BECKHOFF New Automation Technology

Documentation | EN

EPP4174-0002

4-channel analog output ±10 V or 0/4...20 mA, parameterisable, 16 bit

2023-02-01 | Version: 1.2

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

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

Patent Pending

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

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

Copyright

1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Description of instructions

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

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.2	• EtherCAT P status LEDs updated • Technical data updated • Signal connection updated
1.1	• Dimensions updated • UL requirements updated
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) YY - year of production FF - firmware version HH - hardware version	29 - week of production 29 10 - year of production 2010 02 - firmware version 02 01 - hardware version 01

Further information on this topic: Version identification of EtherCAT devices [▶ 61].

2 Product group: EtherCAT P Box modules

EtherCAT P

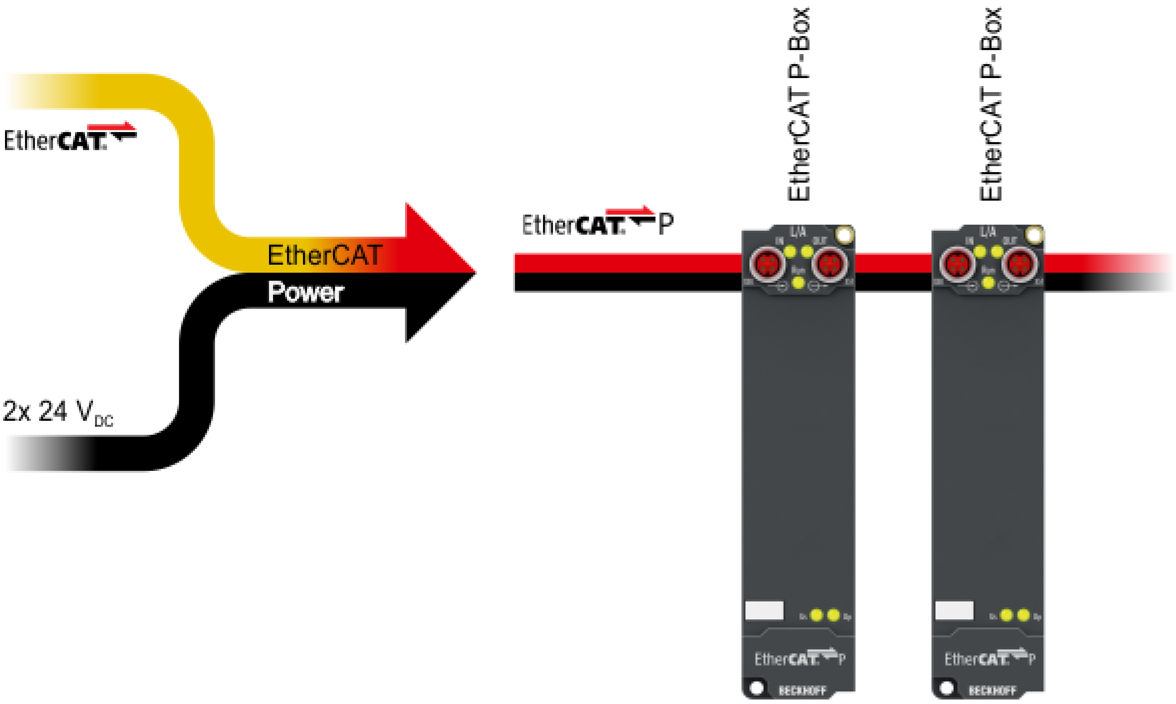
EtherCAT P supplements the EtherCAT technology with a process in which communication and supply voltages are transmitted on a common line. All EtherCAT properties are retained with this process.

Two supply voltages are transmitted per EtherCAT P line. The supply voltages are electrically isolated from each other and can therefore be switched individually. The nominal supply voltage for both is 24 V_{DC}.

EtherCAT P uses the same cable structure as EtherCAT: a 4-core Ethernet cable with M8 connectors. The connectors are mechanically coded so that EtherCAT connectors and EtherCAT P connectors cannot be interchanged.

EtherCAT P Box modules

EtherCAT P Box modules are EtherCAT P slaves with degree of protection IP67. They are designed for operation in wet, dirty or dusty industrial environments.

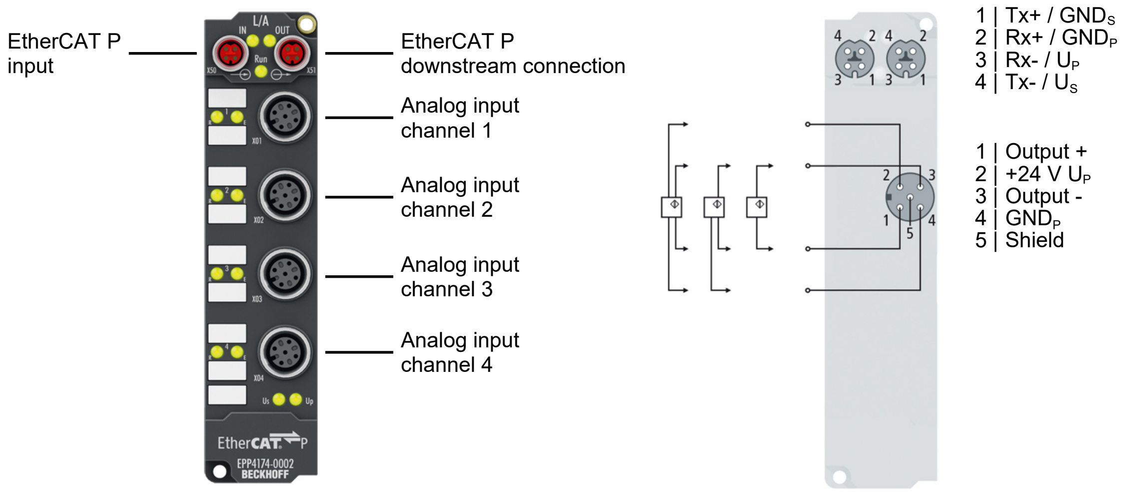


EtherCAT basics

A detailed description of the EtherCAT system can be found in the EtherCAT system documentation.

3 Product overview

3.1 Introduction



The EPP4174-0002 EtherCAT P Box has four analog outputs which can be individually parameterised, so that they generate signals either in the -10 … +10 V or the 0/4 … 20 mA range.

The voltage or output current is supplied to the process level with a resolution of 15 bit (default), and is electrically isolated. The output scaling can be changed if required.

The four outputs have a common ground potential, which is galvanically isolated from the ground potentials of the supply voltages. The analog actuators are supplied from the load voltage (freely selectable up to 30 V_{DC}). The applied load voltage is available for actuator supply of further EtherCAT P Box modules.

Quick links

Technical data [▶ 10]
Process image [▶ 13]
Dimensions [▶ 14]
Signal connection [▶ 20]

3.2 Technical data

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

EtherCAT P	
Connection	2 x M8 socket, 4-pin, P-coded, red

Supply voltages	
Connection	See EtherCAT P connection
U_S nominal voltage	24 V_{DC} (-15 % / +20 %)
U_S sum current: $I_{S,sum}$	max. 3 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. 3 A
Current consumption from U_P	Current for actuator supply.

Number of outputs	4
Connection outputs	M12 socket, screwable
Cable length	max. 30 m from the box to the actuator.
Signal type	Adjustable: -10 … +10 V (default) 0 … +10 V 0 … 20 mA 4 … 20 mA
Load resistor / load	> 5 kΩ for signal types: 10 … +10 V 0 … +10 V < 500 Ω for signal types: 0 … 20 mA 4 … 20 mA
Resolution	16 bits (including sign)
Output error	< 0.1 % (ambient temperature 0 °C ... +55 °C) < 0.2 % (ambient temperature < 0 °C or > 55 °C) related to the final value.
Actuator supply	From the load voltage U_P.
Largest short-term deviation during a specified electrical interference test	0.5 % of full scale value

Housing data	
Dimensions W x H x D	30 mm x 126 mm x 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 cULus
Ambient temperature during storage	-40 … +85 °C
Vibration resistance, shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27 Additional checks [▶ 11]
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, cULus [▶ 22]

*) 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:

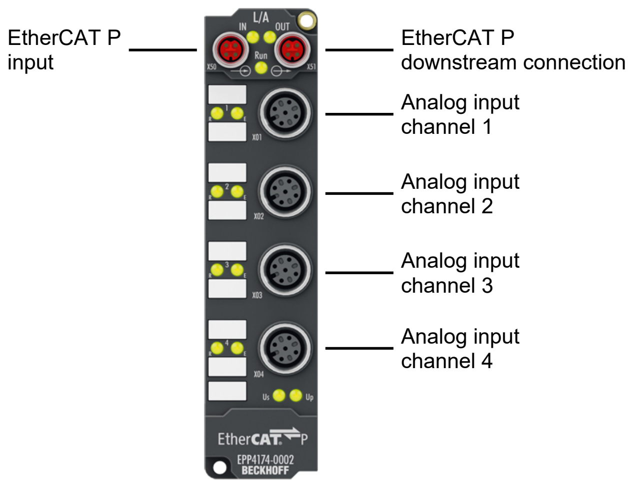
- 1x EPP4174-0002 EtherCAT P Box
- 2x protective cap for EtherCAT P socket, M8, red (pre-assembled)
- 10x labels, blank (1 strip of 10)

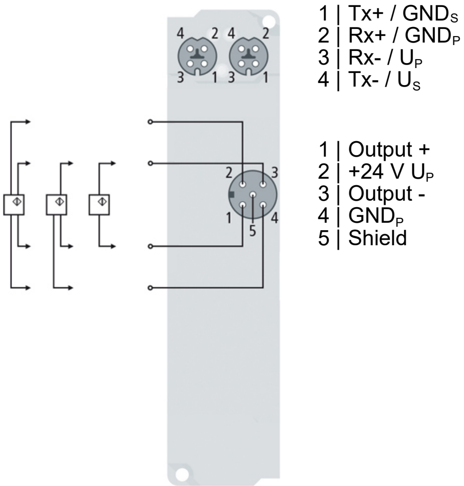
Pre-assembled protective caps do not ensure IP67 protection

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 Status LEDs





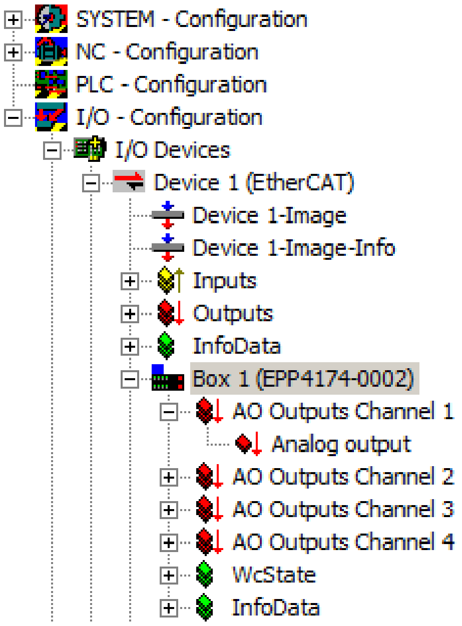
Status LEDs at the M12 connections

Connection	LED	Display	Meaning
M12 socket no. 1-4	R left	off	No data transfer to the D/A converter
		green	Data transfer to the D/A converter
	E right	off	Function OK
		red	Error: Broken wire or measured value outside the measuring range

Power supply

LED	Display	Meaning
Us	off	the power supply voltage, Us, is not present
	green illuminated	the power supply voltage, Us, is present
Up	off	the power supply voltage, Up, is not present
	green illuminated	The power supply voltage, Up, is present

3.5 Process image



AO Outputs Channel 1

The data for the first analog channel can be found under **AO Outputs Channel 1**.

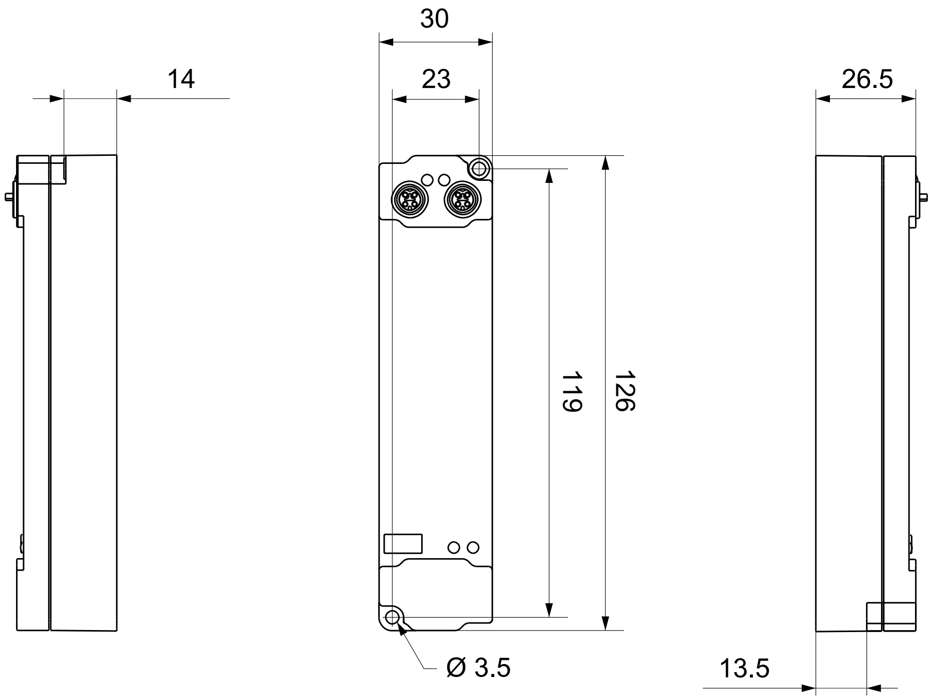
AO Outputs Channel 2 to 4

The data of analog channels 2 to 4 have the same structure as those of the first channel.

4 Mounting and connection

4.1 Mounting

4.1.1 Dimensions



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

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two 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. 126 x 30 x 26.5 mm (without connectors)

4.1.2 Fixing

NOTE

Dirt during assembly

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

- Protect the plug connectors against dirt during the assembly.

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

4.1.3 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.

