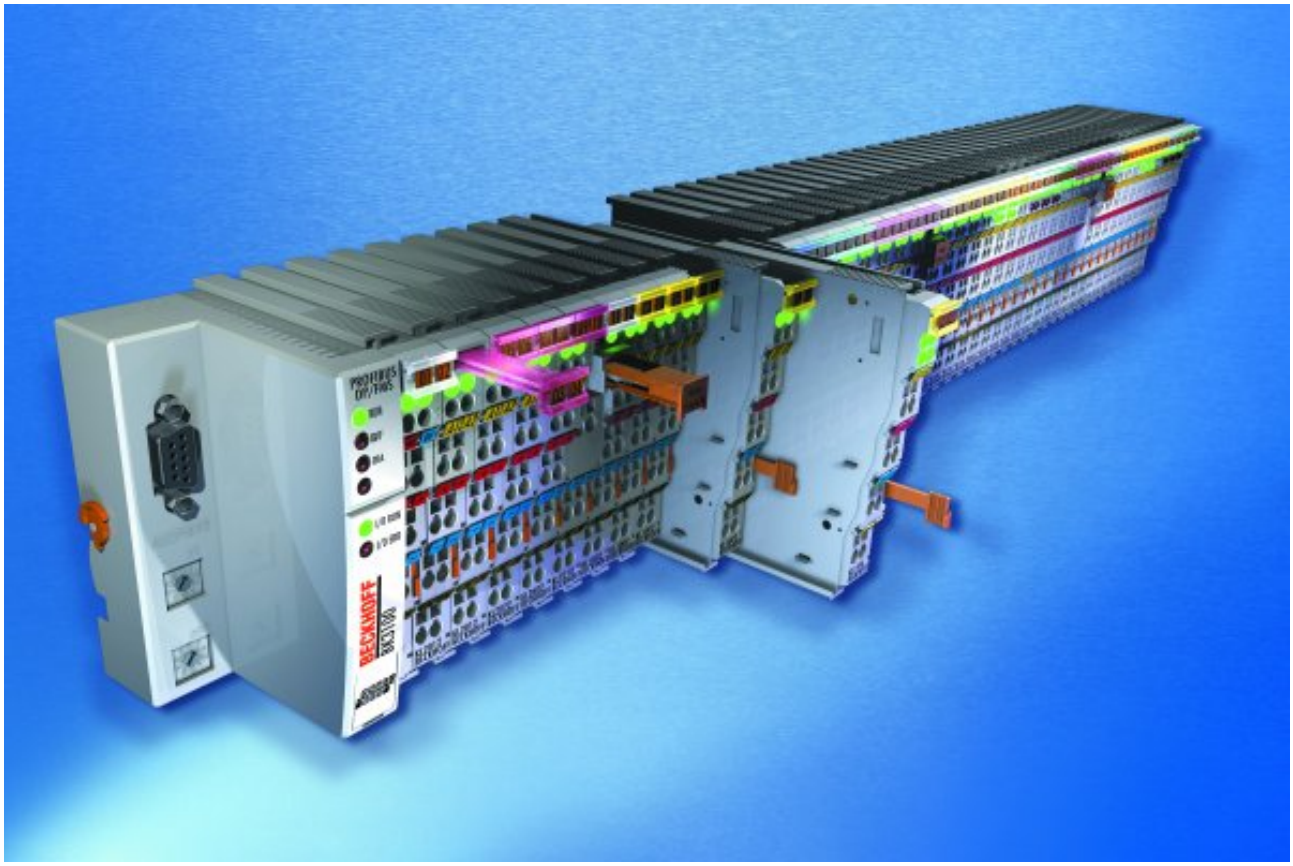

Documentation

KL9540, KL9540-0010 and KL9550

Surge Filter Terminals

Version: 3.0.0
Date: 2017-10-17

BECKHOFF

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

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1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

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

1.3 Documentation issue status

Version	Comment
3.0.0	• Migration
2.1.0	• Technical data updated • ATEX notes added • KL9540-0010 updated
2.0.0	• Permitted ambient temperature range extended • KL9540-0010 added
1.0	First public issue (describes KL9540-0000 and KL9550-0000)

2 Product overview

2.1 Overview

Surge filter terminals for the field supply and K-bus supply

The surge filter terminals include overvoltage filters for the K-bus (Bus Coupler) and/or field supply (power contacts).

The filters protect the components from line-bound surge voltages that can occur due to high-energy disturbance variables such as switching surges at inductive consumers or lightning strikes at the supply lines. The surge filter terminals can be used to protect the Bus Terminal station from damage in particularly hostile environments. The ship classification organizations stipulate the use of surge filters in shipbuilding applications and in the onshore / offshore sector.

