BECKHOFF New Automation Technology

Documentation | EN

KL2819

HD Bus Terminal, 16-channel digital output 24 V DC, with diagnostics

2022-02-11 | Version: 1.1.0

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1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

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Patent Pending

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

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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 instructions

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

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation Issue Status

Version	Comment
1.1.0	• Chapter “Technical data” updated • Document structure updated • Chapter “Instruction for ESD protection” added • Chapter “Disposal” added • New title page • Update revision status
1.0.0	• First published

Firmware and hardware versions

Documentation Version	KL2819	
	Firmware	Hardware
1.1.0	1B	02
1.0.0	1A	00

The firmware and hardware versions (delivery state) can be taken from the serial number printed on the side of the terminal.

Syntax of the serial number

Structure of the serial number: WW YY FF HH

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

Example with serial number 40 15 1A 00:

40 - week of production 40
15 - year of production 2015
1A - firmware version 1A
00 - hardware version 00

2 Product overview

2.1 Introduction and contact assignment

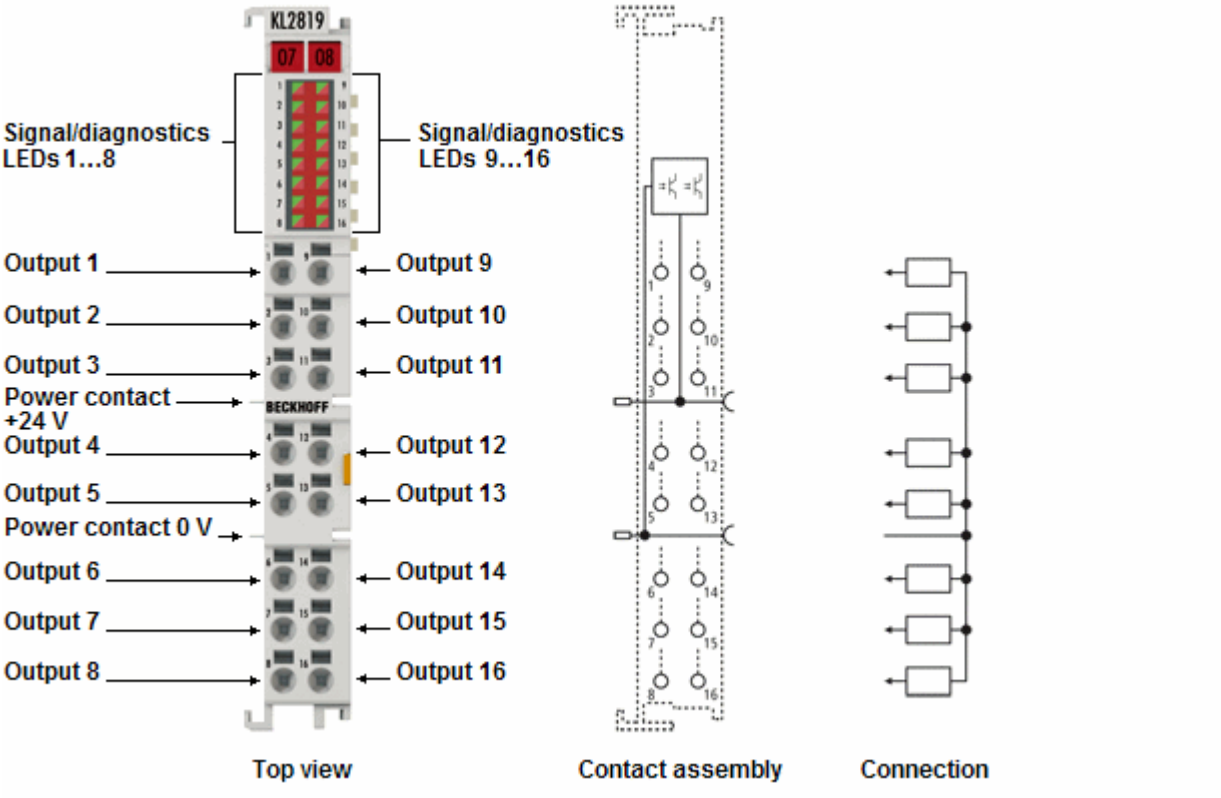


Fig. 1: KL2819

HD Bus Terminal, 16-channel digital output 24 V_{DC}, 0.5 A, with diagnostics

The KL2819 Bus Terminal has 16 digital output channels for the switching of 24 V loads up to 0.5 A. The integrated diagnostics can be evaluated by the controller and indicated by the LEDs. Overtemperature and the lack of a voltage supply to the terminal are supplied as diagnostic information. Moreover, each of the channels can signal e.g. a short circuit. The switching state and any error of the output are indicated by the LED. Maintenance of the application is simplified by the diagnostic function. The power contacts are connected through; reference ground of the outputs is the 0 V power contact. The outputs are electrically isolated from the fieldbus side.

LED displays

LED	Color	Meaning	
OUTPUT 1- 16	green	off	No output signal
		on	Output signal 24 V
DIAGNOSE 1- 16	red	on	ERROR: Overcurrent / Overtemperature

Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
Output 2	2	Output 2
Output 3	3	Output 3
Output 4	4	Output 4
Output 5	5	Output 5
Output 6	6	Output 6
Output 7	7	Output 7
Output 8	8	Output 8
Output 9	9	Output 9
Output 10	10	Output 10
Output 11	11	Output 11
Output 12	12	Output 12
Output 13	13	Output 13
Output 14	14	Output 14
Output 15	15	Output 15
Output 16	16	Output 16

2.2 Technical data

Technical data	KL2819
Connection technology	1-wire
Number of Outputs	16
Rated load voltage	24 V_{DC} (-15 %/+20 %)
Current consumption from K-bus	typ. 30 mA
Load type	ohmic, inductive, lamp load
Max. output current	0.5 A (short-circuit-proof) per channel
Short circuit current	< typ. 1.1 A
Breaking energy	< 300 mJ/channel
Reverse voltage protection	yes
Current consumption power contacts	typ. 50 mA + load
Electrical isolation	500 V (K-bus/field potential)
Output stage	push (high-side switch)
Bit width in the process image	16 bit output and diagnostics (2 x 8 Bit-control/status optional)
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight	approx. 70 g
Mounting	on 35 mm mounting rail according to EN 60715
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
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Installation position	variable, see section Installation positions [▶ 24] of chapter Mounting and wiring
Protection class	IP20
Approvals/markings*	CE, UKCA, EAC

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

2.3 Overload protection

The maximum continuous output current per output is around 0.5 A.

When switching on lamp loads, high starting currents occur that are limited by the output circuit of the terminals. This ensures that the upstream circuit breaker does not trip (see fig. Overload current limitation).

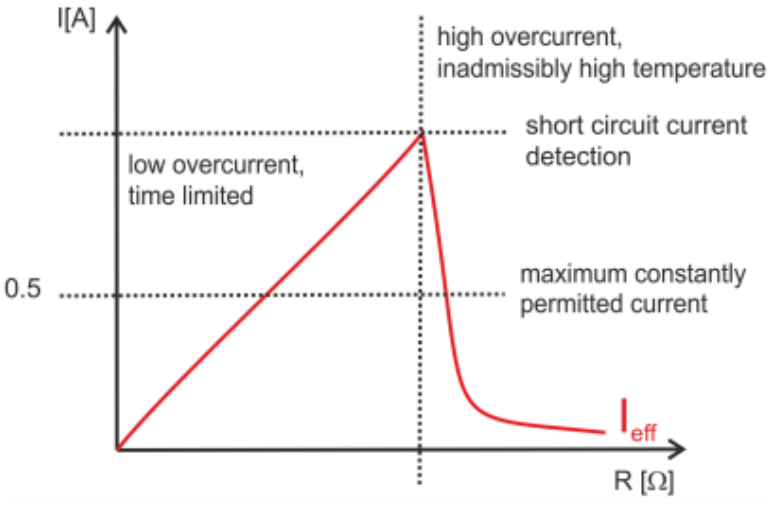


Fig. 2: Overload current limitation

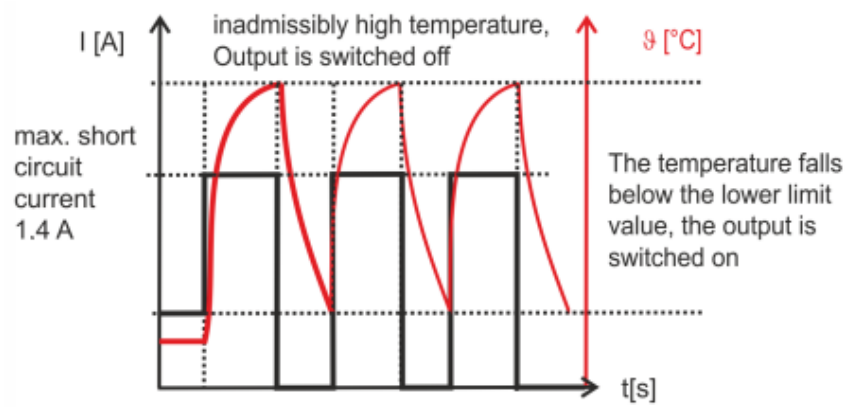


Fig. 3: Schematic illustration of the thermal switch-off in case of overload

In case of a long-term overload and/or short-circuit, the output is protected by the thermal switch-off of the channel.
The output circuit of the terminal limits the current. The terminal maintains this current until important self-heating of the channel occurs.
On exceeding the upper temperature limit, the terminal switches the channel off.
The channel is switched on again after it has cooled down to below the lower temperature limit.
The output signal is clocked until the output is switched off by the controller or the short-circuit is eliminated (see fig. Schematic illustration of the thermal switch-off in case of overload). The clock frequency depends on the ambient temperature and the load of the other terminal channels. This overload cause the device temperature to rise further.

