Documentation

EL9xxx

EtherCAT System Terminals

Version: 3.9
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2 Foreword

2.1 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.

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with corresponding applications or registrations in various other countries.

The TwinCAT Technology is covered, including but not limited to the following patent applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

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2.2 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.

●
ℹ Tip or pointer
This symbol indicates information that contributes to better understanding.

2.3   Documentation issue status

Version	Comment
3.9	- EL9185-0010, EL9550-0012 and EL9180 added - Update chapter "Technical data" - Update structure
3.8	- Chapter "Non-reactive Bus Terminals" added - Update chapter "Technical data" - Update structure
3.7	- Addenda EL9185 - Update chapter "Technical data" - Update structure
3.6	- Update chapter "Technical data" - Update structure
3.5	- Update chapter "Technical data" - Update structure
3.4	- Update chapter "Introduction" - Update structure
3.3	- Update chapter "Technical data" - Update structure
3.2	- Update chapter "Technical data" - Update chapter "Introduction" - Update structure
3.1	- Update chapter "Technical data" - Addenda chapter "Installation instructions for enhanced mechanical load capacity" - Update structure
3.0	- Update structure - 1st public issue in PDF format
2.5	- Update structure
2.4	- Technical data added
2.3	- Technical data added, EL9570
2.2	- Update Technical data
2.1	- Update connection diagram EL9550
2.0	- Addenda EL9540, EL9550
1.9	- Technical data EL9070, EL9181, EL9182, EL9183 added
1.8	- Technical data EL9195 added
1.7	- Firmware compatibility note added
1.6	- Technical data added, EL9184, EL9188, EL9189 added
1.5	- Technical data added, EL9190, EL9200, EL9210, EL9250, EL9260, EL9290 added
1.4	- Technical data EL9150, EL9160 added
1.3	- Technical data EL9110, EL9410 added
1.2	- Technical data EL9100 changed
1.1	- Technical data EL9186, EL9187 added
1.0	- Technical data added
0.1	- first provisional documentation for EL9xxx

2.4   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. 1: EL5021 EL terminal, standard IP20 IO device with serial/ batch number and revision ID (since 2014/01)

Fig. 2: EK1100 EtherCAT coupler, standard IP20 IO device with serial/ batch number

Fig. 3: CU2016 switch with serial/ batch number
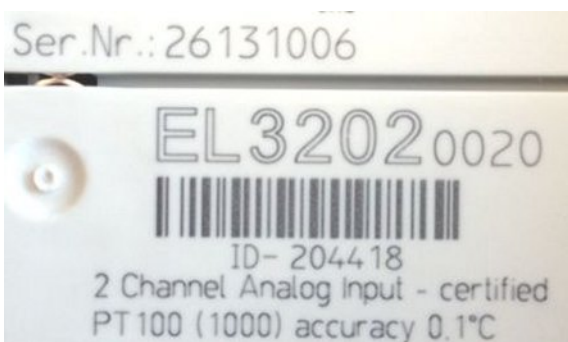
Fig. 4: EL3202-0020 with serial/ batch number 26131006 and unique ID-number 204418
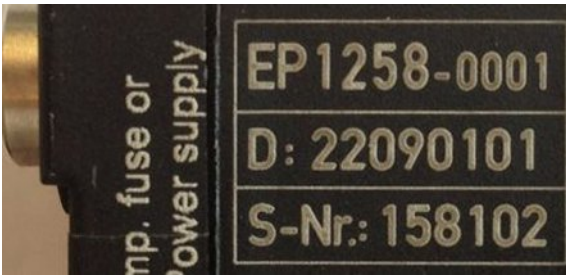
Fig. 5: EP1258-00001 IP67 EtherCAT Box with batch number/ date code 22090101 and unique serial number 158102

Fig. 6: EP1908-0002 IP67 EtherCAT Safety Box with batch number/ date code 071201FF and unique serial number 00346070

Fig. 7: EL2904 IP20 safety terminal with batch number/ date code 50110302 and unique serial number 00331701

Fig. 8: ELM3604-0002 terminal with unique ID number (QR code) 100001051 and serial/ batch number 44160201

2.5   Non-reactive Bus Terminals

ℹ **Use of non-reactive Bus or EtherCAT Terminals in safety applications**

If a Bus or EtherCAT Terminal is described as non-reactive, this means that the consecutive terminal behaves passively in a safety application (e.g. in the case of the all-pole switch-off of a potential group).
In this case the terminals do not represent an active part of the safety controller and do not affect the Safety Integrity Level (SIL) or Performance Level (PL) attained in the safety application.
For details, please refer to chapter 2.17f in the TwinSAFE application manual.

NOTE

Pay attention to the hardware version

Please pay attention to the information about the hardware version and non-reactivity of the respective Bus Terminal in the chapters "Technical Data" or "Firmware Compatibility"!
Only terminals with the appropriate hardware version may be used without the attained SIL/PL being affected!

The Bus or EtherCAT Terminals regarded as non-reactive at the time of preparing this document are listed in the following tables together with their respective hardware versions.

Terminal name Bus Terminal	Hardware versions
KL2408	05 - 07
KL2809	02
KL2134	09
KL2424	05
KL9110	07 -

Terminal name EtherCAT terminal	Hardware versions
EL2004	15 - 21
EL2008	07 - 13
EL2022	09 -
EL2024	06 - 11
EL2034	06 - 07
EL2809	01 - 07
EL2872	01 - 07
EL2878-0005	00 -
EL7031	02 - 11
EL7037	02 -
EL9110	13 -
EL9410	16 -

External wiring

The following requirements are to be ensured *by the system manufacturer* and must be incorporated into the user documentation.

- **Protection class IP54**
  The terminals must be installed in IP54 control cabinets to ensure the necessary protection class IP54.

- **Power supply unit**
  The standard terminals must be supplied with 24 V by an SELV/PELV power supply unit with an output voltage limit U_{max} of 60 V in the event of a fault.

- **Prevention of feedback**
  Feedback can be prevented through different measures. These are described below. In addition to mandatory requirements there are also optional requirements, of which only one needs to be selected.

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◦ **No switching of loads with a separate power supply**
Loads that have their own power supply must not be switched by standard terminals, since in this case feedback via the load cannot be ruled out.
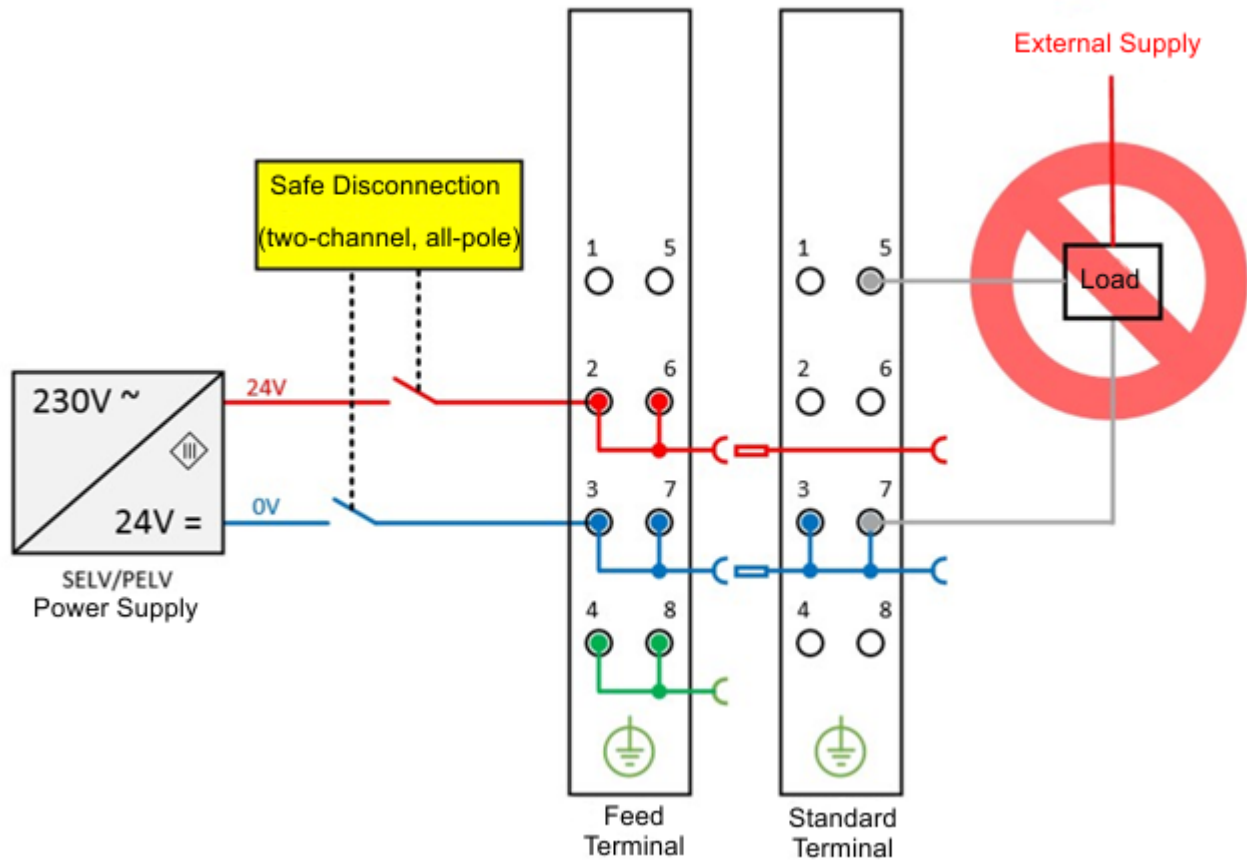
Fig. 9: Negative example – active load

◦ The control of an STO input of a frequency converter could serve here as a **negative example**. **Exceptions** to the general requirement are allowed only if the manufacturer of the connected load guarantees that feedback to the control input cannot occur. This can be achieved, for example, through adherence to load-specific standards.

◦ **Option 1: Ground feedback and all-pole disconnection**
The ground connection of the connected load must be fed back to the safely switched ground of the respective output terminal.
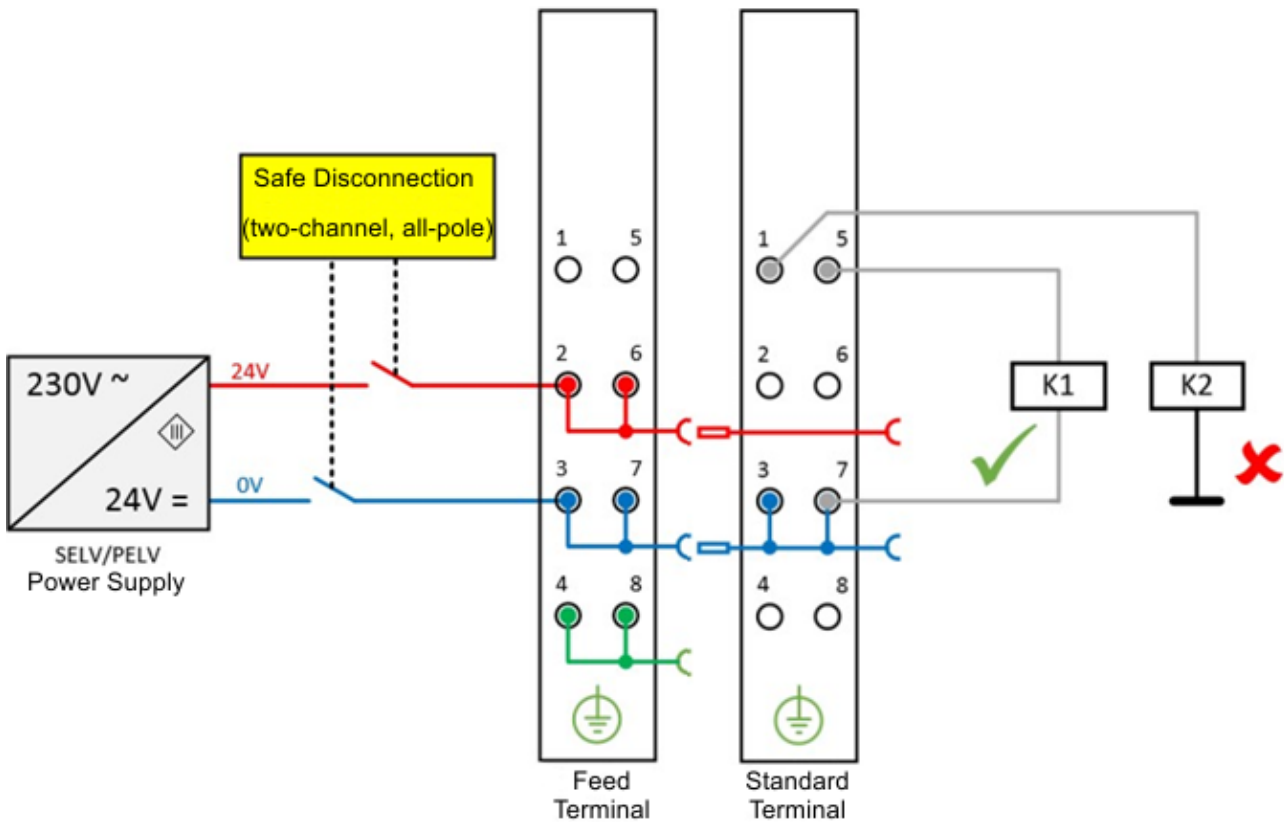
Fig. 10: Ground connection of the load: correct (K1) and incorrect (K2)

- ◦ If either
  a) the ground of the load is not fed back to the terminal or
  b) the ground is not safely switched but connected permanently

  then fault exclusions are necessary with regard to a short-circuit with external potential in order to be able to achieve Cat. 4 PLe according to EN ISO 13849-1:2007 or SIL3 according to IEC 61508:2010 (refer here to the overview in the chapter "Effect of options on the safety level").

- ◦ **Option 2: Cable short-circuit fault exclusion**
  If solution option 1 is not feasible, the ground feedback and all-pole disconnection can be dispensed with if the danger of feedback due to a cable short-circuit can be excluded by other measures. These measures, which can be implemented alternatively, are described in the following sections.

Fig. 11: Short circuit fault exclusion through protected cable laying

- ◦ **a) Possibility 1: Load connection via separate sheathed cables**
  The non-safely switched potential of the standard terminal may not be conducted together with other potential-conducting cores inside the same sheathed cable. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- ◦ **b) Possibility 2: Wiring only inside the control cabinet**
  All loads connected to the non-safe standard terminals must be located in the same control cabinet as the terminals. The cables are routed entirely inside the control cabinet. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
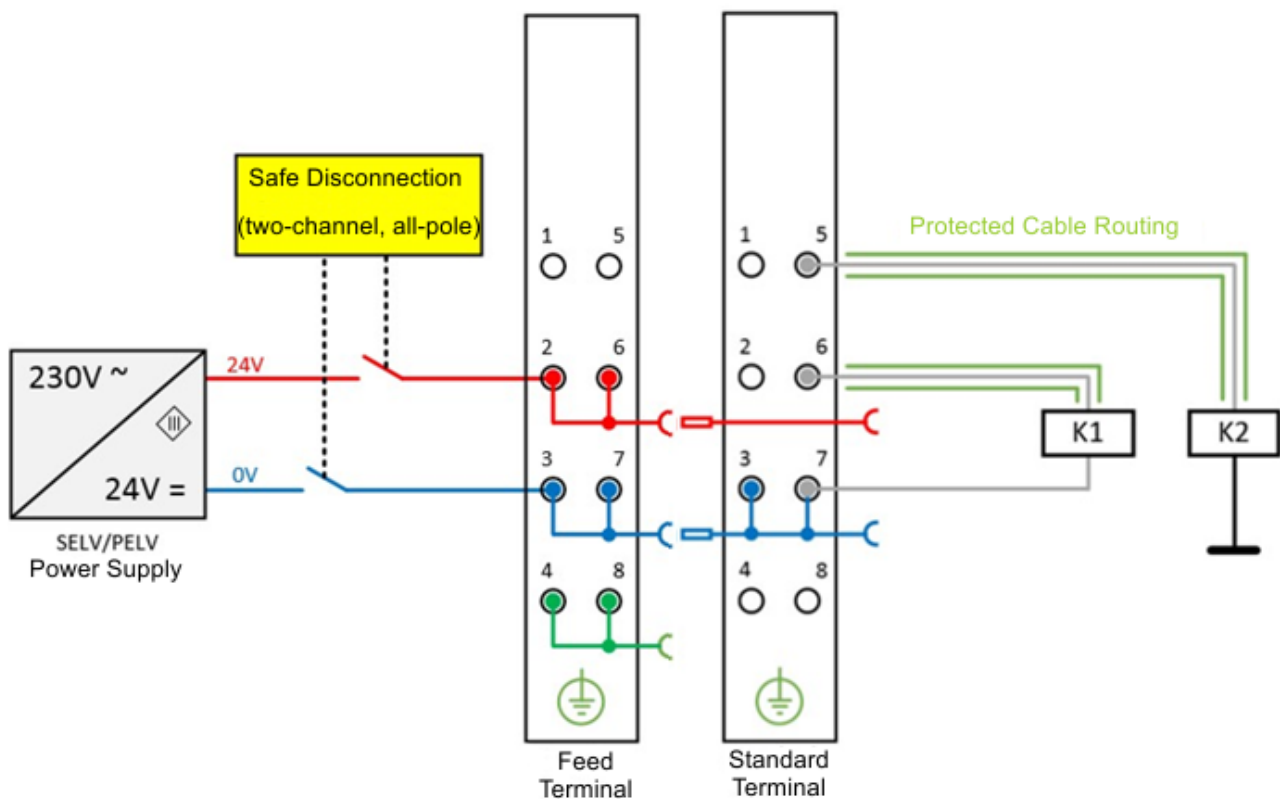- ◦ **c) Possibility 3: Dedicated earth connection per conductor**
  All conductors connected to the non-safe standard terminals are protected by their own earth connection. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- ◦ **d) Possibility 4: Cable permanently (fixed) installed and protected against external damage**
  All conductors connected to the non-safe standard terminals are permanently fixed and, e.g. protected against external damage by a cable duct or armored pipe.
- • **Effect of the options on the safety level**
  In principle, standard terminals in safely switched potential groups are not an active part of the safety controller. Accordingly, **the safety level attained is defined only by the higher-level safety controller**, i.e. the standard terminals are not included in the calculation! However, the wiring of the standard terminals can lead to limitations in the maximum attainable safety level.
  Depending on the solution selected for the avoidance of feedback and the safety standard considered (see Option 1 and Option 2), different maximum attainable safety levels result, which are summarized in the following table:

Summary of safety classifications

Feedback avoidance measures	DIN EN ISO 13849-1	IEC 61508	EN 62061
Fault exclusion Cable short-circuit	max. Cat. 4	max. SIL3	max. SIL2 *
Ground feedback and all-pole disconnection	PLe		max. SIL3

3 Product overview

3.1 EL9011, EL9012, EL9080

3.1.1 EL9011, EL9012, EL9080 - Introduction and Technical Data

Fig. 12: *EL9011*

Each EtherCAT terminal block must be terminated at the right hand end with a EL9011 bus end cap due to mechanical and electrical protection.

Fig. 13: *EL9080*

The EL9080 separation terminal interrupts the power contacts within a bus terminal block. The terminal enables operation with different voltages on the separated sides of the power contacts. But the K-Bus is looped through. The discontinuance of the Power Contacts is especially displayed by the orange front plate of the EL9080. The EL9080 separation terminal does not have any other function or connection facility.