The following types are available:

- KL9540-0000 / KS9540-0000 [▶ 9]: Surge filter terminals for field supply
- KL9540-0010 / KS9540-0010: [▶ 10] Surge filter terminals for field supply of analog Bus Terminals
- KL9550-0000 / KS9550-0000 [▶ 11]: Surge filter terminals for field supply and K-Bus supply

Features

Surge filter terminal	KL9540-0000 KS9540-0000	KL9540-0010 KS9540-0010	KL9550-0000 KS9550-0000
Surge filter for system supply (Us)	no	no	yes
Surge filter for field supply (Up)	yes	yes	yes
Buffers the field supply (Up)	no	yes	no

2.2 KL9540-0000 - introduction

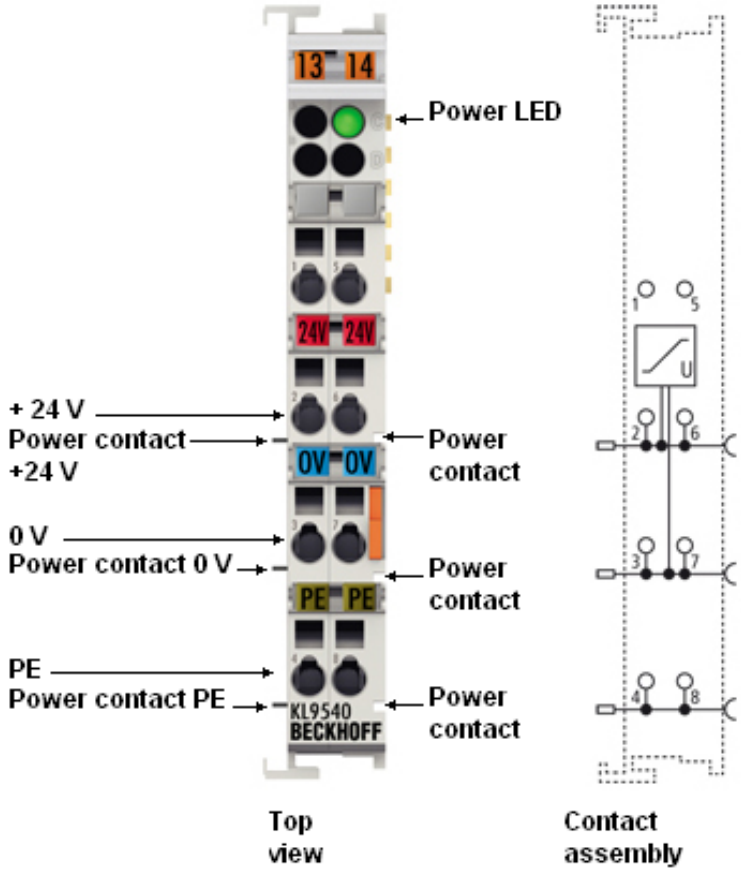

Fig. 1: KL9540

Surge filter terminals for field supply

The KL9540-0000 surge filter terminal contains an overvoltage filter for the field supply. The filter protects the components from line-bound surge voltages that can occur due to high-energy disturbance variables such as switching surges at inductive consumers or lightning strikes at the supply lines.

LED displays

LED	Meaning	
Power (green)	on	Field supply voltage present

2.3 KL9540-0010 - introduction

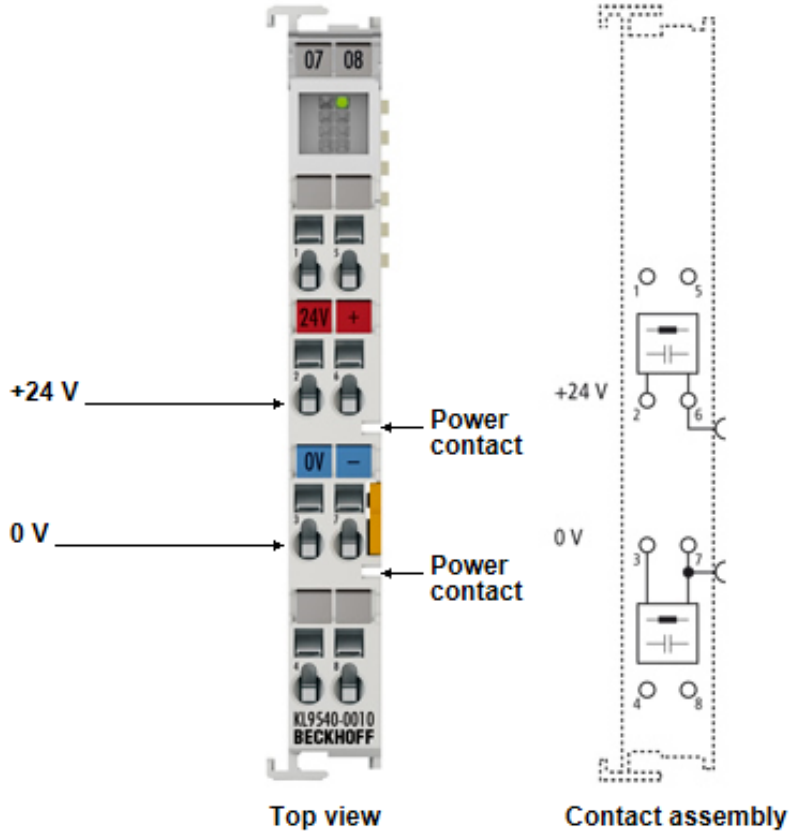

Fig. 2: KL9540-0010

Surge filter terminals for field supply of analog Bus Terminals

The KL9540-0010 system terminal includes an overvoltage filter for the 24 V field supply.
The filter protects the Bus Terminal from line-bound surge voltages that can occur due to high-energy disturbance variables such as switching overvoltages at inductive consumers or lightning strikes at the supply lines.

