BECKHOFF New Automation Technology

Documentation | EN

EK3100

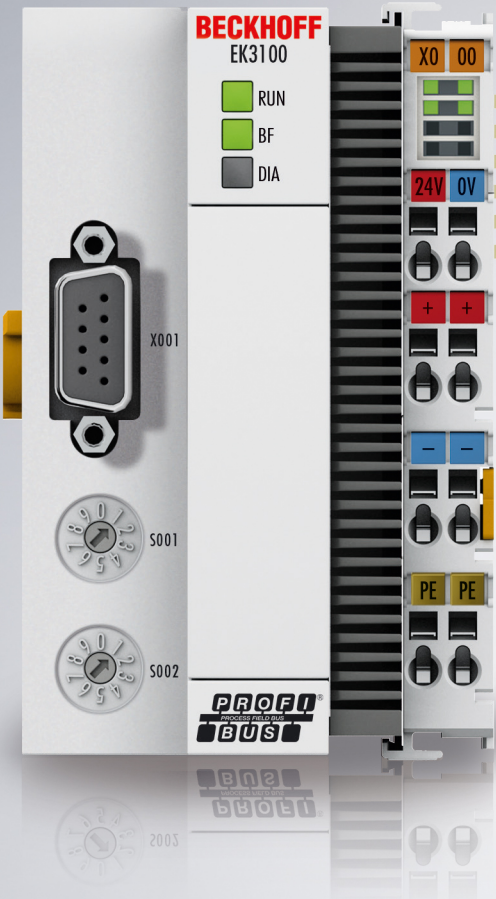PROFIBUS Bus Coupler for EtherCAT Terminals

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.
The qualified personnel is obliged to always use the currently valid documentation.

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

© Beckhoff Automation GmbH & Co. KG, Germany.
The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization are prohibited.
Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

1.2 Guide through documentation

	NOTICE
	Further components of documentation
	This documentation describes device-specific content. It is part of the modular documentation concept for Beckhoff I/O components. For the use and safe operation of the device / devices described in this documentation, additional cross-product descriptions are required, which can be found in the following table.

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
Explosion Protection for Terminal Systems (PDF)	Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

The documentations can be viewed at and downloaded from the Beckhoff website (www.beckhoff.com) via:

- the "Documentation and Download" area of the respective product page,
- the Download finder,
- the Beckhoff Information System.

If you have any suggestions or proposals for our documentation, please send us an e-mail stating the documentation title and version number to: documentation@beckhoff.com

Version: 2.0.0 EK3100

1.3   Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

1.4 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Signal words

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

Personal injury warnings

⚠ **DANGER**
Hazard with high risk of death or serious injury.

⚠ **WARNING**
Hazard with medium risk of death or serious injury.

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

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product

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

1.5   Documentation issue status

Version	Modifications
2.0.0	• Update chapter "Configuration" • Update structure
1.9	• Update chapter "Technical data" • Update structure
1.8	• Addenda chapter "Configuration" • Update structure
1.7	• Addenda chapter "Notes on information security" • Update chapter "Technical data" • Update structure
1.6	• Update chapter "Technical data"
1.5	• Update chapter "Technical data"
1.4	• Update chapter "Configuration"
1.3	• Update chapter UL notice
1.2	• Update chapter "Update Bus Coupler image"
1.1	• Minor corrections & addenda
1.0	• First version and publication

1.6 Version identification of EtherCAT devices

1.6.1 General notes on marking

Designation

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

- family key
- type
- version
- revision

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

Notes

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

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

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

- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. *"EL2872 with revision 0022 and serial number 01200815"*.

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

1.6.2 Version identification of EK Couplers

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

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

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

Example with serial number 12 06 3A 02:

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

BECKHOFF
EK1101
Ser. Nr.: 41130206
Rev. Nr.: 0815
Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20 / D- 33415 Verl
Made in Germany / www.beckhoff.com

Fig. 1: EK1101 EtherCAT coupler with revision 0815 and serial number 41130206

BECKHOFF

1.6.3 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.
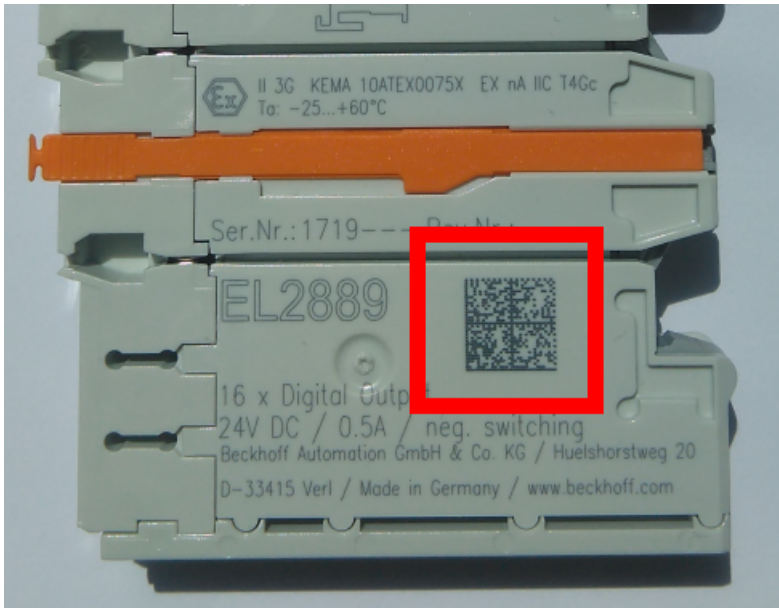
Fig. 2: BIC as data matrix code (DMC, code scheme ECC200)

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. 3: 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.

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

1.6.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

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

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

K-bus devices (IP20, IP67)

Currently, no electronic storage or readout is planned for these devices.
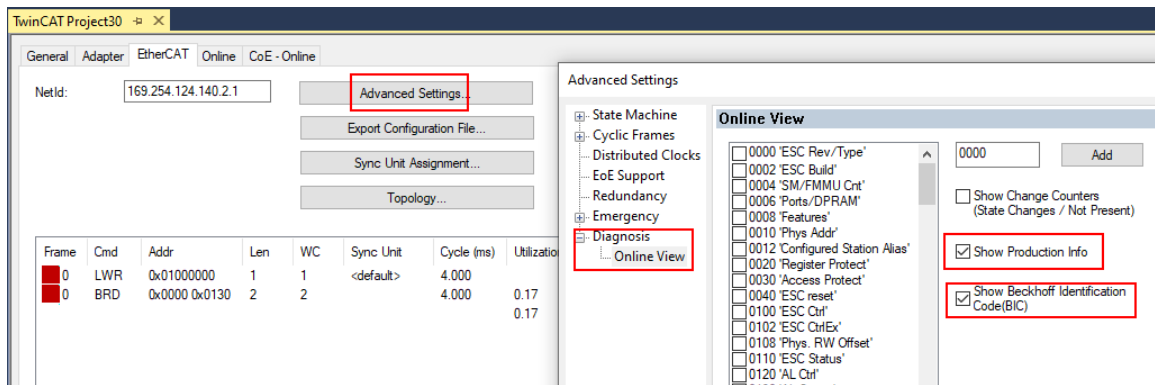
EtherCAT devices (IP20, IP67)

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

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

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

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

    - The BTN and its contents are then displayed:

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

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

Index	Name	Flags	Value		
1000	Device type	RO	0x015E1389 (22942601)		
1008	Device name	RO	ELM3704-0000		
1009	Hardware version	RO	00		
100A	Software version	RO	01		
100B	Bootloader version	RO	J0.1.27.0		
1011:0	Restore default parameters	RO	> 1 <		
1018:0	Identity	RO	> 4 <		
10E2:0	Manufacturer-specific Identification C...	RO	> 1 <		
10E2:01	SubIndex 001	RO	1P158442SBTN0008ekp1KELM3704	Q1	2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <		
10F3:0	Diagnosis History	RO	> 21 <		
10F8	Actual Time Stamp	RO	0x170bfb277e		

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

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

• The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Utilities* as of TwinCAT 3.1 build 4024.24

◦ F_SplitBIC: The function splits the Beckhoff Identification Code (BIC) sBICValue into its components using known identifiers and returns the recognized substrings in the ST_SplittedBIC structure as a return value

◦ BIC_TO_BTN: The function extracts the BTN from the BIC and returns it as a return value

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

• Technical background
The new BIC information is written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50..200 bytes of memory.

• Special cases

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

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

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

PROFIBUS; PROFINET, and DeviceNet devices

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

2 Product overview

2.1 EKxxxx - System overview

Fig. 4: EtherCAT Terminals at an EKxxxx series Bus Coupler

The Bus Couplers from the EKxxxx series allow EtherCAT Terminals to be operated on conventional fieldbus systems. The ultra-fast, high-performance EtherCAT Terminals with their large range of signal types are thus also available for other fieldbus and Industrial Ethernet systems.

The EKxxxx Bus Couplers are fieldbus slaves and contain an EtherCAT master for the EtherCAT terminals. They convert the telegrams from the higher-level fieldbus systems into the E-bus signal representation. A station consists of an EKxxxx and a number of EtherCAT Terminals.

The EKxxxx is integrated in exactly the same way as the Bus Couplers from the BKxxxx series via the corresponding fieldbus system configuration tools and the associated configuration files, such as GSD, ESD or GSDML.

EtherCAT makes a very flexible topology configuration possible. Thanks to the Ethernet physics, long distances can also be bridged without the bus speed being affected. When changing to the field level – without a control cabinet – the EtherCAT Box modules (EPxxxx) in protection class IP65 can also be connected to the EK9xxx.

Bus Couplers for various fieldbus systems

The variants from the EKxxxx series differ from one another by the interface for the higher-level fieldbus system.
An overview of the various Beckhoff Bus Couplers covering the most important fieldbus systems can be found on the Beckhoff Website.

Embedded PCs with fieldbus interface and decentralized control

The TwinCAT-programmable variant is the CX80xx Embedded PC series.

The variants from the CX80xx series differ from one another by the interface for the higher-level fieldbus system and the possibility to program it.
An overview of the various Beckhoff Embedded PCs covering the most important fieldbus systems can be found on the Beckhoff Website.

2.2   EK3100 - Introduction
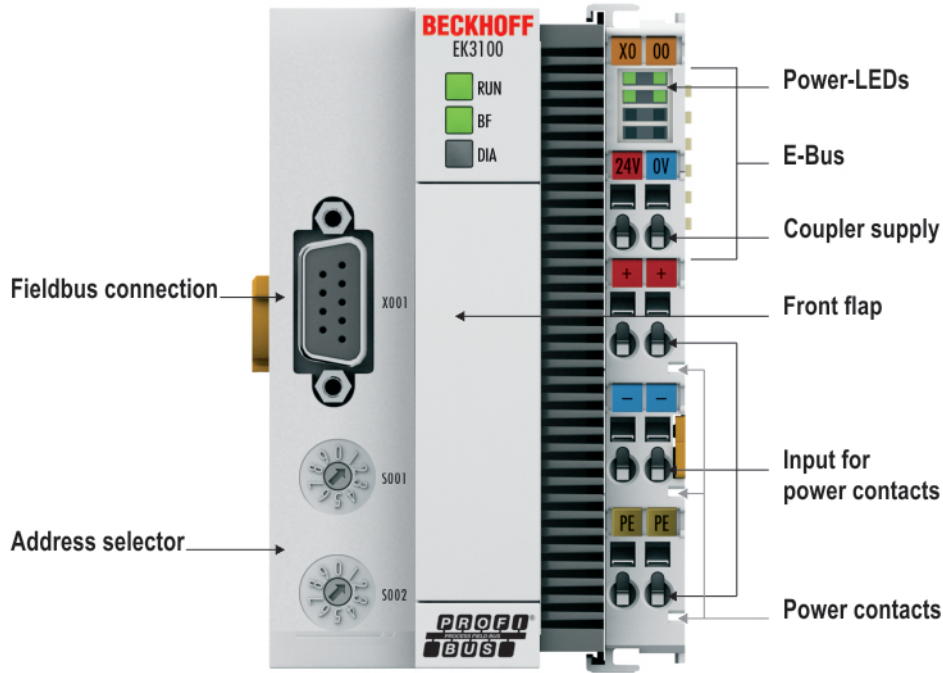
Fig. 5: EK3100 product overview.

The EK3100 Bus Coupler connects PROFIBUS networks with the EtherCAT Terminals (ELxxxx) and EtherCAT Box modules (EPxxxx) and converts the telegrams from PROFIBUS to E-bus signal representation.

One station consists of an EK3100 and any number of EtherCAT Terminals. A 9-pin D-sub connector is used for connecting the coupler to PROFIBUS. In EtherCAT, the PROFIBUS coupler has at its disposal a lower-level, powerful and ultra-fast I/O system with a large selection of terminals. The coupler supports the PROFIBUS profile and therefore fits seamlessly into PROFIBUS networks.

Configuration

The EK3100 is configured via HTML pages provided by the Bus Coupler (Beckhoff device manager) or via the PROFIBUS DPV1 services.