If several channels are overloaded, this leads to a rapid increase in the device temperature. The overloaded channels are switched off when the upper limit for the device temperature is exceeded. The channels are only switched on again if the temperature falls below the lower limit values for both the device and the channel. The non-overloaded channels continue operating properly.

When switching off inductive loads, high induction voltages result from interrupting the current too quickly. These are limited by an integrated freewheeling diode to approx. -35 V. Since the current reduces only slowly, a delayed switch-off can occur in many control applications. For example, a valve remains open for many milliseconds. Switch-off times are realized that correspond, for instance, to the switch-on time of the coil.

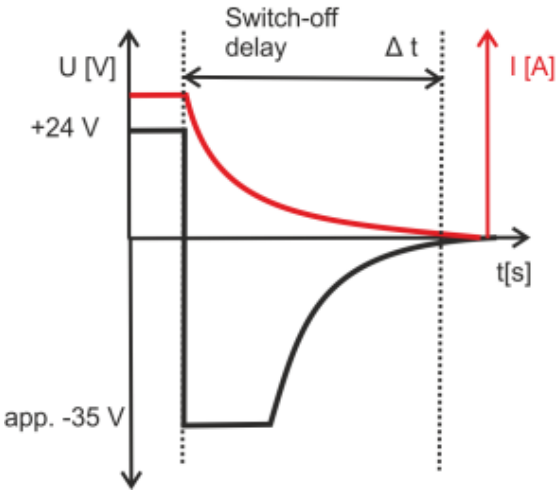


Fig. 4: Switch-off of inductive loads

3 Interference-free Bus Terminals

Use of interference-free Bus or EtherCAT Terminals in safety applications

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

NOTE

Pay attention to the hardware version

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

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

Terminal name Bus Terminal	from hardware version
KL2408	05
KL2809	02
KL2134	09
KL2424	05
KL9110	07

Terminal name EL/ELX terminal	from hardware version
EL2004	15
EL2008	07
EL2022	09
EL2024	06
EL2034	06
EL2809	01
EL2828	00
EL2872	01
EL2878-0005	00
EL9110	13
EL9410	16
ELX1052	00
ELX1054	00
ELX1058	00
ELX2002	00
ELX2008	00
ELX3152	00
ELX3181	00
ELX3202	00
ELX3204	00
ELX3252	00
ELX3312	00
ELX3314	00
ELX3351	00
ELX4181	00
ELX5151	00
ELX9560	03

External wiring

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

- **Protection class IP54**
  The terminals must be installed in IP54 control cabinets to ensure the necessary protection class IP54.
- **Power supply unit**
  The standard terminals must be supplied with 24 V by an SELV/PELV power supply unit with an output voltage limit U_{max} of 60 V in the event of a fault.
- **Prevention of feedback**
  Feedback can be prevented through different measures. These are described below. In addition to mandatory requirements there are also optional requirements, of which only one needs to be selected.
  - **No switching of loads with a separate power supply**
    Loads that have their own power supply must not be switched by standard terminals, since in this case feedback via the load cannot be ruled out.

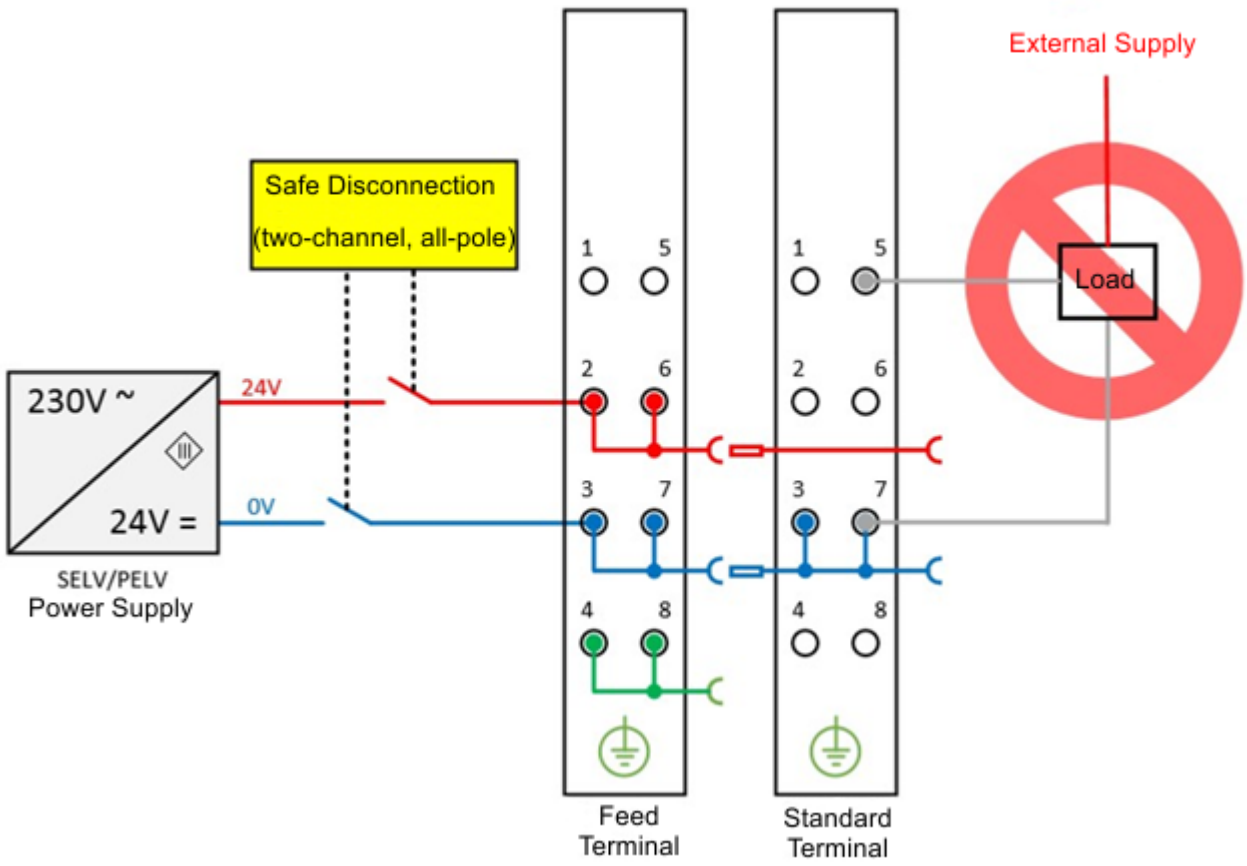


Fig. 5: Negative example – active load

- The control of an STO input of a frequency converter could serve here as a **negative example**. **Exceptions** to the general requirement are allowed only if the manufacturer of the connected load guarantees that feedback to the control input cannot occur. This can be achieved, for example, through adherence to load-specific standards.
- **Option 1: Ground feedback and all-pole disconnection**
  The ground connection of the connected load must be fed back to the safely switched ground.