The KL9540-0010 can protect Bus Terminal stations in particularly harsh environments from damage.
The use of such overvoltage filters is stipulated by the ship classification organizations in shipbuilding and on/offshore applications in which GL certification is required.
The KL9540-0010 is intended in particular for the protection of analog terminals; the standard variant KL9540 for digital terminals.

The LED indicates the 24 V rated voltage. The terminal does not transfer process data to the higher-level control system.

LED displays

LED	Meaning	
Power (green)	on	Field supply voltage present

2.4 KL9550-0000 - introduction

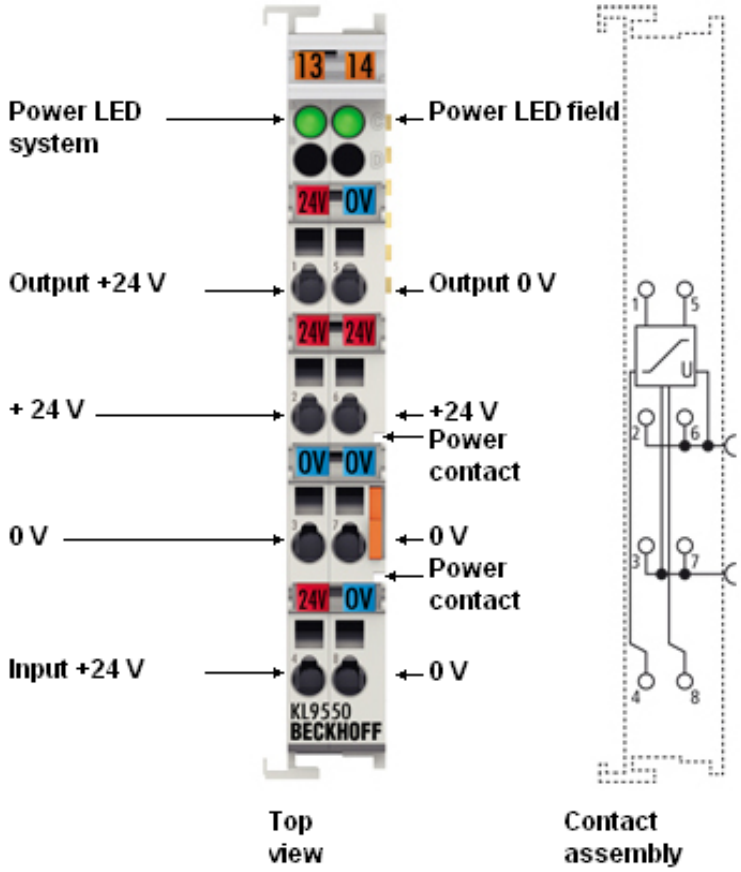

Fig. 3: KL9550

Surge filter terminals for field supply and K-Bus supply

The KL9550-0000 surge filter terminal contains overvoltage filters for the field supply (power contacts) and the K-Bus supply (Bus Coupler). The filters protect the components from line-bound surge voltages that can occur due to high-energy disturbance variables such as switching surges at inductive consumers or lightning strikes at the supply lines.

LED displays

LED	Meaning	
Power system (green)	on	K-Bus supply voltage present
Power field (green)	on	Field supply voltage present

2.5 Technical data

Technical data	KL9540-0000 KS9540-0000	KL9550-0000 KS9550-0000	KL9540-0010 KS9540-0010
Rated voltage	24 V (-15%, +20%)		
Surge filter for field supply (Up)	yes	yes	yes
Surge filter for system supply (Us)	no	yes	no
Buffers the field supply (Up)	no	no	yes
Terminal point for PE	yes	no	no
Current carrying capacity of the field supply	10 A max.		5 A max.
Current carrying capacity of the system supply	-	5 A max.	-
Current consumption from the K-bus	-		
Bit width in the input process image	-		
Bit width in the output process image	-		
Dimensions (W x H x D)	approx. 12 mm x 100 mm x 70 mm		
Weight	approx. 40 g	approx. 50 g	approx. 65 g
Permissible ambient temperature range during operation	-25 °C ... +60 °C (extended temperature range [▶ 26])		0 °C ... +55 °C
Permissible ambient temperature range during storage	-40 °C ... +85 °C		-25 °C ... +85 °C
Permissible relative air humidity	95 %, no condensation		
Mounting [▶ 13]	on 35 mm mounting rail conforms to EN 60715		
Pluggable wiring [▶ 15]	at all KSxxxx series terminals		
Vibration / shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see also Installation instructions [▶ 24] for terminals with enhanced mechanical load capacity		
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP20		
Installation position	variable		
Approval	CE, cULus, ATEX, GL		CE, cULus, GL

