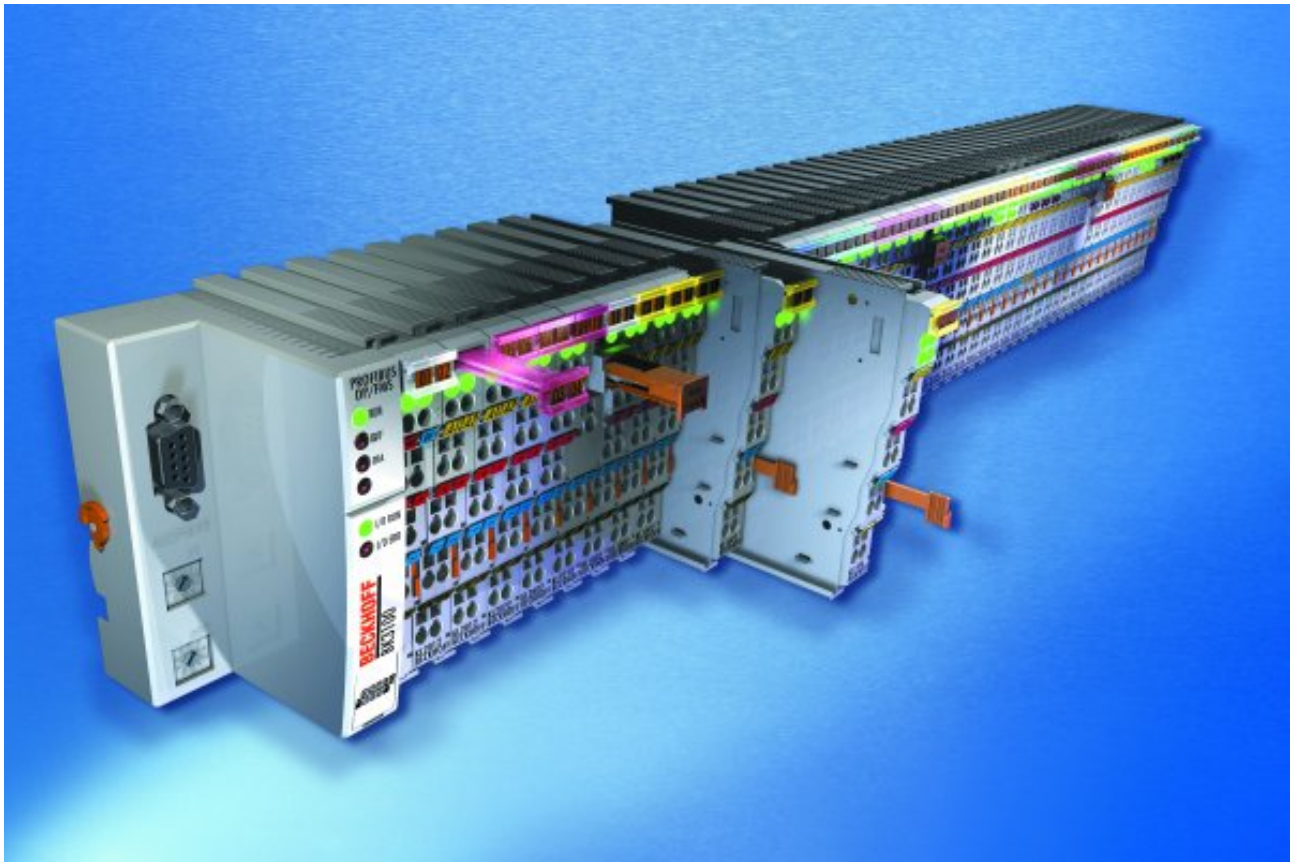

Documentation

KL4494

Analog terminal with two input and two output channels, (-10V...+10V)

Version: 2.0.0
Date: 2017-09-08

BECKHOFF

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 versions

Version	Comment
2.0.0	• Migration • Structure update • Update chapter *Technical data* • Revision status updated • Chapter *Notes on ESD protection* added • Chapter *Installation instructions for enhanced mechanical load capacity* added • Chapters *ATEX – special conditions (standard temperature range)* and *ATEX documentation* added • Update chapter *Connection technology -> Connection*
1.1.0	• Description of the KS2000 configuration software expanded • Description of the basic function principles added • Technical data updated • Register overview and register description updated • Firmware and hardware versions updated
1.0	• Description of connection updated • Technical data updated • English version available
0.1	• Preliminary version (only German language available)

Firmware and hardware versions

Documentation Version	Firmware	Hardware
2.0.0	1C	04
1.1.0	1B	02
1.0	1B	01
0.1	1A	00

The firmware and hardware versions (delivery state) can be found in 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 ser. no.: 31 05 1B 01:

31 - week of production 31
05 - year of production 2005
1B - firmware version 1B
01 - hardware version 01

2 Product overview

2.1 Introduction

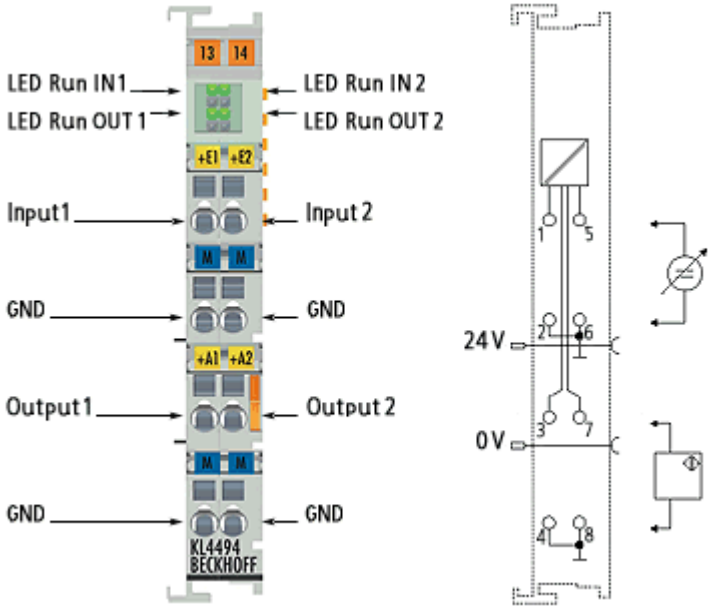


Fig. 1: KL4494

Analog terminal with two input and two output channels, -10 V to 10 V

The KL4494 Bus Terminal combines two analog inputs and two analog outputs in one housing and can process signals in the range -10 V to +10 V. The voltage is digitized to a resolution of 12 bits, and is transmitted, electrically isolated, to the higher-level automation device or to the process level. The input and output channels of the Bus Terminal have a common ground potential that is electrically isolated from the 0 V power contact. The RUN LEDs give an indication of the data exchange with the Bus Coupler.