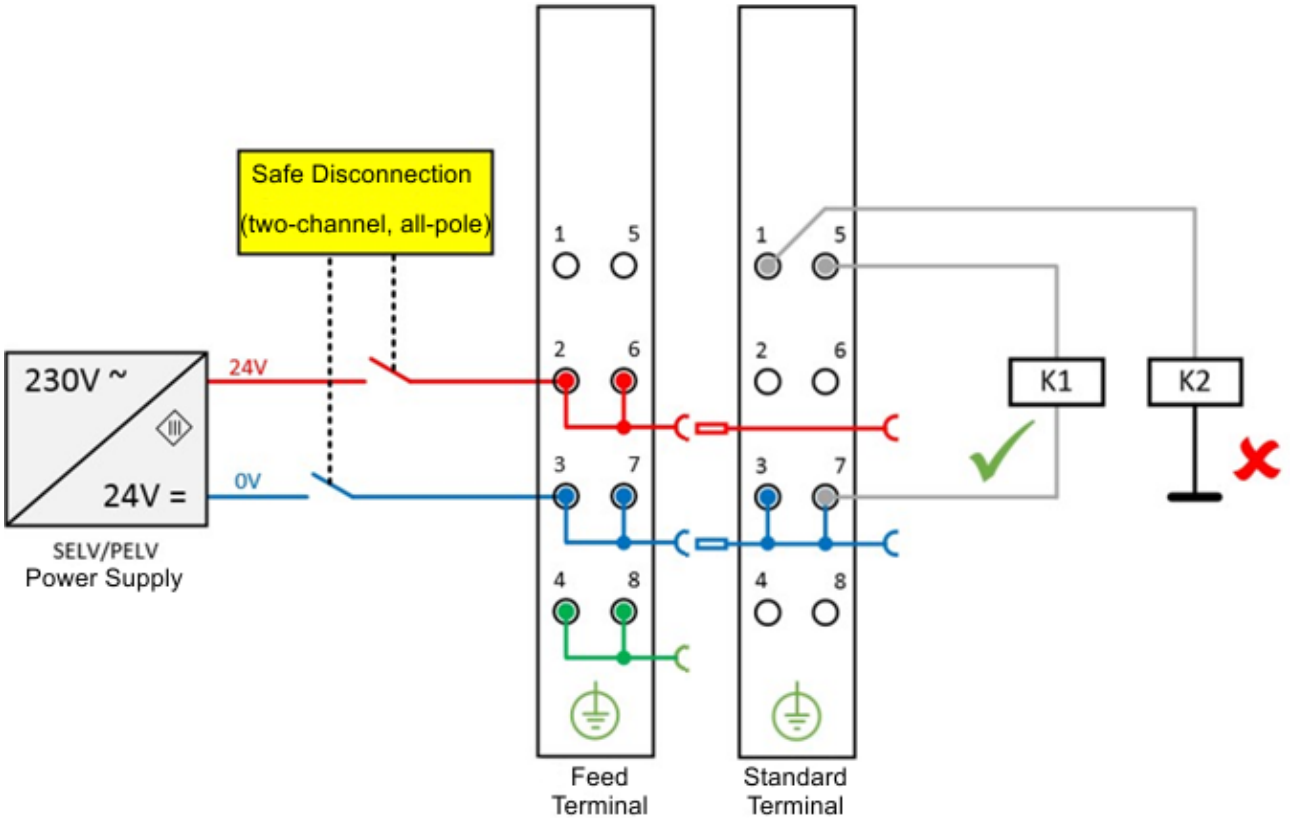


Fig. 6: Ground connection of the load: correct (K1) and incorrect (K2)

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

  then fault exclusions are necessary with regard to a short-circuit with external potential in order to be able to achieve Cat. 4 PLe according to EN ISO 13849-1:2007 or SIL3 according to IEC 61508:2010 (refer here to the overview in the chapter "Effect of options on the safety level").
- **Option 2: Cable short-circuit fault exclusion**
  If solution option 1 is not feasible, the ground feedback and all-pole disconnection can be dispensed with if the danger of feedback due to a cable short-circuit can be excluded by other measures. These measures, which can be implemented alternatively, are described in the following sections.

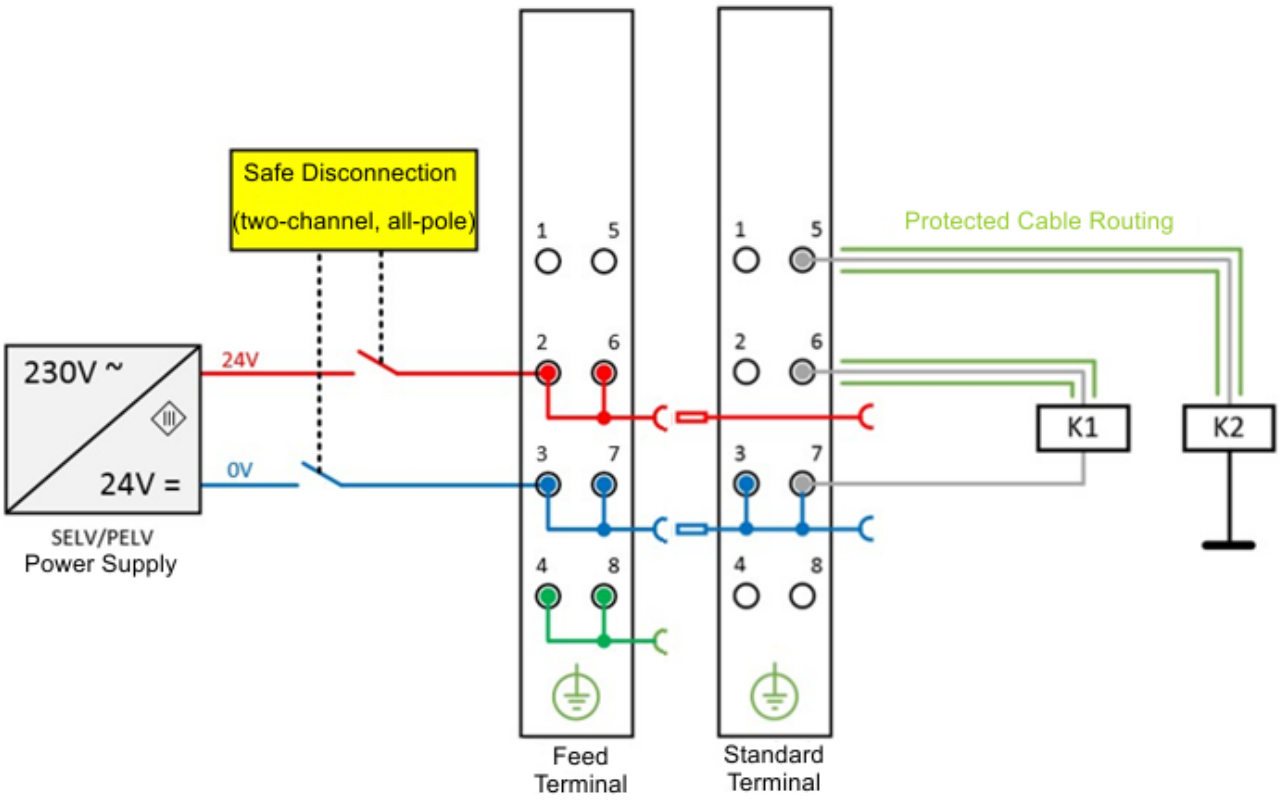


Fig. 7: Short circuit fault exclusion through protected cable laying

- **a) Possibility 1: Load connection via separate sheathed cables**
  The non-safely switched potential of the standard terminal may not be conducted together with other potential-conducting cores inside the same sheathed cable. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **b) Possibility 2: Wiring only inside the control cabinet**
  All loads connected to the non-safe standard terminals must be located in the same control cabinet as the terminals. The cables are routed entirely inside the control cabinet. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **c) Possibility 3: Dedicated earth connection per conductor**
  All conductors connected to the non-safe standard terminals are protected by their own earth connection. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **d) Possibility 4: Cable permanently (fixed) installed and protected against external damage**
  All conductors connected to the non-safe standard terminals are permanently fixed and, e.g. protected against external damage by a cable duct or armored pipe.

- **Effect of the options on the safety level**
  In principle, standard terminals in safely switched potential groups are not an active part of the safety controller. Accordingly, **the safety level attained is defined only by the higher-level safety controller**, i.e. the standard terminals are not included in the calculation! However, the wiring of the standard terminals can lead to limitations in the maximum attainable safety level.
  Depending on the solution selected for the avoidance of feedback and the safety standard considered (see Option 1 and Option 2), different maximum attainable safety levels result, which are summarized in the following table:

Summary of safety classifications

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

4 Mounting and wiring

4.1 Instructions for ESD protection

NOTE

Destruction of the devices by electrostatic discharge possible!

The devices contain components at risk from electrostatic discharge caused by improper handling.

- Please ensure you are electrostatically discharged and avoid touching the contacts of the device directly.
- Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.).
- Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices.
- Each assembly must be terminated at the right hand end with a KL9010 bus end terminal, to ensure the protection class and ESD protection.

