



Documentation

EL9xxx

EtherCAT System Terminals

BECKHOFF

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1 Overview EtherCAT System and Function terminals

EL9011 [▶ 13] (End cap)

EL9070 [▶ 15] (Shield terminal)

EL9080 [▶ 13] (Separation terminal)

EL9100 [▶ 17] (Feed terminal, 24 VDC)

EL9110 [▶ 17] (Feed terminal, 24 VDC, with diagnosis)

EL9150 [▶ 21] (Feed terminal, 230 VAC [120 VAC])

EL9160 [▶ 21] (Feed terminal, 230 VAC [120 VAC], with diagnosis)

EL9181 [▶ 24] (Potential distribution terminal, 2 separated potentials)

EL9182 [▶ 24] (Potential distribution terminal, 8 separated potentials)

EL9183 [▶ 24] (Potential distribution terminal, 1 potential, 16 terminal points)

EL9184 [▶ 27] (Potential distribution terminals, 2 x 8 channels)

EL9186 [▶ 27], EL9187 [▶ 27] (Potential distribution terminals, 8 channels)

EL9188 [▶ 27], EL9189 [▶ 27] (Potential distribution terminals, 16 channels)

EL9190 [▶ 17] (Feed terminal, up to 230 VAC)

EL9195 [▶ 33] (Shield terminal, up to 230 V AC/DC)

EL9200 [▶ 35] (Feed terminal, fused, 24 VDC)

EL9210 [▶ 35] (Feed terminal, fused, 24 VDC, with diagnosis)

EL9250 [▶ 39] (Feed terminal, fused, 230 VAC)

EL9260 [▶ 39] (Feed terminal, fused, 230 VAC, with diagnosis)

EL9290 [▶ 35] (Feed terminal, fused, up to 230 VAC)

EL9400 [▶ 42] (Power supply unit terminal for E-bus)

EL9410 [▶ 42] (Power supply unit terminal for E-bus with diagnosis)

EL9540 [▶ 45] (Surge filter field supply)

EL9550 [▶ 45] (Surge filter system and field supply)

EL9570 [▶ 49] (Buffer capacitor terminal)

2 Foreword

2.1 Notes on the documentation

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 following notes and explanations are followed when installing and commissioning these components.

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.

For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics.

In the event that it contains technical or editorial errors, we retain the right to make alterations at any time and without warning.

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

Trademarks

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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 symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

 DANGER	<p>Serious risk of injury! Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.</p>
 WARNING	<p>Risk of injury! Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.</p>
 CAUTION	<p>Personal injuries! Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.</p>
 Attention	<p>Damage to the environment or devices Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.</p>
 Note	<p>Tip or pointer This symbol indicates information that contributes to better understanding.</p>

2.3 Documentation issue status

Version	Comment
3.1	- Update chapter "Technical data" - Addenda chapter "Installation instructions for enhanced mechanical load capacity" - Update structure
3.0	- Update structure - 1 st 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
CU2008-0000-0000	CU device	2008 (8-port fast ethernet switch)	0000 (basic type)	0000
ES3602-0010-0017	ES terminal (12 mm, pluggable connection level)	3602 (2-channel voltage measurement)	0010 (high-precision version)	0017

Notes

- the elements named above make up the **technical designation**
- The **order designation**, conversely, is made up of
 - family key (EL, EP, CU, ES, KL, CX, etc.)
 - type
 - version
- The **revision** 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 website. The revision has been applied to the IP20 terminals on the outside since 2014/01, see fig. 1.
- 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

Serial number is the name generally given to the 8-digit number that is printed on the device or attached to it on a sticker. This serial number indicates the as-built status on delivery and thus ambiguously marks a whole production lot.

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

Beyond that there are some series in which each individual module has its own unique, sequential serial number.

See also the further documentation in the area

- [IP67: EtherCAT Box](#)
- [Safety: TwinSafe](#)

Examples of markings:

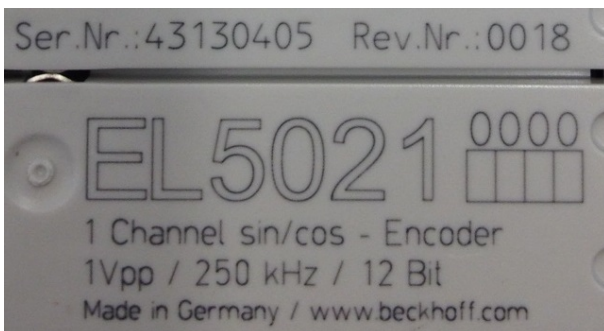


Fig. 1: EL5021 EL terminal, standard IP20 IO device with batch number and revision ID (since 2014/01)



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



Fig. 3: CU2016 switch with batch number

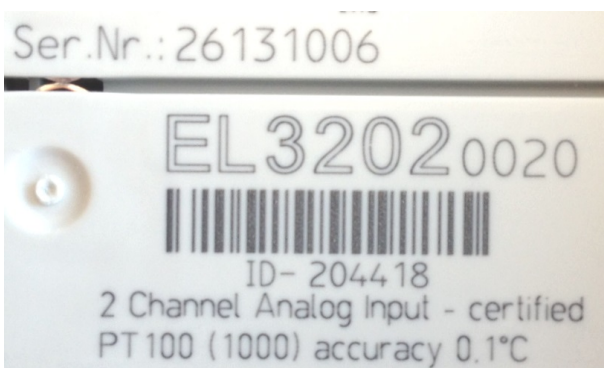


Fig. 4: EL3202-0020 with batch numbers 26131006 and unique D-number 204418

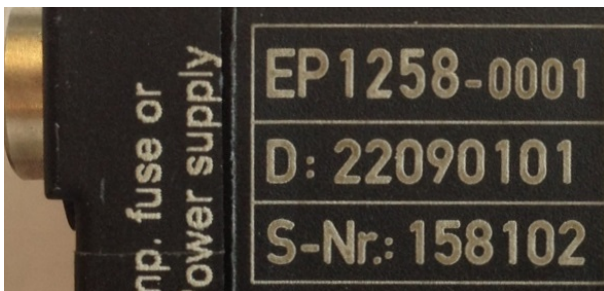


Fig. 5: EP1258-00001 IP67 EtherCAT Box with batch number 22090101 and serial number 158102

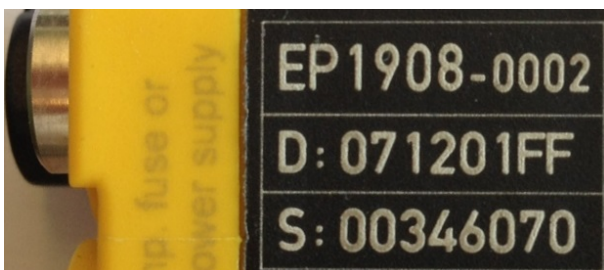


Fig. 6: EP1908-0002 IP76 EtherCAT Safety Box with batch number 071201FF and serial number 00346070

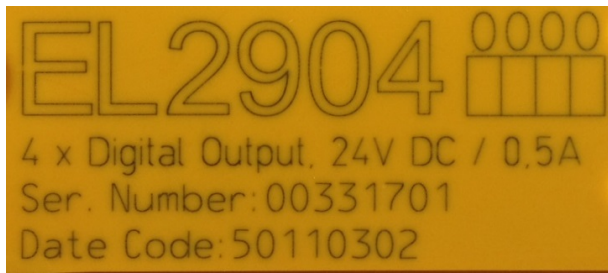


Fig. 7: EL2904 IP20 safety terminal with batch number/date code 50110302 and serial number 00331701

3 Product overview

3.1 EL9011, EL9080

3.1.1 EL9011, EL9080 - Introduction and Technical Data



Fig. 8: 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. 9: 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	EL9080
Electrical isolation	yes	
Bit width in the process image	0	
Configuration	no address or configuration settings	
Diagnosis	-	
PE contact	no	
Electrical connection to mounting rail	no	
Weight	approx. 8 g	approx. 40 g
Permissible ambient temperature	-25°C ... +60°C (extended temperature range) 0°C ... +55°C (according to cULus [▶ 74] for Canada and USA) 0°C ... +55°C (according to ATEX, see special conditions)	
Permissible ambient temperature range (during storage)	-40°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Dimensions (W x H x D)	approx. 7 mm x 100 mm x 34 mm (width aligned: 5 mm)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 60]	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 cULus [▶ 74]	

3.2 EL9070

3.2.1 EL9070 - Introduction and Technical Data

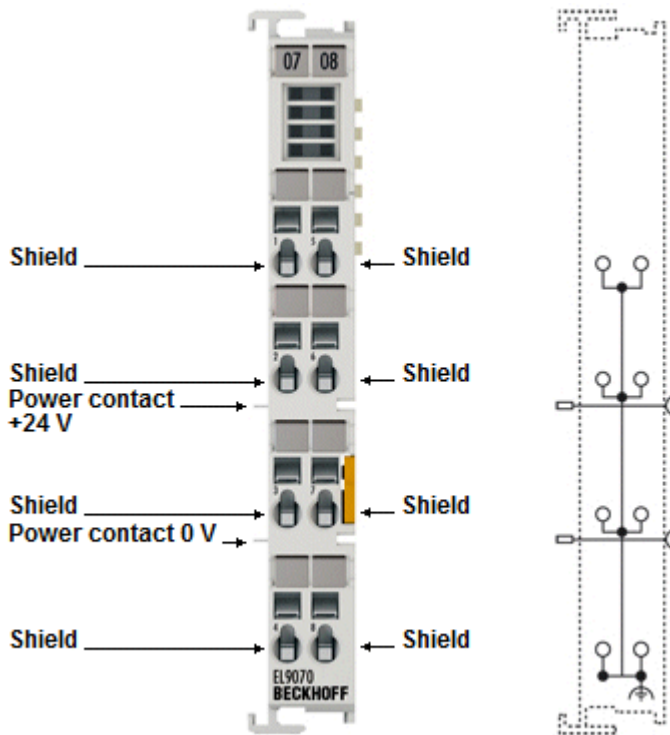


Fig. 10: EL9070

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		-
Diagnostics in the process image		-
Reported to E-bus		-
PE contact		no
Shield connection		8 x
Connection facility to additional power contact		no
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		-
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 [▶ 60]		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 [▶ 70]"
Approval		CE

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

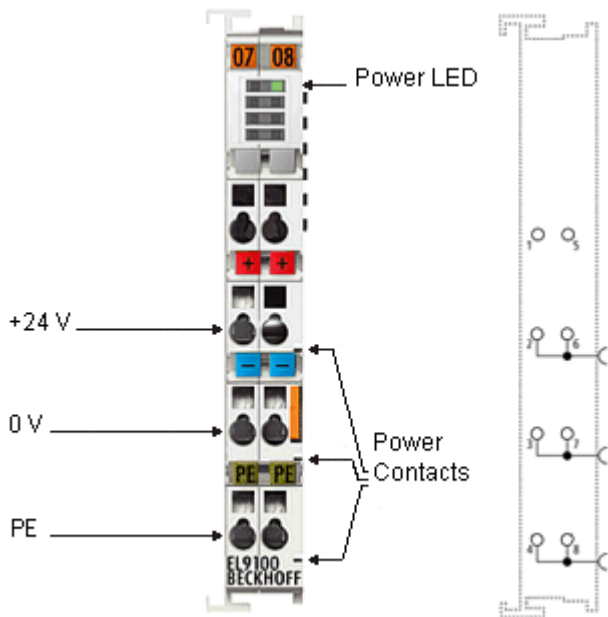


Fig. 11: EL9100

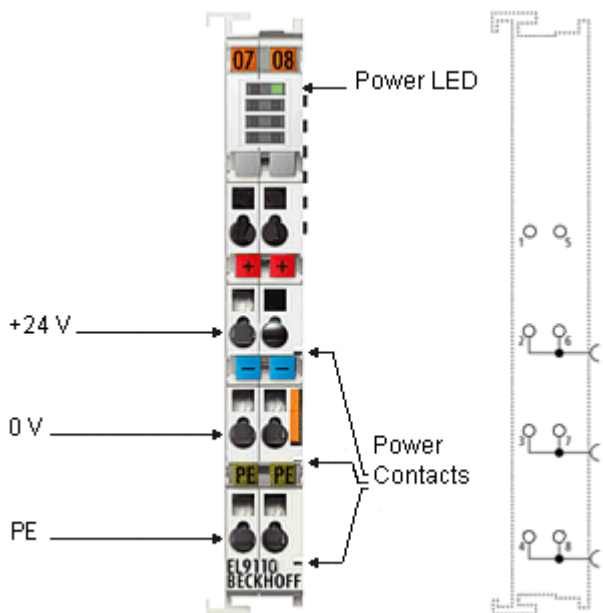


Fig. 12: EL9110

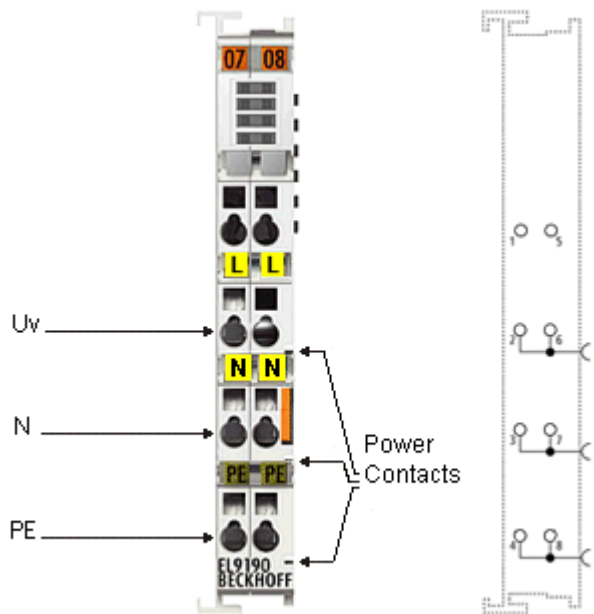



Fig. 13: EL9190

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	yes		
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		
Weight	approx. 50 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range) 0°C ... +55°C (according to cULus [▶ 74] for Canada and USA) 0°C ... +55°C (according to ATEX [▶ 71], see special conditions [▶ 71])		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 [▶ 60]	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 [▶ 63] 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 [▶ 70]"	variable	variable, see chapter "Mounting of Passive Terminals [▶ 70]"
Approval	CE ATEX [▶ 71] cULus [▶ 74]		CE cULus [▶ 74]