2.2 Technical data

Technical data	KL4494
Number of outputs	2
Number of inputs	2 (single-ended)
Signal voltage	-10 V to +10 V
Load of each output	> 5 kΩ
Internal resistance of each input	> 130 kΩ
Resolution	12 bit
Measuring error (total measuring range)	±0.3% of the full scale value
Conversion time	< 2 ms
Bit width in the input process image	2 data words, 2 status byte
Bit width in the output process image	2 data words, 2 control byte
Power supply for the electronics	via the K-bus
Current consumption from K-bus	typically 70 mA
Electrical isolation	500 V (signal voltage/K-bus)
Connection	spring-loaded system
Weight	approx. 55 g
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Mounting [▶ 11]	on 35 mm mounting rail conforms 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 air humidity	95 %, no condensation
Vibration / shock resistance	conforms to EN 60068-2-6/EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [▶ 15]
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Approval	CE, UL, ATEX [▶ 20]

2.3 Diagnostic LEDs

The four green RUN LEDs indicated the operating state of the terminal channels.

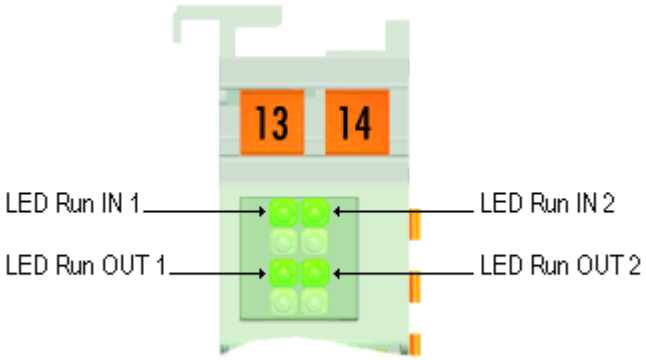


Fig. 2: KL4494 - LEDs

Meaning of the LED displays

LED	Color	Channel	State	
			On	off
Run IN 1	green	Input 1	normal operation	A watchdog-timer overflow has occurred. The green LEDs go out if no process data are transferred between the controller and the Bus Coupler for more than 100 ms.
Run IN 2		Input 2		
Run OUT 1		Output 1		
Run OUT 2		Output 2		

2.4 Basic function principles

Analog input channels

The analog input channels of the KL4494 process signals in the range from -10 V to +10 V with 12-bit resolution (4095 steps). The inputs are single-ended inputs with a common ground potential.

Format of the input values

In the delivery state the process data are shown in two's complement form ($-1_{integer}$ corresponds to 0xFFFF). Siemens output format [▶ 34] can be selected via the feature register R32 as an alternative.

Measured value	Input data	
	decimal	hexadecimal
-10 V	-32768	0x8000
-5 V	-16383	0xC001
0 V	0	0x0000
+5 V	16383	0x3FFF
+10 V	32767	0x7FFF

Process data equations

The process data that are transferred to the Bus Coupler are calculated using the following equations:

Neither user nor manufacturer scaling is active

$Y_a = (B_a + X_{ADC}) \times A_a$ (1.0)
$Y_{out} = Y_a$

Manufacturer scaling active (default setting)

$Y_1 = B_h + A_h \times Y_a$ (1.1)
$Y_{out} = Y_1$

User scaling active

$Y_2 = B_w + A_w \times Y_a$ (1.2)
$Y_{out} = Y_2$

Manufacturer and user scaling active

$Y_1 = B_h + A_h \times Y_a$ (1.3)
$Y_2 = B_w + A_w \times Y_1$ (1.4)
$Y_{out} = Y_2$

Key

X_{adc}:	Output values of the A/D converter	
Y_{out}:	Process data to PLC	
B_a , A_a:	Manufacturer gain and offset compensation	(R17 [▶ 33], R18 [▶ 33])
B_h , A_h:	Manufacturer scaling	(Not implemented)
B_w, A_w:	User scaling	(R33 [▶ 34], R34 [▶ 35])

The equations of the straight line are activated via register R32.

Analog output channels

The analog output channels of the KL4494 generate signals in the range from -10 V to +10 V with a resolution of 12 bits (4095 steps). The outputs are single-ended outputs with a common ground potential.

Format of the output values

In the delivery state the process data are shown in two's complement form ($-1_{integer}$ corresponds to 0xFFFF). Siemens output format [▶ 34] can be selected via the feature register R32 as an alternative.

Output value		Output voltage
hexadecimal	decimal	
0x8000	-32768	-10 V
0xC001	-16383	-5 V
0x0000	0	0 V
0x3FFF	16383	+5 V
0x7FFF	32767	+10 V

Process data equations

The process data, which are transferred to the Bus Terminal, are calculated based on the following equations:

Neither user nor manufacturer scaling is active

$Y_{dac} = X \times A_a + B_a$ (1.0)

Manufacturer scaling active (default setting)

$Y_1 = B_h + A_h \times X$ (1.1)
$Y_{dac} = Y_1 \times A_a + B_a$

User scaling active

$Y_2 = B_w + A_w \times X$ (1.2)
$Y_{dac} = Y_2 \times A_a + B_a$

Manufacturer and user scaling active

$Y_1 = B_h + A_h \times X$ (1.3)
$Y_2 = B_w + A_w \times Y_1$ (1.4)
$Y_{dac} = Y_2 \times A_a + B_a$

Key

X:	Controller process data	
Y_{dac}:	Process data to D/A converter	
B_a , A_a:	Manufacturer gain and offset compensation	(R19 [▶ 33], R20 [▶ 33])
B_h , A_h:	Manufacturer scaling	(Not implemented)
B_w, A_w:	User scaling	(R36 [▶ 35], R37 [▶ 35])

The equations of the straight line are activated via register R32.

3 Mounting and wiring

3.1 Instructions for ESD protection

Attention	**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. a) Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.). b) Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices. c) Each assembly must be terminated at the right hand end with an EL9011 bus end cap, to ensure the protection class and ESD protection.

