BECKHOFF New Automation Technology

Documentation | EN

ERxxxx

EtherCAT Box modules with zinc die-cast housing

Table of contents

BECKHOFF

Version: 1.1

1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

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

Patent Pending

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

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

Copyright

1.2   Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Description of instructions

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

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

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

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

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

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.1	• 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

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

Example with D no. 29 10 02 01:

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

Further information on this topic: Version identification of EtherCAT devices [▶ 21].

2 Product series

2.1 Introduction

The housing shape of the ER series modules is identical to the plastic housings of the EP series. The zinc die-cast housing makes the IP 67 modules particularly robust, so that they are ready for use in harsh industrial and process environments. With the fully sealed design and metal surfaces the ER series is ideal for applications requiring enhanced load capacity and protection against weld spatter, for example. The ER series is the optimum complement to the plastic and stainless steel housing versions. All modules are compatible.

The EtherCAT Box modules with zinc die-cast housing cover the typical I/O signals: digital inputs with various filters, digital outputs with 0.5 A output current, and combi modules with freely configurable digital inputs or outputs. In addition, analog input modules for current/voltage measurement are available. Temperature measurement modules, serial interfaces, encoder inputs and motion modules complement the product range. The modules are available in a slim 30 mm or the broader 60 mm format with different channel options, covering a wide I/O range. Signals can be connected via M8 or M12 connectors.

The modules of the ER series have an EtherCAT interface. Power supply and transmission takes place via M8 connectors or sockets. For high-current outputs, modules with 7/8" power supply and M12 EtherCAT sockets are available.

2.2   Technical data

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

Technical data	Product series ERxxxx
Fieldbus	
Fieldbus	EtherCAT
Connection	2x M8 socket, 4-pin, green
Electrical isolation	500 V (fieldbus / IO)
Distributed Clocks	see Product documentation [▶ 10] for the corresponding module from the EPxxxx series.
Supply voltages	
Connection	Input: 1 x M8 plug, 4-pin, black Downstream connection: 1 x M8 socket, 4-pin, black
Control voltage U_S	
Nominal voltage	24 V_{DC} (-15 % / +20 %)
Sum current	max. 4 A [1]
Peripheral voltage U_P	
Nominal voltage	24 V_{DC} (-15 % / +20 %)
Sum current	max. 4 A [1]
I/O interfaces	
Specifications	See Product documentation [▶ 10] for the corresponding module from the EPxxxx series.
Environmental conditions	
Ambient temperature during operation	-25 .. +60 °C -25 .. +55 °C according to cURus
Ambient temperature during storage	-40 .. +85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 conforms to EN 60529
Mechanics	
Housing material	Die-cast zinc
Installation position	variable
Approvals and conformity	
Approvals	CE, cURus [▶ 19] Exception: ER7xxx devices do not have cURus approval.

[1] This value corresponds to the current carrying capacity of the connections for the supply voltages.

Designs

Technical data	ERxxxx-xx0x	ERxxxx-xx2x
Dimensions W x H x D [2]	30 x 126 x 26.5 mm	60 x 126 x 26.5 mm
Weight, typical	165 g	250 g
Mounting	Two M3 screws	Two M4 screws

[2] without connectors

2.3   Product documentation

The product documentation for the ERxxxx series is in preparation.

The modules of the ERxxxx series are based on modules of the EPxxxx series. For each module of the ERxxxx series there is a module of the EPxxxx series with the same I/O functionality.

Please refer to the product documentation for the corresponding module from the EPxxxx series for the following information:

- Technical data of the I/O interfaces
- Connections of the I/O interfaces
- Commissioning and configuration
- Distributed Clocks - support

Links to documentation for the EPxxxx series

| ERxxxx	Links to documentation (EPxxxx series)
ER10xx-xxxx	EP10xx-xxxx
ER1518-0002	EP1518-0002
ER18xx-xxxx	EP18xx-xxxx
ER20xx-0xxx	EP20xx-0xxx
ER23xx-xxxx	EP23xx-xxxx
ER2624-0002	EP2624-0002
ER28xx-xxxx	EP28xx-xxxx
ER31xx-xxxx	EP31xx-xxxx
ER4174-0002	EP4174-0002
ER4374-0002	EP4374-0002
ER5xxx-xxxx	EP5xxx-xxxx
ER6001-0002	EP6001-0002
ER6002-0002	EP6002-0002
ER7041-xxxx	EP7041-xxxx
ER7342-0002	EP7342-0002
ER8309-1022	EP8309-1022