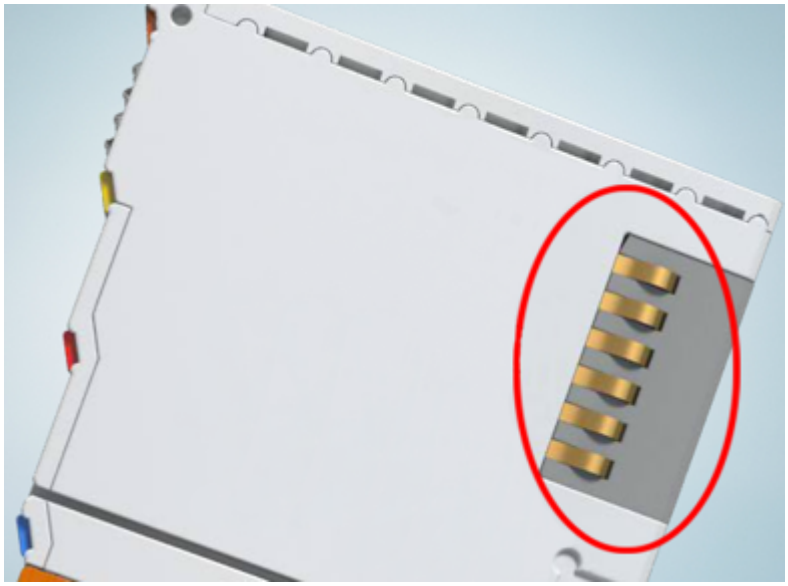


Fig. 8: Spring contacts of the Beckhoff I/O components

4.2 Installation on mounting rails

⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

Assembly

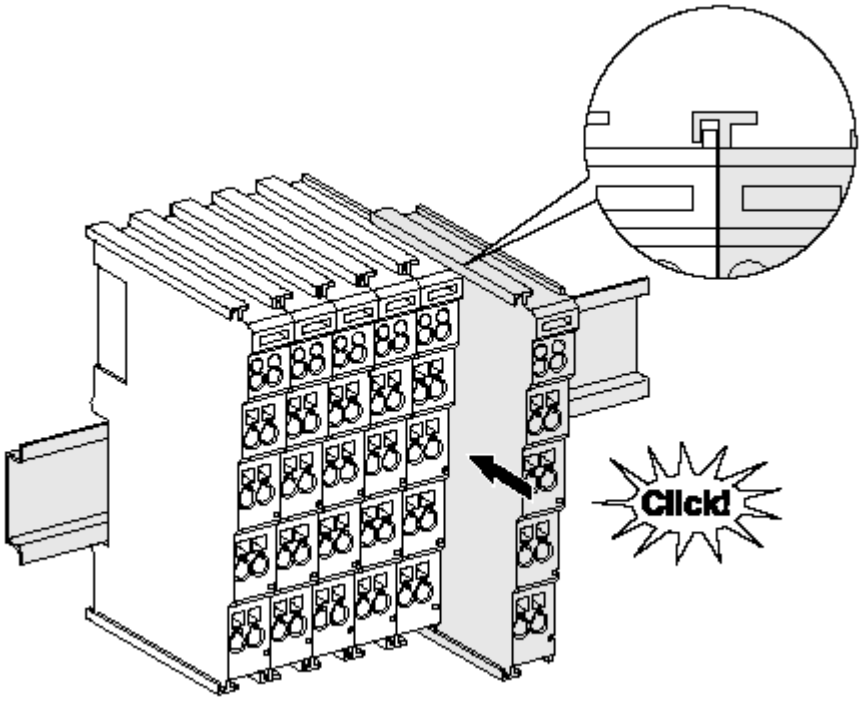


Fig. 9: Attaching on mounting rail

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.

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

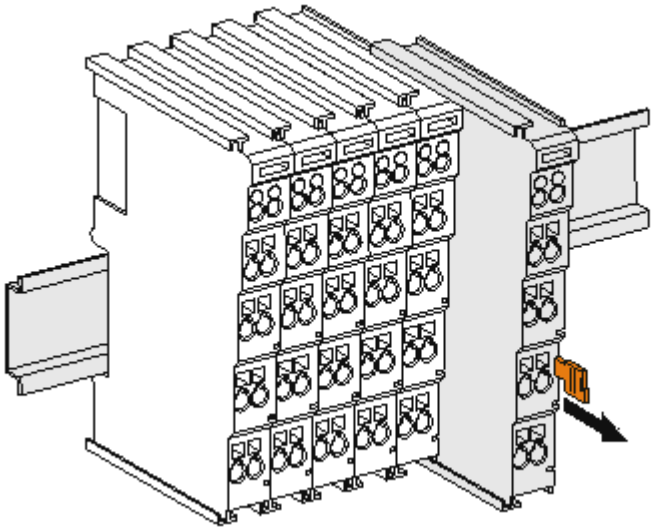


Fig. 10: Disassembling of terminal

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

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

Connections within a bus terminal block

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

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

Power Contacts

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

PE power contact

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

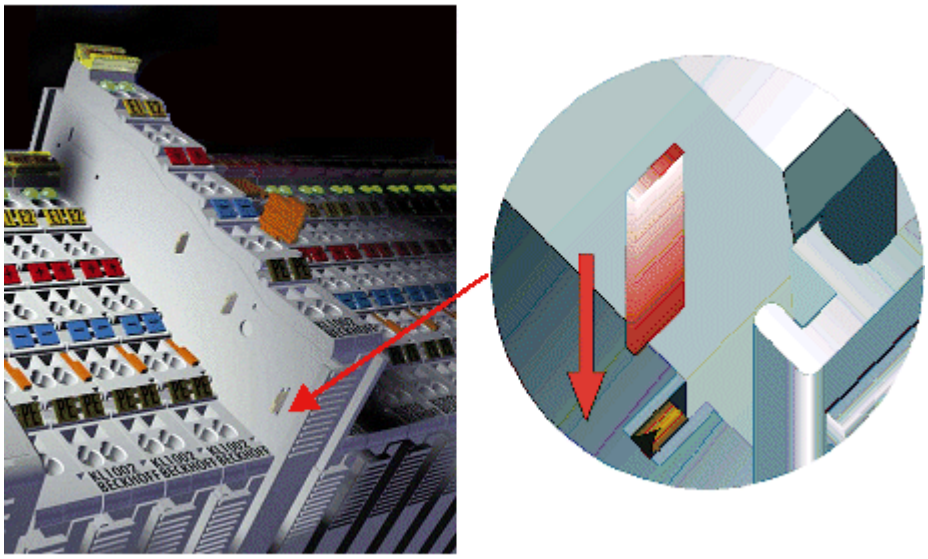


Fig. 11: Power contact on left side

NOTE

Possible damage of the device

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

⚠ WARNING

Risk of electric shock!

The PE power contact must not be used for other potentials!

4.3 Connection

4.3.1 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 ELxxxx and KLxxxx series with standard wiring include electronics and connection level in a single enclosure.
- The terminals of ESxxxx and KSxxxx 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 (ELxxxx / KLxxxx)

Fig. 12: Standard wiring

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

Pluggable wiring (ESxxxx / KSxxxx)

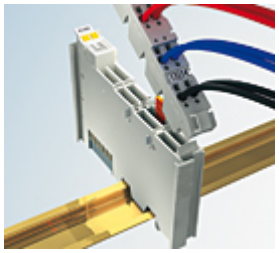


Fig. 13: Pluggable wiring

The terminals of ESxxxx and KSxxxx series feature a pluggable connection level.
The assembly and wiring procedure is the same as for the ELxxxx and KLxxxx series.
The pluggable connection level enables 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 ESxxxx and KSxxxx series has been retained as known from ELxxxx and KLxxxx series.

High Density Terminals (HD Terminals)

Fig. 14: High Density Terminals

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

Wiring HD Terminals

The High Density Terminals of the ELx8xx and KLx8xx series doesn't support pluggable wiring.

Ultrasonically “bonded” (ultrasonically welded) conductors

Ultrasonically “bonded” conductors

It is also possible to connect the Standard and High Density Terminals with ultrasonically “bonded” (ultrasonically welded) conductors. In this case, please note the tables concerning the wire-size width [▶ 23]!

4.3.2 Wiring

⚠ 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!