Connection EL9100, EL9110, EL9190

 CAUTION	<p>Hazard to individuals and devices!</p> <p>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)!</p> <p>Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!</p>
---	---

Terminal point		Description
Indication	No.	
	1	not used
+24 V* / 230 V AC**	2	Supply input + 24 V [EL9100, EL9110] Supply input 230 V AC [EL9190: variable voltage, up to 230 V AC] connected internally with terminal 6 and positive [EL9100, EL9110] resp. 230 V AC [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**	6	Supply input + 24 V [EL9100, EL9110] Supply input 230 V AC [EL9190: variable voltage, up to 230 V AC] connected internally with terminal 2 and positive [EL9100, EL9110] resp. 230 V AC [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
		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:

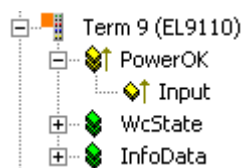


Fig. 14: EL9110 in the TwinCAT tree

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

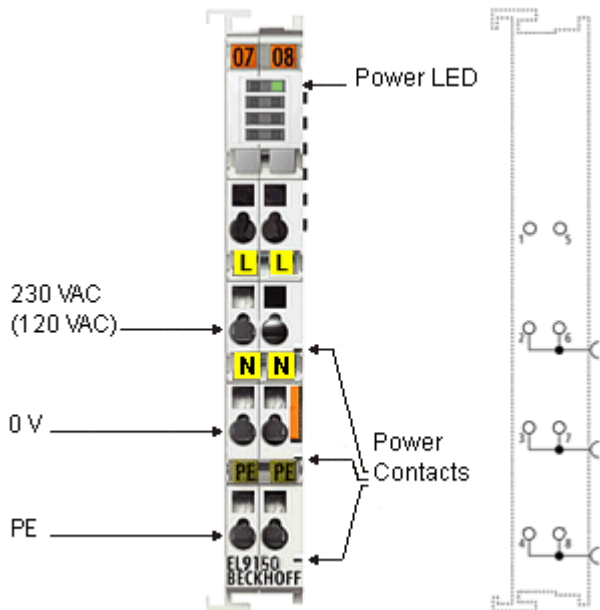


Fig. 15: EL9150

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.

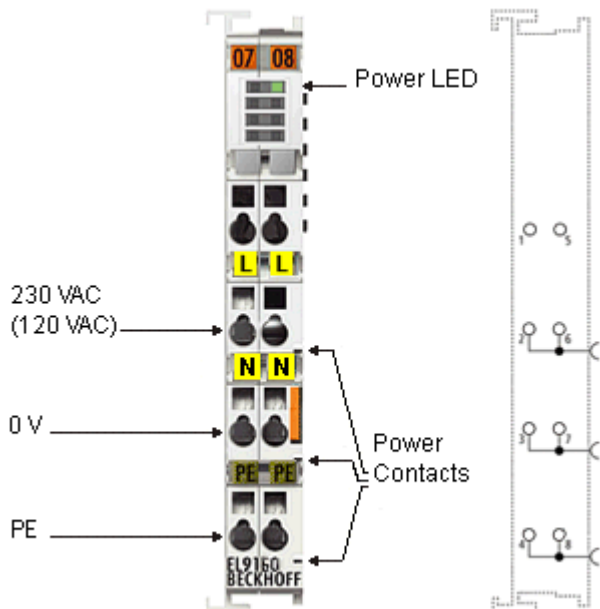



Fig. 16: EL9160

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	yes	
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	
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 [▶ 60]	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 [▶ 70]"	variable
Approval	CE ATEX [▶ 71] cULus [▶ 74]	

Connection EL9150

 CAUTION	<p>Hazard to individuals and devices!</p> <p>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)!</p> <p>Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!</p>
---	---

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:

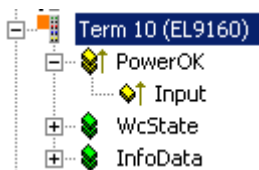


Fig. 17: EL9160 in the TwinCAT tree

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

3.5 EL9181, EL9182, EL9183

3.5.1 EL9181, EL9182, EL9183 - Introduction and Technical Data

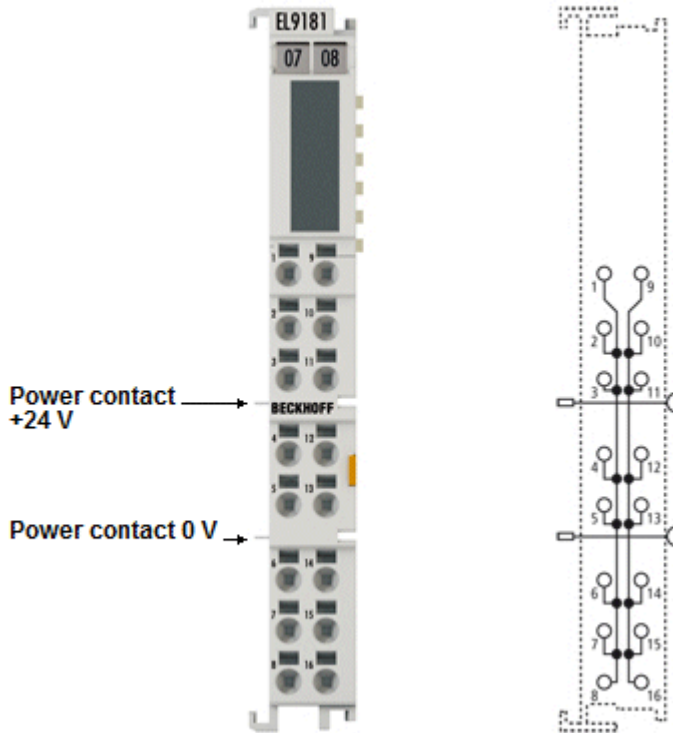


Fig. 18: EL9181

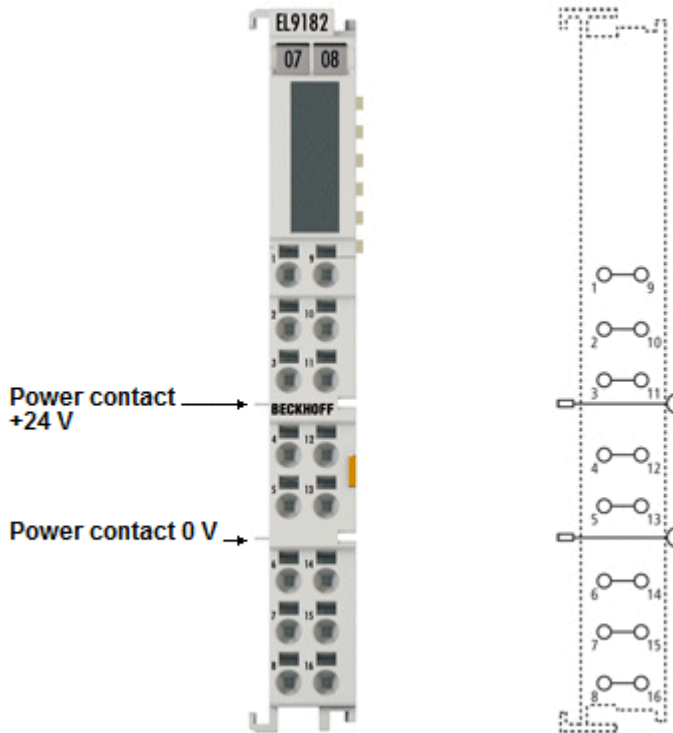


Fig. 19: EL9182

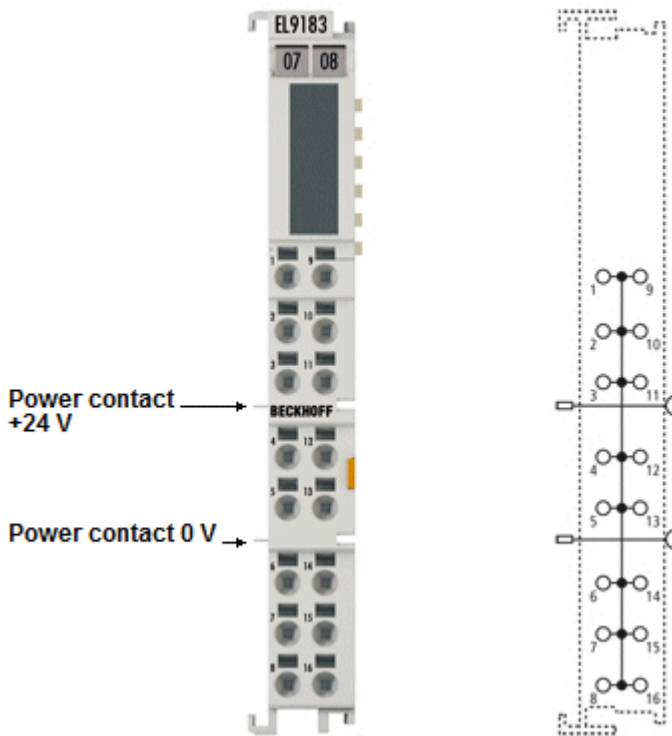


Fig. 20: EL9183

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	$\leq 60 V_{DC}$		
Current load	max. 10 A (per terminal point)		
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		
Bit width in the process image	0		
Electrical connection to mounting rail	-		
Electrical connection to power contacts	-		
Electrical isolation	-		
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 mm ² ; stranded wire: 0.25... 1.5 mm ² ; ferrule: 0.14... 0.75 mm ²		
Weight	approx.. 60 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 [► 60]	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 [► 70]"		
Approval	CE		

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

3.6 EL9184, EL9186, EL9187, EL9188, EL9189

3.6.1 EL9184, EL9186, EL9187, EL9188, EL9189 - Introduction and Technical Data

EL9186, EL9187

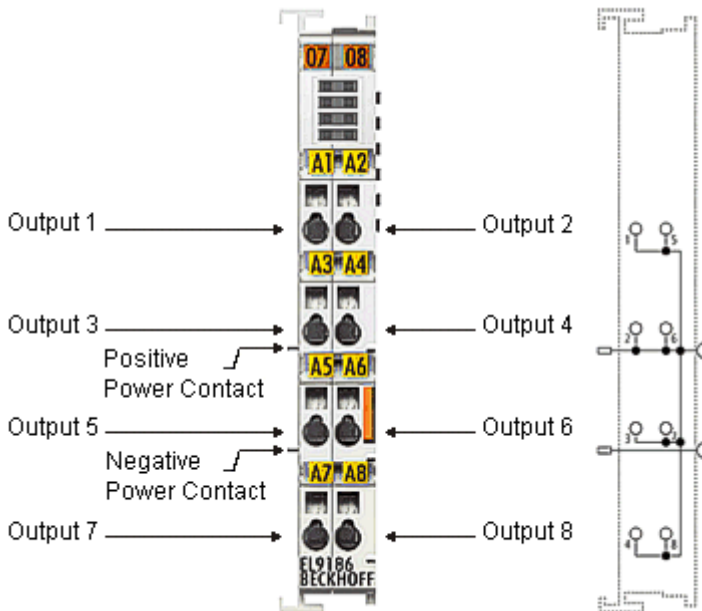


Fig. 21: EL9186

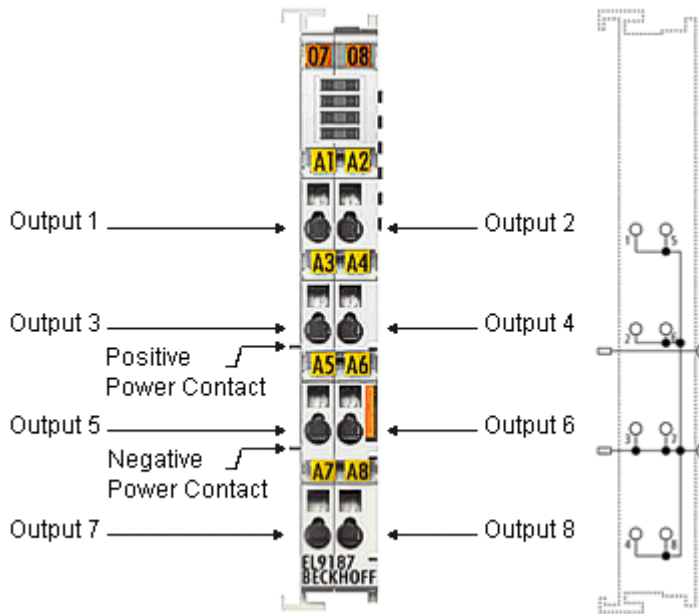


Fig. 22: EL9187

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	-	
Renewed power feed	yes	
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	-	
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.. 60 g	
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range) 0°C ... +55°C (according to cULus [▶ 74] for Canada and USA) 0°C ... +55°C (according to ATEX [▶ 71], see special conditions [▶ 71])	
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 [▶ 60]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 63] 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 [▶ 70]"	
Approval	CE ATEX [▶ 71] cULus [▶ 74]	