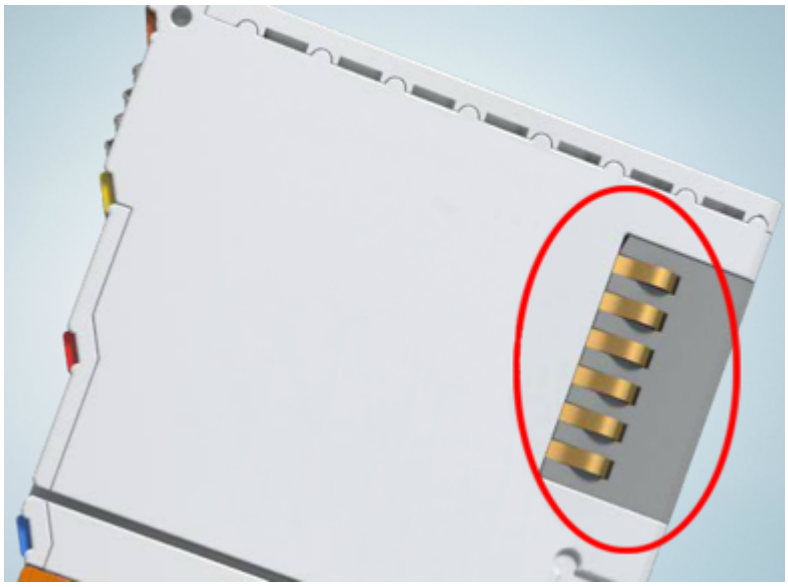


Fig. 3: Spring contacts of the Beckhoff I/O components

3.2 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

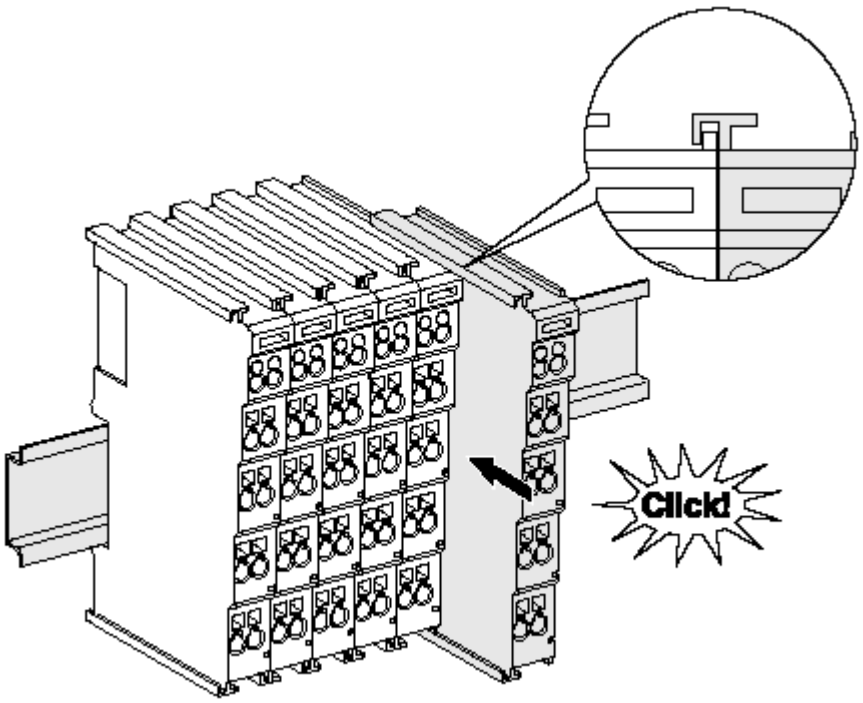


Fig. 4: Attaching on mounting rail

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

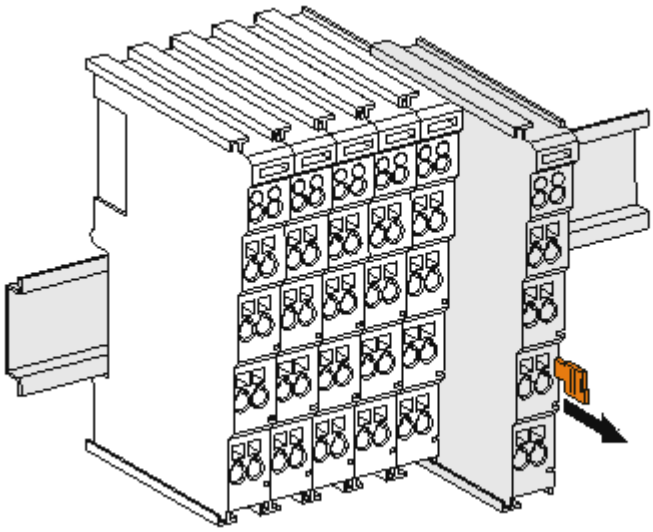


Fig. 5: Disassembling of terminal

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.

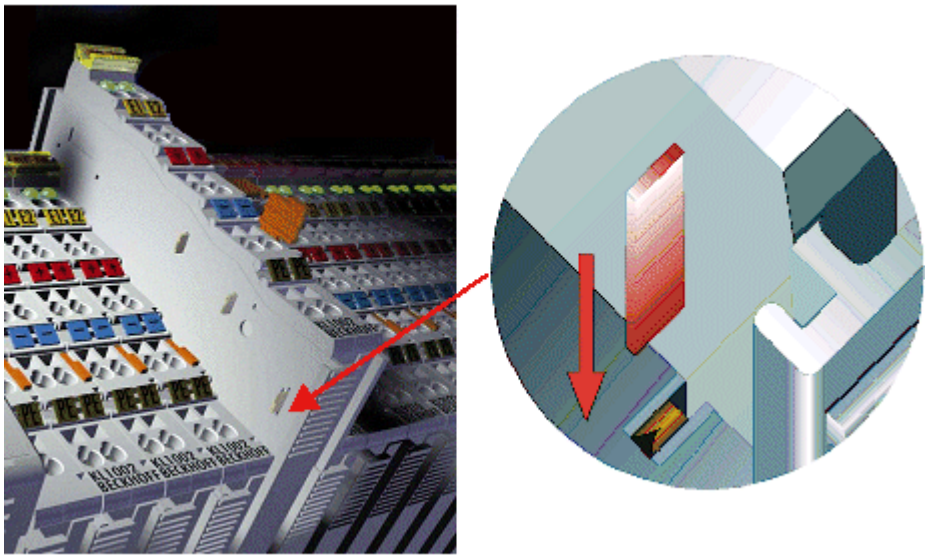


Fig. 6: *Power contact on left side*

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!

3.3 Installation instructions for enhanced mechanical load capacity

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

Additional checks

The terminals have undergone the following additional tests:

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

Additional installation instructions

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

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

3.4 Connection

3.4.1 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. 7: 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)

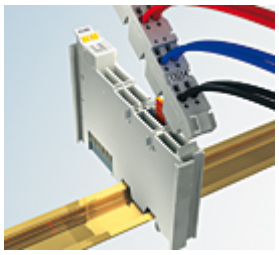


Fig. 8: Pluggable wiring

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

High Density Terminals (HD Terminals)

Fig. 9: *High Density Terminals*

The Bus 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.

Note	**Wiring HD Terminals** The High Density (HD) Terminals of the ELx8xx and KLx8xx series doesn't support pluggable 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 below!