3   Mounting

3.1   Dimensions

ERxxxx-x00x

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

BECKHOFF
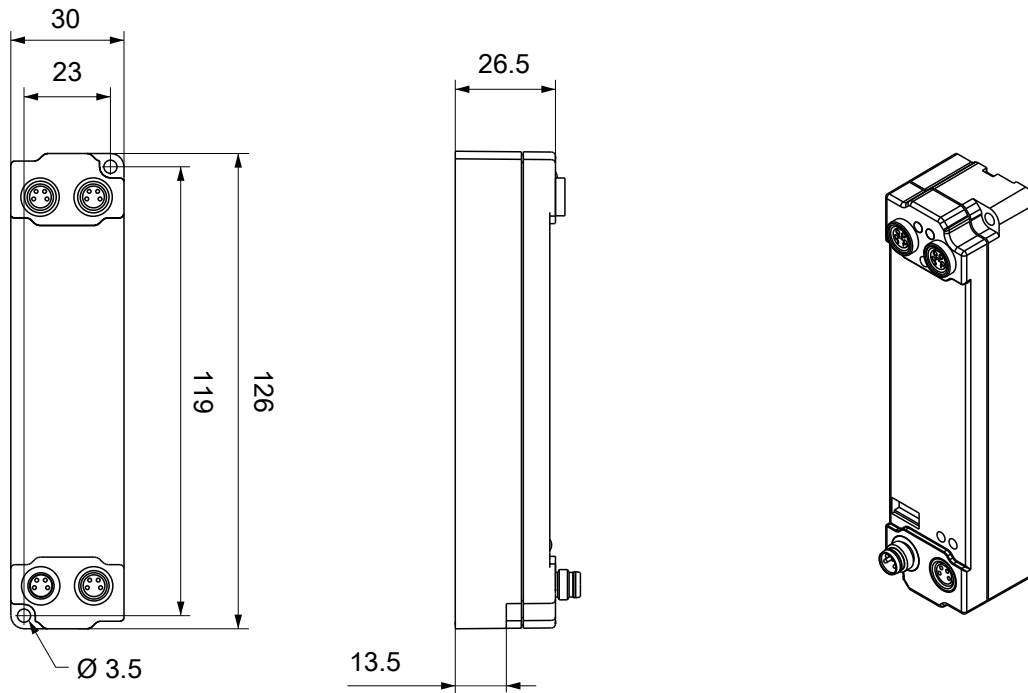
ERxxxx-x02x
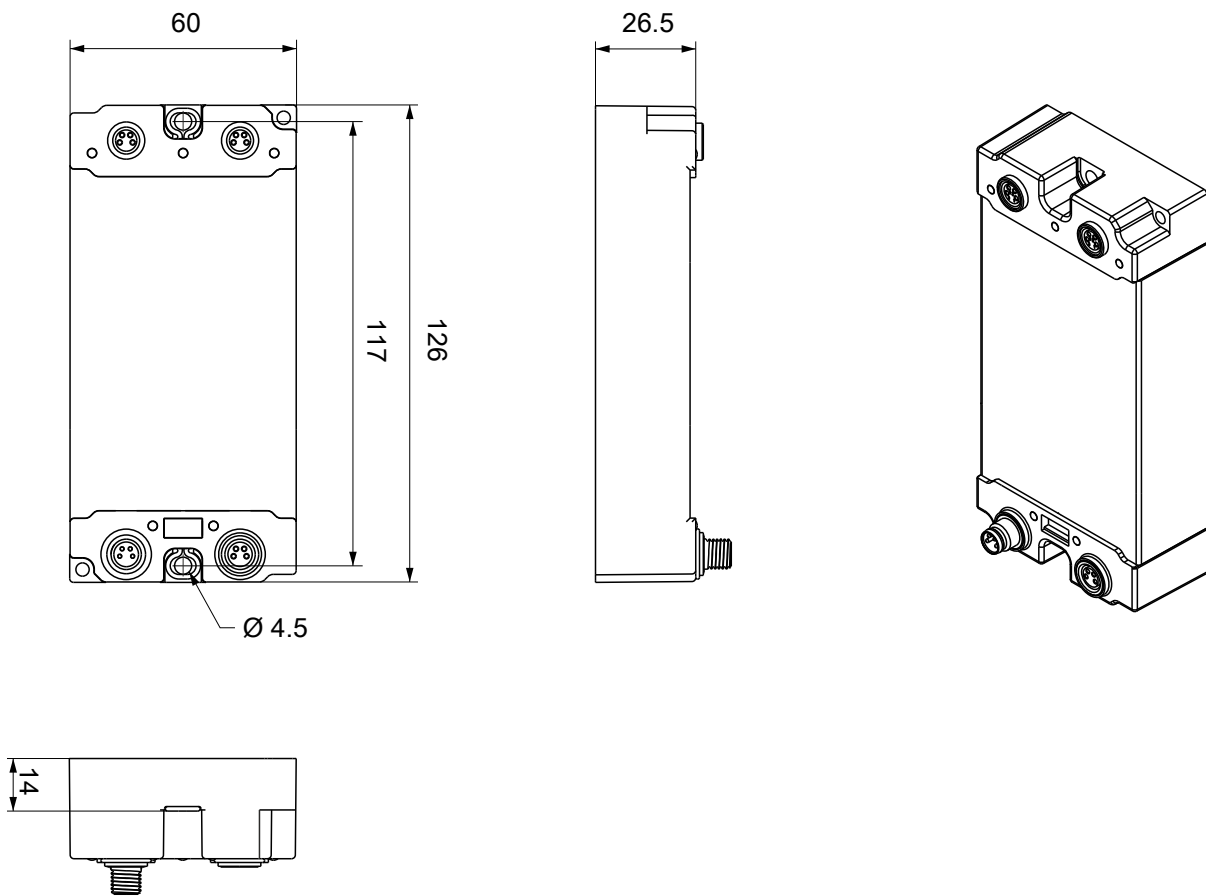
All dimensions are given in millimeters.
The drawing is not true to scale.