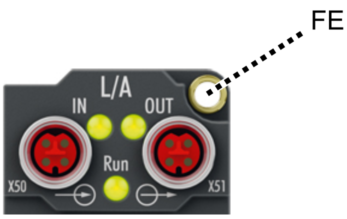


Fig. 1: Connection for functional earth (FE)

4.1.4 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

4.2 EtherCAT P

⚠ 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 the EtherCAT P Power Sourcing Device (PSD).

Notes:

- SELV/PELV circuits may give rise to further requirements from standards such as IEC 60204-1 et al, for example with regard to cable spacing and insulation.
- A SELV (Safety Extra Low Voltage) supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor,
  a PELV (Protective Extra Low Voltage) supply also requires a safe connection to the protective conductor.

⚠ CAUTION

Observe the UL requirements

- When operating under UL conditions, observe the warnings in the chapter UL Requirements [▶ 22].

EtherCAT P transmits 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 P Box has inputs.
- **Peripheral voltage U_P**
  The digital outputs are typically supplied from the peripheral voltage U_P for EtherCAT P Box modules with digital outputs. 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 supply voltages are passed on internally from the "IN" connection to the "OUT" connection. Hence, the supply voltages U_S and U_P can be passed from one EtherCAT P Box to the next EtherCAT P Box in a simple manner.

NOTE

Note the maximum current.

Ensure that the maximum permitted current of 3 A for the M8 connectors is not exceeded when redirecting EtherCAT P.

4.2.1 Connectors

NOTE

Risk of damage to the device!

Bring the EtherCAT/EtherCAT P system into a safe, powered down state before starting installation, disassembly or wiring of the modules!

Two M8 sockets at the upper end of the modules are provided for supply and downstream connection of EtherCAT P:

- IN: left M8 socket for EtherCAT P supply
- OUT: right M8 socket for downstream connection of EtherCAT P

The metal threads of the M8 EtherCAT P sockets are internally linked to the FE connection via high impedance RC combination. See chapter Functional earth (FE) [▶ 15].

Fig. 2: Connectors for EtherCAT P

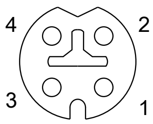


Fig. 3: M8 socket, p-coded

Contact	Signal	Voltage	Core color [1)]
1	Tx +	GND_S	yellow
2	Rx +	GND_P	white
3	Rx -	U_P: peripheral voltage, +24 V_{DC}	blue
4	Tx -	U_S: control voltage, +24 V_{DC}	orange
Housing	Shield	Shield	Shield

[1)] The core colors apply to EtherCAT P cables and ECP cables from Beckhoff.

4.2.2 Status LEDs

4.2.2.1 Supply voltages

EtherCAT P Box modules indicate the status of the supply voltages via two status LEDs. The status LEDs are labeled with the designations of the supply voltages: Us and Up.

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.

4.2.2.2 EtherCAT

L/A (Link/Act)

A green LED labeled "L/A" or "Link/Act" is located next to each EtherCAT/EtherCAT P 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

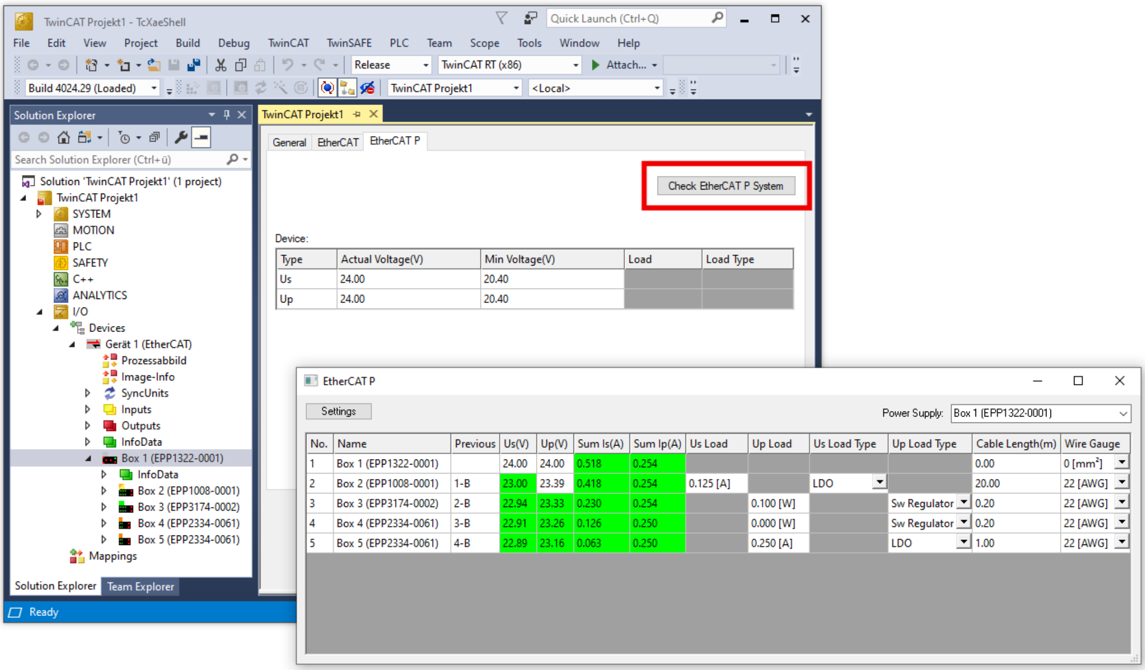
Description of the EtherCAT slave states

4.2.3 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.

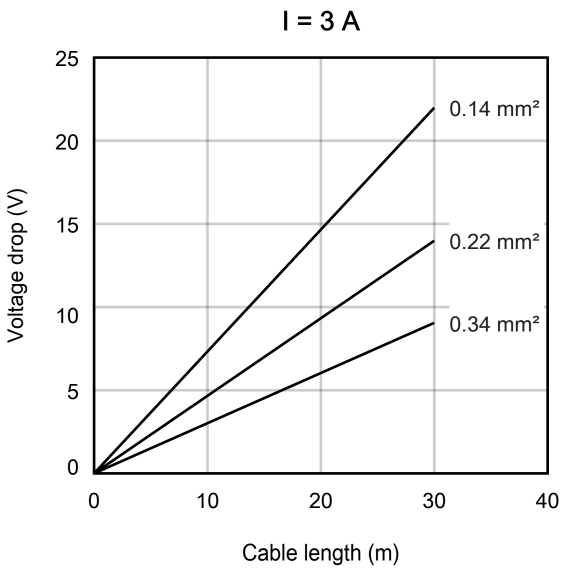
Planning tool for EtherCAT P

You can plan cable lengths, voltages and currents of your EtherCAT P system using TwinCAT 3. The requirement for this is TwinCAT 3 Build 4020 or higher.



Further information can be found in the quick start guide IO configuration in TwinCAT in chapter "Configuration of EtherCAT P via TwinCAT".

Voltage drop on the supply line



4.3 Signal connection

NOTE

Supply and connection of sensors and actuators to EtherCAT P Box modules

The connected sensors and actuators must be supplied by an EtherCAT P Box. GND_S and GND_P from one of the M8 / M12 signal connections of an EtherCAT P Box must not be connected to the machine bed.

Supply of externally powered sensors or actuators

If the sensors and actuators cannot be supplied from the EtherCAT P Box, the supply of externally powered sensors and actuators must be electrically isolated.

EMC shield clamp

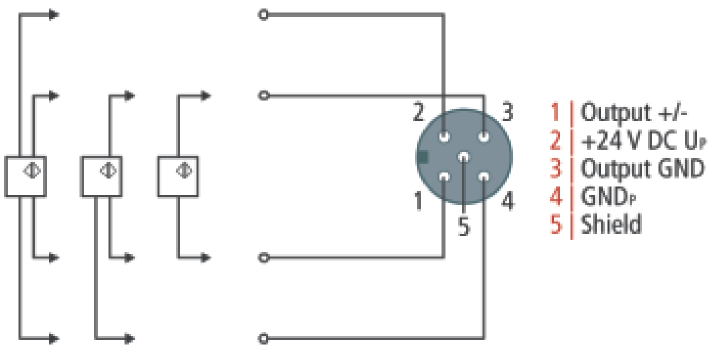
Depending on the application it may be necessary to additionally attach the shield of the sensor cables at the signal inputs of the box with shield clamps ZB8513-0002.

See Chapter: "Accessories", section "Cables" [▸ 60].

4.3.1 Analog voltage outputs (M12)

Analog outputs, -10 to +10 V

The actuator is connected via “Output +/-“ and “Output GND”. The actuator can optionally be operated/ supplied with 24 V_{DC}.



The ground potentials "Output GND" (pin 3) and "GND_P" (pin 4) are galvanically isolated. If the actuator requires a supply voltage and has only one ground connection, connect pin 3 and pin 4 with a bridge.

LED indicators - meanings

There is a green *Run* LED and a red *Error* LED for each channel. The green *Run* LED is lit when data are transferred to the D/A converter. The red *Error* LED indicates that there is an error (open circuit, measured value outside the range).
Correct function is indicated if the green *Run* LED is on and the red *Error* is off.

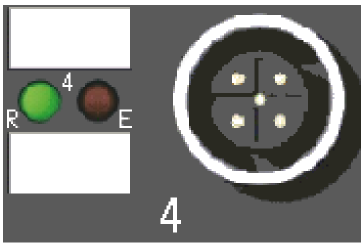
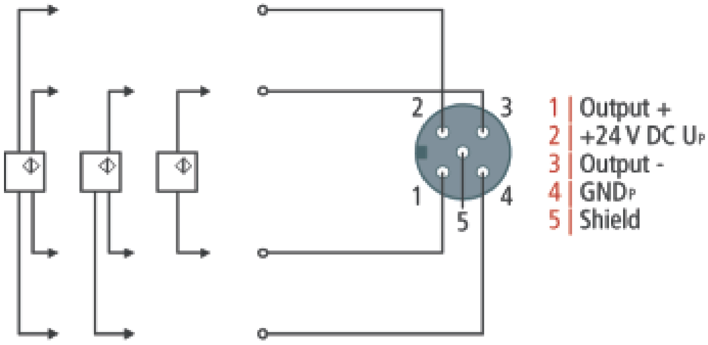


Fig. 4: Status and diagnostic LED at the M12 connector

4.3.2 Analog current outputs (M12)

Analog outputs, 0 to 20 mA or 4 to 20 mA

The actuator is connected via “Output +” and “Output –“. The actuator can optionally be operated/supplied with 24 V_{DC}.



LED indicators - meanings

There is a green *Run* LED and a red *Error* LED for each channel. The green *Run* LED is lit when data are transferred to the D/A converter. The red *Error* LED indicates that there is an error (open circuit, measured value outside the range).
Correct function is indicated if the green *Run* LED is on and the red *Error* is off.

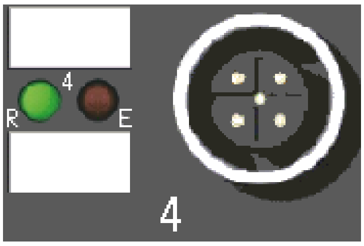


Fig. 5: Status and diagnostic LED at the M12 connector

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/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 Object overview

EtherCAT XML Device Description

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

Index (hex)		Name	Flags	Default value
1000 [▶ 34]		Device type	RO	0x01901389 (26219401$_{dec}$)
1008 [▶ 34]		Device name	RO	EP4174-0002
1009 [▶ 34]		Hardware version	RO	00
100A [▶ 34]		Software version	RO	01
1011:0 [▶ 29]	**Subindex**	Restore default parameters	RO	0x01 (1$_{dec}$)
	1011:01	SubIndex 001	RW	0x00000000 (0$_{dec}$)
1018:0 [▶ 34]	**Subindex**	Identity	RO	0x04 (4$_{dec}$)
	1018:01	Vendor ID	RO	0x00000002 (2$_{dec}$)
	1018:02	Product code	RO	0x104E4052 (273563730$_{dec}$)
	1018:03	Revision	RO	0x00100002 (1048578$_{dec}$)
	1018:04	Serial number	RO	0x00000000 (0$_{dec}$)
10F0:0 [▶ 34]	**Subindex**	Backup parameter handling	RO	0x01 (1$_{dec}$)
	10F0:01	Checksum	RO	0x00000000 (0$_{dec}$)
1600:0 [▶ 34]	**Subindex**	AO RxPDO-Map Ch.1	RO	0x01 (1$_{dec}$)
	1600:01	SubIndex 001	RO	0x7000:11, 16
1601:0 [▶ 35]	**Subindex**	AO RxPDO-Map Ch.2	RO	0x01 (1$_{dec}$)
	1601:01	SubIndex 001	RO	0x7010:11, 16
1602:0 [▶ 35]	**Subindex**	AO RxPDO-Map Ch.3	RO	0x01 (1$_{dec}$)
	1602:01	SubIndex 001	RO	0x7020:11, 16
1603:0 [▶ 35]	**Subindex**	AO RxPDO-Map Ch.4	RO	0x01 (1$_{dec}$)
	1603:01	SubIndex 001	RO	0x7030:11, 16
1C00:0 [▶ 35]	**Subindex**	Sync manager type	RO	0x04 (4$_{dec}$)
	1C00:01	SubIndex 001	RO	0x01 (1$_{dec}$)
	1C00:02	SubIndex 002	RO	0x02 (2$_{dec}$)
	1C00:03	SubIndex 003	RO	0x03 (3$_{dec}$)
	1C00:04	SubIndex 004	RO	0x04 (4$_{dec}$)
1C12:0 [▶ 35]	**Subindex**	RxPDO assign	RW	0x04 (4$_{dec}$)
	1C12:01	SubIndex 001	RW	0x1600 (5632$_{dec}$)
	1C12:02	SubIndex 002	RW	0x1601 (5633$_{dec}$)
	1C12:03	SubIndex 003	RW	0x1602 (5634$_{dec}$)
	1C12:04	SubIndex 004	RW	0x1603 (5635$_{dec}$)
1C13:0 [▶ 35]	**Subindex**	TxPDO assign	RW	0x00 (0$_{dec}$)
1C32:0 [▶ 36]	**Subindex**	SM output parameter	RO	0x20 (32$_{dec}$)
	1C32:01	Sync mode	RW	0x0001 (1$_{dec}$)
	1C32:02	Cycle time	RW	0x000F4240 (1000000$_{dec}$)
	1C32:03	Shift time	RO	0x00003A98 (15000$_{dec}$)
	1C32:04	Sync modes supported	RO	0xC007 (49159$_{dec}$)
	1C32:05	Minimum cycle time	RO	0x000493E0 (300000$_{dec}$)
	1C32:06	Calc and copy time	RO	0x00000000 (0$_{dec}$)
	1C32:07	Minimum delay time	RO	0x00003A98 (15000$_{dec}$)
	1C32:08	Command	RW	0x0000 (0$_{dec}$)
	1C32:09	Maximum Delay time	RO	0x00003A98 (15000$_{dec}$)
	1C32:0B	SM event missed counter	RO	0x0000 (0$_{dec}$)
	1C32:0C	Cycle exceeded counter	RO	0x0000 (0$_{dec}$)
	1C32:0D	Shift too short counter	RO	0x0000 (0$_{dec}$)
	1C32:20	Sync error	RO	0x00 (0$_{dec}$)
Index (hex)		Name	Flags	Default value
7000:0 [▶ 37]	**Subindex**	AO outputs Ch.1	RO	0x11 (17$_{dec}$)
	7000:11	Analog output	RO	0x0000 (0$_{dec}$)
7010:0 [▶ 37]	**Subindex**	AO outputs Ch.2	RO	0x11 (17$_{dec}$)
	7010:11	Analog output	RO	0x0000 (0$_{dec}$)
7020:0 [▶ 37]	**Subindex**	AO outputs Ch.3	RO	0x11 (17$_{dec}$)
	7020:11	Analog output	RO	0x0000 (0$_{dec}$)
7030:0 [▶ 37]	**Subindex**	AO outputs Ch.4	RO	0x11 (17$_{dec}$)
	7030:11	Analog output	RO	0x0000 (0$_{dec}$)