2.3   Technical data - EK3100

Technical data	EK3100
Bus interface	1 x D-sub socket, 9-pin with shielding
Protocol	PROFIBUS DP
Data transfer rates	up to max. 12 Mbit/s (automatic recognition)
Interfaces	1 x USB (behind the front flap)
Web interface	yes
Power supply	24 V DC (-15 %/+20 %)
Power contacts	24 V DC max./10 A max.
Electrical isolation	500 V (power contact/supply voltage)
Max. power loss	3 W
I/O connection	E-bus (EtherCAT Terminals)
Power supply for I/O terminals	max. 2 A
I/O terminals	E-bus (EL, ES, EP), standard digital signals, standard analog signals. All compatible EtherCAT devices are listed in the GSD file. No gateway EC terminals, no EC terminals with XFC or DC function.
Number of EtherCAT devices	max. 255
Dimensions (W x H x L)	65 mm x 100 mm x 73 mm
Weight	approx. 215 g
Operating/storage temperature horizontal mounting position	-25°C … +60°C/-40°C … +85°C see note! **)
Operating/storage temperature other mounting position	0…+55 °C/-25…+85 °C see note! **)
Relative humidity	95 % no condensation
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
Protect. class / installation pos.	IP 20/variable
Markings / Approvals[*]	CE, EAC, UKCA cULus [▶ 25], IECEx [▶ 23], ATEX [▶ 21]

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

ⓘ **E-Bus current/mounting positions [**)**

- for -25°C..+60°C only horizontal mounting position, E-bus current 1 A max.
- for 0...+55°C mounting position any, E-bus current 2 A max.

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.4   Technical data - PROFIBUS

Technical data	PROFIBUS (EK3100)				
Number of I/O modules	depending on controller				
Number of I/O points	depending on controller				
Data transfer medium	shielded copper cable, 2 x 0.25 mm²				
Cable length	1200 m	1000 m	400 m	200 m	100 m
Data transfer rate	9.6/19.2/93.75 kbit/s	187.5 kbit/s	500 kbit/s	1500 kbit/s	3 /6 /12 Mbit/s
Topology	Line topology				
Fieldbus	PROFIBUS DP				
Bus interface	1 x D sub-socket, 9-pin				
Extendable process image	Up to 3 virtual slaves in addition				
max. process image	4 slaves x (240 bytes in / 240 bytes out)				
Protocol					
PROFIBUS DP slave	Yes				
PROFIBUS-DP (virtual slave)	4 (3 virtual PROFIBUS nodes)				
Functions/Services					
PROFIBUS	DP				
DPV1 class 1	Yes				
Diagnostics/Status/Alarm					
RUN LED	Yes, green/red				
BF LED	Yes, green/red				
DIA LED	Yes, green/red				

3 Mounting and wiring

3.1 Instructions for ESD protection

NOTICE
Destruction of the devices by electrostatic discharge possible!
The devices contain components at risk from electrostatic discharge caused by improper handling.

- When handling the components, ensure that there is no electrostatic discharge; also avoid touching the spring contacts directly (see illustration).
- Contact with highly insulating materials (synthetic fibers, plastic films, etc.) should be avoided when handling components at the same time.
- When handling the components, ensure that the environment (workplace, packaging and persons) is properly earthed.
- Each bus station must be terminated on the right-hand side with the EL9011 or EL9012 end cap to ensure the degree of protection and ESD protection.
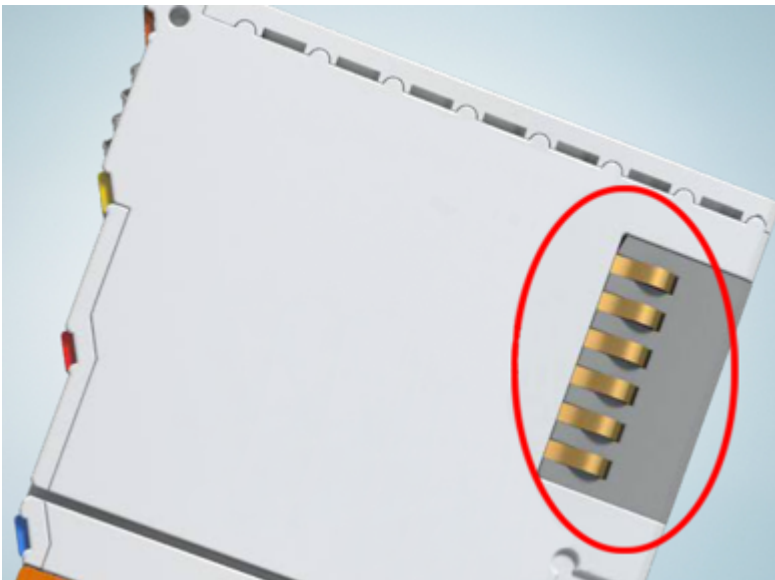

Fig. 6: Spring contacts of the Beckhoff I/O components

3.2 Explosion protection

3.2.1 ATEX - Special conditions (standard temperature range)

⚠ WARNING
Observe the special conditions for the intended use of Beckhoff fieldbus components with standard temperature range in potentially explosive areas (directive 2014/34/EU)! • The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-15! The environmental conditions during use are thereby to be taken into account! • For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range of 0 to 55°C for the use of Beckhoff fieldbus components standard temperature range in potentially explosive areas! • Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! • The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

The Beckhoff fieldbus components with standard temperature range certified according to the ATEX directive for potentially explosive areas bear one of the following markings:

II 3G KEMA 10ATEX0075 X Ex nA IIC T4 Gc Ta: 0 … +55°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or

II 3G KEMA 10ATEX0075 X Ex nA nC IIC T4 Gc Ta: 0 … +55°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.2.2 ATEX - Special conditions (extended temperature range)

⚠ WARNING
Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas (directive 2014/34/EU)!
• The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-15! The environmental conditions during use are thereby to be taken into account!
• For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
• If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
• Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas!
• Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
• The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
• The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
• The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
• Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

The Beckhoff fieldbus components with extended temperature range (ET) certified according to the ATEX directive for potentially explosive areas bear the following marking:

II 3G KEMA 10ATEX0075 X Ex nA IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or

II 3G KEMA 10ATEX0075 X Ex nA nC IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.2.3   IECEx - Special conditions

⚠ WARNING
Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas! • For gas: The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to IEC 60079-15, taking into account the environmental conditions under which the equipment is used! • For dust (only the fieldbus components of certificate no. IECEx DEK 16.0078X Issue 3): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used! • The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1! • Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range for the use of Beckhoff fieldbus components in potentially explosive areas! • The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The front hatch of certified units may only be opened if the supply voltage has been switched off or a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2011
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. IECEx DEK 16.0078X Issue 3)

Marking

Beckhoff fieldbus components that are certified in accordance with IECEx for use in areas subject to an explosion hazard bear the following markings:

Marking for fieldbus components of certificate no. IECEx DEK 16.0078X Issue 3:	**IECEx DEK 16.0078 X** **Ex nA IIC T4 Gc** **Ex tc IIIC T135°C Dc**
Marking for fieldbus components of certficates with later issues:	**IECEx DEK 16.0078 X** **Ex nA IIC T4 Gc**

3.2.4 Continuative documentation for ATEX and IECEx

| NOTICE |
| --- |
| **Continuative documentation about explosion protection according to ATEX and IECEx**

Pay also attention to the continuative documentation

Ex. Protection for Terminal Systems
Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx,

that is available for download within the download area of your product on the Beckhoff homepage www.beckhoff.com! |

3.3   UL notice

⚠ CAUTION
Application Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.

⚠ CAUTION
Examination For cULus examination, the Beckhoff I/O System has only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).

⚠ CAUTION
For devices with Ethernet connectors Not for connection to telecommunication circuits.

Basic principles

UL certification according to UL508 with limited power consumption. The current consumed by the device is limited to a max. possible current consumption of 4 A. Devices with this kind of certification are marked by this sign:
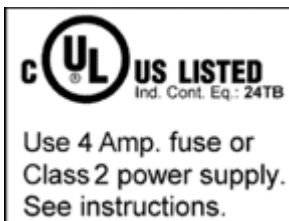
Application

If terminals certified *with restrictions* are used, then the current consumption at 24 V_{DC} must be limited accordingly by means of supply

- from an isolated source protected by a fuse of max. 4 A (according to UL248) or
- from a voltage supply complying with *NEC class 2*.
  A voltage source complying with *NEC class 2* may not be connected in series or parallel with another *NEC class 2*compliant voltage supply!

These requirements apply to the supply of all EtherCAT bus couplers, power adaptor terminals, Bus Terminals and their power contacts.

3.4   Mounting

3.4.1   Dimensions

The following illustrations show the dimensions of the Bus Couplers.

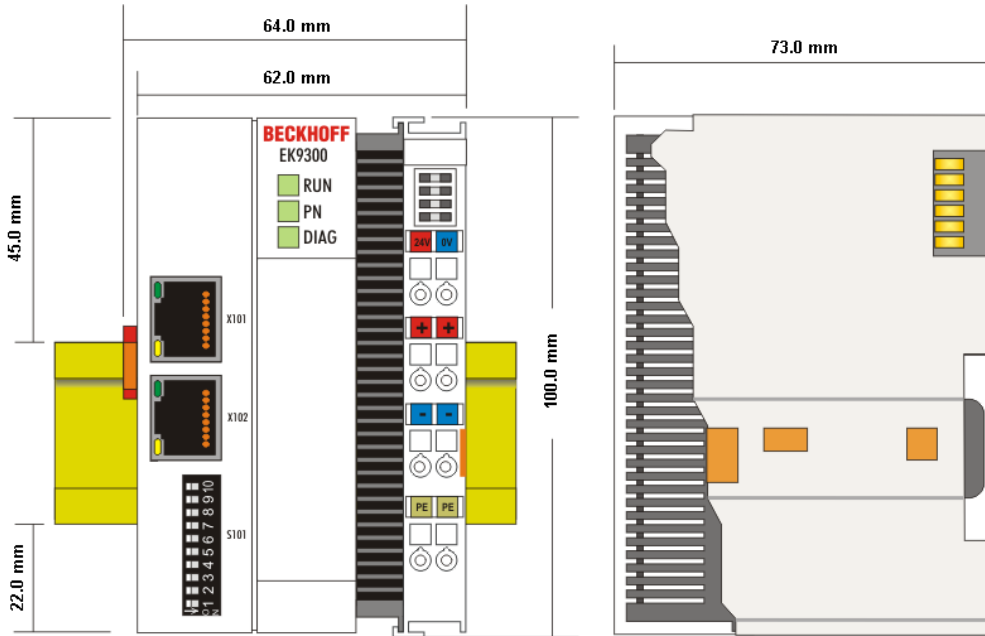Drawings in DWF and STEP format can be found in the Download section of the Beckhoff website.

Fig. 7: Dimensions, based on EK9300 as an example.

3.4.2   Installation on mounting rails – Bus Coupler

Snapping onto the mounting rail

The Bus Coupler can simply be snapped onto the mounting rail. To this end position the block on the mounting rail and push it slightly until it engages on the right-hand side. This is indicated by a distinct click. Use a screwdriver to push up the lock on the left-hand side, thereby turning it and causing it to engage audibly.
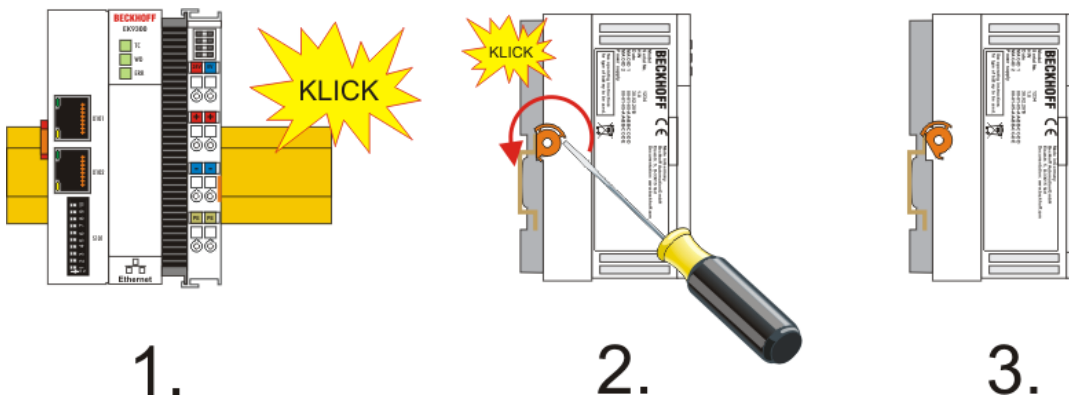

Fig. 8: Snapping onto the mounting rail, based on the EK9300 as an example.

NOTICE
Avoid damage!
Do not force the module or apply excessive pressure!

Installation positions

The installation position of the Bus Coupler is arbitrary.

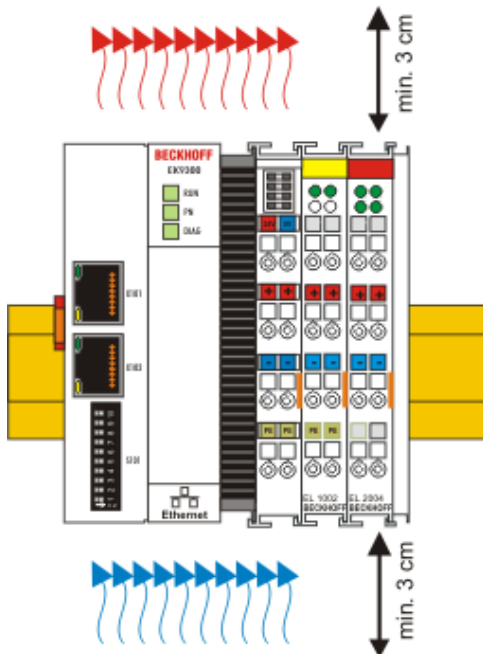| *NOTICE* |
|---|
| **Installation position of EtherCAT terminals** |
| Observe the installation position of the EtherCAT terminals used – not all of them have an arbitrary installation position. Pay attention to the respective EtherCAT infrastructure components and installation instructions. |

Fig. 9: Recommended distances for standard installation position, based on the EK9300 as an example.