3.2   Mounting

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 modules of the type ERxxxx-x00x with two M3 screws in the fastening holes in the corners of the module.

Mount modules of the type ERxxxx-x02x with two M4 screws in the fastening holes located in the center.

3.3   Tightening torques for plug connectors

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

Connector diameter	Tightening torque
M8	0.4 Nm
M12	0.6 Nm

4   Connections

4.1   EtherCAT

4.1.1   Connectors

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

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

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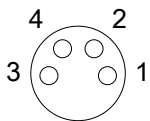
Connection

Fig. 1: M8 socket

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

[1] Core colors according to EN 61918

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

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

4.1.2   Status LEDs

L/A (Link/Act)

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

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

Run

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

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

Description of the EtherCAT slave states

4.1.3   Cables

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

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

Detailed recommendations for the cabling of EtherCAT devices

4.2 Supply voltages

The EtherCAT Box is supplied with two supply voltages.

- Control voltage U_S
- Peripheral voltage U_P

Redirection of the supply voltages

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

NOTE
Pay attention to the maximum permissible current!
Pay attention also for the redirection of the supply voltages U_S and U_P, the maximum permissible current for M8 connectors of 4 A must not be exceeded!

4.2.1 Connectors

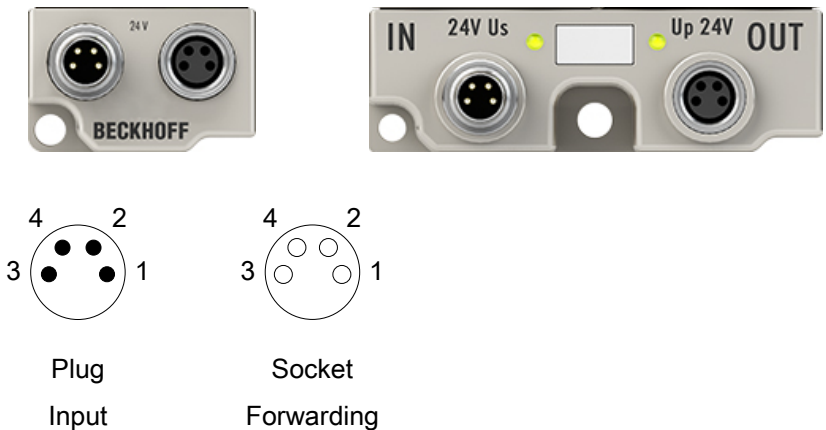| *NOTE* |
|---|
| **Risk of confusion: supply voltages and EtherCAT** |
| Defect possible through incorrect insertion. |
| • Observe the color coding of the connectors:
   black: Supply voltages
   green: EtherCAT |