Index (hex)		Name	Flags	Default value
8000:0 [▶ 30]	**Subindex**	AO settings Ch.1	RW	0x16 (22_{dec})
	8000:01	Enable user scale	RW	0x00 (0_{dec})
	8000:02	Presentation	RW	0x00 (0_{dec})
	8000:05	Watchdog	RW	0x00 (0_{dec})
	8000:07	Enable user calibration	RW	0x00 (0_{dec})
	8000:08	Enable vendor calibration	RW	0x01 (1_{dec})
	8000:11	User scale offset	RW	0x0000 (0_{dec})
	8000:12	User scale gain	RW	0x00010000 (65536_{dec})
	8000:13	Default output	RW	0x0000 (0_{dec})
	8000:14	Default output ramp	RW	0xFFFF (65535_{dec})
	8000:15	User calibration offset	RW	0x0000 (0_{dec})
	8000:16	User calibration gain	RW	0x4000 (16384_{dec})
800E:0 [▶ 37]	**Subindex**	AO internal data Ch.1	RO	0x01 (1_{dec})
	800E:01	DAC raw value	RO	0x0000 (0_{dec})
800F:0 [▶ 37]	**Subindex**	AO vendor data Ch.1	RW	0x06 (6_{dec})
	800F:01	R0 Calibration Offset	RW	0x0000 (0_{dec})
	800F:02	R0 Calibration Gain	RW	0x4000 (16384_{dec})
	800F:03	R1 Calibration Offset	RW	0x0000 (0_{dec})
	800F:04	R1 Calibration Gain	RW	0x4000 (16384_{dec})
	800F:05	R2 Calibration Offset	RW	0x0000 (0_{dec})
	800F:06	R2 Calibration Gain	RW	0x4000 (16384_{dec})
8010:0 [▶ 31]	**Subindex**	AO settings Ch.2	RW	0x16 (22_{dec})
	8010:01	Enable user scale	RW	0x00 (0_{dec})
	8010:02	Presentation	RW	0x00 (0_{dec})
	8010:05	Watchdog	RW	0x00 (0_{dec})
	8010:07	Enable user calibration	RW	0x00 (0_{dec})
	8010:08	Enable vendor calibration	RW	0x01 (1_{dec})
	8010:11	User scale offset	RW	0x0000 (0_{dec})
	8010:12	User scale gain	RW	0x00010000 (65536_{dec})
	8010:13	Default output	RW	0x0000 (0_{dec})
	8010:14	Default output ramp	RW	0xFFFF (65535_{dec})
	8010:15	User calibration offset	RW	0x0000 (0_{dec})
	8010:16	User calibration gain	RW	0x4000 (16384_{dec})
801E:0 [▶ 37]	**Subindex**	AO internal data Ch.2	RO	0x01 (1_{dec})
	801E:01	DAC raw value	RO	0x0000 (0_{dec})
801F:0 [▶ 38]	**Subindex**	AO vendor data Ch.2	RW	0x06 (6_{dec})
	801F:01	R0 Calibration Offset	RW	0x0000 (0_{dec})
	801F:02	R0 Calibration Gain	RW	0x4000 (16384_{dec})
	801F:03	R1 Calibration Offset	RW	0x0000 (0_{dec})
	801F:04	R1 Calibration Gain	RW	0x4000 (16384_{dec})
	801F:05	R2 Calibration Offset	RW	0x0000 (0_{dec})
	801F:06	R2 Calibration Gain	RW	0x4000 (16384_{dec})
Index (hex)		Name	Flags	Default value
8020:0 [▶ 32]	**Subindex**	AO settings Ch.3	RW	0x16 (22_{dec})
	8020:01	Enable user scale	RW	0x00 (0_{dec})
	8020:02	Presentation	RW	0x00 (0_{dec})
	8020:05	Watchdog	RW	0x00 (0_{dec})
	8020:07	Enable user calibration	RW	0x00 (0_{dec})
	8020:08	Enable vendor calibration	RW	0x01 (1_{dec})
	8020:11	User scale offset	RW	0x0000 (0_{dec})
	8020:12	User scale gain	RW	0x00010000 (65536_{dec})
	8020:13	Default output	RW	0x0000 (0_{dec})
	8020:14	Default output ramp	RW	0xFFFF (65535_{dec})
	8020:15	User calibration offset	RW	0x0000 (0_{dec})
	8020:16	User calibration gain	RW	0x4000 (16384_{dec})
802E:0 [▶ 38]	**Subindex**	AO internal data Ch.3	RO	0x01 (1_{dec})
	802E:01	DAC raw value	RO	0x0000 (0_{dec})

Index (hex)		Name	Flags	Default value
802F:0 [▸ 38]	**Subindex**	AO vendor data Ch.3	RW	0x06 (6_{dec})
	802F:01	R0 Calibration Offset	RW	0x0000 (0_{dec})
	802F:02	R0 Calibration Gain	RW	0x4000 (16384_{dec})
	802F:03	R1 Calibration Offset	RW	0x0000 (0_{dec})
	802F:04	R1 Calibration Gain	RW	0x4000 (16384_{dec})
	802F:05	R2 Calibration Offset	RW	0x0000 (0_{dec})
	802F:06	R2 Calibration Gain	RW	0x4000 (16384_{dec})
8030:0 [▸ 33]	**Subindex**	AO settings Ch.4	RW	0x16 (22_{dec})
	8030:01	Enable user scale	RW	0x00 (0_{dec})
	8030:02	Presentation	RW	0x00 (0_{dec})
	8030:05	Watchdog	RW	0x00 (0_{dec})
	8030:07	Enable user calibration	RW	0x00 (0_{dec})
	8030:08	Enable vendor calibration	RW	0x01 (1_{dec})
	8030:11	User scale offset	RW	0x0000 (0_{dec})
	8030:12	User scale gain	RW	0x00010000 (65536_{dec})
	8030:13	Default output	RW	0x0000 (0_{dec})
	8030:14	Default output ramp	RW	0xFFFF (65535_{dec})
	8030:15	User calibration offset	RW	0x0000 (0_{dec})
	8030:16	User calibration gain	RW	0x4000 (16384_{dec})
803E:0 [▸ 38]	**Subindex**	AO internal data Ch.4	RO	0x01 (1_{dec})
	803E:01	DAC raw value	RO	0x0000 (0_{dec})
803F:0 [▸ 38]	**Subindex**	AO vendor data Ch.4	RW	0x06 (6_{dec})
	803F:01	R0 Calibration Offset	RW	0x0000 (0_{dec})
	803F:02	R0 Calibration Gain	RW	0x4000 (16384_{dec})
	803F:03	R1 Calibration Offset	RW	0x0000 (0_{dec})
	803F:04	R1 Calibration Gain	RW	0x4000 (16384_{dec})
	803F:05	R2 Calibration Offset	RW	0x0000 (0_{dec})
	803F:06	R2 Calibration Gain	RW	0x4000 (16384_{dec})
F000:0 [▸ 38]	**Subindex**	Modular device profile	RO	0x02 (2_{dec})
	F000:01	Module index distance	RO	0x0010 (16_{dec})
	F000:02	Maximum number of modules	RO	0x0004 (4_{dec})
F008 [▸ 39]		Code word	RW	0x00000000 (0_{dec})
F010:0 [▸ 39]	**Subindex**	Module list	RW	0x04 (4_{dec})
	F010:01	SubIndex 001	RW	0x00000190 (400_{dec})
	F010:02	SubIndex 002	RW	0x00000190 (400_{dec})
	F010:03	SubIndex 003	RW	0x00000190 (400_{dec})
	F010:04	SubIndex 004	RW	0x00000190 (400_{dec})
F800:0 [▸ 33]	**Subindex**	AO Range Settings	RW	0x04 (4_{dec})
	F800:01	Output type Ch1	RW	0x0000 (0_{dec})
	F800:02	Output type Ch2	RW	0x0000 (0_{dec})
	F800:03	Output type Ch3	RW	0x0000 (0_{dec})
	F800:04	Output type Ch4	RW	0x0000 (0_{dec})

Legend

Flags:
RO (Read Only): this object can be read only
RW (Read/Write): this object can be read and written to

5.3 Object description and parameterization

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

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

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▸ 29] during commissioning
- Objects intended for regular operation [▸ 34], e. g. through ADS access.
- Objects for indicating internal settings [▸ 34] (may be fixed)
- Further profile-specific objects [▸ 37] indicating inputs, outputs and status information

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

5.3.1 Objects to be parameterized during commissioning

Index 1011 Restore default parameters

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

Index 8000 AO settings Ch.1

Index (hex)	Name	Meaning		Data type	Flags	Default
8000:0	AO settings Ch.1	Maximum subindex		UINT8	RO	0x16 (22_{dec})
8000:01	Enable user scale	This entry activates the scaling for 0x8pp0:11 and 0x8pp0:12.		BOOLEAN	RW	0x00 (0_{dec})
8000:02	Presentation	0	Signed presentation The output value range 0x7pp1:11 is shown as 16 bit signed integer. For unipolar terminals (0-10V or 0-20 mA) the negative range is set to zero.	BIT3	RW	0x00 (0_{dec})
		1	Unsigned presentation The output value range 0x7pp1:11 is shown as 16 bit unsigned integer. Negative values are not possible.			
		2	Absolute value with MSB as sign Signed amount representation is active.			
		3	Absolute value The absolute value of the signed representation is formed.			
8000:05	Watchdog	0	Default watchdog value The default value (0x8pp0:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp The ramp (0x8pp0:14) for moving to the default value ((0x8pp0:13)) is active.			
		2	Last output value In the event of an error (triggering of the watchdog) the last process data is output.			
8000:07	Enable user calibration	Enables user calibration		BOOLEAN	RW	0x00 (0_{dec})
8000:08	Enable vendor calibration	Enable vendor calibration		BOOLEAN	RW	0x01 (1_{dec})
8000:11	User scale offset	User scaling: Offset		INT16	RW	0x0000 (0_{dec})
8000:12	User scale gain	User scaling: Gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value one corresponds to 65535 (0x00010000).		INT32	RW	0x00010000 (65536_{dec})
8000:13	Default output	Default output value		INT16	RW	0x0000 (0_{dec})
8000:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		UINT16	RW	0xFFFF (65535_{dec})
8000:15	User calibration offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
8000:16	User calibration gain	User calibration: Gain		UINT16	RW	0x4000 (16384_{dec})

Index 8010 AO settings Ch.2

Index (hex)	Name	Meaning		Data type	Flags	Default
8010:0	AO settings Ch.2	Maximum subindex		UINT8	RO	0x16 (22_{dec})
8010:01	Enable user scale	This entry activates the scaling for 0x8pp0:11 and 0x8pp0:12.		BOOLEAN	RW	0x00 (0_{dec})
8010:02	Presentation	0	Signed presentation The output value range 0x7pp1:11 is shown as 16 bit signed integer. For unipolar terminals (0-10V or 0-20 mA) the negative range is set to zero.	BIT3	RW	0x00 (0_{dec})
		1	Unsigned presentation The output value range 0x7pp1:11 is shown as 16 bit unsigned integer. Negative values are not possible.			
		2	Absolute value with MSB as sign Signed amount representation is active.			
		3	Absolute value The absolute value of the signed representation is formed.			
8010:05	Watchdog	0	Default watchdog value The default value (0x8pp0:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp The ramp (0x8pp0:14) for moving to the default value ((0x8pp0:13)) is active.			
		2	Last output value In the event of an error (triggering of the watchdog) the last process data is output.			
8010:07	Enable user calibration	Enables user calibration		BOOLEAN	RW	0x00 (0_{dec})
8010:08	Enable vendor calibration	Enable vendor calibration		BOOLEAN	RW	0x01 (1_{dec})
8010:11	User scale offset	User scaling: Offset		INT16	RW	0x0000 (0_{dec})
8010:12	User scale gain	User scaling: Gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value one corresponds to 65535 (0x00010000).		INT32	RW	0x00010000 (65536_{dec})
8010:13	Default output	Default output value		INT16	RW	0x0000 (0_{dec})
8010:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		UINT16	RW	0xFFFF (65535_{dec})
8010:15	User calibration offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
8010:16	User calibration gain	User calibration: Gain		UINT16	RW	0x4000 (16384_{dec})