NOTICE
Comply with the permitted installation position and minimum distances!
We recommend the installation in the horizontal position for optimum ventilation. Furthermore, it is not necessary with this installation position to check whether there are terminals present that may only be installed horizontally.

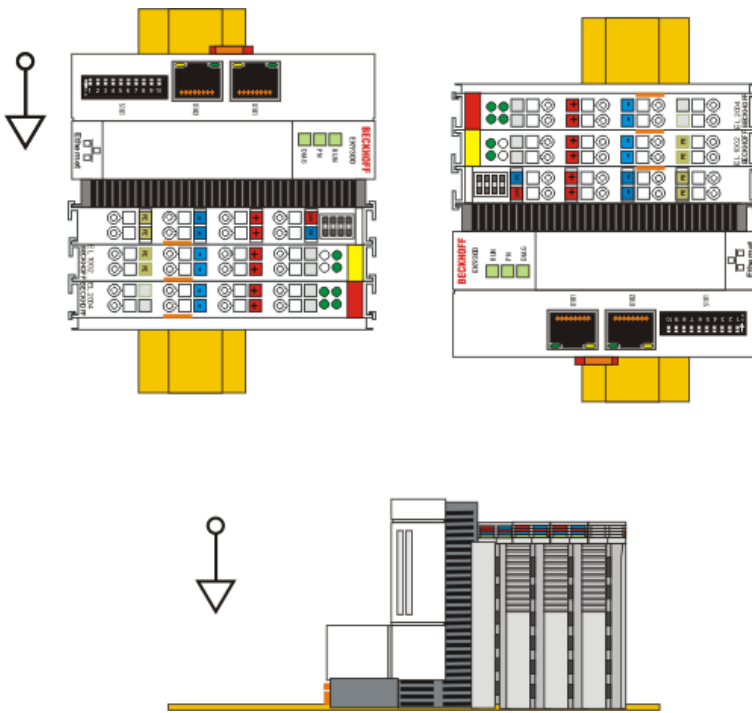Other installation positions are allowed, but not recommended.

BECKHOFF

Fig. 10: Other installation positions, based on the EK9300 as an example.

3.5   Note - power supply

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

3.6 Wiring

3.6.1 Power supply

Supply of Bus Couplers and Bus Terminals (Us)

The Bus Coupler requires a supply voltage of 24 V_{DC} (-15 %/+20 %) for operation.

The connection is made via the two upper terminal points labelled **24 V** and **0 V**. This power input supplies the Bus Coupler electronics and, via the E-Bus, the electronics of the EtherCAT Terminals. It is electrically isolated from the peripheral supply (Up) of the power contacts.

In order to guarantee the operation of the Bus Coupler and the terminal segment in all cases, the power supply unit must supply 2 A at 24 V.
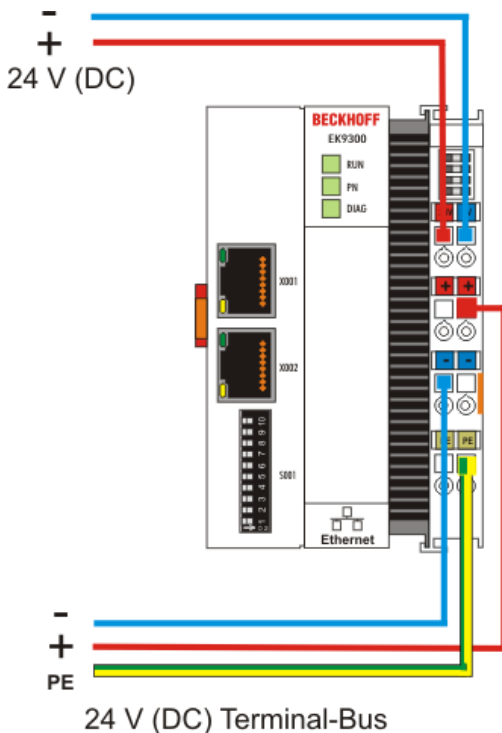

Fig. 11: Bus Coupler power supply, based on the EK9300 as an example.

Power contacts supply (Up)

The three power contacts (spring contacts) are located on the right-hand lateral surface of the Bus Coupler. The spring contacts are hidden in slots so that they can not be accidentally touched. When a Bus Terminal is added, its blade contacts are connected to the spring contacts of the Bus Coupler. The tongue and groove guides on the top and bottom of the Bus Terminal Controllers and of the Bus Terminals guarantees that the power contacts mate securely.

The lower six terminal points labelled **+**, **-** and **PE** are for supplying power to the peripheral supply (Up). These terminal points are connected in pairs to a power contact. This power input allows voltages of up to 24 V and is electrically isolated from the Bus Coupler supply voltage (Us).

The connection of these terminal points in pairs enables the supply to be forwarded. The current load of the power contacts may not permanently exceed 10 A. The current carrying capacity between two terminal points is identical to the current carrying capacity of the connecting wires.

The spring-loaded terminal points are designed for wires with cross-sections from 0.08 mm² to 2.5 mm².

LED

If the power supply unit is connected correctly and the power supply is switched on, the two upper LEDs in the terminal prism are green. The left-hand LED (Us) indicates the supply for the Bus Coupler electronics. The right-hand LED (Up) indicates the supply for the power contacts. The other LEDs indicate the state of the E-bus. The detailed meanings of the LED displays are described in the chapter *LED displays*.

PE power contacts

NOTICE
Power contact PE
The PE power contact must not be used for other potentials.

3.6.2   PROFIBUS interface (X001)

PROFIBUS, 9-pin D-sub

Pin 6 transfers 5 V_{DC}, pin 5 transfers GND for the active termination resistor. These must never be used for other functions, as this can lead to destruction of the device.

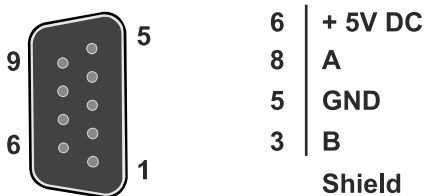Pins 3 and 8 transfer the PROFIBUS signals. These must never be swapped over, as this will prevent communication.

6	+ 5V DC
8	A
5	GND
3	B
	Shield

Fig. 12: *PROFIBUS, Pin assignment D-Sub*

The Profibus bus line is connected via a 9-pin D sub with the following pin assignment:

Pin	Assignment
1	Shielding
2	not used
3	RxD/TxD-P
4	not used
5	GND
6	+5 V_{DC}
7	not used
8	RxD/TxD-N
9	not used

cable colors

PROFIBUS line	D sub
B red	Pin 3
A green	Pin 8

3.6.3   Cabling

Physical aspects of the data transmission are defined in the PROFIBUS standard (see PROFIBUS layer 1: Physical Layer).

The types of area where a fieldbus system can be used is largely determined by the choice of the transmission medium and the physical bus interface. In addition to the requirements for transmission security, the expense and work involved in acquiring and installing the bus cable is of crucial significance. The PROFIBUS standard therefore allows for a variety of implementations of the transmission technology while retaining a uniform bus protocol.

Cable-based transmission:

This version, which accords with the American EIA RS-485 standard, was specified as a basic version for applications in production engineering, building management and drive technology. A twisted copper cable with one pair of conductors is used. Depending on the intended application area (EMC aspects should be considered) the shielding may be omitted.

Two types of conductor are available, with differing maximum conductor lengths (see the RS485 table).

RS-485 transmission according to the PROFIBUS standard	
Network topology	Linear bus, active bus terminator at both ends, stubs are possible.
Medium	Shielded twisted cable, shielding may be omitted, depending upon the environmental conditions (EMC).
Number of stations	32 stations in each segment with no repeater. Can be extended to 125 stations with repeater
Max. bus length without repeater	100 m at 12 Mbit/s 200 m at 1500 Kbit/s, up to 1.2 km at 93.75 kbit/s
Max. bus length with repeater	Repeaters can increase the bus length up to 10 km. The number of repeaters possible is at least 3, and, depending on the manufacturer, may be up to 10.
Data transfer rate (adjustable in steps)	9.6 kbit/s; 19.2 kbit/s; 93.75 kbit/s; 187.5 kbit/s; 500 kbit/s; 1500 kbit/s; 12 Mbit/s
Connector	9-pin D sub connector for IP20 M12 round connector for IP65/67

Cable-related faults

Note the special requirements on the data cable for bit rates greater than 1.5 Mbit/s. The correct cable is a basic requirement for correct operation of the bus system. If a simple 1.5 Mbit/s cable is used, reflections and excessive attenuation can lead to some surprising phenomena. It is possible, for instance, for a connected PROFIBUS station not to achieve a connection, but for it to be included again when the neighboring station is disconnected. Or there may be transmission errors when a specific bit pattern is transmitted. The result of this can be that when the equipment is not operating, PROFIBUS works without faults, but that there are apparently random bus errors after start-up. Reducing the bit rate (< 93.75 kbit/s) corrects this faulty behavior.

If reducing the bit rate does not correct the error, then in many cases this can indicate a wiring fault. The two data lines may be crossed over at one or more connectors, or the termination resistors may not be active, or they may be active at the wrong locations.

> **ℹ** **Preassembled cable from BECKHOFF**
>
> Installation is made a great deal more straightforward if preassembled cables from BECKHOFF are used! Wiring faults are avoided, and commissioning is more rapidly completed. The BECKHOFF range includes fieldbus cables, power supply cables, sensor cables and accessories such as termination resistors and T-pieces. Connectors and cables for field assembly are nevertheless also available.

The following diagram shows the cabling between two stations, as well as the D sub connection assignment:
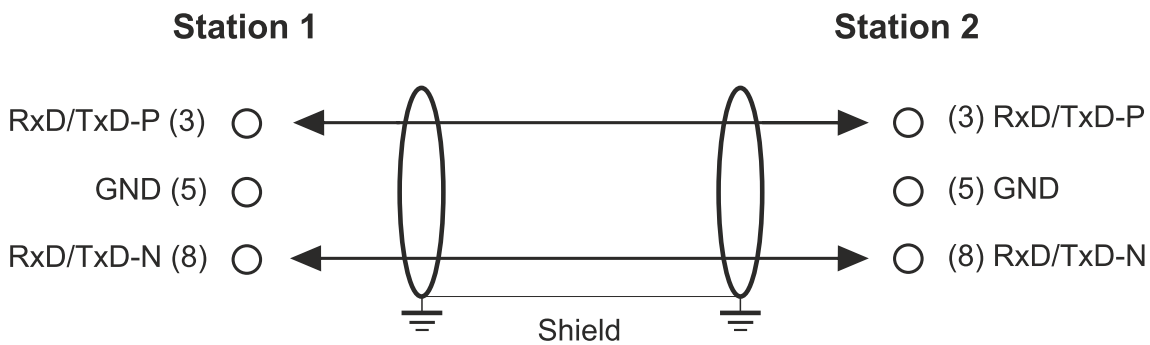
Fig. 13: PROFIBUS cabling

> ℹ **Termination resistors**
>
> In systems with more than two stations all devices are wired in parallel. It is essential that the bus cables are terminated with resistances at the conductor ends in order to avoid reflections and associated transmission problems.

Distances

The bus line is specified in EN 50170. This yields the following lengths for a bus segment.

Bit rate in kbits/sec	9.6	19.2	93.75	187.5	500	1500	12000
Cable length in m	1200	1200	1200	1000	400	200	100

Stubs up to 1500 kbit/s <6.6 m; at 12 Mbit/s stub segments should not be used.

Bus segments

A bus segment consists of at most 32 devices. 125 devices are permitted in a PROFIBUS network. Repeaters are required to refresh the signal in order to achieve this number. Each repeater is counted as one device.

IP-Link is the subsidiary bus system for Fieldbus Boxes, whose topology is a ring structure. There is an IP-Link master in the coupler modules (IP230x-Bxxx or IP230x-Cxxx) to which up to 120 extension modules (IExxxx) may be connected. The distance between two modules may not exceed 5 m. When planning and installing the modules, remember that because of the ring structure the IP-Link master must be connected again to the last module.

Installation guidelines

When assembling the modules and laying the cables, observe the technical guidelines provided by the PROFIBUS User Organization (PROFIBUS Nutzerorganization e.V.) for PROFIBUS DP/FMS (see: www.profibus.de).

Check the PROFIBUS cable

A PROFIBUS cable (or a cable segment when using repeaters) can be checked with a few simple resistance measurements. The cable should meanwhile be removed from all stations:

1. Resistance between A and B at the start of the line: approx. 110 Ohm
2. Resistance between A and B at the end of the line: approx. 110 Ohm
3. Resistance between A at the start and A at the end of the line: approx. 0 Ohm
4. Resistance between B at the start and B at the end of the line: approx. 0 Ohm
5. Resistance between shield at the start and shield at the end of the line: approx. 0 Ohm

If these measurements are successful, the cable is okay. If, in spite of this, bus malfunctions still occur, this is usually a result of EMC interference. Observe the installation notes from the PROFIBUS User Organization (www.profibus.com).