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

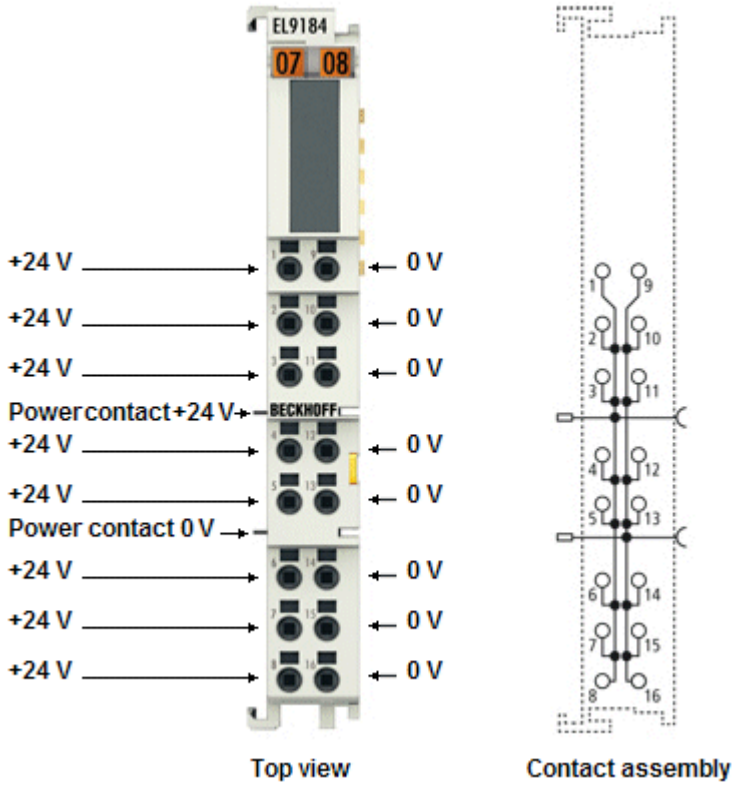


Fig. 23: EL9184

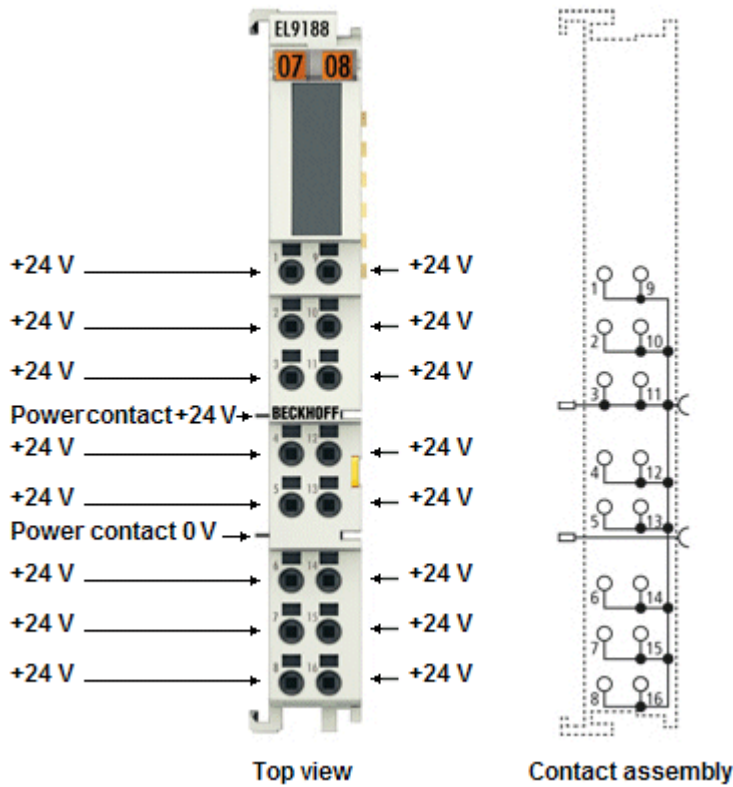


Fig. 24: EL9188

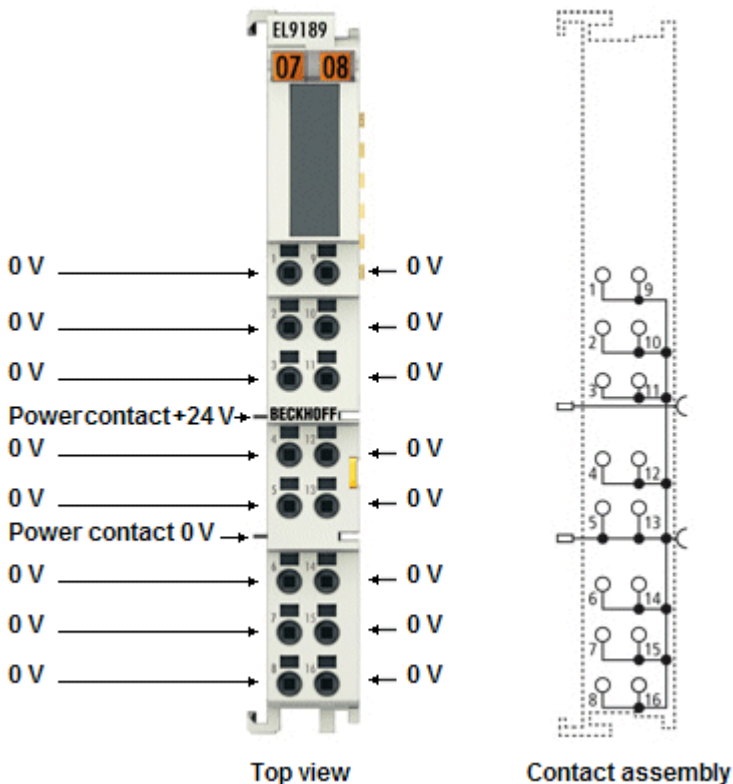


Fig. 25: EL9189

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	-		
PE contact	no		
Renewed power feed	yes		
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	-		
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 mm ² ; stranded wire: 0.25...1.5 mm ² ; ferrule: 0.14...0.75 mm ²		
Weight	approx.. 60 g		
Permissible ambient temperature range (during operation)	-25°C ... +60°C (extended temperature range) 0°C ... +55°C (according to cULus [▶ 74] for Canada and USA) 0°C ... +55°C (according to ATEX [▶ 71], see special conditions [▶ 71])		
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 [▶ 60]	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 [▶ 63] 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 [▶ 70]"		
Approval	CE ATEX [▶ 71] cULus [▶ 74]		

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)

Connection EL9189

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

3.7 EL9195

3.7.1 EL9195 - Introduction and Technical Data

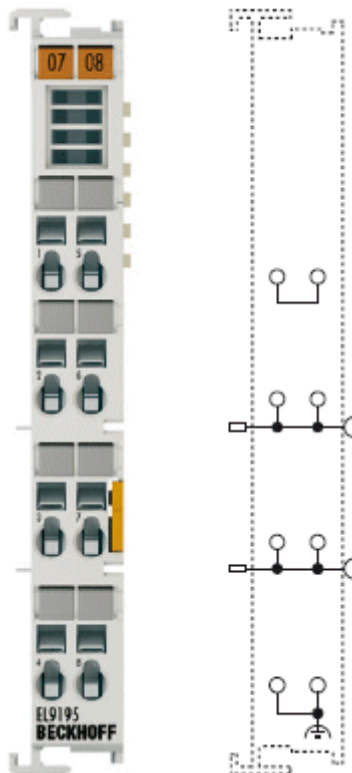



Fig. 26: EL9195

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	-
Diagnosis	-
Reported to E-bus	-
Power contact	2 x power contact
PE 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 [▶ 60]	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 [▶ 70]"
Approval	CE ATEX [▶ 71] cULus [▶ 74]

Connection EL9195

 CAUTION	<p>Hazard to individuals and devices!</p> <p>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)!</p> <p>Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!</p>
---	---

Terminal point No.	Description
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)

3.8 EL9200, EL9210, EL9290

3.8.1 EL9200, EL9210, EL9290 - Introduction and Technical Data

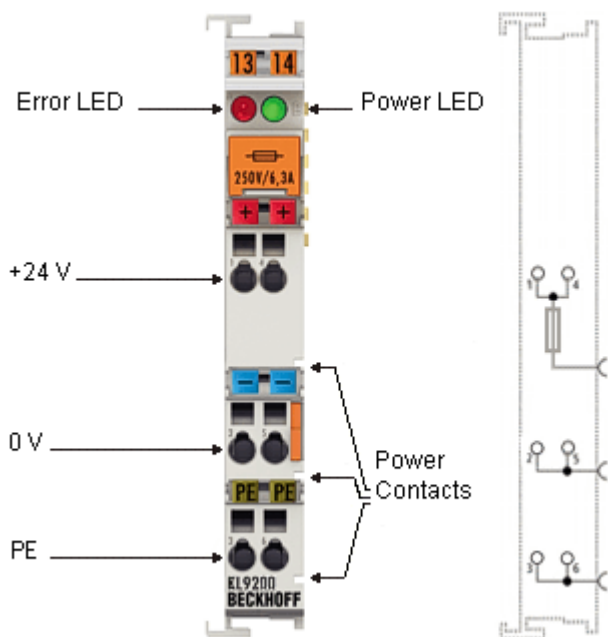


Fig. 27: EL9200

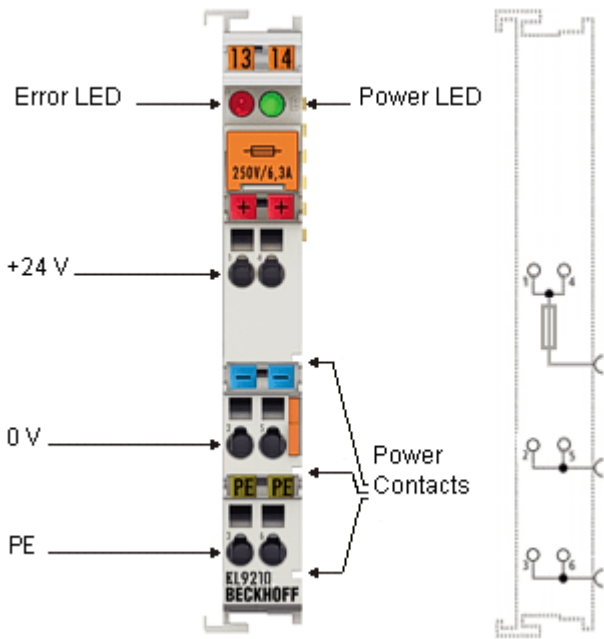


Fig. 28: EL9210

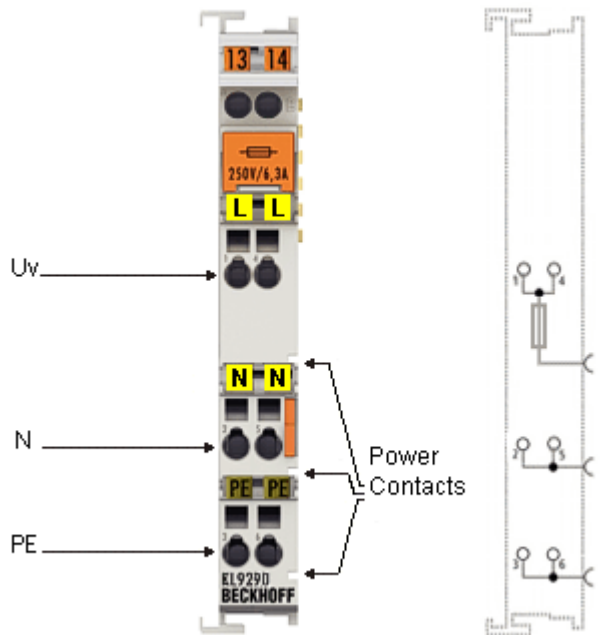



Fig. 29: EL9290

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.