Technical Data	EL9011	EL9012	EL9080
Electrical isolation	-		500 V (E-bus/field potential)
Bit width in the process image	0		
Configuration	no address or configuration settings		
Diagnosis	-		
PE contact	no		
Renewed infeed	-		
Connection facility to additional power contact	-		
Side by side mounting on Bus Terminals with power contact	yes		
Side by side mounting on Bus Terminals without power contact	yes		
Electrical connection to mounting rail	no		
Weight	approx. 8 g	approx. 10 g	approx. 40 g
Permissible ambient temperature	-25°C ... +60°C (extended temperature range)		
Permissible ambient temperature range (during storage)	-40°C ... +85°C		
Permissible relative humidity	95%, no condensation		
Dimensions (W x H x D)	approx. 8 mm x 100 mm x 34 mm (width aligned: 5 mm)	approx. 8 mm x 100 mm x 55 mm (width aligned: 5 mm)	approx.15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	aligned to the last terminal in the terminal block		on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable		
Approval	CE ATEX [▶ 85] cULus [▶ 86]		

3.2   EL9070

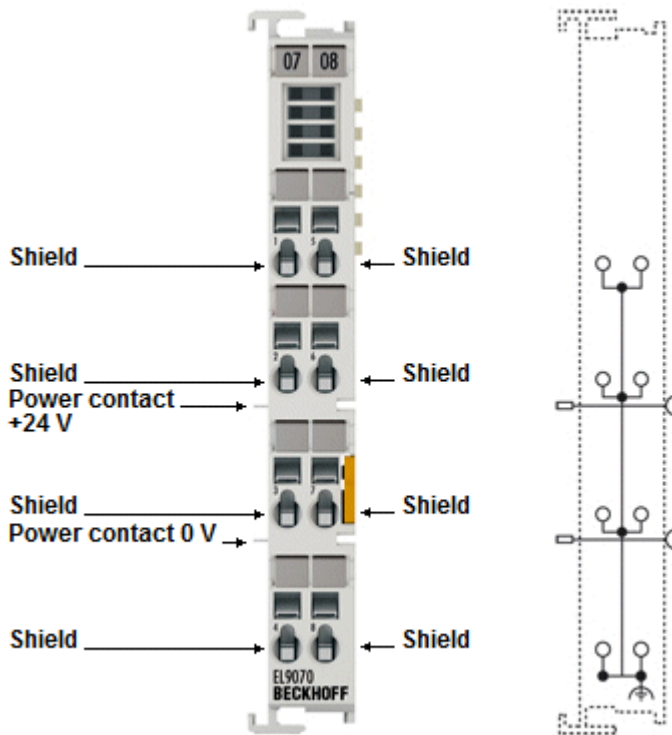### 3.2.1   EL9070 - Introduction and Technical Data

Fig. 14: *EL9070*

The EL9070 shield terminal provides eight terminal points with the potential of the mounting rail and enables the screening to be picked up without further modular terminal blocks or wiring. With its internal seamless copper surface, the EL9070 offers good screening between two EtherCAT Terminals.

Technical data

Technical Data	EL9070
Technology	shield terminal
Current load	≤ 10 A
Power LED	-
Error LED	-
Current consumption E-bus	-
Nominal voltage	arbitrary up to 230 V AC
Integrated fine-wire fuse	-
Electrical isolation	500 V (E-bus/field potential)
Diagnostics in the process image	-
Reported to E-bus	-
PE contact	no
Shield connection	8 x
E-bus looped through	yes
Bit width in the process image	0
Electrical connection to mounting rail	yes (dissipation of EMC interference via large copper surfaces on the mounting rail)
Electrical connection to power contacts	-
Renewed infeed	-
Connection facility to additional power contact	no
Side by side mounting on Bus Terminals with power contact	yes, left side without PE
Side by side mounting on Bus Terminals without power contact	-
Configuration	no address or configuration settings
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight	approx. 50 g
Permissible ambient temperature range (during operation)	0°C ... +55°C
Permissible ambient temperature range (during storage)	-25°C ... +85°C
Permissible relative humidity	95%, no condensation
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE cULus [▶ 86]

Connection

Terminal point		Meaning
Indication	**No.**	
1 - 8	1 - 8	Terminal points 1 - 8 are connected internally

3.3   EL9100, EL9110, EL9190

3.3.1   EL9100, EL9110, EL9190 - Introduction and Technical Data
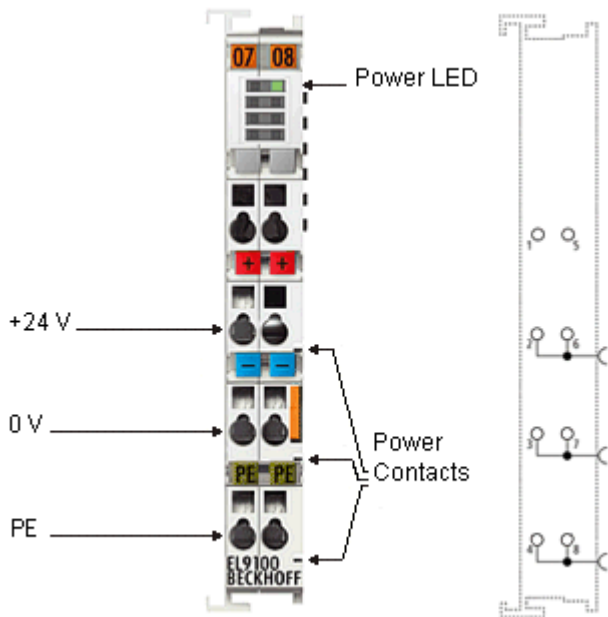
Fig. 15: *EL9100*

Fig. 16: *EL9110*

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Fig. 17: *EL9190*
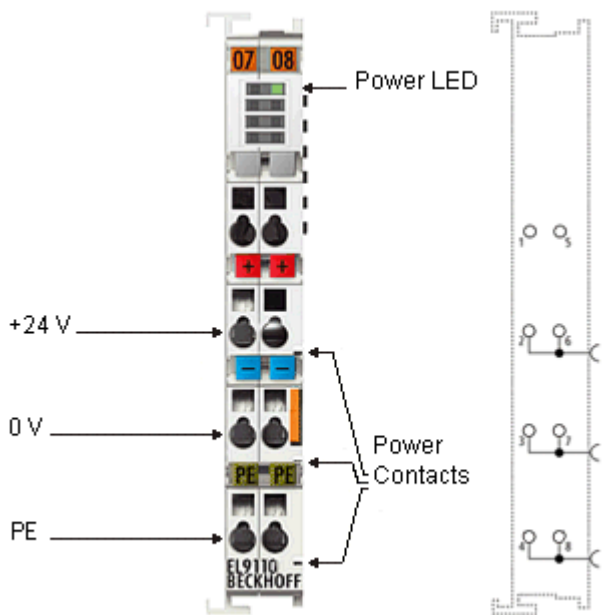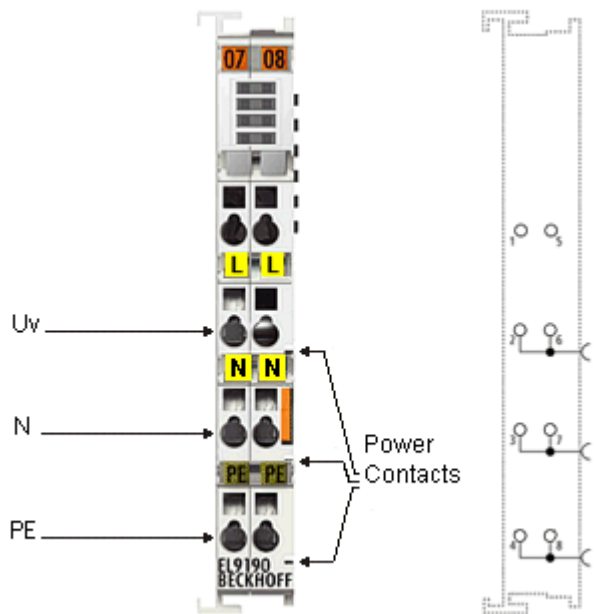
The EL9100 / EL9110 / EL9190 feed terminal can be positioned at any location between the input and output terminals for establishing a further potential group or for supplying the terminals following on the right in applications with high current load. The E-Bus is looped through. As opposed to the EL9100 / EL9190, the EL9110 has a diagnostic function which is displayed on the process image.

Technical data

Technical data	EL9100	EL9110	EL9190
Nominal voltage	24 V DC		variable, up to 230 V AC/DC
Power contact current load	max. 10 A		
Electrical isolation	500 V (E-bus/field potential)		
Current consumption from E-Bus	-	typ. 90 mA	-
Bit width in the process image	-	1 bit (diagnosis)	-
Configuration	no address or configuration settings		
Power LED	yes	yes	no
Diagnosis	no	yes, in process image	no
Electrical connection to mounting rail	no		
PE contact	yes		
Renewed infeed	yes		
Connection facility to additional power contact	1		
Side by side mounting on Bus Terminals with power contact	yes		
Side by side mounting on Bus Terminals without power contact	yes		
Weight	approx. 50 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)		0°C ... +55°C
Permissible ambient temperature range (during storage)	-40°C ... +85°C		-25°C ... +85°C
Permissible relative humidity	95%, no condensation		
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)		
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity		conforms to EN 60068-2-6/ EN 60068-2-27
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	variable	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 85] cULus [▶ 86]		CE cULus [▶ 86]

Connection EL9100, EL9110, EL9190

> ⚠ **CAUTION**
>
> **Hazard to individuals and devices!**
>
> When designing a Bus Terminal block with different potentials on the power contacts (e.g. 230 V AC/DC and 24 V DC), please note that it is mandatory to use potential separation terminals (EL9080)!
> Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Terminal point		Description
Indication	No.	
	1	not used
+24 V* / 230 V AC/DC**	2	Supply input + 24 V [EL9100, EL9110] Supply input 230 V AC [EL9190: variable voltage, up to 230 V AC/DC] connected internally with terminal 6 and positive [EL9100, EL9110] resp. 230 V AC/DC [EL9190] power contact)
0 V* / N**	3	0 V for supply input [EL9100, EL9110] N for supply input [EL9190] connected internally with terminal 7 and negative [EL9100, EL9110] resp. neutral [EL9190] power contact)
PE***	4	PE (connected internally with terminal 8 and PE power contact)
	5	not used
+24 V* / 230 V AC/DC**	6	Supply input + 24 V [EL9100, EL9110] Supply input 230 V AC/DC [EL9190: variable voltage, up to 230 V AC/DC] connected internally with terminal 2 and positive [EL9100, EL9110] resp. 230 V AC/DC [EL9190] power contact)
0 V* / N**	7	0 V for supply input [EL9100, EL9110] N for supply input [EL9190] connected internally with terminal 3 and negative [EL9100, EL9110] resp. neutral [EL9190] power contact)
PE***	8	PE (connected internally with terminal 4 and PE power contact)

** only EL9100, EL9110
*** from hardware status 02

LEDs

LED	Color	Meaning	
Power LED**	green	off	No input voltage at supply input
		on	24 V DC at supply input

** only EL9100, EL9110

Process data (only EL9110)

The EL 9110 has a bit width of 1 bit (diagnosis bit for the power contacts voltage, "PowerOK") and is displayed in the TwinCAT tree as follows:

Fig. 18: *EL9110 in the TwinCAT tree*

If there is *no* voltage impressed on the power contacts, the corresponding diagnosis bit 'PowerOK' has FALSE (0) status.

3.4 EL9150, EL9160

3.4.1 EL9150, EL9160 - Introduction and Technical Data
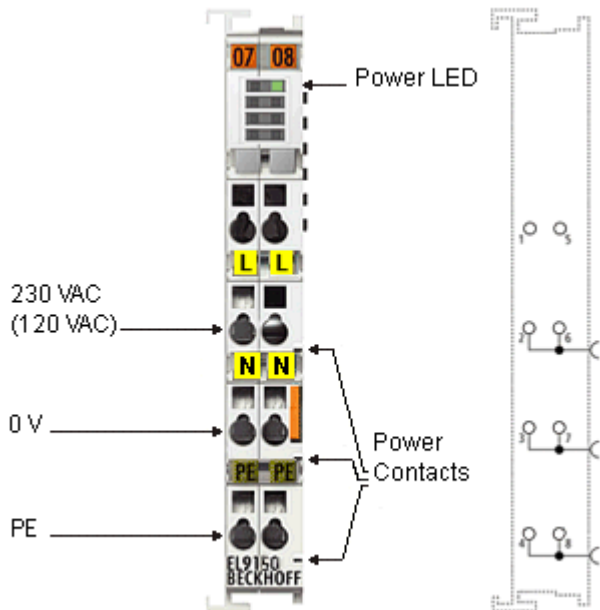
Fig. 19: *EL9150*

The EL9150 feed terminal can be positioned at any location between the input and output terminals for establishing a further potential group or for supplying the terminals following on the right in applications with high current load. The E-Bus is looped through.
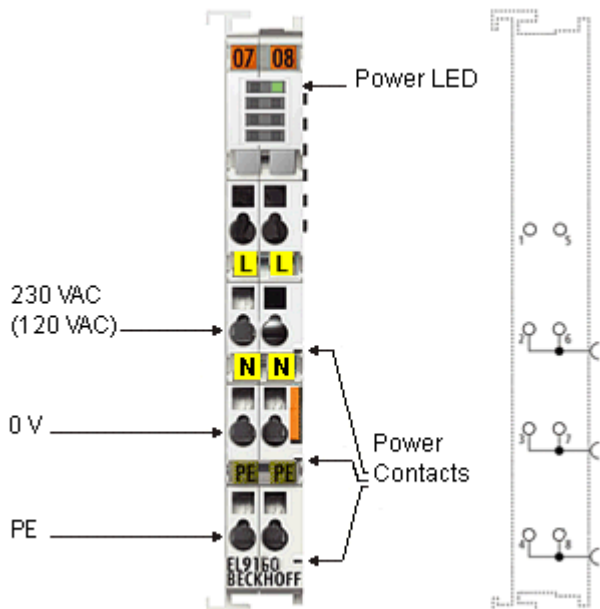
Fig. 20: EL9160

As opposed to the EL9150, the EL9160 has a diagnostic function which is displayed on the process image.

Technical data

Technical data	EL9150	EL9160
Nominal voltage	230 V_{AC} (120 V_{AC})	
Power contact current load	max. 10 A	
Electrical isolation	500 V (E-bus/field potential)	
Current consumption from E-Bus	-	typ. 90 mA
Bit width in the process image	-	1 bit (diagnosis)
Configuration	no address or configuration settings	
Power LED	yes	
Diagnosis	no	yes, in process image
Electrical connection to mounting rail	no	
PE contact	no	
Renewed infeed	yes	
Connection facility to additional power contact	1	
Side by side mounting on Bus Terminals with power contact	yes	
Side by side mounting on Bus Terminals without power contact	yes	
Weight	approx. 50 g	
Permissible ambient temperature range (during operation)	0°C ... +55°C	
Permissible ambient temperature range (during storage)	-25°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4	
Protect. class	IP 20	
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	variable
Approval	CE cULus [▶ 86]	

Connection EL9150

⚠ CAUTION

Hazard to individuals and devices!

When designing a Bus Terminal block with different potentials on the power contacts (e.g. 230 V AC and 24 V DC), please note that it is mandatory to use potential separation terminals (EL9080)!
Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Terminal point		Description
Indication	**No.**	
	1	not used
230 V_{AC} (120 V_{AC})	2	Supply input 230 V_{AC} (120 V_{AC}), connected internally with terminal 6 and power contact)
0 V	3	0 V for supply input (connected internally with terminal 7 and power contact)
PE	4	PE (connected internally with terminal 8 and PE power contact)
	5	not used
230 V_{AC} (120 V_{AC})	6	Supply input 230 V_{AC} (120 V_{AC}), (connected internally with terminal 2 and power contact)
0 V	7	0 V for supply input (connected internally with terminal 3 and power contact)
PE	8	PE (connected internally with terminal 4 and PE power contact)

LEDs

LED	Color	Meaning	
Power LED	green	off	No input voltage at supply input
		on	230 V_{AC} (120 V_{AC}) at supply input

Process data (only EL9160)

The EL9160 has a bit width of 1 bit (diagnosis bit for the power contacts voltage, "PowerOK") and is displayed in the TwinCAT tree as follows:
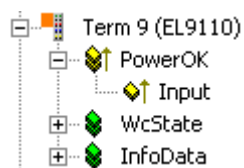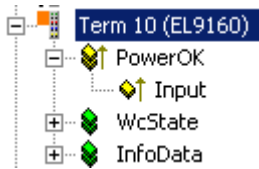

Fig. 21: *EL9160 in the TwinCAT tree*

If there is no voltage impressed on the power contacts, the corresponding diagnosis bit 'PowerOK' has FALSE (0) status.

3.5 EL9180

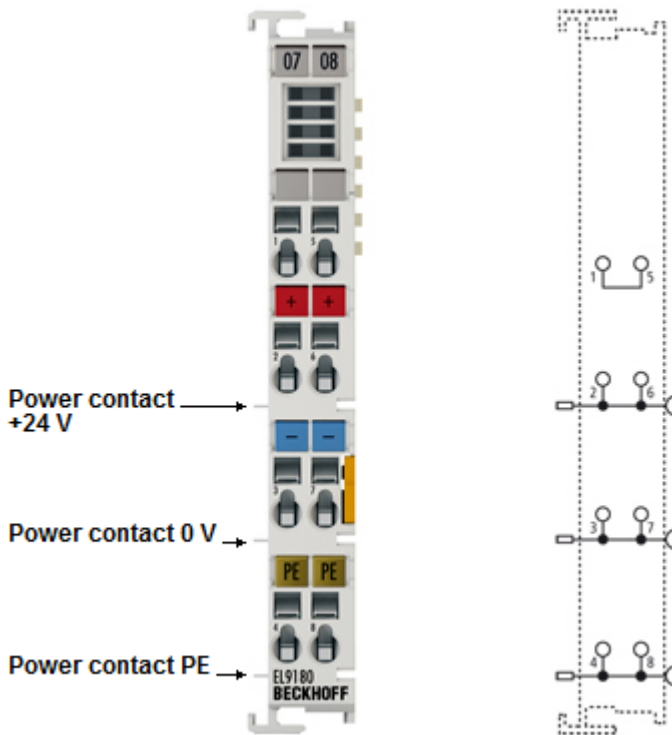## 3.5.1 EL9180 - Introduction and Technical Data

Fig. 22: EL9080

The EL9180 allows the supply voltage to be accessed a number of times via spring force terminals. The EtherCAT Terminal makes it unnecessary to use additional terminal blocks on the terminal strip.