3.4.2 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

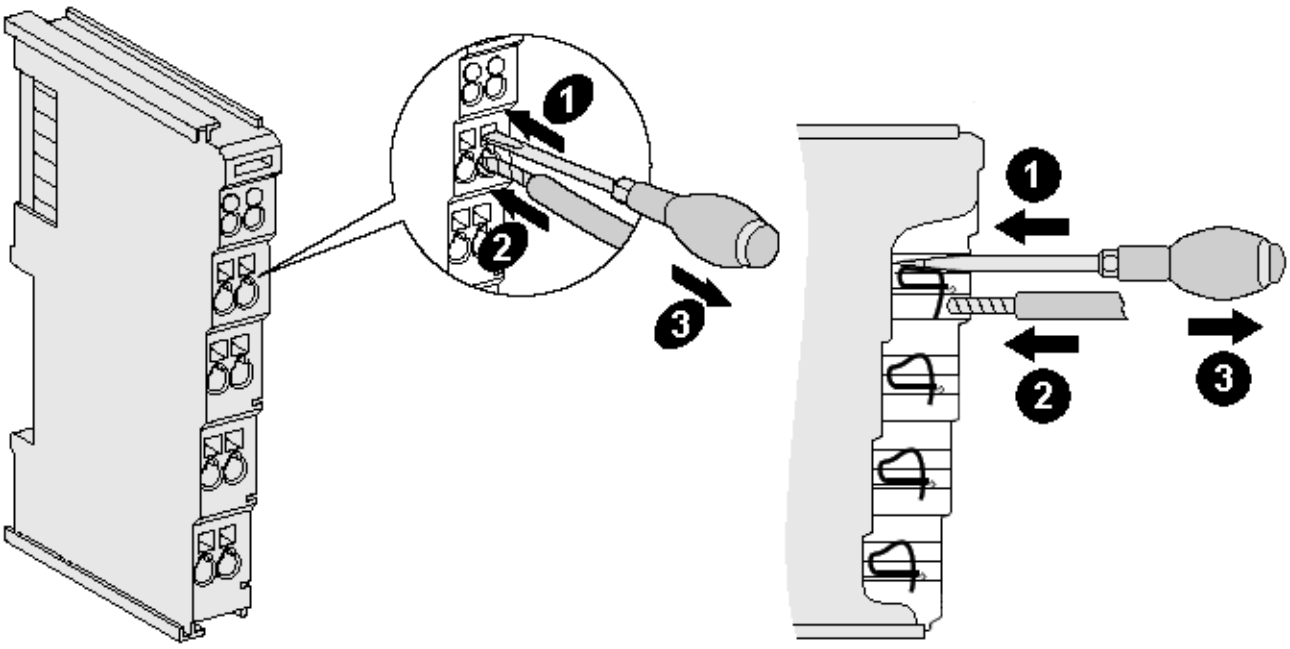


Fig. 10: Connecting a cable on a terminal point

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 mm^2	0.08 ... 2.5 mm^2
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm^2	0,08 ... 2.5 mm^2
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm^2	0.14 ... 1.5 mm^2
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 16]) 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 mm^2
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm^2
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm^2
Wire size width (ultrasonically “bonded" conductors)	only 1.5 mm^2
Wire stripping length	8 ... 9 mm

3.4.3 Shielding

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

3.5 Connection

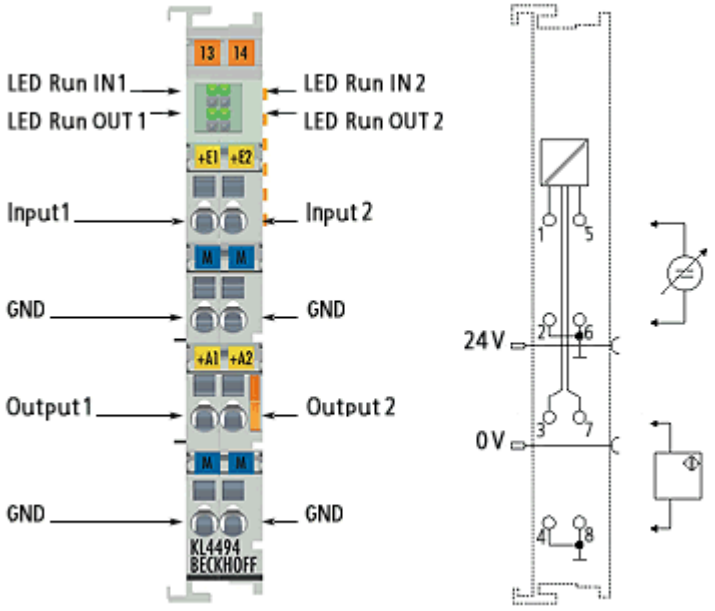


Fig. 11: KL4494

Terminal point	No.	Connection for
Input 1	1	input 1, signal
GND	2	ground*
Output 2	3	output 1, signal
GND	4	ground*
Input 2	5	input 2, signal
GND	6	ground*
Output 2	7	output 2, signal
GND	8	ground*

*) The input and output channels of the Bus Terminal have a common ground potential that is electrically isolated from the 0 V power contact.

3.6 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

3.7 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 KS2000 Configuration Software

4.1 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. 12: 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.

4.2 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 example shown, this is:

- a BK9000 Bus Coupler for Ethernet
- a KL1xx2 digital input terminal,
- a KL4494 analog terminal with 2 input and 2 output channels,
- a KL9010 Bus End Terminal