Index 8020 AO settings Ch.3

Index (hex)	Name	Meaning		Data type	Flags	Default
8020:0	AO settings Ch.3	Maximum subindex		UINT8	RO	0x16 (22_{dec})
8020:01	Enable user scale	This entry activates the scaling for 0x8pp0:11 and 0x8pp0:12.		BOOLEAN	RW	0x00 (0_{dec})
8020:02	Presentation	0	Signed presentation The output value range 0x7pp1:11 is shown as 16 bit signed integer. For unipolar terminals (0-10V or 0-20 mA) the negative range is set to zero.	BIT3	RW	0x00 (0_{dec})
		1	Unsigned presentation The output value range 0x7pp1:11 is shown as 16 bit unsigned integer. Negative values are not possible.			
		2	Absolute value with MSB as sign Signed amount representation is active.			
		3	Absolute value The absolute value of the signed representation is formed.			
8020:05	Watchdog	0	Default watchdog value The default value (0x8pp0:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp The ramp (0x8pp0:14) for moving to the default value ((0x8pp0:13)) is active.			
		2	Last output value In the event of an error (triggering of the watchdog) the last process data is output.			
8020:07	Enable user calibration	Enables user calibration		BOOLEAN	RW	0x00 (0_{dec})
8020:08	Enable vendor calibration	Enable vendor calibration		BOOLEAN	RW	0x01 (1_{dec})
8020:11	User scale offset	User scaling: Offset		INT16	RW	0x0000 (0_{dec})
8020:12	User scale gain	User scaling: Gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value one corresponds to 65535 (0x00010000).		INT32	RW	0x00010000 (65536_{dec})
8020:13	Default output	Default output value		INT16	RW	0x0000 (0_{dec})
8020:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		UINT16	RW	0xFFFF (65535_{dec})
8020:15	User calibration offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
8020:16	User calibration gain	User calibration: Gain		UINT16	RW	0x4000 (16384_{dec})

Index 8030 AO settings Ch.4

Index (hex)	Name	Meaning		Data type	Flags	Default
8030:0	AO settings Ch.4	Maximum subindex		UINT8	RO	0x16 (22_{dec})
8030:01	Enable user scale	This entry activates the scaling for 0x8pp0:11 and 0x8pp0:12.		BOOLEAN	RW	0x00 (0_{dec})
8030:02	Presentation	0	Signed presentation The output value range 0x7pp1:11 is shown as 16 bit signed integer. For unipolar terminals (0-10V or 0-20 mA) the negative range is set to zero.	BIT3	RW	0x00 (0_{dec})
		1	Unsigned presentation The output value range 0x7pp1:11 is shown as 16 bit unsigned integer. Negative values are not possible.			
		2	Absolute value with MSB as sign Signed amount representation is active.			
		3	Absolute value The absolute value of the signed representation is formed.			
8030:05	Watchdog	0	Default watchdog value The default value (0x8pp0:13) is active.	BIT2	RW	0x00 (0_{dec})
		1	Watchdog ramp The ramp (0x8pp0:14) for moving to the default value ((0x8pp0:13)) is active.			
		2	Last output value In the event of an error (triggering of the watchdog) the last process data is output.			
8030:07	Enable user calibra-tion	Enables user calibration		BOOLEAN	RW	0x00 (0_{dec})
8030:08	Enable vendor cali-bration	Enable vendor calibration		BOOLEAN	RW	0x01 (1_{dec})
8030:11	User scale offset	User scaling: Offset		INT16	RW	0x0000 (0_{dec})
8030:12	User scale gain	User scaling: Gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value one corresponds to 65535 (0x00010000).		INT32	RW	0x00010000 (65536_{dec})
8030:13	Default output	Default output value		INT16	RW	0x0000 (0_{dec})
8030:14	Default output ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. If the entry is 100 and the default value 0, for example, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.		UINT16	RW	0xFFFF (65535_{dec})
8030:15	User calibration offset	User calibration: Offset		INT16	RW	0x0000 (0_{dec})
8030:16	User calibration gain	User calibration: Gain		UINT16	RW	0x4000 (16384_{dec})

Index F800 AO Range Settings

Index (hex)	Name	Meaning		Data type	Flags	Default
F800:0	AO Range Settings	Maximum subindex		UINT8	RO	0x04 (4_{dec})
F800:01	Output type Ch1	Output signal range for channel 1		UINT16	RW	0x0000 (0_{dec})
		0	-10…+10 V			
		1	0...20 mA			
		2	4...20 mA			
		6	0...10 V			
F800:02	Output type Ch2	Output signal range for channel 2 (values see channel 1)		UINT16	RW	0x0000 (0_{dec})
F800:03	Output type Ch3	Output signal range for channel 3 (values see channel 1)		UINT16	RW	0x0000 (0_{dec})
F800:04	Output type Ch4	Output signal range for channel 4 (values see channel 1)		UINT16	RW	0x0000 (0_{dec})

5.3.2 Objects for regular operation

The EP4174 has no such objects.

5.3.3 Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default
1000:0	Device type	Device type of the EtherCAT slave: The Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x01901389 (26219401_{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	EPP4174-0002

Index 1009 Hardware version

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

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	01

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	0x6476CAE9 (1685506793_{dec})
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	0x00100002 (1048578_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	0x00000000 (0_{dec})

Index 10F0 Backup parameter handling

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

Index 1600 AO RxPDO-Map Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	AO RxPDO-Map Ch.1	PDO Mapping RxPDO 1	UINT8	RO	0x01 (1_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (AO outputs Ch.1), entry 0x11 (Analog output))	UINT32	RO	0x7000:11, 16

Index 1601 AO RxPDO-Map Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	AO RxPDO-Map Ch.2	PDO Mapping RxPDO 2	UINT8	RO	0x01 (1_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (AO outputs Ch.2), entry 0x11 (Analog output))	UINT32	RO	0x7010:11, 16

Index 1602 AO RxPDO-Map Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	AO RxPDO-Map Ch.3	PDO Mapping RxPDO 3	UINT8	RO	0x01 (1_{dec})
1602:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (AO outputs Ch.3), entry 0x11 (Analog output))	UINT32	RO	0x7020:11, 16

Index 1603 AO RxPDO-Map Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	AO RxPDO-Map Ch.4	PDO Mapping RxPDO 4	UINT8	RO	0x01 (1_{dec})
1603:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (AO outputs Ch.4), entry 0x11 (Analog output))	UINT32	RO	0x7030:11, 16

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x04 (4_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1601 (5633_{dec})
1C12:03	Subindex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1602 (5634_{dec})
1C12:04	Subindex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1603 (5635_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x00 (0_{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	**Value** – 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 – Master cycle time 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	0x00003A98 (15000_{dec})
1C32:04	Sync modes supported	**Bit** / **Value** – Supported synchronization modes: 0 / 1 – free run is supported 1 / 1 – Synchronous with SM 2 event is supported 3.2 / 01 – DC mode is supported 5.4 / 10 – Output shift with SYNC1 event (only DC mode) 14 / 1 – dynamic times (measurement through writing of 0x1C32:08 [▸ 36])	UINT16	RO	0xC007 (49159_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000493E0 (300000_{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	0x00003A98 (15000_{dec})
1C32:08	Command	0 – Measurement of the local cycle time is stopped 1 – Measurement of the local cycle time is started The entries 0x1C32:03 [▸ 36], 0x1C32:05 [▸ 36], 0x1C32:06 [▸ 36], 0x1C32:09 [▸ 36], 0x1C33:03, 0x1C33:06 [▸ 36], 0x1C33:09	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	0x00003A98 (15000_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

5.3.4 Profile-specific objects (0x6000-0xFFFF)

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

Index 7000 AO outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	AO outputs Ch.1		UINT8	RO	0x11 (17_{dec})
7000:11	Analog output	Analog output data	INT16	RO	0x0000 (0_{dec})

Index 7010 AO outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	AO outputs Ch.2		UINT8	RO	0x11 (17_{dec})
7010:11	Analog output	Analog output data	INT16	RO	0x0000 (0_{dec})

Index 7020 AO outputs Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
7020:0	AO outputs Ch.3		UINT8	RO	0x11 (17_{dec})
7020:11	Analog output	Analog output data	INT16	RO	0x0000 (0_{dec})

Index 7030 AO outputs Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	AO outputs Ch.4		UINT8	RO	0x11 (17_{dec})
7030:11	Analog output	Analog output data	INT16	RO	0x0000 (0_{dec})

Index 800E AO internal data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
800E:0	AO internal data Ch.1		UINT8	RO	0x01 (1_{dec})
800E:01	DAC raw value	Raw value of the D/A converter	UINT16	RO	0x0000 (0_{dec})

Index 800F AO vendor data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
800F:0	AO vendor data Ch.1		UINT8	RO	0x06 (6_{dec})
800F:01	R0 Calibration Offset	Vendor calibration: Offset for +/-10 V	INT16	RW	0x0000 (0_{dec})
800F:02	R0 Calibration Gain	Vendor calibration: Gain for +/-10 V	UINT16	RW	0x4000 (16384_{dec})
800F:03	R1 Calibration Offset	Vendor calibration: Offset for 0-20 mA	INT16	RW	0x0000 (0_{dec})
800F:04	R1 Calibration Gain	Vendor calibration: Gain for 0-20 mA	UINT16	RW	0x4000 (16384_{dec})
800F:05	R2 Calibration Offset	Vendor calibration: Offset for 4-20 mA	INT16	RW	0x0000 (0_{dec})
800F:06	R2 Calibration Gain	Vendor calibration: Gain for 4-20 mA	UINT16	RW	0x4000 (16384_{dec})

Index 801E AO internal data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
801E:0	AO internal data Ch.2		UINT8	RO	0x01 (1_{dec})
801E:01	DAC raw value	Raw value of the D/A converter	UINT16	RO	0x0000 (0_{dec})

Index 801F AO vendor data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
801F:0	AO vendor data Ch.2		UINT8	RO	0x06 (6_{dec})
801F:01	R0 Calibration Offset	Vendor calibration: Offset for +/-10 V	INT16	RW	0x0000 (0_{dec})
801F:02	R0 Calibration Gain	Vendor calibration: Gain for +/-10 V	UINT16	RW	0x4000 (16384_{dec})
801F:03	R1 Calibration Offset	Vendor calibration: Offset for 0-20 mA	INT16	RW	0x0000 (0_{dec})
801F:04	R1 Calibration Gain	Vendor calibration: Gain for 0-20 mA	UINT16	RW	0x4000 (16384_{dec})
801F:05	R2 Calibration Offset	Vendor calibration: Offset for 4-20 mA	INT16	RW	0x0000 (0_{dec})
801F:06	R2 Calibration Gain	Vendor calibration: Gain for 4-20 mA	UINT16	RW	0x4000 (16384_{dec})

Index 802E AO internal data Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
802E:0	AO internal data Ch.3		UINT8	RO	0x01 (1_{dec})
802E:01	DAC raw value	Raw value of the D/A converter	UINT16	RO	0x0000 (0_{dec})

Index 802F AO vendor data Ch.3

Index (hex)	Name	Meaning	Data type	Flags	Default
802F:0	AO vendor data Ch.3		UINT8	RO	0x06 (6_{dec})
802F:01	R0 Calibration Offset	Vendor calibration: Offset for +/-10 V	INT16	RW	0x0000 (0_{dec})
802F:02	R0 Calibration Gain	Vendor calibration: Gain for +/-10 V	UINT16	RW	0x4000 (16384_{dec})
802F:03	R1 Calibration Offset	Vendor calibration: Offset for 0-20 mA	INT16	RW	0x0000 (0_{dec})
802F:04	R1 Calibration Gain	Vendor calibration: Gain for 0-20 mA	UINT16	RW	0x4000 (16384_{dec})
802F:05	R2 Calibration Offset	Vendor calibration: Offset for 4-20 mA	INT16	RW	0x0000 (0_{dec})
802F:06	R2 Calibration Gain	Vendor calibration: Gain for 4-20 mA	UINT16	RW	0x4000 (16384_{dec})

Index 803E AO internal data Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
803E:0	AO internal data Ch.4		UINT8	RO	0x01 (1_{dec})
803E:01	DAC raw value	Raw value of the D/A converter	UINT16	RO	0x0000 (0_{dec})

Index 803F AO vendor data Ch.4

Index (hex)	Name	Meaning	Data type	Flags	Default
803F:0	AO vendor data Ch.4		UINT8	RO	0x06 (6_{dec})
803F:01	R0 Calibration Offset	Vendor calibration: Offset for +/-10 V	INT16	RW	0x0000 (0_{dec})
803F:02	R0 Calibration Gain	Vendor calibration: Gain for +/-10 V	UINT16	RW	0x4000 (16384_{dec})
803F:03	R1 Calibration Offset	Vendor calibration: Offset for 0-20 mA	INT16	RW	0x0000 (0_{dec})
803F:04	R1 Calibration Gain	Vendor calibration: Gain for 0-20 mA	UINT16	RW	0x4000 (16384_{dec})
803F:05	R2 Calibration Offset	Vendor calibration: Offset for 4-20 mA	INT16	RW	0x0000 (0_{dec})
803F:06	R2 Calibration Gain	Vendor calibration: Gain for 4-20 mA	UINT16	RW	0x4000 (16384_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index dis-tance	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	0x0004 (4_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list		UINT8	RW	0x04 (4_{dec})
F010:01	SubIndex 001		UINT32	RW	0x00000190 (400_{dec})
F010:02	SubIndex 002		UINT32	RW	0x00000190 (400_{dec})
F010:03	SubIndex 003		UINT32	RW	0x00000190 (400_{dec})
F010:04	SubIndex 004		UINT32	RW	0x00000190 (400_{dec})

5.4 Notices on analog specifications

Beckhoff I/O devices (terminals, box modules, modules) with analog inputs and outputs are characterized by a number of technical characteristic data; refer to the technical data in the respective documents.

Some explanations are given below for the correct interpretation of these characteristic data.

Unless otherwise stated, the explanations apply accordingly to input and output signals.

5.4.1 Full scale value (FSV), output end value

An I/O device with analog input measures over a nominal measuring range, which is limited by an upper and a lower limit (start value and end value), which can usually already be taken from the device designation. The range between both limits is called measuring span and corresponds to the formula (end value - start value). Analogous to pointing devices this is the measuring scale (see IEC 61131) or also the dynamic range.