Technical data

Technical data	EL9180
Technology	potential distribution terminal
Power contact current load	≤ 10 A
Power LED	-
Defect LED	-
Current consumption from E-Bus	-
Nominal voltage	arbitrary up to 230 V AC/DC
Integrated fine-wire fuse	-
Electrical isolation	500 V (E-bus/field potential)
Diagnosis	-
Reported to E-bus	-
Power contact	3 x power contact
PE contact	yes
Shield connection	-
Renewed infeed	-
Connection facility to additional power contact	2
Side by side mounting on Bus Terminals with power contact	yes
Side by side mounting on Bus Terminals without power contact	-
Electrical connection to mounting rail	yes
Bit width in the process image	-
Configuration	no address or configuration settings
Weight	approx. 50 g
Permissible ambient temperature range (during operation)	0°C ... +55°C
Permissible ambient temperature range (during storage)	-25°C ... +85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	on 35 mm mounting rail conform to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 84] cULus [▶ 86]

Connection EL9180

Terminal point	Description
No.	
1	connected internally with terminal 5
2	+24 V (connected internally with terminal 6 and positive power contact)
3	0 V (connected internally with terminal 7 and negative power contact)
4	PE (connected internally with terminal 8 and PE power contact)
5	connected internally with terminal 1
6	+24 V (connected internally with terminal 2 and positive power contact)
7	0 V (connected internally with terminal 3 and negative power contact)
8	PE (connected internally with terminal 4 and PE power contact)

3.6 EL9181, EL9182, EL9183

3.6.1 EL9181, EL9182, EL9183 - Introduction and Technical Data
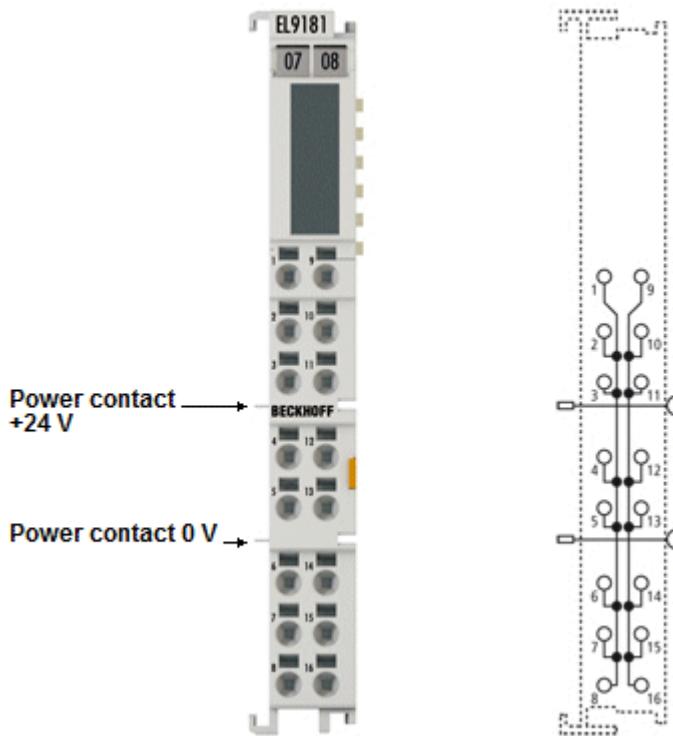
Fig. 23: *EL9181*
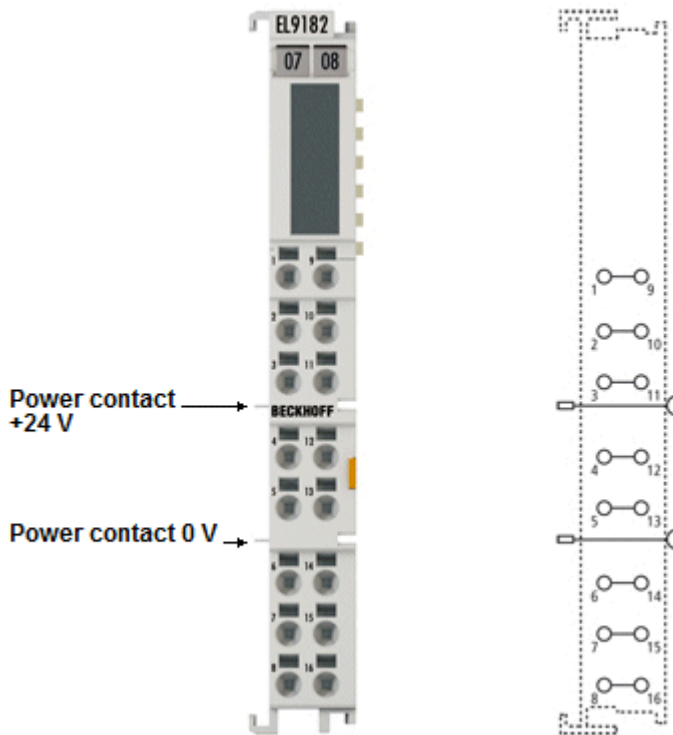
Fig. 24: *EL9182*
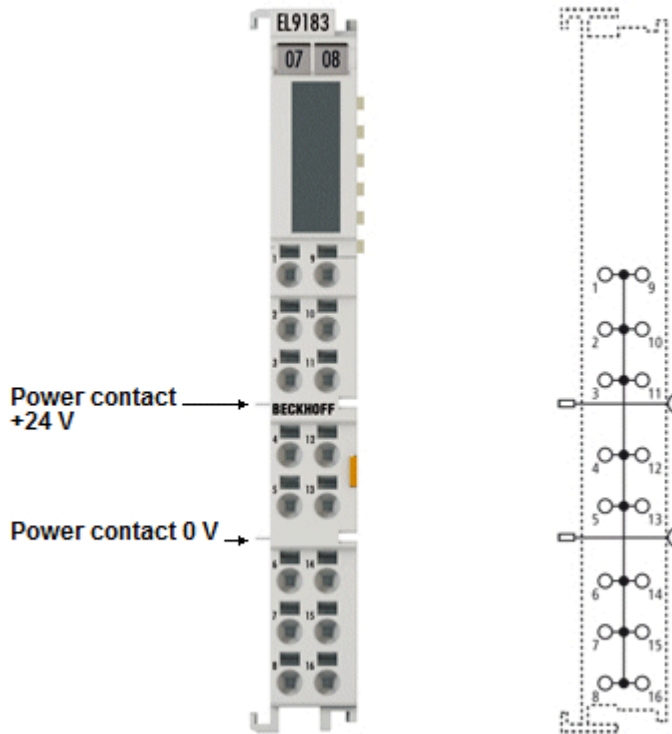
Fig. 25: *EL9183*

The potential distribution terminals EL9181, EL9182 and EL9183 provide 16 terminal points for potential distribution and enable the voltage to be picked up without further terminal blocks or wiring. The power contacts are fed through to the next terminal without connecting to the terminal points.

The HD EtherCAT Terminals (High Density) with increased packing density feature 16 connection points in the housing of a 12 mm EtherCAT Terminal. The conductors can be connected without tools in the case of solid wires using a direct plug-in technique

Technical data

Technical Data	EL9181	EL9182	EL9183
Technology	Potential distribution terminal		
Number of separate potentials	2	8	1
Terminal points per potential	8	2	16
Nominal voltage	≤ 60 V_{DC}		
Current load	max. 10 A		
Current consumption from E-Bus	-		
E-bus looped through	yes		
Power contacts looped through	yes (2 power contacts)		
Diagnosis	-		
Message to E-Bus	-		
PE contact	no		
Renewed infeed	-		
Connection facility to additional power contact	-		
Side by side mounting on Bus Terminals with power contact	yes		
Side by side mounting on Bus Terminals without power contact	-		
Bit width in the process image	0		
Electrical connection to mounting rail	-		
Electrical connection to power contacts	-		
Electrical isolation	500 V (E-bus/field potential)		
Configuration	no address or configuration settings		
Conductor types	solid wire, stranded wire and ferrule		
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver		
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²		
Weight	approx.. 60 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)		
Permissible ambient temperature range (during storage)	-40°C ... +85°C		
Permissible relative humidity	95%, no condensation		
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)		
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity		
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"		
Approval	CE cULus [▶ 86]		

Connection EL9181

Terminal point		Meaning
Indication	No.	
1 - 8	1 - 8	Terminal points 1 - 8 are connected internally
9 - 16	9 - 16	Terminal points 9 -16 are connected internally

Connection EL9182

Terminal point		Meaning
Indication	**No.**	
1, 9	1 + 9	Terminal points 1 + 9 are connected internally
2, 10	2 + 10	Terminal points 2 +10 are connected internally
3, 11	3 + 11	Terminal points 3 + 11 are connected internally
4, 12	4 + 12	Terminal points 4 + 12 are connected internally
5, 13	5 + 13	Terminal points 5 + 13 are connected internally
6, 14	6 + 14	Terminal points 6 + 14 are connected internally
7, 15	7 + 15	Terminal points 7 + 15 are connected internally
8, 16	8 + 16	Terminal points 8 + 16 are connected internally

Connection EL9183

Terminal point		Meaning
Indication	**No.**	
1 - 16	1 - 16	Terminal points 1 -16 are connected internally

3.7   EL9184, EL9185, EL9185-0010, EL9186, EL9187, EL9188, EL9189

3.7.1   EL9184, EL9185, EL9185-0010, EL9186, EL9187, EL9188, EL9189 - Introduction and Technical Data
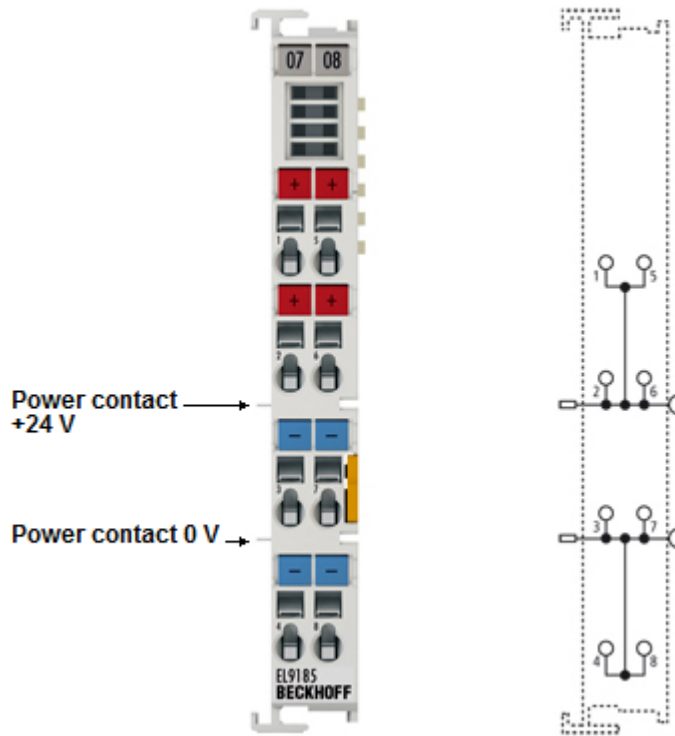
EL9185

Fig. 26: EL9185

The EL9185 EtherCAT Terminal allows the supply voltage to be accessed a number of times via spring force terminals. The EL9185 makes it unnecessary to use additional terminal blocks on the terminal strip.

Technical data

Technical Data	EL9185
Nominal voltage	arbitrary up to 230 V AC/DC
Current load	≤ 10 A
Diagnosis	-
Message to E-Bus	-
PE contact	no
Shield connection	-
Current consumption from E-Bus	-
Bit width in the process image	0
Electrical connection to mounting rail	-
Electrical isolation	500 V (E-bus/field potential)
Renewed infeed	-
Side by side mounting on EtherCAT Terminals with power contact	only 2 power contacts, no PE
Side by side mounting on EtherCAT Terminals without power contact	-
Connection facility to additional power contact	4
Configuration	no address or configuration settings
Weight	approx. 65 g
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)
Permissible ambient temperature range (during storage)	-40°C ... +85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 85] cULus [▶ 86]

Connection EL9185

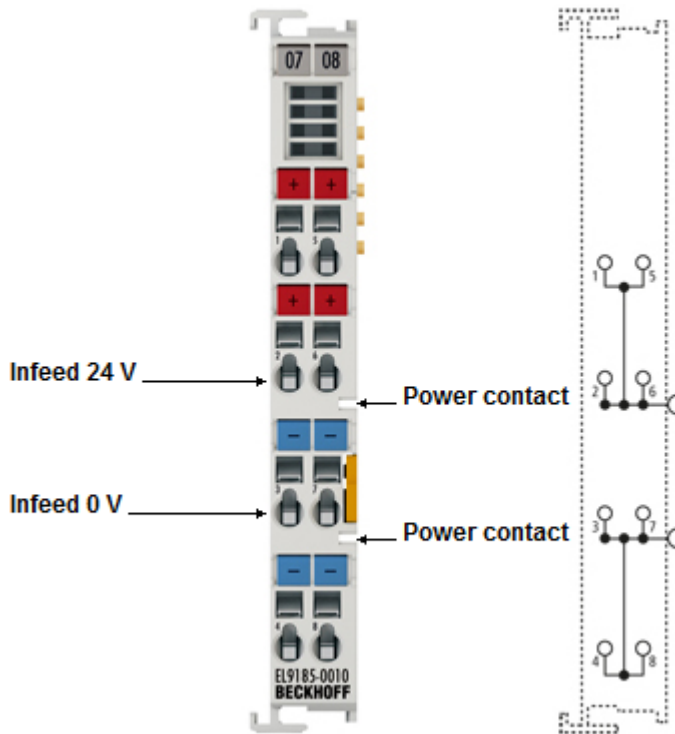| Terminal point		Description
Indication	No.	
Output 1, 2 ,5, 6	1, 2 ,5, 6	Output 1, 2 ,5, 6 (internally connected with positive power contact)
Output 3, 4, 7, 8	3, 4, 7, 8	Output 3, 4, 7, 8 (internally connected with negative power contact)

EL9185-0010

Fig. 27: EL9185-0010

The EL9185-0010 potential distribution terminal with additional power feed function enables multiple tapping of the supply voltage at the terminal points. In addition, it feeds in the supply voltage for the downstream terminals via power contacts and as a result forms a new potential group, as no power contacts are fed out on the left side of the EL9185-0010. The EL9185-0010 makes the use of additional terminal blocks on the terminal strip unnecessary.

Technical data

Technical Data	EL9185-0010
Nominal voltage	arbitrary up to 230 V AC/DC
Current load	≤ 10 A
Diagnosis	-
Message to E-Bus	-
PE contact	no
Shield connection	-
Current consumption from E-Bus	-
Bit width in the process image	0
Electrical connection to mounting rail	-
Electrical isolation	500 V (E-bus/field potential)
Renewed infeed	yes
Side by side mounting on EtherCAT Terminals with power contact	yes
Side by side mounting on EtherCAT Terminals without power contact	yes
Connection facility to additional power contact	3
Configuration	no address or configuration settings
Weight	approx. 65 g
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)
Permissible ambient temperature range (during storage)	-40°C ... +85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE

Connection EL9185-0010

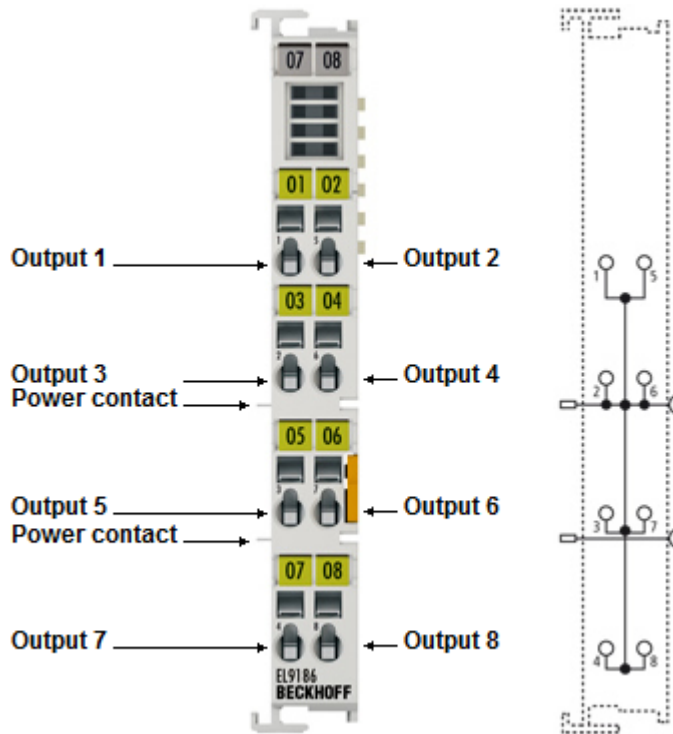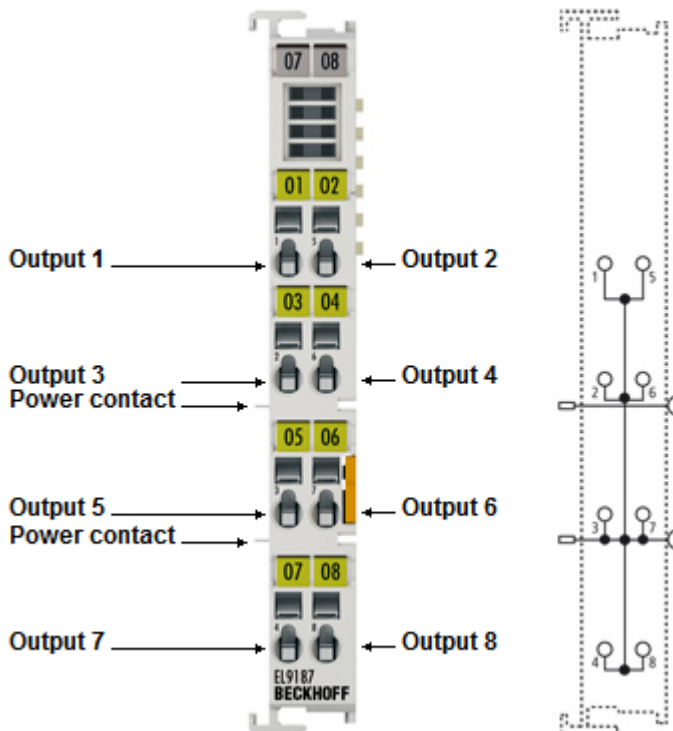| Terminal point		Description
Indication	No.	
Output 1, 2 ,5, 6	1, 2 ,5, 6	Output 1, 2 ,5, 6 (internally connected with positive power contact, right-sided)
Output 3, 4, 7, 8	3, 4, 7, 8	Output 3, 4, 7, 8 (internally connected with negative power contact, right-sided)

EL9186, EL9187

Fig. 28: EL9186

Fig. 29: EL9187

The potential distribution terminals EL9186 and EL9187 provide 8 terminal points with a potential and enable the voltage to be picked up without further bus terminal blocks or wiring.