Fig. 2: M8 connector

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

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

4.2.2   Status LEDs
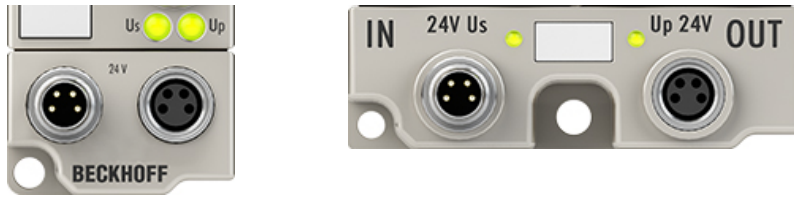
| LED	Display	Meaning
U_S	off	The supply voltage U_S is not available
	green illuminated	The supply voltage U_S is available
	red illuminated	The sensor supply was switched off due to overload [1]
U_P	off	The supply voltage U_P is not available
	green illuminated	The supply voltage U_P is available
	red illuminated	The sensor supply was switched off due to overload [1]

[1] It is irrelevant which of the two LEDs lights up red. The sensor supply can also be branched off from the respective other supply voltage. See "Sensor supply" in the technical data.

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.

Voltage drop on the supply line
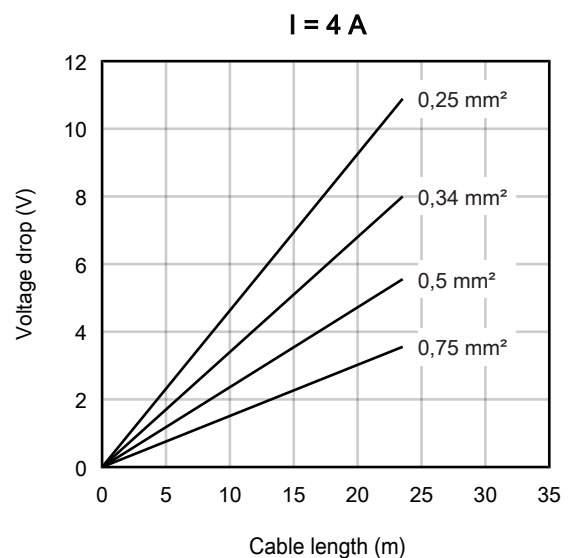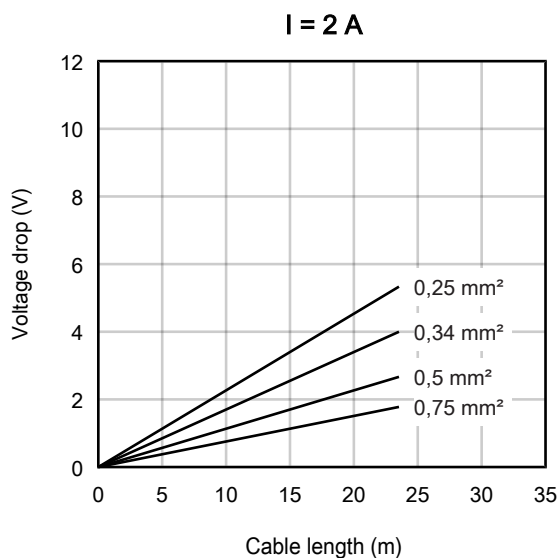
4.3   I/O signal connection

This chapter is in preparation.

NOTE	
	See documentation for the EPxxxx series For each module of the ERxxxx series there is a module of the EPxxxx series with the same I/O functionality. • Please refer to the documentation for the corresponding module from the EPxxxx series [▶ 10].

5   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. 3: UL label

6 Commissioning and configuration

This chapter is in preparation.

	NOTE
	See documentation for the EPxxxx series For each module of the ERxxxx series there is a module of the EPxxxx series with the same I/O functionality. • Please refer to the documentation for the corresponding module from the EPxxxx series [▶ 10].

7 Appendix

7.1 Version identification of EtherCAT devices

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.

Identification number

Beckhoff EtherCAT devices from the different lines have different kinds of identification numbers:

Production lot/batch number/serial number/date code/D number

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

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

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

Example with
Ser. no.: 12063A02:   12 - production week 12 06 - production year 2006 3A - firmware version 3A 02 - hardware version 02

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

Syntax: D ww yy x y z u

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

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

Unique serial number/ID, ID number

In addition, in some series each individual module has its own unique serial number.