For analog I/O devices from Beckhoff, the full scale value (FSV) of the respective product (also: reference value) is selected as the largest limit of the nominal measuring range and is given a positive sign. This applies to both symmetrical and asymmetrical measuring spans.

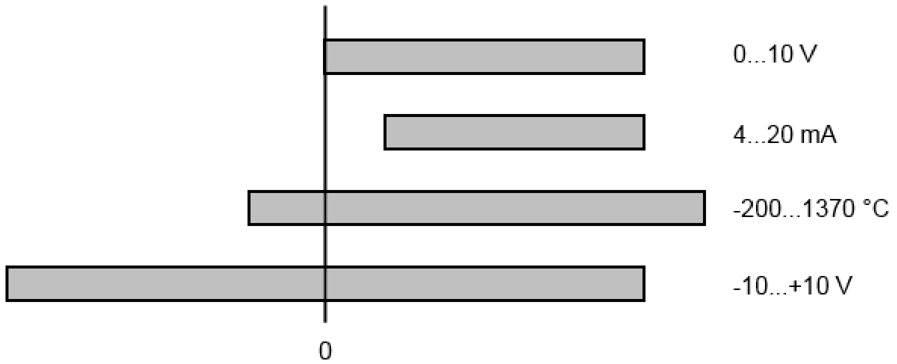


Fig. 7: Full scale value, measuring span

For the above **examples** this means:

- Measuring range 0...10 V: asymmetric unipolar, FSV = 10 V, measuring span = 10 V
- Measuring range 4...20 mA: asymmetric unipolar, FSV = 20 mA, measuring span = 16 mA
- Measuring range -200...1370 °C: asymmetric bipolar, FSV = 1370 °C, measuring span = 1570 °C
- Measuring range -10...+10 V: symmetric bipolar, FSV = 10 V, measuring span = 20 V

Depending on the functionality, an analog input channel may have a technical measuring range that exceeds the nominal measuring range, e.g. to gain more diagnostic information about the signal.
The case-by-case information in the device documentation on the behavior outside the nominal measuring range (measurement uncertainty, display value) must be observed.

The above thoughts are correspondingly applicable to analog output devices:

- The full scale value (FSV) becomes the output end value
- Here, too, there can be a (larger) technical output range in addition to the nominal output range

5.4.2 Measurement error/measurement deviation/measurement uncertainty, output uncertainty

Analog output

The following information also applies analogously to the output end value of analog output devices.

The relative measuring error as a specification value of a Beckhoff analog device is specified in % of the nominal FSV (output end value) and calculated as the quotient of the numerically largest probable deviation from the true measured value (output value) with respect to the FSV (output end value):

$$\text{Measuring error} = \frac{|\text{max. deviation}|}{\text{full scale value}}$$

It should be noted here that the "true measured value" cannot be determined with infinite accuracy either, but can only be determined via reference devices with a higher expenditure of technology and measuring time and thus a significantly lower measurement uncertainty.

The value therefore describes the result window in which the measured value determined by the device under consideration (Beckhoff analog device) lies with a very high probability in relation to the "true value". Thus, colloquially, this is a "typical" value (typ.); this expresses that the vast statistical majority of values will be within the specification window, but in rare cases there may/will be deviations outside the window.

For this reason, the term "measurement uncertainty" has become established for this window, since "error" is now used to refer to known disturbance effects that can generally be systematically eliminated.

The uncertainty of measurement must always be considered in relation to potential environmental influences:

- invariable electrical channel properties such as temperature sensitivity,
- variable settings of the channel (noise via filters, sampling rate, ...).

Measurement uncertainty specifications without further operational limitation (also called "service error limit") can be assumed as a value "over everything": entire permissible operating temperature range, default setting, etc.

The window is always to be understood as a positive/negative span with "±", even if occasionally indicated as a "half" window without "±".

The maximum deviation can also be specified directly.

Example: measuring range 0...10 V (FSV = 10 V) and measurement uncertainty < ± $0.3\%_{FSV}$ → the expected maximum usual deviation is ± 30 mV in the permissible operating temperature range.

Lower measurement uncertainty possible

If this specification also includes the temperature drift, a significantly lower measuring error can usually be assumed in case of a constant ambient temperature of the device and thermal stabilization after a user calibration.

5.4.3 Temperature coefficient tK [ppm/K]

An electronic circuit is usually temperature dependent to a greater or lesser degree. In analog measurement technology this means that when a measured value is determined by means of an electronic circuit, its deviation from the “true” value is reproducibly dependent on the ambient/operating temperature.

A manufacturer can alleviate this by using components of a higher quality or by software means.

The temperature coefficient, when indicated, specified by Beckhoff allows the user to calculate the expected measuring error outside the basic accuracy. The basic accuracy is usually specified for 23 °C ambient temperature, in special cases also at other temperature.

Due to the extensive uncertainty considerations that are incorporated in the determination of the basic accuracy, Beckhoff recommends a quadratic summation.

Example: Let the basic accuracy be ±0.01% typ. (full scale value), tK = 20 ppm/K typ at 23 °C.; the accuracy A35 at 35 °C is wanted, hence ΔT = 12 K:

$$G35 = \sqrt{(0.01\%)^2 + (12K \cdot 20\,\frac{ppm}{K})^2} = 0.026\%\text{ full scale value, typ.}$$

Remarks: ppm ≙ 10^{-6} % ≙ 10^{-2}

5.4.4 Long-term use

Analog devices (inputs, outputs) are subject to constant environmental influences during operation (temperature, temperature change, shock/vibration, irradiation, etc.) This can affect the function, in particular the analog accuracy (also: measurement or output uncertainty).

As industrial products, Beckhoff analog devices are designed for 24h/7d continuous operation.

The devices show that they generally comply with the accuracy specification, even in long-term use. However, as is usual for technical devices, an unlimited functional assurance (also applies to accuracy) cannot be given.

Beckhoff recommends checking the usability in relation to the application target within the scope of normal system maintenance, e.g. every 12-24 months.

5.4.5 Ground reference: single-ended/differential typification

For analog inputs Beckhoff makes a basic distinction between two types: *single-ended* (SE) and *differential (DIFF)*, referring to the difference in electrical connection with regard to the potential difference.

The diagram shows two-channel versions of an SE module and a DIFF module as examples for all multi-channel versions.

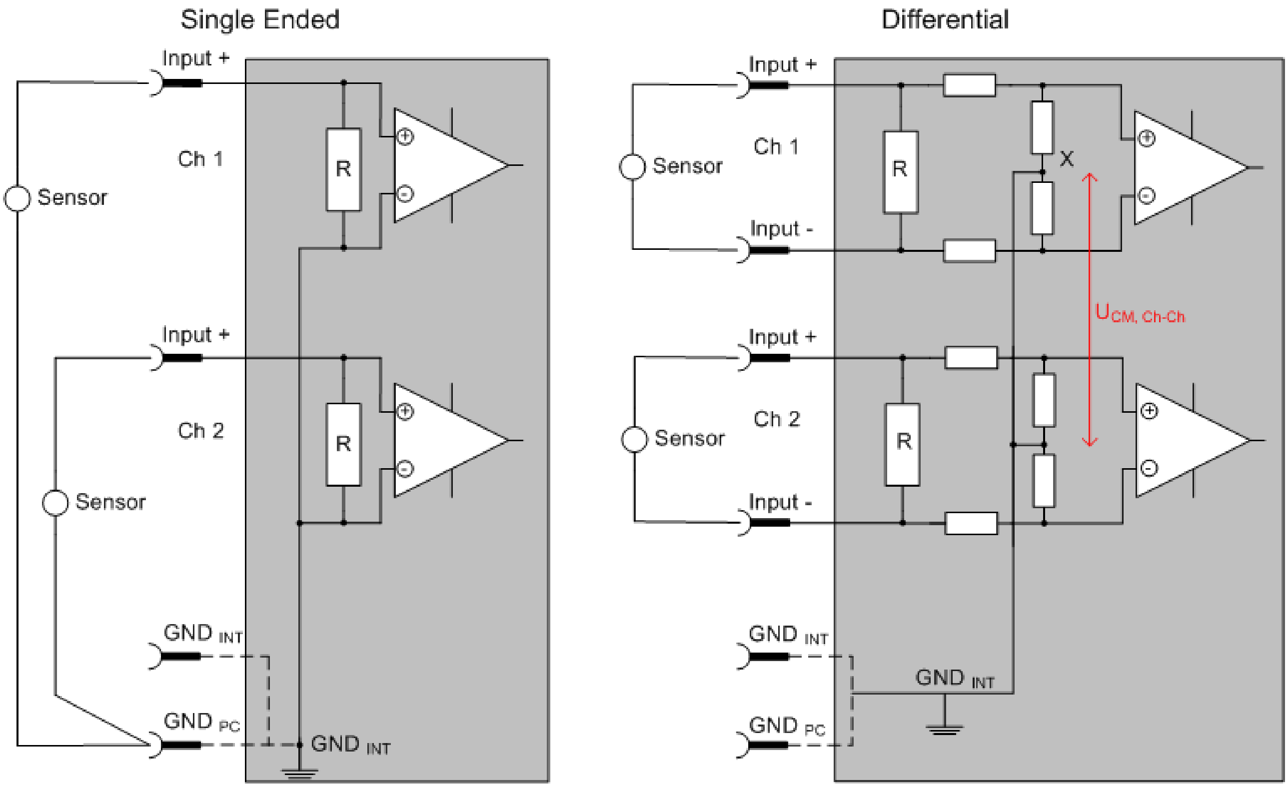


Fig. 8: SE and DIFF module as 2-channel version

Note: Dashed lines indicate that the respective connection may not necessarily be present in each SE or DIFF module. Electrical isolated channels are operating as differential type in general, hence there is no direct relation (voltaic) to ground within the module established at all. Indeed, specified information to recommended and maximum voltage levels have to be taken into account.

The basic rule:

- Analog measurements always take the form of voltage measurements between two potential points. For voltage measurements a large R is used, in order to ensure a high impedance. For current measurements a small R is used as shunt. If the purpose is resistance measurement, corresponding considerations are applied.

- Beckhoff generally refers to these two points as input+/signal potential and input-/reference potential.
- For measurements between two potential points two potentials have to be supplied.
- Regarding the terms “single-wire connection” or “three-wire connection”, please note the following for pure analog measurements: three- or four-wire connections can be used for sensor supply, but are not involved in the actual analog measurement, which always takes place between two potentials/wires.
  In particular this also applies to SE, even though the term suggest that only one wire is required.

- The term “electrical isolation” should be clarified in advance.
  Beckhoff IO modules feature 1..8 or more analog channels; with regard to the channel connection a distinction is made in terms of:
  - how the channels WITHIN a module relate to each other, or
  - how the channels of SEVERAL modules relate to each other.

  The property of electrical isolation indicates whether the channels are directly connected to each other.
  - Beckhoff terminals/ box modules (and related product groups) always feature electrical isolation between the field/analog side and the bus/EtherCAT side. In other words, if two analog terminals/ box modules are not connected via the power contacts (cable), the modules are effectively electrically isolated.
  - If channels within a module are electrically isolated, or if a single-channel module has no power contacts, the channels are effectively always differential. See also explanatory notes below. Differential channels are not necessarily electrically isolated.
- Analog measuring channels are subject to technical limits, both in terms of the recommended operating range (continuous operation) and the destruction limit. Please refer to the respective terminal/ box documentation for further details.

Explanation

- **Differential (DIFF)**
  - Differential measurement is the most flexible concept. The user can freely choose both connection points, input+/signal potential and input-/reference potential, within the framework of the technical specification.
  - A differential channel can also be operated as SE, if the reference potential of several sensors is linked. This interconnection may take place via the system GND.
  - Since a differential channel is configured symmetrically internally (cf. Fig. SE and DIFF module as 2-channel variant), there will be a mid-potential (X) between the two supplied potentials that is the same as the internal ground/reference ground for this channel. If several DIFF channels are used in a module without electrical isolation, the technical property V_{CM} (common-mode voltage) indicates the degree to which the mean voltage of the channels may differ.
  - The internal reference ground may be accessible as connection point at the terminal/ box, in order to stabilize a defined GND potential in the terminal/ box. In this case it is particularly important to pay attention to the quality of this potential (noiselessness, voltage stability). At this GND point a wire may be connected to make sure that $V_{CM,max}$ is not exceeded in the differential sensor cable. If differential channels are not electrically isolated, usually only one $V_{CM, max}$ is permitted. If the channels are electrically isolated this limit should not apply, and the channels voltages may differ up to the specified separation limit.
  - Differential measurement in combination with correct sensor wiring has the special advantage that any interference affecting the sensor cable (ideally the feed and return line are arranged side by side, so that interference signals have the same effect on both wires) has very little effect on the measurement, since the potential of both lines varies jointly (hence the term common mode). In simple terms: Common-mode interference has the same effect on both wires in terms of amplitude and phasing.
  - Nevertheless, the suppression of common-mode interference within a channel or between channels is subject to technical limits, which are specified in the technical data.
  - Further helpfully information on this topic can be found on the documentation page *Configuration of 0/4..20 mA differential inputs* (see documentation for the EL30xx terminals, for example).

- **Single-ended (SE)**
  - If the analog circuit is designed as SE, the input/reference wire is internally fixed to a certain potential that cannot be changed. This potential must be accessible from outside on at least one point for connecting the reference potential, e.g. via the power contacts (cable).
  - In other words, in situations with several channels SE offers users the option to avoid returning at least one of the two sensor cables to the terminal/ box (in contrast to DIFF). Instead, the reference wire can be consolidated at the sensors, e.g. in the system GND.
  - A disadvantage of this approach is that the separate feed and return line can result in voltage/ current variations, which a SE channel may no longer be able to handle. See common-mode interference. A V_{CM} effect cannot occur, since the module channels are internally always 'hard-wired' through the input/reference potential.