Technical Data

Technical Data	EL9186	EL9187
Nominal voltage	≤ 60 V_{DC}	
Current load	≤ 10 A	
Diagnosis	-	
Message to E-Bus	-	
PE contact	no	
Shield connection	-	
Outputs	8 (connected with positive power contact)	8 x 0 V contact (connected with negative power contact)
Current consumption from E-Bus	-	
Bit width in the process image	0	
Electrical connection to mounting rail	-	
Electrical isolation	500 V (E-bus/field potential)	
Renewed power feed	-	
Side by side mounting on EtherCAT Terminals with power contact	yes, left side without PE	
Side by side mounting on EtherCAT Terminals without power contact	-	
Connection facility to additional power contact	8	
Configuration	no address or configuration settings	
Weight	approx. 65 g	
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)	
Permissible ambient temperature range (during storage)	-40°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity	
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4	
Protect. class	IP 20	
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	
Approval	CE ATEX [▶ 85] cULus [▶ 86]	

Connection EL9186

Terminal point		Description
Indication	**No.**	
Output 1 - 8	1 - 8	Output 1 - 8 (internally connected with positive power contact)

Connection EL9187

Terminal point		Description
Indication	**No.**	
Output 1 - 8	1 - 8	Output 1 - 8 (internally connected with negative power contact)

EL9184, EL9188, EL9189

+24 V → 0 V
+24 V → 0 V
+24 V → 0 V
Power contact +24 V →
+24 V → 0 V
+24 V → 0 V
Power contact 0 V →
+24 V → 0 V
+24 V → 0 V
+24 V → 0 V

Top view   Contact assembly

Fig. 30: *EL9184*

+24 V → +24 V
+24 V → +24 V
+24 V → +24 V
Power contact +24 V →
+24 V → +24 V
+24 V → +24 V
Power contact 0 V →
+24 V → +24 V
+24 V → +24 V
+24 V → +24 V

Top view   Contact assembly
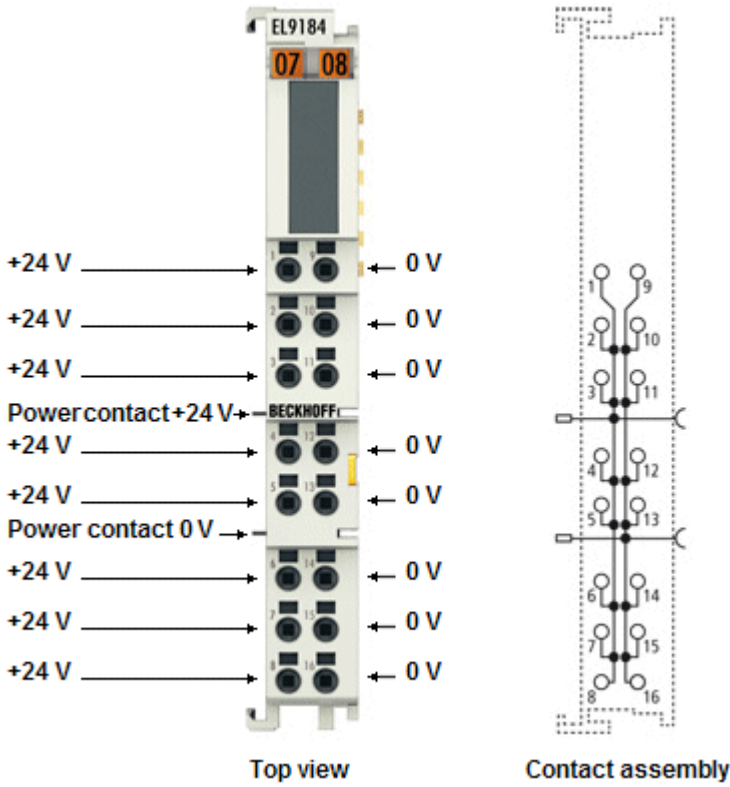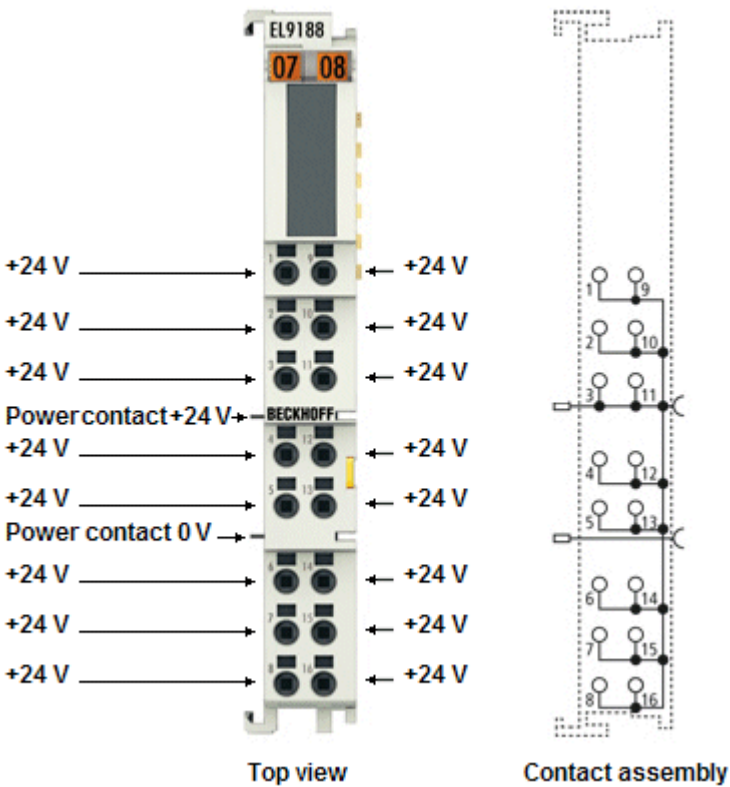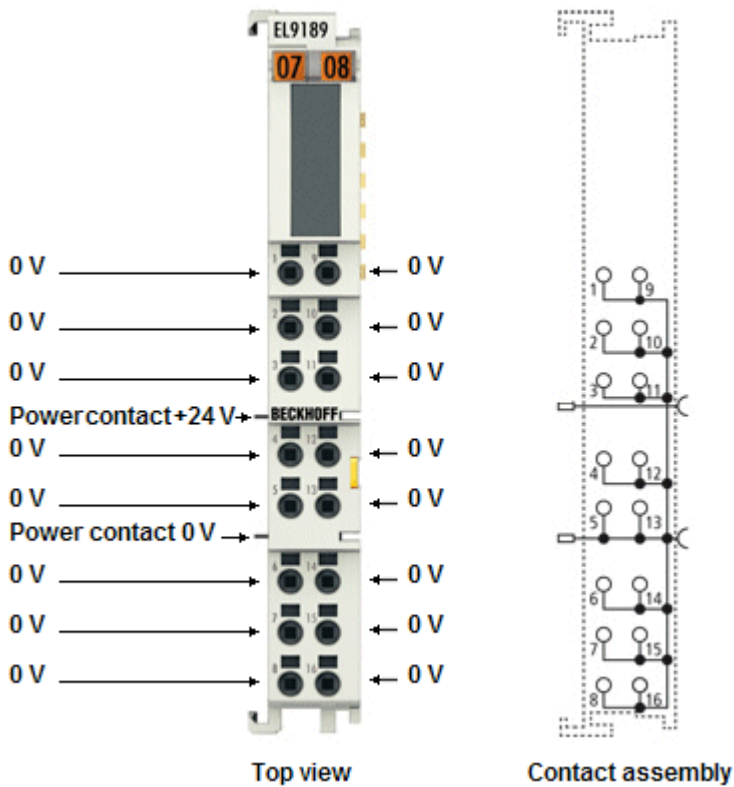
Fig. 31: *EL9188*

Fig. 32: *EL9189*

The potential distribution terminals EL9188 and EL9189 provide 16 terminal points with a potential and enable the voltage to be picked up without further bus terminal blocks or wiring.
The EL9184 provides the potential of the 24 V DC contact at 8 terminal points and the potential of the 0 V contact at 8 terminal points.

The conductors can be connected without tools in the case of solid wires using a direct plug-in technique.

The HD EtherCAT Terminals (High Density) with increased packing density feature 16 connection points in the housing of a 12 mm terminal block.

Technical Data

Technical Data	EL9184	EL9188	EL9189
Nominal voltage	≤ 60 V$_{DC}$		
Current load	≤ 10 A		
Power LED	-		
Error LED	-		
Message to E-Bus	-		
Shield connection	-		
Renewed power feed	-		
Connection facility to additional power contact	8	16	
Side by side mounting on EtherCAT Terminals with power contact	yes, left side without PE		
Side by side mounting on EtherCAT Terminals without power contact	-		
PE contact	no		
Outputs	2 x 8 (e.g.: 8 x 24 V contact, 8 x 0 V contact)	16 (e.g. 16 x 24 V contact)	16 (e.g. 16 x 0 V contact)
Current consumption from E-Bus	-		
Bit width in the process image	0		
Electrical connection to mounting rail	-		
Electrical isolation	500 V (E-bus/field potential)		
Configuration	no address or configuration settings		
Conductor types	solid wire, stranded wire and ferrule		
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver		
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²		
Weight	approx.. 60 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)		
Permissible ambient temperature range (during storage)	-40°C ... +85°C		
Permissible relative humidity	95%, no condensation		
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)		
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity		
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"		
Approval	CE ATEX [▶ 85] cULus [▶ 86]		

Connection EL9184

Terminal point		Description
Indication	No.	
+24 V	1 - 8	+24 V output (internally connected with positive power contact)
0 V	9 - 16	0 V (internally connected with negative power contact)

Connection EL9188

Terminal point		Description
Indication	No.	
+24 V	1 - 16	+24 V output (internally connected with positive power contact)

BECKHOFF

Connection EL9189

Terminal point		Description
Indication	**No.**	
0 V	1 - 16	0 V (internally connected with negative power contact)

3.8   EL9195

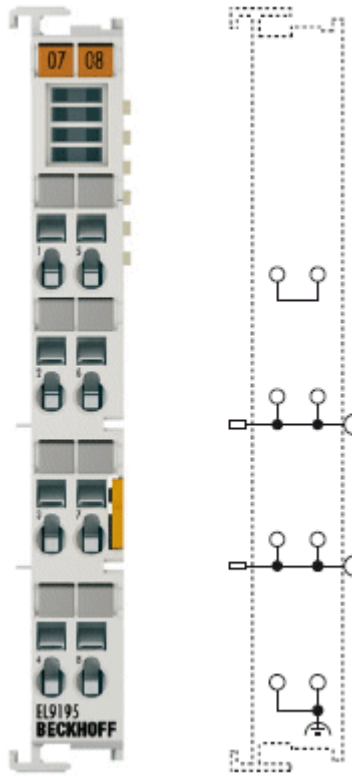## 3.8.1   EL9195 - Introduction and Technical Data

Fig. 33: *EL9195*

The EL9195 EtherCAT Terminal allows the supply voltage to be accessed a number of times via spring force terminals. It makes it unnecessary to use additional terminal blocks on the terminal strip. The EL9195 can be used for the connection of screens. The EL9195 connects the spring force contacts directly to the DIN rail, and can optimally ground incoming electromagnetic radiation. The two power contacts are looped through by the EL9195, allowing two wires to be connected to each power contact.

Technical data

Technical data	EL9195
Technology	shield terminal, for dissipation of EMC interference
Power contact current load	max. 10 A
Power LED	-
Defect LED	-
Current consumption from E-Bus	-
Nominal voltage	arbitrary up to 230 V AC/DC
Integrated fine-wire fuse	-
Electrical isolation	500 V (E-bus/field potential)
Diagnosis	-
Reported to E-bus	-
Power contact	2 x power contact
PE contact	-
Renewed infeed	-
Connection facility to additional power contact	2
Side by side mounting on Bus Terminals with power contact	only 2 power contacts
Side by side mounting on Bus Terminals without power contact	-
Shield connection	2 x
Electrical connection to mounting rail	yes
Bit width in the process image	-
Configuration	no address or configuration settings
Weight	approx. 50 g
Permissible ambient temperature range (during operation)	0°C ... +55°C
Permissible ambient temperature range (during storage)	-25°C ... +85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	on 35 mm mounting rail conform to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 84] cULus [▶ 86]

Connection EL9195

> ⚠ **CAUTION**
>
> **Hazard to individuals and devices!**
>
> When designing a Bus Terminal block with different potentials on the power contacts (e.g. 230 V AC and 24 V DC), please note that it is mandatory to use potential separation terminals (EL9080)!
> Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Terminal point	Description
No.	
1	connected internally with terminal 5
2	Supply input: variable voltage, up to 230 V AC/DC connected internally with terminal 6 and positive resp. phase power contact)
3	0 V / N connected internally with terminal 7 and negative resp. neutral power contact)
4	Shield (connected internally with terminal 8 and mounting rail contact)
5	connected internally with terminal 1
6	Supply input: variable voltage, up to 230 V AC/DC connected internally with terminal 6 and positive resp. phase power contact)
7	0 V / N connected internally with terminal 3 and negative resp. neutral power contact)
8	Shield (connected internally with terminal 8 and mounting rail contact)

Also see about this

📄 Installation instructions for enhanced mechanical load capacity [▶ 76]

3.9   EL9200, EL9210, EL9290

3.9.1   EL9200, EL9210, EL9290 - Introduction and Technical Data
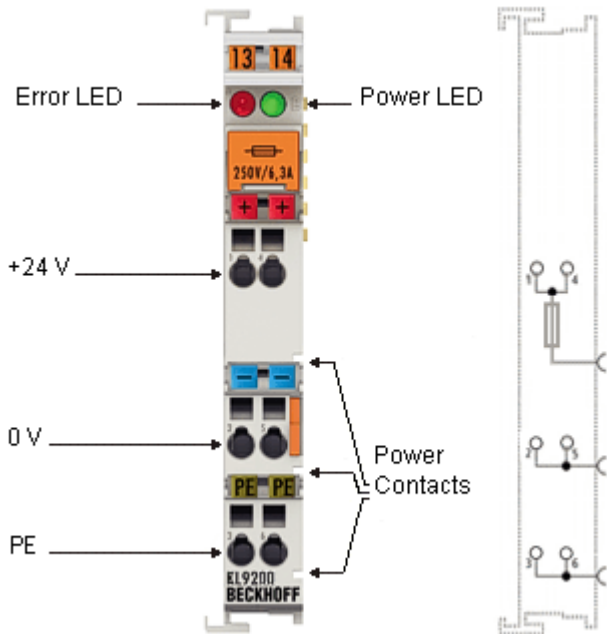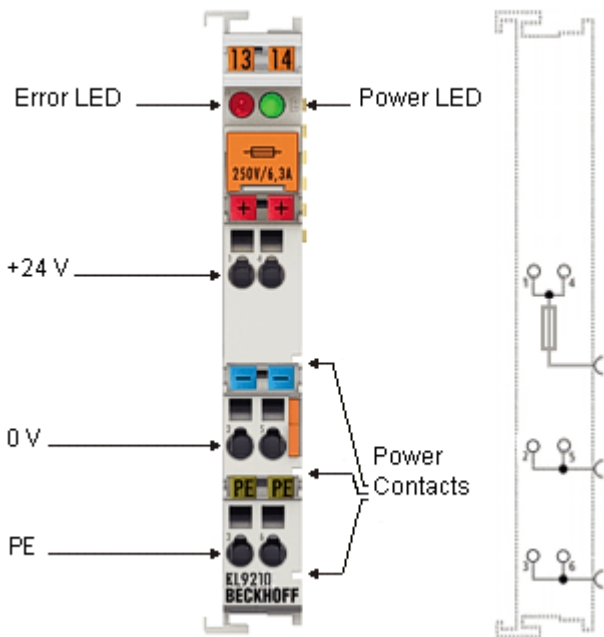
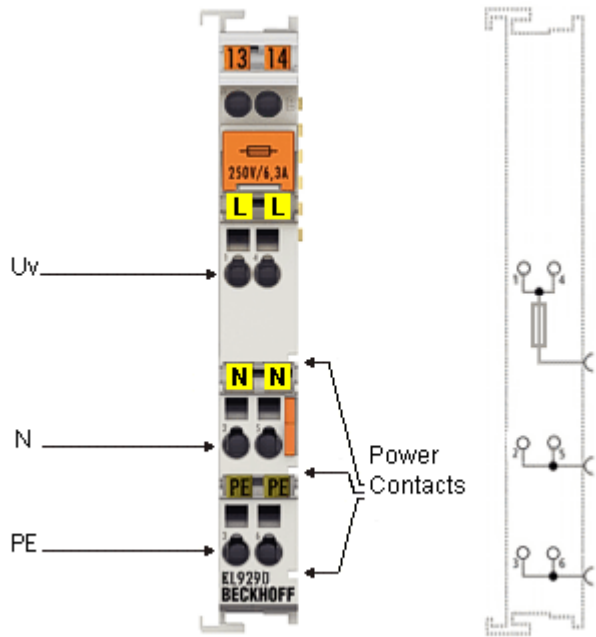

Fig. 34: *EL9200*

Fig. 35: *EL9210*

Fig. 36: *EL9290*

The EL9200 / EL9210 / EL9290 feed terminal can be positioned at any location between the input and output terminals for establishing a further potential group or for supplying the terminals following on the right in applications with high current load. The E-Bus is looped through. As opposed to the EL9200 / EL9290, the EL9210 has a diagnostic function which is displayed on the process image.

BECKHOFF

Technical data

Technical data	EL9200	EL9210	EL9290
Nominal voltage	24 V$_{DC}$		variable, up to 230 V AC
Power contact current load	max. 10 A		
Electrical isolation	500 V (E-bus/field potential)		
Integrated fine-wire fuse	yes; 6.3 A		
Current consumption from E-Bus	-	typ. 90 mA	-
Bit width in the process image	-	1 bit (diagnosis)	-
Configuration	no address or configuration settings		
Power LED	yes	yes	no
Diagnosis (fuse)	yes, Error LED	yes, in process image and ErrorLED	no
Electrical connection to mounting rail	no		
PE contact	yes		
Renewed infeed	yes		
Connection facility to additional power contact	1		
Side by side mounting on Bus Terminals with power contact	yes		
Side by side mounting on Bus Terminals without power contact	yes		
Weight	approx. 55 g		
Permissible ambient temperature range (during operation)	0°C ... +55°C		
Permissible ambient temperature range (during storage)	-25°C ... +85°C		
Permissible relative humidity	95%, no condensation		
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)		
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	variable	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 84] cULus [▶ 86]		CE

Connection EL9200, EL9210, EL9290

> ⚠ **CAUTION**
>
> **Hazard to individuals and devices!**
>
> When designing a Bus Terminal block with different potentials on the power contacts (e.g. 230 V AC and 24 V DC), please note that it is mandatory to use potential separation terminals (EL9080)!
> Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Terminal point		Description
Indication	**No.**	
+24 V* / 230 V AC**	1	Supply input + 24 V [EL9200, EL9210] Supply input 230 V AC [EL9290: variable voltage, up to 230 V AC] connected internally with terminal 4 and positive [EL9200, EL9210] resp. 230 V AC [EL9290] power contact)
0 V* / N**	2	0 V for supply input [EL9200, EL9210] N for supply input [EL9290] connected internally with terminal 5 and negative [EL9200, EL9210] resp. neutral [EL9290] power contact)
PE	3	PE (connected internally with terminal 6 and PE power contact)
+24 V* / 230 V AC**	4	Supply input + 24 V [EL9200, EL9210] Supply input 230 V AC [EL9290: variable voltage, up to 230 V AC] connected internally with terminal 1 and positive [EL9200, EL9210] resp. 230 V AC [EL9290] power contact)
0 V* / N**	5	0 V for supply input [EL9200, EL9210] N for supply input [EL9290] connected internally with terminal 2 and negative [EL9200, EL9210] resp. neutral [EL9290] power contact)
PE	6	PE (connected internally with terminal 3 and PE power contact)

* only EL9200, EL9210
** only EL9290

LEDs

LED	Color	Meaning	
Power LED**	green	off	No input voltage at supply input
		on	24 V_{DC} at supply input
Error LED**	red	off	Fuse OK
		on	Fuse error

** only EL9200, EL9210

Process data (only EL9210)

The EL 9210 has a bit width of 2 bits (diagnosis bit for the power contacts voltage, "PowerOK" and diagnosis bit for fuse error, "FuseError") and is displayed in the TwinCAT tree as follows:
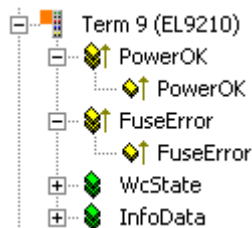

Fig. 37: *EL9210 in the TwinCAT tree*

If there is no voltage impressed on the power contacts, the corresponding diagnosis bit 'PowerOK' has FALSE (0) status.
If there is a fuse error, the corresponding diagnosis bit 'FuseError' has TRUE (1) status.