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	yes		
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		
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 [▶ 60]	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 [▶ 70]"	variable	variable, see chapter "Mounting of Passive Terminals [▶ 70]"
Approval	CE ATEX [▶ 71] cULus [▶ 74]		CE

Connection EL9200, EL9210, EL9290

 CAUTION	<p>Hazard to individuals and devices!</p> <p>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)!</p> <p>Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!</p>
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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:

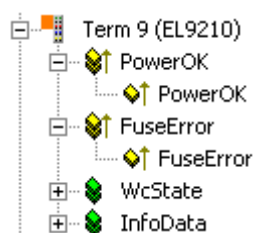


Fig. 30: EL9210 in the TwinCAT tree

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.

3.9 EL9250, EL9260

3.9.1 EL9250, EL9260 - Introduction and Technical Data

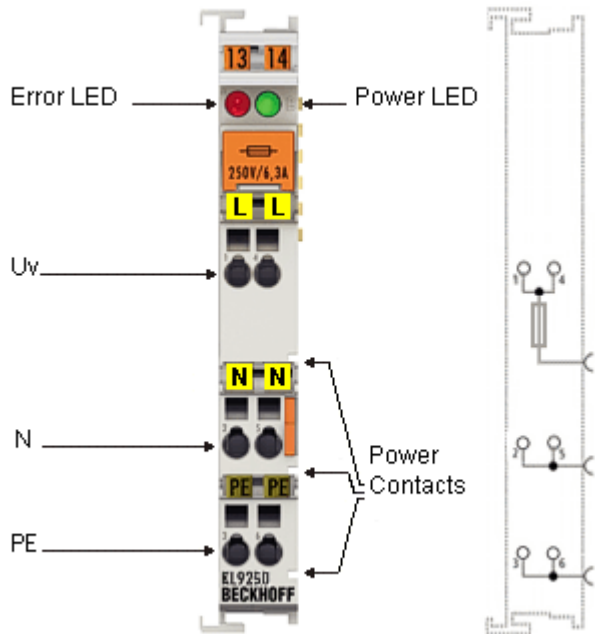


Fig. 31: EL9250

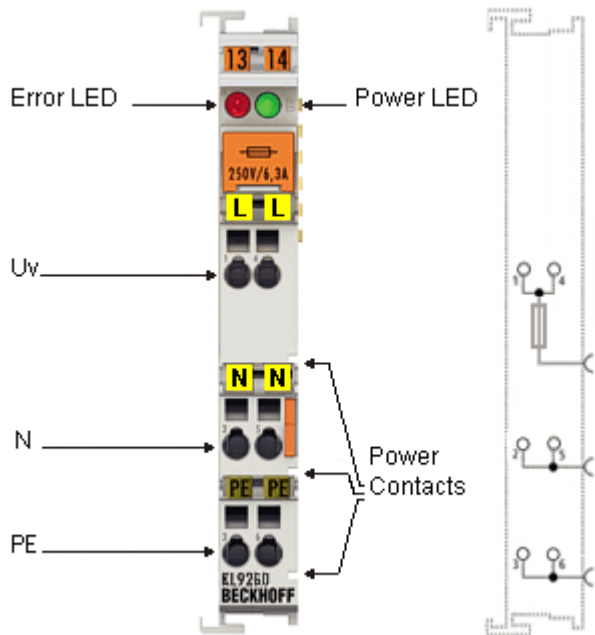



Fig. 32: EL9260

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	yes	
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	
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 [▶ 60]	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 [▶ 70]"	variable
Approval	CE	

Connection EL9250, EL9260

 CAUTION	<p>Hazard to individuals and devices!</p> <p>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)!</p> <p>Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!</p>
---	---

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)

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:

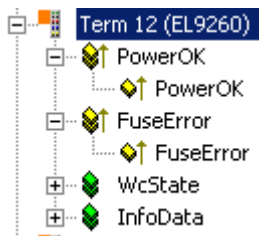


Fig. 33: EL9260 in the TwinCAT tree

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.

3.10 EL9400, EL9410

3.10.1 EL9400, EL9410 - Introduction and Technical Data

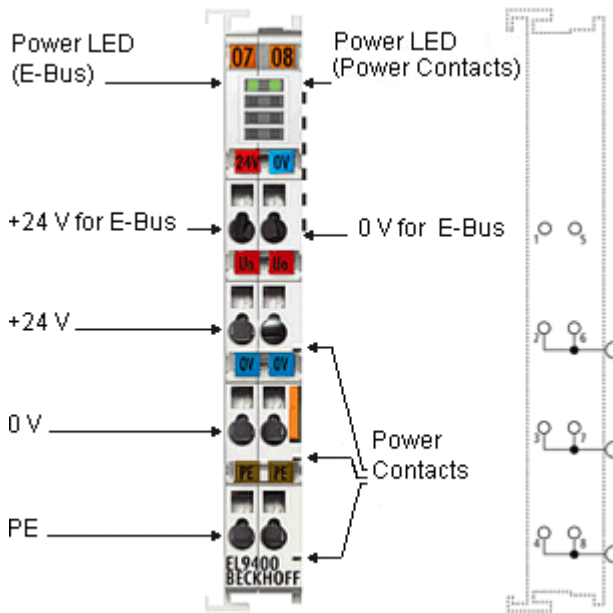


Fig. 34: EL9400

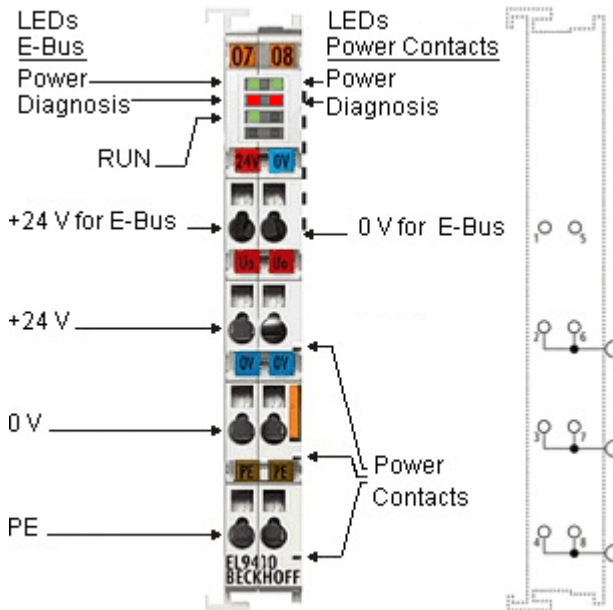


Fig. 35: EL9410

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	yes	
Diagnosis	no	yes, via LED and in the process image
Electrical connection to mounting rail	no	
PE 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 [▶ 60]	on 35 mm mounting rail conforms to EN 60715	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	conforms to EN 60068-2-6/EN 60068-2-27, see Installation instructions [▶ 63] 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 [▶ 70]"	variable
Approval	CE ATEX [▶ 71] cULus [▶ 74]	

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	
		LED state	Meaning
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:

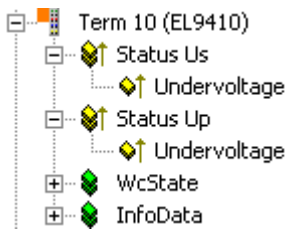


Fig. 36: EL9110 in the TwinCAT tree

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

3.11 EL9540, EL9550

3.11.1 EL9540, EL9550 - Introduction and Technical Data

EL9540, EL9550

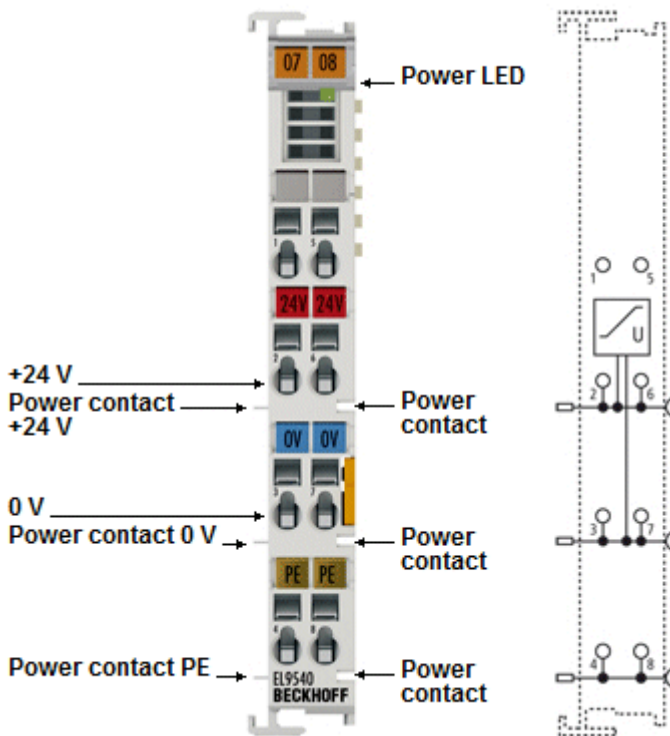


Fig. 37: EL9540

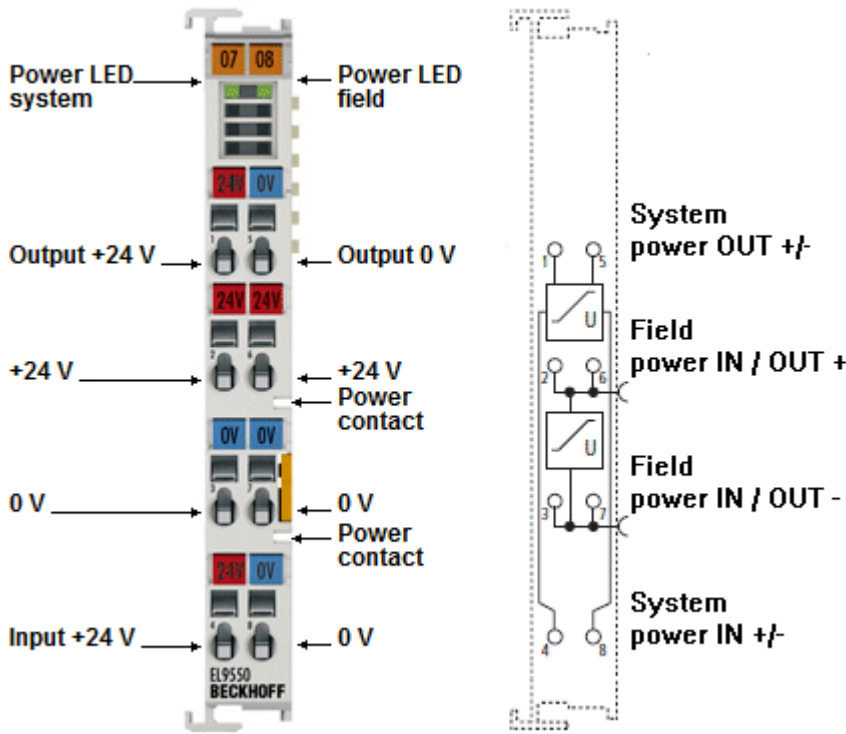


Fig. 38: EL9550

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 disturbances such as switching overvoltages at inductive consumers or lightning strikes at the supply lines.

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
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
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	-	
Side by side mounting on EtherCAT Terminals with power contact	yes	-
Side by side mounting on EtherCAT 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) 0°C ... +55°C (according to cULus [▶ 74] for Canada and USA) 0°C ... +55°C (according to ATEX [▶ 71], see special conditions [▶ 71])	
Permissible ambient temperature range (during storage)	-40°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Mounting [▶ 60]	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 [▶ 70]"	
Approval	CE ATEX [▶ 71] cULus [▶ 74]	

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

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

3.12 EL9570

3.12.1 EL9570 - Introduction and Technical Data

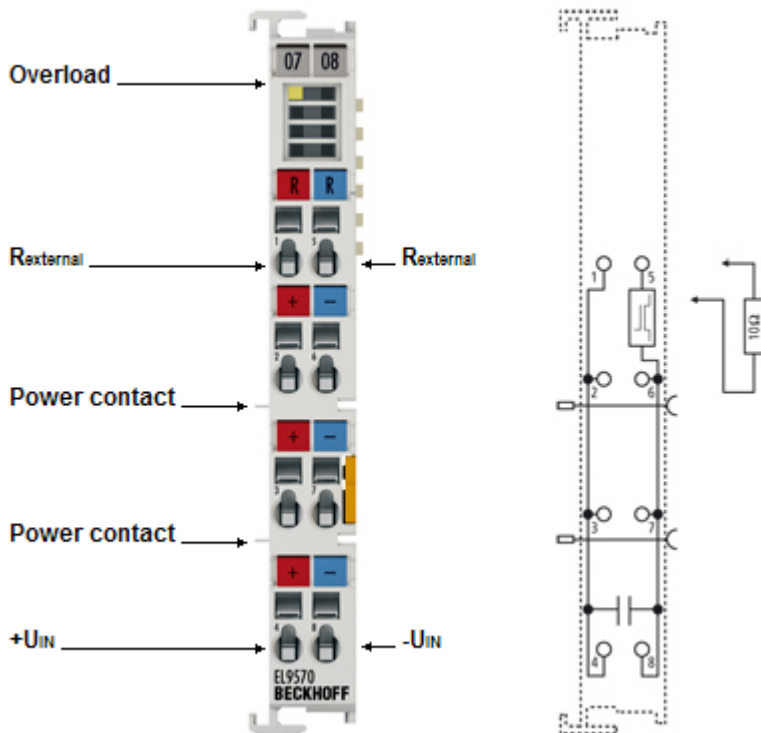


Fig. 39: EL9570

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 μ F
Ripple current	10 A in continuous operation
Internal resistance	< 10 m Ω
Surge voltage protection	> 56 V
Recommended ballast resistor	10 Ω , 10 W typ.
Overvoltage control range	\pm 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	-
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 [► 60]	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 [► 70]"
Approval	CE ATEX [► 71]

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
$+U_{\text{IN}}$	2	Positive input for buffer voltage (internally connected with terminal point 3 and 4)
$+U_{\text{IN}}$	3	Positive input for buffer voltage (internally connected with terminal point 2 and 4)
$+U_{\text{IN}}$	4	Positive input for buffer voltage (internally connected with terminal point 2 and 3)
R_{external}	5	Connection for ballast resistor
$-U_{\text{IN}}$	6	Negative input for buffer voltage (internally connected with terminal point 7 and 8)
$-U_{\text{IN}}$	7	Negative input for buffer voltage (internally connected with terminal point 6 and 8)
$-U_{\text{IN}}$	8	Negative input for buffer voltage (internally connected with terminal point 6 and 7)

3.12.2 Application example

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

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.

