BECKHOFF New Automation Technology

Documentation | EN

EP3751-0160

3-axis accelerometer



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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.
It is absolutely necessary to comply with the documentation and the following notes and explanations 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.
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The EtherCAT Technology is covered by the following patent applications and patents, without this constituting an exhaustive list:
EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
and similar applications and registrations in several other countries.



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1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

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
1.2	• Technical data updated. • Chapter "Calibration and scaling" added.
1.1	• Additional information on the configuration of the acceleration measurement added.
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	Example with D no. 29 10 02 01:
WW - week of production (calendar week)	29 - week of production 29
YY - year of production	10 - year of production 2010
FF - firmware version	02 - firmware version 02
HH - hardware version	01 - hardware version 01

Further information on this topic: Version identification of EtherCAT devices [▶ 60].

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.

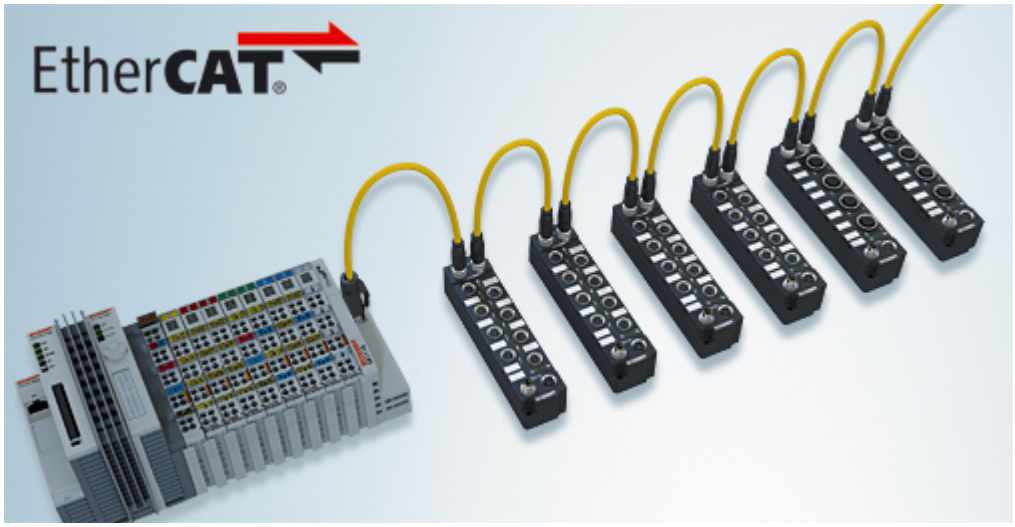


Fig. 1: EtherCAT Box Modules within an EtherCAT network

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



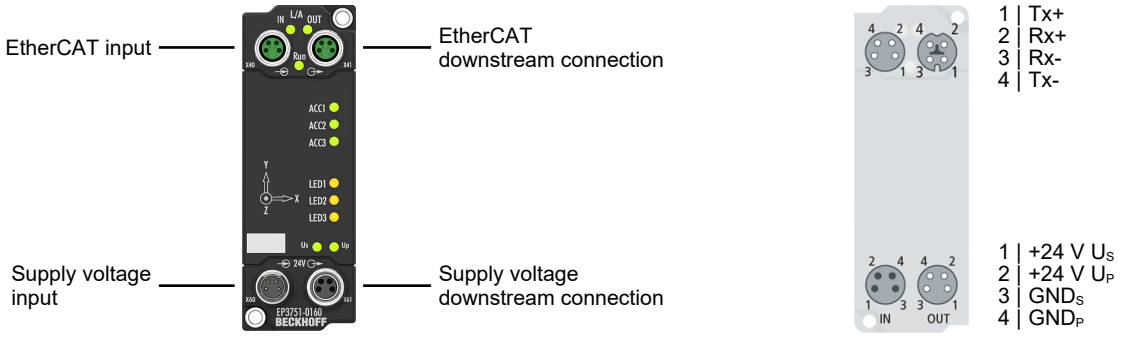
Fig. 3: EtherCAT Box with M12 connections for sensors/actuators

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



The EP3751-0160 EtherCAT Box has an internal ultra-low-noise 3-axis accelerometer with 20-bit resolution and a selectable measuring range of ±2 g, ±4 g and ±8 g. The sampling rate is 4 kHz. The built-in sensor is suitable for applications where low frequencies must be monitored with the lowest possible noise. Applications can be building monitoring, bridge monitoring, robotics or Condition Monitoring, for example.

The EtherCAT connection ensures an almost delay-free transmission and thus evaluation in the measuring system, with TwinCAT Analytics, for example. Parameterizable, the sensor data can also be transmitted as raw values (unprocessed, unfiltered).

Quick links

Technical data [▶ 11]
Process image [▶ 13]
Acceleration measurement [▶ 26]
Inclination measurement [▶ 41]

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
Distributed Clocks	From Firmware 03

Supply voltages	
Connection	Input: M8 connector, 4-pin, A-coded Downstream connection: M8 socket, 4-pin, A-coded
U_S nominal voltage	24 V_{DC} (-15 % / +20 %)
U_S sum current: $I_{S,sum}$	max. 4 A
Current consumption from U_S	100 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.

Accelerometer	
Measuring ranges	±2 g (default) / ±4 g / ±8 g, adjustable
Sampling rate	4 kHz (default) From firmware 03 adjustable from 3.906 Hz to 4 kHz.
Measured value resolution	20-bit incl. sign, default: 1 mg/LSB
Measurement uncertainty	max. ±8 % [1], related to full scale value.
Noise	< 25 µg/√Hz in measuring range ±2 g
Temperature compensation	yes

[1] You can minimize the measurement uncertainty by performing a calibration. See User calibration [▶ 37].

Housing data	
Dimensions W x H x D	30 mm x 86 mm x 22 mm (without plug connectors)
Weight	approx. 95 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 [▶ 23]

*) 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 EP3751-0160
- 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)

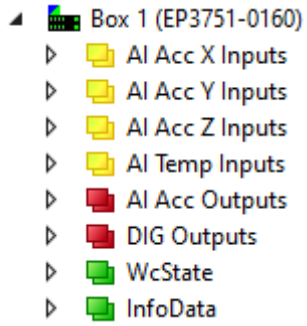
Pre-assembled protective caps do not ensure IP67 protection

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.

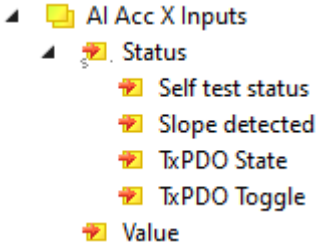
3.4 Process image

The following figure shows the representation of the process image in TwinCAT.



3.4.1 Process data objects

AI Acc X/Y/Z Inputs



Status > Self test status
Status of the self test.
See chapter Self test [▶ 36].

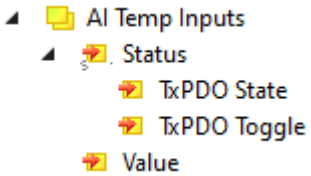
Status > Slope detected
This bit reports jumpy changes of the acceleration measuring value.
See chapter Status display [▶ 35].

Status > TxPDO State
This bit is 1 if the current measured acceleration value is invalid, e.g. if the self test is running.

Status > TxPDO Toggle
This bit is inverted each time the measured acceleration value is updated.

Value
The current measured acceleration value.
Unit: mg/LSB (factory setting).
See chapter Acceleration measurement [▶ 26].

AI Temp Inputs

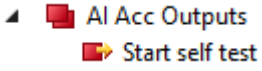


Status > TxPDO State
This bit is 1 if the current measured temperature value is invalid.

Status > TxPDO Toggle
This bit is inverted each time the measured temperature value is updated.

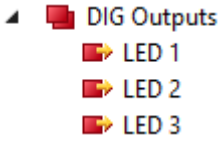
Value
The current measured value of the internal temperature measurement.
Unit: °C

AI Acc Outputs



Start self test
This bit starts the self test of the accelerometer.
See chapter Self test [▶ 36].

DIG Outputs

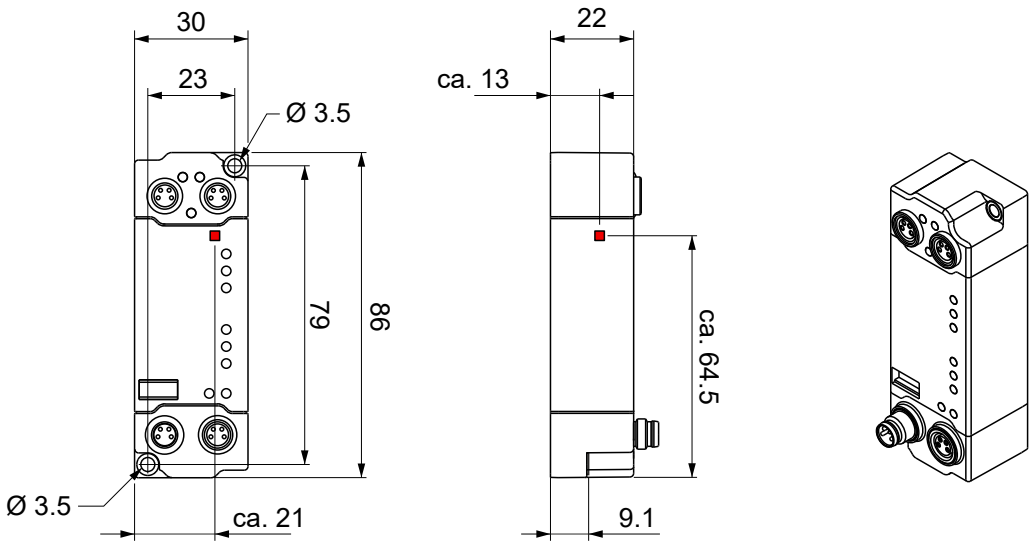


LED 1, LED 2, LED 3
Variables for controlling LEDs on the housing.
See chapter Controlling LEDs [▶ 44].