3.6.4 Topology

- A bus segment may consist of a maximum of 32 devices (including the repeaters).
- The maximum cable length of a segment depends on the data transfer rate in use and on the quality of the bus cables being used.
- No more than 9 repeaters may be installed between two devices.
- Stubs are to be avoided, and are not permitted above 1.5 Mbit/s.
- The maximum number of devices is 125
- Interrupting the supply voltages from cable ends by switching off the repeater/slave, or by pulling out the plug, is not permitted.
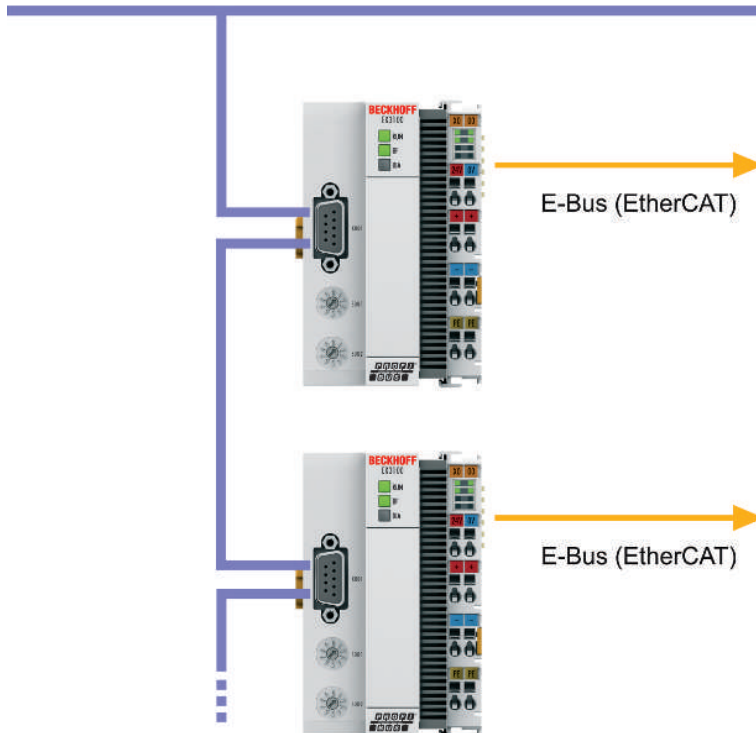
Profibus

Fig. 14: PROFIBUS topology with the EK3100 Bus Coupler.

3.7   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.

4   Parameterization and Commissioning

4.1   USB interface

The USB interface of type B is located behind the front flap of the EK3100 Bus Coupler. The internal flash memory can be reached via the USB interface for updating the image, for example.
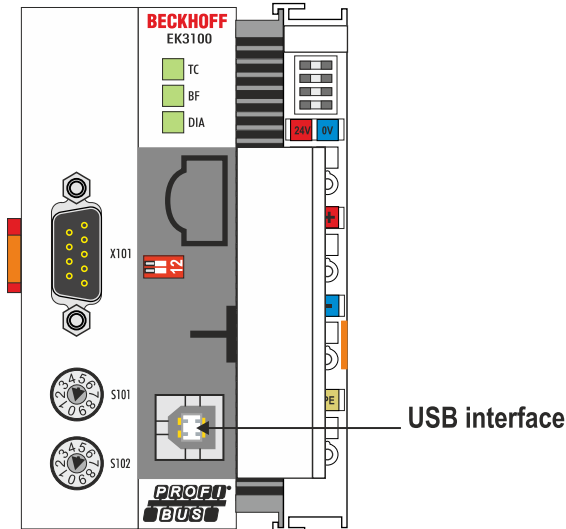

Fig. 15: USB interface of the EK3100 Bus Coupler.

The USB interface can only be used if the 2-pin DIP switch was set accordingly (see: 2-pin DIP switch [▶ 38]).

4.2   Address selection switch

The EK3100 Bus Coupler has two 10-pin address selection switches. The address selection switches can be used to set the Profibus address.
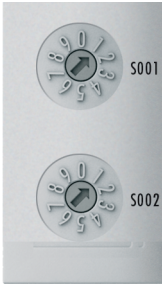

Fig. 16: Address selection switches of the EK3100.

Settings:

- S001 for address x 1
- S002 for address x 10

Example: If S001 is set to 2 and S002 is set to 1, the resulting address is 12.

To ensure that the address set via the two address selection switches is used in TwinCAT, the address also has to be entered in TwinCAT.

4.3 2-pin DIP switch

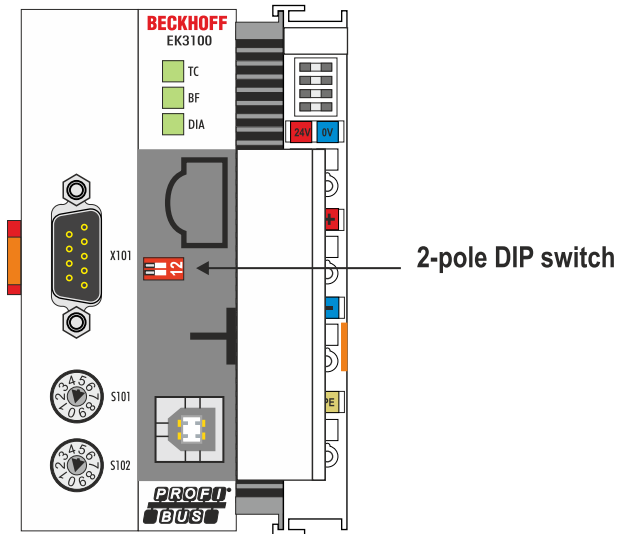The EK3100 Bus Coupler has a 2-pin DIP switch under the front flap.

Fig. 17: 2-pin DIP switch of the EK3100.

Table 1: Possible settings of the 2-pin DIP switch.

DIP switch (red), on = right	Meaning
1 off and 2 off	normal mode, coupler is started
1 on and 2 off	The coupler starts in Config mode. The internal flash memory can be reached via the USB interface (e.g. for an image update).
1 off and 2 on	Factory settings.
1 on and 2 on	No function so far

4.4   IP address (via USB interface)

The IP address can be used to access the EK3100 Bus Coupler via a host PC. To access the EK3100 Bus Coupler, the corresponding USB driver first has to be installed on the host PC (see: Installing the USB driver [▶ 44]).

An ordinary web browser can then be used on the host PC, and the Beckhoff device manager can be started (see: Beckhoff Device Manager [▶ 44]).

The EK3100 has the following fixed network settings:

- **IP address:** 172.21.42.1
- **Subnet mask:** 255.255.255.0

Check whether the IP address of the EK3100 Bus Coupler has been assigned to other devices in the local network or is used by your host PC. If this is the case, you have to change the IP addresses of the devices or deactivate them.

5   Configuration

Configuring EtherCAT Terminals

Since the PROFIBUS is subject to certain restrictions, EtherCAT Terminals cannot be configured via the GSD file. Some EtherCAT Terminals would exceed the maximum data length solely on account of the number of configuration data.

Configuration via the GSD file was deliberately omitted, and the EtherCAT Terminals are configured as follows:

- Via the web interface (see: Beckhoff device manager [▶ 44]),
- Or via the PROFIBUS DPV1 services (see sample program for a TwinCAT controller: https://infosys.beckhoff.com/content/1033/ek3100/Resources/4058251659.zip).

Configuring the process image (mapping) of the EtherCAT Terminals

The process image (mapping) of an EtherCAT Terminal is configured via the GSD file, as usual. If an EtherCAT Terminal has different mappings, the mapping is automatically set by selecting the corresponding module in the GSD file. If an EtherCAT Terminal is added in TwinCAT, for example, you can choose between the available mappings.

The GSD file for the EK3100 Bus Coupler must be copied into the TwinCAT directory:

- TwinCAT 2: *C:\TwinCAT\Io\Profibus*
- TwinCAT 3: *C:\TwinCAT\3.1\Config\Io\Profibus*

Or: The GSD file for the EK3100 Bus Coupler can be installed retrospectively in TwinCAT when the Bus Coupler is added in TwinCAT (see: Adding the EK3100 Bus Coupler in TwinCAT [▶ 51]). A corresponding prompt appears in TwinCAT, which asks you to install the GSD file.

Important configuration files

Table 2: GSD file, USB driver and sample program for the EK3100 Bus Coupler.

File	Download link
GSD file	EK3100DAA.ZIP (common for all Profibus master from firmware 01(V00.07) EK3100DAA02.ZIP (common for all Profibus master from firmware 02(V00.11))
USB driver	EK9XXX_RNDIS6.ZIP (driver for USB interface for Web Diagnostics) EK9XXX_RNDIS6_WIN10.ZIP (driver for USB interface for Web Diagnostics, Windows 10)
Sample program	https://infosys.beckhoff.com/content/1033/ek3100/Resources/4058251659.zip

5.1   EtherCAT configurations

The EK3100 is an EtherCAT master with automatic configuration. This means that all EtherCAT Terminals must be present when the system is switched on. Since the boot-up of the EK3100 generally takes considerably longer than the start-up of the EtherCAT slave devices, the latter can be operated on the same power supply. With decentralized EtherCAT slaves, care must be taken that they are switched on earlier or at the same time as the supply voltage.

Switching EtherCAT devices on or off during the runtime

If one or more EtherCAT devices should fail during the operating phase, an error response is generated on the PROFIBUS. The input data of all EtherCAT devices are then invalid and the output data are no longer accepted. This also applies to the devices that are still in operation on the EK3100. If you wish to use the option to plug in or unplug devices during the runtime, a further "Sync Unit" must be configured. This is not possible with an EK3100. In this case, use a CX803x.

EtherCAT topology

All EtherCAT devices must be entered in the order in which they map themselves on the EK3100 and thus on the EtherCAT master. EtherCAT devices are automatically addressed; with a few exceptions all EtherCAT Bus Terminals are equipped with an EtherCAT ASIC. EtherCAT Terminals without an ASIC are, for example, EL9400, EL9070 and other EL9xxx. You can identify these EtherCAT Terminals using the technical data "Message to E-bus". If there is a "-" here, this terminal need not be taken into account for the mapping.

EtherCAT devices are registered in the direction of the EtherCAT telegram.

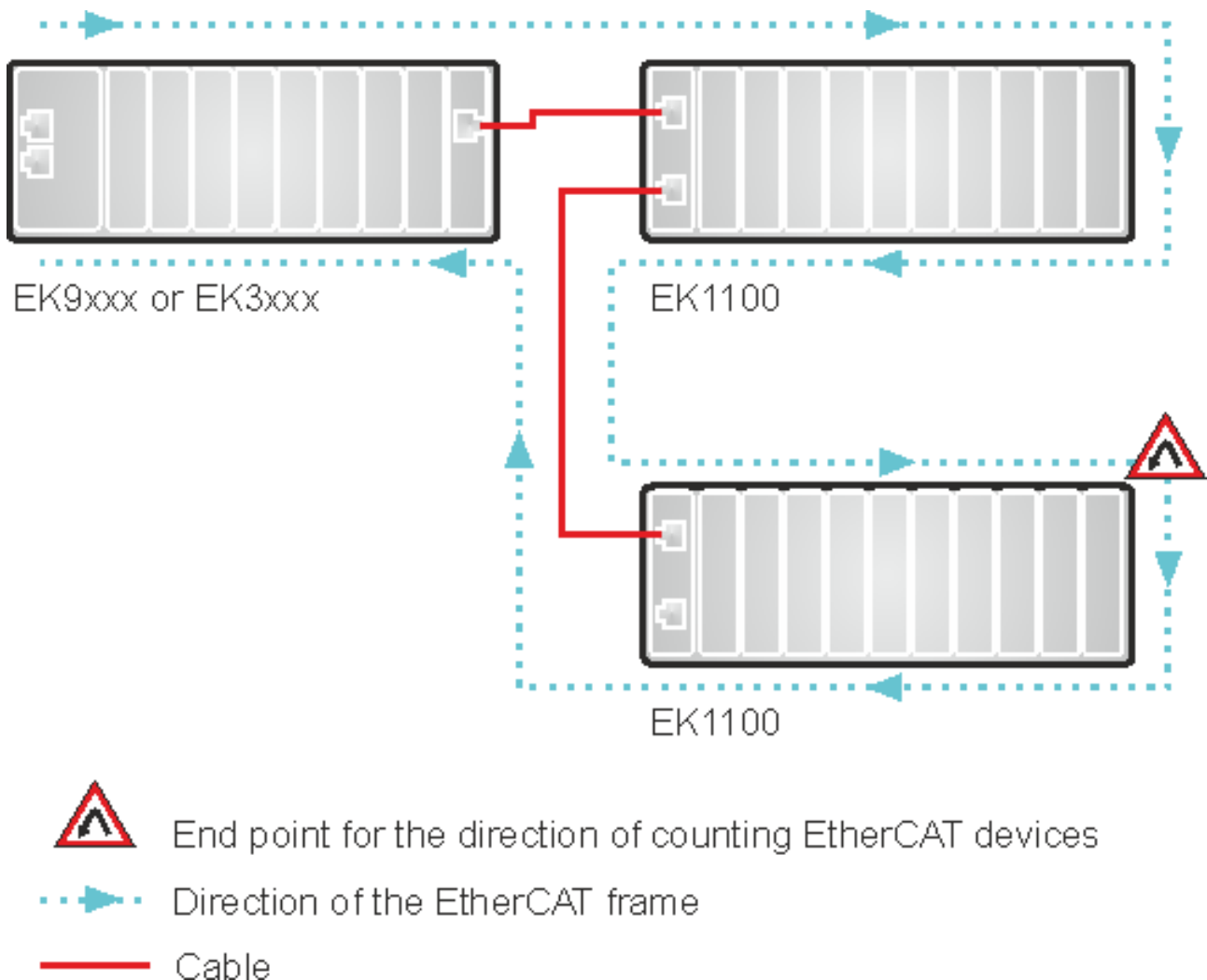**Sample configuration with EK1100 EtherCAT coupler**