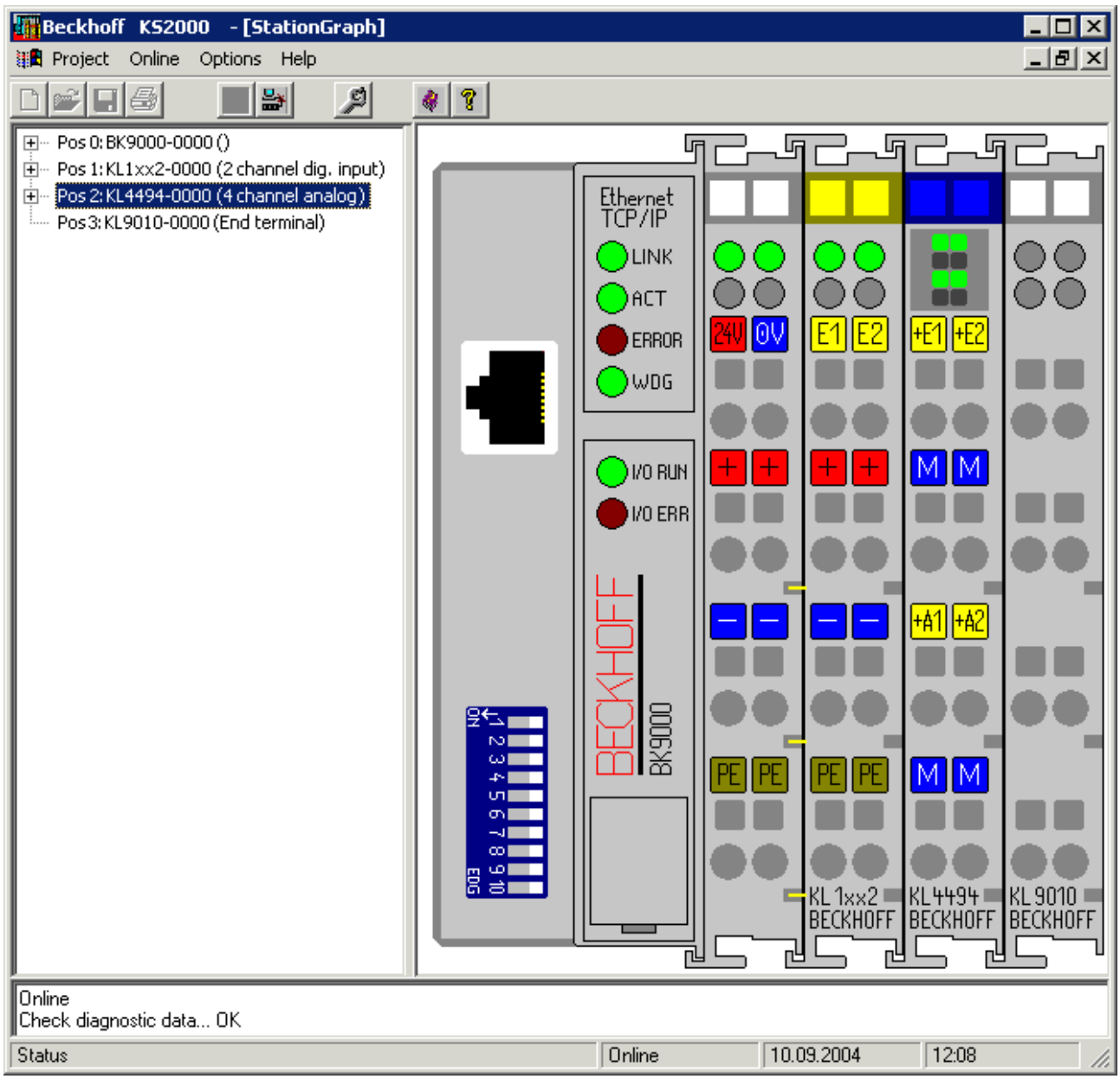


Fig. 13: Display of the fieldbus station in KS2000

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 2 in the example).

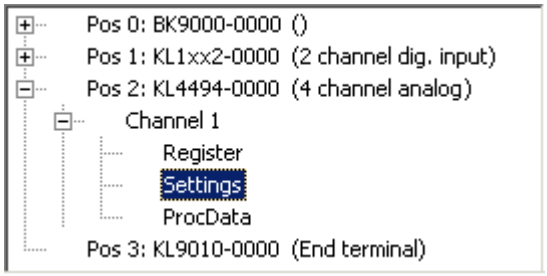


Fig. 14: KS2000 tree branches for channel 1 of the KL4494

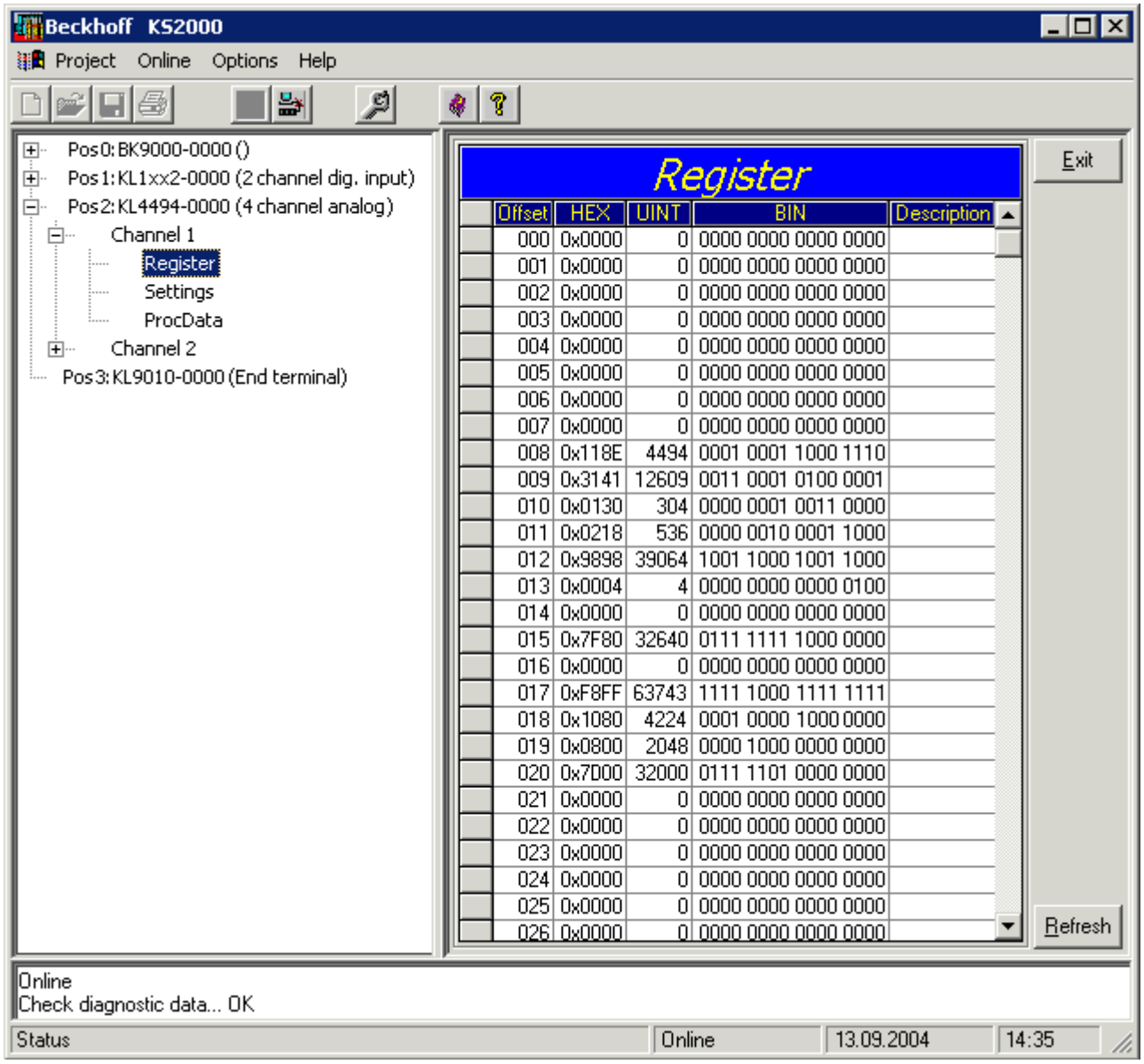
For the KL4494, the branches *Register*, *Settings* and *ProcData* are displayed:

- Register [▶ 25] enables direct access to the KL4494 registers.

- Dialog masks for the parameterization of the KL4494 can be found under Settings [▶ 26].
- ProcData [▶ 27] displays the KL4494 process data.

4.3 Register

You can access the registers of the KL4494 directly under *Register*. The meaning of the register is explained in the register overview [▶ 31].



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	0x118E	4494	0001 0001 1000 1110	
009	0x3141	12609	0011 0001 0100 0001	
010	0x0130	304	0000 0001 0011 0000	
011	0x0218	536	0000 0010 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	0xF8FF	63743	1111 1000 1111 1111	
018	0x1080	4224	0001 0000 1000 0000	
019	0x0800	2048	0000 1000 0000 0000	
020	0x7D00	32000	0111 1101 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	

Fig. 15: Register view in KS2000

4.4 Settings

The dialog mask for the parameterization of the KL4494 can be found under *Settings*.