4 Mounting and connection

4.1 Mounting

4.1.1 Dimensions



■ = Position of the sensor

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

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two mounting holes Ø 3.5 mm for M3
Metal parts	brass, nickel-plated
Contacts	CuZn, gold-plated
Installation position	variable
Protection class	IP65, IP66, IP67 (conforms to EN 60529) when screwed together
Dimensions (H x W x D)	approx. 86 x 30 x 22 mm
Weight	approx. 90 g

4.1.2 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.

4.1.3 Tightening torques for plug connectors

Screw M8 connectors tight with a torque wrench. (e.g. ZB8801 from Beckhoff)
Torque: 0.4 Nm.

4.2 Connection

4.2.1 EtherCAT

4.2.1.1 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

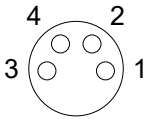


Fig. 4: M8 socket

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

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.

4.2.1.2 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

4.2.1.3 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

4.2.2 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 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 [▶ 23].

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.

4.2.2.1 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

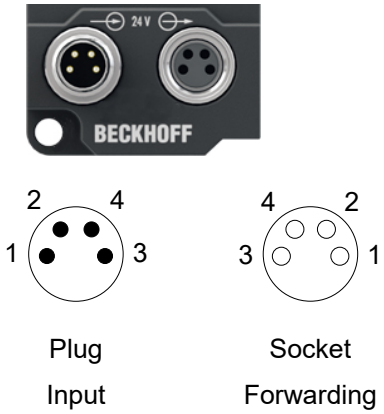


Fig. 5: M8 connector

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

4.2.2.2 Status LEDs

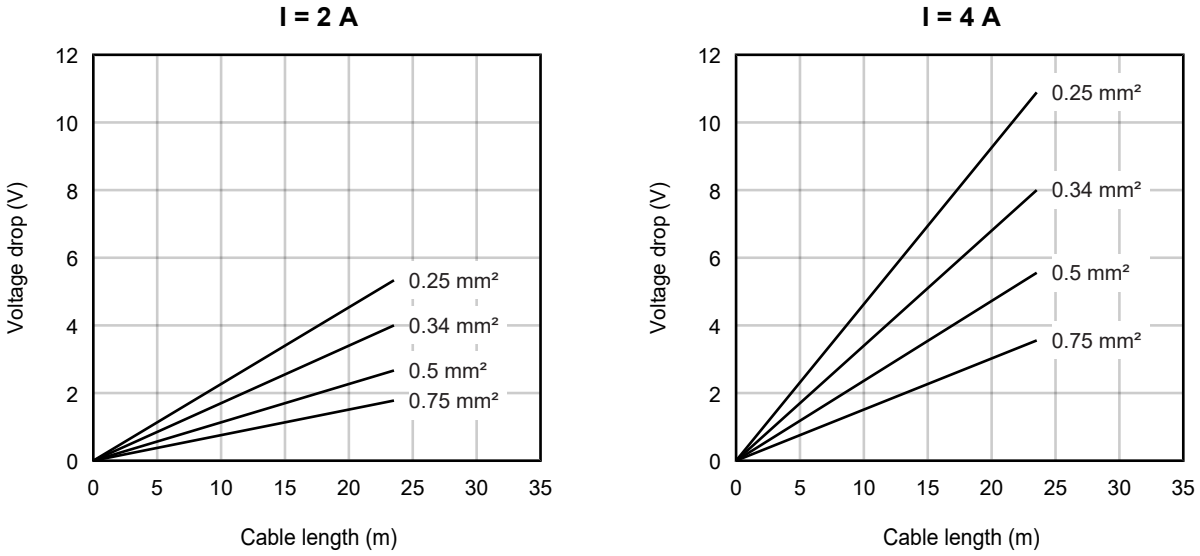


LED	Display	Meaning
U_S (control voltage)	off	The supply voltage U_S is not available.
	green illuminated	The supply voltage U_S is available.
U_P (peripheral voltage)	off	The supply voltage U_P is not available.
	green illuminated	The supply voltage U_P is available.

4.2.2.3 Conductor losses

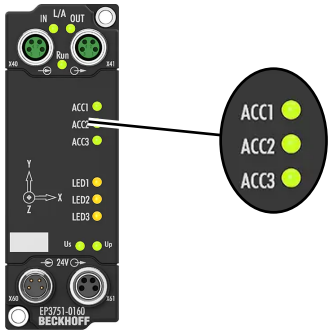
Take into account the voltage drop on the supply line when planning a system. Avoid the voltage drop being so high that the supply voltage at the box lies below the minimum nominal voltage.
Variations in the voltage of the power supply unit must also be taken into account.

Voltage drop on the supply line



4.3 Function test

By means of the LEDs "ACC1", "ACC2" and "ACC3" you can check whether the acceleration measurement is working even without control and without EtherCAT communication.



The LEDs light up when a vibration is detected, e.g. when you tap your finger against the housing. See also Chapter Status display [▶ 35].

The prerequisite for the function test is that the supply voltages are present.

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. 6: 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

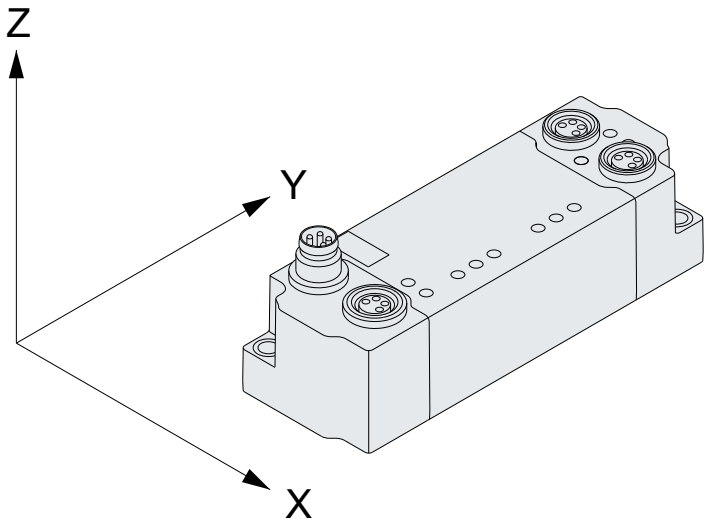
The procedure for integration in a TwinCAT project is described in these Quick start guide.

5.2 Acceleration measurement

The box measures acceleration in all three spatial directions.

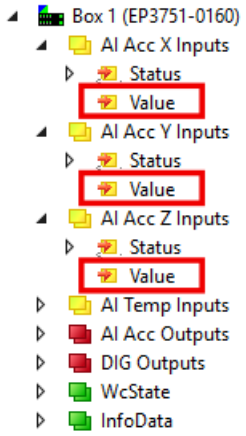
Acceleration axes

The following figure shows the position of the acceleration axes X, Y and Z.



Measured values

The current measured acceleration values are transferred in the variables "Value" in the process data objects "AI Acc X/Y/Z Inputs".



In the factory setting, the measured values are scaled to **1 mg/LSB**. The symbol g stands for the acceleration due to gravity 9.81 m/s². 1 mg corresponds to 0.00981 m/s².

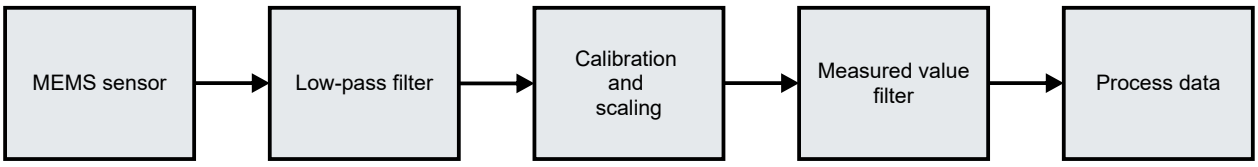
Configuration

The following settings are available for acceleration measurement:

- Measuring range [▶ 28]
- Measured value resolution [▶ 29]
- Sampling-Rate (ODR) [▶ 30]
- Measured value filter [▶ 32]
- Calibration and scaling [▶ 37]

5.2.1 Signal flow

The following diagram shows the internal signal flow of one of the acceleration axes. All three acceleration axes have the same structure.



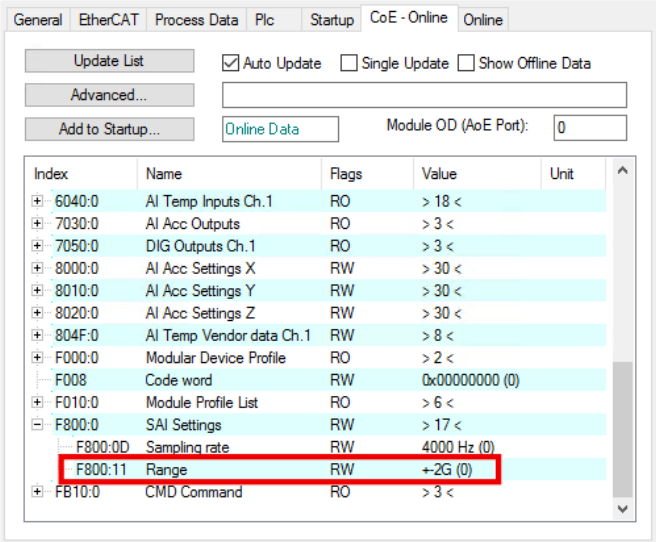
The low-pass filter is configured together with the sampling rate of the sensor, see chapter Sampling-Rate (ODR) [▶ 30].

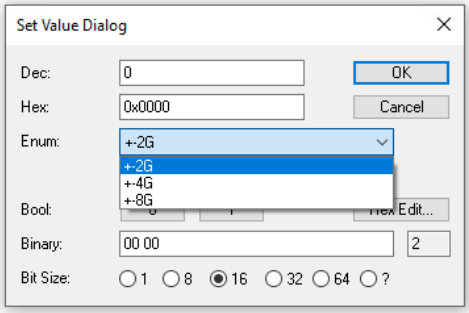
The configuration of the measured value filter can be found in the chapter Measured value filter [▶ 32].