3 Mounting and wiring

3.1 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

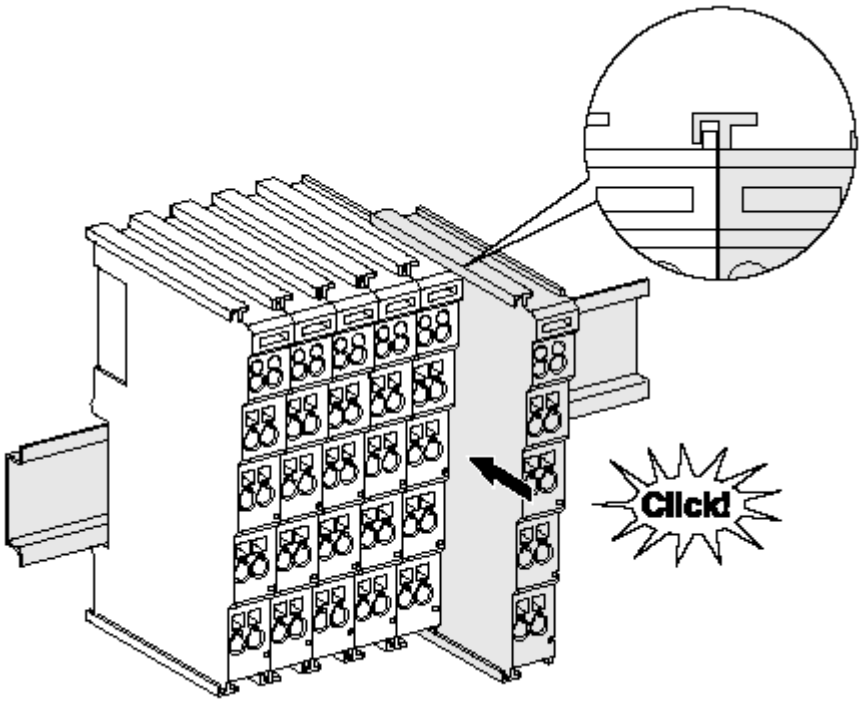

Fig. 4: Attaching on mounting rail

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

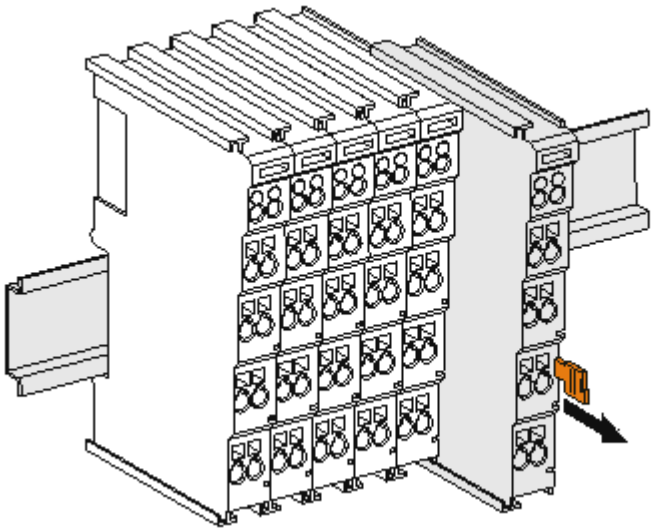

Fig. 5: Disassembling of terminal

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.

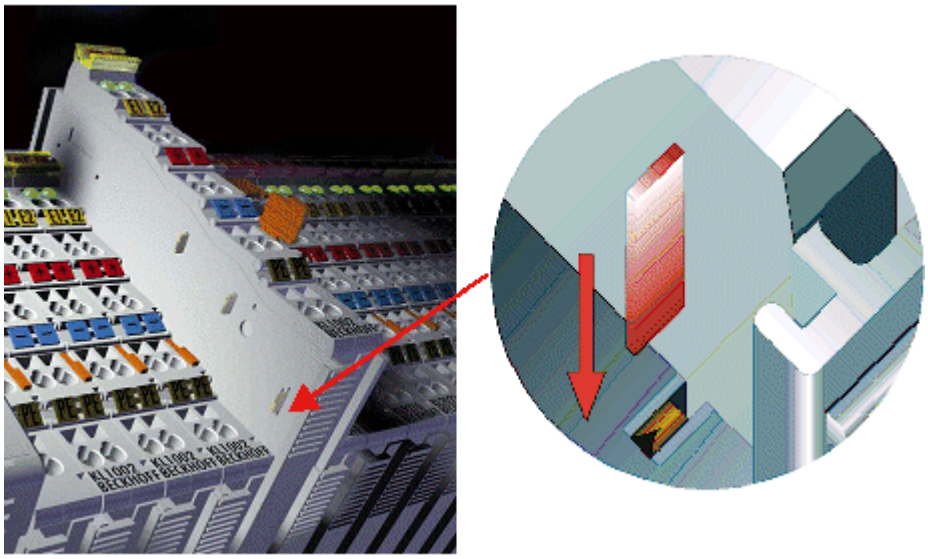

Fig. 6: *Power contact on left side*

Attention	**Possible damage of the device** Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V). For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.
WARNING	**Risk of electric shock!** The PE power contact must not be used for other potentials!

3.2 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. 7: 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

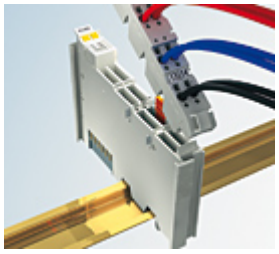

Fig. 8: Pluggable wiring

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

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

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

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

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

High Density Terminals (HD Terminals)

Fig. 9: *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	**Wiring HD Terminals** The High Density (HD) Terminals of the KLx8xx and ELx8xx series doesn't support steady wiring.