3.10   EL9250, EL9260

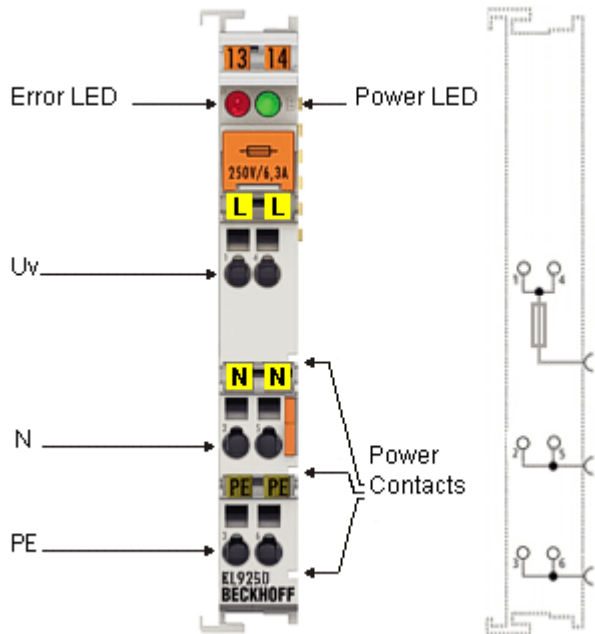### 3.10.1   EL9250, EL9260 - Introduction and Technical Data
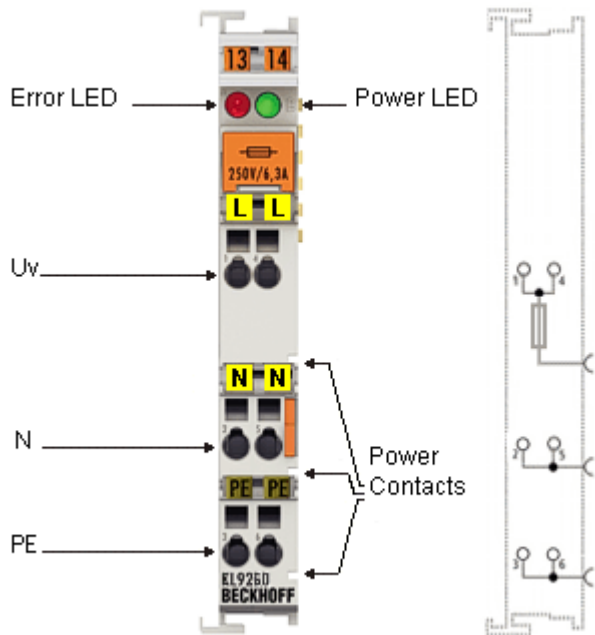

Fig. 38: *EL9250*

Fig. 39: *EL9260*

The EL9250 / EL9260 feed terminal can be positioned at any location between the input and output terminals for establishing a further potential group or for supplying the terminals following on the right in applications with high current load. The E-Bus is looped through. As opposed to the EL9250, the EL9260 has a diagnostic function which is displayed on the process image.

Technical data

Technical data	EL9250	EL9260
Nominal voltage	230 V AC	
Power contact current load	max. 10 A	
Electrical isolation	500 V (E-bus/field potential)	
Integrated fine-wire fuse	yes; 6.3 A	
Current consumption from E-Bus	-	typ. 90 mA
Bit width in the process image	-	2 bit (diagnosis)
Configuration	no address or configuration settings	
Power LED	yes	
Diagnosis (fuse)	yes, Error LED	yes, in process image and Error LED
Electrical connection to mounting rail	no	
PE contact	yes	
Renewed infeed	yes	
Connection facility to additional power contact	1	
Side by side mounting on Bus Terminals with power contact	yes	
Side by side mounting on Bus Terminals without power contact	yes	
Weight	approx. 55 g	
Permissible ambient temperature range (during operation)	0°C ... +55°C	
Permissible ambient temperature range (during storage)	-25°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4	
Protect. class	IP 20	
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	variable
Approval	CE	

Connection EL9250, EL9260

⚠ **CAUTION**
Hazard to individuals and devices!
When designing a Bus Terminal block with different potentials on the power contacts (e.g. 230 V AC and 24 V DC), please note that it is mandatory to use potential separation terminals (EL9080)!   Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Terminal point		Description
Indication	No.	
230 V AC	1	Supply input 230 V AC; connected internally with terminal 4 and 230 V AC power contact)
N	2	N for supply input; connected internally with terminal 5 and neutral power contact)
PE	3	PE; connected internally with terminal 6 and PE power contact)
230 V AC	4	Supply input 230 V AC; connected internally with terminal 1 and 230 V AC power contact)
N	5	N for supply input; connected internally with terminal 2 and neutral power contact)
PE	6	PE; connected internally with terminal 3 and PE power contact)

BECKHOFF

LEDs

LED	Color	Meaning	
Power LED	green	off	No input voltage at supply input
		on	230 V AC at supply input
Error LED	red	off	Fuse OK
		on	Fuse error

Process data (only EL9260)

The EL9260 has a bit width of 2 bits (diagnosis bit for the power contacts voltage, "PowerOK" and diagnosis bit for fuse error, "FuseError") and is displayed in the TwinCAT tree as follows:
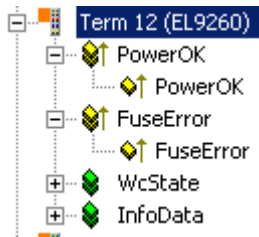

Fig. 40: *EL9260 in the TwinCAT tree*

If there is no voltage impressed on the power contacts, the corresponding diagnosis bit 'PowerOK' has FALSE (0) status.
If there is a fuse error, the corresponding diagnosis bit 'FuseError' has TRUE (1) status.

3.11   EL9400, EL9410

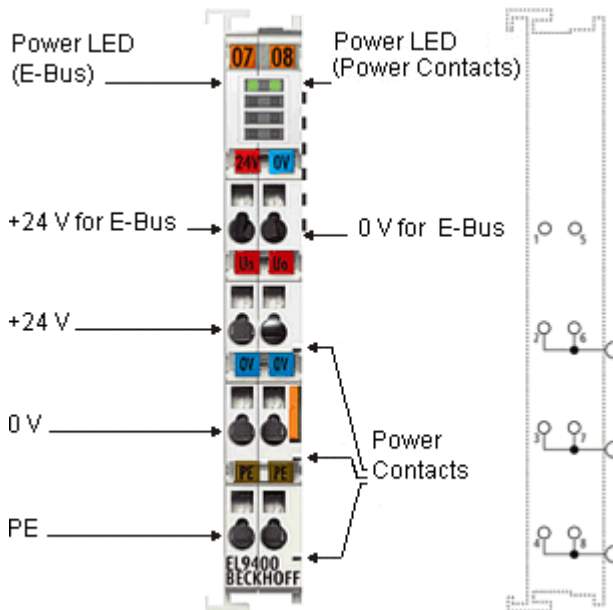### 3.11.1   EL9400, EL9410 - Introduction and Technical Data
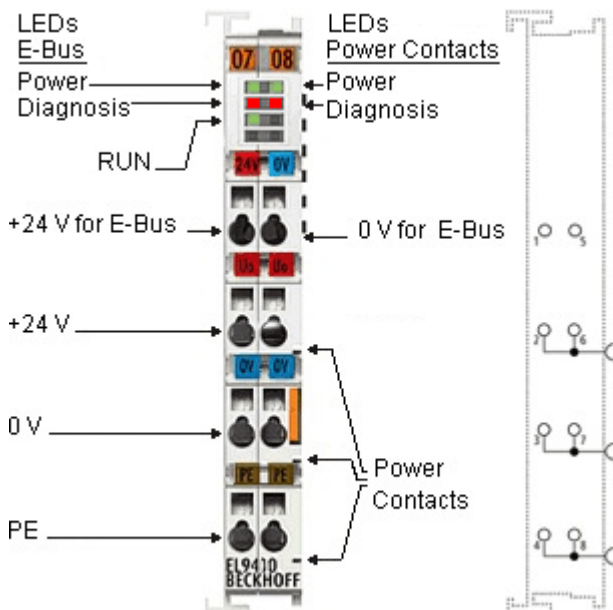

Fig. 41: *EL9400*

Fig. 42: *EL9410*

The EL9400 and EL9410 power supply terminals are used to refresh the E-bus.

Data is exchanged between the coupler and the EtherCAT Terminal over the E-bus. Each terminal draws a certain amount of current from the E-bus (see "current consumption E-bus" in the technical data). This current is fed into the E-bus by the relevant coupler's power supply unit. In configurations with a large number of terminals it is possible to use the EL9400/EL9410 in order to supply an extra 2 A to the E-bus. As opposed to the EL9400, the EL9410 has a diagnostic function which is displayed by LED and on the process image. At the same time the EL9400 can be positioned for establishing a further potential group or for supplying the terminals following on the right (via power contacts).

Technical Data

Technical Data	EL9400	EL9410
Input voltage	24 V_{DC}	
Output current for E-bus supply	2 A	
Power contact voltage	24 V_{DC}	
Power contact current load	max. 10 A	
Current consumption from E-Bus	-	-
Electrical isolation	500 V (E-bus/field potential)	
Diagnosis	no	yes, via LED and in the process image
Electrical connection to mounting rail	no	
PE contact	yes	
Renewed infeed	yes	
Connection facility to additional power contact	1	
Side by side mounting on Bus Terminals with power contact	yes	
Side by side mounting on Bus Terminals without power contact	yes	
Bit width in the process image	-	2 bits (diagnosis)
Configuration	no address or configuration settings	
Weight	approx. 65 g	
Permissible ambient temperature range (during operation)	0°C ... +55°C	
Permissible ambient temperature range (during storage)	-25°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity	
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4	
Protect. class	IP 20	
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"	variable
Approval	CE ATEX [▶ 84] cULus [▶ 86]	

Connection EL9400, EL9410

Terminal point		Description
Indication	No.	
+24 V for E-Bus	1	Supply input + 24 V for the E-Bus
+24 V	2	Supply input + 24 V (connected internally with terminal 6 and positive power contact)
0 V	3	0 V for supply input (connected internally with terminal 7 and negative power contact)
PE	4	PE (connected internally with terminal 8)
0 V for E-Bus	5	0 V for supply input E-Bus
+24 V	6	Supply input + 24 V (connected internally with terminal 2 and positive power contact)
0 V	7	0 V for supply input (connected internally with terminal 3 and negative power contact)
PE	8	PE (connected internally with terminal 4)

LEDs

LED	Farbe	Bedeutung	
Power LED (E-Bus)	green	off	No input voltage at supply input for the E-Bus
		on	24 V_{DC} at supply input for the E-Bus
Power LED (Power Contacts)	green	off	No input voltage at supply input
		on	24 V_{DC} at supply input
Diagnosis LED** Us	red	off	No error
		on	Undervoltage: Us less than 17 V
Diagnosis LED** Up	red	off	No error
		on	Undervoltage: Up less than 17 V
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal
		flashing (2 Hz)	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings
		flashing (1 Hz)	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		on	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible
		flashing (10 Hz)	State of the EtherCAT State Machine: **BOOTSTRAP =** Function for e.g. firmware updates of the terminal

** only EL9410

Process data (only EL9410)

The EL 9410 has a bit width of 2 bits (diagnosis bits for the power contacts voltage [Up] and for the E-Bus voltage [Us], 'Undervoltage') and is displayed in the TwinCAT tree as follows:
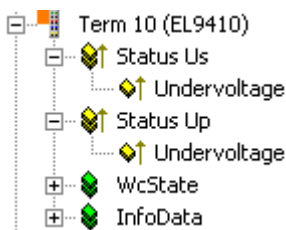

Fig. 43: *EL9110 in the TwinCAT tree*

If the Up or Us voltage is below 17 V, the corresponding diagnosis bit 'Undervoltage' has TRUE (1) status.

3.12   EL9540, EL9550, EL9550-0012

3.12.1   EL9540, EL9550, EL9550-0012 - Introduction and Technical Data
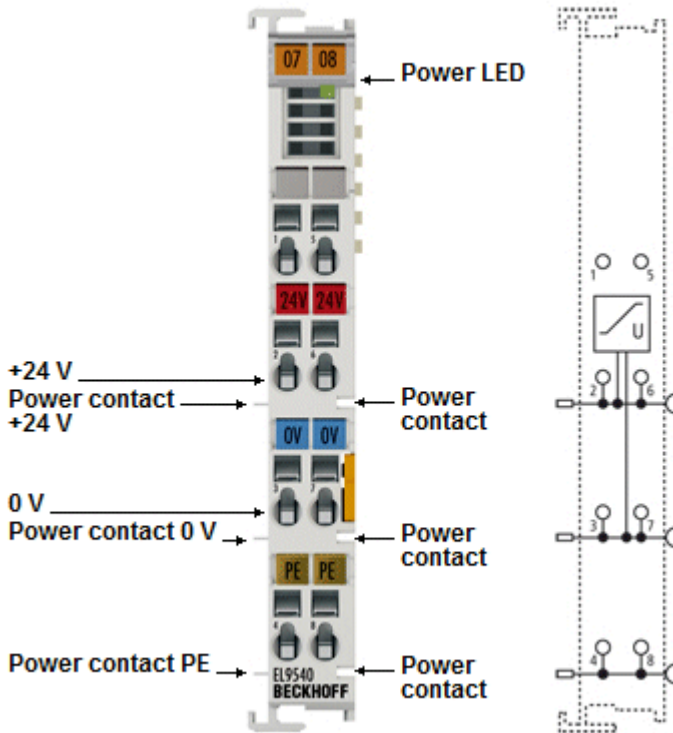
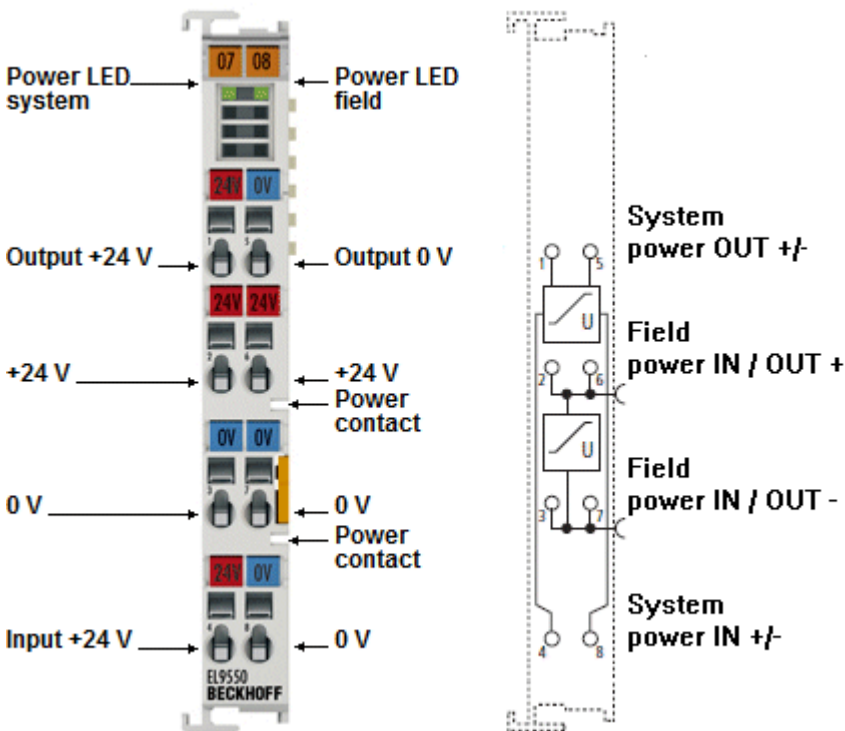**EL9540, EL9550, EL9550-0012**

Fig. 44: *EL9540*

Fig. 45: *EL9550/EL9550-0012*

The EL9540 system terminal contains an overvoltage filter for the 24 V field supply, the EL9550 for the 24 V field and system supply. The filter protects the EtherCAT Terminals from line-bound surge voltages that can occur due to high-energy, dynamic disturbances such as switching overvoltages at inductive consumers or indirect lightning strikes at the supply lines.
In the EL9550-0012 variant, the current load is 10 A for both the field supply and the system supply. The higher system supply is advantageous for the supply of Embedded PCs that have a higher current consumption.

The EtherCAT Terminals EL9540 or EL9550 protect the terminal station from damage in particularly harsh environments. The ship classification organisations require the use in shipbuilding applications and in the onshore/offshore sector.

Technical data

Technical data	EL9540	EL9550	EL9550-0012
Function	surge filter field supply	surge filter system and field supply	
Nominal voltage	24 V (-15 %/+20 %)		
Surge filter field supply	yes		
Surge filter system supply	-	yes	
Rated current field supply	≤ 10 A		
Rated current system supply	-	≤ 1.5 A (from hardware version 03)	≤ 10 A
Diagnostics	-		
Reported to E-Bus	-		
PE contact	yes	-	
Shield connection	-		
Current consumption E-bus	-		
Bit width in the process image	0		
Connection to mounting rail	-		
Electrical isolation	500 V (E-bus/field potential)		
Renewed infeed	yes		
Connection facility to additional power contact	2	1	
Side by side mounting on Ether-CAT Terminals with power contact	yes	-	
Side by side mounting on Ether-CAT Terminals without power contact	yes		
Dimensions (B x H x T)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)		
Configuration	no address- or configuration setting necessary		
Weight	approx. 50 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range)		
Permissible ambient temperature range (during storage)	-40°C ... +85°C		
Permissible relative humidity	95%, no condensation		
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 76] for enhanced mechanical load capacity		
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4		
Protect. class	IP 20		
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"		
Approval	CE ATEX [▶ 85] cULus [▶ 86]	CE ATEX [▶ 85] cULus [▶ 86] IECEx	CE

LEDs and connection EL9540

LED	Color	Meaning	
Power-LED	green	off	24 V_{DC} field supply not present
		on	24 V_{DC} field supply present

Terminal point		Meaning
Indication	**No.**	
n.c.	1	not connected
+24 V	2	+24 V (internally connected with terminal point 6 and positive power contact)
0 V	3	0 V (internally connected with terminal point 7 and negative power contact)
PE	4	PE (internally connected with terminal point 8 and PE power contact)
n.c.	5	not connected
+24 V	6	+24 V (internally connected with terminal point 2 and positive power contact)
0 V	7	0 V (internally connected with terminal point 3 and negative power contact)
PE	8	PE (internally connected with terminal point 4 and PE power contact)

LEDs and connection EL9550/EL9550-0012

LED	Color	Meaning	
Power-LED field	green	off	24 V_{DC} field supply not present
		on	24 V_{DC} field supply present
Power-LED system	green	aoff	24 V_{DC} system supply not present
		on	24 V_{DC} system supply present

Terminal point		Meaning
Indication	**No.**	
Output +24 V	1	Output +24 V
+24 V	2	+24 V (internally connected with terminal point 6 and positive power contact)
0 V	3	0 V (internally connected with terminal point 7 and negative power contact)
Input +24 V	4	Input +24 V
Output 0 V	5	Output 0 V
+24 V	6	24 V (internally connected with terminal point 2 and positive power contact)
0 V	7	0 V (internally connected with terminal point 3 and negative power contact)
Input 0 V	8	Input 0 V

3.13   EL9570

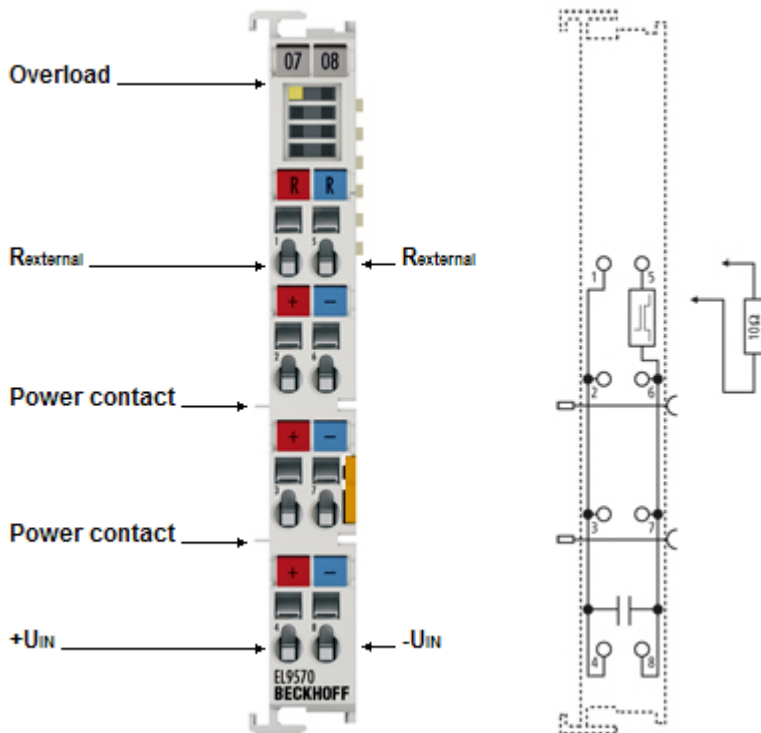### 3.13.1   EL9570 - Introduction and Technical Data

Fig. 46: *EL9570*

The EL9570 Bus Terminal contains high-performance capacitors for stabilizing supply voltages.