5.2.2 Measuring range

You can set the measuring range in parameter F800:11 "Range". In the factory setting the measuring range is ±2 g.

This setting applies to all three acceleration axes.





Possible values for "Range":

Value	Measuring range
0 (factory setting)	"+-2G"
1	"+-4G"
2	"+-8G"

Influence on resolution and noise

If the parameter 80n0:0B "Enable Vendor Calibration" is set to FALSE, a change of the measuring range also influences the resolution of the measured values and the measured value noise of the respective channel.
In the factory setting "Enable Vendor Calibration" is TRUE.

See chapter Measured value resolution [▶ 29].

5.2.3 Measured value resolution

You can set the resolution of the measured values for each acceleration axis individually.

NOTICE

Interactions with other parameters

Certain combinations of parameter values can cause individual settings to become ineffective without being noticed.

- Consider the following interactions of the measured value resolution with other parameters:

- If user calibration or user scale is enabled, the measured value resolution is automatically 1 mg/LSB. The settings described below have no effect.
- If you set a measured value resolution not equal to the factory setting of 1 mg/LSB, the measured value filter is automatically disabled. The filter settings have no effect.

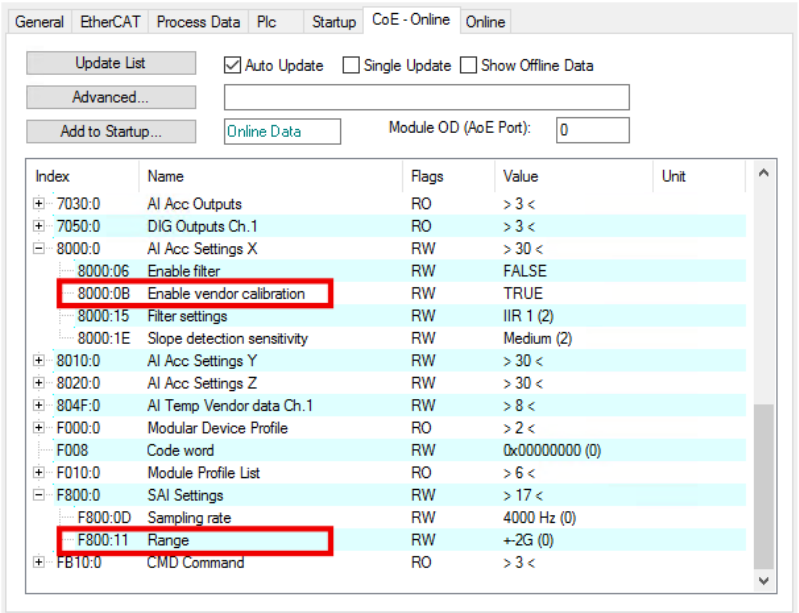
Setting the measured value resolution

The resolution of the measured values is determined by the following parameters:

- 80n0:0B "EnableVendor Calibration"
  (with n=0 for the X-axis, n=1 for the Y-axis, n=2 for the Z-axis)
- F800:11 "Range". Further information in chapter Measuring range [▶ 28].

The following table shows the possible combinations of the two parameters and the resulting measured value resolution.

"Enable Vendor Calibration"	"Range"		Measured value resolution
TRUE (factory setting)	variable		1 mg/LSB
FALSE	0	+-2G	1/256 mg/LSB
FALSE	1	+-4G	1/128 mg/LSB
FALSE	2	+-8G	1/64 mg/LSB



Measured value noise

If “Enable vendor calibration” is FALSE, the noise power density increases with a larger measuring range. See chapter Measured value noise [▶ 34].

5.2.4 Sampling-Rate (ODR)

Adjustable since FW03

The sampling rate specifies how often the box provides an updated measured value for the controller.

The factory setting is the highest possible sampling rate of 4 kHz.

5.2.4.1 Configure

NOTICE

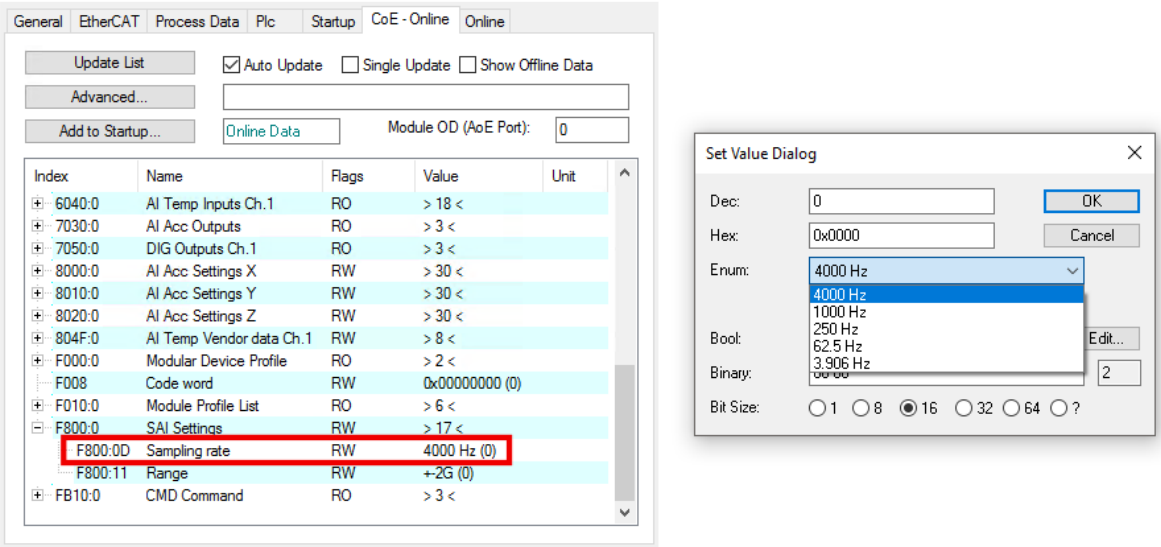
Invalid measured values with activated filters

If one or more filters are activated and the sampling rate is not in the factory setting, invalid measured values may be output.

- Make sure that the measured value filters of all channels are disabled before setting a sampling rate unequal to 4 kHz.
  See chapter Measured value filter [▶ 32].

Up to and including firmware 02, you cannot set the sampling rate.

From firmware 03, you can set the sampling rate in parameter F800:0D "Sampling rate".



By setting the sampling rate, you also influence the cut-off frequency of the integrated low-pass filter, which is used to pre-filter the measured values. This low-pass filter cannot be disabled.

The following table shows the possible values for the sampling rate, the associated cut-off frequency of the low-pass filter and the maximum EtherCAT cycle time recommended in each case.

Value	Sampling rate	3 dB cut-off frequency of the low-pass filter	Recommended maximum EtherCAT cycle time
0 (default)	4000 Hz	1000 Hz	250 µs
2	1000 Hz	250 Hz	1 ms
4	250 Hz	62.5 Hz	4 ms
6	62.5 Hz	15.625 Hz	16 ms
10_{dec}	3.906 Hz	0.977 Hz	256 ms

Ensure that the recommended maximum EtherCAT cycle time for the set sampling rate is not exceeded. If necessary, reduce the sampling rate or the EtherCAT cycle time of the controller. This prevents measuring errors due to aliasing effects.

Influence of the sampling rate on the measured value noise

The measured value noise decreases with lower sampling rate.

5.2.5 Measured value filter

NOTICE

Interactions with other parameters

Certain combinations of settings can cause settings to become ineffective.

- Consider the following interactions:

- If you set a sampling rate not equal to the factory setting of 4000 Hz and one or more measured value filters are enabled, invalid measured values may be output.
- If the measured value resolution is not set to the factory setting of 1 mg/LSB , the measured value filters have no function. The settings described below have no effect.

Recommendation: Do not use the measured value filter

There is already a low-pass filter in the signal path before the measured value filter, which pre-processes the measured values sufficiently. Beckhoff recommends using only this upstream low-pass filter for filtering.

The cut-off frequency is set by adjusting the sampling rate, see chapter Sampling-Rate (ODR) [▶ 30].

Each acceleration axis has a digital measured value filter that can be individually enabled and configured.

In the factory setting, the measured value filters of all acceleration axes are disabled.

The measured value filters influence the EtherCAT synchronization mode of the device:

- All filters disabled: "Synchron" synchronization mode.
- One or more filters enabled: "Free Run" synchronization mode.

5.2.5.1 Enable

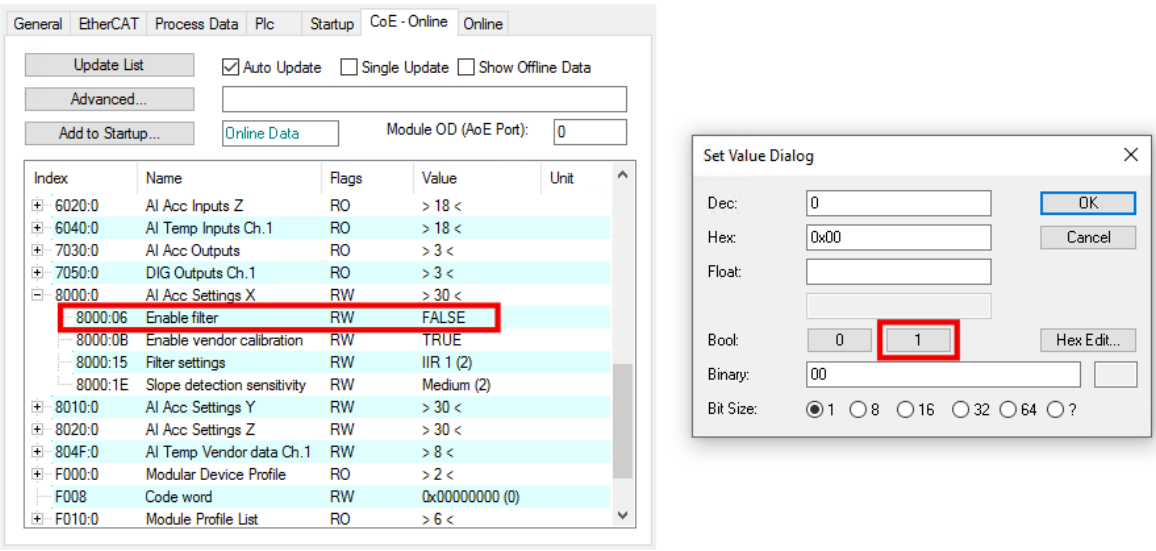
NOTICE

Measured value jumps when enabling or disabling a filter

When a filter is enabled or disabled, short-term measured value jumps can occur in the process data that do not correspond to the physical values.