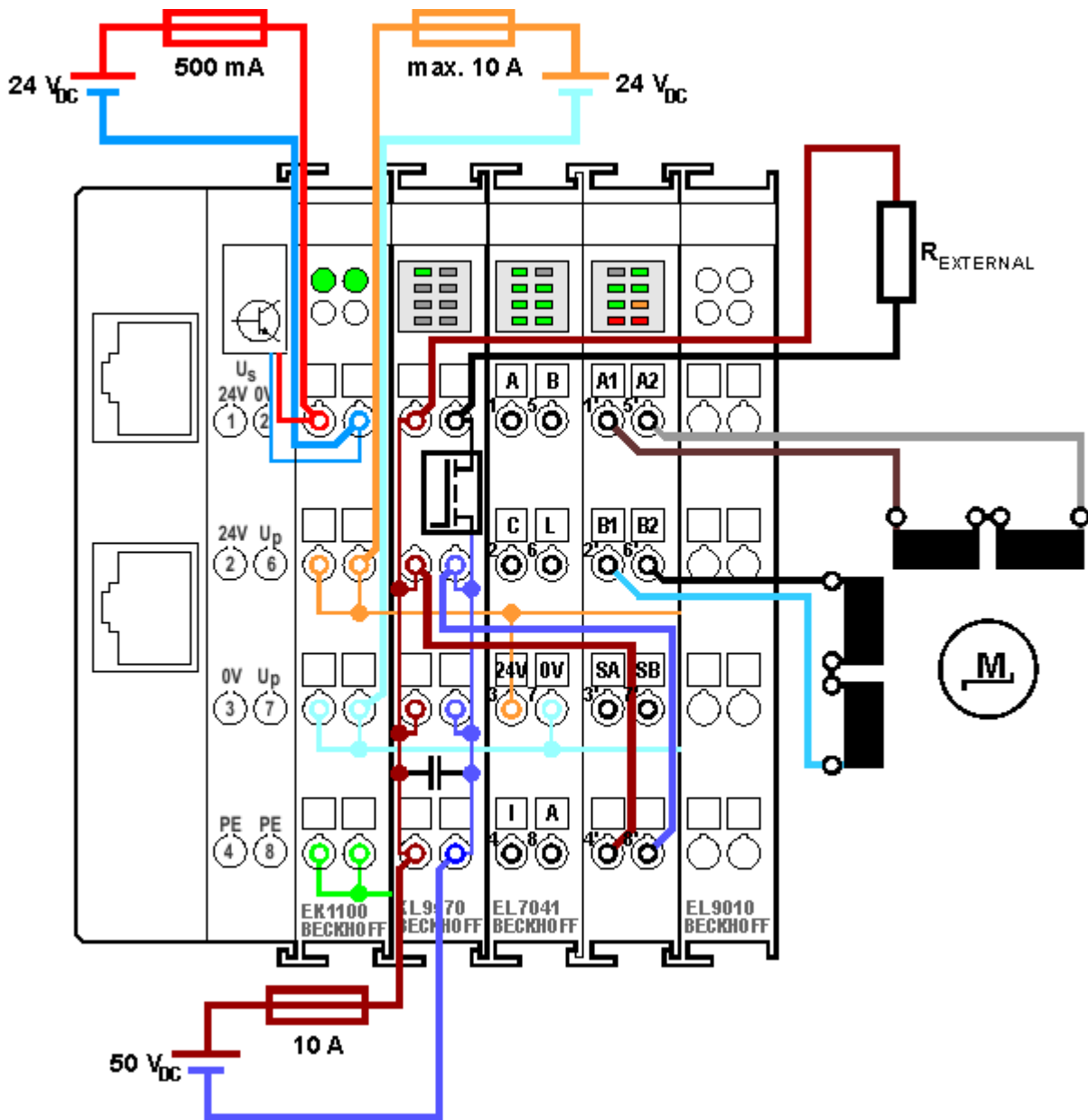




Fig. 40: Application example EL9570

 Note	<p>More motors</p> <p>A capacitor EL9570 terminal is able to condition the power supply of several motors.</p>
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 Attention	<p>Dimensioning of the brake resistor</p> <p>The brake resistor R_{EXTERNAL} (typically 10 Ω) should be dimensioned in that way, that it can stand the expected heat without damage!</p>
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4 Basics communication

4.1 EtherCAT basics

Please refer to the chapter [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.



Note

Recommended cables

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 2A 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.

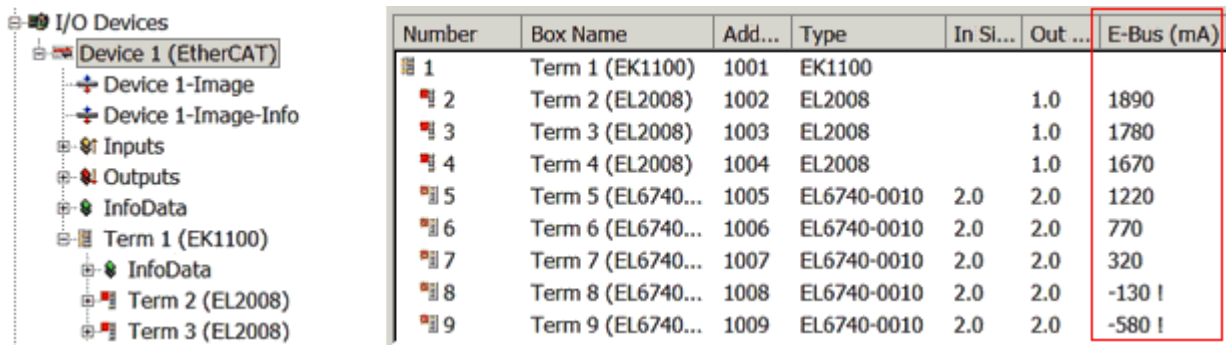



Fig. 41: System manager current calculation



Attention

Caution! 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.

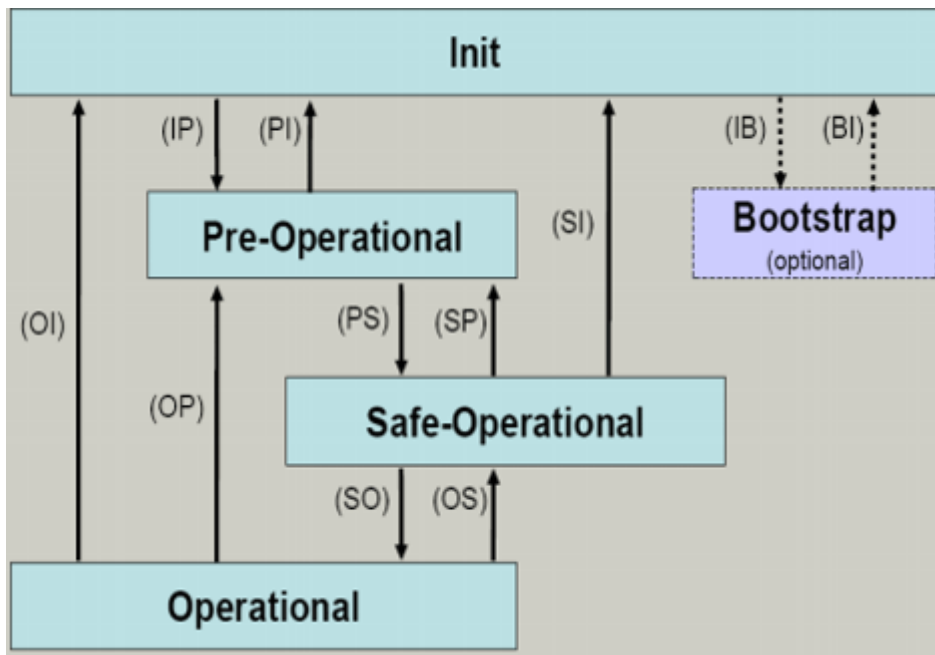


Fig. 42: States of the EtherCAT State Machine

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.



Note

Outputs in SAFEOP state

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: 0...65535
- SubIndex: 0...255


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

The relevant ranges for EtherCAT fieldbus users are:

- x1000: 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.
- x8000: This is where the operational and functional parameters for all channels are stored, such as filter settings or output frequency.

Other important ranges are:

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

 Note	<p>Availability</p> <p>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..</p>
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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:

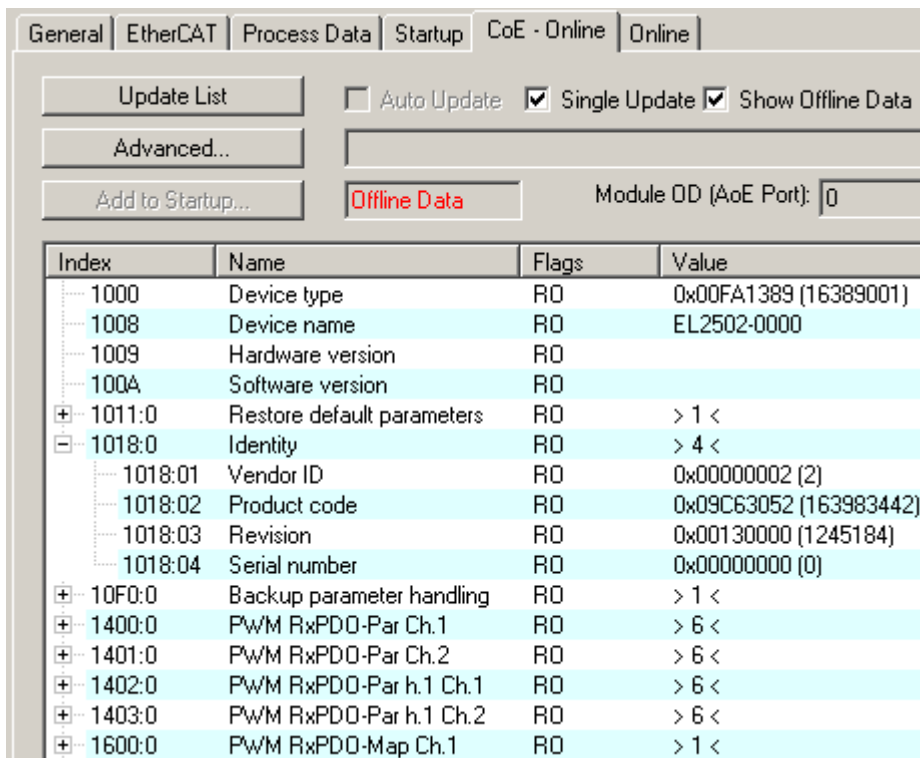


Fig. 43: "CoE Online " tab

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


Data management


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. 1) 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.

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.

 Note	<p>Data management</p> <ul style="list-style-type: none"> ✓ Data management function a) 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. b) Function is not supported: continuous changing of CoE values is not permissible in view of the lifetime limit.
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 Note	<p>Startup list</p> <p>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 parameterised with the specifications of the user.</p> <p>If EtherCAT slaves are used which are unable to store local CoE values permanently, the Startup list must be used.</p>
--	--

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.