Fig. 18: Sample configuration with EK1100 EtherCAT coupler

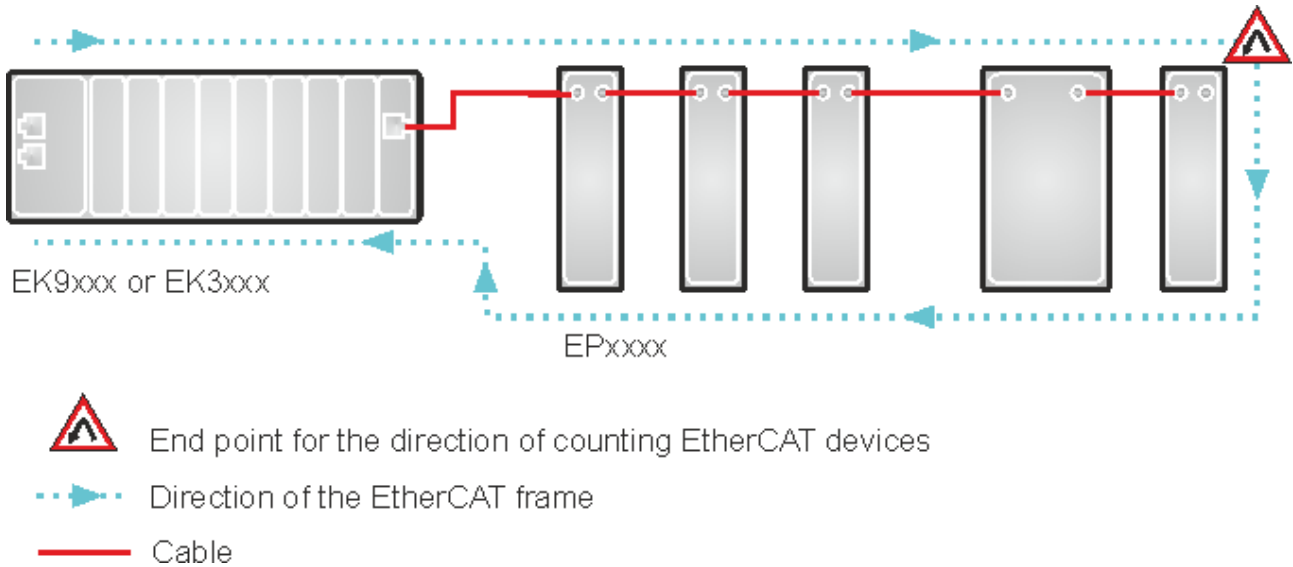**Sample configuration with EPxxxx EtherCAT Box**

Fig. 19: Sample configuration with EPxxxx EtherCAT Box

Example configuration with EK1122 (2-port EtherCAT junction in protection class IP20)

The counting direction is to be observed when using an EK1122!

If EtherCAT junction 1 on the EK1122 is connected, then the EtherCAT frame is forwarded here first (1); if junction 1 is not connected the frame on junction 2 is sent (2), only after that does the sequence continue with the E-bus on the right-hand side (3).
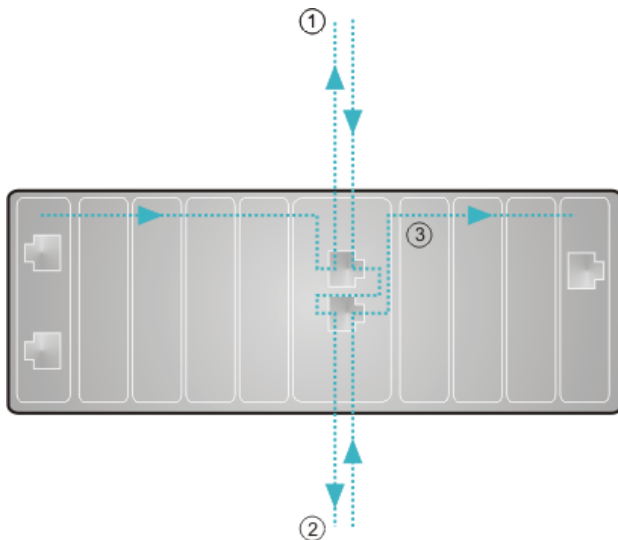

Fig. 20: Example configuration with EK1122 (2-port EtherCAT junction in protection class IP20)

If neither junction is used, then junctions 1 and 2 are bridged, so to speak, and the EtherCAT frame goes directly to the E-Bus on the right-hand side.

Example configuration with EP1122 (2-port EtherCAT junction in protection class IP65)

The counting direction is to be observed when using an EP1122! It is comparable with the EK1122.

If EtherCAT junction 1 on the EP1122 is connected, then the EtherCAT frame is forwarded here first (1); if junction 1 is not connected the frame on junction 2 is sent (2), only after that does the sequence continue with the EtherCAT connection on the right-hand side (3).
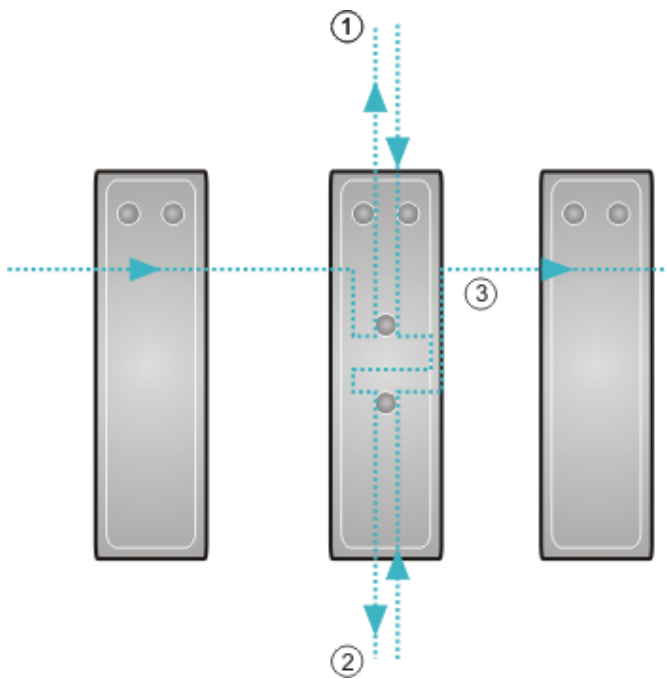
Fig. 21: Example configuration with EP1122 (2-port EtherCAT junction in protection class IP65)

If neither junction is used, then junctions 1 and 2 are bridged, so to speak, and the EtherCAT frame goes directly to the EtherCAT connection on the right-hand side.

No Hot Swap during operation

You cannot use EP1122 and EK1122 on an EKxxxx for Hot Swap and also not for connection and disconnection during operation. EP1122 and EK1122 are suitable only for topology extension (star) on an EKxxxx.

Note restrictions

Please note the following restrictions when you use the EK3100 Bus Coupler with EtherCAT devices:

- Only EtherCAT devices from Beckhoff are supported. To use EtherCAT device from other manufacturers, use the CX8031 Embedded PC instead.
- The EK3100 Bus Coupler does not support hot-plug. All EtherCAT devices have to be connected before the Bus Coupler can be started. The EtherCAT configuration must not be changed during operation. An EtherCAT interrupt generates an error and invalidates the data.
- Only one Sync Unit is supported.
- The EK3100 Bus Coupler does not support distributed clocks. EtherCAT devices requiring distributed clocks cannot be used.
- Use only EtherCAT devices from Beckhoff, which are listed in the GSD file.
- Gateway terminals are not supported. These also include ASI and IO-Link terminals. To use gateway terminals, use the CX8031 Embedded PC instead.
- EtherCAT K-bus Couplers, such as the BK11x0 or the BK1250, are not supported

5.2 Beckhoff Device Manager

5.2.1 Installing the USB driver

> **i**
>
> ● **Allocated IP address**
>
> The USB driver is not fully installed, if the IP address 172.21.42.15 on the host PC is already allocated.
> Use **Prompt > ipconfig** to check whether the IP address is allocated. If this is the case, change the IP address before proceeding.

To access the Beckhoff Device Manager of the EK3100 Bus Coupler, the corresponding USB driver first has to be installed on the host PC.

After successful installation, the driver simulates an additional local Ethernet interface on the host PC with the fixed IP address: 172.21.42.15 and subnet mask: 255.255.255.0

Requirements:

- IP address 172.21.42.15 is not already used on the host PC.
- USB driver for the host PC: --- FEHLENDER LINK ---
- USB driver for the host PC:
  - EK9XXX_RNDIS6.ZIP
  (Driver for USB interface for Web Diagnostics)
  - EK9XXX_RNDIS6_WIN10.ZIP
 (Driver for USB interface for Web Diagnostics, Windows 10)

Install the USB driver as follows:

1. Use a USB cable to connect the EK3100 Bus Coupler to the host PC and start the Bus Coupler.
   The device **Beckhoff Automation GmbH EK Series USB** appears in the device manager of the host PC.

2. Click on **Beckhoff Automation GmbH EK Series USB**, then on **Update Driver Software**.
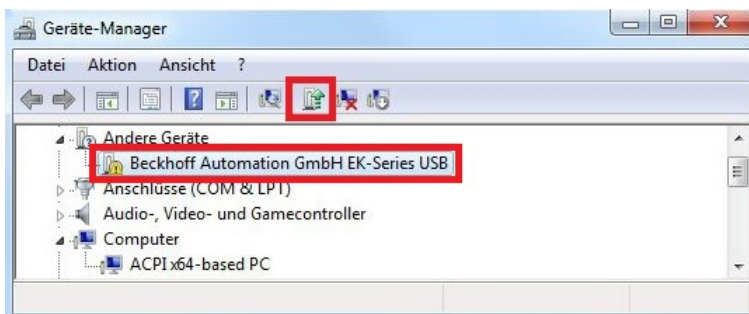
3. Specify the correct file path and install the driver on the host PC.

⇨ The USB driver has been installed successfully if the additional Ethernet interface **Beckhoff Automation GmbH EK9XXX Series USB RNDIS6** appears in the device manager.
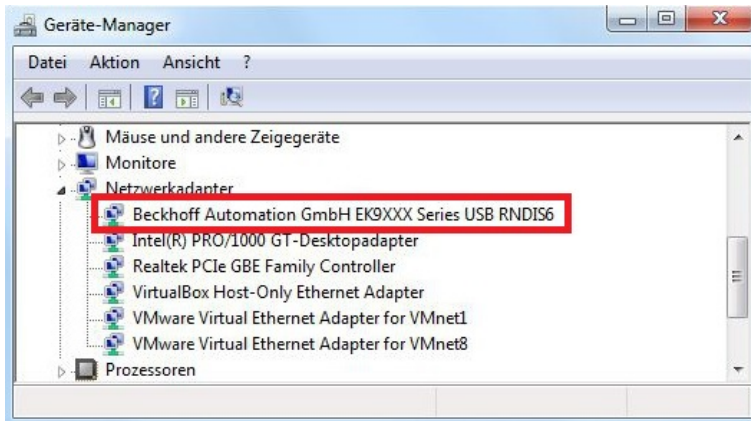
In the next step you can start the Beckhoff Device Manager.

5.2.2   Starting the Beckhoff Device Manager

The Beckhoff Device Manager can be used to configure EtherCAT Terminals that are connected to the Bus Coupler. In addition, the Beckhoff Device Manager can be used for diagnostic purposes relating to the Bus Coupler and the EtherCAT Terminals.

The Beckhoff Device Manager is started via a web browser on a host PC. Access to the Beckhoff Device Manager of the EK3100 Bus Coupler is protected.

Table 3: Access data for the Beckhoff Device Manager.

URL	Access data
172.21.42.1/config	User name: guest Password: 1

Requirements:

- The host PC and the EK3100 Bus Coupler are connected via a USB cable.
- USB driver installed on the host PC (see: <u>Installing the USB driver [▶ 44]</u>).