Set parameter 80n0:0:06 "Enable filter" to TRUE, to enable a filter.

Example for the x-axis:



5.2.5.2 Configure

In parameters 80n00:15 "Filter settings" you can choose between several predefined filter configurations. The factory setting is "IIR1".

Possible values for "Filter settings":

Value	Filter configuration
0	50Hz FIR
1	60Hz FIR
2	IIR1 (factory setting)
3	IIR2
4	IIR3
5	IIR4
6	IIR5
7	IIR6
8	IIR7
9	IIR8

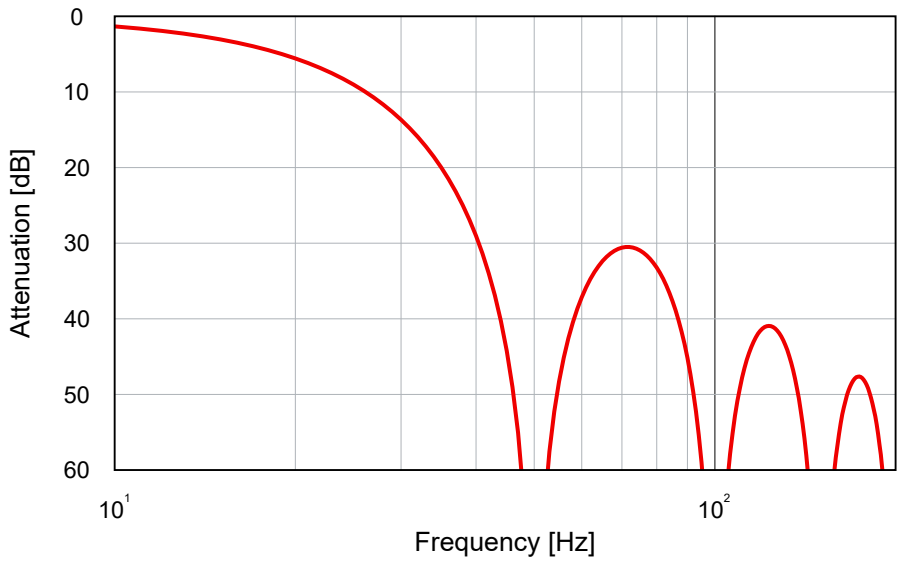
For a description of the FIR and IIR filter categories, see the chapter Filter categories FIR and IIR [▶ 33].

5.2.5.3 Filter categories FIR and IIR

FIR filter

The FIR filters are non-recursive notch filters. A notch filter has zeros (notches) in its frequency response at the filter frequency and multiples of the filter frequency. These frequencies are therefore attenuated in amplitude.

Example of a typical attenuation curve of a notch filter with 50 Hz filter frequency:



IIR filter

The IIR filters are low-pass filters.

IIR1 has the highest cut-off frequency, IIR8 has the lowest cut-off frequency.

5.2.6 Measured value noise

If you set a higher measured value resolution than the factory setting, the measured value will be noisy. The setting of the measured value resolution is described in the chapter Measured value resolution [▶ 29].

Minimize noise

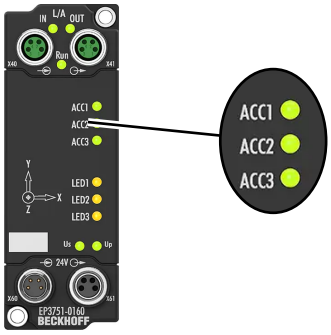
You can minimize the measured value noise with the following settings:

- Reduce the measuring range.
  Select the smallest possible measuring range "Range" that covers the accelerations expected in your application. See chapter Measuring range [▶ 28].
- Disable the measured value filters of the box to be able to set the sampling rate (chapter Measured value filter [▶ 32]). Filter in the PLC instead.
- Select the sampling rate as low as possible; necessarily lower than the EtherCAT data rate (frames / sec). See chapter Sampling-Rate (ODR) [▶ 30].

5.2.7 Status display

Abrupt changes in the measured acceleration values are signaled in two ways:

- The LEDs "ACC1", "ACC2" and "ACC3" flash:
  "ACC1" for the x-direction, "ACC2" for the y-direction, "ACC3" for the z-direction.



- The bits "Slope detected" in the process data are set synchronously with the LEDs.

You can use the LEDs for a quick function test after assembly. See chapter Function test [▶ 22].

Setting the sensitivity

You can set the sensitivity of the status display for each channel individually in the parameters 80n0:1E "Slope detection sensitivity".

Value	Name
0	Very high
1	High
2 (factory setting)	Medium
3	Low
4	Very low
65535	Off

This setting is stored non-volatile in the device. For a function test after assembly, you can therefore set the sensitivity in advance according to the expected vibrations.

5.2.8 Self test

You can perform a self test to check the functionality of the accelerometer.

NOTICE

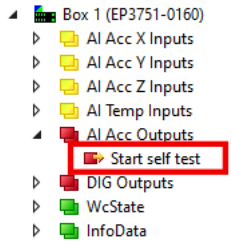
Incorrect measured values during the self test

While the self test is running, the measured acceleration values do not correspond to the real acceleration.

- Ignore the measured values that are output during the self test.

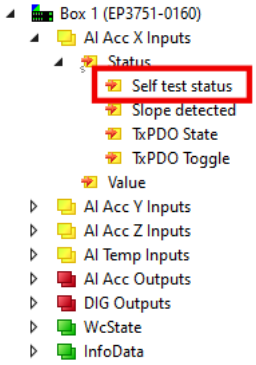
Procedure

1. Give a positive edge to the variable "AI Acc Outputs" > "Start self test".



   ⇨ The self test is started.

2. Wait until the variable "AI Acc X Inputs" > "Status" > "Self test status" takes the value 1.



   ⇨ The self test is running.

3. Wait until the variable "AI Acc X Inputs" > "Status" > "Self test status" takes a value unequal to 1.
   ⇨ The self test is completed.
4. Evaluate the result according to the table below.
5. Set the variable "AI Acc Outputs" > "Start self test" back to 0.
   ⇨ The variable "AI Acc X Inputs" > "Status" > "Self test status" takes the value 0.

Possible values of "Self test status"

"Self test status"	Meaning
0	Ready to start a self test.
1	Self test is running.
2	Self test completed. Sensor defective.
3	Self test completed. Sensor OK.

5.2.9 Calibration and scaling

5.2.9.1 User calibration

From Firmware 05

NOTICE

Measured value resolution is reduced to 1 mg/LSB

If the user calibration is enabled, the measured values are output with a resolution of 1 mg/LSB regardless of the set measured value resolution.

- If you require a measured value resolution other than 1 mg/LSB, you can implement the user calibration in your PLC. See chapter User calibration in the PLC [▶ 38].

You can use the user calibration to minimize the measurement uncertainty.

During user calibration, the measured values are calculated internally using a correction function. The correction function has the following form:

$$Y_U = G_U * (X_U – O_U)$$

Y_U : Measured value after the user calibration

X_U : Measured value before the user calibration

G_U : Gain

O_U : Offset

Enable user calibration

The user calibration is disabled in the factory setting. It can be enabled individually for each acceleration axis. To do this, set the corresponding CoE parameter “Enable user calibration” to TRUE:

Acceleration axis	"Enable user calibration"
X	8000:0A
Y	8010:0A
Z	8020:0A

Setting the calibration coefficients

Set the calibration coefficients via the CoE parameters "User calibration offset" and "User calibration gain":

Acceleration axis	"User calibration offset"	"User calibration gain" [1)]
X	8000:17	8000:18
Y	8010:17	8010:18
Z	8020:17	8020:18

[1)] The parameter "User calibration Gain" is scaled with the factor 2^{14} (16384_{dec}).
The default value 16384_{dec} of the parameter therefore corresponds to Gain = 1.

5.2.9.1.1 User calibration in the PLC

You can also perform the correction calculation in the PLC instead of in the box. This has the advantage that you can set the measured value resolution as required: if the correction calculation is carried out in the box, the measured value resolution is limited to 1 mg/LSB.

Beckhoff also recommends reading the calibration coefficients from the CoE parameters provided for this purpose when calculating corrections in the PLC. This means that the PLC program does not have to be adapted when the box is replaced.