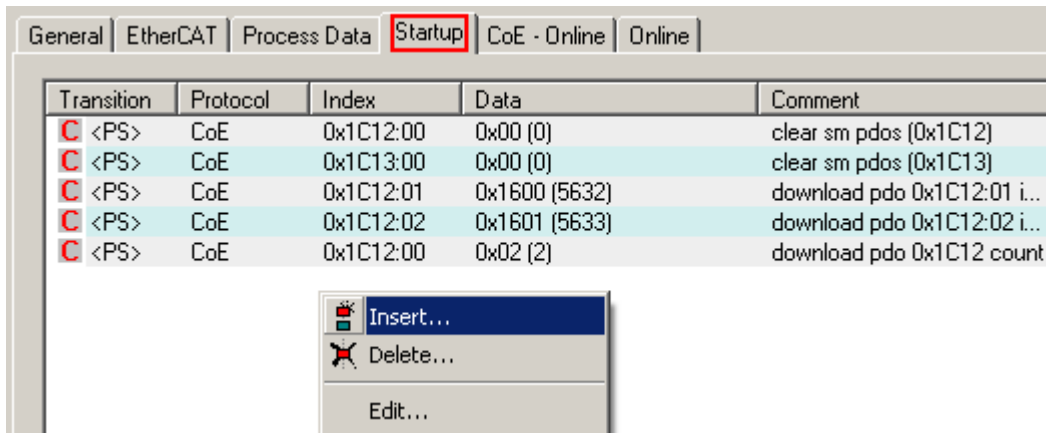


Fig. 44: Startup list in the TwinCAT System Manager

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.

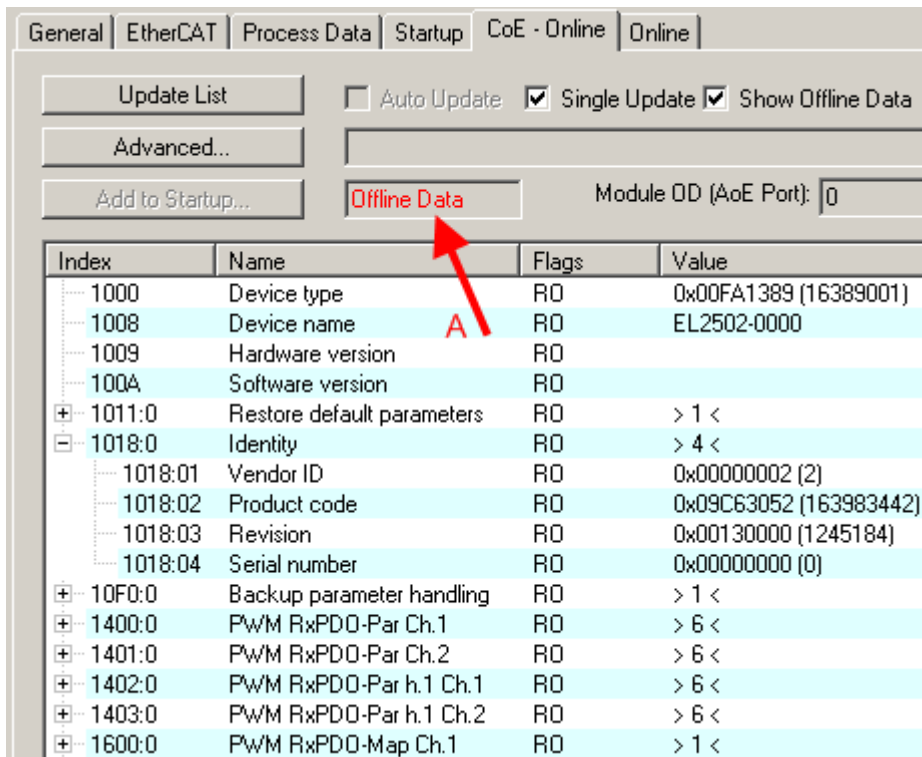


Fig. 45: Offline list

- 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.

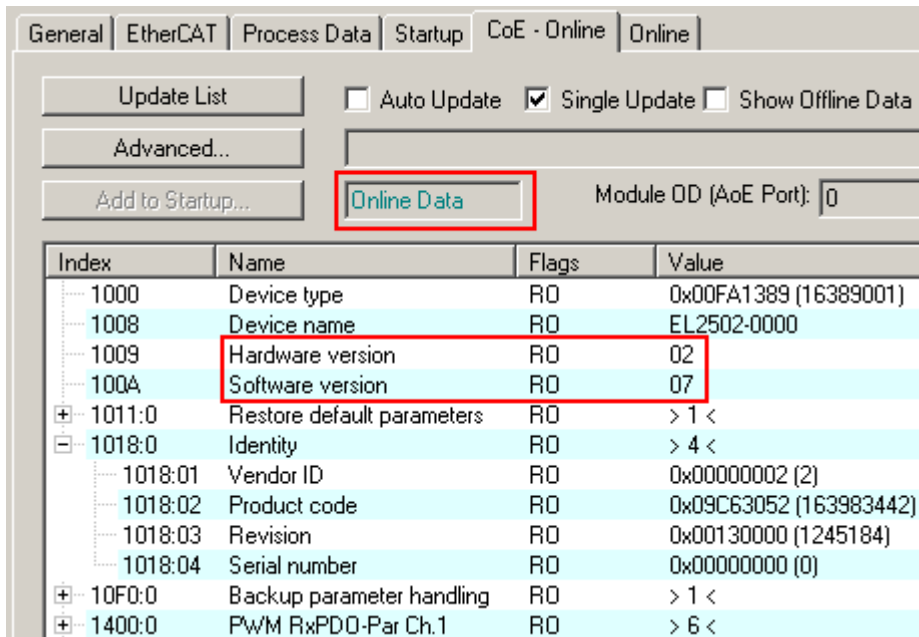


Fig. 46: Online list

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 x8000 exemplifies this:

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

This is generally written as x80n0.

Detailed information on the CoE interface can be found in the [EtherCAT system documentation](#) on the Beckhoff website.

5 Mounting and wiring

5.1 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

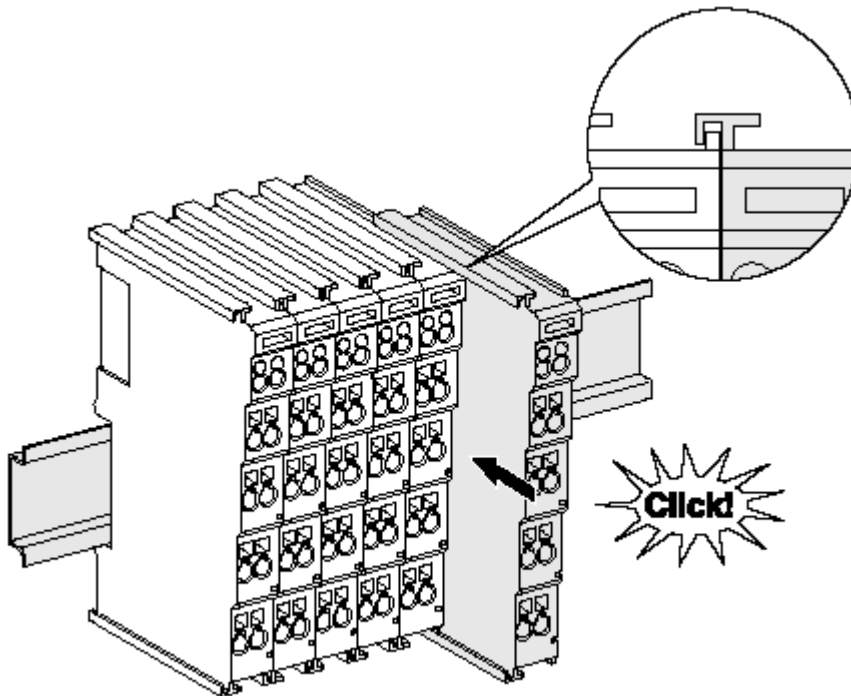


Fig. 47: Attaching on mounting rail

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.



Note

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

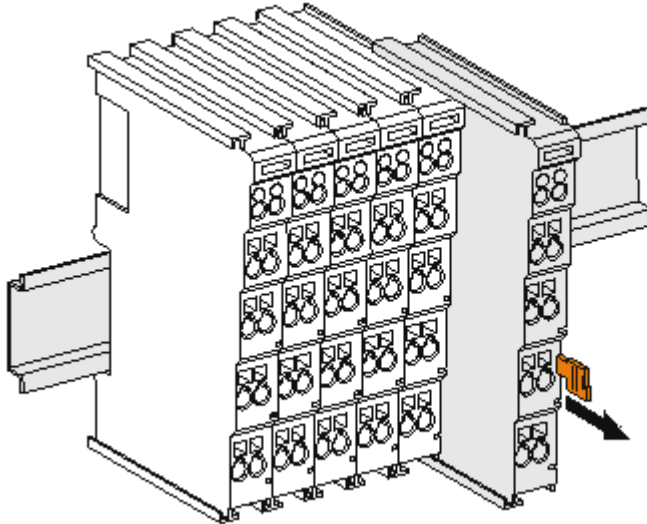


Fig. 48: Disassembling of terminal

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.



Note

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.

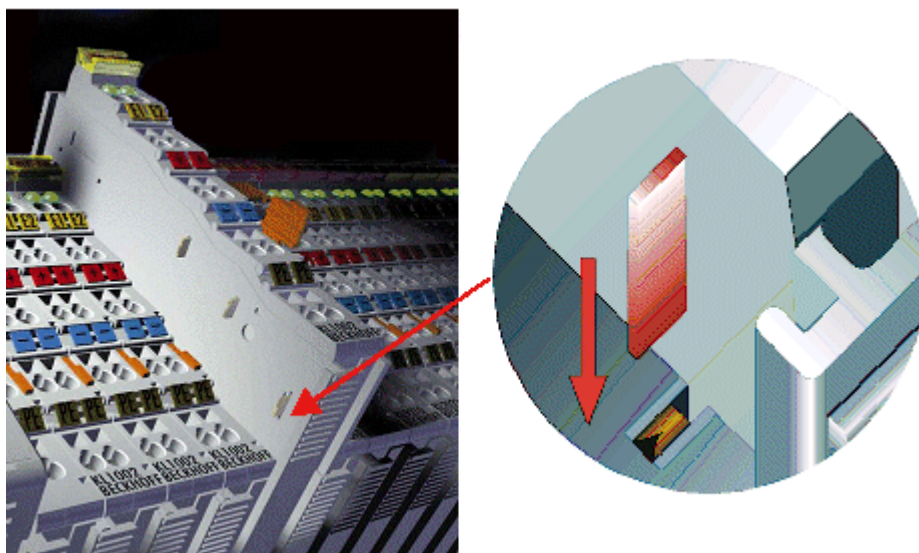





Fig. 49: Power contact on left side

 <p>Attention</p>	<p>Possible damage of the device</p> <p>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.</p>
 <p>WARNING</p>	<p>Risk of electric shock!</p> <p>The PE power contact must not be used for other potentials!</p>

5.2 Installation instructions for enhanced mechanical load capacity

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

- Any installation position is permitted
- 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.

5.3 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. 50: 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. 51: 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 mm² and 2.5 mm² 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. 52: 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.

 Note	<p>Wiring HD Terminals</p> <p>The High Density (HD) Terminals of the KLx8xx and ELx8xx series doesn't support steady wiring.</p>
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Ultrasonically "bonded" (ultrasonically welded) conductors

 Note	<p>Ultrasonically "bonded" conductors</p> <p>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 [▶ 66] below!</p>
--	---

Wiring

Terminals for standard wiring ELxxxx / KLxxxx and terminals for steady wiring ESxxxx / KSxxxx

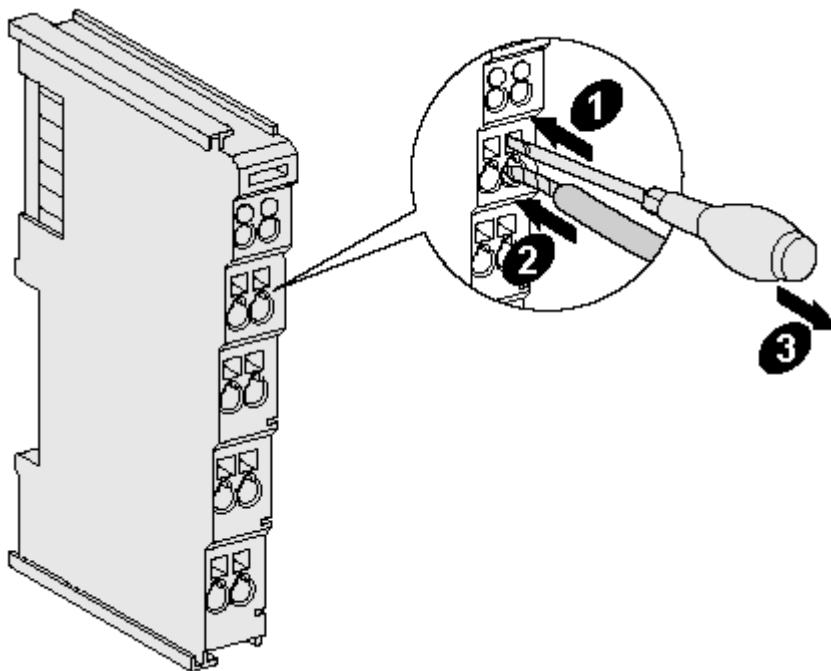


Fig. 53: Mounting a cable on a terminal connection

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 [▶ 65]!)
Wire stripping length	8 ... 9 mm

Shielding



Note

Shielding

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

5.4 Installation positions



Attention

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.