Ultrasonically "bonded" (ultrasonically welded) conductors

Note	**Ultrasonically “bonded" conductors** It is also possible to connect the Standard and High Density Terminals with ultrasonically "bonded" (ultrasonically welded) conductors. In this case, please note the tables concerning the wire-size width [▶ 17] below!

Wiring

Terminals for standard wiring ELxxxx/KLxxxx and for pluggable wiring ESxxxx/KSxxxx

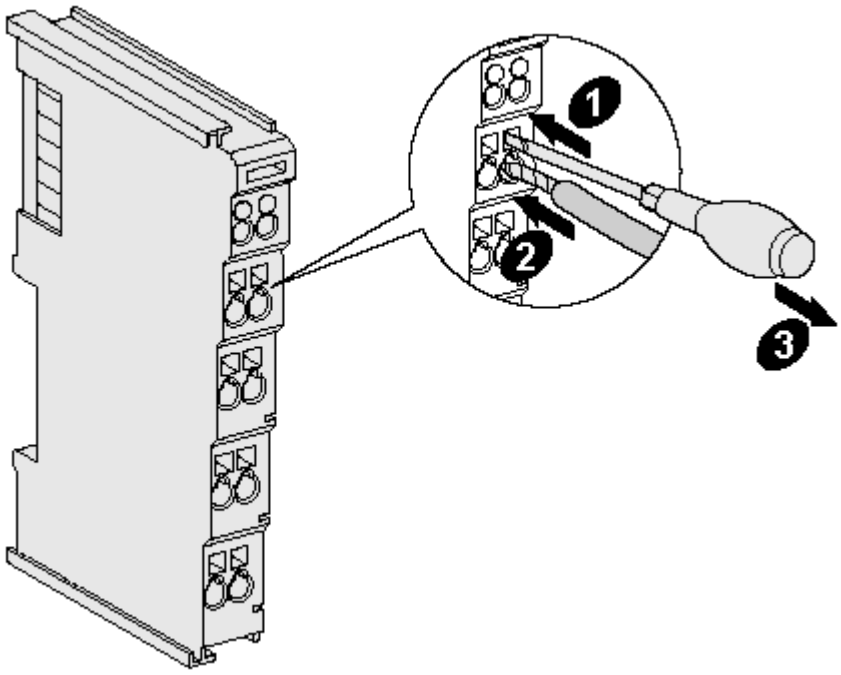

Fig. 10: Mounting a cable on a terminal connection

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 mm²	0.08 ... 2.5 mm²
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 [▶ 17]!)
Wire stripping length	8 ... 9 mm

Shielding

Note

Shielding

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

3.3 KL9540-0000 - connection

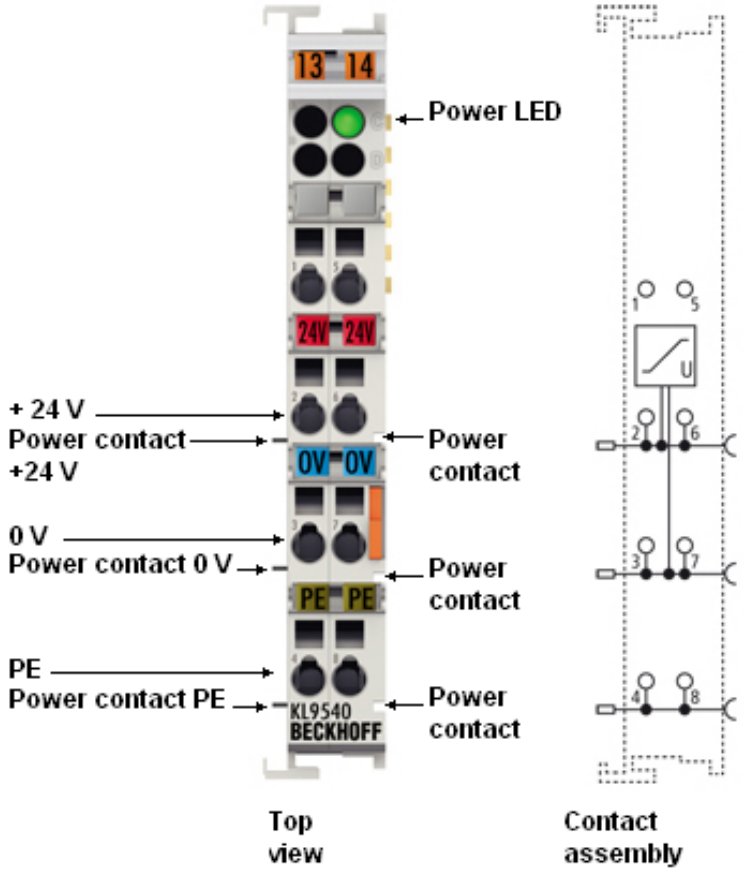

Fig. 11: KL9540 connection

Terminal point	No.	Function
-	1	not used
-	5	not used
+24 V	2	Field supply feed for the power contacts (internally connected to terminal point 6)
+24 V	6	Field supply feed for the power contacts (internally connected to terminal point 2)
0 V	3	Field supply feed for the power contacts (internally connected to terminal point 7)
0 V	7	Field supply feed for the power contacts (internally connected to terminal point 3)
PE	4	PE connection (internally connected to terminal point 8)
PE	8	PE connection (internally connected to terminal point 4)