The EL9570 can be used e.g. in conjunction with the EL7041 stepper motor terminal, the EL7342 DC motor terminal or the EL7201 servomotor terminal.
Low internal resistance and high-pulsed current capability enable good buffering in parallel with a power supply unit. Return currents are stored, particularly in the context of drive applications, thereby preventing overvoltages. If the regenerative energy exceeds the capacity of the capacitors, energy can be dissipated via an external ballast resistor.

Technical data

Technical data	EL9570
Technology	buffer capacitor
Nominal voltage	50 V
Capacity	500 µF
Ripple current	10 A in continuous operation
Internal resistance	< 10 mΩ
Surge voltage protection	> 56 V
Recommended ballast resistor	10 Ω, 10 W typ.
Overvoltage control range	±2 V
Ballast resistor clock rate	load-dependent, 2-point control
Electrical isolation	1500 V
Diagnostics	-
Message to E-Bus	-
PE contact	no
Shield connection	-
Current consumption from E-Bus	-
Bit width in the process image	0
Electrical connection to mounting rail	-
Electrical isolation	-
Renewed infeed	-
Connection facility to additional power contact	-
Side by side mounting on EtherCAT Terminals with power contact	yes, left side without PE
Side by side mounting on EtherCAT Terminals without power contact	yes
Configuration	no address or configuration settings
Weight	approx.. 90 g
Permissible ambient temperature range (during operation)	0°C ... +55°C
Permissible ambient temperature range (during storage)	-25°C ... +85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 73]	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC resistance burst/ESD	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class	IP 20
Installation pos.	variable, see chapter "Mounting of Passive Terminals [▶ 83]"
Approval	CE ATEX [▶ 84]

LEDs und Anschlussbelegung EL9570

LED	Color	Meaning	
Overload	green	off	No error
		on	Overload, energy will be absorbed in the connected ballast resistor

Terminal point		Meaning
Indication	**No.**	
$R_{external}$	1	Connection for ballast resistor
$+U_{IN}$	2	Positive input for buffer voltage (internally connected with terminal point 3 and 4)
$+U_{IN}$	3	Positive input for buffer voltage (internally connected with terminal point 2 and 4)
$+U_{IN}$	4	Positive input for buffer voltage (internally connected with terminal point 2 and 3)
$R_{external}$	5	Connection for ballast resistor
$-U_{IN}$	6	Negative input for buffer voltage (internally connected with terminal point 7 and 8)
$-U_{IN}$	7	Negative input for buffer voltage (internally connected with terminal point 6 and 8)
$-U_{IN}$	8	Negative input for buffer voltage (internally connected with terminal point 6 and 7)

3.13.2   Application example

> ⚠ **WARNING**
>
> **Risk of electric shock and damage of device!**
>
> Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Application example

- The capacitor within the EL9570 compensates peaks on the power supply of the stepper motor / DC motor.
- As soon as the supply voltages increases 55 V, the EL9570 switches on the brake resistor $R_{EXTERNAL}$, to burn the back loaded braking energy of the stepper motor / DC motor connected to the EL7041.

BECKHOFF
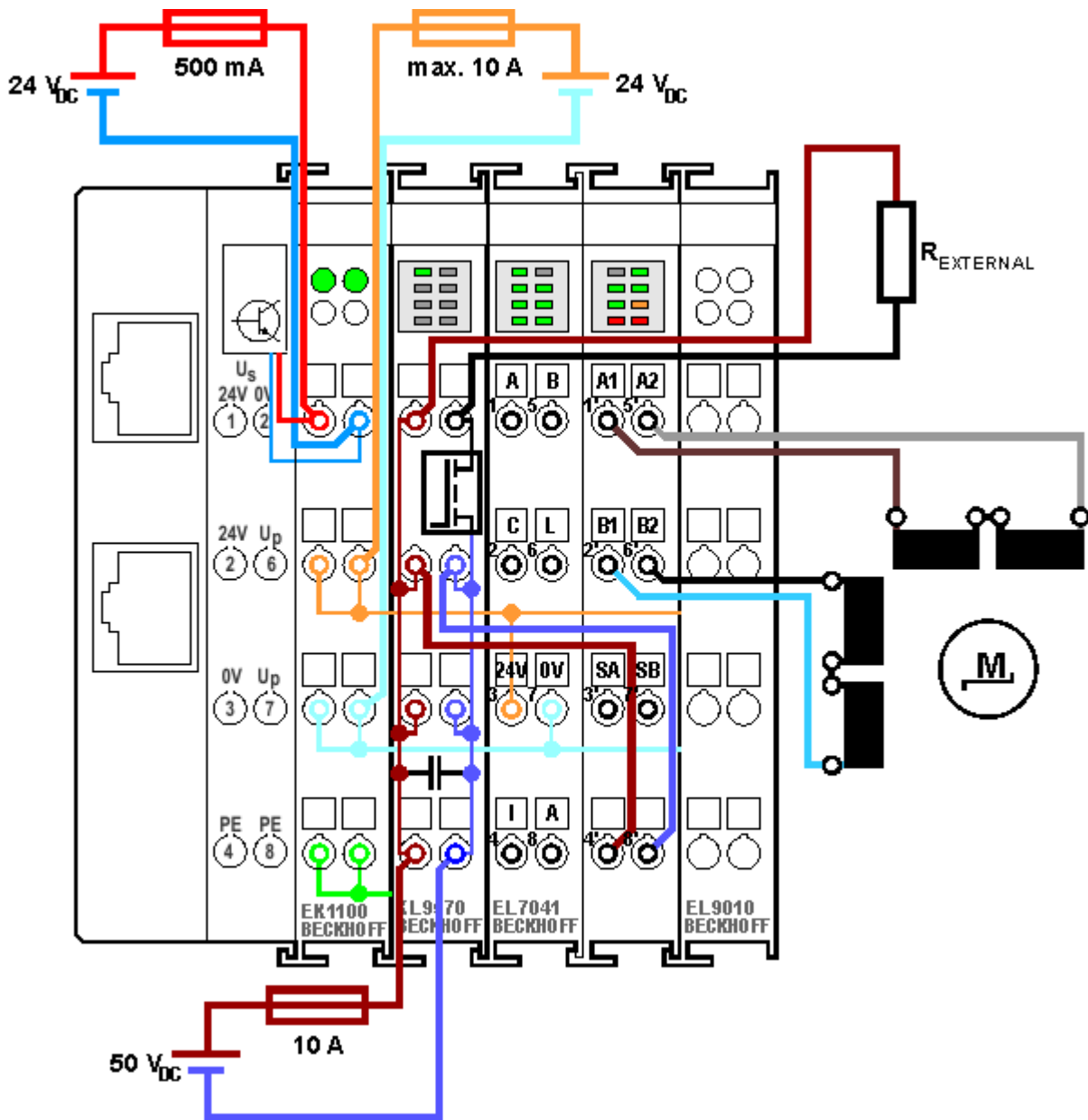
Fig. 47: *Application example EL9570*

● More motors

i A capacitor EL9570 terminal is able to condition the power supply of several motors.

NOTE
Dimensioning of the brake resistor
The brake resistor $R_{EXTERNAL}$ (typically 10 Ω) should be dimensioned in that way, that it can stand the expected heat without damage!

4   Basics communication

4.1   EtherCAT basics

Please refer to the EtherCAT System Documentation for the EtherCAT fieldbus basics.

4.2   EtherCAT cabling – wire-bound

The cable length between two EtherCAT devices must not exceed 100 m. This results from the FastEthernet technology, which, above all for reasons of signal attenuation over the length of the cable, allows a maximum link length of 5 + 90 + 5 m if cables with appropriate properties are used. See also the Design recommendations for the infrastructure for EtherCAT/Ethernet.

Cables and connectors

For connecting EtherCAT devices only Ethernet connections (cables + plugs) that meet the requirements of at least category 5 (CAt5) according to EN 50173 or ISO/IEC 11801 should be used. EtherCAT uses 4 wires for signal transfer.

EtherCAT uses RJ45 plug connectors, for example. The pin assignment is compatible with the Ethernet standard (ISO/IEC 8802-3).

Pin	Color of conductor	Signal	Description
1	yellow	TD +	Transmission Data +
2	orange	TD -	Transmission Data -
3	white	RD +	Receiver Data +
6	blue	RD -	Receiver Data -

Due to automatic cable detection (auto-crossing) symmetric (1:1) or cross-over cables can be used between EtherCAT devices from Beckhoff.

● **Recommended cables**

i   Suitable cables for the connection of EtherCAT devices can be found on the Beckhoff website!

E-Bus supply

A bus coupler can supply the EL terminals added to it with the E-bus system voltage of 5 V; a coupler is thereby loadable up to 2 A as a rule (see details in respective device documentation).
Information on how much current each EL terminal requires from the E-bus supply is available online and in the catalogue. If the added terminals require more current than the coupler can supply, then power feed terminals (e.g. EL9410) must be inserted at appropriate places in the terminal strand.

The pre-calculated theoretical maximum E-Bus current is displayed in the TwinCAT System Manager. A shortfall is marked by a negative total amount and an exclamation mark; a power feed terminal is to be placed before such a position.
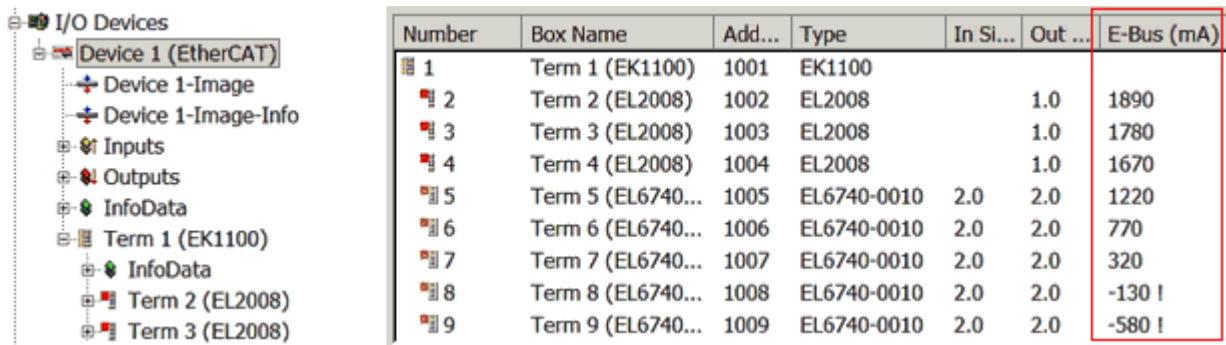
Number	Box Name	Add...	Type	In Si...	Out ...	E-Bus (mA)
1	Term 1 (EK1100)	1001	EK1100			
2	Term 2 (EL2008)	1002	EL2008		1.0	1890
3	Term 3 (EL2008)	1003	EL2008		1.0	1780
4	Term 4 (EL2008)	1004	EL2008		1.0	1670
5	Term 5 (EL6740...	1005	EL6740-0010	2.0	2.0	1220
6	Term 6 (EL6740...	1006	EL6740-0010	2.0	2.0	770
7	Term 7 (EL6740...	1007	EL6740-0010	2.0	2.0	320
8	Term 8 (EL6740...	1008	EL6740-0010	2.0	2.0	-130 !
9	Term 9 (EL6740...	1009	EL6740-0010	2.0	2.0	-580 !

Fig. 48: *System manager current calculation*

NOTE
Malfunction possible!
The same ground potential must be used for the E-Bus supply of all EtherCAT terminals in a terminal block!

4.3　　EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). Depending upon the state, different functions are accessible or executable in the EtherCAT slave. Specific commands must be sent by the EtherCAT master to the device in each state, particularly during the bootup of the slave.

A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational and
- Operational
- Boot

The regular state of each EtherCAT slave after bootup is the OP state.
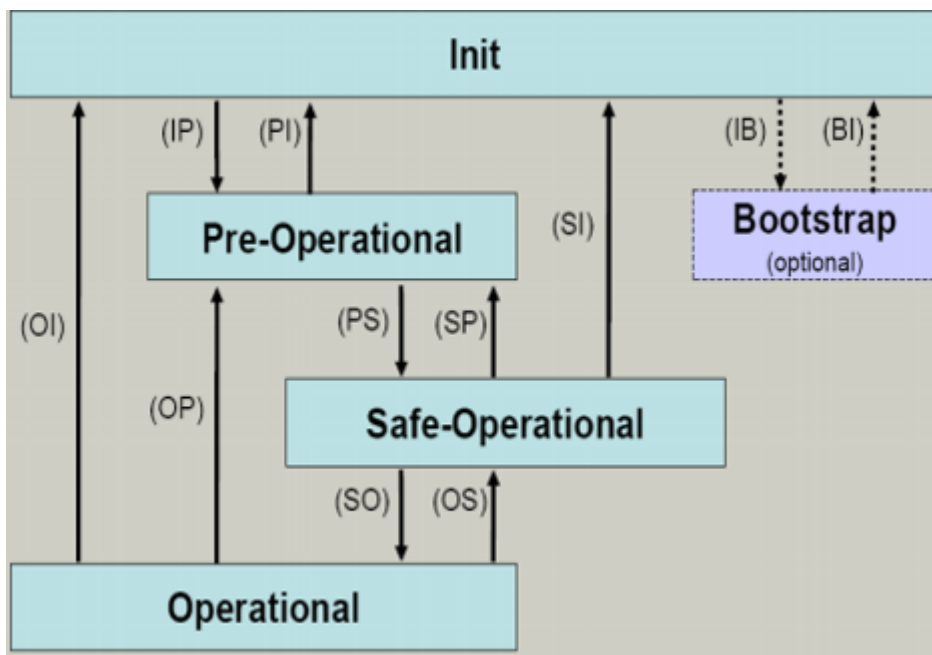
Fig. 49: *States of the EtherCAT State Machine*

Init

After switch-on the EtherCAT slave in the *Init* state. No mailbox or process data communication is possible. The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

Pre-Operational (Pre-Op)

During the transition between *Init* and *Pre-Op* the EtherCAT slave checks whether the mailbox was initialized correctly.

In *Pre-Op* state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

Safe-Operational (Safe-Op)

During transition between *Pre-Op* and *Safe-Op* the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In *Safe-Op* state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.

● **Outputs in SAFEOP state**

i The default set watchdog monitoring sets the outputs of the module in a safe state - depending on the settings in SAFEOP and OP - e.g. in OFF state. If this is prevented by deactivation of the watchdog monitoring in the module, the outputs can be switched or set also in the SAFEOP state.

Operational (Op)

Before the EtherCAT master switches the EtherCAT slave from *Safe-Op* to *Op* it must transfer valid output data.

In the *Op* state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.

Boot

In the *Boot* state the slave firmware can be updated. The *Boot* state can only be reached via the *Init* state.

In the *Boot* state mailbox communication via the *file access over EtherCAT* (FoE) protocol is possible, but no other mailbox communication and no process data communication.

4.4   CoE Interface

General description

The CoE interface (CANopen over EtherCAT) is used for parameter management of EtherCAT devices. EtherCAT slaves or the EtherCAT master manage fixed (read only) or variable parameters which they require for operation, diagnostics or commissioning.

CoE parameters are arranged in a table hierarchy. In principle, the user has read access via the fieldbus. The EtherCAT master (TwinCAT System Manager) can access the local CoE lists of the slaves via EtherCAT in read or write mode, depending on the attributes.

Different CoE parameter types are possible, including string (text), integer numbers, Boolean values or larger byte fields. They can be used to describe a wide range of features. Examples of such parameters include manufacturer ID, serial number, process data settings, device name, calibration values for analog measurement or passwords.

The order is specified in 2 levels via hexadecimal numbering: (main)index, followed by subindex. The value ranges are

- Index: 0x0000 …0xFFFF (0...65535$_{dez}$)
- SubIndex: 0x00…0xFF (0...255$_{dez}$)

A parameter localized in this way is normally written as 0x8010:07, with preceding "x" to identify the hexadecimal numerical range and a colon between index and subindex.

The relevant ranges for EtherCAT fieldbus users are:

- 0x1000: This is where fixed identity information for the device is stored, including name, manufacturer, serial number etc., plus information about the current and available process data configurations.
- 0x8000: This is where the operational and functional parameters for all channels are stored, such as filter settings or output frequency.

Other important ranges are:

- 0x4000: In some EtherCAT devices the channel parameters are stored here (as an alternative to the 0x8000 range).
- 0x6000: Input PDOs ("input" from the perspective of the EtherCAT master)
- 0x7000: Output PDOs ("output" from the perspective of the EtherCAT master)

ⓘ Availability

Not every EtherCAT device must have a CoE list. Simple I/O modules without dedicated processor usually have no variable parameters and therefore no CoE list.