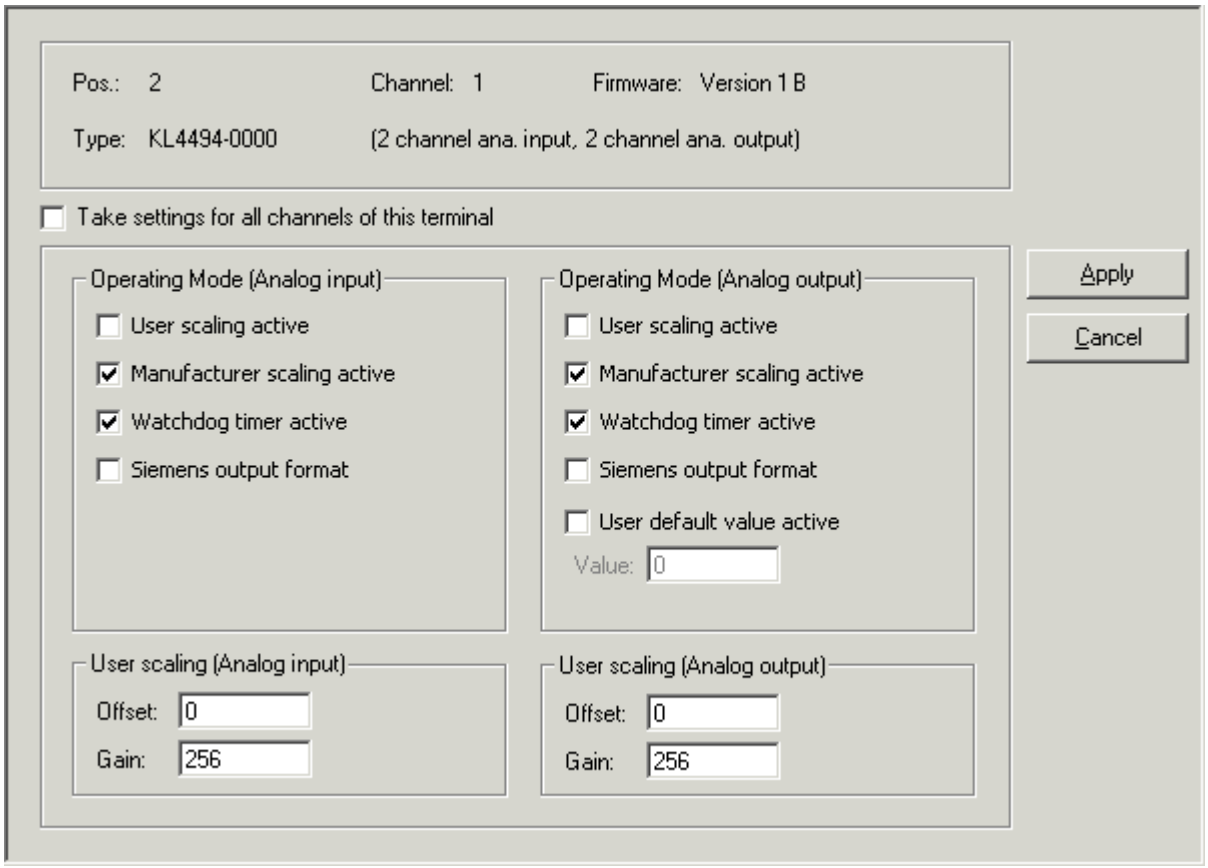


Fig. 16: Settings via KS2000

Operation Mode (analog input)

- **User scaling active (**R32.0 [▶ 34]**)**
  You can activate user scaling here (default: deactivated).
- **Manufacturer scaling active (**R32.1 [▶ 34]**)**
  You can deactivate manufacturer scaling here (default: activated).
- **Watchdog timer active (**R32.2 [▶ 34]**)**
  You can deactivate the watchdog timer here (default: activated).
- **Siemens output format active (**R32.3 [▶ 34]**)**
  You can activate Siemens output format [▶ 34] here (default: deactivated).

Operation Mode (analog output)

- **User scaling active (**R32.8 [▶ 34]**)**
  You can activate user scaling here (default: deactivated).
- **Manufacturer scaling active (**R32.9 [▶ 34]**)**
  You can deactivate manufacturer scaling here (default: activated).
- **Watchdog timer active (**R32.10 [▶ 34]**)**
  You can deactivate the watchdog timer here (default: activated).
- **Siemens output format active (**R32.11 [▶ 34]**)**
  You can activate Siemens output format here (default: deactivated).
- **User switch-on value active (**R32.12 [▶ 34]**)**
  You can activate the user switch-on value here (default: deactivated).

- **User switch-on value (R35 [▶ 35])**
  You can specify the user switch-on value here (default: 0).

User scaling (analog input)

- **Offset (R33 [▶ 34])**
  You can specify the offset for the user-scaling of the analog input here (default: 0).
- **Gain (R34 [▶ 35])**
  You can specify the gain for the user-scaling of the analog input here (default: 256_{dec}, corresponding to a gain factor of 1).

User scaling (analog output)

- **Offset (R36 [▶ 35])**
  You can specify the offset for the user-scaling of the analog output here (default: 0).
- **Gain (R37 [▶ 35])**
  You can specify the gain for the user-scaling of the analog output here (default: 256_{dec}, corresponding to a gain factor of 1).

4.5 Process data

The Status byte (Status), the Control byte (Ctrl) and the process data (Data) are displayed in a tree structure under *ProcData*.

Process Data (Hex.)

Pos	Type	I-Address	Value	Bitsize	O-Address	Value	Bitsize
2	KL4494-0000						
	Channel 1						
	State	0.0	0x00	8			
	Data In	2.0	0x0000	16			
	Ctrl				0.0	0x00	8
	Data Out				2.0	0x0000	16
	Channel 2						
	State	4.0	0x00	8			
	Data In	6.0	0x0000	16			
	Ctrl				4.0	0x00	8
	Data Out				6.0	0x0000	16

Fig. 17: Process data field

The spectacles mark the data that are currently graphically displayed in the *History* field.

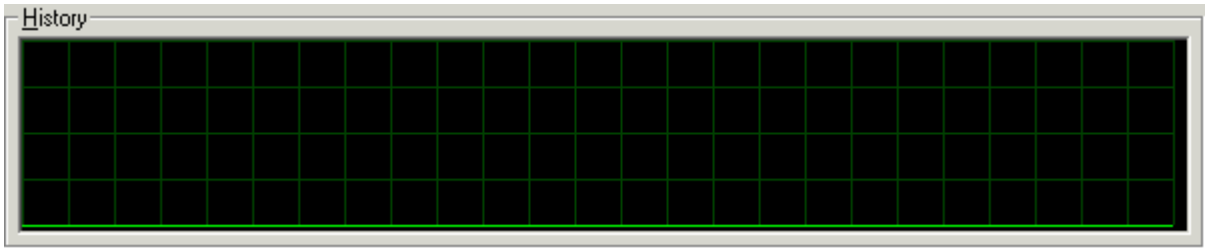


Fig. 18: History field

The current input value is displayed numerically in the *Value* field.

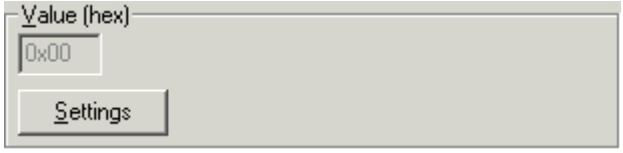


Fig. 19: Value field – display of the input value

Output values can be modified through direct input or by means of the fader control.