3.4 KL9540-0010 - connection

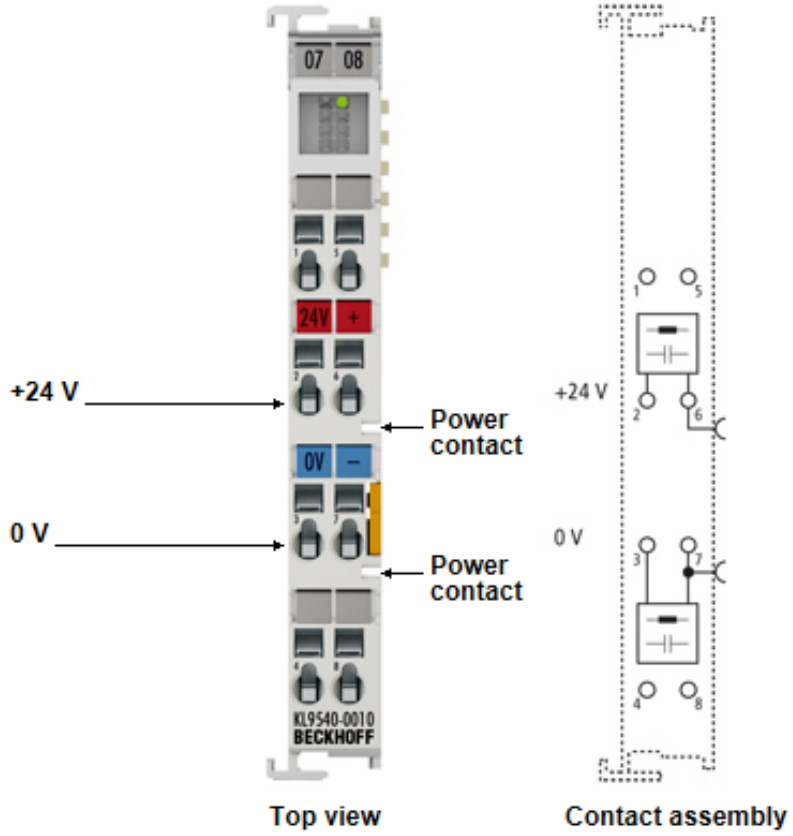

Fig. 12: KL9540-0010 connection

Terminal point	No.	Function
-	1	not used
-	5	not used
+24 V input	2	Field supply feed for the power contacts
+24 V output	6	internally connected to positive power contact
0 V input	3	Field supply feed for the power contacts
0 V output	7	internally connected to negative power contact
-	4	not used
-	8	not used

3.5 KL9550-0000 - connection

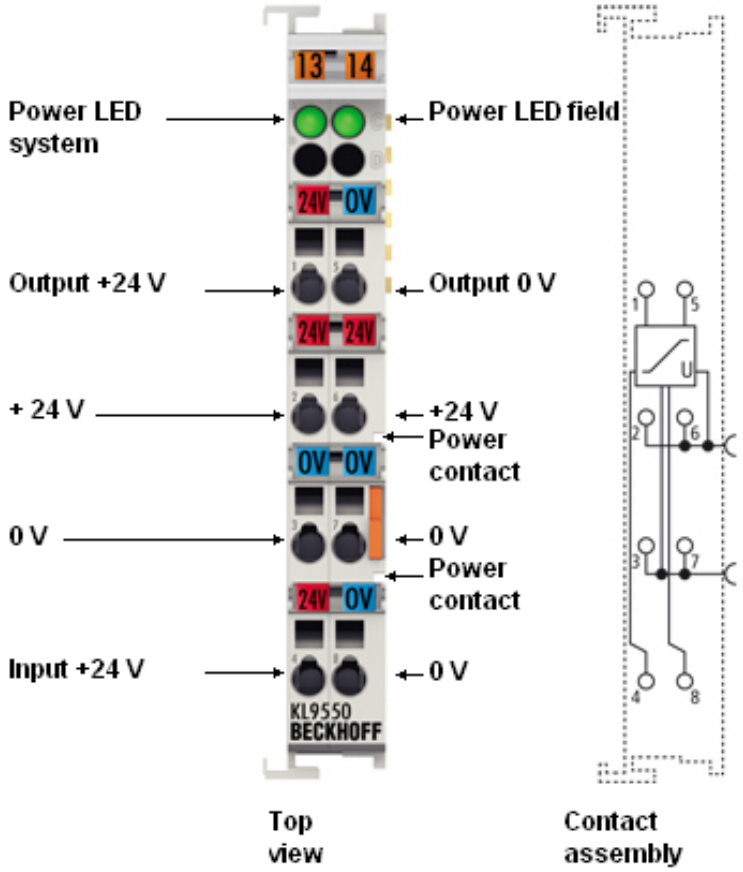

Fig. 13: KL9550

Terminal point	No.	Function
System power +24 V out	1	Distribution of the system supply to the Bus Coupler
+0 V out system power	5	Distribution of the system supply to the Bus Coupler
+24 V	2	Field supply feed for the power contacts (internally connected to terminal point 6)
+24 V	6	Field supply feed for the power contacts (internally connected to terminal point 2)
0 V	3	Field supply feed for the power contacts (internally connected to terminal point 7)
0 V	7	Field supply feed for the power contacts (internally connected to terminal point 3)
System power +24 V in	4	System supply feed
+0 V in system power	8	System supply feed