Start the Beckhoff Device Manager as follows:

1. On the host PC enter the IP address of the Bus Coupler in the web browser, in order to start the Beckhoff Device Manager.
   Example with IP address: http://172.21.42.1/config

2. In the authentication window enter the user name and the password.
   The start page appears.
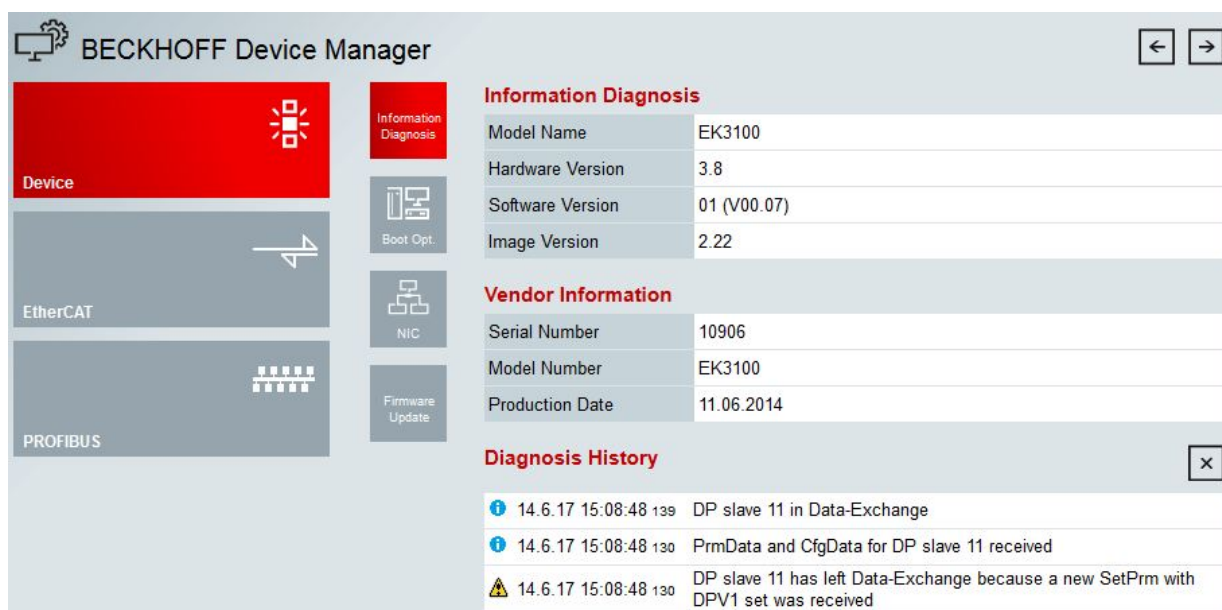
⇨ Navigate further in the menu and configure your hardware. Please note that modifications only take effect once they have been confirmed or the EK3100 Bus Coupler has been restarted.

NOTICE
Restarting the coupler after changing the configuration
If the configuration or mapping is changed, the coupler must be restarted in order to recalculate the mapping of the EtherCAT Terminals. The configuration is based on standard web technology and the browsers therefore work with a cache memory. This can lead to content from the cache memory being displayed and not from the device itself, so it is recommended to delete the cache memory of the browser after restarting the coupler and then call it up again so that old data is not displayed.

5.2.3 Setting the mappings for EtherCAT Terminals

> **ℹ Mapping**
>
> Please note that the settings for the mapping in TwinCAT (GSD file) always take precedence. Deviating settings in the Beckhoff Device Manager are not considered or are overwritten.

In the Beckhoff Device Manager you can set the mapping for an EtherCAT Terminal, if this EtherCAT Terminal supports different mappings. For the analog EL3062 EtherCAT Terminal, for example, you can choose between Standard mapping and Compact mapping. The choice affects the size and therefore the type of data that is available as process data (see GSD file).

Requirements:

- An EtherCAT Terminal that supports different mappings.
- The Beckhoff Device Manager was already started (see: <u>Starting the Beckhoff Device Manager [▶ 46]</u>).

Set the mapping for an EtherCAT Terminal as follows:

1. Click on **EtherCAT**, then on **Master**.
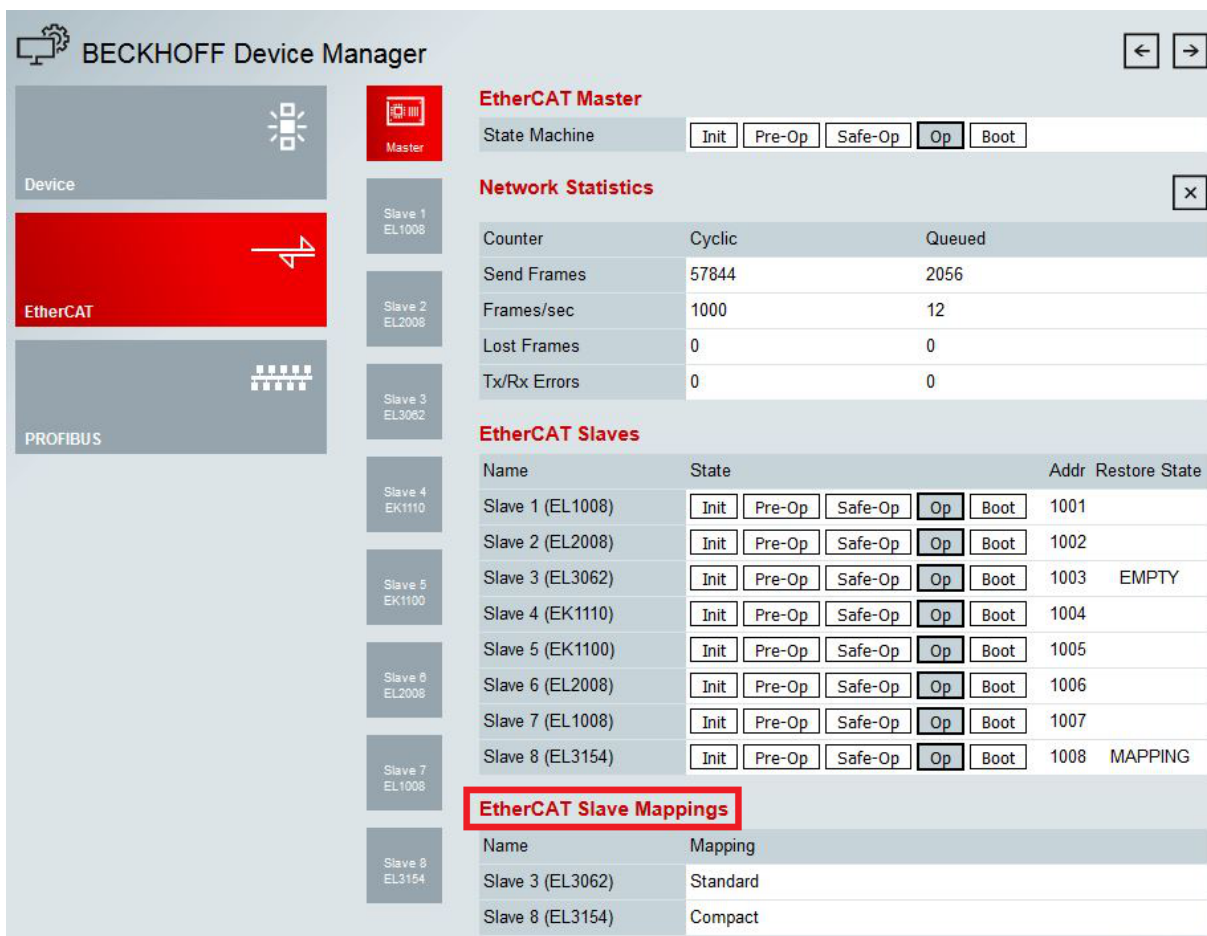
2. Under **EtherCAT Slave Mappings** all EtherCAT Terminals are displayed, which support other mappings.

3. Under **EtherCAT Slave Mappings** double-click on the EL3062 EtherCAT Terminal and select **Standard** or **Compact** mapping.
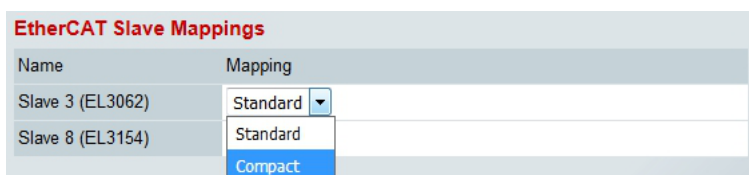
⇨ You have successfully set the mapping for the EL3062 EtherCAT Terminal. Restart the EK3100 Bus Coupler for the settings to take effect after reboot.

Example for process data (mapping)

> ● **Description of the process data**
>
> **i** Further information on the process data (mapping) for any EtherCAT Terminal can be found in the corresponding documentation. For example, for the EL3062 under: **Commissioning > Process data and operation modes> Process data.**

The EL3062 EtherCAT Terminal mentioned above offers two different process data per analog channel for transfer. The analog value *Value (16-bit)* and status information *Status (16-bit)*. The total for the two analog channels is therefore 64 bits or 8 bytes.

There is a choice of two types of process data in the EL3062:

- **Standard:** standard setting, Value (16 bit) and status information (8 or 16 bit) are transmitted per channel.

- **Compact:** only the Value (16 bit) is transmitted per channel.

To obtain a description of the individual bits, add the EtherCAT Terminal to TwinCAT, irrespective of your PROFIBUS configuration, or read the corresponding documentation
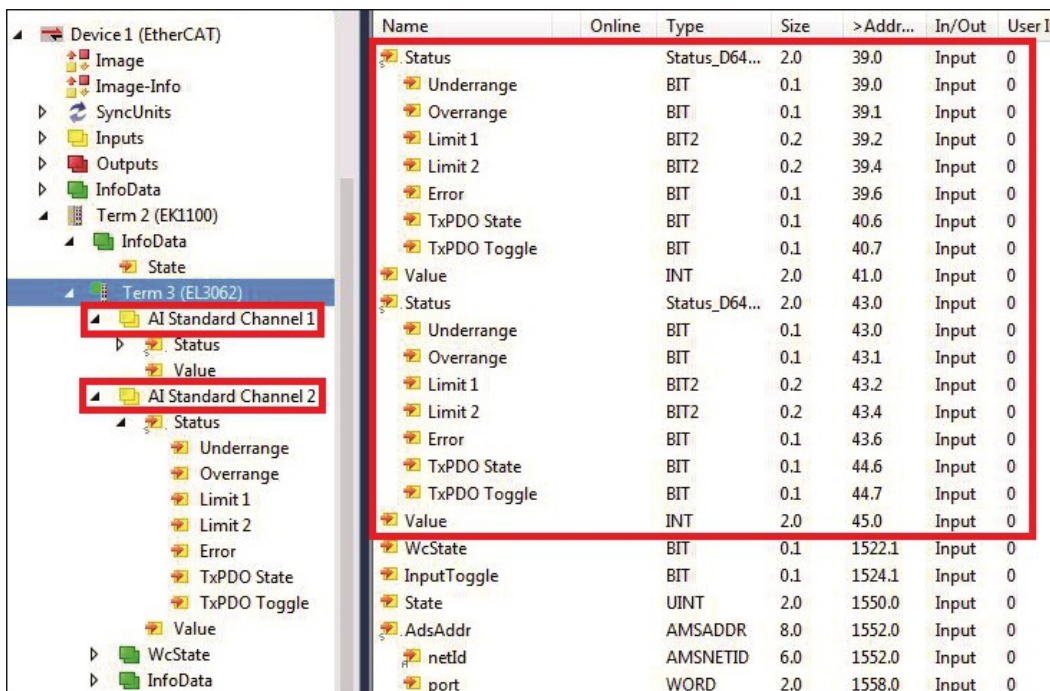

Fig. 22: Meaning of the individual bits with all subvariables and structure contents for the EL3062.

Status word

The status word (SW) is located in the input process image, and is transmitted from terminal to the controller.

Bit	SW.15	SW.14	SW.13	SW.12	SW.11	SW.10	SW.9	SW.8
Name	TxPDO Toggle	TxPDO State	-	-	-	-	-	-

Bit	SW.7	SW.6	SW.5	SW.4	SW.3	SW.2	SW.1	SW.0
Name	-	ERROR	Limit 2		Limit 1		Over-range	Under-range

5.2.4   Configuring EtherCAT Terminals

In this chapter the EL3062 EtherCAT Terminal is used to illustrate how to configure EtherCAT Terminals with the Beckhoff Device Manager.

Further information on the parameters and their meaning for any EtherCAT Terminal can be found in the corresponding documentation. For example, for the EL3062 under: **Commissioning > Object description and parameterization > Configuration data**.

Requirements:

- The Beckhoff Device Manager was already started (see: Starting the Beckhoff Device Manager [▶ 46]).

Configure EtherCAT Terminals as follows:

1. Click on **EtherCAT**, then on **Master**.
2. Click on an EtherCAT Terminal you wish to configure.
   The parameters of the EtherCAT Terminal are displayed.
3. Under **Parameters** you can change the values for the EtherCAT Terminal.

⇨ The settings are stored in the EtherCAT Terminal. Please note that the settings will be lost when you replace the EtherCAT Terminal with a new one.
In order to retain the settings, you can save them in a Restore file (see: Using Restore file [▶ 50]).

5.2.5   Using Restore file

Restore files are used in the Beckhoff device manager for saving existing EtherCAT Terminal configurations and settings.

Without a Restore file, EtherCAT Terminal settings are lost, if the terminal is replaced. If a Restore file was created, the parameters can be copied to a new EtherCAT Terminal when the Bus Coupler is started.

Requirements:

- The Beckhoff Device Manager was already started (see: <u>Starting the Beckhoff Device Manager [▶ 46]</u>).

Use Restore files as follows:

1. Click on **EtherCAT**, then on **Master**.
2. Under **EtherCAT Slaves** all EtherCAT Terminals are displayed, for which a Restore file can be created.
3. Use the option **Restore State** to show whether a Restore file was created for an EtherCAT Terminal.

EMPTY: No Restore file was created.
VALID: A valid Restore file was created.
MAPPING: The mapping was changed and has not yet been saved in the Restore file.