If a device has a CoE list, it is shown in the TwinCAT System Manager as a separate tab with a listing of the elements:
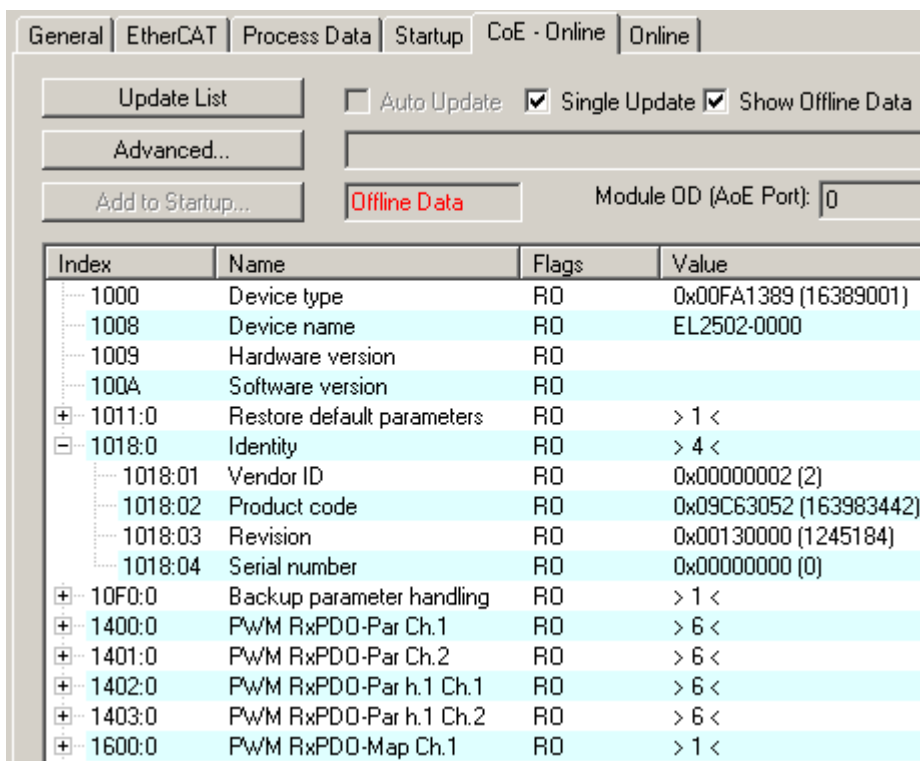
Fig. 50: *"CoE Online " tab*

The figure above shows the CoE objects available in device "EL2502", ranging from 0x1000 to 0x1600. The subindices for 0x1018 are expanded.

Data management and function "NoCoeStorage"

Some parameters, particularly the setting parameters of the slave, are configurable and writeable. This can be done in write or read mode

- via the System Manager (Fig. *"CoE Online " tab*) by clicking
  This is useful for commissioning of the system/slaves. Click on the row of the index to be parameterised and enter a value in the "SetValue" dialog.

- from the control system/PLC via ADS, e.g. through blocks from the TcEtherCAT.lib library
  This is recommended for modifications while the system is running or if no System Manager or operating staff are available.

ⓘ Data management

If slave CoE parameters are modified online, Beckhoff devices store any changes in a fail-safe manner in the EEPROM, i.e. the modified CoE parameters are still available after a restart. The situation may be different with other manufacturers.

An EEPROM is subject to a limited lifetime with respect to write operations. From typically 100,000 write operations onwards it can no longer be guaranteed that new (changed) data are reliably saved or are still readable. This is irrelevant for normal commissioning. However, if CoE parameters are continuously changed via ADS at machine runtime, it is quite possible for the lifetime limit to be reached. Support for the NoCoeStorage function, which suppresses the saving of changed CoE values, depends on the firmware version.
Please refer to the technical data in this documentation as to whether this applies to the respective device.

- If the function is supported: the function is activated by entering the code word 0x12345678 once in CoE 0xF008 and remains active as long as the code word is not changed. After switching the device on it is then inactive. Changed CoE values are not saved in the EEPROM and can thus be changed any number of times.

- Function is not supported: continuous changing of CoE values is not permissible in view of the lifetime limit.

ⓘ Startup list

Changes in the local CoE list of the terminal are lost if the terminal is replaced. If a terminal is replaced with a new Beckhoff terminal, it will have the default settings. It is therefore advisable to link all changes in the CoE list of an EtherCAT slave with the Startup list of the slave, which is processed whenever the EtherCAT fieldbus is started. In this way a replacement EtherCAT slave can automatically be parameterized with the specifications of the user.

If EtherCAT slaves are used which are unable to store local CoE values permanently, the Startup list must be used.

Recommended approach for manual modification of CoE parameters

- Make the required change in the System Manager
  The values are stored locally in the EtherCAT slave

- If the value is to be stored permanently, enter it in the Startup list.
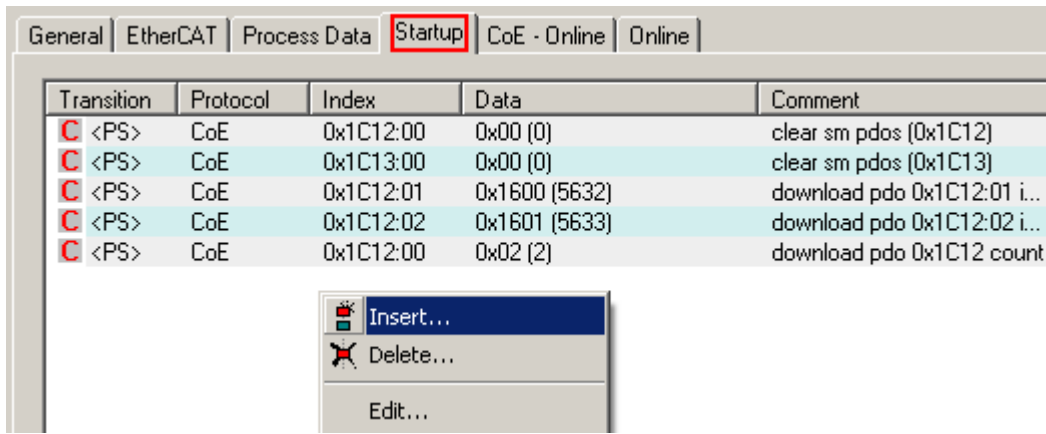 The order of the Startup entries is usually irrelevant.

Fig. 51: *Startup list in the TwinCAT System Manager*

The Startup list may already contain values that were configured by the System Manager based on the ESI specifications. Additional application-specific entries can be created.

Online/offline list

While working with the TwinCAT System Manager, a distinction has to be made whether the EtherCAT device is "available", i.e. switched on and linked via EtherCAT and therefore **online**, or whether a configuration is created **offline** without connected slaves.

In both cases a CoE list as shown in Fig. *"'CoE online' tab"* is displayed. The connectivity is shown as offline/online.

- If the slave is offline
  ◦ The offline list from the ESI file is displayed. In this case modifications are not meaningful or possible.
  ◦ The configured status is shown under Identity.
  ◦ No firmware or hardware version is displayed, since these are features of the physical device.
  ◦ **Offline** is shown in red.
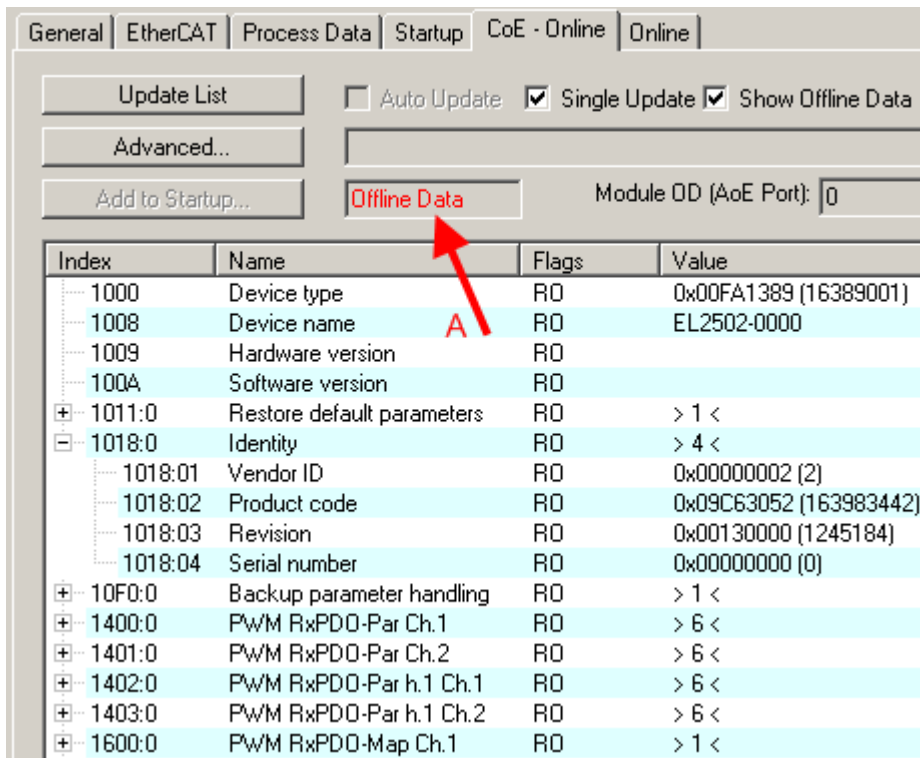
Fig. 52: *Offline list*

- If the slave is online
  - ◦ The actual current slave list is read. This may take several seconds, depending on the size and cycle time.
  - ◦ The actual identity is displayed
  - ◦ The firmware and hardware version of the equipment according to the electronic information is displayed
  - ◦ **Online** is shown in green.
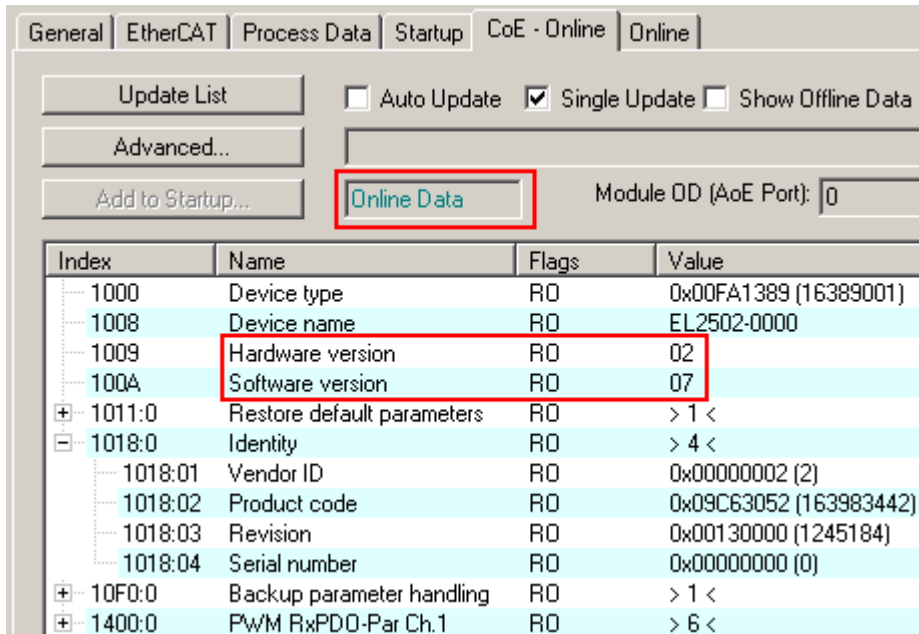
Fig. 53: *Online list*

Channel-based order

The CoE list is available in EtherCAT devices that usually feature several functionally equivalent channels. For example, a 4-channel analog 0..10 V input terminal also has 4 logical channels and therefore 4 identical sets of parameter data for the channels. In order to avoid having to list each channel in the documentation, the placeholder "n" tends to be used for the individual channel numbers.

In the CoE system 16 indices, each with 255 subindices, are generally sufficient for representing all channel parameters. The channel-based order is therefore arranged in $16_{dec}/10_{hex}$ steps. The parameter range 0x8000 exemplifies this:

- Channel 0: parameter range 0x8000:00 ... 0x800F:255
- Channel 1: parameter range 0x8010:00 ... 0x801F:255
- Channel 2: parameter range 0x8020:00 ... 0x802F:255
- ...

This is generally written as 0x80n0.

Detailed information on the CoE interface can be found in the EtherCAT system documentation on the Beckhoff website.

5 Mounting and wiring

5.1 Instructions for ESD protection

NOTE
Destruction of the devices by electrostatic discharge possible! The devices contain components at risk from electrostatic discharge caused by improper handling. • Please ensure you are electrostatically discharged and avoid touching the contacts of the device directly. • Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.). • Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices. • Each assembly must be terminated at the right hand end with an <u>EL9011</u> or <u>EL9012</u> bus end cap, to ensure the protection class and ESD protection.
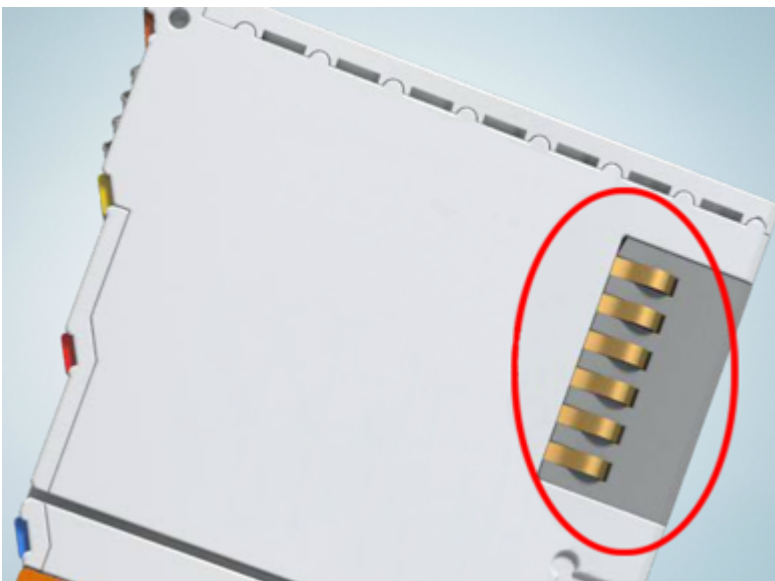
Fig. 54: Spring contacts of the Beckhoff I/O components

5.2   Installation on mounting rails

⚠ WARNING
Risk of electric shock and damage of device! Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

Assembly
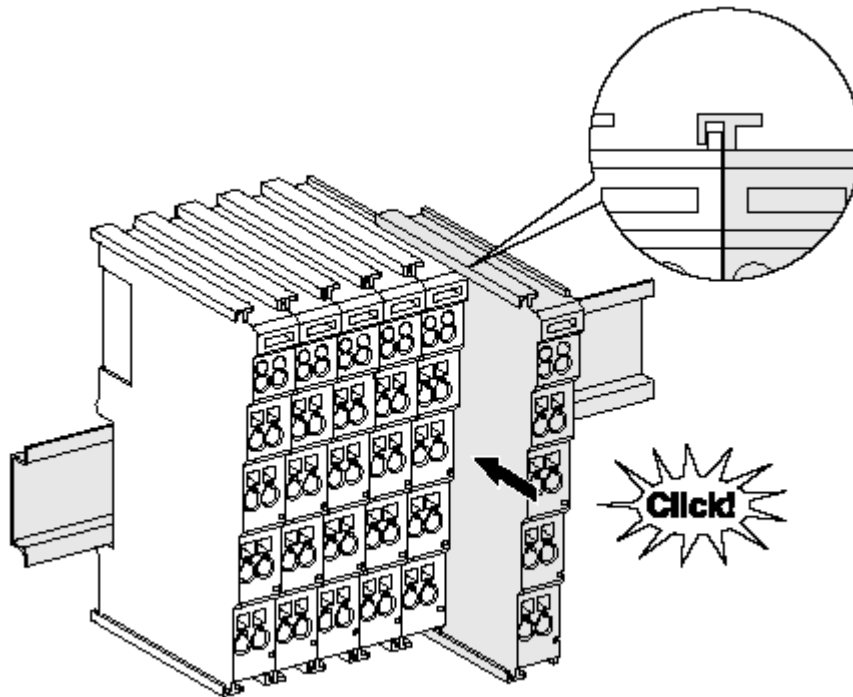
Fig. 55: Attaching on mounting rail

The bus coupler and bus terminals are attached to commercially available 35 mm mounting rails (DIN rails according to EN 60715) by applying slight pressure:

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.
   If the terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

> ℹ **Fixing of mounting rails**
>
> The locking mechanism of the terminals and couplers extends to the profile of the mounting rail. At the installation, the locking mechanism of the components must not come into conflict with the fixing bolts of the mounting rail. To mount the mounting rails with a height of 7.5 mm under the terminals and couplers, you should use flat mounting connections (e.g. countersunk screws or blind rivets).

Disassembly
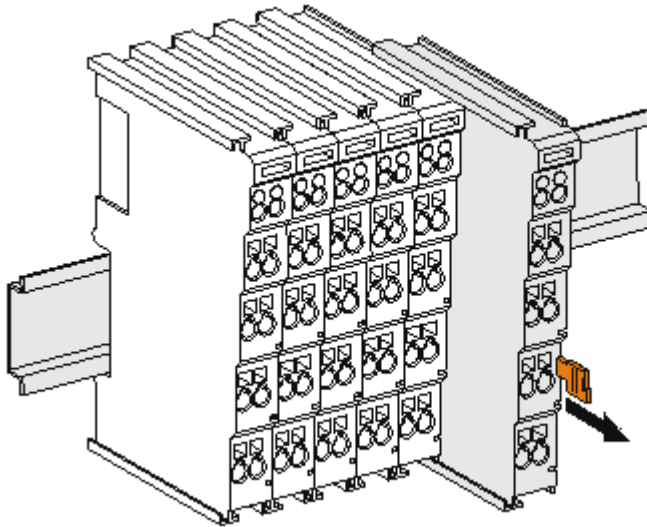
Fig. 56: Disassembling of terminal

Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

1. Pull the terminal by its orange-colored lugs approximately 1 cm away from the mounting rail. In doing so for this terminal the mounting rail lock is released automatically and you can pull the terminal out of the bus terminal block easily without excessive force.
2. Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal out of the bus terminal block.

Connections within a bus terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realized by joining the components:

- The six spring contacts of the K-Bus/E-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler (up to 24 V) or for higher voltages via power feed terminals.

Power Contacts

During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts. Power Feed Terminals (KL91xx, KL92xx or EL91xx, EL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.
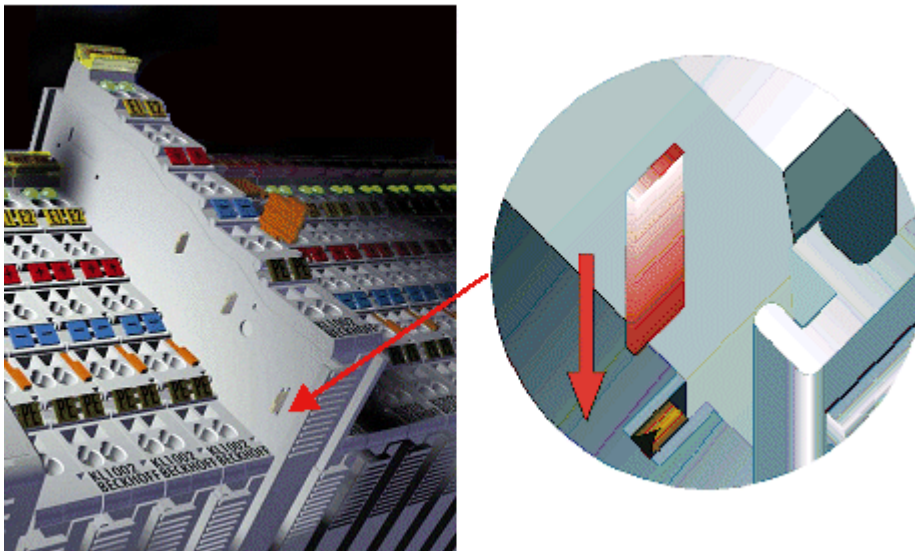
Fig. 57: *Power contact on left side*

NOTE
Possible damage of the device
Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V). For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

⚠ **WARNING**
Risk of electric shock!
The PE power contact must not be used for other potentials!