3.6 KL9540-0000, KL9550-0000 - application example

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

The example shows

- a KL9550-0000 Surge Filter Terminal for supplying
  - the Bus Coupler (U_L: K-Bus supply)
  - the field voltage (U_{S1}: power contacts, potential group 1)
- a KL9540-0000 Surge Filter Terminal in conjunction with the KL9190 power feed terminal for power supply
  - the field voltage (U_{S2}: power contacts, potential group 2)

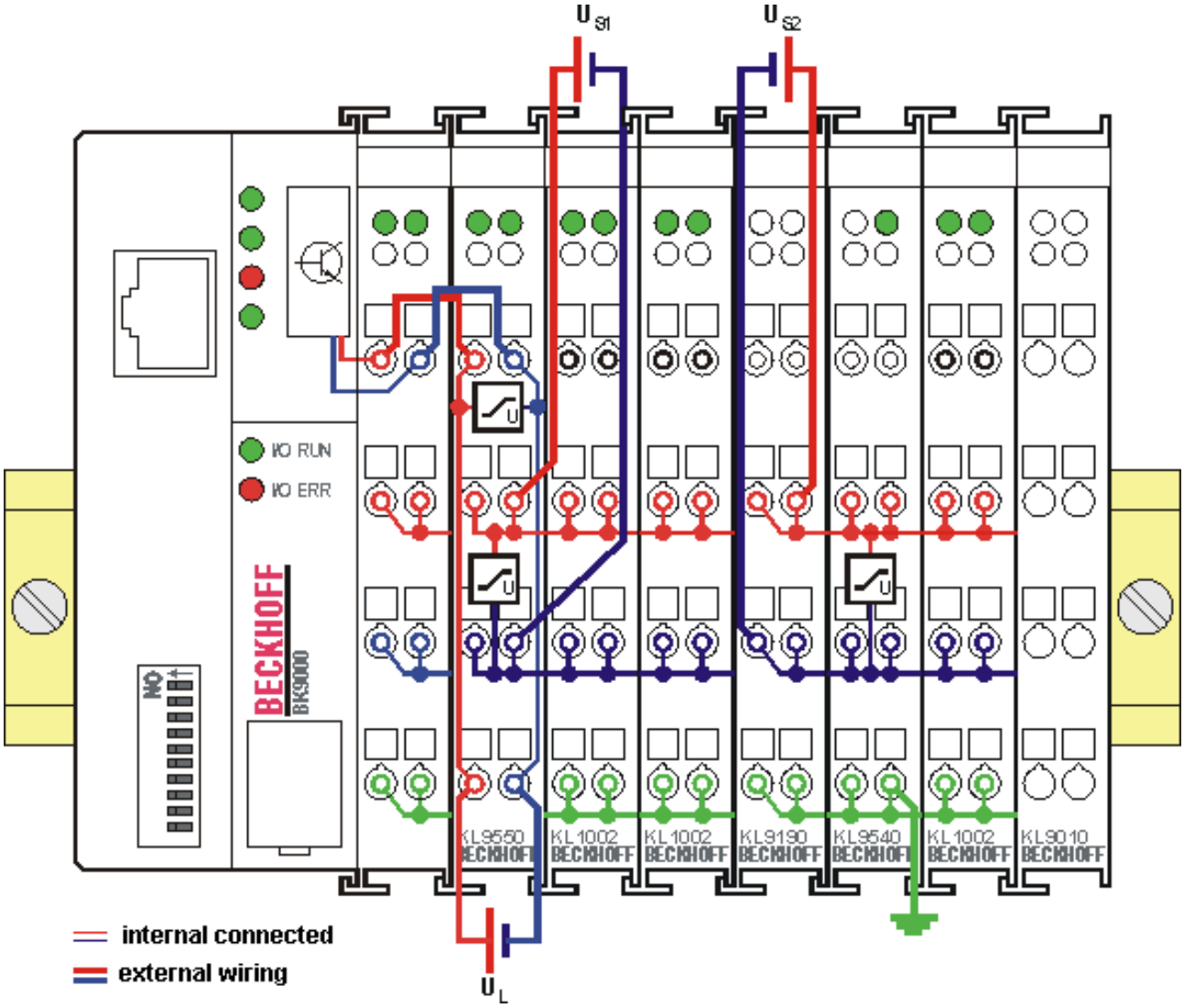

Fig. 14: Application example KL9540, KL9550

3.7 KL9540-0010, KL9550-0000 - application example

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

The example shows

- a KL9550-0000 Surge Filter Terminal for power supply
  - the Bus Coupler (U_L: K-Bus power supply)
  - the field voltage for the digital terminals (U_{S1}: power contacts, potential group 1)
- a KL9540-0010 Surge Filter Terminal for power supply
  - the field voltage for the analog terminals (U_{S2}: power contacts, potential group 2)