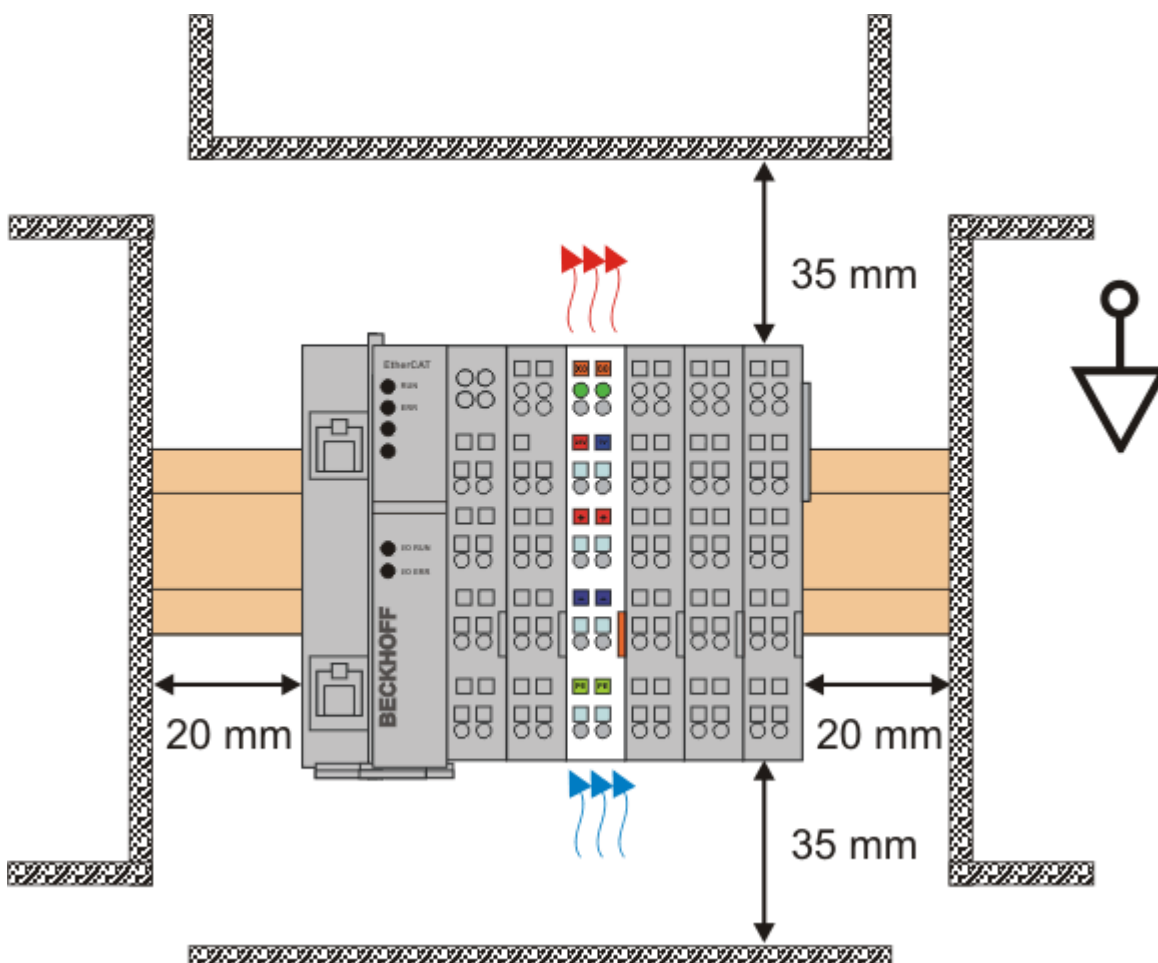


Fig. 54: Recommended distances for standard installation position

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.

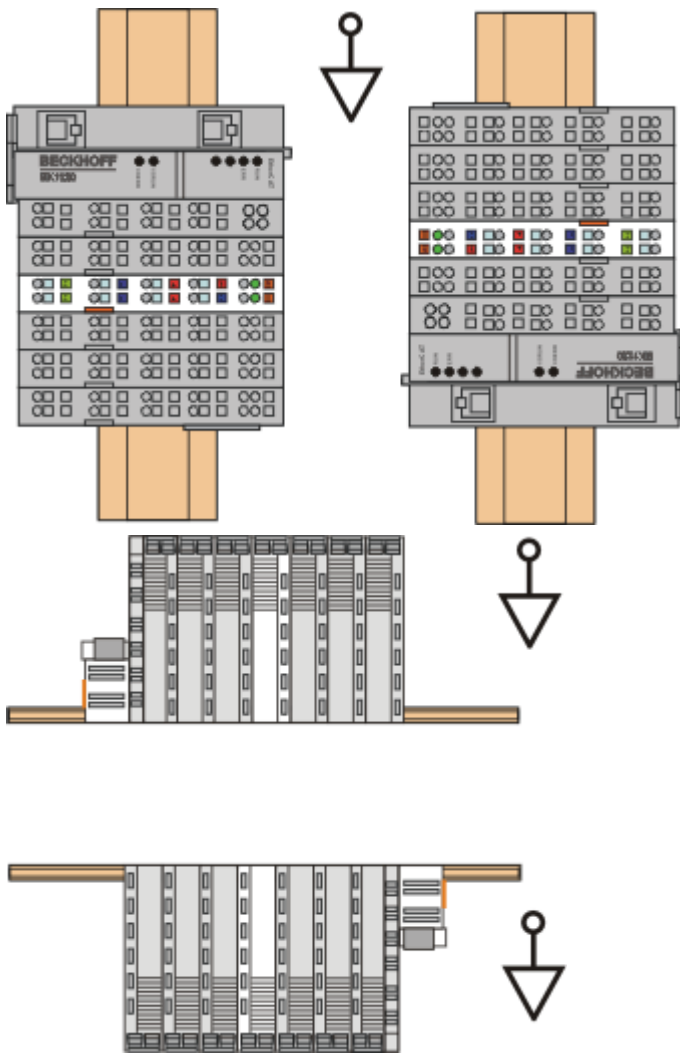


Fig. 55: Other installation positions

5.5 Mounting of Passive Terminals



Note

Hint for mounting passive terminals

EtherCAT Bus 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 mounting passive terminals (highlighted)

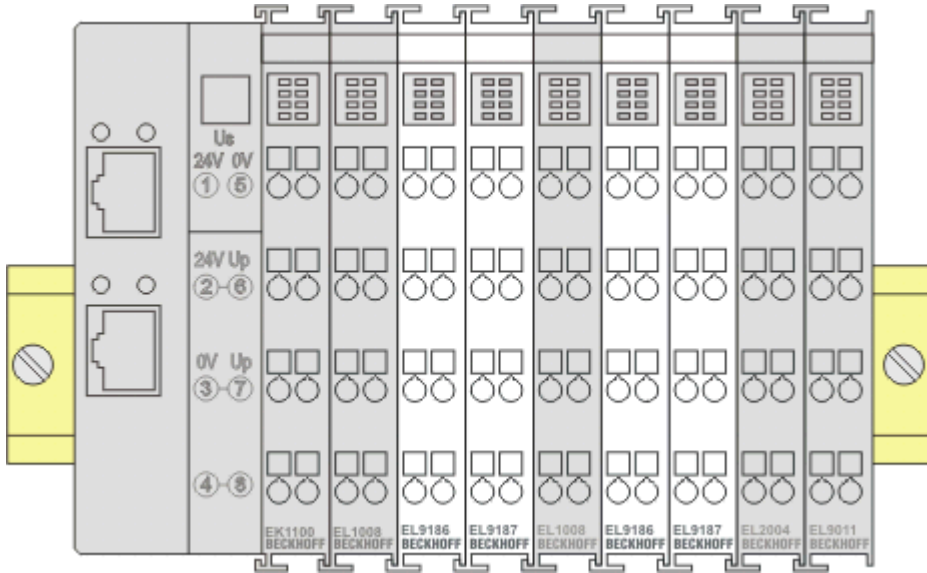


Fig. 56: Correct configuration

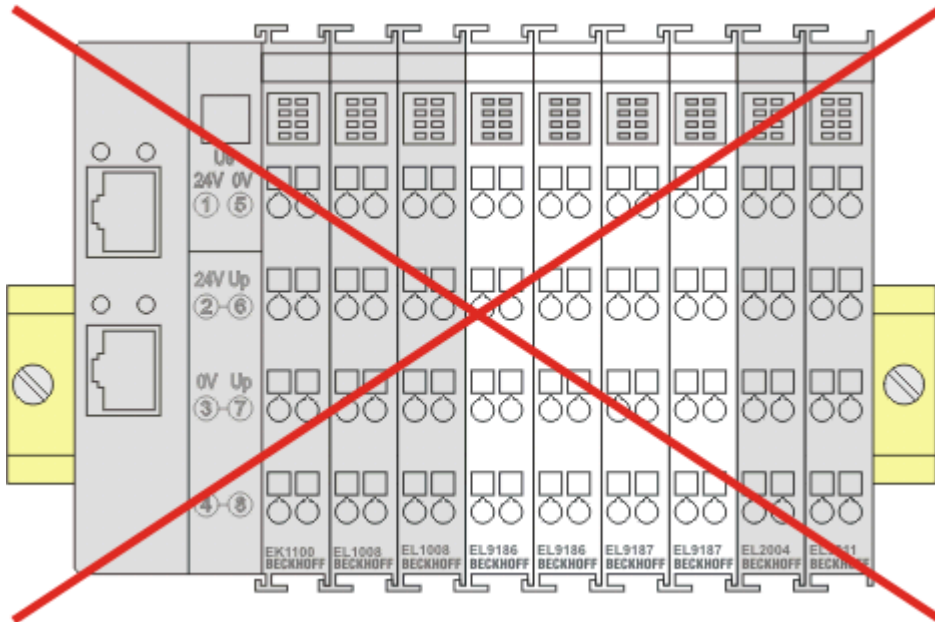


Fig. 57: Incorrect configuration

5.6 ATEX - Special conditions



WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas (directive 94/9/EU)!

✓ Conditions

- a) 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!
- b) 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!
- c) Observe the permissible ambient temperature range of 0 - 55°C for the use of Beckhoff fieldbus components in potentially explosive areas!
- d) Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- e) 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!
- f) 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!
- g) The fuses of the KL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- h) 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: 2006
- EN 60079-15: 2005

Marking

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



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

or



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

Serial number

The Beckhoff fieldbus components bear a serial number that is structured as follows:

WW YY FF HH

WW - week of production (CW, calendar week)

YY - year of production

FF - firmware version

HH - hardware version

Example with ser. no.: 35 04 1B 01:

35 - week of production 35

04 - year of production 2004

1B - firmware version 1B

01 - hardware version 01

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 UL notice

	<p>Application Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.</p>
---	--

	<p>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).</p>
---	---

	<p>For devices with Ethernet connectors Not for connection to telecommunication circuits.</p>
---	--

Basic principles

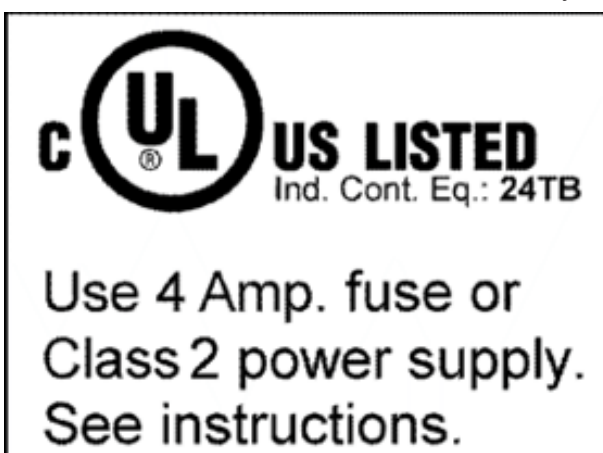
Two UL certificates are met in the Beckhoff EtherCAT product range, depending upon the components:

- UL certification according to UL508
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.

- 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. 4A (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.

7.2 Firmware compatibility - passive terminals

The EL9xxx terminal series has no firmware to update.

7.3 ATEX Documentation



Note

Notes about operation of the Bus Terminal System in potentially explosive areas (ATEX)

Pay also attention to the continuative documentation Notes about operation of the Bus Terminal System in potentially explosive areas (ATEX) that is available in the download area of the Beckhoff homepage <http://www.beckhoff.com>!

7.4 EtherCAT AL Status Codes

7.4.1 Error Code 0x0000

Meaning

No error

Description

No error

Current State (or state change)

Any

Resulting state

Current state

Solution

n/a

7.4.2 Error Code 0x0001

Meaning

Unspecified error

Description

No error code is defined for occurred error

Current State (or state change)

Any

Resulting state

Any + E

Solution

Read user manual or contact device manufacturer

7.4.3 Error Code 0x0002**Meaning**

No Memory

Description

Less hardware memory, slave needs more memory.

Example: For slave configuration, application configuration files are downloaded (possibly via FoE or large CoE objects). The size of those files exceeds the local memory

Current State (or state change)

Any

Resulting state

Any + E

Solution

Download smaller files or objects.

Check user manual.