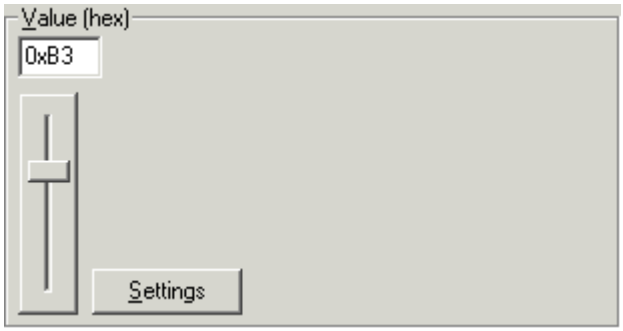


Fig. 20: Value field – input of the initial values

DANGER	**Danger for persons, the environment or equipment** Note that changing initial values (forcing them) can have a direct effect on your automation application. Only modify these initial values if you are certain that the state of your equipment permits it, and that there will be no risk to people or to the machine!

After pressing the *Settings* button you can set the format of the numerical display to hexadecimal, decimal or binary.

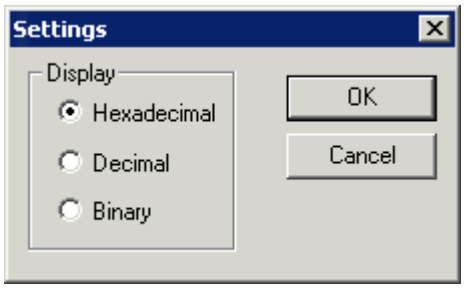


Fig. 21: Setting the display

5 Access from the user program

5.1 Process image

In the process image, the KL4494 is represented with 6 bytes of input data and 6 bytes of output data. These are organized as follows:

Byte offset (without word alignment)	Byte offset (with word alignment*)	Format	Input data	Output data
0	0	Byte	Status byte (SB1 [▶ 29])	Control-Byte (CB1 [▶ 29])
1	2	Word	DataIN1	DataOUT1
3	4	Byte	Status byte (SB2 [▶ 29])	Control byte (CB2 [▶ 29])
4	6	Word	DataIN2	DataOUT2

*) Word alignment: The Bus Coupler places values on even byte addresses

5.2 Control and status bytes

Channel 1: The control and status bytes for channel 1 are illustrated in the following.

Channel 2: The control and status bytes of channel 2 have the same structure as the control and status bytes of channel 1.

Process data mode

Control byte 1 (CB1) in process data mode

Control byte 1 is located in the output image [▶ 29], and is transmitted from the controller to the terminal. In process data mode it has no function.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2	CB1.1	CB1.0
Name	RegAccess	-	-	-	-	-	-	-

Key

Bit	Name	Description	
CB1.7	RegAccess	0_{bin}	Register communication off (process data mode)
CB1.6 - CB1.0	-	0_{bin}	reserved

Status byte 1 (SB1) in process data mode

The status byte 1 is located in the input image [▶ 29] and is transmitted from terminal to the controller.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.1	SB1.0
Name	RegAccess	Error	LimitValue 2 State		LimitValue 1 State		Overrange	Underrange

Key

Bit	Name	Description	
SB1.7	RegAccess	0_{bin}	Acknowledgment for process data mode
SB1.6	Error	1_{bin}	General error bit
SB1.5 - SB1.4	LimitValue 2 State	00_{bin}	Limit value 2 not activated
		01_{bin}	Process data less than limit value 2
		10_{bin}	Process data greater than limit value 2
		11_{bin}	Process data equal limit value 2
SB1.3 - SB1.2	LimitValue 1 State	00_{bin}	Limit value 1 not activated
		01_{bin}	Process data less than limit value 1
		10_{bin}	Process data greater than limit value 1
		11_{bin}	Process data equal limit value 1
SB1.1	Overrange	1_{bin}	Permissible measuring range exceeded
SB1.0	Underrange	1_{bin}	Lower measuring range limit violated

Register communication

Control byte 1 (CB1) in register communication

Control byte 1 is located in the output image [▶ 29], and is transmitted from the controller to the terminal.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2	CB1.1	CB1.0
Name	RegAccess	R/W	Reg. no.					

Key

Bit	Name	Description	
CB1.7	RegAccess	1_{bin}	Register communication switched on
CB1.6	R/W	0_{bin}	Read access
		1_{bin}	Write access
CB1.5 to CB1.0	Reg. no.	Register number: Enter the number of the register that you • want to read with input data word DataIN1 [▶ 29] or • with the output data word DataOUT1 [▶ 29]	

Status byte 1 (SB1) in register communication

The status byte 1 is located in the input image [▶ 29] and is transmitted from terminal to the controller.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.1	SB1.0
Name	RegAccess	R/W	Reg. no.					

Key

Bit	Name	Description	
SB1.7	RegAccess	1_{bin}	Acknowledgment for register access
SB1.6	R	0_{bin}	Read access
SB1.5 to SB1.0	Reg. no.	Number of the register that was read or written.	

5.3 Register overview

The following registers are used for parameterization of the KL4494. Each signal channel of the analog terminal has one register that can be read or written to with the aid of control [▶ 30], status [▶ 30] and data bytes [▶ 29] via register communication [▶ 35].

Register no.	Comment	Default value		R/W	Memory
R0 [▶ 32]	Raw value of the A/D converter (X_R)	-	-	R	RAM
R1	reserved	-		-	-
...	...	...	...	...	...
R5	reserved	-	-	-	-
R6 [▶ 32]	Diagnostic register	-	-	R	RAM
R7 [▶ 32]	Command register	0x0000	0_{dec}	R/W	RAM
R8 [▶ 32]	Terminal type	0x118E	4494_{dec}	R	ROM
R9 [▶ 32]	Firmware version	e.g. 0x3141	e.g. $1A_{ASCI}$	R	ROM
R10 [▶ 32]	Data length (multiplex shift register)	0x0130	304_{dec}	R	ROM
R11 [▶ 32]	Signal channels	0x0218	536_{dec}	R	ROM
R12 [▶ 32]	Minimum data length	0x9898	39064_{dec}	R	ROM
R13 [▶ 32]	Data structure (data type register)	0x0004	4_{dec}	R	ROM
R14	reserved	-	-	-	-
R15 [▶ 33]	Alignment register	e.g. 0x7F80	e.g. 32640_{dec}	R/W	RAM
R16 [▶ 33]	Hardware version number	e.g. 0x0000	e.g. 0_{dec}	R/W	SEEPROM
R17 [▶ 33]	Manufacturer scaling, analog input: Offset (B_a)	variable	variable	R/W	SEEPROM
R18 [▶ 33]	Manufacturer scaling, analog input: Gain (A_a)	typ. 0x1080	typ. 4224_{dec}	R/W	SEEPROM
R19 [▶ 33]	Manufacturer scaling, analog output: Offset (B_a)	0x0800	2048_{dec}	R/W	SEEPROM
R20 [▶ 33]	Manufacturer scaling, analog output: Gain (A_a)	typ. 0x7D00	typ. 32000_{dec}	R/W	SEEPROM
R21 [▶ 33]	Overrange-Limit	0x0000	0_{dec}	R/W	SEEPROM
R22 [▶ 33]	Underrange-Limit	0x0000	0_{dec}	R/W	SEEPROM
R23	reserved	-	-	-	-
...	...	...	...	...	...
R30	reserved	-	-	-	-
R31 [▶ 33]	Code word register	0x0000	0_{dec}	R/W	RAM
R32 [▶ 34]	Feature register	0x0404	1028_{dec}	R/W	SEEPROM
R33 [▶ 34]	User scaling, analog input: Offset (B_w)	0x0000	0_{dec}	R/W	SEEPROM
R34 [▶ 35]	User scaling, analog input: Gain (A_w)	0x0100	256_{dec}	R/W	SEEPROM
R35 [▶ 35]	User default value for analog output	0x0000	0_{dec}	R/W	SEEPROM
R36 [▶ 35]	User scaling, analog output: Offset (B_w)	0x0000	0_{dec}	R/W	SEEPROM
R37 [▶ 35]	User scaling, analog output: Gain (A_w)	0x0100	256_{dec}	R/W	SEEPROM
R38	reserved	-	-	-	-
...	reserved	...	...	...	...
R63	reserved	-	-	-	-