4. Under **Configuration Management** you can specify whether a Restore file should be created, deleted, saved or restored.

⇨ Please note that the settings from a Restore file are not copied to the new EtherCAT Terminal until the Bus Coupler is restarted.

5.3 Configuration in TwinCAT 3

5.3.1 Adding the EK3100 Bus Coupler in TwinCAT

The EK3100 Bus Coupler is added in TwinCAT under a PROFIBUS master. In this step the CX2020 Embedded PC is used with a CX2500-M310 PROFIBUS fieldbus module as an example.

The EK3100 Bus Coupler requires the appropriate GSD file for TwinCAT. Two options are available. The GSD file can be copied into the TwinCAT directory or added to TwinCAT retrospectively. In this step the GSD file is added to TwinCAT retrospectively.

Requirements:

- GSD file for the EK3100 Bus Coupler: https://infosys.beckhoff.com/content/1033/ek3100/Resources/4001508235.zip
- The PROFIBUS master was selected as target system and added in TwinCAT.

Add the EK3100 Bus Coupler in TwinCAT as follows.

1. In the tree view right-click on the PROFIBUS master **Device 1 (CX2500-M310)**.
2. Click on **Add New Item** in the context menu.
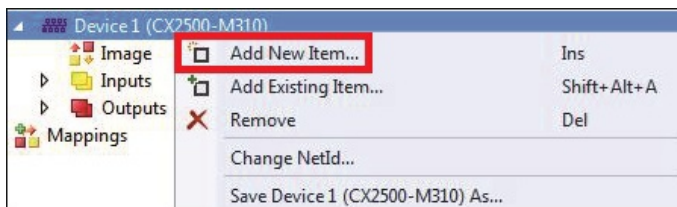
3. Click on **Miscellaneous**, then on **Generic Profibus Box (GSD)**.
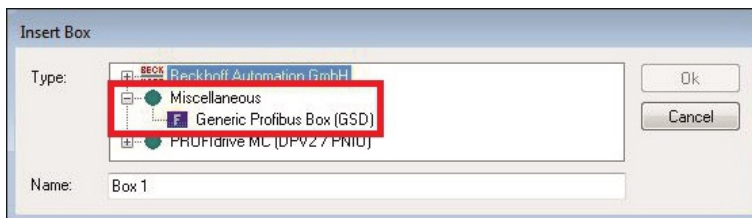
The **Open** window opens.

4. Find the GSD file from the Zip archive in your directory and select the file *EK3100DAA.gsd* for the EK3100 Bus Coupler.
   Box 1 (GSD box) (EK3100) appears under the PROFIBUS master.
5. Click on the **Profibus** tab and enter the Profibus address under **Station No**. The address must be the same as the address that was set with the address selection switches.

⇨ You have successfully added the EK3100 Bus Coupler and the corresponding GSD file in TwinCAT. The **CtrlStatus DWORD module** is automatically added under box 1 (GSD box) (EK3100).
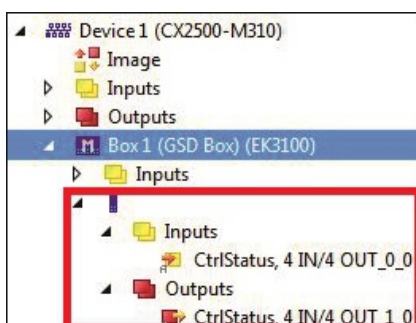
In the next step you can add EtherCAT Terminals in TwinCAT according to your hardware configuration.

5.3.2   Using the CtrlStatus DWORD

The CtrlStatus DWORD module is added automatically when the EK3100 Bus Coupler is added in TwinCAT. The CtrlStatus DWORD (4 bytes) has the following meaning:

Input CtrlStatus DWORD

Table 4: Structure and meaning of the input CtrlStatus DWORD module.

Byte 3	Byte 2	Byte 1	Byte 0
Reserve	Diag	Counter High Byte	Counter Low Byte

Counter WORD (2 bytes):
The counter is an E-bus counter and is incremented with each E-bus telegram. By default, the E-bus runs at 1 ms. Thus, the counter is incremented every ms. If bit 2 is set in the Diag byte, further information about the error is included instead of the counter.

DIAG BYTE (1 byte):
0x10 E-bus fixed after error. Outputs are disabled and have to be reset manually with the control DWORD.

0x04 E-bus error. In the event of an E-bus error, the EK3100 Bus Coupler continues to exchange data with the PROFIBUS master. However, the input data are invalid. The cause of the error is coded in the high byte, the position in the low byte of the counter.

Byte 1, error code counter	Byte 0, counter	Meaning
1	Terminal position	Wrong module.
2		Missing module.
3		Module pulled.
4		Wrong module connected.
5		EtherCAT slave not in OP.
6		State change aborted.
7		Abnormal state change.
8		SDO-Abort
9		Wrong SDO length
10		Wrong SDO data.

Example:
Byte 1 0x03 interruption of the E-bus, byte 0 position of the interruption.

Output CtrlStatus DWORD

Table 5: Structure and meaning of the output CtrlStatus DWORD module.

Byte 3	Byte 2	Byte 1	Byte 0
Reserve	Reserve	Reserve	Control byte

Control byte (bit 0):
If bit 4 (0x10) is set in the DIAG BYTE, the controller can acknowledge the error. To this end, bit 0 (in the first byte of the control DWORD) has to be set to "TRUE", and the E-bus is restarted with a falling edge of bit 0. The output process data are active again immediately.

5.3.3 Adding an EtherCAT Terminal

Please note the order of the EtherCAT Terminals in TwinCAT. The EtherCAT Terminals have to be added to TwinCAT in the same order as they are plugged or addressed by the EtherCAT master (EK3100 Bus Coupler).

Some EtherCAT Terminals do not have to be added in TwinCAT.

- EtherCAT Terminals, which are not visible in the EtherCAT master (EK3100 Bus Coupler) do not have to be entered.
- All other EtherCAT Terminals, which are visible in the EtherCAT master (EK3100 Bus Coupler), always have to be entered. This includes EtherCAT Terminals without process data.

EtherCAT Terminals, which are visible but have no process data:
Example: EK1100, EK1110, …

EtherCAT Terminals, which are not visible and have no process data. These terminals are identified in the technical data with a "-" under "Message to E-bus":
Example: EL9011, EL9080, …

Requirements:

- The Bus Coupler was added in TwinCAT together with the corresponding GSD file

Add EtherCAT Terminals as follows:

1. Always add the first EtherCAT Terminal after the **CtrlStatus DWORD module**.
2. Right-click on **Box 1 (GSD) (EK3100)** on the left in the tree view.
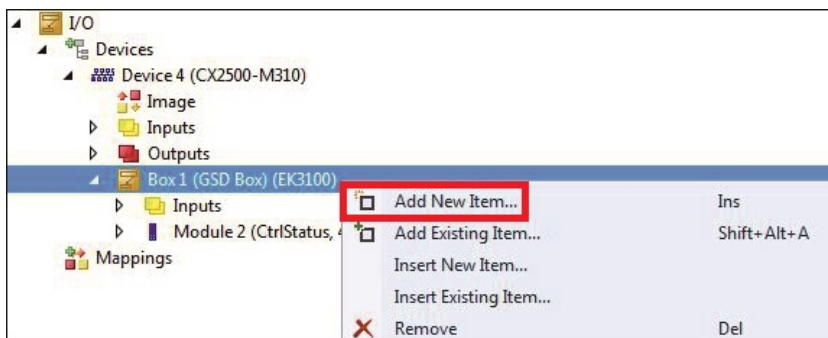
3. Click on **Add New Item** in the context menu.
   The Insert Module window appears.
4. Select the corresponding EtherCAT Terminal in the right order.
   Please note that some EtherCAT Terminals are listed several times, depending on the available mapping.
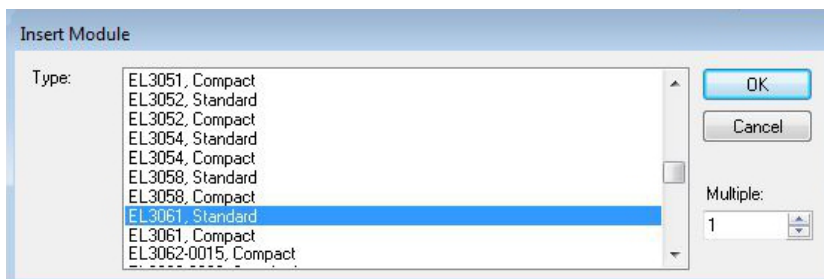
Example: For the analog EL3062 EtherCAT Terminal you can choose between Standard mapping and Compact mapping. The choice affects the size and therefore the type of data that is available as process data (see GSD file).

⇨ Add further EtherCAT Terminals in TwinCAT, until your hardware configuration with all EtherCAT devices is fully mapped in TwinCAT.

5.3.4 Creating a virtual slave

Up to three virtual slaves can be configured for the EK3100 Bus Coupler. Virtual slaves can be used to increase the transfer rate beyond the standard PROFIBUS rate of 244 bytes. The maximum process data size is 240 byte inputs and 240 byte outputs per slave.

In order to be able to use virtual slaves, the EtherCAT Terminals must be successive, and all EtherCAT Terminals must occur in the slaves. In addition, it is important that a slave contains both input and output terminals.

By default only the first slave is activated. The virtual slaves are enabled in the configuration via the parameter data. The parameter data and the CtrlStatus DWORD only have the full functionality for the first slave.

The addressing is fixed and starts with the address, which the first slave uses via an address selection switch. If the address is set to 11, the following addresses are 12, 13 and 14 if all 4 slaves are active.

Table 6: Example of a hardware configuration with a slave.

EtherCAT device, actual hardware configuration										
EK3100	CtrlStatus	EL1008	EL2008	EL3062	EK1110	EK1100	EL2008	EL1008	EL3154	EL9011

Table 7: Distribution of the EtherCAT device in TwinCAT over two slaves.

Slave 1						Slave 2 (virtual slave)				
EK3100	CtrlStatus	EL1008	EL2008	EL3062	EK1110	**EK3100**	CtrlStatus	EK1100	EL2008	EL1008	EL3154
PROFIBUS address: 11						PROFIBUS address: 12. The non-visible EL9011 is omitted.				

Requirements

- The EK3100 Bus Coupler was already added in TwinCAT.

Create virtual slaves as follows:

1. In the tree view on the left, double-click on **Box 1 (GSD box) (EK3100)**.

2. Click on the tab **PrmData (Text)**.

3. Double-click on **Enabled DP Slaves** and select the number of virtual slaves.

4. Add a further EK3100 Bus Coupler under the existing EK3100 Bus Coupler. This Bus Coupler is the virtual slave.

5. Click on the **Profibus** tab and enter the PROFIBUS address "12" under **Station No**.

⇨ Add all EtherCAT Terminals after the EK3100 Bus Coupler and the virtual slave. Use the above table for guidance.

```
▲ 🗁 I/O
   ▲ 🔧 Devices
      ▲ 🔳 Device 4 (CX2500-M310)
            🔼 Image
         ▷ 📁 Inputs
         ▷ 🟥 Outputs
      ▲ 📦 Box 1 (GSD Box) (EK3100)
         ▷ 📁 Inputs
         ▷ ▮ Module 2 (CtrlStatus, 4 IN/4 OUT)
         ▷ ▮ Module 16 (EL1008)
         ▷ ▮ Module 17 (EL2008)
         ▷ ▮ Module 18 (EL3062, Standard)
         ▷ ▮ Module 19 (EK1110)
      ▲ 📦 Box 2 (GSD Box) (EK3100)
         ▷ 📁 Inputs
         ▷ ▮ Module 2 (CtrlStatus, 4 IN/4 OUT)
         ▷ ▮ Module 7 (EK1100)
         ▷ ▮ Module 8 (EL2008)
         ▷ ▮ Module 9 (EL1008)
         ▷ ▮ Module 10 (EL3154, Standard)
```
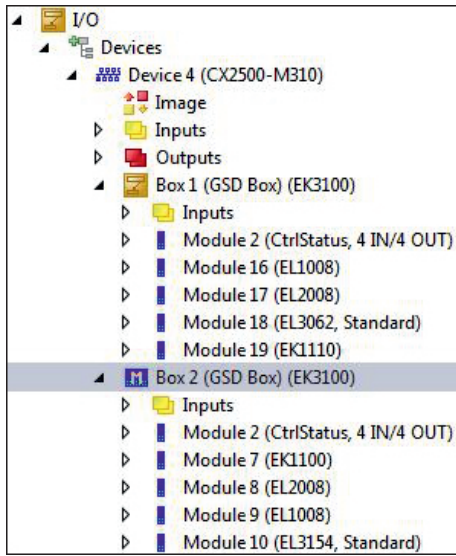
5.3.5 Packing digital signals

EtherCAT Terminals generally always require 1 full byte for process data. 1 full byte for process data is also assigned for EtherCAT Terminals, which effectively only have a process data size of 2 or 4 bits.

In order to fill 1 byte completely, the 2- or 4-channel EtherCAT Terminals can be packed. Please ensure that these EtherCAT Terminals are connected successively and that 1 byte is not exceeded.

The entry EL1xxx or EL2xxx in the GSD file is used for this purpose. The EtherCAT Terminals to be packed have the entry EL1xxx (pack) or EL2xxx (pack). These EtherCAT Terminals then have no data. The data are added to the preceding terminals in the byte.