Sample program for the X-axis

Preparation:

- Integrate the PLC library “Tc2_EtherCAT”. (includes FB_EcCoESdoRead)
- Link "Device ‘EtherCAT’ > InfoData > AmsNetId" with `sAmsNetIdArr`.
- Link "EP3751-0160 > AI Acc X Inputs > Value" with `nAx`.
- Link "EP3751-0160 > InfoData > AdsAddr > port" with `nSlaveAdress`.

```
PROGRAM MAIN

VAR
    nAmsNetIdArr AT %I*: T_AmsNetIdArr;
    nSlaveAddress AT %I*: WORD;
    nAxis_Value AT %I*: DINT;
    eState: (IDLE, INIT_READ_OFFSET, READING_OFFSET, INIT_READ_GAIN, READING_GAIN,
             NOMINAL_OPERATION, ERROR);
    fbSdoRead: FB_EcCoESdoRead;
    sAmsNetId: T_AmsNetId;
    nOffset: INT;
    nGainRaw: INT;
    fGain: REAL;
    fAxCalibrated: REAL;
    bExecute: BOOL;
END_VAR
```

```
CASE eState OF
    IDLE:
        fbSdoRead(bExecute := FALSE);
        sAmsNetId := F_CreateAmsNetId(nAmsNetIdArr);
        IF bExecute THEN
            eState := INIT_READ_OFFSET;
        END_IF

    INIT_READ_OFFSET:
        fbSdoRead(
            sNetId := sAmsNetId,
            nSlaveAddr := nSlaveAddress,
            nSubIndex := 16#17,
            nIndex := 16#8000,
            pDstBuf := ADR(nOffset),
            cbBufLen := SIZEOF(nOffset),
            bExecute := TRUE
            );
        eState := READING_OFFSET;

    READING_OFFSET:
        fbSdoRead();
        IF NOT fbSdoRead.bBusy THEN
            IF fbSdoRead.bError THEN
                eState := Error;
            ELSE
                fbSdoRead(bExecute := FALSE);
                eState := INIT_READ_GAIN;
            END_IF
        END_IF

    INIT_READ_GAIN:
        fbSdoRead(
            sNetId := sAmsNetId,
            nSlaveAddr := nSlaveAddress,
            nSubIndex := 16#18,
            nIndex := 16#8000,
            pDstBuf := ADR(nGainRaw),
            cbBufLen := SIZEOF(nGainRaw),
            bExecute := TRUE
```

```
            );
        eState := READING_GAIN;

    READING_GAIN:
        fbSdoRead();
        IF NOT fbSdoRead.bBusy THEN
            IF fbSdoRead.bError THEN
                eState := ERROR;
            ELSE
                fbSdoRead(bExecute := FALSE);
                fGain := INT_TO_REAL(nGainRaw) / 16384;
                eState := NOMINAL_OPERATION;
            END_IF
        END_IF

    NOMINAL_OPERATION:
        fAxCalibrated := fGain * DINT_TO_REAL(nAxis_Value - nOffset);

    ERROR:
        ;

END_CASE
```

5.2.9.2 User scaling

From Firmware 05

NOTICE

Measured value resolution is reduced to 1 mg/LSB

If user scale is enabled, the measured values are output with a resolution of 1 mg/LSB regardless of the set measured value resolution.

- If you require a measured value resolution other than 1 mg/LSB, you can implement user scale in your PLC.

The transfer function of the user scale for the analog inputs is as follows:

$Y_S = G_S * (X_S – O_S)$

Y_S : Measured value after the user scaling
X_S : Measured value before the user scaling
G_S : Gain
O_S : Offset

Enable user scale

The user scale is disabled in the factory. It can be enabled individually for each channel. To do this, set the respective CoE parameter “Enable user scale” to TRUE:

Acceleration axis	"Enable user scale"
X	8000:01
Y	8010:01
Z	8020:01

Setting the scaling coefficients

Set the scaling coefficients via the CoE parameters "User scale offset" and "User scale gain":

Acceleration axis	"User scale offset"	"User scale gain" [1)]
X	8000:11	8000:12
Y	8010:11	8010:12
Z	8020:11	8020:12

[1)] The parameter "User scale Gain" is scaled with the factor 2^{16} (65536_{dec}).
The default value 65535_{dec} of the parameter therefore corresponds to Gain = 1.

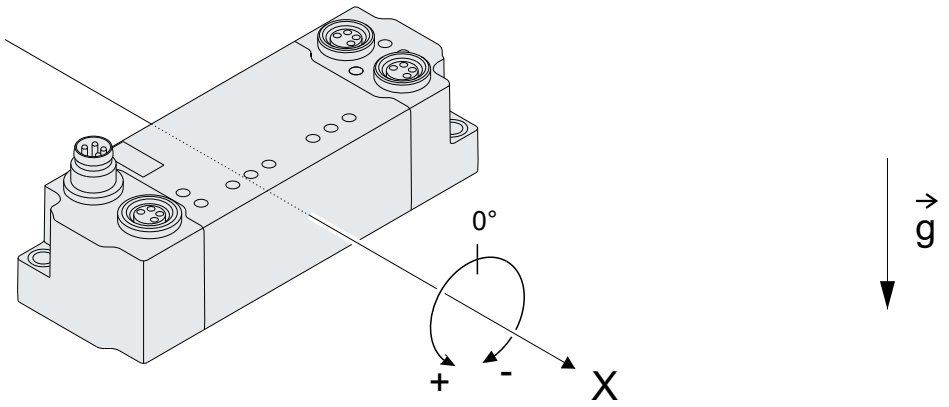
5.3 Inclination measurement

The inclination measurement determines the inclination of the box in relation to the gravity. You can calculate the angle of inclination in a PLC program from the measured acceleration values.

If the box is tilted only in one axis, the calculation is possible with a simple formula.
If the box is tilted in several axes at the same time, the calculation is more complicated. Further information can be found, for example, on the Internet under the keyword "Euler angles".

The following examples show the calculation of the angle of inclination when tilting about one axis at a time.

Example: Inclination around the x-axis, "Roll"



Formula:

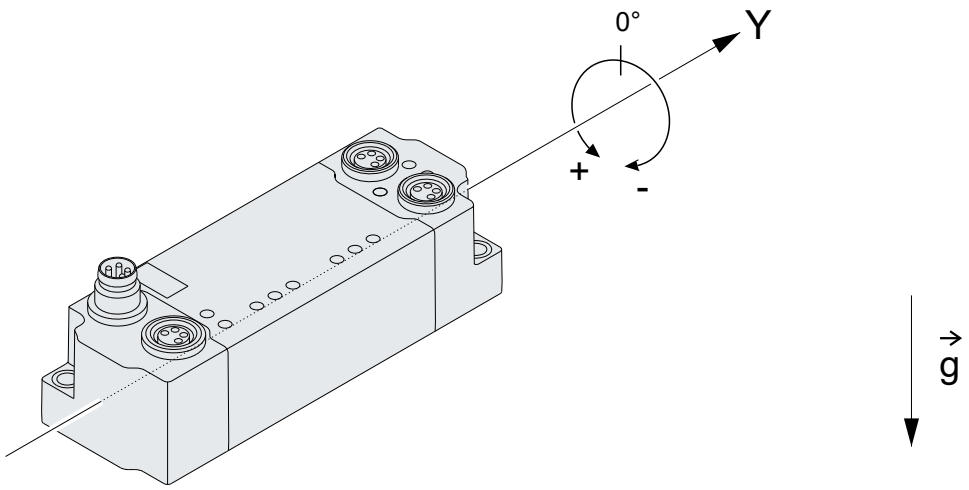
$$\phi = tan^{-1}(\frac{a_y}{\sqrt{a_x^2 + a_z^2}}) * \frac{360^\circ}{2\pi}$$

Implementation in TwinCAT:

```
IF NOT ((ax = 0) AND (az = 0)) THEN
    roll := ATAN(ay / (SQRT(ax * ax + az * az))) * 360/(2*3.14);
END_IF
```

(Note: the IF statement prevents division by zero)

Example: Inclination around the y-axis, "Pitch"



Formula:

$$\theta = tan^{-1}(\frac{a_x}{\sqrt{a_y^2 + a_z^2}}) * \frac{360^\circ}{2\pi}$$

Implementation in TwinCAT:

```
IF NOT ((ay = 0) AND (az = 0)) THEN
    pitch := ATAN(ax / (SQRT(ay * ay + az * az))) * 360/(2*3.14);
END_IF
```

(Note: the IF statement prevents division by zero)

5.4 Distributed Clocks

From Firmware 03

The function "Distributed Clocks" enables equidistant sampling of the measured values. Equidistant sampling is a prerequisite for the application of the Nyquist-Shannon sampling theorem.

A possible use case for the "Distributed Clocks" would be, for example, a frequency analysis of the measured acceleration values.

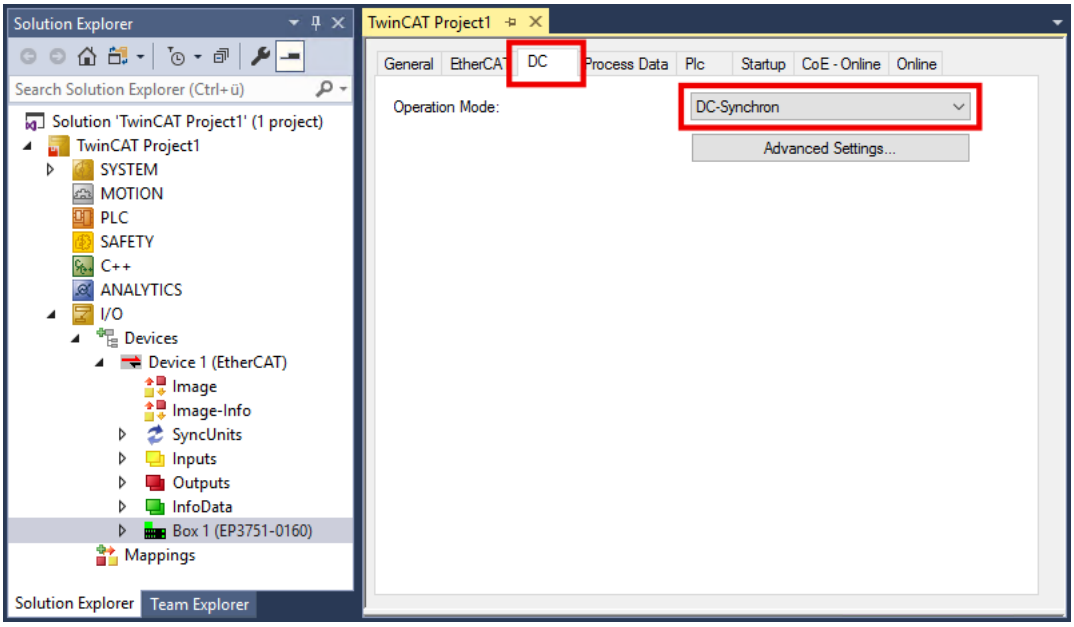
Enable

NOTICE

Measured value filters are automatically disabled

If you enable Distributed Clocks, all measured value filters are automatically disabled. The configuration of the measured value filters in the CoE directory remains unchanged.