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

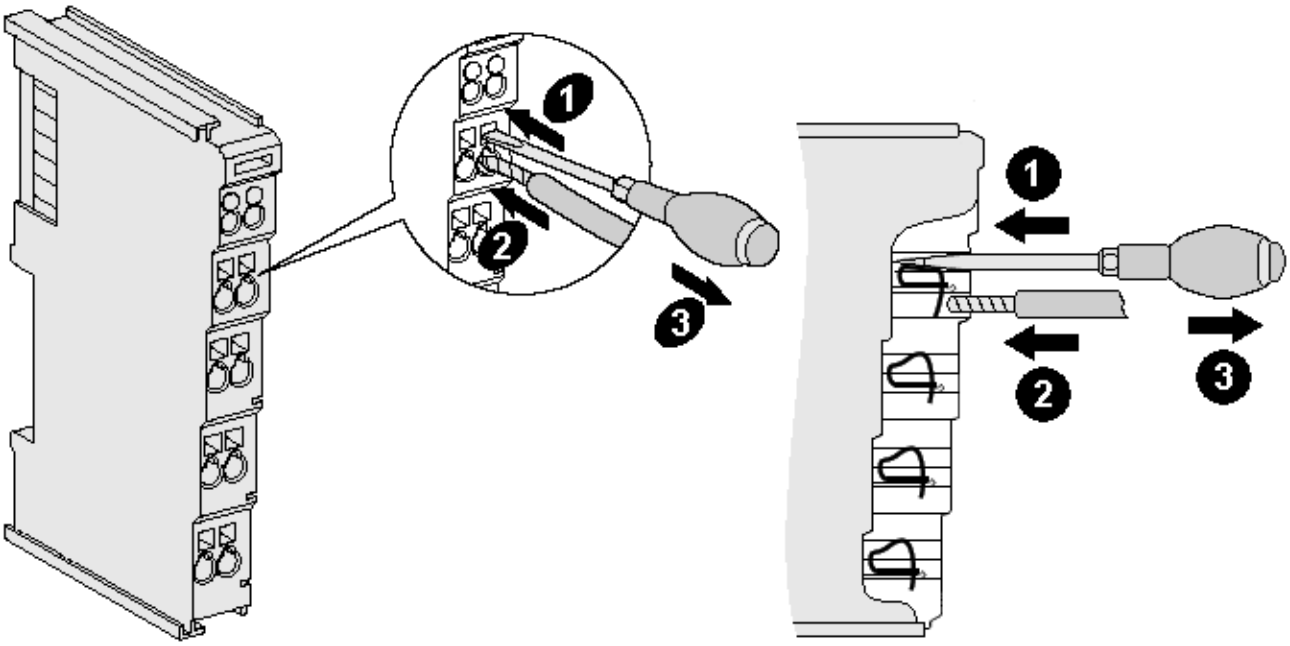


Fig. 15: Connecting a cable on a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the bus terminal. The terminal points are implemented in spring force technology. Connect the cables as follows:

1. Open a terminal point by pushing a screwdriver straight against the stop into the square opening above the terminal point. Do not turn the screwdriver or move it alternately (don't toggle).
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal point closes automatically when the pressure is released, holding the wire securely and permanently.

See the following table for the suitable wire size width.

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width (single core wires)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm²	0.14 ... 1.5 mm²
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 22]) with 16 terminal points

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 terminal 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 (single core wires)	0.08 ... 1.5 mm²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm²
Wire size width (ultrasonically “bonded" conductors)	only 1.5 mm² (see notice [▶ 22])
Wire stripping length	8 ... 9 mm

4.3.3 Shielding

Shielding

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

4.4 Installation positions

NOTE

Constraints regarding installation position and operating temperature range

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

Optimum installation position (standard)

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

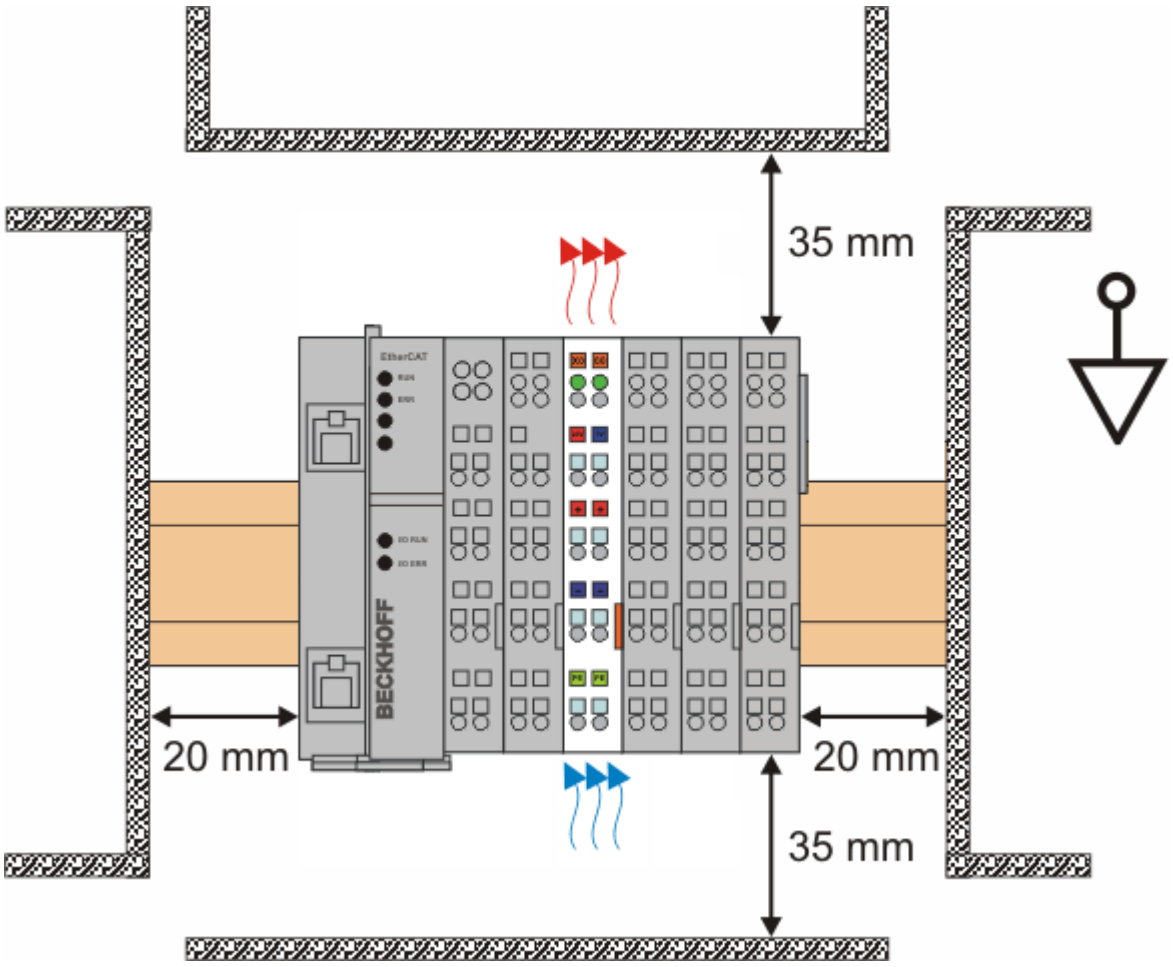


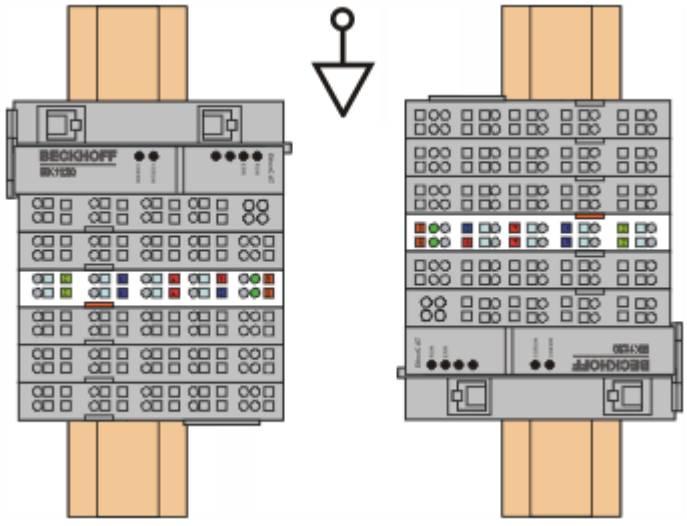
Fig. 16: Recommended distances for standard installation position

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.