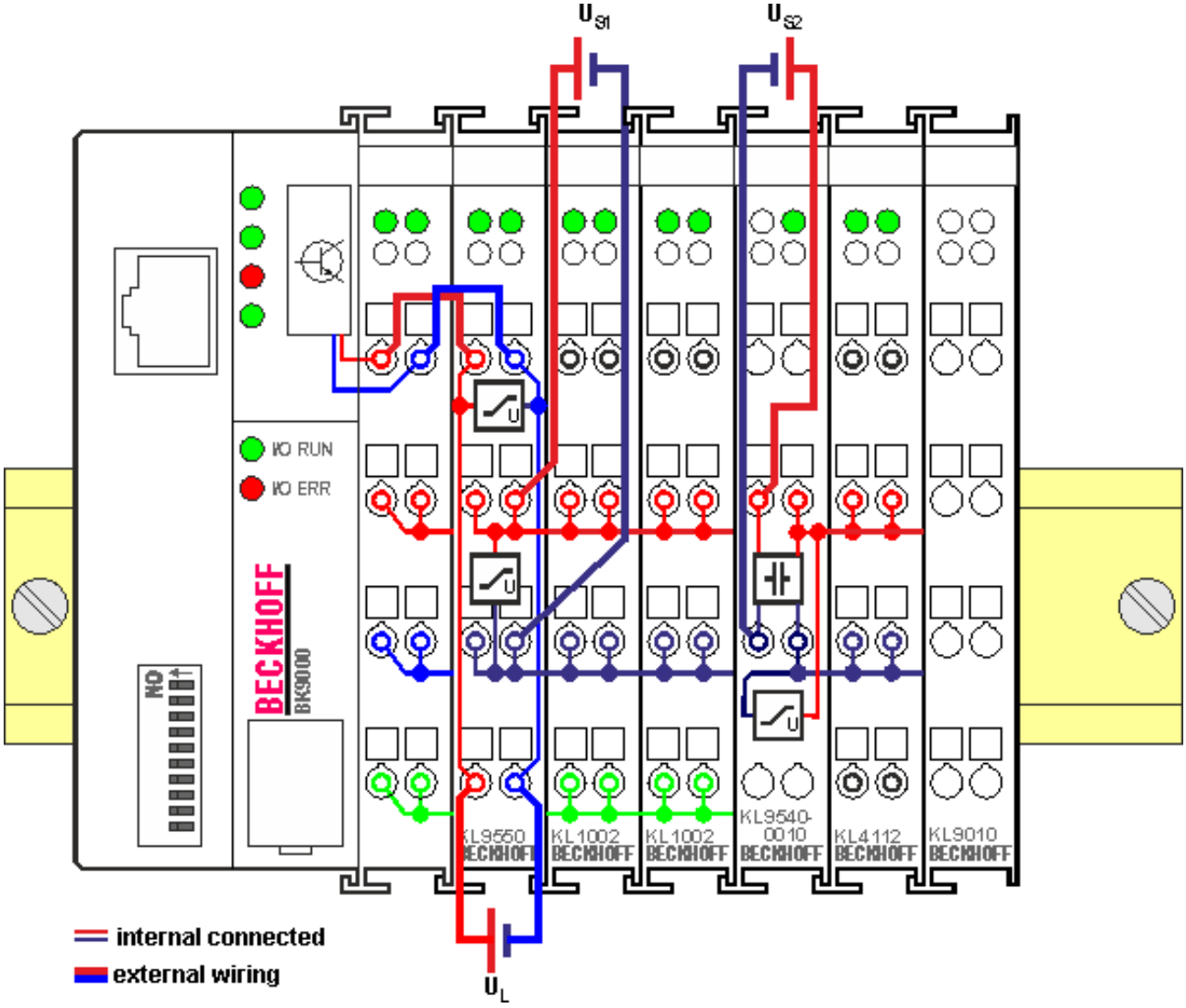

Fig. 15: KL9540-0010, KL9550-0000 - application example

3.8 Installation instructions for enhanced mechanical load capacity

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

Additional checks

The terminals have undergone the following additional tests:

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

Additional installation instructions

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

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

3.9 ATEX - Special conditions (standard temperature range)

 **WARNING**	**Observe the special conditions for the intended use of Beckhoff fieldbus components with standard temperature range in potentially explosive areas (directive 94/9/EU)!** • The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60529! The environmental conditions during use are thereby to be taken into account! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range of 0 to 55°C for the use of Beckhoff fieldbus components standard temperature range in potentially explosive areas! • Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! • The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

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

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010

Marking

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

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

or

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

3.10 ATEX - Special conditions (extended temperature range)

 **WARNING**	**Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas (directive 94/9/EU)!** • The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60529! The environmental conditions during use are thereby to be taken into account! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas! • Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! • The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

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

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010

Marking

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

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

or

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

3.11 ATEX Documentation

Note	**Notes about operation of the Beckhoff terminal systems in potentially explosive areas (ATEX)** Pay also attention to the continuative documentation Notes about operation of the Beckhoff terminal systems in potentially explosive areas (ATEX) that is available in the download area of the Beckhoff homepage http:\\www.beckhoff.com!

4 Appendix

4.1 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49(0)5246/963-0
Fax:	+49(0)5246/963-198
e-mail:	info@beckhoff.com

Beckhoff Support

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

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

Hotline:	+49(0)5246/963-157
Fax:	+49(0)5246/963-9157
e-mail:	support@beckhoff.com

Beckhoff Service

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

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

Hotline:	+49(0)5246/963-460
Fax:	+49(0)5246/963-479
e-mail:	service@beckhoff.com

List of illustrations