Typification of the 2/3/4-wire connection of current sensors

Current transducers/sensors/field devices (referred to in the following simply as 'sensor') with the industrial 0/4-20 mA interface typically have internal transformation electronics for the physical measured variable (temperature, current, etc.) at the current control output. These internal electronics must be supplied with energy (voltage, current). The type of cable for this supply thus separates the sensors into *self-supplied* or *externally supplied* sensors:

Self-supplied sensors

- The sensor draws the energy for its own operation via the sensor/signal cable + and -.
  So that enough energy is always available for the sensor's own operation and open-circuit detection is possible, a lower limit of 4 mA has been specified for the 4-20 mA interface, i.e. the sensor allows a minimum current of 4 mA and a maximum current of 20 mA to pass.
- 2-wire connection see Fig. *2-wire connection*, cf. IEC60381-1
- Such current transducers generally represent a current sink and thus like to sit between + and – as a 'variable load'. Refer also to the sensor manufacturer's information.

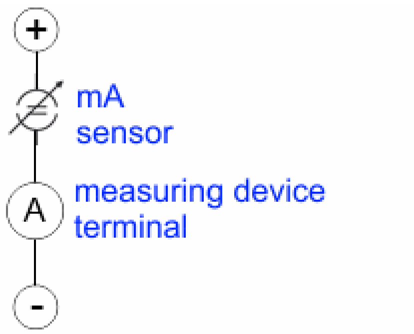


Fig. 9: 2-wire connection

Therefore, they are to be connected according to the Beckhoff terminology as follows:

preferably to **'single-ended' inputs** if the +Supply connections of the terminal/ box are also to be used - connect to +Supply and Signal

they can, however, also be connected to **'differential' inputs**, if the termination to GND is then manufactured on the application side – to be connected with the right polarity to +Signal and –Signal
It is important to refer to the information page *Configuration of 0/4..20 mA differential inputs* (see documentation for the EL30xx terminals, for example)!

Externally supplied sensors

- 3- and 4-wire connection see Fig. *Connection of externally supplied sensors*, cf. IEC60381-1
- the sensor draws the energy/operating voltage for its own operation from two supply cables of its own. One or two further sensor cables are used for the signal transmission of the current loop:
  - 1 sensor cable: according to the Beckhoff terminology such sensors are to be connected to **'single-ended' inputs** in 3 cables with +/-/Signal lines and if necessary, FE/shield

- 2 sensor cables: for sensors with 4-wire connection based on +supply/-supply/+signal/-signal, check whether +signal can be connected to +supply or –signal to –supply.

  - Yes: then you can connect accordingly to a Beckhoff **'single-ended' input**.

  - No: the Beckhoff **'differential' input** for +Signal and –Signal is to be selected; +Supply and –Supply are to be connected via additional cables.
  It is important to refer to the information page *Configuration of 0/4..20 mA differential inputs* (see documentation for the EL30xx terminals, for example)!

Note: expert organizations such as NAMUR demand a usable measuring range <4 mA/>20 mA for error detection and adjustment, see also NAMUR NE043.
The Beckhoff device documentation must be consulted in order to see whether the respective device supports such an extended signal range.
Usually there is an internal diode existing within unipolar terminals/ box modules (and related product groups), in this case the polarity/direction of current have to be observed.

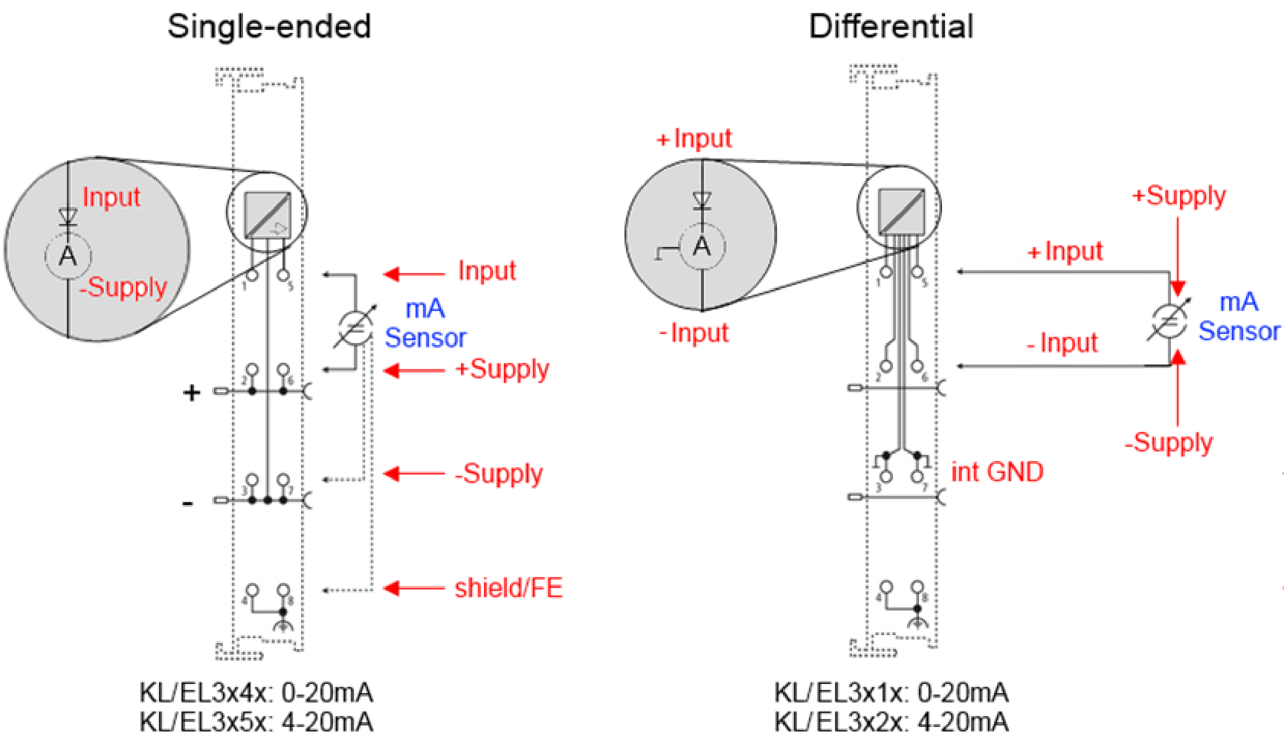


Fig. 10: Connection of externally supplied sensors

Classification of Beckhoff Terminals/ Box modules - Beckhoff 0/4-20 mA Terminals/ Box modules (and related product groups) are available as **differential** and **single-ended**:

Single-ended	**Differential**
EL3x4x: 0-20 mA, EL3x5x: 4-20 mA, same as KL and related product groups	EL3x1x: 0-20 mA, EL3x2x: 4-20 mA, same as KL and related product groups
Preferred current direction because of internal diode	Preferred current direction because of internal diode
Designed for the connection of externally-supplied sensors with a 3/4-wire connection.	The terminal/box is a passive differential current measuring device; passive means that the sensor is not supplied with power.
Designed for the connection of self-supplied sensors with a 2-wire connection	

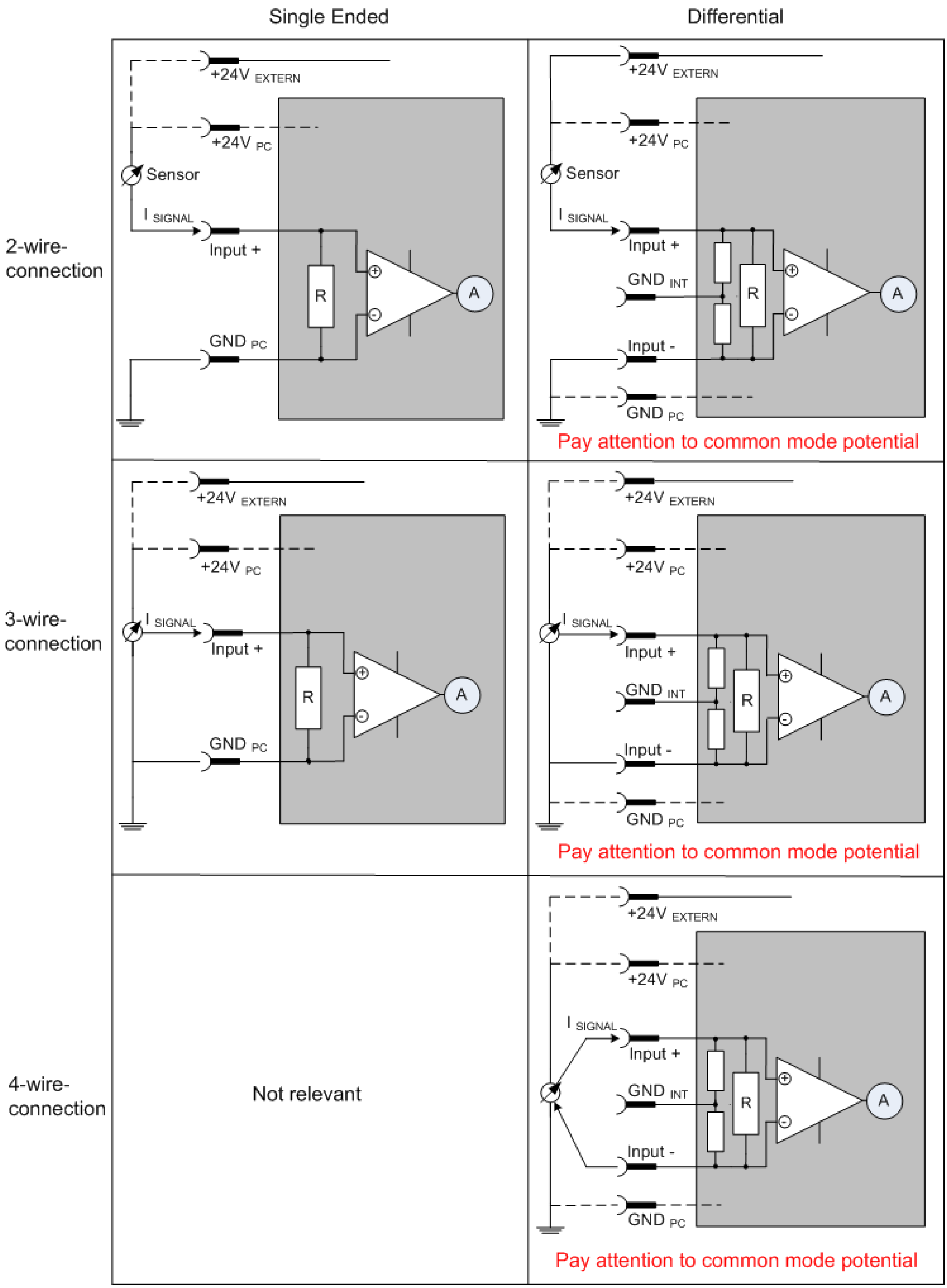


Fig. 11: 2-, 3- and 4-wire connection at single-ended and differential inputs

5.4.6 Common-mode voltage and reference ground (based on differential inputs)

Common-mode voltage (V_{cm}) is defined as the average value of the voltages of the individual connections/ inputs and is measured/specified against reference ground.

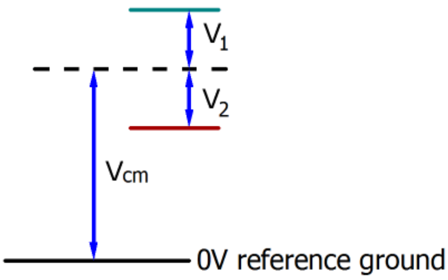


Fig. 12: Common-mode voltage (V_{cm})

The definition of the reference ground is important for the definition of the permitted common-mode voltage range and for measurement of the common-mode rejection ratio (CMRR) for differential inputs.

The reference ground is also the potential against which the input resistance and the input impedance for single-ended inputs or the common-mode resistance and the common-mode impedance for differential inputs is measured.

The reference ground is usually accessible at or near the terminal/ box, e.g. at the terminal contacts, power contacts (cable) or a mounting rail. Please refer to the documentation regarding positioning. The reference ground should be specified for the device under consideration.

For multi-channel terminals/ box modules with resistive (= direct, ohmic, galvanic) or capacitive connection between the channels, the reference ground should preferably be the symmetry point of all channels, taking into account the connection resistances.

Reference ground samples for Beckhoff IO devices:

1. Internal AGND fed out: EL3102/EL3112, resistive connection between the channels
2. 0V power contact: EL3104/EL3114, resistive connection between the channels and AGND; AGND connected to 0V power contact with low-resistance
3. Earth or SGND (shield GND):
    - EL3174-0002: Channels have no resistive connection between each other, although they are capacitively coupled to SGND via leakage capacitors
    - EL3314: No internal ground fed out to the terminal points, although capacitive coupling to SGND

5.4.7 Dielectric strength

A distinction should be made between:

- Dielectric strength (destruction limit): Exceedance can result in irreversible changes to the electronics
    - Against a specified reference ground
    - Differential
- Recommended operating voltage range: If the range is exceeded, it can no longer be assumed that the system operates as specified
    - Against a specified reference ground
    - Differential

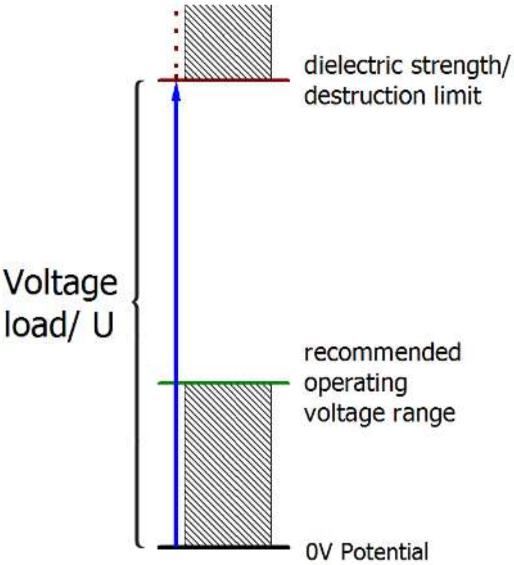


Fig. 13: Recommended operating voltage range

The device documentation may contain particular specifications and timings, taking into account:

- Self-heating
- Rated voltage
- Insulating strength
- Edge steepness of the applied voltage or holding periods
- Normative environment (e.g. PELV)

5.4.8 Temporal aspects of analog/digital or digital/analog conversion

Analog output

The following information applies analogously to analog signal output via DAC (digital-to-analog converter).