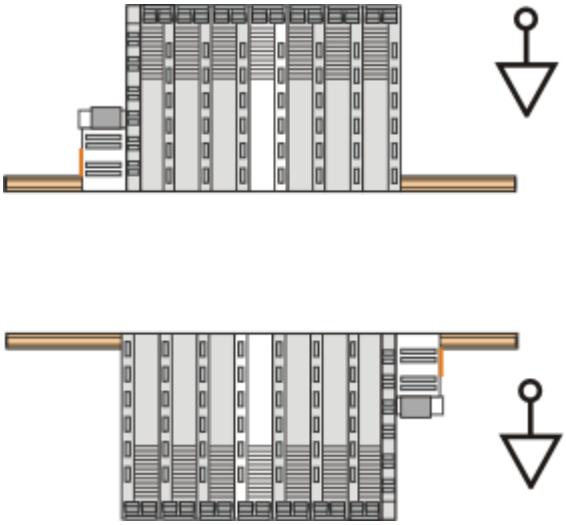


Fig. 17: Other installation positions

4.5 Disposal

Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

5 KS2000 Configuration software

5.1 KS2000 - Introduction

The KS2000 configuration software permits configuration, commissioning and parameterization of bus couplers, of the affiliated bus terminals and of Fieldbus Box Modules. The connection between bus coupler / Fieldbus Box Module and the PC is established by means of the serial configuration cable or the fieldbus.

Fig. 18: KS2000 configuration software

Configuration

You can configure the Fieldbus stations with the Configuration Software KS2000 offline. That means, setting up a terminal station with all settings on the couplers and terminals resp. the Fieldbus Box Modules can be prepared before the commissioning phase. Later on, this configuration can be transferred to the terminal station in the commissioning phase by means of a download. For documentation purposes, you are provided with the breakdown of the terminal station, a parts list of modules used and a list of the parameters you have modified. After an upload, existing fieldbus stations are at your disposal for further editing.

Parameterization

KS2000 offers simple access to the parameters of a fieldbus station: specific high-level dialogs are available for all bus couplers, all intelligent bus terminals and Fieldbus Box modules with the aid of which settings can be modified easily. Alternatively, you have full access to all internal registers of the bus couplers and intelligent terminals. Refer to the register description for the meanings of the registers.

Commissioning

The KS2000 software facilitates commissioning of machine components or their fieldbus stations: Configured settings can be transferred to the fieldbus modules by means of a download. After a *login* to the terminal station, it is possible to define settings in couplers, terminals and Fieldbus Box modules directly *online*. The same high-level dialogs and register access are available for this purpose as in the configuration phase.

The KS2000 offers access to the process images of the bus couplers and Fieldbus Box modules.

- Thus, the coupler's input and output images can be observed by monitoring.
- Process values can be specified in the output image for commissioning of the output modules.

All possibilities in the *online mode* can be used in parallel with the actual fieldbus mode of the terminal station. The fieldbus protocol always has the higher priority in this case.

5.2 Parameterization with KS2000

Connect the configuration interface of your fieldbus coupler with the serial interface of your PC via the configuration cable and start the *KS2000* configuration software.

Click on the *Login* button. The configuration software will now load the information for the connected fieldbus station.
In the sample shown, this is

- a CX5020 Embedded PC
- a KL2819 HD bus terminal
- a KL9010 bus end terminal

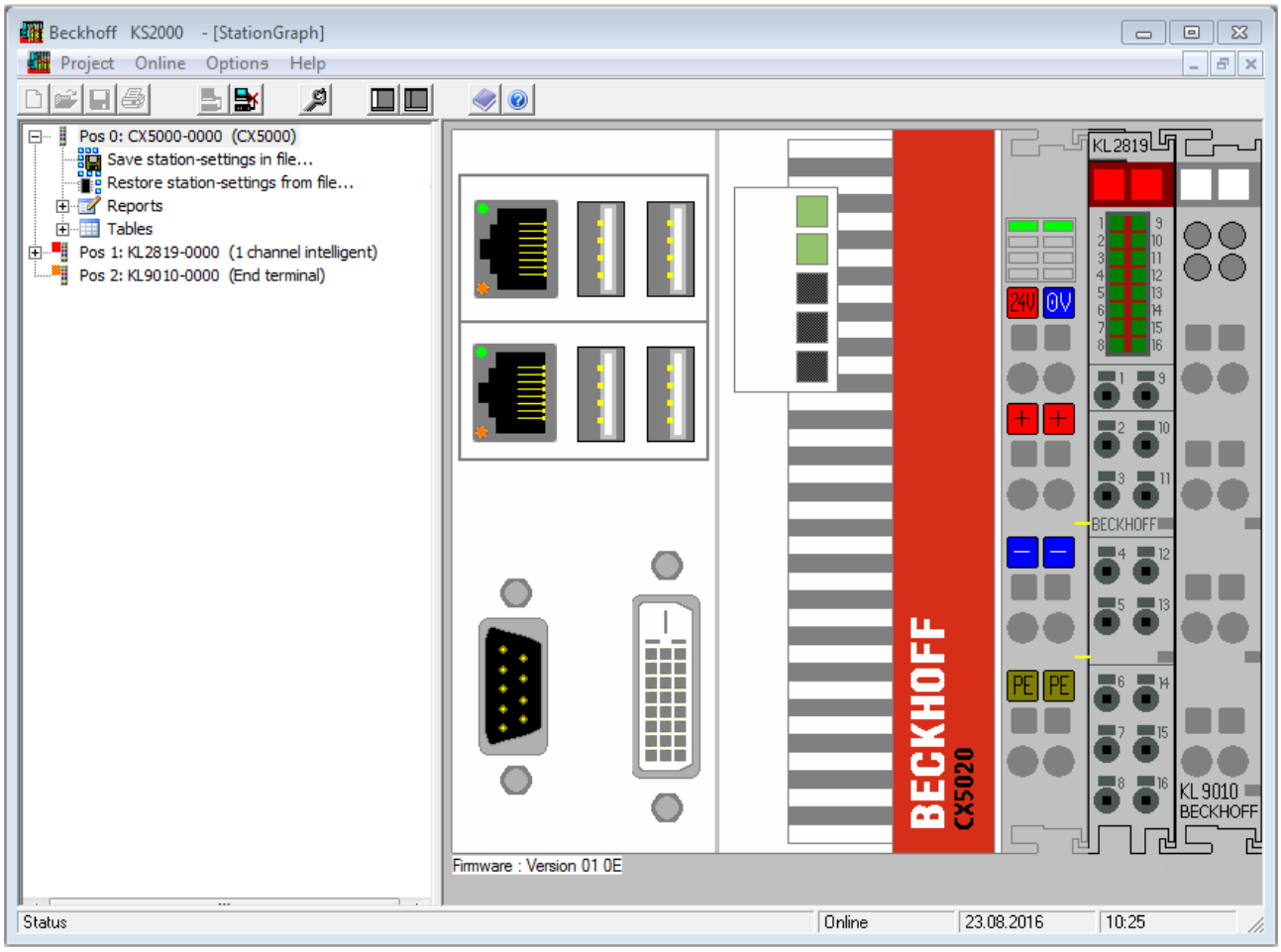


Fig. 19: Display of the fieldbus station in KS2000

The left-hand KS2000 window displays the terminals of the fieldbus station in a tree structure.
The right-hand KS2000 window contains a graphic display of the fieldbus station terminals.

In the tree structure of the left-hand window, click on the plus-sign next to the terminal whose parameters you wish to change (item 1 in the example).