7.4.4 Error Code 0x0011**Meaning**

Invalid requested state change

Description

The EtherCAT State Machine (ESM) defines which state changes are allowed. All other state changes are not allowed

Example: If the master requests the slave to go from OP (AL Control = 0x08) directly to BOOT (AL Control = 0x03).

Current State (or state change)

P→S, I→O, P→O, O→B, S→B, P→B

Resulting state

Current State + E

Solution

Go step-by-step from the original state to the desired state.

7.4.5 Error Code 0x0012

Meaning

Unknown requested state change

Description

The ESM defines the following states. They are coded with fixed values (only lower (=right) nibble):

BOOT: AL Control = 0x03

INIT: AL Control = 0x01

PREOP: AL Control = 0x02

SAFEOP: AL Control = 0x04

OP: AL Control = 0x08

The fifth bit of the AL Control (left nibble is 1) is the "Error Acknowledge Bit". If the slave is in AL STATUS = 0x14, i.e. ERROR SAFEOP the master acknowledges this by setting the Acknowledge bit.

Example: If any other value for AL Control than those specified are sent.

Current State (or state change)

Any

Resulting state

Current State + E

Solution

Do only request the defined states

7.4.6 Error Code 0x0013

Meaning

Boot state not supported

Description

Device does not support BOOT state, but the master requests the slave to go to BOOT (AL Control = 0x03)

Current State (or state change)

I→B

Resulting state

I + E

Solution

n/a

7.4.7 Error Code 0x0014

Meaning

No valid firmware

Description

This error code may be returned after a firmware download, if the downloaded file cannot be used by the application controller

Current State (or state change)

I→P

Resulting state

I + E

Solution

Download a firmware that can be supported by the hardware and bootloader. Check Product Code and Revision Number (CoE object 0x1018). If this cannot be read from the firmware any more you may see this in the network configuration (CoE object dictionary) or probably in the ESI file (element Profile: ObjectDictionary:Objects:Object).

7.4.8 Error Code 0x0015

Meaning

Invalid mailbox configuration

Description

Mailbox communication (= acyclic parameter exchange) is done via two memory areas on the EtherCAT Slave Controller (ESC) – the “Output Mailbox” (master -> slave) and the “Input Mailbox” (slave-> master). Those memory areas are protected by SyncManagers to prevent from simultaneous access from master and slave controller at the same time. SyncManagers are hardware entities on the ESC. They are configured via certain registers in the ESC register area (starting at 0x0800). The configuration includes start address, length, and direction (output or input). If those settings differ from those expected by the host controller of the slave this error is returned

Current State (or state change)

I→B

Resulting state

n/a

Solution

Replace previous network description of old slave with the one of the new slave

7.4.9 Error Code 0x0016

Meaning

Invalid mailbox configuration

Description

Example: The slave hardware was replaced while the network configuration remained unchanged. The new hardware expects different mailbox SyncManager settings

Current State (or state change)

I→S

Resulting state

I + E

Solution

Replace previous network description of old slave with the one of the new slave

7.4.10 Error Code 0x0017

Meaning

Invalid Sync Manager configuration

Description

Process data communication (cyclic communication) is done via extra memory areas on the ESC, separated for outputs and inputs. The process data length and the process data SyncManager length have to be the same. If this is not the case or the start address or direction does not match this error is returned.

Example: The process data configuration was changed of the slaves which also changed the length of the data. The change was not activated in the configuration so that the configuration tool would have recalculated the SyncManager settings.

Current State (or state change)

P→S, S→O

Resulting state

Current State + E

Solution

Issue a re-calculation of the EtherCAT configuration

7.4.11 Error Code 0x0018

Meaning

No valid inputs available

Description

The slave application cannot provide valid input values

Example: A certain hardware which needs to be connected to the slave was disconnected

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

n/a

7.4.12 Error Code 0x0019**Meaning**

No valid outputs available

Description

The slave application cannot receive valid output values.

Example: The slave has a RxPdoToggle output or an "Output Valid" information in its process data. The RxPdoToggle does not toggle or the OutputValid is not true. Therefore the slave has no process data which the application can use. If supported, check the RxPDO Toggle Failed Counter in object 0x1C3x.0E). Also, the Synchronization may have problems (see object 0x10F1:SI2 Sync Error Counter Limit) so that process data are received too late by the slave so that the local slave cycle misses the toggle event. Another reason can be that the PLC stopped working

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

The RxPdoToggle may need to be handled by the PLC program

The outputs valid may have to be set by the PLC program

PLC may have stopped, restart PLC

7.4.13 Error Code 0x001A**Meaning**

Synchronization error

Description

If too many RxPDO Toggle error occur, i.e. the RxPDO Toggle Failed Counter increases the internal limit the slave returns to SAFEPERROR with 0x001A. Multiple synchronization errors. Device is not synchronized any more (used if the causes mirrored by the AL Status Codes 0x2C, 0x2D, 0x32, 0x33, 0x34 cannot be distinguished).

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

n/a

7.4.14 Error Code 0x001B

Meaning

Sync manager watchdog

Description

The slave did not receive process data within the specified watchdog time. Usually, the WD time is 100ms. The WD is re-started every time it receives new process data, usually when the Output SyncManager (SyncManager2) is written. For devices which have only inputs usually no WD is used. Increasing the WD is not a solution.

Reason: PLC stopped

Current State (or state change)

O, S

Resulting state

S + E

Solution

n/a

7.4.15 Error Code 0x001C

Meaning

Invalid Sync Manager Types

Description

n/a

Current State (or state change)

O, S, O, P→S

Resulting state

S + E

Solution

n/a

7.4.16 Error Code 0x001D**Meaning**

Invalid Output Configuration

Description

SM configuration for output process data is invalid

Current State (or state change)

O, S, O, P→S

Resulting state

S + E

Solution

n/a

7.4.17 Error Code 0x001E**Meaning**

Invalid Input Configuration

Description

SM configuration for input process data is invalid

Current State (or state change)

O, S, O, P→S

Resulting state

S + E

Solution

n/a

7.4.18 Error Code 0x001F

Meaning

Invalid Watchdog Configuration

Description

The Watchdog is configured in the ESC register 0x0400 and 0x0420. EtherCAT defines default watchdog settings (100ms) or they are defined in the ESI file. If the slave does not accept a change of the expected settings it returns this AL Status Code Example: A slave may not accept that the WD is deactivated.

Current State (or state change)

O, S, O, P→S

Resulting state

P + E

Solution

Use default WD settings

7.4.19 Error Code 0x0020

Meaning

Slave needs cold start

Description

Slave device require a power off - power on reset

Current State (or state change)

Any

Resulting state

Current State + E

Solution

n/a

7.4.20 Error Code 0x0021

Meaning

Slave needs INIT

Description

Slave application requests INIT state

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.21 Error Code 0x0022**Meaning**

Slave needs PREOP

Description

Slave application requests PREOP state

Current State (or state change)

S, O

Resulting state

S + E, O + E

Solution

n/a

7.4.22 Error Code 0x0023**Meaning**

Slave needs SAFEOP

Description

Slave application requests SAFEOP state

Current State (or state change)

O

Resulting state

O + E

Solution

n/a

7.4.23 Error Code 0x0024

Meaning

Invalid Input Mapping

Description

The process data are described by the configuration (PdoConfig) and PDO assignment (PdoAssign).

PdoConfig: list of actual variables (usually indexes 0x6nnn for inputs and 0x7nnn for outputs). Variables are also called PDO entries. There can be one or several variables with in one list (i.e. within one PDO). The Input PDOs have the index 0x1Amm. The Output PDOs have the index 0x16mm.

PdoAssign: The list of PDOs (object index 0x16nn, 0x1Amm) which are actually part of the process data and hence, are transferred cyclically, are listed in the PDO Assign Objects 0x1C12 (output PDOs) and 0x1C13 (input PDOs). All this can be seen in the SystemManager on the TAB "Process Data". If the mapping which was set by the user on the Process Data tab and which was expected by the slave do not match this Status Code is returned.

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.24 Error Code 0x0025

Meaning

Invalid Output Mapping

Description

The process data are described by the configuration (PdoConfig) and PDO assignment (PdoAssign).

PdoConfig: list of actual variables (usually indexes 0x6nnn for inputs and 0x7nnn for outputs). Variables are also called PDO entries. There can be one or several variables with in one list (i.e. within one PDO). The Input PDOs have the index 0x1Amm. The Output PDOs have the index 0x16mm. Example: Slave does only support one or certain PDO combinations but a different setting was made by the user. For a bus coupler the connected terminals differ from the configured terminals in the SystemManager

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.25 Error Code 0x0026

Meaning

Inconsistent Settings

Description

General settings mismatch

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.26 Error Code 0x0027

Meaning

Freerun not supported

Description

n/a

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.27 Error Code 0x0028

Meaning

Synchronization not supported

Description

n/a

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.28 Error Code 0x0029**Meaning**

Freerun needs 3 Buffer Mode

Description

FreeRun mode, SM has to run in 3-buffer mode

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.29 Error Code 0x002A**Meaning**

Background Watchdog

Description

n/a

Current State (or state change)

S, O

Resulting state

P + E

Solution

n/a

7.4.30 Error Code 0x002B

Meaning

No Valid Inputs and Outputs

Description

n/a

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

n/a

7.4.31 Error Code 0x002C

Meaning

Fatal Sync Error

Description

The hardware interrupt signal (so called Sync signal) generated by the ESC is not generated any more. The master sets and activated the cycle time of the Sync signal during state transition from PREOP to SAFEOP. If a slave was disconnected and reconnected (also due to lost frames or CRC errors) the generation of the SyncSignal may be lost.

Current State (or state change)

O

Resulting state

S + E

Solution

Set master to INIT and back to OP so that the DCs are initialized again

7.4.32 Error Code 0x002D

Meaning

ana

Description

SyncSignal not received: In SAFEOP the slave waits for the first Sync0/Sync1 events before switching to OP, if these events were not received during the SAFEOP to OP-Timeout time the slave refuses the state transition to OP

Current State (or state change)

n/a

Resulting state

n/a

Solution

n/a

7.4.33 Error Code 0x0030**Meaning**

Invalid DC SYNC Configuration

Description

Distributed Clock Configuration is invalid due to application requirements

Current State (or state change)

O, S→O, P→S

Resulting state

P + E, S + E

Solution

n/a

7.4.34 Error Code 0x0031**Meaning**

Invalid DC Latch Configuration

Description

DC Latch configuration is invalid due to application requirements

Current State (or state change)

O, S→O, P→S

Resulting state

P + E, S + E

Solution

n/a

7.4.35 Error Code 0x0032**Meaning**

PLL Error

Description

Master not synchronized, at least one DC event received

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

n/a

7.4.36 Error Code 0x0033**Meaning**

DC Sync IO Error

Description

Multiple Synchronization Errors: At least one SyncSignal was received before. However, the PLL between slave and master is not synchronized any more. This may occur if the master application jitters too much

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

Use specific industrial pc, standard office PCs may have power saving options, graphic accelerators and other system services which disturb the real-time of the master.

CPU power may be too small for the PLC/NC program.

Increase EtherCAT and PLC/NC cycle time.

Use SyncUnits for the slaves using DCs.

7.4.37 Error Code 0x0034

Meaning

DC Sync Timeout Error

Description

Multiple Synchronization Errors, too much SM events missed

Current State (or state change)

O, S→O

Resulting state

S + E

Solution

n/a

7.4.38 Error Code 0x0035

Meaning

DC Invalid Sync Cycle Time

Description

n/a

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.39 Error Code 0x0036

Meaning

DC Sync0 Cycle Time

Description

DC Sync0 cycle time does not fit to the application requirements

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.40 Error Code 0x0037**Meaning**

DC Sync1 Cycle Time

Description

DC Sync1 cycle time does not fit to the application requirements

Current State (or state change)

P→S

Resulting state

P + E

Solution

n/a

7.4.41 Error Code 0x0041**Meaning**

MBX_AOE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.42 Error Code 0x0042

Meaning

MBX_EOE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.43 Error Code 0x0043

Meaning

MBX_COE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.44 Error Code 0x0044

Meaning

MBX_FOE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.45 Error Code 0x0045**Meaning**

MBX_SOE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.46 Error Code 0x004F**Meaning**

MBX_VOE

Description

n/a

Current State (or state change)

B, P, S, O

Resulting state

Current State + E

Solution

n/a

7.4.47 Error Code 0x0050

Meaning

EEPROM No Access

Description

EEPROM not assigned to PDI

Current State (or state change)

Any

Resulting state

Any + E

Solution

n/a

7.4.48 Error Code 0x0051

Meaning

EEPROM Error

Description

EEPROM access error

Current State (or state change)

Any

Resulting state

Any + E

Solution

n/a

7.4.49 Error Code 0x0060

Meaning

Slave Requested Locally

Description

n/a

Current State (or state change)

Any

Resulting state

I

Solution

n/a

7.4.50 Error Code 0x0061**Meaning**

Device Identification Value updated

Description

n/a

Current State (or state change)

P

Resulting state

P + E

Solution

n/a

7.4.51 Error Code 0x00F0**Meaning**

Application Controller available

Description

n/a

Current State (or state change)

n/a

Resulting state

n/a

Solution

n/a

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