Example:
Three EL1002 (each with 2 channels) are connected consecutively. In this example one EL1xxx can be configured and two EL1xxx (pack).

The process data for these EtherCAT Terminals then are as follows:

First EL1002:	x.0 and x.1
Second EL1002:	x.2 and x.3
Third EL1002:	x.4 and x.5

Requirements

- The EtherCAT Terminals must be connected consecutively.

Pack digital signals as follows:

1. Right-click on **Box 1 (GSD) (EK3100)** on the left in the tree view.

2. Click on **Add New Item** in the context menu.
   The Insert Module window appears.
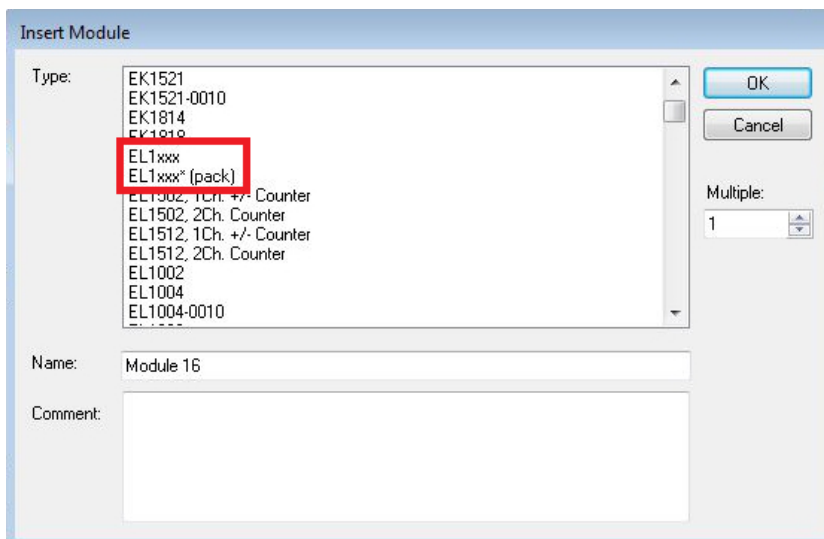
3. Select the terminal **EL1xxx**.
   The EtherCAT Terminal is added in TwinCAT.

4. Then select the terminal **EL1xxx (pack)** and enter the value "2" under the option **Multiple**.

⇨ Three EL1002 EtherCAT Terminals were added in TwinCAT. The data of the two EL1xxx (pack) are added to the preceding EtherCAT Terminal in the byte.

In the example a further EL1002 can be connected to fill the byte. Or other 2-channel input terminals can be used. It is important that they have the same mapping. It is also possible to mix 2-channel and 4-channel EtherCAT Terminals, as long as 1 byte is not exceeded.

5.4 Accessing COE data with DPV1 services

DPV1 MSAC-C1-READ and DPV1 MSAC-C1-WRITE can be used for read and write access to all COE data. The COE data must allow READ and WRITE access.

The access is always via two DPV1 telegrams. The first is always a DPV1 WRITE telegram. The second is a DPV1 READ telegram. The DPV1 WRITE telegram determines which COE data are read or written.

> **ℹ Behavior when the Bus Coupler is restarted**
>
> Please note that the COE data, which are changed by your controller, have to be re-sent to the terminal when the EK3100 Bus Coupler is restarted.

- **Reading data:** During reading a DPV1 WRITE telegram is send to the Bus Coupler. It notifies the Bus Coupler which data are to be read. The second DPV1 READ telegram is then used to fetch the data.

- **Writing data:** During writing, the data are transferred with the CoE parameters, and the acknowledgement of the COE write access is transferred with the DPV1 READ telegram. This consists of 4 bytes. If these are zero, the data were written without error. If they are not zero, an error has occurred.

  The error corresponds to an ADS error code. The meaning of the ADS error codes can be found in the TwinCAT documentation (see: ADS error codes).

5.4.1 Activating the DPV1 service

DPV1 MSAC-C1-READ and DPV1 MSAC-C1-WRITE can be used for read and write access to all COE data. The COE data must allow READ and WRITE access.

For read and write access to COE data, the DPV1 service must be active on the EK3100 Bus Coupler in the parameter data for the EK3100 Bus Coupler. In TwinCAT you can control whether the DPV1 service is active, or you can activate the DPV1 service.

Requirements:

- The Bus Coupler was added in TwinCAT together with the corresponding GSD file.

Activate the DPV1 service as follows:

1. In the tree view on the left, double-click on **Box 1 (GSD box) (EK3100)**.

2. Click on the tab **PrmData (Text)**.
3. Double-click on the option **DPV1 services (class 1)** to activate the service.
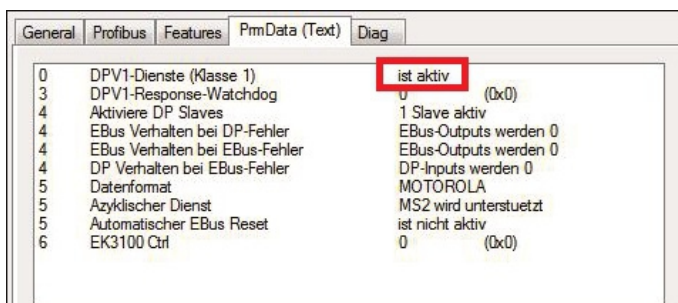
⇨ You have successfully activated the DPSV1 service. For virtual slaves, the settings in the parameter data are irrelevant.
In the next step, you can view the structure of the DPV1 telegram.

5.4.2   Note the structure of the DPV1 telegram

Table 8: Structure of the DPV1 telegram for write and read access.

Index	100
Slot number	Position of the EtherCAT Terminal, absolute position plus 1

Structure	Meaning	Length in bytes
CoE Index	CoE index number.	2
COE subindex	COE subindex number.	1
READ/ WRITE	0-read/ 1-write.	1
Length	Length of the data that is to be written. During reading, this can be zero.	4
Data	Data, only required for writing.	n

If you use virtual slaves, the slot number must contain the actual terminal position, not the slot position of the EtherCAT Terminal.

Example

You want to read the COE data of EtherCAT Terminal EL3154. This EtherCAT Terminal is configured in TwinCAT under slave 2 (virtual slave).

Table 9: Distribution of the EtherCAT device in TwinCAT over two slaves.

Slave 1						Slave 2 (virtual slave)					
EK3100	CtrlStatus	EL1008	EL2008	EL3062	EK1110	**EK3100**	CtrlStatus	EK1100	EL2008	EL1008	EL3154
PROFIBUS address: 11						PROFIBUS address: 12. The non-visible EL9011 is omitted.					

In this example EtherCAT Terminal EL3154 has the slot number 9. The CtrlStatus DWORD module is not included in the count for the EK3100 virtual slave.

Table 10: Distribution of the slot numbers across the EtherCAT devices.

Slave 1					Slave 2 (virtual slave)			
Slot number	2	3	4	5	6	7	8	9
EK3100	EL1008	EL2008	EL3062	EK1110	EK1100	EL2008	EL1008	EL3154
PROFIBUS address: 11					PROFIBUS address: 12. The non-visible EL9011 is omitted.			

● **Reading CoE data**

i To read CoE data, the data to be read must first be written with a DPV1-Write, and only then can the data be read with a DPV1-READ.

6   Error handling and diagnostics

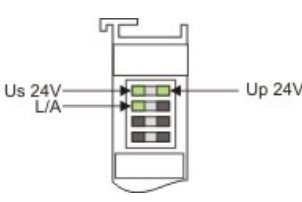## 6.1   Diagnostic LEDs

Table 11: Diagnostic LEDs on the EK3100.

Display	LED	Description	Color	Meaning
BECKHOFF EK3100 RUN BF DIA	RUN	Indicates the status of the coupler.	Green	EK3100 started.
			Blue	Update of the EK3100 via USB possible.
	BF	Shows the PROFIBUS status	Flashing green	No PROFIBUS communication.
			Green illuminated	EK3100 is in data exchange.

LED	Description	Error code - First sequence	Error location - Second sequence	Meaning
DIA	Flashes red in the event of an error. Indicates the error code and the error location through two consecutive sequences.	1 pulse	After Bus Terminal n	Wrong module.
		2 pulses		Missing module.
		3 pulses		Module pulled.
		4 pulses		Wrong module connected.
		5 pulses		EtherCAT slave not in OP mode.
		6 pulses		State change aborted.
		7 pulses		Abnormal state change.
		8 pulses		SDO abort.
		9 pulses		Wrong SDO length.
		10 pulses		Wrong SDO data.

6.2 Power supply terminal LEDs in K-bus mode

The power supply unit checks the connected EtherCAT Terminals. The "L/A" LED is lit in E-bus mode. The "L/A" LED flashes during data transfer.

Table 12: Power supply terminal LEDs on the EK3100.

Display	LED		Meaning
	Us 24 V		Power supply for basic CPU module. The LED lights green if the power supply is correct.
	Up 24 V		Power supply for terminal bus. The LED lights green if the power supply is correct.
	L / A	off	E-bus not connected.
		on	E-bus connected / no data traffic.
		flashes	E-bus connected / data traffic on the E-bus.

6.3 Diagnostics via PROFIBUS

The diagnostics via PROFIBUS is configured as follows. The module at slot 1 is always the CtrlStatus DWORD module. The first EtherCAT Terminal from your hardware configuration is therefore always at slot 2.

For the diagnostics the currently projected position is important, not the actual position in the hardware configuration.

Example:
An EtherCAT Terminal, which in the actual hardware configuration is connected in fourth position after the EK3100, has a problem. In this case the diagnostics would indicate the error at slot 5, since slot 1 is always assigned the CtrlStatus DWORD module.

Fig. 23: Diagnostic example via PROFIBUS with a Siemens project configuration.

Please note this behavior for diagnostics via PROFIBUS.

6.3.1 Diagnostics for virtual slaves

The diagnostics always indicates the slot from the configuration; the "actual" EtherCAT Terminal is indicated via the text.

Example:
You have configured the EK3100 Bus Coupler with an additional virtual slave, and the EtherCAT Terminal at the 9th position has a problem. This EtherCAT Terminal is configured at the 5th slot on the virtual slave. Use the text from the diagnostics, rather than the slot number, to determine the error location.

Fig. 24: Diagnostic example via PROFIBUS for virtual slaves with a Siemens project configuration.

Please note this behavior for diagnostics via PROFIBUS.

6.3.2   Configuration of the diagnostic telegram

Table 13: Configuration of the diagnostic telegram after DPV0 and DPV1.

Byte	Description
Byte [0…5]	Standard diagnosis after DPV0.
from byte [6]	Diagnosis after DPV1.
Byte [6]	0x07 header byte after DPV1 = length specification.
Byte [7]	0x0A status type after DPV1.
Byte [8]	0xXX slot number after DPV1 The slot number refers to the position in the configuration software. The slot number is always +1, since slot 1 is always assigned the CtrlStatus DWORD module. The actual EtherCAT Terminal is shown in byte [10].
Byte [9]	Specifier after DPV1.
from byte [10]	Vendor-specific.
Byte [10]	EtherCAT slave number.
Byte [11]	Value (1) = EtherCAT slave in INIT.
	Value (2) = EtherCAT slave in PreOP.
	Value (3) = EtherCAT slave in SafeOP.
	Value (4) = EtherCAT slave in OP.
	Value (5) = EtherCAT slave not present.
Byte [12]	Value (1) = state change aborted.
	Value (2) = abnormal state change.
	Value (3) = SDO abort.
	Value (4) = wrong SDO length.
	Value (5) = wrong SDO data.
	Value (6) = wrong module configured.
	Value (7) = modules pulled.
	Value (8) = modules connected.
	Value (9) = not all modules connected.
	Value (10) = wrong module connected.
	Value (11) = missing module.

7 Appendix

7.1 Update Bus Coupler image

ℹ **Loss of data**

The data in the internal flash memory are deleted.
Save your data before you update the Bus Coupler image.

The Bus Coupler image can be updated via the USB interface. To this end the Bus Coupler is connected with a host PC via a USB cable. Windows then shows the Bus Coupler as a removable data storage device, and the files can be copied.

The Bus Coupler should only be updated after consultation with the Beckhoff Service. The Beckhoff Service will provide all the required files.

Requirements

- First, check whether the Bus Coupler supports the image.
- The Bus Coupler is connected with the host PC via a USB cable.

Update the image as follows:

1. Switch off the Bus Coupler.

2. Switch the red 2-pin **DIP switch 1** to "on" (to the right) and switch on the Bus Coupler.
   The Bus Coupler appears as a removable data storage device on the host PC.

3. Select and delete all files. Do not format.

BkIpcDiag	01.01.2006 11:00	Dateiordner	
Documents and Settings	01.01.2006 11:00	Dateiordner	
TwinCAT	01.01.2006 11:00	Dateiordner	
NK.bin	22.05.2017 15:03	BIN-Datei	12.697 KB

4. Remove the USB cable, once all files have been copied, and switch the 2-pin DIP switch to "off" (to the left).

5. Restart the Bus Coupler.

⇨ The image has been updated successfully. After the update, the Bus Coupler may take a little longer to start up.

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: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Support

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

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

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com
web:	www.beckhoff.com/support

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
e-mail:	service@beckhoff.com
web:	www.beckhoff.com/service

Headquarters Germany

Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20
33415 Verl
Germany

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

More Information:
www.beckhoff.com/EK3100