See also the further documentation in the area

- IP67: EtherCAT Box
- Safety: TwinSafe
- Terminals with factory calibration certificate and other measuring terminals

Examples of markings

Fig. 4: EL5021 EL terminal, standard IP20 IO device with serial/ batch number and revision ID (since 2014/01)

Fig. 5: EK1100 EtherCAT coupler, standard IP20 IO device with serial/ batch number
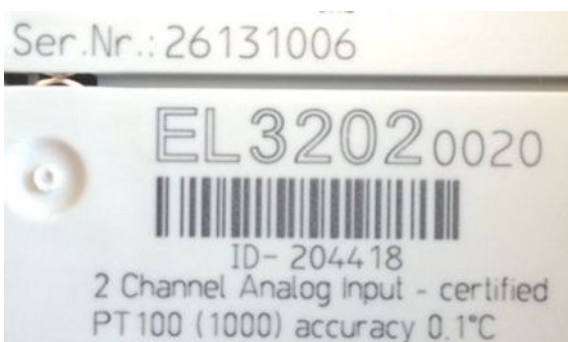

Fig. 6: CU2016 switch with serial/ batch number

Fig. 7: EL3202-0020 with serial/ batch number 26131006 and unique ID-number 204418

Fig. 8: EP1258-00001 IP67 EtherCAT Box with batch number/ date code 22090101 and unique serial number 158102
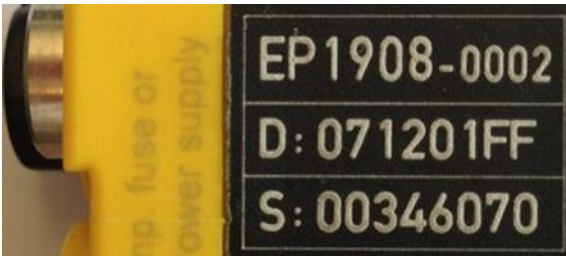

Fig. 9: EP1908-0002 IP67 EtherCAT Safety Box with batch number/ date code 071201FF and unique serial number 00346070

Fig. 10: EL2904 IP20 safety terminal with batch number/ date code 50110302 and unique serial number 00331701

Fig. 11: ELM3604-0002 terminal with unique ID number (QR code) 100001051 and serial/ batch number 44160201

7.1.1 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.
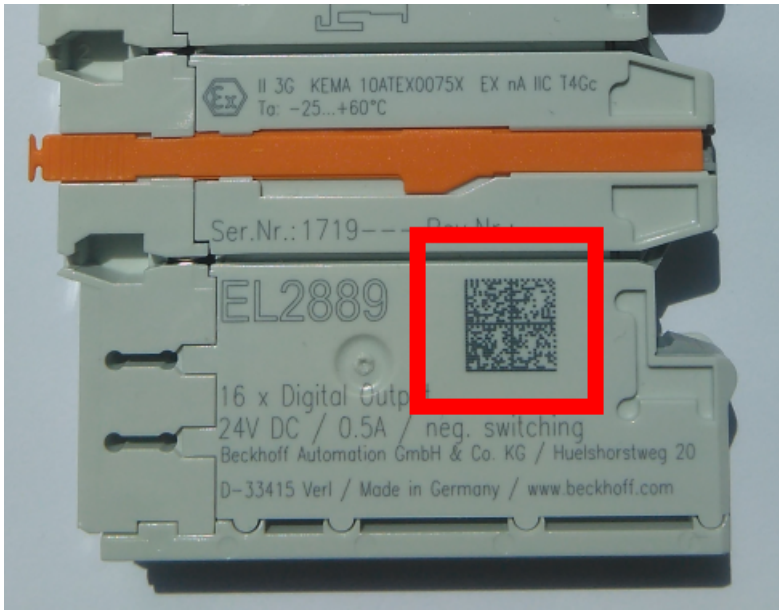

Fig. 12: BIC as data matrix code (DMC, code scheme ECC200)

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. The data under positions 1 to 4 are always available.

The following information is contained:

Item no.	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**	S	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 or calibrated terminals	51S	12	51S678294104
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 item 1 to 4 and 6. The data identifiers are marked in red for better display:

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, item no. 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.

7.2   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:

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

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