
7	1007	Term 7 (EK1110)	OP	0	1	8	2012 KW25 Mo						

- Note: As shown in the figure, the production data HW version, FW version, and production date, which have been programmed since 2012, can also be displayed with "Show production info".
- Access from the PLC: From TwinCAT 3.1. build 4024.24, the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0.
- EtherCAT devices with a CoE directory may also have the object 0x10E2:01 to display their own eBIC, which can also be easily accessed by the PLC:

- The device must be in PREOP/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	1P158442SBTN0008jckp1KELM3704 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 preferentially introduced into stock products in the course of necessary firmware revision.
- From TwinCAT 3.1. build 4024.24, the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC are available in the *Tc2_EtherCAT* library from v3.3.19.0
- The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Uilities* as of TwinCAT 3.1 build 4024.24
 - *F_SplitBIC*: The function splits the Beckhoff Identification Code (BIC) *sBICValue* into its components using known identifiers and returns the recognized substrings in the *ST_SplittedBIC* structure as a return value
 - *BIC_TO_BTN*: The function extracts the BTN from the BIC and returns it as a return value
- Note: If there is further electronic 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 written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50..200 bytes of memory.
- 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 which each have 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.

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.

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