The conversion of the constant electrical input signal to a value-discrete digital and machine-readable form takes place in the analog Beckhoff EL/KL/EP input modules with ADC (analog digital converter). Although different ADC technologies are common, from the user's point of view they all have one common feature: after the end of the conversion, a certain digital value is available for further processing in the controller. This digital value, the so-called analog process data, has a fixed temporal relationship with the "original parameter", i.e. the electrical input value. Therefore, corresponding temporal characteristic data can be determined and specified for Beckhoff analogue input devices.

This process involves several functional components, which act more or less strongly in every AI (analog input) module:

- the electrical input circuit
- the analog/digital conversion
- the digital further processing
- the final provision of the process and diagnostic data for collection at the fieldbus (EtherCAT, K-bus, etc.)

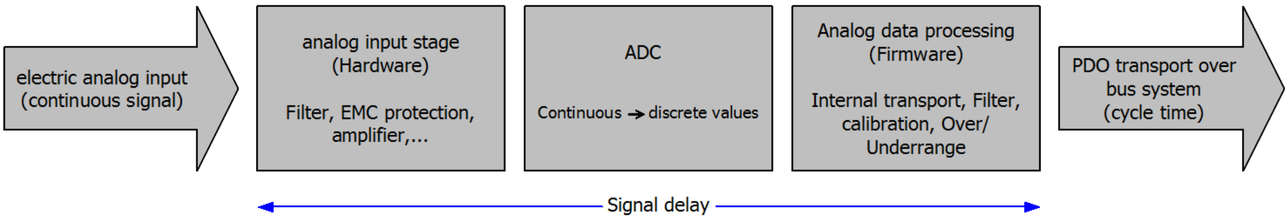


Fig. 14: Signal processing analog input

Two aspects are crucial from a user perspective:

- "How often do I receive new values?", i.e. a sampling rate in terms of speed with regard to the device/ channel
- What delay does the (whole) AD conversion of the device/channel cause?
  So hardware and firmware parts in toto. For technological reasons, the signal characteristics must be considered to determine this specification: depending on the signal frequency, there may be different propagation times through the system.

This is the "external" view of the "Beckhoff AI channel" system – internally the signal delay in particular is composed of different components: hardware, amplifier, conversion itself, data transport and processing. Internally a higher sampling rate may be used (e.g. in the deltaSigma converters) than is offered "externally" from the user perspective. From a user perspective of the "Beckhoff AI channel" component this is usually irrelevant or is specified accordingly, if it is relevant for the function.

For Beckhoff AI devices the following specification parameters for the AI channel are available for the user from a temporal perspective:

1. Minimum conversion time [ms, µs]

This is the reciprocal value of the maximum **sampling rate** [Sps, samples per second]:
Specifies how often the analog channel provides a newly detected process data value for collection by the fieldbus. Whether the fieldbus (EtherCAT, K-bus) fetches the value with the same speed (i.e. synchronous), or more quickly (if the AI channel operates in slow FreeRun mode) or more slowly (e.g. with oversampling), is then a question of the fieldbus setting and which modes the AI device supports.
For EtherCAT devices the so-called toggle bit indicates (by toggling) for the diagnostic PDOs when a newly determined analog value is available.

Accordingly, a maximum conversion time, i.e. a smallest sampling rate supported by the AI device, can be specified.
Corresponds to IEC 61131-2 Chap. 7.10.2 2, "Sampling repeat time"

2. Typical signal delay

Corresponds to IEC 61131-2, Chapter 7.10.2 1, "Sampling duration". From this perspective it includes all internal hardware and firmware components, but not "external" delay components from the fieldbus or the controller (TwinCAT).
This delay is particularly relevant for absolute time considerations, if AI channels also provide a timestamp that corresponds to the amplitude value – which can be assumed to match the physically prevailing amplitude value at the time.
Due to the frequency-dependent runtime of a signal, a dedicated value can only be specified for a given signal. The value also depends on possibly changing filter settings of the channel.
A typical characterization in the device documentation can be:

2.1 Signal delay (step response)

Keyword settling time:
The square wave signal can be generated externally with a frequency generator (note impedance!).
The 90% limit is used as detection threshold.
The signal delay [ms, µs] is then the time interval between the (ideal) electrical square wave signal and the time when the analog process value has reached the 90% amplitude.

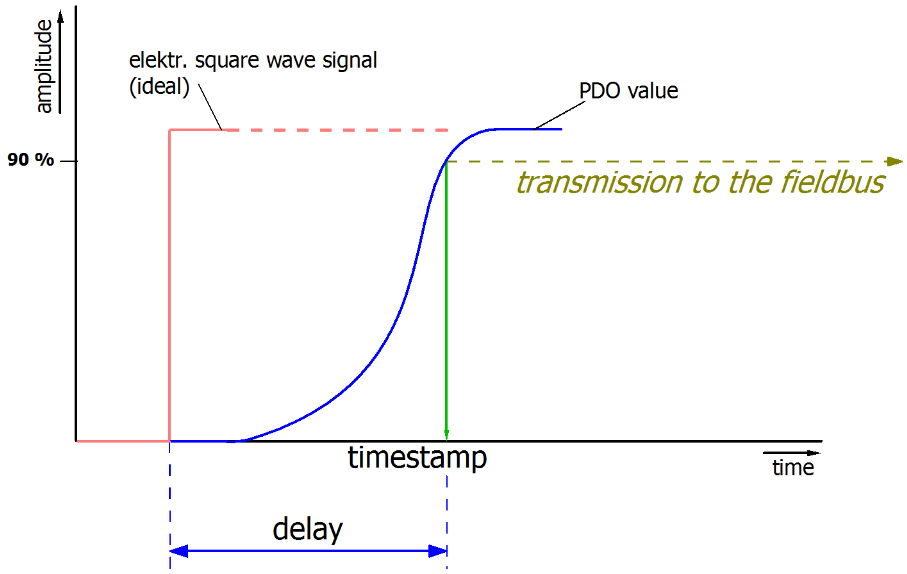


Fig. 15: Diagram Signal delay (step response)

2.2 Signal delay (linear)

Keyword group delay:
Describes the delay of a frequency-constant signal
Test signal can be generated externally with a frequency generator, e.g. as sawtooth or sine. Reference would then be a simultaneous square wave signal.
The signal delay [ms, µs] is then the time interval between the applied electrical signal of a certain amplitude and the moment when the analog process value reaches the same value.
For this purpose, the test frequency must be selected in a reasonable range; this can be, for example, 1/20 of the maximum sampling rate.

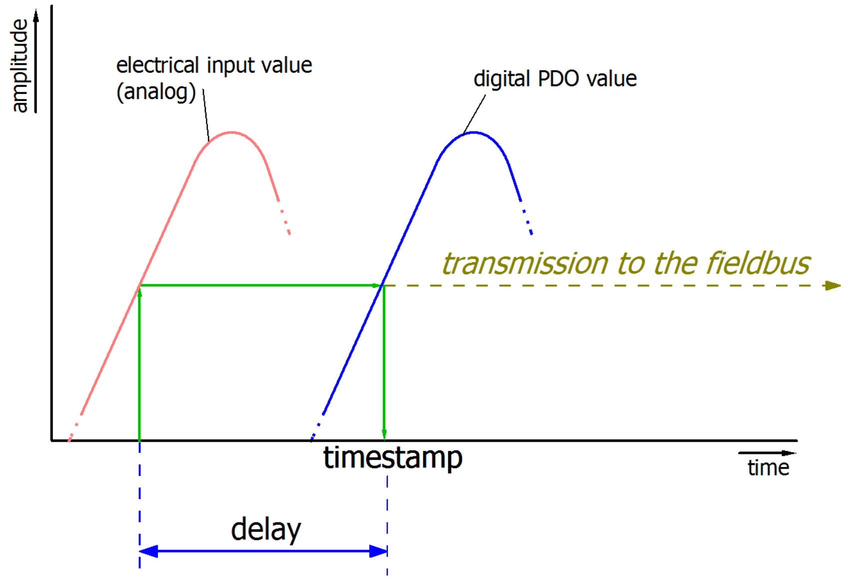


Fig. 16: Diagram Signal delay (linear)

3. Additional information

Additional information may be provided in the specification, e.g.

- actual sampling rate of the ADC (if different from the channel sampling rate)
- time correction values for runtimes with different filter settings
- etc.

5.4.9 Explanation of the term GND/Ground

I/O devices always have a reference potential somewhere. After all, the working voltage is only created by two points having different potentials – one of these points is then called the reference potential.

In the Beckhoff I/O area and in particular with the analog products, various reference potentials are used and named. These are defined, named and explained here.

Note: for historical reasons, different names are used with various Beckhoff I/O products. The following explanations place them on a uniform foundation.

SGND

- Also called: FE, Functional Earth, Shield GND, Shield.
- Use: Dissipation of interference and radiation, predominantly currentless.
- Symbol:  .
- Notes and recommendations on SGND/FE can be found in the separate chapter Notes regarding analog equipment - shielding and earth.
- SGND usually ends at the structural earth star point.
- In order to be usable for its intended purpose, SGND itself should be a low noise/noise-free "clean" current and voltage sink.

PE

- Also called: Protective Earth.
- Use: Protective measure to prevent the occurrence of hazardous touch voltages by dissipating these touch voltages and then tripping upstream protective devices. If installed correctly, the PE conductor is currentless, but according to specification it must be capable of conducting for the protection case.
- Symbol:  .
- PE usually ends at the structural earth star point.
- For specifications and notes on PE, please refer to the relevant rules.

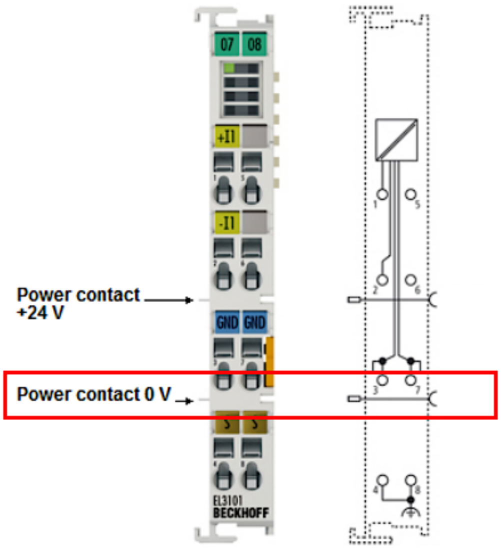
PGND, AGND

- Use: Reference ground or return line of analog or digital signals.
- Depending on use, nominally currentless as reference potential or conducting as return line.
- In the analog area, the so-called standard signals can be 0...10 V and 4...20 mA, measuring bridge signals and thermocouples can be in the range of a few mV and resistance measurement in any Ohm range, and voltages can be from µV to a few thousand Volts.
- In the digital area they can be, for example, 0/24 V, -5/+5 V etc.
- Symbols:

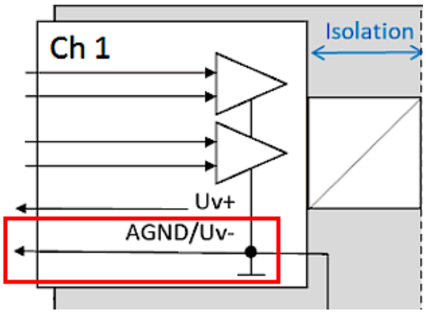
  preferred:  ;

  hardly used any more, but actually means earth potential:  .
- There may be several PGND/AGND networks in a system that are electrically isolated from one another.
- If a device has several AGNDs, due to isolation by channel, these can be numbered: AGND1, AGND2, …
- PGND
  - also called: GND_{PC}, 0 V, power contact 0 V, GND.
  - Version: PGND is a structural description of the "negative" power contact rail of the Bus Terminal system.

- Can be connected to the device electronics, for example for supplying power to the device or as a signal feedback (see chapter Ground reference: single-ended/differential typification [▶ 43]). Refer to the respective device documentation.
- Example: PGND is not connected to the device electronics:



- AGND
  - Also called: GND_{int}, GND, analog ground, GND_{analog}.
  - AGND electrically designates the device's analog reference ground.
  - AGND can, for example, be internally connected to PGND or to a connection point so that it can be connected externally to a desired potential. Electrical restrictions according to the device documentation must be observed, e.g. common mode limits.
  - AGND is usually a currentless reference potential. The action of interference on AGND must be avoided.
  - Example: AGND is fed out on the device plug:



5.4.10 Sampling type: Simultaneous vs. multiplexed

Analog inputs and outputs in Beckhoff devices can operate in two different ways in terms of time: "simultaneous sampling" or "multiplex sampling". This so-called sampling type has a decisive influence on the performance of such a device and must be taken into consideration when selecting a product, at least when it comes to very complex timing control tasks. Whether an analog device operates simultaneously or multiplexed can be taken from the respective device documentation.

This question is relevant for control tasks as well as for measurement tasks (DataRecording), if the timing of the analog value acquisition is sensitive.

Note: The terms "simultaneous" and "multiplex" have been used for a long time and in many contexts, so they have different meanings depending on the historical background and the subject area. In this chapter and in relation to I/O, the terms are used as Beckhoff understands them as an I/O manufacturer for the benefit of the user:

- If a test signal is applied electrically to all channels of a multi-channel device at the same time and the measurements are evaluated in software, e.g. in TwinCAT Scope, and if no significant offset/delay can be observed between the channels, then it is a **simultaneously sampling device** 1)
- If an offset can be seen, it is a **multiplex sampling device**
- The easiest **test** to perform is with a square wave signal because an offset can then be easily observed. However, the rare special case could occur (especially if the test signal is generated from an EL2xxx/EL4xxx from the same IO line) that the square wave signal runs synchronously to the EtherCAT for several minutes and then no offset can be seen.

Absolutely safe is a test with a sinusoidal signal, but then it must be considered that measurement deviations (related to the amplitude) of the channels in the device are also represented as time offset!

Ideally, one should concentrate on the zero crossing.

- 1-channel devices are considered as simultaneous sampling by definition.

Explanation with the example "analog input": if a continuous analog signal is to be digitized and thus fed to the further programmatic processing, it is digitized by a so-called ADC (AnalogDigitalConverter), e.g. with 16 bit resolution:

Fig. 17: Schematic representation of sampling with ADC converter

This represents an analog input channel that is functional in itself. It samples (measures) as often as desired, e.g. 1,000 times per second, and thus sends 1,000 measured values equidistant in time (= at equal time intervals) for further processing.