1. On the “DC” tab, select the “DC-Synchron” option in the “Operation Mode” list box.

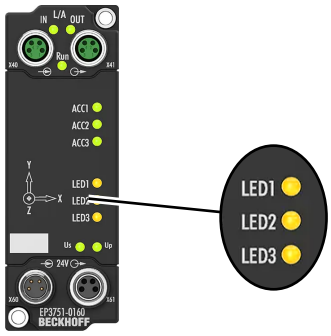


2. Activate the configuration.

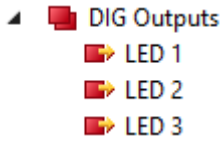


5.5 Controlling LEDs

You can control three LEDs on the front of the housing via the process data: "LED1", "LED2" and "LED3".



For each LED there is a variable in the process data object "DIG Outputs".

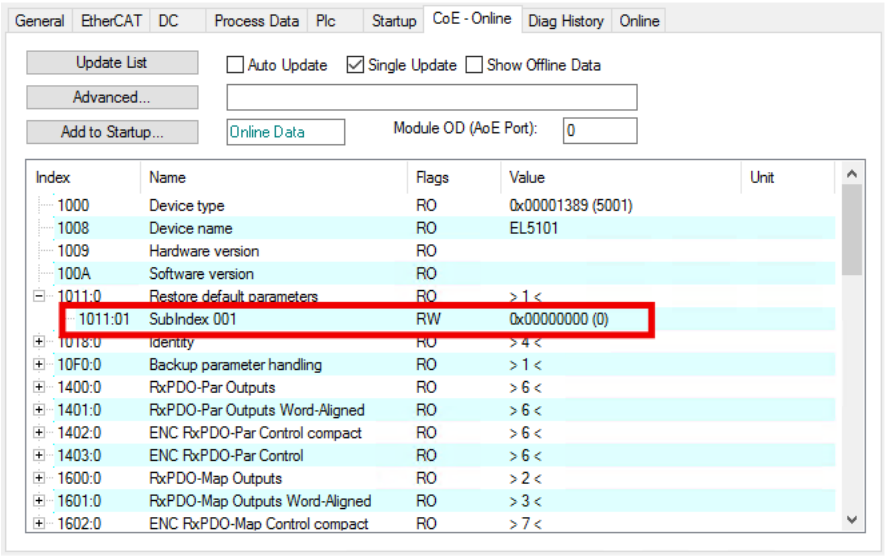


To switch on an LED, set the corresponding variable to 1.

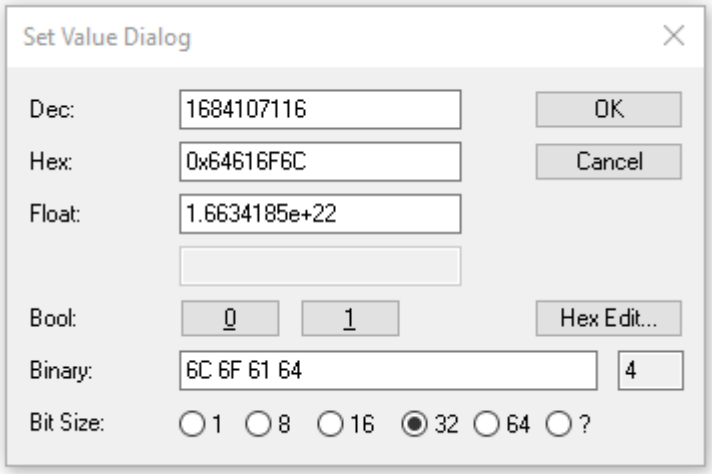
5.6 Restore the delivery state

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.

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.

5.7 Decommissioning

⚠ WARNING

Risk of electric shock!

Bring the bus system into a safe, de-energized state before starting disassembly of the devices!

6 CoE objects

6.1 Objects for parameterization

Index 8000: AI Acc Settings X

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	AI Acc Settings X	Settings for the acceleration axis X	UINT8	RO	0x1E (30_{dec})
8000:01	Enable user scale	Enables the user scale. See chapter User scaling [▶ 40].	BOOLEAN	RW	0x00 (0_{dec})
8000:06	Enable filter	Enables the measured value filter. See chapter Measured value filter [▶ 32].	BOOLEAN	RW	0x00 (0_{dec})
8000:0A	Enable user calibration	Enables user calibration. See chapter User calibration [▶ 37].	BOOLEAN	RW	0x00 (0_{dec})
8000:0B	Enable vendor calibration	Enables the scaling of the measured values to 1 mg/LSB. See chapter Measured value resolution [▶ 29].	BOOLEAN	RW	0x01 (1_{dec})
8000:11	User scale offset	User scale offset.	INT16	RW	0x0000 (0_{dec})
8000:12	User scale gain	User scale gain.	INT32	RW	0x00010000 (65536_{dec})
8000:15	Filter settings	Selection of the measured value filter. See chapter Measured value filter [▶ 32].	UINT16	RW	0x0002 (2_{dec})
8000:17	User calibration offset	User calibration offset.	INT16	RW	0x0000 (0_{dec})
8000:18	User calibration gain	User calibration gain.	INT16	RW	0x4000 (16384_{dec})
8000:1E	Slope detection sensitivity	Controls the sensitivity of the status display. See chapter Status display [▶ 35].	UINT16	RW	0x0002 (2_{dec})

Index 8010: AI Acc Settings Y

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	AI Acc Settings Y	Settings for the acceleration axis Y	UINT8	RO	0x1E (30_{dec})
8010:01	Enable user scale	Enables the user scale. See chapter User scaling [▶ 40].	BOOLEAN	RW	0x00 (0_{dec})
8010:06	Enable filter	Enables the measured value filter. See chapter Measured value filter [▶ 32].	BOOLEAN	RW	0x00 (0_{dec})
8010:0A	Enable user calibration	Enables user calibration. See chapter User calibration [▶ 37].	BOOLEAN	RW	0x00 (0_{dec})
8010:0B	Enable vendor calibration	Enables the scaling of the measured values to 1 mg/LSB. See chapter Measured value resolution [▶ 29].	BOOLEAN	RW	0x01 (1_{dec})
8010:11	User scale offset	User scale offset.	INT16	RW	0x0000 (0_{dec})
8010:12	User scale gain	User scale gain.	INT32	RW	0x00010000 (65536_{dec})
8010:15	Filter settings	Selection of the measured value filter. See chapter Measured value filter [▶ 32].	UINT16	RW	0x0002 (2_{dec})
8010:17	User calibration offset	User calibration offset.	INT16	RW	0x0000 (0_{dec})
8010:18	User calibration gain	User calibration gain.	INT16	RW	0x4000 (16384_{dec})
8010:1E	Slope detection sensitivity	Controls the sensitivity of the status display. See chapter Status display [▶ 35].	UINT16	RW	0x0002 (2_{dec})

Index 8020: AI Acc Settings Z

Index (hex)	Name	Meaning	Data type	Flags	Default
8020:0	AI Acc Settings Z	Settings for the acceleration axis Z	UINT8	RO	0x1E (30_{dec})
8020:01	Enable user scale	Enables the user scale. See chapter User scaling [▶ 40].	BOOLEAN	RW	0x00 (0_{dec})
8020:06	Enable filter	Enables the measured value filter. See chapter Measured value filter [▶ 32].	BOOLEAN	RW	0x00 (0_{dec})
8020:0A	Enable user calibration	Enables user calibration. See chapter User calibration [▶ 37].	BOOLEAN	RW	0x00 (0_{dec})
8020:0B	Enable vendor calibration	Enables the scaling of the measured values to 1 mg/LSB. See chapter Measured value resolution [▶ 29].	BOOLEAN	RW	0x01 (1_{dec})
8020:11	User scale offset	User scale offset.	INT16	RW	0x0000 (0_{dec})
8020:12	User scale gain	User scale gain.	INT32	RW	0x00010000 (65536_{dec})
8020:15	Filter settings	Selection of the measured value filter. See chapter Measured value filter [▶ 32].	UINT16	RW	0x0002 (2_{dec})
8020:17	User calibration offset	User calibration offset.	INT16	RW	0x0000 (0_{dec})
8020:18	User calibration gain	User calibration gain.	INT16	RW	0x4000 (16384_{dec})
8020:1E	Slope detection sensitivity	Controls the sensitivity of the status display. See chapter Status display [▶ 35].	UINT16	RW	0x0002 (2_{dec})

Index F800: SAI Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
800F:0	SAI Settings		UINT8	RO	0x11 (17_{dec})
F800:0D	Sampling rate	*From Firmware 03* Selection of the sampling rate. See chapter Sampling-Rate (ODR) [▶ 30].	UINT16	RW	0x0000 (0_{dec})
800F:11	Range	Selection of the measuring range. See chapter Measuring range [▶ 28].	UINT16	RW	0x0000 (0_{dec})

6.2 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 used CoE profile (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	EP3751-0160

Index 1009: Hardware version

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

Index 100A: Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	03

Index 100B: Bootloader version

Index (hex)	Name	Meaning	Data type	Flags	Default
100B:0	Bootloader version		STRING	RO	N/A

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 you set this object in the Set Value dialog to "0x64616F6C", all backup objects will be set back to the delivery state	UINT32	RW	0x00000000 (0_{dec})