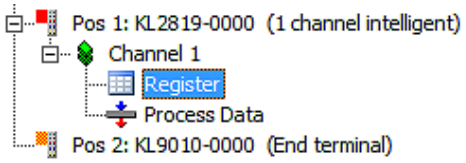


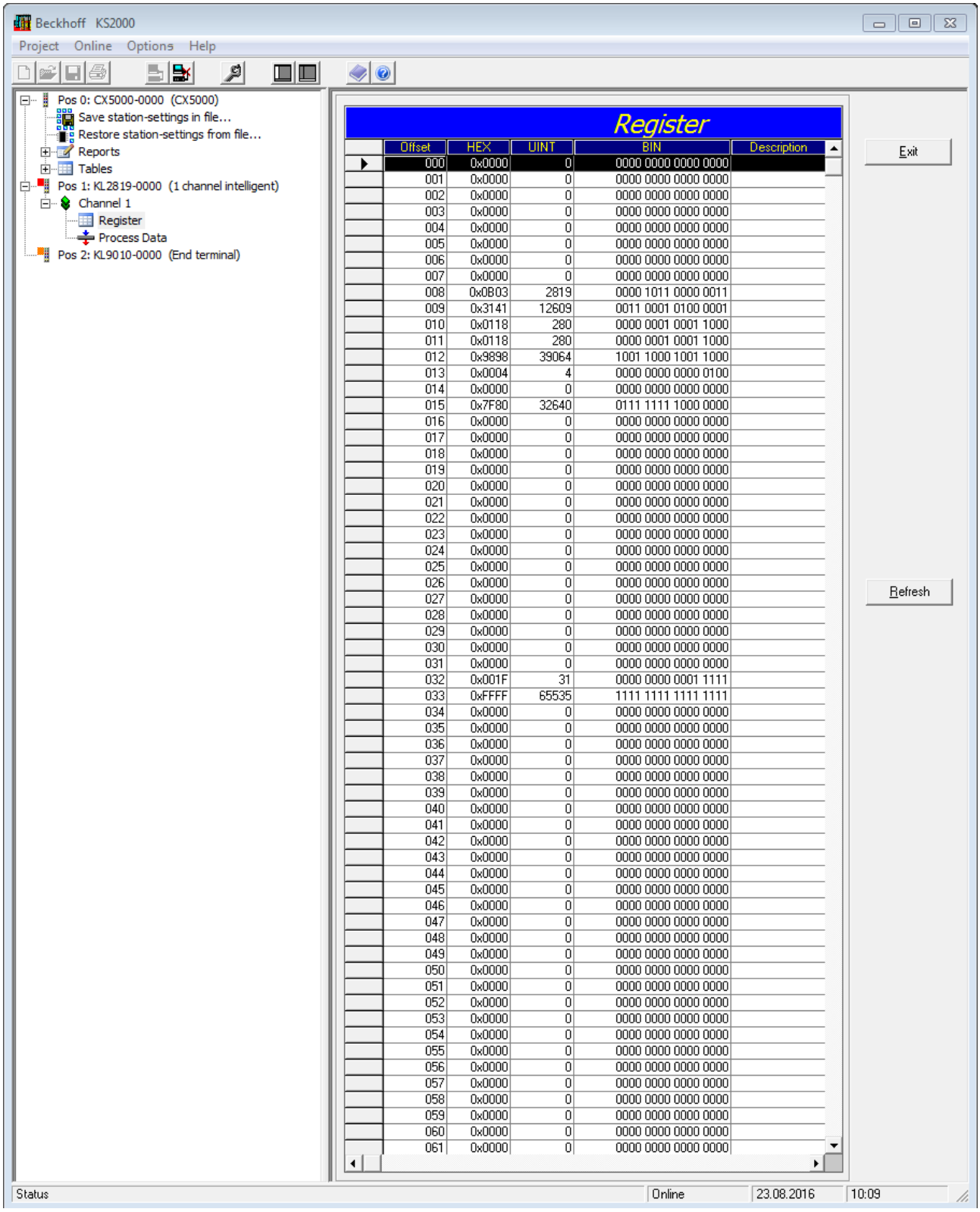
Fig. 20: KS2000 tree branches for channel 1 of the KL2819

For the KL2819, the branches *Register*, *Settings* and *ProcData* are displayed:

- Register [▶ 30] permits direct access to the registers of the KL2819.
- ProcData displays the KL2819 process data.

5.3 Register

You can access the registers of the KL2819 directly under *Register*.– The meaning of the register is explained in the register overview.



Offset	HEX	UINT	BIN	Description
000	0x0000	0	0000 0000 0000 0000	
001	0x0000	0	0000 0000 0000 0000	
002	0x0000	0	0000 0000 0000 0000	
003	0x0000	0	0000 0000 0000 0000	
004	0x0000	0	0000 0000 0000 0000	
005	0x0000	0	0000 0000 0000 0000	
006	0x0000	0	0000 0000 0000 0000	
007	0x0000	0	0000 0000 0000 0000	
008	0x0B03	2819	0000 1011 0000 0011	
009	0x3141	12609	0011 0001 0100 0001	
010	0x0118	280	0000 0001 0001 1000	
011	0x0118	280	0000 0001 0001 1000	
012	0x9898	39064	1001 1000 1001 1000	
013	0x0004	4	0000 0000 0000 0100	
014	0x0000	0	0000 0000 0000 0000	
015	0x7F80	32640	0111 1111 1000 0000	
016	0x0000	0	0000 0000 0000 0000	
017	0x0000	0	0000 0000 0000 0000	
018	0x0000	0	0000 0000 0000 0000	
019	0x0000	0	0000 0000 0000 0000	
020	0x0000	0	0000 0000 0000 0000	
021	0x0000	0	0000 0000 0000 0000	
022	0x0000	0	0000 0000 0000 0000	
023	0x0000	0	0000 0000 0000 0000	
024	0x0000	0	0000 0000 0000 0000	
025	0x0000	0	0000 0000 0000 0000	
026	0x0000	0	0000 0000 0000 0000	
027	0x0000	0	0000 0000 0000 0000	
028	0x0000	0	0000 0000 0000 0000	
029	0x0000	0	0000 0000 0000 0000	
030	0x0000	0	0000 0000 0000 0000	
031	0x0000	0	0000 0000 0000 0000	
032	0x001F	31	0000 0000 0001 1111	
033	0xFFFF	65535	1111 1111 1111 1111	
034	0x0000	0	0000 0000 0000 0000	
035	0x0000	0	0000 0000 0000 0000	
036	0x0000	0	0000 0000 0000 0000	
037	0x0000	0	0000 0000 0000 0000	
038	0x0000	0	0000 0000 0000 0000	
039	0x0000	0	0000 0000 0000 0000	
040	0x0000	0	0000 0000 0000 0000	
041	0x0000	0	0000 0000 0000 0000	
042	0x0000	0	0000 0000 0000 0000	
043	0x0000	0	0000 0000 0000 0000	
044	0x0000	0	0000 0000 0000 0000	
045	0x0000	0	0000 0000 0000 0000	
046	0x0000	0	0000 0000 0000 0000	
047	0x0000	0	0000 0000 0000 0000	
048	0x0000	0	0000 0000 0000 0000	
049	0x0000	0	0000 0000 0000 0000	
050	0x0000	0	0000 0000 0000 0000	
051	0x0000	0	0000 0000 0000 0000	
052	0x0000	0	0000 0000 0000 0000	
053	0x0000	0	0000 0000 0000 0000	
054	0x0000	0	0000 0000 0000 0000	
055	0x0000	0	0000 0000 0000 0000	
056	0x0000	0	0000 0000 0000 0000	
057	0x0000	0	0000 0000 0000 0000	
058	0x0000	0	0000 0000 0000 0000	
059	0x0000	0	0000 0000 0000 0000	
060	0x0000	0	0000 0000 0000 0000	
061	0x0000	0	0000 0000 0000 0000	

Fig. 21: Register view in KS2000

6 Access from the user programm

6.1 Control and status bytes

6.1.1 Process data mode

Control byte (for process data mode)

The control byte (CB) is located in the output image, and is transmitted from the controller to the terminal.

Bit	Name	Description
CB.7	RegAccess	0_{bin}: Register communication off (process data mode)
CB.6	-	reserved
CB.5	-	reserved
CB.4	-	reserved
CB.3	-	reserved
CB.2	-	reserved
CB.1	-	reserved
CB.0	-	reserved

Status byte (in process data mode)

The status byte (SB) is located in the input image and is transmitted from terminal to the controller.

Bit	Name		Beschreibung
SB.7	**RA**	**Reg**Access	Register access (0 = process data mode enabled)
SB.6	**DCF**	**D**iagnostic **C**ommon **F**ault	A diagnostic common fault (OR Combination of all Faults)
SB.5	**MV**	**M**issing **V**oltage	No Voltage for the Outputs (Up < 10 V)
SB.4	**UV**	**U**nder **V**oltage	Low Voltage for the Outputs (Up < 17 V)
SB.3	**OTD**	**O**ver**t**emperature **D**evice	Temperature of the terminal too high
SB.2	**r**	**-**	reserved
SB.1	**r**	**-**	reserved
SB.0	**r**	**-**	reserved

6.1.2 Register communication

Control byte (for register communication)

The control byte (CB) is located in the output image, and is transmitted from the controller to the terminal.

Bit	Name	Description
CB.7	RegAccess	1_{bin}: Register communication switched on
CB.6	R/W	0_{bin}: Read access 1_{bin}: Write access
CB.5 to CB.0	Reg. no.	Register number: Enter here the number of the register that you wish - to read with input data word DataIN, or - to write with output data word DataOUT.

Status byte (for register communication)

The status byte (SB) is located in the input image, and is transmitted from terminal to the controller.

Bit	Name	Description
SB.7	RegAccess	1_{bin}: Acknowledgement for register access
SB.6	R	0_{bin}: Read access
SB.5 to SB.0	Reg. no.	Number of the register that was read or written.

6.2 Register overview

The registers are used for parametering the Bus Terminals and are available for each channel. They can be read or written by means of register communication.