5.4 Register description

All registers can be read or written via register communication [▶ 35].

R0: Raw value A/D-C

Raw value of the A/D converter (X_R)

R6: Diagnostic register

The status byte [▶ 29] is mapped to the low-order byte (bit 7 to bit 0) of register R6.
The high-order byte (bit 15 to bit 8) of register R6 is reserved.

R7: Command register

The command register of KL4494 is currently not used.

R8: Terminal description

The terminal description is contained in register R8: 0x118E (4494_{dec})

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 cannot 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
0x15x	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 version of the terminal; this value cannot be changed.

R17: Hardware compensation for analog input - offset (B_a)

This register is used for the offset compensation of the analog input (see equation 1.1).

R18: Hardware compensation for analog input - gain (A_a)

This register is used for the gain compensation of the analog input.

Scaling: Gain factor = R18 x 2^{-12} (see equation 1.1)

Example: 4096_{dec} (0x1000), equivalent to a gain factor of 1

R19: Hardware compensation for analog output - offset (B_a)

This register is used for the offset compensation of the analog output (see equation 1.1).

R20: Hardware compensation for analog output - gain (A_a)

This register is used for the gain compensation of the analog output.

Scaling: Gain factor = R20 x 2^{-15} (see equation 1.1)

Example: 32768_{dec} (0x1000), equivalent to a gain factor of 1

R21 Overrange-Limit - OvRL (Y_a)

This limit value limits the maximum measuring range of the input terminal (see equation 1.0). If it is exceeded, the associated status bit is set, and the maximum value is displayed.

R22 Underrange-Limit - UnRL (Y_a)

If the value falls below this limit, the associated status bit is set, and the minimum value is displayed (see equation 1.0).

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: 0x0404 (1028_{dec})

High-Byte: analog output configuration

Bit	R32.15	R32.14	R32.13	R32.12	R32.11	R32.10	R32.9	R32.8
Name	-	-	-	enUsrDefault	enSiemens	enWDT	enManScal	enUsrScal

Low-Byte: analog input configuration

Bit	R32.7	R32.6	R32.5	R32.4	R32.3	R32.2	R32.1	R32.0
Name	-	-	-	-	enSiemens	enWDT	enManScal	enUsrScal

Key

Bit	Name	Description		default
R32.15	-	reserved		0_{bin}
...	...	...		...
R32.13	-	reserved		0_{bin}
R32.12	enUsrDefault	1_{bin}	User default value specified via register R35 [▶ 35] is active	0_{bin}
R32.11	enSiemens Analog Output	0_{bin}	Standard output format	0_{bin}
		1_{bin}	Siemens output format	
R32.10	enWDT	1_{bin}	Watchdog timer is active	1_{bin}
R32.9	enManScal Analog Output	0_{bin}	Manufacturer scaling is active	0_{bin}
		1_{bin}	Manufacturer scaling is not active	
R32.8	enUsrScal Analog Output	0_{bin}	User scaling is not active	0_{bin}
		1_{bin}	User scaling is active	
R32.7	-	reserved		0_{bin}
R32.6	-	reserved		0_{bin}
R32.5	-	reserved		0_{bin}
R32.4	-	reserved		0_{bin}
R32.3	enSiemens Analog Input	0_{bin}	Standard output format	0_{bin}
		1_{bin}	Siemens output format: The three bits with the lowest value are used for displaying status information (see below).	
R32.2	enWDT	1_{bin}	Watchdog timer is active	1_{bin}
R32.1	enManScal Analog Input	0_{bin}	Manufacturer scaling is active	0_{bin}
		1_{bin}	Manufacturer scaling is not active	
R32.0	enUsrScal Analog Input	0_{bin}	User scaling is not active	0_{bin}
		1_{bin}	User scaling is active	

Siemens output format

If the Siemens output format is selected, the lowest three bits are used for status evaluation. The process data is represented in bits 15 to 3, with bit 15 representing the sign bit. Scaling of the measured value according to the Siemens standard has to be done via user scaling (R33, R34).

Measured value	Bit 15 ... 3	Bit 2 X	Bit 1 Error	Bit 0 Overflow
Measured value < -10 V		0	0	1
-10 V < Measured value < 10 V	Process data	0	0	0
Measured value >+10 V		0	0	1

R33: User scaling for analog input - offset (B_w)

This register contains the offset of the user scaling for the analog input (default: 0).
User scaling for the analog input can be activated in the feature register via bit R32.0 [▶ 34].

R34: User scaling for analog input - gain (A_w)

This register contains the gain factor of the user scaling for the analog input (default: 256_{dec}, equivalent to a gain factor of 1).
Scaling: Gain factor = R34 x 2^{-8}

User scaling for the analog input can be activated in the feature register via bit R32.0 [▶ 34].

R35: User default value for analog output

Here you can specify the user default value.

R36: User scaling for analog output - offset (B_w)

This register contains the offset of the user scaling for the analog input (default: 0).
User scaling for the analog output can be activated in the feature register via bit R32.8 [▶ 34].

R37: User scaling for analog output - gain (A_w)

This register contains the gain factor of the user scaling for the analog output (default: 256_{dec}, equivalent to a gain factor of 1).

Scaling: Gain factor = R37 x 2^{-8}

User scaling for the analog output can be activated in the feature register via bit R32.8 [▶ 34].

5.5 Examples of Register Communication

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

5.5.1 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.

5.5.2 Example 2: Writing to an user register

Note	**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!

6 Appendix

6.1 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.

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Beckhoff Support

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

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Beckhoff Service

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- repair service
- spare parts service
- hotline service

Hotline:	+49(0)5246/963-460
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List of illustrations