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	0x0EA74052 (245842002_{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	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave; the Low Byte (bit 0-7) of the Low Word contains the year of production, the High Byte (bit 8-15) of the Low Word contains the week of production, the High Word (bit 16-31) is 0	UINT32	RO	0x00000000 (0_{dec})

Index 10E2: Manufacturer-specific Identification Code

Index (hex)	Name	Meaning	Data type	Flags	Default
10E2:0	Manufacturer-specific Identification Code		UINT8	RO	0x01 (1_{dec})
10E2:01	SubIndex 001		STRING	RO	

Index 10F0: Backup parameter handling

Index (hex)	Name	Meaning	Data type	Flags	Default
10F0:01	Checksum	Checksum across all backup entries of the EtherCAT slave	UINT32	RO	0x00000000 (0_{dec})

Index 1600: AI Acc RxPDO-Map Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	AI Acc RxPDO-Map Outputs	PDO Mapping RxPDO 1	UINT8	RO	0x03 (3_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (DIG Outputs Ch.1), entry 0x01 (LED Red))	UINT32	RO	0x0000:00, 2
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7040 (DIG Outputs Ch.1), entry 0x02 (LED Yellow))	UINT32	RO	0x7030:03, 1
1600:03	SubIndex 003	3. PDO Mapping entry (object 0x7040 (DIG Outputs Ch.1), entry 0x03 (LED Green))	UINT32	RO	0x0000:00, 13

Index 1610: DIG RxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1610:0	DIG RxPDO-Map	PDO Mapping RxPDO 17	UINT8	RO	0x04 (4_{dec})
1610:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (DIG Outputs Ch.1), entry 0x01 (LED 1))	UINT32	RO	0x7050:01, 1
1610:02	SubIndex 002	2. PDO Mapping entry (object 0x7050 (DIG Outputs Ch.1), entry 0x02 (LED 2))	UINT32	RO	0x7050:02, 1
1610:03	SubIndex 003	3. PDO Mapping entry (object 0x7050 (DIG Outputs Ch.1), entry 0x03 (LED 3))	UINT32	RO	0x7050:03, 1
1610:04	SubIndex 004	4. PDO Mapping entry (13 bits align)	UINT32	RO	0x0000:00, 13

Index 1A00: AI Acc X TxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	AI Acc X TxPDO-Map	PDO Mapping TxPDO 1	UINT8	RO	0x08 (8_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 8
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (AI Acc Inputs Ch.1), entry 0x03 (Limit))	UINT32	RO	0x6000:09, 2
1A00:03	SubIndex 003	3. PDO Mapping entry (10 bits align)	UINT32	RO	0x6000:0B, 1
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (AI Acc Inputs Ch.1), entry 0x0F (TxPDO State))	UINT32	RO	0x0000:00, 3
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (AI Acc Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:0F, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (16 bits align)	UINT32	RO	0x6000:10, 1
1A00:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (AI Acc Inputs Ch.1), entry 0x12 (Value))	UINT32	RO	0x0000:00, 16
1A00:08	SubIndex 008	8. PDO Mapping entry (16 bits align)	UINT32	RO	0x6000:12, 32

Index 1A01: AI Acc Y TxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	AI Acc Y TxPDO-Map	PDO Mapping TxPDO 2	UINT8	RO	0x08 (8_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 8
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (AI Acc Inputs Ch.2), entry 0x03 (Limit))	UINT32	RO	0x6010:09, 2
1A01:03	SubIndex 003	3. PDO Mapping entry (10 bits align)	UINT32	RO	0x6010:0B, 1
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (AI Acc Inputs Ch.2), entry 0x0F (TxPDO State))	UINT32	RO	0x0000:00, 3
1A01:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (AI Acc Inputs Ch.2), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:0F, 1
1A01:06	SubIndex 006	6. PDO Mapping entry (16 bits align)	UINT32	RO	0x6010:10, 1
1A01:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (AI Acc Inputs Ch.2), entry 0x12 (Value))	UINT32	RO	0x0000:00, 16
1A01:08	SubIndex 008	8. PDO Mapping entry (16 bits align)	UINT32	RO	0x6010:12, 32

Index 1A02: AI Acc Z TxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	AI Acc Z TxPDO-Map	PDO Mapping TxPDO 3	UINT8	RO	0x08 (8_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 8
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (AI Acc Inputs Ch.3), entry 0x03 (Limit))	UINT32	RO	0x6020:09, 2
1A02:03	SubIndex 003	3. PDO Mapping entry (10 bits align)	UINT32	RO	0x6020:0B, 1
1A02:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (AI Acc Inputs Ch.3), entry 0x0F (TxPDO State))	UINT32	RO	0x0000:00, 3
1A02:05	SubIndex 005	5. PDO Mapping entry (object 0x6020 (AI Acc Inputs Ch.3), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6020:0F, 1
1A02:06	SubIndex 006	6. PDO Mapping entry (16 bits align)	UINT32	RO	0x6020:10, 1
1A02:07	SubIndex 007	7. PDO Mapping entry (object 0x6020 (AI Acc Inputs Ch.3), entry 0x12 (Value))	UINT32	RO	0x0000:00, 16
1A02:08	SubIndex 008	8. PDO Mapping entry (16 bits align)	UINT32	RO	0x6020:12, 32

Index 1A03: AI Temp TxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	AI Temp TxPDO-Map	PDO Mapping TxPDO 4	UINT8	RO	0x05 (5_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (14 bits align)	UINT32	RO	0x0000:00, 14
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (AI Temp Inputs Ch.1), entry 0x0F (TxPDO State))	UINT32	RO	0x6040:0F, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (object 0x6030 (AI Temp Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6040:10, 1
1A03:04	SubIndex 004	4. PDO Mapping entry (16 bits align)	UINT32	RO	0x0000:00, 16
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6030 (AI Temp Inputs Ch.1), entry 0x12 (Value))	UINT32	RO	0x6040:12, 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	RO	0x02 (2_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RO	0x1600 (5632_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RO	0x1610 (5648_{dec})

Index 1C13: TxPDO assign

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

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: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: cycle time of the local timer • Synchron with SM 2 Event: cycle time of the master • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{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 1C32:08)	UINT16	RO	0x0003 (3_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x0003D090 (250000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C32:08	Get Cycle Time	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started Entries 1C32:03, 1C32:05, 1C32:06, 1C32:09, 1C33:03, 1C33:06, 1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum 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})
1C32:14	Frame repeat time		UINT32	RW	0x00000000 (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	0x0022 (34_{dec})
1C33:02	Cycle time	as 1C32:02	UINT32	RW	0x000F4240 (1000000_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: Free Run is supported • Bit 1: Synchron with SM 2 Event is supported (outputs available) • Bit 1: Synchron with SM 3 Event is supported (no outputs available) • Bit 2-3 = 01: DC-Mode is supported • Bit 4-5 = 01: Input Shift through local event (outputs available) • Bit 4-5 = 10: Input Shift with SYNC1 Event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 1C32:08 or 1C33:08)	UINT16	RO	0x0003 (3_{dec})
1C33:05	Minimum cycle time	as 1C32:05	UINT32	RO	0x0003D090 (250000_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C33:08	Get Cycle Time	as 1C32:08	UINT16	RW	0x0000 (0_{dec})
1C33:09	Maximum delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 1C32:11	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 1C32:12	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 1C32:13	UINT16	RO	0x0000 (0_{dec})
1C33:14	Frame repeat time		UINT32	RW	0x00000000 (0_{dec})
1C33:20	Sync error	as 1C32:32	BOOLEAN	RO	0x00 (0_{dec})

6.3 Profile-specific objects

Index 6000: AI Acc Inputs X

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	AI Acc Inputs X		UINT8	RO	0x12 (18_{dec})
6000:09	Self test status		BIT2	RO	0x00 (0_{dec})
6000:0B	Slope detected		BOOLEAN	RO	0x00 (0_{dec})
6000:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6000:12	Value		INT32	RO	0x00000000 (0_{dec})

Index 6010: AI Acc Inputs Y

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	AI Acc Inputs Y		UINT8	RO	0x12 (18_{dec})
6010:09	Self test status		BIT2	RO	0x00 (0_{dec})
6010:0B	Slope detected		BOOLEAN	RO	0x00 (0_{dec})
6010:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6010:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6010:12	Value		INT32	RO	0x00000000 (0_{dec})

Index 6020: AI Acc Inputs Z

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	AI Acc Inputs Z		UINT8	RO	0x12 (18_{dec})
6020:09	Self test status		BIT2	RO	0x00 (0_{dec})
6020:0B	Slope detected		BOOLEAN	RO	0x00 (0_{dec})
6020:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6020:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6020:12	Value		INT32	RO	0x00000000 (0_{dec})

Index 6040: AI Temp Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6040:0	AI Temp Inputs Ch.1		UINT8	RO	0x12 (18_{dec})
6040:0F	TxPDO State		BOOLEAN	RO	0x00 (0_{dec})
6040:10	TxPDO Toggle		BOOLEAN	RO	0x00 (0_{dec})
6040:12	Value		INT32	RO	0x00000000 (0_{dec})

Index 7030: AI Acc Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	AI Acc Outputs		UINT8	RO	0x03 (3_{dec})
7030:03	Start self test		BOOLEAN	RO	0x00 (0_{dec})

Index 7050: DIG Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7050:0	DIG Outputs Ch.1		UINT8	RO	0x03 (3_{dec})
7050:01	LED 1		BOOLEAN	RO	0x00 (0_{dec})
7050:02	LED 2		BOOLEAN	RO	0x00 (0_{dec})
7050:03	LED 3		BOOLEAN	RO	0x00 (0_{dec})

Index 800F: AI Acc Vendor data X

Index (hex)	Name	Meaning	Data type	Flags	Default
800F:0	AI Acc Vendor data X	Coefficients of the vendor calibration for the acceleration axis X	UINT8	RO	0x02 (2_{dec})
800F:01	Offset		INT16	RW	0x0000 (0_{dec})
800F:02	Gain		INT16	RW	0x4000 (16384_{dec})