Often several channels are combined in one device, in this case the question arises about the sampling type: simultaneous or multiplex.

1) For experts: such a device could also be equipped with a multiplexing ADC, which works with sample-and-hold on all channels. Then technically multiplex is built in, but from the outside the device works simultaneously, because all channels are electrically read in at the same time.

Simultaneous

As in the 1-channel example, each channel can have its own ADC, shown here for 4 channels:

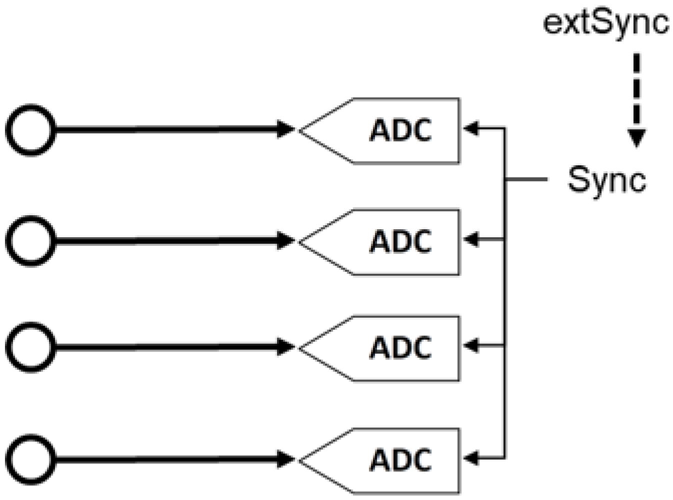


Fig. 18: Schematic representation simultaneous sampling with 4 ADC converters

These ADCs rarely run free in time and sample independently but are normal triggered in some way (the measurement is triggered) to achieve the most desired effect that the n channels sample simultaneously. This gives the analog input device the property that all (4) measurements are obtained at the same time. This gives a temporally consistent view of the machine situation and makes measurement evaluations in the controller very easy. If the ADC are triggered simultaneously by the sync signal, this is called simultaneous sampling.

A special added value arises when such devices are synchronized externally, e.g. via EtherCAT DistributedClocks, and then all analog channels of all devices of a plant operate simultaneously: either really simultaneously without offset among each other or with the same frequency but with constant, known and thus compensatable offset among each other.

As shown above, this requires extensive electronics with multiple identical structures. For this reason, parallel analog devices are usually always simultaneously sampling. Free-running or non-triggered, multiple ADCs are conceivable (and can then no longer be called "simultaneous"), but are rather uncommon.

Multiplex

Simultaneous sampling is often not required for simple automation tasks. This may be because the simplest analog electronics are to be used for cost reasons, or the control cycle time is relatively slow compared to the conversion time in the ADC. Then the advantages of the multiplex concept can be used: Instead of 4 ADC only one ADC is installed, for this a channel switch (from the device manufacturer) must be installed, which switches through the 4 input channels to the ADC quickly one after the other in the µs range. The switching process is performed by the device itself and is usually not accessible from the outside.

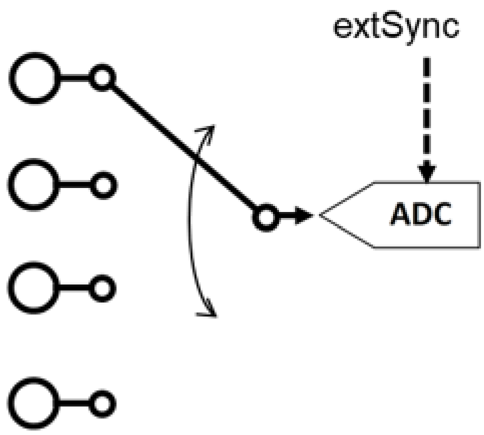


Fig. 19: Schematic representation of multiplex sampling with an ADC converter

This is therefore a time multiplex. As a rule the ADC samples equally clocked, the time intervals of the channels are therefore equal, whereby the start of channel 1 is usually done by the communication cycle (EtherCAT) or DistributedClocks. For further details please refer to the device documentation.

Advantage: cheaper electronics compared to simultaneous setup.

Disadvantage: the measured values are no longer acquired simultaneously, but one after the other.

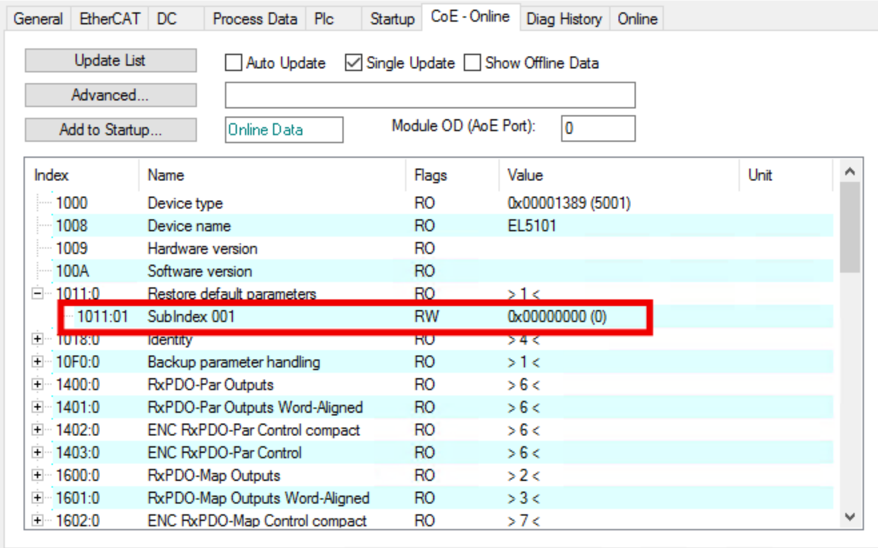
Both circuits have their technical and economic justification, for time demanding automation tasks simultaneous circuits should always be chosen, because with them it is easier to keep the temporal overview.

For analog outputs the same explanations apply, they can also be equipped with multiple simultaneous DACs or output a multiplexed DAC to several outputs.

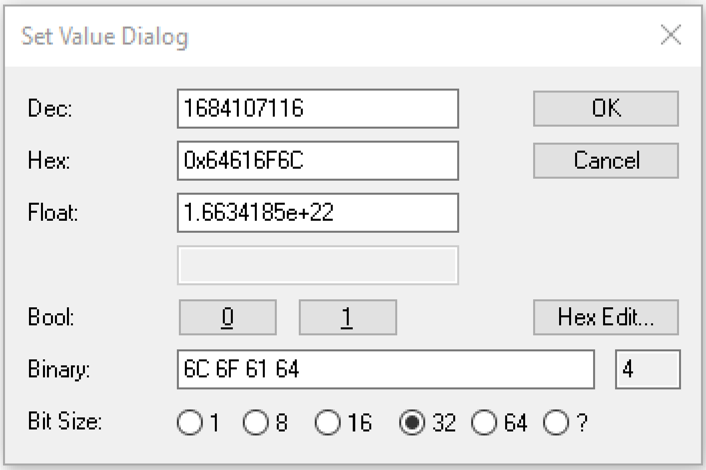
5.5 Restore the delivery state

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.

6 Appendix

6.1 General operating conditions

Protection degrees (IP-Code)

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

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø 50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø 12.5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø 2.5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø 1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.
2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water.

Chemical Resistance

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

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

Key

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

6.2 Accessories

Mounting

Ordering information	Description	Link
ZS5300-0011	Mounting rail	Website

Cables

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

Ordering information	Description	Link
ZB8513-0002	EMC shield clamp for M12 connectors	Data sheet
ZK2000-6xxx-xxxx	Sensor cable M12, 4-pin	Website
ZK2000-7xxx-0xxx	Sensor cable M12, 4-pin + shield	Website
ZK700x-xxxx-xxxx	EtherCAT P cable M8	Website

Labeling material, protective caps

Ordering information	Description
ZS5000-0012	Protective cap for M8 sockets, P-coded, 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.

6.3 Version identification of EtherCAT devices

6.3.1 General notes on marking

Designation

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

- family key
- type
- version
- revision

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

Notes

- The elements mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
  - family key (EL, EP, CU, ES, KL, CX, etc.)
  - type (3314)
  - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. *“EL5021 EL terminal, standard IP20 IO device with batch number and revision ID (since 2014/01)”*.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

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

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

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

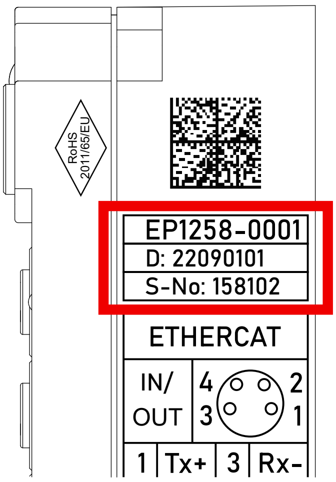


Fig. 20: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

6.3.3 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.

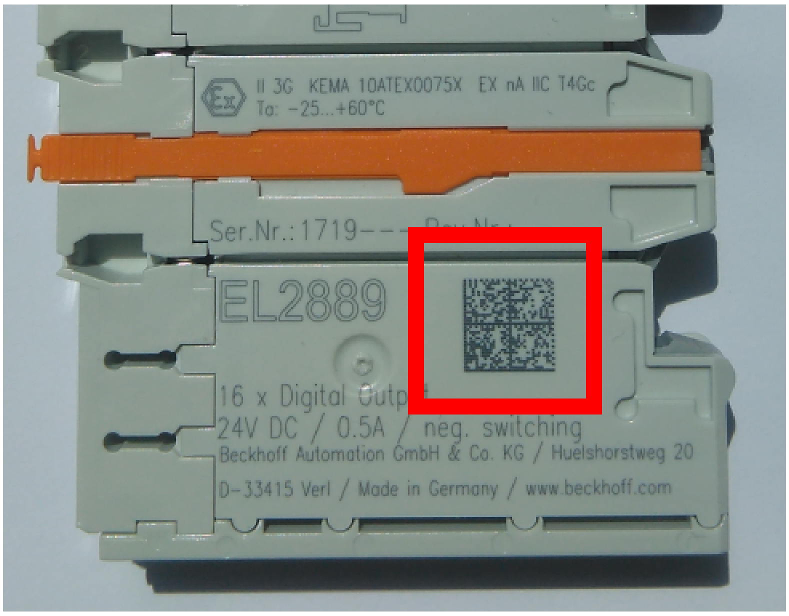


Fig. 21: BIC as data matrix code (DMC, code scheme ECC200)

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

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

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

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

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

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

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

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

Structure of the BIC

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

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

Accordingly as DMC:

Fig. 22: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

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

NOTE

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

6.3.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

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

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

K-bus devices (IP20, IP67)

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

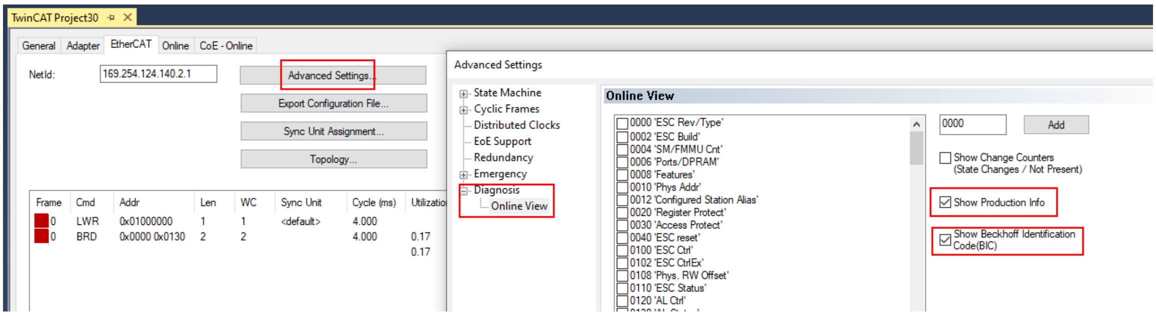
EtherCAT devices (IP20, IP67)

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

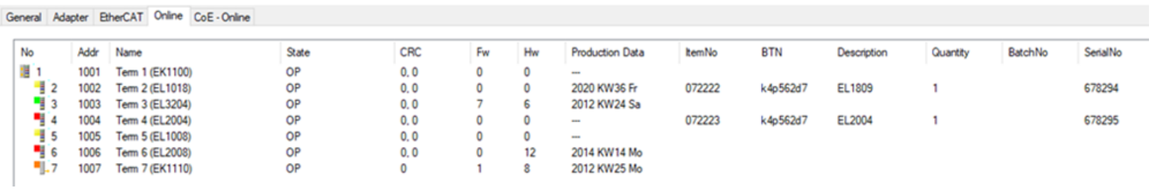
The eBIC is also stored in the ESI-EEPROM. The eBIC was introduced into the Beckhoff I/O production (terminals, box modules) from 2020; widespread implementation is expected in 2021.

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

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



    - The BTN and its contents are then displayed:



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

    ◦ The device must be in 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 introduced into stock products in the course of a necessary firmware revision.
    ◦ From TwinCAT 3.1. build 4024.24 the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC and further eBIC auxiliary functions are available in the Tc2_EtherCAT Library from v3.3.19.0.

- Note: in the case of electronic further processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.
- Technical background
  The new BIC information is additionally written as a category in the ESI-EEPROM during the device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored with the help of a category according to ETG.2010. ID 03 indicates to all EtherCAT masters that they must not overwrite these data in case of an update or restore the data after an ESI update.
  The structure follows the content of the BIC, see there. This results in a memory requirement of approx. 50..200 bytes in the EEPROM.
- Special cases
    ◦ If multiple, hierarchically arranged ESCs are installed in a device, only the top-level ESC carries the eBIC Information.
    ◦ If multiple, non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC Information.
    ◦ If the device consists of several sub-devices with their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

Profibus/Profinet/DeviceNet… Devices

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

6.4 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Beckhoff Support

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

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

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

Beckhoff Service

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

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

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

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

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

More Information:
www.beckhoff.com/epp4174-0002

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com