Register no.	Comment	Default value		R/W	Memory
		hex	dec		
R0	reserved	0x0000	0_{dec}	-	-
…	...	...	…	...	...
R7	Command register	0x0000	0_{dec}	-	-
R8 [▶ 33]	Terminal type	0x0B03	2819_{dec}	R	ROM
R9 [▶ 33]	Firmware version number	0x3141	$1A_{ASCII}$	R	ROM
R10 [▶ 33]	Multiplex shift register	0x0118	280_{dec}	R	ROM
R11 [▶ 33]	Signal channels	0x0118	280_{dec}	R	ROM
R12 [▶ 33]	Minimum data length	0x9898	39064_{dec}	R	ROM
R13 [▶ 33]	Data structure	0x0004	4_{dec}	R	ROM
R14	reserved	0x0000	0_{dec}	-	-
R15 [▶ 33]	Alignment register	Typical 0x7F80	Typical 32640_{dec}	R/W	RAM
R16 [▶ 33]	Hardware version number	0x0000	00_{ASCII}	R	SEEPROM
R17	reserved	0x0000	0_{dec}	-	-
…	...	...	…	...	...
R28	reserved	0x0000	0_{dec}	-	-
R29	Terminal type, special identification	0x0000	0_{dec}	R	ROM
R30	reserved	0x0000	0_{dec}	-	-
R31 [▶ 34]	Code word register	0x0000	0_{dec}	R/W	RAM
R32 [▶ 34]	Feature register	0x001F	31_{dec}	R/W	SEEPROM
R33 [▶ 34]	Activated Channel Diagnostic Register	0xFFFF	65535_{dec}	R/W	SEEPROM
R34 [▶ 34]	Watchdog Channel Outputs Register	0x0000	0_{dec}	R/W	SEEPROM
R35	reserved	0x0000	0_{dec}	-	-
…	...	...	…	...	...
R63	reserved	0x0000	0_{dec}	-	-

6.3 Register description

All registers can be read or written via register communication [▶ 35]. They are used for the parameterization of the terminal.

R8: Terminal description

Register R8 contains the designation of the KL2819 terminal: 0x0B03 (2819_{dez}).

R9: Firmware version

Register R9 contains the ASCII coding of the terminal's firmware version, e.g. **0x3141 (1A)**$_{ASCII}$. **'0x31'** corresponds to the ASCII character **'1'** and **'0x41'** to the ASCII character **'A'**. This value can not be changed.

R10: Data length (multiplex shift register)

R10 contains the number of multiplexed shift registers and their length in bits.

R11: Signal channels

Unlike R10, this contains the number of channels that are logically present. Thus for example a shift register that is physically present can perfectly well consist of several signal channels.

R12: Minimum data length

The particular byte contains the minimum data length for a channel that is to be transferred. If the MSB is set, the control and status byte is not necessarily required for the terminal function and is not transferred to the control, if the Bus Coupler is configured accordingly.

R13: Data structure (data type register)

Data type register	Meaning
0x00	Terminal with no valid data type
0x01	Byte array
0x02	Structure: 1 byte, n bytes
0x03	Word array
0x04	Structure: 1 byte, n words
0x05	Double word array
0x06	Structure: 1 byte, n double words
0x07	Structure: 1 byte, 1 double word
0x08	Structure: 1 byte, 1 double word
0x11	Byte array with variable logical channel length
0x12	Structure: 1 byte, n bytes with variable logical channel length (e.g. 60xx)
0x13	Word array with variable logical channel length
0x14	Structure: 1 byte, n words with variable logical channel length
0x15	Double word array with variable logical channel length
0x16	Structure: 1 byte, n double words with variable logical channel length

R15: Alignment register

Via the alignment register bits, the Bus Coupler arranges the address range of an analog terminal such that it starts at a byte boundary.

R16: Hardware version number

Register R16 contains the hardware revision level of the terminal; this value can not be changed.

R31: Code word register

- If you write values into the user registers without first entering the user code word (0x1235) into the code word register, the terminal will not accept the supplied data.
- If you write values into the user registers and have previously entered the user code word (0x1235) in the code word register, these values are stored in the RAM registers and in the SEEPROM registers and are therefore retained if the terminal is restarted.

The code word is reset with each restart of the terminal.

R32: Feature-Register

The feature register specifies the terminal's configuration. Default: 0x001F (31_{dez})

Bit	R32.15	R32.14	R32.13	R32.12	R32.11	R32.10	R32.9	R32.8
Name	Reserved							

Bit	R32.7	R32.6	R32.5	R32.4	R32.3	R32.2	R32.1	R32.0
Name	Reserved		**WDEn**	Reserved				

WDEn (Watchdog Enable)	
State	**Effect**
0	The last state of the outputs will be conserved in case of a bus error.
1	The defined states of register R34 will be switched to the outputs in case of a bus error.

R33: Active Channel Diagnostic

The register “Active Channel Diagnostic” switches the diagnostic function for each channel on or off:

- 0: Diagnostic function active on channel
- 1: Diagnostic function not active on channel
  Default: 0xFFFF (65535_{dez})

Bit	R33.15	R33.14	R33.13	R33.12	R33.11	R33.10	R33.9	R33.8
Name	Diag. on Channel 16	Diag. on Channel 15	Diag. on Channel 14	Diag. on Channel 13	Diag. on Channel 12	Diag. on Channel 11	Diag. on Channel 10	Diag. on Channel 9

Bit	R33.7	R33.6	R33.5	R33.4	R33.3	R33.2	R33.1	R33.0
Name	Diag. on Channel 8	Diag. on Channel 7	Diag. on Channel 6	Diag. on Channel 5	Diag. on Channel 4	Diag. on Channel 3	Diag. on Channel 2	Diag. on Channel 1

R34: Watchdog Outputs Register

Das Watchdog Ausgangs Register legt die Zustände der Ausgänge bei einem Busfehler fest, wenn **WDEn** des Feature Regsiters R32 [▶ 34] aktiviert ist.

The Watchdog Outputs Register defines the state of the Channel Outputs in case of a bus error.

Default: 0x0000.

Bit	R34.15	R34.14	R34.13	R34.12	R34.11	R34.10	R34.9	R34.8
Name	Definition output Channel 16	Definition output Channel 15	Definition output Channel 14	Definition output Channel 13	Definition output Channel 12	Definition output Channel 11	Definition output Channel 10	Definition output Channel 9

Bit	R34.7	R34.6	R34.5	R34.4	R34.3	R34.2	R34.1	R34.0
Name	Definition output Channel 8	Definition output Channel 7	Definition output Channel 6	Definition output Channel 5	Definition output Channel 4	Definition output Channel 3	Definition output Channel 2	Definition output Channel 1

6.4 Examples of Register Communication

The numbering of the bytes in the examples corresponds to the display without word alignment.

6.4.1 Example 1: reading the firmware version from Register 9

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x89 (1000 1001_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 specify the register number 9 with 00 1001_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access. To change a register, write the required value into the output word.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x89	0x33	0x41

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the firmware version 0x3341 in the input data word (byte 1 and byte 2). This is to be interpreted as an ASCII code:
  - ASCII code 0x33 represents the digit 3
  - ASCII code 0x41 represents the letter A
    The firmware version is thus 3A.

6.4.2 Example 2: Writing to an user register

Code word

In normal mode all user registers are read-only with the exception of Register 31. In order to deactivate this write protection you must write the code word (0x1235) into Register 31. If a value other than 0x1235 is written into Register 31, write protection is reactivated. Please note that changes to a register only become effective after restarting the terminal (power-off/power-on).

I. Write the code word (0x1235) into Register 31.

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111_{bin})	0x12	0x35

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.

- The output data word (byte 1 and byte 2) contains the code word (0x1235) for deactivating write protection.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

II. Read Register 31 (check the set code word)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0x12	0x35

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the current value of the code word register in the input data word (byte 1 and byte 2).

III. Write to Register 32 (change contents of the feature register)

Output data

Byte 0: Control byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xE0 (1110 0000_{bin})	0x00	0x02

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 indicate register number 32 with 10 0000_{bin}.
- The output data word (byte 1 and byte 2) contains the new value for the feature register.

⚠ CAUTION

Observe the register description!

The value of 0x0002 given here is just an example!
The bits of the feature register change the properties of the terminal and have a different meaning, depending on the type of terminal. Refer to the description of the feature register of your terminal (chapter *Register description*) regarding the meaning of the individual bits before changing the values.

Input data (response from the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

IV. Read Register 32 (check changed feature register)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xA0 (1010 0000_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 indicate register number 32 with 10 0000_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000_{bin})	0x00	0x02

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the current value of the feature register in the input data word (byte 1 and byte 2).

V. Write Register 31 (reset code word)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111_{bin})	0x00	0x00

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.
- The output data word (byte 1 and byte 2) contains 0x0000 for reactivating write protection.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

7 Appendix

7.1 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: https://www.beckhoff.com

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

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
Fax:	+49 5246 963 198
e-mail:	info@beckhoff.com
web:	https://www.beckhoff.com

Table of figures

More Information:
www.beckhoff.com/KL2819

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com