Index 801F: AI Acc Vendor data Y

Index (hex)	Name	Meaning	Data type	Flags	Default
801F:0	AI Acc Vendor data Y	Coefficients of the vendor calibration for the acceleration axis Y	UINT8	RO	0x02 (2_{dec})
801F:01	Offset		INT16	RW	0x0000 (0_{dec})
801F:02	Gain		INT16	RW	0x4000 (16384_{dec})

Index 802F: AI Acc Vendor data Z

Index (hex)	Name	Meaning	Data type	Flags	Default
802F:0	AI Acc Vendor data Z	Coefficients of the vendor calibration for the acceleration axis Z	UINT8	RO	0x02 (2_{dec})
802F:01	Offset		INT16	RW	0x0000 (0_{dec})
802F:02	Gain		INT16	RW	0x4000 (16384_{dec})

Index 804F: AI Temp Vendor data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
804F:0	AI Temp Vendor data Ch.1		UINT8	RO	0x08 (8_{dec})
804F:01	Offset		INT16	RW	0x0000 (0_{dec})
804F:02	Gain		INT16	RW	0x0000 (0_{dec})
804F:03	shd0		UINT8	RW	0x00 (0_{dec})
804F:04	shd1		UINT8	RW	0x00 (0_{dec})
804F:05	shd2		UINT8	RW	0x00 (0_{dec})
804F:06	shd3		UINT8	RW	0x00 (0_{dec})
804F:07	shd4		UINT8	RW	0x00 (0_{dec})
804F:08	shd5		UINT8	RW	0x00 (0_{dec})

Index F000: Modular Device Profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular Device Profile	General information for the Modular Device Profile	UINT8	RO	0x02 (2_{dec})
F000:01	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	0x0006 (6_{dec})

Index F008: Code word

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

Index F010: Module Profile List

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module Profile List		UINT8	RO	0x06 (6_{dec})
F010:01	SubIndex 001		UINT32	RO	0x0000012C (300_{dec})
F010:02	SubIndex 002		UINT32	RO	0x0000012C (300_{dec})
F010:03	SubIndex 003		UINT32	RO	0x0000012C (300_{dec})
F010:04	SubIndex 004		UINT32	RO	0x0000012C (300_{dec})
F010:05	SubIndex 005		UINT32	RO	0x0000012C (300_{dec})
F010:06	SubIndex 006		UINT32	RO	0x00000118 (280_{dec})

Index FB10: CMD Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB10:0	CMD Command		UINT8	RO	0x03 (3_{dec})
FB10:01	Request		OCTET-STRING[6]	RW	{0}
FB10:02	State		UINT8	RO	0x00 (0_{dec})
FB10:03	Response		OCTET-STRING[6]	RO	{0}

7 Appendix

7.1 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

7.2 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
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

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

Further accessories

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

7.3 Version identification of EtherCAT devices

7.3.1 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.

7.3.2 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**	Example with serial number 12 06 3A 02:
KK - week of production (CW, calendar week)	12 - production week 12
YY - year of production	06 - production year 2006
FF - firmware version	3A - firmware version 3A
HH - hardware version	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

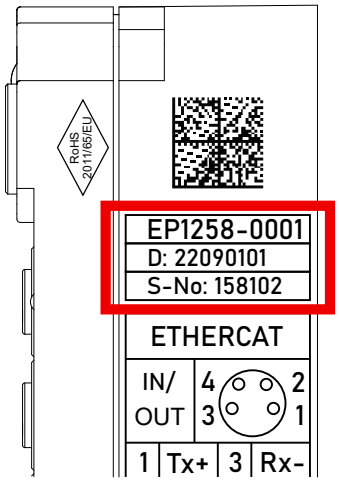


Fig. 7: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

7.3.3 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.

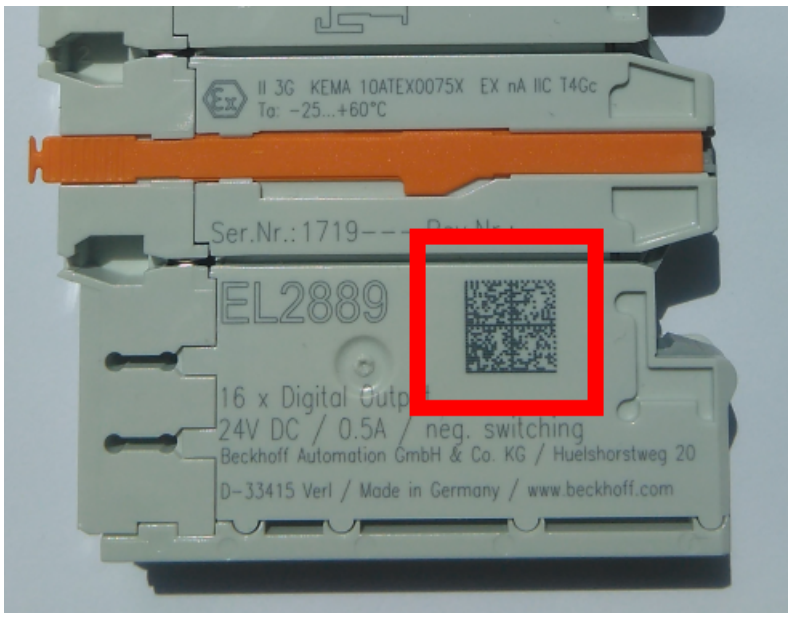


Fig. 8: BIC as data matrix code (DMC, code scheme ECC200)

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	**1K**EL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	**Q**1
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**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:



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

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.

7.3.4 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.

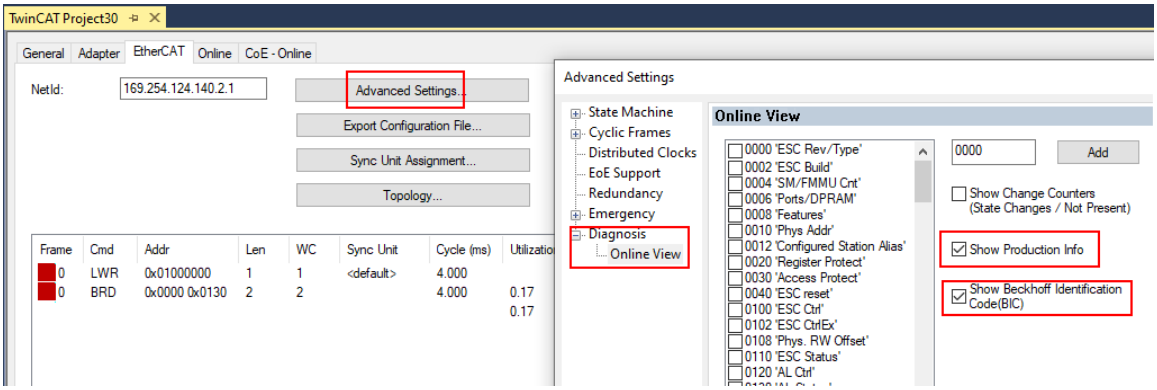
EtherCAT devices (IP20, IP67)

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.

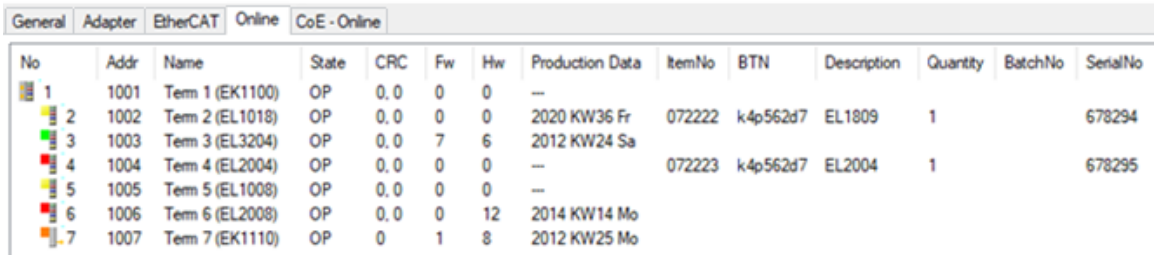
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

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:

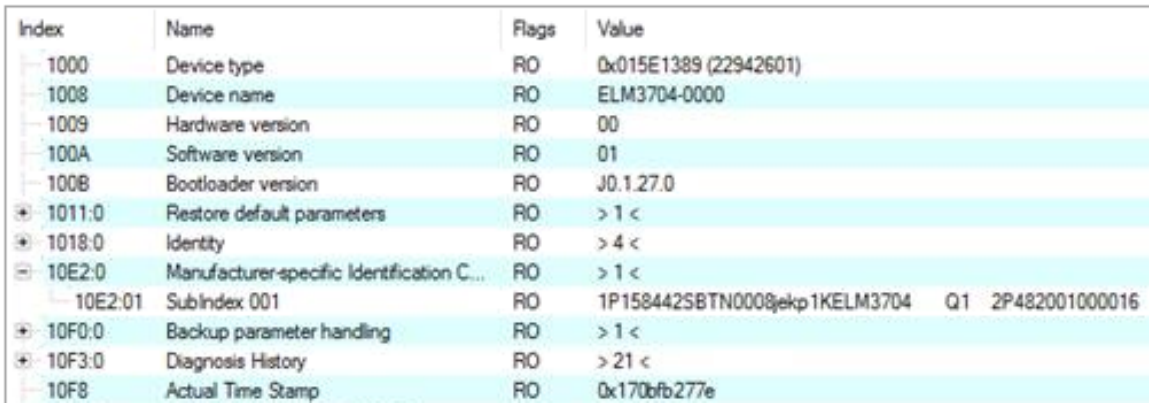


  - The BTN and its contents are then displayed:



  - 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	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 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_Utilities* 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.

7.4 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: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Support

The Beckhoff 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

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web:	www.beckhoff.com/support

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- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
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