5.3 Installation instructions for enhanced mechanical load capacity

⚠ **WARNING**
Risk of injury through electric shock and damage to the device!
Bring the Bus Terminal system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals!

Additional checks

The terminals have undergone the following additional tests:

Verification	Explanation
Vibration	10 frequency runs in 3 axes
	6 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 g, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	25 g, 6 ms

Additional installation instructions

For terminals with enhanced mechanical load capacity, the following additional installation instructions apply:

- The enhanced mechanical load capacity is valid for all permissible installation positions
- Use a mounting rail according to EN 60715 TH35-15
- Fix the terminal segment on both sides of the mounting rail with a mechanical fixture, e.g. an earth terminal or reinforced end clamp
- The maximum total extension of the terminal segment (without coupler) is:
  64 terminals (12 mm mounting with) or 32 terminals (24 mm mounting with)
- Avoid deformation, twisting, crushing and bending of the mounting rail during edging and installation of the rail
- The mounting points of the mounting rail must be set at 5 cm intervals
- Use countersunk head screws to fasten the mounting rail
- The free length between the strain relief and the wire connection should be kept as short as possible. A distance of approx. 10 cm should be maintained to the cable duct.

5.4 Connection system

⚠ WARNING
Risk of electric shock and damage of device!
Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Overview

The Bus Terminal system offers different connection options for optimum adaptation to the respective application:

- The terminals of KLxxxx and ELxxxx series with standard wiring include electronics and connection level in a single enclosure.
- The terminals of KSxxxx and ESxxxx series feature a pluggable connection level and enable steady wiring while replacing.
- The High Density Terminals (HD Terminals) include electronics and connection level in a single enclosure and have advanced packaging density.

Standard wiring

Fig. 58: Standard wiring

The terminals of KLxxxx and ELxxxx series have been tried and tested for years.
They feature integrated screwless spring force technology for fast and simple assembly.

Pluggable wiring
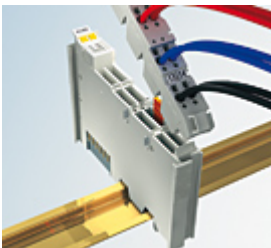
Fig. 59: Pluggable wiring

The terminals of KSxxxx and ESxxxx series feature a pluggable connection level.
The assembly and wiring procedure for the KS series is the same as for the KLxxxx and ELxxxx series.
The KS/ES series terminals enable the complete wiring to be removed as a plug connector from the top of the housing for servicing.
The lower section can be removed from the terminal block by pulling the unlocking tab.
Insert the new component and plug in the connector with the wiring. This reduces the installation time and eliminates the risk of wires being mixed up.

The familiar dimensions of the terminal only had to be changed slightly. The new connector adds about 3 mm. The maximum height of the terminal remains unchanged.

A tab for strain relief of the cable simplifies assembly in many applications and prevents tangling of individual connection wires when the connector is removed.

Conductor cross sections between 0.08 mm^2 and 2.5 mm^2 can continue to be used with the proven spring force technology.

The overview and nomenclature of the product names for KSxxxx and ESxxxx series has been retained as known from KLxxxx and ELxxxx series.

High Density Terminals (HD Terminals)

Fig. 60: *High Density Terminals*

The Bus Terminals from these series with 16 connection points are distinguished by a particularly compact design, as the packaging density is twice as large as that of the standard 12 mm Bus Terminals. Massive conductors and conductors with a wire end sleeve can be inserted directly into the spring loaded terminal point without tools.

> **ⓘ Wiring HD Terminals**
>
> The High Density (HD) Terminals of the KLx8xx and ELx8xx series doesn't support steady wiring.

Ultrasonically "bonded" (ultrasonically welded) conductors

> **ⓘ Ultrasonically "bonded" conductors**
>
> It is also possible to connect the Standard and High Density Terminals with ultrasonically "bonded" (ultrasonically welded) conductors. In this case, please note the tables concerning the wire-size width [▶ 79] below!

Wiring

Terminals for standard wiring ELxxxx/KLxxxx and for pluggable wiring ESxxxx/KSxxxx
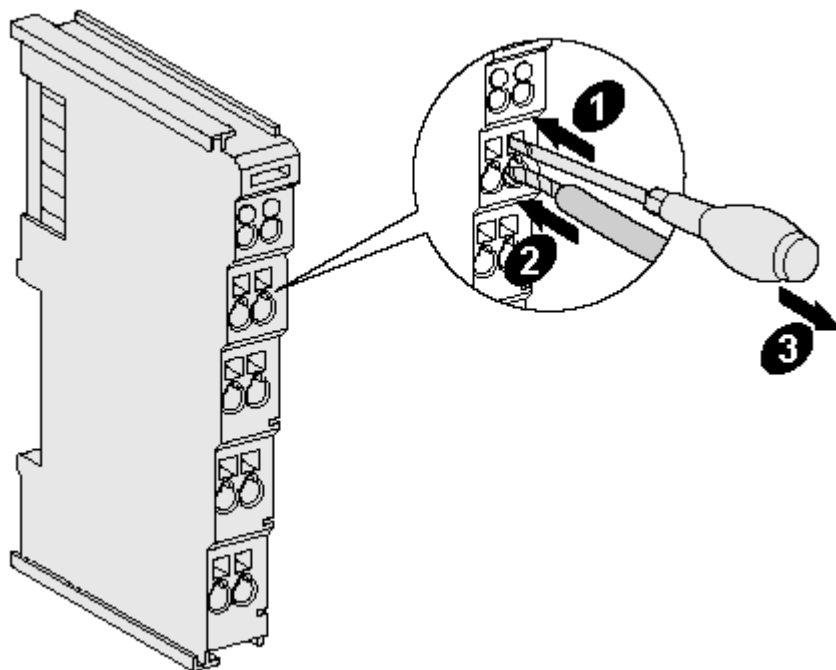
Fig. 61: Mounting a cable on a terminal connection

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The terminals are implemented in spring force technology. Connect the cables as follows:

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal closes automatically when the pressure is released, holding the wire securely and permanently.

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width	0.08 ... 2,5 mm^2	0.08 ... 2.5 mm^2
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals ELx8xx, KLx8xx (HD)

The conductors of the HD Terminals are connected without tools for single-wire conductors using the direct plug-in technique, i.e. after stripping the wire is simply plugged into the contact point. The cables are released, as usual, using the contact release with the aid of a screwdriver. See the following table for the suitable wire size width.

Terminal housing	High Density Housing
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm^2
Wire size width (single core wires)	0.08 ... 1.5 mm^2
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm^2
Wire size width (ultrasonically "bonded" conductors)	only 1.5 mm^2 (see notice [▶ 78]!)
Wire stripping length	8 ... 9 mm

Shielding

● **Shielding**

i Analog sensors and actors should always be connected with shielded, twisted paired wires.

5.5   Installation positions

NOTE
Constraints regarding installation position and operating temperature range
Please refer to the technical data for a terminal to ascertain whether any restrictions regarding the installation position and/or the operating temperature range have been specified. When installing high power dissipation terminals ensure that an adequate spacing is maintained between other components above and below the terminal in order to guarantee adequate ventilation!

Optimum installation position (standard)

The optimum installation position requires the mounting rail to be installed horizontally and the connection surfaces of the EL/KL terminals to face forward (see Fig. *"Recommended distances for standard installation position"*). The terminals are ventilated from below, which enables optimum cooling of the electronics through convection. "From below" is relative to the acceleration of gravity.
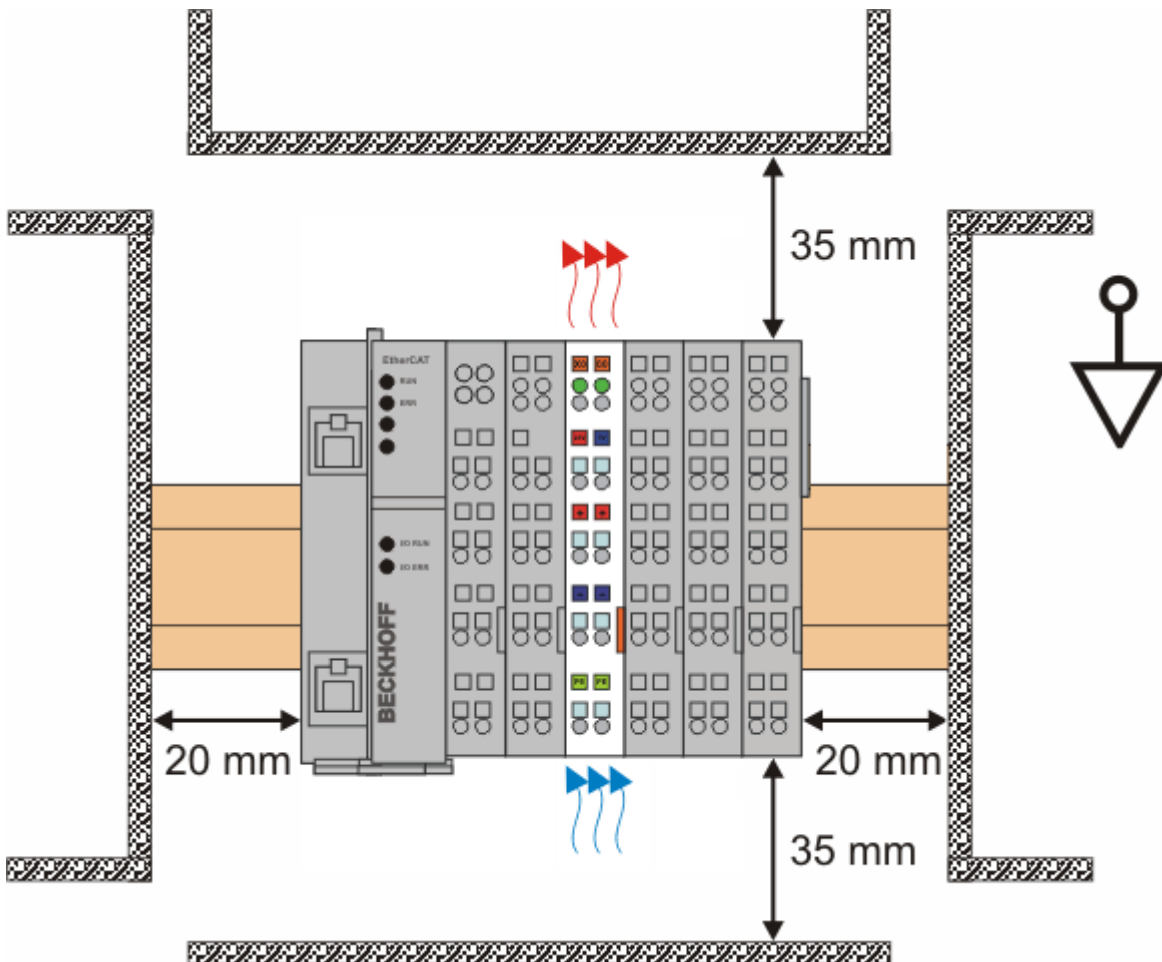
Fig. 62: *Recommended distances for standard installation position*

Compliance with the distances shown in Fig. *"Recommended distances for standard installation position"* is recommended.

Other installation positions

All other installation positions are characterized by different spatial arrangement of the mounting rail - see Fig *"Other installation positions"*.

The minimum distances to ambient specified above also apply to these installation positions.

BECKHOFF
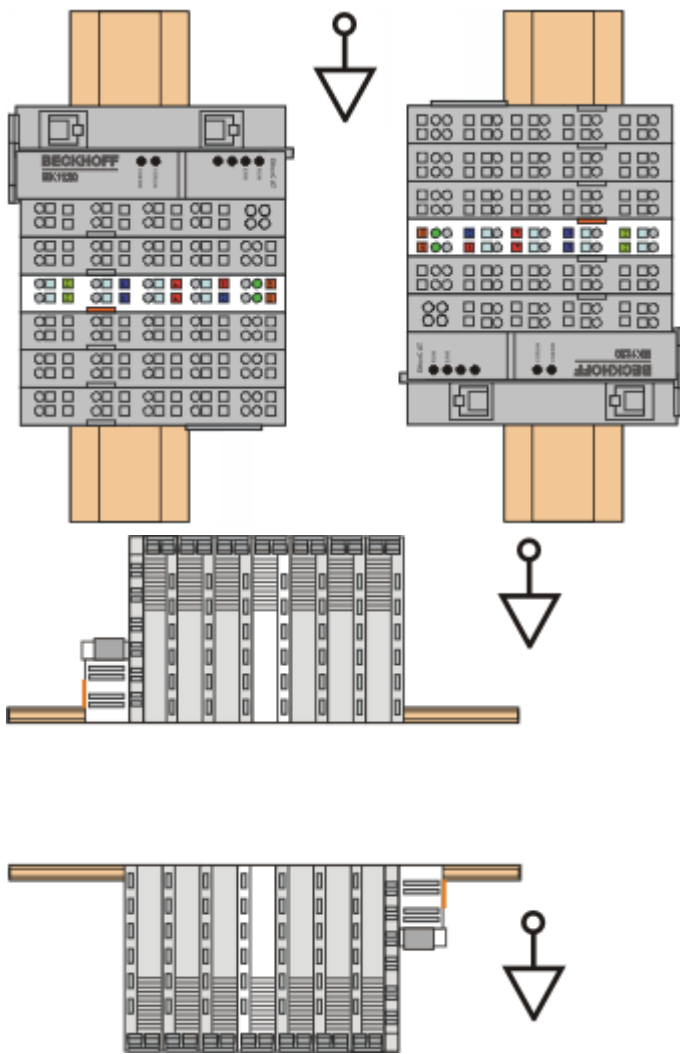
Fig. 63: *Other installation positions*

5.6   Positioning of passive Terminals

i ● **Hint for positioning of passive terminals in the bus terminal block**

EtherCAT Terminals (ELxxxx / ESxxxx), which do not take an active part in data transfer within the bus terminal block are so called passive terminals. The passive terminals have no current consumption out of the E-Bus.
To ensure an optimal data transfer, you must not directly string together more than 2 passive terminals!

Examples for positioning of passive terminals (highlighted)
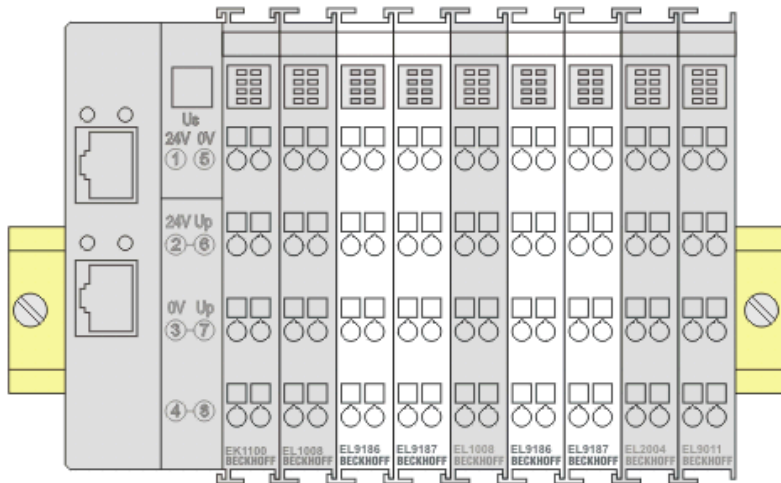
Fig. 64: Correct positioning
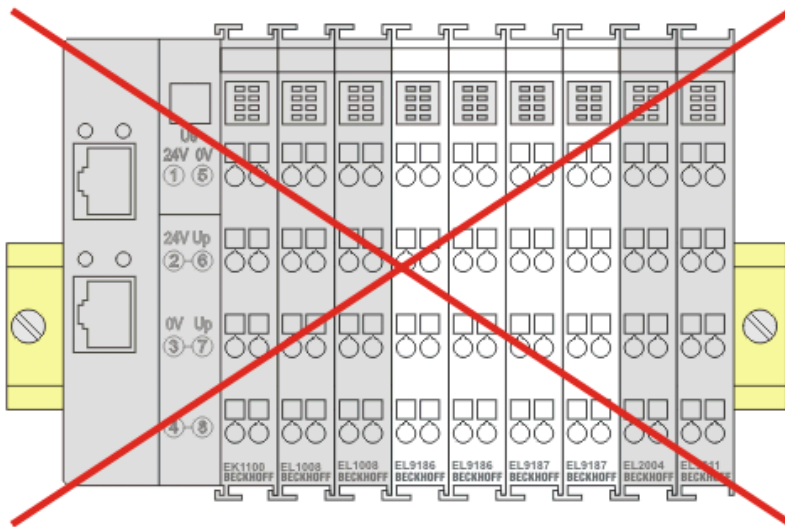
Fig. 65: Incorrect positioning

5.7   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 94/9/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 60529! The environmental conditions during use are thereby to be taken into account!
> - 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

Marking

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

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

or

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

5.8 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 94/9/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 60529! The environmental conditions during use are thereby to be taken into account! • 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

Marking

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

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

or

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

5.9 ATEX Documentation

ℹ️ **Notes about operation of the Beckhoff terminal systems in potentially explosive areas (ATEX)**

Pay also attention to the continuative documentation

Notes about operation of the Beckhoff terminal systems in potentially explosive areas (ATEX)

that is available in the download area of the Beckhoff homepage http:\\www.beckhoff.com!

5.10 UL notice

cULus	**Application** Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.
cULus	**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).
cULus	**For devices with Ethernet connectors** Not for connection to telecommunication circuits.

Basic principles

Two UL certificates are met in the Beckhoff EtherCAT product range, depending upon the components:

1. UL certification according to UL508. Devices with this kind of certification are marked by this sign:

2. 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:
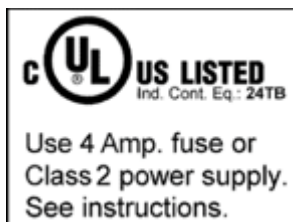
Almost all current EtherCAT products (as at 2010/05) are UL certified without restrictions.

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.

6 TwinCAT System Manager

6.1 Configuration with TwinCAT System Manager - passive terminals

EL9011, EL9070, EL9080;
EL9100, EL9150, EL9181, EL9182, EL9183, EL9184, EL9186, EL9187, EL9188, EL9189, EL9190;
EL9200, EL9250, EL9290;
EL9400;
EL9540, EL9550;
EL9570

There are no address or configuration settings necessary for the mentioned passive terminals.

7 Appendix

7.1 EtherCAT AL Status Codes

For detailed information please refer to the <u>EtherCAT system description</u>.

7.2 Firmware compatibility - passive terminals

The <u>passive terminals [▶ 83]</u> ELxxxx terminal series have no firmware to update.

7.3 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 <u>local support and service</u> on Beckhoff products!

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

You will also find further <u>documentation</u> for Beckhoff components there.

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Beckhoff Support

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

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

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Fax:	+49(0)5246/963-9157
e-mail:	support@beckhoff.com

Beckhoff Service

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

- on-site service

- repair service
- spare parts service
- hotline service

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